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Foreword

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International agreements on cross-border data flows and international trade: a statistical analysis

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This report uses a state-of-the-art gravity model to analyse the effects of selected international data agreements on bilateral trade flows in goods and services for the years 1995-2012. International data agreements can foster cross-border transactions by enhancing consumer trust and the interoperability of national regulatory frameworks, providing legal clarity for firms operating in distinct jurisdictions. Yet they can also involve compliance costs and restrictions on the free flow of data, potentially creating trade barriers. The report sheds light on these issues by examining how entering an international data agreement (e.g. the EU Data Protection Directive, the EU-US and Switzerland-US Safe Harbor agreements or the Council of Europe Convention 108) affects trade among participating countries relative to trade with or among non-participating countries. The results suggest that entering such agreements has a statistically significant and robust effect on trade, though this effect can vary according to the nature of the agreement.

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Data flows across national borders have become a key input to large range of economic activities. Enabled by the global reach of the Internet, these flows are widely regarded as boosting productivity and growth, fostering trade, innovation and entrepreneurship and providing new and enriched means for social interactions and knowledge diffusion.

At the same time, OECD countries have recognised that along with the economic and social benefits of an open and interconnected environment come privacy risks and challenges to the security of personal data. Governments acknowledge the need to improve the interoperability among privacy frameworks as well as strengthen cross-border co-operation among privacy enforcement authorities.

In the 2016 OECD Ministerial Declaration on the Digital Economy, ministers and high-level representatives from 41 countries and the European Union declared that they *will support the free flow of information,* through policies that reinforce the Internet's openness*, while respecting applicable frameworks for privacy and data protection, and strengthening digital security*.

Achieving both policy goals can be a challenging task. On one hand, policies aimed at protecting privacy can lead to restrictions to the free flow of data, which may undermine the viability of international business models, complicate the coordination of international supply chains and create trade barriers for foreign service providers.

On the other hand, regulatory frameworks to protect personal data, in particular those that increase international interoperability, have a potential to foster cross-border transactions by enhancing consumer trust and providing a common legal framework for firms operating in distinct jurisdictions.

Assessing the relationship between cross-border data flows, privacy policies and economic outcomes is complicated by a lack of reliable measures on the characteristics of data and its economic value. In many countries, the lack of empirical evidence on this trade-off has led to a polarized debate about the economic costs and benefits of cross-border data policy. This paper tries to shed new light on these issues, in particular by addressing the economic effects of international data agreements on international trade.

The paper estimates the effects of a country entering an international data agreement on its trade flows with the other countries in the agreement. A positive effect, i.e. a relative increase in trade with the countries in the agreement, suggests that the benefits from the agreement - higher trust and higher interoperability of legal frameworks - are bigger than its costs - restrictions to the free flow of data and complaisance costs. The opposite holds if the estimated effects are negative.

The analysis takes a conservative approach, controlling for the effects of all other factors - e.g. free trade agreements, EU membership, the business cycle, etc. - that affect trade between countries and that, in the absence of such controls, may be wrongly ascribed to international data agreements. The estimated effects are deviations from a pair specific trend, that is, the extent to which trade has increased among participating countries relative to trade with non-participating countries. As in the case of any econometric analysis, and notwithstanding these extensive controls, estimates should be interpreted with caution.

The paper starts with reviewing 10 international data agreements, conventions and guidelines covering 63 countries and provides a characterisation of their main features, e.g.: geographic scope, data coverage, compliance, enforceability, etc.

Out of these 10 agreements, the following could be included in the analysis and their effects tested: the EU Data Protection Directive, the EU-US Safe Harbor, the Switzerland-US Safe Harbor, the Council of Europe Convention 108 and the OECD Privacy Guidelines. The effects of the APEC Cross-Border Privacy Rules as well as the EU-US Privacy Shield and the Switzerland-US Privacy Shield could not be estimated due to the short period of their enforcement.

The effects of the above agreements were estimated separately for trade in services and trade in goods, through a state-of-the-art gravity model. The robustness of these estimates were tested against different hypotheses and specifications.

The Council of Europe Convention 108 is found to have a positive and significant effect on trade in services and trade in goods. Ratification of the Convention is associated with an average relative increase in trade of 12% for services and 6% for goods.

The US Safe Harbor agreements – with both the EU and Switzerland – are estimated to increase trade flows in goods between the country entering the agreement and the US by 8%. No clear effects, however, could be found for trade in services.

The OECD Privacy Guidelines are also estimated to have a positive and highly significant effect on trade in services. However, as many countries in the sample adopted the Guidelines at the time of their accession to the OECD, it is difficult to separate these two effects.

Finally, the effects of the EU Data Privacy Directive turned out to be either non-significant or negative. This estimate, however, should be interpreted with caution as it is mostly driven by the EU15 signing the Convention in 1998 and may just capture the effects of a negative shock to the EU15 trade in the same year, e.g. the Asian financial crisis.

The above findings provide, for the first time, empirical evidence on the potential trade-offs involved in international data agreements. They also open avenues for further analysis of effects that are not explicitly addressed in the current model, e.g.: the effects of data flows regulations that equally apply to all trading partners, or are difficult to interpret, e.g.: the interconnection between data agreements and regional integration in the EU.

1. Introduction

The free flow of information across borders is supporting an increasing number of economic activities. This often involves activities that raise the efficiency of productive processes, such as the geographic co-localization of standard business operations in multinational enterprises, the Internet of Things (IoT) connecting global production processes, international supply-chain coordination, Big Data analytics and Cloud computing (e.g. WEF 2016, López Gonzáles and Jouanjean 2017). Importantly, these effects are additional to and go far beyond the more indirect effects arising from an improved communications infrastructure. More generally, the free flow of information, primarily enabled by the openness and global reach of the Internet, is widely acknowledged to boost productivity and growth, fostering trade, innovation and entrepreneurship and providing new and enriched means for social interactions and knowledge diffusion (OECD 2015a).

At the same time, all OECD member countries have recognised that along with the economic and social benefits of an open and interconnected environment come privacy risks and challenges to the security of personal data, which constitute increasingly valuable assets. They have, therefore, declared their common interest in promoting and protecting not only the global free flow of information, but also the fundamental values of privacy and individual liberties and intensified investigative and legislative activities concerning the protection of privacy with respect to the collection and use of personal data since the 1970s (OECD 2013a). Over time, the discussion has evolved from one concerned mostly with privacy in the classic sense (i.e. relating to the abuse or disclosure of personal data) to a complex synthesis of interests which involves individual liberties more broadly. Basic principles and values which are commonly considered to be important in this area include: setting limits to the collection of personal data in accordance with the objectives of the data collector, restricting the usage of data to conform with openly specified purposes, creating facilities for individuals to learn of the existence and contents of data and have data corrected, and the identification of parties who are responsible for compliance with the relevant privacy protection rules and decisions (ibid).

The OECD (2013a) Privacy Framework, updating the original OECD (1980) Privacy Guidelines, in particular recommends for all countries to develop national privacy strategies and to adopt laws protecting privacy, as well as to establish authorities able to enforce privacy protection and to provide adequate sanctions in case of failures to comply with the laws. Governments thereby specifically acknowledged the need to improve the interoperability among privacy frameworks as well as strengthened cross-border co-operation among privacy enforcement authorities.[1]

The discussion of free flow of data and data privacy accordingly results in a twin-goal for policy makers: supporting the free flow of information on the one hand, while at the same time ensuring that legitimate policy objectives, such as the protection of privacy, are

[1] Data privacy, which is at the core of most data agreements discussed in this paper, is only one of several areas where benefits of access to data and the free flow of information need to be weighed against legitimate private, national, and public interests. Of further relevance in this regard are in particular the protection of intellectual property rights, a pre-condition for investments into data-driven innovation, as well as an effective digital security risk management (OECD 2015b, 2018a).

fulfilled. The close link between these two goals has been captured not only in the OECD Privacy Framework, but was also recognised in the Cancun declaration (OECD 2016), where ministers representing over 42 of the world's leading economies declared that they *will support the free flow of information,* through policies that reinforce the Internet's openness*, while respecting applicable frameworks for privacy and data protection, and strengthening digital security*.

However, achieving both policy goals at the same time can be a challenging task. In particular, policies aimed at protecting data privacy can lead to restrictions to the free flow of information, for example in cases where the transfer of data to third parties in foreign jurisdiction is thought to undermine domestic privacy goals (Meltzer and Mattoo, 2018).[2] As policy analysts and the business community have repeatedly pointed out, these restrictions potentially undermine the viability of international business models, complicate the coordination of international supply chains and create trade barriers for foreign service providers (e.g. Kommerskollegium 2014, López González and Ferencz 2018, Casalini and López González (2019), Ferencz (2019). On the other hand, regulatory frameworks to protect personal data, in particular those that increase international interoperability, will at the same time foster effects on cross-border transactions, enhancing consumer trust, for example in e-commerce, and providing legal clarity for firms operating with personal data in distinct jurisdictions (e.g. OECD 2016, OECD 2019a).

The lack of empirical evidence comprising both sides of the trade-off has led to a highly polarised debate about the economic costs of privacy policies (Ferencz 2019). This paper is part of several work streams trying to shed new light on these issues and particularly addresses the question of the economic effects arising from international privacy agreements.[3]

Section 2 examines the relationship between cross-border data flows and economic outcomes; discusses how the assessment of the potential gains from international data agreements is complicated by a lack of suitable empirical measures for the value of both data and privacy; and reviews selected findings on the relationship between data and trade flows.

Section 3 presents an inventory of international agreements, instruments, conventions, guidelines, and mechanisms that concern cross-border data flows and identifies those with potential effects on economic activities like trade. The inventory brings together 10 instruments governing cross-border data flows in 63 countries and provides a characterisation of their main features, e.g.: geographic scope, data coverage, compliance, enforceability, etc.

[2] The authors provide the example of the EU Court of Justice decision from October 2015, invalidating the Safe Harbour agreement that had been put in place to facilitate data flows between the European Union and the United States. In 2016, the older agreement was replaced by the new Privacy Shield agreement.

[3] There is a much broader discussion about the overall economic efficiency of privacy policies *as such*. Posner (1981) is often cited for criticising privacy protection as being economically inefficient. DeCew (2018) provides an overview of the discussion. This paper does not take a stance in this discussion, acknowledging that for many countries the decision to protect privacy and personal data online is not taken for economic reasons (see Schwartz and Pfeifer 2017).

Section 4 introduces the econometric approach taken in the paper, i.e. a state-of-the-art gravity model, and discusses its strengths and limitations for the analysis of the effects of international trade agreement on trade.

Section 5 presents the data for the analysis.

Section 6 reports the estimates of the gravity model on the effects of international data agreements on trade in services and in goods and tests their robustness against different hypotheses and specifications.

Section 7 summarises the main findings of the paper and make suggestions for further research on these issues.

2. International data agreements and economic outcomes

The aim of this section is to set the ground for the empirical analysis of the links between international privacy agreements, on the one hand, and economic outcomes, on the other. It first discusses the major measurement challenges for the analysis, and mentions some of the approaches that have been used to circumvent these challenges. It then provides a short overview of the possible channels through which international data agreements can affect trade flows.

2.1. Measurement challenges: cross-border data flows and the value of privacy

Assessing the relationship between free data flows, privacy policies and economic outcomes is complicated by a lack of direct empirical measures. This relates to both the measurement of data flows with a precise economic meaning, the categorisation of these flows, in particular for the identification of flows that are affected by privacy policies, as well as the value of privacy itself.

With regard to measuring data flows, a major challenge arises because most available indicators contain only limited information about the economically relevant content of these flows, such as the information they carry, including personal information, and the opportunities to transform this information into value.[4] For example, McKinsey Global Institute (MGI 2016) estimates that compared to 2005 global cross-border bandwidth had grown 45 times larger by 2014, using this increase as a proxy to compare the dynamism of cross-border data flows to the relatively sluggish performance of goods and finance flows. However, proxies like cross-border bandwidth or other measures of Internet traffic provide only limited information about the socio-economic motivation that is driving these flows (Meltzer 2014). Thus, Cisco (2017) estimates that video traffic made up 73 percent of total IP Internet traffic in 2016. It is however highly unlikely that video traffic explains close to three quarters of the value created from cross-border data flows. In particular, none of the above-mentioned productive uses of data flows, such as the coordination of global value chains or cloud computing, appears to be particularly dependent on the transmission of video files.

This proxy problem relates to the more general difficulty of attaching economic value to data flows. The value of data is largely dependent on its intended use and might be different for different users. Additionally, data analytics is crucial for the extraction of information and thus the creation of value from data. As a non-rivalrous, general-purpose resource, different stakeholders can thereby use and re-use data without the resource being depleted (Casalini and López González 2019, OECD 2019b, 2019c, 2019d and 2013b). Accordingly,

[4] Approaches to better measurement of cross-border data flows and their economic impact is the topic of several work streams in the OECD. In particular, two background papers, on the taxonomy of data and the measurement challenges and options for cross-border data flows are currently being prepared in the context of the OECD Going Digital agenda and a corresponding workshop to be held in November 2018 in London.

the same package of bits and bytes can have different economic implications in different contexts.[5]

For a similar reason, it is nearly impossible to find a categorisation of data that fits the need of all stakeholders. Thus, while it is relatively straightforward to categorize data according to objective characteristics such as data format (e.g. whether it is a video or a text file), the relevancy of other, economically more meaningful ways to categorise data, e.g. capturing the type of information contained, the context in which it arises or the envisaged use, will vary for different stakeholders. From a business perspective, it might seem natural for example to distinguish data according to the specific business area in which it arises, e.g. customer, human resource or technical data (e.g. Kommerskollegium 2014). From a policy perspective however, a characterisation according to usage permissions (i.e. proprietary vs. public domain data) or data sensitivity (e.g. with regard to privacy), might be much more relevant (OECD 2018).

This also implies that the descriptive attributes attached to a data file will often vary according to the context in which the data has been created. Firms, for example, might find it difficult to separate out personal data components from a data set, because of the way the data had been generated.[6] In the context of data privacy policies, this can become a real problem, because even datasets containing mostly non-personal information can contain traces of personal data. Privacy policies are therefore likely to affect many data transmissions that according to their intended use and main content would otherwise not be in the focus of policy makers.

This problem is exacerbated because the increasing size and scope of data sets can allow the identification of a particular individual by cross-matching several originally anonymized data points, a process called *de-anonymization* (OECD 2013c, Kommerskollegium 2014, Mattoo and Meltzer 2018). Accordingly, even data sets containing no personal data can have implications with regard to privacy policies, depending solely on the methods applied to the data. Similarly, ambiguities with regard to data attributes can further arise if a given attribute, such as *personal* data, has a different meaning in different jurisdictions. For a firm that is active across jurisdictions, this can make it even more difficult to determine the parts of the data that are relevant from a data privacy perspective (Casalini and López González 2019).

Thus, both the economic value of data flows (which might depend on a yet unknown potential) as well as the share of personal data that it contains (a potential proxy for the impact of privacy related restrictions on these flows), can usually not be measured directly. And the same holds for the other side of the trade-off as well, i.e. the benefits of privacy protection. In particular, previous research has shown that people tend to be very different with respect to their valuation of privacy, measured for example as the amount of money they are willing to spend in order to protect their personal data from disclosure. Additionally, these valuations also tend to be highly context dependent, e.g. depending on recipient of the disclosed data or determined by potential benefits that are expected in return, including so-called freemium services (OECD 2013b, Casalini and López González 2019). The proper valuation of privacy from an individual perspective is thereby further

[5] Casalini and López González (2019) use the example of an excel file, that according to its content (e.g. health records or retail data) can have very a different value for different users.

[6] Personal data is usually understood as data that relates to an identified or identifiable individual (OECD 1980).

complicated because data subjects are increasingly unaware of the decisions taken with regard to the usage of their data (WEF 2014).

Finally, there is a macro dimension related to the benefits of privacy protection that relates to the overall level of trust in an economy and that is even harder to measure. In particular, if the misuse of data reaches a critical level, the default level of trust with regard to cross-border transactions is likely to diminish. As highlighted in WEF (2013), if widespread doubts about privacy of data and other values, such as data security, are not effectively addressed, this could significantly reduce the vitality of the global Internet. The economic consequences would likely be substantial.

2.2. Empirical evidence on the economic linkages between cross-border data flows, trade and privacy policy

The lack of direct measures has led many researchers to use some proxy to estimate the relation between cross-border data flows and economic outcomes.

To estimate the benefits of data flows at a relatively aggregate level, McKinsey Global Institute (MGI 2016) uses the above mentioned internet bandwidth indicator in a time series regression to disentangle the effect of cross-border data flows on GDP from the effect of other cross border flows, including goods trade, migration and financial flows. Their estimates suggest that cross-border data flows accounted for about USD 2.8 trillion in 2014, slightly more than the USD 2.7 trillion contribution of goods trade.

However, singling out the effect of data flows on aggregate measures such as GDP requires strong additional assumptions. The reason is that data flows are not only directly contributing to GDP, e.g. due to efficiency gains arising from better communication, but also indirectly through each of the other channels, for instance as an enabler of trade or investment interactions. In order to account for the full effect of data flows, the McKinsey study for example had to assume that data flows are responsible for about 12% of all the other flows that are contributing to GDP.[7]

Many studies are therefore taking a more partial but direct view on the economic effects of data flows. For example, a direct link between cross-border data flows and economic outcomes can be established for trade interactions. This is particularly evident for so-called digital or ICT-enabled services.[8] These are services delivered remotely over ICT networks, and thus data flows with a very precise economic value attached to them (Meltzer 2014, UNCTAD, 2015). However, most data sources do not distinguish services trade by mode of delivery and thus do not provide information on whether a particular service has actually been delivered online. The statistical community has therefore moved to measure the *potentially* digitally enabled services trade instead, i.e. trade flows pertaining to Balance of Payment categories that can potentially be digitally delivered (e.g. financial or information services). Using this approach, the US Bureau of Economic Analysis (Grimm, 2016) estimates that in 2014, the US exported about USD 385 billion in potentially ICT-enabled

[7] The assumption of a 12% contribution reflects the share of cross-border e-commerce in global trade, compare MGI (2016).

[8] The future measurement agenda for digital trade at the OECD more broadly may be considered in the context of the Going Digital measurement roadmap that is currently being developed. See also OECD (2017) for the approach currently under discussion in the statistics community.

services and imported about USD 231 billion, accounting for 54% of total services exports and 48% of imports respectively. OECD (2018, forthcoming) uses a more conservative approach, estimating that 37% of US services exports have been potentially ICT-enabled in 2016, compared to 31% for imports.[9] This compares to an OECD average of 33% for exports (up from 28% in 2010) and 27% for imports (up from 23%).

López González and Ferencz (2018) apply a gravity approach to both manufacturing and services exports from the TiVA database, providing tentative evidence on the positive association between bilateral digital connectivity, as a proxy for cross-border data flows, and trade.[10] In particular, among all services the study confirms the largest trade-enhancing effects for services that can potentially be digitally delivered. The analysis further highlights that on top of the direct association between digital connectivity and trade, the findings suggests a complementarity between connectivity and trade agreements that provide additional effects of up to a 2.3% increase in exports for each 10% increase in digital connectivity. This approach follows a broader literature that has established a link between international trade and digital interactions that are highly dependent on cross-border data flows. Starting with Freund and Weinhold (2002, 2004), who are using the number of top-level domain names in a given country as a different proxy for digital intensity, the approach has been used frequently in recent years. López González and Ferencz (2018) provides a short overview of this literature.

Other studies have more directly looked at trade that did not exist before the era of cross-border data flows from a gravity model perspective. Blum and Goldfarb (2006) use data on click stream patterns to proxy for the cross-border consumption of digital goods. They find that distance remains an important determinant of trade for taste-dependent digital products, such as music or games, but cannot confirm that role for other products like software. Cowgill and Dorobantu (2014) use data from Google's online advertising platform to analyse geographical patterns of cross-country transactions. Their findings confirm that distance still matters in online trade and that additional measures of cultural and economic closeness are significant determinants of online trade. For e-commerce, including in physical goods, Hortaçsu, Martínez-Jerez and Douglas (2009) confirm a reduced role for distance as a trade deterrent. Lendle et al. (2016) looks at eBay transactions between 61 countries and find the effect of distance to be on average 65% smaller compared to classical trade. Gomez-Herrera, Martens and Turlea (2013) use data from a survey on individuals' e-commerce purchases and confirm the reduced role of distance for online purchases. OECD (2019e) uses big data on online payments to analyse e-commerce patterns of Spanish costumers. The study highlights that the quality and existence of the policy framework, including regulatory quality or the existence of legal frameworks for electronic transactions and cybercrime prevention, can foster cross-border purchases from a given country. Similar effects for the existence of a legal data or consumer protection frameworks could not be confirmed.

[9] The OECD estimates consider only data for audiovisual services, telecommunications, computer, and information services, financial services and charges for the use of intellectual property.

[10] Gravity equations relate trade between two countries or regions to factors like economic size, measured by GDP, as well as factors that affect trade costs, including distance, borders, free trade agreements, a common official language or a common currency. Gravity equations belong to the standard toolkit of empirical trade analysis and are known for their good empirical performance (see Feenstra 2002).

Importantly, the trade-data flow nexus reaches far beyond digitally enabled services and e-commerce and has implications for the efficient coordination of global value chains (GVCs) and trade within multinational enterprises (MNEs).[11] This explains why cross-border data flows have become an important topic from a trade policy perspective (Casalini and López González 2019, OECD 2018g, López Gonzáles and Jouanjean 2017, Meltzer 2014). Accordingly, trade policy research is beginning to look increasingly into the potential trade inhibiting consequences of data flow restrictions (e.g. Porges and Enders 2016, Casalini and López González 2019, Ferencz 2019).

In one of the earlier approaches, Bauer et al. (2014) aim to quantify the losses that result from data localisation requirements and related data privacy and security laws. The study considers the effects of proposed and enacted legislation in Brazil, China, the European Union, India, Indonesia, South Korea and Vietnam. The authors follow a large literature that uses computable general equilibrium model (CGE), and in particular GTAP8, to analyse the impact of policy measures on trade and GDP. They find substantial negative effects on GDP in the enacting countries, ranging from -0.1% in India to -1.7% in Vietnam. The authors further find a reduction in domestic investment and for China and India a reduction of exports by -1.7%.

USITC (2014) also uses a GTAP CGE model to estimate the potential economy-wide effects of digital trade as well as foreign barriers to digital trade on GDP, wages and employment for the US. The authors in particular analyse Internet-based productivity improvements, Internet-based reductions in international trade costs and the effects of the removal of foreign barriers to digital trade. The weighting of different barriers to digital trade follows responses from a firm level survey. Barriers are modelled as sector and country specific export taxes. Results from the analysis suggest that removing foreign barriers would increase U.S. employment in the digitally intensive sectors by 0.4%-0.9%, depending on the sector, and would increase aggregate US employment by up to 0.3%.[12] Effects on real GDP are estimated at 0.1%-0.3%. Trade effects are not explicitly considered.

However, as CGE models are based on a theoretical structure, researchers have to explicitly account for channels of interest in the underlying model. The advantage of these models is that inter-linkages between different parts of the economy are explicitly accounted for, which can help to disentangle the link between policy measures and economic outcomes. On the other hand, this type of analysis is by definition partial. To be precise, the effects considered in virtually all studies as of today relate exclusively to the cost of data flow restrictions, including for example the effect of new regulations on prices for products that rely on data for the production process, a trade barrier effect for products that rely on data for delivery, or a reduction of R&D activities that depend on customer and market data (e.g. Bauer et al 2014).[13] Thus, while the existing CGE models capture the cost

[11] Cross-border data flows are furthermore important determinants of foreign direct investment (FDI), as many MNEs establish foreign affiliates to distribute services abroad, see Meltzer (2014).

[12] Digitally intensive sectors in this particular case are identified based on the concentration of digitally intensive firms in these sectors. Sectors considered digitally intensive according to this methodology are Content, Digital communication, Finance and insurance, Manufacturing, Retail trade, Selected other services (including Accounting, Architectural services, Computer programming and several others) and Wholesale trade. See USITC (2014) for details.

[13] See Lee (2018) for a very recent addition to this literature, focusing on the new EU GDPR regulation.

side of the equation, potential benefits, such as the trade fostering effects associated with enhanced personal data privacy, are not part of the analysis.

This paper follows the previous literature in analysing the economic impact of data policies. Instead of focusing on the trade barrier potential of data localisation requirements and cross-border flow restrictions, the analysis provides the first evidence on the economic effects of international data protection agreements. The analysis is partial in the sense that it only considers effects on trade flows, excluding all additional effects of data policies on GDP, employment etc. However, unlike previous studies, the empirical approach chosen considers the net effect of policy changes on relative trade flows, incorporating implicitly all potential channels through which data agreements could affect trade between two countries.[14] The downside of this approach is that disentangling separate channels becomes very difficult. The following section briefly illustrates some of the channels likely to be involved.

2.3. The effects of international data agreements on cross-border trade

Mainly to avoid the potentially negative consequences of imperfect inter-operability with regard to privacy standards, including the effects of local storage requirements and cross-border data flow restrictions, governments are increasingly enacting international frameworks to provide a basis for simple and safe cross-border data transfers to other countries. As of today, there is however no empirical evidence on the economic effects of these agreements. Section 6 provides the first results of such an analysis. To guide the interpretation of the empirical results, this subsection highlights some of the effects that might arise from international data agreements, in particular for trade. As in most of the literature, a positive relationship between cross-border data flows and trade flows is assumed throughout.

Unlike trade agreements that often exclusively aim at reducing tariff or non-tariff trade barriers, some international data protection agreements incorporate two distinct goals that should be considered separately, namely a) to increase the *interoperability* between different national approaches to data protection *for a given level of data protection* and b) to help establish an *adequate level of data protection*. This complicates the analysis considerably, as both components can potentially have opposite effects on economic outcomes, and particularly trade.

Specifically, *given a particular level* of data protection, international data agreements aim to increase the *interoperability* between (or even *harmonise*) different frameworks across national jurisdictions. Relative to a situation with similar levels of data protection but incompatible regulatory approaches, this can reduce regulatory burdens and foster cross-border data flows for participating countries. Thus, the preamble of the original OECD (1980) Privacy Guidelines explicitly argues that disparities in national legislations threaten to hamper the free flow of personal data across frontiers, causing potentially serious disruptions in important sectors of the economy. The preamble then highlights that this potential risk has been the reason why "*OECD member countries considered it necessary to develop Guidelines which would help to harmonise national privacy legislation and, while upholding such human rights* [i.e. data privacy]*, would at the same time prevent interruptions in international flows of data*." In a similar vein, the recently enacted EU

[14] As explained below, the identification of effects is nevertheless constrained because the empirical model does only use a particular part of variation in the data.

General Data Protection Regulation (GDPR), considered a unilateral approach from the perspective of non-EU countries, specifically highlights that the Directive "*seeks to harmonise the protection of fundamental rights and freedoms of natural persons in respect of processing activities and to ensure the free flow of personal data between Member states*".

Following these arguments, one would then expect a data agreement to have positive effects on data flows, as firms in the participating countries face less regulatory burdens arising from heterogeneous approaches to privacy protection, *relative* to a situation without such agreement. This can decrease costs and foster trade interactions between member countries. To some extent, this resembles a reduction of (non-tariff) trade barriers between member countries, similar in principle to the effects of some free trade agreements.

However, some privacy agreements do not only increase the interoperability between different privacy frameworks, they also affect the *level of data protection* in the jurisdiction of participating countries. In some cases, new rules and regulations embedded in privacy agreements are thereby binding and involve the creation of institutions with a mandate to enforce such rules (see Annex 1). Additional effects on economic outcomes, including trade transactions, are therefore likely to arise as soon as the agreed upon rules differ from national pre-agreement regulation in terms of the level of protection. This can even be the case if the rules of the agreement are non-binding, as the new framework might raise the awareness of data subjects with regard to their privacy rights and the risks associated with cross-border data flows, as well as influence the expectations and decisions of data controllers.

A higher level of data protection can have a positive effect on data and thus trade flows between member countries, because data protection likely enhances trust, increasing the level of cross-border transactions, in particular in the long run. On the other hand, trade between participating and non-participating countries can also increase, if the level of data protection established in participating countries induces trust for consumers in other countries. If the level of trust has been high to begin with for trade between participating countries, the trust-enhancing effect can potentially be even higher for trade between participating and non-participating countries.

However, the equation is even more complicated, because a higher level of privacy protection can be associated with significant additional compliance or adjustment costs for companies affected by the new regulation, i.e. companies residing in or interacting with the enacting country. Significant costs can arise for example from the need to hire specialist lawyers and data protection consultants, as well as required upgrades and investments into database management and software. The International Association of Privacy Professionals (IAPP), in a joint effort with EY, estimates for example that the Fortune 500 companies will spend a combined USD7.8bn to avoid falling foul of the new European General Data Protection Regulation (FT 2017). These adjustment and compliance costs will tend to hamper trade, in particular in the short run, i.e. until companies have fully adjusted to the new regulation.

It seems noteworthy that this effect is likely to be particularly high for firms in participating countries. The reason is that for these firms the new regulation applies to all transactions, including their domestic activities. For firms in agreement countries it will then usually be relatively more attractive to adjust their whole data management structure to the new regulatory environment, whereas for firms in third countries it might suffice to find patches only for those transactions that involve countries forming part of the agreement. This would imply relatively higher adjustment costs for both exporting and importing firms in

participating countries and can lead to a reduction in competitiveness *vis-à-vis* firms that do not have to cope with the new regulation along all dimensions of their business activity. From this perspective, it is possible that the immediate effect of data agreements is to reduce trade between participating countries relative to trade between other possible country pairings. One would expect this effect to be particularly strong for agreements that significantly increase the level of data protection and when firms have the burden of proofing compliance.

In some cases, data agreements do not only increase the compliance costs for firms in third countries engaging with participating countries, but also generate formal barriers to cross-border data flows to countries that are not considered *adequate* in terms of data protection standards. For instance, this seems the case for agreements where the default position on cross-border data flows is "not allowed" (see Annex I). In these cases, data agreements can impede data flows to non-participating countries, creating severe additional trade barriers. This relates to the discussion of the economic effects of data localisation measures discussed earlier and implies that one should expect trade to be reduced if it occurs between a participating and a non-participating country.[15]

As the empirical model below can only provide information on the aggregate effect, it is a *priori* not clear, whether we should expect a data agreement to increase or decrease trade flows. The overall effect is ultimately going to depend on the specifics of the agreement, the time span considered, i.e. whether more short term or long-term effects dominate.

[15] Negative effects at least in the short run could also arise due to increased uncertainty with regard to the legal status of a given transaction and the risk associated with non-compliance.

3. An inventory of relevant international data agreements

The aim of this section is twofold. First, identify a set of international agreements, instruments, conventions, regulations, guidelines and mechanisms that concern cross-border data flows. For sake of simplicity, the remainder of the paper will refer to them as "agreements", although they are quite distinct in nature, ranging from legally binding regulations to unilateral adequacy decisions or non-binding instruments. Second, determine which of these agreements are relevant for the purpose of this paper, i.e. those that can affect economic activities like trade.

Most of the inventory consists of data protection and privacy agreements. At a first look, there also seemed to be several potentially relevant international trade agreements, but many of them have nothing to do with cross-border data flows; specifically exempt such flows from their purview; have not come into force yet; or are too new to have had a measurable impact. The remaining trade agreements may be relevant, but the Trade Directorate, which has undertaken a very similar categorisation/coding exercise, albeit mainly with respect to domestic laws, plans to code international trade agreements sometime in 2019. The present analysis may therefore be extended in the future so as to incorporate this work when it is completed.

The relevant data protection and privacy agreements are therefore:

- 1995 EU Data Protection Directive
- EU-US Safe Harbor Framework
- Switzerland-US Safe Harbor Framework
- EU-US Privacy Shield
- Switzerland-US Privacy Shield
- OECD Privacy Guidelines
- UN Guidelines concerning Computerized Personal Files
- Council of Europe Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data (Convention 108)
- Additional Protocol to the Convention
- The APEC Cross-Border Privacy Rules system

The agreements that are not considered relevant at this stage are

- EU General Data Protection Regulation (because, although it came into force on 24 May 2016, it did not actually apply until 25 May 2018);
- EU Police and Criminal Justice Data Protection Directive [EU 2016/680] (because, although it went into force on 5 May 2016, it did not actually begin to apply until 6 May 2018 and because police data flows are unlikely to have macroeconomic effects);
- APEC Privacy Framework (because the Framework is a set of privacy principles rather than a clear set of rules to be followed). APEC member economies may voluntarily implement the Framework, which is intended to protect personal data

transferred outside the APEC member state in which it was collected by using the principle of 'accountability'. Under that principle, the original collector of the data remains accountable for compliance with the privacy framework that applied when and where the data was collected, regardless of the other organisations or countries to which the data travels. Accountability does not specifically restrict data flows; it imposes compliance responsibilities on parties that transfer personal data internationally. However, the Framework does not constitute a uniform approach. At present, APEC members have their own approaches to privacy protection, which cover a range of positions;

- Agreement between the European Union and the United States of America on the Processing and Transfer of Passenger Name Record Data by Air Carriers to the United States Department of Homeland Security (the 2007 PNR Agreement) (because PNR data flows are unlikely to have macroeconomic effects and because this is not data that companies have an economic interest in transferring; rather, they do it to comply with DHS's requirements, which are related to fighting terrorism);
- Council of the European Union, Council Decision on the conclusion of the Agreement between the European Union and the United States of America on the processing and transfer of Financial Messaging Data from the European Union to the United States for purposes of the Terrorist Finance Tracking Program, 24 June 2010 (because this is another law enforcement agreement that is unlikely to have macroeconomic effects);
- The Madrid Resolution, 'International Standards on the Protection of Personal Data and Privacy' (2009) (because it is not an agreement or an instrument, it is just a proposal, no countries have committed to follow it, and it has been superseded by efforts to modernise Convention 108);
- EU Regulation on a Framework for the Free-Flow of Non-Personal Data in the EU (because it only recently entered into force);
- General Agreement on Tariffs and Trade (GATT) (because it is unclear how data flows are covered in this agreement, see Casalini and Lopez-Gonzalez, 2019);
- General Agreement on Trade in Services (GATS) (because it is unclear how data flows are covered in this agreement, see Casalini and Lopez-Gonzalez, 2019);
- Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) (because it only recently entered into force);
- EU-Japan Economic Partnership Agreement (because it only recently entered into force).

3.1. Coding the relevant data protection and privacy agreements

This work involved describing the features of the relevant agreements in a manner that is understandable to both people and computers. Analysts have to be able to understand the agreements so that an appropriate econometric model can be designed, and software programs have to be able to understand their features in a manner that is compatible with carrying out computations. Accordingly, the components, conditions and effects of the agreements have not only been described in words, but they have also been characterised with 0s and 1s, which convey whether a given characteristic exists or not in the agreement.

This binary characterisation can be used as a set of dummy variables in the estimation of the effects of these agreements on trade flows.

This information has been entered in a spreadsheet (Annex 1) that, for each relevant agreement, provides a general prose description. That is followed by mostly numerical information that conveys the agreement's:

- default position (whether data flow is allowed or not);
- geographic scope;
- sectoral scope;
- the period in which it has been in effect;
- whether data flows are affected conditionally or unconditionally;
- for agreements of a conditional nature, the conditions that will cause data flows to be allowed (or disallowed);
- for agreements of a conditional nature, whether each condition is actionable by businesses (i.e. whether firms can do something to meet the condition or whether it is beyond their control);
- whether compliance with the terms of the agreement is enforceable or merely advisable, desirable, or in good faith;
- if enforceable, how and by whom;
- if enforceable, what the sender is obligated to do vis-à-vis the data protection authority, i.e. provide ex post notification, ex ante notification, or obtain ex ante authorisation;
- if enforceable, the powers that are granted to the enforcement body.

3.2. Example

For example, the EU Data Protection Directive (DPD) is described as follows:

> *Officially, this is "Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data, [1995] OJ L281/31". It is the EU's governing instrument for data protection until 25 May 2018, when the General Data Protection Regulation (GDPR) begins to apply. Each EU Member State has introduced laws based on the DPD, which required them to put its data protection principles into their national laws. The directive, which is legally binding in the 27 EU member states and the three EEA member countries (Iceland, Liechtenstein, and Norway), has mixed effects on data flows because on the one hand, the transfer of personal data within the EU and EEA may not be restricted based on the level of data protection in the recipient country. However, data transfers to non-EU/non-EEA countries are prohibited unless those countries provide 'an adequate level of data protection' as determined by the European Commission, or unless certain other conditions are fulfilled. As of 2017, the EC had determined that 12 jurisdictions provide adequate protection (Andorra, Argentina, Australia, Canada, Faeroe Islands, Guernsey, Israel, the Isle of Man, Jersey, New Zealand, Switzerland, Uruguay and the United States of America (limited to the Privacy Shield framework)).*

Thus, the Directive has some aspects that allow cross-border data flows as a default, but with certain exceptions, and other aspects that restrict data flows as a default, again with certain exceptions. That made it necessary to split the coding into two parts. The Directive's default permissive treatment of intra-EU data flows, along with the exceptions, are coded in one row of the coding spreadsheet. The default restrictive treatment of extra-EU data flows, and the exceptions, are coded in a separate row. The latter serves as the example provided here. Please refer to the Annex to view the portions of the spreadsheet connected with this example.

The default position for this aspect of the Directive is that extra-EU data flows are not allowed. The geographic scope is 30 countries (27 EU member states and three EEA member states). The sectoral scope is all sectors and the period of effect is 1998 through (May) 2018.

There are conditions set out in the Directive that, if applicable, exceptionally permit data to flow across borders. They are all individually sufficient to trigger an exception. In other words, not all of them have to be satisfied; any one of them will do. All of them are marked with a "1". Some of these conditions are:

- Model clauses, approved by a data protection authority (DPA) in the sending country, are used in a contract between the data exporter and the data importer;
- Intra-company compliance programmes called binding corporate rules (concerning the treatment of transferred data) are approved by the sending country's DPA;
- The data subject gives prior consent to the transfer;
- A government official or agency in the sending jurisdiction determines that the recipient country provides an adequate level of data protection;
- The transfer is for the protection or furtherance of the data subject's critical or specific interests;
- The transfer is necessary for the completion of an existing contract between the sender and the subject;
- The transfer serves the public interest;
- The information is already in the public domain;
- The transfer is required for national or public security.

There are several more, but this should give an adequate idea of the nature of the exercise. There are also many more potential conditions that are not applicable in the DPD; these are marked with 0s.

Next, the "bindingness" of the DPD is characterised, first by indicating that compliance is enforceable. Then, textual information about the DPD's enforceability is provided:

> *Each member state must set up a data protection authority, an independent body that monitors the data protection level in that member state, gives advice to the government about administrative measures and regulations, and starts legal proceedings when the regulation has been violated. Individuals may lodge complaints about violations to the supervisory authority or in a court of law.*

Then, with a mixture of textual information, 0s, and 1s, the spreadsheet shows that the DPD obligates data senders to provide *ex ante* notification, though individual states may opt to

require *ex ante* authorisation instead. The DPD also requires DPAs to have the power to order data to be blocked, erased or destroyed and to engage in legal proceedings. Finally, the Directive leaves decisions about the DPAs' powers to European countries that must enforce the DPD, though it notes that individuals who suffer damage because of a violation are entitled to receive compensation from the data controller. Thus, the DPA must be empowered to order compensation to be paid. The DPD also requires countries to identify sanctions to be imposed for infringements.

4. The empirical implementation

The approach chosen in this paper follows a large literature using the gravity model for empirical analysis of trade flows and the impact of policies on these flows, beginning with the seminal work of Jan Tinbergen (1962). The empirical gravity equation relates bilateral trade to factors like the economic size (i.e. *mass*) of countries and the distance between them, explaining the name borrowing from physics. Gravity equations belong to the standard toolkit of empirical trade analysis due to their excellent empirical performance (e.g. Feenstra 2002).

Probably most studies using the gravity model for policy analysis have focused on the trade effects of policies such as free trade agreements (FTAs) or currency unions, though the model is increasingly also applied for areas beyond trade, such as migration or foreign direct investment (FDI).[16] With the rising interest in cross-border data flows and its impact on economic outcomes, often focused on the potential role of data localisation measures as a non-tariff barrier to international trade, it seems natural to consider the trade implications of international attempts to reduce barriers to cross-border data flows by creating formal means for personal data transfers.[17] In a first attempt, this paper empirically treats international privacy agreements in analogy to other integration measures such as FTAs or currency unions, using the standard literature procedure to test for the existence of a statistically significant association between the agreement and trade flows.

The estimation strategy will thereby follow the recent gravity literature as closely as possible with regard to the specifics of the empirical implementation. On the one hand, this involves controlling for the *multilateral resistance terms* that capture the (general equilibrium) relationship between bilateral trade flows for a given country pair and the trade interactions and (potentially varying) trade costs of each of the two trading partners with the rest of the world. This is achieved by adding *time-varying exporter and importer fixed effects* to the model, pinning down any country specific average effects in a given year. Note that this renders some typical gravity controls such as country GDP obsolete, but importantly also accounts for all unilateral policy changes in a given year. Thus, if a country introduces data localisation measures that equally apply to all other countries, then any trade effects that this policy change might have will not show up in the results (e.g. Yotov and Piermantini, 2016). This implies that the empirical results presented below isolate the effect only of changes that affect different trade partners differently, including notably those of a privacy agreement that reduces data flow restrictions to partner countries but not for other countries. More importantly, all level effects of enhanced trust or higher

[16] See Anderson and van Wincoop (2003) and Arkolakis, Cotinot and Rodriguez-Clare (2012) for theoretical underpinnings of the gravity model and Head and Mayer (2014) or Yotov and Piermantini (2016) for a broader review of the literature and best practices.

[17] It should be noted that many data protection agreements are not only relevant for cross-border transactions, but often are first and foremost intended to establish a certain level of data protection in participating countries, with the scope of many passages reaching far beyond or not even touches upon cross-border transactions (e.g. EU GDPR). However, as the international dimension mostly arises due to cross-border considerations and has clear repercussions on cross-border economic activities, an analysis of the trade effects appears relevant.

compliance costs that affect trade with all trading partners equally will also be dropped from the model.

One of the criticisms with regard to the earlier literature analysing the trade effects of trade agreements was that these studies often did not control for the *endogeneity* of such agreements, i.e. the fact that the incentive to sign an agreement increases with the value of trade between two countries (see Baier and Bergstrand, 2007). This can lead to a reverse casualty fallacy where the researcher falsely attributes positive trade effects to an agreement, whereas the actual causality runs in the opposite direction. The problem also arises in the context of international data protection agreements, as safeguarding the free flow of information between two countries is likely to be more important for countries with intensive trade relationships. As *instrumental variable* approaches that could help to deal with this endogeneity problem have delivered mixed results, and natural experiments are seldom available, the literature recommends adding country pair specific or so-called *dyadic fixed effects* to the model (e.g. Head and Mayer 2004). These controls pick up the average volume of trade between any two countries in the sample as well as all other factors that are country pair specific and do not vary over the sample period. Importantly, this includes many time-invariant bilateral trade determinants, such as continuous participation in a currency union, a common language, shared cultural heritage, geographic distance or, for that matter, APEC, EU or OECD membership if that status has not changed over the observed time span.

The addition of dyadic fixed effects also implies that the only variation that can be picked up by the model is variation over time. Thus, the model will not capture potential differences between country pairs in terms of trade volumes if participation in a data protection agreement did not change over the sample period for that specific sub-set of countries, even if these differences are caused by the very conditions of the data protection agreement under consideration. In particular, if two participating countries trade more with each other than other countries, because the agreement allows data to flow freely between the two countries, this difference in average trade flows will be absorbed by the fixed effects, if the participation status has not changed over the sample period. Accordingly, attempting to solve the endogeneity problem has the downside of looking at a partial effect only, with the total effect being potentially much larger.[18]

With most controls that are typically applied to a gravity equation, such as distance, GDP, common language or an indicator for landlocked countries, being absorbed by the inclusion of fixed effects, the empirical specification used in this paper, expressed in its log-linear form, is given by the following equation:

$$\ln X_{odt} = \alpha + \beta\, DPA_{odt} + \boldsymbol{\gamma_1}\, \boldsymbol{\rho_{ot}} + \boldsymbol{\gamma_2}\, \boldsymbol{\sigma_{dt}} + \boldsymbol{\gamma_3}\, \boldsymbol{\mu_{od}} + \boldsymbol{\delta}\, \boldsymbol{PC}_{odt} + \varepsilon_{odt}$$

where $\ln X_{odt}$ is the natural logarithm of the value of exports from origin country *o* to destination country *d* in time *t*, α is a constant and DPA_{odt} is the indicator variable of interest, equal to one if the data protection agreement of interest applies to both the origin and the destination country at a given point in time. Accordingly, the coefficient of interest is β. For the mentioned reasons, the model further includes $\boldsymbol{\rho_{ot}}$, the vector of exporter/ origin-time fixed effects, $\boldsymbol{\sigma_{dt}}$ the vector of importer/destination-time fixed effects and $\boldsymbol{\mu_{od}}$ is a vector of country-pair fixed effects. Finally, $\boldsymbol{PC}_{odt}$ is a set of time-varying country-pair controls and ε_{odt} is the error term, assumed to be log-normally distributed.

[18] As the direction of the agreement effect is *a priori* not clear-cut, "larger" has to be understood as referring to the absolute size of the effect rather than the sign of the effect.

There are two major reason for the inclusion of time-varying country-pair controls $\boldsymbol{PC}_{odt}$. First, some of the agreements considered below, such as the EU Data Protection Directive (95/46/EC), are closely linked to other international "agreements", such as the European single market, which guarantees the free movement of goods, capital, services and labour for member countries. While joint EU membership for a given country pair is controlled for by the pair-fixed effects, as long as the status of both countries has not changed over the sample period, the EU entry of new member countries after 1998 will be perfectly aligned with entry into the data protection agreement. To disentangle the free trade effect from the data protection effect, a time-varying *joint EU membership* control in this example, is crucial.[19]

However, while in this specific case a simple dummy variable can help to solve the problem, there are other dynamic effects that can have an impact on bilateral trade costs but are more difficult to control for. To provide a simple example, consider two long-term members of the European Union, like France and Germany. If the sample period begins in the 80s, the EU membership control, which picks up only time variation, will be muted for these countries, while the country-pair fixed effects will capture only the average trade volume for these two countries relative to other country pairs. If however, the integration effect of the European Union is not a one on/one off effect but rather improving trade conditions continuously, then this effect will not be controlled for by the model. Naturally, this also applies to many other unobserved effects that are pair specific and dynamically affect trade costs.

As highlighted in Bergstrand, Larch and Yotov (2015), anecdotal evidence suggests that unobservable trade costs tend to have declined continuously over time. The theoretical model of Melitz (2013) illustrates how this lowering of trade costs can translate into an expansion of bilateral trade because existing exporters will export more and new exporters will enter the market. The decree to which trade costs decline can thereby be country pair specific (e.g. comparing France and Germany with two landlocked countries at opposite sides of the planet). If the continuous increase of trade over time happens to be stronger for countries that have jointly signed a data protection agreement, than for those that did not, the model might falsely associate the increase over time with the entry into agreement, even if the reason for the decline in trade costs has been completely unrelated.

To control for this, Bergstrand, Larch and Yotov (2015) propose adding country-pair specific time-trends on top of the other dummy variable controls. These capture all linear trends, i.e. steady increases or decreases, in bilateral trade over time. Thus, if two EU members integrate faster than other country pairs, the pair-trends would capture this effect, reducing the risk of confounding the effects of the data protection agreement with other integration effects. This specification implies that the estimated effects are now deviations from a pair specific trend. In simple terms: the estimation results will yield a positive and significant effect whenever trade between two participating countries is significantly higher on average (in a statistical sense) *after* the agreement is enacted, than the overall time trend for these countries would suggest, and provided that a corresponding effect is not present for country pairs not jointly participating in the agreement.

Two caveats are in order. First, controlling for country pair specific trends does not completely rule out the possibility of spurious effects. In particular, if close to the same year in which the agreement was signed other particular events took place that had an

[19] For the same reason, the definition of participation in a data agreement has to be adjusted in some cases, as explained below.

extraordinary (i.e. not captured by the linear trend) effect on trade, then this effect might falsely be picked up by the model as an effect of the agreement. As will be explained below, this is critical in particular for agreements where entry by countries is highly clustered at a given point in time. Thus, for the EU Data Protection Directive in particular, entry into force occurred at the same time for all EU15 members, namely 1998. If most of the variation in the data stems from old EU member countries, as will be argued below, then any other event that happened in that particular year, specific to participating countries and related to trade, might lead to spurious results.[20] It should be noted however, that for the very same reason, the Council of Europe Convention, that provides more variation with regard to ratification dates, is less prone to similar spurious results, because alternative effects would have had to occur for each country close to the signature year, which is specific to each country, and affect trade flows among these particular countries in a particular way.

Second, and as indicated before, the large number of fixed effects, but in particular the inclusion of pair-specific trends, is eliminating a lot of variation that might contain significant explanatory power. To illustrate this point, suppose that the effects of a data privacy agreement, while being ratified in a particular year, happen to evenly distribute over several years. Thus, it might be the case that firms begin to adjust to the agreement from the first moment information about its likely content become public. For example, the EU GDPR has been debated and prepared over four years, until it was finally approved by the EU Parliament in 2016 and enforced in May 2018. Adjustments and other effects might have begun accordingly long before 2018. By the same token, the effects of such a wide-ranging new regulation are likely to trigger potential trade adjustments for some time after the ratification.[21] To the extent that these effects will result in smoothing of effects into a linear trend, the pair-specific time trends would swallow most of the variation that is caused by the agreement.

Accordingly, there is a trade-off between controlling for potentially spurious effects and shutting off variation of actual relevance. Nevertheless, most results will be shown with a trend because the risk of falsely attributing trade effects to the data agreements rather than some other integration dynamic weights heavy.This leaves only pair specific, time-varying effects for interpretation, shifting the focus on the effects on a country of entering an agreement.

Accordingly, the agreement indicator is equal to 1 if both countries form part of an agreement or have signed a specific convention/guideline. The agreement indicator is 0 otherwise. Each country – destination or origin of an export flow – is first coded separately, obtaining an (single-country) indicator value equal to one from the year it signed an agreement onwards. The joint (bilateral) agreement indicator switches on whenever one trade partner *joins* the other in an agreement (or the moment both countries enter if this happens to be the same year).

The interpretation of the coefficient on the resulting estimates then is as follows:

[20] One might argue that the Asian crisis that took place around these dates and significantly diminished intra-EU trade in dollar terms relative to other country could provide such an alternative explanation. See for example here: https://www.wto.org/english/news_e/pres98_e/pr98_e.htm and here: https://www.wto.org/english/news_e/pres00_e/pr175_e.htm.

[21] Baier and Bergstrand (2007) and Anderson and Yotov (2016) provide evidence for strong phasing-in effects of regional trade agreements.

Coefficient β measures the average change in trade between two countries after both have entered a data protection agreement, relative to trade with and between all other countries.

A further discussion of the mechanics of the model and an alternative interpretation of β is provided in Box 4.1.

Box 4.1. The mechanics of the gravity model

The use of exporter-year and importer-year fixed effects has some peculiar effects on the relative size of different predictions that that the gravity model can deliver. In particular, and as illustrated in Hornok (2011), the coefficient on the positively defined agreement estimate (β) will be exactly half the size (with reversed sign) of the coefficient for estimating the effect of a *disagreement* indicator, e.g. changes in bilateral trade caused by one country entering an agreement but not the other. This naturally translates into fixed relationships for economic effects implied by the model. For example, if joining the European Data Directive increases trade among EU member countries by 10%, relative to trade with or between other countries, then the model would simultaneously predict a 4.6% reduction of trade between a non-participating and a participating (i.e. EU member) country, relative to two participating or two non-participating countries.[22]

To summarise the different interpretations of the agreement coefficient and their mechanical relationship:[23]

Coefficient β measures the average change in trade between two countries after both have entered a data protection agreement, relative to trade between all other countries

Coefficient -0.5*β measures the average change in trade between two countries after one of the two has entered a data protection agreement that the other country is not part of, relative to trade between all other countries. For a positive β, this negative effect reflects the fact that the country entering the agreement will trade relatively less with countries not in the agreement.

The reason for this technicality is that the variation used by the model only relates to *relative* changes that are distinct for pairs of countries in an agreement from pairs of countries not in an agreement. All other variation is subsumed by the fixed effects, *including* the level of data protection in each country and the effect of that this level of protection might have on trade, to the extent that this effect is the same for all trading partners. The effect of enhanced privacy protection will only show up in the results to the extent that it affects trade between two participating countries systematically differently from trade between other country pairings. The same holds for the effects of increased compliance costs and other factors.

[22] In order to obtain a 10% increase in relative trade for trade among participating countries, the coefficient β on the agreement effect would have to be 0.095, given that [exp(0.095)-1]*100% = 10%. The disagreement effect would accordingly be [exp(-0.095 * 0.5)-1]*100% = 4.6%.

[23] Alternative specification of the agreement dummy have been tested and the fixed relative size of the effects confirmed for several agreements.

With regard to the potential effects of the agreement that have been discussed earlier, the size and the sign of the measured effect are likely to depend on:

The degree to which the agreement has enhanced interoperability between the different national privacy frameworks and reduced uncertainty for firms (likely to be positive).

Any potential trust enhancing effects, in as far as they are particularly pronounced for trade among participating countries (likely to be positive).[24]

Any potential effect on the compliance costs for firms, in as far as their trade effects are particularly pronounced for trade among participating countries (likely to be negative).

The model estimates will provide the average *net* effect of these and all other potential channels that can have an impact on the size of trade flows among participating countries. For any particular agreement, the estimated effects indicate, whether trade-promoting forces in a data protection agreement outweighed the trade inhibiting forces of the agreement. The focus is thereby not on the absolute level of trade among countries, but rather indicate the extent to which trade has increased among participating countries *relative* to trade with non-participating countries. The empirical approach thereby can provide novel insights into the average effects that different data protection agreements have on trade outcomes. The results should be understood as a first step towards a better understanding of the overall economic impact of data protection agreements and need to be complemented by other approaches to gain a better understanding about the size of particular channels and the potential trade level effects involved.

[24] In theory, this effect could also play in favour of trade with non-participating countries, for example if trust levels are already very high among participating countries, remain virtually unaltered by the new policies, whereas trust increases significantly for consumers living in countries not participating in the agreement.

5. Data and Variables

The analysis will consider both goods and services trade. The two types of trade will be considered separately because the data sources are usually quite different. Both types of trade are considered for comparison reasons. As pointed out above, services trade has some very close links to cross-border data flows, in particular as services are increasingly delivered digitally, and is therefore likely to be particularly affected by data policies. Nevertheless, the literature provides many examples that show how more and more manufacturing and other non-service activities are increasingly linked to cross border data flows (Kommerskollegium, 2015). As the efficiency of production processes partly determines international comparative advantages, manufacturers can easily lose their competitive edge if data flows are restricted. Additionally, the case of connected devices illustrates how trade in goods and cross-border data flows are becoming more and more directly interdependent.[25]

The services data used stems from the OECD-WTO Balanced Trade in Services (BaTIS) dataset, providing annual bilateral data on trade in services in 11 EBOPS 2002 services categories for the years 1995 to 2012 (see Fortanier et al., 2017). Trade flows for goods are from the World Trade Flow (WTF) database, providing bilateral data for manufacturing, mining and agricultural products for the years 1984 to 2016 (see Feenstra and Romalis, 2014).[26] Both data sets contain bilateral trade flows between more than 185 countries and consistently correct for measurement error along several dimensions. The WTF data will be restricted to 1995 to 2012 and services data will be analysed for the total trade value (across categories) in most specifications to make the data sets more comparable. Zero trade flows are not reported in the WTF and were imputed by replacing missing trade flows with zeros for countries that had reported imports for some partner countries in a given year but not for others. Country pair specific control variables are added from the CEPII database, which, among many other variables, provides information on regional trade agreements and currency unions from several sources (Head et al. 2010).

The following analysis captures the effects of/includes the EU Data Protection Directive, the EU-US Safe Harbor Framework, the Switzerland-US Safe Harbor Framework and the Council of Europe Convention. The APEC Cross-Border Privacy Rules system as well as the EU-US Privacy Shield and the Switzerland-US Privacy Shield are in principle also included in the model. However, their enforcement being relatively recent, the identification of their effects is severely limited by data availability (see Table 5.1). The United Nations Guidelines concerning Computerized Personal Files have not been included due to their global ratification and, therefore, missing between-country variation. The OECD Privacy Guidelines are used as a control, but coefficients are not directly analysed, as in most countries the Guidelines entered into force before the sample period (i.e. 1980). For more recent OECD members the effects are difficult to disentangle from OECD membership itself, which is usually accompanied by several regulatory adjustments. The

[25] The German auto industry, encompassing many superstar exporters, reportedly considers access to the personal data of drivers as an important determinant for the future of automobiles, see Schwartz and Pfeifer (2017).

[26] Manufacturing, mining and agriculture are not separable in this sample.

coded OECD variable uses the signature year for the original Privacy Guidelines, because the application of the 2013 update of the Guidelines is not contained in the sample period.

Table 5.1. Country Coverage by Agreement

Agreement, Instrument, Convention, Guidelines or Mechanism	Date of entry into force for that country
EU Data Protection Directive	Belgium (1998), France (1998), Germany (1998), Italy (1998), Luxembourg (1998), Netherlands (1998), Denmark (1998), Ireland (1998), United Kingdom (1998), Greece (1998), Portugal (1998), Spain (1998), Austria (1998), Finland (1998), Sweden (1998), Cyprus[27] (2004), Czech Republic (2004), Estonia (2004), Hungary (2004), Latvia (2004), Lithuania (2004), Malta (2004), Poland (2004), Slovakia (2004), Slovenia (2004), Bulgaria (2007), Romania (2007), Croatia (2013); Iceland (1998), Liechtenstein (1998), Norway (1998)
EU-US Safe Harbor Framework	Belgium (2000), France (2000), Germany (2000), Italy (2000), Luxembourg (2000), Netherlands (2000), Denmark (2000), Ireland (2000), United Kingdom (2000), Greece (2000), Portugal (2000), Spain (2000), Austria (2000), Finland (2000), Sweden (2000), Cyprus (2004), Czech Republic (2004), Estonia (2004), Hungary (2004), Latvia (2004), Lithuania (2004), Malta (2004), Poland (2004), Slovakia (2004), Slovenia (2004), Bulgaria (2007), Romania (2007), Croatia (2013); Iceland (2000), Liechtenstein (2000), Norway (2000)
Switzerland-US Safe Harbor Framework	Switzerland (2009)
OECD Privacy Guidelines (pre-2013)	Australia (1985), Austria (1980), Belgium (1980), Canada (1984), Chile (2010), Czech Republic (1995), Denmark (1980), Estonia (2010), Finland (1980), France (1980), Germany (1980), Greece (1980), Hungary (1996), Iceland (1980), Ireland (1986), Israel (2010), Italy (1980), Japan (1980), Korea (1996), Luxembourg (1980), Mexico (1994), Netherlands (1980), New Zealand (1980), Norway (1980), Poland (1996), Portugal (1980), Slovak Republic (2000), Slovenia (2010), Spain (1980), Sweden (1980), Switzerland (1980), Turkey (1981), United Kingdom (1981), United States (1980)
Council of Europe, Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data (Convention 108)	Albania (2005), Andorra (2008), Armenia (2012), Austria (1988), Azerbaijan (2010), Belgium (1993), Bosnia and Herzegovina (2006), Bulgaria (2003), Croatia (2005), Cyprus (2002), Czech Republic (2001), Denmark (1990), Estonia (2002), Finland (1992), France (1985), Georgia (2006), Germany (1985), Greece (1995), Hungary (1998), Iceland (1991), Ireland (1990), Italy (1997), Latvia (2001), Liechtenstein (2004), Lithuania (2001), Luxembourg (1988), Malta (2003), Monaco (2009), Montenegro (2006), Netherlands (1993), Norway (1985), Poland (2002), Portugal (1994), Moldova (2008), Romania (2002), Russian Federation (2013), San Marino (2015), Serbia (2006), Slovak Republic (2001), Slovenia (1994), Spain (1985), Sweden (1985), Switzerland (1998), FYROM (2006), Turkey (2016), Ukraine (2011), United Kingdom (1987), Cabo Verde (2018), Mauritius (2016), Mexico (2018), Senegal (2016), Tunisia (2017), Uruguay (2013)
Additional Protocol to the Convention (No. 181)	Albania (2005), Andorra (2008), Armenia (2012), Austria (2008), Bosnia and Herzegovina (2006), Bulgaria (2010), Croatia (2005), Cyprus (2004), Czech Republic (2004), Denmark (2015), Estonia (2009), Finland (2012), France (2007), Georgia (2014), Germany (2004), Hungary (2005), Ireland (2009), Latvia (2008), Liechtenstein (2010), Lithuania (2004), Luxembourg (2007), Monaco (2009), Montenegro (2010), Netherlands (2005), Poland (2005), Portugal (2007), Moldova (2012), Romania (2006), Serbia (2009), Slovak Republic (2004), Spain (2010), Sweden (2004), Switzerland (2008), FYROM (2009), Turkey (2016), Ukraine (2011), Cabo Verde (2018), Mauritius (2016), Mexico (2018), Senegal (2016), Tunisia (2017), Uruguay (2013)
EU-US Privacy Shield	Belgium (2016), France (2016), Germany (2016), Italy (2016), Luxembourg (2016), Netherlands (2016), Denmark (2016), Ireland (2016), United Kingdom (2016), Greece (2016), Portugal (2016), Spain (2016), Austria (2016), Finland (2016), Sweden (2016), Cyprus (2016), Czech Republic (2004), Estonia (2016), Hungary (2016), Latvia (2016), Lithuania (2016), Malta (2016), Poland (2016), Slovakia (2016), Slovenia (2016), Bulgaria (2016), Romania (2016), Croatia (2016); Iceland (2016), Liechtenstein (2016), Norway (2016)
Switzerland-US Privacy Shield	Switzerland (2017)
APEC Cross-Border Privacy Rules system	United States (2012), Mexico (2013), Japan (2014), Canada (2015), Korea (2017), Singapore (2018)

[27] Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue". Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus. The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus" issue.

With regard to the Council of Europe Convention (Convention 108), the date of the initial signature is used rather than the date of signature of the additional protocol, as the timing of significant adjustments to regulation are more likely linked to the former rather than the latter.

To prevent the model from picking up effects from other agreements that have fostered trade integration, several time-varying bilateral control variables have been added. This is particular relevant for the European Data Directive (DPD), because, similar to the problem with the OECD Guidelines, after 1998 virtually every new member country of the European Union was automatically subject to the Directive. This implies that the time of entry into the European Union and the application of the Directive are perfectly aligned for new EU members. As the empirical model compares before and after signature trade performance, there is the obvious risk to confound effects of the single market with the data protection directive.

The model therefore includes an EU membership dummy that helps to isolate variation from the variable of interest when it happens to be co-aligned with the signature of a data protection agreement. Additionally, the model controls for all free trade agreements captured in the CEPII database (*fta_wto*), as well as for currency unions (*comcur*) and an additional APEC membership dummy. As some of these controls are overlapping, their coefficients are not very telling individually and should not be the focus of the analysis. Their aim is exclusively to free the coefficient of interest as much as possible from spurious variation in the data, arising for other, likely unrelated regional integration dynamics.

However, in particular for the EU Data Protection Directive, the risk of confounding the effects of the data agreement with the effects of EU integration might remain high even after controlling for the EU membership dummy. The DPD indicator has therefore been further adjusted to reduce the identification problem. In particular, the used indicator *includes* all EU15 countries, plus Iceland, Liechtenstein and Norway, as well as the countries considered to have an *adequate* level of personal data protection, including Andorra, Argentina, Canada, Faroe Islands, Guernsey, Israel, Isle of Man, Jersey, New Zealand, Switzerland and Uruguay. Trade with *adequate* countries is included, as a high level of harmonisation between privacy frameworks can be assumed.

The indicator does however *exclude* most trade interactions involving countries that entered the EU after 1998, in order to minimise the risk of potential alternative effects arising in the wake of new EU integration driving the results.[28] This implies that identification of the DPD effect now rests upon a limited number of sources for variation. In particular, the DPD indicator is equal to one for trade among the EU15 members (plus the three additional signature countries) if it happens after 1998, as well as trade between EU member countries (including the new member countries, Iceland, Liechtenstein and Norway) and countries deemed *adequate*, from the time of the adequacy decision onwards. Trade between new EU members and Iceland, Liechtenstein and Norway is also excluded, because their

[28] A similar adjustment has not been made for the Convention 108 dummy, because the year of signature for the convention deviates from the year of EU accession for most countries. Accordingly, here the EU dummy more effectively controls for spurious correlation, in particular in combination with the country-pair specific trends introduced below.

membership in the European Free Trade Association is likely to have fostered additional integration close to the year of EU entry.[29]

Due to its structural differences, the Safe Harbor Argreement obtains a separate indicator from the EU DPD indicator. The EU and the Switzerland agreements are combined. The agreement indicator is set to zero for the years 2015 and 2016 for trade between the EU and the US due to the invalidation of the agreement and the replacement through the Privacy Shield. The indicator remains equal to 1 for Switzerland throughout and for the EU after 2017, implying that no distinction is drawn between the Safe Harbor agreement and the Privacy Shield. As data for the corresponding years is not used in the current analysis, these modelling choices are not critical for the empirical results. Adjustments can be easily made for usage with more recent data sets.

One important modelling choice is the assumed relationship between the direction of data flows and the direction of trade. The Safe Harbor agreement is one-sided by definition, allowing personal data to flow from Europe to firms in the USA once the conditions are met. Yet, it is not immediately clear how this should be expected to affect trade flows. The first case that comes to mind are goods or services sold from US companies to private or business customers in Europe. This transaction would likely involve a flow of customer information from Europe to the US, implying data flows in opposite direction to the trade flows. However, for some firms in Europe, it might also be necessary to provide data on European team members or payment instructions containing personal information to importers in the US when providing a professional service. In this case, data and services would flow in the same direction. Because there is still a lack of understanding as to how precisely data flows are used by businesses, the modelling approach does not take a stance on the directional relationship between data and trade flows. The Safe Harbor agreement and all other agreements are therefore coded symmetrically, i.e. irrespective of whether the US is an importer or an exporter in this particular case.

With regard to the APEC Cross Border Privacy Rules, the agreement indicator is coded equal to 1 for trade between each of the six CBPR countries, Canada, Japan, Korea, Mexico, Singapore and the USA, and all other APEC countries, beginning with the year that the six CBPR countries had signed up for the CBPR system. All APEC countries are included as trade partners in order to account for the broader scope and applicability of the APEC privacy framework, while still highlighting the special role of the six CBPR participants.[30] The addition of an APEC membership indicator captures effects arising from new members entering the APEC system, in particular Peru, Russia and Vietnam, and is considered a control variable. As the USA entered the CBPR as first country in 2012, the only variation captured by the model stems from the year 2012. Significant effects are therefore not to be expected and any variation eventually picked up by the model likely reflects spurious correlations rather than the impact of the agreement.

[29] On the downside, in terms of variation that is used for identification, the exclusion of new EU member countries now shifts relatively more weight towards the year 1998, when the Directive became binding for all EU15 members. If close to this year alternative events triggered trade effects that were systematically different for EU15 members, then these effects might be picked up by the model (see in the results section for more details).

[30] Even for slightly more recent data, it seems questionable whether the (pure) CBPR system can currently be expected to have a significant effect on bilateral trade flows. By the time of drafting the compliance directory lists a total of only 23 certified firms. Of these, only one company is registered outside of the USA (in Japan).

6. Results

6.1. Baseline Regressions

Table 6.1 presents the regression results for the gravity model discussed above. The left panel shows the effects for trade in services, whereas the right panel provides results for trade in goods. Specification (1) includes all the agreements under consideration as well as exporter-year, importer-year and country-pair fixed effects, omitting controls for trade agreements and currency unions. The results are comparable for both services and goods trade. In particular, both the Convention 108 and the EU Directive show up with significant coefficients but opposite signs. The Safe Harbor agreement does not show any significant effect. The model explains over 92% of the variation in the services data and 84% of the variation in the goods data, with the high explanatory power being normal for gravity equations that incorporate higher dimensional fixed effects.

The positive coefficients for the Convention 108 implies that trade between two countries increases on average once both countries have signed the agreement. This is a relative rather than an absolute increase, with the comparison group consisting of both non-participating country pairs and mixed pairs, i.e. pairs comprised of one participating and one non-participating country. It further abstracts from all effects that have a symmetric impact on trade relationships with participating and non-participating countries.

The negative coefficient for the EU Data Directive on the other hand suggests that trade between DPD signature countries decreased in relative terms after entry. In line with the mechanisms described above, this would suggest that the effects related to the compliance cost channel have outweighed the benefits from enhanced interoperability or higher levels of trust, implying a relative shift of trade interactions towards trade with countries not participating in the agreement.[31] Using the second interpretation introduced above, the DPD coefficient equally indicates that trade between EU members and countries outside of the agreement *increased* compared to trade between two EU members and/or two remaining outside countries. As explained in more detail below and indicated above, such an outcome might suggest that high adjustment costs for European firms increased the (cost) competitiveness of firms from non-participating countries, and that this effect has outweighed the effects of improved interoperability and the differential effect that higher levels of trust had for trade among European countries.

[31] In part, the negative coefficient could also reflect particularly strong trade integration dynamics among countries in the comparator group (e.g. in Asia) during that time.

Table 6.1. Baseline Regressions: Services and Goods Trade

	Services Trade					Goods Trade				
	(1) Pair FX	(2) Pair FX	(3) Trend	(4) PPML/Tr.	(5) PPML/Tr.	(1) Pair FX	(2) Pair FX	(3) Trend	(4) PPML/Tr.	(5) PPML/Tr.
Conv108 (t-1)					-0.0575**					-0.0388
					(0.0225)					(0.0247)
Conv108	0.422***	0.303***	0.0908***	0.0984***	0.0233*	0.304***	0.251***	0.00969	0.0350	0.0160
	(0.0149)	(0.0164)	(0.0229)	(0.0258)	(0.0142)	(0.0314)	(0.0342)	(0.0478)	(0.0226)	(0.0167)
Conv108 (t+1)					0.148***					0.0612***
					(0.0281)					(0.0202)
EU DPD (t-1)					-0.0538***					-0.0132
					(0.0142)					(0.0174)
EU DPD	-0.117***	-0.107***	0.0409	-0.0329*	-0.0101	-0.210***	-0.213***	0.00176	-0.0228	-0.00633
	(0.0259)	(0.0269)	(0.0350)	(0.0189)	(0.0115)	(0.0531)	(0.0539)	(0.0695)	(0.0204)	(0.0146)
EU DPD (t+1)					-0.0194					-0.0213
					(0.0212)					(0.0206)
SHA (t-1)					-0.00625					0.0721***
					(0.0231)					(0.0272)
SHA	0.0391	0.0499	0.100	-0.0370	-0.0173	0.0296	0.0525	0.214*	0.0745*	0.0339
	(0.0608)	(0.0608)	(0.0638)	(0.0331)	(0.0228)	(0.123)	(0.122)	(0.128)	(0.0433)	(0.0254)
SHA (t+1)					-0.0400*					-0.000376
					(0.0226)					(0.0287)
$CBPR_{t-1}$					0.0213					0.0120
CBPR	0.0663	0.0625	0.0812	0.0229		-0.448	-0.434	0.0211	0.0337	
OECD PG_{t-1}					0.0205					0.0316
OECD PG		0.0946***	-0.0501	0.0536*	-0.0158		0.0456	0.0345	0.0469	0.0153
OECD PG_{t+1}					0.0625***					0.0536
EU_{t-1}					0.0191					-0.0491
EU		0.368***	0.159***	0.144***	0.0432**		0.134***	-0.0383	0.0616**	0.0903***
EU_{t+1}					0.0955***					-0.0100
$APEC_{t-1}$					-0.0548**					-0.0763*
APEC		-0.0392	-0.116*	-0.0731*	0.0100		-0.380***	-0.392***	-0.216***	-0.148
$APEC_{t+1}$					-0.0740**					0.0278
FTA_{t-1}					-0.0126					-0.0295*
FTA		0.0189**	0.0146	-0.00993	-0.0191		0.0433**	0.0220	0.0209	0.0180
FTA_{t+1}					0.0278**					0.0484***
CU_{t-1}					-0.0187					-0.0342**
CU		0.0344	0.0722*	-0.00572	0.0222		0.0993	-0.0440	-0.0131	0.0268*
CU_{t+1}					-0.0145					-0.0204
ρ_{ot}, σ_{dt}	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
μ_{od}	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
$trend_{od}$	No	No	yes	yes	yes	No	No	yes	Yes	yes
Obs.	609,073	609,073	609,073	609,394	541,316	479,393	471,171	471,171	689,773	468,962
R^2	0.926	0.926	0.934	0.997	0.997	0.840	0.840	0.859	0.996	0.996

Note: *Conv108* stands for the Council of Europe Convention for the Protection of Individuals with Regard to Automatic Processing of Data, *EU DPD* stands for the EU Data Protection Directive, *SHA* stands for the Safe Harbor Agreements (EU and Switzerland), *CBPR* stands for the APEC Cross-Border Privacy Rules system, *OECD PG* stands for the OECD Privacy Guidelines (1980). *EU* and *APEC* are indicators of European Union or APEC membership. *FTA* and *CU* are indicators of a free trade agreement or currency union respectively (see Head et al. 2010). OLS: Specifications (1)-(3). PPML: Specifications (4)-(5). Specifications (3)-(5) contain pair-specific linear trends. Robust standard errors (in parentheses). PPML: standard errors are clustered at the country pair level; *** p<0.01, ** p<0.05, * p<0.1

Source: Services trade from OECD-WTO BaTIS (Fortanier et al., 2017). Goods trade from World Trade Flow (Feenstra and Romalis, 2014). Considered time: 1995-2012.

Before discussing the economic size of these effects in more detail, specification (2) to (5) subsequently add a number of controls to the model and bring the specification up to the most recent literature standards. In particular, specification (2) adds time-varying and pair-specific controls that will diminish the spurious effects resulting from countries entering free trade agreements or currency unions close in time to the data protection agreements. The specification includes controls for entry into the European Union, entry into APEC, entry into other free trade agreements and entry into currency unions. Additionally, the specification adds an effect that picks up changes in trade when the OECD privacy guidelines become valid for both partner countries.

The coefficient on the OECD privacy guidelines is positive and highly significant, indicating that two OECD countries trade relatively more with each other after both countries have accepted the privacy guidelines. However, as this point in time is also the time of OECD membership accession, often involving several regulatory harmonisation processes, it is difficult to assess whether this effect is due to better inter-operability of privacy frameworks or other effects resulting from OECD membership.

The EU dummy is also highly statistically significant. The coefficient size of 0.37 is larger than the median effect of 0.19 found in the meta-analysis of Head and Mayer (2014), but slightly smaller than the 0.52 found in Cipollina and Salvatici (2010). The Free Trade Agreement (FTA) dummy is positive and significant at the 5% level but significantly smaller than other literature findings (ibid). The Common Currency dummy is not significant. However, as many of these dummy variables are correlated or overlapping, the interpretation of individual effects is likely misleading. Importantly, the coefficients of interest are only slightly reduced in terms of their absolute size and remain highly statistically significant, indicating that variation beyond entry into FTAs and currency unions might be responsible for the results.

Trade integration dynamics are likely to be persistent for some time, implying that the effects of trade integration span well beyond the actual date of entry. Neither the country-pair dummies, that are time invariant, nor the contemporaneous entry effect for FTAs or currency unions would capture such continuous deepening of integration (e.g. Bergstrand et. al. 2015). Specification (3) therefore adds (bi-directional) country-pair specific linear trends, controlling for all integration effects that happen continuously over time.[32] Thus, if trade between France and Germany grows 10% faster each year than trade between France and the United States because of deepening European integration and the common currency, the pair-specific linear trends would capture this difference. To some extent, this eases the concern of spurious correlation arising because countries "select" into signing data agreements as part of a broader dynamic towards trade integration, such as the accession process into a single market like the European Union. Additionally, linear trends also help to account for trade dynamics in the comparator group of countries that could affect the results, such as increasing trade in the Asian region following China's WTO accession or the rise of ASEAN. However, it also implies that the remaining variation used for identification is limited to the deviation from that trend at the point in time the two countries entered into an agreement.

This also implies that the average effect over time that entering a data protection agreement might also have is now lost for identification. However, as the credibility of the

[32] That this can be a problem has been recently highlighted in Larch et al (2017).

identification strategy crucially depends on accounting for alternative integration dynamics, the specification including the trend is to be preferred. Not surprisingly, this has substantial effects on the estimated coefficients that now only capture deviations from a country specific trend, relative to the deviations for other country pairs at a given point in time. The estimated coefficient for the Council of Europe convention drops by two-thirds but remains statistically significant for the services trade data, while the EU Directive ceases to be significant. Both coefficients are no longer significant in the goods trade data, though the Safe Harbor agreement becomes significant and sizeable for trade in goods. The coefficients imply that services trade between two countries that are joining under Convention 108 increases by about 9.5% (= $e^{0.091}$-1) above the trend relative to trade between a participating and a non-participating or two non-participating countries. For trade in goods, the effect for the Safe Harbour agreement implies an increase of goods trade between the USA and European countries of roughly 23.9% above the trend, relative to trade between the USA or European countries and other trade partners and/or trade between two outside countries, such as China and Vietnam.

The ordinary least square results presented so far have two shortcomings (see Yotov and Piermartini 2016). On the one hand, all potential zero trade flows in the data are dropped from the model, as the linear model is formulated in logs. Additionally, trade data is known to be affected by heteroscedasticity, which can lead to bias and inconsistency in log-linear models, such as the one specified above. Specification (4) therefore follows the literature and re-estimates (3) in its multiplicative form, using a Poisson Pseudo Maximum Likelihood (PPML) estimator, as suggested by Santos Silva and Tenreyo (2006) and many others.[33]

Specification (4) presents the results from the higher-dimensional fixed effects PPML regression, including the full set of exporter-year, importer-year and country-pair fixed effects as well as country-specific time trends. The results show, that the effect of Convention 108 remains highly statistically significant for the services trade data. The economic size of the effect increases slightly to 10.3% but remains relatively close to the linear estimates. The effect of the EU DPD also shows up significant again, yet smaller (-3.2%). For goods trade, both the effect of the Convention 108 and the effect of the EU DPD remain insignificant and the effect of Safe Harbor is reduced, yet remains statistically significant at the 10% level, implying a deviation of about 7.2% from the trend in trade between the USA and the EU or Switzerland compared to the trend in trade between other countries.

Finally, Specification (5) takes into consideration that data privacy agreements might have heterogeneous effects over time, i.e. not only for the actual year of ratification. In difference to trade agreements, where tariff reductions are often slowly phased in over time and should have no effects on trade before the agreement has been enacted (e.g. Baier and Bergstrand 2007), the ratification of data protection agreements is sometimes conditioned, or at least accompanied, by institutional changes. Additionally, the "bindingness" after ratification is

[33] The large number of fixed effects, over 40.000 in specification (3), is a heavy burden for the standard PPML command. Glick and Rose (2016) encountered a similar problem when estimating the effects of a currency Union with country-pair fixed effects, deciding to "await computational advances to be able to estimate the Poisson analogs." In the case of this paper , the standard PPML command also failed to provide estimates due to the high number of fixed effects. Luckily, Larch et al (2017), recently introduced an iterative PPML estimator that can flexibly account for multilateral resistance, pair-specific heterogeneity, heteroskedasticty and pair-specific time trends in spite of the data set being large (Stata command: [ppml_panel_sg]).

predictable and firms might therefore begin adjustments to the regulation ahead of time. Of course, the adjustment period might also deliver results for trade that are different from later periods, when all firms have settled within the new regulatory environment.

Specification (5) accounts for this by adding the *future* level of the agreement indicator (one year ahead) as well as the lagged value (one year after the agreement) to the model, to see whether there are dynamic or *phasing-in* effects. As the control variables (e.g. EU membership) are known to have similar phasing-in effects, the leads and lags are added for all variables in the model. As the results in Table 6.1 show, both effects are statistically significant for the Convention 108 in the services trade data. Interestingly, one year ahead of the ratification there is a slight reduction in trade among the participating countries of about 5.6% relative to non-participating countries and trade with outsiders. However, the effect turns slightly positive in the year of the ratification, increasing trade by about 2.4%. After one year, the trade effects are significantly larger, with an increase compared to other country pairs of about 16%. Accordingly, on average, joining the agreement is found to increase trade with other participating countries by about 12.1%, relative to other countries.[34] For goods trade, the (weakly) significant coefficient estimate now also suggests an increase in trade among participating countries by about 6.3%.

The Safe Harbor agreement further turns significant for services trade but with an opposite sign. The estimates suggest that the Safe Harbor agreement increased goods trade by about 7% one year ahead of the instalment but had no additional significant trade effects thereafter, while it diminished services trade between the US and European countries by about 3.9% one year after the instalment.

6.2. Robustness: Extended leads and lags

Before discussing possible explanations for these results, Table 6.2 provides some robustness tests. Specification (1) and (2) are identical to Specification (5) of Table 6.1 but use only every second or third year of the sample respectively. Cheng and Wall (2005) note that "*fixed-effects estimations are sometimes criticized when applied to data pooled over consecutive years on the ground that dependent and independent variables cannot fully adjust in a single year's time*." Several studies, including Bayer and Bergstrand (2007), Bergstrand et al (2015) and Anderson and Yotov (2016) have therefore used three- to five-year intervals instead of yearly data. Because the sample time is reduced considerably when using interval data with future and lagged values, results are only shown for two- and three-year intervals.[35] The results show that the negative effect of a ratification of the Convention 108 in the future, now two or three years ahead, vanishes when introducing gaps between observations, which could suggest that the potentially costly adjustment period began not until close to the ratification date.

Considering the results for the two-year intervals, the contemporaneous effect of ratifying Convention 108 is now larger than before (6.7%) and highly statistically significant for services. The additional positive effect two years after the agreement has slightly diminished (12.7%) and the effect prior to ratification has diminished and is no longer statistically significant, which suggests that the lead and lag effects happened relatively closer to the data of ratification. For trade in goods, the lagged effect has now switched to the contemporaneous effect, likely for similar reasons, and has diminished to 4.5%. The

[34] $[e^{-0.058+0.023+0.148} - 1] \times 100$

[35] In the case of 2-year intervals, the inclusion of one lag implies the agreement status 2 years ago.

overall effect is therefore significantly larger for services trade (20.3%) than for trade in goods, which would be in line with services being relatively more affected by data protection regulation. For the three-year intervals, Specification (2) shows that the effects become overall smaller for services and vanish completely for trade in goods. This is likely driven by the reduction in sample size to one third of the sample size used in Specification (5) of Table 6.1.

Table 6.2. Robustness: Extending the Time of Adjustments

	Services Trade		Goods Trade	
	(1)	(2)	(1)	(2)
VARIABLES	PPML/Trend/S2	PPML/Trend/S3	PPML/Trend/S2	PPML/Trend/S3
Conv108 (t-1)	-0.00193	0.0148	-0.0414	-0.0278
	(0.0327)	(0.0739)	(0.0471)	(0.0872)
Conv108	0.0649***	0.0753	0.0443*	0.0307
	(0.0235)	(0.0594)	(0.0265)	(0.0540)
Conv108 (t+1)	0.120***	0.109***	0.0302	0.0158
	(0.0350)	(0.0306)	(0.0245)	(0.0285)
EU DPD (t-1)	-0.0584**	-0.0792	-0.0227	-0.163*
	(0.0245)	(0.0857)	(0.0328)	(0.0974)
EU DPD	-0.0324	-0.0956**	-0.0178	-0.0517
	(0.0204)	(0.0453)	(0.0220)	(0.0591)
EU DPD (t+1)	-0.0151	-0.0121	-0.0316	-0.0599*
	(0.0253)	(0.0323)	(0.0255)	(0.0329)
SHA (t-1)	0.00763	0.0204	0.0470	0.162**
	(0.0286)	(0.0543)	(0.0371)	(0.0705)
SHA	-0.0714*	-0.0266	0.0490	0.186***
	(0.0384)	(0.0421)	(0.0324)	(0.0478)
SHA (t+1)	-0.0266	-0.0536	-0.0960**	0.0139
	(0.0359)	(0.0417)	(0.0468)	(0.0548)
ρ_{ot}, σ_{dt}	yes	yes	yes	yes
μ_{od}	yes	yes	yes	yes
$trend_{od}$	No	No	yes	yes
PC_{odt}	OECD PG, EU, APEC, FTA, Comcur (t+1; t-1)			
Obs.	236,789	135,384	248,475	132,769
R-squared	0.997	0.999	0.998	0.999

Note: *Conv108*: Council of Europe Convention for the Protection of Individuals with Regard to Automatic Processing of Data; *EU DPD*: EU Data Protection Directive; *SHA*: Safe Harbor Agreements (EU and Switzerland); *CBPR*: APEC Cross-Border Privacy Rules system; *OECD PG*: OECD Privacy Guidelines (1980). *EU* and *APEC* are indicators of European Union or APEC membership. *FTA* and *CU* are indicators of a free trade agreement or currency union respectively (see Head et al. 2010). Specification (1) uses every second year in the sample only, implying 2-year lags and leads. Specification (3) uses every third year only implying 3-year lags and leads. All estimates result from PPML estimation with country pair specific linear trends. Standard errors are clustered at the country pair level; *** p<0.01, ** p<0.05, * p<0.1.
Source: Services trade from OECD-WTO BaTIS (Fortanier et al., 2017). Goods trade from World Trade Flow (Feenstra and Romalis, 2014). Considered time: 1995-2012.

The effect of the European Data Protection Directive remains almost unaltered for services (2-year gap specification) and becomes a slightly larger contemporaneous effect when extending the gaps between observations. Additionally, the effect becomes significant and large both pre- and post-ratification for goods trade with a three year lag. Additionally, the negative effect for services trade slightly after signature of the Safe Harbor agreement

becomes a contemporaneous effect for a two-year gap and substantially increases in size. It ceases to be significant with the three-year gap. The results for goods trade tend to confirm on average that there have been strong positive results ahead of the agreement, but negative or no results thereafter. The effects tend to be larger for goods trade than for services trade.

6.3. Considerations regarding a negative trade effect

The confirmation of a negative DPD effect on trade between participating countries, and in some cases for the Safe Harbor agreement, might seem surprising at first. These findings however need to be evaluated against the identification limitations that were discussed for this particular empirical model in Section (4), including accelerating trade integration between countries outside of Europe that are determining trade dynamics in the comparator group. With regard to the agreement specific trade-off between costs and benefits, it is further important to keep in mind that the European Data Protection Directive, determining both the DPD and the Safe Harbor effect, was not principally about enhancing data flows between countries. It substantially changed the data protection regime in Europe, affecting all areas of activities for a European firm. A large share of these effects, namely to the extent that changes in compliance costs or trust had equal effects for all countries, irrespective of the DPD status, they are fully accounted for by the country-year fixed effects. If the associated effects however affected participating country pairs differently from pairs involving one participating country and one non-participating country, they are going to be captured by the model.

As mentioned before, the *agreement* effect, in the sense of better interoperability between privacy frameworks, is one potential candidate in this regard, but importantly, they might have been others. For example, the regulatory change might have had a particularly strong negative effect on the *cost structure* of European firms, potentially driving some exporters out of the market.[36] For third countries on the other hand, the effect on the cost structure might have been rather limited, due to the small share of interactions with Europe in the overall trade (including domestic) portfolio.[37] From a comparative advantage perspective, this could have led to a relative increase in the attractiveness of overseas trade partners compared to imports from other (increasingly expensive) European countries. Potentially, this effect could have outweighed corresponding positive effects of enhanced trust or a common, though imperfectly harmonised, data protection agreement on inter-European trade.

Partly supporting this line of reasoning, the report EC (2012) highlights that the divergence in implementation, interpretation and enforcement of the Directive by participating countries has hampered the functioning of the internal market by raising compliance costs related to data processing and transfer operations between these countries. This is likely to discourage activities relying on cross-border data transfers within the European Union, potentially in particular if the costs arise on both sides of the border. The report provides also estimates, suggesting a yearly administrative burden of close to EUR 3 billion.

There is an additional implication that might be of relevance for the relative performance of the distinct trade interactions considered here. In particular, the trade literature on

[36] This is related to the Melitz (2003) channel mentioned earlier.

[37] E.g. because firms could rely on *standard contractual clauses* for individual trade interactions instead of reworking their whole privacy setup.

heterogeneous firms following Melitz (2013) has established clear links between attributes like firm productivity, firm size and the ability to sell to distant markets (e.g. Krautheim 2012). This and the empirical literature suggest that one should expect small firms to export relatively more to neighbouring countries, e.g. within Europe, whereas trade with other foreign countries that are often further away would be the reign of larger firms. However, if larger firms can better afford the necessary legal or the technical expertise to ensure compliance with relevant legislations, as suggested in the EC (2012) study, the complex regulatory structure might have had a particular strong effect on the relatively smaller within-EU exporters, *in spite* of the formally higher inter-operability of personal data protection regimes.

Accordingly, the empirical model might pick up that the negative cost effects of the EU Data Directive were particularly high for trade among European firms, overshadowing any potential gains a higher degree of regulatory inter-operability would have generated otherwise. Additionally, it may also be the case that the increased level of trust towards European exporters had a particularly strong beneficial impact on trade with outsider countries, whereas a corresponding effect has been absent or smaller for trade between participants, given that trade interactions involved a higher level of trust to begin with.

It should be noted, that a more technical explanation could further relate to the time span that is driving identification. In particular, as the baseline identification abstracts from the eastern enlargement of the European Union, much of the variation is driven by the implementation among EU15 members in 1998. As this concentrates time variation on a particular year, the risk of alternative events being responsible for the results is relatively higher. One such event that happened roughly at the same time is the Asian crisis that, as mentioned before, had a particular strong and negative impact on trade between European countries (see Footnote 18). However, an initial and indirect test of this channel, involving redefining the agreement dummy to further abstract from trade among EU15 countries, using only variation stemming from trade between *adequate* countries and new or old EU member countries and thus shifting the focus of identification away from 1998, left the negative coefficient intact and rather increased its size (not shown).

This suggests that the sign of the effect is more likely to be driven by the fundamental characteristics of the agreement as mentioned before. It should also be noted that the negative sign, is interesting from the perspective of identification, because it runs against the forces of European integration.

Finally, the negative effect of the Safe Harbor agreement, in particular *after* the instalment, with positive effects up front seems more difficult to explain, given that the agreement's economic potential is based on the number of complying firms, which has risen over time rather than diminished. The potential effects from the Snowden revelations, which might have led to a competitive fallout in later periods for US firms in particular (see USITC 2014), would have occurred in 2013 or later and accordingly is not captured in the sample period. A shift in expectations, with big hopes *ex ante* (towards the agreement) but a normalisation afterwards, paired with increasing awareness about the risks of cross-border data transferals, fostered especially by media attention on the US as host of the largest online platforms, might be able to explain such patterns. However, without taking these distinct channels explicitly into account in the empirical model, it is impossible to provide a final verdict in this regard. Such an exercise however would go beyond the scope of this paper. Future work might be able to shed more light on these specifics.

6.4. Extension: A quick view at the heterogeneity of effects for services sectors

Table 6.3 makes use of the industry variation available in the services trade data. The specification uses 2-year gaps and the results vary widely across industries. In particular, the positive trade effects for the Convention 108 are largest for Royalties and License Fees but significant positive effects also arise for Construction services, Computer and information services, Travel services as well as Communication services. Across sectors, the results seem to confirm that negative effects tend to occur ahead of an agreement while positive effects tend to occur later. For the Insurance industry, there is a strong contemporaneous negative effect, potentially applying strong compliance cost effects in this industry. No positive effects that would foster trade among participating countries seemed to have followed thereafter. There was also no positive agreement effect for Transportation services, Financial services or Other Business services as well as Personal, Cultural and Recreational services. This suggests that firms in these sectors found it difficult to profit from the enhanced inter-operability, for example because some of these sectors (e.g. financial or insurance activities) were subject to additional and heterogeneous national regulation that made it particularly difficult to comply for firms in subscriber countries. As these are countries where the level of data protection and the quality (i.e. effectiveness) of the corresponding institutions tends to be higher than in non-signature countries, agreement-pair specific effects can be plausible. A deeper investigation on the use of data in certain industries would be required to provide a better analysis of these sector specifics and the ongoing measurement work in the OECD and other organisations is likely to help shed light on these differences soon.

The EU Data Protection Directive appears to have had the largest (negative) impact on Computer services, followed by Construction services, Personal, cultural and recreational services, Communication services, Travel and Financial Services. The role of Construction services seems a little odd and requires further analysis. If this is in fact an effect due to data protection regulation, it is likely to be related to information on employees rather than costumers, as trade in construction projects tends to involve employees in other countries. Royalties and License Fees are the only service category where trade among participating countries increased relative to other pair combinations. Here the effect of enhanced inter-operability might have outweighed the negative compliance effects. One potential explanation for this would be that firms specialising on cross-border transactions involving royalties and license fees are more likely to possess a team of legal experts on cross-border regulatory issues ahead of the agreement. Additional fixed costs would therefore be limited.

The Safe Harbor agreement appears to have fostered trade between the US and Europe in particular for Insurance and Personal, cultural and recreational services, followed by Royalties and license fees as well as Communications services. Strong negative results are obtained for Financial services (many of which are excluded from the Safe Harbor agreement) but initially also for Communication services. It is surprising that the overall timing of effects tends to be reversed when looking at the industry level data, with positive effects following negative effects rather than the reverse order that appeared to be dominant in the aggregate regressions, for goods trade in particular.

Future research should more closely focus on the sectoral dimension of these findings. Because the research community as well as public organisations are still struggling to understand and measure the importance of personal data flows for different sectors, this task is not trivial and requires substantial complementary work. It is one of the priorities for measurement of the digital economy and is likely to proof invaluable for substantiating the relevance of the channels highlighted in this paper.

Table 6.3. Trade in Services: Industry Specific Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Transport	Travel	Communication Services	Construction	Insurance Services	Financial Services	Computer and information services	Royalties and Licence Fees	Other Business Services	Personal, cultural and recreational services
Conv108 (t-1)	-0.0695*	0.0560	0.00396	-0.0478	0.0995	0.0142	-0.0626	-0.0830	0.0516	-0.217*
	(0.0404)	(0.0453)	(0.0576)	(0.148)	(0.125)	(0.0788)	(0.0940)	(0.104)	(0.0516)	(0.124)
Conv108	0.0432	0.0892**	-0.0589	0.470***	-0.481***	-0.0724	0.237***	0.350***	-0.00794	0.130
	(0.0335)	(0.0353)	(0.0600)	(0.137)	(0.164)	(0.0813)	(0.0895)	(0.105)	(0.0547)	(0.140)
Conv108 (t+1)	0.112	0.204***	0.216***	-0.133	-0.186	0.0866	0.146	0.290***	0.0680	0.0448
	(0.0688)	(0.0390)	(0.0828)	(0.107)	(0.202)	(0.120)	(0.0889)	(0.104)	(0.0430)	(0.115)
EU DPD (t-1)	-0.0525	-0.0574	-0.0540	-0.551***	-0.0977	0.0178	-0.374***	-0.114	0.0124	-0.138
	(0.0377)	(0.0434)	(0.0663)	(0.174)	(0.102)	(0.0689)	(0.111)	(0.119)	(0.0617)	(0.151)
EU DPD	-0.0703**	-0.129***	-0.184***	0.0651	0.0233	0.0364	-0.144*	-0.0663	0.0573	-0.368***
	(0.0317)	(0.0288)	(0.0547)	(0.0930)	(0.117)	(0.0731)	(0.0744)	(0.0911)	(0.0401)	(0.113)
EU DPD (t+1)	-0.0394	-0.0757*	-0.0376	0.121	0.139	0.00795	-0.128*	0.236***	-0.00108	-0.0892
	(0.0326)	(0.0434)	(0.0579)	(0.104)	(0.108)	(0.0528)	(0.0699)	(0.0863)	(0.0547)	(0.0919)
SHA (t-1)	-0.0900	-0.0598	-0.143*	0.167	0.246	-0.168***	0.106	-0.0791	0.0695	0.713***
	(0.0694)	(0.0469)	(0.0850)	(0.189)	(0.303)	(0.0623)	(0.102)	(0.0720)	(0.0467)	(0.160)
SHA	0.0165	-0.0472	0.192*	0.0541	-0.140	-0.00154	-0.126	0.277***	-0.0807	-0.0782
	(0.0405)	(0.0544)	(0.0993)	(0.167)	(0.337)	(0.0759)	(0.0784)	(0.0949)	(0.0571)	(0.0981)
SHA (t+1)	0.0136	-0.130	-0.00311	-0.0166	0.572**	0.103	0.0133	0.0581	-0.0139	0.427***
	(0.0540)	(0.104)	(0.0676)	(0.187)	(0.222)	(0.0629)	(0.0969)	(0.0767)	(0.0594)	(0.115)
ρ_{ot}, σ_{dt}	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
μ_{od}	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
$trend_{od}$	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
PC_{odt}	OECD PG, EU, APEC, FTA, Comcur (t+1; t-1)									
Obs.	235,402	235,108	228,383	177,200	200,328	211,990	191,042	146,113	234,620	169,525
R-squared	0.993	0.996	0.986	0.960	0.996	0.993	0.993	0.992	0.993	0.980

Note: *Conv108*: Council of Europe Convention for the Protection of Individuals with Regard to Automatic Processing of Data; *EU DPD*: EU Data Protection Directive; *SHA*: Safe Harbor Agreements (EU and Switzerland); *CBPR*: APEC Cross-Border Privacy Rules system; *OECD PG*: OECD Privacy Guidelines (1980). *EU* and *APEC* are indicators of European Union or APEC membership. *FTA* and *CU* are indicators of a free trade agreement or currency union respectively (see Head et al. 2010). All specifications use every second year in the sample only, implying 2-year lags and leads and are results of PPML estimation with country pair specific linear trends. Standard errors are clustered at the country pair level; *** p<0.01, ** p<0.05, * p<0.1.
Source: Services trade from OECD-WTO BaTIS (Fortanier et al., 2017). Considered time: 1995-2012.

7. Conclusions

This report provides novel evidence on the empirical link between international data protection agreements and economic outcomes. In particular, it uses a state-of-the-art gravity model to assess the trade effects of international data agreements. The model specification controls for unobserved heterogeneity along various dimensions, including a time trend in pair-specific trade to capture the effects of ongoing political and trade integration. The remaining time variation was used to assess the trade-off involved in signing a data-protection agreement. On the one hand, and as suggested in the preambles of many such agreements, the international component aims to enhance inter-operability between national privacy frameworks. There are, however, additional factors that might distinguish country-pairs in an agreement from other country pairs, causing additional effects that vary over time and are therefore captured by the model. This can involve, for example, enhanced trust, rising adjustment or compliance costs. If these effects tend to be particularly pronounced for a certain type of country-pair, e.g. two participating countries or one-participating and one non-participating country, they can determine the overall sign on the estimated coefficient.

The empirical results suggest that international data agreements tend to vary substantially with regard to the overall outcome of this trade-off. In particular, the Council of Europe Convention 108 is found to have increased trade among participating countries by over 10% compared to trade with non-participating countries. This effect suggests that the main impact of the Convention is related to enhanced inter-operability or trust, with changes in compliance costs being relatively less pronounced. The EU Data Protection Directive on the other hand appears to have had negative effect on trade among EU countries, relative to trade among other country pairings. The paper proposes that the large regulatory changes that came along with the Directive, including a substantial increase in cost of compliance that could have been particularly severe for EU member countries, might be responsible for this relative reduction in trade interactions.

While the results provide some new insights on the potential trade-offs involved in international data agreements, they should not be used to make assumptions about the overall impact on absolute level of trade flows among distinct pair-groups. The cost of controlling for many unobservable dynamics that could pollute the results involves a clear cost in terms of the measured effects. Additional work would be needed to explore these effects in more detail. While the model in its current version is not apt to provide such results, the literature has sometimes relied on more structural approaches that can provide a complementary perspective but often involve some strong assumptions. A practical approach to disentangle the different channels further would involve using more of the industry variation in the data or to test whether the effects of international data agreements vary according to country characteristics such as the institutional quality in a given country.

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Annex 1

Agreement, Instrument, Convention, Guidelines or Mechanism	Description
EU Data Protection Directive (positive data flow)	Officially, this is "Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data, [1995] OJ L281/31". It is the EU's governing instrument for data protection until 25 May 2018, when the General Data Protection Regulation (GDPR) begins to apply. Each EU Member State has introduced laws based on the DPD, which required them to put its data protection principles into their national laws. The directive, which is legally binding in the 27 EU member states and the three EEA member countries (Iceland, Liechtenstein, and Norway), has mixed effects on data flows because on the one hand, the transfer of personal data within the EU and EEA may not be restricted based on the level of data protection in the recipient country. However, data transfers to non-EU/non-EEA countries are prohibited unless those countries provide 'an adequate level of data protection' as determined by the European Commission, or unless certain other conditions are fulfilled. As of 2018, the EC has determined that 12 jurisdictions provide adequate protection (Andorra, Argentina, Canada (commercial organisations), Faroe Islands, Guernsey, Israel, Isle of Man, Jersey, New Zealand, Switzerland, Uruguay and the United States of America (limited to the Privacy Shield framework)). In this row, exceptions to the directive's default permissive treatment of intra-EU data flows are coded. Exceptions to the directive's default restrictive treatment of extra-EU data flows are coded in the next row.
EU Data Protection Directive (restrictive data flow)	See immediately above. In this row, the exceptions to the directive's default restrictive effects on extra-EU data flows are coded. Exceptions to the directive's default permissive effects on intra-EU flows are coded in the previous row.
EU-US Safe Harbor Framework	The EU did not consider the US to meet the Data Protection Directive's standard of protection. To provide a means for US firms (including counterparts of European businesses or US subsidiaries of European firms) to comply with the Directive and thus enable transfers of personal data from the EU to the US, the US Department of Commerce collaborated with the EU to develop a voluntary "Safe Harbor" framework. Firms wishing to benefit from the framework were required to self-certify their compliance annually. This meant that Member State requirements for prior approval of data transfers were either waived or automatically approved, with any subsequent claims brought by EU citizens heard in the United States. On 6 October 2015, the Court of Justice of the EU ruled that the EC's adequacy finding for the Safe Harbor framework was invalid.
Switzerland-US Safe Harbor Framework	Same as the EU-US Safe Harbor Framework, but a) uniquely for the US and Switzerland; and b) the ECJ's ruling did not affect this framework, so it remains in effect until replaced by the Privacy Shield Agreement.
OECD Privacy Guidelines (pre-2013)	The Guidelines are a non-binding set of principles that member countries may enact. They aim to achieve acceptance of certain minimum standards of privacy and personal data protection and to eliminate, as far as possible, factors that might induce countries to restrict x-border data flows. Member countries are to 'avoid developing laws, policies and practices in the name of the protection of privacy and individual liberties, which would create obstacles to transborder flows of personal data that would exceed requirements for such protection.' The Guidelines were revised in 2013, including with regard to transborder data flows (current version in the row below).
OECD Privacy Guidelines (current version)	The Guidelines are a non-binding set of principles that member countries may enact. They aim to achieve acceptance of certain minimum standards of privacy and personal data protection and to eliminate, as far as possible, factors that might induce countries to restrict x-border data flows. "Any restrictions to to transborder data flows of personal data should be proportionate to the risks presented, taking into acocunt the sensitivity of the data, and the purpose and context of the processing". The Guidelines were revised in 2013, including with regard to transborder data flows. (previous version in the row above)
UN Guidelines concerning Computerized Personal Files	Non-binding guiding document, which concerns also transborder data flows

Agreement, Instrument, Convention, Guidelines or Mechanism	Description
Council of Europe, Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data	This document is commonly known as Convention 108. Article 12 imposes certain limits on Parties' ability to restrict x-border data flows between them, but also provides for some exceptions - i.e. conditions that when met, states parties are allowed to restrict x-border data flows. It is open to countries that are not Member States of the Council of Europe. 9 non-Council of Europe countries have ratified it as of July 2018. All Parties to this convention have passed domestic laws that implement its standards. Note that further to the entry into force of the GDPR in May 2018, a new draft Protocol is intended to be opened for signature in October 2018, to amend the Convention to accommodate the GDPR. The key provision states that restrictions on x-border data flows to another Party's territory are exceptionally permitted when the source country's legislation includes specific regulations for certain categories of personal data (because of the nature of those data or those files), except where the regulations of the destination country provide an equivalent protection (Articles 12(3)(a)-(b)). (the Convention was amended in 1999 but the relevant provisions remained the same)
Additional Protocol to the Convention (No. 181)	This addendum to Convention 108 is about transfers from Party countries to non-Party countries.
EU-US Privacy Shield	This agreement was designed to take the place of the Safe Harbor Framework, which had been invalidated in October 2015. It is similar to the SH framework. US companies wishing to import data from the EU have to publicly certify their compliance every year. Once a company self-certifies, it can import personal data from the EU without having to rely on another x-border data transfer mechanism under the DPD, such as standard contractual clauses.
Switzerland-US Privacy Shield	This agreement applies the same conditions as the EU-US Privacy Shield.
APEC Cross-Border Privacy Rules system	The CBPR system is like the EU-US Privacy Shield in that its contours were designed by governments, but companies voluntarily commit to it. The two are also similar in that companies participate voluntarily, but once they agree to participate, the companies' compliance with the rules becomes enforceable. However, unlike the Privacy Shield, companies participating in the CBPR system do not self-certify their compliance. Instead, the CBPR system uses qualified Accountability Agents that have been recognised by participating economies. The Agents evaluate the companies' privacy policies and practices, then decide whether to certify that those policies and practices comply with the CBPR system's requirements. Certification will not be granted unless the policies and practices are enforceable by law. Accountability Agents are also responsible for ensuring that any non-compliance is remedied in a timely fashion and, in appropriate cases, reported to the relevant enforcement authorities. Notably, unlike the other arrangements, here certified businesses are certified as the source of the information, rather than the recipient. Canada, Japan, Mexico, Korea, Singapore and the US participate in this system, which concerns cross-border data flows only between these 6 countries.

Agreement, Instrument, Convention, Guidelines or Mechanism	Default Position on X-Border Data Flow	Geographic scope (n. of countries)	Sectoral scope	Subject matter scope	Year of entry into force	End year (if any)
EU Data Protection Directive (positive data flow)	Allowed	31	All sectors	Personal	1998	25-05-2018
EU Data Protection Directive (restrictive data flow)	Not allowed	31	All sectors	Personal	1998	25-05-2018
EU-US Safe Harbor Framework	Not allowed	31	All except financial services, telecommunication, meat processors, journalists, most insurance providers, and non-profits.	Personal	2000	06-10-2015
Switzerland-US Safe Harbor Framework	Not allowed	1	All except financial services, telecommunication, meat processors, journalists, most insurance providers, and non-profits	Personal	2009	12-01-2017
OECD Privacy Guidelines (pre-2013)	Allowed	34	All sectors	Personal	1980	2013
OECD Privacy Guidelines (current version)	Allowed	36	All sectors	Personal	2013	
UN Guidelines concerning Computerized Personal Files	Allowed	Global	All sectors	Personal	1990	
Council of Europe, Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data	Allowed	53 (most European)	All sectors	Automated processed personal. But Article 3(2) allows countries to limit the scope further	1985	
Additional Protocol to the Convention (No. 181)	Not allowed	42	All sectors	Automated processed personal	2004	
EU-US Privacy Shield	Not allowed	31	All except financial services, telecommunication, meat processors, journalists ,most insurance providers, and non-profits	Personal	12-Jul-16	
Switzerland-US Privacy Shield	Not allowed	1	All except financial services, telecommunication, meat processors, journalists, most insurance providers, and non-profits	Personal	12-Jan-17	
APEC Cross-Border Privacy Rules system	Not allowed	6	All sectors	Personal	01-Nov-11	

Agreement, Instrument, Convention, Guidelines or Mechanism	Cross-border data flow allowed of conditions are met	Compliance	If enforceable, how and by whom?	Ex ante notification/ authorisation	Powers granted to the enforcement body
EU Data Protection Directive (positive data flow effects)	No	Enforceable		Notification	
EU Data Protection Directive (restrictive data flow effects)	Yes	Enforceable	Each member state must set up a data protection authority, an independent body that monitors the data protection level in that member state, gives advice to the government about administrative measures and regulations, and starts legal proceedings when the regulation has been violated. Individuals may lodge complaints about violations to the supervisory authority or in a court of law.	Notification, but the Directive allows countries to require authorisation	This is up to the European countries who must implement the Directive, but the Directive does say that individuals who suffer damage as a result of a violation are entitled to receive compensation from the data controller, so the DPA must be entitled to order compensation to be paid. Art. 24 also requires countries to identify sanctions to be imposed for infringements.
EU-US Safe Harbor Framework	Yes	Enforceable	US data importers had to publicly certify their compliance with the Safe Harbor principles; they were subject to enforcement by the US FTC (or DoT if relevant) if their certification materially misrepresented any aspect of their processing of data imported from the EU. Enforcement is done also by individuals through direct recourse mechanisms, and by the relevant EU DPA.	Notification	Failure to comply with the Safe Harbor commitments could be penalized under the Federal Trade Commission Act by administrative orders (e.g. losing the right to certify under the framework in the future) and civil penalties of up to $16,000 per day for violations. Sanctions should include both publicity for findings of non-compliance and the requirement to delete data in certain circumstances. Other sanctions could include suspension and removal of a seal, compensation for individuals for losses incurred as a result of non-compliance and injunctive orders.
Switzerland-US Safe Harbor Framework	Yes	Enforceable	Same as immediately above, except concerns only data imported from Switzerland, and there is no role in enforcement to the Swiss DPA or its equivalent.		Same as immediately above.
OECD Privacy Guidelines (pre-2013)	No	Advisable			
OECD Privacy Guidelines (current version)	No	Advisable			
United Nations Guidelines concerning Computerized Personal Files	No	Advisable			

Agreement, Instrument, Convention, Guidelines or Mechanism	Cross-border data flow allowed of conditions are met	Compliance	If enforceable, how and by whom?	Ex ante notification/ authorisation	Powers granted to the enforcement body
Council of Europe, Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data	No	Enforceable	Based on Article 10, all states parties to the Convention have enacted domestic laws to implement it, so it is enforceable under domestic law of each country. Moreoever, the Convention is binding under Public International Law. It does not have a specific enfrocement mechanism, and - subject to questions of jurisdiction - disputes between states regarding its interpretation and implemenation can be settles by the ICJ.	No specific provisions	To the extent the case is brought before the ICJ, its decisions are binding.
Additional Protocol to the Convention (No. 181)	Yes	Enforceable	Based on Article 10, all states parties to the Convention have enacted domestic laws to implement it, so it is enforceable under domestic law of each country. Moreoever, the Convention is binding under Public International Law. It does not have a specific enfrocement mechanism, and - subject to questions of jurisdiction - disputes between states regarding its interpretation and implemenation can be settles by the ICJ.	No specific provisions	To the extent the case is brought before the ICJ, its decisions are binding.
EU-US Privacy Shield	Yes	Enforceable	US data importers have to publicly certify their compliance with the Privacy Shield's principles to the US Dept of Commerce; they are subject to enforcement by the US FTC if their certification materially misrepresented any aspect of their processing of data imported from the EU. Enforcement is done also by individual consumers directly with the company, by ADR or the DPAs, and in some instances by an arbitration mechanism. There's also an ombudsperson for what concerns national security		Failure to comply with the Privacy Shield commitments could be penalized under the Federal Trade Commission Act by administrative orders (e.g. losing the right to certify under the framework in the future) and civil penalties of up to up to $40,000 per violation or $40,000 per day for continuing violations. Additionally, a range of sanctions of varying degrees of severity will allow dispute resolution bodies to respond appropriately to varying degrees of non-compliance. Sanctions should include both publicity for findings of non-compliance and the requirement to delete data in certain circumstances.6 Other sanctions could include suspension and removal of a seal, compensation for individuals for losses incurred as a result of non-compliance and injunctive awards

Agreement, Instrument, Convention, Guidelines or Mechanism	Cross-border data flow allowed of conditions are met	Compliance	If enforceable, how and by whom?	Ex ante notification/ authorisation	Powers granted to the enforcement body
Switzerland-US Privacy Shield	Yes	Enforceable	US data importers have to publicly certify their compliance with the Privacy Shield's principles to the US Dept of Commerce; they are subject to enforcement by the US FTC if their certification materially misrepresented any aspect of their processing of data imported from the Switzerland. Enforcement is done also by individual consumers directly with the company, by ADR or the DPA, and in some instances by an arbitration mechanism. There's also an ombudsperson for what concerns national security		Failure to comply with the Privacy Shield commitments could be penalized under the Federal Trade Commission Act by administrative orders (e.g. losing the right to certify under the framework in the future) and civil penalties of up to up to $40,000 per violation or $40,000 per day for continuing violations. Additionally, a range of sanctions of varying degrees of severity will allow dispute resolution bodies to respond appropriately to varying degrees of non-compliance. Sanctions should include both publicity for findings of non-compliance and the requirement to delete data in certain circumstances.6 Other sanctions could include suspension and removal of a seal, compensation for individuals for losses incurred as a result of non-compliance and injunctive awards
APEC Cross-Border Privacy Rules system	Yes	Enforceable	Accountability Agents are responsible for ensuring that any non-compliance is remedied in a timely fashion and, in appropriate cases, reported to the relevant enforcement authorities.	Authorisation	The CBPRs are flexible on this point, leaving it up to individual countries to determine what powers to grant to DPAs. The APEC Privacy Framework, to which the CBPRs are associated, states that "There are several options for giving effect to the Framework and securing privacy protections for individuals including legislative, administrative, industry self-regulatory or a combination of these methods under which rights can be exercised under the Framework." The Framework further states that "A Member Economy's system of privacy protections should include an appropriate array of remedies for privacy protection violations, which could include redress, the ability to stop a violation from continuing, and other remedies."