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Digital Trade, Data Protection and EU Adequacy Decisions

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Abstract

Using a structural gravity model, we assess whether EU adequacy decisions on data protection are associated with bilateral digital trade. Controlling for digital-relevant bilateral covariates, including preferential trade agreements and other binding data flow arrangements, we find that countries that received EU adequacy exhibit an increase in digital trade between 6-14 percent, representing a trade cost reduction up to 9 percent. This is mostly driven by the EU granting adequacy to the U.S., reflecting the dominance of the EU and U.S. in global digital trade. We also find that countries that have an EU adequacy determination exhibit greater digital trade among each other, suggestive of a network or club effect. Complementary country-specific analysis of post-adequacy digital trade performance using synthetic control methods confirms the positive effects of adequacy.

Keywords

Digital trade; data protection; mutual recognition; equivalence; trade costs

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1. Introduction

Digital trade in services – which includes financial, telecommunications, computer, information, business, professional, audio-visual, and recreational services – has been growing rapidly. Digital trade goes beyond trade in services as it includes also trade in information and communications technology (ICT) goods, as enablers of digitalisation. The share of digital trade has been growing rapidly, with digitally delivered services accounting for 56% of global services trade in 2022, outpacing trade in other products (WTO, 2023).

Digital trade is affected by a range of regulatory measures that apply at or behind the border (DTI: Ferracane, 2022). One important measure is personal data protection regulation and associated restrictions on cross-border data flows. Policies restricting trade in services have historically been reflected in policies that affect the ability of providers to physically cross frontiers to provide services. Typically, cross-border disembodied trade in services has been relatively free in many countries. This has been changing because of the increasing regulation of digital transactions and cross-border data flows. Digitally enabled trade is data intensive, with firms using data as an input into design, R&D, and product innovation, in the production process and to improve logistics, distribution and engagement with customers and clients. These data require processing, storage, modelling, and analysis – all ancillary but critical services that are central to digital value chains.

In this paper we focus on a specific mechanism that has been established by the European Union (EU) to recognize the equivalence of regulatory regimes to protect personal data. The EU is a “market leader” in data protection regulation and has been argued to be an influential standard setter, with other states emulating elements of EU regulation in this area (Bradford, 2020; Cervi, 2022). The EU Global Data Protection Regulation (GDPR) requires companies that process or access personal data originating in the EU to comply with EU regulation. The GDPR provides for so-called adequacy decisions that establish that a country has a regulatory regime in place that ensures an adequate level of data protection that is equivalent to that is ensured within the EU for personal data. Once applied, an adequacy decision covers all companies based in the partner country that engage in bilateral trade with EU companies, permitting personal data to flow freely between the EU and the adequacy-granted country. Adequacy is expected to reduce trade costs by removing the need for companies to obtain individual consent for cross-border data transfers or use contractual clauses that assure data privacy protection (Saluste, 2021).

While other states have mechanisms to accord mutual recognition to data protection regimes (IAPP, 2023), the EU has the most developed formal system to establish adequacy, based on strong regulatory oversight and due process procedures that have been developed by the European Commission (EC), the EU’s executive arm, and are widely used globally. The EU case is therefore of interest both because of the size of the EU market and because it is the most developed regime to govern cross border data flows.

Research on EU adequacy decisions is mostly of a legal or a policy nature. In this paper we contribute to the literature by using a structural gravity model to evaluate whether EU adequacy decisions are associated with bilateral digital trade. Controlling for digital-relevant bilateral covariates, including preferential trade agreements (PTAs) and other binding data flow arrangements between trading partners, we find that countries with EU adequacy decisions exhibit an increase in digital trade between 6-14 percent depending on the definition of trade used and the adequacy partner of focus, representing a trade cost reduction up to 9 percent. Statistically significant results are driven by the EU granting adequacy to the U.S., reflecting the dominance of the EU and U.S. in global digital trade. The bilateral trade relationship across the Atlantic represents the largest in the world, and cross-border data flows between the EU and U.S. are also the highest globally (WTO, 2023).[1]

1 EU-U.S. digital trade flows were US$ 264 billion in 2020 (U.S. Bureau of Economic Analysis).

We also find that states with an EU adequacy decision exhibit greater digital trade among each other. Countries with adequacy benefit indirectly from the adequacy decisions granted by the EU to the U.S., as their digital exports to the U.S. market started to grow each of the two times a Transatlantic data deal was put in place. This third-country network effect is reflected in a change in the composition of digital trade within supply chains: approximately 7 percent of digital value-added trade shifted toward the network of countries with adequacy, away from being previously sourced from countries without adequacy (or from the domestic market).

The bilateral structural gravity framework and demanding set of fixed effects we apply does not permit to assess the country-specific impact on overall digital trade of adequacy. To do so, we apply synthetic control methods to two countries with an EU adequacy decision, Argentina and New Zealand. In both cases we find a positive digital trade effect of adequacy, with the impact being large in the case of Argentina.

The paper proceeds as follows. Section 2 briefly discusses the EU regulatory framework and the adequacy decisions that have been issued since 2000, as well as related research. Section 3 presents the empirical framework, the variables used and their construction. Section 4 reports the results of our baseline regression analyses and robustness checks. Section 5 repeats the gravity estimation using value-added data instead of gross trade. In Section 6 we apply a synthetic control approach to assess the country-level effects of adequacy for Argentina and New Zealand. Section 7 concludes.

2. Regulatory framework and related literature

In 1998, the EU implemented the Data Protection Directive (DPD).[2] This governed the treatment of personal data of European citizens. It stipulated that personal data could be freely transferred to third countries if the EU determined that the receiving country offered an adequate level of protection of personal data.[3] The Court of Justice of the European Union (CJEU) declared an adequacy decision can be granted if the level of protection of fundamental rights and freedoms in the laws and practices of the third country is "essentially equivalent" to that guaranteed within the EU under the DPD, read in light of the Charter of Fundamental Rights of the EU.[4] The DPD was replaced by the GDPR in 2018.[5] The change from a Directive to a Regulation made rules governing data protection directly applicable in each EU member, whereas before each EU country enjoyed some leeway on how to achieve the goal formulated by the Directive. Both legislative acts cover EU members plus the European Economic Area (EEA) countries – Norway, Iceland, and Lichtenstein.

The GDPR continues to provide for adequacy decisions, and sets out the conditions under which personal data can travel to countries in the absence of an adequacy determination. In practice, these entail the use of either Binding Corporate Rules (BCRs), Standard Contractual Clauses (SCCs) or derogations. BCRs provide a legal basis for transferring data within a multinational company and apply only to intra-firm data transfers. SCCs are a legal template defined by the EC for transferring data to a firm located outside EU. Derogations may be invoked if firms obtain consent from data subjects for every cross-border transfer of personal data. This path is cumbersome, especially for large-scale transfers of data, as derogations are interpreted restrictively by the European Data Protection Board (Saluste, 2021).[6]

2 Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals regarding the processing of personal data and on the free movement of such data. Official Journal 281, 23/11/1995 P. 0031 – 0050.

3 Directive 95/46/EC, Art. 25.

4 CJEU 6 October 2015, Case C-362/14, Schrems, ECLI:EU:C:2015:650.

5 Regulation (EU) 2016/679 of the European Parliament and of the Council. At https://eur-lex.europa.eu/eli/reg/2016/679/oj .

6 EDPB (2018), Guidelines 2/2018 on derogations of Article 49 under Regulation 2016/679, 25 May 2018 , accessed at https://edpb.europa.eu/our-work-tools/our-documents/guidelines/guidelines-22018-derogations-article-49-under-regulation_en

Surveys have shown that SCCs are widely used by European companies to transfer personal data (IAPP-EY, 2019; Business Europe, 2020). SCCs and BCRs are relatively costly for firms because of burdensome procedures for approval (Cory et al., 2020a; 2020b). The costs associated with SCCs and BCRs are both fixed and variable. Aside from the contractual arrangement that the data exporter needs to fulfil to use these model documents, firms may need to hire data specialists and consultancy firms to provide data mapping, management, and third-party auditing services. The costs will depend on the number of countries, type of data transfer and processing activity involved. New SCCs must be drafted every time personal data processing activities change (Chivot and Cory, 2020). In the case of BCRs, each EU member state's Data Protection Authority (DPA) in which the firm or a subsidiary is located must approve the data transfer. The relative burden of the fixed costs of using these legal templates will be larger for small and medium sized enterprises (SMEs), with likely implications for cross-border digital trade given that on average firms trading services are smaller (Bento & Restuccia, 2021; Breinlich & Criscuolo, 2011).[7]

Between 2000 and 2021, the EU granted adequacy to 15 states or territories (Figure 1). In most cases, the decisions automatically extend to EEA countries – Norway, Iceland, and Lichtenstein. In the analysis that follows we focus on the 12 adequacy decisions agreed through 2018, the final year for which we have trade data, including both adequacy frameworks agreed with the U.S.[8] While for all other decisions the EC certifies that the data protection regime of the trading partner is overall essentially equivalent to the EU, those with the U.S. certify the adequacy of a specific framework put in place to govern data flows, with adequacy status accorded only to companies that certified compliance with the applicable standards.

The first EU-U.S. agreement securing the free flow of personal data was the Safe Harbor Privacy Principles, signed in the year 2000. This permitted U.S. companies to self-certify compliance with seven basic privacy principles and associated requirements.[9] Any U.S. business or organization subject to regulation by the Federal Trade Commission that self-certified compliance could apply to be part of the Safe Harbor framework.[10] The CJEU struck down the Safe Harbor agreement in 2015, ruling that the scheme did not sufficiently limit the potential for U.S. authorities to access EU citizens' personal data and therefore did not guarantee the protection of the EU fundamental right of privacy. Companies utilizing the Safe Harbor framework were given a grace period of four months to revert to BCRs and SCCs whilst the EU and U.S. negotiated a new agreement. In August 2016, the EC and the U.S. Department of Commerce agreed to a substantially more detailed adequacy regime called the Privacy Shield Framework. This clarified responsibility for compliance and included assurances from the U.S. authorities regarding complaints and redress possibilities.[11]

In our empirical analysis, we include adequacy decisions granted by Switzerland to the U.S. given that they are deeply intertwined with those of the EU. The first two adequacy decisions of the EU were granted to Switzerland and the US on the same day, 26 July 2000. Switzerland then implemented its own Safe Harbor with the U.S. in 2009. This was repealed in 2015 after the EU-U.S. Safe Harbor was struck down by the CJEU and replaced by the Swiss-U.S. Privacy Shield in 2017, in turn was also repealed in 2020 after the invalidation of the EU-U.S. Privacy Shield by the CJEU.[12]

7 Data flows based on SCCs often involve business-to-business transactions. An implication is that data flows are not dominated by the large platforms providing business-to-consumer-facing services that tend to be associated with debates on cross-border data flows.

8 Consequently, we cannot include the adequacy decisions granted to Japan (2019), the UK (2021) and South Korea (2021).

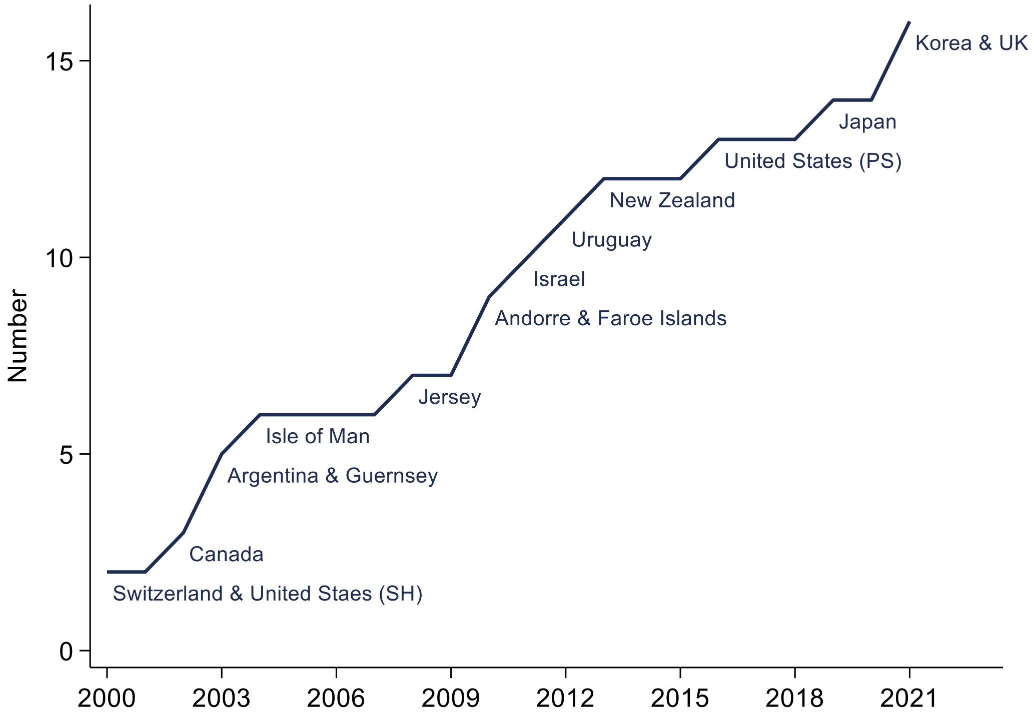
9 The seven principles were: notice, choice, onward data transfer, security, data integrity, access, and enforcement.

10 Some 4,500 (5,300) firms were registered under Safe Harbor (Privacy Shield), many of them services companies. See https://www.privacyshield.gov/welcome

11 In 2020, the CJEU struck down Privacy Shield. As our trade data go through 2018 this does not affect the empirical analysis.

12 The Swiss administration also maintains a list of adequate countries which resembles closely that of the EU. We do not include these in our analysis because both the EU and Swiss Safe Harbor and Privacy Shield frameworks were administered together and in the same way by the U.S. Department of Commerce for registered companies, whereas Switzerland's own adequacy agreements with third countries are not. See https://www.edoeb.admin.ch/edoeb/en/home/data-protection/handel-und-wirtschaft/transborder-data-flows.html

Figure 1: EU adequacy decisions, 2000-2021



Source: European Commission. See Annex Table 1.

Related research

Most of the literature on adequacy decisions and more generally international regulatory cooperation on cross-border data flows is legal or policy-oriented (e.g., Mattoo and Meltzer, 2018; Meltzer, 2019; Saluste, 2021). A growing number of studies focus on recent vintage PTAs that include provisions on data flows or more broadly e-commerce (Wu, 2017; Burri and Polanco, 2020; Elsig and Klotz, 2021). Empirical research tends to find that such PTAs support greater trade in digital products (e.g., Wu et al., 2023; Ma et al., 2023).[13] In the analysis below we control for PTAs in general, as well as for the subset of PTAs that have binding (enforceable) provisions specifically related to data protection.

Given the potential trade costs associated with differences and non-recognition of national data protection regimes, there is a surprising lack of empirical analysis of the potential trade impacts of adequacy decisions. Ferracane and van der Marel (2021b) assess whether global regulatory models of cross-border transfers and domestic processing of personal data have any bearing on digital services exports. They find positive trade correlations between exports and data models open to the cross-border transfers of personal data, as well as for data models aiming at offering a high level of protection to personal data at the domestic level. Spiezia and Tscheke (2020) assess the effects of both enforceable and non-enforceable (voluntary) data agreements through 2012, including the EU Safe Harbor and Privacy Shield decisions, and find an overall positive trade effect of data-related agreements.[14]

We extend the literature by focusing on all EU adequacy decisions through 2018 and measuring the specific *bilateral* arrangement for data protection separately, netting out any trade effects stemming from the DPD and subsuming within co-variates through fixed effects and / or control variables. We also improve on the extant literature by defining different categories of digital trade as opposed to working with total goods and total services trade, exploring the potential network effect of bilateral adequacy determinations, and using a synthetic control approach to assessing the impact of adequacy.

13 In addition to PTAs, states are beginning to negotiate separate digital partnership agreements that complement trade agreements (Honey, 2021; Hoekman and Sabel, 2021). The latter are too recent to permit empirical analysis of impacts.

14 By including adequacy decisions in their DPD dummy, they capture within EU trade effects of the DPD in addition to the trade effects with third countries. In our analysis we focus on extra-EU trade.

3. Empirical approach and data sources

We utilize a structural gravity model framework,[15] with the baseline econometric specification taking the following form:

$$X_{odt}^{dig} = \beta ADQ_{odt} + \beta' GRA_{odt} + \alpha_{ot} + \gamma_{dt} + \delta_{od} + \varepsilon_{odt} \quad (1)$$

where exports (X_{odt}) of ICT goods and digital services between country pair origin *o* and destination *d* in year *t*, ADQ_{odt} is a dummy variable for adequacy, GRA_{odt} is a vector of control variables, α_{ot}, γ_{dt} and δ_{od} are fixed effects and ε_{odt} is the error term. The ADQ_{odt} dummy is set to equal 1 in the year *t* that the EU grants adequacy to a third country. When the adequacy decisions also apply to Norway, Iceland, and Lichtenstein (EEA countries), we assign the dummy variable a value of 1 accordingly. The definition of the ADQ_{odt} dummy variable avoids picking up digital trade inside the EU. We therefore exclude intra-EU trade and focus only on trade between the EU and countries granted adequacy and Switzerland in the case of adequacy decisions for the US.[16] Therefore, altogether we cover 15 adequacy decisions in our regressions, 13 reported by the EU, and 2 by Switzerland (Annex Table 1).

GRA_{odt} is a vector covering the standard dyadic covariates typically found in any gravity model. In our case, given the stringent set of fixed effects defined in the equation, these bilateral gravity variables need to vary over time by country pairs. We incorporate the two most straightforward variables, namely whether countries have become a member of a PTA, sourced from Egger and Larch (2008) and whether countries accede to the World Trade Organization (WTO) during the sample period. The latter dyadic variable is sourced from the ITPD-E gravity database, with missing years for 2017 and 2018 filled in using information from the WTO. Other standard gravity variables are collinear with our set of fixed effects. Annex Table 2 provides information on the variables used and their sources. This vector also contains all the relevant data-related dyadic control variables such as EU and EEA members being part of the DPD.

We employ three sets of fixed effects, α_{ot}, γ_{dt} and δ_{od}. The first two terms are defined by origin-time (*O*-year) and destination-time (*D*-year), respectively. These subsume variables that vary by country-year such as population and GDP. The third set of fixed effects vary by origin-destination (*O*-*D*) and absorb all country-pair variable unaffected by time, such as distance, colonial relationship, shared language or border. Assuming GRA_{odt} together with the fixed effects covers most if not all other time varying trade frictions, the estimated coefficient β for ADQ_{odt} can be recovered without bias for digital services trade. Standard errors are clustered by country-pair.

To control for the possibility that adequacy frameworks between a pair of countries are signed when digital trade and data flows are trending upwards, which would make the case for an exogenous trade effect following the granting of adequacy less likely, we also apply country pair-trend effects as an additional control i.e., we add a linear, pair-specific time trend to the country-pair fixed effects. This captures any potential trends specific to a country-pair reflecting other digital integration factors, such as increasing bilateral cross-border data flows. These additional effects control for any a higher-than-average change in the trend of bilateral digital trade during the sample period relative to countries without adequacy. The resulting set of three-way fixed effects are very demanding, as they remove much of the variation in the data, substantially raising the bar for finding statistically significant relationships between digital trade and adequacy decisions.

Following standard practice (e.g., Baier and Bergstrand, 2007; Anderson and Yotov, 2016; Piermartini and Yotov, 2016), we estimate equation (1) with PPML (Santos Silva & Tenreyro, 2006; Fally, 2015) and check for possible non-existence of estimates (Santos Silva & Tenreyro, 2010).

15 The literature on structural gravity is extensive. See for e.g., Anderson and van Wincoop (2003) and Melitz and Ottaviano (2008) and for later works the references mentioned in Yotov et al. (2016).

16 We include Switzerland for the adequacy decisions between the EU and the U.S. because Switzerland was treated in a similar manner as the EU by the U.S. administration. In fact, the two Swiss Transatlantic decisions mirror those between the EU and the U.S. In a robustness check, we will exclude these two data agreements.

We utilize the procedures developed by Dai et al. (2014) which address the use of a large number of dyadic fixed effects in combination with the trend effects needed to consistently identify the impact of time-varying policies, in our case the adequacy decisions.

3.1. Digital Trade

Data on bilateral gross trade values are sourced from the OECD TiVA dataset because we also are interested in investigating the relationship between adequacy and digital trade on a value-added basis (Section 4). An advantage of using the OECD TiVA dataset is that it records trade for both goods and services in a consistent manner from 1995 to 2018, enabling us to incorporate most adequacy decisions with the exception of Uruguay, for which TiVA does not report data, and the most recent decisions: Japan (2019), Korea (2021) and the UK (2021). The TiVA trade data are structured so that reporter and partner countries are only defined once as country *o* and country *d*. As the database records trade data which are squared and balanced across exports and imports, results are similar for exports and imports. We choose to use exports.

We construct four alternative measures of digital trade as there is no generally accepted definition. The OECD-WTO-IMF Handbook on Measuring Digital Trade (OECD-WTO-IMF, 2020) separates digital trade into two (overlapping) sets of products, distinguishing between digitally ordered and digitally delivered trade. Given that the former is more difficult to measure, and because the handbook concludes that only services can be digitally delivered, we focus on digitally delivered services. The handbook defines these as comprising all services except those closely tied to goods trade such as transport, processing of physical inputs owned by others, maintenance and repair of goods, travel and construction. This scope of sectors is broad, and leaves open the question whether some sectors are sensitive to cost frictions related to data protection because they rely on personal data in their production models.

An alternative approach to defining digital services is developed by Ferracane and van der Marel (2021a) who use an indicator of "data-intensity" for each services sector. This is proxied by the ratio of software to labour costs. Using U.S. data, the sectors with the highest software-to-labour ratios are telecommunications, computer services, information services, finance and insurance. Yet another approach to defining digital trade is to refer to the list of companies that are covered by the Privacy Shield Framework maintained by the U.S. Department of Commerce. This includes information on their primary sector of activity. Most companies are active in a services sector. The sectoral shares of covered companies can be compared to all US firms using the US Census, giving an indication of the relative importance of the Privacy Shield (and thus cross-border data flows) for each services sector. Annex Table 3 reports the number of firms registered under the Privacy Shield framework, the total number of firms surveyed in the US Census, and the computed share, respectively. Sectors are manually concorded between the two sets of data. The sectoral coverage of firms under Privacy Shield suggests that business services, healthcare, media and entertainment, education and travel services should be added to the Ferracane and van der Marel classification.[17]

The approach we follow in defining digital trade is summarized in Annex Table 4, which provides four different definitions of digital services using the TIVA sector classification (which is in line with ISIC Rev 4). These are informed by the different efforts noted above to define digital services. We use the categorization in Annex Table 4 in the gravity regressions, starting with (1) the TiVA category of "Information industries" (called DINFO) – which covers ICT goods plus core digital services: IT and information, publishing and telecom services – and progressively expand on this by adding (2) business and professional services, (3) financial services and (4) restaurants, accommodation, health and education services.[18]

17 A recent survey executed by Kearney among SMEs in four European markets, representing 65 percent of EU GDP and 55 percent of SMEs in the EU, shows that travel services, business services and the arts, entertainment, and recreation in the form of media and entertainment are high utilizers of personal data (Kearney, 2021).

18 Firms in the arts and entertainment and energy sectors account for higher share of firms in Privacy Shied than in the US Census but are not included in our broadest list of digital sectors. The main reason is that media companies are covered under publishing, audio-visual and broadcasting activities (ISIC Rev 4 sector 59), whereas energy is a good and is not classified as a digital deliverable

Digital goods are defined by the separate classification of Information industries in the TiVA database. This encompasses all 4-digit sub-sectors that belong to 2-digit ISIC Rev 4 sector 26, comprising computer, electronics, and optical equipment. Digital goods are combined with the digital services sectors. Hence, ICT goods are included in all four specifications of digital trade.[19]

4. Results

Table 1 presents the baseline results for digital exports, using the four different definitions of digital trade as discussed above, where sectoral coverage progressively expands as indicated in Annex Table 4. Due to the large number of fixed effects, we only obtain the dyadic time-varying variables from the regressions, including the main variable of interest, whether a country has received adequacy (*ADQ).*

Table 1: Baseline regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ	0.065***	0.079***	0.062**	0.049**	0.053**	0.067***	0.052**	0.043*
	(0.007)	(0.000)	(0.016)	(0.046)	(0.021)	(0.001)	(0.032)	(0.067)
PTA	-0.019	-0.016	-0.015	-0.005	-0.019	-0.016	-0.015	-0.005
	(0.522)	(0.575)	(0.626)	(0.873)	(0.538)	(0.593)	(0.622)	(0.867)
WTO	-0.367***	-0.404***	-0.450***	-0.474***	-0.377***	-0.412***	-0.458***	-0.479***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.002)
DPD					-0.082**	-0.079**	-0.067**	-0.048
					(0.026)	(0.020)	(0.050)	(0.124)
CON 181					0.011	-0.000	0.015	0.009
					(0.664)	(0.991)	(0.550)	(0.689)
CBPR					0.042	0.039	0.040	0.021
					(0.291)	(0.283)	(0.309)	(0.595)
EU					0.091	0.084	0.081	0.084
					(0.255)	(0.252)	(0.246)	(0.188)
FE O-year	Y	Y	Y	Y	Y	Y	Y	Y
FE D-year	Y	Y	Y	Y	Y	Y	Y	Y
FE O-D	Y	Y	Y	Y	Y	Y	Y	Y
O-D Trend	Y	Y	Y	Y	Y	Y	Y	Y
Obs.	101904	102024	102312	102408	101904	102024	102312	102408
R2	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Notes: Information denotes "information industries" as defined in the text. All four specifications of digital trade include ICT goods. *, **, and *** denote 10%, 5% and 1% significance levels.

We find a positive and significant coefficient for the adequacy variable in the first four specifications [columns (1) – (4)] when only the PTA and WTO terms are added as controls. As the definition of digital trade expands to cover more sectors, the economic importance somewhat declines. Estimates for specification (4), which adds personal, health and education services, includes services activities where the average firm is likely to be less dependent on the free flow of data. The PTA dummy is not significant, suggesting that in the sample period PTAs had little effect on digital trade.

service in OECD-WTO-IMF (2020).

19 OECD-WTO-IMF (2021) provides a list of 6-digit ICT products based on the HS-2017 classification, but these are difficult to concord to a specific 2-digit ISIC sector used in TiVA.

This possibility is consistent with the fact that only in recent years various PTAs have started to actively cover data-related provisions (Wu, 2017). This PTA term might therefore be too broad to measure any impact on digital trade, and we correct for this imprecise estimate below as part of our robustness checks.[20] The WTO variable is negative and strongly significant, indicating no relationship between accession during the sample period and digital trade.[21]

Columns 5-8 report estimates of specifications with additional control variables relevant for digital trade. The first is *DPD*, the 1995 EU Directive 95/46/EC, requiring the protection of citizens with regards to the free movement and processing of personal data. The second is the 1981 Council of Europe Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data, protecting the right to privacy of individuals. This prescribes certain limits and exceptions among member countries for cross-border flows of data and includes an addendum called Convention 181 which covers transfers from Party to non-Party countries. Country membership of these conventions varies by year. The third control variable is a dummy for the application of the APEC Cross Border Privacy Rules (CBPR) system, an agreement between Canada, Japan, Mexico, Korea, Singapore, and the U.S. dealing with cross-border data flows. The CBPR has some similarity with the EU-U.S. Privacy Shield in that companies voluntarily subscribe to it, but unlike the Privacy Shield, the CBPR system uses so-called qualified Accountability Agents, recognised by the participating economies, that certify the policies and practices a company must comply with. To date few firms have used this system – e.g., only 20 US firms had obtained certification as of 2019 (Fefer, 2019). Finally, we control for EU membership given that adequacy decisions are issued by the EU.[22]

The coefficient estimates outcomes for *ADQ* for the four different specifications of digital trade become somewhat smaller but continue to be significant, albeit only weakly so for the broadest definition of digital trade. With the exception of DPD, the controls are not significant. Negative estimates for *DPD* were also found by Spiezia and Tscheke (2020) and may reflect high compliance costs associated with heterogeneity in how individual member states implemented the Directive, negatively affecting exporters engaging in intra-EU trade. On average, the combined results from estimates of *ADQ* imply that in economic terms obtaining an adequacy decision is associated with an increase in digital trade of some 6 percent.

We extend the analysis by (a) distinguishing between US and other adequacy decisions; (b) excluding Switzerland with respect to the two adequacy agreements it had with the US; and (c) including only PTAs with data-related provisions as a control. The adequacy agreements between the EU and the U.S. are by far the most important in terms of the volume of trade covered. They also were issued twice as a result of the CJEU decision, so that the regulatory framework for Transatlantic data flows has more variation over time than the bilateral framework applying to other countries granted adequacy. The exclusion of Switzerland is motivated by the fact that we are interested in whether the two Swiss data agreements with the U.S. are not driving the trade effect when separating between the Safe Harbor and Privacy Shield agreements and other adequacy decisions. In the baseline analysis we apply a one-year gap during which there was no data flow agreement between EU members and the U.S. (i.e., the *ADQ* dummy is set at zero for 2015) and a two-year gap for Switzerland (when included) for 2015 and 2016, which may affect results.

Given that many PTAs do not specifically address digital trade, a third robustness check is to include only PTAs with binding provisions on the requirement to establish a data protection. We use information from the Trade Agreements Provisions on Electronic-commerce and Data (TAPED)

20 Wu et al. (2023) construct the depth and scope indicators of digital trade rules included within PTAs and investigate the relationship between digital trade provisions and services trade along value chains using a gravity model framework. They find that both the depth and the scope indicators of digital trade provisions are positively associated with services exports.

21 The accession countries are Bulgaria (1996), China (2001), Estonia (1999), Croatia (2000), Kazakhstan (2015), Cambodia (2004), Laos (2013), Lithuania (2001), Latvia (1999), Russia (2012), Saudi Arabia (2005), Taiwan (2002), Vietnam (2007). Several developing countries also became WTO member during the sample period (1995-2018) but are not included in the TiVA database.

22 Membership of the EU does not overlap one-to-one with the DPD control variable given that the latter has EEA relevance. The date of entry into force of the DPD for most countries (i.e., EU15) was 1998. For other European countries the year of implementation was 2004, 2007, or 2013 depending on date of EU accession.

database which records all types of digital-related provisions in PTAs since 2000 to develop a variable that captures hard data-related provisions on data protection as formulated in a specific e-commerce chapter (Burri and Polanco, 2020).[23]

Columns (1) – (4) in Table 2 report results for the two Safe Harbor and Privacy Shield agreements each in which Switzerland is still included, while columns (5)-(8) remove Switzerland. Coefficient estimates for the non-US adequacy decisions are insignificant. Conversely, estimates for the two U.S. decisions are positive and statistically significant. The implication is that the previous estimates for ADQ are driven by the two Transatlantic data agreements. Removing Switzerland increases the magnitude of the coefficient estimates, again pointing to the importance of the two agreements with the U.S. The PTA variable now becomes positive and weakly significant (at the 10% level) when financial services are added to the list of digital sectors. Results for all control variables do not change. Averaging across the different specifications for digital trade, the EU-U.S. adequacy frameworks are associated with an increase in digital trade of 8 percent.

Table 2: Differentiating between adequacy partners and type of PTA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ	0.013	-0.013	-0.042	-0.036	0.015	-0.011	-0.039	-0.034
	(0.786)	(0.753)	(0.497)	(0.528)	(0.753)	(0.788)	(0.518)	(0.546)
SH & PS	0.061**	0.081***	0.069***	0.057**				
	(0.020)	(0.000)	(0.003)	(0.014)				
SH & PS (ex. CHE)					0.071**	0.089***	0.082***	0.067***
					(0.013)	(0.000)	(0.001)	(0.005)
PTA (Data e-com)	0.046	0.069	0.101*	0.033	0.046	0.069	0.101*	0.032
	(0.513)	(0.299)	(0.094)	(0.648)	(0.514)	(0.302)	(0.095)	(0.650)
WTO	-0.376***	-0.408***	-0.451***	-0.476***	-0.375***	-0.408***	-0.450***	-0.477***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.002)
DPD	-0.081**	-0.078**	-0.067*	-0.048	-0.077**	-0.076**	-0.061*	-0.044
	(0.028)	(0.021)	(0.051)	(0.125)	(0.035)	(0.025)	(0.072)	(0.162)
CON 181	0.011	-0.001	0.014	0.008	0.010	-0.003	0.012	0.006
	(0.675)	(0.965)	(0.579)	(0.724)	(0.714)	(0.909)	(0.631)	(0.773)
CBPR	0.044	0.041	0.043	0.021	0.043	0.041	0.041	0.020
	(0.267)	(0.261)	(0.287)	(0.596)	(0.276)	(0.267)	(0.302)	(0.614)
EU	0.090	0.082	0.079	0.082	0.090	0.082	0.079	0.081
	(0.262)	(0.267)	(0.261)	(0.203)	(0.264)	(0.266)	(0.264)	(0.208)
Obs.	101904	102024	102312	102408	101904	102024	102312	102408
R^2	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Notes: SH: Safe Harbor; PS: Privacy Shield. All specifications include origin, destination, origin-destination, and O-D-time fixed effects. Information denotes “information industries” as defined in the text. All four specifications of digital trade include ICT goods. *, **, and *** denote 10%, 5% and 1% significance levels.

23 The TAPED database records provisions related to the free flow of data anywhere in a PTA but does not do so for provisions for data protection. In some PTAs, data-related provisions are specific to a sector. Because of the associated potential for biasing results, we omit these provisions. We are grateful to Mira Burri for advice on using the TAPED database.

4.1. Third country network effects and leads and lags

Adequacy decisions may have implications for digital trade that go beyond flows between the country pair covered by an agreement if trade between countries with adequacy is also affected. Insofar as two countries have an EU adequacy framework, this may also facilitate digital trade between them. This is plausible given that their regulatory and legal framework presumably are similar as otherwise they would not have been granted adequacy by the EU. While bilateral digital trade will be governed by the legal frameworks put in place by the countries concerned, EC (2020) notes that Switzerland, Israel, Argentina, Uruguay, and the UK recognize each other as adequate, creating a potential "de facto" plurilaterization of adequacy.[24] The analysis of possible network effects is important from a policy perspective as well as being of analytical interest. In and outside the WTO, groups of countries have begun to negotiate plurilateral agreements that are distinct from PTAs to address digital trade-related policies. Examples include the Digital Economy Partnership Agreement between Chile, New Zealand, and Singapore; the Digital Economy Agreement between Australia and Singapore; and the Japan-US Agreement on Digital Trade. The EU is also beginning to pursue such cooperation, reflected in digital partnerships with Japan, Korea and Singapore.

To examine whether such network effects are observed, we assign a separate dummy that takes the value of one for each bilateral relationship in which these third countries are incorporated, but where the bilateral relationship between an EU member and the adequacy-granted third country itself is excluded. Hence, only third country pairs are covered. We do this for the two categories of adequacy decisions separately, i.e. for the *ADQ* as well as the *SH & PS* variable, and for all third-countries mentioned above, except the UK, which only received adequacy in 2021 and thus falls outside our period of analysis.[25] In these regressions we continue to exclude Switzerland in the *SH & PS* variable.[26]

Results are reported in Table 3. There is some evidence of a club effect given that the coefficient estimates for this variable are positive and statistically significant, albeit only weakly. However, this third-country effect is only significant in combination with the Safe Harbor and Privacy Shield [columns (5)-(8)] and not for the other adequacy agreements [columns (1)-(4)]. Considering these results, taking the expected value of the coefficient estimates imply an economic effect of the two Transatlantic data deals of about 14 percent, which must be seen as an upper-bound (see below), and a network effect of 13 percent.[27]

24 Two countries that have an EU adequacy decision have not (yet) extended such equivalence determinations to other members of the "adequacy club:" New Zealand and Canada. To date, New Zealand has not formally designated any country as providing equivalent data protection, although it is an active proponent of digital economy partnership agreements which include provisions on data flows (Honey, 2021). This does not mean however that digital trade between New Zealand and other EU adequacy-granted countries would increase as a result of EU adequacy as long as the services and goods traded between them contains EU citizens data which is governed by the GDPR. Canada does not have privacy legislation that provides for the possibility to use adequacy decisions as a tool to support international data transfers. On Canada's digital trade-related policy, see Fay & Ciuriak (2022).

25 Other countries, e.g., Colombia, that recognize the EU/EEA as well as third countries as adequate but have not received an EU adequacy determination are not included in our third-country variable.

26 We also remove the one-year break between the repeal of Safe Harbor and adoption of Privacy Shield to reflect the four month "grace period" granted by the CJEU for companies under the Safe Harbor to continue to transfer personal data across the Atlantic without having to adopt additional safeguard measures such as SSCs and BCRs.

27 The recent literature estimating the impact of services PTAs on trade in services find that ambitious provisions are associated with 15–65 percent higher bilateral trade (Borchert and Di Ubaldo, 2021).

Table 3: Results with third-country effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ	0.009	-0.017	-0.045	-0.038				
	(0.851)	(0.686)	(0.452)	(0.490)				
ADQ THRD	-0.092	-0.054	-0.034	-0.033				
	(0.320)	(0.391)	(0.609)	(0.605)				
SH & PS (excl. CHE)					0.114**	0.139***	0.149***	0.113***
					(0.016)	(0.002)	(0.001)	(0.007)
SH & PS THRD					0.101*	0.101**	0.152*	0.139*
					(0.074)	(0.045)	(0.066)	(0.070)
PTA (Data e-com)	0.045	0.067	0.099*	0.031	0.046	0.067	0.099	0.031
	(0.526)	(0.316)	(0.100)	(0.668)	(0.519)	(0.315)	(0.104)	(0.664)
WTO	-0.383***	-0.418***	-0.460***	-0.484***	-0.371***	-0.402***	-0.441***	-0.468***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.002)
DPD	-0.105***	-0.114***	-0.099***	-0.075**	-0.068*	-0.061*	-0.039	-0.029
	(0.006)	(0.002)	(0.008)	(0.030)	(0.069)	(0.074)	(0.256)	(0.353)
CON 181	0.011	-0.001	0.013	0.008	0.008	-0.004	0.011	0.006
	(0.672)	(0.972)	(0.584)	(0.726)	(0.752)	(0.884)	(0.657)	(0.795)
CBPR	0.051	0.053	0.054	0.031	0.045	0.042	0.043	0.024
	(0.195)	(0.154)	(0.183)	(0.449)	(0.255)	(0.250)	(0.284)	(0.554)
EU	0.097	0.092	0.087	0.089	0.089	0.081	0.078	0.082
	(0.224)	(0.205)	(0.210)	(0.164)	(0.272)	(0.279)	(0.272)	(0.204)
Obs.	101904	102024	102312	102408	101904	102024	102312	102408
R2	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Notes: All specifications include origin, destination, origin-destination, and O-D-time fixed effects. Information denotes "information industries" as defined in the text. All four specifications of digital trade include ICT goods. *, **, and *** denote 10%, 5% and 1% significance levels.

Baier and Bergstrand (2007), Bergstrand et al. (2015) and Anderson and Yotov (2016) have found evidence for both anticipatory and lagged effects of PTAs.[28] We consider both types of dynamic effects. For the phasing-in effects, we apply a 1-year lag (-1) on all variables of interest, including for the one measuring the third-country effect, for both the conventional adequacy and for the two EU-U.S. data agreements. For the anticipatory effects, we apply a 1-year lead (+1) on all similar variables. Findings are reported in Table 4. Lagging the *ADQ* variable results in statistically significant coefficient estimates for the two broadest specifications of digital trade for the third country effect, but not for the main *ADQ* variable or when leading *ADQ* by one year. For the *SH & PS* variable, results suggest significant dynamic effects when applying the lag, but the standard variable measuring the two U.S. agreements remains significant in columns (7) and (8) while the anticipatory effect continue to be insignificant or even negative in the last column. Further, the results indicate an anticipatory effect for the group of third countries.

28 Larch et al. (2019) note that ideally one should not see anticipatory effects so that the actual variable of interest would not measure any trade effects which are already in place.

Table 4: Results with leads, lags and third-country effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ (-1)	0.014	0.008	-0.021	-0.016				
	(0.722)	(0.829)	(0.658)	(0.717)				
ADQ THRD (-1)	0.043	0.085	0.099*	0.094**				
	(0.564)	(0.265)	(0.078)	(0.049)				
ADQ	-0.008	-0.027	-0.016	-0.017				
	(0.737)	(0.223)	(0.516)	(0.435)				
ADQ THRD	-0.073	-0.066	-0.058	-0.056				
	(0.215)	(0.257)	(0.235)	(0.220)				
ADQ (+1)	-0.011	-0.008	-0.023	-0.017				
	(0.776)	(0.805)	(0.396)	(0.508)				
ADQ THRD (+1)	-0.088	-0.084	-0.064	-0.060				
	(0.595)	(0.538)	(0.423)	(0.411)				
SH & PS (-1) (excl. CHE)					0.155***	0.162***	0.173***	0.142***
					(0.001)	(0.000)	(0.000)	(0.001)
SH & PS THRD (-1)					0.021	0.016	0.094	0.083
					(0.660)	(0.727)	(0.194)	(0.199)
SH & PS (excl. CHE)					0.028	0.033	0.041**	0.037**
					(0.209)	(0.140)	(0.047)	(0.043)
SH & PS THRD					0.018	0.029	0.020	0.020
					(0.342)	(0.131)	(0.424)	(0.389)
SH & PS (+1) (excl. CHE)					-0.032	-0.016	-0.038	-0.043**
					(0.302)	(0.562)	(0.111)	(0.047)
SH & PS THRD (+1)					0.098**	0.089***	0.080**	0.071**
					(0.012)	(0.008)	(0.011)	(0.017)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
FE O-year	Y	Y	Y	Y	Y	Y	Y	Y
FE D-year	Y	Y	Y	Y	Y	Y	Y	Y
FE O-D	Y	Y	Y	Y	Y	Y	Y	Y
O-D Trend	Y	Y	Y	Y	Y	Y	Y	Y
Obs.	93412	93500	93764	93830	93412	93500	93764	93830
R2	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Note: All four specifications of digital trade include ICT goods. *, **, and *** denote 10%, 5% and 1% significance levels. Results assume no break between the two Transatlantic agreements. Control variables not reported but are included in the regressions.

4.2 Robustness: Alternative gravity data and clustering errors

To assess the robustness of the previous results we repeat the analysis using an alternative gravity data set, the International Trade and Production Database for Estimation (ITPD-E) (Borchert et al., 2021) and applying three-way clustering following Egger and Tarlea (2015). The ITPD-E is constructed using administrative data and therefore does not include information estimated by statistical techniques. Another advantage is that it covers many more countries and industries and sectors than the TiVA database, in particular for developing countries, albeit at a cost to data quality.[29] Results are reported in Annex Table 5. The estimate of *SH & PS* is not significant, but the third-country effect comes out as highly significant for the narrow definition of digital trade.[30] Estimations incorporating leads and lags using ITPD-E data (Annex Table 6) now show a different outcome for the SH & PS variable which comes out as highly significant for all digital trade. The network effect is weakly significant in column (5). No anticipatory effects are found. Using the more conservative estimates, the significant coefficient estimates imply an economic effect of about 8-9 percent following the two Transatlantic data deals.

5. Digital Value-added Trade

Thus far all regressions have used gross exports and thus ignores value-added embedded in gross trade. Teasing out the value-added of trade allows to assess the share of exports that originates domestically or else is sourced from foreign countries (Johnson and Noguera, 2012; World Bank, 2020). The foreign value-added content of exports is particularly relevant when considering the third-country effects of U.S. adequacy found previously, which suggests that given a Transatlantic data agreement, other countries with adequacy benefit by sourcing more digital inputs from each other, as well as by EU members and the U.S., insofar these inputs contain personal data form the EU or if network countries recognize each other as adequate too.

This effect can be estimated by measuring the extent to which foreign value-added in exports of adequacy-granted countries is sourced from each other, including the U.S., during the time when Safe Harbor and the Privacy Shield were implemented. To investigate this, we follow the approach of Borchert and Di Ubaldo (2021), who construct a variable that captures the share of value-added sourced from country *o* in the exports of the country *d* in total value-added exports of the latter country. Because this approach assesses the foreign value added that is exported in shares, it essentially measures a composition effect of foreign value-added exports in digital sectors that is increasingly sourced from inside the network of adequacy-granted countries. We compute this for all four specifications of digital trade in the same way using TiVA data. Hence, we use trade data on the origin of value added in gross exports, namely the EXGR BSCI indicator from TiVA, and compute:

$$share\ XVA_{odt}^{dig} = \frac{XVA_{odt}^{dig}}{\sum_o XVA_{odt}^{dig}} \qquad (2)$$

where $share\ XVA_{odt}^{dig}$ denotes the share of exported value-added of a destination country *d* in digital sectors that is sourced from origin country *o* in total digital value added exported by the destination country. Here the country combination *o-d* represents all trading partners that have received adequacy involving the U.S. too. Note again that the variable measuring the third country effect would not include the adequacy agreements between EU members and the U.S. nor between EU members and any other country received adequacy; it only covers third countries.

29 ITPD-E only has trade in services data starting in 2000, the year Safe Harbor was agreed. Without applying the one-year break in 2015, the non-varying *SH & PS* dummy variable in our covered period could incorrectly evaluate the Transatlantic trade effect. As Eastern European countries acceded to the EU in 2004 or 2007, a significant coefficient might measure whether digital trade was created with or diverted from the US after accession, and not the adequacy decision. We therefore allow for the 2015-break.

30 The results using TiVA, with a break and three-way clustered standard errors are reported in Annex Table 7. Results for the *SH & PS* variable remain statistically significant, but those for the club variable lose significance.

Results are reported in Table 5, applying three-way clustered standard errors. As before we first estimate the third-country effect for the conventional adequacy agreements alone, i.e., excluding the U.S., and then in a second step include the U.S. The third country effects for the conventional adequacy decisions provides a negative and significant outcome for the two largest definitions of digital trade in columns 3 and 4.

Coefficient estimates for the third country effect involving the U.S. are positive and weakly significant in the first two specifications for digital trade in columns 5 and 6.[31] The variables measuring the direct effect of adequacy decisions are imprecisely estimated throughout all columns. The results suggest that the adequacy EU-U.S. decisions had a positive impact on the composition of digital trade (in value-added) with about 7 percent shifting away from being sourced from non-adequacy-granted countries (or the domestic market) to countries within the adequacy network.[32]

Table 5: Value-added in exports (XVA) with 3rd country effects, break in SH & PS & 3-way clustering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ	0.049	0.035	0.021	0.013				
	(0.437)	(0.515)	(0.453)	(0.610)				
ADQ THRD	-0.056	-0.048	-0.085**	-0.086**				
	(0.284)	(0.194)	(0.014)	(0.014)				
SH & PS (excl. CHE)					-0.051	-0.023	-0.045	-0.046
					(0.202)	(0.519)	(0.190)	(0.187)
SH & PS THRD					0.073*	0.061*	0.041	0.041
					(0.051)	(0.054)	(0.198)	(0.198)
PTA (Data e-com)	0.064	0.078	0.117	0.116	0.063	0.078	0.116	0.115
	(0.515)	(0.455)	(0.332)	(0.339)	(0.515)	(0.453)	(0.331)	(0.338)
WTO	-0.201*	-0.180*	-0.185**	-0.183**	-0.203*	-0.181*	-0.187**	-0.184**
	(0.054)	(0.073)	(0.035)	(0.022)	(0.051)	(0.071)	(0.033)	(0.020)
DPD	-0.111*	-0.084*	-0.052	-0.058	-0.124*	-0.091*	-0.064	-0.069
	(0.084)	(0.097)	(0.275)	(0.204)	(0.060)	(0.084)	(0.201)	(0.147)
CON 181	0.017	-0.020	-0.012	-0.015	0.017	-0.020	-0.011	-0.014
	(0.751)	(0.645)	(0.761)	(0.687)	(0.746)	(0.640)	(0.771)	(0.699)
CBPR	0.083*	0.099**	0.110**	0.113**	0.099**	0.111**	0.123***	0.126***
	(0.068)	(0.044)	(0.019)	(0.011)	(0.030)	(0.025)	(0.009)	(0.005)
EU	0.168	0.074	0.036	0.029	0.163	0.071	0.031	0.024
	(0.154)	(0.541)	(0.757)	(0.797)	(0.165)	(0.558)	(0.789)	(0.830)
Obs	102144	102576	102720	102816	102144	102576	102720	102816
R2	0.968	0.975	0.978	0.980	0.968	0.975	0.978	0.980
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Notes: All specifications include origin, destination, origin-destination, and O-D-time fixed effects. Information denotes “information industries” as defined in the text. All four specifications of digital trade include ICT goods. *, **, and ***denote 10%, 5% and 1% significance levels.

31 Results include the 2015 break. Dropping this break provides even stronger results.

32 As noted by Borchert and Di Ubaldo (2021) it is not possible to estimate which of the two channels of this composition effect dominates as value added initially sourced from the domestic market cannot be distinguished from non-adequacy-granted countries due to the country-year fixed effects. Results should therefore be interpreted as an average change in foreign value-added to adequacy-granted countries. Using results from the regressions without the 2015 break applied, this composition effect would have been about 13 percent taking the narrow definition of digital trade.

6. Heterogeneous effects of adequacy: a synthetic control approach

The relationship between adequacy and digital trade might be country specific, with any positive association driven in part by the characteristics of the country considered and those it trades with. To consider such potential country-specificity, we depart from the bilateral gravity framework and use a synthetic control approach to consider two case studies. Synthetic control methods (SCM) permit inferring the effect of adequacy by comparing the performance of a jurisdiction granted adequacy with that of a synthetic counterfactual group that matches the characteristics of the country receiving adequacy. SCM minimize pre-adequacy differences between the treated country and a constructed (synthetic) counterfactual by aggregating the pool of potential control units without adequacy based on their individual performance with respect to both the outcome of interest (digital trade) and the variables used for matching purposes (Abadie et al., 2015; Opatrny, 2021). Provided a set of identifying assumptions hold, the difference between the treated and synthetic control in the post-adequacy period can be attributed to being granted adequacy.[33]

We consider New Zealand and Argentina. Argentina represents an interesting case study as its digital trade expanded substantially during the sample period, reflected for example in the activity of MercadoLibre, the largest on-line e-commerce platform in Latin America. Moreover, as one of only two Latin American Spanish speaking countries with EU adequacy, the selection of the donor pool is straightforward.[34] New Zealand is an interesting case because it is English speaking and geographically remote, located in a time zone that is hours ahead/after the time zone of the EU and U.S., the two largest digital services traders (WTO, 2023).[35]

6.1 Methodology

We follow Hollingsworth and Wing (2022), using a matching algorithm that relies on the Least Absolute Shrinkage and Selection Operator (Lasso) for the selection of the mix of matching variables and pre-adequacy lags for the dependent variable. Variable selection through Lasso regression analysis has the advantage of not involving subjective assumptions regarding the relevance of each pre-adequacy period in the definition of the set of matching covariates. The synthetic control (SC) estimator of the effect of adequacy, $\widehat{\beta_{st}}$, can be summarized as follows:

$$\widehat{\beta_{st}} = Y_{0t\prime} - Y_t^* = Y_{0t\prime}(1) - \sum_{s=1}^{S} Y_{st\prime}\pi_s \quad (3)$$

where $Y_t^* = \sum_{s=1}^{S} Y_{st\prime}\pi_s$ is a weighted combination of control units and $Y_{0t\prime}$ (1) is the post-adequacy performance of a "treated" country (New Zealand or Argentina) with respect to the outcome of interest.[36] The parameter π_s is the weight attached to each country in the donor pool, and captures the similarity of a potential control country to the one of interest, which in turn depends on the set of matching variables considered and their trends in the pre-adequacy period. For Argentina, the donor pools include all Spanish speaking countries in Latin America. In the case of New Zealand, the donor pool spans all English-speaking countries in the Indo-Pacific area included in the TiVA database, excluding the US and Canada given that they both received adequacy themselves and are located in a very different time zone.

33 Hollingsworth and Wing (2022) summarize the set of "pseudo-identifying" assumptions and identify a series of threats to the validity of estimates. The assumptions are: (i) no spillover effects (or, no interference between units); (ii) Factor Structure Model (performance of unexposed countries is driven by a set of common factors that vary over time but is constant across countries); (iii) performance of unexposed units is allowed to vary from each other due to an idiosyncratic exogenous shock; (iv) no pre-period perfect multicollinearity of common factors; and (v) existence of weights such that a synthetic counterfactual actually exists. The five assumptions are needed to ensure that a synthetic counterfactual can be constructed and be used for causal inference. Assumptions (i) and (v) are readily verifiable. Concerning the former, Argentina or New Zealand receiving adequacy did not affect the policy on digital trade or data protection in the potential controls in the period considered. As for the latter, the fact that we were able to get a synthetic counterfactual proved itself the existence of the weights. The remaining 3 assumptions rely on unobserved factors, although the restricted geographical span provides confidence that the trends control units were subjected to respect all three assumptions. See Abadie (2021) and the references cited there for a more detailed discussion on threats to validity in the SCM setting.

34 We cannot include Uruguay, the other Latin American country with an EU adequacy decision, as it is not covered by the TiVA database.

35 Trade in services is sensitive to time zones (Head et al., 2009).

36 The notation assumes *s = 0, ..., n* countries, with *s = 0* representing the treated country and *s = 1,..,n* representing the donor pool.

To illustrate the role of the matching variables, the SC estimator can be rewritten as

$$\widehat{\beta_{st}} = argmin_{\beta}\left\|X_t^{pre} - \beta X_S^{pre}\right\| = \sqrt{\sum_p \left(X_{t,p}^{pre} - \sum_{i\in S}\beta_p\, X_{S,p}^{pre}\right)} \quad (4)$$

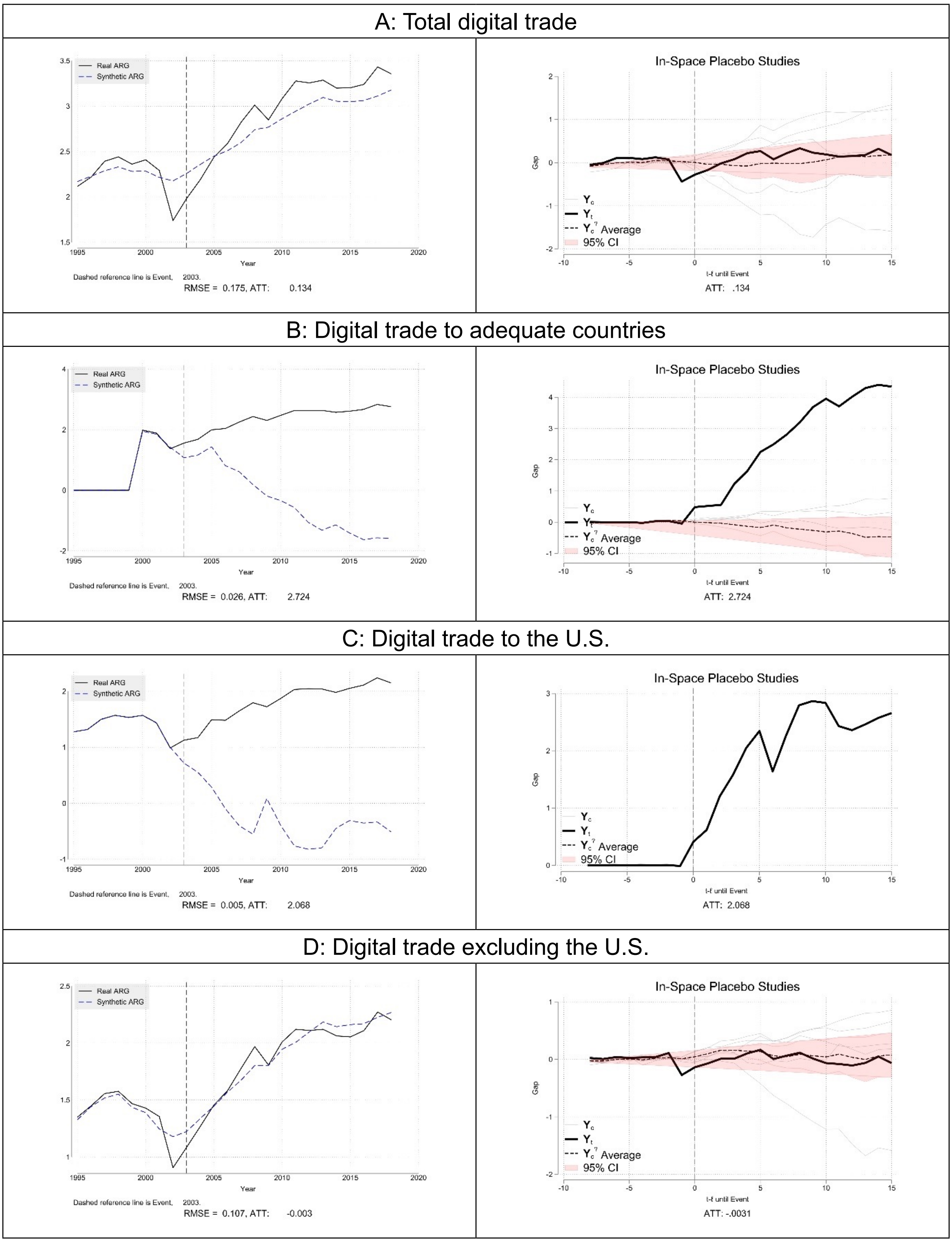
i.e. as an optimization problem minimizing the distance between all the observable characteristics of the control units ($X_S,\ S = 1, \dots, S$) and the country obtaining adequacy (X_o).[37] We estimate the effect of adequacy using the most comprehensive definition of digital trade, i.e. the fourth definition provided in Annex Table 4. The set of potential matching variables include, in addition to pre-adequacy digital trade (in logs): domestic trade in digital goods and services, total trade (also both in logs), the ratio of digital trade on total trade, per capita GDP (in logs), plus a set of country specific fixed effects to absorb all country specific characteristics (such as time zone and geographic location) that do not vary over time.

6.2 Results

We present four variants for each of the two case studies, with results plotted in four stacked panels in Figures 2 and 3. Panel A reports results for total digital trade; Panel B restricts the dependent variable to trade flows with other countries granted adequacy by the EU); Panel C reports results for digital trade with the U.S.; and Panel D reports results for trade with non-U.S. countries granted adequacy. Each left-hand side plot compares the actual performance of the treated country (the solid line labelled "real") with that of its synthetic control (the dashed line). The year that adequacy was granted is indicated by the vertical dashed line (2003 for Argentina and 2013 for New Zealand). In addition to the stacked SC plots for each of the four trade scenarios defined above, we also report an accompanying "spaghetti plot", reporting the in-space placebo test obtained by randomly assigning adequacy to any of the potential control units. This additional exercise provides a measure of the confidence that the effects identified through the SCM can be attributed to adequacy and not to any country specific trends. These plots therefore provide information on the robustness/reliability of the SC estimates.

37 Abadie (2021) shows that the SC estimator is biased, although such bias is bounded and decreasing provided the underlying identifying assumptions are valid. As noted, the set of identifying assumptions hold in both our exercises, although the relatively short pre-adequacy period for Argentina case might raise minor concerns.

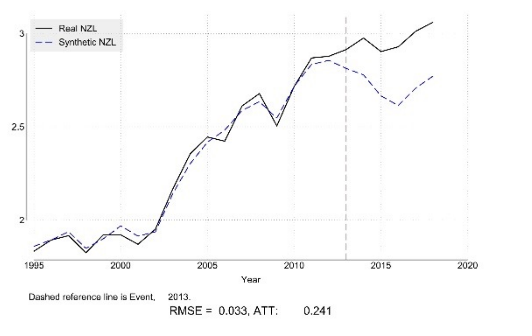
Figure 2: Synthetic Control Estimates – Argentina

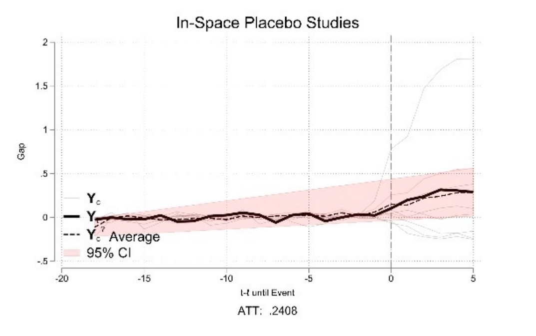


Notes: The outcome of interest is total digital trade, which includes Information industries, Business, Financial & Insurance, Accommodation, Education, and Health services.

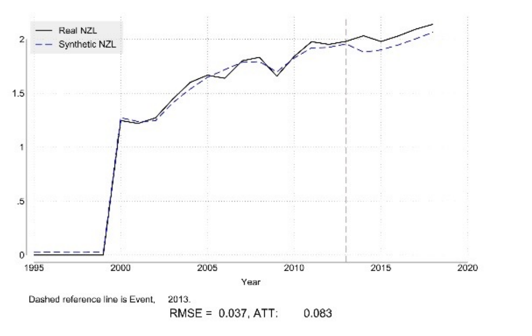
Figure 3: Synthetic Control Estimates – New Zealand

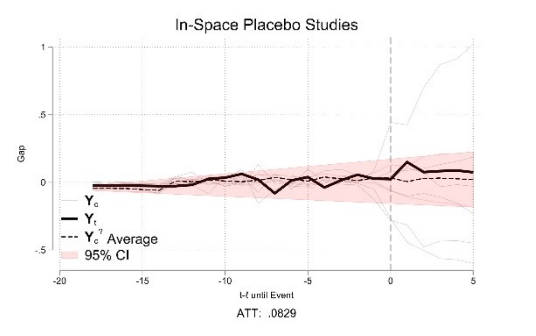
A: Total digital trade



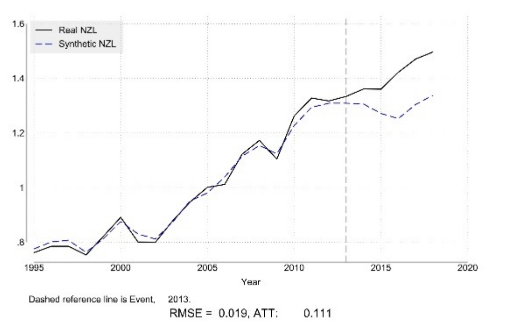


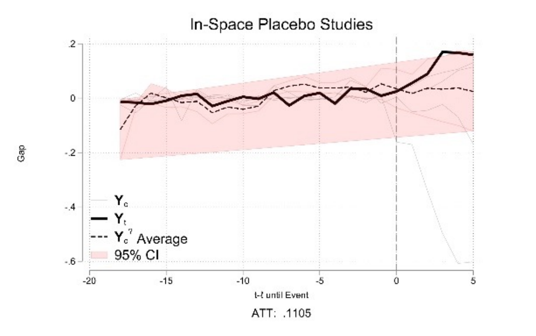
B: Digital trade to adequate countries



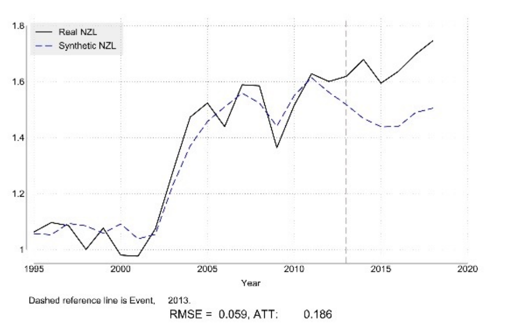


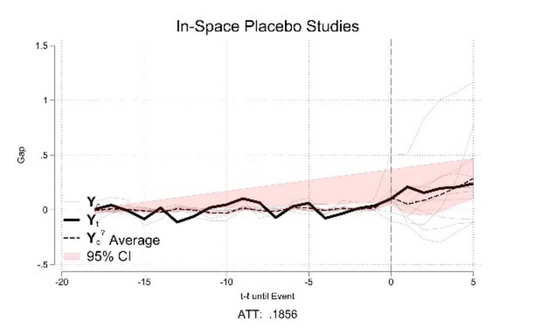
C: Digital trade to the U.S.





D: Digital trade excluding the U.S.





Notes: The outcome of interest is total digital trade which includes Information industries, Business, Financial & Insurance, Accommodation, Education, and Health services.

The results are consistent with our gravity estimates in showing that adequacy can be important for digital trade. The two case studies also highlight that such effects can be very heterogenous, reflected in the large difference in the estimated effects for the two countries. Figure 2 shows that total digital trade has been increasing both in Argentina and in the Latin American countries considered in the control pool. Panel A suggests that the adequacy decision did not boost Argentina's digital trade beyond the increasing trend over time observed in the Latin American control group. However, focusing only on trade with countries granted EU adequacy (Panel B), the performance of Argentina diverges substantially from that of the Latin American countries included in the donor pool, increasing post-adequacy, while that of the control group shows a declining trend.

The Argentina results suggest adequacy was associated with sustaining Argentina's digital trade whereas otherwise it would have been characterized by the performance of the counterfactual group of countries. Panel C suggests that this "adequacy effect" is driven by digital trade with the U.S. The pattern of both the increase in digital trade for Argentina and the decline for the countries in the donor pool control group in Panel C is very similar to that in Panel B. Panel D repeats the exercise in Panel C for all countries, irrespective of adequacy status, but excluding the US. This shows that Argentina and the control group display virtually identical performance. Thus, these results are consistent with the main message concerning the importance of the U.S. that emerged from the gravity regressions.

The SC results for New Zealand show a different pattern in that although there is an increase in total digital trade relative to the donor pool (Panel A) we do not observe the divergence in performance between the treated country and the control group. Digital trade of New Zealand with countries that have adequacy is very similar to that of the donor pool (Panel B). However, we again obtain the US result in that trade with the US shows a more positive trend than is the case for the donor pool, but the differences are less stark.[38]

7. Conclusion

Using a structural gravity model and controlling for digital-relevant bilateral covariates, including PTAs with binding data flow provisions, we find that countries that received EU adequacy exhibit an increase in digital trade between 6-14 percent, representing a trade cost reduction up to 9 percent. This trade effect is driven largely by the two data protection agreements the EU granted to the U.S., as no significant trade effects are found for other countries that received adequacy. Results from the SCM as an alternative estimation approach confirm that the positive impact of adequacy on digital trade is largely driven by the agreement between the EU and the U.S.

An additional new finding from the analysis is evidence from both the gravity and synthetic control analysis of a network effect of EU adequacy determinations. Countries with adequacy exhibit greater digital trade among each other. This effect also appears to be associated with the U.S.: countries within the EU adequacy network benefit indirectly from the two adequacy decisions granted to the U.S., as their digital exports to this market increased following the agreement of each Transatlantic data deal. This network effect is reflected in a change in the composition of digital trade within supply chains. We find that approximately 7 percent of digital value-added trade shifted towards the "club" of adequacy countries, away from other sources. Moreover, the SCM also reveals substantial heterogeneity across the network of adequacy countries, with the U.S. playing a clear role in the case of Argentina, but much less so for New Zealand. At any rate, these results indicate EU adequacy decisions matter for digital trade but not necessarily for digital trade with the EU.

38 For both Argentina and New Zealand, digital trade with the EU, the largest market among the countries with adequacy and the hub of its network of adequacy partners, does not respond to adequacy. It only increases marginally for New Zealand, while showing no effects in the Argentinian case.

The EU is often championed as a regulatory pioneer in the digital economy, which is said to have a large influence in the rest of the world, a phenomenon sometimes referred to as the “Brussels effect”. Our findings suggests that for digital trade flows such an effect is more complex and contingent on the EU’s largest digital trading partner, namely the U.S. This also applies to the potential network or “club” effect of EU adequacy decisions. How robust these findings are to inclusion of additional large countries in the network of adequacy and digital partnerships is an important and policy-relevant question for future research.

Data constraints precluded the inclusion of three recent adequacy decisions granted to Japan, Korea, and the UK. These are relatively large countries and thus there is potential that these agreements may further alter digital trade directly and indirectly with the EU. Future research will be important to assess if and how our findings are affected by these additional adequacy decisions. Similarly, trade data availability precluded assessment of the impact of the CJEU decision striking down Privacy Shield. Future research should encompass other agreements as well. While we control for digital-relevant PTAs, especially those that contain binding data protection provisions, a wave of new digital-related agreements in the form of digital partnerships have been established recently on a bilateral and plurilateral basis. Assessing the impacts of these arrangements is presently not possible because not enough time has passed to generate the trade data needed to do so. Future research should empirically assess the trade effect of regulatory recognition of not only data protection regimes, but also other areas covered by these digital partnerships that are very relevant for digital trade.

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Annex

Annex Table 1: Adequacy decisions, 2000 – 2021

Adequacy agreement	Year	EEA relevance	Note
EU - Switzerland	2000	Yes	
EU - United States (SH)	2000	Yes	Till 2014 (repealed in 2015)
EU - Canada	2002	No	20 Dec 2001
EU - Argentina	2003	Yes	
EU - Guernsey	2003	Yes	
EU - Isle of Man	2004	Yes	
EU - Jersey	2008	Yes	
Switzerland - United States (SH)	2009	N/A	Till 2014 (repealed in 2015)
EU - Andorra	2010	Yes	
EU - Faroe Islands	2010	Yes	
EU - Israel	2011	Yes	
EU - Uruguay	2012	Yes	
EU - New Zealand	2013	Yes	19 Dec 2012
EU - United States (PS)	2016	Yes	Till 2019 (repealed in 2020)
Switzerland - United States (PS)	2017	N/A	Repealed in 2020
EU - Japan	2019	N/A	
EU - UK	2021	N/A	
EU - South Korea	2021	N/A	

Annex Table 2: Variable description and sources

Variable	Description	Source
ADQ	Adequacy	European Commission & Swiss Government; see Annex Table 1
PTA	Preferential Trade Agreement (includes Customs Union, Free Trade Agreement, Partial Scope Agreement, Economic Integration Agreement)	Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008)
PTA (Data e-com)	Preferential Trade Agreement with binding data-related provisions related to free flow of data and data protection	Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008) & Trade Agreements Provisions on Electronic-commerce and Data (TAPED) (Burri & Polanco, 2020
WTO	World Trade Organization	WTO & ITPD-E gravity database
DPD	Data Protection Directive	EU
CON 118	Council of Europe Protocol No. 8 to the Convention for the Protection of Human Rights and Fundamental Freedoms (Treaty No. 118)	Spiezia and Tscheke (2020) & Council of Europe
CBPR	APEC Cross Border Privacy Rules System	Spiezia and Tscheke (2020) & APEC from apec.org
EU	European Union	ITPD-E gravity database
Digital trade	Data / digital-intensity measure	Ferracane and van der Marel (2021a), OECD-WTO-IMF Handbook, privacysheild.org & US Census

Annex Table 3: Share of organizations / firms covered by Privacy Shield (PS)

Sector description	# organizations PS	US Census category	# firms Census	Share companies covered by PS
Information and communication technology	2067	Information	79,662	**2.59**
Business and professional services	617	Professional, scientific, and technical services	811,320	**0.08**
Healthcare	230	Healthcare and social assistance	655,069	**0.04**
Media and entertainment	120	Arts, entertainment, and recreation	130,107	**0.09**
Financial services	117	Finance and insurance	238,408	**0.05**
Education	102	Educational services	93,500	**0.11**
Travel and tourism	63	Travel and tourism	74,929	**0.08**
Distribution and logistics	34	Transportation and warehousing	185,028	0.02
Retail trade	29	Retail trade	647,927	0.00
Energy	12	Utilities	5,957	0.20
Design and construction	11	Construction	701,477	0.00
Food and beverages	11	Accommodation and food	539,886	0.00
Wholesale trade	9	Wholesale trade	298,127	0.00

Source: authors' calculations using privacyshield.gov and US Census.

Annex Table 4: Alternative specifications of digital trade

Sector	Specifications for digital sectors				Software-labor ratio	ISIC Rev 4
	(1)	(2)	(3)	(4)		
Information	●	●	●	●	N/A	26; 58-63
Computer electronics	●	●	●	●	N/A	26
Publishing & audio-visuals	●	●	●	●	2.69	58-60
Telecom	●	●	●	●	4.05	61
IT & Info	●	●	●	●	5.28	62-63
Business services		●	●	●	0.99	69-75, 77, 78-82
Finance & Insurance			●	●	2.77	64-66
Accommodation				●	0.04	55-56
Education				●	0.26	85
Health				●	0.26	86-88

Note: Software-labor ratios are based on van der Marel and Ferracane (2021a)

Annex Table 5: ITPD-E data with 3rd country effects & three-way clustering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ	-0.093	-0.064	-0.066	-0.068				
	(0.468)	(0.495)	(0.825)	(0.552)				
ADQ THRD	0.105	0.014	0.061	0.061				
	(0.585)	(0.863)	(0.930)	(0.606)				
SH & PS (excl. CHE)					0.005	0.025	0.042	0.027
					(0.914)	(0.946)	(0.917)	(0.940)
SH & PS THRD					0.150***	0.127	0.143	0.146
					(0.000)	(0.629)	(0.647)	(0.713)
PTA (Data e-com)	-0.038	-0.014	-0.023	-0.050	-0.037	-0.013	-0.021	-0.048
	(0.723)	(0.783)	(0.899)	(0.370)	(0.566)	(0.935)	(0.908)	(0.759)
WTO	-0.340***	-0.294*	-0.308*	-0.299	-0.343***	-0.291	-0.309*	-0.298
	(0.005)	(0.052)	(0.069)	(0.102)	(0.001)	(0.120)	(0.085)	(0.150)
DPD	-0.243	-0.149	-0.158	0.142	-0.246	-0.153	-0.161	0.140
	(0.427)	(0.582)	(0.516)	(0.505)	(0.443)	(0.548)	(0.540)	(0.445)
CON 181	-0.022	0.056	0.062**	0.075	-0.022	0.055	0.062**	0.075*
	(0.466)	(0.190)	(0.024)	(0.157)	(0.446)	(0.113)	(0.020)	(0.053)
CBPR	0.003	-0.019	-0.017***	-0.077	0.011	-0.011***	-0.007***	-0.066***
	(0.977)	(0.752)	(0.000)	(0.244)	(0.838)	(0.000)	(0.000)	(0.000)
EU	0.124	0.075	0.092	-0.021	0.131	0.088	0.108	-0.007
	(0.622)	(0.748)	(0.616)	(0.903)	(0.645)	(0.650)	(0.617)	(0.955)
Obs.	485314	658291	356763	656437	657161	381714	362650	361348
R2	0.994	0.992	0.982	0.991	0.995	0.985	0.982	0.983
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Note: All specifications include origin, destination, origin-destination, O-D-time fixed effects and 3-way clustering of standard errors. *, **, and *** denote 10%, 5% and 1% significance levels.

Annex Table 6: TiVA data, 3rd country effects & three-way clustering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ	0.009	-0.017	-0.045	-0.038				
	(0.842)	(0.726)	(0.435)	(0.495)				
ADQ THRD	-0.092	-0.054	-0.034	-0.033				
	(0.149)	(0.318)	(0.286)	(0.268)				
SH & PS (excl. CHE)					0.076	0.094**	0.091*	0.075*
					(0.124)	(0.023)	(0.070)	(0.062)
SH & PS THRD					0.069	0.072	0.098	0.094
					(0.194)	(0.131)	(0.170)	(0.170)
PTA (Data e-com)	0.045	0.067	0.099*	0.031	0.048	0.070	0.103*	0.035
	(0.531)	(0.334)	(0.061)	(0.690)	(0.510)	(0.319)	(0.061)	(0.655)
WTO	-0.383***	-0.418***	-0.460***	-0.484***	-0.374***	-0.406***	-0.447***	-0.472***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
DPD	-0.105**	-0.114**	-0.099*	-0.075	-0.079	-0.075	-0.058	-0.041
	(0.040)	(0.014)	(0.082)	(0.122)	(0.163)	(0.123)	(0.296)	(0.424)
CON 181	0.011	-0.001	0.013	0.008	0.009	-0.003	0.012	0.006
	(0.710)	(0.975)	(0.613)	(0.728)	(0.762)	(0.912)	(0.649)	(0.769)
CBPR	0.051	0.053	0.054	0.031	0.048	0.046	0.048	0.028
	(0.208)	(0.222)	(0.330)	(0.585)	(0.228)	(0.265)	(0.369)	(0.617)
EU	0.097	0.092	0.087	0.089	0.091	0.084	0.081	0.084
	(0.412)	(0.377)	(0.392)	(0.343)	(0.433)	(0.414)	(0.421)	(0.369)
FE O-year	Y	Y	Y	Y	Y	Y	Y	Y
FE D-year	Y	Y	Y	Y	Y	Y	Y	Y
FE O-D	Y	Y	Y	Y	Y	Y	Y	Y
O-D Trend	Y	Y	Y	Y	Y	Y	Y	Y
Cluster	O, D, Y	O, D, Y	O, D, Y	O, D, Y	O, D, Y	O, D, Y	O, D, Y	O, D, Y
Obs.	101904	102024	102312	102408	101904	102024	102312	102408
R2	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Note: Information denotes "information industries" as defined in the text. All four specifications of digital trade include ICT goods. *, **, and *** denote 10%, 5% and 1% significance levels.

Annex Table 7: ITPD-E data, lags and leads, 3rd country effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ (-1)	-0.100	-0.051	-0.186	-0.155				
	(0.193)	(0.750)	(0.280)	(0.265)				
ADQ THRD (-1)	-0.007	0.007	0.331	0.096				
	(0.969)	(0.983)	(0.432)	(0.920)				
ADQ	0.003	0.023	0.013	0.009				
	(0.967)	(0.771)	(0.847)	(0.919)				
ADQ THRD	-0.095	-0.426	-0.369	-0.408				
	(0.668)	(0.372)	(0.362)	(0.405)				
ADQ (+1)	-0.072	0.060	0.069	0.072				
	(0.381)	(0.569)	(0.467)	(0.488)				
ADQ THRD (+1)	-0.086	0.234	0.210	0.257				
	(0.529)	(0.544)	(0.613)	(0.644)				
SH & PS (-1) (excl. CHE)					0.059	0.150*	0.144***	0.052
					(0.209)	(0.087)	(0.008)	(0.462)
SH & PS THRD (-1)					0.135**	0.328***	0.479***	0.503***
					(0.012)	(0.002)	(0.000)	(0.002)
SH & PS (excl. CHE)					0.169***	0.449***	0.544***	0.593***
					(0.001)	(0.000)	(0.000)	(0.000)
SH & PS THRD					0.089*	0.031	0.022	0.056
					(0.093)	(0.644)	(0.739)	(0.372)
SH & PS (+1) (excl. CHE)					-0.003	0.062	0.074	0.106
					(0.948)	(0.359)	(0.158)	(0.111)
SH & PS THRD (+1)					0.010	-0.000	0.019	-0.002
Controls	Y	Y	Y	Y	Y	Y	Y	Y
FE O-year	Y	Y	Y	Y	Y	Y	Y	Y
FE D-year	Y	Y	Y	Y	Y	Y	Y	Y
FE O-D	Y	Y	Y	Y	Y	Y	Y	Y
O-D Trend	Y	Y	Y	Y	Y	Y	Y	Y
Obs.	252250	253125	264620	230305	252045	236367	286033	306561
R2	0.989	0.979	0.974	0.971	0.989	0.981	0.979	0.979
Information	●	●	●	●	●	●	●	●
Business		●	●	●		●	●	●
Fin. & Insur.			●	●			●	●
Accomm.				●				●
Education				●				●
Health				●				●

Note: Information denotes “information industries” as defined in the text. All four specifications of digital trade include ICT goods. *, **, and *** denote 10%, 5% and 1% significance levels.

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