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Eurostat-OECD compilation guide on land estimation

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Foreword

The *Eurostat-OECD compilation guide on land estimation* represents the first comprehensive overview of conceptual and practical issues related to the compilation of the balance sheet item 'land' in the national accounts.

The aim of the compilation guide is to provide conceptual and practical guidance to statisticians concerning the estimation and valuation of land and to increase international comparability. The guide clarifies theoretical concepts and proposes a breakdown of land into categories so that international comparisons can be more easily made. It also discusses possible data sources, elaborates direct and indirect estimation methods and addresses several special estimation cases. The guide presents the information that is available on this topic in the System of National Accounts 2008 and in the European System of Accounts 2010 in a systematic and accessible way. It draws on a wide range of experience and expertise by reviewing the methods used in estimating land in an attempt to describe practical and suitable measurement methods.

The primary purpose of the compilation guide is to help producers of national accounts data on land. As such, the manual is designed to help them prepare reliable estimates that are comparable between countries. This particularly applies to countries that are in the process of developing estimates for land. The guide therefore includes country examples that illustrate the practical application of the guidelines.

However, the compilation guide is also useful to users of the data. For them the guide not only provides background information about how data on land can be compiled, but also about the limitations of the data. In addition, the final chapter discusses more specifically the use of the data especially in assessing the wealth of households.

Since data for land are often not available it is hoped that this compilation guide will help countries to fill in the information gaps exposed by the 2007–2008 financial crisis. This is of particular importance in view of the housing market's role in the financial crisis in several countries. Compiling estimates of land will move countries one step closer to providing a complete set of information on a nation's balance sheet.

The electronic version of the *Eurostat-OECD compilation guide on land estimation* is available on the websites of Eurostat and the OECD.

We trust that this guide will be a useful resource to both compilers and users of data on land, and wish to express our sincere thanks to all those involved in its production.

Martine Durand
OECD Chief Statistician and Director of Statistics

Walter Radermacher
Director-General of Eurostat

Preface and acknowledgements

The *Eurostat-OECD compilation guide on land estimation* was prepared by the Task Force on Land and other non-financial assets. Both Eurostat and the Organisation for Economic Co-operation and Development (OECD) consider the compilation of non-financial assets, and in particular land, as a high priority and therefore it was decided to bundle the resources and to create a joint Eurostat-OECD Task Force.

Apart from the growing importance of balance sheet data in general, there were two more specific reasons for the establishment of this Task Force. First, in 2011 at a conference organised by the OECD and the International Monetary Fund (IMF) on strengthening the sectoral balance sheets there were repeated calls for better estimates of land on the balance sheet. Thus, the OECD considered that this issue needed further study considering the lack of information on land currently available at the time. Second, in the discussions on the European System of Accounts 2010 transmission programme, the Council Working Party on Statistics agreed with a (partially) mandatory transmission of the balance sheet item land, but also requested more guidance regarding its compilation. As a follow-up, Eurostat's National Accounts Working Group decided in its April 2012 meeting to establish the Task Force on Land and other non-financial assets; this decision was supported by the OECD's Working Party on National Accounts. The joint Eurostat-OECD Task Force started its work in June 2012.

Representatives from various European Union (EU) and non-EU OECD countries were represented in the Task Force and the European Central Bank participated as well. The Task Force was chaired by Silke Stapel-Weber/Hans Wouters (Eurostat) and Peter van de Ven/Jennifer Ribarsky (OECD). Other members of the Task Force were, in alphabetical order: Taehyoung Cho (Korea), Florian Gruber/Elisa Huber (Austria), Christian Gysting (Denmark), Ville Haltia/Martti Pykari (Finland), Wesley Harris (United Kingdom), Ruben van der Helm/Zlatina Balabanova (ECB), Marllena Ifrim/Brenda Bugge (Canada), Bob Kornfeld (US), Gang Liu (Norway), Martina Nemeckova (Czech Republic), Paolo Passerini (Eurostat), Ghislain Poullet (Belgium), Paola Santoro (Italy), Oda Schmalwasser/Sascha Brede (Germany), Tatjana Smokova (Eurostat), Nina Strazisar (Slovenia), Martha Tovar (Mexico), Erik Veldhuizen/Joy Sie Cheung (The Netherlands).

The Task Force on Land and other non-financial assets met six times:

— 9–10 July 2012	Eurostat, Luxembourg
— 10–11 December 2012	OECD, Paris
— 24–25 June 2013	Statistics Austria, Vienna
— 2–3 December 2013	Destatis, Wiesbaden
— 26–27 June 2014	Statistics Canada, Ottawa
— 8–9 December 2014	Czech statistical office, Prague

All Task Force members actively contributed to the work and drafted chapters or sections of the compilation guide. The work on the compilation guide was coordinated by Hans Wouters (Eurostat). The editing was performed by Jennifer Ribarsky (OECD).The draft chapters and preliminary versions of the compilation guide were available for comments on Eurostat's website.

The *Eurostat-OECD compilation guide on land estimation* benefitted from contributions of many countries that replied to the questionnaire on depreciation and service lives and the questionnaire on classification of land. The manual also benefitted from the comments that have been received from Eurostat's National Accounts Working Group, OECD's Working Party on National Accounts, the Advisory Expert Group, Eurostat's units Agriculture and fisheries, Environmental statistics and accounts and Regional statistics and geographical information.

Eurostat and OECD would like to thank all those who contributed to the *Eurostat-OECD compilation guide on land estimation*.

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1

Why do we need this compilation guide?

Introduction

1.1. At its thirty-ninth and fortieth sessions in February 2008 and February 2009, the United Nations Statistical Commission (UNSC) adopted the System of National Accounts 2008 (SNA 2008) as the international statistical standard for national accounts and encouraged Member States, regional and sub-regional organisations to implement the standard and support all aspects of the implementation of the updated SNA 2008. The SNA 2008 guidelines were produced under the joint responsibility of the United Nations (UN), the International Monetary Fund (IMF), the statistical office of the European Union (Eurostat), the Organisation for Economic Co-operation and Development (OECD) and the World Bank (WB). Countries are encouraged to use the SNA 2008 as the framework for compiling and integrating economic and related statistics, as well as for national and international reporting of national accounts statistics.

1.2. To achieve the objectives set by the Treaty on the Functioning of the European Union (EU), and more specifically on economic and monetary union, high-quality statistical instruments are needed which provide the Union institutions, governments, economic and social operators, and analysts with a set of harmonised and reliable statistics on which to base their decisions and policy advice. The European System of National and Regional Accounts (ESA 2010) is an internationally compatible accounting framework — broadly consistent with SNA 2008, but adapted to the circumstances and needs of the EU — for a systematic and detailed statistical description of an economy. To ensure that the concepts, methodologies and accounting rules set out in ESA 2010 are strictly applied, it has been decided, following a proposal from the Commission, to give it a solid legal basis. ESA 2010 was thus adopted in the form of a regulation of the European Parliament and of the Council dated 21 May 2013. This regulation comprises binding methodological rules to secure comparability of national accounts aggregates, and a compulsory data transmission programme.

1.3. The fortieth session of the UNSC also requested a coordinated effort by the Inter-Secretariat Working Group on National Accounts (ISWGNA) on the development of manuals, implementation guides, data collection tools and standardised training material, and in use of modern and innovative tools, such as distance learning and knowledge bases, to provide easy access on a range of information, including best practices, to facilitate the implementation of the SNA 2008. The ISWGNA subsequently also formulated a global strategy for the implementation of the SNA 2008 and supporting statistics, taking into account the different levels of implementation of existing international standards and the statistical capacity in the various countries.

1.4. The Eurostat-OECD compilation guide on land estimation is one of a number of manuals, handbooks and guidance notes under the umbrella of the ISWGNA to strengthen the statistical capacity for compiling national accounts, in accordance with the implementation programme for the SNA 2008 and the ESA 2010 in the EU. The concepts are described and defined in line with the SNA 2008 as well as the ESA 2010.

1.5. The compilation guide also helps fulfil some of the data gaps identified by the International Monetary Fund (IMF) and the Financial Stability Board (FSB). In response to the 2007–2008 financial crisis the Group of Twenty (G-20) Finance Ministers and Central Bank Governors Working Group on Reinforcing International Co-operation and Promoting Integrity in Financial Markets called on the IMF and the FSB to explore information gaps and provide appropriate proposals for strengthening data collection. As a result, the G-20 Data Gaps Initiative (DGI) was established focusing on 20 recommendations that aim to deal with the information gaps exposed by the crisis ([1]). In particular, recommendation 15 calls for the development of 'a strategy to promote the compilation and dissemination of the balance sheet approach, flow of funds, and sectoral data more generally, starting with the G-20 economies.'

1.6. The work on recommendation 15 is being undertaken under the auspices of the Inter-Agency Group on Economic and Financial Statistics (IAG). The IAG comprises the Bank for International Settlements (BIS), the European Central Bank (ECB), Eurostat, the Financial Stability Board (FSB), the IMF (Chair), the Organisation for Economic Co-operation and Development (OECD), the United Nations (UN), and the World Bank (WB). It was established in 2008 to coordinate statistical issues and data gaps highlighted by the global crisis and to strengthen data collection.

1.7. Recommendation 15 highlights the usefulness of balance sheet data in providing economic policy makers with information on the inter-linkages between groups of actors which may have different economic objectives, functions, and behaviour within an economy. The importance of sectoral coverage of national balance sheets provides a way for economic policy makers to better monitor the vulnerability of domestic economies to shocks.

1.8. Not only can balance sheet data be used to monitor economic activity but can also be used to monitor the change in national wealth and accordingly used to assess sustainability. Making these data more robust provides information to support analysis in line with the recommendations of the Stiglitz/Sen/Fitoussi Report (2009) that states 'while gross domestic product and production measures provide

([1]) For information on the recommendations to the G-20 Finance Ministers and Central Bank Governors see www.imf.org/external/np/g20/pdf/102909.pdf important information on market production and employment there should also be an emphasis on well-being. In this regard, measures of well-being should be put in context with sustainability because increases in current well-being might occur at the expense of future well-being' ([2]).

1.9. The concept of compiling national balance sheets — that is, a statement of the values of assets owned and of the liabilities owed at a particular point in time — for countries is not new, but there is increasing demand, also in view of the causes of the economic and financial crisis, for complete balance sheets of countries. The compilation of financial assets and liabilities is common practice for many countries, yet data, especially data on non-financial assets, in total and by institutional sector, are often not available. Because of this, the G-20 DGI provided a template of minimum and encouraged stocks of non-financial assets by asset type and by sector ([3]). In response to interest on balance sheet data, the revised transmission programme for ESA 2010 requires additional mandatory items for Table 26 'balance sheets for non-financial assets'. The annex of this chapter reproduces Table 26 from ESA 2010 and highlights the required items. In addition, the OECD collects information related to balance sheet items and is the primary data collector and validator for non-European member countries of the OECD. OECD members agreed to Article 3 a) of the OECD Convention to 'furnish the Organisation with the information necessary for the accomplishment of its tasks', including providing short term, structural and other analytical statistics and their associated methodological information needed for adequate policy analysis and surveillance. As such, OECD members are requested to provide the balance sheet information for Table 26.

1.10. Discussions on various fronts have been undertaken to strengthen the sectoral balance sheet data ([4]). One important finding from discussions with both EU and non-EU countries was the recognition that the valuation of land and dwellings is a central issue for compiling balance sheets for non-financial assets. Central to this issue was the difficulty of most countries to separately identify the value of the land underlying the structure from the value of the structure on it.

1.11. Recognising the need for more practical guidance on the estimation of non-financial assets, in particular for land and structures, a joint Eurostat-OECD Task Force, including participation from the ECB, was created in June 2012. The Task Force on Land and other non-financial assets established an expert group from national statistical institutes (NSIs) and international organisations. The goal of the Task Force was to elaborate on the conceptual and measurement issues related to the estimation of non-financial assets. The initial focus of the Task Force was on issues related to land and the result of this effort can be seen in this compilation guide.

1.12. The Task Force developed a list of research issues and established a work plan and a division of tasks. The following countries and international organisations participated in the Task Force: Austria, Belgium, Canada, Czech Republic, Denmark, Finland, Germany, Italy, Korea, Mexico, Netherlands, Norway, Slovenia, United Kingdom, United States, the ECB, Eurostat, and the OECD. The Task Force was chaired jointly by Eurostat and the OECD and the secretariat was provided by Eurostat.

1.13. This chapter begins with a brief discussion of assets and the importance of land on the balance sheet of a country. It further describes the purpose of this compilation guide and summarises its contents.

Assets and the importance of land

1.14. According to the SNA 2008, assets 'are entities that must be owned by some unit, or units, and from which economic benefits are derived by their owner(s) by holding or using them over a period of time'. (SNA 2008 paragraph 1.46) Economic assets may be either financial assets or non-financial assets.

1.15. In the SNA 2008 and ESA 2010 non-financial assets are grouped into two broad categories: produced and non-produced assets. Produced assets are non-financial assets that have come into existence as outputs from production processes that fall within the production boundary of the SNA 2008. Non-produced assets are non-financial assets that have come into existence in ways other than through processes of production. Non-financial assets, or capital, have a dual role in an economy as a source of capital services in production and storage of wealth. Measuring Capital (OECD, 2009) discusses the concepts and provides practical guidelines for measuring stocks and flows related to (primarily) produced non-financial assets. However because of the importance of land, the OECD manual briefly addresses the measurement challenges related to land.

1.16. Although land is a non-produced asset, it is well established in the economic literature as a factor of production

([2]) Stiglitz, J., A. Sen, J.-P. Fitoussi, '*Report by the Commission on the Measurement of Economic Performance and Social Progress*', 2009. See recommendation 3 'Consider income and consumption jointly with wealth' at http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf

([3]) International Monetary Fund, '*Templates for Minimum and Encouraged Set of Internationally Comparable Sectoral Accounts and Balance Sheets*', July 11 2012. Available at http://www.imf.org/external/np/sta/templates/sectacct/index.htm

([4]) The OECD and IMF jointly organised a conference in March 2011 on '*Strengthening Sectoral Position and Flow Data in the Macroeconomic Accounts*', see www.imf.org/external/np/seminars/eng/2011/sta/

and therefore as an asset that provides a flow of capital services into production.

The first and oldest recognised form of non-produced capital is land. Land is special in that, under good management, the value is assumed to remain constant from year to year except for the effects of inflation in land prices. That is to say, there is no depreciation of land and all the contribution to production can be regarded as income (SNA 2008 paragraph 20.41).

1.17. Land can be considered an environmental asset as well as an economic asset, as land will typically have an economic value. This means that in practice, the valuation of land is important for compiling a complete non-financial balance sheet but also for use within the System of Environmental-Economic Accounting (SEEA, 2012).

1.18. Historically, there has been considerable discussion both in official statistics and by academics on the best approach to obtain reliable estimates of land; however, this has not led to agreement across NSIs on a common or best practice approach. One of the major difficulties in valuing land is that the valuation is often combined with the valuation of dwellings and other buildings and structures that exist on the land. Therefore, practical guidance on a wide range of issues is needed.

Purpose and structure of this compilation guide

1.19. Because the compilation of non-financial assets, especially of non-produced assets (e.g. land) is relatively new for many countries, the purpose of this compilation guide is to provide guidance on the compilation of estimates for land on the balance sheet ([5]). It is especially important for EU Member States where the total value of land in the combined sector of households and non-profit institutions serving households (S.14+S.15) is required to be transmitted to the European Commission (Eurostat) by 2017. This compilation guide includes descriptions of sources and methods, practical guidance, numerical examples, and country case studies that are meant to assist countries in compiling internationally comparable estimates of land. Compiling estimates that are comparable across countries and that are of suitable quality is especially important for EU Member States in light of the data requirements of Table 26 and the importance of the higher EU level aggregates.

([5]) While the role of land as an asset that provides a flow of capital services and the role of land as an environmental asset are important and interesting topics they will not be discussed in this compilation guide.

1.20. The following paragraphs briefly outline the contents of this compilation guide. Chapter 2 presents the SNA 2008 and the ESA 2010 concepts and definitions that are relevant for the balance sheet item land and the related transactions and other changes in land. It also addresses the more conceptual issue of when and how to decompose changes in the value of land on the balance sheet into transactions, other changes in volume and revaluations.

1.21. The need for a coherent and consistent classification that includes all types of land is described in Chapter 3. The chapter discusses various classifications of land, including how land is to be classified under SEEA and proposes a classification structure for land to be used for national accounting purposes.

1.22. The methods used in compiling estimates of land for the balance sheet can be constrained in large part by the nature of the data available. Chapter 4 describes the types of source data that may be available to NSIs when compiling estimates on land value.

1.23. In Chapters 5 and 6 guidance is given on how to estimate land depending on what sources of information are available. Chapter 5 discusses the estimation of land using the direct approach. This may be viewed as a physical inventory method where the area of each parcel of land is multiplied by an appropriate price. Because separate price and quantity information may not be available especially when the land has a structure on it, Chapter 6 discusses estimating the value of land through an indirect method.

1.24. An indirect estimation method, as the name implies, either obtains the value of land indirectly or obtains the price of the land indirectly. Based on countries' current practices, there are three different indirect estimation methods discussed in this guide: the residual approach, the land-to-structure ratio (LSR) approach, and the hedonic approach. The first two indirect approaches derive the value of the land indirectly. The residual approach obtains the value of the land by subtracting the depreciated structure value from the combined total value. This method controls to the estimated real estate value of the property. The LSR approach derives the value of the land indirectly by multiplying the depreciated structure value by the LSR. The LSR approach does not control to the total real estate value. The hedonic approach utilises a hedonic regression model to deconstruct the real estate property value (that is, the combined value of land and structures) into separate prices for the land and for the structure. The total value of land is then derived by multiplying the indirectly derived price by the area of land.

1.25. As mentioned in the introduction, it is important not only to estimate the total stock of land in a country but also to provide estimates by institutional sector. Chapter 7 addresses the issues of sectorisation and cross-classification.

1.26. Some specific estimation issues are further explored in Chapter 8. Such issues address estimations of agricultural and wooded land and how to separate the value of land improvements which are recorded as gross fixed capital formation from the value of the land. In addition, the chapter addresses some of the more conceptual issues of what land should be included within the asset boundary, such as, issues related to government owned land.

1.27. The final chapter, Chapter 9, explores land as a component of households' real estate wealth and the use of real estate wealth for macroeconomic and financial analysis.

Annex: Balance sheet for non-financial assets

Table 1A.1: Balance sheet for non-financial assets (1)
(unit: current prices)

Code	List of variables	Sectors
AN.1	1. Produced non-financial assets (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.11+ AN.12	2. Fixed assets + Inventories (3)	S.1, S.11 (4), S.12 (4), S.13 (4), S.14 + S.15 (4)
AN.11	3. Fixed assets (5)	S.1, S.11 (4), S.12 (4), S.13 (4), S.14 + S.15 (4)
AN.111	4. Dwellings	S.1, S.11, S.12, S.13, S.14 + S.15
AN.112	5. Other buildings and structures (5)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1121	6. Buildings other than dwellings (3)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1122	7. Other structures (3)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.113+AN.114	8. Machinery and equipment + Weapons systems (5)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.115	9. Cultivated biological resources (5)	S.1, S.11 (4), S.12 (4), S.13 (4), S.14 + S.15 (4)
AN.117	10. Intellectual property products (5)	S.1, S.11 (4), S.12 (4), S.13 (4), S.14 + S.15 (4)
AN.1171	11. Research and development (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1172	12. Mineral exploration and evaluation (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1173	13. Computer software and databases (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1174	14. Entertainment, literary or artistic originals (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1179	15. Other intellectual property products (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.12	16. Inventories (3)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.13	17. Valuables (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.2	18. Non-produced non-financial assets (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.21	19. Natural resources (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.211	20. Land	S.1 (2), S.11 (2), S.12 (2), S.13 (2)
		S.14 + S.15 (4)
AN.212	21. Mineral and energy reserves (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.213+AN.214	22. Non-cultivated biological resources and water resources (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.215	23. Other natural resources (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.22	24. Contracts, leases and licences (2)	S.1, S.11, S.12, S.13, S.14 + S.15
AN.23	25. Purchases less sales of goodwill and marketing assets (2)	S.1, S.11, S.12, S.13, S.14 + S.15

(1) Transmission requirements according to Table 26 of the ESA 2010 transmission programme.

(2) On a voluntary basis.

(3) Data for reference years before 2012 to be transmitted on a voluntary basis. Transmission for reference years from 2012 onwards is compulsory.

(4) First transmission in 2017.

(5) Data for reference years before 2000 to be transmitted on a voluntary basis. Data for reference years 2000–2011 on a compulsory basis only for total economy. Transmission is compulsory for total economy and for institutional sectors for reference years from 2012 onwards.

Source: European System of Accounts 2010, Annex B

2

Concepts and definitions

Introduction

2.1. The concepts and definitions that are of importance for the item land are scattered over many chapters and paragraphs in the SNA 2008 and ESA 2010. They are combined in this chapter and presented in a systematic way. Where necessary, this chapter describes how the SNA 2008 and ESA 2010 concepts should be applied to and interpreted for land. However, the chapter will not discuss the practical application, measurement and way of compilation and estimation. This is done in the following chapters.

2.2. The chapter begins by addressing some general aspects of land as a balance sheet item. It presents the position of land on the balance sheet as defined in the SNA 2008 and ESA 2010. It discusses the definition of the asset 'land' and its aggregates. Clarifications on definitions and borderlines of the asset land are provided as well.

2.3. The remaining parts of the chapter deal with several conceptual issues that are relevant for land. In these parts the scope is not limited to land as a stock, but changes in the stocks of land — transactions and other changes —are considered as well. Attention is successively paid to the topics of ownership and economic benefits from land, ownership related to the lease of land and public-private partnerships, land in the system of national accounts (stocks and flows), valuation of land, time of recording, netting and consolidation, data issues in the measurement of flows of land.

Position of land on the balance sheet and definitions of land and related assets

Position of land on the balance sheet

2.4. Land is an asset on the balance sheet of a country and its institutional (sub)sectors. Land is a subcomponent of the broader asset category natural resources, which in turn is a component of non-produced non-financial assets. Table 2.1 below illustrates the position of land on the balance sheet.

Table 2.1: Balance sheet according to the SNA 2008 and ESA 2010

	Assets			Liabilities and net worth	
AN	Non-financial assets	4 621	AF	Liabilities	7 762
AN.1	Produced non-financial assets	2 818	AF.1	Monetary gold and SDRs	0
AN.11	Fixed assets	2 579		Etc.	1 471
AN.12	Inventories	114			
AN.13	Valuables	125			
AN.2	Non-produced non-financial assets	1 803			
AN.21	Natural resources	1 781			
AN.211	Land	1 001			
AN.212	Mineral and energy reserves	443			
AN.213	Non-cultivated biological resources	103			
AN.214	Water resources	88			
AN.215	Other natural resources	146			
AN.2151	Radio spectra	91			
AN.2159	Other	55			
AN.22	Contracts, leases and licences	22			
AN.23	Purchases less sales of goodwill and marketing assets	0			
AF	Financial assets	8 231			
AF.1	Monetary gold and SDRs	770			
Etc.	Etc.	1 482			
			B.90	Net worth	5 090

Source: TF on Land and other non-financial assets, based on ESA 2010, fictitious data

Definitions

2.5. The SNA 2008 defines a balance sheet as 'a statement, drawn up in respect of a particular point in time, of the values of assets owned and of the liabilities owed by an institutional unit or group of units' (SNA 2008 paragraph 13.2). Similarly, according to the ESA 2010 a balance sheet is 'a statement, drawn up for a particular point in time, of the values of assets economically owned and of liabilities owed by an institutional unit or group of units' (ESA 2010 paragraph 7.01).

2.6. An asset is a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another (SNA 2008 paragraph 3.30, ESA 2010 paragraph 7.15).

2.7. Non-financial assets (AN) are non-financial items over which ownership rights are enforced by institutional units, individually or collectively, and from which economic benefits may be derived by their owners by holding, using or allowing others to use them over a period of time. (ESA 2010 Annex 7.1). Non-financial assets are divided into produced (non-financial) assets (AN.1) and non-produced (non-financial) assets (AN.2).

2.8. Non-produced assets (AN.2) are non-financial assets that have come into existence in ways other than through processes of production (SNA 2008 paragraph 10.9b). Non-produced assets consist of three categories: natural resources; contracts, leases and licences; and purchased goodwill and marketing assets (SNA 2008 paragraph 10.14). According to the ESA 2010 non-produced non-financial assets are economic assets that come into existence other than through processes of production. Non-produced assets consist of natural resources, contracts, leases, licences, permits, goodwill and marketing assets (ESA 2010 paragraph 7.24).

2.9. Natural resources (AN.21) as defined in the SNA 2008 consist of naturally occurring resources such as land, water resources, uncultivated forests and deposits of minerals that have an economic value (SNA 2008 paragraph 10.15). According to the ESA 2010 natural resources are non-produced assets that naturally occur and over which ownership may be enforced and transferred. Environmental assets over which ownership rights have not, or cannot, be enforced, such as open seas or air, are excluded. Natural resources consist of land, mineral and energy reserves, non-cultivated biological resources, water resources and other natural resources (ESA 2010 Annex 7.1).

2.10. Land (AN.211) consists of the ground, including the soil covering and any associated surface waters, over which ownership rights are enforced and from which economic benefits can be derived by their owners by holding or using them (SNA 2008 paragraph 10.175, ESA 2010 Annex 7.1). For land it is important to note that this includes allowing others to use the land.

Clarifications definitions and borderline cases

2.11. As mentioned in paragraph 2.10 associated surface water is included in the definition of land. Associated surface water covers territorial waters and any inland waters (reservoirs, lakes, rivers, etc.) over which ownership rights can be exercised and that can, therefore, be the subject of transactions between institutional units.

2.12. However, water bodies from which water is regularly extracted, against payment, for use in production (including for irrigation) are not included in the definition of land. They form part of the asset water resources (AN.214). Furthermore, the value of land excludes cultivated crops, trees and animals (AN.115), mineral and energy reserves (AN.212) — sometimes referred to as subsoil assets — and non-cultivated biological resources (AN.213). These resources should also be registered as separate assets.

2.13. Even more important from a quantitative point of view, the value of land should exclude any buildings or other structures (AN.111, AN.1121 and AN.1122) that are situated on the land or physically connected to the land. Although they are often purchased or sold together with the land on which they are situated (i.e. without separate valuations being placed on the structures and the land) an effort should be done to separate the value of the buildings and other structures from the value of the underlying land.

2.14. In case that it is not possible to separate the land from the related assets (buildings and other structures, water resources, mineral and energy resources, cultivated and non-cultivated biological resources), SNA 2008 and ESA 2010 recommend to register the combined value under the more valuable asset (SNA 2008 paragraph 13.46, ESA 2010 paragraph 7.52). However, in this compilation guide it is advised to make a serious effort to produce estimates for the separate components. Separate estimates, even if they are rough, are clearly to be preferred above registration of the combined value under the more valuable asset. Chapter 6 will provide guidance regarding the question of how structures and the underlying land can be separated.

2.15. Land can be improved in many different ways. Land clearance and the creation of wells could be examples of land improvements (AN.1123). Land improvements should be considered as separate (fixed) assets and therefore should be excluded from the determination of land value. In Chapter 8.2 the issue of land improvements will be elaborated more extensively.

2.16. When land is purchased or sold, often costs have to be paid for the ownership transfer. The costs of ownership transfer are recorded as gross fixed capital formation (GFCF) and are, therefore, considered a produced asset that should be excluded from the asset land itself. Instead, by convention, the costs of ownership transfer should be registered as part of the fixed asset land improvements. This is in contrast to the value of natural resources other than land on the balance sheet. While the costs of ownership transfer for other natural resources are also recorded as GFCF, the value of the natural resources other than land includes these costs on the balance sheet. This is due to the fact that the costs of ownership transfer on non-produced assets other than land cannot be easily integrated with the value of another produced asset (as in the case for land).

2.17. Costs of ownership transfer are also paid when dwellings and other building and structures are purchased or sold. If these transfer costs are based on the total property value (the combined value of the structure and the underlying land) then in theory these costs of ownership transfer should be split into costs of ownership transfer on the produced asset (e.g. dwelling) and the non-produced asset (e.g. land). If it is not possible to separate the costs of ownership transfer it is recommended to register the combined value of the costs of ownership transfer under the more valuable asset (i.e. costs of ownership transfer related to the structure or costs of ownership transfer related to the land).

Disaggregation of land and definition of components

2.18. The SNA 2008 does not specify a disaggregation of land. In Chapter 23 of the ESA 2010 land is broken down into land underlying buildings and structures (AN.2111), land under cultivation (AN.2112), recreational land and associated surface water (AN.2113) and other land and associated surface water (AN.2119), but no definitions of these components are provided. However, a breakdown of the asset land and clear definitions of its components are considered to be very useful. On the one hand users could be interested in more specified data on land. On the other hand, the distinction of components could be helpful in estimating the total value of land.

2.19. The components of land, the definitions of the components and the rationale behind the breakdown of land are comprehensively discussed in Chapter 3.

Conceptual issues

Ownership and economic benefits from land

2.20. In general the SNA 2008 (SNA 2008 paragraphs 1.48, 2.19, 4.10) and ESA 2010 (ESA 2010 paragraph 2.07) require that a unit should be engaged in economic activities and transactions on a significant scale for at least more than a year at a certain location within the economic territory of a country in order to recognise that location as a 'centre of economic interest'. However, the ownership of land (and buildings) within the economic territory is deemed to be sufficient for the owner to have a centre of predominant economic interest there.

2.21. The definition of land mentions the enforcement of ownership rights as an important characteristic of land as an asset (SNA 2008 paragraph 10.175, ESA 2010 Annex 7.1). From the definition it can be concluded that land can only be considered as an asset if there exists an institutional unit that exercises effective ownership rights over the land. If this is the case, the institutional units are usually — but not always — in the position to derive economic benefits from the land and the land is considered to fall within the asset boundary and has to appear on the balance sheet of that unit. Institutional units can be non-financial or financial corporations, government, households and non-profit institutions serving households. It seems reasonable to assume that all land within the borders of a country is owned by one of these institutional units. Even where ownership cannot be clearly identified, the government could be considered as the legal owner of the land.

2.22. It is very well possible that a foreign institutional unit owns a piece of land in the national territory. In case land located in a territory is owned by a non-resident entity, for national accounts purposes an artificial unit is created. This so called notional resident unit is considered as being the resident owner of the land. The notional unit is a quasi-corporation and should be included in the non-financial corporations' sector. The non-resident owns the notional resident unit, rather than owning the land directly. So there is an equity liability of the resident notional unit to the non-resident, but the land itself is always an asset of the economy in which it is located.

2.23. However, there is one exception to the principle that land is always an asset of the economy in which it is located. This exception concerns land (and buildings) in extraterritorial enclaves of foreign governments (such as land underlying embassies, consulates and military bases) that are subject to the laws of the home territory and not those of the territory where they are physically situated. Therefore, the land in extraterritorial enclaves should be registered on the balance sheet of (the government of) the home country instead of the country where the land is located.

2.24. From the above it can be concluded that in case of a purchase, both the purchaser and seller of land are residents by definition. From that it follows that, for the economy as a whole, the aggregate value of total purchases of land must equal the aggregate value of total sales. The value of acquisitions less disposals of land is thus zero for the economy as a whole, excluding transactions that change the boundary of the economic territory itself. Of course, separate institutional sectors or subsectors usually will have a value of acquisitions less disposals of land that differs from zero.

2.25. Another criterion mentioned in the definition of land — and in the definition of an asset in general — is the need to derive economic benefits from it. Contrary to the criterion of ownership, in some cases it will be difficult to determine whether or not this criterion is fulfilled. One example where it might be difficult to derive economic benefits from the land could be remote land, inaccessible deserts or tundras. It might not be possible to derive any economic benefits from these types of land given the technology existing at the time, in which case they should not be registered on the balance sheet.

Ownership related to the lease of land and public-private partnerships

2.26. The SNA 2008 and ESA 2010 distinguish three types of lease: operating lease, financial lease and resource lease (SNA 2008 paragraph 17.300, ESA 2010 paragraph 15.04). In case of land, usually the resource type of lease applies. A resource lease is one where the owner of a natural resource makes it available to a lessee in return for a payment recorded as rent. In a resource lease the resource asset — for example, the land — remains on the balance sheet of the lessor even though it is used by the lessee. An exception, when a long-term lease of land may be taken as the sale of the land, is described below.

2.27. A resource lease on land may be considered as a sale of the land if the lease satisfies certain criteria. These criteria include: (a) costs and benefits assumed by the lessee, (b) upfront payment or instalment made by the lessee, (c) substantial length of the lease contract, (d) cancellation and transferability possibilities: lessor cannot easily cancel the contract or transfer it to another lessee. The assessment of these criteria may lead to the conclusion that a sale of the land has to be registered. After the sale, the land will appear on the balance sheet of the lessee.

2.28. In some jurisdictions, the land under buildings remains in the legal ownership of a landlord other than the owner of the buildings. If regular payments are made to the landlord, these are recorded as rent. However, it is sometimes the case that, even though the land legally belongs to another unit, the right to occupy it for an extended period is paid for in a single upfront payment often when the building is acquired. As explained in the previous paragraph, this suggests recording the payment as the acquisition of the asset. In such a case, when the building changes ownership, the purchase price includes an element representing the present value of future rent payments on the land. In such a case, the land is recorded as if the ownership is transferred along with the building above the land. If, at the end of the land lease, a further payment is liable for extension of the lease for another long-term period, this should be recorded as capital formation and an acquisition of an asset in a manner similar to costs of ownership transfer on purchase and sale of an asset.

2.29. Public-private partnerships (PPPs) are complex, long-term contracts between two units, one of which is normally a corporation (or a group of corporations, private or public) called the operator or partner, and the other normally a government unit called the grantor. At the end of the contract, the grantor usually acquires legal ownership of the fixed assets. A general description that includes the most common accounting problems is as follows: a corporation agrees to acquire a complex of fixed assets and then to use those assets together with other production inputs to produce services. Those services may be delivered to government, either for use as an input to its own production or for distribution to the public without payment such as education services, in which case government makes periodic payments during the contract period and the corporation expects to recover its costs and earn an adequate rate of return on its investment from those payments. More details about PPPs can be found in SNA 2008 paragraphs 22.154–22.163 and ESA 2010 paragraphs 20.276–20.302.

2.30. As with leases, the economic owner of the assets in a PPP is determined by assessing which unit bears the majority of the risks and which unit is expected to receive a majority of the rewards of the assets. The provisions of each PPP contract shall be evaluated in order to decide which unit is the economic owner. The assets (that also could include land) will after assessment be allocated to the economic owner and has to be registered on his balance sheet.

Land in the system of national accounts

2.31. The primary goal of this compilation guide is to provide guidance on the compilation of estimates for the stock of land. However, it is important to realise that there is a close mutual coherence between the stock of land and the changes in the stock through transactions and other changes. That is, the value of land at a certain point in time is expressed in the balance sheet but the changes in the value are visible in the flow accounts: either as transactions or as other changes. The mutual coherence between balance sheets, transactions and other changes will be elaborated in the paragraphs below.

2.32. The overview below presents a picture of the relationships between stocks and flows in general (ESA 2010 paragraph 7.12).

Table 2.2: Relationships between stocks and flows

The value of the stock of a specific type of asset in the opening balance sheet		
plus	transactions	the total value of that asset acquired in transactions that take place during the accounting period
minus		the total value of that asset disposed of in transactions that take place during the accounting period
minus		consumption of fixed capital (if applicable)
plus	other changes in the volume of assets	other positive changes in volume affecting that asset
minus		other negative changes in volume affecting that asset
plus	revaluations	the value of nominal holding gains accruing during the period resulting from changes in the price of that asset
minus		the value of nominal holding losses accruing during the period resulting from changes in the price of that asset
equals the value of the stock of that asset in the closing balance sheet.		

Source: ESA 2010

Note that since land does not depreciate the consumption of fixed capital equals zero in the case of land.

2.33. The accounting links for the asset land between the opening balance sheet and the closing balance sheet via transactions, other changes in the volume of assets, and holding gains and losses are shown below (ESA 2010 Annex 7.2).

Table 2.3: Accounting links between opening and closing balance sheet for land

Classification of assets, liabilities and net worth	IV.1 Opening balance sheet	III.1 and III.2 Transactions	III.3.1 Other changes in volume	III.3.2 Holding gains and losses		IV.3 Closing balance sheet
				III.3.2.1 Neutral holding gains and losses	III.3.2.2 Real holding gains and losses	
Land	AN.211	NP.1	K.1, K.22, K.3, K.4, K.5, K.61, K.62	K.71	K.72	AN.211

Source: ESA 2010, Annex 7.2

Stocks

2.34. The balance sheet completes the sequence of accounts. It shows the ultimate effect of the entries in the production, distribution and use of income, and accumulation accounts (SNA 2008 paragraph 13.5, ESA 2010 paragraph 7.03).

2.35. The item land (AN.211) on the opening balance sheet (IV.1) and closing balance sheet (IV.3) relates to the value of this asset at a particular moment of time: the beginning and end of an accounting period. The accounting period can be any period, but usually is a year or a quarter. The closing balance sheet at the end of the period should be equal to the opening balance sheet at the beginning of the next period.

2.36. The stock of land can be determined for the total national economy and the resident institutional sectors. The institutional sectors are non-financial corporations, financial corporations, general government, households and non-profit institutions serving households (SNA 2008 paragraph 4.24); most of them can be broken down into subsectors. The asset land does not appear on the balance sheet of the rest of the world towards the national economy.

2.37. Although from a conceptual point of view assets can only be owned by institutional units, for some purposes, like productivity analysis, it can be useful to break down assets — and also land — by industry as well. In the United Nations' International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4) and its European equivalent Nomenclature générale des Activités économiques dans les Communautés Européennes — Statistical classification of economic activities in the European

Communities (NACE Rev.2) a standardised breakdown into industries can be found.

2.38. Given land's important role in both sectoral and national wealth, this guide is primarily concerned with the measurement of the stock of land.

Transactions

2.39. Transactions in land should be registered under acquisition less disposals of natural resources (NP.1) (SNA 2008 paragraph 10.174 and Table 10.4, ESA 2010 paragraphs 3.185–3.186). Acquisitions less disposals of non-produced assets are recorded in the capital account of the sectors. At the total economy level, these transactions net to zero, as inter-sectoral purchases and sales cancel each other out. Transactions in land take place when an institutional unit buys or sells land to another institutional unit.

2.40. As discussed in paragraph 2.22, land is always an asset of the economy in which it is located. Thus, all purchases and sales of land normally take place between resident units. The one exception is when the boundaries of the economic territory itself are changed, for example, when a foreign government, or international organisation, purchases or sells land that is added to, or taken away from, the enclave in which its embassy or offices are located.

2.41. Purchases and sales of land should be recorded excluding costs of ownership transfer for both buyers and sellers. The costs of ownership transfers should by convention be registered under transactions in land improvements that form part of GFCF (P.51g).

2.42. Land improvements such as land clearance and creation of wells and watering holes are separate assets that should be registered under AN.112 other buildings and structures. As a consequence transactions in land improvements should not be registered as acquisition less disposals of natural resources (NP.1), as is the case for land, but as GFCF.

2.43. Consumption of fixed capital (P.51c) is defined as the decline in value of fixed assets owned, as a result of normal wear and tear and obsolescence (SNA 2008 paragraph 10.25, ESA 2010 paragraph 3.139). As land is not a fixed asset and as land is not subject to obsolescence, no consumption of fixed capital should be calculated and registered for land.

2.44. Transactions in land can be significant, especially for certain types of land as well as for certain institutional sectors. However, they can also be difficult to observe and therefore challenging to measure due to the paucity of data sources. To the extent that inter-sectoral land transactions are excluded from the sector capital accounts, net lending/borrowing is misstated; and, the case of integrated capital and financial accounts sector statistical discrepancies are also exacerbated.

2.45. It is useful for compilers to consider the types of common transactions that should appear in the capital account in their respective economies. This is a first step towards identifying new or improved data sources. It is important to note that not all of these sources will necessarily be coherent in terms of definitions and valuation, but they should be assessed for their relative strengths and weaknesses as part of a process to generate measurement strategies and methodologies. Some key types of common land transactions are considered below.

2.46. Governments can sell public land under their custodianship for agricultural or other developmental uses to the private sector. Government data sources may well have such details under the general heading of 'disposals of assets' with appropriate values. Agricultural censuses may have estimates of new farmland entering in production, either in values or volumes or both.

2.47. Farmland can be sold by unincorporated or incorporated enterprises to developers to accommodate new residential or non-residential construction. In this case, some information may be found in agricultural census-surveys on farmland sold. Alternatively, there may be administrative data by regions where changes in land use are recorded that can be leveraged. In addition, developers themselves should have acquisition costs (though possibly inclusive of costs of ownership transfer) associated with their land inputs.

2.48. A significant transaction in land in many economies relates to residential development. This is the case where new housing is sold and the underlying land ownership moves from the developers (typically corporate sector) to the new owners (typically individuals, though some residential development is sold to other corporations for rental purposes). Given that residential real estate acquisitions are big ticket purchases for households and are typically associated with other transactions such as loans to finance the investment, it is important to strive to estimate in the capital account not only the structures acquired/sold (produced asset) but also the underlying land (non-produced asset) in these real estate transactions. Real estate developers typically compile information on new construction in progress and change in inventory, and they may also compile sales of dwellings including and excluding land — with the difference being an acceptable estimate for land sold in a period. If this detail is available then the remaining issue will be to determine how much of the new real estate changes sectors in sales to households and what proportion of the underlying land is transferred with those sales (given that land proportions (i.e. land as a share of the total real estate value) are different on individual dwellings versus large rental units).

2.49. Land can also be transacted among large corporations. In many cases these transactions are intra-sectoral within the non-financial corporations' sector (e.g. the case of real estate developers selling units to real estate renters), and therefore net to zero. In a smaller number of cases, the transactions can be inter-sectoral and knowledge of the market may be sufficient to generate some adequate estimates. Lastly, land can be transferred among corporations as part of mergers and acquisitions activity, but direct transactions in land typically do not need to be recorded in these cases.

Other flows

2.50. Other changes are economic flows, other than those that occur through transactions recorded in the capital and financial accounts that change the value of assets and liabilities (ESA 2010 paragraph 6.02).

2.51. Two types of other changes are distinguished. The first consists of other changes in the volume of assets (III.3.1). The second is through nominal holding gains and losses (III.3.2) (ESA 2010 paragraph 6.02).

2.52. Concerning the first one: other changes in the volume of assets include flows that allow assets to enter or leave the accounts other than by transactions — for example, entrances and exits due to the discovery, depletion and degradation of natural assets. Other changes in the volume of assets also include the effect of exceptional, unanticipated external events that are not economic in nature, and changes resulting from reclassification or restructuring of institutional units or assets and liabilities.

2.53. Concerning the second one, nominal holding gains and losses: the nominal holding gains and losses (K.7) that relate to an asset are the increases or decreases in the asset's value accruing to its economic owner as a result of increases or decreases in its price.

Other changes in the volume of assets and liabilities

2.54. As can be concluded from Table 2.3, there are seven types of other changes in volume that are relevant for the asset land. They are economic appearance of assets (K.1), other economic disappearance of non-produced assets (K.22), catastrophic losses (K.3), uncompensated seizures (K.4), other changes in volume n.e.c. (K.5), changes in sector classification and structure (K.61) and changes in classification of assets and liabilities (K.62).

2.55. Economic appearance of assets (K.1) is the increase in the volume of produced and non-produced assets that is not the result of production (SNA 2008 paragraphs 12.12–12.44, ESA 2010 paragraph 6.06). It includes (a) transfers of other natural resources to economic activity and (b) quality changes in natural assets due to changes in economic uses.

2.56. An example of a transfer of natural resources to economic activity could be the transfer of land from a wild or waste state to land that can be put to economic use. The natural resources may also acquire value due to economic activity in the vicinity, for example, land may be recognised as valuable because of a nearby development or creation of an access road. The cost of land improvements is recorded as GFCF but any excess in the increase of value of the land over the value of the land improvements is recorded as economic appearance.

2.57. Concerning quality changes in natural assets due to changes in economic uses: these changes have to be recorded here as the counterpart of the changes in economic use that are shown as changes in classification. For example, the reclassification of cultivated land to land underlying buildings and structures may result in an increase in value as well as a change in classification. In this case the asset is already within the asset boundary and it is the change in quality of the asset due to the change of economic use that is regarded as the appearance of an asset. (See paragraph 2A.9 in annex to this chapter.)

2.58. Economic disappearance of assets (K.2) concerns the exit of natural resources from the asset boundary (SNA 2008 paragraphs 12.12–12.44, ESA 2010 paragraph 6.07). K.21 depletion of natural resources does not apply to land, but K.22 other economic disappearance of non-produced asset could be relevant. Many of the possible entries are simply the negative alternative to the positive entries just discussed in paragraphs 2.55–2.57.

2.59. Catastrophic losses (K.3) recorded as other changes in volume result from large-scale, discrete and recognisable events that destroy economic assets (SNA 2008 paragraphs 12.46–12.47, ESA 2010 paragraphs 6.08–6.09). Such events include major earthquakes, volcanic eruptions, tidal waves, exceptionally severe hurricanes, drought and other natural disasters; acts of war, riots and other political events; and technological accidents such as major toxic spills or release of radioactive particles into the air. Examples of such events for land could be deterioration in the quality of land caused by abnormal flooding or wind damage.

2.60. Uncompensated seizures (K.4) occur when governments or other institutional units take possession of the assets of other institutional units, including non-resident units, without full compensation, for reasons other than the payment of taxes, fines or similar levies. The seizure of property related to criminal activity is considered to be a fine. The uncompensated part of such unilateral seizures is recorded as other changes in volume (SNA 2008 paragraphs 12.48–12.49, ESA 2010 paragraphs 6.10–6.11). An example applying to land could be the seizure of a piece of land by the government that previously belonged to a household, without providing compensation for this to the household.

2.61. Other changes in volume not elsewhere classified (K.5) are the effects of unexpected events on the economic value of assets (SNA 2008 paragraphs 12.50–12.62, ESA 2010 paragraphs 6.12–6.15). For example, this might concern a decline in the value of land as result of unforeseen effects of acidity in air or rain.

2.62. Reclassifying an institutional unit from one sector to another (K.61) transfers its entire balance sheet, e.g. if an institutional unit classified in the households sector becomes financially distinct from its owner, it may qualify as a quasi-corporation and be reclassified in the non-financial corporations' sector (SNA 2008 paragraphs 12.64–12.67, ESA 2010 paragraphs 6.17–6.20). For instance, if an unincorporated owner of a large farm changes into an incorporated unit, the land of the farm (and all other assets and liabilities) should be transferred from the households sector to the sector of the non-financial corporations. This transfer should be registered as K.61 on the other changes in volume of assets account.

2.63. Changes in classification of assets and liabilities (K.62) occur where assets and liabilities appear under one classification, such as land under cultivation, in the opening balance sheet and under another classification, such as land underlying dwellings, in the closing balance sheet (SNA 2008 paragraphs 12.68–12.71, ESA 2010 paragraphs 6.21–6.25). In the case of land, both entries (a negative entry for the old category, a positive one for the new category) are made with the same value. For example, unit A sells farm land to unit B, which uses it to build houses on. If A acquires a building permit before selling the land it should be registered as a change in classification in A's accounts (with a probable gain in value to be recorded as another volume change also in A's accounts), and then a sale of building land to B. If B acquires the building permit after the sale is complete, then it is farm land that is sold and B records a change of classification (and possibly another volume change) in its books.

Nominal holding gains and losses

2.64. The nominal holding gains and losses (K.7) that relate to an asset are the increases or decreases in the asset's value accruing to its economic owner as a result of increases or decreases in its price (ESA 2010 paragraph 6.27). In the SNA 2008 the nominal holding gain on a non-financial asset is the value of the benefit accruing to the owner of that asset as a result of a change in its price over a period of time (SNA 2008 paragraph 12.74). As the prices of land often change over time, this type of other changes will occur frequently and could be an important explanation for the changes between opening and closing balance positions of land. The holding gain or loss in the value of land will be unrealised as long as the land is owned by the same entity between opening and closing balance sheets. The holding gain or loss in the value of land will be realised when the land is sold.

2.65. Nominal holding gains and losses (K.7) comprise neutral holding gains and losses (K.71) and real holding gains and losses (K.72).

2.66. The neutral holding gains and losses (K.71) relate to assets and liabilities and are the value of the holding gains and losses that accrue if the price of the asset or liability changes over time in the same proportion as the general price level (ESA 2010 paragraph 6.37). The SNA 2008 defines a neutral holding gain (loss) over a period as the increase (decrease) in the value of an asset that would be required, in the absence of transactions and other changes in the volume of assets, to maintain command over the same amount of goods and services as at the beginning of the period (SNA 2008 paragraph 12.75). Neutral holding gains and losses are identified to facilitate the derivation of real holding gains and losses, which redistribute real purchasing power between sectors. The general price index to be applied for the calculation of neutral holding gains and losses is a price index for final expenditure.

2.67. The real holding gains and losses (K.72) relate to an asset or liability and are the difference between the nominal and the neutral holding gains and losses on that asset (ESA 2010 paragraph 6.42). According to the SNA 2008 a real holding gain (loss) is the amount by which the value of an asset increases (decreases) over the neutral holding gain for the period, in the absence of transactions and other changes in the volume of assets (SNA 2008 paragraph 12.76).

Valuation

Stocks of land

2.68. On the balance sheet land should be valued at its current market price (SNA 2008 paragraph 13.16, ESA 2010 paragraph 7.33), which is the value of the land as if it were being acquired on the date to which the balance sheet relates. Any expenditure on land improvements is recorded as GFCF and the additional value it provides is excluded from the value of land shown in the balance sheet and is instead shown in a separate asset category for land improvements (AN.1123).

2.69. When market prices for transactions are not observable, valuation according to market-price-equivalents provides an approximation to market prices. For example, if the market price of a certain piece of land is not available, prices of land with a comparable use and location could be used. Alternatively, the acquisition costs of the land could be used as a starting point that subsequently should be adjusted for revaluations and other changes in the volume of assets. If none of the methods mentioned above can be applied, stocks may be recorded at the discounted present value of expected future returns.

Flows

2.70. The SNA 2008 and ESA 2010 prescribe to value transactions at market prices (SNA 2008 paragraph 3.119, ESA 2010 paragraph 1.94). Market prices for transactions are defined as amounts of money that willing buyers pay to acquire something from willing sellers; the exchanges are made between independent parties and on the basis of commercial considerations only, sometimes called 'at arm's length'.

2.71. Acquisitions and disposals of land (and other natural resources) are valued at current market prices prevailing at the time the acquisitions/disposals occur. Transactions in land are recorded at the same value in the accounts of the purchaser and in those of the seller. This value excludes the costs of ownership transfer of the natural resource. These costs are treated as GFCF.

2.72. In order to determine the valuation of the other changes in the volume of assets, it is usually necessary to value the asset before and after the change in volume and take the difference that is not explained by any transaction as the value of the other changes in the volume of assets (SNA 2008 paragraph 3.151).

2.73. Holding gains and losses usually accrue continuously to land. In general, they are estimated by deducting from the total change in the value of assets those that can be attributed to transactions and to other changes in volumes (SNA 2008 paragraph 3.153).

2.74. However, the estimation of the components of the flows (transactions, other changes in the volume of assets, holding gains and losses) heavily depends on the available sources. For instance, if information on the price developments of land is available, it might be possible to estimate the holding gains and losses autonomously and derive one of the other flow components as a residual.

Time of recording

2.75. When discussing timing in the SNA 2008 and ESA 2010, an essential distinction should be made between stock data as recorded in balance sheets, on one hand, and flow data as recorded in the accounts, on the other. Balance sheets, by definition, refer to specific points in time. In contrast, flows are aggregations, over some chosen accounting period, of individual transactions or other flows, which are themselves scattered over the accounting period.

Stocks

2.76. Balance sheets can be drawn up for any point in time. The SNA 2008 and ESA 2010 define balance sheets for all sectors at the moment when one accounting period ends and a new accounting period begins. The closing balance sheet of one period is identical to the opening balance sheet of the next one, so there remain no price changes, reclassifications or other economic flows that are not duly recognised by the SNA 2008 and ESA 2010 (SNA 2008 paragraph 3.189, ESA 2010 paragraph 7.11).

Flows

2.77. Cash accounting cannot be used generally for economic and national accounting as the times at which payments take place may diverge significantly from the economic activities and transactions to which they relate and it is these underlying activities and transactions that the SNA 2008 and ESA 2010 seek to portray. Therefore the general principle regarding the time of recording of transactions is accrual accounting (SNA 2008 paragraph 3.166, ESA 2010 paragraph 1.101).

2.78. Accrual accounting records flows at the time economic value is created, transformed, exchanged, transferred or extinguished. This means that flows that imply a change of ownership are entered when the change occurs, services are recorded when provided, output at the time products are created and intermediate consumption when materials and supplies are being used.

2.79. Applying the accrual principle to the acquisition less disposals of natural resources (NP.1) (that includes the transactions in land) implies that the purchase or sale of land should be registered at the moment when the economic ownership of the land changes hands. When a change in ownership is not obvious, the change can be considered to occur at (or proxied by) the time the parties to the transaction record it in their books or accounts and, failing that, the moment when physical possession and control is acquired.

2.80. Other changes in the volume of assets are usually discrete events that accrue at precise moments or within fairly short periods of time (SNA 2008 paragraph 3.182).

2.81. Changes in structure and classification should be entered at the moment when a unit or an asset is moved to a different category than that to which it was classified previously. An integrated stock-flow system requires that all reclassifications are recorded and all entries for the reclassification are recorded at the same time (SNA 2008 paragraph 3.185).

2.82. Changes in prices often have a more continuous character, particularly in respect of assets for which active markets exist. In practice, nominal holding gains or losses will be computed between the beginning of the accounting period or the point in time when ownership of the land is acquired, and the end of the accounting period or the point in time that the land is disposed of (SNA 2008 paragraph 3.183).

Netting and consolidation

2.83. Net recording concerns a registration whereby the values of some elementary items are offset against items on the other side of the account (for example asset against corresponding liability) or which have an opposite sign (SNA 2008 paragraph 3.193, ESA 2010 paragraph 1.110). With respect to stocks of land: as land can only appear on the asset side of the balance sheet and as the value is always positive, stocks of land cannot be netted. With respect to transactions in land: these are netted by definition as the transactions are defined as acquisitions (or purchases) less disposals (or sales) of non-financial assets.

2.84. Consolidation is a method of presenting the accounts for a set of units as if they constituted one single entity (unit, sector, or subsector). It involves eliminating transactions and reciprocal stock positions and associated other economic flows among the units being consolidated (SNA 2008 paragraph 3.197, ESA 2010 paragraph 1.106). As land is a non-financial asset without a counterpart liability consolidation is not applicable to stocks of land.

Data issues in the measurement of flows of land

2.85. As noted above, the measurement of land transactions is typically a challenging undertaking for compilers due to lack of data sources. Further, in many instances of inter-sectoral land transactions, the asset is created beforehand or at the same time; and, the asset can also change value and/or use (that is, type) at or near the time of transaction. However, compilers may find that the transactions, the revaluation changes, or the other changes in volume are difficult to estimate and/or separate. As a result, some or all of these components may represent either data gaps or data series of lower quality.

2.86. In addition, a further issue relates to the appropriate classification of the transactions in land by type in the simultaneous sale (one type of land) and purchase (another type of land). As a result, land transactions are not commonly generated by type of land in national accounts' estimates. Rather, the availability of estimates of land classified by type is more typical of balance sheet data.

Annex: Distinguishing other changes in volume from holding gains and losses

Introduction

2A.1. The primary goal of this compilation guide is to provide guidance when compiling estimates of the stocks of land in a country. However, as described in Chapter 2, there is coherence between the stocks of land and the changes in stocks of land. The change in value between balance sheets is the result of transactions, other changes in volume, or revaluations (due to changes in price). While other chapters discuss the issues of how to value the stock of land on the balance sheet this annex focuses on how changes in the value of land between opening and closing balance sheets, that are not the result of transactions can be deconstructed into changes in price and changes in volume.

2A.2. There are several reasons why valuing the stocks of land is difficult in practice and much of this compilation guide discusses those reasons, such as the difficulty in separating the value of the land from the value of the structure upon the land. Even when there are separately identifiable land values derived from transactions without buildings, such as agricultural land, it is hard to argue that these unit prices should be used as a proxy for the price of land underlying dwellings. If this were done, the value of the urban land would be undervalued because most transactions in land without buildings would occur in rural areas or on the outskirts of cities where prices are usually much lower than in developed urban areas.

2A.3. Therefore, it is not only important to know the size of the land area (i.e. number of square metres) but also the location and the use of a specific piece or tract of land (i.e. the quality characteristics) and to price it accordingly. Because different qualities reflect different use values this guide, which will be discussed in Chapter 3, recommends classifying land by type/use. Without the necessary subcategories of land it would be difficult to allocate changes in quality (the use of land) as changes in volume.

Description of the issue

2A.4. Differentiating between non-transaction related value changes driven by price 'revaluation' and changes driven by 'other changes in volume' (quantity/quality) may be difficult to implement in practice. Not all land included in the geographic surface area of a country is necessarily within the asset boundary of the SNA 2008/ESA 2010. Land may make its economic appearance when it is transferred from a wild or waste state to one in which ownership may be established and the land can be put to economic use (see SNA 2008 paragraph 12.21). In such cases, the national accountants may be able to observe an increase in the quantity of land (number of square metres) of the economy as a whole and be able to record such an increase as a change in volume.

2A.5. In cases where the total quantity of land within the asset boundary remains the same for the economy as a whole it may be more difficult to identify the changes in the use of land if all that is observed is a change in value. In this instance, one might attribute a change in value solely to changes in price. As was stated previously, this is why detailed classifications should be used so that national accountants are better equipped to identify changes in the value of land as change in volume.

Conceptual issues in identifying quality changes

2A.6. This section discusses some of the conceptual issues that arise when trying to differentiate between value changes driven by revaluation and those driven by other changes in volume. A basic principle of the SNA 2008 is that different use values are reflected as differences in quality. Therefore changes in economic use of land that lead to a change in classification should be recorded as a change in volume and any excess in the value due to the change in classification should be recorded as an economic appearance of an asset.

2A.7. The following passage from the ESA 2010 describes the various scenarios of what can be considered as an economic appearance of an asset:

'Economic appearance of assets is the increase in the volume of produced and non-produced assets that is not the result of production. Included are…

Quality changes in natural assets due to changes in economic uses. Changes in quality are recorded as changes in volume. The quality changes recorded here occur as the counterpart of the changes in economic use that are shown as changes in classification (see paragraph 6.21). For example, the reclassification of cultivated land to land underlying buildings may result in an increase in value as well as a change in classification. In this case the asset is already within the asset boundary and it is the change in quality of the asset due to the change of economic use that is regarded as the appearance of an asset' (ESA 2010 6.06f).

2A.8. In addition, there are relevant passages from the SNA 2008 as well.

'12.23 The SNA 2008, in general, treats differences in quality as differences in volume. As explained with respect to goods and services in Chapter 15, different qualities reflect different use values (and in the case of goods and services, different resource costs). Different qualities are, therefore, economically different from each other. The same principle applies to assets. The quality changes recorded here occur as the simultaneous counterparts of the changes in economic use that are shown as changes in classification, as described below. For example, the reclassification of cultivated land to land underlying buildings may result in a change of value as well as a change in classification. In this case, the asset is already within the asset boundary, and it is the change in quality of the asset due to changes in its economic use that is regarded as the appearance of additional amounts of the asset. Another example is that of livestock treated as capital formation, for example, dairy cattle, if they are sent to slaughter earlier than expected.

12.29 The changes recorded here are the negative equivalent of the upward changes in volume associated with the changes in classification. For example, if a change in land use leads to reclassifying some land from cultivated land to communal grazing land, there well may be a resulting change in the value of the land.

12.30 All degradation of land, water resources and other natural assets caused by economic activity is recorded in the other changes in the volume of assets account. The degradation may be an anticipated result from regular economic activity or less predictable erosion and other damage to land from deforestation or improper agricultural practices.'

Change in use

2A.9. Table 2A.1 describes a common scenario where the use of the land has changed which leads to a change in classification. Suppose at the beginning of the time period 1 000 square kilometres of agricultural land valued at 20 per square kilometre are re-zoned for residential use valued at 100 per square kilometre. The changes in value of the land for each asset type should be recorded as other changes in volume. However, there are several entries that occur. The change in classification from agricultural to residential use should be recorded as changes in classification of assets and liabilities (K.62). The change in classification (K.62) is an offsetting adjustment in that agricultural land shows a negative value of – 20 000 (1 000 * 20) and land underlying dwellings shows a positive value of 20 000. Because the price of the agricultural land is lower than the price of the land underlying dwellings the total value of the land increased, this excess value (80 000) should be recorded as an economic appearance of assets (K.1).

Table 2A.1: Change in use of land from agricultural land to land underlying buildings and structures

	Opening balance sheet			Closing balance sheet					
	Quantity	**Unit price**	**Value**	**Quantity**	**Unit price**	**Value**	**Revaluation**	**Other changes in volume**	**Notes**
Land (AN.211)	1 000	20	20 000	1 000	100	100 000	0	80 000	
Land underlying buildings and structures				1 000	100	100 000	0	100 000	
Land underlying dwellings	0	100	0	1 000	100	100 000	0	100 000	
								80 000	Economic appearance of assets (K.1)
								20 000	Changes in classification of assets (K.62)
Land underlying other buildings and structures									
Land under cultivation	1 000	20	20 000	0	20	0	0	-20 000	
Agricultural land	1 000	20	20 000	0	20	0	0	-20 000	
								-20 000	Changes in classification of assets (K.62)
Forestry land									
Surface waters used for aquaculture									
Recreational land and associated surface water									
Other land									

Source: TF on Land and other non-financial assets, fictitious data

Apparent 'quality' changes

2A.10. An example of changes in the apparent 'quality' of land that may be less clear to national accountants is when the value of a tract of land changes because the surrounding land now has another use. The market value of two identical buildings can be quite different depending on location and amenities such as being close to parks, highways, job opportunities, etc.

2A.11. Table 2A.2 illustrates a scenario where a park is rezoned and is therefore reclassified as land on which dwellings can be built. Under such a scenario, the value of the residential properties — that is the value of the dwelling including the land — overlooking the park land is likely to decrease. There is an increase in the value of the reclassified park land because land underlying dwellings generally have a higher price. It is fairly clear according to the SNA 2008 that the reclassified park land is a change in use and represents a change in quality. What might be less clear is how to record the change in value of the tract of land that is not reclassified.

2A.12. After consulting the Advisory Expert Group (AEG) on national accounts, from a purely conceptual point of view the change in the value of land that is due to changes in the surrounding amenities of the land are to be recorded as other changes in volume. Essentially the value of land is not only determined by the economic use, location, and size but also by surrounding amenities (such as parks, high quality schools, and access to public transportation, etc.) and these surrounding amenities should be considered as quality-characteristics. The argument is that any increase/decrease in value of the land as a consequence of activities in the vicinity should be recorded as economic appearance of assets /economic disappearance of non-produced assets. This is in accordance with SNA 2008 paragraph 12.21 that states:

'Not all land included in the geographic surface area of a country is necessarily within the asset boundary of the SNA 2008… It may also acquire value because of activity in the vicinity, for example, land that becomes more desirable and thus more valuable because of a new development is established nearby or the creation of an access road.'

Table 2A.2: Reclassification of surrounding land for another use

	Opening balance sheet			Closing balance sheet					
	Quantity	Unit price	Value	Quantity	Unit price	Value	Revaluation	Other changes in volume	Notes
Land (AN.211)	2 000	70	140 000	2 000	80	160 000	0	20 000	
Land underlying buildings and structures	1 000	100	100 000	2 000	80	160 000	0	60 000	
Land underlying dwellings	1 000	100	100 000	2 000	80	160 000	0	60 000	
Existing dwellings near park	1 000	100	100 000	1 000	80	80 000	0	-20 000	Other economic disappearance of non-produced assets (K.22)
Park land reclassified for residential use				1 000	80	80 000		80 000	
								40 000	Economic appearance of assets (K.1)
								40 000	Changes in classification of assets (K.62)
Land under cultivation									
Agricultural land									
Forestry land									
Surface waters used for aquaculture									
Recreational land and associated surface water	1 000	40	40 000	0	40	0		-40 000	
Park land	1 000	40	40 000	0	40	0		-40 000	Changes in classification of assets (K.62)
Other land									

Source: TF on Land and other non-financial assets, fictitious data

2A.13. Under perfect competition and transparent markets, an argument can be made that price relatives at a particular point in time reflect differences in volume (quantities or qualities). According to this line of reasoning, having a higher price because of attributes in the vicinity (view on a park, high quality school in the neighbourhood) actually reflect differences in quality. Taking this point one step further, one could argue that a decline in the value of the land underlying the dwelling, because of a nearby park being changed into a residential area (or worse), reflects a quality decrease.

2A.14. One can look at price and volume measurement theory and theory of discrete choice to understand this line of reasoning. In principle, the price components should include changes arising solely from price changes, while all other changes (relating to quantity and quality and compositional changes) should be included in the volume components ([6]). As a theoretical framework a 'characteristics' approach is used to deconstruct the observed price movement into a 'pure' price change and a change due to changes in characteristics. What is apparent when one thinks about constructing constant-quality prices is that (i) too many quality characteristics exist for quality-mix changes to be considered adequately covered by different classifications; (ii) any price index used to deflate values belonging to a particular classification must be tailored to transactions and changes in quality-mix characteristics within that classification; and (iii) while a detailed classification is analytically useful there are trade-offs because a too detailed classification will reduce the effective sample size ([7]).

2A.15. However, the AEG recognised the difficulty in identifying such a change in value in practice. As a result, the change in the value of land due to changes in the surrounding amenities will most likely be recorded as revaluations ([8]).

Borderline with land improvements

2A.16. Another example is that the quality of land may appear to change because there is some sort of improvement to the land, such as clearing land so that houses can be built on the land. This apparent 'change' in the quality of land should not be recorded as a volume change in the non-produced category of land but as land improvements that should be recorded as gross fixed capital formation. Chapter 8.2 discusses this issue in more detail and describes how land improvements can be separated from land.

Practical advice

2A.17. In practice, it may be very difficult to make such a nuanced distinction between other changes in volume versus revaluation changes. The situation may be blurred, and it might not be possible to distinguish these different characteristics in land, as a consequence of which the relevant changes will most likely be recorded as revaluations.

2A.18. If detailed information does not exist to deconstruct changes in value between balance sheets within a particular classification then a national statistical institute can draw a boundary of what should be recorded as other changes in volume. One such practical solution could be to record as changes in volume only those tracts of land that change economic use (proxied as a change in classification). On the other hand, if incidental and exceptionally large changes in the value of land due to changes in the surrounding amenities can be identified by a country, then these changes in quality may be recorded as other changes in volume. However, in practice, this will most likely be rarely done.

([6]) Eurostat, *Handbook on price and volume measures in national accounts*. Available at http://ec.europa.eu/eurostat/documents/3859598/5827257/KS-41-01-543-EN.PDF/10be98a9-083d-446a-a528-682c95914e9f?version=1.0

([7]) Mick Silver is a specialist in price statistics at the International Monetary Fund and contributed to the discussion on price theory.

([8]) For the issue paper presented at the 9th Advisory Expert Group meeting 8–10 September 2014 as well as the conclusions of the meeting see http://unstats.un.org/unsd/nationalaccount/aeg/2014/M9-2.asp

3

Classification of land

Introduction

3.1. A coherent and consistent classification that covers all types of land within a country is needed to adequately estimate the total value of land. However, that is not to say that the entire geographic surface area of a country is included within the asset boundary of the SNA 2008 (SNA 2008 paragraph 12.21). Only land that fits the definition of an asset should be included within the asset boundary, that is, all land on which effective ownership rights can be assigned to (an) institutional unit(s) and from which economic benefits are derived by their owner(s) by holding or using them over a period of time (SNA 2008 paragraph 1.46). While it is not explicitly stated in SNA paragraph 1.46 it is important to note that this includes allowing others to use the land.

3.2. A well-defined land classification is needed because the use of a particular tract of land can correspond to major differences in price. For instance, the price (development) of land underlying dwellings may differ substantially from agricultural land. Therefore, it is not only important to know the size of the land area (i.e. number of square metres) and the location, but also the use of the land and price it accordingly. Sub-classifications are further necessary to appropriately capture changes in the value of land due to changes in classification (i.e. changes in use) as volume changes instead of price changes ([9]).

3.3. This chapter starts with discussing the purpose of a new classification of land in compiling land statistics. It further provides a general overview of the already existing classification approaches and discusses several problems in their practical application. Building upon national accounts guidelines, experience of national statistical institutes (NSIs), national central banks and international organisations a new classification of land is introduced. Furthermore, borderline cases concerning the assignment of certain land types to the proposed classification categories are discussed. Finally, case studies for Korea and Germany are presented illustrating the application of the proposed classification.

Why do we need a new classification?

3.4. Although for the ESA 2010 transmission programme reporting requirements, European Union (EU) Member States are only required to report the total value of land for the combined households and the non-profit institutions serving households sector, a well-defined classification of land is essential.

3.5. Since the estimation of land is relatively new for quite a number of countries, there is a lack of a widely accepted classification ([10]). Ideally, a classification of land that is based on broad international consensus will lead to a more widespread use among the NSIs and increase the possibilities for cross-country comparisons. In addition, the importance of a commonly used classification is clearly illustrated by the notion that the choice of a particular classification may substantially affect the estimation of the total value of land. This is due to the fact that classifications may differ significantly in scope (the types of land included), purpose and definitions.

3.6. The various classifications that are currently used by NSIs that estimate land on the balance sheet may be explained by the limited guidance that existing national accounting guidelines provide for classifying land. For instance, the SNA 2008 lacks a disaggregation of land into the various subtypes (such as in SNA 1993 Annex definition of assets). Rather, it recommends the use of the categories provided by the System of Environmental-Economic Accounting (SEEA 2012) as guidance (SNA 2008 paragraphs 10.178, 10.181, 10.183). Also, ESA 2010 provides limited guidance. Although it presents a disaggregated classification of land, it lacks detailed definitions of the particular categories.

3.7. The variety in the applied classifications could potentially reduce international comparability regarding national estimates for the total value of land. From that perspective, the establishment of a broadly supported classification is desirable since it can induce a more widespread implementation, enhancing international comparability.

3.8. Therefore, to increase the usefulness of land estimates, it is important that a classification contains the most important subtypes of land such that price differences are taken into account. However, keeping in mind the already existing classifications as well as the data restrictions that countries face, the proposed classification should not go into extensive detail. As a result, the new classification should be regarded as a minimal common denominator.

3.9. Overall, an internationally accepted classification of land can be regarded as a crucial requirement to compile land estimates that are suitable for cross-country comparisons. A classification that encompasses all relevant land use types is important in order to successfully and accurately

([9]) A basic principle of the SNA 2008 is that different land use values are reflected as differences in quality. Therefore changes in economic use of land that lead to a change in classification should be recorded as a change in volume and any excess in the value due to the change in classification should be recorded as an economic appearance of an asset. See SNA 2008 paragraph 12.23.

([10]) Several national classifications — which may differ significantly — were used by the countries. See Advisory Expert Group, 'Issues Note: The recording and measurement of land and natural resources (and dwellings)', paragraph 4. Available at http://unstats.un.org/unsd/nationalaccount/aeg/2012/M7-261.PDF estimate the value, price and volume changes of different types of land and, ultimately, all economically relevant land. In fact, the existence of a wide range of different approaches to this topic shows that a commonly accepted classification is desirable.

Existing approaches for classifying land

3.10. This section provides an overview of some of the existing classifications of land that can be used as a suitable starting point for developing a new classification for use by NSIs for the estimation of land on the balance sheet.

3.11. Existing classifications are often based on land use or land cover statistics and thus tackle quite different issues. Land cover, as defined in SEEA, refers to the observed physical and biological cover of the Earth's surface and includes natural vegetation and abiotic (non-living) surfaces. Land use can be defined as: '[t]erritory characterised according to its current and future planned functional dimension or socio-economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational)' ([11]).

3.12. The following examples illustrate the differences:

— broad leaved trees (land cover) — forestry (land use);

— broad leaved trees (land cover) — recreational (urban green) (land use);

— cereal crops (land cover) — agriculture (land use);

— reeds, grasses (land cover) — none / natural protected site (land use);

— hard sealed surface (land cover) — road transport network (highway) (land use);

— hard sealed surface (land cover) — air traffic (airport runway) (land use);

— grassland (land cover) — sport & leisure (golf course) (land use).

3.13. Since the SNA 2008 recommends guidance provided by SEEA to disaggregate land into various types the SEEA classification is first explored. SEEA 2012 provides two approaches for classifying land, land cover or land use. The types of categories included in the SEEA land cover classification are shrubs, grasslands, mangroves, etc. and do not appear to fit well with what national accountants are trying to measure, i.e. what the land is used for.

3.14. Thus, for national accounting purposes, land use may be a more appropriate classification. In SEEA 2012, land use reflects both (i) activities undertaken and (ii) the institutional arrangements put in place; for a given area for the purpose of economic production, or the maintenance and restoration of environmental functions. In this classification, land is divided into seven sub-classifications and includes, for example, forestry, land used for aquaculture, and land used for maintenance and restoration of environmental functions. Furthermore, inland water is separated from land and divided into four sub-classifications.

Table 3.1: Land use Classification proposed by SEEA

SEEA 2012 ([1])
Land
Agriculture
Forestry
Land used for aquaculture
Use of built up and related areas
Land used for maintenance and restoration of environmental functions
Other uses of land n.e.c.
Land not in use
Inland waters
Inland waters used for aquaculture or holding facilities
Inland waters used for maintenance and restoration of environmental functions
Other uses of land waters n.e.c.
Inland waters not in use

Source: SEEA 2012

(1) SEEA 2012 provides two approaches for classifying land, which focus on land use or land cover. The approach introduced here focuses on land use (SEEA 2012 paragraph 5.252). Particular differences between land use and land cover are discussed in paragraph 3.12.

3.15. Even though land use classification is a more appropriate classification from a national accounting perspective, the SEEA 2012 classification of land focuses primarily on environmental aspects. Therefore, it appears that what is also needed, from the perspective of national accounting, is a classification based on land as an economic asset.

3.16. Therefore, besides SEEA 2012, classifications used for other statistics are considered as well. Among them are the directive for establishing an Infrastructure for Spatial Information in Europe (INSPIRE) ([12]), the Coordination of information on the environment (CORINE) programme and High Resolution Layers (HRL) on specific classes which are both included in the Copernicus programme ([13]), and

([11]) Official Journal of the European Union, 2007.

([12]) See http://inspire.ec.europa.eu/

([13]) See http://www.copernicus.eu/

the Land Use/Cover Area Frame Survey (LUCAS). The latter deals with an area sample for the provision of coherent and harmonised statistics on land use and land cover. The land use classification of LUCAS has a particular focus on agricultural land, but also contains a fair amount of detailed categories such as residential land; industry and manufacturing; commerce, finance and business ([14]). At first glance, the land use categories provided by LUCAS appeared a viable option but in the end was rejected because the categories were too detailed since the goal was to develop a minimum classification recommendation.

3.17. Since this guide addresses land as an economic asset, the prior classification of land in the SNA 1993 and ESA 1995 was reviewed as well as the current ESA 2010 classification, presented in Table 3.2. This classification meets the criteria of classifying land by use with a focus of land being an economic asset. Key in this classification is that land underlying buildings and structures (AN.2111) is shown as a separate category of land (SNA 1993 Annex definition of assets, and ESA 1995 Annex 7.1). This reflects the principle that a correct estimation of the value of land requires a separation between the value of buildings and structures and their underlying land (SNA 2008 paragraph 13.44). Another positive aspect of this classification is that it provides information that is requested as an 'encouraged' item in the G-20 Data Gap Initiative template of stocks of non-financial assets by asset type and by sector.

Table 3.2: Categories proposed by SNA/ESA

SNA 1993, ESA 1995/2010
Land (AN.211)
Land underlying buildings and structures (AN.2111)
Land under cultivation (AN.2112)
Recreational land and associated surface water (AN.2113)
Other land and associated surface water (AN.2119)

Source: SNA 1993, ESA 1995, ESA 2010

3.18. All classification approaches discussed above provided useful information during the development process of the new classification. Among these, the SNA 1993/ESA 1995/ESA 2010 were best suited as a general reference to describe land as an economic asset. In addition, SEEA 2012 was used in providing definitions of the types of land included in the categories.

Proposed classification of land

3.19. The main purpose of a new classification is to find the lowest common denominator out of the many already existing classifications, with the intention to increase international comparability as well as to provide guidance to compile land statistics. The proposed classification intends to cover all land of a country that falls within the asset boundary. While there are several ways to classify land (e.g. land cover, ownership), the proposed classification is based on land use statistics ([15]).

3.20. Given the definition of an asset (SNA 2008 paragraph 1.46), all land to which economic ownership can be assigned and from which economic benefits can be derived should be included in the balance sheet. The proposed classification, shown in Table 3.3, includes all these relevant land types. To do justice to the diversity of land types across countries as well as the differences in prices, the following classification is proposed as a minimum classification. This leaves flexibility for countries to further disaggregate their data into more detailed categories that include more types of land. However, it is recommended for international comparability purposes that the detailed categories be maintained in such a way that they may simply be aggregated into the proposed minimum classification.

Table 3.3: Proposed classification

Classification of land
1. Land underlying buildings and structures (AN.2111)
1.1 Land underlying dwellings (AN.21111)
1.2 Land underlying other buildings and structures (AN.21112)
2. Land under cultivation (AN.2112)
2.1 Agricultural land (AN.21121)
2.2 Forestry land (AN.21122)
2.3 Surface water used for aquaculture (AN.21123)
3. Recreational land and associated surface water (AN.2113)
4. Other land and associated surface water (AN.2119)

Source: TF on Land and other non-financial assets

3.21. This proposed classification is in accordance with ESA 2010; however, it introduces further sub-classifications for land underlying buildings and structures as well as for land under cultivation. It consists of the following main items:

1. Land underlying buildings and structures is in most countries the most valuable type of land, both in unit price and in total value. Since most national compilers further distinguish between dwellings and other buildings and structures in their capital stocks, the proposed classification also specifies this further sub-classification.

([14]) More information is available at: http://ec.europa.eu/eurostat/web/lucas/overview

([15]) Classification approaches based on institutional sectors are discussed in Chapter 7 of this compilation guide.

In doing so, the importance in terms of economic value of land underlying dwellings and the corresponding residential real estate is highlighted.

2. Land under cultivation is further disaggregated into agricultural land, forestry land and surface water used for aquaculture.

3. Recreational land and associated surface water includes privately as well as publicly owned recreational areas together with associated surface water.

4. Other land and associated surface water contains, for example, exploitation areas and surface waters. In most cases the total value of these areas is relatively low.

3.22. Now that the proposed structure has been discussed the next section provides further definitions for the various land types included in each category. The definitions presented in the next section are based on the definitions provided in SNA 1993/ESA 1995 and SEEA 2012, although in many cases definitions are adapted and further specified in detail in order to capture all important aspects for measuring purposes.

Definitions

3.23. Land and its components are defined as follows.

Land

Land (as an economic asset) consists of the ground, including the soil covering it and any associated surface waters, over which ownership rights are enforced and from which economic benefits can be derived by their owners by holding, using, or allowing others to use them.

The value of land excludes any buildings or other structures situated on it or running through it; cultivated crops, trees and animals; mineral and energy resources; non-cultivated biological resources and water resources below the ground. The associated surface water includes any inland waters (reservoirs, lakes, rivers, etc.) over which ownership rights can be exercised and which can, therefore, be the subject of transactions between institutional units. However, water bodies from which water is regularly extracted against payment, for use in production (including for irrigation) are not included in water associated with land but in water resources (SNA 2008 paragraph 10.175, ESA 2010 Annex 7.1). Water resources are non-produced non-financial assets but are included in another sub-category of natural resources. If it is not possible to separate the value of the water resource from the associated land, the whole should be allocated to the category representing the greater part of the total value (SNA 2008 paragraph 10.184).

1. Land underlying buildings and structures

Land on which dwellings, non-residential buildings and structures are constructed or into which their foundations are dug, including yards and gardens deemed an integral part of farm and non-farm dwellings and their corresponding access roads. Land underlying buildings and structures also includes land underlying public or private transport infrastructure like highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways and waterways. Building land on which construction of (farm) dwellings, non-residential buildings or structures takes place or for which such construction activities are planned, are included in this category as well ([16]).

1.1 Land underlying dwellings

Land on which dwellings are constructed or into which their foundations are dug, including yards and gardens deemed an integral part of farm and non-farm dwellings and access roads to farm dwellings. Building land on which construction of dwellings takes place or for which such construction activities are planned, are included in this category as well.

1.2 Land underlying other buildings and structures

Land on which non-residential buildings and structures are constructed or into which their foundations are dug, including land underlying public or private transport infrastructure like highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways and water ways. Building land on which construction of non-residential buildings or structures takes place or for which such construction activities are planned, are included in this category as well.

2. Land under cultivation

Land under cultivation encompasses agricultural land, forestry land, and surface water used for aquaculture as defined below. Cultivation is defined as fostering the growth of something (plants, trees, animals) through human intervention. Not included in this category is land underlying farm dwellings, farm buildings or other corresponding structures because, if possible, this should be included in land underlying buildings and structures.

([16]) Construction land according to land registers or zoning plans should be categorised in 'land underlying buildings and structures' regardless of actual planning and/or building activities taking place. If such information is not available, countries may use building permissions as a criterion. However, institutional frameworks as well as data availability may differ significantly between countries; therefore, countries should handle this issue depending on their individual context.

2.1 Agricultural land

The total of land under temporary or permanent crops, meadows and pastures as well as land with temporary fallow; this category includes tilled and fallow land, and naturally grown permanent meadows and pastures used for grazing, animal feeding or agricultural purpose.

2.2 Forestry land

Land used for forestry. It does not include the forest itself, only the underlying land. Land that is predominantly used for agricultural purposes or urban use is also excluded.

2.3 Surface water used for aquaculture

Surface water used for aquaculture facilities and fish farming activities. Aquaculture refers to the farming of aquatic organisms: fish, molluscs, crustaceans, aquatic plants, crocodiles, alligators, turtles, and amphibians. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc.

3. Recreational land and associated surface water

Land that is used as privately owned amenity land, parklands and pleasure grounds and publicly owned parks and recreational areas, together with associated surface water (ESA 1995/SNA 1993).

4. Other land and associated surface water

All land within the asset boundary not elsewhere classified. Also included in this category are surface waters not captured by the other categories (e.g. rivers).

Borderline cases

3.24. As source data differ significantly between the countries, borderline cases may arise in which it is unclear how areas should be allocated within the proposed classification of land. Overall it has to be stated, that estimates of land should fit the proposed classification as adequately as possible. However, if this is not possible it is recommended to apply the SNA 2008/ESA 2010 principle to register the combined value under the more valuable asset as was discussed in paragraph 2.14. If an NSI cannot determine which asset is the most valuable then the main land use principle can be used as a proxy.

3.25. The main land use principle refers to the area measures for a specific land use type on a respective plot of land. It implies that plots of land that cannot be accurately measured or distinguished are classified to the type of land that is regarded as the main use of the area. For instance, land underlying farm dwellings or land underlying farm buildings like barns, stalls, etc. ideally should be separated from the rest of the farm land and assigned to the category land underlying dwellings or land underlying other buildings and structures, respectively, instead of assigning it to agricultural land. However, if this separation is not possible, it should be assigned to the more valuable asset or, lacking that information, the main use of the total area of which the plot is part of, in this case most likely agricultural land.

3.26. Another borderline case arises when a particular building has a mixed-use. For example, there may be stores in the first few levels and flats in the upper levels of a building. According to the proposed definition, part of the building plot should be assigned to land underlying other buildings and structures (commercial use) and the other part to land underlying dwellings (residential use). The value of the part of the building for commercial or residential use may be used to allocate the value of the underlying land to the separate categories. As such detailed data may not be available in most countries, the respective building plot may be categorised according to its main use (i.e. square metres of commercial use relative to residential use).

3.27. Another example is national parks since the value of each part of the combined asset is probably difficult to determine. National parks may be classified as forestry land if there is human intervention in fostering the growth of the trees such as planting and/or deliberate seeding. If the trees are not cultivated or if certain plots in the national park are covered by moor or wetlands then these areas should not be considered as forestry land. Only parts of national parks that consist of forestry can be classified as such, but distinguishing such areas may be very hard in practice. Once again the main land use approach has to be applied: if a separation of the particular areas is not possible, they should be assigned to the main land use of the national park; that is, to other land if it is primarily for environmental conservation or if it is primarily used for recreational purposes to recreational land.

3.28. Finally, the category surface water used for aquaculture should only contain surface water, not buildings and structures that are typically built on land situated next to it. If countries are able to separate the area covered by surfacve water and the corresponding land area, they should assign these areas to the different categories. However, if a separation cannot be conducted, the whole area should be assigned to the category of its main use. This procedure should be applied to similar issues, but only if a separation poses major difficulties or is even impossible.

3.29. The category other land should only be used if the assignment to another category is not possible to conduct, given the fact that the observed type of land is within the asset boundary.

Case studies

Case study classification: Korea

In Korea, land is currently classified into 28 categories according to the Act on land survey, waterway survey and cadastral records. For the purposes of international comparison and compiling national balance sheets, the 28 categories are reclassified into the proposed classification of this compilation guide 1) land underlying dwellings, 2) land underlying other buildings and structures, 3) agricultural land, 4) forestry land, 5) surface water used for aquaculture, 6) recreational land, and 7) other land, as shown in column 2 of Table 3.4.

Table 3.4: Korea's land category by use and its reclassification according to the new classification

Proposed classification of this compilation guide	Reclassification of domestic land categories according to this compilation guide
Land underlying buildings	Building site, factory site, school site, parking lot, gas station site, warehouse site (Land underlying dwellings and land underlying other buildings are separately estimated in the later stage based on secondary sources or current state of land use information)
Land underlying other structures	Road, railroad site, bank, ditch, water supply site
Agricultural land	Dry paddy field, paddy field, orchard, pasture, saltern
Forestry land	Forestry
Surface water used for aquaculture	Fish farm
Recreational land	Park, gymnastics site, recreation site, religion site, historic site, mineral spring site
Other land	Rivers, marsh, burial, miscellaneous area

Source: Bank of Korea; TF on Land and other non-financial assets

Table 3.5 shows the result of the reclassification according to the new classification. Land underlying buildings and structures occupies 9.0 % of total land area while land under cultivation, recreational land and other land occupy 85.1 %, 0.5 % and 5.4 %, respectively. Among land under cultivation, agricultural land and forestry land, the two largest land types in terms of area, cover 20.8 % and 64.2 % of total land, respectively.

Table 3.5: Reclassification of land according to the new classification as of 2011
(km²)

Land classification	Total (¹)		Ownership				
			Government	Natural person	Judicial person	Clan, religious body, village community	Others
Total land	100 148	[100]	31 980	53 009	6 431	8 313	416
Land underlying buildings and other structures	9 039	[9.0]	5 026	2 638	1 272	88	14
Land underlying buildings	3 978	[4.0]	443	2 433	1 013	78	10
Land underlying dwellings	These two classifications are estimated based on secondary sources or current state of use information						
Land underlying other buildings							
Land underlying other structures	5 061	[5.1]	4 583	205	259	10	4
Land under cultivation	85 203	[85.1]	22 493	49 831	4 330	8 160	388
Agricultural land	20 848	[20.8]	1 419	17 919	879	531	100
Forestry land	64 337	[64.2]	21 073	31 898	3 448	7 629	289
Surface water used for aquaculture	18	[0.0]	1	15	2	0	0
Recreational land	505	[0.5]	198	23	260	23	0
Other land	5 402	[5.4]	4 262	516	569	41	13

(¹) Figures in [ ] indicate a share of each land category in total land area as of 2011.

Source: Bank of Korea; research TF on Land and other non-financial assets

It should be kept in mind that land underlying dwellings and land underlying other buildings are not separated at this stage. Mixed-use areas are a potential source for problems in assigning the land to the corresponding category. It might be very difficult for the countries to separate buildings by type from the underlying land, since information on this might not be available. In order to compile a complete set of land valuation, a distinction between these two classifications should be implemented to ensure accuracy in the classification process. Therefore, a potential solution is to review the current state of use to try to determine land underlying dwellings and then to calculate land underlying other buildings as a residual. Another issue related to land underlying buildings and structures is that in Korea, sometimes land is classified as a building site but there are no buildings, either dwellings or other buildings, on it. This land is included in the relevant land underlying buildings or structures, anyway. This is in accordance with the recommended treatment in this compilation guide that includes building land within the land underlying buildings and structures category.

Case study classification: Germany

Statistics on area size are decentralised in Germany. The Statistical Offices of the federal states receive annual data about the area measures of the respective year from the associated land surveying offices. As an outcome annual datasets containing information about area measures are available and transmitted to the Federal Statistical Office. Combining the datasets of all 16 federal states of Germany leads to a comprehensive dataset for the whole territory of Germany on a reference date. The published statistic based on these data is called Statistic of areas of actual type of use (SAAU). This statistic is available for the whole territory of Germany, subdivided by federal states ([17]) and, if necessary, subdivided by rural districts or communities ([18]). Since 2009 the SAAU is published annually ([19]).

In Germany, a directory of land uses exists encompassing 300 different land use types. This high number of land use types is consolidated into 60 categories. Area data for 60 land use categories are not available for the whole territory of Germany, since only a few federal states collect such detailed data. To do justice to this issue it was decided, that all involved offices would have to commit themselves to publish data at least on the level of ten main categories and their corresponding sub-categories ([20]) to provide consistent data for Germany. These ten main categories and their corresponding sub-categories are available for all parts of Germany and represent the database for the country. Table 3.6 provides an overview of the area measures for Germany separated by the available main and sub-categories as provided by the SAAU for 2011 and 2012.

Table 3.6: Area of Germany 2011-2012
(km^2)

Land use category	Area of Germany	
	2011	2012
Land underlying (LU) buildings	24 676	24 797
LU dwellings	12 168	12 259
Industrial land	3 296	3 315
Plant area (without exploitation area)	858	883
Recreational land	4 083	4 148
Park	2 751	2 799
Cemetery	361	364
Traffic area	17 993	18 032
Street, way, place	15 743	15 754
Agricultural area	186 771	186 465
Moor	922	915
Heath	653	645
Wooded area	107 814	107 970
Surface water	8 576	8 634
Exploitation area	1 623	1 581
Other land	4 382	4 294
Wasteland	3 234	3 197
Built up and traffic area	47 971	48 225
Germany	357 138	357 169

Source: Statistisches Bundesamt, 2013; TF on Land and other non-financial assets

Nevertheless, for the valuation of land an even higher level of disaggregation is used to ensure that price differences between different land use types are adequately captured. For this purpose, a classification approach is developed for the valuation of land based on the aforementioned 60 categories, which encompasses all main categories that are needed for an adequate estimation. Since comprehensive data are only available for the categories as provided by the SAAU various estimation methods are applied to derive the area measures for each desired sub-category.

For the purposes of international comparison and compiling national balance sheets the categories of the SAAU and their corresponding sub-categories are reclassified into the proposed classification of this guide: 1) land underlying dwellings, 2) land underlying other buildings and structures, 3) agricultural land, 4) forestry land, 5) surface water used for aquaculture, 6) recreational land, and 7) other land. Table 3.7 illustrates how the categories are mapped into the categories used in the proposed classification. Taking into account that only land within the asset boundary should be valued, wasteland should be excluded when valuing the area of Germany.

([17]) Statistisches Bundesamt, 'Bodenfläche nach Art der tatsächlichen Nutzung 2012', 2013. Available at https://www.destatis.de/DE/Publikationen/Thematisch/LandForstwirtschaft/Flaechennutzung/BodenflaechennutzungPDF_2030510.pdf?__blob=publicationFile

([18]) Statistische Ämter des Bundes und der Länder, 'Flächenerhebung nach Art der tatsächlichen Nutzung', 2014. Available at https://www.regionalstatistik.de/genesis/online/data;jsessionid=7CFF340610B535A4419F81F43E1979AB?operation=statistikAbruftabellen&levelindex=0&levelid=1418309225229&index=2

([19]) Statistisches Bundesamt, 'Flächenerhebung nach Art der tatsächlichen Nutzung', 2013, p.3 Available at https://www.destatis.de/DE/Publikationen/Qualitaetsberichte/LandForstwirtschaft/Flaechenerhebung.pdf?__blob=publicationFile.

([20]) Statistisches Bundesamt, 'Flächenerhebung nach Art der tatsächlichen Nutzung', 2013, p.18. Available at https://www.destatis.de/DE/Publikationen/Qualitaetsberichte/LandForstwirtschaft/Flaechenerhebung.pdf?__blob=publicationFile

Table 3.7: Categories as provided by the Statistic of areas of actual type of use (SAAU) and their assignment to the categories of the minimal classification

<table>
<tr><th>Main categories of the minimal classification</th><th>Subcategories of the minimal classification</th><th colspan="2">Subcategories</th></tr>
<tr><td rowspan="2">Land underlying buildings and structures</td><td>Land underlying dwellings</td><td>Land underlying dwellings</td><td rowspan="2">Mixed use with dwellings</td></tr>
<tr><td>Land underlying other buildings and structures</td><td>Industrial area, Land underlying buildings (LuB) for public purposes, LuB for commercial and service purposes, LuB for public supply, LuB for traffic purposes, LuB for recreational purposes, LuB for agricultural and forestry purposes, LuB not elsewhere classified, heap, plant area for public supply, plant area not elsewhere classified, traffic area, cemetery</td></tr>
<tr><td rowspan="3">Land under cultivation</td><td>Agricultural land</td><td>Moor, heath, farmland, greenland, agricultural land not elsewhere classified</td><td></td></tr>
<tr><td>Forestry land</td><td>Wooded area</td><td></td></tr>
<tr><td>Surface water used for aquaculture</td><td></td><td></td></tr>
<tr><td>Recreational land</td><td></td><td>Park, recreational area not elsewhere classified</td><td></td></tr>
<tr><td>Other land</td><td></td><td>Other land (not captured by wasteland), exploitation area, surface water</td><td></td></tr>
</table>

Source: TF on Land and other non-financial assets

Table 3.8 presents area measures for Germany for 2011 and 2012 according to the proposed minimal classification. Because detailed data on the area measure for surface water used for aquaculture are currently not available in Germany, this category is not shown.

Table 3.8: Area of Germany according to the minimal classification, 2011–2012
(km²)

Land use category	Area of Germany	
	2011	2012
1. Land underlying buildings and structures	43 886	44 075
1.1 Land underlying dwellings	12 909	13 002
1.2 Land underlying other buildings and structures	30 977	31 073
2. Land under cultivation	294 514	294 364
2.1 Agricultural land	186 722	186 416
2.2 Forestry land	107 792	107 948
3. Recreational land	4 083	4 149
4. Other land	11 356	11 303
Total	353 840	353 891

Source: Statistisches Bundesamt, 2013a; TF on Land and other non-financial assets

4

Data sources

Introduction

4.1. In practice, the methods used in compiling estimates of the value of land for the balance sheet can be constrained in large part by the nature of the data available. Types of data available can be classified under two broad headings: administrative sources (cadastre maintained by a land registry office, tax authorities, or land information centre) and collection sources (population and housing census, business survey, or other type of survey data). While data sources for particular countries will vary, data may also be available from government agencies concerned with: agriculture; forestry; fishing; environment; geological survey; urban planning and land administration.

4.2. This chapter begins with the challenges of obtaining data for land estimation then discusses the types of data that are available. The last section summarises the data sources available and the annex provides results from an OECD questionnaire on methods and data sources used to measure land (OECD, 2011).

Description of issue

4.3. One of the major constraints in estimating land is the lack of data from a single source. It appears that most countries that value land do so by combining multiple sources of information. The source of the information used differs by country and has an impact on (as well as being impacted by) the type of method the country uses to estimate the value of land (i.e. direct estimate of land or indirect estimate of land). Results from the OECD questionnaire show that the estimation of the stock of land can be classified into the following three cases:

— Non-existence of data: neither quantities nor prices are available

— Partial existence of data: either quantities or the total value of buildings and structures including land are available

— Existence of data: value estimates for both structures and land shown separately; and/or, both quantity and price information are available

4.4. The following sections describe what types of information may be available for use in estimating land or the combined total value of structures and land on the balance sheet.

Types of data available

Administrative source

4.5. Administrative data (cadastre, land registry, tax data) usually provide detailed quantity data, including type of land (land under dwellings, agricultural, etc.), location, and owner.

4.6. A cadastre is a comprehensive register of the property within a country. It is commonly maintained to record the physical status and legal ownership of land and is often used (or at least initially created) for taxation purposes. A cadastre could also be used for land management or planning purposes. It includes very detailed maps showing the location of the parcels of land and dimensions of land (e.g. square metres). It also typically includes the use of the land, ownership, and value of the individual parcels of land. Many times the ownership of the land is maintained through the use of a land title registry that records the change in ownership and may be combined with cadastral information (referred to by some countries as a 'cadastral system'). In addition, some countries may reassess land values periodically especially if the value is used as a basis for taxation. However, it should be noted that cadastre values may not reflect current market prices. As always with administrative data, adjustments may be needed to align administrative sources with national accounting concepts. Many countries that derive estimates of the value of the stock of land on the balance sheet do so by using cadastral data either fully (quantity and prices) or partly (quantity only).

4.7. The case study below paragraph 4.10 illustrates the type of information that is available from a cadastral system.

4.8. Additional types of administrative data that may be useful in combination with cadastral data, or if cadastral data are not available, are (land) registers. Typically a register will include a list of addresses of buildings and dwellings (so that a very precise location can be determined), type of use and sector of ownership, size of land area, and often transaction prices. The register may be maintained by the national statistical institute (NSI) but it may also be maintained by another government department.

4.9. Tax data can be another source of administrative information because many countries levy a property tax. In many cases, the tax bill is proportional to the assessed value of property and the latter is usually based on valuation undertaken by professional chartered surveyors either under contract or directly employed by the taxation authority ([21]).

([21]) See for more information on data sources Eurostat, *Handbook on Residential Property Prices Indices*, 2013. Available at http://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-RA-12-022

As such, tax data provides values (the combined total value of structures and land), or the value of land itself. When valuing the property, tax authorities often take into consideration characteristics of the property, such as location and size of plot. In addition, if different levels of taxation are applied to different types of land then land use may be recorded. National compilers of land estimates, usually NSIs, may have difficulty with verifying the valuations of the tax authority. In addition, the updating of the valuations may be infrequent due to the field costs involved.

4.10. Because of these drawbacks, tax data may be of limited use. That being said, this source of official valuation information has been exploited by national compilers. Sometimes countries used information from tax authorities to derive an average price per square metre that is then applied to quantity data from another source to estimate a combined total value of structures and land. Alternatively, countries have directly used the combined total value of dwellings and land from tax data as the value on the national accounts balance sheet. Evaluation of the tax data must be made by each country to assess whether the tax data conform to national accounting definitions and quality standards. If a country's tax valuation is based on up to date transactions that value the asset using a net present value concept then the valuation may be appropriate to use directly in the national accounts. In other cases adjustments will be necessary.

Case study sources: Australian cadastral system

The Australian cadastral systems typically comprise the following components:

— Textual component — the land register identifies real property parcels, which includes all land parcels and identifies owners' rights, restrictions, and responsibilities, ownership, easements, mortgages etc.

— Spatial component — cadastral maps show all land parcels graphically corresponding to the registered title with plan numbers and unique identifiers. These are all now digitised. Cadastral maps consist of fixed and general boundaries, about 90 % and 10 % respectively:

- Fixed boundaries are those with legally surveyed measurements used to precisely identify most parcel boundaries determined by cadastral surveys such as subdivision etc.

- General boundaries (graphical) are not survey accurate and are based on natural or man-made physical features, such as high water mark, or walls and buildings as found on cluster or strata titles.

— Additional legal, valuation, local government, utilities and planning activities are involved in land administration, and are heavily reliant on the fundamentals of the cadastral system. In particular local government rates, land tax and stamp duty (as a result of land transfer) on land parcels is a major revenue raiser for the economy.

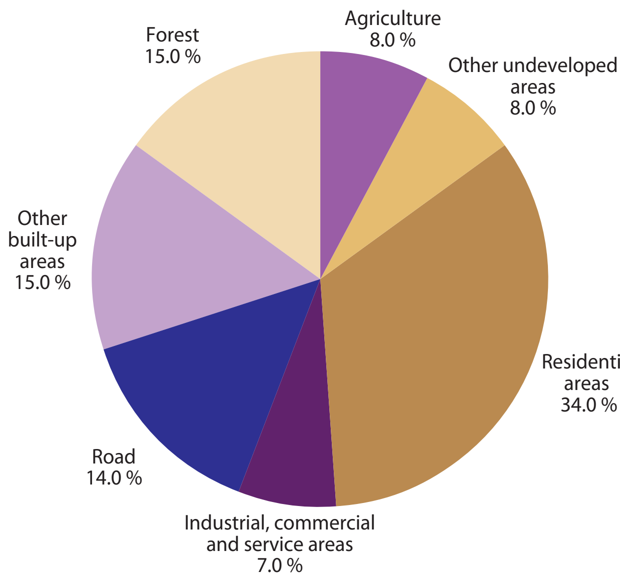
Crown Lands Management have the management and administrative responsibility for public state-owned lands

Source: Australia country report at http://www.cadastraltemplate.org/

Collection sources

4.11. Various national land surveys can be used to provide information for an NSI. Typically these types of surveys capture various characteristics of land such as how the land is used and the size. This data is often collected for land management and planning purposes. For example, land use statistics often provide information on built-up areas that cover dwellings, businesses, recreation, and roads and data on undeveloped areas like forest and other natural resources. Many times this type of survey is conducted by another government department or agency and not the NSI that compiles the national accounts. Figure 4.1 illustrates the type of information that is available from land use statistics.

Figure 4.1: Proportion of land use and land resources in urban areas, by category. The whole country, 2011
(% share of land use)



Source: Statistics Norway

4.12. A survey or census of agriculture is a common source of information for various types of land used for agricultural purposes, such as land under cultivation. Many times this information is collected by another government office with a particular focus on agriculture, such as a department or Ministry of Agriculture.

4.13. Population censuses or housing surveys are common sources for counts of the number of dwellings in a country. In general, this information is combined with price information (usually from another source) to derive a total real estate value, that is the combined value of the dwelling and the land. Since census information is usually not available every year, construction statistics (such as dwelling completions and demolitions) can be used to interpolate between census years and to extrapolate from the latest census year. This allows NSIs to maintain a more up to date stock of dwellings.

4.14. Another potential source of information that does not appear to be commonly used by NSIs is statistical surveys requesting the value of land. Business accounting data record the value of the land separately from the value of buildings and structures but such estimates would most likely be valued at historical cost on their balance sheets instead of current market values. In addition, only corporations keep a complete set of accounts so data would most likely not be available for unincorporated enterprises. Moreover, if data are collected using a sample survey rather than a census then account should be taken of the fact that many businesses rent land rather than own it, with ownership concentrated in certain industries. As a result, the optimal survey design for land may be different than a design of a general economic survey.

4.15. Yet another statistical source is to ask construction survey respondents to provide a value for land. This approach will mainly capture the value of land that is purchased for new development so it might not be representative of the value of land underlying existing buildings. Also, it might introduce a fairly high level of subjectivity because timing plays an important role in that builders often purchase large areas of vacant or undeveloped land but only develop it with some time lag that could be significant.

4.16. Sometimes the sources of information discussed above are not used directly in deriving a total estimate of the value of land but are instead used to allocate the value of land across sectors. For example, land use statistics can be used in allocating land across sectors while another source is used to derive the total value of land in an entire country ([22]).

([22]) For information on estimating data see Balabanova Z. and R. van der Helm, '*National Data on Housing Wealth and ECB estimates*', 11 March 2013.

Prices

4.17. Many countries utilise separate information on prices and quantities when valuing either the total value of the real estate (the combined value of the building or structure including land) or just the value of land (a common method for valuing land under cultivation where a structure is usually not situated). Therefore, a brief discussion of price information is needed because many times the price information does not come from the same source as the quantity information.

4.18. In practice, reliable information on land prices is often limited with either no relevant price indices existing or the coverage is not appropriate. Prices are typically based on real estate transactions, publically-appraised market prices, property tax information converted to a market price, survey of existing land values, housing price or construction price indices, and thus are often affected by the methods used to differentiate between land and buildings. Obtaining different prices for different types of land is also a challenge, with prices needed for residential, non-residential and cultivated land, because each type of land has different characteristics. Approaches vary widely from country to country and the price information used is dependent on the source information available and the method used; for example, sometimes the total real estate price is used to derive a combined total value of buildings including land.

4.19. Some of the sources described in the administrative and collection sources sections are also used when constructing price indices. For example, land registries often record the transaction price of the property sold. Sometimes national land use surveys record the purchase price of the land. However, because there may be few purchases of land for a particular use (a thin market) the prices are often not representative for valuing the whole land use category. It is also possible to have bias on frequently traded land due to overestimation based on a limited sample that contains a predominance of a particular location and/or purpose. A specific example of an administrative source used for constructing price indices is the case for Germany where every disposal of real estates has to be concluded by a notary, who is then committed to report each disposal to an institution called 'Gutachterausschuss' which can be translated as 'committee of valuation experts'. They value single plots and determine the standard land values (or sometimes called generalised standard land values), that is the land values are defined as average local ground values.

4.20. Residential property price indices (RPPI) are often used in measuring the aggregate real estate housing wealth in an economy. In addition, the RPPI could be decomposed into two components: a quality adjusted price index for the dwelling and a price index for the land on which the house is built. The Eurostat Handbook on Residential Property

Prices Indices (Eurostat, 2013) dedicates a chapter on how to do this, as well as Chapter 6.4 in this guide which discusses the hedonic approach.

Other types of information

4.21. If the information discussed above is not available, a country can look to other sources of data that could be used as a proxy. For example, a country may be able to estimate the total value of land in their country but not have the detailed data to allocate the land to a given institutional sector (see the Netherland's case study in Chapter 7). In such cases, a country could analyse various indicators related to land — like fixed assets of structures — to develop an adequate proxy. Another potential source of data is information available from another country if it is determined to be an adequate proxy. For example, the retirement and depreciation rates of other countries with similar investment structures could be used to estimate the value of the structures for a country where no estimate is available or the average ratio of residential properties to the dwelling stock of another similar country could give an adequate estimate of the total property value. A case study provided by the European Central Bank that utilises proxy data in constructing the euro area estimate of households' housing wealth is discussed in the annex to this chapter.

4.22. Remote sensing methods could be another source for estimating land use and land area. Remote sensing is the acquisition of information about an object without making physical contact using satellite or aerial images. Remote sensed imagery can be integrated into a geographic information system. A geographic information system manages location-based information and provides tools for display and analysis of various statistics, including population characteristics, economic development opportunities, and vegetation types. These methods may be useful in identifying when a certain type of land changes use.

4.23. Many countries maintain land cover databases which could be a source to construct estimates by land use using the underlying data.

Summary

4.24. The use of a timely survey or census (at least annually), or comprehensive register information will greatly assist in the compilation of a complete set of attributes related to land and dwellings and other buildings and structures. If a regular or irregular census is used then an appropriate method needs to be used to provide up to date information between each census. When register or cadastral information is used, then an NSI should ensure that up to date valuation information is available. In practice, it may be desirable that a combination of different data sources is used.

4.25. The statistical uncertainty associated with administrative data should not preclude its use. As with all data sources, there is a need to carefully assess the source data and apply appropriate conceptual, scope and quality adjustments if necessary. Adjustments in this case could include smoothing values over time or the use of supplementary information (such as an alternative more regular survey) so as to improve coverage and minimise any volatility from the administrative data.

4.26. The availability and quality of relevant price information will depend on country practices. The development of reliable price information is an important input to the calculation of the value of land.

4.27. The table in Annex 4.1 presents the responses to the OECD questionnaire on methods and data sources used to measure land. The results are displayed by country and the table briefly describes the asset type, source data, and the corresponding estimation method.

Case study proxy data: European Central Bank

The European Central Bank (ECB) estimates and publishes the two components of euro area households´ housing wealth (HHW) — that is the current market value of all residential dwellings owned by the euro area households sector (including non-profit institutions serving households) and the value of the land on which the properties are built. The compilation of households' stock of dwellings as produced fixed assets is based on the reported annual country data from Tables 26, 20 and 22 of the ESA 2010 transmission programme (ESA 2010 TP). For countries where there is no data available the perpetual inventory method (PIM) is used for the compilation of the stock series.

The compilation of the euro area figures for value of land is more challenging due to the scarce country data on land provided by euro area Member States and also due to the fact that land is a non-produced asset, thus methods like PIM cannot be used directly. In order to obtain estimates for euro area value of land underlying dwellings the ECB has developed an optimisation model that uses proxy data. The presented method estimates country-specific figures for non-financial assets by sector as well as HHW. The value of land underlying dwellings for the households sector is calculated as a residual of HHW and capital stock of households' dwellings. The euro area aggregates are compiled based on the existing reported data and the estimates for missing countries.

The paragraphs below describe the optimisation model used for the estimation of non-financial assets by sector and an indirect estimate of value of land underlying dwellings for the households sector.

As of early 2014 there are only 10 euro area countries that report the complete balance sheet information of non-financial assets by asset type and institutional sector (Table 26). Total economy capital stock by assets is reported by most of the euro area countries in Table 20 from the ESA 2010 TP (with few exceptions). In addition, for all euro area members' data on gross fixed capital formation (GFCF) broken down by asset type and activity (Table 22) are available. Only three euro area countries report the value of land underlying dwellings (Table 26). In order to estimate the euro area figures for value of land underlying dwellings held by households an optimisation model to estimate non-financial assets by sector is used based on proxy data taken from Tables 26, 20 and 22.

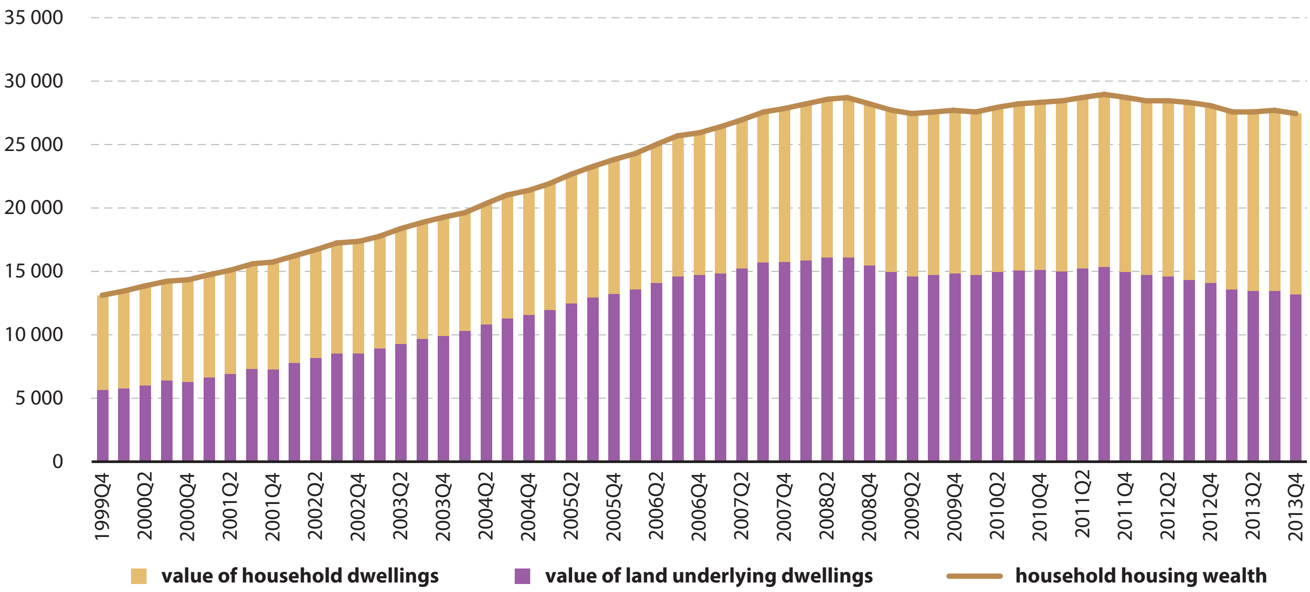
The model (Balabanova and Van der Helm, 2015) ([23]) is a two-step procedure, which compiles a full institutional sector breakdown for each asset type for each euro area country. The main assumption is that countries that have very similar activity shares also have similar sector shares.

In the first step of the estimation, data on GFCF broken down by activity (Table 22) are used to estimate a measure that indicates how close the activity breakdown of each non-reporting country is to the activity breakdown of each of the reporting countries. Subsequently, based on the result from the first step, the shares of all reporting countries are weighted to form the breakdown for the non-reporting countries. In this respect, the breakdown of assets by institutional sectors for each non-reporting country is a linear function of the breakdown of all reporting countries.

Since land is a non-produced asset, the PIM cannot be used for its calculation. Usually, land is estimated using administrated data or surveys. Alternatively, land can be estimated as residual of HHW and households' housing stock (HHS). For the current estimates the ECB uses available national data on HHW to calculate the average ratio of net HHW over net HHS. This ratio is subsequently used to estimate HHW for non-reporting euro area countries. Next, the euro area HHW is derived as an aggregate of the reported country HHW and the estimated ones. Euro area land underlying dwellings is calculated as the difference between HHW and HHS.

Figure 4.2 shows the euro area estimates of land underlying dwellings for the households sector based on the above described method.

Figure 4.2: Euro area households' housing wealth and components
(billion EUR)



Source: European Central Bank

([23]) Balabanova, Z. and R. van der Helm, *'Enhancing Euro Area Capital Stock Estimates'*, 2015. Available at http://www.bis.org/ifc/events/7ifcconf_balabanova_helm.pdf

Annex: Results from 2011 OECD survey on land valuation in the national accounts

Table 4A.1: Results from 2011 OECD Survey on Land Valuation in the National Accounts

Country	Asset category	Data sources concerning land types	Data sources concerning prices	Estimation method	Separately published land value
Australia	Residential (Value of land & structure)	Census of Population and housing (every 5 years); Inter Census years extrapolated forward using dwelling completions net of demolitions	Administrative - Publicly asses value of land by government (Valuer's general data)	Price * Quantity approach for total; Land derived residually	Yes Land by sector (where applicable)
	Commercial	Publicly assessed values by government (Valuers general data for total value by state and territory)		Directly from value. Value of national aggregate allocated to sector based on ratio of land to structures	Yes Land by sector (where applicable)
	Rural	Publicly assessed values by government (Valuers general data for total value by state and territory)		Directly from value. Value of national aggregate allocated to sector based on ratio of land to structures	Yes Land by sector (where applicable)
	Other land (land owned by Government which is not zoned residential)	Public Finance data		Directly from value. Value data assigned to government sector	Yes
Austria	Land underlying building & structures	Federal Office for Calibration and Measurement Statistics Austria: Information from the address, buildings, dwellings register	Austrian Economic Chamber Different prices for factory premises and for building sites	Direct method (Price * Land area)	No
	Land under cultivation		No appropriate source at present		No
Bulgaria	Land	Total value for land and structures: Reported annually in the investment report filled in by all institutional sectors except households		Does not separate the value between land and structures	
Canada	Residential	Land-to-structure ratio- New building activity by type (single or multiples) across the country. Consists of three key details: 1) Building Permit Values; 2) Sales value of the total residential real estate unit; 3) Physical address of the unit completed and sold.	Residential real estate (no break out of land): 1) Teranet-National Bank house price index based on a repeat-sales methodology; 2) Multiple Listing Service (MLS) average prices published by Canadian Real Estate Association are simple average transaction prices for residential properties sold through MLS. Both are used in the projection of the land-to-structure ratio. Land: Price index for land is available as part of Statistics Canada's New Housing Price Index (NHPI). Survey collects contractors' estimates of the current value (evaluated at market price) of the land. However, not currently used in estimation.	Land-to-structure ratio applied to dwellings stock. Residential structures estimates are constructed using PIM	Only total land by sector is published; internal estimates of details
	Non-residential	Land-to-structure ratio- historical ratio derived from business survey data projected quarterly using current indicators of real estate activity and prices	Real estate prices	Land-to-structure ratio applied to non-residential structures stock. Non-residential structures stock are constructed using PIM	See above comment
	Agricultural land	Census of Agriculture Allocated to sector based on percentage of farm capital held by the corporate sector to the total value of farm capital. Residual is allocated to the household sector.		Directly from value	See above comment

Country	Asset category	Data sources concerning land types	Data sources concerning prices	Estimation method	Separately published land value
Croatia	Land underlying dwellings	Census of Population dwelling stock		Residual	
Czech Republic	All Land	Information on land area (types of land) from Czech office of Surveying, Mapping and Cadastre	Average purchaser's prices of building sites by district; average purchaser's prices of agricultural landed estate for national economy; forest land according to price decree for national economy. Estimate of water and other land for national economy from data available on Internet	Direct method (Price * Land area)	Yes
	Land underlying buildings and structures	Statistical survey		Direct method (Price * Land area)	Yes
	Land under cultivation	Structural surveys conducted in the agricultural industry and from annual reports of the Land Fund		Direct method (Price * Land area)	Yes
	Forest land	Forest Management Institute		Direct method (Price * Land area)	Yes
Finland	All land including land underlying buildings and structures	Cadastre and land register held by the National Land Survey. Data available are area by land use categories, location, and by owner	Prices are available in official purchase price register based on real estate transactions maintained by National Land Use Survey	Direct method (Price * Land area)	No, not in official statistics but calculated for special purposes
France	All land including land underlying buildings and structures	Annual survey led by the Ministry of Agriculture	Price index of existing dwellings Selling value of lands from annual survey led by the Ministry of Agriculture	Residual approach for land underlying buildings	Yes
Germany	Land underlying building and structures	Land Survey from Federal Statistical Office compiled quadrennial as a census of total surface area of land by type of actual use	Purchase Values of Building Land from Federal Statistical Office	Direct method (Price * Land area)	Yes
Iceland	Land underlying buildings and structures Land under cultivation	Icelandic Property Registry- responsible for valuing property for taxation and for compulsory domestic fire insurance purposes. Icelandic Property Registry maintains The Property Registry Database that consists of four parts: Title and Interests, as well as Base (such as location and boundary), Building, and Valuation.	Sale prices and methods of payment from every sale contract are collected into the Land Registry Database and used for the calculation of economic indicators, such as the real estate price index		
Italy	Land underlying dwellings and some types of non-residential buildings (offices, shops, arts and crafts workshops, garages and other storage structures) (Value of land & structure)	1) Number of dwellings: Population and Dwellings Census updated using dwelling completions; 2) Number of non-residential buildings: Cadastral data provided by the Observatory Real Estate OMI- Tax office; 3) Average surface per square meter: Cadastral data provided by the Observatory of the Real Estate OMI- Tax Office	Average current market prices for residential and non-residential buildings are provided by Observatory of the Real Estate OMI - Tax Office; prices are estimated by matching a number of sources: all the notary deeds of sales, stipulated during the relevant year, integrated with suggestions deriving from real estate agents and from experts of Tax Office.	Number of buildings * average surface of buildings * average price per sqm; land is derived residually	No
	Land underlying other non-residential buildings (factories, hotels, banks, shopping centres, etc.) (Value of land & structure)		Cadastral values provided by Observatory of the Real Estate OMI- Tax Office.	Cadastral values adjusted to current market price; land is derived residually	No
	Land under cultivation	Annual survey on structure & production of agricultural enterprises (SPA); Census of agricultural holdings	Market prices per hectare provided by National Institute of Agricultural Economics	Direct method (Price * Land area)	No

Country	Asset category	Data sources concerning land types	Data sources concerning prices	Estimation method	Separately published land value
Japan	Land underlying buildings and structures	Ministry of Internal Affairs and Communications	Publicly assessed values of land by Ministry of Land, Infrastructure and Transport	Direct method (Price * Land area)	Yes
	Land under cultivation	Ministry of Internal Affairs and Communications	Publicly assessed values of land by Ministry of Land, Infrastructure and Transport	Direct method (Price * Land area)	Yes
	Other land (including land underlying forests)	Ministry of Internal Affairs and Communications	Publicly assessed values of land by Ministry of Land, Infrastructure and Transport	Direct method (Price * Land area)	Yes
	Government land	Ministry of Finance Statistics	Ministry of Finance Statistics	Direct method (Price * Land area)	Yes
	Government-related organisations	Information collected from inquires	Information collected from inquires	Direct method (Price * Land area)	Yes
	Land owned by local government	Ministry of Internal Affairs and Communications; for selected items information collected from inquires	Unit price from the prefecture	Direct method (Price * Land area)	Yes
	Non-profit institutions	Agency for Cultural Affairs; Ministry of Land, Infrastructure, Transport and Tourism; Ministry of Education, Culture, Sports, Science and Technology; Ministry of Health, Labour, and Welfare;	Unit price from the prefecture	Direct method (Price * Land area)	Yes
Korea	Land underlying buildings	Cadastral records from Ministry of Land, Infrastructure and Transport Land underlying dwellings is separated from land underlying buildings by using information of the current state of use of land, whereas the residual of land underlying buildings minus land underlying dwellings belongs to land underlying other buildings.	Publicly appraised and noticed individual land prices from Ministry of Land, Infrastructure and Transport The price of land underlying dwellings is separately identified from the publicly appraised and noticed individual land prices by using information of the current state of use of land. The publicly noticed individual land price is raised to market prices (or equivalents) by using real estate actual transaction price reporting system and precedent appraisal information.	Direct method (Price * Land area)	Yes
	Land underlying dwellings				
	Land underlying other buildings				
	Land underlying other structures				
	Agricultural land				
	Forestry land				
	Surface water used for aquaculture				Included with agricultural land
	Recreational land				Yes
	Other land				
Latvia	Total Land	1) For financial and non-financial sector: Survey collecting the value of land as reported on business accounts 2) For general government: annual surveys and The Treasury No estimates for Households			
Mexico		National Institute of Statistics and Geography and Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food			

Country	Asset category	Data sources concerning land types	Data sources concerning prices	Estimation method	Separately published land value
Nether-lands	Residential (Value of land & structure)	Tax data adjusted by owner-occupied dwelling price to estimate current market price		Direct estimate of value; land derived residually	Yes
	Non-residential (Value of land & structure)	Tax data adjusted to current market price		Direct estimate of value; land derived residually	Yes
	Land under cultivation	Agricultural census and land use statistics		Direct method (Price * Land area)	Yes
Poland	Land underlying building & structures	Information system of Chief Office of Geodesy and Cartography, which keeps registers of land by land users by voivodeships	Information about transaction prices for built-up land and land properties from Registers of Prices and Values of Real Estate, kept by the Starosta (district officer) and mayors of the cities with district status, by using the data derived from notarial deeds.		No
	Forest land	Information system of Chief Office of Geodesy and Cartography, which keeps registers of land by land users by voivodeships	Estimated prices - from the National Forest Holding - Lasy Państwowe (about 80 % of the forest area in Poland is held/ managed by the company)		No
	Agricultural land	Information system of Chief Office of Geodesy and Cartography, which keeps registers of land by land users by voivodeships	Agricultural Property Agency		No
Portugal		Census of population and dwellings for data on dwellings; Some balance sheet information on the corporation sector			No
Slovenia		The Real Estates Register was established in 2008 by the Surveying and Mapping Authority of the Republic of Slovenia (SMA). This database is composed of data from the Real Estate Census in 2007, the Land Cadastre, the Register of Buildings (established in 2000).			No
Sweden	Land except government	Tax data adjusted to current market price			No
	Government owned land	Physical data in square meters			No

5

Direct estimations of land

Introduction

5.1. There are various estimation methods (broadly labelled as direct or indirect) used by countries to estimate the value of land depending on what sources of information are available in a given country. The estimation of land using a direct method may be viewed as a physical inventory method where the area of each parcel of land is multiplied by an appropriate price. By summing up the value of each parcel of land that is within the asset boundary across a nation, the total value of land in a given country can be obtained.

5.2. Because detailed price and quantity information may not be available — especially when the land has a structure on it — many countries use an indirect method to value the land underlying a structure. In this chapter, the direct method is discussed. The three indirect methods will be explained in Chapter 6.

5.3. This chapter begins with the general methodology of estimating the value of land using the direct method as well as its data requirements and ends with a discussion on the method's strengths and weaknesses. The methodology will be illustrated by numerical examples and a case study from Korea.

Description of the method

5.4. Generally, the direct approach can be described by

(1) $$LV_t = \sum_{i=1}^{n} p_{i,t} * x_{i,t}$$

where LV_t is the total value of land in the observed year t. p_{it} reflects the price for land type i in the observed year t and x_{it} the corresponding area measure. Summing up all land types yields the total value of land for that particular year. Since the value of land is highly dependent on the location and land use, it is recommended that this calculation is done at the lower regional level by each land type. The direct method can be described by the following procedure with which the countries can conduct adjustments in a few steps, if needed.

a) Estimation of land area by land types in a single year or over a couple of years
b) Estimation of changes in the land types annually to produce time series
c) Estimation of representative unit prices for each relevant land type for a single year or a couple of years
d) Modelling the price changes for each land type over time (specifying price indices) in order to produce unit price time series
e) Bringing together the area and price information to produce time series on land value (balance sheet information)
f) Specifying volume changes and price changes per year for the other changes in the volume of assets account and the revaluation account

5.5. If annual data are available — for the whole period to be covered — it might be needless to conduct steps b) and d). In this case, the procedure can be conducted using only steps a), c), e), and f).

a) Estimation of land area by land types in a single year or over a couple of years

5.6. This section is directly linked to Chapter 3 because several land types of the minimal classification shall be used here as a reference.

5.7. Measuring the area of a country constitutes the basis for an economic valuation of land. Typically, this information is provided in square kilometres or any other surface measure [24]. The process of estimating the area of land can generally be described in three steps. The first step consists of the registration of the total territory of a country to ensure the area of interest. In the second step, the economic territory of a country is determined according to the SNA 2008 definition of asset (see SNA 2008 paragraph 1.46). In the third, the economic territory is classified to land types according to the use of the land (usually based on land use statistics). This classification should be done at least at the minimum level of categories as proposed in Chapter 3 of this compilation guide.

5.8. If countries have a more detailed classification of land then they should use this in their estimation if the level of price information is also available at the same level. As was stated earlier, a high level of disaggregation in land types will ensure that price differences for different land use types are adequately captured. However, in order to facilitate international comparisons, it is recommended that the detailed categories be grouped in such a way that they add up to the minimal classification [25]. Thus, following these three steps countries shall be able to gather detailed information on surface area measures for one or more years. Potential data sources for area measures by land use types are presented in Chapter 4. To illustrate the general procedure of direct estimation, Table 5.1 provides an example of the total economic area of land in a given country allocated to different land use types based on the minimum classification:

[24] Information on this is provided by land use - land cover statistics.
[25] For detailed information on the proposed classification, such as definitions of the categories and examples of their application, see Chapter 3 of this compilation guide.

Table 5.1: Area data by land types and year
(km²)

Year	Land underlying buildings and structures		Land under cultivation			Recreational land	Other land	Total
	Land underlying dwellings	Land underlying other buildings and structures	Agricultural land	Forestry land	Surface water used for aquaculture			
2007	21 000	30 000	178 000	110 000	800	2 500	700	343 000
2008	22 000	31 000	177 000	109 000	900	2 500	600	343 000
2009	22 000	32 000	177 000	107 000	900	3 500	600	343 000
2010	23 000	32 000	176 000	107 000	1 000	3 500	500	343 000
2011	24 000	33 000	174 000	106 000	1 200	4 300	500	343 000
2012	24 000	34 000	174 000	105 000	1 200	4 400	400	343 000

Source: TF on Land and other non-financial assets; fictitious data

b) Estimation of changes in the land types annually to produce time series

5.9. Area data are not published on an annual basis by many countries and therefore it might be difficult to produce representative time series illustrating the area changes (per year) between the different land types. If these data are not available yearly but are available on a less frequent schedule (e.g. every five years) the following example illustrates how these changes can be calculated:

Table 5.2: Changes of area by land type
(km²)

Land use type	Change 2008-2010			Change 2010-2012		
	Area 2008	Area 2010	Change	Area 2010	Area 2012	Change
Land underlying dwellings	22 000	23 000	1 000	23 000	24 000	1 000
Land underlying other buildings and structures	31 000	32 000	1 000	32 000	34 000	2 000
Agricultural land	177 000	176 000	-1 000	176 000	174 000	-2 000
Forestry land	109 000	107 000	-2 000	107 000	105 000	-2 000
Surface water	900	1 000	100	1 000	1 200	200
Recreational land	2 500	3 500	1 000	3 500	4 400	900
Other land	600	500	-100	500	400	-100
Total	343 000	343 000	0	343 000	343 000	0

Source: TF on Land and other non-financial assets; fictitious data

5.10. Table 5.2 shows data by land types for the years 2008, 2010, 2012 ([26]). Columns 4 and 7 provide information on how area data have changed between the observation points subdivided by land types ([27]). To produce representative time series a simple (linear) interpolation approach can be conducted here.

5.11. The volume of land is usually assumed to be constant across years for many productivity analyses. In the SNA 2008, however, differences in quality are, generally, treated as differences in volume. In other words, the change in value of the stock of land due to changes in its economic use should be regarded as the appearance of additional amounts of land and recorded as changes in volume of land. As large changes in the value of land are due to reclassification from agricultural land and forestry into building sites, the result of reclassification should be measured as changes in volume.

5.12. Consequently, a differentiation between volume and price changes requires data on changes of area between several types of land and — if possible — within one land type for different qualities of land.

([26]) Time lags may vary between countries.

([27]) Ideally, area changes between different land types should sum up to zero. However, this might not always be the case, since areas might be demolished by some sort of disaster and not captured in the asset category anymore (which leads to negative numbers), or new areas have entered the asset boundary and have to be valued which leads to positive numbers. In the example presented, these factors are held constant across time.

5.13. It might be quite difficult to assign these changes to the different land types (28) or quality categories. A general way to separate price and volume changes is introduced in step f) of the above mentioned procedure.

5.14. For the numerical example presented here, the total area of land is held constant across time, which corresponds with the idea that in practice an entry or exit of land within the asset boundary is most likely minimal.

c) Estimation of representative unit prices for each relevant land type for a single year or a couple of years

5.15. The direct estimation of the value of land not only requires data on surface areas but also appropriate price information. The price should reflect the actual market transaction price or its equivalents, as required by SNA 2008 paragraph 13.44. The actual market transaction price, if available, is the most preferred. If that price is not available, other sources may be used, such as: publicly-appraised market-price equivalent, property tax information converted to a market price, market price of a nearby parcel of land of similar use, generalised standard land values, an artificial price based on a nearby parcel of land that is adjusted by a certain conversion factor, etc. For the purposes here, price data shall be documented specifically and differentiated according to the classification of land proposed in Chapter 3, because price differences between the land use types have to be taken into account when valuing land (29).

5.16. Table 5.3 provides an illustration of unit price (30) information differentiated by various land use types.

5.17. Experience has shown that many issues may arise regarding adequate price information. For instance, price data can be quite old or even missing for some land types or years, since less frequent transactions of land may lead to data gaps. Furthermore, price information can be provided by different sources and it is necessary to match these different data sources to obtain reliable price data. Differences in land use types are not the only consideration when constructing a representative price, regional aspects have to be taken into account (e.g. by using stratification) since the same land use type of different regions might have significantly different price values. In addition, various land parcel sizes might not have a similar price per square metre. Larger land parcels are likely to have a lower price per square metre. To allow for this, representative prices may need to be stratified according to the size of the land parcel on which each price is based.

5.18. It can be concluded, that collecting reliable price information for the estimation of land can be very difficult especially for land underlying dwellings and buildings. If separate information on the price of land is not available then one could consider deriving the price indirectly as discussed in the indirect method chapter under the hedonic approach (see Chapter 6.4). Depending on the sources and institutional circumstances in a given country, issues that arise may differ significantly amongst countries. How to handle these issues depends on each country's expertise, abilities, and data sources regarding these types of information. Nevertheless the representativeness of the price used for calculations should be guaranteed.

Table 5.3: Price data by year and land types
(EUR per m^2)

Year	Land underlying buildings and structures		Land under cultivation			Recreational land	Other land
	Land underlying dwellings	Land underlying other buildings and structures	Agricultural land	Forestry land	Surface water used for aquaculture		
2007	120.00	15.00	5.00	2.00	1.00	3.00	0.50
2008	115.00	13.00	4.50	2.00	1.00	4.00	0.40
2009	115.00	13.00	4.50	1.50	1.50	3.50	0.50
2010	120.00	14.00	4.00	1.50	1.00	4.00	0.40
2011	120.00	14.00	4.00	1.00	1.50	3.50	0.40
2012	125.00	15.00	3.50	1.00	1.00	4.00	0.50

Source: TF on Land and other non-financial assets; fictitious data

(28) For instance, it might be very difficult to assign certain gains of land underlying dwellings or land underlying other buildings and structures to losses of, for instance, agricultural area or forestry area.

(29) Sources for price and area data are discussed in Chapter 4.

(30) This price represents the price valid as of the balance sheet date since intra-annual price data may be difficult to obtain for some countries. Moreover, the price as proposed here may also be interpreted as the average price across the year.

d) Modelling the price changes for each land type over time (specifying price indices) in order to produce unit price time series

5.19. Because the availability of unit price data by land type may only be available in specific years, indicators may be needed to produce unit price time series. Since the source data may differ significantly by country general advice is very difficult to give. However, whatever data are used to model the price change, countries should ensure the method applied meets the claim of representativeness concerning price information.

e) Bringing together the area and price information to produce time series on land value (for all relevant years)

5.20. As mentioned before, estimating the total value of land requires matching information about different land types and the corresponding prices. To determine the sub-values by types and, subsequently, the total value of land, a simple multiplication and summation is used. The first step consists of multiplying the area size with the appropriate price for each type of land in the observed year. For example, the total value for land underlying dwellings of the year 2009 is 22 000 square kilometres x 115.00 EUR per square metre = EUR 2 530 billion. This procedure is conducted across all land use types. Secondly, the resulting values of all land use types are summed up to determine the total value of land. These steps are repeated for each year to establish a time series. The results for this example are presented in Table 5.4.

f) Specifying volume changes and price changes per year

5.21. It is necessary to decompose the changes in the value of land per year into changes in volumes and in prices for the other changes in the volume of assets account and the revaluation account, respectively. For the direct method this decomposition can be conducted with the steps described below.

5.22. Depending on data availability, the change in the value of land can be decomposed into holding gains and losses and volume changes in two different ways. In the following example it is important to note that the equations presented are from the perspective of the total economy and do not show transactions. Transactions have to be treated separately ([31]). In general, holding gains and losses are estimated by deducting from the total change in the value of assets those changes in value that can be attributed to transactions and to other changes in volume ([32]). If information on the price developments of land is available, it might be possible to estimate the holding gains and losses separately and derive one of the other flow components as a residual ([33]). However, both principles lead to the same results for volume changes and the corresponding holding gains and losses and vice versa.

5.23. Both principles have in common that in the first step the change in the value of land (per land type i) for period t+1 can be estimated by

(2) $$\Delta LV_{i,t+1} = LV_{i,t+1} - LV_{i,t} = p_{i,t+1} * x_{i,t+1} - p_{i,t} * x_{i,t}$$

where $LV_{i,t+1} - LV_{i,t}$ reflects the change in the value of land (per land type i) in the next observation period.

Table 5.4: Value of land across time
(billion EUR)

Year	Land underlying buildings and structures		Land under cultivation			Recreational land	Other land	Total
	Land underlying dwellings	Land underlying other buildings and structures	Agricultural land	Forestry land	Surface water used for aquaculture			
2007	2 520.0	450.0	890.0	220.0	0.8	7.5	0.4	4 088.7
2008	2 530.0	403.0	796.5	218.0	0.9	10.0	0.2	3 958.6
2009	2 530.0	416.0	796.5	160.5	1.4	12.3	0.3	3 916.9
2010	2 760.0	448.0	704.0	160.5	1.0	14.0	0.2	4 087.7
2011	2 880.0	462.0	696.0	106.0	1.8	15.1	0.2	4 161.1
2012	3 000.0	510.0	609.0	105.0	1.2	17.6	0.2	4 243.0

Source: TF on Land and other non-financial assets; fictitious data

([31]) SNA 2008 12.84 gives a solution for including transactions.
([32]) See paragraph 2.73.
([33]) See paragraph 2.74.

5.24. If information on the price developments of land is available holding gains and losses (per land type) can be estimated by

(3) $$Hold_{i,t+1} = x_{i,t} * (p_{i,t+1} - p_{i,t})$$

and the corresponding, volume changes (per land type i) can be deduced by

(4) $$\Delta Vol_{i,t+1} = \Delta LV_{i,t+1} - Hold_{i,t+1}$$

5.25. Holding gains and losses can also be deduced as the residual of the total change in the value of land and the corresponding volume changes. Therefore, in the first step the volume change can be estimated by

(5) $$\Delta Vol_{i,t+1} = p_{i,t+1} * (x_{i,t+1} - x_{i,t})$$

and the corresponding holding gains and losses can be deduced by

(6) $$Hold_{i,t+1} = \Delta LV_{i,t+1} - \Delta Vol_{i,t+1}$$

5.26. To illustrate the procedure of separating annual price changes and the annual volume changes, area data, price data and the corresponding value of land are necessary. This information can be deduced by using the data provided by Table 5.1, 5.3 and 5.4 in this chapter. Based on data provided by Table 5.4 total annual changes in the value of land by land use type were estimated and are presented in Table 5.5.

Table 5.5: Value changes of land across time
(billion EUR)

Year	Land underlying buildings and structures		Land under cultivation			Recreational land	Other land	Total
	Land underlying dwellings	Land underlying other buildings and structures	Agricultural land	Forestry land	Surface water used for aquaculture			
2008	10.00	-47.00	-93.50	-2.00	0.10	2.50	-0.11	-130.01
2009	0.00	13.00	0.00	-57.50	0.45	2.25	0.06	-41.74
2010	230.00	32.00	-92.50	0.00	-0.35	1.75	-0.10	170.80
2011	120.00	14.00	-8.00	-54.50	0.80	1.05	0.00	73.35
2012	120.00	48.00	-87.00	-1.00	-0.60	2.55	0.00	81.95

Source: TF on Land and other non-financial assets; fictitious data

5.27. As mentioned before, the annual value changes presented in Table 5.5 can be separated in holding gains and losses and volume changes. It is assumed that information on the price developments of land is available and, therefore, holding gains and losses can be estimated separately.

5.28. For the numerical example the total holding gains and losses and annual holding gains and losses for each land type are estimated and presented in Table 5.6.

Table 5.6: Estimated holding gains and losses of land across time
(billion EUR)

Year	Land underlying buildings and structures		Land under cultivation			Recreational land	Other land	Total
	Land underlying dwellings	Land underlying other buildings and structures	Agricultural land	Forestry land	Surface water used for aquaculture			
2008	-105.00	-60.00	-89.00	0.00	0.00	2.50	-0.07	-251.57
2009	0.00	0.00	0.00	-54.50	0.45	-1.25	0.06	-55.24
2010	110.00	32.00	-88.50	0.00	-0.45	1.75	-0.06	54.74
2011	0.00	0.00	0.00	-53.50	0.50	-1.75	0.00	-54.75
2012	120.00	33.00	-87.00	0.00	-0.60	2.15	0.05	67.60

Source: TF on Land and other non-financial assets; fictitious data

5.29. Correspondingly, the estimated total volume changes and annual volume changes for each land type were estimated residually and are presented in Table 5.7.

Table 5.7: Estimated volume changes of land across time
(billion EUR)

Year	Land underlying buildings and structures		Land under cultivation			Recreational land	Other land	Total
	Land underlying dwellings	Land underlying other buildings and structures	Agricultural land	Forestry land	Surface water used for aquaculture			
2008	115.00	13.00	-4.50	-2.00	0.10	0.00	-0.04	121.56
2009	0.00	13.00	0.00	-3.00	0.00	3.50	0.00	13.50
2010	120.00	0.00	-4.00	0.00	0.10	0.00	-0.04	116.06
2011	120.00	14.00	-8.00	-1.00	0.30	2.80	0.00	128.10
2012	0.00	15.00	0.00	-1.00	0.00	0.40	-0.05	14.35

Source: TF on Land and other non-financial assets; fictitious data

5.30. Apart from changes in economic use of land, if the value of a certain piece of land changes mainly due to surrounding amenities, it is recommended to record this change as holding gain or loss (revaluation) rather than a volume change. For example, if the value of land underlying dwellings located right next to a park decreases because the park is replaced by a factory, these value changes shall be recorded as holding gains or losses. Even if, conceptually, changes in the value of land that are due to changes in the surrounding amenities of the land should be recorded as a volume change. For practical reasons recording these types of changes as revaluations is prudent given that it may be very difficult to make such a nuanced distinction between other changes in volume versus revaluation changes. (See the annex of Chapter 2 and Chapter 8.2 for further discussion).

Case study: alternative way for estimating holding gains and losses

Equations (3) to (6) of this chapter explain one possibility to decompose value changes $(\Delta LV_{i,t+1})$ into holding gains and losses $(Hold_{i,t+1})$ and other changes in volume $(\Delta Vol_{i,t+1})$ by

(7) $\Delta LV_{i,t+1} = x_{i,t} * (p_{i,t+1} - p_{i,t}) + p_{i,t+1} * (x_{i,t+1} - x_{i,t})$

This approach decomposes holding gains and losses as $Hold_{i,t+1} = x_{i,t} * (p_{i,t+1} - p_{i,t})$ and other changes in volume as $\Delta Vol_{i,t+1} = p_{i,t+1} * (x_{i,t+1} - x_{i,t})$. Characteristic of this decomposition method is that holding gains and losses refer to area data at time t $(x_{i\,t})$ and other changes in volume to price data at time t+1 $(p_{i\,t+1})$. The final results are not influenced by the order of estimating or in other words it makes no difference if holding gains and losses or other changes in volume are calculated first. If holding gains and losses are calculated first the corresponding residual of the total value change belongs to other changes in volume or vice versa.

Alternatively, a different decomposition method is feasible. In this case, the total value change is estimated by the following identity

(8) $\Delta LV_{i,t+1} = \bar{x}_{i,t} * (p_{i,t+1} - p_{i,t}) + \bar{p}_{i,t} * (x_{i,t+1} - x_{i,t})$

where $\bar{x}_{i,t}$ is defined as $\bar{x}_{i,t} = \frac{(x_{i,t+1} + x_{i,t})}{2}$ and $\bar{p}_{i,t}$ as $\bar{p}_{i,t} = \frac{(p_{i,t+1} + p_{i,t})}{2}$.

In this approach holding gains and losses are estimated by $Hold_{i,t+1} = \bar{x}_{i,t} * (p_{i,t+1} - p_{i,t})$ and other changes in volume by $\Delta Vol_{i,t+1} = \bar{p}_{i,t} * (x_{i,t+1} - x_{i,t})$. In contrast to the previously presented decomposition method, holding gains and losses are calculated based on the average land area of adjacent years and other changes in volume on the average of price data of adjacent years. Similar to the original decomposition method the order of estimation does not have an impact on the final result. If holding gains and losses are calculated first the remaining amount of the total value change belongs to other changes in volume and vice versa. A notable advantage of this procedure is that it will lead to a smoother decomposition, particularly, when large changes happen either in prices or in volume.

For both approaches, the identities among value changes, price changes and other changes in volume still hold. Countries might choose a way depending on how land and price data are obtained and which method can be implemented more appropriately given the circumstances in the respective country.

Strengths and weaknesses

5.31. Before applying the direct method users should consider its major strengths and weaknesses. Besides its general advantage as a very simple and easy computational methodology, the focus on area measure moreover ensures that all relevant areas are considered and only those areas that should be excluded from the SNA 2008 asset boundary (SNA 2008 paragraph, 1.46) are left out. Therefore, it can be stated that using an area measure as a basis for, or at least together with, the valuation is the only possibility to guarantee the full coverage of all land within the asset boundary.

5.32. Additionally, in some cases practical experiences have shown that the direct method might lead to more smoothened results compared to indirect approaches since the results estimated by the direct method are not as sensitive to key assumptions as the results estimated by the indirect method (e.g. perpetual inventory method assumptions when using the indirect method).

5.33. Apart from its general application when land is not underlying a structure, the direct method can be used when indirect methods are not feasible or combined values of both land and structures are not available. The direct method is normally preferred by countries for the valuation of agricultural land on which no buildings or structures are situated. While the indirect method can be used in cases where combined values of buildings and underlying land are available — as is the case in the actual real estate transaction of buildings or structures — the direct method may still be a suitable alternative because not all countries have access to such data.

5.34. Although the direct method seems very simple and easy in computational methodology, it demands huge data requirements. For the direct method to be applied, ideally, the price and area information of every parcel of land should be available, which will not be the case for most countries. Data on land area is available quite extensively in most countries, but area data should be available on a high level of disaggregation to ensure that price differences for different land use types are adequately captured.

5.35. How to obtain the current market-price information for each parcel of land by different land types will be an inevitable prerequisite for this approach. Since the value of land is highly dependent on several factors e.g. location, land use and the presence of nearby facilities, such information should be incorporated in the land price data. This can be illustrated by the fact that agricultural land is generally lower priced than land underlying dwellings. Also, the presence of a nearby road will likely influence the value of the surrounding land. The latter implies that a certain type of land may be differently priced, depending on the region where it is located. As a consequence, it is important that the direct method employs land prices that are precisely specified and reflect such conditions. It must be born in mind that representative prices are crucial for a realistic estimation of the values of the different plots and the corresponding total value of land within a country.

Case study direct method: Korea

The value of the stock of land was officially published in the Korean national balance sheets for the first time on May 14, 2014. The stock of land valued at market prices is computed using the direct method. That is, the value of land is estimated at the regional level by multiplying land areas by type and region by their corresponding market price equivalents to obtain the total value of the stock of land across the nation. The distinctive characteristics of Korean land valuation lie in the way in which the market price equivalents for land are obtained.

Estimating the land area

Based on the Act on land survey, waterway survey and cadastral records land area in Korea is currently classified into 28 categories. For the purpose of international comparison and valuation of land, these 28 categories are reclassified into the proposed minimum classification suggested by this compilation guide: 1) land underlying dwellings, 2) land underlying other buildings and structures, 3) agricultural land, 4) forestry land, 5) surface water used for aquaculture, 6) recreational land and 7) other land, as shown in the Korean case study (Table 3.4) in Chapter 3. Attention should be paid to the fact that land underlying dwellings and land underlying other buildings are not separated at this stage. Table 5.8 summarises the Korean data sources for land area and prices.

Table 5.8: Data sources for land area and price

Area/price	Sources	Information
Land area	Cadastral records	Parcel number, land use category (28 types), ownership (government, private, judicial person, others, etc.)
Land price	Real estate price public notification system	Almost all individual land is publicly appraised and notification of the results given every year as of January 1. The publicly-noticed price of an individual parcel of land serves basically for taxation purposes, its value is known to be considerably lower than the market price.
	Real estate actual transaction price reporting system	A real estate broker is obliged to report to a local government body concerned the actual price of a transaction between a buyer and a seller, within 60 days after the contract date.
	Precedent Appraisal information	As actual real estate transaction data are not sufficient for some regions or land types, precedent appraisal information is added to supplement the transaction data.

Source: Bank of Korea

Estimating the market price of land

The two major sources for land price data are the real estate price public notification system and the real estate actual transaction price reporting system. The real estate price public notification system provides publicly appraised and notified prices (PNPs) for almost all individual parcels of land. For clearer understanding, the process of how each individual parcel of land is publicly appraised is explained further. As of January 1st, around 500 000 parcels of land are sampled (this is called standard land or reference land), making up 1.3 % (in 2011) of the total number of parcels of land nationwide. This sample of parcels (standard land) are publicly appraised by around 1 300 appraisers (in 2011), led by the Minister of Land, Infrastructure and Transport (MOLIT) with support from the Korea Appraisal Board. The prices of individually registered parcels of land (equation 9) across the nation can then be computed by referring to the publicly appraised prices of adjacent standard land and to the land price conversion index. The land price conversion index is used to convert the standard land price into the individually registered parcels of land price by taking into account several attributes of the parcel of land. These attributes include differences in land use, the configuration of the ground, access to roads, any existence of adjacent noxious facilities, the fertility of arable land, the readjustment of arable land, etc. The PNPs of individual parcels of land are finalised after verification by the appraisers, reviews of appeals from the land owners, and deliberations of the real estate valuation committees of the municipalities concerned. These individual land prices are then publicly announced by the MOLIT.

(9) *PNP of an individual land parcel = PNP of an adjacent standard land parcel * land price conversion index*

At this stage, the PNP of an individual parcel of land is available across the nation. The PNPs serve as guidance information for participants in the real estate market, and as the basis for imposing taxes and various charges and providing compensation for any publicly expropriated land.

The weakness is that a PNP does not fully reflect the market price since its basic purpose is for taxation. The real estate actual transaction price reporting system makes up for and overcomes this weakness. For most countries, market price data related to land transactions in the real estate market is not easy to obtain, especially on the nationwide dimension. In Korea, fortunately, national accountants have had access to these market prices or market price equivalents since 2006, when it became mandatory for a real estate agent brokering a deal regarding residential buildings or land between a buyer and a seller to report the actual transaction price (ATP) to the local government body concerned within 60 days following the contract date. These ATP data can be compared with PNPs and then used to value the stock of land at market prices or market price equivalents. Meanwhile, for some regions or land types, cases of actual real estate transactions might be non-existent or very sparse. Precedent appraisal information, held by the Korean Association of Property Appraisers and analysed by the Korean Real Estate Research Institute is accordingly added to supplement the transaction data. ATPs and PNPs play key roles in Korean land valuation at the market price equivalents.

Estimating the total value of land

A full set of land area and price data are available from the PNPs and ATPs. As mentioned above, the distinctive characteristics of Korean land valuation lie in how the market prices (or equivalents) for land are calculated. Following the SNA 2008 land valuation principle, the PNPs of individual parcels of land need to be readjusted to the market price equivalents in accordance with the steps listed below, using the ATPs obtained from the MOLIT together with precedent appraisal data. The caveat is that the ATPs are available for only a tiny portion of the total land. Since 2006, the amount of land traded has constituted from 5 to 7 % in number of parcels of land and from 1 to 3 % in terms of area, depending upon real estate market conditions.

Table 5.9: Portion of traded land over total land

	2006	2008	2010	2012
Total land area (km^2)	99 678	99 828	100 033	100 263
Total number of parcels of land (1 000)	36 983	37 332	37 605	37 725
Traded land area (km^2) (1)	3 334	2 312	1 972	1 824
	[3.3]	[2.3]	[2.0]	[1.8]
Traded parcels of land (1 000) (1)	2 643	2 289	2 071	2 045
	[7.2]	[6.1]	[5.5]	[5.4]

(1) Figures in [ ] indicate a proportion (%) of traded land in total land.

Source: Ministry of Land, Infrastructure and Transport of Korea

The readjustment of PNPs to their market price equivalents proceeds as follows.

Step 1

The unit prices per square metre (UPNPs) from the PNPs of individual parcels of land are computed by land use type at the regional level. The unit prices per square metre (UATPs) from the reported ATPs are then computed for the same land use type and regions as for the UPNPs.

Step 2

The UATP-to-UPNP ratios (market price conversion ratios; MPCRs) are computed for the same regions and usages as for the UPNPs. An MPCR is assumed to be equal across the same region and usage. A given year's MPCR at the year-end is computed as the average of the UATPs for two years — that is year t and year t+1 — divided by the UPNP at the end of year t. The average of two years of UATPs is used to reduce the possible bias incurred from small samples by doubling the number of ATPs observed in the real estate market.

Step 3

The value of each parcel of land is computed by equation (10). In this equation, the multiple 0.9 is used to avoid the possibility of overvaluation incurred from a small sample of transaction prices. The risk of overvaluation is considered greater than that of undervaluation in the case of stock of land valuation. The total value of Korea's stock of land is computed by summing up the values of land across regions and uses.

(10) $$\sum_{j=1}^{m}\sum_{i=1}^{7} UPNP_{i,j}^{t} * MPCR_{i,j}^{t} * Land_{i,j}^{t} * 0.9$$

where *i*, *j* and *land* indicate types, regions and area of land concerned respectively, the UPNP and MPCR indicate the unit price per square metre from PNP and the market price conversion ratio, *t* is the time of estimation.

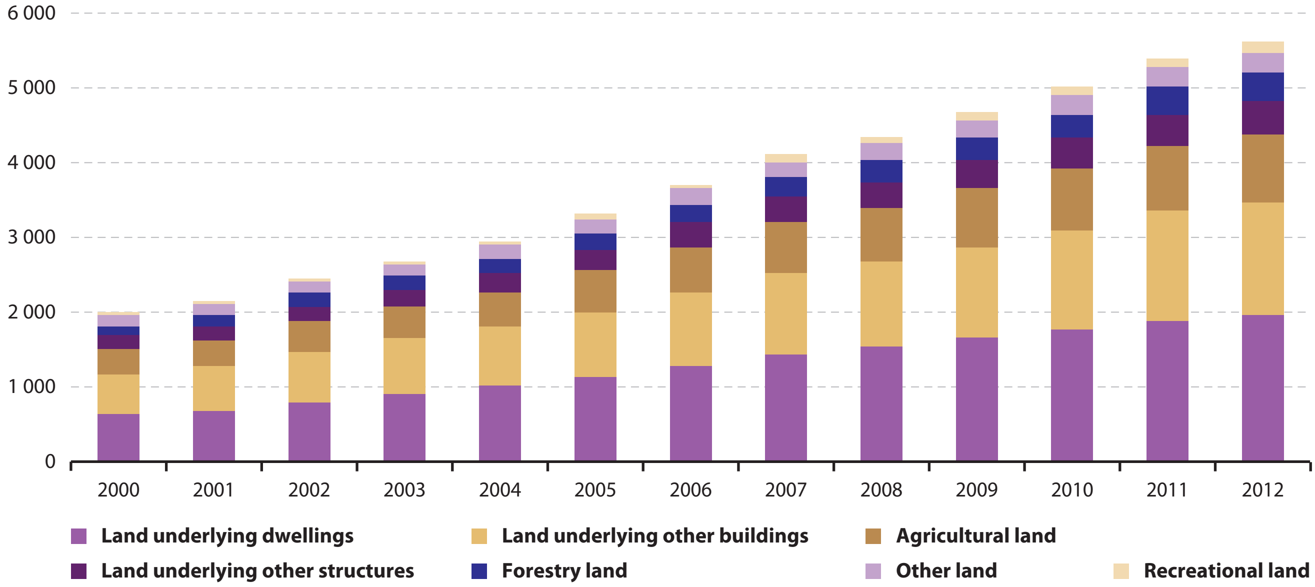
As this process is implemented with matrices of information by region, by use and by ownership, the value of the stock of land is now computed at the national level as well as by institutional sector. Market price equivalents are in addition applied to both publicly-notified and un-notified land to obtain the total value of stock of land across the nation without any missing un-valued land. The following Figure 5.1 shows that the estimate of stock of land value at the market price equivalents through the method just described stands much higher than that using the publicly notified prices. Since 2000, the value of total land based on publicly notified prices ranged from 68 to 82 % of the market price-based total land value.

Figure 5.1 Comparison of stock of land values based on market prices or publicly-noticed prices
(trillion KRW)

Source: Bank of Korea and Statistics Korea

Figure 5.2 shows the values of land by classification and how they have evolved since 2000. The value of land underlying buildings (dwellings or other buildings) makes up 56 % of the total value of land, although its share in the total land area equals no more than 4 %.

Figure 5.2 Value of land of Korea by classification
(trillion KRW)



Note: Surface water used for aquaculture is included with agricultural land.

Source: The Bank of Korea and Statistics Korea

6

Indirect estimations of land

6.1. Chapter 5 described how the value of land can be directly estimated by multiplying the area of each parcel of land by an appropriate price. However, it might be difficult to collect separate (and reliable) price information for the estimation of the land without any structures or crops. One of the challenges in estimating the value of land underlying structures or crops is that often only information is available on real estate that is sold on the market (i.e. the combined value). Thus, if separate information on the price of land without structures or crops is not available then an indirect estimation method could be used.

6.2. In this chapter three indirect estimation approaches are discussed. Indeed, there is no 'best' method; which of these approaches should be used, heavily depends on the available data sources.

6.3. Because the indirect method often relies on the total real estate value as the starting point of the calculations this chapter starts by explaining how the total real estate value, that is the combined value of land and structures, can be estimated (Chapter 6.1) before discussing each of the indirect approaches.

6.4. Subsequently three approaches to separate land from the structures are discussed in this chapter: the residual approach (Chapter 6.2), the land-to-structure ratio approach (Chapter 6.3) and the hedonic approach (Chapter 6.4). In this chapter the importance of service lives and depreciation for indirect estimates of land is introduced as well (Chapter 6.5).

6.1 Methods for estimating the combined value of land and structures

Introduction

6.5. The combined value of land and structures (CV) is often called the total value of a property (real estate). The CV combines the value of the structure and the value of a particular plot of land attached. It is often the only information available from the real estate market.

6.6. The market value of a given property is most influenced by its location and use. This information combined with the characteristics of the building such as size, age, maintenance (including major repairs and renovations) that best reflects the difference between new and existing buildings, helps determine the market value. Relevant data sources used for the CV estimation are one of the main issues in obtaining the appropriate estimates.

6.7. There are many reasons for differences among countries in the quality of estimates of the CV: social and natural factors, such as population density and share of population in the rural areas. Climate, hydrology or topography can also have great influence on transaction price data.

6.8. Below it is explained how the CV can be calculated by using different data sources on real estate characteristics, such as location, size of the structure, age, etc. combined with appropriate transaction price data mostly available from sales registers. This chapter discusses two methods used in many countries to obtain estimates of the CV — appraisals and 'quantity, times, price' approach.

Definition and characteristics

6.9. According to the balance sheets valuation requirements in the national accounts system, the CV should be presented at actual or at estimated current market prices. However, the vast majority of existing properties are not sold in a reference period; for the economy as a whole, market values of the CV must be estimated. Focus shall be put on how market values can be obtained for the two different models used for estimation of the CV as well as basic information on the construction of price indices for both methods.

6.10. The first method is a bottom-up type of approach, where each individual unit is specified in great detail. Then the individual units can be added up to give the total value. The second method is a top-down approach where the known quantity information at the country level is first divided into regional levels. Subsequently the CV of a country is obtained by summing the regional CV values. Nevertheless, in practice the choice of the approach depends on the availability of data sources and the country's compilation practice. Mixed approaches can be used as well.

6.11. This chapter starts with discussing the appraisal method, a bottom-up approach that builds the total real estate value from individual characteristics of the real estate (e.g. location, price, size, age, etc.). This information is usually provided from a well-built property registration system in a country combining information from different administrative databases governed by law to form a nationwide real estate register (see Figure 6.1). Micro level characteristics of a property available from the real estate register are then linked together to form larger regional systems of real estate information, sometimes on many territorial levels, until a complete top level system is formed in order to obtain the appraised total real estate value in a country.

6.12. The second method, called 'quantity, times, price' approach, is a top-down approach also known as stepwise design, where, for instance, the number of dwellings in a country is broken down into regions. First, an overview of the national system is formulated, specifying but not detailing any first level regions. Subsequently, each region is elaborated in greater detail using the local prices on a real estate market. It is important that the sum of regional estimates of the CV is consistent with the national total of the CV.

6.13. In general, depending on the available data sources, the CV concept can be mainly applied for estimating different types of residential and non-residential real estates. Ideally, the data would be based on real estate transaction price data. Although the CV for a non-residential real estate (i.e. commercial buildings, unmarketable buildings such as schools) is usually not based on actual transactions; therefore, various methods should be applied such as a discounted cash flows method or a depreciated value of construction costs method. For more information, see the Dutch case study at the end of this chapter and further information in De Haan (2013) and Van den Bergen (2010). In addition, if transaction prices for the combined value of forest real estate (or for cultivated land) are available in a country, the CV concept can be used as well. Chapter 8.1 describes how the 'quantity, times, price' approach could be applied for wooded land available for wood supply. Problems associated with the decomposition of the CV into the value of the timber and the value of the underlying land is also addressed in Chapter 8.1, more particularly in a Finnish case study.

Description of the methods

Appraisals

6.14. Assessed real estate values (or assessments) are referred to as appraisals (Eurostat, 2013). An appraisal takes the physical characteristics (e.g. size, age, maintenance) and location of each real estate into account when forming a judgment about value. The value of the plot on which the building stands is as a rule included in the value of the appraised real estate.

6.15. In many countries, official government assessments are available for all real estate, because such data are needed for real estate taxation. Many countries are likely to have an official property valuation office that provides periodic appraisals of all taxable real estate properties (i.e. tax assessment). In other words, for these countries the entire stock of buildings (including both structures and the underlying land) for the period under consideration is valued.

6.16. In a typical appraisal, there are three approaches to estimate the CV: (i) the cost approach, where the appraiser relies upon information about input costs for building a replacement of the structure and adds an estimated land value; (ii) the income approach, where the appraiser relies on the income from the real estate being valued and on a capitalisation rate; (iii) and the sales comparison approach, where the appraiser relies upon comparable sales (see International Association of Assessing Officers (IAAO), 2013).

Data requirements

6.17. The derivation of the combined market value for all properties (traded and non-traded) relies on the availability of data on a micro level. A crucial prerequisite is a real estate register in a country (see Figure 6.1) where actual transactions obtained from the sales register can be related to comprehensive real estate information on prices that are determined by physical (and possibly other) characteristics such as size, age, maintenance, etc. and most importantly, location. These administrative sources, further explained in Chapter 4, are e.g. land cadastre, land register, sales register, etc.

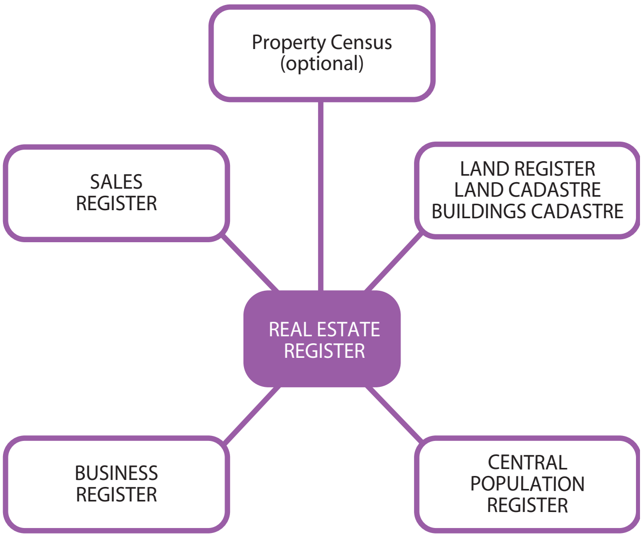
6.18. The accuracy of values depends foremost on the completeness and accuracy of real estate characteristics and adequate market data. Accurate valuation of real estate by any method requires descriptions of land and building characteristics. Data on real estate characteristics should be updated regularly in response to changes brought about by new construction, new parcels, remodelling, demolition or destruction. The most efficient method involves building permits and/or aerial photography identifying new or previously unrecorded construction or land use (see IAAO, 2013).

6.19. According to IAAO (2013), to determine a real estate value, the appraiser must rely upon valuation equations, tables, and schedules developed through a detailed analysis of the local real estate market. Thus, the model should include all real estate characteristics that influence value in the local marketplace.

6.20. For residential properties, geographic stratification is appropriate when the value of real estate varies significantly among areas and each area is large enough to provide adequate market data (sales).

6.21. As regards sectorisation, the real estate register or similar administrative sources used in an appraisal system usually includes information on ownership which is required for a successful allocation of the CV by sector and industry in the national accounts system. See Chapter 7 for more details.

Figure 6.1: Basic input data sources for the real estate register



Source: TF on Land and other non-financial assets

Numerical example

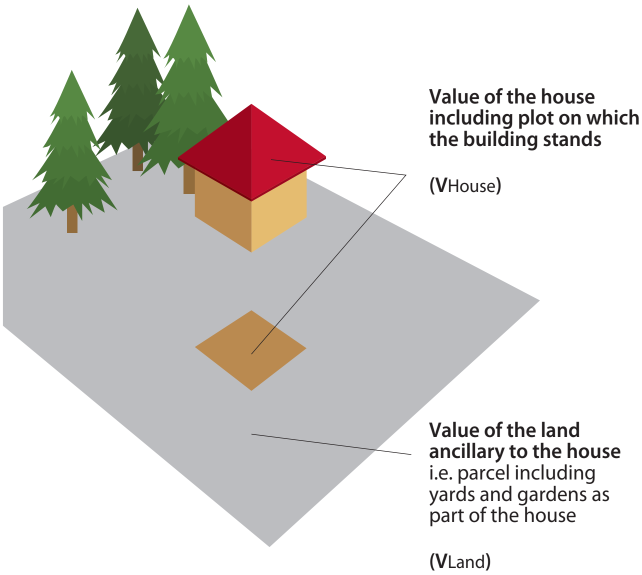
6.22. The example below illustrates how a house could be appraised (assessed) in practice, following the sales comparison approach (see GURS (2011)). Nevertheless, there could be many other ways to calculate these values. A key data source for conducting the appraisal (assessment) is the sales register or a similar data source where transaction price data of similar properties have been analysed. As an output of this analysis, the reference real estate is produced, having average characteristics such as size, age, and maintenance. The reference real estate is then used as a unit of comparison as presented in the numerical example. The method is technically quite sophisticated, based on well-developed statistical modelling to simulate the real estate market. Countries use various methods to produce such models e.g. hedonic regression methods, sometimes in combination with visual inspections ([34]) and local market information (IAAO, 2013).

6.23. Assessments can be more clearly presented in the form of value tables (VT) and rating tables, which take into account the quality characteristics of the real estate as well as the value zones. Value zones reflect the influence of the location on the value of the real estate.

6.24. In the valuation modelling process prior to the appraisal where VTs are created, value zones represent independent variables for different locations in a country. In other words, value zones are areas in which the same type of real estate has similar value (Pšunder and Tominc, 2013). Thus, the VT of each real estate is defined according to the value zone in which the real estate is located (Smodiš, 2011).

6.25. Before paying attention to how the valuation model works in practice, the different parts of a real estate are considered. The real estate usually combines the values of the building and the plot of land on which the building stands including yards and gardens (see Figure 6.2).

Figure 6.2: The structure of the combined value of a real estate



Source: The Surveying and Mapping Authority of the Republic of Slovenia

6.26. In general the combined value of the real estate (CV) can be estimated by the following valuation model:

$$CV = (V_{House} + V_{Land}) * F_{DF} \quad (1)$$

Where

CV	Combined value of the real estate (total value)
V_{House}	Value of the house (including the value of the land underlying the house ([35]))
V_{Land}	Value of the land ancillary to the house (i.e. yards and gardens)
F_{DF}	Correction factor for the distance from linear facilities such as motorways, public highways or railways for the house

6.27. The example describes the calculation of the market value of a house (one-dwelling buildings ([36])) — the *CV* from equation (1) — for which physical characteristics such as location, size of the house and the plot, and information

([34]) On-site verification of real estate characteristics should be conducted at least once every 4 to 6 years (IAAO, 2013).

([35]) The land underlying the house is defined as part of the area of the land on which the building stands

([36]) According to the *Classification of Types of Constructions* (1998).

on maintenance of the house are key inputs known by the appraiser. The calculation of each of the two components of equation (1) will be elaborated separately.

6.28. First the available data are presented. The tables below show the available individual data for the appraised house (Table 6.1) and additional information on the reference real estate available for the appraiser prior to valuation (Tables 6.2 and 6.3). In special pre-defined tables the appraiser has also correction factors for the quality of a house at his disposal, such as a correction factor for the distance from linear facilities (F_{DF}), etc. The quality characteristic of the real estate mainly depends on the variety of available information from the real estate register. The model presented in the example is adjusted according to the information in Table 6.1.

Table 6.1: Basic data for the appraised real estate

1	Real estate's location (geocode address)	x y coordinates
2	Type of construction	One-dwelling buildings
3	Year of construction	1980
4	Floor space area of the structure (net)	230 m²
5	Size of the plot belonging to the structure	900 m²
6	Year of roof repair of the structure	2006
7	Year of window change of the structure	2007
8	Year of installation change of the structure	/
9	Distance from linear facilities (influence area) of the real estate	50 m from the Road II Order

Source: TF on Land and other non-financial assets

VTs are available for several value zones (see discussion in paragraphs 6.23 and 6.24). Table 6.2 displays the VT for the 7th value zone (zone 7) as an example.

Table 6.2: Value table for houses in zone 7
(EUR)

Size (m²)		Adjusted year of construction						
		– 1929	1930 – 1944	1945 – 1954	1955 – 1964	1965 – 1974	1975 – 1984	1985 – 1994
0 – 49	Base	0	0	0	0	0	0	0
	Additional m²	300.78	417.75	518.01	601.56	668.40	785.37	885.63
50 – 99	Base	15 039	20 888	25 901	30 078	33 420	39 269	44 282
	Additional m²	284.07	334.20	367.62	401.04	434.46	467.88	518.01
100 – 124	Base	29 243	37 598	44 282	50 130	55 143	62 663	70 182
	Additional m²	267.36	300.78	334.20	367.62	401.04	434.46	467.88
125 – 149	Base	35 927	45 117	52 637	59 321	65 169	73 524	81 879
	Additional m²	200.52	267.36	300.78	334.20	367.62	401.04	434.46
150 – 199	Base	40 940	51 801	60 156	67 676	74 360	83 550	92 741
	Additional m²	183.81	233.94	284.07	317.49	350.91	384.33	401.04
200 – 249	Base	50 130	63 498	74 360	83 550	91 905	102 767	112 793
	Additional m²	116.97	150.39	167.10	183.81	200.52	217.23	233.94
250 – 299	Base	55 979	71 018	82 715	92 741	101 931	112 630	124 490
	Additional m²	116.97	133.68	150.39	167.10	183.81	200.52	217.23
300 –	Base	61 827	77 702	90 234	101 096	111 122	123 654	135 351
	Additional m²	100.26	116.97	133.68	150.39	167.10	183.81	200.52

Source: The Surveying and Mapping Authority of the Republic of Slovenia

Required information for the valuation of the land surrounding the house, are presented in Table 6.3.

Table 6.3: Interval values for plots of real estate

Plot sizes (m²)	Price (EUR/m²)
Z_0: 0 - 150	33.0
Z_1:150 - 600	10.0
Z_2: 600 - 1 200	7.5
Z_3: 1 200 - 2 400	2.0

Source: The Surveying and Mapping Authority of the Republic of Slovenia

6.29. In the first step, the value of the house, V_{House} in equation (1), is calculated. This requires the calculation of the base value of the house, V_{H_VT}, according to equation (2):

(2) $$V_{H\_VT} = VT_{H,base} + A_{H,m2} * P_{H,m2}$$

Where

V_{H_VT} Base value of the house

$VT_{H,base}$ Value of the reference house according to size and age of the house from VT

$A_{H,m2}$ Additional size of the house in square metres

$P_{H,m2}$ Price per square metre for additional size of the house

6.30. The information and calculations that are needed as input for equation (2) include: (i) the appropriate value zone and value level of the house; (ii) information on the year of construction and years of major renovations (e.g. roof repair, window change, installation change) in order to calculate an adjusted year of construction that takes renovations into account; (iii) information on the size of the house. For major renovations the appraiser uses correction factors from pre-defined tables accordingly.

6.31. For example, the appraiser could, according to the above mentioned input data, determine that the house to be valued is located in value zone 7 (out of, for example 10 value zones). It can be further assumed that according to the major renovations information the adjusted year of construction could be determined by the appraiser as 1984. With this information and the data from Table 6.1 and the equation (2) the appraiser can now calculate the base value of the house, V_{H_VT}.

6.32. From the VT (see upper value in grey coloured cells in Table 6.2) it can be concluded that the base value of a reference house ($VT_{H,base}$) of 200 square metres built in 1984 equals EUR 102 767. However, the house to be valued is 30 square metres larger than the base value of the reference house: 230 square metres instead of 200 square metres, so $A_{H,m2}$ = 30 square metres. The price for the additional square metres ($P_{H,m2}$) is also shown in the VT (see lower value in grey coloured cells in Table 6.2): EUR 217.73. Now all elements are available to calculate the base value of this house:

$$V_{H\_VT} = VT_{H,base} + A_{H,m2} * P_{H,m2}$$

EUR 109 283 = 102 767 + 30 * 217.23

6.33. To calculate the final value of the house (V_{House}), V_{H_VT} must be multiplied by predefined correction factors (F_{OF}, F_{CM}, F_{AR}) for the quality of the house (see discussion in paragraph 6.28). For the calculation of the final value of the house the equation (3) is used:

$$(3) \qquad V_{House} = V_{H\_VT} * F_{OF} * F_{CM} * F_{AR}$$

Where

V_{House} Final value of the house (incl. the value of the land underlying the house)

F_{OF} Correction factor for the other features of the house (e.g. building type)

F_{CM} Correction factor for the construction material of the house

F_{AR} Correction factor for the area ratio of the house

6.34. According to the additional quality information about the house (e.g. from the real estate register) and the pre-defined correction factors the appraiser can then calculate the final value of the house. The pre-defined correction factors that this appraiser has at its disposal are: F_{OF} = 0.96, F_{CM} = 0.80 and F_{AR} = 1.00. With this information and the result from equation (2) the final value of the house can be calculated with equation (3):

$$V_{House} = V_{H\_VT} * F_{OF} * F_{CM} * F_{AR}$$

EUR 83 929 = 109 283 * 0.96 * 0.80 * 1.00

6.35. In the second step the V_{Land} component of equation (1) is calculated. It should be noted that the value of the plot on which the building stands (i.e. the land underlying the house) is indirectly included in V_{House}. As shown in Table 6.3 the plots of land surrounding the house have to be broken down into different sizes with different values per square metre (z_i). The value of the surrounding land (V_{Land}) can then be calculated by applying equation (4):

$$(4)\ V_{Land} = Pz_0 * Vz_{0\_VT} + Pz_1 * Vz_{1\_VT} + Pz_2 * Vz_{2\_VT} + Pz_3 * Vz_{3\_VT}$$

Where

V_{Land} Value of the land ancillary to the house

P_{zi} Size of parcel for individual interval value

V_{zi} Interval value per square metre of land (based on information from the land value table)

z_i Interval values of parcel sizes z_0, z_1, z_2, z_3

6.36. With help of equation (4) and the data in the land value table (see Table 6.3) the value of the plot surrounding the house (measuring 900 square metres, see Table 6.1) can now be calculated as follows:

$$V_{Land} = Pz_0 * Vz_{0\_VT} + Pz_1 * Vz_{1\_VT} + Pz_2 * Vz_{2\_VT} + Pz_3 * Vz_{3\_VT}$$

EUR 11 700 = 150 * 33 + (600 – 150) * 10 + (900 – 150 – 450) * 7.5 + 0 * 2

6.37. In the example, sub-valuations for the house (3) and surrounding land (4) do not take into account the distance characteristics. However, the variation in the real estate value is highly dependent on how 'central' or how 'accessible' properties are. Therefore, in the final step of the calculation the F_{DF} component of equation (1) is considered. The influence of the distance correction factor F_{DF} might in practice be quite extensive. Not taking into account this factor, may result in a rather different valuation of the real estate. With the help of a geographic information system (or other information) the distance to, for example, the central business district or the nearest commercial centre can be determined. This information can be used for the estimation of the distance correction factor F_{DF}.

6.38. In this example, it is assumed that the appraiser knows from the real estate register the distance of the real estate from facilities like motorways, etc. Based on this information the distance correction factor (F_{DF})for the location of the house and surrounding land is estimated at 0.9. Now all information is available to determine the combined value (CV) of the house:

$$CV = (V_{House} + V_{Land}) * F_{DF}$$

$$\text{EUR } 86\,067 = (83\,929 + 11\,770) * 0.9$$

6.39. The example above shows how the system of appraisals works and how the CV is calculated for just one individual unit. The CV for all dwellings in the total economy can be obtained by repeating this exercise for all dwellings in the economy and adding up the outcomes: it is the bottom-up approach first introduced in paragraph 6.11. Information about the owner and shares of owning rights obtained from the land cadastre should be used to allocate the estimations to institutional sectors. These data should be updated on a regular basis using the information from the business register for legal persons and the central population register for natural persons.

6.40. In most countries, data used for calculating the appraised CV are not as detailed as presented in this numerical example. Nevertheless, countries should follow international standards and recommendations such as IAAO and other standards when producing CV by appraisal methods.

Strengths and weaknesses

6.41. The major advantage of appraisals is full coverage. However, the use and interpretation of data gathered by appraisals should be done with some caution. Studies show that appraisals appear to lag the true sales prices, falling significantly below in hot markets and remaining significantly above in cold markets. Not surprisingly, the worst performance of appraisals occurred during the 2007–2008 financial crisis (see Cannon et al., 2011 and Devaney et al., 2011).

6.42. There are several studies that have examined the reliability of commercial real estate appraisals, but according to Cannon (ibid.), most of them are now quite dated and rely upon information from only one cycle of the commercial real estate market. Cannon (ibid.) therefore proposes to measure the accuracy of an appraisal as the percentage difference between the sales price and the appraised value.

6.43. Another concern is that appraisals are not updated frequently. Consequently, they match the market value at its reference period registered in prices of a few years back (i.e. historic prices). In this case the appraisal cannot be used directly but must be taken forward in time by using appropriate price indices.

6.44. In this context, the most appropriate price indices for dwellings are the residential property price indices (RPPIs). RPPIs are based on the market transactions for new and existing dwellings and as such they cover the land and the structure components jointly. Various methods are possible to control the changes in the quality mix of the transacted dwellings from one period to the next, in order to produce constant quality RPPIs ([37]).

6.45. However, because of their reference to the observed market prices, RPPIs give an average price change that reflects weights usually based on the subset of dwellings that are transacted during the period ([38]). As long as the distribution of transactions by stratum is not representative for the stock distribution, the use of these RPPIs for stocks revaluation gives a bias due to a compositional effect. The use of stock-weighted RPPIs would therefore be preferable to avoid this kind of bias. However, while stock-weighted RPPIs are also treated in the Handbook on Residential Property Prices Indices (Eurostat, 2013), they are, in general, less readily available than transaction-weighted RPPIs.

Other information

6.46. Methods that involve some controls of quality by using multiple regression models with the real estate attributes as independent variables are hedonic methods. In this context the use of the 'sale price appraisal ratio' (SPAR) method is to be mentioned, which uses information on matched sales and appraisals to construct house price indices. This method is explained in detail for the case of house price indices in the RPPI Handbook and by Bourassa et. al. (2006). The advantage of the SPAR method as compared to the hedonic regression methods is that information on only a few property characteristics is needed: assessed values (relating to a common reference period), possibly some stratification variables, and addresses to merge the data files if the selling prices and appraisals come from different data sources (Eurostat, 2013). Bourassa et al. (2006) noted that the SPAR method could be applied for constructing land price indices as well but only if available information permits this. This method requires a system of regularly and with sufficient frequency updated appraisals.

([37]) These include for example the stratification and the hedonic approach. For an in depth review of the various methods see the RPPI Handbook referenced in footnote 21.

([38]) The precise scheme for internal weights depends on the various compilation practices, which in turn are constrained by the sources available.

6.47. Diewert and Shimizu (2014) discuss constructing price indices for non-residential real estate for national accounting purposes, as well as decomposing the real estate price into land and structure price indices. Their empirical analysis of commercial offices is based on the assessment of appraisal data from the Japanese Real Estate Investment Trust (REIT) market in the Tokyo area. A variant of the builder's model [39] applied to the commercial property assessed values is presented where assessed values present a dependent variable enabling decomposition of overall value into separate land and structure components. The builder's model already used for valuing a residential property is a hedonic model in which the structure price component is constrained exogenously. This model has been applied to residential property sales by de Haan and Diewert (2011), Diewert, de Haan and Hendriks (2011a) (2011b) and Diewert and Shimizu (2013). In addition to the assessed value information, the age of the building, the floor space area of the structure, the area of the land plot, and the building costs per square metre and the costs of the land per square metre were used in the model as well. By using the builder's model, which has been traditionally applied to residential property sales, Diewert and Shimizu suggest a special case of the hedonic approach and suggest that the applied method is practical and could be used by statistical agencies to improve their balance sheets estimates for commercial properties (ibid.).

6.48. If a country operates a well-organised economy-wide public assessment system for real estate, e.g. for dwellings, this information can be used to measure the CV. Usually countries for taxation purposes assess each private-owned individual real estate. This tax assessment value may be, as an alternative to the numerical example above, adjusted to the market price by comparing the ratio of the real estate transaction price to the tax assessment value. Here, it is assumed that the ratio for traded real estate will be representative of that of untraded. If more and more real estate transaction data are obtainable during the reference period, the readjusted tax assessment value can be more closely approximated to the market price of the real estate. Meanwhile, this comparison process for each individual real estate can be applied at the national level and enable national accountants to compute the total CV of the relevant real estate across the country.

6.49. Lastly, it should be noted that costs of ownership transfer (SNA 2008 paragraph 10.51), such as notary, real estate agent, surveyor services, transfer tax, etc., are not included in the appraisals.

[39] See Diewert, W.E. and C. Shimizu, *'Residential Property Price Indexes for Tokyo'*, 2014. Available at http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.22/2014/Diewert_and_Shimizu_Paper_01.pdf

'Quantity times price' approach

6.50. The 'quantity, times, price' approach is another option to calculate the CV of land and structures by using quantity and real estate price information. There are many ways to calculate these two variables depending on the availability of data sources. In most countries a common way is to estimate the CV for residential properties by applying average values of dwellings, derived from sales data (price), to population and housing census based estimates of the number of dwellings (quantity). Quantity estimates that do not incorporate the census data could be less reliable.

6.51. It should be noted that this approach is rarely used for estimation of the CV of non-residential real estate. However, it can be applied in case of cultivated land.

Data requirements

6.52. The main idea that underlies this approach is the availability of plausible market values of dwellings including land which can be observed on the real estate market. The assumption is that real estate properties sold are representative of the population of the real estate properties including those not sold. Price information from actual transactions (sales) is then used to infer an average value of all the properties not sold during the reference period. Using actual transactions data on sales of properties is one of the better ways to estimate the price component. See the Australian case study at the end of this chapter.

6.53. By stratifying the stock according to price-determining characteristics of properties, compositional effects can be reduced. It is desirable for sales data to only be used to infer the value of similar properties. The finer the stratification, the more representative and less compositionally affected the data become.

6.54. The sales data should provide broad geographical coverage, encompassing both urban and rural areas. This is especially important in countries where regional differences have significant impact on the real estate prices.

6.55. Data sources supporting the 'price' part of this approach can be sales registers or similar administrative sources where information on the transfer of ownership of dwellings and land is recorded. Whenever a real estate is sold, information about the timing of the sale (date of contract), the real estate sold (e.g. information about the location and quality characteristics of the building) and the price paid can be made available from administrative sources, possibly integrated with other sources. Similar databases have been developed by several countries for the compilation of RPPIs, which measure house price movements usually on a quarterly basis. See the Australian case study for an approach that combines sales data and RPPI information in the estimation of the 'price' component.

6.56. The quantity part of this approach, the number of dwellings, can be derived from a combination of census data as a starting point and additional information from construction statistics on the number of completions and conversions that occur between two censuses. The estimated stock between two censuses should be compared with other data sources such as cadastral data.

6.57. In order to stratify the data so that an appropriate price can be matched with the 'quantity' information, it is useful to classify dwellings into different types, e.g. separate houses, attached dwellings (e.g. semi-detached, row and terrace houses and flats, units and apartments, etc.). This information can be derived from census data as well. Nevertheless, there is no single convention for classification; it can be different from country to country.

Table 6.4: Basic information available on quantity and prices for country X and region A

Year	Country X			Region A		
	Dwelling stock, census (number of dwellings)	Net addition (number of dwellings)	Dwelling stock, total (number of dwellings)	Dwelling stock, total (number of dwellings)	Number of sales	Average property price (EUR)
2002	784 912		784 912	363 652	7 849	62 202
2003		6 356	791 268		7 913	63 046
2004		13 069	804 337		7 980	79 266
2005		20 291	824 628		8 051	95 099

Source: TF on Land and other non-financial assets; fictitious data

6.58. As noted by Reuter Town (2013) additional variables (e.g. age, location of the building, number of rooms, etc.) for further stratification of the dwelling stock could be useful for improving representativeness, but the availability of new variables must be balanced against the requirement for having sufficient sales data in each stratum ([40]) to derive the mean values.

6.59. With the usage of census data, e.g. tenure status or tenure type, a proxy for different types of sector ownership can be calculated and applied to the CV.

Numerical example

6.60. The simple numerical example below shows how the method could be applied in practice using the stratification approach (see Reuter Town, 2013). First, information on the number of dwellings (quantity) should be collected. The total number of dwellings can, for instance, be determined with the number of all dwellings (occupied and unoccupied) from the last census of population and housing. It can be however of interest, for various purposes, to have numbers for occupied and unoccupied dwellings separately. Especially if there are large amounts of unoccupied dwellings. For inter-census years the number of dwellings obtained by census could be extrapolated forward, using information from construction statistics, e.g. dwelling completions, demolitions.

6.61. Consider a country X that consists of two regions: region A and region B. For country X and its two regions census data are available for 2002. The annual net additions to the dwelling stock could be determined for the years 2003–2005 from construction statistics, but only on a country level. The price data on real estate (number of sales, mean property price) for region A are available for the years 2002–2005. All available data for country X and region A are shown in Table 6.4.

6.62. As a next step the number of dwellings in region A can be estimated for the years 2003–2005. This can be done by using the proportion of the dwelling stock in region A to the dwelling stock in country X in 2002, and applying this ratio to the dwelling stock of country X for later years. Or, more generally:

(5) $$\hat{q}_{regionA,t} = \hat{q}_{countryX,t} * \frac{\hat{q}_{regionA,0q}}{\hat{q}_{countryX,0}}$$

Where

$\hat{q}_{regionA,t}$ Estimated number of dwellings in region A in a current period t

$\hat{q}_{countryX,t}$ Estimated number of dwellings in country X in a current period t

$q_{regionA,0}$ Number of dwellings in region A according to the last census

$\hat{q}_{countryX,0}$ Number of dwellings in country X according to the last census

6.63. The result of the calculations can be found in Table 6.5 (grey coloured cells).

([40]) That is a subset (part) of the population (entire collection of items under consideration) which is being sampled.

Table 6.5: Estimated dwelling stock (quantity) for region A
(number of dwellings)

Year	Country X			Region A
	Dwelling stock, census	Net addition	Dwelling stock, total	Estimated dwelling stock, total
2002	784 912		784 912	363 652
2003		6 356	791 268	366 596
2004		13 069	804 337	372 651
2005		20 291	824 628	382 052

Source: TF on Land and other non-financial assets; fictitious data

6.64. The total number of dwellings in region A for each reference period is then multiplied by the mean market value of dwellings in this region (i.e. properties that have been sold within the reference period). Or, more generally:

(6) $$CV_{\text{regionA,t}} = \bar{p}_{\text{regionA,t}} * \hat{q}_{\text{regionA,t}}$$

Where

$CV_{\text{regionA,t}}$ The combined value of properties in region A in a current period

$\bar{p}_{\text{regionA,t}}$ Mean price of properties in region A in a current period

$\hat{q}_{\text{regionA,t}}$ Estimated dwelling stock in region A in a current period

6.65. The results of the application of equation (6) — which is, in terms of the example, the multiplication of the dwelling stock of region A (number of dwellings) and the mean price of real estate for region A — are shown in Table 6.6. These results represent the combined values of dwellings and underlying land (CV of properties) for the region A in a country X (grey coloured cells).

6.66. If comparable data for region B in country X are available, the exercise could be repeated for this region B. This procedure has to be conducted for all dwelling types.

Table 6.6: Estimated combine value of dwellings for region A

Year	Region A		
	Estimated dwelling stock, total (number of dwellings)	Average property price (EUR)	CV of properties (billion EUR)
2002	363 652	62 202	22.6
2003	366 596	63 046	23.1
2004	372 651	79 266	29.5
2005	382 052	95 099	36.6

Source: TF on Land and other non-financial assets; fictitious data

6.67. In case there are no sales in the stratum in the reference period, one way to estimate the mean price is to impute it from the mean value of a region with similar characteristics on the real estate market.

Strengths and weaknesses

6.68. Although the method presented above is very useful and accessible for calculating the CV, there are still some measurement issues, which should be considered before adopting this method.

6.69. In order to be successful this method requires the availability of reliable sales data. Bias may occur if the characteristics of the untraded stock differ from the characteristics of the traded dwellings.

6.70. Concerning representativeness, the stratification method does broadly control for the changes in the composition of buyers and sellers in the market, but the low rates of turnover in sales still mean that it is subject to some compositional effects. This is especially the case if there is no activity for a particular market segment that differs significantly from the stock traded in the period (see Reuter Town, 2013 and Burnell, 2007).

6.71. A disadvantage of this method is that it cannot successfully be applied for the estimation of non-residential buildings, mainly because non-residential buildings are usually traded on thin markets where the number of sales is too low.

6.72. As in case of appraisals, the costs of ownership transfer (SNA 2008 paragraph 10.51) are not included in the CV calculation. Proxy data on costs of ownership transfers could for instance be obtained from the survey on gross fixed capital formation.

Case study estimating the combined value of land and structures: The Netherlands

Data sources

This case study presents the Dutch approach for the appraisal of non-residential buildings including the underlying land, the combined value.

As explained by De Haan (2013), Van den Bergen et al. (2010), De Vries et al. (2009), in the Netherlands for tax purposes the so-called WOZ-value of every dwelling is derived from tax registers ([41]). The WOZ-value pertains to the combined value of land and structure and in case of dwellings; it is based on actual prices of dwellings sold. Therefore, it provides an accurate estimate of the market price. Also for most non-residential buildings including land, WOZ-values are available ([42]). However, unlike WOZ-values of dwellings, in many cases WOZ-values of non-residential buildings cannot be directly based on selling prices. The reason for this is that often few to none comparable transactions of non-residential buildings exist. As an alternative to transaction data, tax authorities apply various methods for estimating the WOZ-value of non-residential buildings. In order to do so, a distinction is made between marketable buildings (commercial real estate such as office buildings and stores) and unmarketable buildings (e.g. school buildings, hospitals or an energy plant). For commercial real estate the WOZ-value is mostly determined by the net present value of future rentals. In case of unmarketable non-residential buildings valuation is frequently based on the depreciated value of construction costs. Both methods rely on extensive guidelines.

Methods

Determining the WOZ-value of an unmarketable non-residential building using the depreciated value of construction costs, requires an estimation of the costs of rebuilding and depreciation. Example 1, shown in Table 6.7, provides a simplified numerical example of this method for estimating the WOZ-value of a production facility. It consists of the estimation of the values for the primary construction of the production hall, the finalisation and furnishing of the production hall, plant installations for production, the underlying land and infrastructure, as well as a deduction for the presence of soil contamination. For the production hall and the plant installations, determining depreciation requires a distinction between technical and functional ageing. Technical ageing takes into account the age of the non-residential building/plant installations, the estimated lifespan, and the expected residual value. In this example, the technical ageing factor of the primary construction hall takes into account the residual value, which presents 40 % of the construction costs. Since 60 % of the value is depreciated over a lifespan of 50 years, the yearly depreciation rate is 1.2 %. Five years of the life span have passed, resulting in a technical ageing deduction of 6 % and a technical ageing factor of 0.94. Functional ageing reckons with economic ageing (to the extent at which a need exists for the building), changes of construction costs, (legal) obstacles for particular usages, and excessive maintenance costs. Since these aspects may not change yearly, it is possible that depreciation due to functional ageing is estimated at zero. This is the case for the primary construction of the production hall and its finalisation and furnishing, as shown in Table 6.7 where the functional ageing deduction is zero. The last column shows the depreciated costs after one year. The computed WOZ-value of the production plant is the sum of these costs including the values of infrastructure, land and the deduction of the present soil contamination. Finally, for the WOZ-register the computed WOZ-value is rounded to the nearest thousand (i.e. the registered total value).

Table 6.7: Example 1 - the depreciated value of construction costs

Production facility		Size (m²)	Price per m² (EUR)	Construction costs (EUR)	Depreciated construction costs (EUR)
Primary construction production hall		500	300	150 000	141 000
Life span (years)	50				
Residual life span (years)	45				
Residual value (%)	40				
Technical ageing deduction (%)	6				
Technical ageing factor	0.94				
Functional ageing deduction (%)	0				
Functional ageing factor	1				

([41]) In the Netherlands, some taxes are based on the value of the dwelling or building that people own. This is laid down in the Dutch Real Estate Appraisal Act (WOZ). The value that the government subsequently assigns to each dwelling and building is called the WOZ-value.

([42]) Except for tax-exempted buildings such as churches.

Production facility		Size (m²)	Price per m² (EUR)	Construction costs (EUR)	Depreciated construction costs (EUR)
Finalisation and furnishing production hall		500	250	125 000	115 000
Life span (years)	50				
Residual life span (years)	45				
Residual value (%)	20				
Technical ageing deduction (%)	8				
Technical ageing factor	0.92				
Functional ageing deduction (%)	0				
Functional ageing factor	1				
Plant installations for production				90 000	78 660
Life span (years)	15				
Residual life span (years)	13				
Residual value (%)	40				
Technical ageing deduction (%)	8				
Technical ageing factor	0.92				
Functional ageing deduction (%)	5				
Functional ageing factor	0.95				
Infrastructure		900	65		58 500
Land		1 550	200		310 000
Soil contamination					-30 000
Computed total value					673 160
Registered total value					673 000

Source: Statistics Netherlands

For commercial real estate, the WOZ-value is frequently estimated by using the method of discounted cash flows (DCF) to determine the net present value of the future rentals, see Table 6.8 example 2. This method is applied when no comparable non-residential building in the vicinity exists or when there is not much useful price information available. Examples of non-residential buildings that are typically valued with DCF are hotels, bars, and gas stations. To estimate the WOZ-value with the DCF method the net present value of a stream of future income minus costs is computed. In most cases, the discount rate is set equal to the interest rate of a long term government bond although it may deviate depending on the uncertainty of the future income streams. The standard period of discounting is 20 years.

Table 6.8: Example 2 — discounted cash flows

Estimated yearly income (EUR)	96 000
Estimated yearly costs (EUR)	72 000
Discount rate (%)	2
Time of cash flows (years)	20

Source: Statistics Netherlands

Final calculation of net present value (NPV), EUR:

$$NPV = \sum_{t=0}^{N} \frac{CF}{(1+i)^t}$$

Where

C F = Cash flow
i= discount rate
t = Time of cash flows (years)

$$NPV = \sum_{t=0}^{20} \frac{24\ 000}{(1+0.02)^t} = 416\ 434$$

Case study estimating the combined value of land and structures: Australia

Data sources

The Australian approach utilises four key sources of data: (i) information on the price of dwellings is collected through administrative by-product data. Each of the eight Australian states and territories has a land-titles office or valuer general's office (hereinafter VG) that records the transfer of ownership of dwellings and land. (ii) The Census of Population and Housing, conducted every 5 years (most recently in 2011) provides information on the number of dwellings in Australia as well as information on tenure type (which is used as a proxy for ownership), and dwelling structure. (iii)

Information on additions to the dwelling stock is obtained from Australian Bureau of Statistics (ABS) survey data (the Building Activity Survey). (iv) The residential property price index (RPPI) is used to calculate mean property prices where complete VG's coverage is not yet available. The index is primarily compiled using VG's data. These data are supplemented with mortgage loan data from banks and other mortgage lenders to provide a better estimate of residential property price change in the most recent periods.

Methods

The approach in Australia to calculate a total value of residential dwellings including land is to stratify the dwelling stock by geography and dwelling type, and calculate total values (using 'quantity times price') for each strata, and then aggregate up to sub-national and national estimates. All calculations used the combined values of the structures and land and exclude any vacant land. This approach is for residential land only; it does not apply to rural and commercial land.

Data from the census is used to create a point in time estimate of the number of dwellings in the stock. To get quarterly estimates of the number of dwellings, the ABS estimates the net additions to the stock since the latest census. Estimates of gross additions to the stock are available from the Building Activity Survey conducted by the ABS.

The long term realisation rate, the rate at which gross additions to the stock results in net additions to the stock, is applied to gross additions data in order to derive net additions to the stock. Net additions to the stock are added to census counts to get quarterly estimates of the number of dwellings in the stock (i.e. the quantity).

Quantity information is calculated at the state level. Strata level quantity estimates are subsequently derived from state totals by using dwelling shares (i.e. the percentage of total dwellings each strata contained at the latest census).

Once a complete set of VG's data are available, strata level price estimates are derived by taking the arithmetic mean price of dwellings sold in the quarter. Where insufficient data are available, the mean price is imputed from a larger geography region to which the strata belongs.

Of note, due to the way sales data are recorded in Australia (lag between the exchange and settlement dates), it takes approximately 6–9 months to get VG's data on all transactions. Direct calculation of the CV in time for publication (6 weeks after the end of the reference period) is not possible. It is necessary to use an alternative data source for the latest two quarters of data to calculate a mean price where the most recent mean price is moved in line with the movements of the RPPI. This is because movements in the RPPI have been shown to correlate very well with movements in the final estimates (based on VG's data).

For example, in the December quarter the RPPI is 104.5, then 103.4 for September and 102.1 for June (fictitious data). VG price data is only available for June, so for region A, the mean price is, for example, 532 000 Australian dollars (AUD). To calculate the mean price for September extrapolate June's VG mean price by the RPPI, that is 103.4/102.1 * AUD 532 000 = AUD 538 773, and for December it is 104.5/103.4 * AUD 538 773 = AUD 544 504. When the next quarterly estimate occurs (i.e. the March quarter in this example), the September quarter mean price is re-calculated using the newly available VG transactions data and then the change in the RPPI is used to obtain the December and March values.

Once price and quantity level data are available for each stratum, values are calculated, and aggregated to produce state and Australia level totals.

State level estimates of the total values are then sub-divided into sectors (households, government and non-financial corporations) using information on Tenure Type from the latest census.

Table 6.9 illustrates the data needed for calculating the combined value of dwellings according to the Australian method.

Table 6.9: Calculation combined value according to Australian method

State/strata (1)	Census (1 000)	Dwelling share (%)	Net additions (1 000)	Estimated dwellings (1 000)	Mean price (AUD)	Combined value (billion AUD)
	Quantity	Quantity/ quantity (state)	Share * additions (state)	Quantity + net additions	Price	Quantity + net additions * price
NSW	2 839.0	100.00	17.3	2 856.3	(2)	1 577 580.7 (3)
Strata 1	3.2	0.11	1.9	5.1	504 000	2 570.4
Strata 2	3.4	0.12	2.1	5.5	807 000	4 438.5
Strata 3	2.9	0.10	1.7	4.6	350 000	1 610.0
…	…	…	…	…	…	…

State/strata ([1])	Census (1 000)	Dwelling share (%)	Net additions (1 000)	Estimated dwellings (1 000)	Mean price (AUD)	Combined value (billion AUD)
	Quantity	Quantity/ quantity (state)	Share * additions (state)	Quantity + net additions	Price	Quantity + net additions * price
VIC	2 265.6	100.00	33.6	2 299.2	([2])	1 150 030.9 ([3])
…	…	…	…	…	…	
Australia	9 002.7	100.00	94.9	9 097.6	([2])	4 456 988.8 ([4])

([1]) Strata level data are illustrative only.
([2]) Can be calculated by taking the total value and dividing it by dwellings but not directly derived from VG's data.
([3]) Sum of all strata combined values.
([4]) Sum of all state values.
Source: Australian Bureau of Statistics

Output

In addition to information published in the sectoral balance sheets in the Australian System of National Accounts the following information is published alongside the RPPI:

— total value of residential dwelling stock (households sector and non-households sector) by state/territory;

— total number of residential dwellings by state/territory;

— mean price of residential dwellings by state/territory.

6.2 The residual approach

Introduction

6.73. For many countries the real estate value of the property is available and can be used in conjunction with capital stock estimates (i.e. the depreciated structure cost) to derive the value of the land residually. Therefore, the residual approach is used by many countries to estimate the value of land underlying buildings and structures because of the accessibility of the data.

6.74. Separate information on prices and volumes for land and the structure situated on the land are needed for a direct approach but very often it is hardly available in existing administrative sources, as structures and underlying land are typically sold together in a single transaction and not as separate assets. In some cases, separate data may exist for the two assets but information is usually not up-to-date and/or reliable enough (either at national or regional level). For example, corporations may record the value of land and the value of buildings and structures in separate items (if not on the balance sheet then in explanatory notes of their financial statements). However, the value on the business accounts is usually registered at the historical cost rather than on the basis of the market prices, as recommended in the SNA 2008. Additionally, business accounting data are often available only for corporations while unincorporated enterprises are not generally required to keep a complete set of accounts for their capital assets. This is a relevant issue in particular for those countries whose economic structure is characterised by a large number of small enterprises.

6.75. On the other hand, running statistical surveys on the value of land can be very expensive and may be considered as an excessive burden on enterprises. Moreover, the accuracy of the results depends on the soundness of the answers given by those interviewed. The survey cost should be weighed against the obtainable benefit.

6.76. The residual approach relies on information generally already accessible or easy to collect. So, in view of the reliability and availability of data, for some countries, it appears to be the only applicable method to estimate the value of land; in particular, the value of land underlying dwellings and other buildings and structures (see below under section 'Applicability of the residual approach').

6.77. In the following paragraphs, the residual approach will be explained in more detail: how to apply this method, which data sources are required, for which type of land it can be applied, its key strengths and limits. For more practical understanding, the cases of Italy and Denmark are also presented. Moreover, the direct and the residual methods are compared in the Finnish experience.

Description of the method

6.78. Through the proposed method, the value of underlying land (LV^i_t) for each category of constructions *i* (e.g. dwellings, non-residential buildings, other structures) is obtained as a residual, by subtracting the estimate of constructions (C^i_t), i.e. the depreciated structure cost, from the combined value of structures and land (CV^i_t), at time *t*.

(7) $$LV^i_t = CV^i_t - C^i_t$$

6.79. The total value of land underlying buildings and structures at time t (LV_t) is obtained by aggregating all the estimates LV^i_t

(8) $$LV_t = \Sigma^n_{i=1} LV^i_t$$

6.80. To apply the residual approach, the following information is needed:

1. The real estate value at current market prices, by type (the so called 'combined value' CV^i_t);
2. The net capital stock of constructions which excludes the land at current prices, by type (C^i_t);
3. Additional indicators to breakdown estimates by institutional sector, if the information 1) and 2) is not available by institutional sector (see also Chapter 7).

6.81. For details on the combined value CV^i_t (estimation methods, data requirements and open issues), see Chapter 6.1.

6.82. C^i_t is generally estimated by applying the perpetual inventory method (PIM). This value excludes the value of underlying land because land is a non-produced asset and, as a consequence, its acquisition is not included in gross fixed capital formation (SNA 2008 paragraph 13.44). However, the costs of ownership transfer on land are treated as gross fixed capital formation (GFCF).

6.83. Almost all countries obtain the net stock of constructions — for total economy, by industry and by sector — through the PIM; so, the information should be readily available.

6.84. For more details on measuring the net capital stock (description of the method, data requirements, assumptions) see Measuring Capital (OECD, 2009 and 2001) and section 6.5 of this compilation guide.

Numerical example

6.85. Assume that the following information is available:

Table 6.10: Combined value of constructions and underlying land (CV), by type and year

Year	Dwellings (a)	Non-residential buildings (b)	Other structures (c)	Total (d=a+b+c)
1	100	80	60	240
2	150	85	62	297
3	200	90	65	355
4	250	100	70	420
5	300	110	75	485
6	400	115	80	595

Source: TF on Land and other non-financial assets, fictitious data

6.86. Using the PIM-method the depreciated value of the structures can be estimated:

Table 6.11: Net capital stock of constructions (C), by type and year

Year	Dwellings (e)	Non-residential buildings (f)	Other structures (g)	Total (h=e+f+g)
1	50	43	40	133
2	70	45	41	156
3	95	47	43	185
4	115	53	46	214
5	140	58	49	247
6	190	60	52	302

Source: TF on Land and other non-financial assets, fictitious data

6.87. The value of the land can then be derived as a residual:

Table 6.12: Value of land (L), by type and year

Year	Dwellings (j=a-e)	Non-residential buildings (k=b-f)	Other structures (l=c-g)	Total (m=d-h=j+k+l)
1	50	37	20	107
2	80	40	21	141
3	105	43	22	170
4	135	47	24	206
5	160	52	26	238
6	210	55	28	293

Source: TF on Land and other non-financial assets calculations based on fictitious data

6.88. The final estimate of LV at time t can be obtained with more granularity: on the basis of available information, the estimates CV^i_t and/or C^i_t can be derived as the sum of more detailed values, on:

— the type of constructions (for example, the value of non-residential buildings can be calculated as the sum of the value of retail shops, hotels, banks, factories, etc.);

— the territorial breakdown (the country value can be obtained as the sum of the values calculated for regions, municipalities.);

— the classification of the owner (the value for total economy can be obtained as the sum of the values calculated for institutional sectors or industries).

6.89. So, for example, the value of land underlying dwellings (j) is obtained as the aggregation of the estimates calculated at the regional level; or the net stock of non-residential buildings (f) is the sum of values available by industry.

6.90. To correctly estimate the value of underlying land through the residual method, it is necessary to verify what the values CV^i_t and C^i_t include. In particular, costs of land preparation and costs of ownership transfer are critical components to investigate.

6.91. According to SNA 2008 paragraphs 10.70, 10.74, 10.76 and ESA 2010 Annex 7.1, PIM estimate C^i_t includes the value of the structures as well as all the costs of site clearance and preparation (also see paragraphs 8.61–8.62). The CV^i_t generally incorporates such costs as well, as on the real estate market a single contract refers to the value of constructions, including land in its natural state and costs of land preparation. From a theoretical point of view, the costs of site clearance and preparation, being included in both elements, should not produce any distortion: of course a statistical discrepancy between the two valuations must be taken into account.

6.92. CV^i_t often does not include costs of ownership transfer, depending on the available data sources and on the methodology chosen to calculate it: for example, if a 'quantity x price approach' is applied to estimate CV^i_t and the prices observed on the real estate market are used, they usually do not include professional charges paid to lawyers, commissions paid to real estate agents and tax paid on the transfer of the ownership of the asset ([43]). On the contrary, the PIM estimate C^i_t has to incorporate this value: the SNA 2008 and the ESA 2010 recommend to treat it as GFCF and to include it in the balance sheet jointly with the value of the relevant asset.

6.93. As a consequence, to correctly estimate the value of underlying land, costs of ownership transfer should be excluded from the value C^i_t or their value (for example, estimated by the PIM) has to be added to the CV^i_t. If not, the value of the underlying land would be systematically underestimated.

Applicability of the residual approach

6.94. In principle the residual approach may be used to estimate all types of land for which a combined value exists and is measurable.

6.95. Theoretically, it may be applied for all land underlying both buildings and other structures; however, it appears difficult to calculate the combined value for structures and some kinds of buildings (for example, factories, commercial centres) traded on thin markets, as representative prices and quantities might be neither observable nor correctly estimable for the relevant stocks. Therefore, the residual approach is more appropriate for land underlying dwellings and some types of non-residential buildings regularly and actively traded on the real estate market. Notably the valuation is easier for land underlying dwellings, as the required information is more accessible.

6.96. As mentioned in paragraph 6.5, the term 'combined value' is used for the sum of the value of the structure and the value of the land that the structure is built on. However, this concept can also apply to other assets whose value is given by the sum of two or more components (fixed assets and non-fixed assets). Therefore, according to this definition, other types of land could also be estimated by applying the residual approach.

6.97. In theory, some kinds of land under cultivation could be estimated through the residual approach; for agricultural land, it may be that market transactions (and prices) of land used in agricultural activity refer to a combined asset: that is, the value of land at its natural state (the non-produced component), the value of actions that lead to major improvements in the quality/quantity/productivity of land (the produced fixed asset 'land improvements'), the value of crops and trees and, sometimes, the value of rural structures sited on it (a produced fixed asset). As a consequence, if each of these components could be estimated (for example, the produced fixed assets may be estimated using the PIM method) and subtracted from the combined value at market prices, the value of land under cultivation could be obtained ([44]).

6.98. However, in many countries, agricultural land is usually estimated using a direct method rather than the residual approach (even if the obtained value may include the value of fixed assets that are situated on the land). See Chapter 8.1 for a more detailed discussion.

6.99. In principle, the residual approach could also be applied to forestry land, if the value of the forest can be estimated separately from the underlying land and then subtracted from the value of the combined asset. However countries' practices in this approach show that some assumptions and modifications to the approach are required to obtain economically meaningful results. See Chapter 8.1 for a more detailed discussion.

6.100. Recreational land may have structures or other produced fixed assets situated on it but it appears very hard to apply the residual approach for this balance sheet item: an active market does not exist for this asset, so a combined value is not known or easily estimable.

([43]) Also the value of buildings including land registered for tax purposes may exclude the costs of ownership transfer (D. van den Bergen, A.J. de Boo, P. Taminiau-van Veen and E. Veldhuizen, 2011, 2010)

([44]) The value of land underlying rural structures should be isolated, and not be assigned to land under cultivation but to land underlying buildings and structures.

6.101. Because the category 'other land and associated surface water' generally does not have any structure upon it, the residual approach is not applicable for this category.

6.102. Table 6.13 below summarises the applicability of the residual approach for estimating the various land types.

Table 6.13: Applicability of the residual approach, by type of land

Land types	Applicable	Not applicable	Applicable, with some difficulties or assumptions
Land underlying buildings and structures			
Land underlying dwellings	X		
Land underlying other buildings and structures			X
Land under cultivation			
Agricultural land			X
Forestry land			X
Surface water used for aquaculture		X	
Recreational land and associated surface water			X
Other land and associated surface water		X	

Source: TF on Land and other non-financial assets

Strengths of the residual approach

6.103. As explained above, separate data sources for the value of buildings and land do not exist in many countries, so the residual approach seems to provide a satisfactory alternative procedure to estimate land underlying buildings and structures.

6.104. Information required to apply the method is often already available or measurable. The values of the real estate properties (CV) are frequently observable or could be estimated for some types of structures, especially for dwellings. Moreover, almost all countries obtain the net stock of structures — constructions (C) — by using the PIM, so this value is based on a sound, consistent and widespread estimation methodology.

6.105. Furthermore, the value of land underlying constructions, calculated as a residual, can be an important benchmark to verify assumptions underlying the PIM (see paragraph 6.110).

6.106. To estimate the value of land through the residual approach it is necessary to evaluate the real estate value of the properties which is one of the main components of the non-financial wealth of a country, as described in Chapter 9 of this compilation guide.

Weaknesses of the residual approach

Applicability of the residual approach

6.107. As explained above, not all types of land can be estimated by applying the residual approach, so the total value of land in a country cannot be obtained by only using the residual approach (see Table 6.13).

The value of land as a by-product of other estimates

6.108. Every bias in the PIM and/or in the methodology used to calculate the combined value affects the resulting value of underlying land.

6.109. As to the value of CV^i_t, systematic distortions could be derived from inaccurate data sources; for example, if the reference prices/values are the ones on which tax on properties are calculated and paid, and they are just declared by the owner without any inspection by the tax authority, they could be underestimated for tax evasion.

6.110. As to the value of C^i_t, incorrect assumptions on the length of the service lives and depreciation rates of dwellings and structures can generate inaccurate estimates of net stocks and, as a consequence, of land underlying buildings and structures. Errors can also derive from methods used to compute time series of GFCF or from an inaccurate estimate of the starting value of the time series.

6.111. The value of land is also influenced by any possible weakness in GFCF estimates of constructions. For example, if the change of ownership of 'second-hand' assets among sectors is not traced in GFCF, the stock can turn out to be overestimated or underestimated for different sectors because, according to PIM, assets belong to the stock of the sector of their first investment along their whole service life. This is especially true for buildings, as they are frequently traded on the 'second hand market' and also because they have a very long service life. The effect is not negligible. The same limitation exists if an institutional unit is reclassified from one sector to another (for example, an enterprise changes its legal form and is moved from the households sector to the non-financial corporations' sector or vice versa) and the change is not correctly traced in the PIM estimate.

6.112. Inaccurate and inconsistent estimates of CV^i_t and C^i_t, due to biases in the estimation method and/or in data sources, can lead to negative values of land (if the value of C^i_t is higher than CV^i_t), which is not, of course, an economically meaningful result. This occurred in the United States for some components (Wasshausen, D., 2011) and in Denmark for certain years in the period 1995–2002 (see the Danish case study in Chapter 6.4) and in Finland for forestry land for some years (see the Finnish case study in Chapter 8.1).

6.113. Therefore, estimates calculated by applying the residual method need to be tested over a reasonable time span, including the ups and downs of the economic cycle, before releasing balance sheet data. Moreover, plausibility checks should be done — for example reviewing and comparing with another country the share of land to the total property (ratio LV^i_t /CV^i_t) and the weight of LV^i_t to the total non-financial wealth — to ensure that estimates are sensible and economically consistent. These analyses should be performed within homogeneous clusters of countries to take into account the characteristics in the real estate market, territorial distribution of constructions, geographical features of land (mountainous versus flat country), population density, propensity/restriction to land consumption, dearth of land, building permits.

Other issues related to the residual approach

6.114. Another critical issue of the residual approach is that when C^i_t is obtained through the PIM, most of the holding gains and losses for real estate properties will be allocated to land. This is because the PIM-based estimate of C^i_t only includes the change in prices driven by fluctuations in the construction costs, as the most common method of calculating price indices in the PIM is through a cost approach (the change in price of the finished asset is calculated from price changes of labour and material inputs). Therefore the value LV^i_t calculated as a residual will include all the other changes in prices that are not connected with the changes in the costs of construction.

6.115. Even if most holding gains and losses for the produced asset 'building' probably originate mainly from fluctuations in the construction costs, other kinds of revaluations involving the building itself may exist, but their impact may be supposed to be limited. For example, in a given period of time, buildings characterised by a specific quality feature (historical buildings versus new buildings, apartment versus detached house, apartment at the top/first floor) could be most appreciated and demanded, so that their prices increase. As a consequence, if it is not feasible to calculate and to isolate these revaluation factors, the value of land obtained by applying the residual approach could be overestimated.

6.116. Except for this possible error, imputing all the revaluations — other than those included in the PIM estimate of constructions — to the land underlying the construction is not to be considered a real weakness of the residual approach, if it is assumed that every change in price due to demand fluctuations on the real estate market accrues more to land than to structures upon it, as land is non-reproducible, limited and in short supply ([45]).

6.117. The value of real estate properties also change if the quality of the surrounding land changes. This may be the case if new amenities or infrastructures are created (for example, a school or a train station is built or a park is replaced by an industrial zone), generating (positive/negative) externalities. These new higher/lower values will be totally included in the value of land underlying constructions, when the residual approach is used. If it is assumed that the surrounding amenities are to be considered as quality characteristics of underlying land (see the annex to Chapter 2) then this result is not necessarily a weakness of this approach. As a consequence, any increase/decrease in the value of the land — given by changes in the surrounding amenities in the vicinity — reflects changes in the quality of underlying land.

Case studies

Case study residual approach: Italy

In Italy, the value of land underlying dwellings is estimated by applying the residual approach. To estimate the combined value, a 'quantity x price approach' is used (see Chapter 6.1).

In notation:

(9) $$CVt = Nt * St * Pt$$

CV_t Combined value at time *t*
N_t Number of dwellings at time *t*
S_t Average surface (square metres) of dwellings at time *t*
P_t Average price per square metre of dwellings at time *t*

The methodology is applied on an annual basis, at regional level (NUTS 2 ([46])).

([45]) In some cases and in certain economic circumstances, also depending on country specifications (mainly on how scarce is the supply of land in a certain country), the revaluations could be allocated more to structures than to the underlying land.

([46]) NUTS is a three level hierarchical classification. It subdivides each Member State into a number of NUTS 1 regions, each of which is in turn subdivided into a number of NUTS 2 regions and so on. See Eurostat, *Regions in the European Union — Nomenclature of territorial units for statistics*, 2011. Available at http://ec.europa.eu/eurostat/documents/3859598/5916917/KS-RA-11-011-EN.PDF

The number of dwellings in Italy for the years 2001 and 2011 is provided by the 14th Population and Dwellings Census (2001) and by the 15th Population and Dwellings Census (2011). For the period 2002–2010 and for the years after 2011, the number of dwellings at time *t* is estimated starting from census data, updated each year by adding the number of new constructions and adjusting for divisions and unions of dwellings. The number of new dwellings (registered and unauthorised ones) is estimated by using the outcomes of the survey on building permits together with information provided by the Centre for Social and Economic Research on Construction and Territory (CRESME). Information on divisions and unions of dwellings is obtained from cadastral data.

The accuracy of extrapolating the census data using the number of new constructions adjusted for divisions and unions of dwellings was checked by comparing the outcomes obtained using this extrapolation method with the results from the 2011 Population and Dwellings Census. The difference between the two results was approximately 0.5 %, confirming the reliability of the procedure.

The average surface and the average market price are provided by the Observatory of the Real Estate Market (OMI), a Directorate of the Revenue Agency.

The average surface is calculated on gross surfaces, including accessory, external areas and perimeter walls, and it is derived from cadastral registers.

The average price per gross square metre is an average market price at time *t*. It is calculated on the basis of actual purchaser's prices of all residential units traded during the relevant year and included in the deeds of sale.

In order to be representative of all the existing dwellings (traded and not traded in the year), these market prices are weighted by different types of residential buildings sited on the territory, as recorded on cadastral registers, in particular as to their distribution (at micro-level) and to their features.

Then the value of units that are de facto accessory areas of dwellings but are recorded in cadastral registers with a separate code (mainly garages and other storage structures) are added to the estimate of the CV for dwellings. Essentially, the value of these de facto accessory areas is obtained by applying equation (9) to the relevant information (number, average surface and average market price of de facto accessory areas) provided by OMI. In addition, the number of dwellings at time t should be adjusted to take into account dwellings demolished during time *t*. Because no information is available on the quantity of residential units demolished, the number estimated on the basis of the production value of the demolition of residential buildings included in the demolition industry (NACE 43.11) is subtracted.

The net stock of residential buildings is calculated by applying the perpetual inventory method (PIM) under the hypothesis of:

— constant average service life (79 years);

— truncated normal distribution of retirements;

— linear consumption of fixed capital.

Because PIM estimates are not available at regional level, the regional combined values are added together in order to obtain the national estimate. Finally, the value of land underlying dwellings (LV) is obtained as a residual, by subtracting the net stock of residential buildings (PIM estimate, C) from the combined value.

Table 6.14: Land underlying dwellings estimated through the residual approach, Italy, 2001–2011
(billion EUR)

	Number of dwellings	Surface (m²)	Price (EUR per m²)	CV (billion EUR)	CVa (¹) (billion EUR)	C (billion EUR)	LV (billion EUR)
2001	27 291 993	111.0	995	3 014	3 174	1 568	1 606
2002	27 655 199	111.0	1 070	3 285	3 478	1 649	1 829
2003	28 039 266	112.0	1 150	3 611	3 811	1 715	2 096
2004	28 464 043	112.0	1 236	3 940	4 178	1 810	2 368
2005	28 924 981	113.0	1 326	4 334	4 572	1 922	2 650
2006	29 400 509	114.0	1 449	4 857	5 107	2 011	3 096
2007	29 856 542	114.0	1 532	5 214	5 507	2 133	3 374
2008	30 267 932	114.0	1 595	5 504	5 820	2 250	3 570
2009	30 639 195	114.0	1 588	5 547	5 889	2 321	3 568
2010	30 948 827	115.0	1 594	5 673	5 998	2 403	3 595
2011	31 208 161	116.0	1 596	5 778	6 101	2 514	3 587

(¹) CVa= CV including the value of accessory areas

Source: Italian National Institute of Statistics

Table 6.14 show the results for the years 2001 to 2011 in which CV denotes the combined value (CV); CVa the combined value including accessory areas and net of demolitions; C the net stock of dwellings by the PIM; and LV the value of land underlying dwellings.

Case study residual approach: Denmark

At Statistics Denmark, a project on measuring the value of owner-occupied dwellings has been carried out. The result has not been published, but is part of a research agenda with the aim of measuring the wealth of the households at the individual level. Because some of the project's components are also items included on the balance sheet, the project is considered part of the development of complete balance sheets for Denmark. The project covers the period 2004 to 2012.

Residual approach used for measuring the value of land

The combined value of buildings and land is compiled by combining observed market values with official real estate valuations by the tax authorities. All dwellings in Denmark are assessed by the tax authorities. The values of land are compiled by using the residual approach — by subtracting the value of the building from the combined value of building and land. The values for the depreciated buildings are obtained from the direct estimates of the capital stock for owner-occupied dwellings. The direct estimation of the stock of dwellings is a method which combines empirical estimates for the gross stock with PIM estimations for the net stock and consumption of fixed capital and is briefly described later in the example.

The combined value

In practice, the combined value for all owner-occupied dwellings is calculated at the individual level. Each real estate is valued by the tax authorities — the tax assessment — and this assessment is the starting point for the calculations.

The tax assessment is subsequently adjusted for two reasons; the tax assessment is representing a specific point in time which is not identical with the reference period of the balance sheets and the tax assessment of the building is, by law, valued a little below the actual market value.

In order to adjust for these two factors an adjustment ratio is calculated. For each type of dwelling (one family houses, flats etc.) and location (postal code) the average ratio between the tax assessment and the observed market price is calculated for all traded dwellings. For all real estates within the same stratum the tax assessment is adjusted with the adjustment ratio. The adjusted values are considered the market prices for the combined value of building and land for all owner-occupied dwellings.

The value of dwellings

The depreciated building component of owner-occupied dwellings is calculated by the capital stock estimation. Statistics Denmark uses direct estimates for measuring the value of dwellings; the gross stock is derived by multiplying number of square metres with price per square metre, the net stock is derived by adding assumptions on service lives and the depreciation profile. The number of square metres of dwellings is known from administrative records and the price per square metre is gathered for a benchmark period and taken forward in time by using construction cost indices. Statistics Denmark use Winfrey curves and straight line depreciation for deriving the net stock.

Results

Table 6.15 shows the results for the period 2004 to 2012 at the aggregated level. It can be seen that the combined value increases (in nominal terms) until 2008, then declines strongly in 2009 because of the global financial crises which also impacted the real estate market in Denmark. In the following years (2010–2012), the value of real estate continues to decline.

Table 6.15: Owner occupied dwellings, end of year (billion DKK)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Combined value	2 488	2 962	3 646	3 938	3 988	3 509	3 498	3 396	3 324
Buildings	1 197	1 252	1 378	1 483	1 546	1 518	1 528	1 590	1 644
Land	1 291	1 710	2 268	2 455	2 442	1 991	1 970	1 806	1 680

Source: Statistics Denmark

The value of buildings also increases in nominal terms until 2008, but for most of the years with a lower growth rate. Then, in 2009, the value of dwellings is also impacted by the financial crisis but not to the same degree as the value of land. The value of land starts to decline in 2008 and the decline continues in the following years. Because the price of buildings follow the construction costs most of the decline in the value of real estate is attributed to the land component.

Case study comparison direct and residual method: Finland

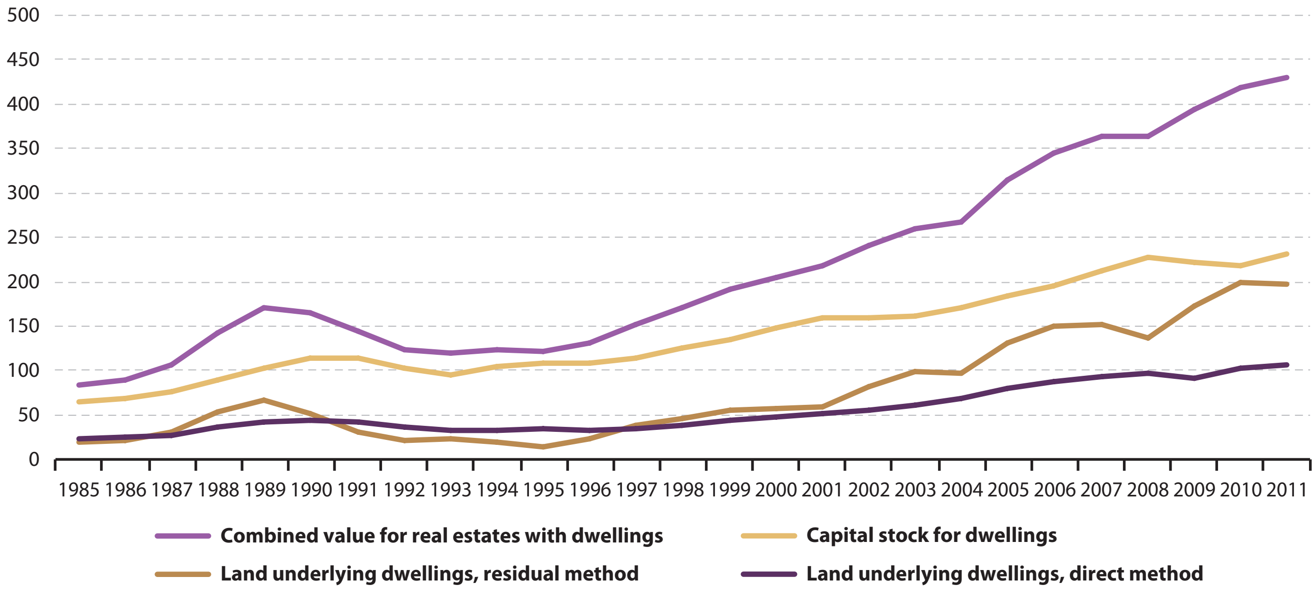
When the capital stock model was specified in the Finnish national accounts, the aim was mainly to use it to produce an estimate of the consumption of fixed capital for the national accounts. However, as part of the ESA 2010 revision, a need for estimates of capital stocks as part of the balance sheets for non-financial assets has arisen, as well.

When assessing the current state of the capital stock from the balance sheets point of view, comparative calculations were made to estimate the value of dwellings. In addition, these calculations can be used to analyse land estimates and factors impacting the value of land, when the residual method is applied.

There are efficient markets for dwellings in Finland, and therefore the regional market prices per square metre are available. If also information on the surface area for different types of dwellings is available, the combined value can be calculated. In addition, the National Land Survey has evaluated land underlying dwellings for national wealth purposes.

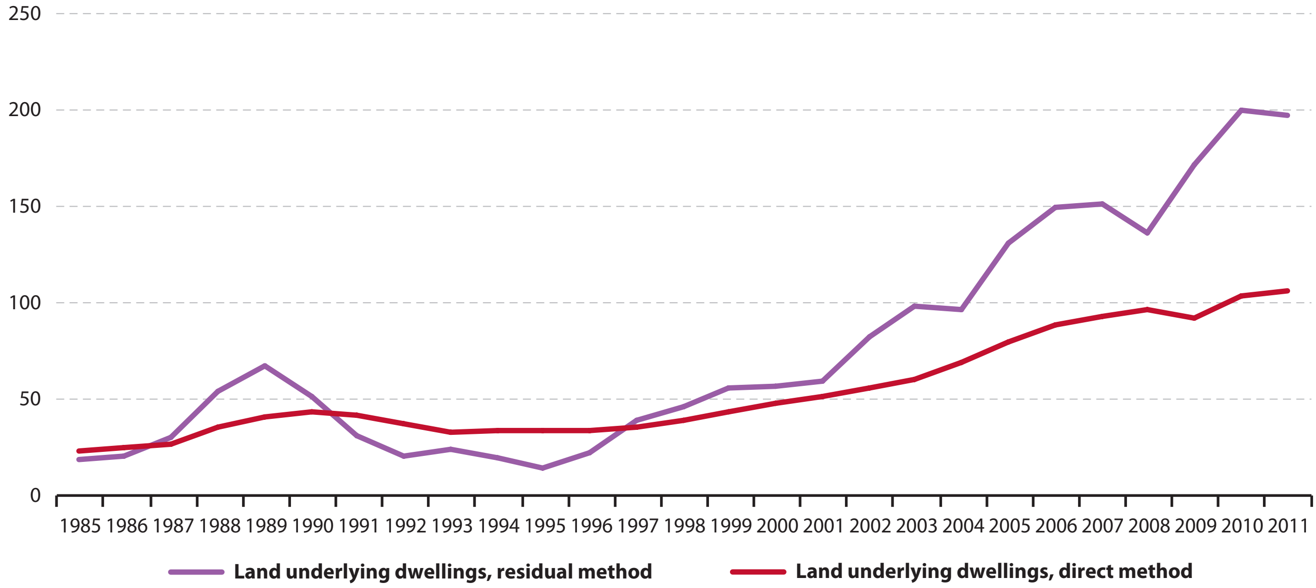
Applying this data, comparative calculations can be made between the value of land obtained through the direct method and the value of land obtained through the residual method. The results are shown in Figure 6.3. The light purple line denotes the combined value of dwelling real estates, the yellow line is the value of capital stock for dwellings in national accounts calculated with the perpetual inventory method (PIM), and the brown line denotes the value of land calculated using the residual method. The dark purple line denotes the value of land underlying dwellings estimated by the direct method.

Figure 6.3: Comparative results for land values
(billion EUR)



Source: Statistics Finland, National Land Survey of Finland

Figure 6.4: Land underlying dwellings estimated with direct and residual method
(billion EUR)



Source: Statistics Finland, National Land Survey of Finland

Figure 6.4 focuses on the value of land underlying dwellings estimated according to the different methods for the time period 1985–2011.

The results illustrate that the pattern of land value by the direct method is significantly smoother and less volatile over time than the pattern obtained using the residual method.

These observations can be reasoned by the assumptions in PIM. Firstly, the slope of the capital stock curve (Figure 6.3, red line) is dependent on the chosen price index. In Finland the price index is based on the construction costs, and it cannot perfectly reflect market price changes in dwelling prices.

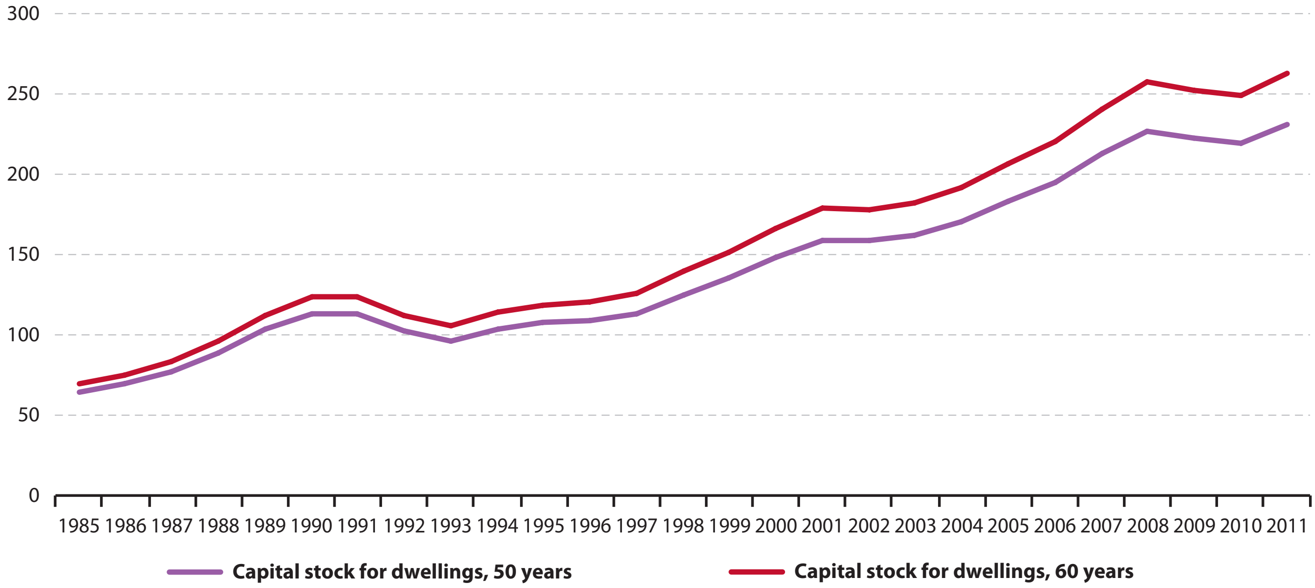
Secondly, the slope of the capital stock curve is also dependent on the chosen depreciation profile. Currently a linear depreciation model is applied in Finland. Test calculations indicate that geometric profile could be more realistic for dwellings.

Thirdly, the value of the capital stock is strongly dependent on the chosen service life for dwellings. Figure 6.5 illustrates a consequence of changing service lives for dwellings from 50 years (current practice at the time) to 60 years.

Based on this analysis it was decided to change the service life for dwellings from 50 to 60 years in Finland. The service life of 60 years is also closer to service lives applied for dwellings in other European countries. This can be seen as a first step in PIM development. The depreciation profile and price index will be reviewed and possibly changed at a later stage, when the land estimates by the direct method are finalised.

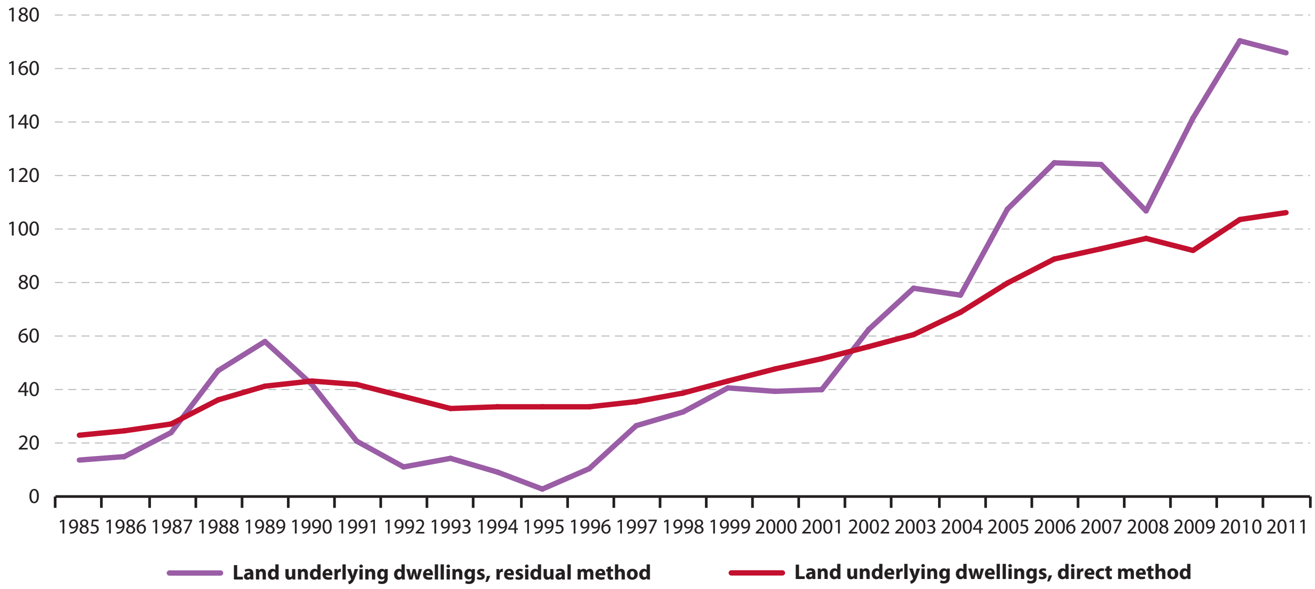
Any change in the capital stock assumptions are also reflected in the consumption of fixed capital, and should therefore be done carefully.

Figure 6.5: Capital stock for dwellings with 50 and 60 years of service lives
(billion EUR)



Source: Statistics Finland, National Land Survey of Finland

Figure 6.6: Land value by the direct method and by the residual method with 60 years' service life for dwellings
(billion EUR)



Source: Statistics Finland, National Land Survey of Finland

A possible reason for the difference in the land values between the two methods (Figure 6.6) could be the increase in value of existing dwellings near the city centres, which may exceed the increased rate of construction costs, especially during economic booms. It can be concluded that the value of land by residual approach is strongly dependent on the assumptions of PIM such as service life, depreciation profile and price index. Whereas the direct method is dependent on unit prices and the assumption that prices are accurately representative.

As long as assumptions and methods used vary from one country to another, comparing their land wealth should be done carefully.

In general, changes in real estate prices will be reflected in the land component using the residual approach whereas, the direct method may allocate price fluctuations more to the building component.

6.3 The land-to-structure ratio approach

Introduction

6.118. The land-to-structure ratio (LSR) approach represents another option to indirectly derive the value of land. This method shares similarities with the residual approach discussed in Chapter 6.2, more specifically because of the reliance on a derived measure of the depreciated structure built on a given property. Therefore, this approach can be used for the estimation of land underlying dwellings and other buildings and structures.

6.119. The LSR approach is recommended when available data sources permit the derivation of a higher quality estimate for a representative LSR compared to an estimate for total property value.

6.120. In the following paragraphs, the LSR approach will be described in detail, including a description of the method, the data sources required and the strengths and weaknesses of this approach. The approach will also be illustrated by means of a case study for Canada.

Description of the method

6.121. At its most basic, the LSR method uses a simple identity valid at any level of aggregation:

(10) *Land-to-structure ratio = value of land/ value of structures*

6.122. Using estimates for the value of structures and the LSR, the value of land can be easily derived by reversing the previous identity:

(11) *Value of land = value of structures * land-to-structure ratio*

6.123. The accuracy of the land value estimates obtained through this approach increases with the level of detail at which these calculations are done, as the matching between structures and LSRs will more fully take into account property characteristics in terms of type, location, and geography.

Estimation of structures value

6.124. In most countries, the valuation of dwellings and other buildings and structures is based on a perpetual inventory method (PIM). Given that these derivations are included in the national accounts framework, mostly through the balance sheet programme, the PIM approach has the major advantage of ensuring consistency across the accounts, with investment flows that are captured in the capital account fully consistent with the stock values derived through PIM.

6.125. The PIM provides a viable alternative to estimating a 'fair' value for dwellings and other structures in the absence of directly observable market prices. As most real estate transactions concern the total value of the property, which includes the inextricably linked values of buildings and the land on which they stand, the value of structures has to be estimated through the use of a proxy, regularly called 'replacement value'. This valuation approach, which underlies the PIM methodology, provides, in essence, the cost of acquiring a similar produced asset that would provide the exact same level of utility to its user.

6.126. The PIM uses information about investment flows, demolitions, destructions, price indices, average service lives of capital, as well as a choice of a depreciation method. In essence, the PIM cumulates capital investment flows to obtain estimates of structures for a given time period. For more information on the assumptions and estimation methods used by countries see Chapter 6.5 in this guide. A more detailed description of the PIM can be found in Measuring Capital (OECD, 2009).

6.127. The wide use of the PIM-based approach in the derivation of values for dwellings and other structures provides a solid basis for cross-country comparison and consistency.

6.128. The use of the PIM methodology yields, in most countries, estimates for structures with a relatively high level of granularity, mostly dependent on data availability for investments flows. The finer the level of detail used in the derivation, the more accurate the estimates will be by type of structure and sectoral dimension.

Estimation of land-to-structure ratio

6.129. The derivation of the LSR relies on the availability of data on the value of structures and land components for a clearly defined set of properties, in other words, a sample of the total stock of properties within an economy. An essential aspect of this step in the LSR methodology is the degree of representativeness of the LSR sample relative to the total set of properties for which it will be used.

6.130. The accuracy of the method increases with a closer match between the type of structures and the LSR available. In most cases, PIM estimates are available for dwellings by type of dwelling as well as for non-residential structures. In countries where regional differences are significant, the geographical detail is also very important; therefore, it should be included in the derivation of the value of structures.

6.131. The next step in the methodology is the matching of structures with the corresponding LSR, at the lowest level of detail afforded by data availability. This derives a value for land for that particular type of property with a specific geographical profile. This approach can be easily applied at a high level of aggregation, however at the expense of some loss in estimate accuracy. This impact will be more significant the more heterogeneous the set of developed properties are in a given economy.

Data requirements

Data requirements for the estimation of the value of dwellings and other buildings and structures

6.132. The PIM data requirements are normally well understood, given the widespread use of the methodology in deriving capital stock estimates.

6.133. In brief, the PIM approach requires data on investment flows, including new construction, renovations and other fees associated with new building transactions. Price indices, service lives of structures and data on demolitions and destructions are also used to develop the stock time-series. Finally, the depreciation method is the final element to consider in the accumulation of deflated capital investment flows. The typical choice is between a linear and a geometric depreciation method.

6.134. The PIM is a versatile model that can be customised to work at a level of detail afforded by data availability. Ideally, the value of dwellings should be estimated by type — singles, multiples, condos as well as by the relevant geographic detail.

6.135. For non-residential structures, or structures other than dwellings, it is useful to distinguish between types of structures, for building structures (such as offices, plants) and engineering structures (such as roads, bridges). This information is typically available through surveys of capital expenditures, with these data also providing the basis for the investment flows in the capital account of the national accounting framework.

Data requirements for the estimation of land-to-structure ratios

6.136. The estimation of a LSR requires complete information on two of the three variables involved — the total combined value of the property, the value of the structure, the value of land — through research or preferably, regular observations for a representative sample. This would allow the calculation of the value of structures and the corresponding value of underlying land and thus the desired ratio.

6.137. The quality and degree of representativeness of the sample are essential aspects to consider in deciding to use the LSR method. As a general observation, such samples are less of a challenge for residential properties, as many countries already have in place survey frameworks to capture current residential construction, an economic activity very relevant to a number of high-profile statistical programmes (as well as policy making). In addition, any information on the total value of residential properties entering the real estate market is likely to be close to fair values, based on the assumption that residential real estate price dynamics would be implicitly incorporated in transaction prices.

6.138. In addition, for new residential construction, the value of structures completed in the current reporting period should be readily available through such survey frameworks, as it would rely mostly on current costs, therefore the subjectivity inherent in respondent reporting will be less of a concern.

6.139. Another alternative is asking respondents (such as major builders) to provide a value for land. Although entirely feasible, this approach will introduce a fairly high level of subjectivity in the estimates, particularly because issues such as timing will play an important role. Often, builders purchase large areas of vacant or undeveloped land but only develop it with some time lag that could be significant. In such cases, the transaction prices for the land purchase are unlikely to capture its current or fair value. This is of particular concern during periods when residential real estate markets perform strongly, given that most of the appreciation in property values is associated with the land component.

6.140. Another possible challenge presents itself for countries where the residential building construction industry is very fragmented and comprised, for the most part, of a large number of small builders. This will complicate the task of setting up and managing a successful survey.

6.141. One important aspect for the use of the LSR method is the level of detail for which data on the respective variables are available. In other words, the estimated value of land will be more accurate if LSRs are calculated by type of property, by geographic region as well as taking into account the differences between urban and suburban areas. Ideally, the resulting set of LSRs will have at least as much granularity as the PIM-based structure value estimates to allow the estimation of the value of land at a low level of aggregation. If that is not feasible given data availability, aggregate averages of LSRs represent a second best solution.

6.142. For non-residential properties, the estimation of LSRs is likely to pose more challenges. For the most part, markets for such properties are very illiquid if observable at all. Therefore, total property values are as subjective as the associated land values. Property value assessments, typically done by specialised assessors may provide a reasonable fair value estimate for one of the two variables — combined value of the property or land value.

6.143. Maintaining a survey frame that would allow a representative coverage for non-residential properties is inherently difficult. This is a particularly valid concern for buildings, such as offices and plants. For certain components of engineering structures, such as bridges and roads, information that could be used to derive LSRs can potentially be available in public accounts, as most of these properties would fall under government or public ownership.

6.144. For both residential and non-residential properties, property tax assessments represent another potential data source, at the extent that the breakdown between the value of the structure and the value of the land is required and is reported reliably. One major advantage of property tax assessments is the full (or near full) coverage of properties. However, differences in assessment approaches across jurisdictions, a reality for most countries, adds an additional layer of complexity to ensure full consistency.

6.145. Finally, irregular research into the valuation of real estate that could provide insight on average or aggregate LSRs can constitute an alternative method to valuing land, in the absence of more accurate data sources. In such cases, given that the ratios would not be available on a regular basis, price information through real estate indices as well as indicators of real estate activity may be used as supplementary inputs into the derivation of LSRs.

6.146. In addition to the sources of data and the supplementary information used, the frequency at which these data are available is also critical to an accurate valuation of land. Although one-time, infrequent valuations for land are useful, ideally, the value of land should be an integral part of the national accounts regular releases. Therefore, countries can opt for an annual or sub-annual frequency (e.g. quarterly) for the value of land estimates, depending on their current practices for the relevant national account programmes, particularly the balance sheet accounts.

6.147. An important factor for consideration here is the potential gap between the frequency with which the source data for the LSR approach method become available and the release frequency. For example, quarterly estimates for the value of land are ideal to align with a quarterly balance sheet accounts programme. However, the survey(s) providing the source data could be annual. Property tax assessment data may also be available at lower frequencies (annual, or even once every 2–4 years). In such cases, based on the availability of proxies and supplementary information, the gap could be bridged by using projections, however, ensuring consistency in the quality of estimates in the time series could become an additional challenge in the valuation of land.

Sectoral dimension

6.148. So far the estimation of the value of structures and the LSRs by type of property, location and geography has been discussed. Another relevant dimension is the sectoral allocation of the derived value of land, an integral component to sectoral balance sheets.

6.149. Ideally, the source data would be available at a level of detail that facilitates the allocation of residential land between the households sector, the government and the corporate sector. In practice, however, some assumptions and extrapolations may be necessary. The government holdings and new construction of residential properties may be available through public accounts as they mostly would relate to niche-type housing, although this may vary greatly across countries.

6.150. Information on the corporate sector's holdings of apartment buildings may also be available directly through surveys. The remainder (the highest proportion) would then be allocated to the households sector.

6.151. Non-residential land will be mostly allocated to the corporate sector and the government. Assuming additional direct data is available on government-owned non-residential properties, most of the residual will represent corporate sector holdings. A relatively small portion is owned by unincorporated enterprises, part of the households sector in most countries.

6.152. In the absence of such detail, however, one alternative is to use as a starting point the relative sector allocation of PIM-derived structures, which, in most countries is available by sector and often by industry. However, in some cases, the assumption of equal LSRs across the various sectors may be too strong. For example, government-owned subsidised housing properties are likely to be situated in areas characterised by lower LSRs relative to households' holdings of residential properties. Such considerations though will have to rely on a subjective assessment of these differences, in the absence of additional information through direct observation or research findings. A detailed discussion on sectorisation can be found in Chapter 7.

Strengths and weaknesses

6.153. The LSR approach allows the derivation of fair values for land underlying dwellings and other buildings and structures in the absence of reliable data on developed property values within an economy. The methodology is inherently versatile, and thus can be applied at the level of aggregation dictated by data availability constraints.

6.154. The main data requirements for the derivation of the ratios are likely to be met by many countries, given that the same data sets are valuable inputs in other statistical programmes within the national accounts framework. Reliance on PIM estimates of structures also ensures consistency across the accounts.

6.155. Moreover, this approach avoids the potential issue of negative values for land, given that it builds the total property value from its two components, as opposed to the residual land methodology.

6.156. Among weaknesses, of particular mention is the actual degree of representativeness of the sample used to build the LSRs. In practice, if relying on new construction data, the sample composition could differ markedly from the composition of the existing stock of properties. Therefore, bias represents a concern, particularly over reporting periods when a particular type of property is in great demand or specific geographic areas perform significantly stronger relative to others.

6.157. Countries that release higher-frequency balance sheets (e.g. quarterly) also need to address the likely lag in the availability of data used in the calculation of LSRs. To offset the lack of information for current period(s), real estate price and activity indicators can be used in projecting the ratios, using the underlying assumption that the price movement is associated with the land component.

6.158. Finally, the LSR method is applicable only to developed land, and often the data available relates only to completions. Therefore, for other types of land, such as vacant land, land under development during the respective reporting period, as well as agricultural land, other alternative methodologies will need to be used.

6.159. In conclusion, the LSR method represents a viable approach to deriving land values for land underlying structures, providing countries an alternative to the direct and residual method, with data availability determining the final choice of method by type of land.

Case study land-to-structure-ratio approach: Canada

Canada produces a set of quarterly national balance sheet accounts (NBSA) which includes estimates of non-financial assets for all relevant sectors of the economy.

For NBSA purposes, land is comprised of residential land, non-residential land and agricultural land. Public land (such as parks) or any other type of land that is not associated with a given structure is outside the NBSA scope. (Land under standing timber is implicitly included in the value of that natural resource).

The estimation of residential and non-residential land is based on the land-to-structure ratio (LSR) approach. For agricultural land, the estimates are derived using data from the census of agriculture, conducted every five years. Given that the focus of this section is on the LSR approach, the following discussion will detail the derivation of residential and non-residential land only.

Residential land

Residential structures

The value of residential structures is constructed using the PIM approach, based on information on investment flows, price indices, average service lives and a geometric depreciation method.

The starting point is a stock estimate obtained through the 1941 Census. Investment flow data includes new construction, renovations (excluding repairs) and various fees associated with new residential construction to reflect the value of the investment to the final buyer.

The types of structures covered comprise detached dwellings, single, semi-detached or double, row and apartment units as well as mobiles, cottages and conversions from non-residential buildings.

Sector estimates for residential structures are derived through a number of steps. Data on government holdings of residential structures (e.g. subsidised housing, military housing) are available from public accounts, and this small amount is allocated to the government sector estimates of residential structures in the NBSA. The remaining value is then allocated between the households and the corporate sector, based on dwelling stock data by type and tenure (occupied/non-occupied, rented/owned). This approach is consistent with the sectoring of residential investment flows.

Land-to-structure ratios

The quarterly estimates for the LSRs are derived for new residential construction, by type of dwelling — single or multiples — across Canada. This information is available through a monthly survey of builders, and it covers newly completed dwellings. The survey is administered by Canada Mortgage and Housing Corporation, Canada's national housing agency, who shares the monthly files with Statistics Canada.

For the valuation of residential land, Statistics Canada uses three key variables from this survey, by individual property:

— the building permit value (BPV), which represents the value of the dwelling only;

— the absorption price value (APV), which represents the sales value of the residential property — in other parts of this guide this is called the combined value; it includes the BPV, any upgrades to the dwelling after the filing of the BPV, as well as the market value of the land associated with the structure;

— the address of the unit completed and sold.

The LSRs are then derived using the formula:

(12) *Land-to-structure ratio = (APV – BPV) / BPV*

Finally, based on the third variable, the physical location of the property, the units are classified to urban centres or to suburban areas of major cities (the vast majority of new units). LSRs are always higher in urban core areas and a further adjustment is made to the ratios to account for the higher depreciation of older buildings in such areas. Using a simplified numerical example, Table 6.16 illustrates the calculation of the LSRs, based on survey data, for a hypothetical geographical area in a given quarter.

Table 6.16: Derivation of land-to-structure ratios for residential properties for geographical area A

	Location of property		Type of property		Value/price (thousands of dollars)		Land-to-structure ratio (LSR)
	Address	Type of area	Specific property type from survey	Single/ multiple	Absorption price value APV	Building permit value BPV	LSR = (APV - BPV) / BPV
1	…	Urban core	Single	Single	750	400	0.88
2	…	Urban core	Apartment	Multiple	410	250	0.64
3	…	Urban fringe	Single	Single	400	260	0.54
4	…	Urban fringe	Row	Multiple	310	210	0.48
5	…	Non-urban	Single	Single	510	370	0.38
6	…	Non-urban	Semi-detached	Multiple	200	165	0.21
…	…	…	…	…	…	…	…
Averages for geographical area A							
		Urban core		Singles			0.80
				Multiples			0.65
		Urban fringe		Singles			0.58
				Multiples			0.45
		Non-urban		Singles			0.39
				Multiples			0.24

Note: The shaded columns represent calculations based on survey information.
Source: Statistics Canada; fictitious data

Census weights are then used to aggregate the LSRs over census metropolitan areas and by region. This results in economy-wide LSRs for singles and multiples. Building on the numerical example above, Table 6.17 illustrates this calculation using a hypothetical scenario of an economy with only two geographical areas. (The census weights are constructed using census data on type of dwellings for Canada, by census metropolitan areas and census agglomerations).

Table 6.17: Derivation of economy-wide land-to-structure ratios

			LSR (a)	Census weights (b)	Weighted LSR (a)*(b)
Geographical area A					
1	Urban core	Singles	0.80	0.149	0.119
2		Multiples	0.65	0.160	0.104
3	Urban fringe	Singles	0.58	0.006	0.004
4		Multiples	0.45	0.001	0.001
5	Non-urban	Singles	0.39	0.004	0.002
6		Multiples	0.24	0.000	0.000
Geographical area B					
7	Urban core	Singles	0.91	0.740	0.674
8		Multiples	0.73	0.818	0.597

			LSR	Census weights	Weighted LSR
			(a)	(b)	(a)*(b)
9	Urban fringe	Singles	0.85	0.065	0.056
10		Multiples	0.62	0.015	0.009
11	Non-urban	Singles	0.56	0.035	0.020
12		Multiples	0.24	0.005	0.001
Economy-wide					
		Singles (1+3+5+7+9+11)		1.000	0.873
		Multiples (2+4+6+8+10+12)		1.000	0.713

Source: Statistics Canada; fictitious data

Valuation of land

The ratios obtained for singles and multiples are then used, in combination with the residential dwelling stock, to derive residential land values at the level of the total economy. Table 6.18 illustrates the calculation.

Table 6.18: Derivation of total residential land value for a given quarter

	Value of residential dwellings (billion CAD)	LSR	Value of residential land (billion CAD)
	(a)	(b)	(a)*(b)
Singles	1 170	0.87	1 018
Multiples	630	0.71	447
Economy-wide, all residential properties	1 800		1 465

Source: Statistics Canada; fictitious data

Furthermore, sector estimates are built using the sector composition of singles and multiples using the corresponding LSR. The higher proportion of single dwellings in the households sector results in a larger LSR for this sector.

Reliance on the method detailed above is not exclusive. Aside from the fact that this approach is labour-intensive, the APV information is typically available with a significant lag, therefore, the LSRs are projected using a set of current residential real estate market indicators.

Cross-reference checks against other sources of information on residential real estate values are performed whenever such data becomes available. One such example is an occasional survey of households' net worth, the Survey of Financial Security. This collects details on assets and debt, providing an aggregated micro data estimate comparable to the households' holdings of real estate in the NBSA programme.

Another comparison project, currently underway, uses tax assessment files collected from municipalities across Canada. Although conceptual and statistical differences cannot be fully eliminated, these data sources provide a valid check for the LSR approach.

Non-residential land

Non-residential land comprises all commercial land owned by enterprises, incorporated and unincorporated, non-profit institutions serving households and governments.

The value of non-residential land is also derived based on a LSR methodology. Data availability, however, is much more of a constraint for non-residential properties than for residential properties. Therefore, the current approach is based on a historical LSR derived from an old survey of real estate as a starting point. This historical ratio is being projected using current indicators of real estate activity and prices. A review of this methodology is currently being considered.

The derivation of the value of non-residential structures is based on the PIM approach and is generally consistent with the method used for residential structures. The sectorisation approach is similar, in that the sector allocation of land is based on the sectorisation of non-residential structures.

6.4 The hedonic approach

Introduction

6.160. The hedonic approach is an alternative method for obtaining the value of land underlying buildings and structures. A hedonic regression model is the centre of this approach and it requires technical skills to make the estimations. However, when applied, it returns values for both the price of land and the price of buildings which match with the total price for the properties, which is a very positive characteristic of the approach.

6.161. The outcome of the hedonic regression model is in practice an estimate of the representative price for one square metre of land for a given time period. A useful secondary outcome of the calculation is a representative price for one square metre of building located on the land. The total value of land is derived by multiplying the representative price per square metre of land with the total number of square metres of land for the area to be measured. Inputs into the calculations are price per property (combined value of land and structure), number of square metres of building and number of square metres of land.

6.162. If the aim is to calculate the value of land for an entire country, it is most unlikely that this can be done at the country level with meaningful results. For the same reasons discussed in prior chapters, the price of land is heavily influenced by its location and the type of use. Therefore, it is recommended to calculate a representative price per square metre for each different use of land (residential, factory, office or commercial) and different locations. In other words, using the hedonic approach most likely requires many regression models or the introduction of dummy variables because data should be divided into homogenous subsamples.

Description of method

6.163. The hedonic approach is basically built upon a regression model with a set of independent explanatory variables and a dependent variable. The specification of the regression model is not unique, i.e. the number of independent variables could vary depending on available source data and which set-up gives the best model. In the following, a simple hedonic regression model is introduced together with some more advanced approaches.

Distinguishing the representative property price from price indices

6.164. The hedonic regression model described in this chapter is based on theory from the Handbook on Residential Property Price Indices (Eurostat, 2013) and an article by Diewert, de Haan and Hendriks (2010). The RPPI Handbook presents a hedonic regression model for decomposing a general residential property price index into two separate indices, one for the price development for land and one for the price development for structures (the building). The two separate price indices measure the price development across time (quarters).

6.165. Measuring the price development across time — which is the aim of the model presented by the RPPI Handbook — and calculating a representative price for a square metre of land — which is the goal of this section of the compilation guide — is of course not exactly the same. However, the required data for running the regression model and the set-up of the regression model is very much related. For that reason, this compilation guide borrows from the theory described in the RPPI Handbook. If a more technical presentation of the hedonic method is required, the original sources are recommended.

6.166. The authors of the RPPI Handbook mention multicollinearity and that the method is data intensive as the main disadvantages for using the hedonic regression approach. However, the advantages are separate indices for land and buildings which are very difficult to compile otherwise.

A simple hedonic regression model

6.167. For a given period of time, location and type of land (for instance a specific postal zip-code and residential land), the hedonic regression model in its most simplistic form is given by:

(13) $$P_i^P = P^B * B_i + P^L * L_i + \epsilon_i,\ i=1,..,n.$$

6.168. The outputs of the model are values for two parameters; P^B, which is the price per square metre of building, and P^L, which is the price for one square metre of land. Input to the model is P_i^P, which is the property price for observation number i, B_i is size of the building measured in square metres for observation number i, and L_i is size of the land measured in square metres for observation number i. The sample contains n observations, and ε_i is the error term.

Expanding the model

6.169. In its simplest form the hedonic regression model treats one square metre of building equally regardless of the age of the building; the price for one square metre of a one year old building is assumed to be the same as the price for one square metre of a building which is 30 years old. This is not what one would expect since buildings depreciate in value as they age. Therefore, the regression model can be expanded to take account of depreciation of buildings. The expanded model is given by:

(14) $$P_i^P = P^B * (1 - \delta A_i) B_i + P^L * L_i + \epsilon_i,\ i=1,..,n.$$

6.170. In the expanded model δ represent the yearly depreciation rate. The parameter A_i represent the age of the building, and the combined value δA_i increases with the age of the building. The term $(1 - \delta A_i)B_i$ can be interpreted as quality adjusted square metres for buildings.

An example

6.171. It might be useful to illustrate the exercise with a small numerical example, see Table 6.19. Assume seven property sales (dwellings) have taken place in a given period. They are listed together with the number of square metres of land and buildings for each transaction. Also listed are the year of construction and the implicit age of the buildings.

6.172. The task is to estimate the values P^L and P^B for the seven transactions with the restriction that the error terms should be minimised. The values P^L and P^B are shared for all the observations. As was discussed above, information about the age of the building could be included in the calculations. Thus, quality adjusted square metres can be derived by using information on the age of the buildings. The average service life is assumed to be 75 years for the buildings; this corresponds to a yearly depreciation rate equal to 0.0133.

6.173. If the expanded model is used on the data shown in Table 6.19, the estimated prices per square metre are P^B = 19 629 and P^L = 2 037. The observed total value for the seven real estate properties is DKK 21 315 000. The value for land and buildings can in this case be calculated to DKK 11 351 000 (= 2 037 * 5 573) and DKK 9 919 000 (=z19 629 * 505). The combined value for land and buildings is DKK 21 270 000 which is DKK 45 000 less than the observed value. The difference occurs because the error term is not zero. Using the simplified regression model for the seven observations, the results are P^B = 20 991 and P^L = – 80.4, which is not an economically meaningful result. In this example it is required to include the information on the age of the buildings for achieving an economically meaningful result.

Table 6.19: Example hedonic approach

Property transaction	Property price	Land		Buildings					
		Price	Square metres	Price	Square metres	Quality adjusted square metres	Not explained	Year of construction	Age of building
1	2 700 000		886		136	58	e1	1969	43
2	3 200 000		843		143	74	e2	1976	36
3	2 115 000		729		110	34	e3	1960	52
4	3 600 000	P^L	761	P^B	162	73	e4	1971	41
5	2 800 000		749		143	72	e5	1975	37
6	3 050 000		791		143	72	e6	1975	37
7	3 850 000		814		171	121	e7	1990	22
	21 315 000		5 573		1 008	505			

Source: TF on Land and other non-financial assets, fictitious data

Dealing with multicollinearity

6.174. Hedonic regression models which use square metres of land and square metres of buildings as independent variables have a high risk of multicollinearity. Multicollinearity means that two or more variables are highly correlated and one of correlated variables can be predicted (linearly) by the others. The consequence of multicollinearity is that the estimates of the parameters become less accurate and more volatile. The econometric literature discusses multicollinearity and provides methods to deal with this problem.

6.175. Diewert and Shimizu (2013) dealt with the multicollinearity problem by introducing a construction cost index into the regression model. Further, they merged all time periods into one regression. The introduction of a construction cost index into the regression model is also discussed in the RPPI Handbook. If Diewert and Shimizu's model is transformed into measuring values instead of prices indices, the regression model is given by:

(15) $$P^P_{i,t} = \beta * C_t(1 - \delta A_i)B_{i,t} + P^L_t * L_{i,t} + \epsilon_{i,t},$$
i=1,..,n and t=1,…,T.

6.176. In this regression model, C_t is the construction cost index and b is a constant parameter which transforms the construction cost index into a value per square metre. Following the setup of Diewert and Shimizu the output of the regression model would be b, δ and (for t=1,…,T).

6.177. The transformation of the regression model given by Diewert and Shimizu might be one way to get around the problem of multicollinearity. A full discussion on how to eliminate multicollinearity cannot be given in this compilation guide because in order to resolve the issue it usually depends on the data.

Data requirements

6.178. The data requirements for running the hedonic regression is a set of observations for sales of real estate properties, including number of square metres of land and number of square metres of buildings for the traded real estate properties. If the sample is non-homogeneous with respect to location or types of buildings, it would improve the reliability of the estimations if the sample could be subdivided into subgroups with similar characteristics. The hedonic regression model can be compiled without information on year of construction, but it clearly improves the quality of the results, if this information is included in the calculations. Sometimes it is a necessity.

Strengths and weaknesses

6.179. Using the hedonic approach for compiling separate values for land and buildings and using the hedonic approach for compiling separate price indices for land and buildings is based on the same methodology. Thus some of the same weakness and benefits must be assumed for two types of calculations.

6.180. The advantages can be summarised as the following:

— Should other — and easier — methods fail, the hedonic approach is probably the only method which will result in reliable figures for the value of land.

— Output of the calculations is a set of consistent figures for land, buildings and the combined value of buildings and land. The regression model could be used to produce stock figures for land and buildings. And the figures could be part of the balance sheets.

— Includes information on actual sales prices, number of square metres and age of buildings. The figures are used consistently.

6.181. The disadvantages can be summarised as the following:

— It is technically difficult to implement in practice. A significant amount of time may be needed to specify which regression model gives the best results.

— The calculations are data intensive. A large dataset which includes information on number of square metres of building and land, age of building together with actual sales prices has to be compiled.

— There is a high risk of multicollinearity. This distorts the results and should be avoided.

— The estimated figures for buildings would most likely not be consistent with capital stock figures for buildings (compiled by the use of the perpetual inventory method). Some kind of balancing would probably be required if capital stock figures are used for the balance sheets.

— In practice, the hedonic approach has not yet been implemented by any country in estimating the value of land. Further, the hedonic approach has not yet been applied for non-residential buildings.

Case study hedonic approach: Denmark

The hedonic approach has not been applied by Statistics Denmark in practice, but Statistics Denmark is planning to test the hedonic approach in the future for some specific periods of time and for some specific types of buildings. If the test is successful, the results of the hedonic approach could be used in officially released figures. The reason for considering the hedonic approach is that the alternative — residual approach — does not provide reliable figures for some years.

Problematic alternative

An earlier effort at Statistics Denmark attempted to measure the value of land underlying buildings and structures for the period 1995–2002. The residual approach was used for measuring the value of land; however the residual approach proved problematic for the years 1995 and 1996 with negative values for land. The reason for the negative values for land was that a major recession hit Denmark at the end of the 1980's and beginning of the 1990's which also impacted the real estate market. Prices for real estate decreased strongly, but construction costs did not, and because prices for buildings follow construction costs (as a consequence of the chosen perpetual inventory method/direct estimation method) whereas the price for land indirectly follows the price for real estate (which declined strongly), the value of land became negative. Therefore, the residual approach did not produce reliable figures for these years.

Statistics Denmark is planning to test the hedonic approach as an alternative to the residual approach. The plan is to test the hedonic approach for two different periods of time, one with reliable figures from the residual approach (2010–2011) and one with problematic figures (1995–1996). Since transactions in owner-occupied dwellings are the most widespread, the application of the hedonic approach will be restricted to this type of buildings. If the test is successful, the figures might be used for official releases.

The requirements for running the hedonic model are square metres of land, square metres of building and transaction price for all traded buildings. Statistics Denmark has access to this information together with information on the age of buildings.

6.5 The importance of service lives and depreciation for indirect land estimates

6.182. Previous chapters have discussed the residual approach (Chapter 6.2) and the land-to-structure ratio approach (LSR, Chapter 6.3) for producing separate estimates of national stocks of structures and underlying land. These indirect methods rely on estimates of the net stock of structures usually obtained through the perpetual inventory method (PIM), in which, gross fixed capital formation (GFCF) are added to the stock, and depreciation and retirements of assets subtracted from the stock. Although the PIM has many advantages, a disadvantage of the PIM is that precise information on service lives and patterns of depreciation is difficult to obtain. Errors in the assumptions of the PIM, estimates of GFCF, and prices can all lead to errors in estimates of net stocks of structures, which can then lead to errors in the estimates of the value of the underlying land.

6.183. This chapter presents a summary of the responses to a 2013 OECD-Eurostat survey of national practices in estimating net stocks of structures. The survey asked national accountants to provide, for a detailed list of structures, the assumptions and methods used for the PIM. The goal was not to select a single 'best' approach for the PIM, but to promote discussions, facilitate detailed comparisons of PIM assumptions, and provide concrete options for those seeking to produce improved, internationally comparable estimates of net stocks of structures and underlying land. This chapter provides an overview of the survey and the theory of capital measurement; summarises and compares reported patterns of depreciation (linear, geometric, other), patterns of retirement, and other aspects of the PIM; and describes respondents' sources of information, main concerns, and plans for the future.

Overview of the survey

6.184. The survey asked respondents to provide the methods and assumptions for their estimates of net stocks of structures. Respondents reported whether they use the PIM or other methods (census, administrative records, etc); assumed service lives, depreciation patterns, and retirement patterns; sources of information used to make these assumptions; and other information.

6.185. The survey asked respondents to provide these assumptions for a detailed list of structures to assist comparisons of similar types of structures, such as dwellings, office buildings, and schools. The list of assets conforms to widely used classifications found in the SNA 2008, ESA 2010, and the Central Product Classification v2 (CPCv2) ([47]):

— For dwellings (AN.111) — one- and two-dwelling residential buildings, multi-dwelling residential buildings, major improvements, and costs of ownership transfer.

— For buildings other than dwellings (AN.1121) — warehouses, manufacturing or industrial buildings, office buildings, buildings for shopping and entertainment, hotels, restaurants, schools, hospitals, farm buildings, prisons, major improvements, and costs of ownership transfer.

— For other structures (AN.1122) — several types of assets including roads, railways, harbours, dams and other waterworks, mining structures, flood barriers, communication and power lines, sewage and water treatment plants, electric power plants, and natural gas structures.

6.186. The survey also asked respondents to provide information about recent ratios of net stocks to Gross Domestic Product (GDP), sources of information for estimates of GFCF and prices, the treatment of transfer of ownership costs and major improvements to structures, frequency of updates of estimates, estimates of government owned land, major concerns and plans for the future.

Respondents and the use of the PIM

6.187. Responses were received from a total of 32 countries — Australia, Austria, Belgium, Canada, Chile, Cyprus ([48]) ([49]), Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Israel ([50]), Italy, Japan, Korea, Latvia, Lithuania, Malta, Mexico, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, the United Kingdom, and the United States.

6.188. The vast majority of respondents reported using the PIM to estimate net stocks and depreciation of structures. Most countries base these estimates on years of GFCF and price data that reflect construction spending and costs and not land values. Some countries (including Canada,

([47]) See SNA 2008 paragraphs 10.68–10.78, ESA 2010 Annex 7.1, and the Central Product Classification v2 which is available at http://unstats.un.org/unsd/cr/registry/docs/CPCv2_structure.pdf

([48]) The information in this document with reference to Cyprus relates to the southern part of the island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the 'Cyprus issue'.

([49]) The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the government of the Republic of Cyprus.

([50]) The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

France, Hungary, Iceland, Korea, Mexico and Slovenia) obtain initial or periodic benchmark-year capital stock estimates, based on a census, survey, or administrative records, and then use a PIM to extrapolate subsequent changes in the capital stock. A few countries rely on administrative records or surveys of stocks rather than a PIM to estimate the stock of fixed assets (Poland; Denmark, for dwellings and other buildings; Lithuania, for dwellings and roads; Malta and Sweden, for dwellings). However, since the majority of the respondents derive the estimates of net stock using the PIM this chapter focuses mainly on the PIM methodology and does not discuss methods for the direct estimation of the stock of fixed assets.

6.189. Only a few countries currently use the residual approach (Australia, Belgium, France, Italy and the Netherlands) or the LSR approach (Canada) to estimate stocks of land with the PIM-based estimates of net stocks of structures. Korea uses the residual method as a check on its direct estimates. Some respondents expressed an interest in using the residual method in the future.

Overview of capital measurement and the PIM

6.190. Measuring Capital (OECD 2009) ([51]) explains the theory and methods of capital measurement, and both Measuring Capital and ESA 2010 offer recommendations as to how to measure net stocks. A brief overview of these perspectives is useful for understanding and interpreting the survey responses.

6.191. Measuring Capital emphasises that PIM-based estimates of net stocks should be part of a broader set of capital measures that reflect capital's dual role as both a storage of wealth and a source of capital services in production. The age-price profile of a single homogeneous asset shows how its price declines as it ages and reflects depreciation or consumption of fixed capital, defined as the loss in value of an asset due to physical deterioration (wear and tear) and normal obsolescence. The age-efficiency profile of a single homogeneous asset summarises the change of its productive capacity over time, as measured by capital services. For a single asset, these two profiles are related: a particular age-efficiency profile implies an age-price profile (depreciation pattern) and vice versa, so, in theory, depreciation patterns and age-efficiency profiles should be set together.

6.192. Two common depreciation patterns are linear and geometric. With simple linear or 'straight line' depreciation, a homogeneous asset with a service life of T years loses a constant proportion (1/T) of the initial asset value each period, until the asset's value becomes zero at the end of year T. With geometric depreciation, an asset stock loses value at a constant depreciation rate (say, 2 %) each year. Geometric depreciation patterns (with the value of an asset stock on the vertical axis and time on the horizontal axis) are 'convex to the origin' in that the amount of depreciation (in currency units) is largest at the beginning of the asset's life and declines over time. Over time, the remaining stock becomes smaller but does not disappear unless forced to do so.

6.193. When measuring net stocks of entire cohorts of assets that are similar but not quite homogenous (such as all one-unit dwellings), national accountants may assume that not all assets in a cohort will retire at the same time. Retirement refers to the removal of an asset from the capital stock because the asset is exported, sold for scrap, dismantled, or abandoned. Under the assumption of linear depreciation and a distribution of retirement ages for a cohort of assets, for example, some 'sub-cohorts' will depreciate linearly with shorter service lives while other sub-cohorts will depreciate linearly with longer service lives. With a typical bell-shaped retirement pattern, the probability of retirement is low in the early years of an asset's life, gradually increases to a peak near the average service life of the cohort and gradually falls in the years after the average service life.

6.194. As Measuring Capital explains, for a cohort of assets, the combined age-efficiency and retirement profiles, or the combined age-price and retirement profiles, often tends to produce depreciation patterns for a cohort that are convex to the origin and resemble geometric depreciation. With linear depreciation for a homogeneous asset and a bell-shaped retirement distribution for a cohort of assets, for example, the asset cohort's value tends to decline more rapidly initially (in currency units) and less rapidly later, consistent with geometric depreciation. Measuring Capital also points out that geometric depreciation is supported by empirical studies. Accordingly, Measuring Capital 'recommends the use of geometric patterns for depreciation because they tend to be empirically supported, conceptually correct and easy to implement.' (page 12).

6.195. ESA 2010 paragraph 3.143 recommends that 'consumption of fixed capital shall be calculated according to the "straight line" [linear] method, by which the value of a fixed asset is written off at a constant rate [of its initial value] over the whole lifetime of the good.' ESA 2010 also recognises the advantages of geometric depreciation, stating that (ESA 2010 paragraph 3.144) 'In some cases, the geometric depreciation method is used when the pattern of decline in the efficiency of a fixed asset requires it.'

6.196. In practice, national statistical institutes may use several ways to derive depreciation rates, service lives, and retirement patterns. Some might start with information

([51]) Organisation for Economic Co-operation and Development, *Measuring Capital: OECD Manual, Second edition*, 2009. Available at http://www.oecd.org/std/productivity-stats/43734711.pdf. This section is a brief summary of a more detailed explanation of capital measurement found in Chapters 3–5 of Measuring Capital.

about an asset's age-efficiency profile and then derive age-price profiles, depreciation rates, and perhaps retirement patterns. Some might start with information about an asset's service life and then infer a depreciation pattern and possibly the retirement pattern for the purpose of estimating depreciation. Some may derive depreciation patterns through empirical studies of used asset prices. The survey attempts to record these different approaches, with no intention to select a 'best' approach.

Linear depreciation, with and without additional retirement distributions

6.197. The most common reported approach for estimating depreciation assumes a linear pattern. A total of 20 respondents report using linear depreciation — Belgium, Chile, Czech Republic, Denmark, Estonia (except dwellings), Finland, France, Germany, Hungary, Israel (52), Italy, Latvia, Lithuania (for buildings other than dwellings and for structures other than roads), Malta, Mexico, Poland, Portugal, Slovakia, Slovenia, and the United Kingdom. With linear depreciation, the speed of depreciation depends partly on the assumed service life, which can vary widely even for very similar assets (see Table 6.20).

6.198. As the previous discussion implies, comparing the service lives of similar assets across countries in Table 6.20 is not straightforward because retirement patterns must also be taken into account. For countries that use linear depreciation without a retirement pattern, the pattern of depreciation depends on the service life in a straightforward way. With a commonly used bell-shaped retirement pattern, on the other hand, some assets will retire before and after the average service life.

Table 6.20: Service life assumptions for countries using linear depreciation for estimates of net stocks of structures (years)

	One-unit dwellings	Manufacturing buildings	Retail buildings	Hospitals	Schools	Roads	Retirement pattern
Belgium	60	35	40	40	60	55	Lognormal
Chile	40	40	40	40	40	40	S-3 Winfrey
Czech Republic	90	60	60	70	70	50	Lognormal
Denmark	75	55	55	65	65	50	Winfrey
Estonia (1)	:	50	50	50	50	55	Linear
Finland	60	40	40	50	50	55	Weibull
France	90	90	75	75	75	120	Lognormal
Germany	77	53	53	66	65	57	Gamma
Hungary	83	83	83	75	75	75	Normal
Israel	50	25	50	50	50	50	Truncated normal
Italy	79	35	65	35	:	:	Truncated normal
Latvia	75	53	52	56	66	50	Lognormal
Lithuania (1)	:	95	95	95	95	:	Logistic
Malta	85	100	100	100	100	100	Normal (non-dwellings)
Mexico	60	60	60	60	60	60	None
Portugal	50	50	50	50	50	60	Delayed linear
Slovakia	55	60	60	60	60	60	None
Slovenia	74	33	33	70	70	50	None
UK	59	60	80	75	75	80	Normal

(1) Lithuania uses geometric depreciation for dwellings and roads only; Estonia uses geometric depreciation for dwellings only.

Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

6.199. Some respondents report using a linear depreciation method with no additional retirement pattern (Mexico, Slovakia and Slovenia). While this assumption may be unrealistic in a literal sense, it may provide a reasonable, computationally simple approximation of an asset cohort's depreciation over time. ESA 2010 recommends using linear or geometric depreciation. Among the countries that use simple linear depreciation, service lives for similar assets vary noticeably.

6.200. Other respondents report combining linear depreciation with a retirement distribution to produce a depreciation pattern for an asset cohort that is, in many cases,

(52) For Israel, see footnote 50.

convex to the origin and similar to geometric depreciation, which Measuring Capital recommends. The countries that combine linear depreciation with retirement distributions employ a range of mathematical retirement functions to produce bell-shaped or other retirement patterns, and the specific parameters of these chosen distributions vary as well. This range of assumptions further complicates comparisons of depreciation patterns of similar assets across countries. (See Measuring Capital, Chapter 13, for more information on these retirement distributions.)

— The normal distribution for retirements (Hungary, Malta for non-dwellings, and the United Kingdom) is symmetric, with 95 % of the probabilities lying within two standard deviations around the mean.

— The lognormal retirement distribution (Belgium, Czech Republic, France and Latvia) is a distribution whose logarithm is normally distributed; it is right-skewed, with a low probability of retirement in the first years of an asset's life and higher retirement probabilities later in an asset's life.

— A truncated normal retirement distribution (Israel ([53]) and Italy) has a retirement period that is restricted to fall within a specified range of years before and after an asset's average service life.

— Chile and Denmark combine linear depreciation with an S-3 Winfrey retirement distribution, which is also symmetric and bell-shaped.

— Germany uses the gamma distribution to calculate the distribution of retirements. The choice of this function was based on empirical data of motor vehicle registration. The parameters (and shape) of the gamma function were chosen based on empirical studies ([54]). The gamma distribution leads to a nearly bell-shaped retirement distribution and an age-price profile that is convex to the origin.

— Finland uses a Weibull retirement distribution, which is flexible, widely used, and can accommodate a range of shapes.

6.201. Respondents using linear depreciation also vary in terms of the level of asset detail at which service life assumptions are made. Separate PIM-based estimates of net stocks for detailed categories of structures enable statisticians to produce estimates of values for detailed categories of land, assuming the underlying PIM assumptions are reliable. Some (such as Finland, Germany and the UK) report assumptions that vary by detailed categories of types of assets or industries. Others (such as Chile, Mexico, Portugal, Slovakia, or Slovenia) report assumptions for the PIM for a few broadly defined asset types (such as one assumption for all buildings that are not dwellings).

Geometric depreciation

6.202. Geometric depreciation is the second most commonly reported functional form. Austria, Canada, Estonia (for dwellings), Iceland, Japan, Lithuania (for dwellings and roads), Norway, Sweden, and the United States use geometric depreciation rates in their PIM estimates. Measuring Capital recommends the use of geometric depreciation; ESA 2010 recommends straight-line or geometric depreciation. Respondents did not report separate retirement distributions with geometric depreciation; this convex pattern is already broadly consistent with the pattern of attrition produced by a number of retirement distributions.

6.203. Across countries that choose geometric depreciation pattern, the assumed annual depreciation rates vary even for very similar assets (Table 6.21). In the case of dwellings, for example, annual depreciation rates range from a low of 0.011 for the USA and Sweden (which borrows the USA's assumptions) to a high of 0.055 for wooden dwellings in Japan; other countries tend to use depreciation rates that range from 0.02 and 0.03. Across countries that choose geometric depreciation patterns, the annual depreciation rates range from 0.018 to 0.081 for schools. Other assets display similar ranges of depreciation rates.

6.204. These differences in depreciation rates can lead to substantial differences in the proportion of a cohort of an asset that remains in the stock over time, especially for long-lived assets such as structures. After 25 years, for example, the percentage of the original value of a dwelling that is left ranges from 75 % in the United States to 30 % in Japan (for non-wooden and wooden dwellings combined). After 50 years, the percentage of the original value of a dwelling that is left ranges from 56 % in the United States to 9 % in Japan (for non-wooden and wooden dwellings combined). Even small differences in assumed annual depreciation rates can lead to substantial differences in estimates of the value of land, estimated through the residual method.

([53]) For Israel, see footnote 50.

([54]) Schmalwasser, Oda and Michael Schidlowski, 'Kapitalstockrechnung in Deutschland', June 2006. Available at https://www.destatis.de/DE/Publikationen/WirtschaftStatistik/VGR/Kapitalstockrechnung.pdf?__blob=publicationFile. Slightly abridged version in English available at https://www.destatis.de/EN/Publications/Specialized/Nationalaccounts/MeasuringCapitalStockWista1106.pdf?__blob=publicationFile

Table 6.21: Depreciation rate assumptions for countries using geometric depreciation for estimates of net stocks of structures
(%)

	One-unit dwellings	Manufacturing buildings	Retail buildings	Hospitals	Schools	Roads
Austria	0.020	0.024-0.030	0.024	0.020	0.020	0.030
Canada	0.020	0.072	0.091	0.061	0.055	0.106
Estonia (¹)	0.020	:	:	:	:	:
Iceland	0.025	0.040	0.025	0.025	0.025	0.030
Japan (wooden)	0.055	0.081	0.081	0.081	0.081	:
Japan (non-wooden	0.040	0.059	0.059	0.059	0.059	0.033
Lithuania (¹)	0.016	:	:	:	:	0.033
Norway	0.020	0.030	0.030	0.030	0.030	0.030
Sweden	0.011	0.031	0.026	0.019	0.018	0.020
USA	0.011	0.031	0.026	0.019	0.018	0.020

(¹) Lithuania uses linear depreciation for non-dwelling buildings; Estonia uses linear depreciation for non-dwellings

Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

Other patterns of depreciation and retirement

6.205. The Australian Bureau of Statistics (ABS) and the Bank of Korea employ hyperbolic age-efficiency profiles (55). The ABS combines the hyperbolic age-efficiency profile (which tends to be concave to the origin) with a bell-shaped Winfrey pattern of retirement. Specifically, ABS assumed a Winfrey S3 retirement pattern for all structures except major improvements in dwellings, which assume a Winfrey S0 retirement pattern. Together, the hyperbolic age-efficiency profile and the Winfrey retirement distribution imply a cohort age-price profile that resembles a geometric pattern of depreciation for structures, with average service lives varying by type of asset (Table 6.22). The Bank of Korea employs a hyperbolic age-efficiency function with a Winfrey R3 retirement distribution. The age-price profile is based on these assumptions (56).

6.206. Other respondents report a variety of assumptions. Statistics Netherlands (57) uses hyperbolic age-efficiency profiles with a Weibull retirement distribution to describe the decline in the value of an asset cohort over time. The form of the Weibull distribution used assumes that the

Table 6.22: Service life assumptions for countries using other depreciation patterns for estimates of net stocks of structures
(years)

	One-unit dwellings	Manufacturing buildings	Retail buildings	Hospitals	Schools	Roads	Assumed age-efficiency and retirement patterns
Australia	88	38	50	50	50	33	Hyperbolic age-efficiency profiles, S-3 Winfrey retirement pattern
Cyprus	75	60	75	75	75	55	Lognormal retirement pattern
Korea	55	47	50	55	55	60	Hyperbolic age-efficiency profiles, Winfrey R-3 retirement pattern
Netherlands	75	27–46	27–46	27–46	27–46	25–55	Hyperbolic age-efficiency profiles, Weibull retirement distributions

Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

(55) The hyperbolic age-efficiency function (Measuring Capital, Chapter 11) can be represented by gn(T) where n is the asset's age (0 to T). Because the efficiency of a new asset has been set to equal one, every gn(T) represents the relative efficiency of an asset of age n compared to a new asset. $G_n = (T - n)/(T - b * n)$, with $0 < b < 1$. For structures, b is set to 0.75 for both Korean and Australian estimates, implying a concave age-efficiency pattern.

(56) The service lives of buildings increase after 1980 because of improvements in the quality of new construction over time. The Korean accounts also analysed the relationship between a structure's age and its service life based on data on all buildings registered in the Architectural Information System (AIS). For a reference, see Cho, Taehyoung, Byungchang YI and Kyeongtak Do, 'Measuring service lives of assets in Korean capital measurement', 2012.

(57) Bergen, Dirk van den, Mark de Haan, Ron de Heij, and Myriam Horsten. 'Measuring Capital in the Netherlands'; 2009. Available at http://www.cbs.nl/NR/rdonlyres/FAECCC9A-75E0-4545-9C2C-E42E44371DE4/0/200936x10pub.pdf

probability of retirement rises over time [58]. Cyprus [59] employs a lognormal retirement distribution.

Comparing depreciation patterns across countries

6.207. Because there is no single best set of assumptions for estimating net stocks of structures, national accountants may take a more practical approach, and may simply want to know whether their chosen depreciation patterns are roughly comparable with the patterns chosen by national accountants in other countries with roughly comparable types of structures. Based on the tables of service lives and depreciation rates and the descriptions of different depreciation and retirement patterns, however, it is not easy to compare and contrast the different assumptions for the PIM across countries.

6.208. One way to facilitate these cross-national comparisons of depreciation patterns is to calculate, for specific types of assets such as dwellings, the proportion of an initial cohort of assets that remains in the stock after a specific number of years. The calculations for each country should be based on each country's assumed functional forms and parameters for depreciation and retirement. This information would enable one to assess whether their assumptions produce unusually fast or slow rates of depreciation. Some examples of these calculations are shown in the following graphs. In some cases, these calculations are approximations based on the information provided by the survey respondents. They are intended to be broadly illustrative of the variation in depreciation and retirement patterns across countries that use the PIM.

6.209. The results indicate that the proportion of the initial investment left in the stock after 25, 50 and 75 years varies widely. One important lesson from these results is that countries that employ similar patterns of depreciation (linear or geometric) and retirement often display very different age-price profiles. After 25 years, for example, the proportion of an initial investment remaining in the stock of dwellings varies noticeably across countries that employ linear depreciation. Among countries that use geometric depreciation (such as Canada, Japan and the United States), the proportion of the stock of dwellings that remains after 25 years also varies considerably. After 25 years, the countries that show a similar amount of value for dwellings remaining in the stock (50–60 %) employ a range of different depreciation and retirement patterns. The conclusions are similar when one examines the proportion of the stock of dwellings remaining after 50 and 75 years and also the results for manufacturing buildings, hospitals, schools, and roads. These results all suggest that national accountants interested in comparing depreciation and retirement patterns across countries should examine these comparative calculations in addition to assumptions about service lives or the functional form of retirement and depreciation.

6.210. The percentages of stock remaining after a certain year are calculated for the aggregated categories. To ensure international comparability of the chart, Japan has calibrated, among the investments in dwellings, manufacturing buildings, or schools as of the year 2012, how much the remaining values would be, taking into account the variation in depreciation rates depending on the buildings being wooden or non-wooden. It should be noted that in Japan's national accounts they do not assume any variety in the depreciation rates according to the usage of the buildings (other than whether it is for residential or non-residential).

6.211. In other words, Figures 6.7 to 6.10 of the guide have been calibrated using more refined estimates received from Japan than the depreciation rates shown in Table 6.21. The difference is that the depreciation shown in Table 6.21 of, say, 'roads' is 'average' of the depreciations of several assets consisting of roads, the more accurate information is based on more detailed information on depreciation rates.

6.212. The two-letter ISO codes are used as the country abbreviations for Figures 6.7 to 6.10: Australia (AU), Austria (AT), Belgium (BE), Canada (CA), Chile (CL), Cyprus (CY) [60], Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Hungary (HU), Iceland (IS), Israel (IL) [61], Italy (IT), Japan (JP), Korea (KR), Latvia (LV), Lithuania (LT), Malta (MT), Mexico (MX), Netherlands (NL), Norway (NO), Portugal (PT), Slovakia (SK), Slovenia (SI), Sweden (SE), United Kingdom (UK), United States (US).

[58] The Weibull frequency function (Measuring Capital, Chapter 13) is written as: $F_T = \alpha\lambda (\lambda T)^{\alpha-1} e^{-(\lambda T)\alpha}$ where T is the age of the asset, $\alpha>0$ is the shape parameter (which measure of changes in the risk of an asset being discarded over time) and $\lambda > 0$ is the scale parameter of the distribution. Specifically, $0 < \alpha < 1$ indicates that the risk of discard decreases over time; $\alpha = 1$ indicates that the risk of discard remains constant; $1 < \alpha < 2$ indicates that the risk of discard increases with age but at a decreasing rate; $\alpha > 2$ indicates a progressively increasing risk of discard. For dwellings, α=2.5; for other buildings: α=1.01–2.2; for other structures and improvements: α=1.5.

[59] For Cyprus, see footnotes 48 and 49.

[60] For Cyprus, see footnotes 48 and 49.

[61] For Israel, see footnote 50.

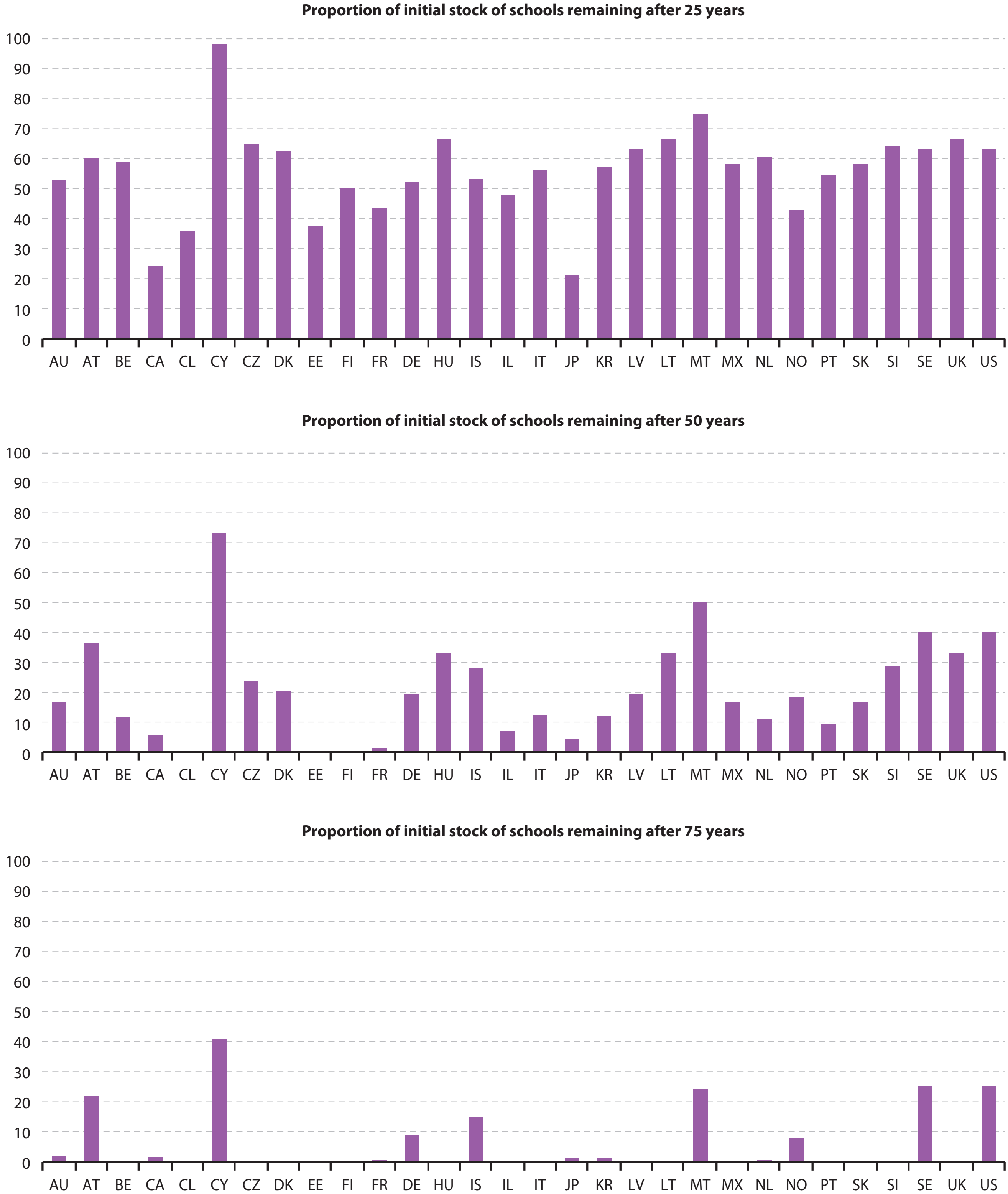
Figure 6.7: Proportion of initial stock of dwellings remaining after 25, 50 and 75 years
(% of stock of dwellings)

Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

Figure 6.8: Proportion of initial stock of manufacturing buildings remaining after 25, 50 and 75 years
(% of stock of manufacturing buildings)

Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

Figure 6.9: Proportion of initial stock of schools remaining after 25, 50 and 75 years
(% of stock of schools)



Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

Figure 6.10: Proportion of initial stock of roads remaining after 25, 50 and 75 years
(% of stock of roads)

Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

Sources of information for the assumptions of the PIM

6.213. To estimate service lives and patterns of depreciation and retirement, respondents relied on several sources of information, including tax authorities, company accounts, administrative property records, expert advice, econometric studies, other countries' estimates, and statistical surveys. It is difficult to compare the reliability of these sources of information. Some of the notable statistical surveys and studies are briefly summarised below (and see the case study for the United States).

6.214. Japan's Capital Expenditure and Disposal survey, conducted annually since 2005, collects observations on the disposal of assets by private corporations. The survey provides detailed information on disposed assets, the time of acquisition, the acquisition value, whether the asset is sold for continued use or for scrap, and its sales value. Nomura and Momose (2008) ([62]) estimated ratios between disposal and acquisition prices (adjusted for inflation and other factors) to estimate geometric age-price profiles. Japan also conducted National Wealth Surveys in 1970, and these surveys provide benchmark service lives for capital stocks owned by corporations, government and households.

6.215. Statistics Canada's annual Capital and Repair Expenditures Survey, conducted annually since the 1980s, collects data on the service lives and prices of used assets that are sold, the original cost of these assets, and companies' expected service life of assets. A recent study used these data to estimate age-price profiles and compared these estimated depreciation patterns with expected service lives reported by companies. The estimated age-price profiles and the expected service lives were generally similar to one another and similar to previous results. Note that the depreciation rates from Canada and Japan (which are based on annual surveys) often differ substantially from the depreciation rates from the USA (which are based on numerous occasional studies of used asset markets.) ([63])

6.216. For Korea, the service life for dwellings is estimated based on several versions of the Housing Census, which provide data on how many dwellings had been built in each previous year and how many had survived. The average life is set to equal the age at the point of time when half of the houses newly-built at a certain year in the past are retired. The estimates of service lives for non-residential buildings are based on the estimates for residential buildings and also a survey ([64]).

6.217. For France, most assumptions about the service lives of non-residential assets were set in 1996 based on a review of other countries' assumptions, business surveys that collected data on the age of assets, and a review of stocks and flows of capital reported in companies' balance sheets. These data were used to estimate retirement patterns ([65]). For dwellings, estimates of the stock of housing from the National Housing Survey, conducted about every five years, have been used to refine the PIM estimates.

6.218. Other countries have also conducted notable surveys or studies of capital stocks. The Netherlands has conducted surveys of discards (second-hand use and scrap) for manufacturing firms annually since 1991. For Germany, the service lives of buildings and structures, in particular residential buildings, commercial buildings and public buildings, were extracted from the long-term property accounts ([66]). Other countries, including Spain, Lithuania, and Slovenia, have also conducted surveys of fixed assets.

6.219. These surveys and associated studies (see the case study for the United States) provide very useful information about depreciation and retirement patterns and can be more reliable than depreciation patterns based on tax records, which often reflect changes in tax policy rather than true economic depreciation. The survey based results have some limitations. Sold assets may not be representative of all assets, and do not include those that have already been scrapped. For second-hand assets, survey respondents may provide an age of the asset under its current ownership and not the full age of the asset. Survey results may also be less applicable for other countries with assets that have dissimilar physical characteristics or face different conditions.

Transfer of ownership costs and improvements to structures

6.220. Costs of ownership transfer consist of costs required to take ownership of an asset and include taxes and fees paid to brokers, surveyors, engineers, and so on. SNA 2008 recommends depreciating costs of ownership transfer over the period the asset is expected to be held by the purchaser; when data are insufficient for this treatment, SNA 2008 recommends depreciating costs of ownership transfer in the year of acquisition.

([62]) *Measurement of Depreciation Rates Based on Disposal Asset Data In Japan* (OECD, 2008).

([63]) See Baldwin, John, Huju Liu, and Marc Tanguay *An Update on Depreciation Rates for the Canadian Productivity Accounts*, January 2015. Available at http://www.statcan.gc.ca/daily-quotidien/150126/dq150126d-eng.htm

([64]) For Korea, see footnote 56.

([65]) For an earlier reference, see Atkinson, Margaret and Jacques Mairesse, *Length of life of equipment in French manufacturing industries*, 1978.

([66]) See footnote 54.

6.221. Because the period of ownership is typically shorter than the service life of the structure, and because the price deflator for these costs often differs from the price deflator for the structure, the costs of ownership transfer are often measured as a separate asset category and depreciated faster than the structure. Among the countries that follow this practice, the service lives of costs of ownership transfer range from one year (UK) to 10 years (Norway), 12 years (USA), 17 years (Korea), 18 years (Australia), 17–30 years (Denmark), 20 years (Netherlands), 25 years (Finland), and 34 years (Italy). Some countries lack separate data sources for these costs and estimate them as a proportion of GFCF (Czech Republic, Netherlands and Hungary). Other countries either do not measure costs of ownership transfer or include them as part of total GFCF. The depreciation of these costs at the same rate as the structure may lead to an upward bias in the estimated stock of structures.

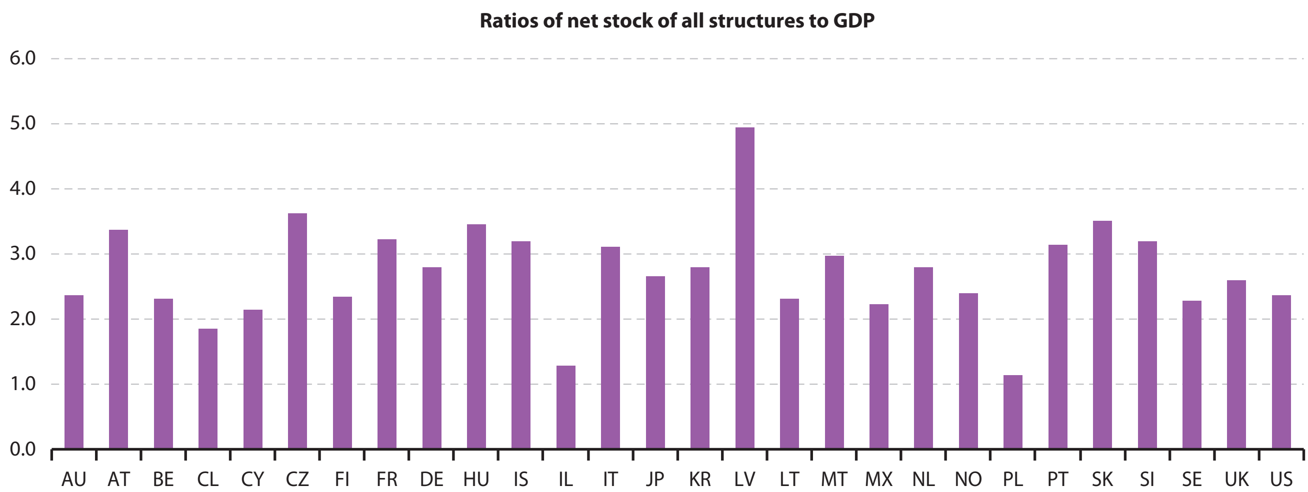
6.222. The SNA 2008 and ESA 2010 both recommend treating major improvements and renovations to structures as GFCF and depreciating them. Several countries report measuring improvements as part of GFCF and/or depreciating improvements separately (Austria, Australia, Belgium, Canada, Estonia, Finland, Germany, Hungary, Iceland, Israel ([67]), Italy, Latvia, Lithuania, Malta, Portugal, Sweden, UK and the USA). As expected, the service lives and depreciation functions vary across these countries.

Net stocks of structures relative to GDP

6.223. Still another way to compare the estimates of net stocks of structures is to compare ratios of net stocks of structures to GDP. These comparisons are difficult to interpret: they may reveal countries with measurement problems or unrealistic PIM assumptions, or they may simply reveal true variation in trends in investment or depreciation over time. As the figure shows, the ratios of net stocks of all structures to GDP for 2012 average about 2.7 among survey respondents providing this information. Some countries, such as Austria, Czech Republic, France, Hungary, Iceland, Italy, Latvia, Portugal, Slovakia and Slovenia have ratios above 3; Israel ([68]) and Poland (which does not use a PIM) have ratios below 1.3. Ratios of net stocks of dwellings to GDP average close to 1.2 among respondents, with Austria, France, Germany, Iceland, Italy, Malta, the Netherlands, Portugal, Slovenia, and the UK reporting ratios of 1.4 or more, while Chile, Japan, Lithuania, and Poland report ratios below 0.8. The ratios of net stocks of other buildings and structures to GDP also vary noticeably across countries.

6.224. The two-letter ISO codes are used as the country abbreviations for Figure 6.11: Australia (AU), Austria (AT), Belgium (BE), Chile (CL), Cyprus (CY) ([69]), Czech Republic (CZ), Finland (FI), France (FR), Germany (DE), Hungary (HU), Iceland (IS), Israel (IL) ([70]), Italy (IT), Japan (JP), Korea (KR), Latvia (LV), Lithuania (LT), Malta (MT), Mexico (MX), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Slovakia (SK), Slovenia (SI), Sweden (SE), United Kingdom (UK), United States (US).

Figure 6.11: Ratios of net stocks of all structures, dwellings, and other buildings and structures to GDP, 2012

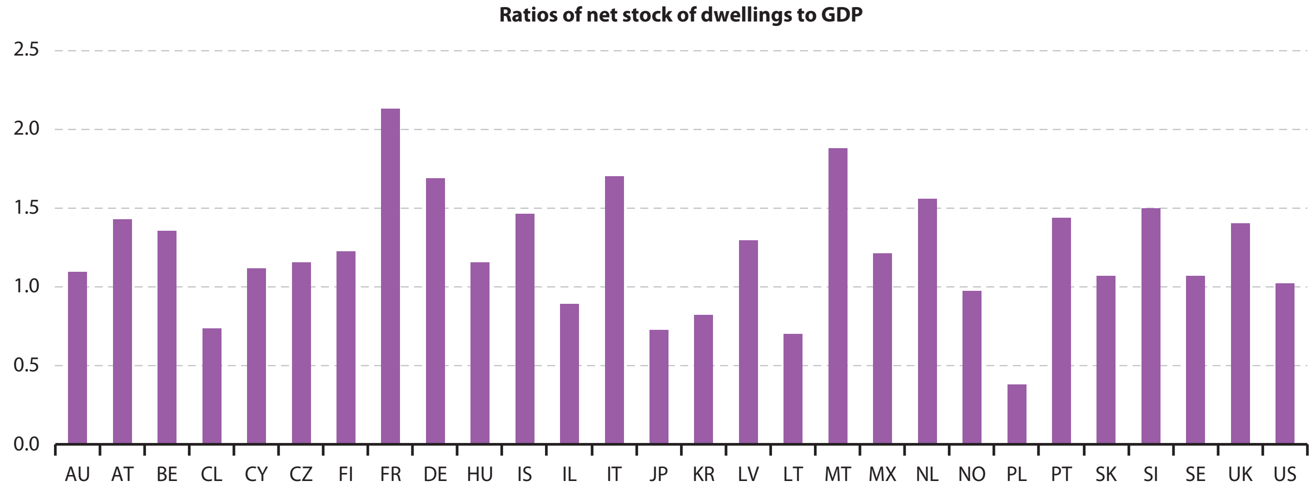


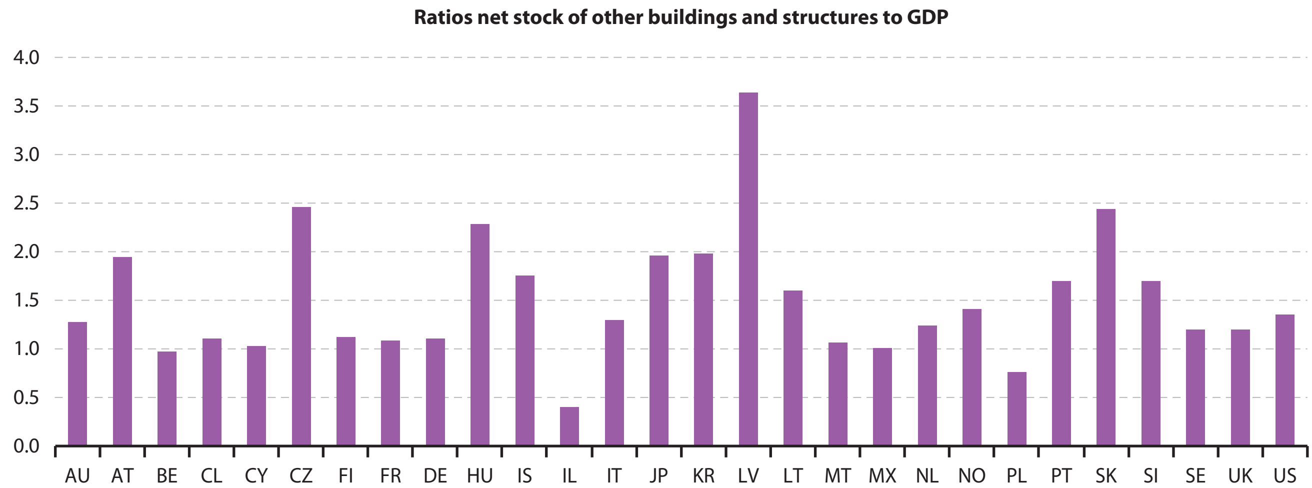
([67]) For Israel, see footnote 50.

([68]) For Israel, see footnote 50.

([69]) For Cyprus, see footnotes 48 and 49.

([70]) For Israel, see footnote 50.





Source: TF on Land and other non-financial assets, based on OECD-Eurostat survey of national practices in estimating service lives, depreciation, net stocks

Government owned land

6.225. Chapter 8.3 notes the importance of estimates of government owned land. The survey finds that only a few countries report producing measures of the stock of government-owned land, through the residual approach or any other way. The countries that report estimates of government-owned land are Australia, the Netherlands (although not land under roads), Czech Republic, Japan, Italy (for land under dwellings and buildings, by applying LSRs), Korea (for all government-owned land) and Romania (for agricultural land). Several countries report PIM assumptions for net stocks of typical government-owned assets (roads, bridges, airports, waterways, and so on) but these estimates are usually not used to estimate underlying stocks of land.

Major concerns and plans for the future

6.226. Respondents were generally confident about the quality of their estimates but also expressed a range of concerns. The major concerns include the reliability of assumptions of service lives and depreciation; the quality of GFCF data and price deflators (especially for earlier decades); price indices that do not adequately capture quality and productivity gains; inadequate measurement of costs of ownership transfer, improvements, or second-hand sales; measures of GFCF that are on net terms (acquisitions less disposals) instead of separately identifying new investment; and inaccurate estimates of stocks of land through the residual or ratio approaches.

6.227. The most common plans for improving estimates in the future include the implementation of the provisions of SNA 2008 and ESA 2010 along with research to improve the estimates of nonfinancial assets for national balance sheets. Many expressed an interest in improving estimates of the total value of land and structures, improving estimates of land through the residual approach, improving assumptions about service lives and depreciation, and improving price measures.

Conclusions

6.228. As the survey results indicate, national accounts across countries vary — sometimes considerably — in their assumptions and sources of information for estimates of net stocks based on a PIM. Different assumptions for the PIM can, in turn, lead to different estimates of land values obtained through the residual or LSR approach. These assumptions may vary across countries with similar 'true' patterns of depreciation because of measurement errors. Even without measurement error, differences in assumptions across countries may also correctly reflect real differences in factors that affect depreciation (the physical nature of structures, building materials, maintenance, climate, variation in the use of structures, etc.). Thus, disparities in estimates of land values across countries can be difficult to interpret. As this chapter notes, one way to facilitate comparisons of approaches across countries with different functional forms of depreciation and retirement is to compute the proportion of a cohort of assets left after a number of years, using each country's assumptions for the PIM.

6.229. Despite the uncertainties in estimating net stocks of structures through the PIM, the PIM and the residual and ratio approaches for estimating stocks of land still have many advantages. For many countries, these indirect approaches may be the only credible approach for estimating stocks of land underlying structures. The residual approach gives countries a useful credibility check for estimates of the combined value of structures and land and estimates of net stocks and depreciation, which are needed for national income accounting. The presence of negative or unrealistic estimates of land values can indicate problems in one or both of these estimates. Balance sheets could arguably rely solely on estimates of the combined value of structures and land (through real estate data, for example), but these estimates alone provide an incomplete picture. The residual approach can help countries assess whether increases in the total value of land and structures arises mainly from land or from structures. Assuming bubbles are most likely to appear as increases in land values under the residual approach, year-to-year changes in the residual estimates of land values may be useful in identifying bubbles.

6.230. The results of the survey will hopefully lead to sharing of information across countries and useful discussions about how best to produce reasonable, internationally comparable estimates of net stocks of structures. A more detailed presentation of the responses to the survey is presented in a separate report 'Eurostat-OECD survey of national practices in estimating net stocks of structures'.

Case study depreciation estimates: United States

The US Bureau of Economic Analysis (BEA) bases its depreciation patterns on empirical evidence of used asset prices in resale markets wherever possible ([71]). For most asset types, including all structures, geometric patterns are used because the available data suggest that they more closely approximate actual profiles of price declines than straight-line patterns. The geometric rates for several types of fixed assets are determined by dividing the appropriate declining-balance rate for each asset by the asset's assumed service life. BEA's depreciation rates for structures are not regularly updated; most are based on several detailed studies conducted several years ago.

The declining-balance rates for structures used by BEA are primarily derived by Fraumeni from estimates made by Hulten and Wykoff under the auspices of the U.S. Department of the Treasury (1979–1981) ([72]). For some structures, extensive data were available for estimating geometric rates of depreciation: office buildings, medical buildings, commercial warehouses, other commercial buildings, multi-merchandise shopping, food and beverage establishments, mobile offices, and manufacturing buildings. For some other buildings (hospitals, special care, lodging, and amusement and recreational buildings), more limited data were available, and the depreciation rates are based on judgment and the results of empirical research ([73]).

Depreciation rates for other structures are based on several studies. For communication, electric light and power, gas, and petroleum pipeline structures, the service lives are derived by comparing book value data provided by regulatory agencies with various perpetual inventory estimates calculated using alternative service lives. The depreciation rate for wind and solar was calculated by BEA based on industry trade data. For petroleum and natural gas exploration, shafts, and wells, the lives are based on data from the Census Bureau's annual surveys of oil and gas for 1979–1982. For farm structures, the average service life is derived from U.S. Department of Agriculture studies. For other types of non-farm structures, service lives are based on published and unpublished data from studies conducted during the

([71]) This information is primarily taken from these BEA documents: 1) BEA Depreciation Estimates, 2) *Barbara M. Fraumeni, The Measurement of Depreciation in the U.S. National Income and Product Accounts*, July 1997, pp. 7–23, 3) *Fixed Assets and Consumer Durable Goods in the United States 1925–97,.September 2003: M-29–M-33.*

([72]) The information on Hulten-Wykoff methodology is taken from three sources: 1) Hulten, Charles R., and Frank C. Wykoff, *The Estimation of Economic Depreciation Using Vintage Asset Prices*, April 1981, pp. 367–396. 2) Hulten, Charles R., and Frank C. Wykoff, *The Measurement of Economic Depreciation*, 1981, pp. 81–125. 3) Wykoff, Frank C., and Charles R. Hulten, *Tax and Economic Depreciation of Machinery and Equipment: A Theoretical and Empirical Appraisal, Phase II Report, Economic Depreciation of the U.S. Capital Stock: A First Step*, July 26 1979.

([73]) This research was conducted by BEA, Dale Jorgenson, the Bureau of Labor Statistics, and Jack Faucett Associates. See for details Fraumeni, Barbara M. *The Measurement of Depreciation in the U.S. National Income and Product Accounts*, July 1997, pp. 7–23. Available at http://www.bea.gov/scb/pdf/national/niparel/1997/0797fr.pdf

1960s and 1970s by the U.S. Department of the Treasury ([74]), as well as rates for other, roughly similar assets.

The average service lives for most types of new residential structures are taken from a 1963 study ([75]). Improvements to residential structures are assigned the following lives: additions and alterations are assumed to have lives one-half as long as those for new structures; and lives for residential major replacements are based on industry estimates for items replaced during the 1970s. Manufactured homes are assigned a life of 20 years, based on trade association data. Residential costs of ownership transfer are depreciated based on the typical period of ownership (12 years).

The depreciation rates for government structures are based as much as possible on information for similar private assets. The service life for highways is set at 60 years, based on studies conducted at BEA in 1999 ([76]).

The US statistical system can produce estimates of the value of structures and the underlying land using the residual method, but BEA does not recommend this approach because of concerns about measurement problems.

Table 6.23: BEA rates of depreciation for structures
(%)

Type of asset	Rate of depreciation
Private non-residential structures	
Office buildings	0,0247
Medical buildings	0,0247
Commercial warehouses	0,0222
Other commercial buildings	0,0262
Multimerchandise shopping	0,0262
Food and beverage establishments	0,0262
Mobile offices	0,0556
Hospitals	0,0188
Special care	0,0188
Manufacturing	0,0314
Electric light and power :	
Years before 1946	0,0237
1946 and later years	0,0211
Gas	0,0237
Petroleum pipelines	0,0237
Wind and solar	0,0303
Communication	0,0237
Railroad replacement track	0,0249
Other railroad structures	0,0176
Mining exploration, shafts, and wells:	
Petroleum and natural gas :	
Years before 1973	0,0563
1973 and later years	0,0751
Other	0,0450
Religious buildings	0,0188
Educational buildings	0,0188
Lodging	0,0281
Amusement and recreational buildings	0,0300
Farm	0,0239
Local transit	0,0237
Air transportation	0,0237
Other transportation	0,0237
Other land transportation	0,0237
Water supply	0,0225
Sewage and waste disposal	0,0225
Public safety	0,0237
Highway and conservation and development	0,0225
Residential capital (private and government)	
1-to-4-unit structures-new	0,0114
1-to-4-unit structures-additions and alterations	0,0227
1-to-4-unit structures-major replacements	0,0364
5-or-more-unit structures-new	0,0140
5-or-more-unit structures-additions and alterations	0,0284
5-or-more-unit structures-major replacements	0,0455
Brokers' commissions and other costs of ownership transfer	0,1375
Manufactured homes	0,0455
Other structures	0,0227
Government nonresidential structures	
Buildings:	
Industrial	0,0285
Educational	0,0182
Hospital	0,0182
Other	0,0182
Nonbuildings:	
Highways and streets	0,0202
Military facilities	0,0182
Other	0,0152

Source: US Bureau of Economic Analysis

([74]) U.S. Department of the Treasury, Office of Industrial Economics, *Business Building Statistics*, U.S. Government Printing Office, Washington DC, August 1975.

([75]) Raymond W. Goldsmith and Robert Lipsey for the National Bureau of Economic Research, 1963.

([76]) Barbara M. Fraumeni, *Productive Highway Capital Stock Measures*, January 1999.

7

Sectorisation and cross-classification

Introduction

7.1. Previous chapters have examined general principles and approaches to estimate the value of land. As discussed in Chapter 1, the coverage of national balance sheets by institutional sectors is of particular interest for economic policy analysis. There may also be a need to provide a further breakdown of the total value (e.g. by types of land, industries). This chapter looks at producing estimates for different sectors of the economy as well as for different types of land and industry.

7.2. It is not currently straight-forward to obtain estimates by institutional sector and cross-classification of land. This chapter discusses their relevance as well as the challenges faced in obtaining these estimates. It also provides suggested approaches to producing such estimates. These estimates can be produced either by starting at the top and breaking down the data into more detail or by producing data at the bottom level and aggregating up to the total.

7.3. This chapter starts by considering the definitions of sectorisation and cross-classification and why such estimates are needed. It then considers how to extend each of the previously considered methods for estimating the value of land to provide estimates by sector and cross-classification. The chapter continues by discussing challenges faced by estimating at this level of detail before ending with a case study from the Netherlands.

Definitions

7.4. Sectorisation refers to the production of estimates for institutional sectors of the economy as shown in Table 7.1 below.

Table 7.1: Sectors of the economy

Code	Sector
S.1	Total economy
S.11	Non-financial corporations
S.12	Financial corporations
S.13	General government
S.14	Households
S.15	Non-profit institutions serving households (NPISH)

Source: ESA 2010

7.5. Cross-classification refers to a breakdown of land by sector that is further subdivided into land by type and/or by industry. It is the way that either the classification of land (as discussed in Chapter 3) or the classification of industries is divided up across the institutional sectors mentioned above.

7.6. Table 7.2 below shows the cross-classification of land by sector and type of land. It shows an imaginary country with a value of 100 billion for land in the economy, which is broken down into the institutional sectors and by type of land.

Table 7.2: The cross-classification of land by sector

	S.1	S.11	S.12	S.13	S.14	S.15
Total land (AN.211)	100	40	3	15	37	5
Land underlying buildings and structures (AN.2111)	80	30	3	11	32	4
Land under cultivation (AN.2112)	15	10	0	0	5	0
Recreational land and associated surface water (AN.2113)	4	0	0	3	0	1
Other land and associated surface water (AN.2119)	1	0	0	1	0	0

Source: TF on Land and other non-financial assets, fictitious data

7.7. Table 7.3 shows the cross-classification of land by industry and by institutional sector. It uses the same imaginary country as in Table 7.2 above, although this time the rows have been changed from land types to industries.

Table 7.3: Cross-classification of land by industry and by sector

	S.1	S.11	S.12	S.13	S.14	S.15
Total industry	100	40	3	15	37	5
Other production	20	12	0	0	8	0
Manufacturing	10	10	0	0	0	0
Construction	5	5	0	0	0	0
Services	65	13	3	15	29	5

Source: TF on Land and other non-financial assets, fictitious data

Why are sectorisation and cross-classification important?

7.8. At the centre of the national accounting framework is the production concept and the way in which labour, capital and natural resources, including land, define economic activity. This involves both benefits to economic agents and the risk associated with the link between the three main economic activities within the national accounting scope: production, consumption and accumulation.

7.9. The behaviour of economic agents is driven, to a large extent, by the actual and potential benefits arising from ownership of assets and liabilities as well as the associated risk dynamics. The national accounting framework recognises this by showing the various types of accounts — production, consumption and accumulation at institutional sector and/or industry level. Therefore, ensuring a complete coverage of assets and liabilities at sector level is essential for a representative picture of economic activity and risk allocation within a country's boundaries.

7.10. Among non-financial assets, land stands as an important factor of production and a store of wealth; it is therefore an integral part of a complete sectoral balance sheet. For many institutional sectors, real estate, and thus land, represents a significant proportion of their non-financial assets, an additional argument for a sectoral distribution of the value of land within an economy. A true measure of wealth and net worth at sector level cannot be obtained by excluding the value of land.

7.11. In addition to the productive potential derived from its legal and/or economic ownership rights, land as an asset presents a unique set of risks for its owner(s). This is because a significant number of real estate transactions are intermediated by debt in the form of mortgage loans. This argument carries particular weight for the households sector, given that, in most countries, households own a large amount of real estate, and therefore land, some of which is financed through debt.

7.12. The financial situation of the households sector is a major consideration for financial stability, monetary, and fiscal policies as mentioned in Chapter 9 on real estate wealth. The value and price dynamics associated with households' holdings of real estate, particularly as they relate to the associated mortgage debt contain important analytical information. This has been highlighted by the post-2008 events in the United States, as well as other countries, where sudden downturns in real estate markets have set off chain reactions with significant economic and financial costs that, in many cases, have lingered for many years. Therefore, the significance of having a value of land allocated to the households sector cannot be overstated, as it is generally accepted that real estate market fluctuations are closely associated with the land component of residential properties; the value of dwellings being mostly driven by input (construction costs) inflation.

7.13. The value of land in the households sector is also important because for some countries it may be used to impute values to the production of households that are owner-occupiers. If the user cost approach is used it is best to compute user costs for dwellings and user costs for the land underlying the dwellings ([77]).

7.14. As discussed in Chapter 1, the sectoral breakdown of land is included, among other balance sheet items, in Table 26 of the ESA 2010 data transmission programme. The allocation of land to households and non-profit institutions serving households will be a mandatory item from 2017, whilst the other sectors will remain voluntary.

7.15. Another argument for sectoral allocation of land relates to the government sector's holdings and a more accurate measure of government net worth.

7.16. The sectoral allocation of land is important not only for providing a more accurate economic and financial picture of each sector in the economy, but may also be relevant for valuation purposes, depending on the methodology being used. For example, residential land that is owned by the government, which often is used for providing subsidised housing, will generally tend to be of lower value compared to residential land owned by households.

7.17. Whilst cross-classification of land is not required for mandatory data returns, it is still useful for more detailed analysis. For example an additional breakdown for industries is helpful when looking at productivity analysis.

Methods of estimating the value of land by sector or cross-classification

7.18. This section looks at the different methods which are covered earlier in this compilation guide and shows how to extend them to sectorise and cross-classify.

7.19. One of the most important factors in determining a method and the sectorisation/cross-classification method is the availability of data sources for both sectors and by

([77]) Organisation for Economic Co-operation and Development, *Measuring Capital: OECD Manual*, Second edition, 2009, Chapter 18, p. 159. Available at http://www.oecd.org/std/productivity-stats/43734711.pdf type of land and/or industry. In practice, due to limited data or resources, it may not be possible to use only one of these methods. In this case, combining different methods may be applicable.

7.20. For example, when sectorising land, a country may be able to use the direct method for government land as there are detailed administrative records. For the rest of the sectors in the economy they may use the residual approach if data on total real estate value (the combined value of the structure and the land) are available at the sector level.

7.21. The availability of data sources will also dictate whether a top-down or a bottom-up approach is possible for producing estimates. A top down approach may start with a high level figure for the total economy by asset and then break that down into sectors, land types or industries using a proxy indicator.

7.22. The bottom-up approach would instead estimate data at the bottom level, for instance producing estimates for all combinations of land by asset, sector and industry, and then aggregating up these values to the total economy level.

7.23. The bottom-up approach is preferred as it uses detailed data from existing data sources which as a result gives a higher level of accuracy in the resulting estimates. Another benefit of the bottom-up approach is that it may provide better links between national accounts land estimates and outputs from other areas, particularly environmental and social statistics. These areas might require the partitioning of land that cuts across the institutional sectors or land use classification.

7.24. If detailed data are not available or its quality is not sufficient then a top down approach can be considered. The accuracy of resulting estimates in this case will depend on the validity of assumptions underlying the choice of proxy indicators to distribute the total value to the required level of detail.

7.25. There is further discussion of the use of the bottom-up and top-down methods in the country case study at the end of this chapter.

7.26. When preparing a cross-classification, a combination of these approaches is even possible. For example when the type of land is available at bottom level, this can be aggregated up to the total value of land. Next, the total value of land could be allocated to industry based on a proxy to produce bottom level data by industry or even to produce data by type of industry further subdivided by type of land.

Direct method

Introduction

7.27. This section extends the description of the direct method covered in Chapter 5 to include sectorisation and cross-classification.

7.28. The direct method either takes the land area and multiplies it by the price (bottom-up approach) or it uses a proxy (e.g. land area) to break down the value of land at the total economy level (top-down approach). This method depends on a source of data for the value of land excluding any buildings or other structures built upon it.

Description of method and data requirements

7.29. This method can include additional variables, for example sectors or cross-classifications, by sub-dividing the source or proxy data. Once the source or proxy data has been allocated to the extra variable, for example by sector, the usual method, as described in Chapter 5, can be used to produce the value of land by sector.

7.30. Some countries already collect data on land by type of land. Where this is the case, the existing categories can be matched to the list in Chapter 3 on the classification of land.

7.31. The model requires the following variables:

— land area;
— land price;
— land type.

7.32. To extend the model, the following variables could be added:

— institutional sector;
— industry.

7.33. If land price data are not available, the total land value for the economy could be broken down using land area as a proxy. This top-down approach assumes that there are no large price variations across the categories. It is likely, however, that this assumption will not hold in all cases and this would result in an over- or underestimation of some sectors or land types.

Example

7.34. For countries with an existing land classification, Table 7.4 shows how this can be aggregated to make the classifications used in Chapter 3. In the case of orchards and pasture, they can be added up to make a value for agricultural land. In some cases, where an existing category fits into two or more land classification category, a proportion of the value of that land should be used for each of the categories. This is shown for building site land which has been split between land underlying dwellings and land underlying other buildings and structures.

7.35. Table 7.5 shows an example of how to sectorise using the direct method. For the bottom-up approach, once the land area and price for each sector has been collected, the land area is multiplied by the price to produce the value. For example, public corporations in the table below have a land area of 10 000 and a price of 9, making a land value of 90 000.

7.36. For the top-down approach, only the total value and the land area is known. The land area could then be used as a proxy to distribute the value of land across the institutional sectors. In this approach, public corporations have a land area of 10 000 which is 10 % of the total land area. Therefore, the value is estimated at 10 % of the total, which gives a land value of 100 000.

Table 7.4: Aggregating existing land types
(billion KRW)

Country land type	Value	Land classification type	Value
Orchard	1 400	Agricultural land	24 200
Pasture	22 800		
Warehouses	119 900	Land underlying other buildings and structures	1 160 400
Roads	588 400		
Schools	364 100		
Building site	220 000	Split 60 % dwellings and 40 % other buildings and structures	-
Dwellings	2 670 000	Land underlying dwellings	2 802 000

Source: Bank of Korea and TF on Land and other non-financial assets

Table 7.5: Sectorising land value using the direct method

Institutional sector	Bottom-up approach			Top-down approach		
	Land area (hectares)	Price (EUR)	Value (billion EUR)	Land area (hectares)	Price (EUR)	Value (billion EUR)
Total economy	100 000	10	1 000 000	100 000	:	1 000 000
Public corporations	10 000	9	90 000	10 000	:	100 000
Private non-financial corporations	6 000	12	72 000	6 000	:	60 000
Financial corporations	1 000	11	11 000	1 000	:	10 000
Central government	35 000	5	175 000	35 000	:	350 000
Local government	25 000	9	225 000	25 000	:	250 000
Households	20 000	20	400 000	20 000	:	200 000
Non-profit institutions serving households	3 000	9	27 000	3 000	:	30 000

Source: TF on Land and other non-financial assets

Other factors to consider

7.37. The value of the sectors may not add up to the value for the total economy if the source of the land and/or price data for sectors is different to the source for the whole economy. If this happens and no consistent source is available, the data should be constrained to make the data consistent.

7.38. In order to estimate the value of land by sector as well as possible, disaggregated data on type of land is vital. For instance, central government may own both land underlying non-residential buildings and agricultural land which will differ in price. If data about land type by owner is available, taking into account price differences will provide an improvement of land estimation.

Indirect methods — the residual approach

Introduction

7.39. The residual approach was described in Chapter 6.2. This section discusses aspects relevant to the sector allocation and cross-classification of land values under this approach.

Description of method and data requirements

7.40. To briefly summarise, the two main variables used in the residual approach are the total value of real estate (e.g. structures and underlying land) and the corresponding value of structures, where the last variable is usually derived using a perpetual inventory method (PIM) model. As discussed in Chapter 6.5, a few countries rely on administrative records or surveys of stocks rather than a PIM to estimate the stock of fixed assets. Therefore, the ability to derive satisfactory estimates of land value by sector and type of land depends largely on the sources of data available on which the estimation of the two main variables relies.

7.41. In most countries, the PIM-based value of structures is generally estimated with a high level of granularity — by sector and industry as well as by type of structure, namely for dwellings, and other buildings and structures. The use of the PIM, in spite of its shortcomings, is well established within the international national accounting community, and this provides for a consistent methodology where coherence among investment flows, consumption of fixed capital, and stock of assets is ensured. In countries where the regional dimension is relevant, the PIM has sufficient flexibility to accommodate this additional dimension. For countries that rely on administrative records or surveys of stocks the more granular data may also be available.

7.42. The second variable, the total value of real estate is more problematic, as it is often derived by a combination of methods and assumptions where ensuring consistency is challenging. Furthermore, the level of sectoral breakdown and type of property for which the total value is available, based on a given methodology, depends on source data available. Only by introducing a full mapping between the levels of detail in the derivation of the structure value on the one hand and the total real estate value on the other hand, can a complete sector allocation of land be achieved. This, in turn, requires additional derivations for the total real estate to complete the full mapping to structures detail.

Other factors to consider

7.43. Several observations can be made here, which although more visible at lower level of aggregation, are valid for the residual approach generally. A recognised challenge of this approach is the somewhat constrained ability to impose full consistency in the derivation of the two main variables. While the PIM-derived structures are built within the national accounts framework following national accounting relationships, the total value of real estate is often sourced from different data sources, often potentially subject to specific biases (e.g. taxation incentives), thus coherence with the national accounts framework is difficult in practice.

7.44. Finally, the residual approach, by extension, inherits all the weaknesses of the PIM approach, through the many simplifications and assumptions used. As noted, these issues are inherent to the residual approach; however, they become potentially more acute at lower levels of aggregations, where the scope for inter-sector and inter-property type offsets is more limited. In extreme cases, the resulting value of land is negative, a result which is economically impossible. In such cases, further analysis is warranted to investigate potential sources as well as to identify viable solutions that would ensure a reasonable residual value for land. For example, supplementing the analysis with information on land-to-structure ratios (LSRs), or using an alternative method to derive the total real estate value may yield useful analytical insights into whether adjustments may be needed in the PIM assumptions or the total real estate value in order to derive economically meaningful land values.

Indirect methods — the land-to-structure ratio approach

Introduction

7.45. The LSR approach was detailed in Chapter 6.3. This section discusses aspects relevant to the sector allocation and cross-classification of land values under this approach.

Description of method and data requirements

7.46. Similar to the residual approach discussed above, the LSR approach relies on the estimation of the value of structures as a starting point in the indirect derivation of land value. However, the second variable used is the LSR which in turn permits the calculation of land in the absence of a control total for the real estate value.

7.47. The derivation of the LSR is ideally done at sector level and by type of land/industry and structure, provided satisfactory sources of data exist. Assuming the LSR can be calculated with the same level of detail as the structures derived through the PIM approach, a complete sector allocation and cross-classification for the value of land can be achieved by simply mapping the two variables at any given level of aggregation. This is the bottom-up approach.

Other factors to consider

7.48. In practice, however, the derivation of the LSR has its share of limitations, as it is often based on samples. In such circumstances, the composition of the sample may not necessarily align fully with the full coverage assumed in the PIM — with respect to type of property and location, both very significant dimensions of the derivation of the value of land. Moreover, if a full mapping between the LSR and the structures detail cannot be obtained, an average LSR could be used, although any compositional differences will introduce a bias in the calculation of land at sector level and/or by type of land/industry. For sectors and/or property types where direct information to derive the LSR is not available, proxies could be built using data on existing LSRs and various qualitative and quantitative assumptions. This is the top-down approach.

7.49. As is the case with the residual approach, the LSR approach extrapolates the PIM shortcomings to the derivation of land, however, it does avoid the issue of negative land values since both the LSR ratio and the structure value are both positive. In essence the LSR approach does not control to a total real estate value whereas the residual approach constrains to the total.

Hedonic approach

Introduction

7.50. The hedonic approach was explained in Chapter 6.4. This section extends the description to include sectorisation and cross-classification.

7.51. The hedonic approach involves the use of regression models to estimate the price of land and buildings. This approach depends on a detailed data source of real estate properties and their characteristics (such as the number of square metres of land).

Description of method and data requirements

7.52. The existing method can include data by sector and for cross-classifications as required. As previously described in Chapter 6.4, additional models can be used for each subsample, namely for each sector, for each industry or for each land type. The introduction of sectors and cross-classifications will mean that further models and lower level data are required. This will increase the amount of time and effort needed to successfully use this method.

7.53. As described in Chapter 6.4, the expanded model requires the following variables:

— property price;
— square metres of land;
— square metres of buildings;
— building year of construction;
— average service life of buildings.

7.54. To extend the model, the following variables could be added:

— institutional sector;
— industry;
— land type.

Example

7.55. Table 7.6 expands the example of the seven real estate properties provided in Chapter 6.4 by adding an additional variable of 'sector' to break down the dataset into subsamples so that the regression model can be run separately. In this example the sectors are limited to S.11 non-financial corporations, and S.14 households. The principle can be applied in the same way for cross-classification by industry or land type.

Table 7.6: Source data required for sectorising using the hedonic approach

Property transaction	Sector	Property price (DKK)	Land (m^2)	Buildings (m^2)	Quality adjusted (m^2)	Year of construction
1	S.14	2 700 000	886	136	58	1969
2	S.11	3 200 000	843	143	74	1976
3	S.11	2 115 000	729	110	34	1960
4	S.14	3 600 000	761	162	73	1971
5	S.14	2 800 000	749	143	72	1975
6	S.11	3 050 000	791	143	72	1975
7	S.14	3 850 000	814	171	121	1990
	Total S.11	8 365 000	2 363	396	180	
	Total S.14	12 950 000	3 210	612	324	

Source: TF on Land and other non-financial assets

Other factors to consider

7.56. In adding extra detail about sector or industry, it is necessary to assume that the sector/industry of both the land and the building is the same. This may be true for most cases, although this assumption should be checked against industry or country-specific circumstances.

7.57. The average service life of buildings may differ between sectors/industries/land types. For example, the average life length of buildings in the households sector which is mainly dwellings may be different to that in the private non-financial corporations' sector, which would include a range of buildings such as factories, office blocks and warehouses.

Summary of approaches

7.58. On a final note, although the discussion above focused on one approach at a time, in practice, a combination of methods could be used to complete the allocation of land to institutional sectors. For example, based on data availability one method may be applicable to certain type(s) of land, while for others different data sources may facilitate the use of a different approach. In such cases, although ensuring consistency across sectors and types of land/industry may represent an additional challenge, the ability to fully show the breakdown of land values within the national accounts will provide data users valuable analytical information on an important driver of economic behaviour.

Challenges

Data sources

7.59. As it has been emphasised in Chapter 4, identifying and utilising data sources for assessing land values represents a major challenge. In most cases, direct information on land holdings is sparse; therefore there is a need to rely on partial information, proxies and an estimation methodology. These data challenges will differ from country to country and they will largely determine the choice of approach for deriving land values by sector and type of land.

7.60. Data sources with partial coverage and information exist in any given country; however, the challenge is to ensure comparability, conceptual coherence and to develop a unifying framework under which the missing information can be derived reliably. This condition holds for the derivation both at the aggregate level and at the recommended level of granularity with respect to sector and type of land and/or industry.

Shared land

7.61. Shared land describes a case when two or more economic agents use the same piece of land for economic purposes. This presents a problem for sectorisation as the two economic agents may be in different sectors and this makes it difficult to allocate the land to just one sector.

7.62. There are many examples of different economic agents using the same piece of land, however in these cases there is usually a single owner. For example, a rented out office building housing multiple businesses, shopping malls, or apartment buildings in which also stores are established.

7.63. Many airplanes use the same runway at an airport. The runway is owned by the airport and the airplane companies are paying to use the facility. Two or more sports teams may use the same stadium. One of the teams may own the stadium and lease it out to the other. In both cases the land is not shared.

7.64. More than one farm uses common land to graze their animals. In this case, the common land is shared at no charge to the farmer; however, the land is owned by the government and would be allocated to the government sector.

7.65. If it is not possible to find a single owner for a piece of land, the data should be shared between the owners in proportion to the amount of land that they own. For example, if a piece of land is valued at 100 and 2 companies own it equally, then the value of 50 should be given to each company.

7.66. Chapter 3 provides further guidance on how to classify shared land by type. Further details are also available in SNA 2008 paragraphs 17.344 to 17.348.

Shared ownership

7.67. Shared ownership describes the situation where two or more economic agents own one piece of land. It is also known as equity sharing, for example when both a household and a house building company own parts of a house and the land underlying it. In this case, if there is not a clear single owner, the data should be shared between the owners in proportion to the amount of land that they own, as described above.

Households as producers/unincorporated enterprises

7.68. One particular difficulty, along the lines of the shared ownership challenge discussed above, relates to land owned by households as producers. This becomes an issue only for countries where a finer granularity of sectoral allocation is desired, more specifically, where a non-corporate business sector is shown separately from the households sector. This distinction may be particularly relevant in emerging economies where the share of self-employment in the total employment is large.

7.69. Unincorporated enterprises should be separated from the incorporated enterprises. The unincorporated enterprises should be allocated in S.14 households, with the exception of quasi-corporations.

7.70. In countries where the unincorporated enterprises are shown as a separate sector, the associated structures (dwellings) and investment flows are presented separately from those allocated purely to households. This relative breakdown then can serve as a proxy for the allocation of land.

Changes in classification or sector allocation

7.71. A major challenge in the sector allocation of land is the capturing of data on reclassifications from one type of land to another (e.g. agricultural land reclassified to non-residential or residential) with or without a change in sector ownership. In theory, if the value of land by type and by sector is accurate at any given point in time, and the transactions among sectors are properly captured, such reclassifications would be properly captured. In practice, given the limited data availability, capturing these flows as they happen may be difficult. Furthermore, decoupling transactions and other changes in volume may not be possible (see the Netherlands case study on agricultural land at the end of this chapter). However, over a number of reporting periods, that information should filter into the estimates through the various economic signals and assumptions used in the overall methodology, such that medium- and long-term trends in land sector allocation and cross-classification reflect economic reality.

Case study sectorisation and cross-classification of land: The Netherlands

Introduction

Statistics Netherlands publishes yearly estimates of three types of land: land underlying dwellings, land underlying non-residential buildings and land under cultivation. To attain a division into industries and sectors, a top down approach is used. This implies that the total value of each type of land is estimated first after which land is allocated to different industries and sectors. The argument for using the top down approach is that the only available source data are on the national level. Data on land prices or surface areas by industry or sector are not available.

This case study discusses the division of land into industries and sectors for land underlying dwellings and land under cultivation in the Netherlands. Land underlying dwellings serves as an example for land that is estimated indirectly, while land under cultivation is an example of directly estimated land.

Land underlying dwellings (estimated using indirect method)

In the Netherlands, the total value of land underlying dwellings is estimated indirectly, using the residual approach. First, the total value of dwellings, including the underlying land, is estimated using tax register data. Subsequently, the value of dwellings is subtracted to derive the value of land underlying dwellings.

To attain a division of land underlying dwellings into industry and sector, the value of dwellings by industry and sector from the capital stock can be used. This assumes a relationship between the value of the dwellings and the underlying land. This relationship depends on whether a bottom up or top down approach is employed. In a bottom up approach, land-to-structure ratios are suitable to estimate the value of land underlying dwellings by industry or sector. Subsequently, the total value of land is derived by aggregating the values by industry or sector. In contrast, in the top-down approach the total value of land is estimated first. Then, the distribution of the value of the dwellings from the capital stock is used to distribute land underlying dwellings across industries and sectors. In the Netherlands, the top-down approach is used.

The following numerical example illustrates how capital stock data can be applied to compile a complete balance sheet of land underlying dwellings at the sector level for the year 2005. Effectively, the distribution of the capital stock of dwellings across sectors is used for the sector allocation of land. The capital stock data required at a sector level are the opening and closing balance sheet, and purchases less sales. The opening and closing balance sheet of the total value of land underlying dwellings as well as the revaluation percentage are also required. Tables 7.7 and 7.8 show the required input data and Table 7.9 the computation for sectorisation.

In this example, the opening and closing balance sheet of the total value of land underlying dwellings in 2005 are respectively EUR 900 billion and EUR 1 000 billion (Table 7.8). To allocate land underlying dwellings to sectors, first the opening and closing balance sheet of land underlying dwellings are proportionally related to the opening and closing balance sheets of the dwellings capital stock (Table 7.9). For example, the share of dwellings for the non-financial corporations' sector on the opening balance sheet is 20 % (200/1 000) so the total value of land underlying dwellings on the opening balance sheet (900) is multiplied by this proportion in order to derive the value of land for the non-financial corporations' sector (180). To obtain the revaluation, the percent change in the price index of land underlying dwellings is multiplied with the opening balance sheets of the respective sectors to compute the amount of revaluation at a sector level. The revaluation percentage by sector is assumed to be similar and set equal to the revaluation percentage of the national estimation (in this example 5 %). The next column of Table 7.9, purchases less sales (transactions) of land are based on the purchases less sales of dwellings. Purchases less sales of dwellings per sector are computed as a percentage of the opening balance sheets of dwellings after which, in each sector, the resulting percentage is multiplied with the opening balance sheets of land underlying dwellings. For instance, when five per cent of the dwellings are sold, relative to the opening balance sheet, it is also assumed that five per cent of the underlying land is sold. Finally, given the opening balance sheet, the revaluation, transactions of land, and the closing balance sheet, the other changes in volume of land in each sector are computed as a residual.

Table 7.7: Input data: value of dwellings in the capital stock, 2005

Sector Code	Sector	Opening balance sheet (billion EUR)	Purchases less sales (billion EUR)	Closing balance sheet (billion EUR)	Purchases less sales (share of opening BS)
S.1	Total economy	1 000	0.0	1 200	
S.11	Non-financial corporations	200	1.0	240	0.005
S.12	Financial corporations	40	-3.0	45	-0.075
S.13	General government	10	0.0	15	0.000
S.14	Households	750	2.0	900	0.003

Source: Statistics Netherlands

Table 7.8: Input data: total value and price index land underlying dwellings

Total value land underlying dwellings 2004 (billion EUR)	900
Total value land underlying dwellings 2005 (billion EUR)	1 000
Price index land underlying dwellings (%)	5

Source: Statistics Netherlands

Table 7.9: Distribution of land underlying dwellings based on capital stock, 2005
(billion EUR)

Sector code	Sector	Opening balance sheet	Revaluation	Purchases less sales	Other volume changes	Closing balance sheet
S.1	Total economy	180+36+9+675=900	9+2+1+34=46	1-3+0+2=0	10+3+2+39=54	200+38+12+750=1 000
S.11	Non-financial corporations	200/1 000*900=180	0.05*180=9	0.005*180=1	200-180-9-1=10	240/1 200*1 000=200
S.12	Financial corporations	40/1 000*900=36	0.05*36=2	-0.075*36=-3	38-36-2+3=3	45/1 200*1 000=38
S.13	General government	10/1 000*900=9	0.05*9=1	0*9=0	12-9-1-0=2	15/1 200*1 000=12
S.14	Households	750/ 1 000*900=675	0.05*675=34	0.003*675=2	750-675-34-2=39	900/1 200*1 000=750

Source: Statistics Netherlands

Land under cultivation (estimated using direct method)

The total value of land under cultivation in the Netherlands is estimated directly using price information and data on surface areas. Land under cultivation consists of open farmland and land underlying greenhouses. These types of land are estimated separately due to the availability of detailed price and surface area information. Since no relation exists with the capital stock, the division of land under cultivation into industries and sectors relies on a different method than the division of land underlying dwellings.

The following example illustrates how open farmland is allocated to industries and sectors. Table 7.10 shows the total surface area of open farmland at the beginning of the year and its division into leased and non-leased open farmland. The share of each type of open farmland is assessed yearly and based on data from the Economic Institute for Agriculture. Leased and non-leased farmland are valued separately since prices for non-leased farmland are higher (Table 7.11). Table 7.12 shows the computation of the balance sheets. Since input data for the quantities and prices are respectively beginning and end of the year data, estimating open farmland in a particular year requires data from different years. For instance the closing balance sheet of 2011 requires 2012 quantity data and 2011 price data.

Table 7.10: Partition of total open farmland into non-leased and leased land

Year	Total area open farmland (1 000 hectares)	Share non-leased land (share of total area)	Share leased land (share of total area)	Area non-leased land (1 000 hectares)	Area leased land (1 000 hectares)
2010	2 400	0.58	0.42	1 392	1 008
2011	2 300	0.57	0.43	1 311	989
2012	2 100	0.56	0.44	1 176	924

Source: Statistics Netherlands

Table 7.11: Input data prices for open farmland
(million EUR, rounded)

Year	Non-leased land (1 000 EUR/hectare)	Leased land (1 000 EUR/ hectare)	Price index % change
2009	46.0	23.0	2
2010	47.0	23.5	6
2011	50.0	25.0	5

Source: Statistics Netherlands

Table 7.12: Balance sheets open farmland (1)
(million EUR, rounded)

Year	Opening balance sheet	Revaluation	Purchases less sales and other volume changes	Closing balance sheet
Non-leased open farmland				
2010	1 392*46=64 032	64 032*0.02=1 281	61 617-64 032-1 281=-3 696	1 311*47=61 617
2011	1 311*47=61 617	61 617*0.06=3 698	58 800-61 617-3 698=-6 515	1 176*50=58 800
Leased open farmland				
2010	1 008*23=23 184	23 184*0.02=464	23 242-23 184-464=-406	989*23.5=23 242
2011	989*23.5=23 242	23 242*0.06=1 395	23 100-23 242-1 395=-1 537	924*25=23 100

(1) Calculation: surface area (thousands of hectares) * price (thousands EUR/hectare) = balance sheet value

Source: Statistics Netherlands

Table 7.13 shows how open farmland is allocated to industries for 2011. First, all non-leased open farmland is assigned to the industry agriculture, forestry and fishing. Leased open farmland is allocated to several industries, using information from government reports.

Table 7.13: Balance sheets open farmland by industry, 2011
(million EUR, rounded)

Industry	Percentage	Opening balance sheet	Revaluation	Purchases less sales and other volume changes	Closing balance sheet
Non-leased land					
Agriculture	100	61 617	3 698	- 6 515	58 800
Leased land					
Government	26	0.26*23 242=6 041	0.26*1 395=363	6 006-6 041-363=-398	0.26*23 100=6 006
Financial corporations	11	0.11*23 242=2 557	0.11*1 395=153	2 541-2 557-153=-169	0.11*23 100=2 541
Insurance companies	12	0.12*23 242=2 789	0.12*1 395=167	2 772-2 789-167=-184	0.12*23 100=2 772
Households	41	0.41*23 242=9 529	0.41*1 395=572	9 471-9 529-572=-630	0.41*23 100=9 471
Agriculture	10	0.10*23 242=2 324	0.10*1 395=140	2 310-2 324-140=-154	0.10*23 100=2 310

Source: Statistics Netherlands

Subsequently, given the industry classification, industries are assigned to a sector, see Table 7.14. For open farmland (both non-leased and leased land) in the agricultural industry the sector allocation is based on annual production data and assigned to S.11 non-financial corporations and S.14 households. For other industries, farmland is directly linked to a specific sector. For instance, open farmland owned by insurance companies is assigned to the sector S.12 financial corporations.

Table 7.14: Allocation of open farmland by industry to sectors, 2011
(million EUR)

Industry	Percentage of industry to sector	Sector	Opening balance sheet	Revaluation	Purchases less sales and other volume changes	Closing balance sheet
Agriculture (non-leased and leased land)			63 941	3 838	-6 669	61 110
Agriculture	25	S.11	15 985	959	-1 667	15 277
Agriculture	75	S.14	47 956	2 879	-5 002	45 833
Government	100	S.13	6 041	363	-398	6 006
Financial corporations	100	S.12	2 557	153	-169	2 541
Insurance companies	100	S.12	2 789	167	-184	2 772
Households	100	S.14	9 529	572	-630	9 471

Source: Statistics Netherlands

As previously discussed, to obtain the total value of land under cultivation in the Netherlands land underlying greenhouses must be estimated. While not shown in the example above, the allocation of land underlying greenhouses follows a similar procedure. To allocate land underlying greenhouses to industries and sectors, all land used for agricultural production is assigned to the industry agriculture, forestry and fishing. A separate estimation is made for land underlying greenhouses that is used by garden centres. It is based on the number of garden centres and their average size. The value is assigned to the industry retail trade and repair. It is assumed that all other land underlying greenhouses are part of agricultural companies. Therefore, its value is assigned to the industry agriculture, forestry and fishing. Given the allocation of land underlying greenhouses to either retail trade and repair, or agriculture, forestry and fishing, each industry is subsequently subdivided into sectors. As with open farmland, the allocation to sector is based on annual production data.

8

Some special estimation cases

8.1. This chapter discusses a number of specific estimation cases. Chapter 8.1 discusses some special characteristics concerning (the valuation of) agricultural land and wooded land available for wood supply. Chapter 8.2 elaborates an asset type that is closely related to land: land improvements. The compilation and valuation of government owned land is described in Chapter 8.3.

8.1 Agricultural land and wooded land available for wood supply

8.2. In Chapter 5 the direct estimation method of land is explained. Chapter 6 addresses the indirect estimation of land, where three approaches were discussed that can be used to separate structures from the underlying land. The main principles that are elaborated in these two chapters are also applicable for agricultural land and wooded land available for wood supply. However, there are some peculiarities that make it worthwhile to pay separate attention to these types of land in this chapter.

8.3. Therefore, first part of Chapter 8.1 will discuss specific characteristics of agricultural land and the second part will elaborate details regarding wooded land available for wood supply. A case study at the end of the chapter illustrates the Finnish practice regarding the valuation of land underlying timber.

Agricultural land

Introduction

8.4. In many countries agricultural land represents an important part of the total land area. For that reason and because prices of the different types of agricultural land can deviate from each other considerably, this section pays attention to the issue of agricultural land and its valuation. In the history of economics, the three fundamental factors of production were considered to be land, labour and capital; land meant agricultural land in this context. Land, in addition to being a factor of production, is an important store of value and can be used by landlords and owner-occupier farmers as collateral for loans. Policy makers are interested in the extent to which agricultural policy measures are capitalised into land values.

8.5. Four issues related to agricultural land are addressed below. The first section discusses the distinction of different types of agricultural land. The second section addresses the data sources that countries could use to derive quantity and price data. Section three provides methodological recommendations on the prices that should be used for the correct valuation of agricultural land and the final section briefly addresses the issue of determining the total value of agricultural land.

Classification of agricultural land (78)

8.6. Various types of agricultural land can be distinguished: permanent grassland, arable land (irrigable and non-irrigable) and permanent crops. Permanent crops include orchards, vineyards, olive groves etc. In principle all land that is used for agricultural purposes should be classified under AN.21121, see paragraph 3.23.

8.7. In most countries permanent grassland and arable land are by far the most important types of agricultural land; their definitions are mentioned below. Areas devoted to permanent crops are usually less important, in some countries even negligible.

8.8. Agricultural statistics where the primary focus is for agricultural purposes includes kitchen gardens as a separate category of agricultural land. Traditionally, farm households have a garden in which they grow fruit and vegetables for their own consumption. Any surplus, which may be considerable, is sold on the market. In certain countries and at certain times, fruit and vegetables grown in such gardens may have a significant share of the market. However, for national accounts purposes they should be included in AN.2111 land underlying buildings and structures. Usually they are not of major importance. Also see Chapter 3 on land classification.

8.9. Arable land is land worked (ploughed or tilled) regularly, generally under a system of crop rotation. It can be broken down into irrigable arable land and non-irrigable arable land. Irrigable arable land is defined as arable land area which could, if necessary, be irrigated in the reference year using the equipment and the quantity of water normally available on the holding. Non-irrigable arable land can be defined as arable land area which cannot be irrigated due to the lack of water for irrigation on the holding.

8.10. Countries for which the irrigable land area is relatively large and for which its price is significantly higher than the price of non-irrigable land, are advised to implement the above mentioned breakdown of arable land and to determine the value of both types of arable land separately.

8.11. More concretely, those countries for which the irrigable arable land area exceeds 15 per cent of the total utilised agricultural area and the prices per hectare are more

(78) The definitions and descriptions in paragraph 8.6–8.13 are mainly derived from Commission Regulation (EC) No. 1200/2009 of 30 November 2009. Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:329:0001:0028:EN:PDF.

than 50 % higher than the prices for the non-irrigable arable land price per hectare, are recommended to implement this breakdown.

8.12. Permanent grassland is land used permanently (for five years or more) to grow herbaceous forage crops, through cultivation (sown) or naturally (self-seeded) and which is not included in the crop rotation on the holding.

8.13. Land for permanent crops comprises orchards, vineyards, olive groves and the like. It includes fruit plantations, nurseries and 'other permanent crops' such as Christmas trees.

Sources

8.14. In order to calculate the value of the different types of agricultural land sources on quantities (areas in square metres) and prices have to be collected. Below an overview is provided of sources that countries can possibly use for these purposes.

Area

8.15. Many countries collect data on the areas of various types of agricultural land: permanent grassland, arable land (irrigable and non-irrigable), permanent crops, and kitchen gardens through a survey. Data are often available at the national and, in the European Union (EU), at the regional NUTS 2 ([79]) levels.

8.16. The cornerstone of agricultural statistics in the EU is the Farm Structure Survey (FSS) which is carried out in all Member States of the EU. Analogous surveys exist in other countries. The FSS is a farm census that is carried out every 10 years (most recently in 2010) and for which a large sample survey is held every 3–4 years in between. It covers the numbers of farms of various sizes and records many characteristics of each farm surveyed. This information enables the total area of the various types of agricultural land to be estimated for small regions (NUTS 2) and larger ones (NUTS 1), and for each Member State as a whole. The common methodology used means that the areas are comparable across EU Member States.

Prices

8.17. Statistical data on prices of agricultural land can be collected by means of:

— Direct observation of land prices by category of agricultural land. In this case, the agricultural holding is contacted directly and asked about prices of actual transactions related to the holding or about an average theoretical price/rent. The data can be collected through separate surveys or be integrated into the system of surveys which already exists (i.e. land use surveys, agricultural economic indicators, etc.).

— Statistical data collection via a network of experts — 'expert estimates'. This practice could involve experts from the regional statistical offices, local representations of the Ministries of Agriculture, agents from the real estate agencies at the regional level, the agricultural advisory service, etc.

— Use of administrative data to obtain statistical information. This method of data collection should be used only when the information provided by administrative sources proves to be of equal quality to the information obtained from statistical surveys (the information from administrative sources is often prone to significant under-reporting and does not provide any breakdown by type of land).

In some cases, countries could combine one or both of the first two data collection methods mentioned above with the administrative data sources.

8.18. In most cases the national authorities of the EU Member States (national statistical institutes) and/or Ministries of Agriculture are responsible for collecting land prices and rents, and calculating the corresponding average prices for their country.

8.19. It is recommended to collect separate price data for arable land and permanent grassland. If no separate price data for permanent crops land is available they may be approximated using the price data for grassland and arable land ([80]). Where possible, it is advised to collect this price data at the regional level (NUTS 2).

Methodology on agricultural land prices

8.20. The price of one hectare of agricultural land sold/purchased for agricultural use is proposed as the observation unit. The field of observation should include agricultural land and/or permanent grassland sold to (or purchased from) private owners or estate agencies who sell land for agricultural use. In order to keep the price of agricultural land as pure as possible transactions for non-agricultural purposes (lifestyle buyers, construction sites etc.) and transactions of land between relatives should be excluded.

8.21. The agricultural land prices should represent the average price of the sold/purchased land in a calendar year.

([79]) See footnote 46.

([80]) Data for Agricultural Price Statistics are stored in the Eurostat dissemination database, Eurobase. This database can be consulted by external users via the Eurostat website http://ec.europa.eu/eurostat/data/database

It is not usual to take into account the value of any crops on the land at the time of sale. This is because the value of the crop is much smaller than the value of the land itself.

8.22. According to the market price concept, the price of agricultural land is the price received/paid by the holder in free trade without deduction of taxes or levies (except deductible value added tax) and without the inclusion of subsidies.

8.23. Prices can be collected from the owner of agricultural land who is selling agricultural land for agricultural use (selling prices) or from the person who is purchasing agricultural land for agricultural use (purchase prices).

8.24. The selling/purchase price of land should:

— include the value of related levies/taxes (other than deductible value added tax);

— exclude the entitlements related to the land;

— exclude the value of any monetary compensation received by farmers for the sale/acquisition of the utilised agricultural area;

— exclude the value of any building on the sold/purchased agricultural land;

— exclude inheritance transfers.

In practice, fees of estate agents and the like are usually borne by the seller and implicitly included in the sale price. On the other hand, lawyers' fees are usually borne by the buyer; they are generally invoiced separately and thus not included in the land price.

Valuation of agricultural land

8.25. In Chapters 5 and 6 the direct and indirect method to calculate the value of land are discussed. In case of agricultural land, ownership is registered and thus changes in ownership can be discovered. Most countries have an active land market with part of the land sold publicly. Thus for agricultural land the direct method will most likely be used. The value of the agricultural land can be determined by multiplying the areas of agricultural land and its prices per hectare. However, this assumes that the land coming on the market is representative of all agricultural land of the same type, an assumption which is difficult to test.

8.26. In order to get the best possible results it is recommended to perform this calculation at the most detailed level: by different types of land and by region. National estimations can be determined by aggregation.

8.27. Sometimes, it might be impossible to measure land area adequately or to obtain appropriate prices for agricultural land. In this case, net present value of future income expected from the agricultural land at time t (LV_t) could be applied as an approximation to the value of agricultural land by

(1) $$LV_t = \sum_{t=1}^{\infty} \frac{R_t - C_t}{(1+i)^t}$$

where R_t, C_t and i indicate revenue from agricultural land, cost for agricultural cultivation and discount rate, respectively.

Although this method may not be easily applied due to lack of information on relevant variables, it could be used as an alternative when other methods are not feasible.

Wooded land available for wood supply

8.28. This section briefly discusses two issues relevant for wooded land available for wood supply (hereafter also called 'land underlying timber'): the classification and registration and the estimation and valuation of wooded land including the separation of the trees from the underlying land.

Classification and registration of wooded land available for wood supply

8.29. Forestry land, as discussed in paragraph 3.23, is defined as wooded land under cultivation and includes not only land under cultivation for wood supply but also other types of wooded land under cultivation. However, this section focuses only on wooded land that is available for wood supply. Therefore, for the purposes of classifying land on the balance sheet, a distinction should be made for land underlying cultivated timber versus non-cultivated timber ([81]).

8.30. The first category of land underlying timber concerns land used for regular wood production. This type of wooded land is cultivated for economic exploitation since regular human intervention takes place. In this case, the standing timber — that is, the trees on the land — is classified as a produced asset and the value added corresponding to the growth of timber is considered production, and thus contributes to gross domestic product. The timber, according to ESA 2010 and SNA 2008 guidelines, is registered on the balance sheet under AN.1221 inventories, work in progress on cultivated biological resources. The growth of the timber is registered as changes in inventories (P.52) and the land itself is classified under forestry land (AN.211 land, sub-item AN.21122).

([81]) In the European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF) 2002, the concept of forest and other wooded land is used. This is not the same as the classification of forestry land presented in Chapter 3. The IEEAF proposes a further breakdown on wooded land from the perspective of trees that are or are not available for wood supply. See for more information Eurostat, *The European Framework for Integrated Environmental and Economic Accounting for Forests — IEEAF*, 2002. Available at http://ec.europa.eu/eurostat/documents/39314/44178/Handbook-IEEAF-2002.pdf/c7b2aeaa-c4dd-49ce-bf25-05740d90e043

8.31. The second category of land underlying timber concerns natural forests in which no human intervention has taken place for many years. Non-cultivated timber stands do not give rise to direct cultivation costs, but the timber is deemed available for wood supply.

8.32. Trees from the second category are registered under the balance sheet item non-cultivated biological resources (AN.213). The natural growth of trees classified as non-cultivated biological resources is entered in the flow accounts as economic appearance of assets (K.1). As soon as they are harvested, this is registered as economic disappearance of non-produced assets (K.2).

8.33. The paragraph directly above discusses the classification of the trees themselves on the balance sheet. The land underlying the trees is within the asset boundary and should be registered on the balance sheet if the land is deemed to provide economic benefits to the owner (or user). However, only land underlying cultivated timber should be classified as forestry land (AN.21122). Land underlying non-cultivated timber (if it is deemed to be within the asset boundary) should be classified depending on the main use of the land, most likely under other land and associated surface water (AN.2119).

8.34. The categories discussed above may be important for the correct valuation of the timber and the underlying land. Of course, other characteristics, like damage to trees, level of biodiversity, forest soil acidification or degradation are also of importance for a correct valuation.

Estimation and valuation of wooded land available for wood supply, possible sources

8.35. The value of wooded land available for wood supply can be estimated using the methods that are elaborated in the Chapters 5 and 6 of this compilation guide.

8.36. The direct method (as discussed in Chapter 5) can be applied if separate data on the bare land — that is the land underlying the timber — are available. In some countries, prices of transacted bare land are available, for example from administrative sources. Alternatively, the price of bare land may also be approximated by the price of comparable land, e.g. starting from prices of marginal agricultural land. In cases where land is rented, a third option could be to estimate the net present value of the future rents.

8.37. However, usually only the combined value is available and, therefore, the indirect method (as discussed in Chapter 6) must be used to isolate the value of the underlying land.

8.38. The combined value of the wooded property may be available from a register of transactions managed by a land registry office or from a fiscal database. However, a major drawback is that there are usually only a few transactions in a given time period, thus it may be difficult to derive prices that are representative for all types of wooded land available for wood supply. In addition, data that come from fiscal databases may suffer from systematic underreporting.

8.39. As a next step in an indirect approach, the value of the standing timber is estimated. In forest economics the net present value method is recommended; this method is also in line with ESA 2010 guidelines. According to this method the value of forest assets is calculated as the net present value of future economic benefits. However, the full application of this method raises some complex problems and requires detailed data. Therefore some simpler variants are also proposed in forest economics: the stumpage value method and the consumption value method.

8.40. In its simplest variant, the stumpage value method calculates an average stumpage price for the total harvest. This average price is applied to the whole stock. This method is rather simple: the stumpage value of the felled timber after deduction of the logging costs is divided by its volume. The resulting price is multiplied by the stock of standing timber. Physical data are generally available from forestry statistics and forest inventories. More detailed variants apply average stumpage prices e.g. per species to the volume of standing timber (or the natural growth) per species.

8.41. In the consumption value variant, different stumpage prices are used for the various categories of timber in terms of both species and age or diameter classes. These prices may be directly available, or have to be calculated starting from the prices of the various assortments of felled timber (log prices by diameter class, pulp wood prices, fuel wood prices, etc. by species). These stumpage prices are applied to the respective stocks (per species and per age or diameter class), as given by the forest inventories.

8.42. After having applied one of the above described methods, the value of land can be calculated as a residual. An average annual value of land may be calculated to estimate the trend and, therefore, smooth the annual volatility of market prices.

8.43. A more detailed description of the valuation of timber and forests goes beyond the purpose of this compilation guide. However, detailed (also technical) elaborations of the proposed methods can be found in two publications on forests and other wooded land: The European Framework for Integrated Environmental and Economic Accounting for Forests ([82]), in particular Chapter 3 and Annex 3, and Valuation of European forests ([83]). Although these publications were is-

([82]) See footnote 81.

([83]) Eurostat, *Valuation of European forests — results of IEEAF test applications*, 2000, Available at http://bookshop.europa.eu/en/valuation-of-european-forests-pbKS3100699/?CatalogCategoryID=Oq0KABst8WEAAAEjsZEY4e5L sued in the first decade of the 21st century and often refer to ESA 1995 (instead of ESA 2010), most of the text is still valid and can rather easily be connected with ESA 2010 guidelines.

Case study estimating the value of land underlying timber: Finland

Introduction

The value of land is estimated by direct method as a rule in Finland. However, using data on real estate transactions to value land underlying timber leads to significant overestimation for the value of land, because transactions of forestry land always include the value of standing timber. As a matter of fact, the vast majority of the value derived from those transactions should be allocated to timber (inventories) instead of the underlying land.

How can the value of forestry land and the value of standing timber be separately identified? Can the value of the underlying land be estimated by deducting the value of timber from the combined value? Or would it be possible to use a direct method to estimate the value of the underlying land? The long history of Finnish forest research gives some tools to make comparative calculations by using different methods.

The residual approach for forestry land

As described in Chapter 6.2, the residual approach can be applied for the cultivated land as well: if the produced asset standing on the land can be evaluated and subtracted from the combined value at market prices, the value of cultivated land can be obtained.

The volume for standing timber by institutional sector in Finland can be obtained by the National Forest Inventory system carried out by the Finnish Forest Research Institute. The system has produced estimates on Finnish forest resources since 1920.

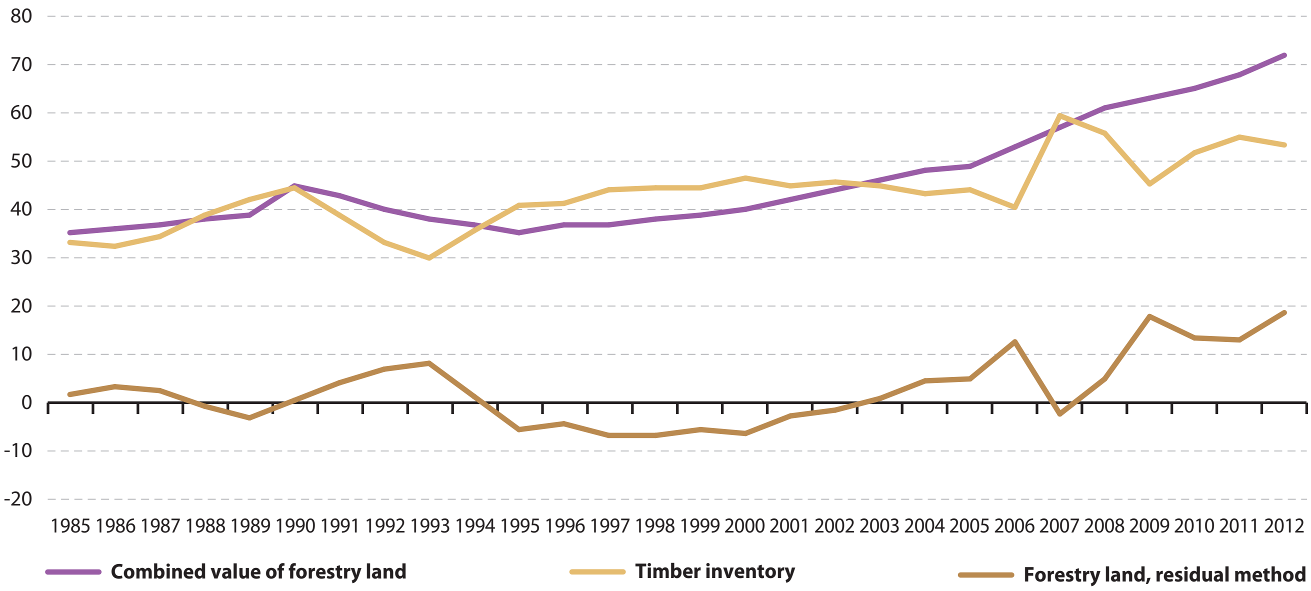
The total volume of standing timber as well as annual growth and fellings are based on extensive field measurements and systematic sampling. The field plots are located in clusters that form a network over the whole country.

The value of standing timber can then be derived by multiplying the timber assortment volumes by corresponding stumpage prices (sale on the stump is by far the most popular form of sale). There are three commercially significant tree species in Finland, for which prices are registered separately for saw timber and pulpwood. The relevant market prices are collected by the Finnish Forest Resource Institute, as well.

The value of standing timber is already currently registered in national accounts as work-in-progress inventories on cultivated biological assets.

Figure 8.1 shows the combined value of forestry land, the value of timber inventories, and the value for underlying land calculated as residual for the period 1985–2012.

Figure 8.1: The value of forestry land estimated with the residual method
(billion EUR)



Source: Statistics Finland, Finnish Forest Research Institute, National Land Survey of Finland

The figure indicates that the residual method leads to negative values for forestry land for some years. This is due to two reasons.

First, the combined value, which is based on transactions of timber and the underlying land, is probably underestimated. This follows from the fact that the transactions used are related to sales of forests with a young tree stand. In other words, the combined value may be downward biased.

Second, the value of timber inventory is revised approximately five years backwards annually, when new information from the National Forest Inventory is gathered every year. This leaves the value of timber inventory with high uncertainty for the recent years.

In addition Figure 8.1 indicates that the residual value for forestry land is quite volatile; i.e. the variance in timber prices is reflected also in the value of underlying land. This is not a reasonable result taking into account the long period of tree growth in Finland (from 50 to 90 years depending on the latitude and the wood species). The value of clean forestry land should develop more smoothly, and reflect the productivity of the land more than cyclical changes in timber prices.

Therefore, the residual approach to estimate forestry land may require some kind of modifications, at least to avoid negative land values.

The direct method

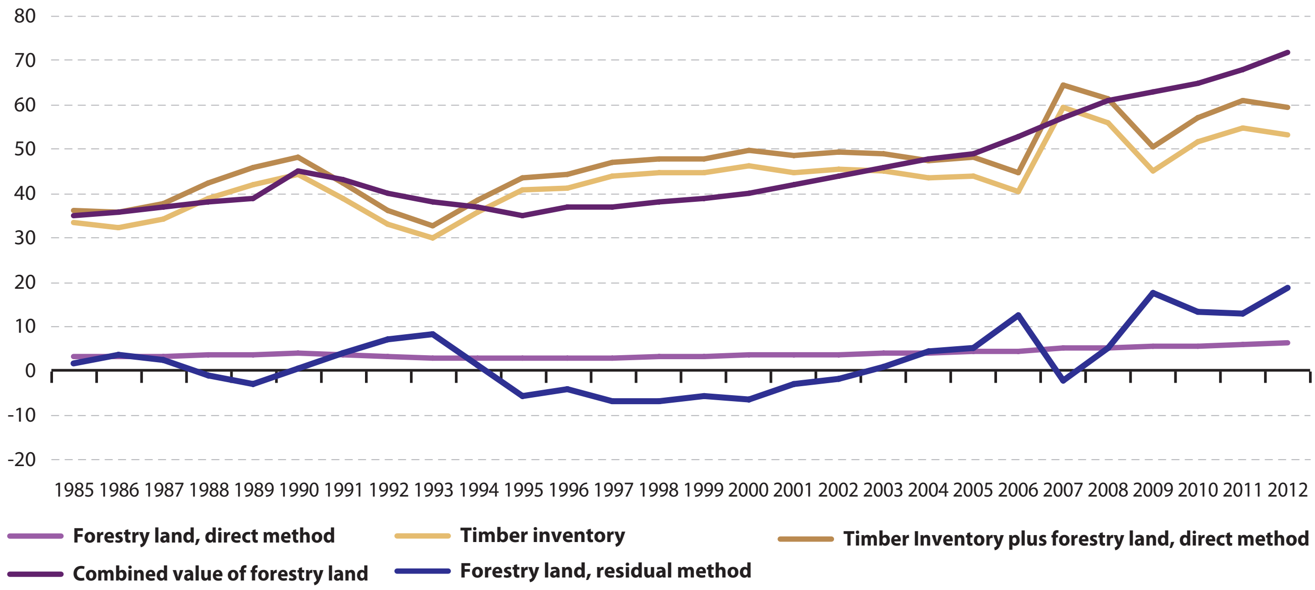
There are active markets for forest real estates in Finland. When an estate is evaluated for trade, usually the so-called summation approach is used. In this method, the total value of a forest real estate is the value of the land plus the standing timber value including expectation values for young growing stands.

The Forestry Development Centre Tapio produces unit prices for different forest land types (excluding timber), to be applied in the evaluation of forest real estates. The price formation process considers different types of soil and several other factors that affect the economic value of forestry land.

Area information for different site fertility classes on mineral soils and on mires on forest land are available from the statistics published by the Finnish Forest Research Institute.

Applying the above mentioned information on unit prices and land area the total value for the land underlying the standing timber in economic use can be calculated for a single year (2012). In order to estimate the value of forestry land for the period 1985–2012, the price index for forest estates from the National Land Survey was applied. The results are shown in Figure 8.2.

Figure 8.2: Comparative results for forestry land value (billion EUR)



Source: Statistics Finland, Finnish Forest Research Institute, National Land Survey of Finland

Figure 8.2 indicates that the value of forestry land computed by the direct method is less volatile than the results obtained by the residual approach. Because the direct method is not based on realised market prices but on the estimated productive value of forest land types, it implicitly excludes the value of capitalised land improvements. The residual approach instead includes the land improvements by definition. Therefore, if the residual approach is applied, the stock of land improvements should be deducted to obtain the value of forestry land in accordance with ESA 2010 (see Chapter 8.2).

It can be concluded that in estimating the value of Finnish forests the direct method leads to more reliable results. It is known that the market prices of forest real estates are not as sensitive to timber prices as the results of the residual approach would imply. More steady development of the forestry land value is a consequence of long production period (from 60 to 100 years) of timber in Finland. In reality, economic cycles do not have such a strong impact on forest real estate prices, but the prices are more dependent on the productivity of the piece of land.

Then again, if the use of the direct method is not possible, the residual approach could be used as a second best solution to estimate the value of forestry land. It leads to results which are within the same magnitude as the results obtained by applying the direct method. If the residual approach is applied, it is necessary to check the values of underlying land year by year carefully and to eliminate possible outliers like negative land values. Calculations to evaluate forestry land 2009–2011 are shown in Table 8.1.

Table 8.1: Calculation of forestry land value
(million EUR)

Year/Asset	2009	2010	2011
Combined value based on forest estate sales	63 112	65 072	67 967
Timber inventory value	45 227	51 548	54 904
Forestry land value, residual method	17 885	13 524	13 063
Net stock of land improvements on forestry land	3 133	3 313	3 339
Forestry land value with deducted land improvements	14 752	10 211	9 724
Forestry land value, direct method	5 453	5 650	6 068

Source: Statistics Finland

8.2 Land improvements

Introduction

8.44. Activities such as land clearance, land contouring, creation of wells and watering holes will lead to the improvement of land. As land improvements are very closely related to land itself, they are the subject of this chapter of the compilation guide.

8.45. The definition of land improvements, its relationship to land and the position of land improvement in the system of national accounts is described in the first part of this chapter. Here also some possible data sources are mentioned. The second part of the section discusses possibilities to separate land from land improvements and in the third part the borderlines between the assets land, land improvements and dwellings and other buildings and structures are explored. The fourth part of the chapter elaborates four accounting examples. The accounting examples not only serve as an illustration for the borderline cases, but also show how information on stocks, transactions and other changes can be used to derive missing values. At the end of this chapter a country example for Finland is elaborated.

Definition, characteristics and data sources

8.46. Land improvements (AN.1123) are the result of actions that lead to major improvements in the quantity, quality or productivity of land, or prevent its deterioration (SNA 2008 paragraph 10.79, ESA 2010 Annex 7.1). Examples include the increase in asset value arising from land clearance, land contouring, creation of wells and watering holes. Land improvements, according to this definition, may apply to any type of land (and is not restricted to, for example, agricultural land).

8.47. Activities such as land clearance, land contouring, creation of wells and watering holes that are integral to the land in question are to be treated as resulting in the asset land improvements. However, activities such as the creation of seawalls, dykes, dams and major irrigation systems which are in the vicinity of the land but not integral to it, which often affect land belonging to several owners and which are often carried out by government, result in assets that are not to be classified as land improvements, but as structures.

8.48. Land improvements are fixed assets (AN.11) and form part of the asset category AN.112 other buildings and structures.

8.49. Land improvements represent a category of fixed assets distinct from the non-produced land asset as it existed before improvement. Land before improvements remains a non-produced asset and as such is subject to holding gains and losses separately from price changes affecting the improvements.

8.50. The asset land improvements by convention also includes the costs of ownership transfer of land.

8.51. Transactions in the asset land improvements should be registered in the capital account as gross fixed capital formation (GFCF, P.51g). As land improvements are fixed assets, the value of land improvements should be written off (consumption of fixed capital, P.51c). The write-off for land improvements other than the costs of ownership transfer should take place over a suitably long period, but the costs of ownership transfer are written off over the period the owner expects to own the land.

8.52. If other changes in the volume of assets and nominal holding gains and losses apply to land improvements, they have to be registered on the other changes in volume of assets account and the revaluation account, respectively — separately from those of land.

8.53. The sources to be used for the estimation of land improvements are quite heterogeneous. They strongly depend on the specific country situation. Only in a limited number of cases will direct sources on the stocks of land improvements be available. Such stock data might be directly available as part of investment surveys for several industries like construction or agriculture. Alternatively, stock data might be available from administrative sources, for example from Ministries (e.g. Ministry of Agriculture, Ministry of Economic Affairs), or from information from large companies working on the area of land clearing and land contouring or their trade organisations.

8.54. If no (reliable) direct information on stocks is available, an alternative could be to use the available flow information that is often available from investment surveys for industries that work on the area of land improvements. The available information on flows — part of P.51g GFCF — can probably be accumulated in order to get an estimate for the stock of land improvements. Another, more sophisticated method could be to use the perpetual inventory method (PIM) and make assumptions on service lives and depreciation rates to derive the stock values of land improvements.

8.55. In some cases the values of land improvements might be an integral and inseparable part of the stocks of AN.111 dwellings, AN.1121 buildings other than dwellings, or AN.1122 other structures. In these cases these stocks will be overestimated while the stock value of AN.1123 land improvements will be underestimated for the same amount. As a consequence, at the more aggregated level the over- and underestimation cancel out and the values are expected to be correct.

Separation of land improvements from land

8.56. Land improvements can sometimes only be observed in combination with the land itself. However, as can be concluded from the above, in the ESA 2010 and SNA 2008 land and land improvements are classified as separate assets. In case land and land improvements cannot be separated from each other, ESA 2010 and SNA 2008 recommend to register the composite asset in the category representing the greater part of its value. In the Manual on the Changes between ESA 1995 and ESA 2010, this case is elaborated in Chapter 11 ([84]). Accounting examples are included as well.

8.57. However, in order to keep the asset categories as 'pure' as possible and to enhance international comparability, this compilation guide advises to make serious attempts to separate land improvements from the land itself.

8.58. If only a combined value is available, it might be possible to make an estimate of land improvements by using the residual approach discussed in Chapter 6.2. The value of the land improvements can be determined by using PIM. Subsequently the value of land can be derived as the difference between the combined value and the PIM-based estimates for land improvements.

8.59. The PIM enables the compilation of a net stock estimate for land improvements, using data on GFCF and consumption of fixed capital in land improvements. This is only possible if sufficiently long time series of both the GFCF and consumption of fixed capital in land improvements is available. The PIM is described in detail in Measuring Capital (OECD, 2009) ([85]).

8.60. As land improvements will lead to major improvements in the quantity, quality or productivity of land, the value of the land will usually rise significantly because of the improvements. Data on value changes could be helpful to separate the land improvements from the land. In the paragraphs 8.73–8.76 accounting examples 3 and 4 will show how this separation can be realised.

([84]) Eurostat, *Manual on the Changes between ESA 1995 and ESA 2010*, 2014, Chapter 11. Available at http://ec.europa.eu/eurostat/documents/3859598/5936825/KS-GQ-14-002-EN.PDF/b247b032-6910-4db8-8f29-cb71d575752f

([85]) Organisation for Economic Co-operation and Development, *Measuring Capital: OECD Manual, Second edition*, Paris, 2009. Available at http://www.oecd.org/std/productivity-stats/43734711.pdf

Borderline between land improvements and dwellings and other buildings and structures

8.61. A first borderline case concerns costs of site clearance to prepare it for construction. One might argue that these costs could be considered as a type of land clearance and therefore should be considered as land improvements. However, the costs of clearing and preparing the site for construction are included with the costs of new dwellings or other buildings and structures and are thus included in the value of the buildings and structures (AN.111, AN.1121, AN.1122) on the balance sheet. They should not be considered as land improvements (AN.1123).

8.62. SNA 2008 paragraph 13.46 mentions that land improvements 'includes site clearance, preparation for the erection of buildings or planting of crops and costs of ownership transfer' should be interpreted in a very restrictive way. These activities should only be classified as land improvements if they would, eventually in the future, facilitate the erection of buildings on the land.

8.63. As mentioned in paragraph 8.47, some types of other structures form a second borderline case (which is, however, only relevant on the four digit level detail). Three possibilities can be distinguished.

8.64. Firstly, wells and watering holes that are integral to the piece of land in question are to be registered as land improvements (AN.1123). In exceptional cases structures like dams, dykes and irrigation systems could also be considered as land improvements, provided that they are integral to the land and belong to one owner.

8.65. Secondly, seawalls, dykes, dams and major irrigation systems which are in the vicinity of the land but not integral to it, which often affect land belonging to several owners and which are often constructed by government, are not to be classified as land improvements, but as other structures (AN.1122).

8.66. Thirdly, a structure like a dam can also be built with another purpose besides keeping out water. For example, a dam may be built to produce electricity. In such a case the dam is always to be registered as other structures (AN.1122), even if it is integral to the land.

Accounting examples

8.67. In the paragraphs below four accounting examples are elaborated. First, each of the examples shows under what circumstances a certain asset should be registered as land, land improvements or other structures. In that sense they illustrate the borderline cases that were discussed above. Second, the examples show how information on stocks, transactions and other changes can be used together to derive missing values. Third, the examples illustrate what transaction, other changes and asset codes/categories should be used in different situations.

Example 1: land entering the asset boundary as a consequence of activity in the vicinity

8.68. Not all land included in the geographic surface area of a country is necessarily within the asset boundary of the SNA 2008 and ESA 2010. Land may make its economic appearance when it is transferred from a wild or waste state to one in which ownership may be established and the land can be put to economic use. It may also acquire value because of activity in the vicinity, for example, land that becomes more desirable and thus more valuable because of a new development being established nearby or the creation of an access road.

8.69. Assume that a piece of land is in a wild state and is not yet within the asset boundary. In year *t* a road is constructed that gives access to this piece of land; construction costs amount to 25. Consumption of fixed capital in year *t* will be 2. After the road construction, the land can be used for agricultural purposes. The government, that is now the owner of this parcel, will be able to sell this land to a farmer for a value of 40. No changes in price levels are considered.

Table 8.2: Elaboration example 1

Classification of assets	IV.1 Opening balance sheet	III.1 and III.2 Transactions	III.3.1 Other changes in volume	III.3.2 Holding gains and losses	IV.3 Closing balance sheet
Other structures (road) (AN.1122)	-	25 (P.51g) -2 (P.51c)	-	-	23
Land (AN.211)	-	-	40 (K.1)	-	40

Source: TF on Land and other non-financial assets, fictitious data

8.70. The construction costs (25) and consumption of fixed capital (– 2) should be registered as transactions in GFCF and consumption of fixed capital respectively. At the end of year t the balance of these entries will appear on the closing balance sheet (25 – 2 = 23). The road is in the vicinity of the land, but not integral to it. Therefore the road should be classified as other structures (AN.1122) and not as land improvements (AN.1123). Because of the improved accessibility of the land, the land (AN.211) can be put to economic use and will enter the asset boundary. Its value on the closing balance sheet equals 40. The difference between the value of the land on the closing balance sheet and the opening balance sheet also equals 40; this change should be registered in the other changes in volume of assets account as an economic appearance of assets (K.1).

Example 2: land value change as a consequence of activity in the vicinity

8.71. A second example concerns land that is included within the asset boundary, but that has a low value, for example because it is very dry and infertile. The building of an irrigation channel may lead to a significant rise in the value of the land. Assume that at the beginning of year *t* a dry and infertile area of land has a value of 20. Assume that an irrigation channel will be built in year *t* in the vicinity of the piece of land. As a consequence it will become possible to irrigate this piece of land — and also other parcels in the surrounding area. The construction costs of this irrigation channel amount to 60. The annual consumption of fixed capital for the irrigation channel will be 3. At the end of year *t* the value of this area of the land has increased to 75 (for example determined on the basis of prices of comparable irrigated pieces of land). Again, assume that there are no changes in the price levels.

Table 8.3: Elaboration example 2

Classification of assets	IV.1	III.1 and III.2	III.3.1	III.3.2	IV.3
	Opening balance sheet	**Transactions**	**Other changes in volume**	**Holding gains and losses**	**Closing balance sheet**
Other structures (irrigation channel) (AN.1122)	-	60 (P.51g)	-	-	57
		-3 (P.51c)			
Land (AN.211)	20	-	55 (K.1)	-	75

Source: TF on Land and other non-financial assets, fictitious data

8.72. In this example the cost of building the irrigation channel (60) is treated as GFCF again. This should be entered in the accounts, together with the consumption of fixed capital (– 3) as a transaction. The irrigation channel is not integral to the land: it is only in the vicinity of the land and it can also serve other pieces of land. Therefore it should not be considered as land improvements (AN.1123), but it must be registered on the closing balance sheet as other structures (AN.1122) for a value of 57. Conceptually, the rise in the value of the land (because it benefits from the presence of the irrigation channel) should be considered as another change in volume of land and thus be registered as an economic appearance of an asset (K.1). However, identifying the driving factors behind such a change in value in practice may be very difficult. Thus, if detailed information does not exist it is reasonable to consider such as change in practice as a revaluation of the land and register this as nominal holding gains and losses (K.7). For further information on this and the decision of the Advisory Expert Group, see Annex A of Chapter 2.

Example 3: land entering the asset boundary as a consequence of activities on the piece of land

8.73. In the third example a piece of land that initially was in a wild state, will enter the asset boundary because the government decides to construct watering holes on this particular parcel. Assume that the construction costs amount to 19 and that the consumption of fixed capital in the first year equals 1. At the end of the year it could be determined that comparable parcels of land have a market value of 35. In this year the prices of land did not change.

Table 8.4: Elaboration example 3

Classification of assets	IV.1	III.1 and III.2	III.3.1	III.3.2	IV.3
	Opening balance sheet	Transactions	Other changes in volume	Holding gains and losses	Closing balance sheet
Land improvements (watering holes)) (AN.1123)	-	19 (P.51g) -1 (P.51c)	-	-	18
Land (AN.211)	-	-	17 (K.1)	-	17

Source: TF on Land and other non-financial assets, fictitious data

8.74. The creation of watering holes has to be registered as a transaction in GFCF (19), while the consumption of fixed capital should be entered for a value of – 1. As only this particular piece of land benefits from the investments, the result of the investments should be expressed on the closing balance sheet under the item land improvements (AN.1123) for a value of 18. The total value of the land including the improvements equals 35; as the land improvements part equals 18, the land part can be calculated as the residual: 35 – 18 = 17. This value should be registered under the item land (AN.211) on the closing balance sheet. As the land was not yet recognised as an asset at the beginning of the year, the full amount of 17 should be registered as an economic appearance of assets (K.1).

Example 4: land improvements as a consequence of activities on the piece of land

8.75. The fourth example considers a case where land is again included in the asset boundary, but has a low value because it is dry and infertile. At the start of year *t* its value equals 20. To improve this situation some ditches are constructed on this particular piece of land. The costs of constructing the ditches amount to 15. The consumption of fixed capital in the first year will be 1. At the end of year *t* the value of this parcel including the ditches has risen to 60 (for example this value could be determined on the basis of prices of pieces of land of comparable quality in the surroundings). No price changes occurred in year *t*.

Table 8.5: Elaboration example 4

Classification of assets	IV.1	III.1 and III.2	III.3.1	III.3.2	IV.3
	Opening balance sheet	Transactions	Other changes in volume	Holding gains and losses	Closing balance sheet
Land improvements (ditches) (AN.1123)	-	15 (P.51g) -1 (P.51c)	-	-	14
Land (AN.211)	20	-	26 (K.1)	-	46

Source: TF on Land and other non-financial assets, fictitious data

8.76. Actions that lead to major improvements in the quality of land should be considered as leading to the asset item land improvements if the actions are limited to this particular piece of land only ('integral' to the land). The improvement actions (15) themselves — digging the ditches — have to be registered as a transaction in GFCF. Consumption of fixed capital should be entered for the value – 1. The resulting item for land improvements on the closing balance sheet will equal 14 (= 15 – 1). The value on the closing balance sheet for land (AN.211) can be calculated as the difference between the total value of the parcel after the improvements minus the value of the land improvements: 60 – 14 = 46. Finally, the difference between the values of land on the closing and opening balance sheet equals the value change resulting from the land improvements: 46 – 20 = 26. In accordance with SNA 2008 paragraph 12.21, the excess in the increase in the value of land over the value of land improvements should be recorded as economic appearance of assets (K.1). However, as in example 2, this may be difficult in practice. Therefore, this value change may be registered as nominal holding gains and losses (K.7), assuming that the economic use of the land does not change as a result of the land improvement. In the case where the use changes, this should be identifiable, and therefore, the value change should be registered as an economic appearance of assets (K.1) on the other changes in volume of assets account. Again, see the annex to Chapter 2 for further information.

Case study estimating land improvements: Finland

In the national accounts of Finland this asset type (land improvements, AN.1123) mainly consists of investments in land under cultivation (AN.2112), i.e. land improvement investments in agriculture and forestry. Land improvements in other industries are mostly included in other structures (AN.1122).

Major improvements in agriculture include fertilising and subsoil drainage. The value of fertiliser use is based on data to be found in agricultural enterprise and income statistics and the Farm Accountancy Data Network. The data sources can be considered quite reliable. Data on the sale of agricultural fertilisers and other land improvement materials are used for control purposes. For the subsoil drainage, the industry organisation Subsoil Drainage Centre collects data about it by area and cost in hectares. Expenditures on land improvements can also be found in Statistics on the Finances of Agricultural and Forestry enterprises collected by Statistics Finland.

In the forestry industry, these investments consist of forest management and land improvement to be found in the Statistics on Forestry and Forest Improvement Activities collected by the Finnish Forest Research Institute. It contains: preparation of renewal area, artificial regeneration, seedling stand care, refining young forest, thinning of thicket and forest fertilisation.

Above mentioned land improvements are recorded as gross fixed capital formation by industries in the national accounts. Because they are part of fixed assets, consumption of fixed capital has to be estimated. This is done by using the perpetual inventory method (PIM). For the land improvements on agriculture, a service life of 30 years is applied, and for the forestry 50 years, respectively. Straight line depreciation function is used for both of the industries concerning land improvements.

As a result of recorded investments and the PIM, the net capital stock for the land improvements (AN.1123) can be calculated. The PIM also includes a price index for the land improvements, and applying that the holding gains and losses can be calculated.

The net capital stock of land improvements can then be utilised in land estimates by deducting the value of the net capital stock from the market value of land. In other words, it is assumed, that the estimated market value of land includes also the value of land improvements.

The case of land improvements in Finland is similar to example 4 presented in this chapter. Tables 8.6 and 8.7 below show the registration of land improvements and corresponding land type in the accounts for agricultural land and forestry land in Finland in 2012.

Table 8.6: Registration of land improvements and land value on agricultural land

Classification of assets	IV.1	III.1 and III.2	III.3.1	III.3.2	IV.3
	Opening balance sheet	Transactions	Other changes in volume	Holding gains and losses	Closing balance sheet
Land improvements (ditches) (AN.1123)	1 270	33 (P.51g)	-	72	1 286
		-89 (P.51c)			
Market value of agricultural land (AN.211 + AN.1123)	20 976	-	-	-	22 000
Land (AN.211)	19 706	-	-19 (K.1)	1 027	20 714

Source: TF on Land and other non-financial assets, fictitious data

Table 8.7: Registration of land improvements and land value on agricultural land

Classification of assets	IV.1	III.1 and III.2	III.3.1	III.3.2	IV.3
	Opening balance sheet	Transactions	Other changes in volume	Holding gains and losses	Closing balance sheet
Land improvements (ditches) (AN.1123)	3 339	212 (P.51g)	-	116	3 438
		-229 (P.51c)			
Market value of forestry land	9 407	-	-	-	9 683
Land (AN.211)	6 068	-	-	177	6 245

Source: TF on Land and other non-financial assets, fictitious data

8.3 Treatment of government owned land

Introduction

8.77. The compilation of balance sheets needs information about the values of the stocks of assets held by individual institutional units or groups of units (sectors). According to the SNA 2008 and ESA 2010, government is one of the five mutually exclusive institutional sectors that make up the total economy.

8.78. As one essential asset, land owned by the government can be used for carrying out a range of tasks pertaining to urban planning, environmental protection, real estate management, and economic development more generally. To this end, a good measure of land in terms of both physical quantities and monetary values is of crucial importance.

8.79. The measurement of total land owned by the government as well as the information on the composition of the land across different types is indispensible for the purpose of policy making, decision taking, and economic analysis.

8.80. For instance, the financial crisis of 2007–2008 has given rise to an increasing concern about the capability of payment of some debt-entrenched nations. To address this concern, information on the liquidity condition among a variety of assets, including different types of land owned by the government in question is of significant value.

8.81. In addition to the common issues associated with the measurement of land in general, which are covered by other chapters of this compilation guide, measuring government owned land has some special characteristics that are worth being discussed and clarified.

8.82. This chapter provides some discussions in respect of government owned land, with the view of putting forward a number of recommendations for treating government owned land in a way that is consistent with the SNA 2008 and ESA 2010.

8.83. The rest of the chapter is organised as follows. The next section points out that land owned by government should be registered in the balance sheets only if it is within the asset boundary as defined by the SNA 2008 and ESA 2010. A suggested classification of government owned land into different types is also presented in this section.

8.84. In the following section, the three most common cases related to licences and permits to use government owned land are discussed. The focus is put on how to appropriately record land owned by government, but used by other institutional units, into the relevant balance sheets.

8.85. Valuing government owned land is the main topic in the subsequent section, which makes it clear that despite thin markets and scarce information, all land owned by government and within the asset boundary should be valued.

8.86. To facilitate the empirical estimation in practice, the last two sections provide country cases that consist of an overview about national practices in this regard, drawn from a 2013 OECD-Eurostat survey, and a specific case study with Germany as an example.

Scope of balance sheets for government owned land

8.87. Besides the land that is unambiguously recognised as being owned by the government, any other land within the border of a nation's territory over which ownership cannot be acknowledged could also be considered as owned by the government by default. But this pragmatic treatment does not mean that all the land should be recorded in the balance sheets of the nation.

8.88. Some kinds of remote and inaccessible land such as deserts and tundras are outside of the asset boundary as stipulated by the SNA 2008 and ESA 2010, and therefore should not be included in the balance sheets at all. The reason is that even though the ownership could be identified to these lands, they are not capable of bringing any economic benefits to their owners, given the technology existing at the time.

8.89. Within the asset boundary as defined by the SNA 2008 and ESA 2010, land owned by the government can be sub-classified into different types of land. One option for classification as suggested in Chapter 3 of this compilation guide is displayed in Table 8.8. All the different types of land as listed in Table 8.8 and owned by government should be recorded in the balance sheets with the government as owner.

8.90. Information about the physical quantities (areas) of land is relatively easy to collect, for example, by means of national land use and land cover statistics. But in general, the evaluation of government owned land involves several complicated issues, even though some useful information can be extracted directly from public records, such as national cadastres.

Table 8.8: Composition of government owned land

Classification of land
1. Land underlying buildings and structures (AN.2111)
1.1 Land underlying dwellings (AN.21111)
1.2 Land underlying other buildings and structures (AN.21112)
2. Land under cultivation (AN.2112)
2.1 Agricultural land (AN.21121)
2.2 Forestry land (AN.21122)
2.3 Surface water used for aquaculture (AN.21123)
3. Recreational land and associated surface water (AN.2113)
4. Other land and associated surface water (AN.2119)

Source: TF on Land and other non-financial assets

Licences and permits to use government owned land

8.91. In many countries licences and permits to use land are generally issued by government since government claims ownership of the land on behalf of the community at large. There are basically three different cases that may apply to the use of land that is owned by the government, but used by other institutional units ([86]).

8.92. The first case is that the government may permit the land to be eternally used by other institutional units, which is equivalent to the outright sale of land to the user. As a consequence, this case should be recorded as the ownership transfer from the government to the user.

8.93. With the second and most frequent case, the government may extend or withhold permission to continued use of the land from one year to the next. Then the use of the land should be treated as a resource lease. The user as the lessee will regularly pay resource rent to the government as the lessor. As a result, the land should be recorded in the balance sheets of the government.

8.94. The third case is that the government may allow the land to be used for an extended period of time in such a way that in effect the user controls the use of the land during this time with little if any intervention from the government as the legal owner. This case leads to the creation of an asset for the user, distinct from the land itself but where the value of the land and the created asset (licence and permit) allowing use of the land are linked.

8.95. For example, a buyer of a private building situated on government owned land may sometimes pay for the right to use the land for an extended period in an upfront payment, which is normally recorded as the acquisition of an asset, rather than a payment of resource rent. When the building changes ownership, the purchase price includes an element representing the present value of future rent payments.

([86]) The same treatments discussed here apply if the land is privately owned and its use by other institutional units is permitted.

8.96. In such a case, the land is recorded in the SNA 2008 as if the ownership is transferred along with the building above the land. If, at the end of the land lease, a further payment is liable for extension of the lease for another long-term period, this should be recorded as capital formation and an acquisition of an asset in a manner similar to costs of ownership transfer on purchase and sale of an asset.

8.97. The borderline between the second and third cases is not always clear-cut. For instance, a resource lease on land may be considered as a sale of an asset connected to land if the lease satisfies most or all of the same criteria as those listed for payments for a mobile phone licence to be considered a sale of an asset (SNA 2008 paragraphs 17.317–17.318).

Valuation of government owned land

8.98. Not all tracts of land owned by government are subject to licences and permits. It is common that certain parts of government owned land, such as national parks and public roads, may be provided for use by other institutional units with either no or economically insignificant fees being charged.

8.99. Another observation concerning government owned land is that it is rarely, if ever traded on the market compared with land owned by private owners, even if the latter is not often traded either. All these characteristics regarding government owned land have brought about thorny valuation issues.

8.100. Under such circumstances with scarce market information, the common rule to follow for evaluating government owned land is to seek out land with similar attributes (size, quality, location, etc.) but owned by private owners, and to which the market information could be found.

8.101. This rule may apply reasonably well for valuation of some types of land, such as land under cultivation, and land under dwellings. However, for some other types of land, in particular, the land underlying public infrastructure like national parks and roads, there are significant difficulties.

8.102. Some argue that the value of the land underlying public infrastructure has already been included in the value of the adjacent land, since the latter depends, i.a., on its accessibility to public infrastructure; including a separate value in the balance sheets for the land underlying public infrastructure will lead to double counting.

8.103. Further, the land underlying public infrastructure does not seem to generate any economic benefits to the government, and thus does not have a genuine market value as long as it is used as such. In many countries, land underlying public roads and dams may not be allowed to be sold since the roads and dams built on it have public functions (e.g. providing access to residential areas, and protecting the surroundings from being flooded) that have been predetermined by a government urban development plan.

8.104. Based on these arguments, but also due to measurement difficulties, the land underlying public infrastructure is frequently not valued in the balance sheets for land in some countries. However, these arguments do have their weaknesses.

8.105. First of all, there is no land in the world whose value would not be affected by the surrounding lands and structures. In this case, the surplus value accrued to the adjacent land due to easy accessibility may well be used to estimate the value of the land underlying the public infrastructure. But recording the value of both lands in the balance sheets is not double counting, simply because each land has its own value, no matter how the one is reflected in the other.

8.106. Second, given that the fundamental function of government is to provide public services, it is customary to expect government not to benefit from owning public infrastructure and the land underlying. However, even though the government benefits nothing economically and the land underlying cannot be sold on the market, it does not necessarily mean that the underlying land is of no value.

8.107. The land underlying public infrastructure is obviously different from inaccessible deserts and remote tundras. Because the former has value and can be realised if allowance is made for use by other institutional units ([87]), however, the latter has no value even if allowance is made for use by other institutional units, given the technology level and scientific knowledge at the time.

8.108. It is conceptually clear that the land underlying public infrastructure should also be valued in spite of measurement difficulties that will be encountered in practice. In some countries, there are now examples of privately owned toll ways and railways, from which information may be drawn for evaluating the comparable land owned by government.

8.109. In cases where it is almost impossible to find the comparable land, other methods may be employed. One alternative is to start with surface data of public infrastructure and to find an appropriate price per surface unit. Another alternative is to use relevant information from nearby privately owned land. More research along these lines should be encouraged.

Overview of country practices

8.110. In the 2013 OECD-Eurostat survey of general methods applied by national statistical institutes for estimating depreciation, and net capital stocks of dwellings and other buildings and structures, a question was raised about whether and how the value of government owned land is estimated in each country participating in the survey ([88]). Among the survey respondents, the vast majority do not have any estimates of government owned land. Nonetheless there are a few countries that do have such estimates.

8.111. In the Czech Republic, estimates of government owned land are derived from the cadastral data for the whole economy by using information from the State Land Office, the Forest Management Institute and other statistical surveys. In Romania, for the balance sheets of general government, data for agricultural land is provided, which is generated by the statistics in the Ministry of Finance.

8.112. The Australian Bureau of Statistics obtains relevant data on government owned land from the Australian Commonwealth and State Treasuries, and public non-financial corporations. Although the majority of government owned land is captured, for some States, however, the value of land under roads is missing because the Treasuries of these States do not include it.

8.113. Draft estimates of land underlying dwellings and land underlying buildings other than dwellings that are owned by general government are available in Italy. They are obtained by applying the land-to-structure ratio (i.e. the ratio of underlying land to net capital stock of buildings) for total economy to the relevant net capital stock of buildings owned by general government. All the estimates of the net capital stock of buildings just mentioned are derived by means of the perpetual inventory method. However, no estimates are currently available for land underlying other structures, due to the lack of information.

8.114. In the Netherlands, the capital stock of dwellings and non-residential buildings by institutional sector is used to divide land underlying dwellings and buildings into sectors including general government. For agricultural land, government reports are used to divide leased farmland into sectors. Nevertheless, the Netherlands do not have appropriate data to estimate government owned land underlying roads and other structures.

([87]) In principle, the public infrastructure together with the underlying land could be sold to private owners. Under the discretion of private owners, economic benefits can be drawn by charging fees from the users. The land underlying public infrastructure could also be reallocated for other purposes, then the increase (or decrease) in value due to this change should be treated as other changes in volume due to reclassification of assets.

([88]) The survey was designed and sent to countries by the Eurostat-OECD Task Force on Land and other non-financial assets. More on this survey and its corresponding results can be found in Chapter 6.5 of this compilation guide.

8.115. Drawing upon the survey results, one may conclude that though conceptually clear, valuing government owned land, in particular, those types of land underlying other structures such as public infrastructure, is still challenging in practice. One of the main difficulties is lack of appropriate data.

8.116. In the following paragraphs, a specific country case study is presented with the view of showing how the statistics within and beyond national statistical institutes can be utilised to draw helpful information about the value of government owned land, especially the land underlying public infrastructure such as public roads.

Case study government owned land: Germany

In Germany at least two possible sources exist that can be employed to generate useful information about the value of government owned land. The first is the annual budget funds provided by the Federal Ministry of Finance, the other is the statistics of land purchasing values published by the Federal Statistical Office.

Source 1: information from budget funds data

The budget funds contain information on the amount of money not only planned, but also actually spent by the central government for acquisition of land, including land used for federal roads and its corresponding building projects. Table 8.9 provides such information over a number of years.

Table 8.9: Money spent by the German central government for acquisition of land
(million EUR)

Year	Money spent
2000	66.56
2001	67.01
2002	67.36
2003	59.29
2004	64.78
2005	47.71
2006	40.32
2007	24.68
2008	49.11
2009	23.54
2010	27.76
2011	28.50
2012	22.27
2013	22.09

Source: German Budget funds

Although the information revealed in Table 8.9 is rather rough and only at a highly aggregated level, once supplemented with other data on the corresponding physical quantities (such as area in square metres), it is of use for deriving information about the average transaction price of government owned land under public roads.

Source 2: information from transactions data

The second source in Germany, the statistics of land purchase values, has more detailed information with regard to government owned land. It includes data about transactions covering both selling and buying of land by government, the number of transactions, the transacted areas, and the corresponding average purchasing values ([89]).

Table 8.10 provides information about the land that is purchased by the central/state government from different sellers, including natural and legal persons, housing associations, other central/state government institutions, and local government. Table 8.12 gives the corresponding information about land that is sold by the central/state government to the others. Table 8.11 and Table 8.13 present similar information for local government.

The second row of Tables 8.10 to 8.13 indicates the purposes for which the transacted land is supposed to be used. The heading of 'overall' refers to the transacted land that can be used for all building types; while that of 'building land' means that the transacted land is to be used for industrial and public transport purposes or just as open land.

([89]) More detailed information (in German language) is available at https://www.destatis.de/DE/Publikationen/Thematisch/Preise/AlteAusgaben/BaulandpreiseJAlt.html

Table 8.10: Land purchased by the central/state government from different sellers, 2012

Sellers	Natural person		Other legal person		Housing association		Central/state government		Local government	
Purposes	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**
Number of transactions	559	514	98	70	11	9	19	16	88	67
Purchased area (1 000 m²)	1 312	1 265	1 264	1 161	48	26	67	56	374	147
Average purchasing value (EUR/m²)	6.92	5.66	13.64	8.11	114.93	8.34	5.28	3.45	28.99	16.00

Source: Statistisches Bundesamt

Table 8.11: Land purchased by local government from different sellers, 2012

Sellers	Natural person		Other legal person		Housing association		Central/state government		Local government	
Purposes	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**
Number of transactions	2 758	1 612	457	300	97	65	131	88	153	114
Purchased area (1 000 m²)	5 705	2 912	1 973	1 037	160	89	857	262	430	301
Average purchasing value (EUR/m²)	25.94	16.54	41.92	32.00	31.69	27.73	19.86	14.20	88.50	92.49

Source: Statistisches Bundesamt

Table 8.12: Land sold by the central/state government to different buyers, 2012

Sellers	Natural person		Other legal person		Housing association		Central/state government		Local government	
Purposes	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**
Number of transactions	1 005	56	173	58	11	:	19	16	131	88
Purchased area (1 000 m²)	1 103	160	1 767	1 338	47	:	67	56	857	262
Average purchasing value (EUR/m²)	71.86	25.61	70.23	13.63	87.36	:	5.28	3.45	19.86	14.20

Source: Statistisches Bundesamt

Table 8.13: Land sold by local government to different buyers, 2012

Sellers	Natural person		Other legal person		Housing association		Central/state government		Local government	
Purposes	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**	**Overall**	**Building land**
Number of transactions	22 876	1 728	1 668	745	312	9	88	67	153	114
Purchased area (1 000 m²)	20 350	5 315	10 136	6 610	652	63	374	147	430	301
Average purchasing value (EUR/m²)	84.01	37.57	55.55	37.32	243.32	167.55	28.99	16.00	88.50	92.49

Source: Statistisches Bundesamt

Compared with Table 8.9, information drawn from Tables 8.10 to 8.13 is much richer. It provides information of transacted government owned land not only in values but also in physical quantities. This allows the construction of the average purchasing values that can be further applied to valuing the government owned land with comparable characteristics.

In addition, by offering the detailed information about the transactions of government owned land among different institutional sectors (shown as buyers and sellers in Tables 8.10 to 8.13), Tables 8.10 to 8.13 make it possible to provide valuable information for constructing the relevant sector accounts.

The information drawn from Tables 8.10 to 8.13 is, however, still highly aggregated, although the heterogeneity has been reduced to some extent if compared with that from Table 8.9, because the latter provides information at an even more aggregated level.

Therefore, it is worth mentioning that to value government owned land, the average purchasing values at this level as shown in Tables 8.10 to 8.13 should be applied with due caution. Nonetheless the German case study has clearly demonstrated the possibility and feasibility of valuing government owned land, even the land underlying public roads.

9

The value of land and its contribution to wealth

9.1. The previous chapters of this guide focused on the different approaches in which to decompose the total value of a real estate into its two basic components: the value of land underlying dwellings and the value of the construction itself. The objective of this chapter is to show the analytical implications of data on the value of land and the value of dwellings in microeconomic and macroeconomic analysis.

9.2. This chapter is composed of two sections. The first section concentrates on the microeconomic approach to analyse the value of dwellings and the value of land underlying dwellings in relation to households' wealth. It also looks at some macroeconomic aspects closely related to this. The second section introduces the importance of wealth and its two underlying components in macroeconomic analysis and policy making.

9.1 Dwellings and land underlying dwellings as a storage of wealth

Introduction

9.3. The concept of wealth generally refers to the financial and non-financial resources at the disposal of an institutional unit or sector shown in the balance sheet. These resources are summarised in the balancing item, net worth. Net worth is defined as the value of all the assets owned by an institutional unit or sector less the value of all its outstanding liabilities. For the economy as a whole, the sum of non-financial assets and net claims on the rest of the world is often referred to as national wealth (SNA 2008 paragraph 13.4).

9.4. On the balance sheets, there are many non-financial assets comprising wealth. They are dwellings, other buildings and structures, machinery and equipment, cultivated biological resources, intellectual property products, inventories, land, mineral and energy reserves, non-cultivated biological resources, etc. Among them, dwellings, other buildings and structures, and land are often the most valuable ones.

9.5. This chapter focuses on the importance of dwellings and land underlying dwellings as a component of wealth. More specifically, the role of dwellings as a storage of wealth is explained at the households' level as well as at the national level. At each level, the inclusion of the value of underlying land will lead to a more realistic analysis.

9.6. With the increasing availability of balance sheet data for non-financial assets (through the ESA 2010 transmission programme Table 26) and initiatives like the Task Force 'Household Perspective' [90], the data to measure wealth is becoming more accessible. This will help to better understand the source of households' wealth. The compilation of non-financial assets by institutional sector is a substantial improvement in the availability of national accounts data. By combining this data with financial assets and liabilities it completes the data on wealth.

The concept of dwellings and wealth analysis

9.7. The concept of wealth generally refers to economic resources in the form of assets and liabilities. For example, the SNA 2008 refers to the wealth of an economy's inhabitants as being the levels of an economy's assets and liabilities at particular points of time (SNA 2008 paragraph 1.2).

9.8. As explained in the introduction wealth will be analysed using two different approaches: a microeconomic and macroeconomic approach. In the micro level approach the definition of wealth, or net worth, is the value of all assets owned by a household less the value of all their liabilities at a particular point in time. At the macro level it is the same definition, assets less liabilities.

9.9. There are differences between the micro and macro approaches. The micro assets component 'principal residence' is composed of two components, 'fixed assets' and 'natural resources', without the separation of land from the buildings that stand on it [91]. This is the most distinctive feature of the standard micro data representation of households' wealth compared to the macro level representation. The micro approach is quite different from the balance sheet approach in the SNA 2008 where the value of buildings and land value underlying them are separately recorded as produced non-financial assets and non-produced non-financial assets, respectively. From this point of view, wealth analysis is mostly based on the combined value of land and structure rather than separating them like balance sheets in the SNA 2008.

9.10. The major difference between the micro data approach and the balance sheet approach (macro data) of the SNA 2008 comes from their different objectives. The micro data approach focuses on households' wealth as it is. So the separation of underlying land from dwellings is not necessary. In addition, the micro data approach reflects more closely the real estate market transaction where the combined value of the dwelling and its underlying land is traded

(90) This Task Force has been mandated by the so-called 'Eurostat/INSEE Sponsorship group' to study the feasibility of the recommendations done in the Stliglitz/Sen/Fitoussi report and strengthen the availability of non-financial assets statistics.

(91) Organisation for Economic Co-operation and Development, *OECD Guidelines for Micro Statistics on Household Wealth*, 2013, p. 225. Available at http://www.oecd.org/statistics/OECD-Guidelines-for-Micro-Statistics-on-Household-Wealth.pdf

as one asset. Contrastingly, one of the purposes of capital measurement in the SNA 2008 is to estimate consumption of fixed capital in order to measure net income which is more relevant to economic welfare. Thus, dwellings must be depreciated and separately recorded from the underlying land which is not depreciated.

9.11. Although the balance sheet approach of the SNA 2008 does not share the common objective of the micro level approach, the combined value of structures and their underlying land on the balance sheet should be analysed when wealth is tackled. This harmonisation will lead to more consistent comparisons of wealth at the micro level as well as at the macro level.

Dwellings as a storage of wealth for households and non-profit institutions serving households

9.12. In the developments related to the 2007–2008 financial crisis there have been many initiatives to strengthen the availability of statistical data. In this respect there are two points of reference regarding non-financial assets and wealth. The first one is the Stiglitz/Sen/Fitoussi Report (2009) ([92]) that emphasised the role of measuring wealth to assess the economic sustainability of growth and promotion of a wider availability of country specific balance sheet statistics. In this respect recommendation 3 of the Stiglitz/Sen/Fitoussi Report states: 'Income and consumption are crucial for assessing living standards, but in the end they can only be gauged in conjunction with information on wealth. A household that spends its wealth on consumption goods increases its current well-being but at the expense of its future well-being. The consequences of such behaviour would be captured in a household's balance sheet, and the same holds for other sectors of the economy, and for the economy as a whole. To construct balance sheets, comprehensive accounts of assets and liabilities are needed. Balance sheets for countries are not novel in concept, but their availability is still limited and their construction should be promoted.'

9.13. The Stiglitz/Sen/Fitoussi Report highlighted the importance of the compilation of households' balance sheets in assessing the economic well-being of the households sector. Since not all countries compile such statistics the 'Eurostat/INSEE Sponsorship group' launched several recommendations aimed at:

— promoting the development of households' balance sheets;

— improving the availability of comparable data;

— expanding the coverage of assets to dwellings and land, so as to better monitor how households' net worth changes with developments in the housing market;

— improving the timeliness of the compilation of households' balance sheets.

9.14. A second initiative is the G-20 Data Gaps Initiative, through its Recommendation 15 that calls for developing a strategy to promote the compilation and dissemination of the balance sheet approach, flow of funds, and sectoral data, starting with G-20 economies.

9.15. The two initiatives listed above support the use of all the available data to compile balance sheet statistics. One of the data sources that are promoted to accomplish better balance sheet statistics is households' surveys, particularly by the incorporation of survey data on households' wealth in addition to income and consumption data ([93]) ([94]).

Dwellings as a storage of wealth at the national level

9.16. In national accounts the items dwellings and land underlying dwellings are reported as part of non-financial assets on the balance sheet. Table 9.1 displays the composition of the balance sheet with the focus on these assets.

Table 9.1: Balance sheet, summary

Assets		Liabilities and net worth	
AN	Non-financial assets		
AN.1	Produced non-financial assets		
AN.11	Fixed assets		
AN.111	Dwellings		
AN.2	Non-produced non financial assets		
AN.21	Natural resources		
AN.211	Land		
	of which:		
	Land underlying dwellings		
AF	Financial assets	AF	Financial liabilities
		B.90	Net worth

Source: SNA 2008, ESA 2010

([92]) See footnote 2.

([93]) Fesseau, M. and M. L. Mattonetti, *Distributional Measures Across Household Groups in a National Accounts Framework*, 2013, pp. 1–8. Available at http://www.oecd-ilibrary.org/docserver/download/5k3wdjqr775f.pdf?expires=1420814342&id=id&accname=guest&checksum=587E48A38DE5B324A7BBF2FCB2C431D5

([94]) Organisation for Economic Co-operation and Development, 2013, pp. 119–143. Available at http://www.oecd.org/statistics/302013041e.pdf

9.17. For households ([94]) the value of housing wealth is composed of the value of the dwelling and its underlying land and is usually the most valuable item in their balance sheet. Table 9.2 illustrates the shares of financial, non-financial, housing wealth, and land as a percentage of total wealth. As seen in Table 9.2, the importance of housing wealth differs among countries from 63 % of household wealth in France to 25 % in the United States. For European households, housing wealth is around half of the wealth of this sector. The share of land, as a proportion of housing wealth, represents 33 % in France, the largest share of the countries shown, and the smallest share in Germany with 16 %.

Table 9.2: Shares of financial and non-financial wealth in gross wealth of households and non-profit institutions serving households
(% of total wealth)

Country ([1])	Financial wealth	Non-financial wealth	Housing wealth	Value of land
Italy	40	60	57	27
Germany	43	57	52	16
The Netherlands	54	46	43	21
United States	69	31	25	-
France	35	65	63	33

([1]) Data for Italy, The Netherlands and France refer to 2011. Data for Germany and United States refer to 2012.
Sources: Banca d'Italia, DESTATIS, Deutsche Bundesbank, ONS, CBS, FED; ECB calculations.

9.18. The varying role of housing as part of wealth may be attributed to specific economic developments such as the extent of mortgage loans or a relatively high land price compared to other wealth elements in each country.

9.19. The value of dwellings (excluding land) is one of the most important items even at the national level. As shown in Table 9.3, the share of dwellings to the total value of produced non-financial assets constitutes 54.9 % for France and 22.2 % for Japan. Although some of the differences across countries may be attributed to different service lives and estimation methods for dwellings (see Chapter 6.5 for a discussion of service lives and depreciation), it is clear that dwellings make up a large share of the value in national balance sheets.

Table 9.3: Composition of produced assets, year 2010
(%)

	Asset ([1])	Australia ([2])	France	Japan	Canada	Czech Republic
N.1	Produced assets	100.0	100.0	100.0	100.0	100.0
N.11	Fixed assets	96.4	93.1	95.5	94.0	90.3
N.111	Tangible fixed assets	87.4	88.5	93.6	89.1	88.1
N.1111	Dwellings	34.8	53.2	22.2	45.5	24.5
N.1112	Other buildings and structures	39.2	26.5	59.0	35.6	49.2
N.1113	Machinery and equipment	12.8	8.5	12.4	8.0	14.3
N.1114	Cultivated assets	0.6	0.3	0.0	-	0.1
N.112	Intangible fixed assets	4.1	4.6	1.9	4.9	2.2
N.12	Inventories	3.6	5.0	4.5	6.0	9.1
N.13	Valuables	-	1.9	-	-	0.6

([1]) The classification is according to SNA 1993
([2]) For Australia this sum presents a difference in the original data
Source: OECD database

9.20. Table 9.3 does not tell the whole story of the importance of dwellings wealth at the national level. Land underlying dwellings should also be included when national wealth is concerned. Land underlying dwellings occupies a large portion of the value of total land. Hence the importance of dwellings combined with the underlying land will not be diminished even though the scope of wealth is extended to the value of land.

([95]) A number of countries are not able to provide a breakdown of households and non-profit institutions serving households (NPISHs) in their sector accounts. As a consequence, to ensure the highest level of comparability, the figures shown here are for the households sector including NPISHs.

9.21. Complete analysis of the importance of housing wealth across countries can only be done when the value of land is fully compiled on the balance sheet. A few countries currently estimate the total value of land on the national balance sheet as shown in Table 9.4: Australia, Canada, Czech Republic, France, Japan and Korea. The share of produced assets to total non-financial assets range from 47 % to 67 %, the largest share is shown for the Czech Republic and the smallest share is shown for Korea. Whereas non-produced assets (including land) shares range from 33 % to 53 % of total non-financial assets.

Table 9.4: National balance sheet, portion in the value of total non-financial assets, 2011
(%)

	Australia	Canada	Czech Republic	France	Japan	Korea
Total non-financial assets	100	100	100	100	100	100
Produced assets	51	65	67	54	58	47
Non-produced assets	49	35	33	46	42	53
Value of total land	39	35	7	44	42	53

Sources: OECD database

9.2 Households' real estate wealth data as an indicator in macroeconomic and financial analysis

9.22. The availability of granular statistics on dwellings and land are important for policy makers when assessing economic stability and macroeconomic imbalances. As argued in Chapter 9.1 households' housing wealth and its key constituents dwellings and land underlying dwellings are large components of total households' wealth. This chapter focuses on the macroeconomic consequences of changes in house prices and households' wealth which are driven mainly by fluctuations in the value of dwellings and the value of land underlying dwellings. In this respect having detailed statistics on value of land and dwellings could help to pinpoint the driving elements that cause macroeconomic imbalances related to the households sector and help understanding of the causes of the vulnerability of the households sector in times of financial instability.

9.23. This chapter does not intend to provide arguments for debate, it rather tries to serve the purpose of presenting national accounts statistics, more specifically those statistics described and developed through the compilation guide, which can be used to capture real estate market developments and imbalances. It should be noted that the compilation guide focuses on the valuation of land, whereas housing wealth and housing prices reflect the value (changes) of the real estate property, including the structure and underlying land. However, as argued earlier, the value of land represents a large portion of the property's total value. Besides that, in many cases it represents the difference between the market value and the so-called replacement value of the structure which is estimated using the perpetual inventory method.

9.24. The impact of households' wealth (which is the value of dwellings and land owned by the household) on households' expenditure, as well as on economic stability is of interest to economists and policy makers, in particular following the role that housing market developments have played in the 2007–2008 financial crisis in several countries. Source data used for the estimation of the (total) value of land, such as (average) land prices, may be a useful indicator themselves. As land is an asset, large price variations, similar to properties, may indicate unsustainable developments. Land prices can also be an early indicator of future housing market developments, as a shortage of land and increasing prices will impact on the price of future building projects. Cooper (2012) shows a positive correlation between real house price developments and real households' consumption. This can be explained by the fact that house prices impact on households' consumption through standard macro models (confidence, wealth effects) and real-financial linkages (working through collateral, loans and banks).

9.25. Housing wealth represents a significant fraction of total households' portfolio wealth in most economies (see Table 9.2 from Chapter 9.1). Price developments can have a significant impact on consumer confidence, households' behaviour and households' expenditure as the property can, apart from providing shelter, be used as an investment (storage of wealth, expected rent income) or may provide room for additional, 'free' collateral (housing equity withdrawals for consumption purposes). Such developments do not necessarily lead to macroeconomic, financial and price instability. However, past or expected high price increases of housing may alter households' investment behaviour, the allocation of financial and non-financial investment and households' indebtedness. As a result of a sudden decline in property prices, households' balance sheets and thus wealth deteriorate, which may alter their consumption behaviour, which, in certain circumstances, can lead to macroeconomic instability. Worsening economic conditions may then further impact on the situation of the household, reduce income, employment and investment, and increase the debt to income ratio.

9.26. To limit the harm of a rapidly deflating or even bursting bubble, which is possibly costly in both economic and social terms, one could argue that policy strategies are required to prevent imbalances (e.g. housing bubbles) occurring. Whether or not to act is subject to debate and preferences depend heavily on the economic and political background. Apart from the discussion about the preferred policy to deal with asset price bubbles (i.e. 'leaning against the wind' (ECB, 2010)), the views on the potential negative impact of housing bubbles on long run economic growth diverge and scepticism exists whether bubbles can be detected in real time allowing policy makers to react in a timely manner (Alessi and Detken, 2011).

9.27. Mainstream economic theory suggests that it is impossible to (accurately) predict the timing of a housing bubble bust, as (fully) informed investors would anticipate the sharp drop of house prices, sell their real estate disallowing a boom-bust cycle. Nevertheless the behaviour of (a set of) housing market indicators can provide fairly reliable indications of the likelihood of a bust, subject to the inevitable limitation of accuracy as to the precise timing of the event (Kannan et al., 2009).

9.28. Housing market indicators cover a wide range of (financial and non-financial) ratios and economic indicators to evaluate the valuation of residential property. They compare the observed levels with those that proved to be unsustainable in the past. Kannan et al. (2009) for example find that 'inflation, output and the stance of monetary policy do not typically display unusual behaviour ahead of asset price busts. By contrast, credit, shares of investment to gross domestic product (GDP), current account deficits, and asset prices typically rise, providing useful, if not perfect, leading indicators of asset price busts.' Of which '(..) large deviations in credit relative to GDP, in the current account balance, in the residential investment share of GDP, and in house prices themselves are particularly predictive of an impending housing price burst.'

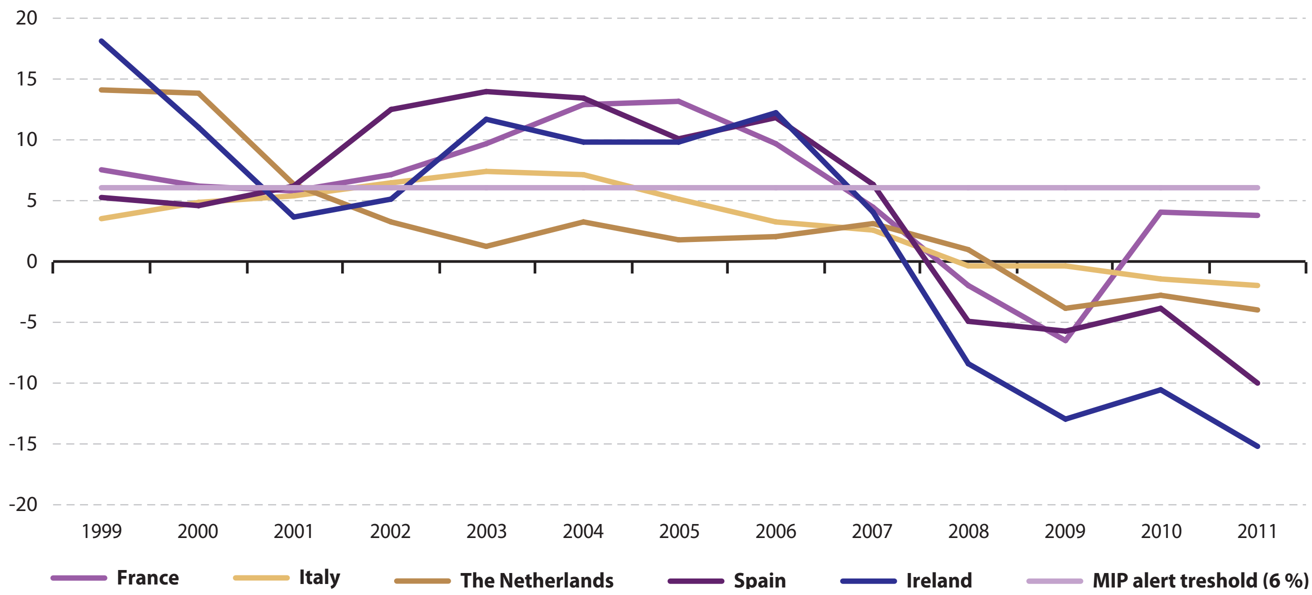
9.29. Regardless of the chosen policy approach, central banks around the world closely monitor property market developments. Furthermore, following the global financial, and related European sovereign debt crisis, the European Union (EU) introduced the European Systemic Risk Board (ESRB) in 2010 in order to strengthen macro prudential oversight at EU level. Furthermore, in 2011 the Macroeconomic Imbalances Procedure (MIP) was established in the EU, focusing on possible causes of macroeconomic misalignments [96]. Based on the ESRB and MIP indicators the so-called dashboard/scoreboard has been set up, which aims to identify possible risks for financial and macroeconomic stability in Europe at an early stage, enabling supervisory mechanisms and policymakers to act and prevent or mitigate these risks. To allow for real time or early stage warning both the dashboard and scoreboard include a number of indicators, among which are some related to house prices and households' indebtedness.

9.30. Two relevant aspects of the housing market, which also play an important role in the build-up of imbalances (bursting of a housing bubble), are the valuation of housing and the indebtedness of households. The affordability of housing can be measured as the price level of dwellings to households' disposable income, monthly or annual mortgage burden to households' disposable income, price-to-rent ratio, estimates for owner-occupied housing costs derived from the user cost approach or simply by analysing house price developments over time corrected for general inflation, i.e. changes in 'real house prices' (see also ECB, 2011). As the ratios or growth in real house prices reach unsustainable levels, fewer households are able to afford to acquire property, leading to a decrease in demand and, eventually, to falling house prices. Figure 9.1 shows the trend of deflated house prices in some countries; the impact of the financial crisis in 2007–2008 is clearly observable. The economic imbalances that this situation provoked determined important readjustments in the real estate market.

9.31. As discussed earlier, estimations for the value of land and source data described in the compilation guide can contribute to macroeconomic and financial analyses. First, the value of property, which consists of both the value of the structure and the land it sits on, can be used to make estimates for loan-to-value ratios (see Figure 9.2). Note that this indicator represents the aggregate resident households sector and does not provide any information of dispersion within the households sector. Large differences may persist between ratios for wealthy and poor households as well as first time buyers and 'longer established' households due to the repayment of the principle (loan).

(96) For more detailed information regarding regulation and the background of both sets of indicators see http://www.esrb.europa.eu/home/html/index.en.html (European Systemic Risk Board) and http://ec.europa.eu/economy_finance/economic_governance/macroeconomic_imbalance_procedure/index_en.htm (Macroeconomic Imbalances Procedure).

Figure 9.1: Deflated house prices, selected countries
(% year-on-year change)



Source: European Commission, MIP scoreboard

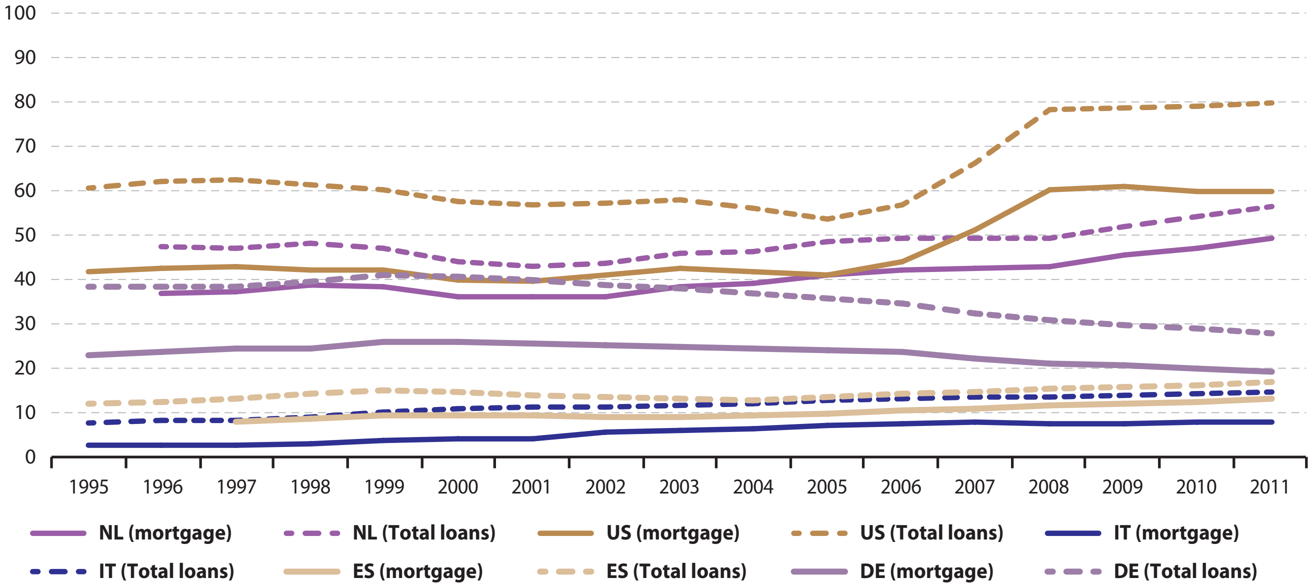
9.32. Debt to income and debt to equity (or loan-to-value and loan-to-collateral) ratios are different measures of households' indebtedness. The debt to income indicates to what extent the debt is sustainable (see Figure 9.3). An alternative measure would be the monthly or annual cost of house ownership, which includes, besides mortgage payments, also utilities, structural insurance, mandatory service charges, regular maintenance and repairs and property taxes, as a ratio of monthly or annual income (see also EU statistics on income and living conditions (EU-SILC)).

9.33. The loan-to-value ratio measures financial leverage, as it shows the ratio of the loan taken to the value of the underlying property. In some countries households can take out a loan larger than the value of the underlying property, leading to a ratio greater than 1. The ratio may also exceed 1 due to second mortgages or mortgage equity withdrawal, though the effect of this has been small in most European countries. Sharply decreasing house prices, while keeping the amount of the loan unchanged, leads to a sharp increase of indebtedness relative to equity, which in turn may lead to financial and macroeconomic instability.

9.34. To capture housing bubbles one should concentrate on country specific analysis as there may be major structural and policy differences across countries, which may change over time. Real house prices (and demand for houses) are influenced by demographic developments, housing supply, households' gross disposable income, structural unemployment, financial (de)regulation, interest rates and taxation (Andrews, 2010). Andrews (2010) shows that quite large differences between OECD countries exist for responsiveness of housing supply, mortgage interest deductions (tax relief) and transaction cost. The same applies for the very different ratios of owner-occupiers across countries.

Figure 9.2: Households' loan to value ratio, selected countries

(%)



Source: FED, CBS, Deutsche Bundesbank, DESTATIS, Banca d'Italia, Banco d'Espana, OECD, ECB calculations.

9.35. Similarly to households' housing wealth, estimates for commercial property following the compilation guide and in particular Chapter 7 (sectorisation and cross-classification) are useful to assess developments in commercial property owned by other institutional sectors. In 2008 the sovereign debt crisis in Europe showed problematic consequences of deteriorating prices of commercial property portfolios of banks, which needed to be supported by national governments (which, in turn, received support from the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM)). In addition, more accurate estimates of net wealth of non-financial corporations and governments contribute to net worth assessment of these sectors.

9.36. The usefulness of housing market indicators depends heavily on the timeliness of relevant data. Macroeconomic and macro prudential analysis require more timely dissemination of the wide range of statistics used as housing market indicators. The Federal Reserve (FED) for example publishes real estate developments (flows and outstandings) in its quarterly Flow of Funds Accounts for the United States approximately 60 days after the end of the reference period. However in Europe, statistics for non-financial assets are disseminated relatively late, especially when compared to main aggregates and financial statistics. Currently the transmission deadline for non-financial assets is 24 months after the reference period, whereas quarterly main aggregates are available 2 months after the reference period and residential property prices 90 days after the reference period.

Figure 9.3: Debt to income ratio, selected countries
(% of households' gross disposable income)

(1) Last observation for Cyprus and Greece refers to 2011
Source: European Central Bank, ESRB dashboard

9.37. Finally, for compiling regional aggregates, such as euro area or EU aggregates, the comparability of the statistical methods applied is an important requirement for analysis and policy uses. Given the difficulty to identify observable (price) characteristics of land, the international efforts undertaken with this compilation guide to improve the comparability of current methods are an important step in this direction.

List of abbreviations and acronyms

AEG	Advisory Expert Group
AN	non-financial assets
BIS	Bank for International Settlements
CORINE	Coordination of information on the environment
CV	combined value
DGI	Data Gaps Initiative
ECB	European Central Bank
ESA	European System of Accounts
ESA 2010 TP	transmission programme connected to European System of Accounts 2010
EU	European Union
Eurostat	statistical office of the European Union
FSB	Financial Stability Board
FSS	Farm Structure Survey
GDP	gross domestic product
GFCF	gross fixed capital formation
HHS	households' housing stock
HHW	households' housing wealth
IAAO	International Association of Assessing Officers
IAG	Inter-Agency Group on Economic and Financial Statistics
IEEAF	Integrated Environmental and Economic Accounting for Forests
IMF	International Monetary Fund
INSPIRE	Infrastructure for Spatial Information in Europe
ISWGNA	Inter-Secretariat Working Group on National Accounts
LSR	land-to-structure ratio
LUCAS	Land Use / Cover area Frame Survey
NPISH	non-profit institutions serving households
NPV	net present value
NSI	national statistical institute
NUTS	Nomenclature of territorial units for statistics
OECD	Organisation for Economic Co-operation and Development
PIM	perpetual inventory method
PPP	public-private partnerships
RPPI	residential property price index
SEEA	System of Environmental-Economic Accounting
SNA	System of National Accounts
UN	United Nations
UNSC	United Nations Statistical Commission
VT	value table
WB	World Bank

Glossary

Absorption price value	The sale value of the residential property.
Accrual accounting	Accrual accounting records flows at the time economic value is created, transformed, exchanged, transferred or extinguished. This means that flows that imply a change of ownership are entered when the change occurs, services are recorded when provided, output at the time products are created and intermediate consumption when materials and supplies are being used. It is different from cash recording and, in principle, from due-for-payment recording, defined as the latest time payments can be made without additional charges or penalties.
Acquisitions less disposals of non-produced assets (NP)	Transactions in assets that have not been produced within the production boundary, and that may be used in the production of goods and services. This covers transactions in natural resources (which includes land), in contracts, leases and licences and in goodwill and marketing assets. Acquisitions less disposals of non-produced assets are recorded in the capital account of the sectors, the total economy and the rest of the world.
Administrative data (or sources)	Administrative data refers to information collected primarily for administrative (not research) purposes. This type of data is collected by government departments and other organisations for the purposes of registration, transaction and record keeping, usually during the delivery of a service. Types of administrative data for land include cadastre, land registry, and tax data.
Agricultural land (AN.21121)	Land primarily used for agricultural purposes. The total of land under temporary or permanent crops, meadows and pastures as well as land with temporary fallow; this category includes tilled and fallow land, and naturally grown permanent meadows and pastures used for grazing, animal feeding or agricultural purpose. Excludes land underlying farm dwellings, farm buildings or other corresponding structures.
Appraisal method	An approach to obtain the combined value of land and structures on the land, whereby a method for officially assessing real estate values for the purpose of taxation is used. This method is taking into account the physical characteristics and location of each real estate when assessing its value.
Arable land	Arable land is land worked (ploughed or tilled) regularly, generally under a system of crop rotation. Arable land can be broken down into irrigable arable land and non-irrigable arable land.
Asset boundary	Assets as defined in ESA 2010 and SNA 2008 are entities that must be owned by some unit, or units, and from which economic benefits are derived by their owner(s) by holding or using them over a period of time. The asset boundary is the borderline between assets that do and do not fulfil these conditions.
Balance sheet	A statement, drawn up in respect of a particular point in time, of the values of assets owned and of the liabilities owed by an institutional unit or group of units.
Bottom up approach	The bottom up approach takes low level data and aggregates it to produce totals.
Building permit value	The value of the dwelling as reported on the Building Permit Survey.
Buildings other than dwellings (AN.1121)	Buildings other than dwellings, including fixtures, facilities and equipment that are integral parts of the associated structures and costs of site clearance and preparation. Public monuments identified primarily as non-residential buildings are also included. Other examples of buildings other than dwellings include warehouse and industrial buildings, commercial buildings, buildings for public entertainment.
Cadastre	A cadastre is a comprehensive register of the property within a country. It is commonly maintained to record the physical status and legal ownership of land and is often used (or at least initially created) for taxation purposes. A cadastre could also be used for land management or planning purposes. It includes very detailed maps showing the location of the parcels of land and dimensions of land (e.g. square metres). It also typically includes the use of the land, ownership, and value of the individual parcels of land.

Capital account	The capital account records acquisitions less disposals of non-financial assets by resident units and measures the change in net worth due to saving (final balancing item in the current accounts) and capital transfers. The capital account makes it possible to determine the extent to which acquisitions less disposals of non-financial assets have been financed out of saving and by capital transfers. It shows a net lending corresponding to the amount available to a unit or sector for financing, directly or indirectly, other units or sectors, or a net borrowing corresponding to the amount which a unit or sector is obliged to borrow from other units or sectors.
Catastrophic losses (K.3)	Catastrophic losses include major earthquakes, volcanic eruptions, tidal waves, exceptionally severe hurricanes, drought and other natural disasters; acts of war, riots and other political events and technological accidents, such as major toxic spills or release of radioactive particles into the air. Catastrophic losses recorded as other changes in volume result from large-scale, discrete and recognisable events that destroy economic assets. For the asset land an example is the deterioration in the quality of land caused by abnormal flooding or wind damage.
Census	A census is a survey conducted on the full set of observation objects belonging to a given population or universe.
Collection sources	Information gathered from targeted surveys.
Combined value	The total value of the real estate that combines the value of the structure or biological resources (such as, crops) attached directly to land, as well as the value of land itself.
Consolidation	Consolidation is a method of presenting the accounts for a set of units as if they constituted one single entity (unit, sector, or subsector). It involves eliminating transactions and reciprocal stock positions and associated other economic flows among the units being consolidated. As land is a non-financial asset without a counterpart liability consolidation is not applicable to stocks of land.
Consumption of fixed capital (P.51c)	The decline in value of fixed assets owned, as a result of normal wear and tear and obsolescence. The estimate of decline in value includes a provision for losses of fixed assets as a result of accidental damage which can be insured against. Consumption of fixed capital covers anticipated terminal costs, such as the decommissioning costs of nuclear power stations or oil rigs or the clean-up costs of landfill sites. Such terminal costs are recorded as consumption of fixed capital at the end of the service life, when the terminal costs are recorded as gross fixed capital formation. As land is not subject to obsolescence, no consumption of fixed capital should be calculated and registered for land.
Consumption value method	Method to value standing timber. According to this method different stumpage prices are used for the various categories of timber in terms of both species and age or diameter classes. These stumpage prices are applied to the respective stocks (per species and per age or diameter class) in order to calculate the total value of the standing timber.
Cost approach	One of the three main methods of appraisal whereby the appraiser relies upon information about input costs for building a replacement of the structure and adds an estimated land value. Data on current cost of rebuilding and depreciation data adjusted to the local market are required.
Costs of ownership transfer	All costs associated with acquiring and disposing of assets: professional charges or commissions, trade and transport costs separately invoiced, taxes related to acquisition or disposal of the asset, (dis)installation costs, terminal costs. The costs of ownership transfer are treated as gross fixed capital formation in the capital account. In the balance sheets such costs are, in general, incorporated in the value of the asset to which they relate even if the asset is non-produced, but for the asset land the cost of ownership transfer is a produced asset that, by convention, should be registered as part of the fixed asset land improvement.
Cross-classification	Refers to the breakdown of land by sector that is further subdivided into land by type and/or by industry.
Demolition	Deliberate destruction of a building.

Depreciated value of construction costs	See cost approach.
Depreciation	See consumption of fixed capital.
Depreciation (geometric, linear)	Depreciation, or consumption of fixed capital, is the decline, during the course of the accounting period, in the current value of the stock of fixed assets owned and used by a producer as a result of physical deterioration, normal obsolescence or normal accidental damage. (SNA 2008, Chapter 6). Under geometric depreciation, the value of the stock declines by a constant proportion each period. Under linear depreciation, the value of a cohort of assets declines by a constant amount each period.
Depreciation rate	The (assumed) rate at which an asset is depreciated in value during an accounting period. If geometric deprecation is applied the depreciation rate is constant across time for a specific type of asset.
Direct method	The direct method may be viewed as a physical inventory method to estimate the value of land. The area data of each parcel of land can be considered as physical inventory. If the appropriate price for the land is available, the value of land can be computed directly by multiplying the area of each parcel of land by its corresponding price.
Discounted cash flows	A method to determine the combined value of land and structures by estimating the net present value of future rentals of the property. The net present value is obtained by the discounted stream of future incomes minus costs. This method can be used when price information for the property is not available.
Dwellings (AN.111)	Buildings that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences. Houseboats, barges, mobile homes and caravans used as principal residences of households are also included, as are public monuments identified primarily as dwellings. Costs of site clearance and preparation are also included. Examples include residential buildings, such as one- and two-dwelling buildings and other residential buildings intended for non-transient occupancy. Uncompleted dwellings are included to the extent that the ultimate user is deemed to have taken ownership. Dwellings acquired for military personnel are included as well. The value of dwellings is net of the value of land underlying dwellings, which is included in land.
Economic (dis)appearance of assets (K.1, K.2)	Economic appearance/disappearance of assets is the increase/decrease in the volume of produced and non-produced assets that is not the result of production. It includes entries/exits from the asset boundary of natural resources. The transfer of land from a wild or waste state to land that can be put to economic use is an example of an economic appearance.
Economic asset	An economic asset is a store of value representing the benefits accruing to the economic owner by holding or using the entity over a period of time. This implies that effective ownership over the asset can be exercised such that the owner is able to derive economic benefits from the asset. An economic asset is a means of carrying forward value from one accounting period to another.
Economic benefits	An economic benefit is defined as denoting a gain or positive utility arising from an action. The economic benefits consist of primary incomes such as operating surplus, where the economic owner uses the asset, or property income, where the economic owner lets others use it. The benefits are derived from the use of the asset and the value, including holding gains and losses, that is realised by disposing of the asset or terminating it.
Economic territory	The economic territory is the area under the effective economic control of a single government. However, currency or economic unions, regions, or the world as a whole may be used, as they may also be a focus for macroeconomic policy or analysis.
Economic use of land	Use of land that generates economic benefits (e.g. habitation, agriculture etc.)

ESA 2010	European system of accounts. ESA 2010 is an internationally compatible accounting framework for a systematic and detailed description of a total economy, its components and its relations with other total economies. ESA 2010 is consistent with the System of National Accounts (SNA) 2008, but adapted to the circumstances and needs of the European Union. It has legal status in the European Union. See also SNA 2008.
Farm Structure Survey (FSS)	The FSS is a farm census every 10 years and a large sample survey every 3–4 years in between. It covers the numbers of farms of various sizes and records many characteristics of each farm surveyed. This information enables the total area of the various types of agricultural land to be estimated for small regions (NUTS II) and larger ones (NUTS I), and for each Member State as a whole.
Financial lease	A financial lease is one where the lessor as legal owner of an asset passes the economic ownership to the lessee who then accepts the operating risks and receives the economic benefits from using the asset in a productive activity. In return, the lessor accepts another package of risks and rewards from the lessee. It is frequently the case that the lessor, though the legal owner of the asset, never takes physical delivery of the asset but consents to its delivery directly to the lessee. One indicator of a financial lease is that it is the responsibility of the economic owner to provide any necessary repair and maintenance of the asset. Under a financial lease, the legal owner is shown as issuing a loan to the lessee with which the lessee acquires the asset. Thereafter the asset is shown on the balance sheet of the lessee and not the lessor; the corresponding loan is shown as an asset of the lessor and a liability of the lessee.
Financial wealth	Financial wealth is the value of the net financial assets of an institutional unit, sector or the total economy. It is calculated by taking the total market value of all the financial assets of the entity and then subtracting all its liabilities.
Fixed assets (AN.11)	Produced non-financial assets that are used repeatedly or continuously in production processes for more than one year. Fixed assets consist of dwellings, other buildings and structures, machinery and equipment, weapons systems, cultivated biological resources, and intellectual property products.
Flows	Flows reflect the creation, transformation, exchange, transfer or extinction of economic value. They involve changes in the value of an institutional unit's assets or liabilities. Economic flows are of two kinds: transactions, and other changes.
Forestry land (AN.21122)	Land used for forestry. It does not include the forest itself, only the underlying land. Land that is predominantly used for agricultural purposes or urban use is also excluded.
Government owned land	Government owned land refers to those parts of land to which the ownership is acknowledged, and from which economic benefits can be drawn, by government units (including social security funds) by holding, using or allowing others to use the land. Information on market transactions of government owned land is normally scarce, which necessitates special considerations when valuing the land owned by government.
Gross capital stock	The stock of assets surviving from past investment and re-valued at purchasers prices of new capital goods of the current period.
Gross fixed capital formation (P.51g)	Gross fixed capital formation is measured by the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain specified expenditure on services that adds to the value of non-produced assets. Included are dwellings, other buildings and structures (including major improvements to land), machinery and equipment, weapons systems, cultivated biological resources, costs of ownership transfer on non-produced assets, R&D, mineral exploration and evaluation, computer software and databases, entertainment, literary or artistic originals, other intellectual property products.
Hedonic approach	An indirect estimation method that utilises a hedonic regression model to deconstruct the real estate property value (that is, the combined value of land and structures) into separate prices for the land and for the structure.

Hedonic regression models	A statistical process for calculating a linear relationship between a dependent variable (Y) and a set of independent variables($X_1,\ldots,X_n$). Output of the regression model is a set of regression coefficients ($b_1,\ldots,b_n$).
Holding gains and losses	See nominal holding gains and losses.
Households	Group of persons who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food. In general, each member of a household should have some claim upon the collective resources of the household. At least some decisions affecting consumption or other economic activities must be taken for the household as a whole.
Households as producers	Entrepreneurs producing market goods and non-financial and financial services (market producers) provided that the production of goods and services is not by separate entities treated as quasi-corporations.
Housing census/survey	A housing census (or survey) is the total process of collecting, compiling, evaluating, analysing and publishing or otherwise disseminating statistical data pertaining, at a specified time, to all living quarters and occupants thereof in a country or in a well-delimited part of a country.
Housing wealth	Housing wealth represents the market value of all the residential assets located in a particular country.
Improvements, major	Major improvements to existing fixed assets, such as buildings or computer software, increase their productive capacity, extend their service lives, or both. Improvements are treated as gross fixed capital formation that leads to an increase in the value of the improved asset rather than the creation of a new asset. Major improvements to land in its natural state are, on the other hand, treated as the creation of a new fixed asset and are not regarded as giving rise to an increase in the value of the natural resource. If land, once improved, is further improved, then the normal treatment of improvements to existing fixed assets applies.
Income approach	One of the three main methods of appraisal, based on the concept that current value is the present worth of future benefits. In its simplest form, it requires an appraiser to (1) determine net annual income, (2) determine the capitalisation rate, and (3) capitalise income into an estimate of value.
Indirect method	A method to estimate the value of land indirectly, either by obtaining the value of the land indirectly or by obtaining the price of the land indirectly. There are three different indirect estimation methods discussed in the compilation guide: the residual approach, the land-to-structure approach, and the hedonic approach. (See description of each approach.)
Industry	A group of establishments engaged in the same, or similar, kinds of activity.
Institutional sector	A grouping of institutional units. Institutional units are economic entities that are capable, in their own right, of owning assets, incurring liabilities and engaging in economic activities and in transactions with other entities.
Institutional units	Institutional units are economic entities that are capable of owning goods and assets, of incurring liabilities and of engaging in economic activities and transactions with other units in their own right.
Investment flows	Value of acquisitions less disposals of fixed assets.
Irrigable arable land	Irrigable arable land is arable land area which could, if necessary, be irrigated in the reference year using the equipment and the quantity of water normally available on the holding.
Kitchen gardens	Gardens of farm households in which they grow fruit and vegetables for their own consumption. Any surplus, which may be considerable, is sold on the market. For national accounts purposes kitchen gardens should be included in land underlying buildings and structures.
Land cover	Land cover refers to the observed physical and biological cover of the Earth's surface and includes natural vegetation and abiotic (non-living) surfaces.

Land improvements (AN.1123)	Land improvements are the result of actions that lead to major improvements in the quantity, quality or productivity of land, or prevent its deterioration. Examples include the increase in asset value arising from land clearance, land contouring, creation of wells and watering holes. Land improvements, according to this definition, may apply to any type of land (and is not restricted to, for example, agricultural land).
Land registry	A land registry registers the ownership of property.
Land underlying buildings and structures (AN.2111)	Land on which dwellings, non-residential buildings and structures are constructed or into which their foundations are dug, including yards and gardens deemed an integral part of farm and non-farm dwellings and their corresponding access roads. Land underlying buildings and structures also includes land underlying public or private transport infrastructure like highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways and waterways. Building land on which construction of (farm) dwellings, non-residential buildings or structures take place or for which such construction activities are planned, are included in this category as well.
Land underlying dwellings (AN.21111)	Land on which dwellings are constructed or into which their foundations are dug, including yards and gardens deemed an integral part of farm and non-farm dwellings and access roads to farm dwellings. Building land on which construction of dwellings takes place or for which such construction activities are planned, are included in this category as well.
Land underlying other buildings and structures (AN.21112)	Land on which non-residential buildings and structures are constructed or into which their foundations are dug, including land underlying public or private transport infrastructure like highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways and water ways. Building land on which construction of non-residential buildings or structures take place or for which such construction activities are planned, are included in this category as well.
Land use	Territory characterised according to its current and future planned functional dimension or socio-economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational).
Land-to-structure ratio	Ratio of the value of land to the value of the structure on the land.
Land-to-structure ratio approach	An indirect estimation method that obtains the value of the land by multiplying the depreciated structure value by the land-to-structure ratio.
Licences and permits	Licences and permits are official documents which give the licencee permission to do, use, or own something. As regards the licences and permits to use a natural resource in general, and land in particular, three cases are of special interests: (1) The licencee can use the land permanently, which is equivalent to the outright sale of land; (2) The permission to continued use of the land from one year to the next may be extended or withheld, which is a resource lease in the form of the lessee (licencee) regularly paying rents to the lessor; (3) The land may be used for an extended period in such a way that in effect the licencee controls the use of the land during this period with little if any intervention from the legal owner, which leads to the creation of an asset for the licencee, distinct from the land itself but where the value of the land and the created asset allowing the use of the land are linked.
Macroeconomic approach	Approach that focuses on the movement and trends in the economy as a whole.
Main-land use principle	The principle of main land use implies that plots of land that cannot be accurately measured or distinguished are classified to the type of land that is regarded as the main use of the surrounding area.
Market price of land	The price of land at a certain point of time that would result if the property would be sold in a 'free market'.
Market valuation of land	Market valuation is valuation against prices that are current on the date to which the balance sheet relates. Land should thus be valued as if it was acquired at the date to which the balance sheet relates.
Microeconomic approach	Approach that focuses on factors that affect the decisions made by firms and individuals.

Multicollinearity	Two or more variables in a regression model are highly correlated and one of the variables can be predicted by the other variables.
Net capital stock/ wealth capital stock	The stock of asset surviving from past investment adjusted for price changes and depreciation and other volume changes. The net stock captures the wealth aspect of capital and they are the entries for the balance sheets.
Net present value (NPV)	The net present value method is a method that can be applied to value an asset if there is no appropriate market price available. According to the NPV method the market value can be approximated by estimating the stream of net future earnings and discounting it to the present by applying an appropriate interest rate.
Net stocks of structures (see net capital stock)	The value of the stock of structures at the end of a period, net of depreciation and other volume changes. Structures include dwellings, other buildings and structures, improvements, and transfer of ownership costs.
Net worth	The value of all the non-financial and financial assets owned by an institutional unit or sector less the value of all its outstanding liabilities. Net worth is the balancing item in the balance sheets. The net worth can be calculated for institutional units and sectors and for the total economy.
Netting	Net recording concerns a registration whereby the values of some elementary items are offset against items on the other side of the account (for example asset against corresponding liability) or which have an opposite sign. As land can only appear on the asset side of the balance sheet and as the value is always positive, stocks of land cannot be netted.
Nominal holding gains and losses (K.7)	Nominal holding gains and losses that relate to an asset are the increases or decreases in the asset's value accruing to its economic owner as a result of increases or decreases in its price. They have to be registered on the revaluation account.
Non-cultivated biological resources (AN.213)	Animal, tree, crop and plant resources that yield both once-only and repeat products over which ownership rights are enforced but for which natural growth and/or regeneration is not under the direct control, responsibility and management of institutional units. Examples are virgin forests and fisheries within the territory of the country. Only those resources that are currently, or are likely soon to be, exploitable for economic purposes should be included.
Non-financial assets (AN)	Non-financial items over which ownership rights are enforced by institutional units, individually or collectively, and from which economic benefits may be derived by their owners by holding, using or allowing others to use them over a period of time. Non-financial assets are further subdivided into those that are produced and those that are non-produced.
Non-financial wealth	Non-financial wealth represents the portion of wealth constituted by non-financial assets, at the disposal of an institutional unit or sector as shown in the balance sheet.
Non-irrigable arable land	Non-irrigable arable land is arable land area which cannot be irrigated due to the lack of water for irrigation on the holding.
Non-produced assets	See non-produced non-financial assets.
Non-produced non-financial assets (AN.2)	Non-produced non-financial assets are non-financial assets that have come into existence in ways other than through processes of production. Included are natural resources (which include land), contracts, leases and licences, and purchases less sales of goodwill and marketing assets.
Non-residential land	Land containing mostly stores or businesses, rather than dwellings.
Non-urban land	Land in rural areas.
Notional unit	A notional unit is a unit that does not 'physically' exist, but that is created for statistical purposes. When land located in a territory is owned by a non-resident entity, a notional unit that can be treated as resident is identified for statistical purposes as being the owner of the land. The only exception is made for land and buildings in extraterritorial enclaves of foreign governments (such as embassies, consulates and military bases) that are subject to the laws of the home territory and not those of the territory where they are physically situated.

Operating lease	An operating lease is one where the legal owner is also the economic owner and accepts the operating risks and receives the economic benefits from the asset by using it in a productive activity. One indicator of an operating lease is that it is the responsibility of the legal owner to provide any necessary repair and maintenance of the asset. Under an operating lease the asset remains on the balance sheet of the lessor.
Other buildings and structures (AN.112)	Other buildings and structures consist of buildings other than dwellings, other structures and land improvements. Uncompleted buildings and structures are included to the extent that the ultimate user is deemed to have taken ownership, either because the construction is for own use or as evidenced by the existence of a contract of sale/purchase. Buildings and structures acquired for military purposes are included. The value of other buildings and structures is net of the value of land underlying them, which is included in land (AN.211).
Other changes	Other changes are economic flows, other than those that occur though transactions recorded in the capital and financial accounts, that change the value of assets. Other changes can be decomposed into other changes in volume and nominal holding gains and losses. Synonym for other flows.
Other changes in assets account	The other changes in assets account records changes in assets and liabilities of units, other than in connection with saving and voluntary transfers of wealth, the latter being recorded in the capital and financial accounts. It is divided into the other changes in volume of assets account and the revaluation account.
Other changes in the volume of assets	The other changes in the volume of assets consist of the changes in assets, liabilities, and net worth between opening and closing balance sheets that are due neither to transactions between institutional units, as recorded in the capital and financial accounts, nor to holding gains and losses as recorded in the revaluation account. For the case of land these might, for example, be changes in classification, entry/exit of (a plot of) land into the asset boundary or (measureable) changes in the quality of (a plot of) land.
Other changes in volume	See other changes in the volume of assets.
Other changes in volume not elsewhere classified (K.5)	Other changes in volume not elsewhere classified (K.5) are the effects of unexpected events on the economic value of assets. Examples include unforeseen obsolescence, differences between allowances included in consumption of fixed capital for normal damage and actual losses, degradation of fixed assets not accounted for in consumption of fixed capital, abandonment of production facilities before completion, exceptional losses in inventories.
Other changes in volume of assets account	The other changes in volume of assets account records the changes in assets, liabilities, and net worth between opening and closing balance sheets that are due neither to transactions between institutional units, as recorded in the capital and financial accounts, nor to holding gains and losses as recorded in the revaluation account.
Other land and associated surface waters (AN.2119)	All land and associated surface water within the asset boundary not elsewhere classified.
Other structures (AN.1121)	Structures other than residential structures, including the costs of streets, sewers and site clearance and preparation. Also included are public monuments not classified as dwellings or buildings other than dwellings; shafts, tunnels and other structures associated with mining mineral and energy reserves; and the construction of sea-walls, dykes and flood barriers intended to improve land adjacent but not integral to them. Examples include highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways; waterways, harbours, dams and other waterworks; long-distance pipelines, communication and power lines; local pipelines and cables, ancillary works; constructions for mining and manufacture; and constructions for sport and recreation.
Ownership	Two types of ownership can be distinguished, legal ownership and economic ownership. For national accounts purposes economic ownership is the most relevant concept. The economic owner of entities such as goods and services, natural resources, financial assets and liabilities is the institutional unit entitled to claim the benefits associated with the use of the entity in question in the course of an economic activity by virtue of accepting the associated risks.

Permanent crops	Crops that cover the land permanently. It comprises orchards, vineyards, olive groves and the like. It also includes fruit plantations, nurseries and 'other permanent crops' such as Christmas trees.
Permanent grassland	Permanent grassland is land used permanently (for five years or more) to grow herbaceous forage crops, through cultivation (sown) or naturally (self-seeded) and which is not included in the crop rotation on the holding.
Perpetual inventory method	A widely used method for estimating net capital stocks by accumulating past gross fixed capital formation and deducting accumulated consumption of fixed capital (depreciation) and the remaining value of assets that have reached the end of their service lives.
Physical inventory method	Determination of the physical stock of land that has to be valued. (See direct method)
Produced assets	See produced non-financial assets.
Produced non-financial assets (AN.1)	Non-financial assets that have come into existence as outputs from production processes that fall within the production boundary of the SNA 2008/ESA 2010. They consist of fixed assets, inventories and valuables.
Property price	See real estate price.
Property value assessments	Estimated land and property value typically conducted by specialised assessors.
Public-private partnerships	Public-private partnerships are long-term contracts between two units, whereby one unit acquires or builds an asset or set of assets, operates it for a period of time and then hands the asset over to a second unit. Such arrangements are usually between a private enterprise and government but other combinations are possible, with a public corporation as either party or a private non-profit institution (NPI) as the second party. These schemes are described variously as Public-Private Partnerships (PPPs), Private Finance Initiatives (PFIs), Build, Own, Operate, Transfer schemes (BOOTs) and so on.
Quantity times price approach	An approach to obtain the combined value of land and structures on the land based on information on quantity (i.e. number of dwellings) and the real estate price. This approach is usually applied for residential real estate and cultivated land.
Real estate price	Price of a property sold on the real estate market including the value of land and the value of buildings and other structures attached to land (i.e. combined value).
Recreational land and associated surface water (AN.2113)	Land that is used as privately owned amenity land, parklands and pleasure grounds and publicly owned parks and recreational areas, together with associated surface water.
Renovations	Major repairs that extend the life of an asset. Renovations are treated as capital formation and the value of the repairs and renovations is added to the value of the asset before the work was undertaken. The value of the capital repairs is supposed to be equal to the discounted value of the increased services that the asset will yield, either by increasing the services in each of the remaining years of the initial life length, or extending the life length, or both.
Representative price	A price is representative if it adequately reflects the actual market price for a given plot of land (or property) or for a given land type (or property type).
Residential land	Land containing mostly dwellings, rather than stores or businesses.
Residential Property Price Index (RPPI)	Index based on the market transactions for new and existing dwellings. As such it covers the land and the structure components jointly.
Residual approach	An indirect estimation method that obtains the value of land by subtracting the depreciated structure value from the combined value of structures and land. Generally, the combined value is the real estate value at current market prices; the value of the depreciated structure is usually estimated using the perpetual inventory method (PIM).

Resource lease	A resource lease is one where the owner of a natural resource makes it available to a lessee in return for a payment recorded as rent. In a resource lease the resource asset — for example the land — remains on the balance sheet of the lessor even though it is used by the lessee. A long term lease of land might be treated as an exception and may be taken as the sale of the land.
Retirement (normal, lognormal, Winfrey, Weibull)	'Retirements' and 'discards' refer to the removal of an asset from the capital stock, with the asset being exported, sold for scrap, dismantled, pulled down or simply abandoned. Retirement patterns are frequently measured in the form of a distribution, such as normal, lognormal, Winfrey, or Weibull. (For more details, see Measuring Capital (OECD, 2009), Chapter 13).
Revaluation account	The revaluation account records the holding gains and losses accruing during the accounting period to the owners of financial and non-financial assets and liabilities
Revaluations	See nominal holding gains and losses.
Sale price appraisal ratio (SPAR)	See SPAR method.
Sales comparison approach	One of the three main methods of appraisal, whereby the value of the property is estimated by analysing the sale prices of similar properties.
Sector	See institutional sector.
Sectorisation	Sectorisation is the process of allocating institutional units or data to sectors of the economy.
SEEA 2012	The System of Environmental-Economic Accounting contains the internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics on the environment and its relationship with the economy.
Service lives	The typical length of time in which a fixed asset contributes to production.
Shared land	Shared land concerns the case when two or more economic agents use the same piece of land for economic purposes.
Shared ownership	Shared ownership is a situation where two or more economic agents own one piece of land.
Site clearance	Site clearance concerns the preparation of a piece of land in order to enable the construction of dwellings or other buildings and structures. Basically, the costs of site clearance must be included in the value of the buildings and should not be considered as land improvements.
SNA 2008	System of national accounts (SNA) 2008 is the internationally agreed standard set of recommendations on how to compile measures of economic activity in accordance with strict accounting conventions based on economic principles. The accounting framework provides a comprehensive and detailed record of the complex economic activities taking place within an economy and the interaction between the different economic agents, and groups of agents, which takes place on markets or elsewhere.
SPAR method	An acronym for Sale Price Appraisal Ratio method, an approach to construct a residential property price index which combines the current period selling prices with appraisals (assessed values) pertaining to some earlier base period.
Stocks	Stocks are the holdings of assets and liabilities at a point in time. Stocks are usually recorded at the beginning and end of each accounting period. The accounts that show stocks are called balance sheets. Stocks result from the accumulation of prior transactions and other flows, and they are modified by future transactions and other flows. Thus stocks and flows are closely related.
Stratification approach	Stratification is the process whereby the population is broken down into subsets (called strata) and whereby an independent sample is selected in each subset. The process of stratification may be undertaken on a geographical basis or by reference to some other quality of the population.

Stumpage value method	Method to value standing timber. The stumpage value method calculates an average stumpage price for the total harvest. According to this method the average price is calculated by dividing the stumpage value of the felled timber after deduction of the logging costs by its volume. This average price is applied to the whole stock.
Surface water	Surface water includes any inland waters (reservoirs, lakes, rivers, etc.) over which ownership rights can be exercised and that can, therefore, be the subject of transactions between institutional units. It is part of the asset land. In the proposed land classification, surface water is classified by use: surface water used for aquaculture, surface water associated with recreational land, and surface water associated with other land. However, water bodies from which water is regularly extracted, against payment, for use in production (including for irrigation) are included not in water associated with land but in water resources.
Surface water used for aquaculture	Surface water used for aquaculture facilities and fish farming activities. Aquaculture refers to the farming of aquatic organisms: fish, molluscs, crustaceans, aquatic plants, crocodiles, alligators, turtles, and amphibians. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc.
Surrounding amenity	A surrounding amenity is a facility that has a positive or negative effect on the quality of a real estate property. Examples of positive effects are nearby located parks, shopping malls, or access roads that increase the attractiveness of an area. An example of a possible negative effect is a factory that is built opposite to the real estate property.
Survey	A survey is an investigation about the characteristics of a given population by means of collecting data from a sample of that population and estimating their characteristics through the systematic use of statistical methodology.
Tax data	Data coming from tax records.
Time of recording	Time of recording refers to the point in time at which transactions between units are registered. The general principle in national accounting is that transactions between institutional units have to be recorded when claims and obligations arise, are transformed or are cancelled. This time of recording is called an accrual basis.
Top down approach	The top down approach breaks down a total into sub-components, when lower level data is unavailable. An example is a breakdown of data for the total economy into institutional sectors.
Transactions	A transaction is an economic flow that is an interaction between institutional units by mutual agreement or an action within an institutional unit that it is analytically useful to treat like a transaction, often because the unit is operating in two different capacities.
Uncompensated seizures (K.4)	Uncompensated seizures occur when governments or other institutional units take possession of the assets of other institutional units, including non-resident units, without full compensation, for reasons other than the payment of taxes, fines or similar levies. The seizure of property related to criminal activity is considered to be a fine. The uncompensated part of such unilateral seizures is recorded as other changes in volume.
Unincorporated enterprises	The production activity of a government unit, NPISH or households that cannot be treated as the production activity of a quasi-corporation.
Urban core	Large urban area.
Urban fringe	All small urban areas that are not contiguous with the urban core.
Use of land	See land use.
Value of land	See market valuation of land.
Value of real estate (or property)	See combined value.

Volume changes	Volume changes are changes in value which can be assigned to a change in area (quantity) or quality, either due to transactions or due to other changes in volume, and not to revaluations.
Wealth	Financial and non-financial resources at the disposal of an institutional unit or sector as shown in the balance sheet. The assets involved in this concept have the characteristic to generate or have the potential to generate future income.

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Eurostat-OECD compilation guide on land estimation

The repercussions of the 2007–2008 financial crisis have acted as an impetus to improve the quality and availability of statistical information. One such initiative addresses the importance of compiling a complete accounting of a nation's wealth, and especially the wealth of households. This is of particular importance in view of the housing market's role in the financial crisis in several countries.

The most valuable item on the households' balance sheet is usually housing wealth which is composed of the value of the dwelling and its underlying land. Many countries experience difficulties in valuing land and in particular separating the value of the land from the value of the structure. To assist countries, the *Eurostat-OECD compilation guide on land estimation* represents the first comprehensive overview of conceptual and practical issues related to the compilation of the balance sheet item land in the national accounts, in total and by institutional sector.

The *Eurostat-OECD compilation guide on land estimation* was prepared by the Task Force on Land and other non-financial assets under the joint leadership of Eurostat and the OECD. Representatives from various European Union (EU) and non-EU OECD countries were represented as well as the European Central Bank.

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