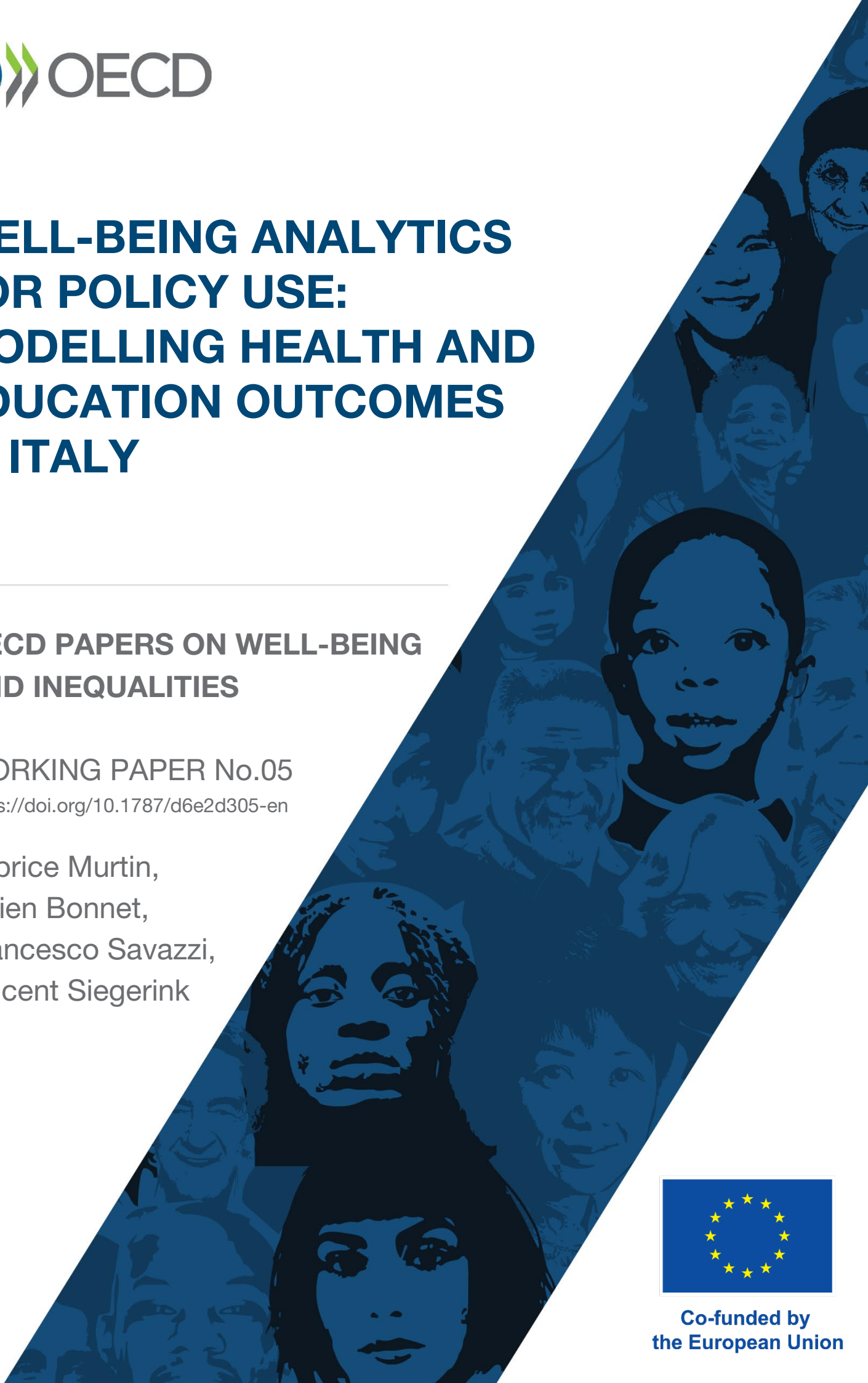
WELL-BEING ANALYTICS FOR POLICY USE: MODELLING HEALTH AND EDUCATION OUTCOMES IN ITALY



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Well-being analytics for policy use: Modelling health and education outcomes in Italy

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Abstract

This paper analyses the policy determinants of three well-being indicators to forecast them and inform the Italian government's budget planning process. For each of the three indicators (healthy life expectancy, overweight and obesity, and early school leaving), a model is developed that allows projecting future trends under a status-quo scenario, and that allows estimating the impact of policy and budget levers on future outcomes. Overall, macro-economic models of life expectancy at birth and of the rate of early school leavers have a very high explanatory power with an R^2 above 0.90, while the micro-economic models for being in good health or being overweight have a moderate explanatory power with an R^2 ranging between 0.05 and 0.3. Key policy-amenable determinants of health outcomes include income, education and lifestyle, while the early school leaving rate is mainly predicted by labour market factors as well as resources and organisational features of the general and vocational school systems.

Résumé

Ce document analyse les déterminants politiques de trois indicateurs de bien-être pour les prévoir et informer le processus de planification budgétaire du gouvernement italien. Pour chacun des trois indicateurs (espérance de vie en bonne santé, surpoids et obésité, et abandon scolaire précoce), un modèle est développé et permet de projeter les tendances futures dans le cadre d'un scénario de statu quo, et d'estimer l'impact des leviers politiques et budgétaires sur les résultats futurs. Les modèles macroéconomiques d'espérance de vie à la naissance et d'abandon scolaire précoce ont un pouvoir explicatif élevé avec un R^2 supérieur à 0.90. Les modèles micro-économiques de bonne santé et de surpoids ont un pouvoir explicatif modéré avec un R^2 compris entre 0,05 et 0,3. Les principaux déterminants des variables de santé actionnables par des réformes politiques sont le revenu, l'éducation et le style de vie, tandis que l'abandon scolaire est surtout influencé par le marché du travail ainsi que par les ressources et l'organisation du système scolaire général et professionnel.

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1. Introduction

1.1. Well-being Metrics in the Italian Budget Process

1. As governments grow increasingly interested in using well-being measures to evaluate policies and steer budget decisions, it is necessary to develop suitable modelling tools that can support detailed impact analyses. Italy is one of the first countries to link a set of well-being indicators to its economic policy programming. The reform of the Italian budget law (n. 163/2016), which modified the Law n. 196/2009 (law of public accounting), required the incorporation of well-being indicators into the economic-financial programming cycle, with the aim of better exposing the link between public policies and a range of well-being dimensions, going beyond economic outcomes and factoring in distributional and sustainability considerations. An ad hoc Committee – chaired by the Minister of Economy and Finance and composed of the President of the Italian National Institute of Statistics (ISTAT), the Governor of the Bank of Italy and two independent experts from universities or research institutions – was established to select specific indicators to measure equitable and sustainable well-being, drawing on national and international experience.

2. Starting from the 130 ESW indicators of the "Rapporto sul Benessere equo e sostenibile" (Report on equitable and sustainable well-being, or ESW), produced every year by ISTAT, the Committee selected a sub-set of twelve indicators across eight domains for integration in the budget cycle (see Table 1). The eight domains of the ESW indicators set considered in the economic policy programme of the Ministry of Economy and Finance (MEF) are derived from the twelve domains of ISTAT's ESW Report and they consider well-being through a multidimensional approach that measures the quality of life not only from an economic point of view, but also from a social and environmental perspective.

Table 1. The MEF's 12 ESW Indicators

ESW domain	ESW indicator	Official data sources
Economic wellbeing	1. Adjusted gross disposable income per capita	ISTAT - National Account (**NA**)
	2. Net income inequality (s80 / s20)	ISTAT - **Eu-Silc**
	3. Absolute poverty Index	ISTAT - Household Budget Survey (**HBSs**)
Health	4. Healthy life expectancy at birth	ISTAT - Survey on Aspects of daily life (**ADL**) ISTAT - Life table (**LT**)
	5. Excess weight (overweight & obese)	ISTAT - Survey on Aspects of daily life (**ADL**)
Education and training	6. Early leaving from education and training	ISTAT - Labour force survey (**LF**)
Work and life balance	7. Non-participation rate, by gender	ISTAT - Labour force survey (**LF**)
	8. Ratio of employment rate for women aged 25-49 years with preschool age children to the employment rate of women aged 25-49 without children	ISTAT - Labour force survey (**LF**)
Security	9. Predatory crime rates (burglary rates, pick-pocketing rates, robbery rates)	Data on crimes reported to Police Forces (**Ministry of Interior**) | Data on Citizens' Safety Survey (**ISTAT**)
Politics and institutions	10. Efficiency of civil justice (length of civil proceedings)	**Ministry of Justice** - Directorate General for Statistic and Organizational Analysis
Environment	11. Emissions of CO_2 and other greenhouse gases (tons of CO_2 equivalent per capita)	ISTAT, **Ispra** - Inventory and emissions accounts

ESW domain	ESW indicator	Official data sources
Landscape and cultural heritage	12. Illegal building rate	Cresme - Center for social, economic and market research for building and territory (**Cresme**)

Source: ISTAT, https://www.ISTAT.it/en/well-being-and-sustainability/the-measurement-of-well-being/indicators.

3. The multidimensionality of well-being goes beyond traditional monetary accounting of progress: only one of the MEF's ESW domains regards the monetary dimension (material well-being), the others refer to health, education and training, work-life balance, safety, politics and institutions, environment and landscape and cultural heritage.

4. The twelve indicators are now integrated into the economic and financial planning cycle by means of two official annual documents prepared by the MEF and presented to the Parliament. The first document is a yearly Report presented by the Minister of Economy and Finance to the Italian Parliament by February 15 in which the evolution of the twelve ESW indicators is analysed in light of the policy measures that were adopted with the recent Budget Law and other related legislation adopted by 31 January. The second one is an annex to the Economic and Financial Document (EFD) submitted to Parliament no later than 10 April of each year that includes a forecast of the twelve selected ESW indicators over the following three years, both under a no-policy change scenario (unchanged legislation) as well as a policy scenario (considering the possible impact of the economic policy that the Government intends to adopt over this period).

5. The inclusion of well-being indicators in the economic and financial planning cycle by the MEF opens the way to a broader examination of the impact of public policies on social progress and the evaluation of public policies in terms of their impact on well-being. This initiative necessitates the development of methodologies to forecast or estimate the evolution of the indicators based on the policy measures adopted by the Government or those that it intends to adopt in the near future. As part of the MEF's ESW project, the Department of the Treasury of the MEF proposed a project on Modelling of Equitable and Sustainable Well-Being Indicators for Policy Use, supported by the EU's Structural Reform Support Programme (SRSP) and implemented in cooperation with the OECD. In this context, in collaboration with the MEF, the OECD has developed modelling tools to forecast three ESW indicators: early school leaving, healthy life expectancy and the share of people that suffer from excess weight. These modelling tools will allow the MEF to make projections on future trends as well as build policy scenarios that compute the impact of policies on its well-being indicators.

6. Since the emergence of an international agenda on measuring progress, a number of countries, notably Italy, Spain, Ireland, the United Kingdom and New Zealand, have started to develop concrete approaches to embed and integrate a multi-dimensional outcomes perspective into policy and decision-making processes (Exton and Shinwell, 2018[1]). Efforts to incorporate well-being metrics into government processes have included ex-ante and ex-post policy evaluations based on multi-dimensional outcomes, using legislation to embed outcome-based approaches into government processes and budget decision-making, and implementing and monitoring national development strategies. The benefits of such approaches are that resource allocation is based on evidence using outcomes that matter for people, while considering the diverse experiences of different groups and supporting strategic alignment across government.

7. Italy has taken a significant step in this direction by integrating its ESW indicators into the economic programming cycle, as already explained. While economic models on the impact of policies on output or employment are well established, appropriate tools to forecast and evaluate ex-ante the policy impact on well-being indicators have yet to come to maturity. The goal of this project is to develop models to provide policy-makers with scenarios on the potential impact of various policy options. The present analysis provides methodologies to forecast of 3 ESW indicators and conduct policy analysis could to inform the government's budget plans (Figure 1).

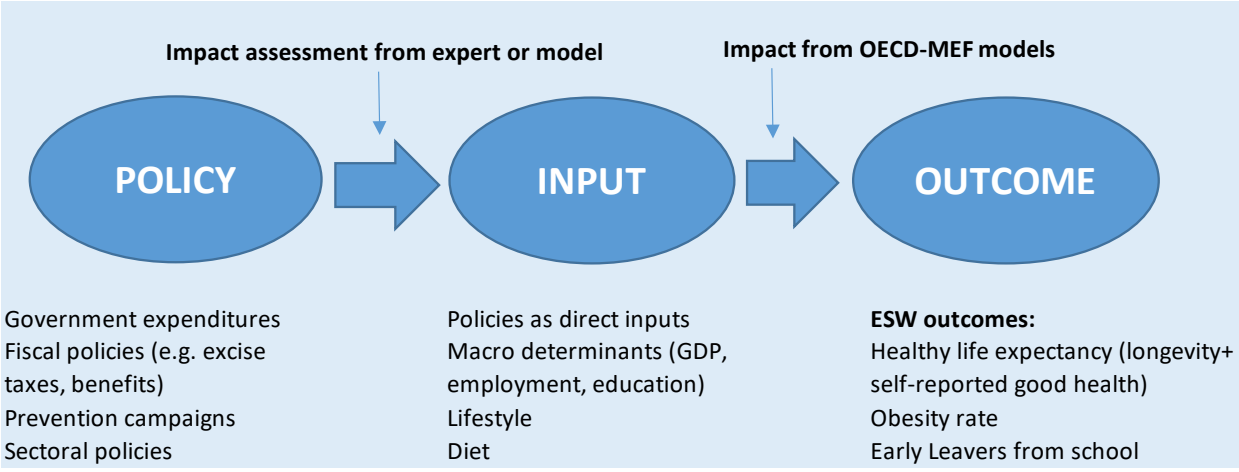
Figure 1. Policy use of this methodology

Preceding budget law (February)	**Projections of ESW indicators based on the previous year's budget law**
Preparation for next budget law (April)	**Providing a set of policy options with impact assessment to inform budget plans for the following year**

1.2. Overview of the results

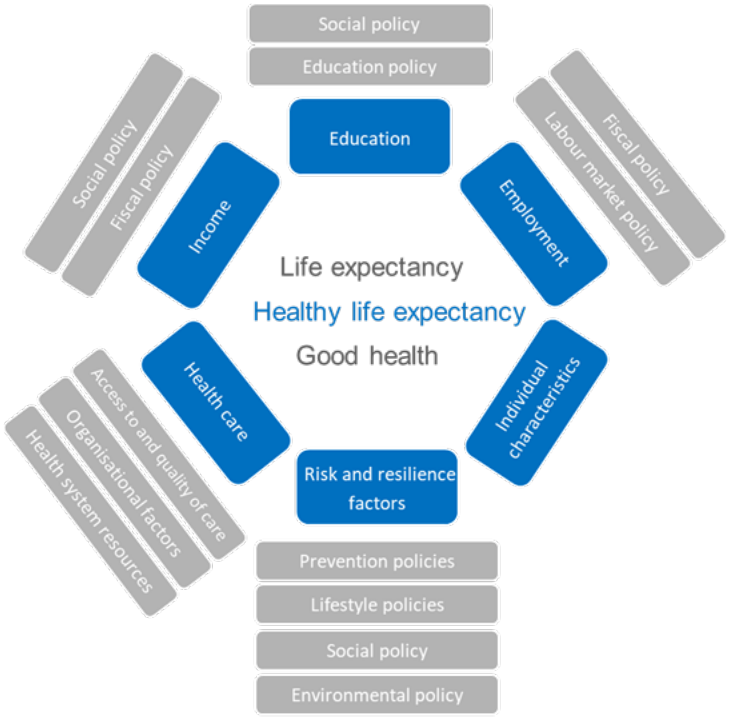
8. Figure 2 describes the general methodological framework for analysing policy impacts using the models developed in this report. As a first step, policy levers were identified. They can either be included directly into the ESW models as policy determinants of well-being outcomes or have an indirect impact on some of their key determinants. For instance, health and education public spending as well as some organisational features of the health and education systems enter directly into the set of explanatory variables of the models. In this case, the potential policy impacts on ESW outcomes are estimated via the OECD-MEF models and are available immediately. On the other hand, other (structural) policies can influence some key input determinants of health and education outcomes, such as GDP, household income and poverty rates, lifestyle and diet, or education quality. For instance, tobacco excise taxes can reduce the rate of smokers and associated diseases, which benefit life expectancy; in general, structural policies (i.e. fiscal policy, labour market and product market policies) influence GDP and household income which in turn impact on health and education outcomes. In the case of indirect effects, potential policy impacts on ESW outcomes would rely on auxiliary information (i.e. expert assessment or satellite models) assessing the policy impacts on ESW input determinants. These are not provided by the current report, which is more limited in scope. However, the report provides the coefficients on the ESW input determinants, from which the indirect policy impacts can be calculated.

Figure 2. The OECD-MEF methodological framework



9. For each ESW outcome, the list of input determinants is established via a thorough literature review. Input determinants are organised in a coherent way and are mapped with policies. As an example, Figure 3 lists 6 types of input determinants of healthy life expectancy, which are mapped with some relevant set of policies: i) income (impacted by social and fiscal policies); ii) education (by social and education policies); iii) employment (fiscal and labour market policies); iv) healthcare (access and quality of care, organisational factors, resources); v) risk and resilience factors (affected by prevention and lifestyle policies, as well as social and environmental policies); vi) individual characteristics, namely age, gender, family status.

Figure 3. Theoretical model of Healthy Life Expectancy: input determinants and policy drivers



Note: Conceptual framework developed as part of the project in collaboration between the OECD and the MEF.

10. Table 2 summarises the key findings from the report and constitutes a shortcut to model-based policy evaluation. It describes the main input determinants of the three ESW indicators as well as the magnitude of their potential impact. For each determinant, a standardised change features on the column “Benchmark input”, while the last two columns describe the associated change in ESW indicators as provided by the OECD-MEF models, both in relative and absolute terms. These model-based elasticities are helpful for back-of-the-envelope evaluation of many potential policy reforms. Policy analysts can simply multiply the size of estimated inputs (depending on external information) with a proportionality rule to estimate the impacts on ESW outcomes. In the table, the benchmark inputs have been calibrated with a relatively small size to reflect what is reasonably observable year-on-year.

11. Turning to the results, life expectancy at birth is very well predicted by 5 core inputs that all have a significant influence in the cross-country macro-economic model (R^2 above 0.95). Altogether, the combination of changes in benchmark inputs yields an increase in life expectancy by 0.33 years, which is approximatively equal to its former annual change before the COVID-19 pandemic.

Table 2. Summary of potential impacts on ESW outcomes

	Source	Benchmark input	Relative Variation of Outcome	Absolute Variation of Outcome
Life expectancy at birth (baseline is 83.6 years)				
Macroeconomic				
Health expenditures per capita	OECD-MEF Model	+1% expenditure	0.03%	0.026
GDP per capita	OECD-MEF Model	+1% GDP per capita	0.04%	0.034
Higher Education	OECD-MEF Model	+1ppt of people with at least upper secondary educ. (from 59.8% to 60.8%)	0.03%	0.029
Lifestyle				
Prevalence of smoking	OECD-MEF Model	-1ppt of smokers (from 19.8% to 18.8%)	0.15%	0.124
Alcohol consumption	OECD-MEF Model	-10% consumption (from 7.6L per capita to 6.8L)	0.14%	0.121
Total			**0.40%**	**0.33 years**
Good health status (% of population - baseline is 62% among 18+)				
Macroeconomic				
Employment rate	OECD-MEF Model	+1ppt employment rate	0.09%	0.057
Economic insecurity	OECD-MEF Model	-1ppt of highly insecure	0.11%	0.068
Foster Higher Education	OECD-MEF Model	-1ppt of people with lower or secondary educ.	0.12%	0.075
Lifestyle				
Mental health	OECD-MEF Model	-1ppt of people with low mental health	0.36%	0.223
Diet	OECD-MEF Model	+/- 1ppt of people consumming more vegetables and fruits, and less snacks and sweets	0.18%	0.111
Sport	OECD-MEF Model	+1ppt of people doing sport and fitness	0.28%	0.171
Obesity	OECD-MEF Model	-1ppt of overweight or obese people	0.01%	0.008
NCDs	OECD-MEF Model	-1ppt in the prevalence rate of 15 NCDs	3.13%	1.943
Total			**3.96%**	**2.66 ppt**
Overweight and obesity (% of population - baseline is 47.6%)				
Macroeconomic				
Economic insecurity	OECD-MEF Model	-1ppt of highly insecure people	-0.04%	-0.020
Foster Higher Education	OECD-MEF Model	-1ppt of people with high school or middle high school degree	-0.32%	-0.153
Lifestyle				
Healthy diet	OECD-MEF Model	+1ppt of population having adequate breakfast, awareness of salt intake, -1ppt of population having large alcohol and carbonated drinks consumption	-0.43%	-0.203
Sport practice	OECD-MEF Model	+1ppt of population doing sport	-0.16%	-0.075
Total (excl. Prevention)			**-0.94%**	**-0.45 ppt**
Prevention				
Food labelling & media campaign	SPHeP model	see OECD(2019) Table 6.1		
Broaden food choices and transport options	SPHeP model	see OECD(2019) Table 6.1		
Tax & subsidies	SPHeP model	see OECD(2019) Table 6.1		
Regulation of advertising, banning products	SPHeP model	see OECD(2019) Table 6.1		
Early Leavers from School (% of 18-24 population - baseline is 13.1%)				
Macroeconomic				
Education spending as a share of GDP	OECD-MEF Model	+10%	-0.45%	-0.059
GDP per capita	OECD-MEF Model	+1%	-0.25%	-0.033
Youth unemployment	OECD-MEF Model	+10%	-1.21%	-0.159
Share of jobs in industry	OECD-MEF Model	5%	-1.09%	-0.143
Share of jobs in agriculture	OECD-MEF Model	5%	-1.20%	-0.157
Share of jobs in construction	OECD-MEF Model	5%	-1.81%	-0.237
Share of disadvantaged students	OECD-MEF Model	-1ppt of disadvantaged students	-0.66%	-0.087
Demographic				
Share of young people	OECD-MEF Model	-1%	-0.84%	-0.111
Migrants rate	OECD-MEF Model	5%	-0.43%	-0.057
Education				
PISA reading score	OECD-MEF Model	+1%	-0.86%	-0.113
Pre-primary enrolment rate (lag)	OECD-MEF Model	+1ppt in pre-primary enrolment rate	-0.67%	-0.087
Share of Secondary students in vocational	OECD-MEF Model	+1ppt in share of students in vocational	-0.30%	-0.039
Professional development for teachers	OECD-MEF Model	+1%	-0.89%	-0.117
Accountability	OECD-MEF Model	+10%	-0.88%	-0.115
Autonomy in curriculum	OECD-MEF Model	+10%	-0.51%	-0.067
Autonomy in resource allocation	OECD-MEF Model	-10%	-1.27%	-0.167
Total			**-13.35%**	**-1.75 ppt**

Note: estimates are derived directly from the models of log life expectancy and the log rate of early leavers; for good health status and obesity logit models, the change in the underlying probability is proxied as dp=dX.α/4 (derivative near dX=0), where dX is the change in the variable and α its coefficient reported in the regression table. The relative variation is then dp/p where p is the baseline rate. All considered changes go in the direction of a better outcome. For good health, results are calculated from averaging across the 6 demographic groups considered in the regressions.
Source: OECD calculations.

12. The micro-economic models for being in good health (as declared by the respondents) have a reasonable explanatory power with an R^2 ranging between 0.2 and 0.3. The strongest predictors of good health are by far the prevalence of chronic diseases, followed by low mental health, sport practice and diet. Overall, the combined changes in inputs yield an improvement in the share of people declaring being in good health by 2.7 ppt, from a baseline of 62% among people older than 18.

13. The micro-economic models for being overweight or obese have lower explanatory power with an R^2 comprised between 0.05 and 0.15. As a result, the combined changes in inputs yield a relatively small decrease by 0.5 ppt starting from a baseline of 47.6% of the population. The most important predictors are those associated with a healthy diet. Admittedly, this micro-econometric approach does not account for important public health interventions that can be assessed via more sophisticated micro-simulations models such as the SPHeP model of the OECD Health Division (see OECD (2019[2])).

14. Finally, the cross-region macro-economic model of early school leaving has high explanatory power (R^2 above 0.90) and highlights a wide range of 'push and pull' factors. Factors that pull or help retain pupils into schools are linked to education quality, which is shaped by available resources as well as specific organisational features of the school system. Factors that push pupils out of school are linked to their lower socio-economic background as well as to the availability of outside options on the labour market, which are determined by low youth unemployment and the importance of specific sectors such as construction. The combination of benchmark inputs yields a decrease in the rate of early leavers by 1.8 ppt, starting from a baseline of 13.1%.

15. Overall, these results highlight the large scope for policy intervention to improve ESW outcomes, as well as the multiplicity of policy levers. This analysis has sought to systematically integrate sectoral policy indicators such as organisational features of the health and education systems. Yet, it remains less sophisticated than more specific models drawn for instance from epidemiology or education sciences, which adopt a more structural approach. On the other hand, the OECD-MEF models are flexible, can be updated at low cost and are relatively easy to use to fulfil one of their purposes, namely completing projections of ESW indicators over time.

16. In terms of future improvements, the models described in this report can be improved by becoming more granular, for instance by integrating sub-national characteristics or policy features that help shape ESW outcomes. Another path to further develop these models is the integration of richer policy information.

17. The rest of the report is composed of three Chapters, one for each ESW indicator under study (healthy life expectancy being the composite of life expectancy and being in good health). Each Chapter reviews the key stylised facts and the input determinants of each ESW indicator as described by academic studies, before describing the models, the empirical results and the projections of ESW indicators.

2. Healthy Life Expectancy

18. This document is part of the technical support that the OECD and the Directorate-General for Structural Reform Support of the European Commission (DG REFORM) are providing to the Government of Italy through the project "Modelling of Equitable and Sustainable Well-being Indicators For Policy Use" ("the Project"), funded by the Structural Reform Support Programme (SRSP) of the European Union. The technical support aims at enhancing the in-house analytical capacity of Italy's Ministry of Economy and Finance, in particular Unit V of the Economic and Financial Analysis and Research Directorate in the Treasury Department. The Project consists of modelling a selected set of well-being indicators for use in policy and budget decision-making. In the context of uneven improvements in well-being across territories and individuals, the integration of Equitable and Sustainable Well-being Indicators into the policy and budget cycles represents a key opportunity to monitor and address policy interventions that impact on social outcomes, especially in the fields of health and education. These improvements can also support Italy's progress on other global commitments, such as the Sustainable Development Goals.

19. Life Expectancy and its quality-of-life adjusted derivative Healthy Life Expectancy are leading indicators of health and well-being, and are included among all well-being measurement frameworks across OECD countries. This chapter presents a modelling framework for assessing the policy impacts on Healthy Life Expectancy. It consists of a macro-economic model on the determinants of life expectancy that uses cross-country data on core determinants (i.e. health spending, material conditions, educational attainment, and health risk factors) and health systems characteristics, observed between 2000 and 2016. The other component, namely perceived good health, is based on a micro-economic model using the Aspects of Daily Life (ADL) survey by ISTAT. The two models highlight the potentially large impact that macroeconomic and public health policies may have on Healthy Life Expectancy.

2.1. Introduction

20. The present chapter presents the methodology developed to forecast Healthy Life Expectancy (henceforth: "HLE") for the purpose of embedding ex ante and ex post policy impact assessments in the Italian budget cycle. A first version of a forecast based on this model, for the years 2020 to 2023, was included in the Ministry of Economy and Finance's (MEF) February 2021 ESW report to the Italian Parliament. This forecast is based on two empirical models that separately forecast the two components of HLE, namely life expectancy and perceived good health. The life expectancy component is based on a macro-economic model using cross-country data on life expectancy between 2000 and 2016, while the perceived good health component is based on a micro-economic model of individual determinants of self-reported health using data from the 2018 Aspects of Daily Life (ADL) survey.

21. One of the aims of developing these models is to provide Italian policy makers with evidence on the potential impact of policies on ESW indicators, allowing them to make decisions that result in the largest gains in well-being for citizens, if possible at the least cost. Importantly, the models presented here can be adapted to create policy scenarios for different types of interventions. The forecasts presented in this chapter incorporate only a small number of policy measures that were proposed in the 2021 Budget Law. These include the impact of fiscal stimulus in the context of the COVID-19 crisis and labour market policies. In the future, the MEF should

work with Ministries across the Italian government to better integrate proposed policies in its forecasting, and ideally, incorporate evidence from these models to inform its budgeting and policy programming decisions. With this goal in mind, this chapter already highlights a number of policy reforms that may be conducive to gains in HLE in the future.

22. Because of the particular situation in which this project took place, in the midst of the COVID-19 pandemic, life expectancy projections for the years 2020 to 2023 were informed by an epidemiological model, in addition to the macro-economic model developed for this project. While the macro-economic model may be useful to inform policy impacts and projections under normal circumstances, the particularity of the COVID-19 pandemic necessitated to consider the impact of excess mortality related to the health crisis on life expectancy. The results of the forecast based on the macro-economic model aligned with those of the epidemiological model, although this seems to be coincidental as the causal pathway through which the economic model predicted a decline in life expectancy is not reflective of real world events. This first attempt therefore also underlines the limitations of these modelling tools and the need for caution in interpreting the results.

23. The key insights from the 2021 forecast exercise were as follows:

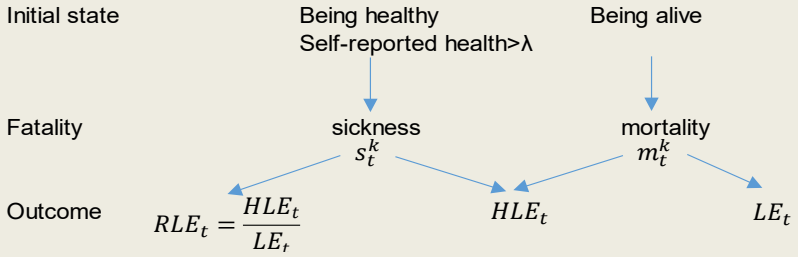
- The epidemiological model projected a decline in life expectancy at birth of about 1.1 year in 2020 (1.2 years for males and 1.0 year for females). This compares to 1.2 years in reality.
- In 2021, life expectancy was projected to increase by about 0.5 year relative to 2020 (0.5 year according to the epidemiological scenario and 0.4 year for the economic scenario). Life expectancy should have recovered its 2019 level by 2022 (epidemiological scenario) or 2023 (economic forecast).
- The share of people reporting being in good health was projected to drop by 3.5 percentage points in 2020, with a slightly stronger effect for men (-3.6%) than for women (-3.4%). This drop is explained primarily by losses in the oldest age group. This forecast did not materialise, with self-reported good health actually rising in 2020, from 70.4% to 74.3%. The forecast predicts a gradual rise of self-reported health in subsequent years (2021 to 2023).
- As a result of the declines in life expectancy and self-reported good health, Healthy Life Expectancy was projected to decrease by 2.2 years between 2019 and 2020, and to gradually return to its pre-pandemic level in the year 2023. Due to the unexpected rise in self-reported good health, Healthy Life Expectancy in fact increased in the COVID-19 year of 2020, underlining the challenges related to forecasting subjective indicators.

24. This chapter starts by presenting recent developments in terms of health outcomes and related policies in Italy, and then describes the conceptual and empirical framework, followed by the forecasts and a description of the results.

Box 2.1. Indicator definition

Healthy life expectancy at birth is formally defined as the **average number of years that a child born in the reference year can expect to live in good health**, under the assumption that the risks of disease and death at different ages observed in that same year remain constant over time. In practice, the indicator compounds two types of survival rates, namely being alive and being in good health (see figure below).

Combining Life Expectancy and Good Health



The health status component of the indicator as defined in the MEF's ESW report is calculated on the basis of people perceptions of their health status. This diverges from the indicators on healthy life expectancy or healthy life years employed by the World Health Organization (WHO) and Eurostat, where the good health component is based on the number and severity of various morbidities.

The self-reported data on health status is collected through the Aspects of Daily Life survey (ADL), using a survey question that asks people "How is your health in general", which allows the following response options: "Very good", "Good", "Neither bad nor good", "Bad", and "Very bad". The share of people in good health is computed as the share of people that respond either **"Good"** or **"Very good"** to this question. The indicator therefore captures the average number of years a child can expect to live with a self-reported health status that is either good or very good.

For the purpose of international comparisons, it should be noted that Eurostat compiles data on self-reported health based on the same question, but with differing results. Comparisons between the SILC estimates, which are collected by ISTAT through the *Indagine sulle condizioni di vita*, and the ADL estimates reveal that population estimates of self-reported good health quite substantially between the two surveys (Table 2.1). Possible explanations are slight sampling differences, or survey mode or question order effects.

Table 2.1. Comparison between EU-SILC and ADL good health estimates, 2019 data

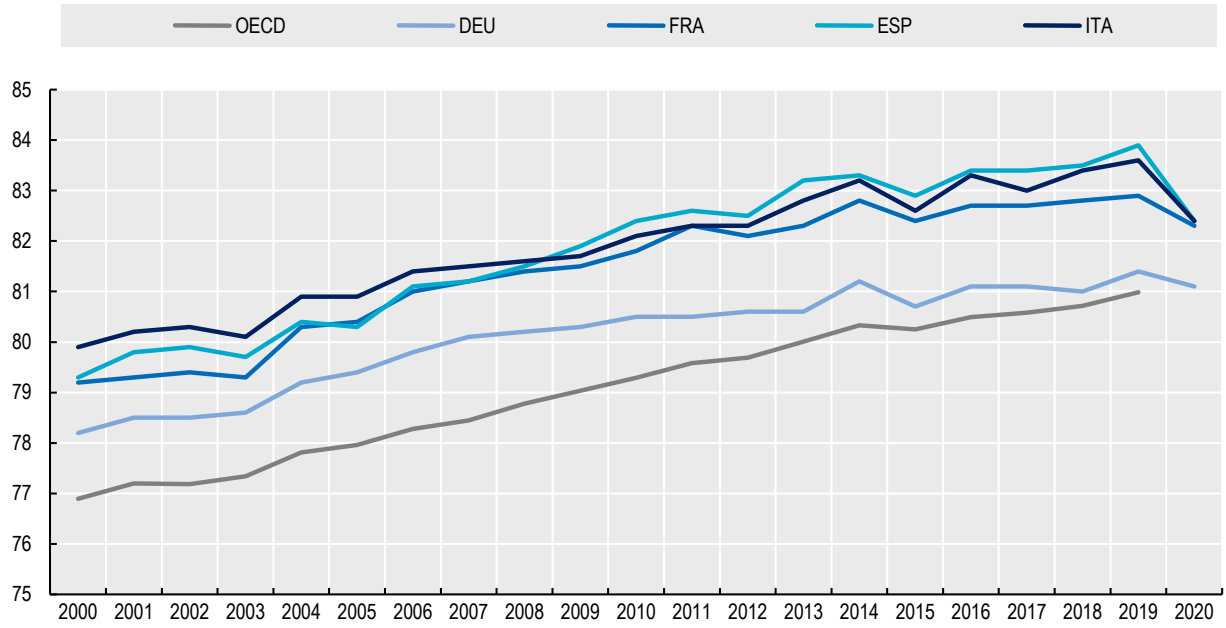
	SILC	ADL
From 25 to 34 years	91.3	87.3
From 35 to 44 years	89	78.6
From 45 to 54 years	83	68.8
From 65 to 74 years	51.9	43.7
75 years or over	28.4	27.5

Source: (ISTAT, n.d.[3]), *Health Statistics (database),* https://www.istat.it/en/health-statistics and (Eurostat, n.d.[4]), EU-SILC (database), https://ec.europa.eu/eurostat/data/database.

2.2. Stylised facts

25. Italy continues to lead the pack in Europe in terms of high levels of life expectancy (see Figure 2.1). In 2019, the year before the COVID-19 pandemic, Italy ranked second behind Spain with a life expectancy at birth of 83.6 years. Progress in longevity has not stopped its course in Italy, although the COVID-19 pandemic has led to a break in the positive trend. In 2020, life expectancy dropped by 1.2 years in Italy, down to 82.4 years, equal to Spain. The relative importance of causes of death in Italy reflect those in the European Union (EU) more broadly, with three primary causes of death being diseases related to the circulatory system (306), cancer (252), and respiratory diseases (70), out of a total of 875 age-standardised deaths per 100 000 people (OECD/European Union, 2020[5]).

Figure 2.1. Trends in life expectancy in Italy and reference countries, 2000-2020

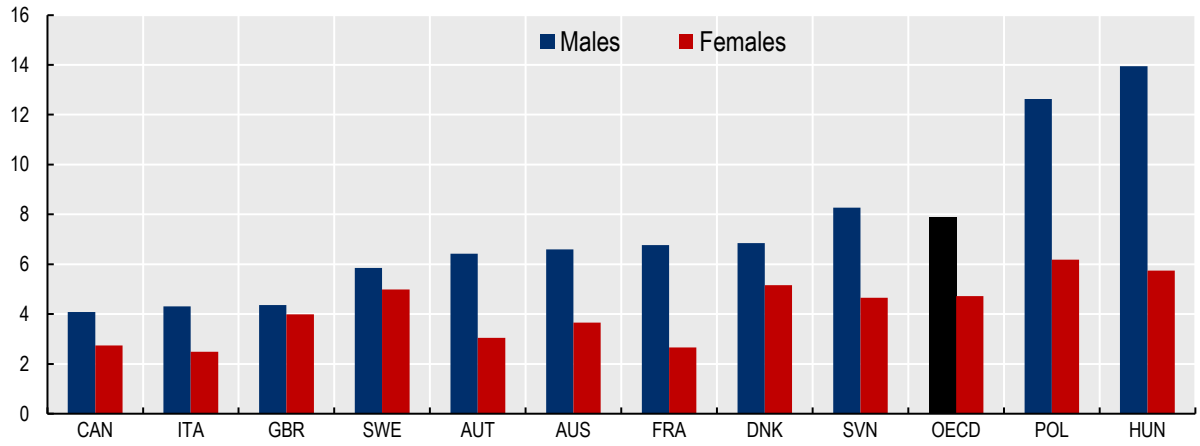


Source: (OECD, n.d.[6]), Health status (database), https://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT

26. In addition to boasting a high level of life expectancy at birth, Italy also enjoys one of the lowest inequalities in life expectancy (Figure 2.2), with the gap between high and low educated people amounting to just under 5 years for men and even less for women (Murtin et al., 2017[7]). The gap in life expectancy at birth between women and men is also relatively small in Italy, but still amounts to 4.4 years, potentially reflecting continued differences in lifestyle factors: i.e. 24% of Italian men smokes daily, as opposed to 15% of women. Overweight and obesity rates were significantly higher in Italian boys (25%) than in Italian girls (12%) in 2018 (OECD/European Union, 2020[5]) and are also higher in adult men (55%) than women (38.4%).[1]

[1] Source: ISTAT, http://dati.ISTAT.it/Index.aspx?QueryId=16734&lang=en.

Figure 2.2. Life expectancy gap at age 25 between high and low educated people

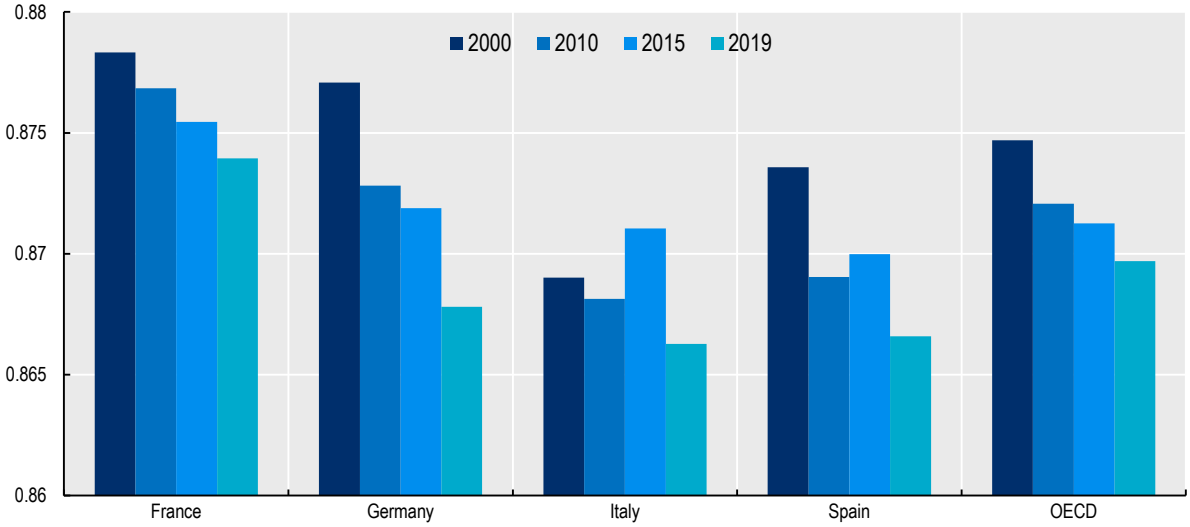


Source: (Murtin et al., 2017[7]), "Inequalities in longevity by education in OECD countries: Insights from new OECD estimates", *OECD Statistics Working Papers, No. 2017/02,* OECD Publishing, Paris, https://doi.org/10.1787/6b64d9cf-en.

27. Finally, the ratio of healthy life expectancy to life expectancy has gradually fallen in Italy between 2005 and 2016, meaning that while people are living longer, the change in the share of people in good health is smaller than the change in life expectancy (Figure 2.3). In other words, the "healthiness" of longevity has decreased. To some extent, this is the mechanical result of the fact that people living longer also display more morbidities.

Figure 2.3. Trends in the "Healthiness" of life expectancy

The share of expected life years that are lived in good health (healthy life expectancy divided by life expectancy)

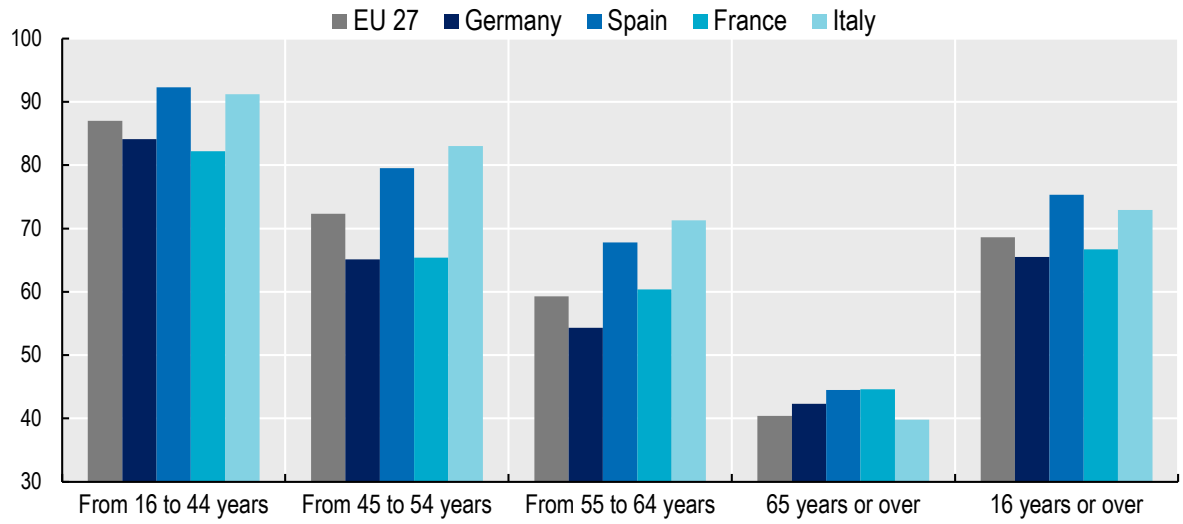


Note: The WHO definition of Healthy Life Expectancy differs from the definition used in the ESW indicators, as the "healthy" component of the indicator is based on data on burden and prevalence of disease rather than a self-reported health survey question.
Source: (WHO, n.d.[8]), *Global Health Observatory* (database), https://www.who.int/data/gho/data/indicators/indicator-details/GHO.

28. Unsurprisingly, self-reported health outcomes deteriorate with age. Figure 2.4 shows international comparisons of good health outcomes by age group[2]. Overall, Italy is second to Spain among peer countries in terms of the share of people reporting being in good health. In young adulthood (ages 16-44), a large majority (87%) of people in the EU report being either in "good" or "very good" health, a share that is even higher in Italy (91.2%). By middle age (55 to 64 years old), this share declines to 59.3% on average in the EU, and 71.3% in Italy. In the middle age groups, Italians report better health than those in all peer countries. After middle age, when disease burden grows, perceived good health declines more steeply, and only 40.4% of older people (65 or older) in the EU reports being in good health. However, among this older cohort, Italians report significantly lower good health outcomes than peers, a result which does not seem to be explained by differences in life expectancy with the peer countries presented in the figure, which largely match or exceed Italy's.

Figure 2.4. Good health by age, Italy and peer countries

Share of people reporting their health is either "good" or "very good"



Source: (Eurostat, n.d.[4]), *EU-SILC* (database), https://ec.europa.eu/eurostat/data/database.

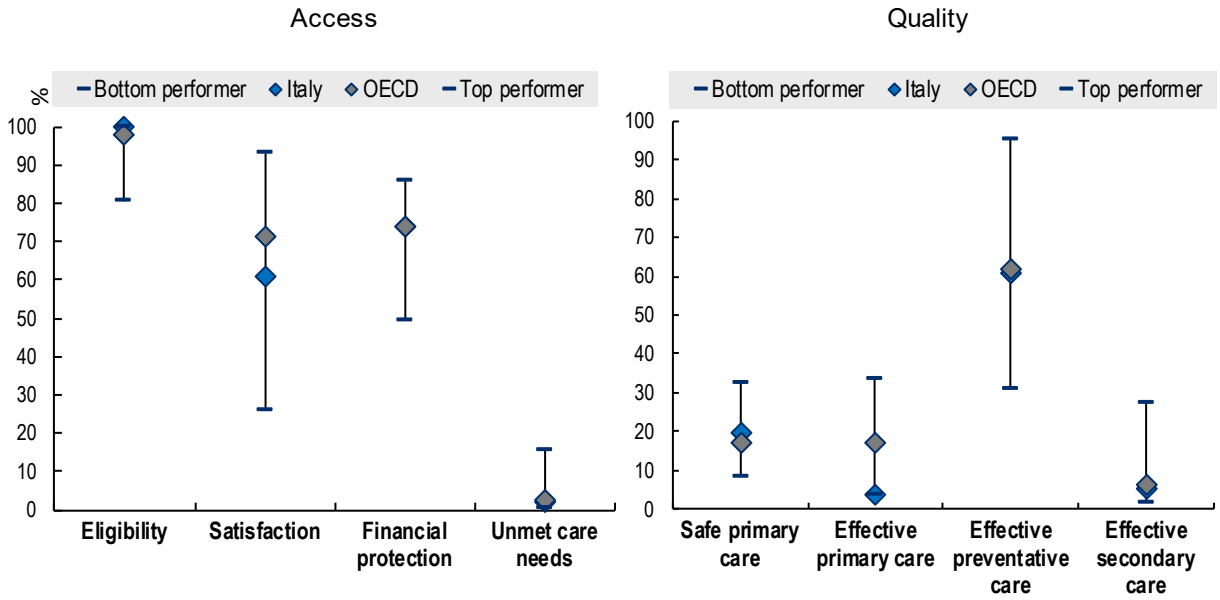
29. While health outcomes are a function of a number of different determinants and policies, which will be further discussed in the next section, the performance of the health care system is evidently an important factor contributing to longevity and good health along the life course. For this reason, it is worth comparing how Italy's health system performs relative to its peers. The OECD compiles comparative statistics on health system performance in five broad categories: Health status (i.e. outcomes such as life expectancy), Risk factors (e.g. smoking and alcohol abuse), Access to care, Quality of care, and Health system capacity and resources.

30. Starting with access to and quality of health care services (Figure 2.5), Italy's performance is not particularly outstanding or lacking. In terms of access, there is broad eligibility to health care services, as is the case in the majority (but not all) of OECD countries. Financial protection offered by the system is in line with the OECD average, and few people report having unmet care needs. That said, overall, people in Italy are less satisfied with the health care system (61% reports being satisfied) than on average in OECD countries (71%). Italy's performance in terms of quality is also largely average when compared to other OECD countries, although

[2] It was previously noted that these figures, based on the EU-SILC survey, do not yield identical estimates to those from the ADL survey, but they provide for insights into Italy's comparative performance.

on an indicator on the quality of primary care (number of avoidable COPD admissions per 10 000 people) it is the top performer across OECD countries.

Figure 2.5. Italy performance on access and quality to care, 2019 (or latest available)

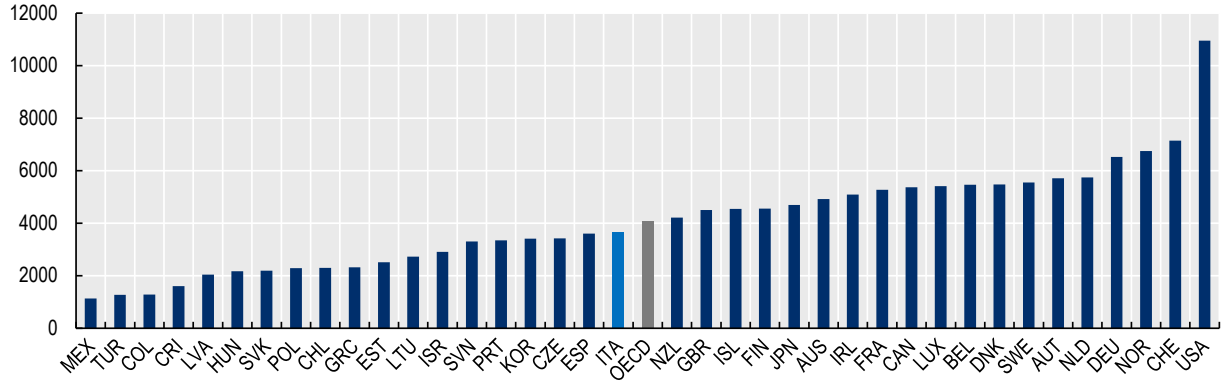


Note: Access: Eligibility refers to the population eligible for core services; Satisfaction refers to the population satisfied with availability of quality health care; Financial protection refers to the expenditure covered by compulsory prepayment; and Service coverage refers to the population reporting unmet needs for medical care. Quality: Safe primary care refers to daily doses of antibiotics prescribed per 1 000 people; Effective primary care refers to the number of avoidable COPD admissions per 10 000 people; Effective preventative care refers to the share of 50-69 year old women that received mammography screenings in the last 2 years; Effective secondary care refers to the 30-day mortality following an acute myocardial infarction (AMI) per 100 000 people.
Source: (OECD, 2021[9]), *Health at a Glance 2021: OECD Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/ae3016b9-en.

31. In terms of health care resources, Italy's health performance is achieved at relatively low cost compared to other OECD countries. While its per capita health care expenditure is slightly below the OECD average (Figure 2.6), this figure needs to be interpreted against a context of a strongly ageing population: 22.9% of Italians are 65 or above, compared to 17.3% in other OECD countries, and well above some of the countries that have less per capita health care expenditure. And while Italy has slightly more physicians (4.1 per 1 000) compared to OECD countries (3.6 per 1 000), it has significantly fewer nurses (6.2 versus 8.8 per 1 000) and fewer hospital beds (3.2 versus 4.4 per 1 000). So, considering the current and future needs of its ageing population, its health system resources are likely on the lower end of the spectrum among OECD countries.

Figure 2.6. Health expenditure per capita, 2019

Total spending on health by country, USD per capita



Source: (OECD, n.d.[10]), *Health Statistics* (database), https://stats.oecd.org/.

2.3. Policy background and conceptual framework

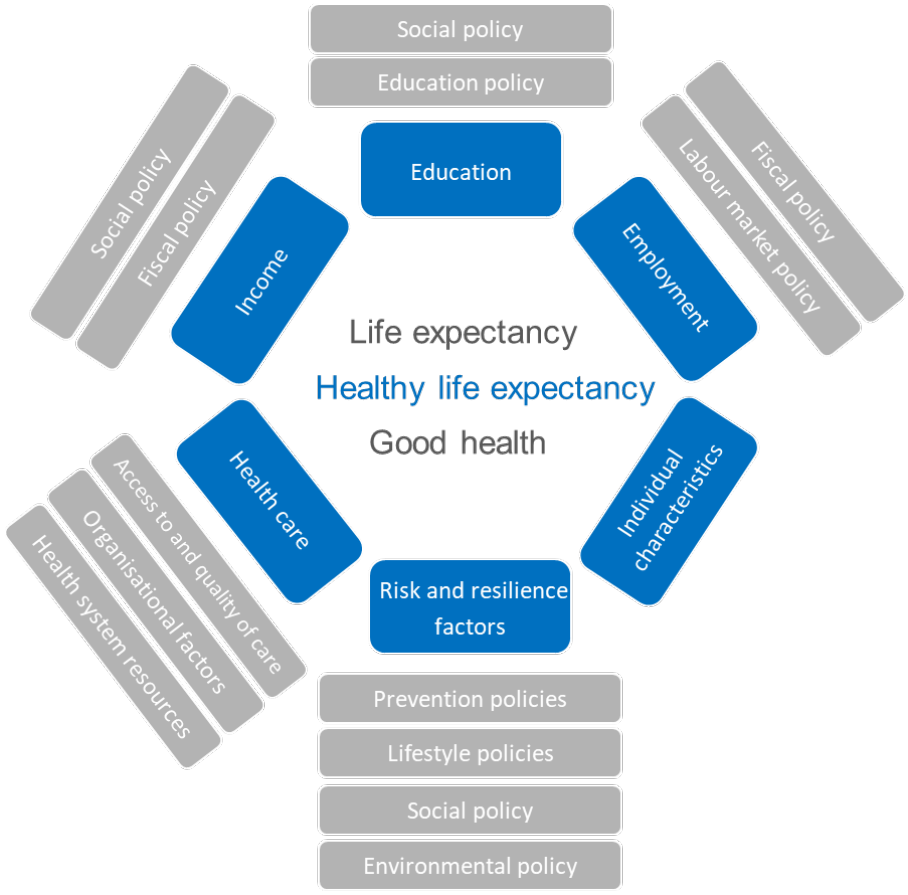
32. As a first step in building a comprehensive model for assessing policy impacts on healthy life expectancy, we identify a conceptual framework. Rooted in a long tradition of academic literature and existing OECD work on the individual and societal determinants of health outcomes, this conceptual framework provides a theoretical underpinning for the micro and macro models. Six broad types of factors are identified to influence mortality and health status outcomes (Figure 2.7). These include socio-economic and demographic factors that are well known to affect both self-reported health and life expectancy, namely individual characteristics, notably age and gender, education level, income and employment status.

33. In addition to these, mortality and health status are influenced by risk and resilience factors, which broadly comprise lifestyle factors such as consumption habits (eating and drinking), activity and time use (engagement in exercise, sedentary habits), as well as other circumstantial factors such as mental health (depression, stress) and environmental factors (family relations, exposure to pollution). These factors contribute to an individual's likelihood of contracting disease, to the extent that poor health outcomes are environmentally determined.

34. And finally, health outcomes also depend on the characteristics of the health system, such as the amount of health expenditures, the degree of access to healthcare and the organisational features of the health system. A recent OECD study compared the features of health systems across OECD countries to understand which of these contribute to cross-country differences in life expectancy (Lorenzoni et al., 2018[11]). This study compiles comparable attributes in health systems based on three surveys carried out in 2008, 2012 and 2016, based on a pre-existing conceptual framework grounded in concrete structural or organisational characteristics of health systems (OECD, 2008[12]). This framework consists of three broad domains: health financing and coverage arrangements, health care delivery systems and governance and resource allocation.

35. The conceptual framework presented in Figure 2.7 lists both the immediate determinants of health outcomes as well as the policies that influence them. The framework demonstrates that health outcomes are really a whole-of-government effort. The health care system and lifestyle and prevention policies of course have a central role to play in promoting better health outcomes among citizens. But a wide range of other government policy areas, including education policy, social policy, environmental policy, and labour market and fiscal policies can play potential direct or indirect roles in affecting the health status of Italian citizens.

Figure 2.7. Theoretical model of Healthy Life Expectancy: determinants and policy drivers



Note: Conceptual framework developed as part of the project in collaboration between the OECD and the MEF.

36. While health outcomes rely on a wide range of policies, the health care system of course has a major role to play, both when it comes to longevity as well as for people's experienced health. To describe the key health system characteristics in a meaningful and useful way, (Lorenzoni et al., 2018[11]) built a core set of 17 policy oriented indicators on the basis of their relevance to performance analysis and their availability for cross-country comparison.[3] Table 2.2 shows the list of indicators by domain. The selected indicators are a subset of those used by the OECD in previous comparative analyses of efficiency and health care spending trends (Joumard, André and Nicq, 2010[13]; de la Maisonneuve and Oliveira Martins, 2014[14]).

[3] A mapping of questions and responses included in the three surveys allowed the identification of comparable questions and responses. As an example, a change in multiple-choice responses concerning "cost sharing by function of care" did not allow the selection of "height of basic coverage" as an indicator for this analysis.

Table 2.2. List of indicators selected for the analysis by domain

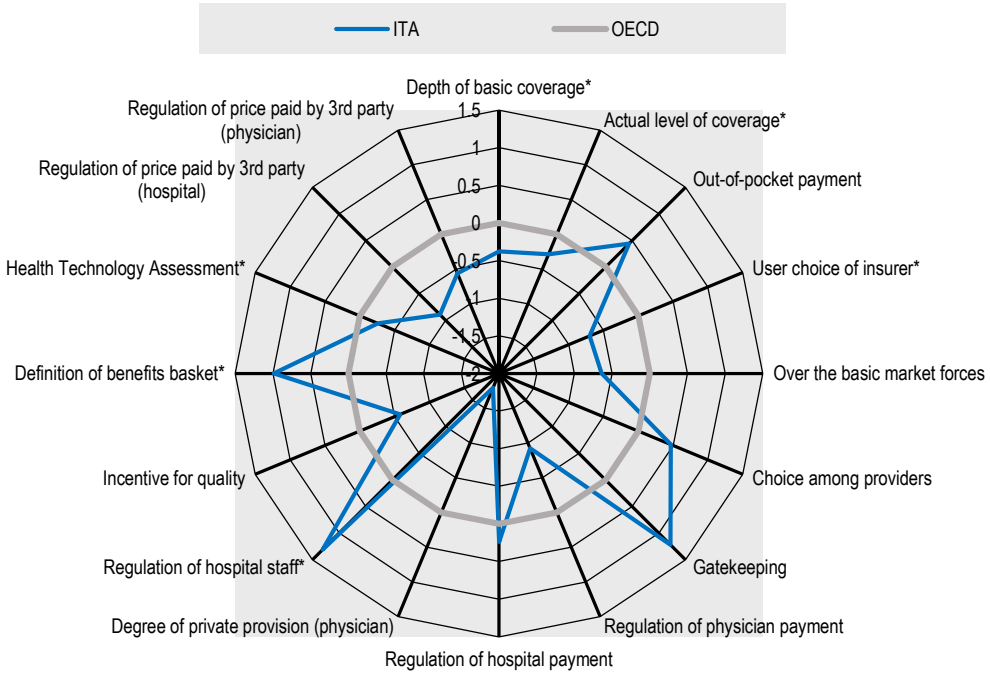
Health financing and coverage arrangements	Health care delivery systems	Governance and resource allocation
Role of primary care in the health system (gate-keeping)	Incentives for volume increase in physicians' payment methods	Regulation of prices/fees for hospitals' services paid by third-party payers
Level of financial protection for health care users	Incentives for volume increase in hospitals' payment methods	Regulation of fees for primary care physicians' services paid by third-party payers
Depth of basic coverage	Degree of private provision – physicians	Use of Health Technology Assessment
Out-of-pocket payments for curative care	Regulation of medical staff in hospitals	Definition of the health benefit basket
Degree of user choice for basic coverage	Incentives for health care quality	
Levers for the insurance market		
"Over the basic" coverage		
Patient choice among providers		

37. In their analysis, (Lorenzoni et al., 2018[11]) identify six features of health systems that are associated with longer longevity:

- *Deeper basic health insurance*: reflects the generosity of the benefits package covered by tax-funded compulsory social health insurance.
- *Higher actual level of coverage*: a high level of financial protection for health care users indicates a low share of out-of-pocket expenditure in total health expenditure.
- *Broader user choice of insurer*: higher score is assigned when there are multiple insurers, which unleashes competition among insurers and raise incentives to deliver high quality services to attract customers.
- *Tighter regulation of hospital staff:* the maximum score is assigned when recruitment is decided by central or sub-national governments and pay scales are set or negotiated at the national level, which is consistent with a more even quality of healthcare across territories.
- *Sharper definition of benefits basket*: The highest score was assigned when the benefit basket was defined at central level by a positive list, encouraging effective preventive and health promotion services through explicit priority setting in public health may lead to lower hospital admission rates and reduced use of expensive therapies in the longer term (Kenkel and Sindelar, 2011[15]).
- *Use of Health Technology Assessment (HTA):* the use of health technology assessments for decision-making and the creation of national agencies dedicated to assess new technologies in countries like Australia, France, Finland, Sweden and the United Kingdom has promoted value for money in public spending on health care through evaluation of the efficacy and cost-effectiveness of health interventions (Mossialos and Le Grand, 1999[16]).

38. Figure 2.8 highlights the scores of Italy with respect to the OECD average across all health system characteristics. Those that were found to be significantly associated with higher life expectancy are marked with star signs. It appears that the high value-for-money observed for the Italian system relatively to other OECD countries may partly be the result of two aspects of Italy's health care system, namely its *regulation of hospital staff* and the *definition of benefits basket*. Conversely, areas where improvements would be associated with better health outcomes are the *depth of basic insurance*, broader *actual level of coverage* (i.e. less out-of-pocket payments), and increased *user choice of insurer* and *HTA*.

Figure 2.8 Italy's health system characteristics with respect to OECD average



Note: Health system features significantly associated with higher life expectancy are marked with a * sign.
Source: (Lorenzoni et al., 2018[17]), "Which policies increase value for money in health care?", *OECD Health Working Papers*, No. 104, OECD Publishing, Paris, https://doi.org/10.1787/a46c5b1f-en.

2.4. Empirical framework

The data

39. This section presents a combined micro-macro model that was developed in collaboration between the OECD and the Ministry of Economy and Finance in Italy with the purpose of forecasting and conducting an assessment of the potential impact of policies on healthy life expectancy in Italy. The first possible use of the model is to obtain a forecast of healthy life expectancy based on existing trends in the determinants of self-reported health and mortality with existing policy settings. The model incorporates the six groups of determinants presented above[4] and projects their future pathways, largely through linear extrapolations but also through auxiliary models, to assess how healthy life expectancy in Italy will develop as a function of changes in the factors that are associated with healthy life expectancy. The official healthy life expectancy indicator used in the ESW documents is based on ISTAT's Aspects of Daily Life Survey (ADL), and the data from this survey forms the basis of the micro model used to identify the determinants of being in good health. Because the ADL is a cross-sectional survey, this model is static and is not underpinned by a causal relationship between determinants and weight outcomes. The macro-model is based on an international panel of life expectancy and its determinants.

[4] Individual characteristics, education outcomes, income, employment, risk and resilience factors, and health system characteristics.

Box 2.2. The Aspects of Daily Life (ADL) survey

The data that underpin the micro-model for self-reported health status are drawn from the annual Aspects of Daily Life (ADL) survey, a multipurpose survey on household and individual behaviour conducted by ISTAT. The survey covers a sample of 20 000 households and 50 000 people, living in over 800 Italian municipalities each year. It contains information on demographic and socio-economic characteristics (age, sex, citizenship, education, employment status and health conditions) as well as a large set of thematic questions, including on lifestyle and eating habits, health limitations, interactions with the health system, and environmental and other life factors. It is therefore a good starting point for an analysis on the determinants of self-reported health status.

Administrative data related to income and pension linked to respondents in the ADL survey are provided by INPS (the National Social Welfare Institution). At the time of writing, income and pension variables were only available for the 2018 data. To complete the dataset, we performed a multiple imputation estimation for the 2019 values based on a set of individual characteristics that include education, labour force status, employment sector, age, gender, size of the municipality of residence and economic satisfaction.

While the ADL survey provides a rich set of relevant determinants, including policy amenable variables, it also faces some limitations. Because the dataset is cross-sectional, it does not allow for estimating causal links between determinants and healthy life expectancy. One data gap relates to nutrition. While the ADL contains a large number of variables on consumption and food intake, these variables may not be the most fit for capturing the negative (self-reported) health impacts of poor diet. For example, while the survey sheds light on the frequency of consumption of certain food, it does not provide information on the quantity of food intake, either per food group or in total. With regards to food quality, the survey provides information on the types of food groups that are consumed, but it does not reflect some particularly relevant and worrying food trends such as the rise in processed food consumption and fast food.[5] As such, there are limitations in the extent to which the survey can be used to model relevant trends in nutrition and the way they relate to the prevalence of excess weight and to health outcomes.

40. Data on mortality rates by age and gender for Italy is obtained directly from ISTAT's mortality tables.[6] Table 2.3 below depicts summary statistics for some key variables among the entire sample of respondents in 2018.

41. The model for healthy life expectancy presented here is based on ADL microdata from 2018. In the future, the model will be expanded by incorporating data points from other ADL waves, in order to increase the precision of estimates through larger sample size. Future waves of the survey will also help refining projections. Currently, the projections made to forecast certain lifestyle habits (explained in the "Projections" section) are based on existing tables from the ISTAT website, which provides time series data of up to twenty years for a number of these variables. Some of them are specified slightly differently than those used in the model, and thus these projections are based on the closest variant.[7]

[5] See for example: https://www.pwc.com/it/it/publications/assets/docs/market-vision-foodservice.pdf.

[6] At the time of writing this report, daily mortality tables were available for the years 2015 up until the end of October, 2020. These tables contain daily death figures for each age group, by gender and municipality. The tables can be found here: https://www.ISTAT.it/it/archivio/240401.

[7] For example, ISTAT.it does not provide data on the variable computed for the purpose of this model on vegetarianism. Therefore, the projections made on this variable rely on time trends in the average shares of people eating various types of meats.

Table 2.3. Summary statistics ADL

Variable	Description	Sample	Mean	S.D.
Good health	Person believes their health in general is good or very good	44 682	0.68	0.47
Age: 0-17	Age: 0-17	44 682	0.16	0.37
Age: 18-44	Age: 18-44	44 682	0.30	0.46
Age: 45-64	Age: 45-64	44 682	0.30	0.46
Age: > 64	Age: > 64	44 682	0.24	0.43
Tertiary education or more	Person has completed tertiary education or more	44 682	0.13	0.34
Upper secondary education or more	Person has completed upper sec. education or equivalent	44 682	0.33	0.47
Lower secondary education or less	Person has completed lower sec. education or less	44 682	0.49	0.50
Employed	Labour force status: employed	38 675	0.44	0.50
Employment: Worker	All other workers (workers, freelancers, self-employed)	44 682	0.39	0.49
Employment: White collar	Executive manager, middle manager or office worker	44 682	0.25	0.43
Employment: Entrepreneur	White collar entrepreneur or freelancer in service sectors	44 682	0.04	0.19
Employment: Other	Apprentice	44 682	0.32	0.47
Vegetarian	Person eats meat less than once a week	44 682	0.05	0.22
Fruit	Person eats a piece of fruit at least once a day	44 682	0.74	0.44
Snack	Person eats a salty snack at least once a day	44 682	0.04	0.20
Sweets	Person eats dessert or sweet snack at least once a day	44 682	0.13	0.34
Binge drinking	Person consumes > 6 glasses of alcohol at least once a year	44 682	0.07	0.26
Smoking	Person smokes cigarettes on a daily basis	44 682	0.14	0.35
Television	Person watches TV more than 5 hours per day	44 682	0.09	0.29
Economic insecurity	Person is not satisfied with economic situation in the last year	44 682	0.39	0.49
Satisfaction with family relations	Person is not satisfied with family relations in the last year	44 682	0.07	0.26
Time use satisfaction	Person is not satisfied with spare time in the last year	44 682	0.28	0.45
Satisfaction with env. conditions	Person is not satisfied with env. conditions in the last year	44 682	0.23	0.42
Bike possession	Person possesses a bike	44 682	0.62	0.49
Bike commuting	Person uses a bike to commute to school or work	44 682	0.02	0.13
Sports: occasional or frequent	Person plays one or more sports occasionally or frequently	44 682	0.35	0.48
Sports: infrequently	Person engages in some kind of activity in their spare time	44 682	0.14	0.34
No specialist: wait list	Person did not see a specialist in the last year: wait list	44 682	0.03	0.16
No specialist: affordability	Person did not see a specialist in the last year: affordability	44 682	0.05	0.21
BMI: overweight or obese	BMI > 25 (only for > 17 year olds)	37 397	0.47	0.50
Limitations	Person experiences severe limitations due to health problems	44 682	0.05	0.23
Neurological disease	Affected by neurological disorder	44 682	0.05	0.21
Osteoporosis	Affected by osteoporosis disorder	44 682	0.09	0.28
Arthritis	Affected by arthritis	44 682	0.17	0.38
Renal disease	Affected by renal disease	44 682	0.03	0.16
Cirrhosis of liver	Affected by cirrhosis of the liver	44 682	0.00	0.06
Liver calculus	Affected by liver calculus	44 682	0.02	0.14
Stomach ulcer	Affected by stomach ulcers	44 682	0.03	0.16
Cancer	Affected by cancer	44 682	0.02	0.15
Allergy	Affected by allergies	44 682	0.12	0.32
Asthma	Affected by asthma	44 682	0.04	0.19
Bronchitis	Affected by bronchitis	44 682	0.04	0.19
Angina or heart disease	Affected by angina	44 682	0.03	0.17
Heart infarction	Affected by myocardial infarction	44 682	0.02	0.13
Diabetes	Affected by diabetes	44 682	0.06	0.23
Hypertension	Affected by hypertension	44 682	0.19	0.39

Models and results

Macro-economic model of life expectancy

42. The modelling of longevity takes a production function approach whereby life expectancy takes at birth (*LE*) for country *i* in year *t* is assumed to follow a Cobb-Douglas production function, with health expenditures, income, education, observed and unobserved risk factors as key inputs (*k*):

$$LE_{i,t} = \prod_{k} (X_{i,t}^{k})^{b_{i,k}}$$

43. In turn, the elasticities of these factors (*b*) are country-specific as they are determined by health policies and institutions (*m*):

$$b_{i,k} = \alpha_k \times e^{\sum_m \pi_m . Z_i^m}$$

44. where Z_i^m is a normalized index of health policies (with zero-mean and unity standard deviation), α_k the average return of the factor *k*, and π_m a coefficient capturing the effect of policies on life expectancy. After log-linearising and accounting for unobserved country effects c_i, the model becomes:

$$\log LE_{i,t} = e^{\sum_m \pi_m . Z_i^m} \times \left[\alpha \log H_{i,t-5} + \sum_k \lambda_k \log X_{i,t-5}^{k} + c_i \right] + \varepsilon_{i,t} \qquad (1)$$

45. where $H_{i,t-5}$ is the total health spending expressed in per capita constant USD PPP[8], and $X_{i,t-5}^{k}$ is a set of other observed factors, which includes income as measured by GDP per capita at constant USD PPP net of total health expenditure, the stock of upper secondary and higher education, prevalence of daily smokers and alcohol consumption in litres per capita.[9] Lags of five years are eventually considered to account for delayed effects on health status.

46. In this report, a simplified production function without health system characteristics is considered (i.e. Z=0). This simplification is more adapted to the building of projections. However, the full version of the results with health system characteristics can be found in (Lorenzoni et al., 2018[11]). Table 2.4 reports the results. For both males and females, both ages 0 and 65, and both lagged and current explanatory variables, life expectancy is significantly associated with the set of core determinants. This set of regressions will be used to extrapolate longevity over the period 2021-2023 as described below.

[8] Purchasing Power Parities (PPPs) are conversion factors that show the ratio of the prices in national currencies of the same basket of goods and services in different countries. Thus they can be used as both currency converter and price deflators. When PPPs are used to convert expenditure to a common unit, the results are valued at a uniform price level and should reflect only differences in volumes of goods and services consumed in countries (Eurostat and OECD, 2012[87]).

[9] This model follows (James, Devaux and Sassi, 2017[88]). Environmental factors, unemployment rate and healthy diet were excluded from the model as the association between life expectancy and those variables was not significant in their analysis.

Table 2.4. Results of the macro-economic model on life expectancy at birth

	Men		Women	
	Current	*Lagged*	*Current*	*Lagged*
Log health spending	3.421***	3.163***	1.790***	2.970***
	(0.39)	(0.40)	(0.29)	(0.32)
Log GDP per capita	4.844***	5.329***	5.510***	2.776***
	(0.65)	(0.64)	(0.49)	(0.51)
Higher education	5.397***	2.035***	5.075***	2.127***
	(0.54)	(0.43)	(0.41)	(0.35)
Smoking	-3.892***	-3.748***	-2.207***	-1.967***
	(0.33)	(0.36)	(0.25)	(0.29)
Alcohol	-5.704***	-1.692***	-3.605***	-0.909***
	(0.50)	(0.40)	(0.38)	(0.32)
Country dummies	Yes	Yes	Yes	Yes
Time dummies	No	No	No	No
N	508	508	508	508
r2	0.972	0.978	0.968	0.971

Note: Standard errors in parentheses: ** p<0.05; *** p<0.01"

Micro-economic model of being in good health

47. The micro-economic model consists in running a logit model of being in good health (a binary variable) for each age and gender group. The structure of the model is:

$$Y_{j,i,t} = X_{j,i,t}.\alpha_j + \varepsilon_{j,i,t}$$

48. where $Y_{j,i,t}$ is the outcome variable for individual *i* in group *j* at time *t*.

49. The results of the micro-economic model of being in good health are depicted in Table 2.5 below. Coefficients marked in *blue* are significant and follow the expected sign, while coefficients in *grey* display an ambiguous sign. For example, smokers and people who drink aged 65 and above report to be in better health than non-smokers in that age group. While this is not necessarily fully counterintuitive – it is conceivable that there are inherent differences of these groups in judging their own health – these results cannot be the basis of policy recommendations as alcohol use and smoking enter negatively into the model indirectly by raising the odds of cardio-vascular and respiratory disease and cancer, among other diseases. As such, these variables are excluded from the model used for projections (excluded terms are marked in *black*).

50. Of course, reverse causality and endogeneity may be a potential problem throughout this model, where many factors are interrelated and reinforce each other. Particularly ambiguous relationships may be present with regards to variables related to mental health (i.e. *down in the dumps*, *happy*, *family relations satisfaction*), which may reinforce health problems and for which there is a distinct shared method variance. These variables are also excluded from the model. Finally, intrinsic, non-policy amenable model terms, such as disease factors, age and region variables, in addition to other non-significant results, are also excluded from the projection model (and marked in *grey*).

Table 2.5. Results of the micro-economic model on being in good health

	Health satisfaction (logit)					
	18-44		45-64		>65	
	Male	Female	Male	Female	Male	Female
Weight control	-0.219	-0.121	-0.125	-0.045	0.174	-0.166
Vegetarian	-0.093	-0.041	0.293**	0.320***	0.051	-0.239
Fruit	0.246***	0.336***	0.313***	0.123	0.113	-0.197*
Snack	-0.448**	-0.079	0.409*	0.393*	0.174	-0.26
Sweets	0.103	-0.284***	-0.254**	-0.088	0.099	0.038
Carbonated drinks	-0.021	-0.209	0.19	0.11	-0.179	-0.129
MM: lunch	-0.238	0.102	-0.132	0.124	0.245	-0.091
MM: dinner	-0.231	0.155	-0.079	0.123	0.229	-0.014
Alcohol	0.320***	0.067	0.131*	0.144	0.167**	0.254***
Binge drinking	0.064	-0.017	0.162	0.116	0.226	0.183
Smoking	-0.190**	0.01	0.024	-0.005	0.212*	0.276**
Limitations	-1.897***	-1.429***	-1.945***	-1.839***	-1.396***	-1.503***
Television	-0.356*	0.051	-0.268*	-0.011	-0.223**	-0.028
Books	-0.013	-0.045	0.177**	0.167**	0.073	0.257***
Bike possession	0.001	0.151*	-0.067	0.018	0.144*	0.078
Bike for commuting	0.327	0.426	0.054	0.35	0	0
Sports	0.340***	0.390***	0.348***	0.288***	0.597***	0.626***
Fitness	0.362***	0.181**	0.176**	0.150**	0.348***	0.410***
Down in the dumps	-0.675***	-0.334**	-0.573***	-0.576***	-0.251	-0.168
Happy	1.045***	0.922***	0.872***	0.700***	0.927***	0.982***
Family relations sat.	-0.370***	-0.270**	-0.491***	-0.229**	-0.382**	-0.369**
Time use sat.	-0.186**	-0.289***	-0.231***	-0.328***	-0.275***	-0.323***
Environment sat.	-0.281***	-0.119	-0.226***	-0.145**	-0.169*	-0.145*
Economic insecurity	-0.214**	-0.248***	-0.253***	-0.295***	-0.330***	-0.307***
Emergency room visit	-0.262*	-0.290**	-0.361***	-0.188	-0.410***	-0.124
Hospitalisation	-1.299***	-0.374*	-0.144	-0.673***	-0.231	-0.431*
Specialist visit	-0.509***	-0.599***	-0.416***	-0.436***	-0.314***	-0.389***
No specialist: costs	-0.278	-0.346**	-0.239*	-0.348***	-0.316	-0.231
No specialist: waitlist	-0.185	-0.383*	-0.266	-0.23	-0.412	-0.271
Neurological dis.	-1.503***	-1.130***	-1.304***	-0.904***	-1.153***	-0.791***
Osteoporosis	0.059	-0.201	0.604	-0.632***	-0.465**	-0.560***
Arthritis	-0.756***	-1.682***	-0.861***	-0.759***	-0.628***	-0.541***
Renal diseases	-0.186	-0.859***	-0.31	-0.407*	-0.436**	0.21
Cirrhosis of liver	4.447	4.695**	0.724	6.524***	0.079	4.163***
Liver calculus	-0.071	-1.062***	-0.378	-0.272	0.08	-0.371*
Stomach ulcer	-0.447	-1.138***	-0.467**	-0.615***	-0.161	-0.365*
Cancer	-0.307	-2.391***	-1.127***	-1.515***	-1.085***	-1.179***
Allergy	-0.482***	-0.314***	-0.193*	-0.287***	-0.242	-0.259**
Asthma	-0.351	-0.276	-0.281	-0.532***	-0.418**	-0.523***
Bronchitis	-0.507	-1.175**	-0.21	-0.355	-0.454***	-0.302*
Angina or heart disease	-1.634***	-1.553***	-0.737***	-0.597*	-0.901***	-0.763***
Heart infarction	-1.038	7.942**	-0.743***	-0.051	-0.658***	-0.194
Diabetes	-1.185***	-1.146**	-1.296***	-1.287***	-0.907***	-0.726***
Hypertension	-1.319***	-0.677***	-0.629***	-0.535***	-0.261***	-0.358***
BMI	-0.035***	-0.027***	-0.038***	-0.041***	-0.017	-0.034***
Employed	0.028	0.102	0.283***	0.209***	0.376**	0.602***
White collar	-0.007	0.009	0.270***	0.226***	0.117	0.039

Entrepreneur	-0.008	0.445	0.163	0.511***	0.208	-0.295
Other	-0.429***	0.062	0.332**	0.167*	0.096	0.139
Upper secondary	-0.330**	-0.224**	-0.031	-0.168*	-0.007	0.022
Lower secondary or less	-0.500***	-0.454***	-0.132	-0.167	-0.207	-0.154
North east	0.134	0.392***	0.007	0.128	-0.082	0.082
Center	0.266**	0.410***	0.067	0.153*	0.163	0.176*
South	0.393***	0.528***	-0.113	0.098	-0.271**	-0.353***
Islands	0.456***	0.429***	-0.1	0.171	-0.201	-0.083
Age: 20-24; Age 50-54; Age 70-74	-0.159	-0.163	-0.134	-0.04	0.023	-0.056
Age: 25-29; Age 50-59; Age 75-79	-0.488*	0.371*	-0.237**	-0.066	-0.042	-0.152
Age: 30-34; Age 60-64; Age 80-84	-0.689***	0.2	-0.371***	-0.197**	-0.167	-0.253**
Age: 35-39; n/a ; Age 85-89	-0.846***	-0.453**			0.041	-0.322**
Age: 40-44; n/a ; Age 90-94	-1.017***	-0.459**			-0.428	0.302
n/a ; n/a ; Age: 95-99					0.006	0.12
n/a ; n/a ; Age: >100						1.077
Constant	3.788***	2.370***	2.109***	1.867***	0.433	1.371***
	-0.47	-0.39	-0.32	-0.26	-0.4	-0.34
N	6659	6657	6402	6926	4682	5898
pseudo R-sq	0.222	0.217	0.246	0.234	0.27	0.293

Standard errors in parentheses" (* p<0.10; **p<0.05; ***p<0.01)

Note: Coefficients marked in *blue* are significant and follow the expected sign, while coefficients in *grey* display an ambiguous sign. Variables in dark blue are kepts as part of the model, and variables in black are excluded from the model. Standard errors in parentheses" (* p<0.10; **p<0.05; ***p<0.01).

2.5. Projections of Healthy Life Expectancy

Forecasting model determinants

51. This section describes the assumptions made to forecast model determinants of healthy life expectancy, which are part of either the macro-economic model of life expectancy or the micro-economic model of being in good health.

Lifestyle factors

52. Forecasting trends in lifestyle factors over time is challenging, as such factors are themselves the product of a wide array of different influences, ranging from price, availability, cultural changes, geo-spatial factors, etc. For the moment, the assumption is made that long-term trends in lifestyle factors apply when there is no evident reason for a break in the trend. This means that linear extrapolations are used to project changes in dietary, exercise or other time use variables up until 2023.[10] Linear extrapolations are used for the model terms on sports and fitness, fruit consumption, following a vegetarian diet, heavy television usage (> 5 hours a day), smoking, and binge drinking.

53. This model was developed in 2020 during the year following the emergence of the COVID-19 pandemic, which provided a major aberration in terms of the way people lived their lives. This was evident from the various studies conducted by ISTAT and others that attempted to understand how people's lifestyles, dietary habits and time use have changed during 2020, in particularly during the period between March and May when the country experienced a lockdown that has no precedent in recent memory, and there was little comparable data to draw

[10] This is done using ADL time series available on I-STAT's data portal. For some variables, the exact definition of the variable as used in the model is not available and a proxy variable is used in order to identify the trend.

from. Some studies provided indicative information but are not necessarily easily translated into quantifiable changes that can directly inform projections (or rather, now-casting) for lifestyle factors in 2020. For example, the ISTAT study "Le Giornate In Casa Durante Il Lockdown"[11] documents whether respondents believed they increased or decreased certain habits, but it does not provide information on the magnitude of the change.

54. In order to account for some of these lifestyle changes, we estimated the 2020 values for engagement in sports and television use from the evidence available in the ISTAT survey. For the variable on heavy television use (the dummy variable uses a cut-off of 5 hours per day), we assumed that the people that are affected by this change are those at the margin of this cut-off, who currently spend between 3 and 6 hours watching TV. The respective shares of people indicating more (45.9%) or less (3.9%) are used to estimate the share of people who move from one category to the other.

55. As for sports, which is a dummy variable in the model, it was assumed that the people who indicated to engage in more sports activity (37.3%) or less (25.3%) cancel each other out, so that the net effect of the change in sports activity habits is an increase of 12.0%. In addition, we assumed that these people then move from one category to the next (and disregard the possibility that there may be people who move within a category, e.g. from playing sports occasionally to playing sports continuously).

56. Finally, for the COVID-19 impacts on these lifestyle factors a 3-month impact was assumed, meaning that the forecast changes by a quarter of the estimated impacts.

The impact of COVID-19 disease and hospitalisation on good health

57. The SARS-CoV-19 virus imposes a significant health impact on a subset of people that contract it. The health implications of the associated COVID-19 disease can be partitioned into three broad categories: mild, severe and critical disease.[12] Initial studies estimated that the share of people suffering each category of disease is about 81% for the mild disease, 14% for severe disease and 5% for critical disease (Wu and McGoogan, 2020[18]). In order to account for the impact of COVID-19 disease on self-reported health, both the direct impact of the disease as well as the impact of the hospitalisation were taken into consideration. Of course, these may be interrelated, but the micro-model shows that hospitalisation may present a negative effect in addition to the experience of chronic disease.

58. The micro-model accounts for both the effect of hospitalisation and emergency room visits on self-reported health. However, the effects differ for men and women in the older cohorts. Because in relation to COVID-19, a visit to the emergency room and hospitalisation are likely to occur together, both model terms were used to estimate the impact of COVID-19. Based on self-reported hospitalisations from ADL data, the total share of hospitalisations in Italy equals 117.6 per 1 000 people in 2018. Data from the European Centre for Disease Control records 3.86 hospitalisations per 1 000 people in 2020 associated with COVID-19.[13] Making the crude assumption that hospitalisations primarily affect people in the oldest age cohort (aged 65 and above), this implies 16.6 hospitalisations per 1 000 people in that cohort, or a 14.1% increase in hospitalisations with respect to pre-pandemic hospitalisation rates. For 2021, we assumed half the impact of COVID-19 relative to 2020, following a return to pre-pandemic levels in the following year.

59. To account for the effect of COVID-19 disease itself, the model components dealing with the experience of a disease may provide an insight into the possible self-reported health consequences of COVID-19 disease. To give justice to the health impacts of the disease even among younger cohorts, we assumed that the relative risk of suffering severe or critical COVID-19 disease is identical to the relative risk of mortality. Relative risks of

[11] https://www.ISTAT.it/it/archivio/243829.

[12] See for example: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html.

[13] https://www.ecdc.europa.eu/en/publications-data/download-data-hospital-and-icu-admission-rates-and-current-occupancy-covid-19.

dying of COVID-19 were estimated at 14.8% for people older than 80 years, 8.0% for those aged 70-79, 3.6% for people aged 60-69, 1.3% for 50-59 year olds, 0.4% for those aged 40-49, and 0.2% for those younger than 40. Using the population structure, we computed the relative risk of dying for three age cohorts that correspond roughly with those used in our model, which are 7.87% for people aged 60+, 0.86% for people between 40 and 59 years old, and 0.20% for people younger than 40. Using the total number of COVID-19 cases in Italy in 2020, which according to the ECDC amounts to 2 155 314 confirmed cases, we estimated the following figures for the number of people in each age cohort having experienced severe or critical COVID-19 disease in 2020. These figures correspond well with the total share of hospitalisations, which were around 232 000, which, assuming that all critical patients were hospitalised means that about a third of severe was hospitalised and the other two-thirds were at home.

Table 2.6. Estimate of severe or critical COVID-19 cases in Italy in 2020 by age cohort

	Total	0-44	45-64	65+
Severe (dyspnea, hypoxia, or more than 50% lung involvement on imaging): 14%	301 743.96	12 856.38	36 076.36	252 811.23
Critical (respiratory failure, shock, or multi-organ system dysfunction): 5%	107 765.7	4 591.56	12 884.4	90 289.72

60. In order to estimate the impact of these cases on self-reported health, two model coefficients are selected to represent the possible impact of the disease, namely the model terms on bronchitis and angina or heart disease. As a primarily respiratory disease, bronchitis is the model disease term that models COVID-19 most closely. However, COVID-19 is well known to present itself in various ways, and cardiovascular issues may be one of the collateral effects of COVID-19 in the body. To model the impact of COVID-19, we therefore modelled an increase in the share of people suffering from these two diseases with a magnitude of the numbers presented in Table 2.7 as a share of the people in the population. We therefore present an age-specific self-reported health impact of the disease.

Economic insecurity and good health

61. Because the micro-model of self-reported health currently does not include household income as a determinant, a useful proxy for the potential effect of macro-economic developments and associated household income changes is perceived economic insecurity. To model the potential increase in economic insecurity related to the COVID-19 pandemic in 2020 and 2021, we used a comparable measure in Eurobarometer for which data from 2020 is already available. The survey question on economic security in the ADL asks respondents whether they are “satisfied with the economic situation in the last 12 months”. The Eurobarometer asks “how would you judge the current situation of the national economy”. While the two questions differ, the change between 2019 and 2020 may be comparable with the expected change in the ADL question in 2020 and 2021. We therefore assume that the changes in the Eurobarometer measure in 2019 and 2020 are comparable to the ADL measure, amounting to a 14% increase in people not being satisfied with the economic situation. Following, we stipulated an annual decline of dissatisfaction of 3% from 2021 onwards, with a gradient that is comparable to previous economic recoveries.

62. In summary, Table 2.7 presents the projections for the full list of model determinants that feed into the micro-economic model of perceived good health or the macro-economic model on life expectancy. It lists in *blue* the model terms that are included in the present forecast, in *black*, model determinants for which currently no forecast is available, which have not yet been assessed for this forecast, or which for other reasons cannot be included in the forecast at this stage. *Grey* boxes indicate that the determinant is not included in the model.

Table 2.7. Forecasts for model determinants 2020-2023

Determinants	LE	HS	2020	2021	2022	2023
Economic						
GDP (real)			-9.3	4.5	5.3	2.6
GDP (nominal)			-8.3	5.4	6.6	3.8
GDP per capita (real)			-9.3	4.5	5.3	2.6
GDP per capita (nominal)			-8.3	5.4	6.6	3.8
Household income			-3.6	2.5	4.2	2.9
Economic insecurity			1.4	-0.3	-0.3	-0.3
Employed: Total			-2	0.1	2.2	1.7
Employed: Male			0.2	-1.5	0.4	3.5
Employed: Female			-3.1	3.3	3.3	-1
Education						
Tertiary education or more			4	4	4	4
Upper secondary			1	1	1	1
Lower secondary or less			-1.5	-1.5	-1.5	-1.5
Lifestyle						
Smoking			-1.4	-1.4	-1.4	-1.4
Alcohol use			1.6	1.6	1.6	1.6
Vegetarian			0.2	0.2	0.2	0.2
Fruit			-0.3	-0.3	-0.3	-0.3
Sweets			0	0	0	0
Binge drinking			1.6	1.6	1.6	1.6
Television			1.8	0.5	-4.6	-0.8
Television COVID impact			2.6	1.3	-3.8	0
Bike possession			0	0	0	0
Bike for commuting			0	0	0	0
Sports			2.5	1.7	-1.3	1
Fitness			0.1	0.1	-4.4	0.1
Time use sat.			0	0	0	0
Environment						
Environment sat.			0	0	0	0

Determinants	LE	HS	2020	2021	2022	2023
Health care system						
Health care spending			2.4	2.4	2.4	2.4
Scope of basic coverage			0	0	0	0
Actual coverage			0	0	0	0
O-o-p payments ess. care			0	0	0	0
User choice basic cov.			0	0	0	0
Incentives hospital p'ment			0	0	0	0
Regulation of hosp. staff			0	0	0	0
Health benefits basket			0	0	0	0
Effective use of HTA			0	0	0	0
No specialist: costs			0	0	0	0
No specialist: waitlist			0	0	0	0
Health status						
Emergency room visit			14	-6	-7	0
Hospitalisation			14	-6	-7	0
Overweight/Obese			1.3	-2	0.7	-1
Limitations			0	0	0	0
Neurological dis.			1	1	1	1
Osteoporosis			1	1	1	1
Arthritis			-1	-1	-1	-1
Renal diseases			0	0	0	0
Cirrhosis of liver			0	0	0	0
Liver calculus			0	0	0	0
Stomach ulcer			-2	-2	-2	-2
Cancer			0	0	0	0
Allergy			1.1	1.1	1.1	1.1
Asthma			0	0	0	0
Bronchitis			-0	-0	-0	-0
Angina or heart disease			0	0	0	0
Heart infarction			1.4	1.4	1.4	1.4
Diabetes			1.8	1.8	1.8	1.8
Hypertension			1.2	1.2	1.2	1.2
COVID 19: age 0-44			0.1	0	0	0
COVID 19: age 45-64			0.3	0.1	0	0
COVID 19: age >64			2.5	1.2	0	0

Note: The table lists in blue the model terms that are included in the present forecast, in black, model determinants for which currently no forecast is available, which have not yet been assessed for this forecast, or which for other reasons cannot be included in the forecast at this stage. Grey boxes indicate that the determinant is not included in the model.

Resulting forecasts

63. This section provides a brief discussion of the results of the present forecast for Healthy Life Expectancy. Because the model is based on ADL data from 2018, the model provides projections for the years 2019 to 2023. The figures for 2019 are based on mortality tables from 2019, which are already fully available.

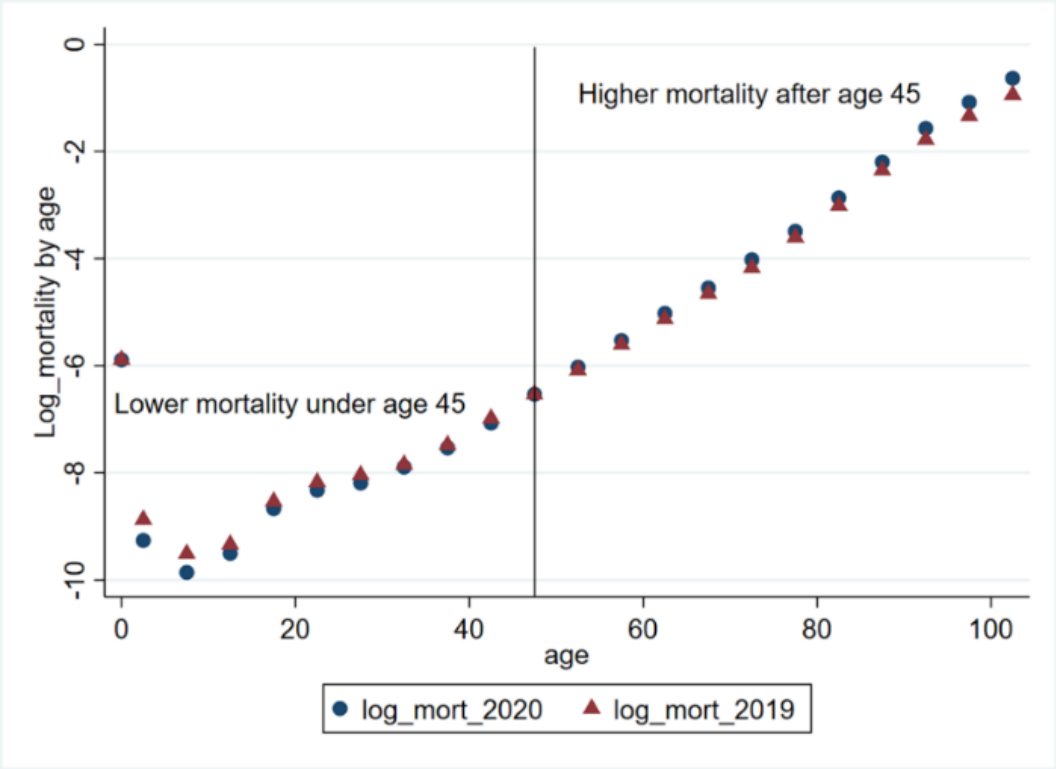
Mortality rates and life expectancy 2020-2023

64. Life expectancy is projected with the help of two different methodologies, whose results are found to be largely consistent. First, a forecast is constructed with the help of the macroeconomic model described in Section 2 together with the scenarios about the trajectories of explanatory variables. This modelling operates in total abstraction of the COVID-19 impact on mortality. Second, an epidemiological scenario is built based on what is known about mortality rates by age and gender in 2019 and 2020, and what is likely to happen over the forthcoming years.

65. The epidemiological scenario is constructed along the following lines. For the year 2020, daily mortality is currently available for the months January to October, and therefore assumptions need to be made for the months of November and December. For this purpose, we assume that the November and December impacts of COVID-19 on the mortality rate are equal to the impact of the pandemic on mortality in April and May of 2020. In order to estimate the mortality rate for November and December, we therefore multiply the average mortality rate in the years 2015-2019 by the same factor with which the mortality rate is multiplied in the months of April and May of 2020 relative to preceding years.

66. As a result, Figure 2.9 shows a hike in mortality rates after age 45 in 2020, while mortality rates have decreased below this age threshold. These results are intuitive as the COVID-19 severe consequences have almost exclusively the former age group.

Figure 2.9. Mortality projection 2020



Source: OECD calculations based on ISTAT data.

Note: For the year 2021, the mortality observed during the first semester of 2021 could look like the one recorded in 2020, while mortality during the second semester of 2021 could be in line with that of 2019. Then, we assume an impact of the pandemic being half the magnitude of the year 2020 for the entire population, meaning that the change in mortality rate relative to the pre-pandemic years is equal to half the change observed between 2019 and 2020. For the population older than 45 years, this scenario reflects the gradual introduction of vaccines, which should be fully deployed by the Summer 2021. For the population younger than 45 years, this reflects on the contrary an increase in mortality during the second semester of 2021, as social interactions and economic activity resume and more accidents are being recorded.

67. For the year 2022, the mortality rate is assumed to return to its pre-pandemic level of 2019 for both population groups. Finally, in 2023 the mortality of younger people is similarly assumed to be that of 2019. Regarding people older than 45, the victims of COVID-19 present on average several important co-morbidities and are deemed to have lower life expectancy than people of the same age, implying that an anti-selection effect may be at play. In other words, the excess mortality observed in 2020 as compared to 2019 may be compensated by a shortage of deaths in 2023 relative to 2019. This feature has been observed for the flu epidemic in Germany and the UK over the 2015-2019 period (Morgan et al., 2020[19]). In practice, it is assumed that about one third of excess mortality in 2020 would translate in a decrease of mortality in 2023 relative to its 2019 level. Admittedly, this assumption is conservative as a larger shortage of deaths may be observed in years to come.

68. The results from the epidemiological and economic scenarios are presented in Table 2.8. The key take-away are as follow:

- Life expectancy at birth was projected to decrease by about 1.1 year in 2020 (1.2 years for males and 1.0 year for females).
- In 2021, life expectancy would increase by about 0.6 year relative to 2020 (0.6 year according to the epidemiological scenario and 0.5 year for the economic scenario).
- Life expectancy should have recovered its 2019 level by 2022 (epidemiological scenario) or 2023 (economic forecast).
- It is unlikely that the two scenarios would be additive, as vital consequences of the pandemic cannot be dissociated from their economic consequences. The addition of the two types of year-on-year changes would entail an increase in life expectancy that is deemed to be way too fast to be credible (about 1.0 year increase every year).

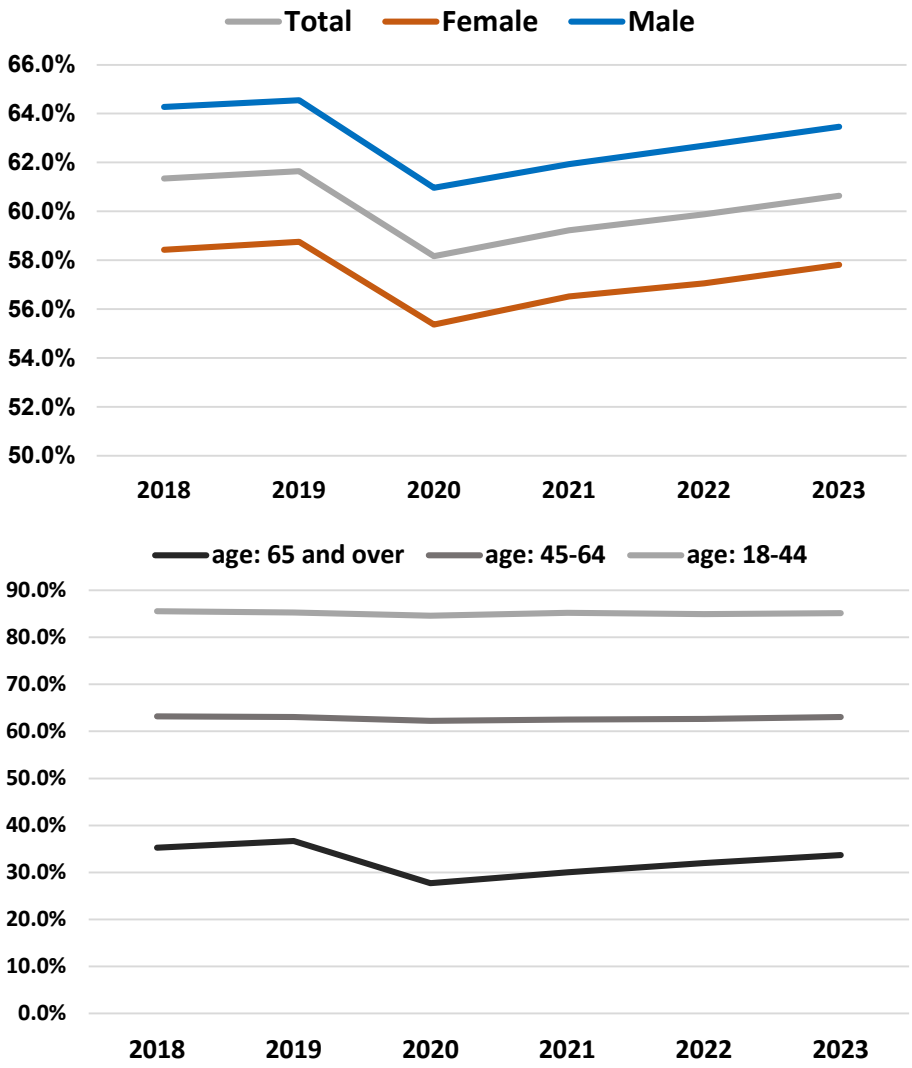
Table 2.8. Life expectancy forecasts

	2019	2020	2021	2022	2023
	Epidemiological scenario				
Total	83.4	82.3	82.9	83.4	83.9
Men	81.3	80.1	80.7	81.3	81.9
Women	85.6	84.6	85.1	85.6	86
	Economic factors				
Total			82.8	83.2	83.5
Men			80.5	80.9	81.2
Women			85	85.5	85.8

Self-reported health

69. As for self-reported health, a significant decrease in self-reported good health was projected for 2020, in line with the potential impact of the pandemic and associated disease, particularly among older people (Figure 2.10). The forecasted drop in the share of people reporting they are in good health amounts to -3.48% for the total population, which a slightly stronger effect for men (-3.57%) than for women (-3.38%). This drop is explained primarily by losses in the oldest age group, where they amount to a -8.97% change in the share of people in good health, with significantly smaller losses in the other two age groups (-0.79% for 45-64 year olds; -0.67% for 18-44 year olds). These effects take account all the included model terms and are therefore not exclusive to the effects of COVID-19 disease itself, but also potential collateral effects of lifestyle changes. As for life expectancy, self-reported health is projected to gradually return to its 2019 level by 2023.

Figure 2.10. Share of people reporting being in good health forecast, by gender and age



Source: OECD calculations based on ADL microdata (ISTAT, n.d.[20])

Healthy life expectancy forecast

70. According to ISTAT, healthy life expectancy at birth is estimated at 58.6 years for total population in 2019, while men's HLE exceeds women's HLE by over 2 years. This result stems directly from the higher self-reported health among men, who nonetheless record lower life expectancy. Netting out the two opposite effects, the one stemming from self-reported health dominates. As a result, women enjoy longer lives but men enjoy longer healthy lives.

71. The final HLE forecast combines the projections on life expectancy and the share of people in good health following the methodology used by ISTAT (Table 2.9). The projected forecast results in a 2.2 years drop in HLE between 2019 and 2020, following a gradual recovery in the years to follow, with Healthy Life Expectancy almost returning 2018 level in the year 2023 (for men a return is envisioned in 2023, for women HLE remains below 2018 levels in 2023).

72. The change in healthy life expectancy between 2019 and 2020 is projected not be the same in absolute magnitude for both genders, although the underlying self-reported health projections do differ between genders.

Likewise, gender-specific economic projections of life expectancy reported about did not reveal particularly diverging trends across genders during the recovery period.

Table 2.9. Healthy Life Expectancy forecast, by gender

	2018	2019	2020	2021	2022	2023
Male	59.4	59.8	***57.6***	***58.3***	***58.8***	***59.4***
Female	57.7	57.6	***55.4***	***56.2***	***56.6***	***57.1***
Total	58.5	58.6	***56.4***	***57.1***	***57.6***	***58.2***

Source: OECD calculations based on ADL microdata and mortality data from ISTAT (ISTAT, n.d.[20]).

Projections of HLE determinants based on policy scenarios

73. For the purpose of the report to Parliament in February 2021, a number of relevant budget items of the 2021 budget were identified to be integrated in the projections of Healthy Life Expectancy. These budget items can be classified into six categories: Health spending; Tobacco excise; Sports expenditure; Labour Market measures; Education measures; and Fiscal Policy and Income related measures (Table 2.10).

74. At the current stage in the project, a number of these measures have been integrated in the forecast, while further methodological work needs to be done to fully account for the various budget measures. For example, limited available information on the Sports Fund proposed in the budget does not allow estimating the potential effects on engagement in exercise.

Table 2.10. Scenarios included in current projections

Measure	Value	Inclusion	Next steps
Health spending	2.4% spending increase per year	Current projections based on a linear extrapolation of trend	Develop methodology to make projections based on spending plans
Heated tobacco excise	5% excise increase in 2021, 2022, 2023	Measure excluded from projections	Possibility to incorporate heated tobacco smoking rates in macro model
Sports fund	€50 mln for 2021	Currently excluded: exact destination of funds is yet to be decided	Potentially provided policy options for spending in April report
Labour market	Approx. €13.5 bln increase in 2021	Included indirectly via MEF employment projections	
Education	Approx. €700 mln increase in 2021	Currently excluded: education projections based on linear trend	Develop methodology to link spending to education forecast
Fiscal policy/income	Approx. €7 bln increase in 2021	GDP effect included in macro-model on LE Currently excluded as a direct effect in micro-model	Include income term in micro-model by linking ADL data with household income data

Smoking policy

75. One of the proposed measures in the 2021 Italian budget law introduced to combat premature mortality and improve healthy life expectancy is an increase in the excise duty on heated tobacco. Smoking remains the largest avoidable health risk factor in the EU and the primary cause of premature death in EU countries (OECD/European Union, 2020[5]). Smokers in the EU die 14 years earlier on average, as tobacco use is a major risk factor for the two leading causes of mortality – circulatory diseases and cancer – as well as an important risk factor for chronic respiratory diseases.

76. Tobacco taxation has been identified as an effective policy lever to reduce smoking in the population and can prevent significant mortality and morbidity[14,15]. The current model is well set up to respond to potential changes in tobacco taxation policy, as the smoking rate is currently included in the macro model, and numerous estimates of the price elasticity of demand have been made. One recent study by the World Health Organisation suggests a short-term price elasticity of demand of -0.15 in high income countries, implying a decrease of smoking prevalence of 0.15% following a 1% price increase (the short term is defined as a 1-3 year time horizon). In the Italian context, Gallus et al. (2003) considered 30 years of data on tobacco smoking and prices in Italy between the 1980s and the early 2000s and estimate a price elasticity of demand of 0.30.

77. To estimate the impact of the excise increase on heated tobacco however, it would be necessary to compile comparable data on heated tobacco smoking rates, and include these in the model. In addition, the health effects of heated tobacco use are still disputed. Incorporating the full effects of a heated tobacco usage in the model would also necessitate considering the substitution effect between heated tobacco and electronic cigarette usage and combustible cigarettes.[16]

[14] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4794304/.

[15] https://europepmc.org/article/med/12883388.

[16] An estimate of the cross elasticity of demand of combustible cigarettes in response to changes in the price of heated tobacco is 1.3, i.e. a 13% increase in demand of traditional cigarettes in response to a 10% increase in the price of electronic cigarettes.

Box 2.3. Updated forecast MEF ESW Report 2022

On March 7, 2022, the MEF launched its annual ESW Report to Parliament, presenting the latest data on ESW indicators alongside forecasts for the years 2021 to 2024. These forecasts are based on the methodology presented in this report. The model was updated using newly estimated model coefficients based on the latest ADL microdata. The table below presents the updated figures, showing the previously forecasted Healthy Life Expectancy figures from the model for the year 2020 and the actual data computed by Istat.

Strikingly, contrary to the findings of the model presented in this Chapter, HLE actually increased in Italy in the COVID-19 year of 2020, as opposed to the foreseen decline. The increase in HLE is solely the result of a significant increase in the share of people who report being in good health, a trend that was observed in a number of European countries in the year 2020. The MEF offers a number of possible explanations for this increase, one suggesting a potential "comparison" effect where people assess their health higher relative to others that may have been affected by the pandemic. Another potential explanation is that COVID-19 patients were underrepresented in the survey sample. It is also possible that the model underestimated the positive lifestyle consequences of the pandemic, related to time use, physical activity or reduced presence at work.

The MEF's projections foresee a continued increase in HLE in the next three years, with another substantial increase in 2021 as COVID-19 mortality is reduced, following more modest increases in the following years.

Healthy Life Expectancy forecast 2021-2024

	2018	2019	2020	2021	2022	2023	2024
Male	59.4	59.8	~~57.6~~ 61.9	**62.6**	**62.8**	**63.0**	**63.1**
Female	57.6	57.6	~~55.4~~ 60.1	**60.8**	**61.4**	**62.0**	**62.5**
Total	58.5	58.6	~~56.4~~ 61.0	**61.7**	**62.1**	**62.4**	**62.8**

Note: The forecast for 2020 based on model presented in this chapter is shown in red. The revised figures are true figures based on observed data. Revised forecasts by the MEF are shown in bold.
Source: (MEF, 2022[21]), 2022 ESW Report to Parliament, Ministry of Economy and Finance, https://www.mef.gov.it/inevidenza/Trasmessa-al-Parlamento-la-Relazione-BES-2022/.

3. Excess Weight and Obesity

78. Excess weight and obesity represent a widespread problem across the Italian population. In 2020, almost half of the Italian population is overweight or obese. The factors contributing to excess weight are multiple and of different nature, and include individual characteristics, lifestyle factors and the quality and quantity of food intake. Using micro-data from the Aspects of Daily Life Survey, this chapter employs a static micro-economic model to forecast the share of the Italian population in excess weight between 2021 and 2024. Despite the constant trend of the last few years and the sharp increase in 2020, excess weight is predicted to decrease by 2.0 percent points by 2024, mainly triggered by higher educational attainment and sport practice. However, this reduction is not equally distributed across gender and age groups. There are several policy interventions that the government can undertake to prevent and contrast the phenomenon. However, strong collaboration among stakeholders is fundamental to assertively reduce the strong negative impact of excess weight on health and on the economy.

3.1. Introduction

79. At the individual level, excess weight is strongly associated with a number of chronic diseases and disabilities that reduce quality and expectation of life. At the societal level, it is associated with lower levels of life expectancy and other poor health outcomes, a reduction in labour productivity with consequent effects on economic growth, and an increase in health expenditure. Overweight and obesity can be prevented through policies that either directly or indirectly lead to better nutrition habits and a more active lifestyle. Because of the many factors shaping these habits, a strong and coordinated policy intervention is necessary to address the problem.

80. This chapter presents a micro-economic model developed with the purpose of forecasting the share of people with excess weight in Italy and for use as a tool to evaluate policies. The model is based on the ADL Survey, a large annual population-based survey run by ISTAT that includes data on lifestyle and nutrition factors, demographic, income and employment related variables, as well as people's self-reported weight and height. This model is intended to assist the Italian government in making evidence-based policy decisions on the potential impact of policies and compute policy scenarios in order to identify the most effective policies to improve well-being outcomes.

81. The key insights from the forecast exercise are as follows:

- Despite the constant trend of the recent past and an increase in the COVID-19 pandemic year (2020), the model projects a decline in overweight and obesity in Italy of 2.0 percent points by 2024.
- Forecasted changes in education levels, as well as in physical activity, alcohol consumption and food consumption awareness are the main contributors to the projected reduction of excess weight.
- The increase in the habit of ordering food online and possibly associated nutrition factors provide a counterweight to this trend.
- The projected decline is slightly more pronounced for women than for men, which is concerning as it is men who have the highest burden of obesity.
- The decline is primarily driven by the older age group, where there is also more room for improvement.

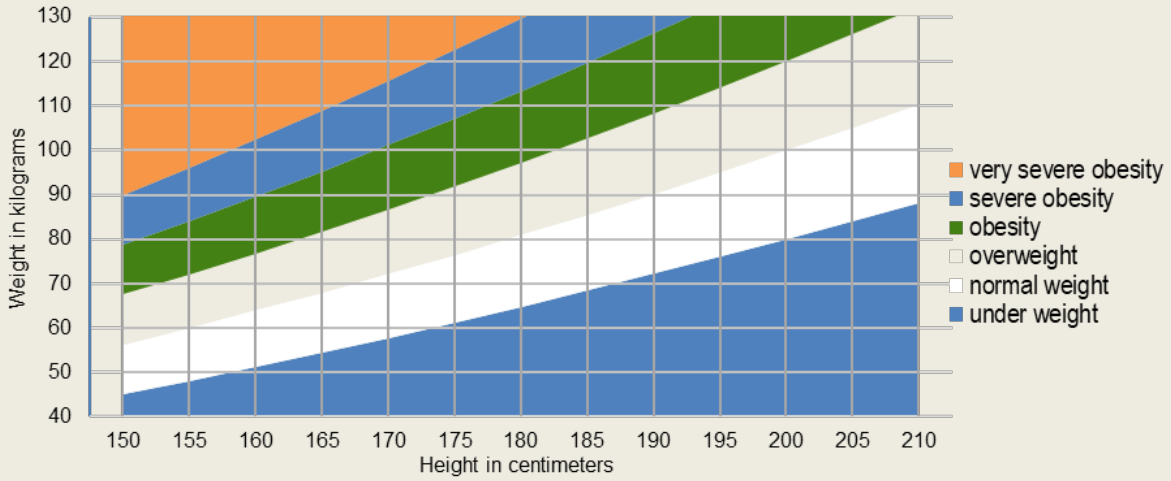
82. This chapter is structured as follows. After an overview of the burden of excess weight across population groups in Italy, the chapter introduces the relevance of excess weight and its impact on health and the economy. Following, a policy framework is introduced that can be used to assess the potential impact of new or existing policies, along with an empirical framework that outlines the main model and the data used. Finally, the results section shows not only the final forecast of excess weight in Italy, but also the impact that each determinant has on the Body Mass Index (BMI) and the forecast of each determinant, computed with auxiliary models.

Box 3.1. Indicator definition

Excess weight in adults is internationally defined using the Body Mass Index (BMI), a measure used to classify whether a person is under weight, normal weight or overweight. BMI is calculated by dividing the weight of the subject (expressed in kilograms) by the square of his or her height (expressed in meters). According to this classification, six categories are identified in relation to BMI: underweight (BMI < 18.5), normal weight (18.5 ≤ BMI ≤ 24.9), overweight (25.0 ≤ BMI ≤ 29.9), class I obesity or obesity (30.0 ≤ BMI ≤ 34.9), class II obesity or severe obesity (35.0 ≤ BMI ≤ 39.9), and class III obesity or very severe obesity (BMI ≥ 40.0).[17] BMI has a number of known limitations, such as the fact that it does not consider differences in people's physical characteristics (e.g. with respect to the fact that muscles have higher density than fat), age, sex, or ethnicity, it provides useful standardised information about weight conditions.

The ESW excess weight indicator used by the Italian Ministry of Economy and Finance concerns the "standardized proportion of people aged 18 and over that are overweight or obese, out of the total of people aged 18 and over" and it derives from the classification of body weight adjusted for height based on the body mass index (BMI) (see figure below). In coherence with the indicator chosen by the Committee, the excess weight indicator under analysis is calculated using the Italian Aspects of Daily Life (ADL) Survey. For the purpose of the ESW indicator and the present analysis, excess weight is defined as having a BMI > 25, with a distinction between overweight (25.0 ≤ BMI ≤ 29.9) and obesity (BMI > 30), in line with the WHO standard. Population data are standardised using the EU 2013 standard population in order to facilitate comparisons of the prevalence of overweight and obesity that is agnostic to (changes in a) country's population structure.[18]

Classifications of obesity status using BMI



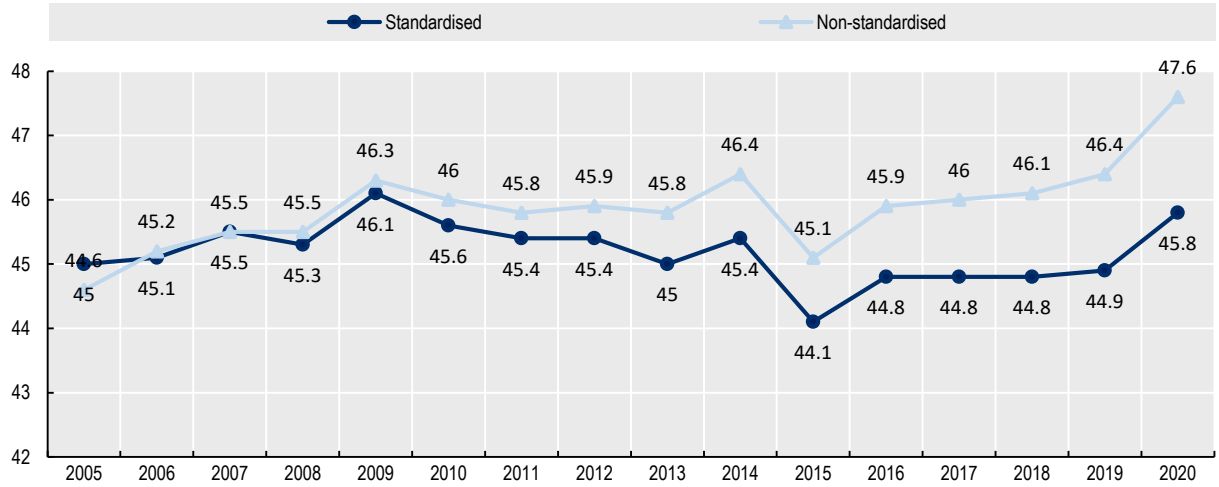
The EWS indicator is based on survey data collected by ISTAT where weight and height is self-reported, while in many countries these data are measured. One advantage of this approach is that the survey data on BMI comes with many covariates on lifestyle and individual characteristics. As pointed out in research done in the past (Nyholm et al., 2007[22]) and as reported by the Italian monitoring system "Passi",[19] self-reported weight tends to be underestimated, particularly among overweight people. In addition, the bias between self-reported and measured values is not constant across ages and genders. For this reason, country comparisons in this paper are used using measured overweight and obesity data by the WHO. The values measured by the WHO for the rate of overweight and obesity in Italy are indeed much higher than those provided by ISTAT. In 2016 58.5% of the adult population was measured to be in excess weight by the WHO, while the self-reported value published by ISTAT was just 45.9%.

3.2. Stylised facts

Trends in excess weight and obesity

83. The most recent survey among the Italian population conducted by ISTAT shows that in 2020, 47.6% (45.8% if standardized) of the adult population was overweight or obese. After an increase between 2005 and 2009, overweight and obesity rates remained relatively constant until 2019 (Figure 3.1). During the first year of the COVID-19 pandemic an unprecedented 1.2% increase brought the share of the population in excess weight to the highest value ever recorded in the country. This means that nearly half of the Italian population is of excess weight. Overweight and obesity rates are not equally distributed across different population groups. Age, gender and education level are all important vectors of inequalities in overweight and obesity rates, and there are also marked differences between regions in Italy.

Figure 3.1. Share of population overweight or obese in Italy, 2005 to 2020



Note: The standardised population rate is based on the EU 2013 standard population.
Source: (ISTAT, n.d.[3]), *Health Statistics* (database), https://www.istat.it/en/health-statistics.

84. Starting with gender differences, men have a significantly higher rate of excess weight than women, with the average rate of excess weight in adults 17 percentage points higher for males than for females in 2020 (Figure 3.2). The gender gap exists in all age groups, and is particularly pronounced in middle age. That said, the share of obese people (BMI > 30) in the total share of people in excess weight is higher among women than among men in all age groups, and in the older age groups the absolute share of obese people is roughly equivalent between men and women, while the share of people that are only overweight but not obese are markedly lower among women than men.

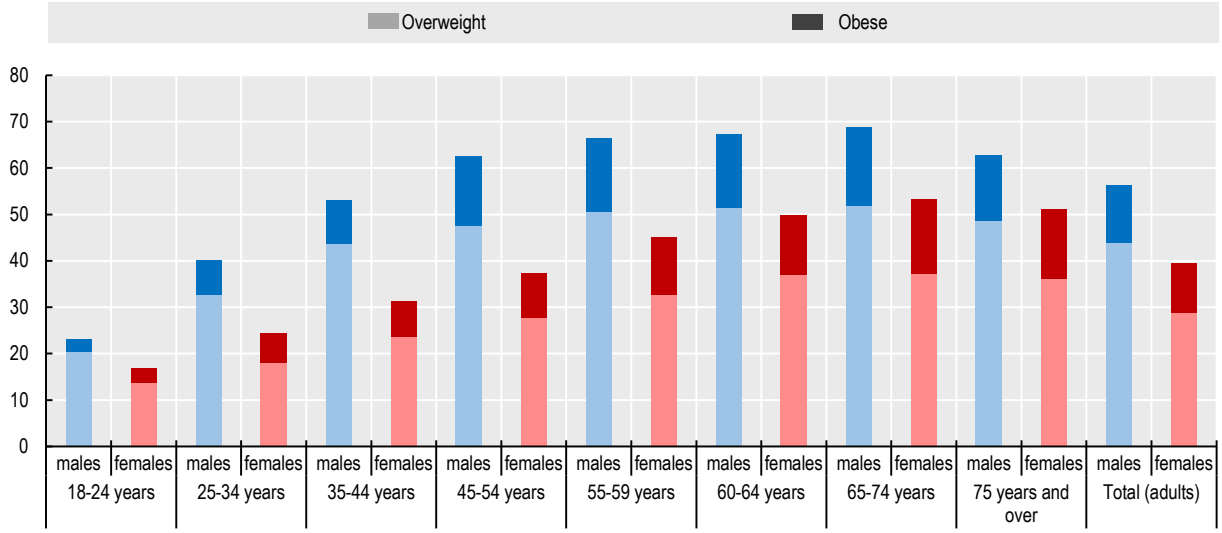
[17] When it comes to children, according to the WHO, overweight is defined as BMI being > than 1 standard deviation over the median, while obesity is defined as BMI being > than 2 standard deviations over the median. However, this definition for children is not adopted everywhere. The Italian monitoring system of childhood obesity "Okkio alla Salute" uses the International Obesity Task Force (IOTF) definitions.

[18] Revision of the European Standard Population, Report of Eurostat's Task Force, Methodologies and Working Paper, 2013 edition http://ec.europa.eu/eurostat/documents/3859598/5926869/KSRA-13-028-EN.PDF).

[19] https://www.epicentro.iss.it/passi/dati/sovrappeso#tecnici.

85. For both genders, the share of people in excess weight increases with age, with the highest rates among 65-74 year olds, after which the rate declines slightly. In this age group, 68.7% of men and 53.3% of women are of excess weight. The relative share of obese people also increases with age, comprising only a minor part of people in excess weight among the youngest age groups (11.6% of men aged 18-24 years old with excess weight are obese, and 19% of women). This figure rises to a quarter in older men and almost a third in older women.

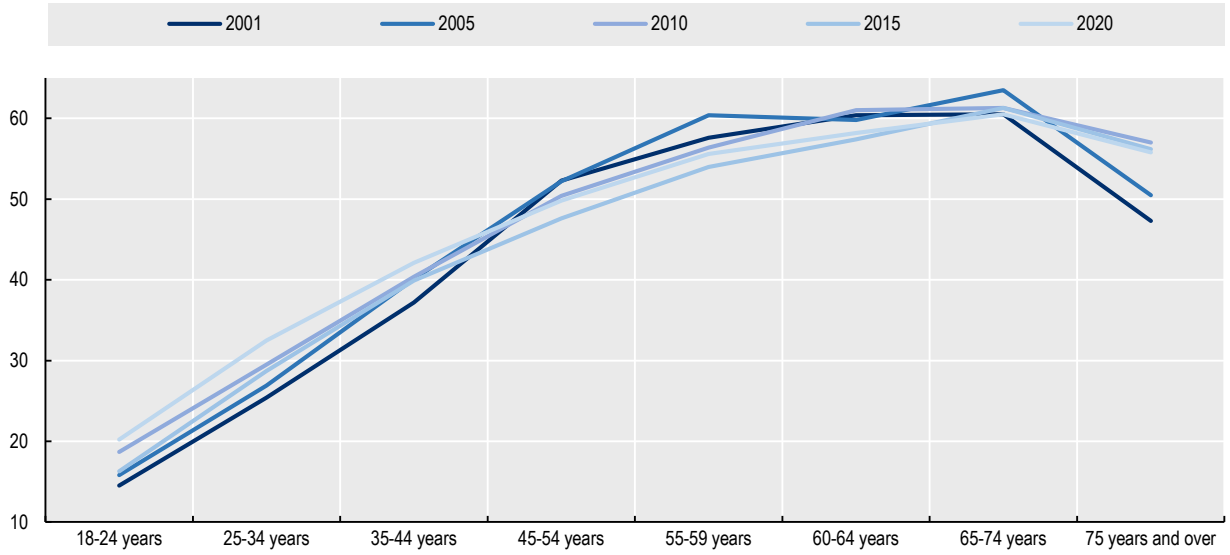
Figure 3.2. Share of population obese or overweight in Italy, by age and gender, 2020



Source: (ISTAT, n.d.[3]), *Health Statistics* (database), https://www.istat.it/en/health-statistics.

86. Although the differences across age groups are still large, over the last 20 years there has been a reduction in the gap between the young and middle-aged groups in terms of the share of people with excess weight. This trend has gone largely at the expense of younger generations, among which the share of people with excess weight has increased significantly. In the youngest age group, the share of people in excess weight increased from 14.5% in 2001 to 20.2% in 2020. On the contrary, among 55-59 year olds a 2 percentage point decrease has taken place over the same period. The oldest age group (75 year olds and over) have also seen an increase in overweight and obesity. In Figure 3.3 each line represents a year, the darker the line, the more recent is the observation.

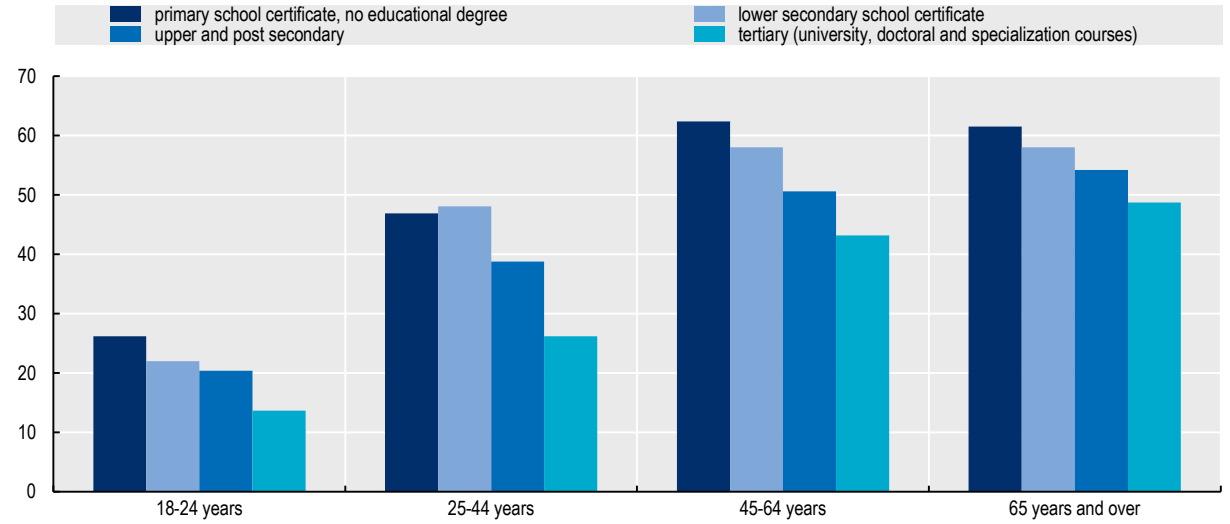
Figure 3.3. Share of population in excess weight in Italy, by age group, 2001-2020



Source: (ISTAT, n.d.[3]), *Health Statistics* (database), https://www.istat.it/en/health-statistics.

87. In line with the literature (OECD, 2019[2]), educational attainment is an important source of differences in the incidence of excess weight between groups in Italy. People with a higher level of educational attainment consistently have lower rates of excess weight than those with less educational attainment. This effect wears off slightly over time: the relative difference between people with a tertiary education and those with primary or secondary school is about a quarter among the elderly, but almost half in adults from 25-44 years old. Weight gain comes with age in all groups, but at a young age, it appears that differences in life circumstances and behaviours between education groups are a strong determinant in the incidence of overweight and obesity.

Figure 3.4. Share of people in excess weight in Italy, by age and education, 2020



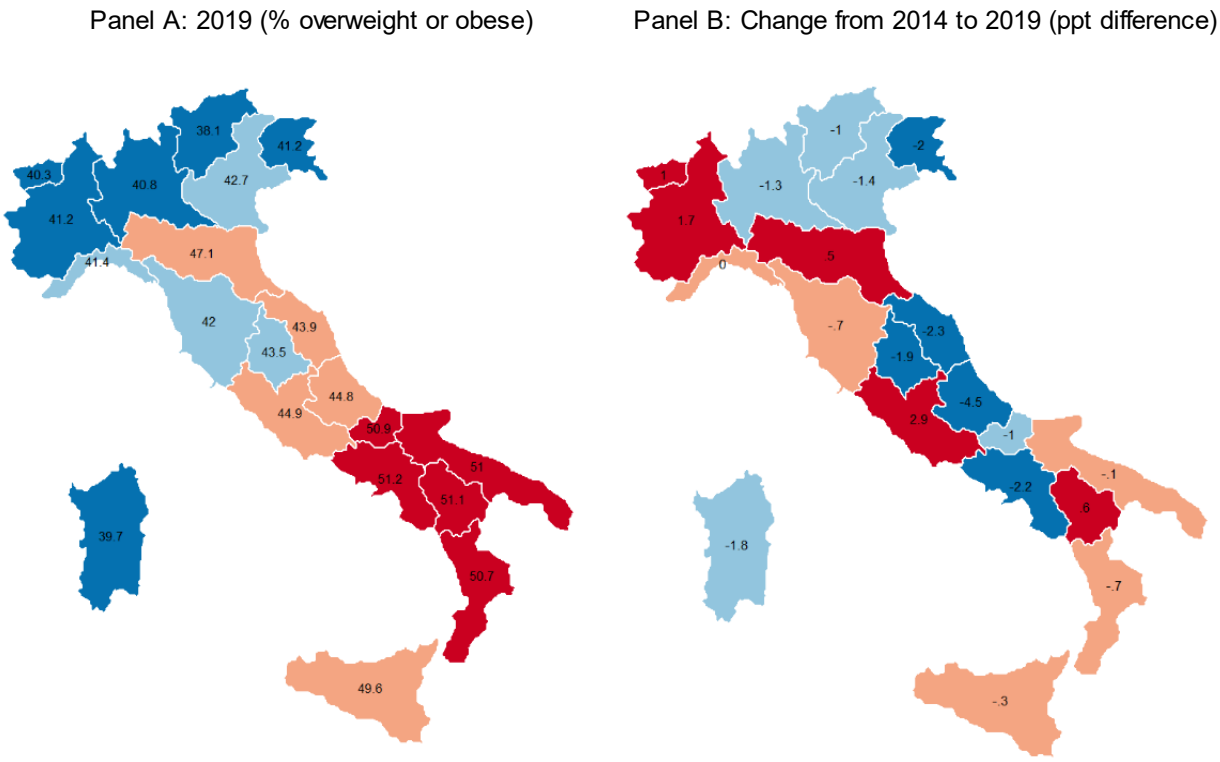
Source: (ISTAT, n.d.[3]), *Health Statistics* (database), https://www.istat.it/en/health-statistics.

88. There are also marked differences in the share of people with excess weight between regions in Italy and particularly between the North and the South. The share of people with (standardized) excess weight is substantially higher in the southern regions than elsewhere (Figure 3.5), with levels ranging from 49.6% in Sicilia to 51.2% in Campania compared to 40.8% in Lombardia and 38.1% in Provincia Autonoma di Trento. Changes in recent years, shown in the second panel below, are a bit more diffuse, although among the regions with the highest values only Campania shows an improvement. In the other most southern regions, the share of people who are overweight or obese has only worsened.

89. In order to better visualise the magnitude of the differences between regions over time, the two box plots below show the dispersion of excess weight and the relative gender gap (Figure 3.6). There is a degree of variability in the distribution over time; the first quartile varies between 39.9% and 43.2% and the third quartile between 47.3% and 50.1%. Overall, there is evidence for some convergence, as the dispersion has become more concentrated. The average of the regional values has always been higher than the median value (except for 2011), meaning that the distribution is skewed towards the lowest values with more dispersion at the higher end.

90. There are also significant gender gaps at the regional level, and there is some evidence that the gender gap has declined in recent years. In 2019, the median gender gap was 17.2 percentage points, compared to 17.7 percentage points in 2005. Despite the small difference, the median gender gap has not always been constant. It increased to a maximum of 20.9 percentage points in 2009, before recovering following a gradual downward path. The interquartile range shows an overall decrease from its initial value from 4.0 percentage points in 2005 to 2.9 in 2019. This indicates a greater concentration of values around the median, thus reducing differences between regions. However, this measure shows marked variability over time (in 2018 the interquartile range was at its highest, 4.3 percentage points) and caution should be applied when assessing it.

Figure 3.5. Excess weight by region, 2019 and difference between 2014 and 2019

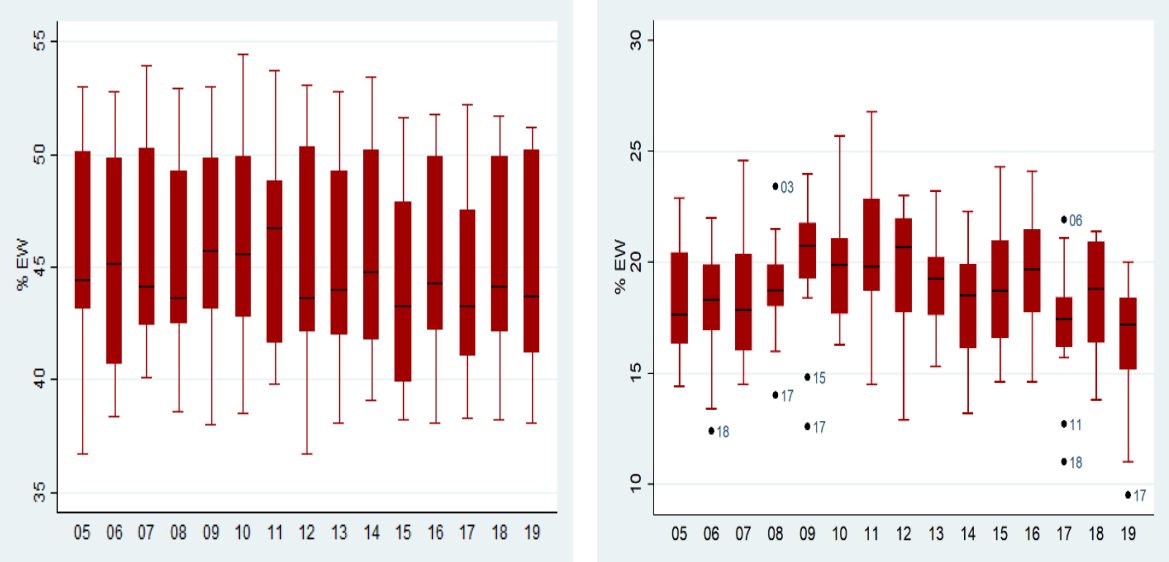


Note: Values are adjusted to the EU 2013 standard population.
Source: (ISTAT, n.d.[3]), *Health Statistics* (database), https://www.istat.it/en/health-statistics.

Figure 3.6. Changes in the regional distribution and the gender gap by region, 2005 to 2019

Panel A: % overweight or obese across regions

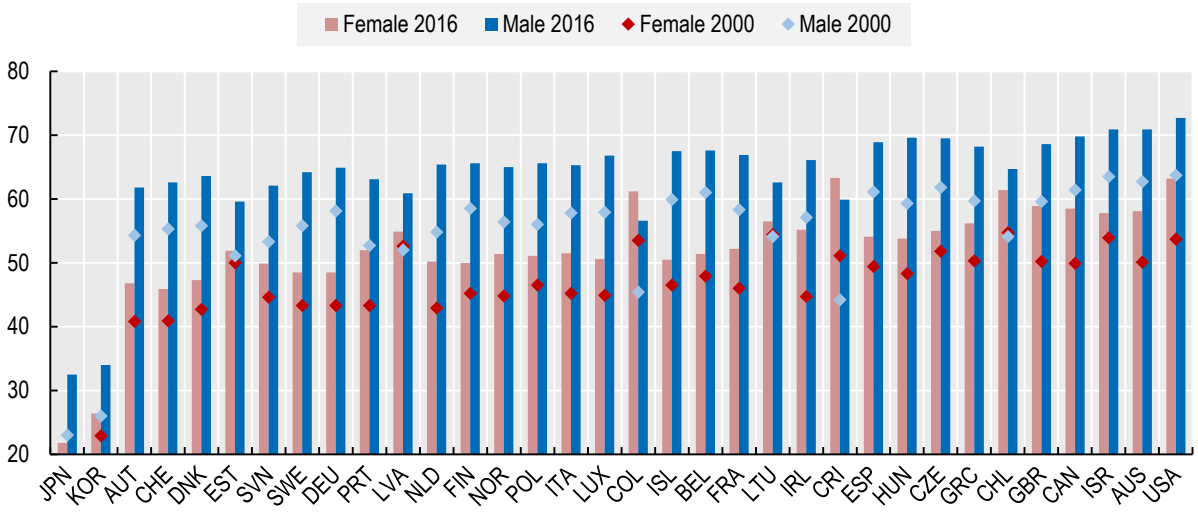
Panel B: ppt. difference between men and women across regions



Note: The gender gap denotes the % difference in excess weight between men and women. In the panel on the right, 03 = Lombardia; 06 = Friuli-Venezia Giulia; 11= Marche; 15 = Campania; 17 = Basilicata; 18 = Calabria.
Source: (ISTAT, n.d.[3]), *Health Statistics* (database), https://www.istat.it/en/health-statistics.

91. In international perspective, Italy's overweight and obesity rate is moderate (Figure 3.7). In 2016, the most recent year for which measured overweight and obesity data is available, 58.5% of people in Italy had a BMI higher than 25 – 51.5% for women and 65.3% for men. The highest value in this year was recorded in the USA where 67.9% of the population is overweight or obese, while the lowest value (27.2%) has been found in Japan. The differences among genders are still significant also in the measured data and men have higher overweight and obesity rates than women in all countries but Colombia, Mexico and Turkey. Without exception, excess weight has increased over time in all OECD countries.

Figure 3.7. Country comparison of excess weight, 2000 and 2016



Source: (WHO, n.d.[8]), *Global Health Observatory* (database), https://www.who.int/data/gho/data/indicators/indicator-details/GHO.

92. Although the present analysis focuses on the determinants of overweight and obesity in adults, it is worth noting that levels of child obesity and overweight in Italy are extremely high. According to WHO data[20], only 3 countries in the OECD have a share of excess weight among children (aged 5 to 19) higher than in Italy. 36.8% of Italian children are above the optimal level of weight, while the OECD average is 28.6%. The analysis of trends over the last years concerning child obesity and overweight leads to different conclusions depending on the source of the data used. The WHO data show an increase in the incidence of excess weight from 30.9% to 36.8% for children aged between 5 and 19. On the contrary, the Italian monitoring system "Okkio alla Salute" registers a decline in the rates of overweight and obesity in children aged 8-9 years.[21] The value registered measuring 40 thousand children in the 3rd year of elementary school was 35.2% in 2008-09, decreasing to 29.8% in 2019. These differences may simply be explained by the different reference groups and timeframes. Regardless, the fact remains that most recent international comparisons show a very high rate of excess weight in Italy.

The impact of excess weight on society

93. The importance of overweight and obesity rates in a policy context is due to its role as a significant negative health determinant, and therefore has implications for societal health outcomes, human capital and health expenditures. The time trends in overweight and obesity rates presented previously make it clear that modern lifestyles are implying a significantly higher burden of obesity, and this has consequences for health and well-being. In 2019, the OECD published a book on the wide-ranging impacts of overweight and obesity on our society (OECD, 2019[2]). A number of findings from this work are presented as follows.

The link between excess weight and health outcomes

94. The association between BMI and the risk of developing chronic diseases has been widely proven in the literature. BMI is an independent health risk factor for type 2 diabetes, cardiovascular diseases, respiratory diseases, musculoskeletal disorders, several types of cancer and depression. In the next 30 years, nearly 60% of all new diabetes cases will be the result of overweight, while cardiovascular disease, dementia and cancer cases will increase, due to overweight and obesity, by 18%, 11% and 8%, respectively. Figure 3.8 shows the projected number of disease cases associated with excess weight in 52 OECD, EU and G20 countries covered by the OECD's SPH-eP-NCD's model, highlighting the damaging effect of excess weight on people's health outcomes. It should be noted that in older age groups excess weight results in a decline in disease burden as a result of the mortality impact associated with overweight and obesity in these age groups.

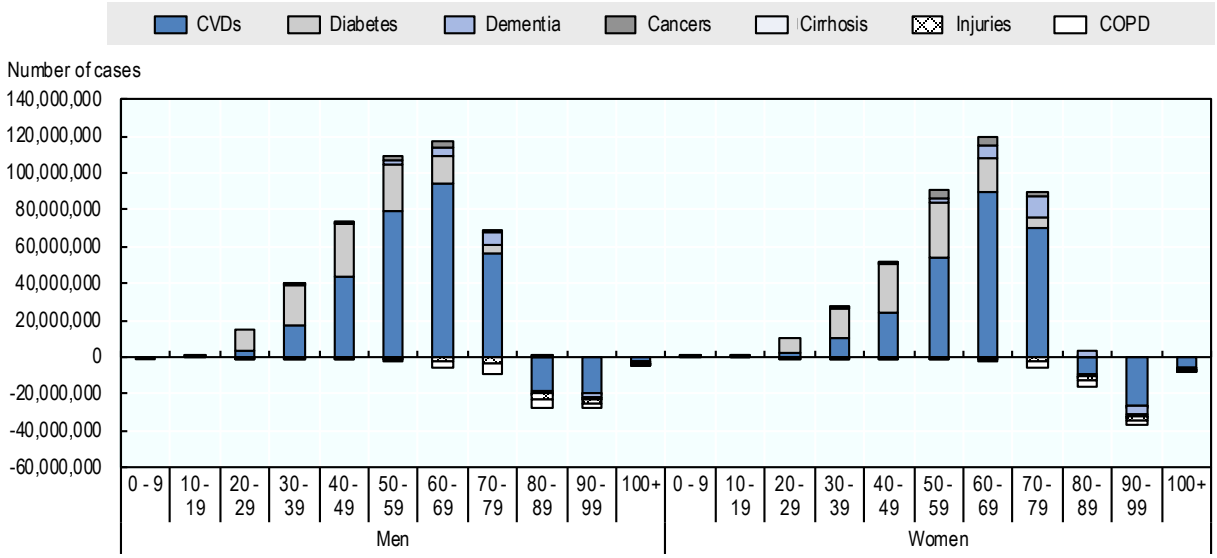
95. As a result of the increase in disease incidence, it is projected that over the period between 2020 and 2050, 92 million people will die prematurely and life expectancy will be reduced by about 3 years as a result of overweight and obesity in OECD, EU and G20 countries. Beyond the impact of overweight-related disease on mortality, excess weight also limits people's quality of life. In OECD countries, 4 000 disability-adjusted life years (DALYs) per 100 000 population every year due to excess weight. Most of this reduction in life expectancy is indirect as overweight increases the risk of being affected by other diseases. In the same OECD study, the main chronic diseases associated with a high BMI level are analysed Figure 3.9).

[20] https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-overweight-among-children-and-adolescents-bmi-1-standard-deviations-above-the-median-(crude-estimate)-(-).

[21] https://www.epicentro.iss.it/okkioallasalute/.

Figure 3.8. The impact of excess weight on disease incidence, by age group and sex

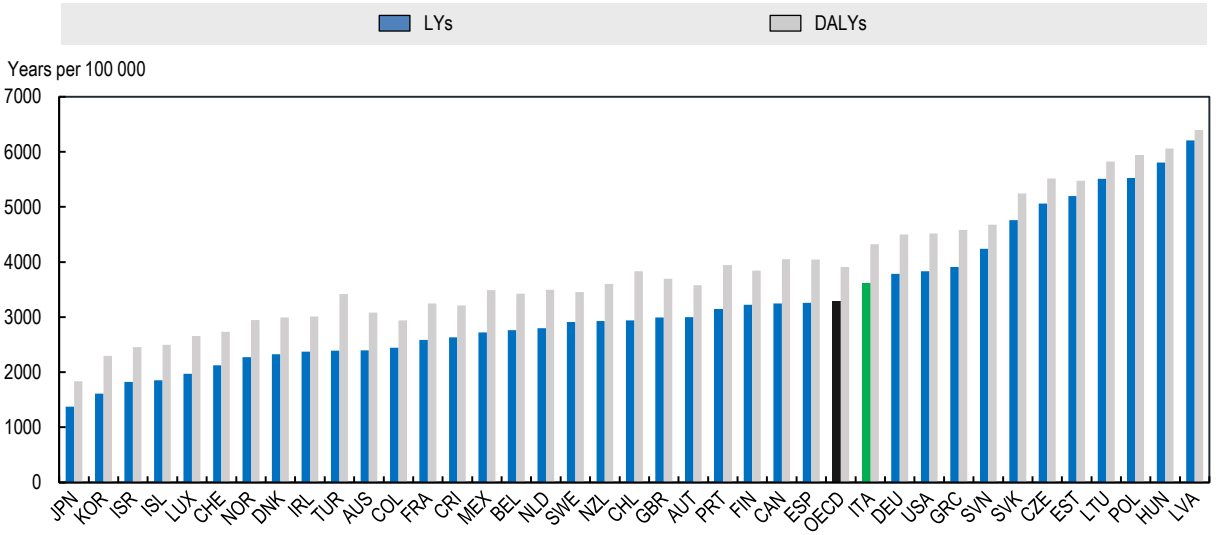
Total number of cases due to overweight, by sex and 10-year age group, total 2020-50



Note: This figure refers to the 52 OECD, EU and G20 countries covered by the OECD's SPHeP-NCDs model.
Source: OECD analyses based on the OECD SPHeP-NCDs model (OECD, 2019[2]).

Figure 3.9. Impact of obesity on life-years lost across countries

Life-years (LYs) and disability-adjusted life-years (DALYs) lost per year per 100 000 population due to excess weight, average 2020-50



Source: OECD analyses based on the OECD SPHeP-NCDs model (OECD, 2019[2]).

96. These results are in line with those from studies in the Italian context. (Atella et al., 2015[23]) used a large observational dataset containing over half a million patient records collected by Italian general practitioners to study the impact of different levels of BMI on the probability of chronic disease. They observed significantly higher disease burdens among overweight people and particularly so for those with a BMI over 30. The share of people with diabetes among adults aged between 18 and 55 differed from about 1.1% among

people with a normal weight to 7.3% among adults with a BMI between 30 and 35 and 16.7% among those with a BMI over 40. The occurrence of cardiovascular diseases (CVD) of obese people in the sample was more than 3 times that of people with normal weight. A similar pattern is recorded for the incidence of hypertension and dyslipidemia.

97. Excess weight can also have a large impact on quality of life. (Manucci et al., 2010[24]) found that higher levels of BMI are correlated with moderate to severe levels of stress. A high BMI score was also found to be associated with a significant decrease in physical and psychological well-being. In the study by Atella et al. (2015[23]) depression rates were higher among the obese, but not the overweight, and only in the younger age group (under 55). (WHO Europe, 2017[25]) also reports that weight bias and obesity stigma are associated with poor body image, low self-esteem, loneliness, suicidal thoughts and acts, depression, and anxiety. Obesity stigma leads to exclusion and marginalisation of persons with obesity, and can therefore contribute to wider well-being inequalities.

The link between excess weight and economic outcomes

98. Societies are rapidly aging, lifestyles are changing, chronic diseases are on the rise, and the threat of infectious diseases is constantly evolving. Together with existing resource constraints, which were further magnified by the COVID-19 pandemic, these trends are putting increasing financial pressure on health systems. As we have seen in the previous section, excess weight negatively affects people's lives in many ways. This happens through a reduction of life expectancy, an increase of associated diseases and also through a worsening of psychological and more general life quality features. All these aspects have a large impact on the economy and are, at least partially, quantifiable in terms of economic and financial costs.

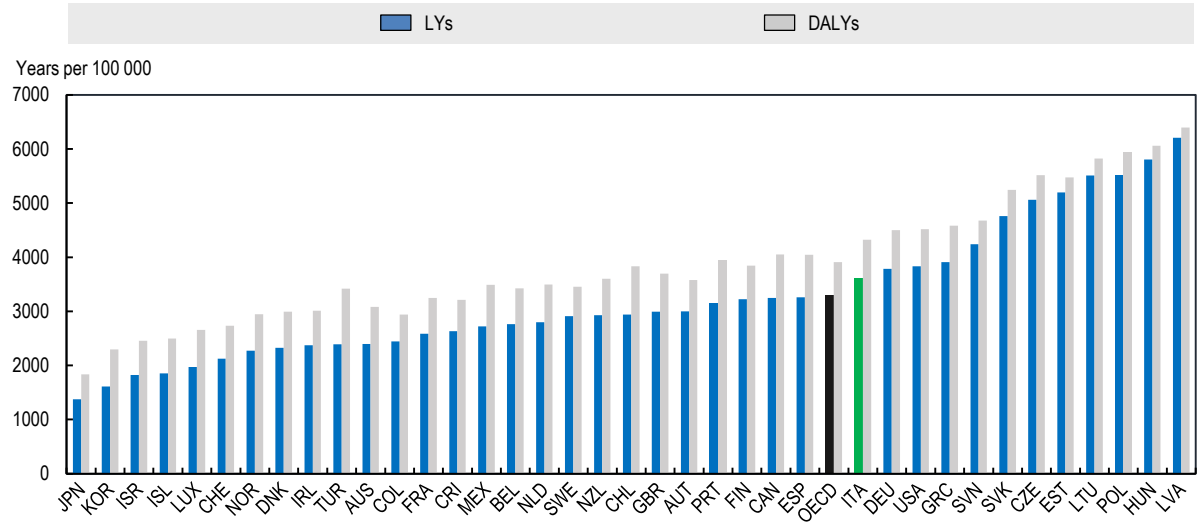
99. Recent and updated estimates of the OECD show that treating the diseases caused by obesity is associated with an increase of 8.4% in total health care spending on average across OECD countries, and 9% in the case of Italy (Figure 3.10). Overweight and obesity are the cause of 70% of all treatment costs for diabetes, 23% of treatment costs for cardiovascular diseases and 9% for cancer (OECD, 2019[2]). This figure takes into account differences in health systems across the OECD countries, such as the price of delivering health care services, the mix of health care services used and the share of the population with access to effective health care services.

100. The OECD's projections resonate with studies done in the Italian context, specifically. (Atella et al., 2015[23]) estimate that total health care expenditure of overweight people in Italy is around 3% higher for overweight people, while those with obesity ($30.0 \leq BMI \leq 34.9$), severe obesity ($35.0 \leq BMI \leq 39.9$) and very severe obesity ($BMI > 40$) have respectively 18%, 41% and 50% higher health care costs than normal-weight counterparts. Much of these increased costs can be attributed to three very prevalent chronic diseases: hypertension, type 2 diabetes and CVDs.

101. The economic costs of excess weight are not limited to the health care system. The physical and psychological consequences of obesity and associated chronic diseases also have an impact on people's labour market outcomes and productivity. There are four main channels through which excess weight can exert an impact on the labour market. Their modelled impact on labour market outcomes in terms of average wages is shown in Figure 3.11. Presenteeism, where employees are physically present at work but not fully productive, is the largest contributor to per capita labour market output reductions. Overweight people also tend to be more absent from their job and individuals with a chronic disease have a 1.5% higher absenteeism rate. Reduced employment and early retirement are also large contributors to the gap in labour market outcomes. In Italy, the economic impact of excess weight is relatively low, which is partially driven by the incidence of excess weight but also by the wage differential.

Figure 3.10. Health expenditure associated with overweight and obesity

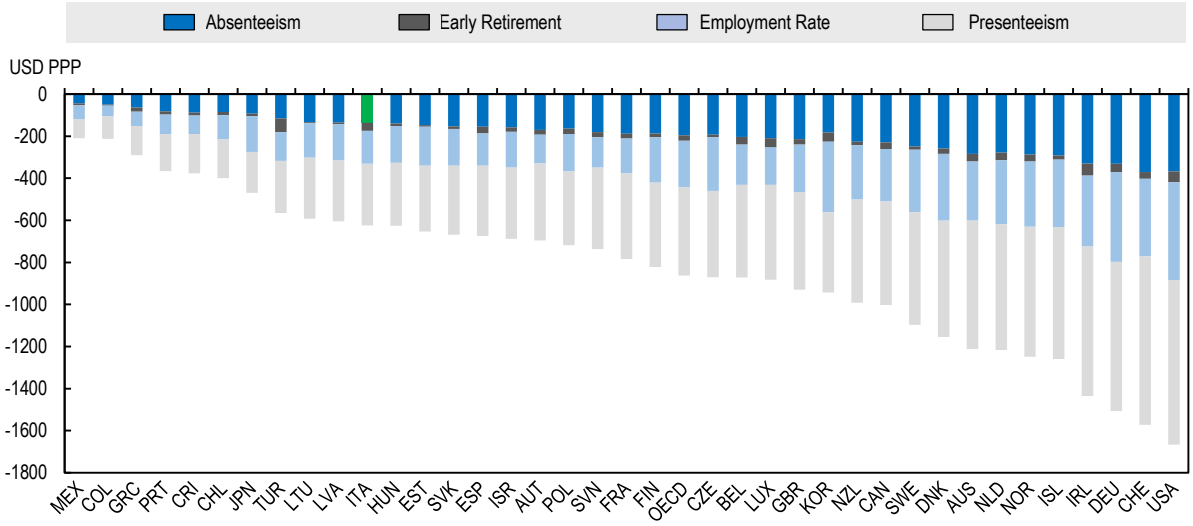
Health expenditure due to excess weight per year, in USD PPP per capita and as a percentage of total health expenditure, average 2020 2050



Note: Health expenditure measures the final consumption of health care goods and services for personal health care including curative care, rehabilitative care, preventative care, ancillary services and medical goods but not long-term care.
Source: OECD analyses based on the OECD SPHeP-NCDs model (OECD, 2019[2]).

Figure 3.11. Economic impact of excess weight in the labour market

Impact on per capita labour market output based on average wages, per year, in USD PPP, average 2020-2050



Source: OECD analyses based on the OECD SPHeP-NCDs model (OECD, 2019[2]).

102. The total economic impact of a higher mortality rate, increased healthcare costs and poor labour market performances can be estimated in terms of GDP reduction. The OECD has estimated that excess weight is associated with a reduction of 3.3% in GDP each year on average in OECD countries (OECD, 2019[2]). Although in Italy the reduction is expected to be lower, it still accounts for more than a 2.5% reduction in GDP on a yearly basis. These results do not consider the impact of increases in life expectancy and retirement rates. In a

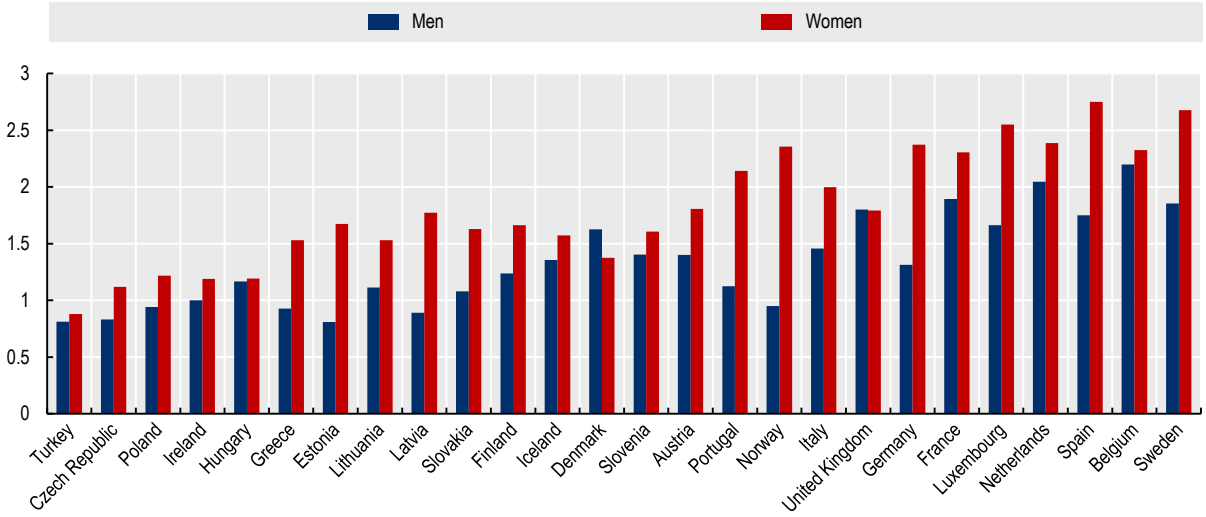
scenario where retirement ages are increased by two-thirds of a year for every year of additional life expectancy, the impact of overweight on GDP would be doubled, with the average for OECD countries going from 3.3% to 6.8%. In addition, the model estimates that the fiscal pressure associated with excess weight under the current policy mix is USD PPP 359 per year.

The link between excess weight and societal inequalities

103. Finally, obesity is associated with and can exacerbate poor socio-economic outcomes and perpetuate inequalities. Previously it was noted that people with lower educational outcomes had higher rates of excess weight. The relation between education levels and excess weight can be partially explained through the link between education outcomes and (un)healthy behaviour. However, there is likely a causal pathway in the opposite direction as well (OECD, 2019[2]). A recent meta-analysis found compelling evidence on the link between weight status and tertiary education performance, which may be the result of stigma or lower aspirations (Hill, Rodriguez Lopez and Caterson, 2019[26]). Other studies have shown that becoming overweight as a child is a significant risk factor for adverse school outcomes (Datar and Sturm, 2006[27]).

104. Later in life, excess weight may result in poorer material well-being outcomes. People with obesity related chronic disease in a given year are 8% less likely to be employed in the following year than healthy counterparts (OECD, 2019[2]). When they have a job, people in excess weight are more often absent and at the aggregate less productive. This has implications for earnings and income. Indeed, when we look at data on the relation between income and excess weight, it appears that people in the lowest income quintile are significantly more likely to be overweight or obese than people in the highest income quintile. In Italy, women in the lowest quintile are twice as likely to be obese than those at the top of the income distribution. The relationship is slightly weaker for men, who are almost 50% more likely to be obese if they are in the lowest income quintile as opposed to those in the highest quintile. A similar, slightly less strong pattern is found for those with overweight (Figure 3.12).

Figure 3.12. Relative index of income inequality (RII) of people with obesity (BMI > 30)



Note: Inequalities in income can be evaluated using the relative index of inequality (RII). RII is a statistical measure used to approximate the level of inequality in a health outcome (such as overweight and obesity) due to a socio-economic characteristic. For example, an RII or 1.5 suggests that individuals at the lowest quintile of income are 50% more likely to develop overweight or obesity than individuals at the highest quintile of income.
Source: OECD analyses based on the OECD SPHeP-NCDs model (OECD, 2019[2]).

105. As education and income are also correlated, the relationship between excess weight and education and labour market performance and thereby socio-economic outcomes is very likely to be two-directional, with

poor socio-economic conditions posing a risk of excess weight but also overweight and obesity outcomes giving rise to further poor socio-economic outcomes.

3.3. Policy background and conceptual framework

Italy's policy action to address excess weight

106. Over the last decades, the Italian government has recognised the necessity of policy action in order to reduce the burden of obesity. Several policies have been implemented and a national strategy has been put in place. A National Prevention Plan (PNP), as well as Regional Preventions Plans (PRPs) are published every 4 to 5 years. The last PNP was published in 2020, establishing strategies to prevent several diseases up to 2025.[22] The PNP has a strong focus on noncommunicable diseases (NCDs), many of which are chronic and include diabetes, cancer, cirrhosis and CVDs. The plan recognises the role excess weight plays in the development of NCDs, defining and excess weight as an "intermediate risk factor". Moreover, it identifies nutrition habits, smoking, large alcohol consumption and sedentary behaviours as the "primary risk factors" for chronic diseases.

107. A second important achievement in the Italian health sector is the national "Gaining Health" (Guadagnare Salute) program enforced in 2007. The main objective is to prevent and change unhealthy behaviours that increase degenerative and chronic diseases. It has a particular focus on fighting tobacco and alcohol consumption, promoting healthy eating habits and physical activity. At the European level, "Gaining Health" is part of the strategy for the prevention and control of chronic diseases promoted by the WHO in 2006. At national level, the program is promoted by the National Centre for Disease Prevention and Control (CCM). This program operates in collaboration with the National Institute of Health (ISS). The ISS is also responsible for various monitoring systems of people's health. In particular, three monitoring systems have been created: "Okkio alla salute" for children aged 8-9 years old, "Passi" for adults between 18 and 65 and "Passi d'Argento" for people over 65. These monitoring systems provide important data on nutrition and physical activity habits.

108. At the sub-national level, in 2015 all Italian regions but two (Valle d'Aosta and the autonomous province of Bolzano) already adopted at least one policy intervention in their Regional Prevention Plans specifically aimed at controlling obesity (Nicolluci et al., 2015[28]). However, large differences in policy action among regions exist. Although policies to increase sport activities at school were implemented in most of the regions, only four regions have adopted policies to improve the quality of food. Sport activities for adults have been promoted in only 3 regions. Finally, in the assessment of (Nicolluci et al., 2015[28]), the Regional Preventions Plans are usually not detailed enough regarding how to adapt policies to the regional context and they do not provide a cost-benefit analysis.

109. The majority of OECD, EU28 and G20 countries have adopted a national action plan to address adult and child obesity. Most countries have also developed national guidelines to promote physical activity. Although Italy is among them, what seems to be missing is a coordinated multi-sectoral response and broad awareness of the issue across a range of government departments. While some policies may be very effective, none of them is sufficient if taken alone. Strong coordination across different sectors, between policymakers at all levels and the various national institutions as well as the private sector, can be part of the solution of reducing overweight and obesity levels.

110. For instance, as described in the previous section, there is an indirect connection between the effects of policies aimed at improving educational outcomes and excess weight: higher educational status is generally associated with healthier nutritional habits. In addition, there are links between policies aimed to reduce high BMI levels and those aimed to tackle climate change: prevention measures could direct the demand of consumers and the supply of food production chains towards more sustainable and climate resilient production

[22] The PNP is available here https://www.salute.gov.it/imgs/C_17_notizie_5029_0_file.pdf.

methods and products. Adequate nutrition reduces food waste and the production of greenhouse gases resulting from the production of the agri-food industry and transport (Sassi and Hurst, 2008[29]).

111. Positive interactions also exist with respect to policies to reduce poverty and income inequality (Nugent et al., 2018[30]), improve economic productivity, combat absenteeism and presenteeism (Feigl et al., 2019[31]). However, to boost these synergies greater awareness and collaboration is needed between the various ministries within the central government, as well as between the central government and local governments for a firm and decisive improvement in overweight and obesity trends.

A framework for policy action on excess weight

112. The OECD has previously developed a framework to categorize public health policies, including policies to tackle overweight and to promote healthier lifestyles (Sassi and Hurst, 2008[32]). These policies concern very concrete policy options aimed at influencing the two direct contributors to weight gain, namely nutrition and physical activity. These four broad groups that need to be addressed simultaneously by policymakers if an effective result is to be achieved. However, as we will see, beyond these four direct policy options, a wider ecosystem of public policies is necessary to address overweight and obesity in a holistic manner. The four categories of policy options that can be used to tackle excess weight are (see also Table 3.1):

- **Policies influencing lifestyles through information and education**. These interventions are not usually targeting a particular population group. Therefore, their effectiveness is, in some cases, dependent on socio-economic factors and they should be designed carefully to ensure that they do not lead to the exacerbation of health inequalities (Lorenc et al., 2013[33]).
- **Policies widening the set of healthy choice options**. The importance of a coordinated multi-sectoral response is particularly true in the case of policies influencing lifestyles through information and education and policies that aim to create a local environment rich in opportunities to engage in healthy lifestyles. For example, prescribing physical activity may be ineffective if there is a lack of safe, walkable and green spaces.
- **Policies modifying the cost of health-related choices**. A more balanced diet may be also influenced and promoted by economic incentives, including price interventions.

113. **Policies regulating or restricting actions promoting unhealthy choice options**. Restrictions on the advertising of unhealthy food are implemented in most OECD countries, but Italy is not among them.

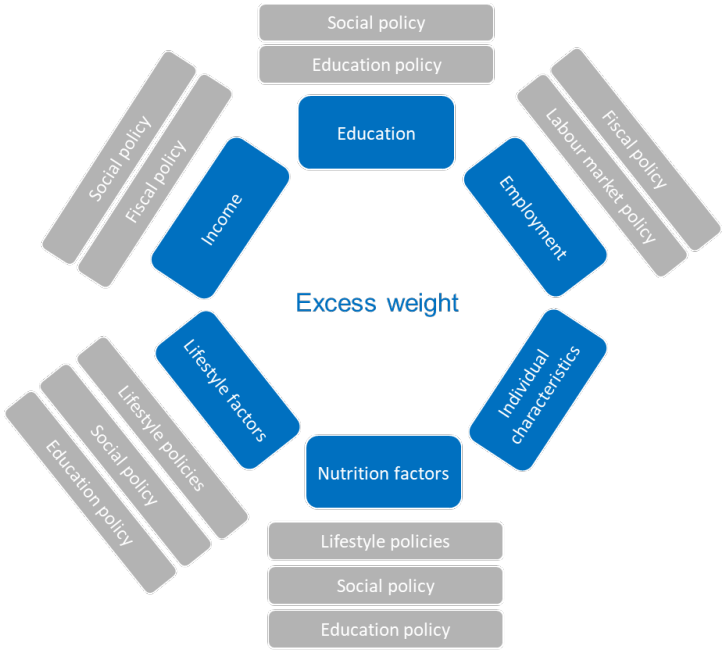
Table 3.1. Categories of public health policies that tackle obesity

Policies influencing lifestyles through information and education	
Food labelling	Food labels on pre-packaged foods aim to inform consumers about the nutritional value of foods.
Menu labelling	Restaurant menu labelling involves listing information on the calorie content, as well as on the content of other nutrients, such as salt and sugar, of items on the menu at points-of-purchase of restaurants and cafeterias.
Mass media campaigns	Health-promoting mass media campaigns have the potential to reach many people, while affecting multiple overweight risk factors at the same time.
New technologies	A number of countries have shown increasing interest in testing new electronic tools designed to promote various health-related behavioural changes. Among them are applications, which can help individuals count the numbers of steps they walk in a day, or estimate calories consumed.
Prescription of physical activity by primary care doctors	Physicians may be in a good position to provide advice on proper nutrition including diet or combine the prescription of physical activity with a nutrition education component.
Polices designed to widen choices	
School-based and other environmental policies that can influence children	Many policy options exist to reduce child obesity, e.g. physical activity and dietary education classes, provision of healthy food in schools and regulations on nutrition in schools.
Workplace policies	Similarly, workplace-based actions, such as healthy food options in cafeterias or the promotion of physical activity are increasingly considered as a potentially effective tool to influence choices favouring healthier lifestyles.
Policies promoting active transport and walking	They can include, for example, access to dedicated cycle lanes and bike-sharing schemes, urban planning to increase the number of parks, recreational areas and green spaces.
Policies to modify the costs of health-related choice	
Price policies	Governments can affect food-related consumer behaviour by implementing targeted price policies, e.g. taxation of products high in sugar, saturated fats or salt or targeted price reductions for healthier foods sold in shops
Healthy food subsidies for health purposes	Some countries provide targeted subsidies for foods considered healthy by their nutritional profile, including vouchers for healthy meals or discounts for healthier foods purchases through governmental assistance programmes.
Changes in nutritional community environment through economic incentives	E.g., Incentives for retailers to improve availability, accessibility and affordability of food options in their stores, financial incentives for healthier food outlets to be located in underserved neighbourhoods
Policies to regulate or restrict actions promoting unhealthy choice options	
Regulation of advertising	Food marketing represents a key factor incentivising the consumption of high-calorie and nutrient-poor foods through persuasive messages. Statutory restrictions on commercial food advertising and promotion can have a significant effect on dietary intake.
Other restrictions	More stringent regulatory restrictions that apply to specific foods with potentially harmful properties

Source: For a complete analysis of each policy see: (OECD, 2019[2]), *The Heavy Burden of Obesity: The Economics of Prevention*, OECD Health Policy Studies, OECD Publishing, Paris, https://doi.org/10.1787/67450d67-en.

114. The policy framework that this paper is rooted in (Figure 3.13) builds on the four categories of policy interventions presented above, but extends these to incorporate the idea that a whole-of-government approach is necessary to comprehensively address well-being challenges. As has been clear from the evidence presented above, while excess weight is a direct function of caloric intake and food quality and physical activity, other factors, including individual characteristics, education, labour market outcomes and income also potential impacts on overweight and obesity. The present model is therefore set up to be sensitive to other types of policies that may indirectly affect excess weight outcomes. These include social policy and links to childhood outcomes, income and lifestyle outcomes, fiscal policy and macro-economic outcomes related to income and education, and education and labour market policies that indirect overweight and obesity through corresponding outcomes. This framework can therefore form the basis of an integrated model for assessing the ex-ante and ex-post results of policies on excess weight.

Figure 3.13. Determinants of excess weight and policy applications



3.4. Empirical framework

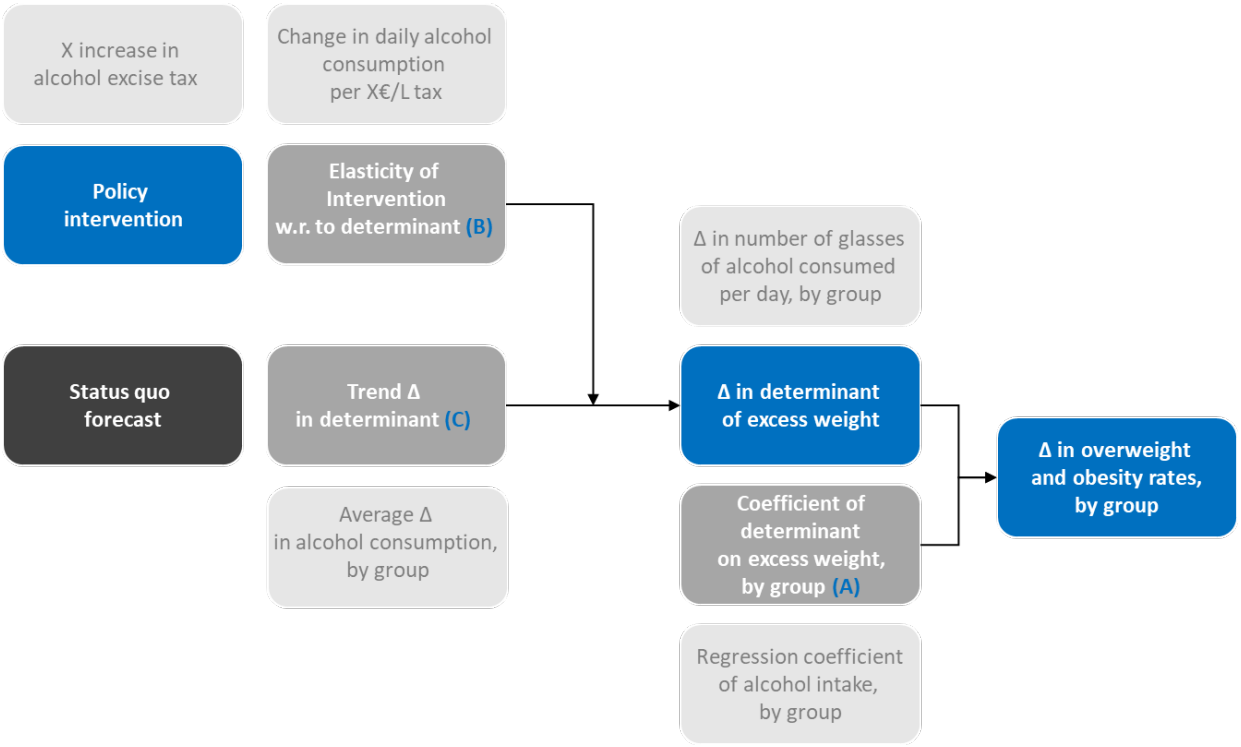
Methodology

115. This section presents a static micro-model that was developed with the support of the EU's SRSP and in collaboration between the OECD and the Ministry of Economy and Finance in Italy with the purpose of forecasting and conducting an assessment of the potential impact of policies on excess weight in Italy. The first possible use of the model is to obtain a forecast of excess weight based on existing trends in the determinants of overweight and obesity with existing policy settings. The model incorporates the six groups of determinants of excess weight presented above[23] and projects their future pathways, largely through linear extrapolations but also through auxiliary models, to assess how overweight and obesity rates in Italy will develop as a function of changes in the factors that are associated with excess weight. The official excess weight indicator used in the ESW report and the economic and financial planning cycle is based on ISTAT's Aspects of Daily Life Survey (ADL), and the data from this survey forms the basis of this micro model. Because the ADL is a cross-sectional survey, the model is static and is not underpinned by a causal relationship between determinants and weight outcomes.

116. The model can be used to estimate the impact of specific policies on future developments in the overweight and obesity rate. If applied ex ante, it can help policymakers make decisions about the relative (cost) effectiveness of different policy interventions. Most of the time, this requires inserting externally sourced elasticities of the (estimated) effect of specific policies on the explanatory variables included in the model. Figure 3.14 illustrates how the model generates a status quo or a policy impact forecast of excess weight. In the example, estimating the impact of an alcohol excise tax on excess weight requires evidence on elasticities of alcohol excise on alcohol consumption. These elasticities can then be inserted in the model to derive the policy impact, together with the model coefficients derived from the analysis that is presented in the remaining of the following section.

[23] Individual characteristics, education outcomes, income, employment, and lifestyle and nutrition factors.

Figure 3.14. Incorporating interventions in excess weight forecast



Existing approaches to forecast overweight and obesity rates

117. Given its economic and societal significance, several attempts have been made to forecast future trends in the share of people in excess weight. In early approaches, forecasts were made primarily based on strategies that extrapolated trends of past overweight and obesity levels while accounting for future trends in population structures. Existing such projections including by the (OECD, 2017[34]) suggest that overweight and obesity trends continue to increase linearly in the coming decade.[24] (Finkelstein et al., 2012[35]) introduced an approach that combines BMI trends with a logit model that incorporates trends in a number of individual and state level determinants on BMI, in the United States. This model suggests a levelling off in the rate of increases in obesity, with forecast rates lower than predicted in linear models. (Baik, 2018[36]) uses a similar approach to forecast BMI in the South Korean context by applying a logit model to estimate the impact of a number of individual and lifestyle variables.

118. An alternative approach is taken by (Janssen, Vidra and Bardoutsos, 2020[37]) who observed that increases in obesity prevalence are decelerating. In line with models for other health epidemics, such as of smoking rates, they designed a model based on a long-term wave-shaped obesity epidemic, where obesity peaks somewhere between 2030 and 2052 among men, and between 2026 and 2054 among women, for 17 European countries and the US. According to this model, in Italy, the estimated peak levels will be reached in 2036 and 2034 respectively. (Jung et al., 2020[38]) created a dynamic microsimulation model to predict eventually decreasing rates of obesity in Korea in the next two decades. Such approaches, while more sophisticated than linear forecasts, consider policy responses to be endogenous factors in determining the shape of future trends and therefore do not allow assessing the impact of policy responses on future trends.

119. The OECD has developed a sophisticated tool that allows policymakers to link health risk factors, health outcomes and health care expenditure in an integrated way, called the OECD Strategic Public Health Planning

[24] https://www.oecd.org/health/health-systems/Obesity-Update-2017.pdf.

for non-communicable diseases (NCDs) or SPHeP-NCDs model.[25] The model simulates the potential impact of major risk factors, such as obesity and alcohol use, on a number of societal outcomes, including disease incidence, mortality, but also health expenditure and labour market outcomes. The NCDs model can be used to assess the concrete results of specific policy interventions to address obesity, such as menu labelling, advertisement campaigns or the regulation of advertisement. In this model, however, overweight and obesity is treated as a risk factor, and the model does not actually forecast trends in excess weight rates associated with these interventions.

120. In order to design a model that is sensitive to policy changes, the present approach will build on those by (Finkelstein et al., 2012[35]) and (Baik, 2018[36]) by estimating trends in the prevalence of excess weight in Italy by incorporating individual and lifestyle determinants of excess weight and future changes in these determinants. Data from the ADL survey allow using a variety of determinants that cover a number of lifestyle and nutrition related variables. To the best of our knowledge, this is the first application of such a model in the Italian context.

Selecting the determinants of excess weight

121. The framework presented earlier (in Figure 3.13) considers six broad groups of determinants of excess weight, namely individual characteristics (e.g. age, gender, migration status), education, income, employment status, and lifestyle and nutrition variables. All of these, aside from individual characteristics, which are largely a given, are to some degree policy amenable. Variables in each of these broad groups are included in the ADL survey (see Box 2.2 for more information on the survey). The rationale for including education, income and labour market status has already been given in the background section. The following elaborates on the nutrition and lifestyle variables that are relevant for excess weight and their inclusion in the ADL.

122. The difference between energy intake through nutrition and energy consumption through physical activity, is the main contributor to the increase in BMI levels (Hill, Wyatt and Peters, 2012[39]). It is therefore straightforward that people's habits concerning nutrition and lifestyle are good predictors and determinants of BMI scores. Unfortunately, it is not easy to identify which particular habit is linked with a larger calorie intake or with a lower calorie consumption. In this section, we will give an overview of what the literature has found so far. Costa-Font (2016[40]) and Popkin et al. (2006[41]) point out that the trends of increasing urbanization and globalisation are associated with an increase of unhealthy behaviours such as a more sedentary lifestyle and larger consumption of energy-dense foods.

123. Nutrition is, therefore, a fundamental variable if we aim to understand the increasing trends in overweight. According to the OECD (2019[2]), food supply has increased by nearly 20% in the OECD countries in just fifty years, rising from 2 700 kcal/capita per day in 1961 to a little more than 3 200 kcal/capita per day in 2013. Mozaffarian et al. (2011[42]), in a study conducted on 120 877 US women and men, finds that weight change was most strongly associated with the intake of snacks, carbonated drinks, potatoes and processed food. Conversely, the relation has been found to be negative for fruit, vegetables, whole grains and nuts and yogurt. For this reason, without undervaluing the importance of the quantity of consumption, it is also important to analyse the trends in the quality of food consumed in order to forecast overweight. In Italy, less than 40% of the population eats at least the recommended quantity of fruit and vegetables, which is 5 portions in total per day (Graf and Cecchini, 2017[43]).

124. Another set of variables that have a direct impact on overweight is that of lifestyle-related habits and, in particular, those that are associated with higher energy consumption. Calorie consumption is related to three main components: resting metabolic rate, thermic effect of food (energy associated with the digestion and processing of food), and physical activity (Hall et al., 2012[44]). Physical activity is one of the components that can be influenced by policymakers and it can be divided into four main domains: domestic, transport, occupational and leisure time. It is therefore important to analyse trends not only regarding sport activities, which

[25] http://oecdpublichealthexplorer.org/ncd-doc/.

fall into the leisure time domain, but also the means of transport preferred, the type of domestic duties carried out and whether a job is physically demanding or not. Figure 4 shows that, according to the WHO data, in Italy more than 40% of the population is not physically active, with 40% being one of the highest values in the OECD.

The data

125. Table 3.2 below depicts summary statistics for key variables in the sample of respondents in 2018 and 2019. In order to allow for the forecasts of the determinants to enter into the model, thresholds are set to create binary variables. Some variables are easily defined using only one corresponding question of the ADL survey. For instance, for the variable related to vegetable consumption, we set the threshold at those consuming more than 2 portions of vegetables per day, which is the daily recommended intake in Italy.

Table 3.2. Summary statistics for key variables

Variable	Description	Sample	Mean	S.D.
	Nutrition			
Adequate breakfast	Person that consumes food for breakfast	90237	0,736	0,441
Fruit consumption	Person that consumes more than 2 portions of fruit per day	90237	0,363	0,481
Vegetables consumption	Consumes more than 2 portions of vegetables per day	90237	0,227	0,419
Vegetarian	Person that eats any kind of meat less than once a week	90237	0,05	0,218
Carbohydrates	More than one portion of pasta, rice, bread or potatoes per day	90237	0,27	0,444
Sweets and desserts	Consumes sweets or desserts more than once a day	90237	0,023	0,151
Salt intake concern	Person reporting being using care in the quantity of salt used	90237	0,35	0,477
Alcohol	More than 1/2 litre of wine or beer or > than 2 spirits per day	90237	0,025	0,156
Carbonated drinks	Consumes 1-2 or more glasses of carbonated drinks per day	90237	0,069	0,254
Ordered food online	Person that reports having ordered food in the last 12 moths	90237	0,111	0,314
Reaching food markets	Person that reports having had difficulties in reaching food	90237	0,067	0,25
Reaching supermarkets	Reports having had difficulties in reaching supermarkets	90237	0,131	0,338
Binge drinking	Person consumes > 6 glasses of alcohol at least once a year	90237	0,042	0,201
Meat consumption	Person that eats meat more than once a day	90237	0,01	0,101
Cheese consumption	Person that eats cheese more than once a day	90237	0,008	0,091
Eggs consumption	Person that eats snacks more than once a day	90237	0,035	0,185
Snacks consumption	Person that eats eggs more than once a day	90237	0,055	0,227
Check food labels regularly	Person that checks food labels regularly	45555	0,171	0,376
Buying bio food regularly	Person that buys biological food regularly	45555	0,059	0,236
Buying local food	Person that buys local food sometimes	45555	0,292	0,455
	Lifestyle			
Reading books	Person that declares to read at least one book per year	90237	0,385	0,486
Sport	Person that practices sport regularly	90237	0,301	0,459
Bike Use	Person that uses bike or bike sharing for commuting	90237	0,02	0,141
Time use dissatisfaction	Person is not satisfied with spare time in the last year	90237	0,271	0,445
Bad family relations	Person is not satisfied with family relations in the last year	90237	0,075	0,263
Watching a lot of TV	Person that watches more than 3 hours of TV per day	90237	0,475	0,499
	Income and employment			
Log income	Log of HH income divided by the square route of the HH size	44682	8,887	2,877

Log income squared	Square of HH log income	44682	87,258	31,162
Economic dissatisfaction	Person is not satisfied with economic situation in the last year	90237	0,377	0,485
Unemployed	Person who is unemployed	90237	0,085	0,278
Education				
University degree	Person has completed tertiary education or more	86034	0,137	0,344
High school degree	Person has completed upper sec. education or equivalent	86034	0,34	0,474
Middle school at most	Person has completed lower sec. education or less	86034	0,524	0,499
Individual characteristics				
North West	Person living in the north west of Italy	90237	0,216	0,412
North East	Person living in the north east of Italy	90237	0,211	0,408
Centre	Person living in the centre of Italy	90237	0,185	0,388
South	Person living in the South of Italy	90237	0,287	0,453
Islands	Person living in the Islands of Italy	90237	0,101	0,301
Foreign citizenship	Person with a foreign citizenship	90237	0,946	0,226
Living alone	Person that lives alone	90237	0,136	0,343
City centre	Person that lives in a city centre	90237	0,118	0,323
City periphery	Person that lives in a city periphery	90237	0,102	0,303
Mun sz. 0-2 thousands	Municipality of residence between 0-2 thousands inhabitants	90237	0,081	0,272
Mun sz. 2-10 thousands	Municipality of residence between 2-10 thousands inhabitants	90237	0,268	0,443
Mun sz. 10-50 thousands	Municipality of residence between 10-50 thousands inhabitants	90237	0,266	0,442
Mun sz. 50+ thousands or	Municipality of residence 50 thousands inhabitants or more	90237	0,165	0,371
Age 0-17	Age: 0-17	90237	0,16	0,366
Age 18-44	Age: 18-44	90237	0,294	0,455
Age 45-64	Age: 45-64	90237	0,304	0,46
Age 65+	Age: > 64	90237	0,243	0,429

Note: Missing values represent a small fraction among some variables and are set to zero to preserve observations.
Source: OECD calculations based on ADL microdata (ISTAT, n.d.[20]).

Box 3.2. The Aspects of Daily Life (ADL) survey

The data that underpin the micro-model for excess weight are drawn from the annual Aspects of Daily Life (ADL) survey, a multipurpose survey on household and individual behaviour conducted by ISTAT. The survey covers a sample of 20 000 households and 50 000 people, living in over 800 Italian municipalities each year. It contains information on demographic and socio-economic characteristics (age, sex, citizenship, education, employment status and health conditions), as well as a large set of thematic questions, including on weight, eating habits, health status, lifestyle and satisfaction with various life domains. For this reason, it is an attractive starting point for enquiries into the determinants of excess weight. Administrative data related to income and pension linked to respondents in the ADL survey are provided by INPS (the National Social Welfare Institution).

The dataset used for the present model consists of pooled microdata from 2018 and 2019, the most recent available year. There are a few minor differences between the two vintages. The 2019 ADL survey includes a few newly introduced questions on food consumption, such as on biological and local food consumption frequency and the extent to which people pay attention to food labels. At the time of writing, income and pension variables were only available for the 2018 data. To complete the dataset, we perform a multiple imputation estimation for the 2019 values based on a set of individual characteristics that include education, labour force status, employment sector, age, gender, size of the municipality of residence and economic satisfaction.

While the ADL survey provides a rich set of relevant determinants, including policy amenable variables, it also faces some limitations. To start with, because the dataset is cross-sectional, it does not allow for estimating causal links between determinants and excess weight and it does not take into account the impact of individual historical behaviours (e.g. past work, nutrition, lifestyle, etc.) on excess weight. Moreover, while the ADL includes a rich set of variables related to nutrition, for the purpose of the analysis of excess weight it lacks some crucial aspects of nutrition related behaviour. While the survey sheds light on the frequency of consumption of certain food groups, in most cases it does not provide information on the quantity of food intake, either per food group or in total (in the form of caloric intake). With regards to food quality, the survey provides information on the types of food groups that are consumed, but it does not reflect some particularly relevant and worrying food trends such as the rise in processed food consumption and fast food.[26] As such, there are limitations regarding the extent to which the survey can be used to model relevant trends in nutrition and the way they relate to the prevalence of excess weight and to health outcomes. In the future the model may be expanded, by incorporating data points from other ADL waves, in order to increase the precision of estimates.

126. Other variables were constructed by combining multiple variables of the original dataset. For example, “large alcohol consumption” has been defined using three variables: quantity of wine, quantity of beer and quantity of spirits drunk in a day, with differing thresholds for each of the alcohol types. Similarly, the “bike use” variable relies on two variables that indicate if a person uses the bike to commute to work or to school and if they have used a bike-sharing service in the past twelve months.

[26] See for example: https://www.pwc.com/it/it/publications/assets/docs/market-vision-foodservice.pdf.

The models

Micro-economic model of overweight and obesity

127. The foundation of the excess weight model is a static micro-economic model supported by a few auxiliary models that underpin the projections for the model determinants. This section presents the general approach to the micro-model.

128. The binary specification of the outcome variables lend themselves to a logit regression model with the following specification:

$$P_{i,a,g} = \ln\left(\frac{\pi_{i,a,g}}{1-\pi_{i,a,g}}\right) = \sum_{x=1}^{k} c_{x,a,g} * X_{x,i,a,g}$$

where π is the probability of being in excess weight for individual *i.* We conduct separate regressions for gender, *g,* and age groups *a* (under 18s, adults from 18-44, adults from 45-64, and those aged 65 and older) in order to compute group-specific coefficients. We will refer to the set of logit regression coefficients as $c_{x,a,g}$. We indicate with x the set of determinants including: a) economic and employment related variables that are influenced by macro-economic developments and fiscal policy, such as employment status, income and economic dissatisfaction; b) nutrition related variables; c) lifestyle variables; d) additional demographic variables (e.g., related to household composition and foreign citizenship) and e) level of instruction of the individual. It should be noted here that not all the independent variables that entre into the regression are finally used in the model. Depending on significance and interpretation, we decide to exclude a number of variables from the model itself, even though they are included in the regression.

129. In order to compute the forecasts, the model results are combined with the projections of the determinants from the auxiliary models (these will be further explained in the next section). These projections forecasts produce a coefficient $d_{x,a,g,t}$ for each model determinant which represents the predicted change in variable *x* for the group with age *a* and gender *g* in year *t*. While it would be possible to disaggregate projections for regions, we presently focus on the aggregate. Regression coefficients $c_{x,a,g}$ for each determinant are derived from the regression specified above and are time invariant. Finally, a weighted forecast coefficient $m_{x,a,g,t}$ for each year, age group and gender of each determinant *x* is computed by multiplying the forecast coefficients $d_{x,a,g,t}$ by the regression coefficients $c_{x,a,g}$.

$$m_{x,a,g,t} = d_{x,a,g,t} * c_{x,a,g}$$

130. Each weighted forecast value $m_{x,a,g,t}$ of year *t* is finally applied to the excess weight outcome of individual *i* in the starting year, allowing to compute forecasted group and aggregate averages.

$$P_{i,a,g,t} = P_{i,a,g,t-1} + \sum_{x=1}^{k} m_{x,a,g,t}$$

Auxiliary models of determinant forecasts

131. The forecasts of the determinants of excess weight are computed using various auxiliary models. For the variables reliant on macro-economic developments and policies, notably household income and unemployment, we rely on the projections provided by the MEF's macro-economic forecast, which takes into consideration the economic conjuncture and the government's economic and fiscal policies that the Government intends to adopt over the forecast period. In connection to this, we develop a side-model that forecasts people's experiences of economic insecurity related to macro-economic developments.[27] Using a 20-year time-series of perceived economic insecurity, we assess the consequences of changes in GDP growth and the unemployment

[27] A similar approach has been used by (Eggink, Woittiez and Ras, 2016[86]).

rate on economic insecurity. This very simple model suggests that for the middle-aged and elderly groups, one percent of GDP growth is associated with a 0.56% decline in the share of people that are pessimistic about the economic situation. As such, we project the change in perceived economic insecurity in line with the MEF's output projections.

132. For the demographic, lifestyle and nutrition variables, a linear model is used to forecast future changes, where sufficient data is available to make such a projection. To compute this forecast, we calculate the average annual change, dividing the total variation from the first available year to the last and dividing it by the number of years between the first and the last. To adjust for volatility, we substitute the value of the first available year with the average value of the first three years and similarly for the last three years. We then divide the total variation by the number of years between the second year and the second to last year:

$$d_{x,a,g} = \frac{\frac{(v_{tn,x,a,g} + v_{tn-1,x,a,g} + v_{tn-2,x,a,g})}{3} - \frac{(v_{t1,x,a,g} + v_{t2,x,a,g} + v_{t3,x,a,g})}{3}}{n-3}$$

where *n* is the number of available observations and *v* is the value for each specific variable (*x*), year (*t*), age (*a*), and gender (*g*). Most of the variables are covered for at least 10 years. Not all the variables are available in this dataset and not all of them are specified in the same manner as in the regression model, and therefore should be interpreted as proxies.

Regressions results

133. Table 3.3 shows the results of the regression of different variables on excess weight for adult men, women and the full adult sample. The model that underpins the forecast takes into consideration gender-age group-specific regression coefficients, results of which are presented in Annex 3.B. Not all regression terms are used in the final forecast model, due to interpretation and ambiguity issues, or because they are not significant, or a forecast is not available.

Nutrition

134. Among nutrition-related variables, variables that are most strongly associated with the probability of being overweight or obese for all or most groups include having a vegetarian diet, eating adequate breakfast as well as alcohol consumption and/or binge drinking, the latter of which is primarily significant for men. Adequate fruit consumption is associated with a lower probability of being overweight or obese for children and less so for adults. These findings are largely in line with expectations from the literature.

135. With respect to variables related to food sourcing and purchasing decisions, ordering food online is positively associated with higher weight, which is concerning in light of the growing habit of purchasing food online. Conversely, regularly purchasing organic food, a new variable only available in 2019, is associated with a lower probability of being overweight or obese. For (middle-aged) men, easy access to smaller food markets is negatively associated with overweight and obesity, whereas easy access to supermarkets may lead to higher weight. In addition, the results show that people that are particularly aware of their salt intake are at lower odds of excess weight, which may be more broadly suggestive of a relationship between conscious eating habits and weight.

136. A few variables yield less intuitive results. A higher frequency of carbohydrate and sweet and dessert intake is associated with lower odds of being overweight or obese, whereas frequent vegetable consumption is associated with higher weight. As mentioned earlier, the ADL variables do not provide insights into the actual quantity of food groups consumed, only of the frequency of intake, which may not correspond to quantity. It is unclear what explains the positive relationship between carbohydrate intake and lower weight. In order to ensure

that the model that we use aligns with theory and existing evidence[28] and provides useful policy recommendations, we exclude the carbohydrate, sweet and dessert and vegetable variables from the model. Other nutrition variables, such as frequent meat, cheese, egg and snack consumption do not yield significant results.

Lifestyle

137. Of particular interest are also the variables related to lifestyle. Unsurprisingly, practicing sports is strongly associated with a lower BMI for all groups, although the effect is particularly strong for children. Watching a lot of TV (more than 5 hours per day) is significantly associated with a higher probability of being overweight or obese, although curiously this association is inverse among children. People who are dissatisfied with their time use are at higher risk of having excess weight, which may point to constraints in finding time for sufficient exercise or to prepare healthy meals. Finally, spending time reading books is associated with a lower probability of being overweight, which may be explained by similar mechanisms behind the positive effect of educational attainment on weight status.

Income, employment and education

138. As for the relationship between income, education and employment related variables, the evidence is slightly ambiguous. It is evident that education is a strong determining factor in weight status, with lower educational attainment significantly associated with a higher probability of being overweight or obese for all groups, an effect that is strongest among young adults and slightly weakens at older ages. Income is only a significant determinant for younger adults, with the weight status of older adults being independent of income. For young adults, this relationship appears to be non-linear, with income being positively associated with higher weight at lower ends of the distribution but negatively at higher levels of income. In addition, people who have a poor outlook on the state of the economy also tend to have higher weight, which may point to a link between financial insecurity and overweight and obesity. This applies not only to young adults but also to older cohorts. Unemployment in our model is not found to be a significant predictor of overweight and obesity. As these variables do not directly impact BMI, the poor significance of some of them might be due to the fact that their correlation is already captured by other more relevant variables. Indeed, the correlation between income and excess weight has been already established in the literature (OECD, 2019[2]).

Individual characteristics

139. Finally, the demographic variables confirm well-known disparities between Italian regions, with excess weight more prevalent in the South than in Northern regions, with some of the lowest rates of excess weight registered in the North West. Foreign citizenship is associated with lower weight, as is living alone. We include dummies for different degrees of rural or urban areas of residence, which show mixed results.

[28] For example, according to (Mozaffarian et al., 2011[42]), vegetable consumption is a positive contributor to normal weight, while a large consumption of potatoes is negatively correlated with normal weight.

Table 3.3. Regression results

✓= variable included in the model; ✗= the variable excluded from the model

Dependent variable: having excess weight		Male	Female	Total
Nutrition				
Adequate breakfast	✓	-0.197***	-0.161***	-0.208***
Adequate fruit consumption	✓	0	-0.01	-0.006
Vegetarian	✓	-0.315***	-0.394***	-0.390***
Salt intake awareness	✓	-0.245***	-0.250***	-0.287***
Large alcohol consumption	✓	0.111**	-0.185	0.218***
Large carbonated drinks consumption	✓	-0.008	0.121***	0.097***
Ordered food online	✓	0.120***	0.191***	0.158***
Difficulties in reaching food markets	✓	0.185**	0.009	0.092*
Difficulties in reaching supermarkets	✓	-0.055	0.02	-0.017
Adequate vegetables consumption	✗	0.059**	0.099***	-0.008
Frequent carbohydrates consumption	✗	-0.170***	-0.054**	-0.071***
Frequent sweets consumption	✗	-0.188**	-0.114	-0.190***
Binge drinking	✗	0.165***	0.057	0.325***
Frequent meat consumption	✗	0.001	0.019	0.039*
Frequent cheese consumption	✗	-0.01	-0.048	-0.055
Frequent eggs consumption	✗	0.004	0.064	-0.005
Frequent snacks consumption	✗	0.141	0.094	0.095
Check food labels regularly[1]	✗	0.057	-0.116***	-0.116***
Buying bio food regularly[1]	✗	-0.243***	-0.121**	-0.193***
Buying local food sometimes[1]	✗	0.102***	0.025	0.050**
Lifestyle				
Reading books	✓	-0.111***	-0.170***	-0.243***
Sport	✓	-0.352***	-0.492***	-0.299***
Bike Use	✓	-0.142**	-0.134	-0.06
Time use dissatisfaction	✓	0.072***	0.061**	0.037**
Bad family relations	✗	-0.064	0	-0.044
Environmental dissatisfaction	✗	0.004	-0.01	0.009
Watching a lot of TV	✗	0.071***	0.188***	0.079***
Income and employment				
Log income	✓	0.045**	0.042**	0.021
Log income squared	✓	-0.005***	-0.004**	-0.002
Perceived economic insecurity	✓	0.026	0.133***	0.079***
Unemployed	✓	-0.076*	-0.042	-0.033
Education				
High school degree at most	✓	0.169***	0.243***	0.239***
Middle school degree at most	✓	0.234***	0.490***	0.372***
Demographics				
North West	✓	-0.218***	-0.072*	-0.171***
North East	✓	-0.07	0.02	-0.054*
Centre	✓	-0.057	0.019	-0.041
South	✓	0.153***	0.207***	0.169***
Foreign Citizenship	✓	-0.106**	-0.125***	-0.054
Living alone	✓	-0.149***	-0.046	-0.092***
Rural/urban dummies	✗	yes	yes	yes
5 year age group dummy	✗	yes	yes	yes
Constant		-0.08	-0.227***	-0.189***
Observations		43570	46666	90237

Note: (1) Based on separate regression with 2019 data only; *=p<0.10, **=p<0.05, ***=p<0.01.

3.5. Projections of Excess Weight and Obesity

Forecasting model determinants

140. The outcomes of the final forecasts are dependent on the results of the regression combined with the projections of the regression determinants. The results of these assumptions, based on the methodology presented in the previous section, are described here. Figure 3.15 below presents past trends in lifestyle, nutrition and demographic variables in Italy over the past decade(s). These trends provide us with a best possible guess of how crucial contributing factors may evolve in the future. However, as mentioned previously, the methodology does not allow predicting a break in trends. Similarly, possible future changes in nutrition and lifestyle habits or demographic changes given by the Sars-Cov 2 pandemic are not captured in our model. Unfortunately, for a small number of variables in the model, no time series is available, and for the moment we do not include a projection of these variables. This is the case for the variables on buying local food, organic food and for the variable on whether people regularly check food labels.[29]

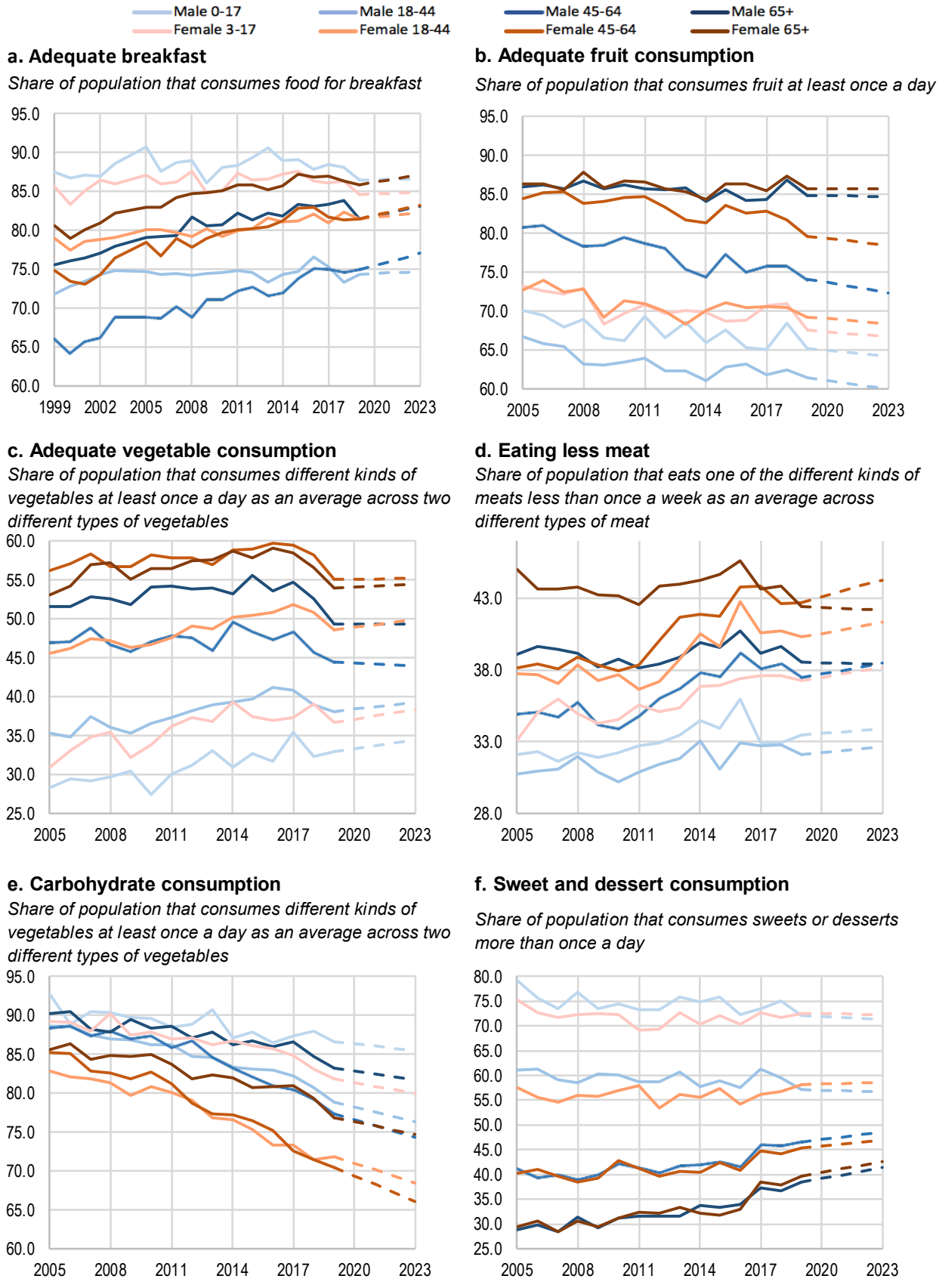
Nutrition

141. While some unhealthy habits are declining, others are on the rise. On the positive side, alcohol consumption has decreased significantly since 2006, in particular among older men, which could be partially explained by increasing taxes on alcohol. The same can be said for the consumption of carbonated drinks among young people, for whom we see a decline. Food consciousness seems to be significantly on the rise, with more and more people indicating that they are being careful about the quantity of salt they consume. More people are having an adequate breakfast, which is also considered a healthy food habit. What is visible across such variables is a convergence of habits over time, across ages and genders.

142. Emerging unhealthy trends include moderate declines in fruit consumption. The definition of vegetarianism used for the forecast (See Figure 3.15 “Eating less meat”) differs from the regression determinant due to the absence of microdata for the entire time series. The definition of the proxy is the average of the share of the population that eats one of the different kinds of meats (i.e. fish, cow, pork chicken and cold cuts) less than once a week. Although the absolute values between the variables cannot be compared, the variation from year to year provides a reasonable proxy for trends in reductions in meat intake. The same has been done for vegetable consumption. The ADL survey provides two different variables for vegetable intake: the share of people eating leaves at least once a day and the share of people eating other kinds of vegetables at least once a day. The variable “adequate vegetable consumption” has been computed by taking the average of the two. Sweet or dessert consumption seems to be increasing for older age groups. Of particular interest due to the prevalence of processed food in it is the increase in online food ordering. Moreover, it appears to be increasingly easier to reach supermarkets, while smaller local markets are becoming harder to reach.

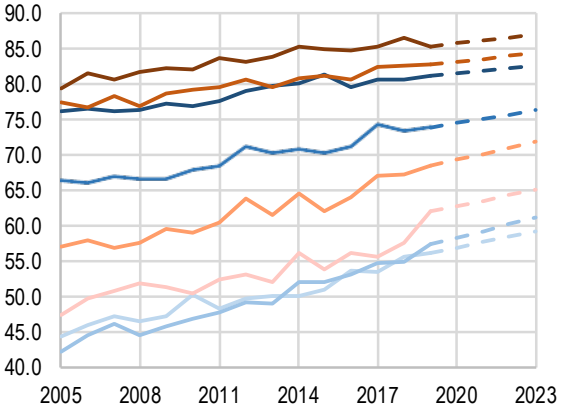
[29] The coefficients of these three variables have been estimated in a different regression where the 2018 data have been removed. The reason is that these variables are only available in the 2019 wave.

Figure 3.15. Nutrition related determinants



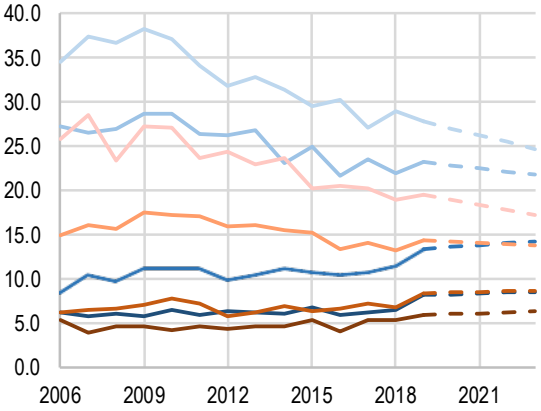
g. Salt intake awareness

Share of population reporting using care in the quantity of salt used



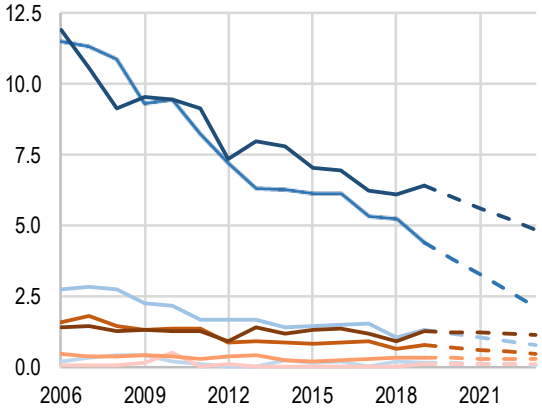
h. Carbonated drinks consumption

Share of population that consumes 1-2 or more glasses of carbonated drinks per day



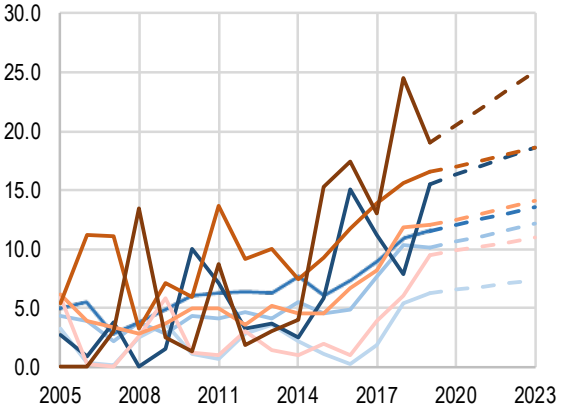
i. Large alcohol consumption

Share of population that consumes more than 1/2 litre of wine per day



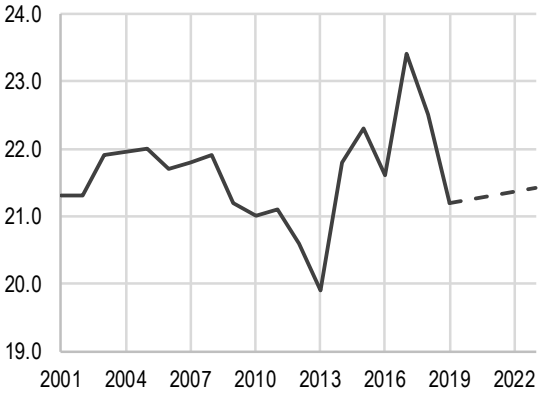
j. Ordering food online

Share of population that reports having ordered food in the last 12 months



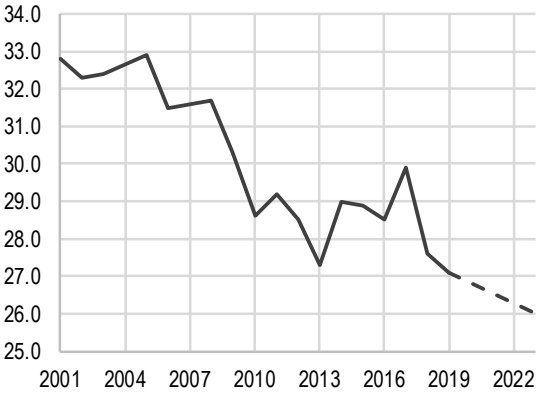
k. Difficulties in reaching food markets

Share of population reports having had difficulties in reaching food



l. Difficulties in reaching supermarkets

Share of population reports having had difficulties in reaching supermarkets



Lifestyle

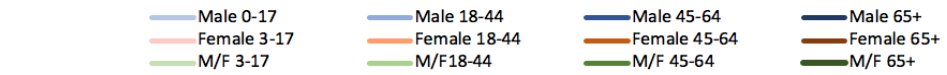
143. For lifestyle variables the linear assumption is again well respected in most cases (see Figure 3.16). However, the trends for bike use among older groups were found to be extremely volatile, and therefore no projection is included for this variable. For some variables (e.g. poor family relations and time use dissatisfaction) disaggregation by gender is not available. On TV use, mixed evidence is available as to how TV habits are evolving toward the future. No time trends were available, and due to the uncertainty surrounding future developments, we set the TV forecast to zero. No time series is available for binge drinking, either.

144. Trends in lifestyle related variables are mixed. Lifestyle habits among old people, who typically have more unhealthy habits, seem to be improving. Older generations are reading more books, using the bicycle more often and practicing sports more regularly. Young people instead have mixed trends. Sport activities have increased over the past years and time use dissatisfaction has decreased slightly. However, poor family relations have increased, less young people are reading books and using the bicycle to commute.

145. When it comes to education, the forecast of which is presented in Annex 3.B (Annex Figure 3.B.2), time series show a sharp increase in educated people. An increasing share of people holds a more advanced degree, a trend which is observed across all genders and age groups. Of course, it should be taken into consideration that the achievement of a degree occurs in the first 20-30 years of people's lives. Therefore, changes in the older generation are a consequence of time and experience and not of recent policies. This being said, the increase in the completion of university degrees among young people, particularly among females, is promising.

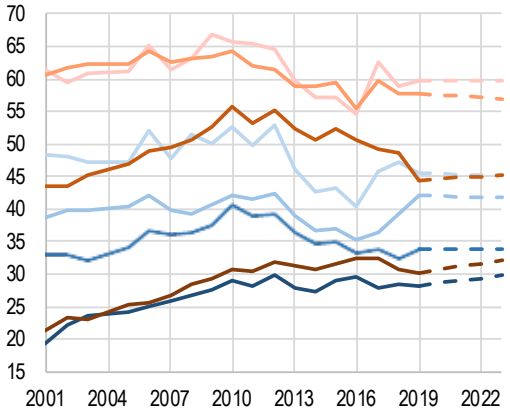
146. As for demographic variables and other individual characteristics, there is a slight increase in the share of the population living in the centre and in the north of Italy with respect to the south and the islands (Annex Figure 3.B.1). The trend for foreign citizenship, which shows a significant increase, has been computed with only two available data points deriving from the ISTAT census of 2011 and 2014. While Annex Figure 3.B.1 shows the values for 2001 they are not used in the computation of the forecast. Finally, although quite linear for all the age and gender groups, the share of people living alone has followed very different paths for each of these. Among young people, living alone is becoming less and less common, whereas it is becoming more prevalent among other people.

Figure 3.16. Lifestyle related determinants



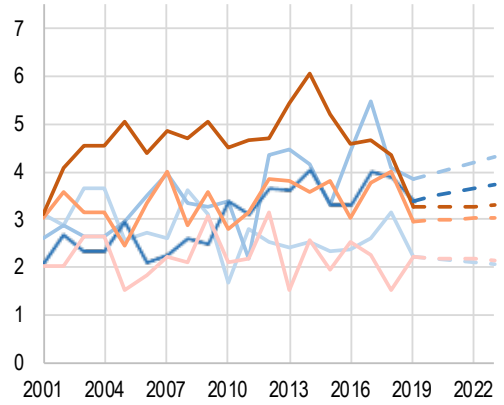
a. Reading books

Share of population that declares to read at least one book per year



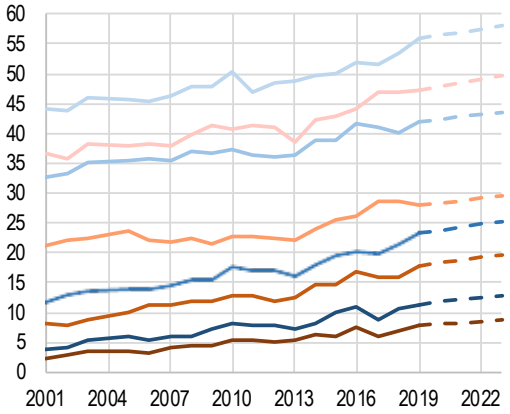
b. Bike usage

Share of population that uses bike for commuting



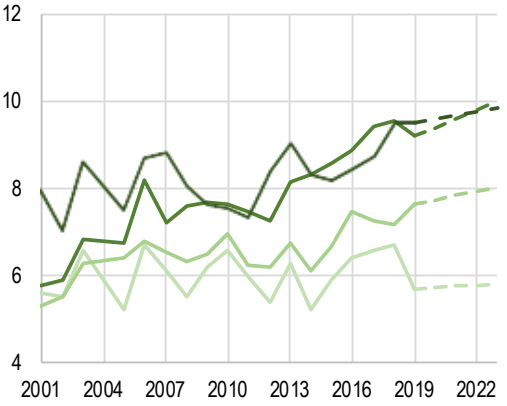
c. Sports

Share of population that practices sport regularly



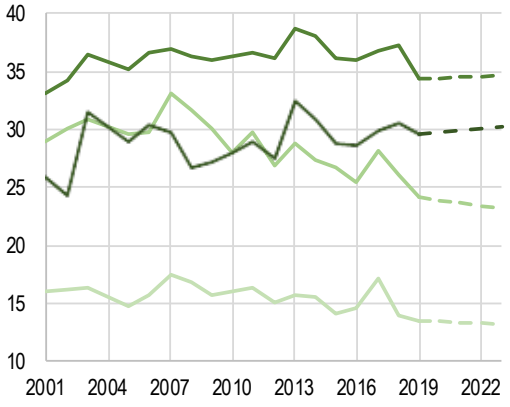
d. Poor family relations

Share of population that declares to be unsatisfied with family relations



e. Time use dissatisfaction

Share of population that declares to be unsatisfied with time management



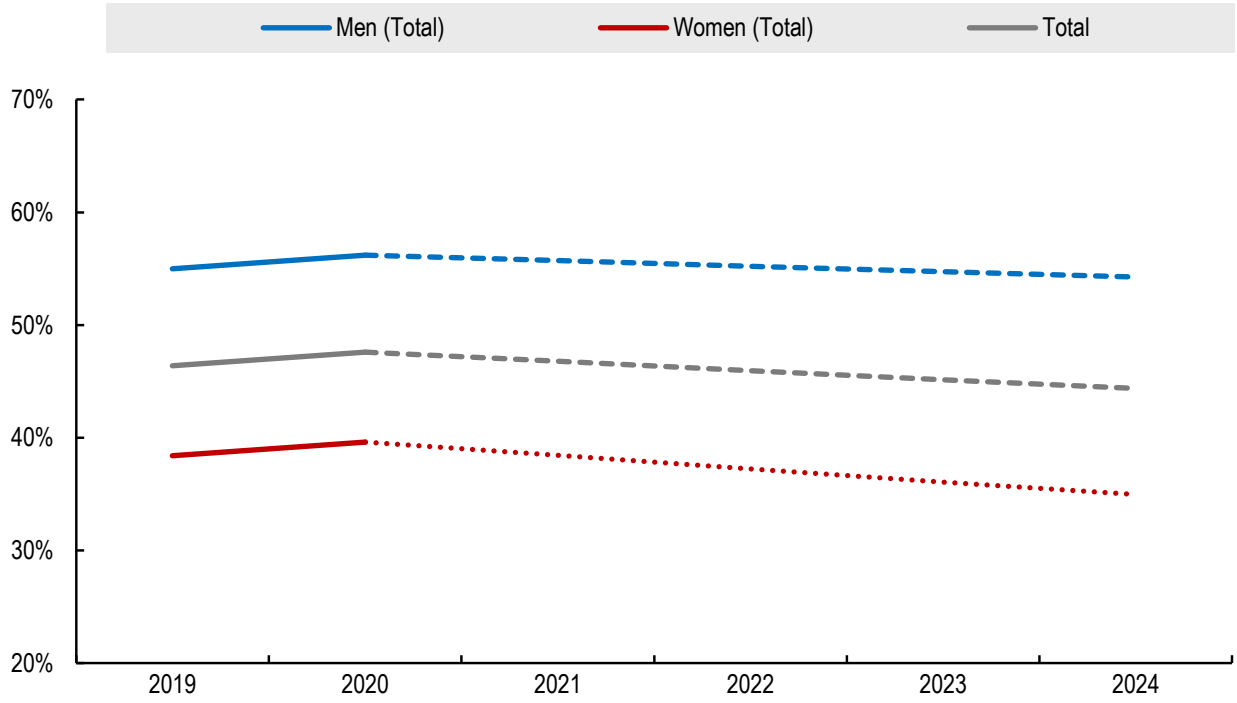
Projections results

147. This section presents the results of the forecast of the incidence of overweight and obesity for the years 2021 to 2024 (Figure 3.17). As already mentioned, the interpretation of these results is strictly dependent on the assumptions made at various stages of this paper, which include the limitations of a cross-sectional micro-economic model and the linearity assumptions of the determinant forecast. The results are also limited by omitted variables in the ADL dataset, notably on caloric intake and variables on food quality.

148. A baseline and a policy forecast are presented (Table 3.4), where the policy forecast takes into consideration the impact of the MEF's macro-economic policy programme on economic outcomes that affect excess weight.[30] The forecast projects a gradual decline in overweight and obesity rates for both men and women over the next few years. A 3.2% decline in the total share of Italians in excess weight is expected. Moreover, the decline is more pronounced for women than for men (4.6% and 2% respectively), while it is men who have the highest burden of obesity. The decline is primarily driven by the older age group, where there is also more room for improvement.

Figure 3.17. Excess weight forecast for 2021 to 2024

Including MEF policy programme



Note: Adjusted to EU 2013 standard population.
Source: OECD calculations based on ADL microdata (ISTAT, n.d.[20]).

149. The impact of the government's fiscal programme on the current projection is limited. Only the effect of macro-economic policies is taken into account in the policy scenario, which affect excess weight through the impact of household income, perceived economic insecurity and unemployment. The regression results have shown that the weight status of some groups is more sensitive to economic

[30] With respect to baseline scenario, the policy scenario includes additional measure to support households and firms and the enhancement of the programmed interventions in the National Recovery and Resilience Plan.

variables than others. It should also be noted that the difference between the baseline economic forecast and the forecast that takes into consideration the government's policy programme is also of a small order of magnitude, contributing to a relatively small difference between the two forecasts.

Table 3.4. Excess weight forecast for 2021 to 2024, by gender

Baseline forecast and forecast including MEF policy programme

	2019	2020	2021	2022	2023	2024
Baseline forecast						
Male	**55.00%**	**56.20%**	55.72%	55.21%	54.72%	54.25%
Female	**38.40%**	**39.60%**	38.43%	37.22%	36.07%	34.96%
Total	**46.40%**	**47.60%**	46.79%	45.94%	45.14%	44.36%
Including MEF policy programme						
Male	**55.00%**	**56.20%**	55.74%	55.23%	54.74%	54.27%
Female	**38.40%**	**39.60%**	38.44%	37.22%	36.07%	34.97%
Total	**46.40%**	**47.60%**	46.80%	45.95%	45.15%	44.37%

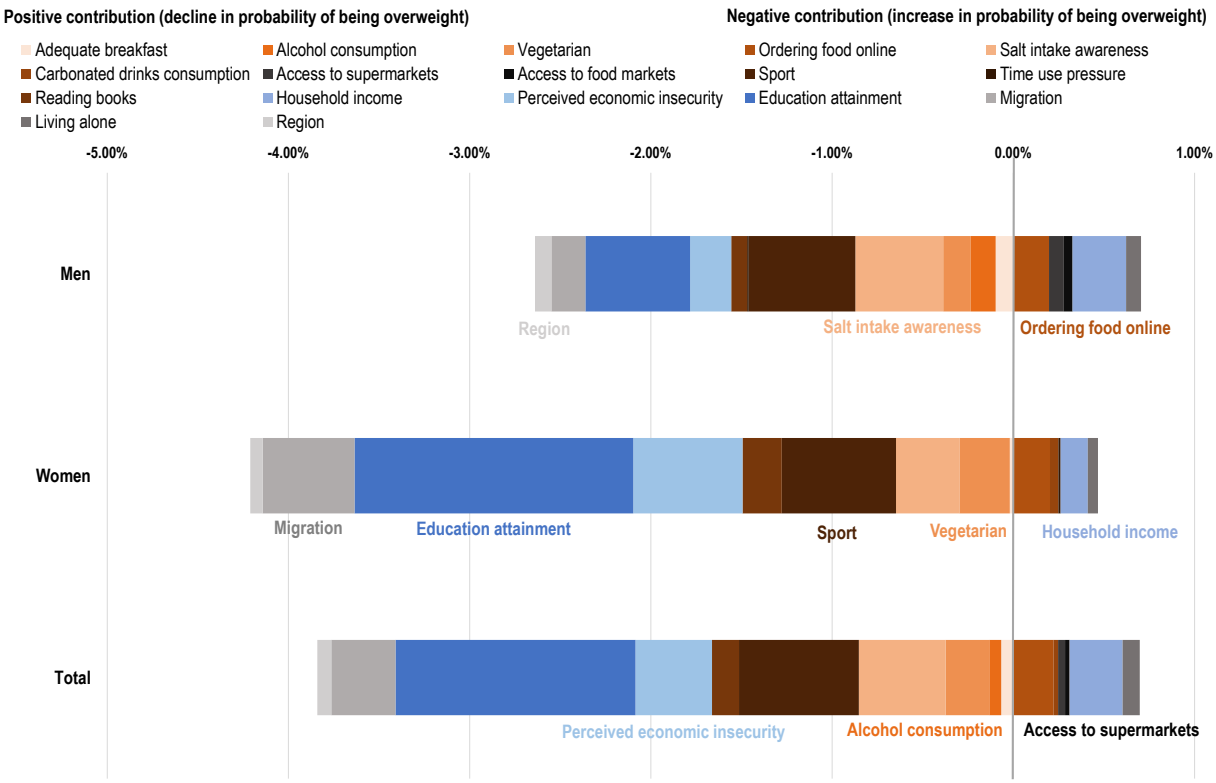
Note: Forecast presented is not adjusted to EU 2013 standard population.
Source: OECD calculations based on ADL microdata (ISTAT, n.d.[20]).

150. It is worth illustrating exactly which factors contribute to changes in overweight and obesity rates. For this reason, we present a figure that summarises the $m_{x,a,g,t}$ coefficients referred to earlier, which are the product of the regression coefficients $c_{x,a,g}$ and the projected changes $d_{x,a,g,t}$ in the determinant. These values tell us whether a determinant is exerting upward or downward pressure on the overweight and obesity rate for a specific group, in terms of their contribution to the probability of an individual in a given group being in excess weight.

151. A summary of the sum of the m values between 2021 and 2024 is presented in Figure 3.18 for total gender groups and the full sample (and in Annex 3.C, Annex Figure 3.C.1) for each age/gender group). The most important positive contributor to the excess weight forecast is education attainment, as a consequence of continuing rises in education levels in Italy, a benefit which is accrued particularly by young women. As for the impact of the volatile macro-economic situation, a deep fall in GDP and household income in Italy in 2020 associated with the pandemic is projected to be followed by a rebound in 2021, meaning that the impact of the household income and economic insecurity variables are unusually strong. On balance, the effect of a rebound of household income, which is significant among the younger cohorts, results in a slight increase in rates of excess weight (possibly related to expanded possibilities for consumption), whereas the downward pressure of GDP growth on economic insecurity results in a positive contribution to changes in excess weight, particularly driven by the older cohorts.

152. Increases in the uptake of sports across the population contribute to the decline in excess weight, whereas there is a minor impact of time use dissatisfaction among some groups. With regards to nutrition, increased salt intake awareness, which may indicate broader nutrition-related consciousness, contributes positively to the downward trend among younger groups. Counterweighting factors are people ordering food online, particularly among the young and middle-aged groups. On balance, increases in the share of people who consume little, or no meat also contribute to declines in overweight and obesity rates. Finally, improvements in access to supermarkets and a decline in access to smaller local food markets both have a negative effect, although this effect is only seen among middle aged men.

Figure 3.18. Contributions to changes in overweight and obesity rates between 2021 and 2024



Source: OECD calculations based on ADL microdata (ISTAT, n.d.[20]).

Box 3.3. Updated forecast MEF ESW Report 2022

On March 7, 2022, the MEF launched its annual ESW Report to Parliament, presenting the latest data on ESW indicators alongside forecasts for the years 2021 to 2024. These forecasts are based on the methodology presented in this report. The model was updated using newly estimated model coefficients based on the latest ADL microdata. The table below presents the updated figures, showing the forecasted Excess Weight figures from the model for the years 2021 to 2024.

The revised projections imply a more modest decline in the share of people in excess weight than previously projected. It is still expected that HLE continues to decline in the years to follow, with a stronger decrease among women than among men.

Excess weight forecast 2021-2024

	2019	2020	2021	2022	2023	2024
Male	55.0%	56.2%	~~55.7%~~ **55.9%**	**55.6%**	**55.3%**	**55.0%**
Female	38.4%	39.6%	~~38.4%~~ **39.0%**	**38.4%**	**37.9%**	**37.4%**
Total	46.4%	47.6%	~~46.8%~~ **47.1%**	**46.7%**	**46.3%**	**45.8%**

Note: The forecast presented here refers to non-standardised excess weight figures. The forecast for 2020 based on model presented in this chapter is shown in red. The revised figures are true figures based on observed data. Revised forecasts by the MEF are shown in bold.
Source: (MEF, 2022[21]), 2022 ESW Report to Parliament, Ministry of Economy and Finance, https://www.mef.gov.it/inevidenza/Trasmessa-al-Parlamento-la-Relazione-BES-2022/.

Annex 3.A. Regression results

Annex Table 3.A.1. Excess weight regression results by age and gender group

✓= variable included in the model; ✗= the variable excluded from the model

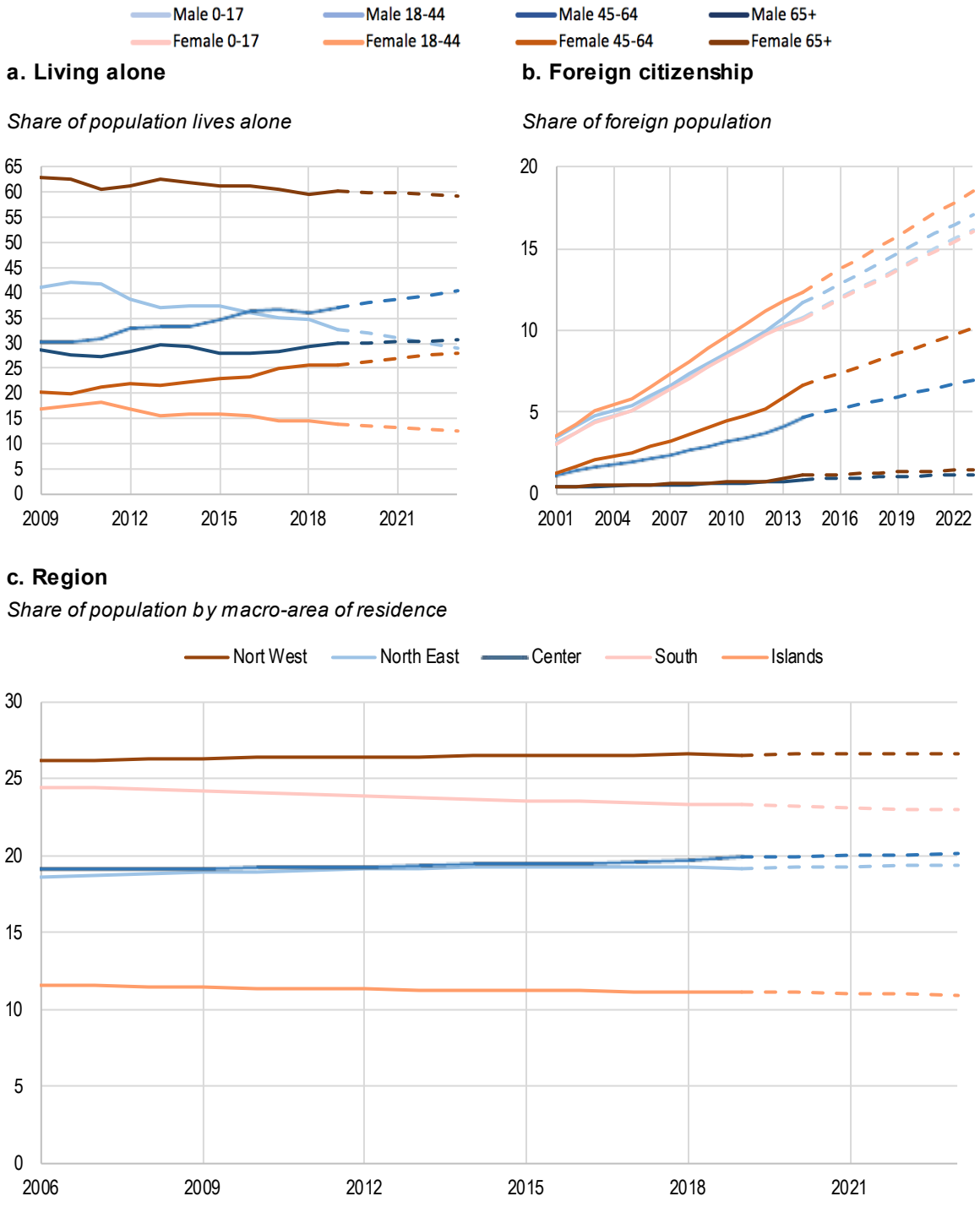
Variable		Age: 0-18		Age: 18-44		Age: 45-64		Age: > 64	
Nutrition		**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Adequate breakfast	✓	-0.936***	-1.244***	-0.140***	-0.147***	-0.098**	-0.001	-0.028	0.064
Adequate fruit consumption	✓	-0.322***	-0.328**	-0.003	0.029	0.009	-0.025	0.075	0.057
Vegetarian	✓	-0.068	-0.145	-0.304***	-0.272***	-0.261***	-0.443***	-0.356***	-0.425***
Salt intake awareness	✓	-0.662***	-0.673***	-0.128***	-0.233***	-0.278***	-0.204***	-0.155***	-0.164***
Large alcohol consumption	✓	-0.65	1.906	0.217**	-0.397	-0.025	-0.2	0.248***	-0.045
Large carbonated drinks consumption	✓	-0.056	-0.169	-0.049	0.064	0.043	0.117*	0.07	0.288***
Ordered food online	✓	-0.163	-0.178	0.109*	0.141**	0.160**	0.213***	0.005	0.18
Difficulties in reaching food markets	✓	-0.259	-0.066	0.144	0.054	0.597***	0.089	-0.02	-0.004
Difficulties in reaching supermarkets	✓	0.02	-0.091	-0.059	-0.079	-0.204*	-0.026	0.071	0.105
Adequate vegetables consumption	✗	-0.015	0.381**	0.142***	0.161***	0.034	0.101**	-0.031	-0.003
Frequent carbohydrates consumption	✗	-0.639***	-0.645***	-0.116***	0.079	-0.149***	0.02	-0.087*	-0.072*
Frequent sweets consumption	✗	0.365*	0.071	-0.249*	-0.143	-0.353**	-0.07	-0.105	-0.128
Binge drinking	✗	-0.41	-0.819	0.103**	0.045	0.318***	-0.097	0.14	0.338*
Frequent meat consumption	✗	-0.036	-0.1	0.033	0.08	0.076	0.111*	-0.078	-0.069
Frequent cheese consumption	✗	0.143	-0.1	0.016	-0.008	0.093	-0.072	-0.12	0.006
Frequent eggs consumption	✗	0.408	0.348	0.063	0.119	0.047	0.153	-0.357	-0.217
Frequent snacks consumption	✗	0.117	-0.091	0.26	0.257	0.026	0.082	-0.543	-0.373
Check food labels regularly[1]	✗	0.034	0.06	0.081	-0.11	0.039	-0.085	0.024	-0.167***
Buying bio food regularly[1]	✗	-0.192	-0.687	-0.264***	-0.135	-0.223***	-0.107	-0.276**	-0.138
Buying local food sometimes[1]	✗	-0.438*	0.056	0.052	0.003	0.150**	0.059	0.119*	0
Lifestyle									
Reading books	✓	-0.202*	-0.108	-0.123***	-0.07	-0.038	-0.205***	-0.204***	-0.236***
Sport	✓	-0.605***	-0.643***	-0.321***	-0.379***	-0.342***	-0.510***	-0.279***	-0.435***
Bike Use	✓	-0.275	-0.879	-0.115	-0.2	-0.138	-0.013	-0.288	-0.964**
Time use dissatisfaction	✓	0.109	0.081	0.094**	0.003	0.144***	0.097**	-0.065	0.079*
Bad family relations	✗	-0.008	0.08	-0.114	0.155*	0.029	0.016	-0.108	-0.120*
Environmental dissatisfaction	✗	0.128	0.284	0.019	-0.038	-0.037	-0.042	0.023	0.043
Watching a lot of TV	✗	-0.237**	-0.190*	0.033	0.228***	0.093**	0.236***	0.221***	0.240***

Income and employment		**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Log income	✓	0.057	0.014	0.088***	0.085*	0.028	0.034	0.003	0.034
Log income squared	✓	-0.006	-0.005	-0.009***	-0.009**	-0.003	-0.003	0	-0.003
Perceived economic insecurity	✓	-0.122	0.218	-0.046	0.164***	0.059	0.133***	0.113**	0.101**
Unemployed	✓	-0.019	0.916	-0.016	-0.009	-0.102	-0.091	-0.223	-0.035
Education									
High school degree	✓	-0.008	-0.453	0.223***	0.391***	0.138**	0.130**	0.135	0.185**
Middle school degree at most	✓	0.105	-0.315	0.326***	0.734***	0.201***	0.420***	0.226***	0.417***
Demographics									
North West	✓	-0.149	0.066	-0.130*	0.212**	-0.130*	-0.085	-0.475***	-0.241***
North East	✓	-0.028	0.087	-0.035	0.260***	-0.002	0.036	-0.222**	-0.129*
Centre	✓	-0.041	0.049	-0.026	0.101	0.001	-0.015	-0.196**	0.012
South	✓	0.391***	0.265*	0.187***	0.192**	0.295***	0.197***	-0.115	0.305***
Foreign citizenship	✓	-0.268**	0.162	-0.157**	0.123*	0.071	-0.397***	0.146	-0.359*
Living alone	✓	-	-	-0.187***	-0.214**	-0.160***	-0.045	-0.081	-0.002
Rural/urban dummies	X	yes	yes	yes	yes	yes	yes	yes	yes
5 year age group dummy	X	yes	yes	yes	yes	yes	yes	yes	yes
Constant		0.595***	0.371	-1.333***	-2.742***	0.233	-0.499***	0.681**	0.021
Observations		7351	7052	13289	13196	13205	14219	9722	12194

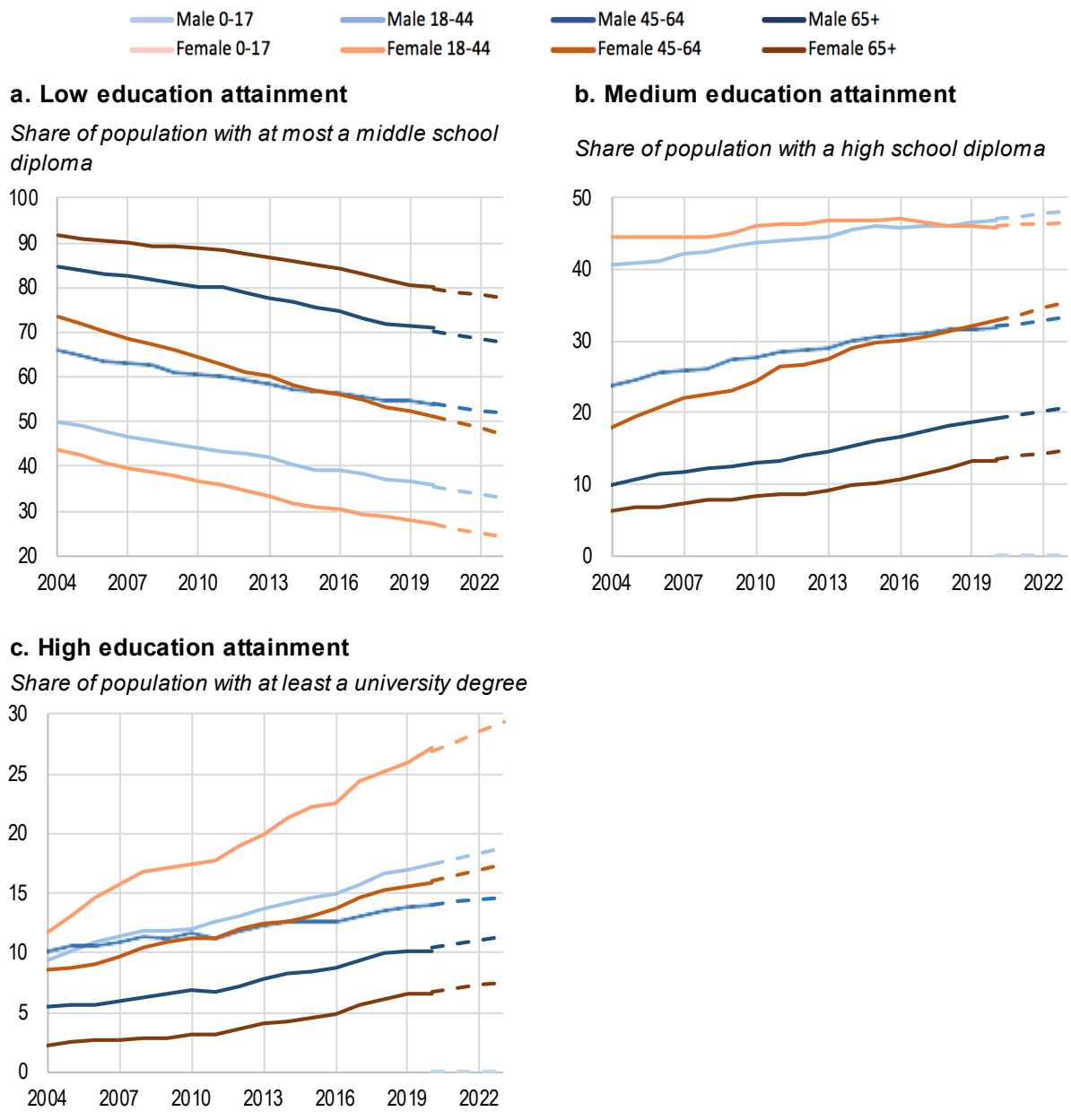
Note: (1) Based on separate regression with 2019 data only; *=p<0.10, **=p<0.05, ***=p<0.01.

Annex 3.B. Forecasts for demographic and education determinants

Annex Figure 3.B.1. Demographic-related determinants

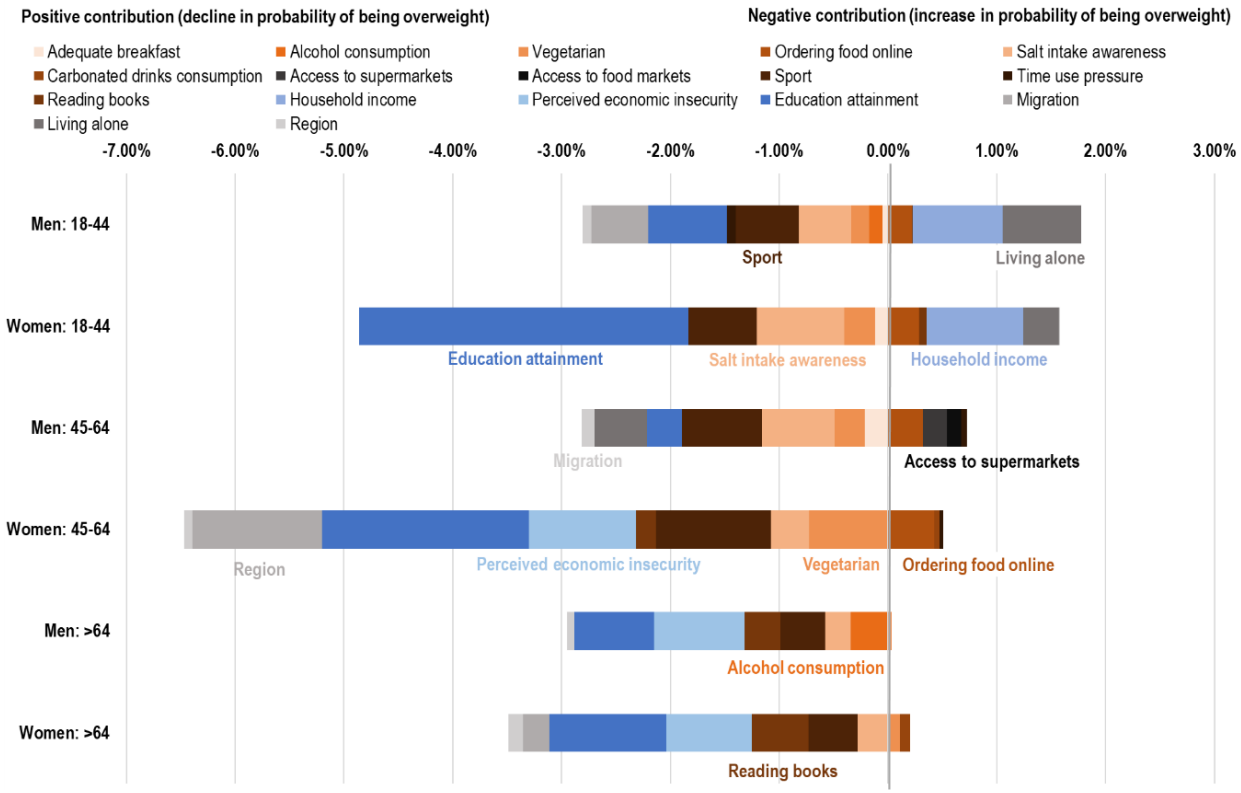


Annex Figure 3.B.2. Education-related determinants



Annex 3.C. Forecasts for demographic and education determinants

Annex Figure 3.C.1. Contributions to changes in overweight and obesity rates between 2021 and 2024, by group



4. Early Leavers from School

153. Like health, education is a key engine of prosperity over the long run, as it yields many benefits in terms of higher long-term economic growth, higher employment rates, lower inequalities across the board and larger social capital. While there is a clear policy case for reducing the rate of Early Leavers from School, its policy determinants are less studied and less well-known. This chapter builds a macroeconomic model of early school leaving at regional level spanning the period 1998-2020. Key determinants include a large set of macroeconomic factors (e.g. GDP, sectoral employment shares), education policies (e.g. education spending, school system characteristics) and other contextual factors (e.g. share of immigrants, education quality as reflected by average PISA scores). A predictive model based on the macroeconomic forecasts made by the Italian treasury yields a reduction of 0.35% in the early school leaving rate between 2019 and 2024 (from 13.5% to 13.15%) – which could be improved by a further 0.6% with adequate reforms in the education system. The model also suggests a lower regional dispersion of the early school leaving rate in the future, confirming the long-term interregional converging trend that has already been observed over the last twenty years.

4.1. Introduction

154. Over the past few decades, the vast majority of governments have fostered an increase in the general education level of the population in order to answer the challenges raised by an increasingly skill-based and technology-reliant labour market. For example, in 2020, the OECD average proportion of tertiary education graduates in the population was 45.5% among the 25-34 year-old versus 28.8% for the 55-64 year-old group – an increase of 63% in around 30 years.

155. Unfortunately, these policies have also left people behind. In 2020, still, the OECD average of population aged 25-64 years having not completed more than lower secondary education was 20.9%. These so-called “early school leavers” have progressively emerged as a well-identified disadvantaged group in social sciences studies, as it has been shown that they were facing a higher risk of social exclusion and unemployment than the general population (Sparkes and Glennerster, 2002[45]). Several factors significantly correlated with early school leaving, many of them external to schools, have already been identified, such as family background (Traag and van der Velden, 2008[46]) or labour market composition and unemployment (Micklewright, Pearson and Smith, 1990[47]), but their relative importance is not always well-known. Moreover, the direction of the possible causal relationship between early school leaving and these factors is not always obvious. The research carried out in the present study, one of the first to tackle the phenomenon on a large regional scale, aims at addressing these issues.

156. The influence of education policies, as causes or remedies for early school leaving (and, more generally, social outcomes) is also frequently debated. Decentralization of the school system, for example, has sometimes been presented as a solution to better take into account the local school and family conditions faced by the students and therefore provide them with more adapted teaching contents and methods. However, the social effectiveness of these policies seems actually far from obvious (Blanchenay, Burns and Köster, 2014[48]) – school accountability being a critical factor of success (Woessman, 2007[49]). The role of the vocational (professional) educational system is also often emphasized in the fight against

early school leaving, since it may provide an alternative track to students eager to stop studying theoretical subjects. However, tracking students towards vocational education, especially when it happens early, has also been proved to reinforce social inequalities (Woessmann, 2009[50]): students from disadvantaged socio-economic backgrounds are more likely to join this kind of education.

157. In this report, we try to untangle the role of the different factors contributing to early school leaving (see Box 4.1 for an exact definition). Based on a macroeconomic model built on a panel of 355 regions in 34 OECD countries over 23 years (1998-2020), we first draw a picture of the Italian school system among its OECD counterparts and then provide the Italian government with regional-level early school leaving previsions built on the national macro-economic previsions over the next few years.

158. The main findings of the study are as follow:

- At the macro-economic level, the model emphasizes the role of income as well as labour market (in terms of sectoral composition, access to jobs and youth (un)employment) as driving forces of early school leaving. Concerning the school system more specifically, access to vocational education, local school pedagogical autonomy and accountability (in order to provide students with adapted school curricula and materials), continued training for teachers and pre-primary enrolment are correlated with a decrease in early school leaving.
- Regarding Italy more specifically, most of the policies already in place (large share of vocational training in upper secondary education, high pre-primary enrolment rate and significant school pedagogical autonomy) have a positive influence. However, the improvement of socio-economic conditions of the youth (which also contribute to a high level of NEET) is a priority. The importance of socio-economic factors also explains the high regional heterogeneity in early school leaving still present in Italy to this day (though these differences have been decreasing in the long term), as they are reflecting significant disparities in terms of income or employment.
- The model predicts a decrease of approximately 0.35 percentage point (from 13.5% to 13.15%) in the early school leaving rate between 2019 and 2024. The introduction of several administrative reforms[31] in the Italian school system could decrease this rate by a further 0.6% by the year 2024. Moreover, the interregional dispersion of the early school leaving rate, though still higher than in most of the other big European countries, could continue to decrease between 2019 and 2024 (as it did since 2000).

[31] Increase in school pedagogical autonomy combined with accountability, higher share of students in vocational education, increased professional development opportunities for teachers, increased school performance (represented by PISA reading score), decrease in share of socially disadvantaged students.

Box 4.1. Indicator definition

According to the definition shared by many international institutions such as Eurostat (Eurostat, 2021[51]) and the World Bank (The World Bank, 2019[52]), **Early School Leavers (ESL) are young adults (18 to 24 year-old) having completed at most a lower secondary education and being not in further education nor in training.**

The reduction of the number of ESL is a focus of many education policies, as many of them are likely to face significant hurdles on the job market and may face a higher risk of social exclusion (see Buddelmeyer, Leung and Scutella (2012[53]) and Sparkes and Glennerster (2002[45])), for example become NEET (not in Education, Employment or Training). It is important to note, though, that the relationship between the two concepts is far from being linear, since early school leavers can have a job while NEET can have completed upper secondary or higher education.

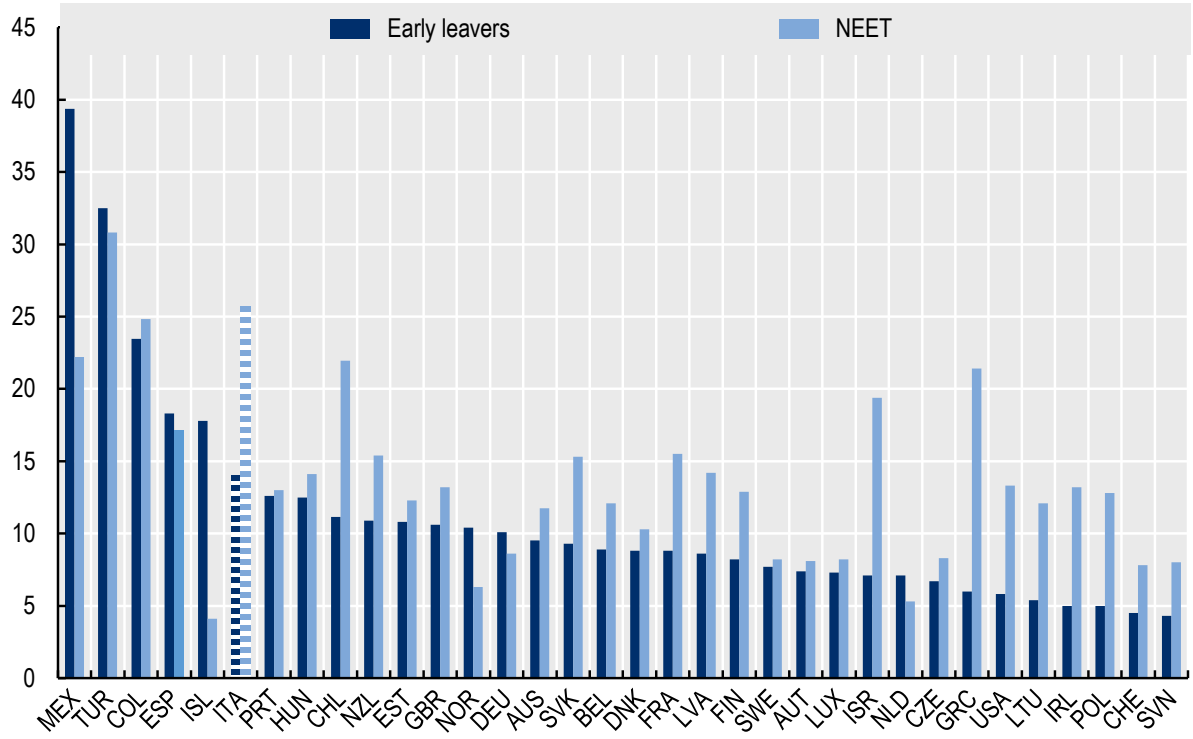
4.2. Stylised Facts

International comparison of early leaving in Italy and among OECD countries

159. The OECD average for early school leaving was 11.1% of the 18 to 24 year-old population in 2017[32]. With a rate of 14% on the same year (Figure 4.1), Italy performs poorly, ranking 6th among OECD countries (on 34), though this figure hides important regional differences (see paragraph 162). Another specificity of Italy is the large difference between the figures for NEET and the figures for early school leavers: at 25.7% of the 18 to 24 year old population, the NEET rate is 84% higher than the early school-leaving rate. This means that a large part of Italy's youth – the non-ESL NEET – faces difficulties on the labour market, but has not encountered major troubles during their school years. However, the importance of Italy's early school leaving rate in absolute terms still makes this phenomenon a critical issue for Italy's policymakers.

[32] This study excludes four OECD countries (on 38) for which no data on early school leaving is available (Canada, Costa Rica, Japan, Korea).

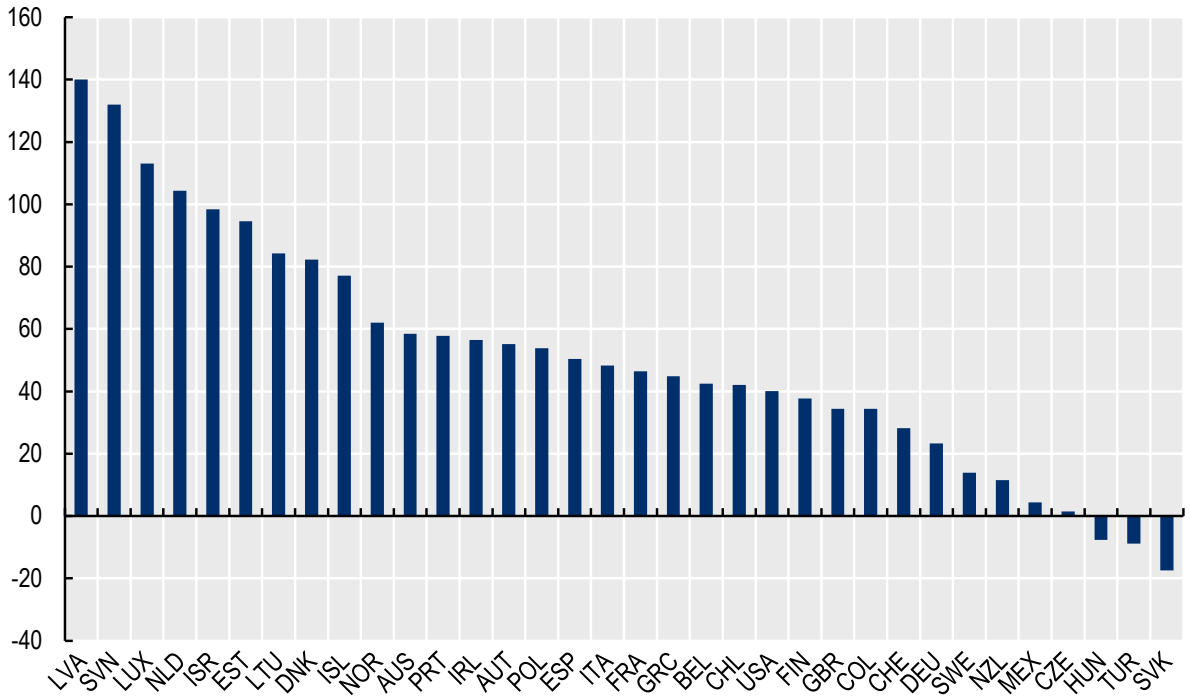
Figure 4.1. Early school leavers and NEET rate in OECD countries, % of 18 to 24 y.o. population



Note: Year 2017.
Source: (OECD, n.d.[54]), *Regions and Cities* (database), https://stats.oecd.org/.

160. In most OECD countries, the rate of early school leaving is much higher among men than among women (see Figure 4.2). In 2017, only three countries displayed a higher rate among women (Hungary, Slovakia, Turkey). The relationship between performance in reducing gender equality in early school leaving and performance in fighting early school leaving as a whole is far from obvious: among the countries for which the gender gap is small, there are both countries with low early leaving rate (for example Czech Republic, Slovakia) and countries with high early leaving rate (Mexico, Turkey). In Italy, the rate was 48% higher for boys relatively to girls – this is very close to the OECD average (51%). Several categories of factors, both internal to schools and external (family, labour market) may explain sex differences in dropping out: on the one hand, girls are discriminated in their access to school in many traditional societies, and face lower parental expectations (OECD, 2015[55]). On the other hand, boys are more likely to underachieve when they attend socially disadvantaged schools, and contribute more to discipline issues (Legewie and Di Prete, 2012[56]). They also have better employment opportunities outside of the school, on the formal and informal labour market (Borgna and Struffolino, 2017[57]).

Figure 4.2. Difference between male and female early school leavers rate (% relative to female)

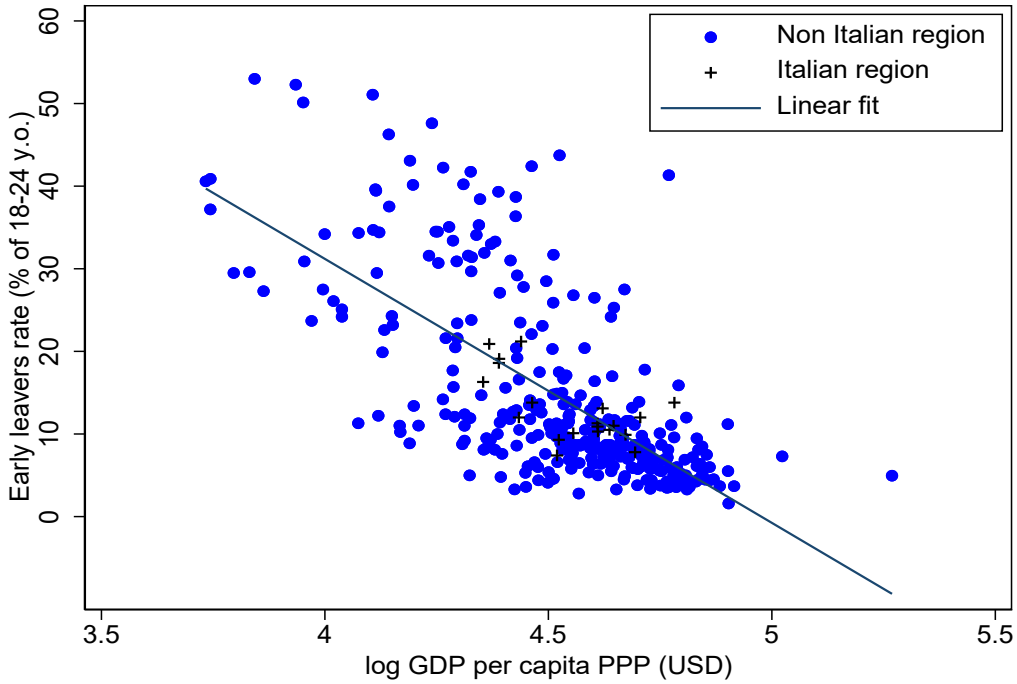


Note: Year 2017.
Source: (OECD, n.d.[54]), *Regions and Cities* (database), https://stats.oecd.org/.

161. Data on the early leavers rate, as well as a number of microeconomic indicators, are also available at the NUTS2 and OECD-equivalent[33] regional level (for 355 regions in 34 countries). The correlation between income (GDP per capita) and early school leaving, though tangible, is far from explaining all the heterogeneity between regions (see Figure 4.3): it is relatively possible to single out the richest regions (above USD 50 000 PPP per capita), which display a relatively low ESL rate (below 12%), but there is significant heterogeneity among low income regions – with an ESL rate largely spread from a small percent to more than 50 percent.

[33] NUTS2 (Nomenclature of Territorial Units for Statistics) is an EU notion. The OECD has defined a similar notion for non-EU countries. In Italy, their boundaries correspond to the first level administrative subdivision (regions), but this is not the case everywhere.

Figure 4.3. GDP PPP per capita (USD) versus ESL regional rate in OECD countries

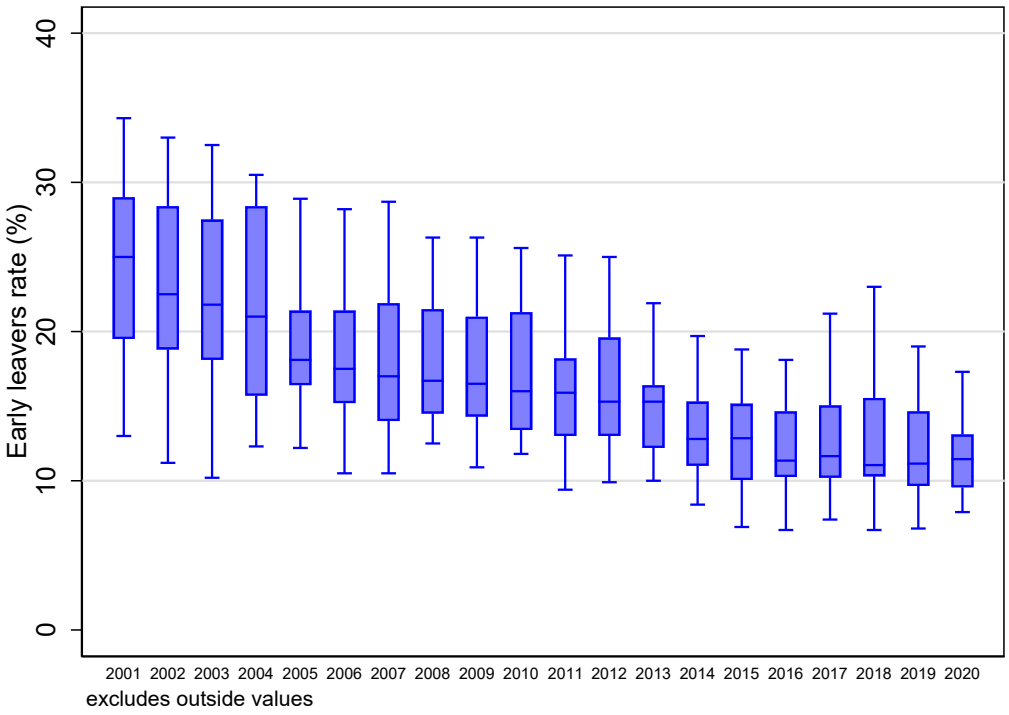


Note: Year 2017.
Source: (OECD, n.d.[54]), *Regions and Cities* (database), https://stats.oecd.org/.

Trends and regional discrepancies in early school leaving in Italy

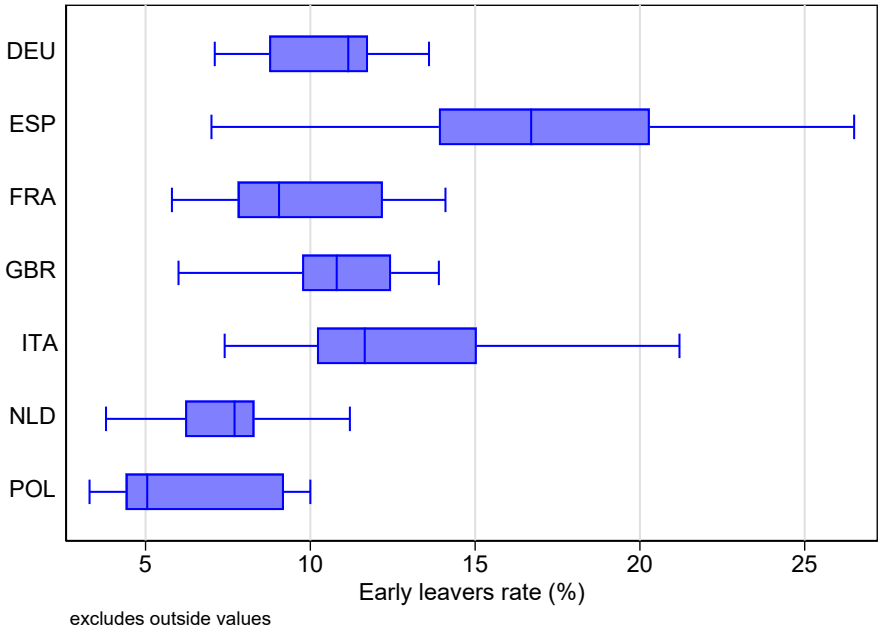
162. Over the last two decades, the number of early school leavers has steadily decreased in Italy: the national rate decreased from 25.9% of the 18 to 24 year-old population in 2001 to 13.1% in 2020. Although there has been inter-regional convergence to some extent since 2000, the differences between regions remain significant (see Figure 4.4). In particular, the spread of the distribution of regional rates in higher in Italy than in most of other large European countries (see Figure 4.5).

Figure 4.4. Distribution of early leavers rate by NUTS region in Italy from year 2001 to 2020



Note: Box corresponds to 25% and 75% quantiles.
Source: (OECD, n.d.[54]), *Regions and Cities* (database), https://stats.oecd.org/.

Figure 4.5. Distribution of early leavers rate by NUTS region in a selection of European countries

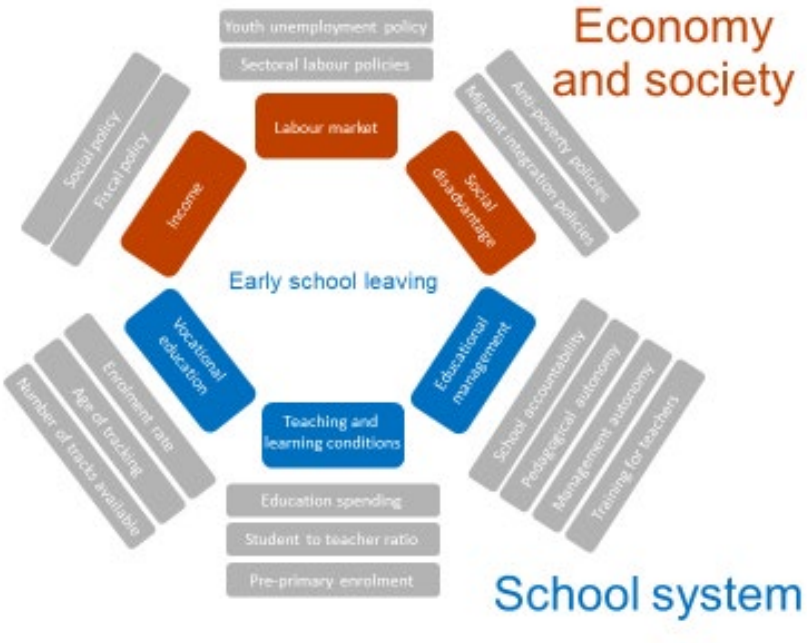


Note: Box corresponds to 25% and 75% quantiles; year 2017.
Source: (OECD, n.d.[54]), *Regions and Cities* (database), https://stats.oecd.org/.

4.3. Policy background and conceptual framework

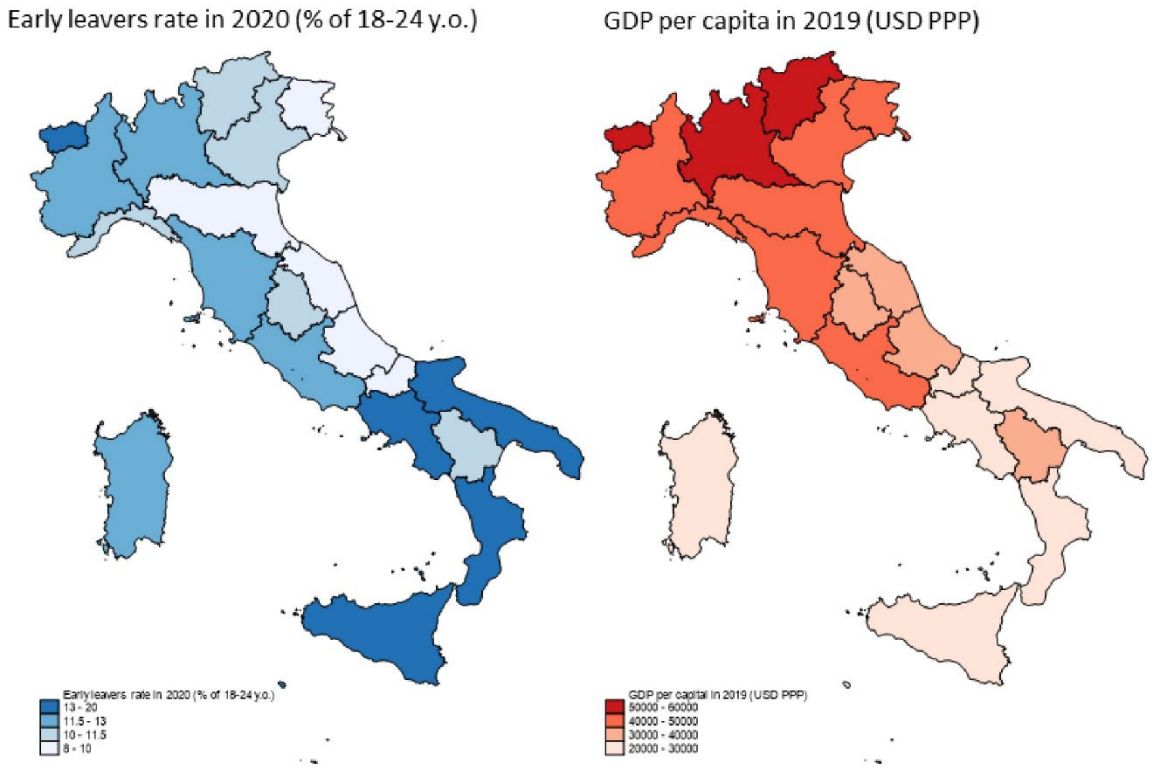
163. The factors influencing early school leaving can be broken down into two different categories, calling thus for two different sets of policies in order to tackle early school-leaving: macro socio-economic factors one the one hand and factors directly related to the school system on the other. In this study, most of the macro-economic variables are present at the regional level (NUTS2 or NUTS2-equivalent) while school system variables are national – as most of the educational policies are.

Figure 4.6. Determinants of early school leaving and policy applications



From a geographical perspective, the correlation between school leaving and income is quite visible: most of the regions located in the South display both a higher early leaving rate and a lower GDP per capita than in the North. Nevertheless, a detailed geographical analysis of the data reveals a more nuanced picture (see Figure 4.7): for instance, in the North, most of the regions located on the Adriatic Coast (Friuli Venezia Giulia, Emilia Romagna, Marche, Abruzzo, and Molise) had a very low early leaving rate in 2020 (below 10%), while Lombardia and Piemonte were between 11.5% and 12%. Moreover, the biggest difficulties are concentrated on a small number of regions: four southern regions (Calabria, Campania, Puglia, Sicilia) plus Valle d'Aosta had a rate between 15% and 20% in 2020 while no other region was above 12%. This would call for ESL policies targeting more specifically these five regions.

Figure 4.7. Maps of early leavers rate and GDP per capita per region in Italy

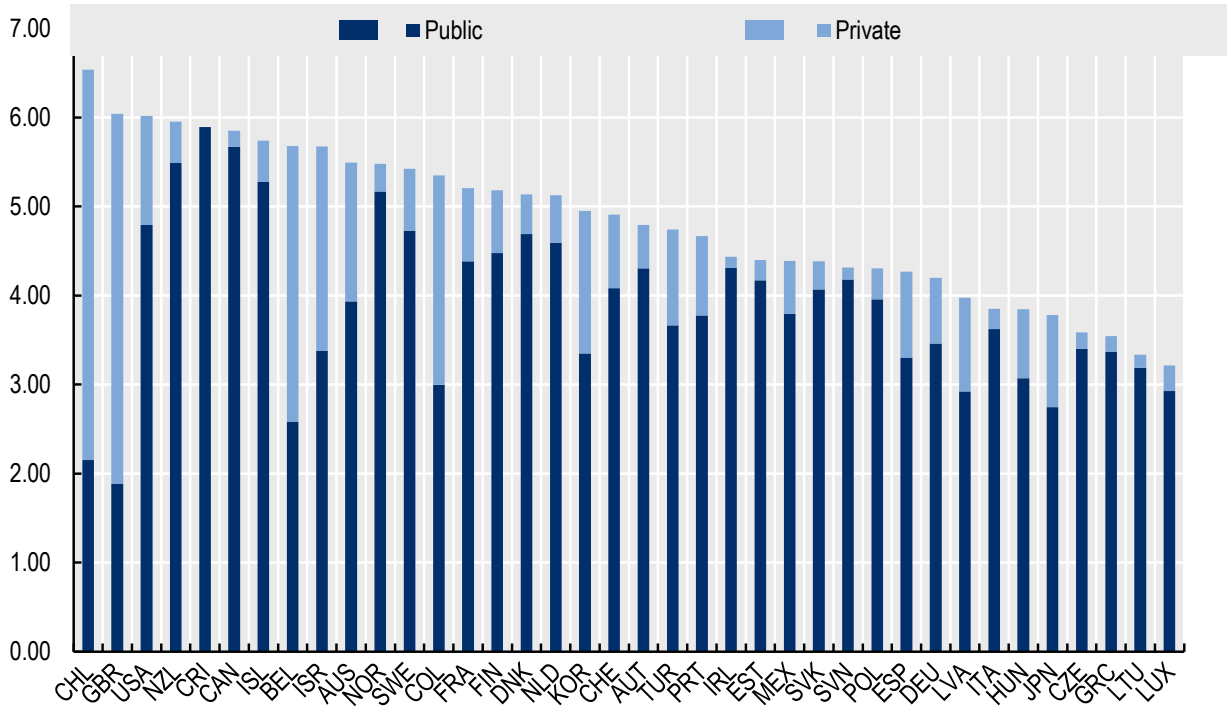


Source: (OECD, n.d.[54]), *Regions and Cities* (database), https://stats.oecd.org/.

164. Previous research has also suggested causal explanation for early school leaving originating from the local labour market – with young people recording low school performance more likely to stop school if they find more unqualified, possibly informal, job opportunities (Tumino and Taylor, 2015[58]). For this reason, taking into account the sectoral composition of the labour market may be relevant, since the proportion of low-skilled jobs varies greatly by sector in OECD countries (OECD, 1998[59]).

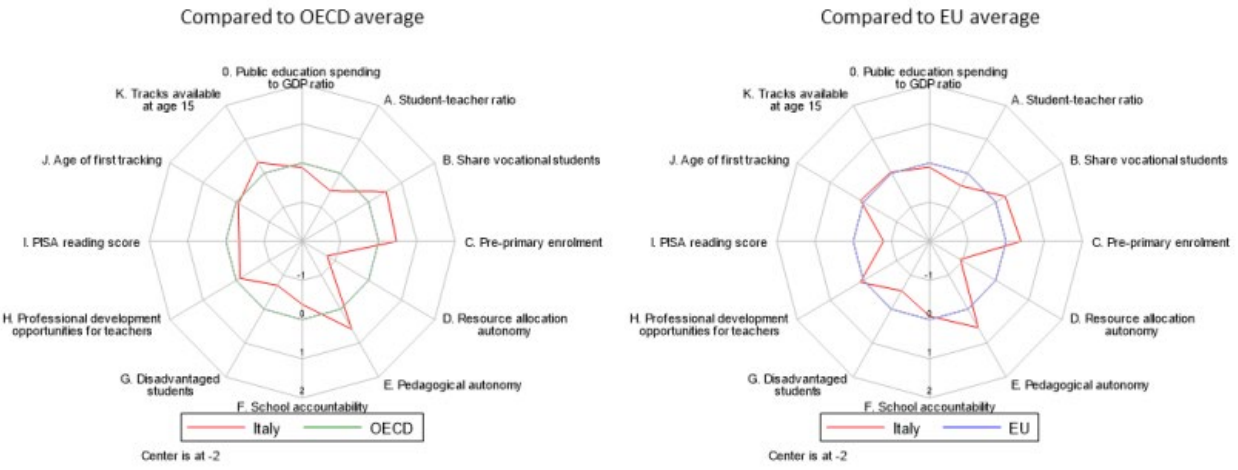
165. Regarding the education sector more specifically, the financial resources dedicated by Italy to its education sector are smaller than the OECD average: in 2017, the total education spending of Italy represented 3.9% of the national GDP, compared to 4.8% for the average of the 38 OECD countries. This relatively low figure may however be partly explained by the low share of young people (0-14 year old people making up 13.2% of Italy's total population in 2019, compared to 17.2% for the OECD average). In fact, Italy still has a lower student-to-teacher ratio and a higher pre-primary enrolment rate than the OECD and EU averages (see Figure 4.9). A large share of Italian expenditures stems from public sources (94% in Italy, versus 80% for the OECD average, see Figure 4.8).

Figure 4.8. Education expenditure as % of GDP in OECD countries



Note: Year 2017, except 2013 for Switzerland, 2016 for Ireland, 2015 for Slovakia.
Source: (OECD, n.d.[60]), *Education and Training* (database), https://stats.oecd.org/.

Figure 4.9. Education policies in Italy in 2018 (standardized)



Note: 34 OECD countries - 0: OECD or EU average, 1: one standard deviation.
Source: See Table 4.1.

In upper secondary education, Italy proposes a vast number of different tracks to the students, including general schools (*licei*), technical schools (*istituti tecnici*) and professional schools (*istituti professionali*). This tracking starts at 14 years old, which is very similar to the OECD average. The share of upper secondary students in technical or professional education (54% in 2019) is higher than the OECD average (44%). Enrolment in secondary vocational education has been shown to ease entrance on the labour

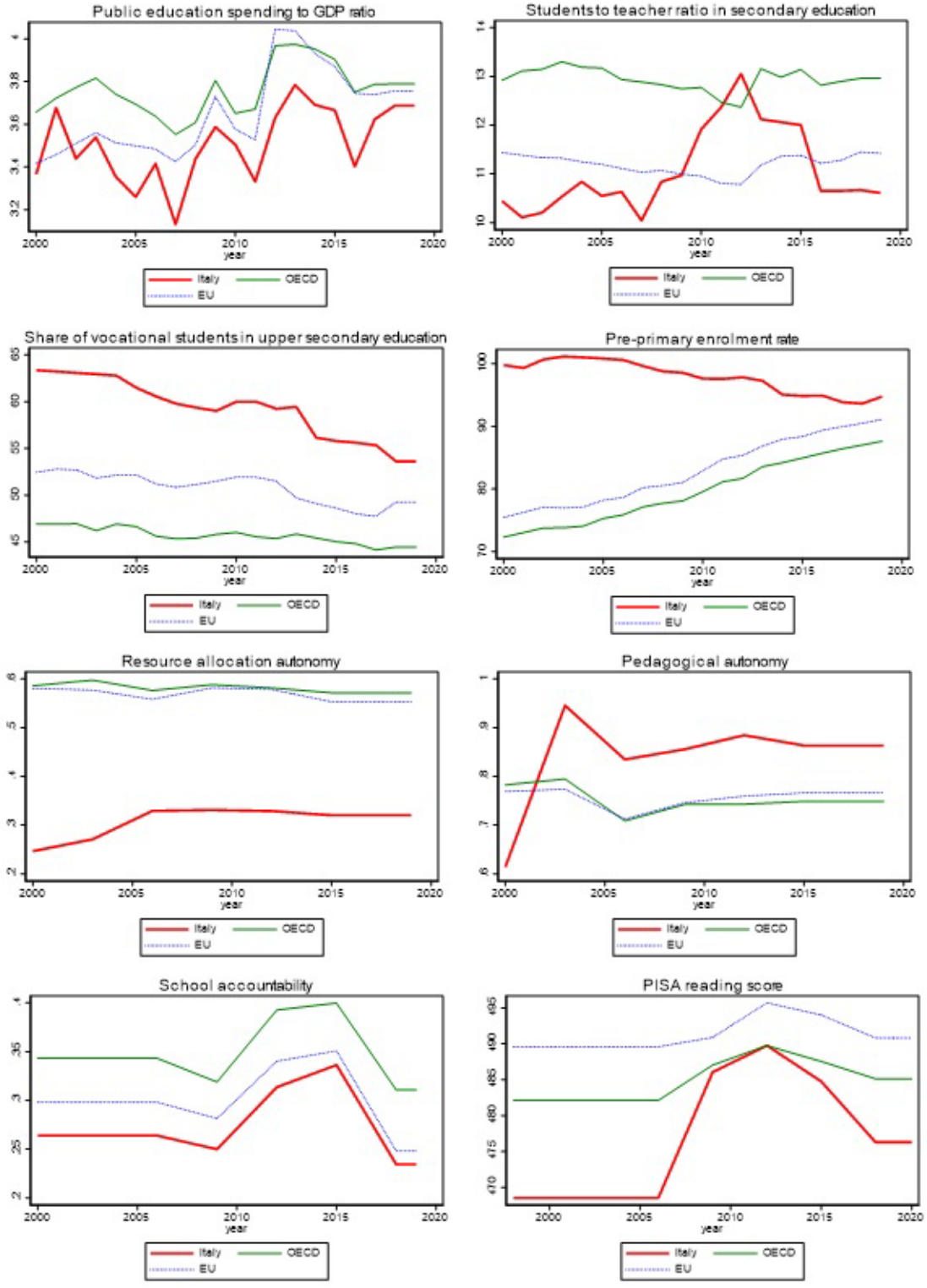
market (Shavit and Müller, 2000[61]; Buddelmeyer, Leung and Scutella, 2012[53]). However, it should be noted that social origins tend to have a stronger impact on educational performance in highly tracked school systems (Van de Werfhorst and Mijs, 2010[62]).

166. According to PISA (*Programme for International Student Assessment*) surveys, Italian schools tend to have a relatively low autonomy in terms of resource allocation (hiring teachers, determining their salaries) but a rather high one in terms of pedagogical choices.[34] Both trends have been relatively stable over the past twenty years (see Figure 4.10). The effects of decentralization on students' performance and inequality between schools are still widely debated (Blanchenay, Burns and Köster, 2014[48]), though previous research has shown that school management accountability (OECD, 2011[63]) and the level of economic development (Hanushek, Link and Woessman, 2013[64]) have a significant impact on the merits of a higher school autonomy.

[34] See Annex 4.A for more information about the calculation of these indicators.

Figure 4.10. Key policy determinants through time

Italy, OECD average and UE average



Note: PISA times series have only been collected in years 2000, 2003, 2006, 2009, 2012, 2015 and 2018 – the rest is linear interpolation.
Source: See Table 4.2.

4.4. Empirical Framework

Data

167. The analysis and projections presented in this chapter are based on macro-economic models estimated at the regional level: 355 EU NUTS2 regions and equivalent administrative divisions in other OECD countries are included in the dataset (representing a total of 34 countries).[35] These 355 regions form a panel spanning 23 years, from 1998 to 2020. Most of the variables had some missing values on some countries/years. All those missing values were imputed by linear interpolation when they were located between two non-missing values, and replaced by the first (resp. last) non-missing value when they were located at the beginning (resp. end) of the time series. More precisions about missing values and imputations are detailed in Annex 4.A.

168. The main dependent variable (early leavers rate) is collected at the subnational level. The data is available in the OECD regional statistics database. Two kinds of explanatory variables are included into the dataset, corresponding to the two categories of factors identified in Section 4.3. The first ones are related to the macro-economic and sociological context of each region (Table 4.1), the second ones are national variables reflecting education policies (Table 4.2). All the education variables were centered and reduced (divided by standard deviation) when used in the models to allow comparisons between variables. While all the education variables are only available at the national level (and therefore, are the same for two regions belonging to the same country), most of the macro-economic variables are available at the regional level. All variables except two ("age of first tracking", "number of tracks available at age 15") are time series, namely they vary with time (years).

169. There is one variable representing public expenditure on education (public education spending to GDP ratio). This variable is available at the regional level for most OECD countries where education is mostly organized by regional and local governments (instead of national ones): United States, Spain, Germany, Belgium, Colombia, and Switzerland. For the other countries, the national public education spending to GDP ratio was imputed to each region.

170. Most of variables are either directly obtainable from publicly available data or derived from simple calculations (ratios). However, the policy variables derived from the OECD studies (PISA and TALIS (*Teaching and Learning International Survey*)), as introduced in part 4.3 of the present report, have required more complex calculations from survey questions: "School autonomy in resource allocation", "School autonomy in curriculum and assessment" and "Professionnal development opportunities for teachers". These questions were previously used in other OECD studies on the impact of school autonomy (OECD, 2011[63]). The calculations are detailed in Annex 4.A.

171. Many other variables were available in the raw data, but not included in the final dataset. In most of the cases, the reason for this choice was that they did not provide much additional information and might have generated collinearity issues in the models: for example, "student to teacher ratio in primary education" was quite similar to "student to teacher ratio in secondary education". More generally, many more macro-economic variables (e.g. urbanization rate or life expectancy), were present in the raw data but not included in the end since they displayed significant correlation with the general development level of the regions, which was somehow already reflected in variables such as "GDP per capita" and "share of young people".

[35] Data on early school leaving is missing for 4 OECD countries: Canada, Costa Rica, Japan, South Korea.

Table 4.1. Regional macro-economic (core) variables – 2018 statistics

34 OECD countries

	Mean	Standard deviation	Source	Additional calculations from raw data
Public education spending to GDP ratio	3.78	0.86	(OECD, n.d.[60])	Yes (ratio)
GDP per capita (2015 USD)	43511	18313	(OECD, n.d.[54])	No
Share of young people	17.48	3.66	(OECD, n.d.[54])	No
Youth unemployment rate	14.40	8.10	(OECD, n.d.[54])	No
Share of jobs in agriculture (%)	4.89	3.83	(OECD, n.d.[54])	No
Share of jobs in industry (%)	14.49	5.83	(OECD, n.d.[54])	No
Share of jobs in construction (%)	7.04	1.37	(OECD, n.d.[54])	No
Immigrants rate (%)	14.9	9.60	(OECD, n.d.[54]) completed with (UN, 2019[65])	Yes (regional values available for a single year – 2015 –, expanded as times series with national evolution rates)

Table 4.2. National variables related to education policies – 2018 statistics

34 OECD countries

	Mean	Standard deviation	Source	Additional calculations from raw data
Student to teacher ratio in secondary education	12.96	4.39	(OECD, n.d.[60])	Yes (ratio)
Vocational students share in upper secondary education	45.82	15.27	(WB, n.d.[66])	Yes (ratio)
Pre-primary enrolment rate (6 years lag)	81.48	18.56	(OECD, n.d.[60])	Yes (ratio)
School autonomy in resource allocation*	0.57	0.20	(OECD, n.d.[67])	Yes (average of several questions)
School autonomy in curriculum and assessment*	0.75	0.19	(OECD, n.d.[67])	Yes (average of several questions)
School accountability*	0.31	0.20	(OECD, n.d.[67])	No (only year and country average)
Share of socially disadvantaged students	23.42	11.70	(OECD, n.d.[67])	No (only year and country average)
Professional development opportunities for teachers*	0.40	0.08	(OECD, n.d.[68])	Yes (average of several questions)
PISA reading score	484.8	25.38	(OECD, n.d.[69])(from (OECD, n.d.[67]))	No
Age of first tracking	14.15	2.03	(Bol and van de Werfhorst, 2013[70])	No
Number of tracks available at age 15	2.56	1.37	(Bol and van de Werfhorst, 2013[70])	No

Note: * more details about the variable in Annex 4.A.

Empirical model

172. As stated in many other works on human capital in sectors such as education or healthcare (Lorenzoni et al. (2018[11]) and Égert, Botev and Turner (2019[71])), the dependent variable, early school leaving rate (EL) in each region *r*, is the product of education policies Z^m (present here at the level of each individual country *c*) interacted with regional macro-economic (core) determinants X^i. This corresponds to the following Cobb-Douglas function:

$$EL_{r,t} = A_{r,t} \prod_m E_{c,t}^{m\,\pi_m} \prod_i {X_{r,t}^i}^{\beta_i}$$

with $E_{r,t}^m = \exp\left(Z_{c,t}^m\right)$ representing education policies. This leads to the following linear panel model, accounting for year- and region- fixed effects:

$$\log EL_{r,t} = a_r + b_t + \sum_m \pi_m . Z_{c,t}^m + \sum_i \beta_i \log X_{r,t}^i + \varepsilon_{r,t}$$

Results

173. The results of five different regressions based on the chosen model are presented below (Table 4.3). All these regressions were conducted at the regional level (i.e. a panel of 355 regions from 34 OECD countries from 1998 to 2020). In the regressions (1), (4) and (5), which involve regional fixed effects, the three subsets of explanatory variables are gradually included (regional macro-economic variables only in (1), then regional variables plus time-varying national education policies in (4), and finally constant national variables in addition to all the other variables in (5)). The fact that the sign and significance of the coefficients do not differ between the three regressions indicates a high degree of robustness of the analysis.

174. Regression (2) includes the same variables as regression (1), but on a panel formed with EU regions only (which on average may be more similar with Italian regions than OECD regions as a whole). Regression (3) is an OECD-wide regression also quite similar to regression (1), except that it also contains year fixed effects. The main difference between regressions (1) and (3) is the loss of significance for the "GDP per capita' variable, which means that the year fixed effects we introduced in (3) probably capture a large part of the worldwide (or OECD-wide) macro-economic climate represented by the GDP indicator. For this reason, we preferred not to include year fixed effects in the other regressions.

175. As stated in 4.3 – and shown in (1) and (4), many macro-economic factors influence early school leaving. An increased education spending (relatively to GDP) has positive effects (Jackson, Johnson and Persico, 2016[72])[36], though this variable bears many obvious interactions with several education policies – the importance of the size of expenditures itself is thus still highly debated (Nicoletti and Rabe, 2017[73]) Nevertheless, income (and thus, level of economic development) certainly have in impact (OECD, 2012[74]). This is reflected in the model by variables such as, of course, "GDP per capita", but also "share of young people" or "share of jobs in the agriculture sector" (these two variables being often higher in developing economies). The hypothesis of a causal explanation for early school leaving originating from the labour market, already mentioned in part 4.3, seems supported by the results of the regressions – not only by the negative sign of the coefficient of "youth unemployment", but also by the fact that the sectors which provide a lot of informal and/or low-qualified jobs, such as construction (significantly present in all the regressions), are likely to be the most important contributors.

[36] This study from the US estimated that a 10% increase in per pupil spending each year for all 12 years of public school led to 0.31 more completed years of education.

Table 4.3. Early school leavers model – regression results

	(1) OECD	(2) EU	(3) OECD	(4) OECD	(5) OECD
	Log of Regional Early Leavers Rate				
Time-varying regional variables (socio-economic):					
Education spending to GDP (log)	-0.063***	-0.056***	-0.033***	-0.048***	-0.048***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP per capita (log)	-0.516***	-0.043	-0.016	-0.256***	-0.256***
	(0.04)	(0.06)	(0.04)	(0.04)	(0.04)
Share of young people (log)	0.913***	0.767***	0.218***	0.843***	0.843***
	(0.05)	(0.07)	(0.05)	(0.05)	(0.05)
Youth unemployment (log)	-0.109***	-0.027**	-0.121***	-0.128***	-0.128***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Share of jobs in agriculture (log)	0.269***	0.165***	0.076***	0.235***	0.235***
	(0.02)	(0.04)	(0.02)	(0.02)	(0.02)
Share of jobs in industry (log)	0.234***	0.988***	0.028	0.213***	0.213***
	(0.03)	(0.06)	(0.02)	(0.03)	(0.03)
Share of jobs in construction (log)	0.395***	0.448***	0.166***	0.356***	0.356***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Immigrants rate (log)	0.088***	0.228***	0.173***	0.085***	0.085***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Time-varying national variables (education):					
Student to teacher ratio in secondary education				-0.002	-0.002
				(0.01)	(0.01)
Share of upper secondary students in vocational education				-0.067***	-0.067***
				(0.01)	(0.01)
Pre-primary enrolment rate (lag)				-0.147***	-0.147***
				(0.01)	(0.01)
Autonomy in resource allocation				0.086***	0.086***
				(0.01)	(0.01)
Autonomy in curriculum and assessment				-0.012*	-0.012*
				(0.01)	(0.01)
Accountability				-0.090***	-0.090***
				(0.01)	(0.01)
Share of disadvantaged students				0.093***	0.093***
				(0.02)	(0.02)
Professional development opportunities for teachers				-0.160***	-0.160***
				(0.01)	(0.01)
PISA reading score				-0.062***	-0.062***
				(0.01)	(0.01)
Time-constant national variables (education):					
Age of first tracking					-0.818***
					(0.03)
Number of tracks available at age 15					-0.975***
					(0.06)
Region-fixed effects	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	No	No	Yes	No	No
N	8165	3818	8165	8165	8165
R^2	0.913	0.894	0.931	0.924	0.924

Standard errors in parentheses
* p<0.10 **p<0.05 *** p<0.01

176. Sociological conditions are also strongly correlated with early school leaving. More students from socially disadvantaged backgrounds means more early leaving (cf. (4) and (5)). In fact, depending on the context, early school leaving can be seen as both a symptom and a cause of social disadvantage (Ross, Dooly and Hartsmar, 2012[75]; Vallejo and Dooly, 2013[76]). There is also a positive correlation between early school leaving and immigrants rate, since migrants are more likely to face worse socio-economic conditions than the general population (Hippe and Jakubowski, 2018[77]), as well as worse academic and social outcomes than the general student population, especially because of language barriers, concentration in specific schools or areas, and social exclusion in school (Cebolla-Boado and Fernández Reino, 2021[78]; OECD, 2018[79]; Mezzanotte, 2022[80]).

177. Regarding secondary education, the model – regressions (4) and (5) – confirms the positive role of vocational education (in terms of reducing early school leaving), as stated in part 4.3. However, students tracking should happen at a later age, as (5) shows: this contributes to reduce the dispersion of educational performance (Van Elk, Van der Steeg and Webbink, 2009[81]) as well as the influence of family background on the students' achievements (Woessmann, 2009[50]). School results (illustrated here by the PISA reading score) are also directly correlated with early school leaving. On the other hand, the impact of good material conditions seems more limited in our model (no significant coefficient for student to teacher ratio in (4) and (5) for instance), though their positive influence has already been proved in the past (Koc and Çelik, 2015[82]).

178. Pre-primary education also plays a part in determining early school leaving. Enrolment in pre-primary education (*materna*) has already been shown to facilitate long-term success in education and reducing drop out (Cortázar et al., 2020[83]), which is confirmed by our model. It should be noted, however that, due to the limited timespan of the series (22 years), the pre-primary variables are present with a lag of 6 years only. A lag of 15 years, corresponding to the difference between pre-primary attendance and school leaving in the life of a student, may have been more appropriate.

179. The results of the three regressions confirm the positive role of pedagogical school autonomy (autonomy on teaching materials and content, as well as student assessment). These findings are in line with most of the current recommendations, which emphasize the need to take into account the local school and family conditions to fight early school leaving (Thibert, 2013[84]). On the other hand, management autonomy (making decisions on the budget and on hiring teachers locally) does not contribute positively to reducing dropout rate. Accountability of the schools is anyway crucial (Woessman, 2007[49]). Apart from that, offering more professional development opportunities to teachers is also correlated with a lower early school leaving rate, as more frequent and adequate professional training is known to have positive impacts on the students' performance in general (Yoon et al., 2007[85]).

180. Regarding Italy more specifically, the larger share of vocational training in upper secondary education, the high pre-primary enrolment rate and the significant school pedagogical autonomy (cf. part 4.2) are positive factors. This means that a significant part of early school leaving in Italy is driven by macro-economic conditions (as seen in Table 4.3 income and labour market access and composition).

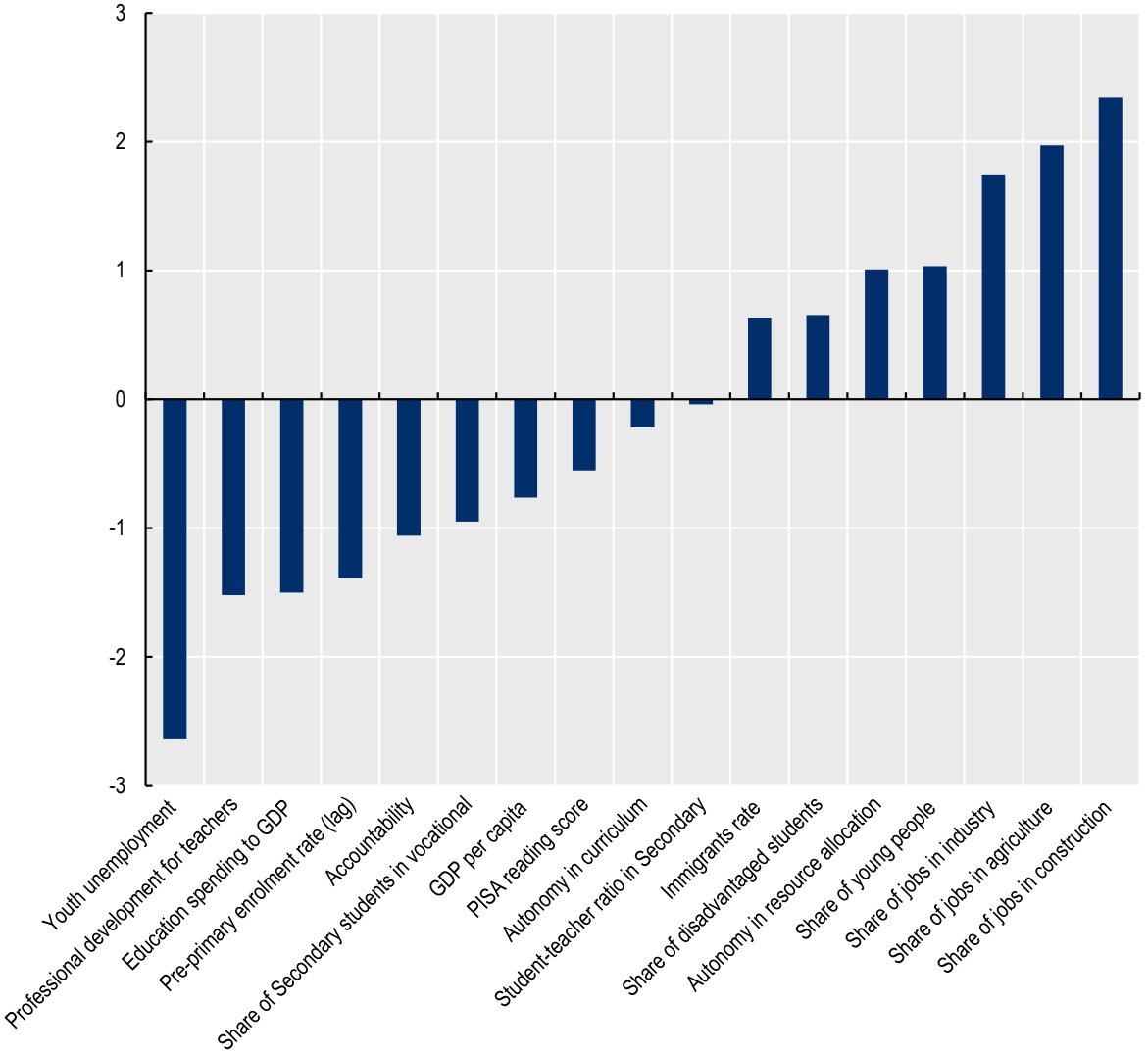
4.5. Projections of Early Leavers from School

181. The coefficients from the regression (5) presented in Table 4.3 allow us to assess the importance of the variables included in the regression. Figure 4.11 below represents the relative variation of the ESL rate caused by a variation equal to one standard deviation of the yearly change in each explanatory variable. This figures particularly highlights the role of the labour market in early school leaving, as suggested in Borgna and Struffolino (2017[57]) and Tumino and Taylor (2015[58]). The increase in youth unemployment is related to a decrease of 2.6% for the ESL rate, while relative employment increases in the agriculture, industry and, most importantly, construction sectors, which provide a significant number of low-skilled jobs, are related to increases of ESL rates around 2%. Figure 4.11 also emphasizes the positive

contribution (in terms of reducing ESL rate) that educational reforms could bear: increase in professional development opportunities for teachers, in school accountability, in enrolment of secondary students in vocational education, in academic outcomes (represented by the PISA reading score) and in school autonomy in curriculum and assessment.

Figure 4.11. Relative variation (%) of early school leaving rate due to changes in variables

Impact of a variation equal to one standard deviation of the yearly change in each variable X (variation of $\sigma(\Delta_t X)$)



Note: Standard deviations are calculated on the whole OECD dataset – cross-year and cross-regions.
Source: See Table 4.1 and Table 4.2.

182. Based on the full model (regression (5)), two different predictive scenarios for the period 2021-2024 were elaborated (with regional results aggregated at the national level):

- The first one is based solely on the macro-economic evolution as contemplated by the Italian Treasury (for GDP per capita, youth unemployment[37] and labour market sectoral composition) and ISTAT (immigrants' rate). In this scenario, the national ESL rate would only slightly decrease, from

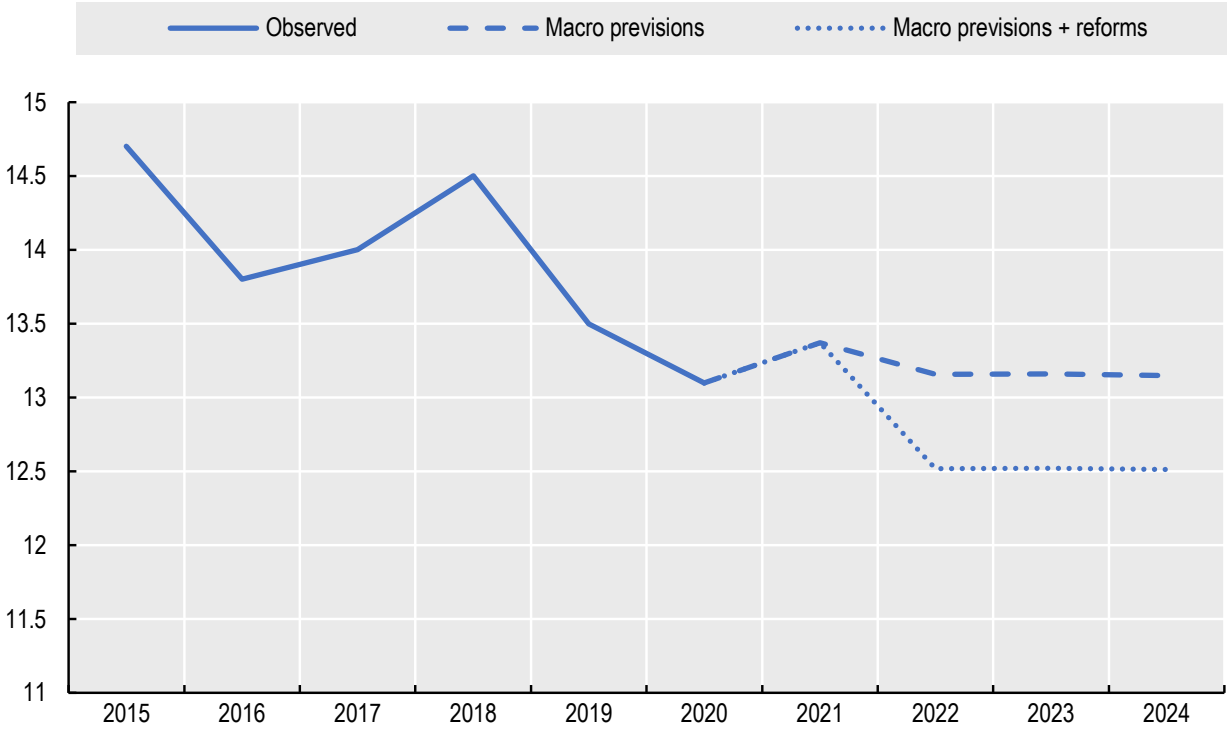
[37] Usually not included in the macroeconomic projections but instead calculated by independently by MEF.

13.50% of the 18-24 y.o. population in 2019 to 13.15% in 2024. The rebound in 2021 is mostly driven by labour market factors (lower youth unemployment, higher share of jobs in construction), despite a strong post-COVID economic rebound (strong GDP growth).

- The second one adds educational reforms in 2022. They consist (as suggested in Figure 4.11) of an increase equal to one standard deviation (at the OECD dataset level) of the yearly change in each policy variable. In this scenario, the national ESL rate would be 12.51% in 2024, an improvement of 0.6 percentage points from the macroeconomic evolution alone.

Figure 4.12. Previsions of Italian national early school-leaving rate

Based on macro-economic forecast made by Ministry of Economy and Finance



Note: Model and coefficients as described in Table 4.3.
Impact of an increase in School autonomy in curriculum and assessment, School accountability, Share of upper secondary students in vocational education, Professional development opportunities for teachers and PISA reading score – impact of a decrease in Share of socially disadvantaged students.
Source : OECD, MEF and Istat calculations.

183. The regional results (Figure 4.13) point to a lowest regional dispersion of the ESL rate in the future, confirming the long-term trend already observed in Figure 4.4. The 2019-2024 decrease could be above 4% in Sardinia, and above 2% in most of the southern regions but, at the same time, the ESL could slightly increase in many northern regions. This difference can be explained by the fact that, in our model, many drivers of early school leaving (apart from income), are actually lower in the South, like youth employment and immigrants rate.

Figure 4.13. Early leavers rate decrease (2019-2024) – Regional dispersion

Absolute decrease of the ESL rate in the macroeconomic evolution + educational reforms scenario – percentage points

Annex 4.A. Additional precisions on variables

School autonomy and climate indices constructed from PISA and TALIS surveys

184. Four variables were built from a series of questions from the PISA and TALIS studies, in accordance with (OECD, 2011[63]):

- **School autonomy in resource allocation** is computed considering whether "principals", "teachers", a "school governing board", a "regional or local education authority" or a "national education authority" have responsibility for 6 items: (1) selecting teachers for hire; (2) dismissing teachers; (3) establishing teachers' starting salaries; (4) determining teachers' salary increases; (5) formulating the school budget; and (6) deciding on budget allocations within the school. For each item, a score of 1 is given if the decision is only taken at the school level (including teachers, principals and school boards), 0 if the decision is only taken by the national or the regional/local school authority, 0.5 if both. The mean of the 6 items gives an autonomy score for each school taking part in the PISA School questionnaire. The school results are then aggregated at the national level according to pre-calculated sampling weights to construct a country- and time-dependant variable.
- **School autonomy in curriculum and assessment** is computed considering whether "principals", "teachers", a "school governing board", a "regional or local education authority" or a "national education authority" have responsibility for 4 items: (1) establishing student-assessment policies; (2) choosing which textbooks are used; (3) determining course content and (4) deciding which courses are offered. For each item, a score of 1 is given if the decision is only taken at the school level (including teachers, principals and school boards), 0 if the decision is only taken by the national or the regional/local school authority, 0.5 if both. The mean of the 4 items gives an autonomy score for each school taking part in the PISA School questionnaire. The school results are then aggregated at the national level according to pre-calculated sampling weights to construct a country- and time-dependant variable.
- **Professional development opportunities for teachers** is based on the answers of teachers to 7 yes/no questions regarding their participation in different types of professional development activities during the 12 months before the study : (1) courses/workshops (on subject matter and/or methods and/or other education-related topics); (2) education conferences or seminars (where teachers and/or researchers present their research results and discuss educational issues); (3) observation visits to other school; (4) qualification programme or degree programme; (5) participation in a network of teachers formed specifically for the professional development of teachers; (6) individual or collaborative research on a professional topic of interest; (7) mentoring and/or peer observation and coaching. The mean of the 7 items (yes=1 and no=0) gives a score for each teacher taking part in the TALIS Teacher questionnaire. The results are then aggregated at the national level according to pre-calculated sampling weights to construct a country- and time-dependant variable.

185. The **school accountability** variable is based on a single PISA question, in accordance with (OECD, 2011[63]) : *does the school post achievement data publicly?*

Completing missing values in times series

186. As said above, missing values were generally imputed by linear interpolation when they were located between two non-missing values, and replaced by the first (resp. last) non-missing value when they were located at the beginning (resp. end) of the time series. Some more particular choices also had to be made due to country-specific issues:

- Belgium: Most of the available time series refer to regions (Brussels, Flanders, Wallonia), but some others refer to language communities (Dutch and French speaking), especially regarding public spending on education. In the end, Flanders and Wallonia were identified with their respective language communities, and no observations for bilingual Brussels have been included in the final dataset.
- Colombia: Four departments (first-level divisions) were dropped from the final dataset due to very large public education spending to GDP ratios in the raw data (above 15%): Atlántico, Cauca, Córdoba and la Guajira.
- France: Some variables, especially immigrants rate, were only available for the pre-2015 regions (before mergers). In this case, we imputed to the new merged regions the time series of the largest pre 2015 regions from which they were made.
- Hungary: A single series “Budapest region” coexists with a combination of two other series (“Pest county + Budapest city”) in parts of the raw data due to changes in the NUTS nomenclature. Only the combination “Pest county + Budapest city” was kept in the final dataset.
- Italy: Bolzano province and Trento province are part of the same region (Trentino-Alto Adige) but they appear as two different NUTS2 in the raw data. The data relative to Trentino-Alto Adige in the maps and graphs of this document is a simple average of the values for Trento and Bolzano.
- Poland: A single series “Mazovia region” coexists with a combination of two other series (“Mazovia suburban + Warsaw city”) in parts of the raw data due to changes in the NUTS nomenclature. Only the combination “Mazovia suburban + Warsaw city” was kept in the final dataset.
- Sweden: There is no data for “share of disadvantaged students” in the PISA school questionnaire. The child poverty rate (9.1% in 2015) was imputed instead.
- USA: There is no data about secondary vocational education in the USA in the World Bank development indicators. The share of upper secondary students enrolled in vocational education was set to 0 in accordance with (Bol and van de Werfhorst, 2013[70]).

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