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WORKING PAPER

Digital Trade, Data Protection and EU Adequacy Decisions*

Martina Ferracane (EUI), Bernard Hoekman (EUI and CEPR)†, Erik van der Marel (ECIPE and ULB) and Filippo Santi (Università di Bologna)

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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 with digital trade provisions and other data flow arrangements, we find that countries that obtained EU adequacy exhibit an increase in digital trade ranging between 6-14 percent, representing a trade cost reduction up to 9 percent. This is mostly driven by EU adequacy arrangements with the U.S., reflecting the dominance of the EU and U.S. in global digital trade. Countries granted EU adequacy exhibit more digital trade between each other, suggestive of a club effect. Complementary country-specific analysis of post-adequacy digital trade performance using synthetic control methods confirms our findings.

Keywords: Digital trade; data protection; mutual recognition; regulatory equivalence; clubs

JEL codes: D18; F13; F14: K24; L88; O38

Declaration of interest: None

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† Corresponding author. Robert Schuman Centre, European University Institute, via Boccaccio 121, Florence 50133 Italy. Email: bernard.hoekman@eui.eu.

Non-technical Summary

Digital trade is a fast-growing part of the world economy, accounting for 12% to 22% of world trade, depending on the definition of digital goods and services. Growth rates of digital-based services associated with cross-border data flows over online networks have been outpacing all other types of trade. Such trade is subject to regulations, including requirements pertaining to the protection of personal data crossing borders.

An EU trade partner may request a determination by the European Commission that its regulatory regime offers a level of data privacy protection that is similar enough to that of the EU to enable data to move freely between the two jurisdictions. A positive adequacy evaluation by the Commission requires that the country has a regime that is 'essentially equivalent' to the European one. Between 2000 and 2021, the EU granted adequacy status to 15 states or territories. If adequacy is granted, personal data can flow freely to and from the EU, Norway, Lichtenstein, and Iceland and the pertinent jurisdiction, akin to intra-EU data flows.

In this paper we assess the digital trade implications of EU adequacy decisions. Given that there is no official definition of digital trade, we construct four alternative measures. The first comprises information and communications technology goods plus core digital services: computer and information services, publishing and telecommunications. We then progressively add to this (1) business and professional services, (2) financial services, and (3) restaurants, accommodation, health, and education services. Altogether, the four definitions range from a narrow to a very broad set of digital goods and services.

We find that the EU adequacy decisions positively affect digital trade between the EU and the countries that obtain adequacy decisions. Countries that obtained EU adequacy exhibit an increase in digital trade ranging between 6-14 percent, representing a trade cost reduction of up to 9 percent. This positive trade effect is driven to an important extent by the adequacy decisions pertaining to the United States (U.S.).

Beyond the two transatlantic partners, other adequacy-receiving countries appear to have benefitted indirectly from the adequacy decisions granted to the U.S. An additional new finding from the analysis is evidence of a 'club effect' of EU adequacy decisions. Countries with adequacy exhibit greater digital trade among each other. This effect appears to be associated with the granting of adequacy to US companies. Countries with an EU adequacy determination benefit indirectly from the data adequacy agreement between the EU and the US, as their digital exports increased following the implementation of transatlantic data deal.

This club 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. This may reflect the fact that global supply chains in both digital goods and services are spread across many countries. If American firms outsource their data-based activities to third countries with an EU adequacy

determination, the trade cost of doing so is lower as no additional personal data protection safeguards are required.

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 complement our empirical analysis with case studies for Argentina and New Zealand. In each instance we compare the digital trade performance of these two countries, which were granted adequacy by the EU at different points in time, with a suitable comparator group of countries that have similar characteristics to Argentina and New Zealand, respectively, and simulate what digital trade performance would have been had each country not obtained an adequacy decision.

We find that the adequacy decisions had a significant positive impact on digital trade with other countries that also have adequacy status, corroborating the EU adequacy 'club effect', but also show that the drivers of increased intra-club trade differ. In the case of Argentina, the increase reflects trade with the United States. In the case of New Zealand, the club effect reflects trade with countries with adequacy *other* than the United States.

Digital Trade, Data Protection and EU Adequacy Decisions

1. Introduction

Digital trade – encompassing digitally deliverable services and information and communications technology (ICT) products – has been growing rapidly, outpacing other categories of trade (WTO, 2023).[1] Digitally delivered services accounted for over half of world trade in services (54%) in 2022 (World Bank and WTO, 2023). Such trade is subject to a range of regulatory measures (Ferracane, 2022). One important example is personal data protection regulation and associated restrictions on cross-border data flows. Policies restricting trade in services have historically been reflected in measures affecting the ability of suppliers 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 increasing regulation of digital transactions and cross-border data flows. Digital trade is data intensive, with firms using data as an input into R&D, product design, production processes, logistics, marketing, sales and engagement with customers and clients. These data require processing, storage, and analysis in multiple countries with associated digital value chains.

The European Union (EU) is a "market leader" in personal data protection (Bradford, 2020; Cervi, 2022). The EU General 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 determining that a country has a regulatory regime that ensures a level of personal data protection equivalent to that of the EU. A formal system to establish adequacy, based on strong regulatory oversight and due process procedures, has been put in place by the European Commission (EC). Once approved, an adequacy decision permits companies to freely transfer data to and from the EU and the country granted adequacy. Such determinations are expected to reduce trade costs by removing the need for companies to obtain individual consent for cross-border

[1] As discussed further in Section 3.1, in the empirical analysis we use different definitions of digital trade, including both digital goods and digital-enabled services – financial, telecommunications, computer, information, business, professional, audio-visual, and recreational services.

data transfers or employ firm-specific contractual mechanisms to ensure data privacy (Saluste, 2021).

In this paper we use a structural gravity modelling framework to evaluate whether EU adequacy decisions are associated with greater bilateral digital trade. The EU case is 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.[2] Controlling for digital-relevant bilateral covariates, including preferential trade agreements (PTAs) that encompass provisions on digital trade as well as other 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 partner country. This represents a trade cost reduction of 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).[3]

Of particular interest considering current debates on directing trade in sensitive products towards countries that share similar values and regulatory regimes (e.g., Hoekman *et al*. 2023), we also find that states with an EU adequacy decision exhibit more digital trade among each other. Specifically, 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 grew in connection with the two Transatlantic data deals. This network effect is also reflected in a change in the composition of digital trade within supply chains: approximately 7 percent of digital value-added trade shifts toward the "club" of countries with EU 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 does not permit to assess the country-specific impact of adequacy on overall digital trade. To do so,

[2] While other states may also have mechanisms to accord mutual recognition to data protection regimes (IAPP, 2023) these are generally less developed.
[3] EU-U.S. digital trade flows were US$ 264 billion in 2020 (U.S. Bureau of Economic Analysis).

we apply synthetic control methods to two countries with an EU adequacy decision, Argentina and New Zealand. In both cases we find a positive effect of adequacy on digital trade, with the impact being larger 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 several robustness checks. Section 5 repeats the gravity estimation using value-added data instead of gross trade. Section 6 presents the results of a synthetic control approach to assess the country-level effects of adequacy for Argentina and New Zealand. Section 7 concludes.

2. Regulatory framework, descriptive evidence and related literature

In 1998, the EU implemented the Data Protection Directive (DPD).[4] 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.[5] 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.[6] The DPD was replaced by the GDPR in 2018.[7] 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

[4] 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.
[5] Directive 95/46/EC, Art. 25.
[6] CJEU 6 October 2015, Case C-362/14, Schrems, ECLI:EU:C:2015:650.
[7] Regulation (EU) 2016/679 of the European Parliament and of the Council. At https://eur-lex.europa.eu/eli/reg/2016/679/oj .

EU members plus the European Economic Area (EEA) countries – Norway, Iceland, and Lichtenstein.

The GDPR continues to provide for adequacy decisions and lays 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 latter path is cumbersome, especially for large-scale transfers of data, as derogations are interpreted restrictively by the European Data Protection Board (Saluste, 2021).[8]

Surveys show 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 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 and Restuccia, 2021; Breinlich and Criscuolo, 2011).[9]

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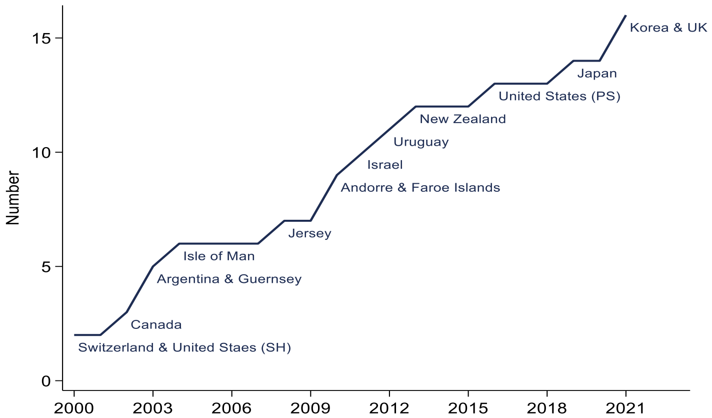
[8] EDPB (2018), Guidelines 2/2018 on derogations of Article 49 under Regulation 2016/679, 25 May 2018, at https://edpb.europa.eu/our-work-tools/our-documents/guidelines/guidelines-22018-derogations-article-49-under-regulation_en

[9] 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.

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 13 adequacy decisions agreed through 2018, the last year for which we have trade data,[10] including both adequacy frameworks agreed with the U.S. 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 certify compliance with the applicable standards.

Figure 1: *EU adequacy decisions, 2000-2021*



Source: European Commission. See Annex Table 1.

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.[11] 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.[12] 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

[10] Consequently, we are unable to include the adequacy decisions granted to Japan (2019), the UK (2021) and South Korea (2021) in the analysis.

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

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

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. Following the 2020 ruling of the CJEU striking down Privacy Shield, in 2023 the EC approved a third mechanism called the EU-US Data Privacy Framework (EC, 2023).[13]

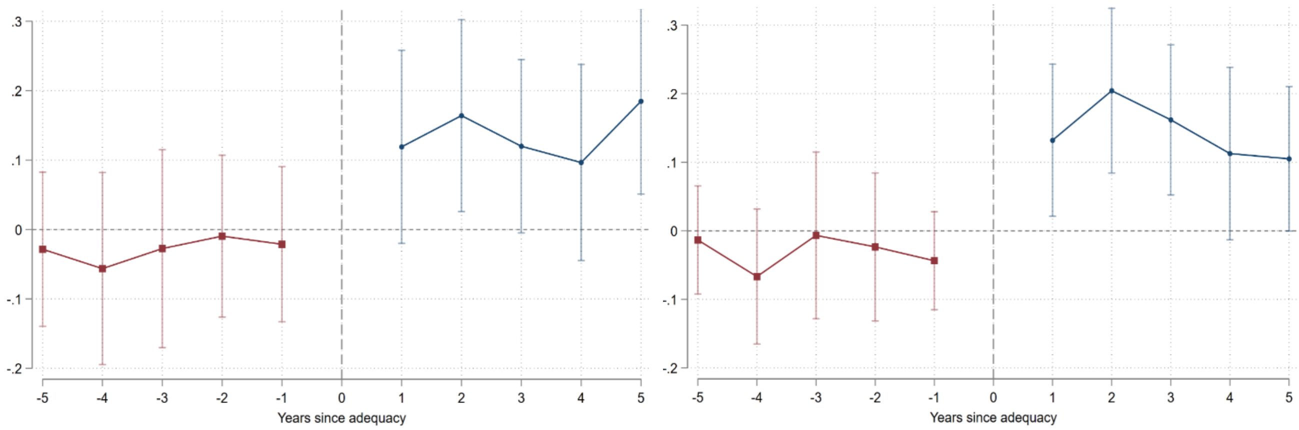
The increasing number of adequacy decisions granted by the EU to its trading partners raises questions about their impact on digitally enabled trade. Of particular interest is the potential "network effect" of bilateral adequacy determinations. Bilateral regulatory recognition arrangements create opportunities for a state with an adequacy agreement with Country A to consider other countries that also have an adequacy framework with Country A as being equivalent, thus facilitating digital trade. We contribute to the literature by assessing whether there is evidence of such digital trade facilitation associated with bilateral data adequacy decisions.

A simple event study assessing the relationship between adequacy determinations and bilateral trade in information and communications and technology (ICT) goods and services between the EU and countries with an adequacy arrangement suggests there is a positive relationship.[14] Figure 2 plots the five-year period preceding an adequacy decision (at t=0) and the subsequent five years for EU exports to (left panel) and EU imports (right panel) from countries that obtain adequacy. Prior to an adequacy decision there is no statistically significant increase in trade activity compared to countries that have not and will not be granted adequacy in the relevant sample period. Post-adequacy we observe an increase in digital trade, with coefficient estimates that are statistically significant in several years post-adequacy. A test of the equality of coefficients 1 year before and 1 year after adequacy is rejected, with p-values of 0.0004 or smaller.

[13] Whether this will survive legal challenge remains to be determined. As our trade data go through 2018, the 2020 decision and subsequent events do not affect the empirical analysis.

[14] In the empirical analysis we employ four definitions of digital trade, differentiated by the types of good and services included. The simple event study reported in Figure 2 pertains to ICT goods and services. Results for more comprehensive definitions of digital trade show comparable patterns.

Figure 2: *Bilateral digital trade and adequacy decisions*



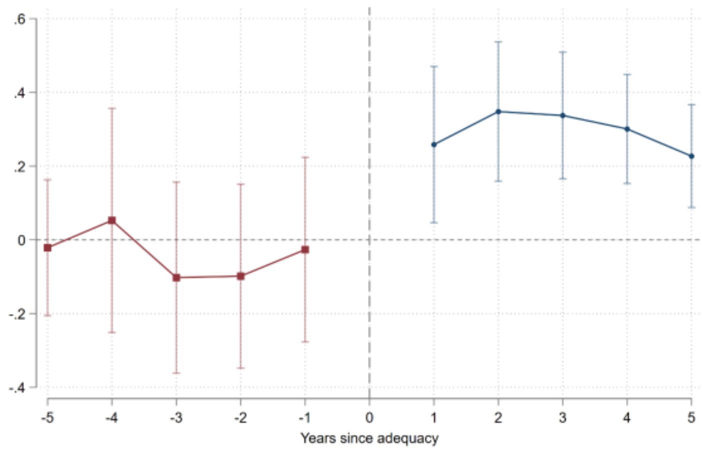
EU exports to ADQ countries

EU imports from ADQ countries

Source: Authors, based on TIVA data (OECD).

More interestingly, Figure 3 suggests that countries with EU adequacy decisions also expand digital trade with each other, relative to countries that do not obtain adequacy during the sample period.[15] This descriptive evidence motivates the structural gravity analysis and synthetic control undertaken in what follows.

Figure 3: *Bilateral digital trade among countries before and after EU adequacy*



Source: Authors, based on TIVA data (OECD).

[15] Figure pertains to exports of ICT goods and services, as by definition imports of countries with adequacy of such products from each other are equal to exports to each other.

2.1 Related literature

There is very limited empirical analysis of the trade effects of national data protection laws and regulation of cross-border data flows, and even fewer studies of the potential trade impacts of adequacy decisions. This is striking given the potential trade costs associated with differences in national data protection regimes and the potential for international cooperation to lower such costs. 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). 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 that exports are positively associated with data models that are 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.

A growing number of papers focus on recent vintage PTAs that include provisions on data flows or more broadly e-commerce (Wu, 2017; Burri and Polanco, 2020). This tends to find that such PTAs support greater trade in digital products (e.g., Wu *et al.*, 2023; Ma *et al.*, 2023).[16] In the analysis in this paper we therefore control for PTAs in general, as well as for the subset of PTAs that have binding (enforceable) provisions specifically related to data protection.

The paper that is most closely related to ours is Spiezia and Tscheke (2020), who assess the effects of both enforceable and non-enforceable data agreements through 2012, including the EU Safe Harbor and Privacy Shield decisions. They find an overall positive trade effect of the agreements considered.[17] We add to their analysis by focusing on all EU adequacy decisions through 2018 and measuring the specific *bilateral* arrangements for data protection separately, netting out any trade effects stemming from the DPD and subsuming within co-variates through fixed effects and control variables. We also expand on their analysis by defining and analysing different categories of digital trade as opposed to

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

[17] By including adequacy decisions in their DPD dummy, they capture within EU trade effects in addition to those with third countries. In this analysis we focus on extra-EU trade.

working with total goods and total services trade and complement the use of gravity regression frameworks with a synthetic control approach to assessing country-specific implications of adequacy.[18] Our paper is the first to assess potential 'club' effects of bilateral adequacy agreements.

3. Empirical approach and data sources

We utilize a structural gravity model framework,[19] 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 the 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 on trade only between the EU and countries granted adequacy.[20]

GRA_{odt} is a vector covering the standard dyadic covariates typically found in any gravity model. In our case, given the demanding set of fixed effects included in equation (1), 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

[18] The use of digital trade rather than total trade rests on the assumption that changes in data regulations will affect digital trade proportionately more, given that digital trade has been shown to be more data intensive (Ferracane and van der Marel, 2021a).
[19] The literature on structural gravity is extensive. See Anderson and van Wincoop (2003) and Melitz and Ottaviano (2008) and the discussion and references in Yotov *et al.* (2016).
[20] As a robustness check we also add Switzerland's adequacy decisions for the U.S. for reasons set out above. We therefore cover 15 adequacy decisions, 13 issued by the EU, and 2 by Switzerland (see Annex Table 1).

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.[21]

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, domestic trade, 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, and border. Assuming GRA_{odt}, together with the fixed effects, capture 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 initially clustered by country-pair, but as a robustness check we also cluster by country-pair-time.

To control for the possibility that adequacy agreements 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 a higher-than-average change in the trend of bilateral digital trade during the sample period relative to countries without adequacy. The resulting estimation framework is very demanding, as the three-way fixed effects 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). We utilize the procedures developed by Dai *et al.* (2014) which address the use of many 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.

[21] For example, that both EU member states and EEA signatories are covered by the DPD. The change from DPD (directive) to the GDPR (regulation) in 2018 does not affect this control variable given that both legal instruments cover a similar set of EU and EEA countries.

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).[22] The TiVA trade data are structured so that reporter and partner countries are only defined once as country o and country d. Given that the database records trade data which are squared and balanced across exports and imports, results are similar for both types of flows. We choose to use exports.

There is no generally accepted definition of digital trade. OECD-WTO-IMF (2023) separates digital trade into two (overlapping) sets of products, distinguishing between digitally ordered and digitally delivered trade. Because 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. Ferracane and van der Marel (2021a) develop an alternative approach to defining digital services by using 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

[22] TiVA does not report trade data for the five micro-states Guernsey, Isle of Man, Jersey, Andorra, and the Faroe Islands. Uruguay and Japan are included in our robustness checks when using ITPD-E trade data.

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 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 (2021a) classification.[23]

For the empirical analysis we construct four alternative measures of digital trade, using the TiVA sector classification (which is in line with ISIC Rev 4) to construct alternative definitions of digital trade, informed by the different efforts noted above. The differences in coverage are described in Annex Table 4. We start with (1) the TiVA category "Information industries" (called DINFO) which covers ICT goods plus core digital services: IT and information, publishing, and telecom services. This is denoted SPX1 in the analysis. We then progressively expand on this by adding (2) business and professional services (SPX2), (3) financial services (SPX3) and (4) restaurants, accommodation, health and education services (SPX4).[24] All four definitions include digital (ICT) goods. These are defined following the 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.[25]

4. Results

Table 1 presents the baseline results for digital exports, using the four different definitions of digital trade sectors as discussed above, where sectoral coverage progressively expands in subsequent columns as indicated in Annex Table 4. Due to the large number of fixed

[23] A survey of SMEs in four European markets, representing 65 percent of EU GDP and 55 percent of EU SMEs found 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 and ECIPE, 2021).
[24] 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), while energy is a good, not a digital deliverable service.
[25] OECD-WTO-IMF (2023) provides a list of 6-digit ICT products based on the HS-2017 classification, but it is not feasible to concord this to a specific 2-digit ISIC sector used in TiVA.

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*).

We find a positive and significant coefficient estimate for the adequacy variable in the first four specifications [columns (1) – (4)] where only the PTA and WTO terms are added as controls. As the definition of digital trade used expands to cover more sectors, the economic importance of the estimate somewhat declines. Estimates for specification (4) add personal, health and education services and thus 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 at least in the sample period PTAs had little effect on digital trade. This possibility is consistent with the fact that PTAs have only recently begun to include data-related provisions (Wu, 2017).[26] As the general PTA term might therefore be too broad to capture any impact on digital trade, we use a narrower set of PTAs that include digital trade provisions as part of our robustness checks.[27] The WTO variable is negative and strongly significant, indicating no relationship between WTO accession during the sample period and digital trade.

Columns 5-8 report estimates for specifications with additional control variables relevant to digital trade. The first is *DPD,* the 1995 data protection directive, requiring the protection of citizens with regard 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. The agreement 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 this convention varies by year.

[26] 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.

[27] 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.

Table 1: *Baseline regression for Adequacy (ADQ)*

Flow	SPX 1	SPX 2	SPX 3	SPX 4	SPX 1	SPX 2	SPX 3	SPX 4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADQ	0.073***	0.085***	0.072***	0.056**	0.061**	0.073***	0.062**	0.050**
	(0.004)	(0.000)	(0.005)	(0.022)	(0.014)	(0.001)	(0.010)	(0.031)
PTA	-0.020	-0.017	-0.017	-0.007	-0.019	-0.016	-0.015	-0.006
	(0.519)	(0.574)	(0.586)	(0.836)	(0.535)	(0.591)	(0.616)	(0.863)
WTO	-0.367***	-0.403***	-0.450***	-0.475***	-0.376***	-0.412***	-0.457***	-0.479***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.002)
DPD					-0.078**	-0.077**	-0.062*	-0.044
					(0.032)	(0.023)	(0.067)	(0.155)
CON 181					0.010	-0.002	0.013	0.008
					(0.693)	(0.947)	(0.584)	(0.721)
CBPR					0.041	0.039	0.039	0.020
					(0.298)	(0.287)	(0.322)	(0.611)
EU					0.091	0.085	0.081	0.084
					(0.256)	(0.251)	(0.249)	(0.191)
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

Notes: *, **, and *** denote 10%, 5% and 1% significance levels, respectively. P-values in parenthesis. The four definitions of digitally enabled trade are reported in Annex Table 4.

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 only a few firms have used this system – e.g., only 20 U.S. firms had obtained certification as of 2019 (Fefer, 2019). Finally, we control for EU membership given that adequacy decisions are issued by the EU.[28]

The coefficient estimates for *ADQ* for the four different specifications of digital trade become somewhat smaller with inclusion of the controls but continue to be significant, albeit at only the 5% level for SPX(1) and SPX(3). Apart from the coefficient estimate for

[28] 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 the date of EU accession.

DPD, which is weakly significant, the controls are insignificant. Negative estimates for *DPD* were also found by Spiezia and Tscheke (2020) and may reflect high compliance costs associated with heterogeneity in implementation of the Directive by EU member states that negatively affects 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 this analysis by (a) distinguishing between US and other adequacy decisions; (b) including Switzerland with respect to the two adequacy agreements it concluded with the U.S.; and (c) including only PTAs with binding data-related provisions. The EU-U.S. adequacy agreements are by far the most important in terms of the volume of trade covered and are also somewhat different because firms need to sign up for them. They also were issued twice because of the CJEU decision, so that the regulatory framework for transatlantic data flows varies more over time than that applying to other countries granted adequacy.

The inclusion of Switzerland is motivated by the fact that we are interested in whether the two Swiss data agreements with the U.S. are not altering in any way the trade effect when separating between the Safe Harbor and Privacy Shield agreements and other adequacy decisions.[29] Adequacy decisions granted by Switzerland to the U.S. are deeply intertwined with those of the EU. The first two adequacy decisions of the EU were granted to Switzerland and the U.S. 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 two years later in 2017, which in turn was also repealed in 2020 after the invalidation of the EU-U.S. Privacy Shield by the CJEU.[30]

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[29] In the baseline analysis we apply a one-year gap between Safe Harbor and the Privacy Shield frameworks 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.

[30] The Swiss administration maintains a list of adequate countries which resembles closely that of the EU. We do not include these in our robustness checks because although 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, Switzerland's 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

Given that many PTAs do not specifically address digital trade, we use information from the Trade Agreements Provisions on Electronic-commerce and Data (TAPED) database to identify a subset of PTAs negotiated since 2000 with digital-related provisions to develop a variable that captures binding provisions on data protection in a specific e-commerce chapter (Burri and Polanco, 2020).[31]

Table 2: *Differentiating between adequacy partners and type of PTA*

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

Notes: SH: Safe Harbor; PS: Privacy Shield. All specifications include origin, destination, origin-destination, and O-D-time fixed effects. The four definitions of digitally enabled trade are reported in Annex Table 4. *, **, and *** denote 10%, 5% and 1% significance levels, respectively. P-values in parentheses.

Table 2, columns (1)-(4) report results for the Safe Harbor and Privacy Shield agreements with the US (in which Switzerland is still excluded), while columns (5)-(8) add the two Swiss-U.S. data agreements. Coefficient estimates for the remaining non-US adequacy decisions are insignificant. Conversely, the 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. Including Switzerland lowers somewhat the size of

[31] 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.

the coefficient estimates. The PTA variable now becomes positive and weakly significant (at the 10% level) when financial services are included in the definition of digital trade. Results for controls 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 some 8 percent.

4.1 Network effects

Adequacy decisions may have implications for digital trade that go beyond flows between the country pair covered by an agreement. 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 frameworks presumably are similar as otherwise they would not have been granted adequacy by the EU. While bilateral digital trade is 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.[32]

The analysis of possible club 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 potential EU "adequacy club" effects, 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 non-EU country pairs having an adequacy decision are covered. We do this for both categories of adequacy decisions

[32] New Zealand and Canada have not (yet) extended such equivalence determinations to other members of the "adequacy club." Canada does not have privacy legislation providing for the possibility of using adequacy decisions to support international data transfers (Fay and Ciuriak, 2022).

separately, i.e., for the *ADQ* and the *SH & PS* variable.[33] In these regressions we continue to exclude Switzerland in the *SH* & *PS* variable.[34]

Results are reported in Table 3. There is some evidence of a club effect given that the coefficient estimates are positive and (weakly) significant. However, this third-country effect is only apparent in combination with the Safe Harbor and Privacy Shield [columns (5)-(8)] and not for the other adequacy agreements [columns (1)-(4)]. The expected value of the coefficient estimates imply an upper bound economic effect of the two Transatlantic data deals of some 14 percent, and a club effect of 13 percent.[35]

Table 3: *Results with third-country effects*

Flow	SPX 1	SPX 2	SPX 3	SPX 4	SPX 1	SPX 2	SPX 3	SPX 4
	(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)	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

Notes: All specifications include origin-year, destination-year, origin-destination, and origin-destination--trend fixed effects. Definitions of digitally enabled trade specified in Annex Table 4. *, **, and *** denote 10%, 5% and 1% significance levels, respectively. P-values in parentheses.

[33] The UK (post-Brexit) and Korea both obtained adequacy in 2021 and fall outside our sample period Other countries, e.g., Colombia, that recognize the EU/EEA as well as other countries as adequate but have not received an EU adequacy determination are not included in our adequacy network variable.

[34] 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 safeguard measures such as SSCs and BCRs. Japan only received adequacy in 2019 and therefore is excluded when using TiVA, but not when using ITPD-E data.

[35] To put these estimates in perspective, 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).

4.2 Leads and lags

Baier and Bergstrand (2007), Bergstrand *et al*. (2015) and Anderson and Yotov (2016) have found evidence for both anticipatory and lagged effects of PTAs. We control for such potential effects by applying a 1-year lag (-1) and lead (+1) on all variables of interest, including the measure of the third-country effect, for both the conventional adequacy decisions and the two EU-U.S. data agreements. Findings are reported in Table 4. Lagging adequacy-related variables by one year, results in larger coefficient estimates when considering the SH and PS agreements, whereas SH and PS are associated with a positive and significant network effect only when considered with a one-year lead. The SH and PS results indicate significant dynamic effects when applying the lag, and an anticipatory effect for the group of countries with adequacy.

Table 4: *Results with leads and lags*

Flow	SPX 1	SPX 2	SPX 3	SPX 4	SPX 1	SPX 2	SPX 3	SPX 4
	(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)
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

Note: Results assume no break between the two Transatlantic agreements. Control variables not reported but are included in the regressions. All specifications include origin-year, destination-year, origin-destination, and origin-destination--trend fixed effects. The four definitions of digitally enabled trade are reported in Annex Table 4. All four specifications of digital trade include ICT products. *, **, and *** denote 10%, 5% and 1% significance levels, respectively. P-values in parentheses.

4.3 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 apply 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, albeit at a cost to data quality and a shorter time frame until 2019.[36] Results are reported in Annex Table 5. The estimate of *SH & PS* is not significant, but the third-country effect is strongly significant for the narrow definition of digital trade.[37] The *SH & PS* variable becomes strongly significant for all definitions of digital trade when estimations incorporate leads and lags using ITPD-E data (Annex Table 6). 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

Up to this point all the regressions use gross exports and thus ignore value-added embedded in gross trade. Teasing out the value-added content 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).

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[36] 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 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.

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

The foreign value-added content of exports is particularly relevant when considering the club effect found in the previous section as the estimate was statistically significant in combination with the two U.S. adequacy decisions. This suggests that given a Transatlantic data agreement, other countries with EU adequacy benefit by sourcing more digital inputs from each other insofar these inputs contain personal data from the EU or from network countries recognizing each other as adequate too. This is because of the removal of the need to fulfil the costly procedures associated with SCCs and BCRs, which lowers trade costs for sourcing inputs within the adequacy network. Moreover, the statistical significance of the adequacy network effect only in relation to the U.S. may be explained by the strong role of the U.S. in digital trade, and the capacity for U.S. firms to adjust their digital supply chain activities whilst exploiting the cost advantages deriving from new adequacy decisions.

To investigate this, we measure 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. We follow Borchert and Di Ubaldo (2021), who construct a variable capturing the share of value-added sourced from country *o* in the exports of country *d* in total value-added exports of country *d*. This essentially measures a composition effect of foreign value-added exports in digital sectors sourced from inside the club of adequacy-granted countries. We compute this for all four specifications of digital trade in the same way using TiVA data. Specifically, we use trade data on the origin of value added in gross exports (the EXGR BSCI indicator from TiVA) to 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 network effect does not include the adequacy agreements between EU members and the U.S. or between EU members and any other country with adequacy; it only covers third countries. 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 effects for the conventional adequacy decisions point to a negative and significant outcome for the two largest definitions of digital trade in columns 3 and 4. The coefficient estimates for the third country effect involving the U.S. are however positive and weakly significant in the first two specifications for digital trade in columns 5 and 6.[38] The variables measuring the direct effect of adequacy decisions remain imprecisely estimated throughout. The results suggest that the adequacy EU-U.S. decisions were associated with a change in the composition of digital trade (in value-added), involving about 7 percent shifting away from being sourced from non-adequacy-granted countries (or the domestic market) towards countries within the 'adequacy club'.[39]

Table 5: *Adequacy and value-added in exports (XVA)*

Flow	SPX 1	SPX 2	SPX 3	SPX 4	SPX 1	SPX 2	SPX 3	SPX 4
	(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)	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

[38] Results include the 2015 break. Dropping this break provides even stronger results.
[39] 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.

Note: All specifications include origin, destination, origin-destination, O-D-time fixed effects and three-way clustering. The four definitions of digitally enabled trade are reported in Annex Table 4. All four specifications of digital trade include ICT products. *, **, and *** denote 10%, 5% and 1% significance levels, respectively. P-values in parentheses.

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 (i) the characteristics of the country considered; (ii) the characteristics of the country it trades with; and (iii) by the definition of digital trade considered. To take such potential country-specificity into account, we use a synthetic control approach to investigate 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 an artificially constructed (i.e., synthetic) counterfactual unit that approximates the performance of the country obtaining adequacy should such country never have obtained it. SCM minimize pre-adequacy differences between the treated country and a constructed 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.[40]

We consider the cases of New Zealand and Argentina. Argentina's digital trade expanded substantially during the period of analysis, reflecting the activity of companies such as MercadoLibre, the largest on-line e-commerce platform in Latin America. Moreover, as one

[40] 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 exists. The five assumptions ensure that a synthetic counterfactual can be constructed and used for causal inference. Assumption (i) is readily verifiable. Adequacy for Argentina or New Zealand did not affect digital trade policy or data protection in the potential controls in the period considered. Assumption (v) holds because we were able to generate a synthetic counterfactual, implying the existence of the weights. The remaining assumptions rely on unobserved factors, but the restricted geographical span provides confidence that the trends in control respect all three assumptions. See Abadie (2021) and the references cited there for more detailed discussion of threats to validity in the SCM setting.

of only two Latin American Spanish speaking countries with EU adequacy, the selection of the donor pool is straightforward.[41] New Zealand is English speaking and geographically remote, with a time zone hours ahead/behind those of the EU and U.S., the two largest digital services traders (WTO, 2023).[42]

6.1 Methodology

We follow Hollingsworth and Wing (2022) and use 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. The synthetic control (SC) estimator of the effect of adequacy, $\widehat{\beta_{st}}$, can be summarized as follows:

$$\widehat{\beta_{st}} = Y_{0t'} - Y_t^* = Y_{0t'}(1) - \sum_{s=1}^{S} Y_{st'}\pi_s \quad (3)$$

where $Y_t^* = \sum_{s=1}^{S} Y_{st'}\pi_s$ is a weighted combination of control units and $Y_{0t'}(1)$ is the post-adequacy performance of a "treated" country (New Zealand or Argentina) with respect to the outcome of interest.[43] 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 pool includes all Spanish speaking countries in Latin America; for New Zealand, the donor pool spans all English-speaking countries in the Indo-Pacific included in the TiVA database, excluding the US and Canada given that both were granted adequacy and are in a very different time zone.[44]

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

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

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

[41] Uruguay, the other Latin American country with EU adequacy, is not included in the TiVA database.
[42] Trade in services is sensitive to time zones (Head *et al.*, 2009).
[43] Of $s = 0, \dots, n$ countries, $s = 0$ represents the treated country and $s = 1, .., n$ the donor pool.
[44] Given its geographic remoteness from the EU, South Africa is also included in the donor pool, despite being in a more proximate time zone as it is far from New Zealand. Israel, another English-speaking country included in the dataset is instead excluded, due to being in a time zone that is incompatible with that of New Zealand, in close geographic proximity to the EU and remote from the country of interest.

(X_o).[45] 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. Variable selection through Lasso 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.

We estimate the effect of adequacy on all the four definitions of digital trade used throughout the previous section. Figures 4 and 5 report the results using the narrower definition of digital trade (information and communication services), respectively for Argentina and New Zealand. The results for the more comprehensive definitions of trade for both case studies are summarized in Annex Table 8, with the remaining SCM plots reported in Annex Figures 1-6.

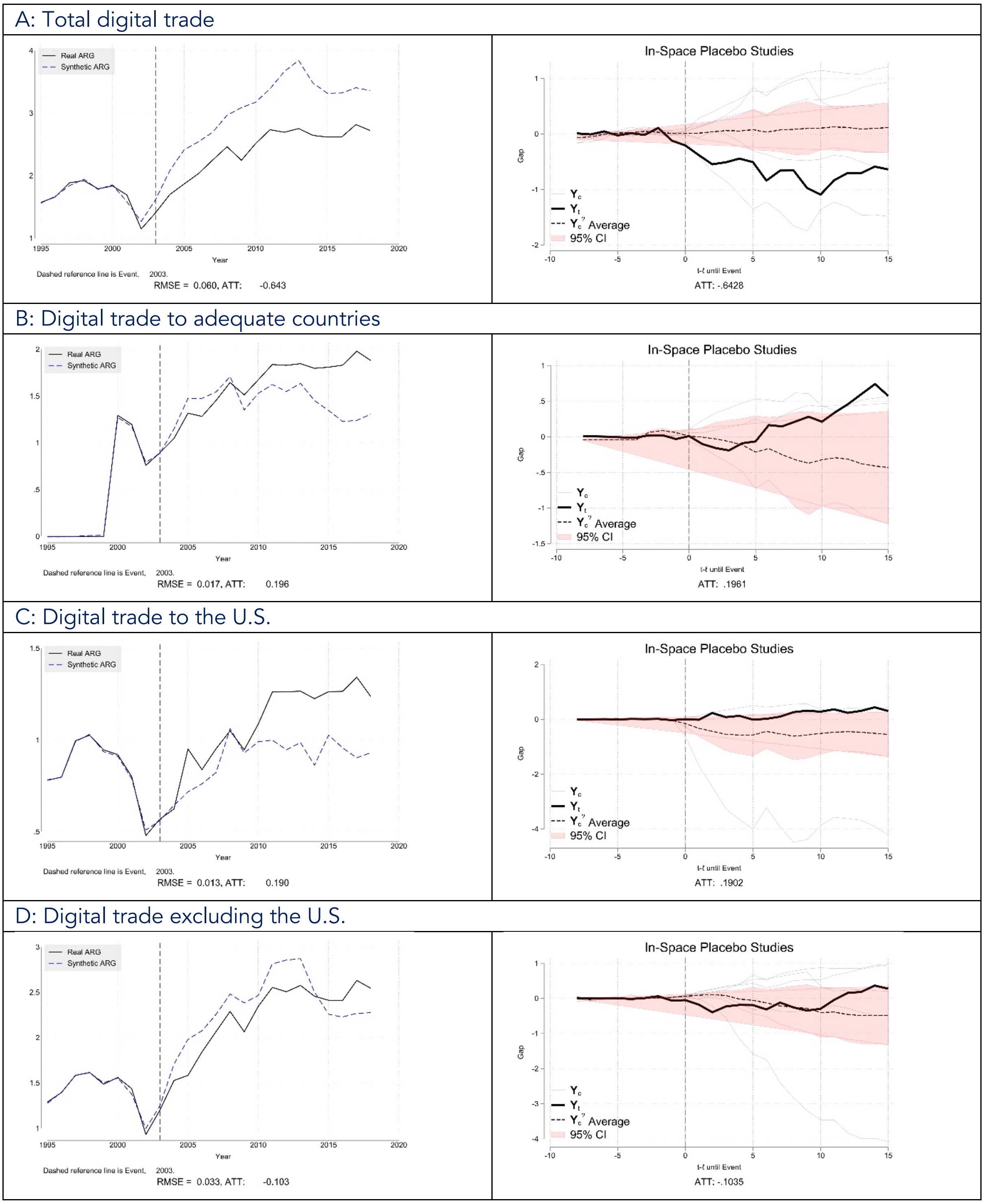
6.2 Results

We present four scenarios for the two case studies, with results plotted in four vertically stacked panels in Figures 4 and 5. Panel A reports results for digital trade to all partners irrespective of whether they have been granted adequacy; 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.; Panel D reports results for trade with non-U.S. countries.[46]

[45] Abadie (2021) shows that the synthetic control 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 pre-adequacy period for the Argentina case is relatively short.

[46] Annex Table 8 and Annex Figures 1 to 6 have the same structure.

Figure 4: *Synthetic Control Estimates – Argentina*



Note: The outcome of interest is digital trade in information and communication goods and services (SPX1).

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 which is 2003 for Argentina and 2013 for New Zealand. In addition to the stacked plots for each of the four trade scenarios defined above, we also report an accompanying "spaghetti plot" in the right-hand panels. These report 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 trend. These plots therefore provide information on the robustness of the synthetic control estimates.

The results plotted in Figures 4 and 5 (and Annex Figures 1 to 6) are largely consistent with the gravity estimates in showing that adequacy can matter for digital trade. The two case studies also highlight that the effect of adequacy can be heterogenous across countries, as reflected in the large difference in the estimated effects for the two cases. While total digital trade increased for both Argentina and New Zealand during the period considered, adequacy did not boost Argentina's digital trade beyond the trend increase observed in the Latin American control group. The estimates suggest Argentina performed relatively poorly compared to how it would have, absent the adequacy decision. Focusing only on trade with countries granted EU adequacy (Panel B), Argentina's performance differs from its synthetic counterfactual. While digital trade consistently increased following the adequacy decision, the synthetic counterfactual experienced an inverse-U trend, initially increasing but then declining. This suggests adequacy was associated with sustaining Argentina's digital trade whereas otherwise it would have been decreasing. Consistent with the gravity estimates, a comparison of Panels C and D reveals that this "adequacy effect" on digital trade is driven by the U.S.[47]

The results for New Zealand reveal a different pattern (Figure 5). Total digital trade increases relative to the donor pool (Panel A), but in this case the club effect reflects trade with countries with adequacy *other* than the U.S. (Panels B to D). While digital trade increases for New Zealand, there is a declining trend in its synthetic counterfactual (except for Panel C). Although this result is only statistically significant in Panel B, the overall trend suggests that adequacy might compensate in part for increasing restrictiveness of digital

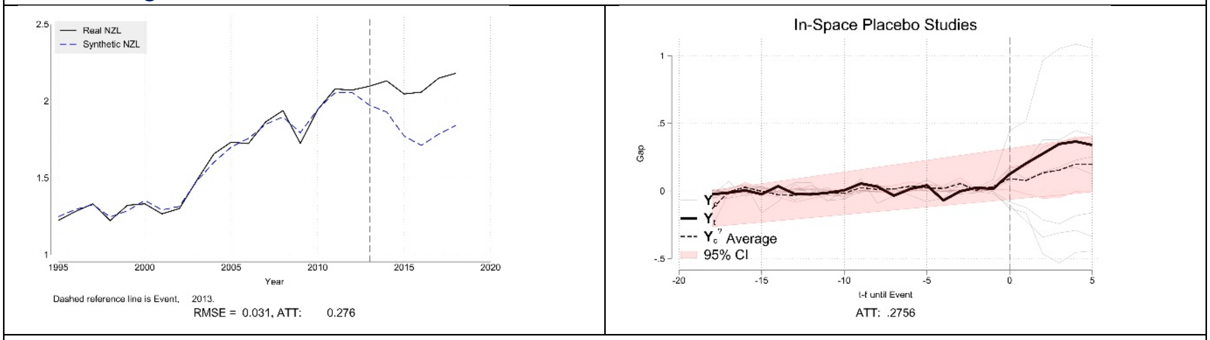
[47] Results do not change if we consider digital trade with all adequate countries except the U.S.

trade at global level. The two case studies suggest that the bilateral impact of adequacy and potential club effects depends on the specific country considered.

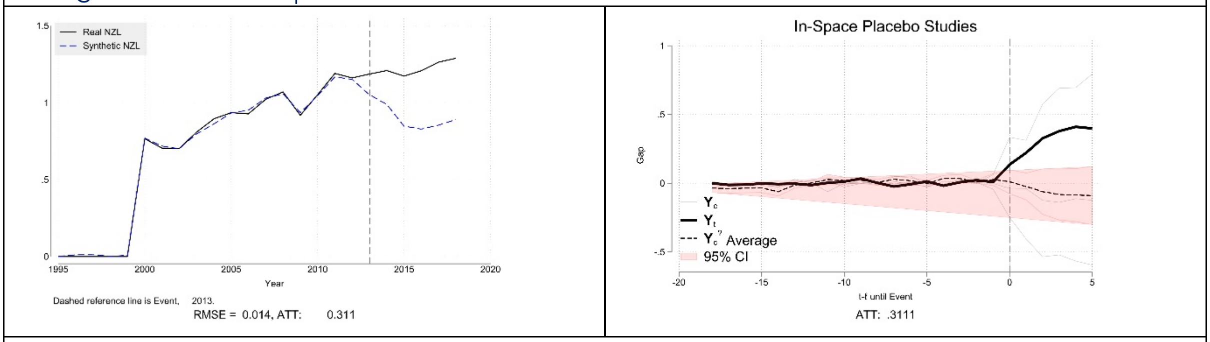
Results of the analysis using different definitions of digital trade reported in Annex Table 8 confirm that the impact of adequacy decisions is stronger for the narrower definition of digital trade in ICT products and business services. This suggests adequacy may be effective at promoting digital trade with the EU and other countries with an adequacy determination for more narrowly defined digital trade, but broader categories of digital trade are influenced more by other factors, with heterogeneity reflecting both country- and sector-specific factors that call for more granular analysis.

Figure 5: *Synthetic Control Estimates – New Zealand*

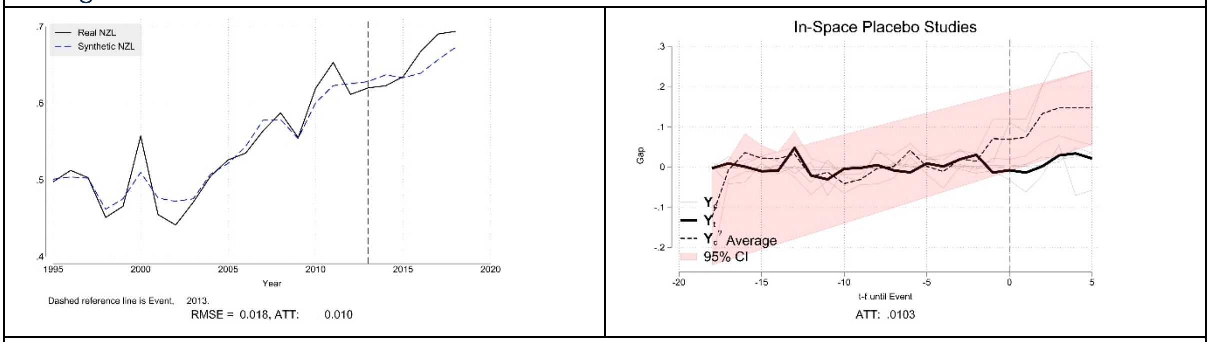
A: Total digital trade



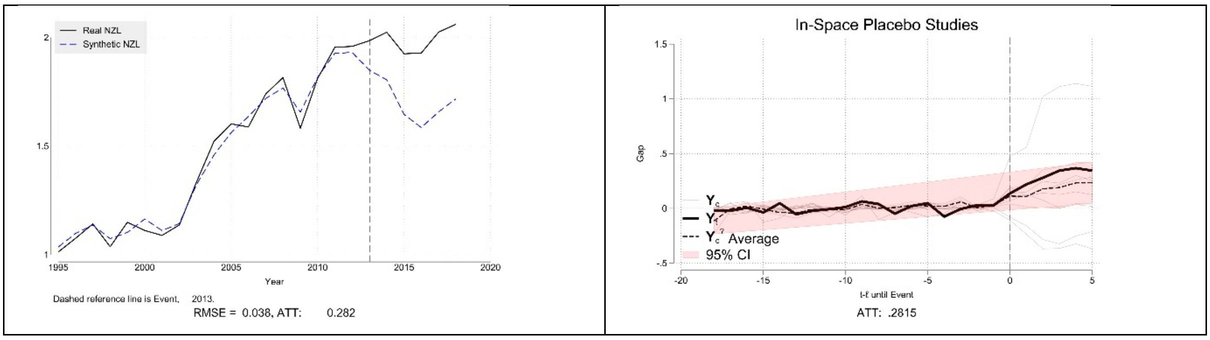
B: Digital trade to adequate countries



C: Digital trade to the U.S.



D: Digital trade excluding the U.S.



Note: The outcome of interest is digital trade in information and communication services and products.

7. Conclusion

Using a structural gravity model and controlling for digital-relevant bilateral covariates, including PTAs with binding data flow provisions, this paper finds 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 analyses of a club effect of EU adequacy decisions. 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 club 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 club 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. These results indicate that EU adequacy decisions matter for digital trade but not necessarily for digital trade with the EU.

The SCM methodology complements the gravity regression analysis which uses aggregate trade to estimate an 'average' club effect associated with adequacy. The SCM analysis provides additional insight into the structure and direction of trade within the 'adequacy club', reflected in the difference in results obtained for New Zealand and Argentina and for narrower as opposed to broader definitions of digital trade.

The EU is often championed as a leader in regulating the digital economy and to influence regulation in the rest of the world, the so-called "Brussels effect" (Bradford, 2020). Our findings suggests that for digital trade flows discerning any such effect is complex and contingent on the EU's largest digital trading partner, the U.S. This also applies to the potential club effect of EU adequacy decisions. A possible explanation of these findings is that U.S. companies are best equipped to take advantage of adequacy decisions, as they have the capacity to adjust their supply chains and exploit the benefits offered by being part of the club – a possibility that is supported by our results using value-added trade data. Another explanation could be connected to the specificity of the mechanisms of adequacy with the U.S., which rely on self-certification of participating companies. Only companies that want to certify incur additional costs, while other companies in the economy are not subject to additional data protection requirements that might impact productivity (Ferracane *et al*, 2020).

The robustness of these findings to the inclusion of additional large countries in the EU adequacy club and digital partnership agreements that are beginning to be negotiated among non-EU countries is an important and policy-relevant question for future research. Data constraints precluded the inclusion of three most recent EU adequacy decisions agreed with 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. Once sufficient time has passed to generate the required trade data, future research will be important to assess if and how our findings are affected by these additional EU adequacy decisions, the impact of the CJEU decision striking down the Privacy Shield agreement, and the digital trade partnership agreements being negotiated on a bilateral and plurilateral basis (Honey, 2021).

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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	No. of organizations (PS)	US Census category	No. of 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 (SPX)				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-labour ratios sourced from 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		•	•	•		•	•	•
Finance & Insurance			•	•			•	•
Accommodation				•				•
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 with p-values in parenthesis.

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		•	•	•		•	•	•
Finance & Insurance			•	•			•	•
Accommodation				•				•
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 with p-values in parenthesis.

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		•	•	•		•	•	•
Finance & Insurance			•	•			•	•
Accommodation				•				•
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 with p-values in parenthesis.

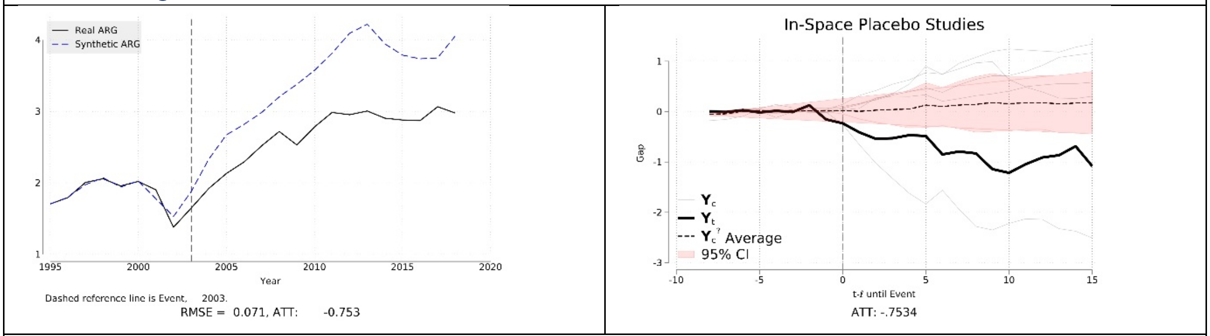
Annex Table 8. *Synthetic Diff in Diff estimates*

		Argentina		New Zealand	
		ATT	RMSE	ATT	RMSE
SPX 1	Total Digital Trade	-0.643	0.06	0.276	0.031
	Trade to Adequate Countries	0.196	0.017	0.311	0.014
	Trade to the US	0.19	0.013	0.01	0.018
	Digital Trade excl. US	-0.103	0.033	0.282	0.038
SPX 2	Total Digital Trade	-0.753	0.071	0.201	0.032
	Trade to Adequate Countries	0.137	0.02	0.271	0.018
	Trade to the US	0.223	0.005	0.087	0.009
	Digital Trade excl. US	0.336	0.027	0.177	0.054
SPX 3	Total Digital Trade	-0.744	0.074	0.218	0.033
	Trade to Adequate Countries	1.988	0.023	0.186	0.035
	Trade to the US	0.344	0.007	0.078	0.018
	Digital Trade excl. US	-1.038	0.075	0.166	0.044
SPX 4	Total Digital Trade	0.134	0.175	0.241	0.033
	Trade to Adequate Countries	2.724	0.026	0.083	0.037
	Trade to the US	2.068	0.005	0.111	0.019
	Digital Trade excl. US	-0.003	0.107	0.186	0.059

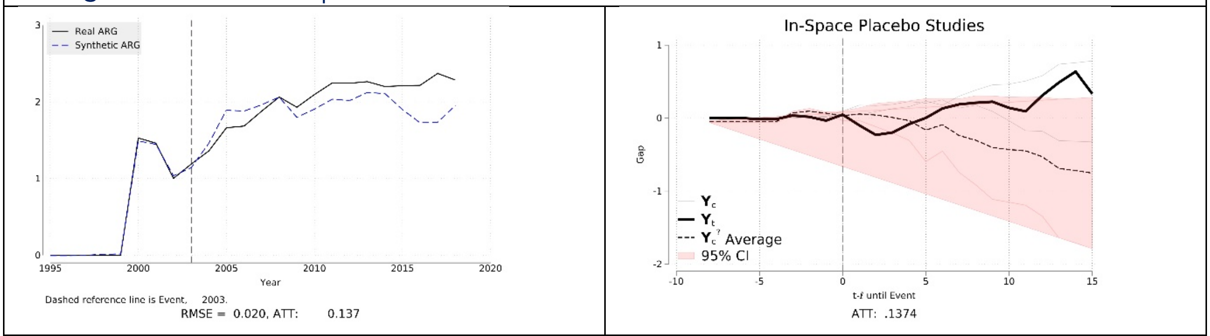
Notes: ATT: Average Treatment on the Treated. RMSE: Root mean squared error.

Annex Figure 1. *Synthetic Control Estimates: Argentina, SPX(2) definition of digital trade*

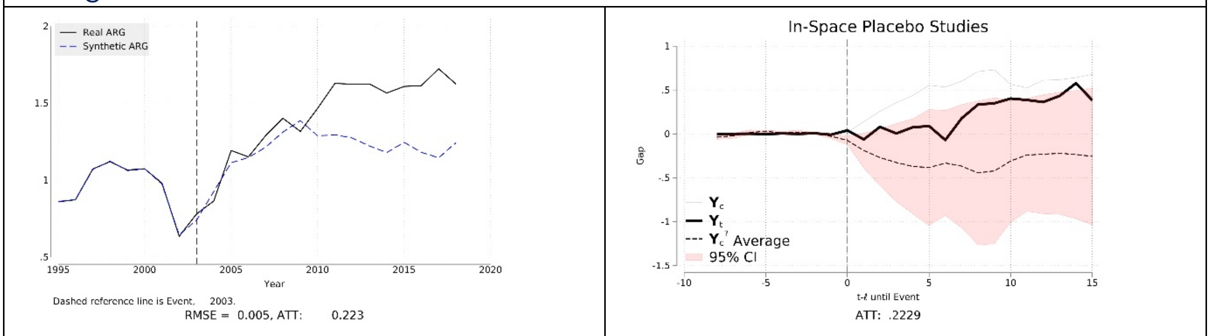
A: Total digital trade



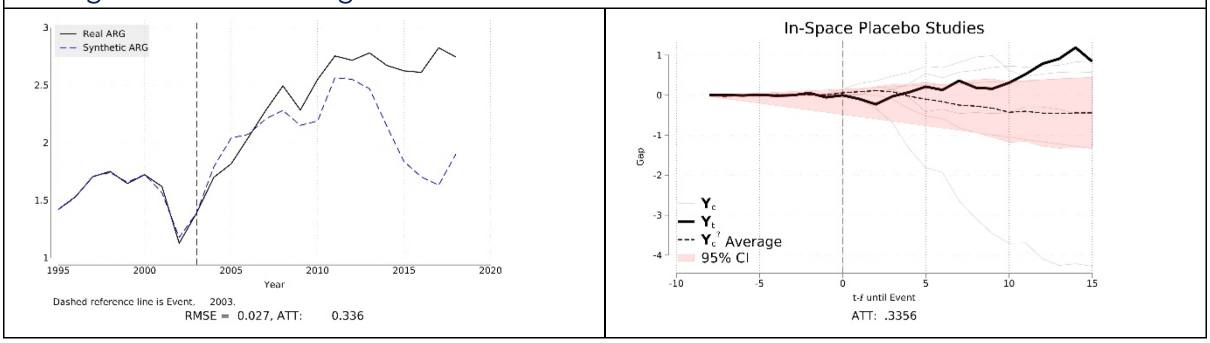
B: Digital trade to adequate countries



C: Digital trade to the U.S.



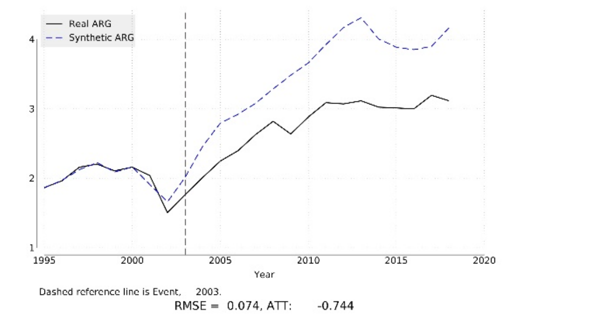
D: Digital trade excluding the U.S.

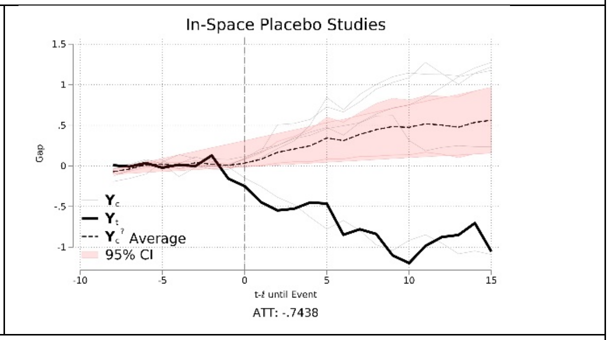


Notes: The outcome of interest is digital trade in Information and Communication Industries and Business services. See Annex Table 4 for the specific definition.

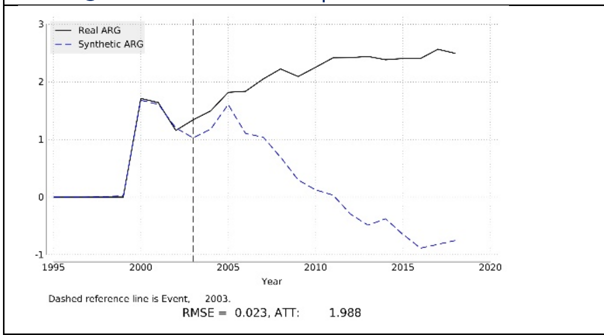
Annex Figure 2. *Synthetic Control Estimates: Argentina, SPX(3) definition of digital trade*

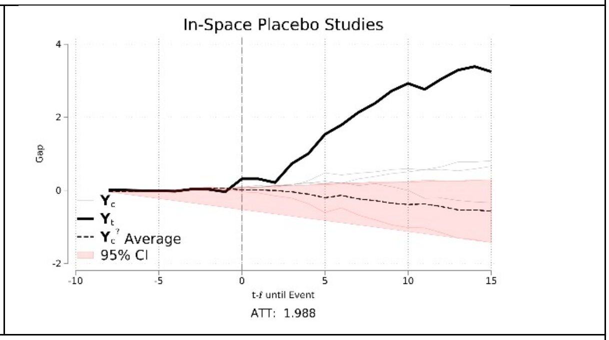
A: Total digital trade



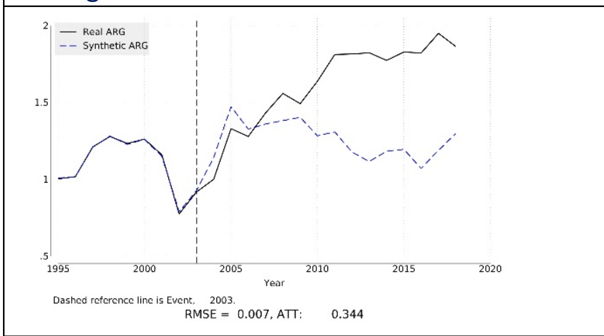


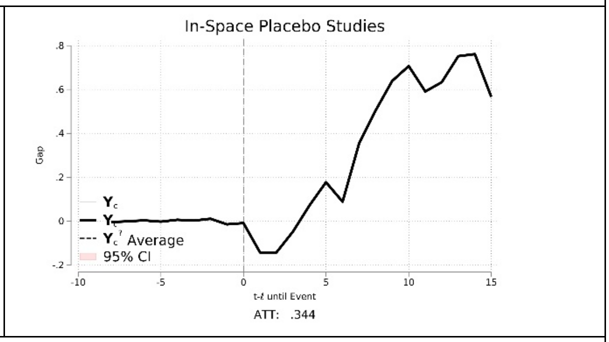
B: Digital trade to adequate countries



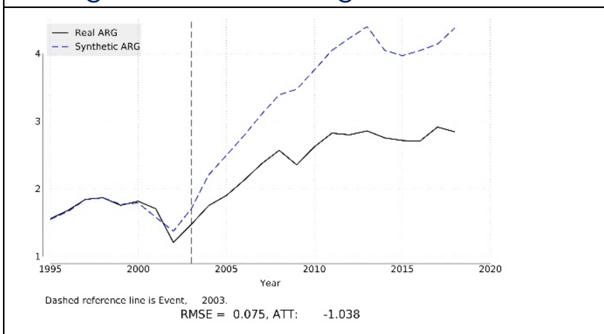


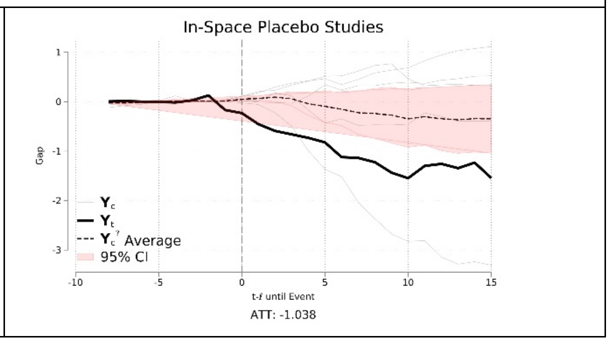
C: Digital trade to the U.S.





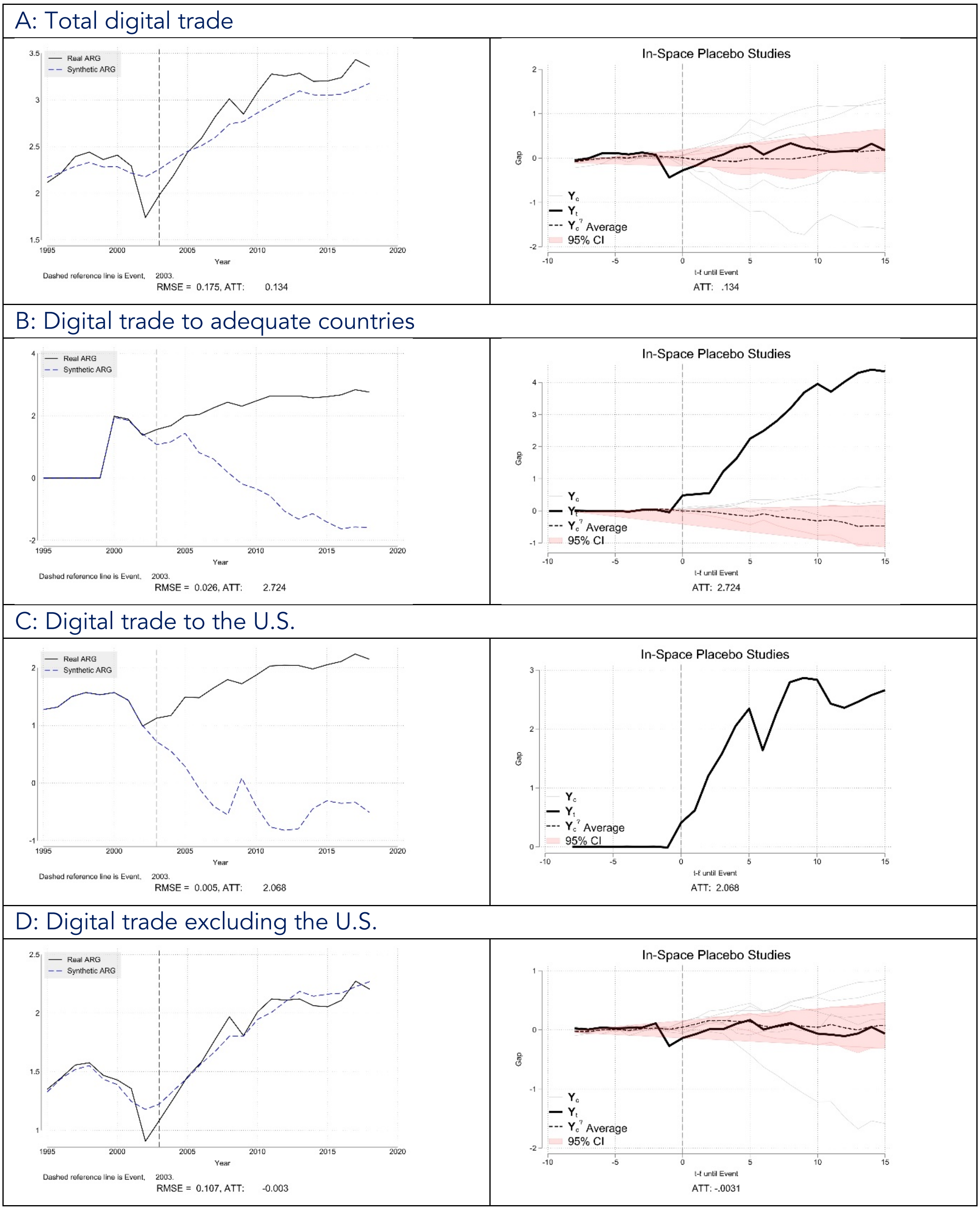
D: Digital trade excluding the U.S.





Note: The outcome of interest is digital trade in Information and communication Industries, Business services, and Financial & Insurance services. See Annex Table 4 for the specific definition.

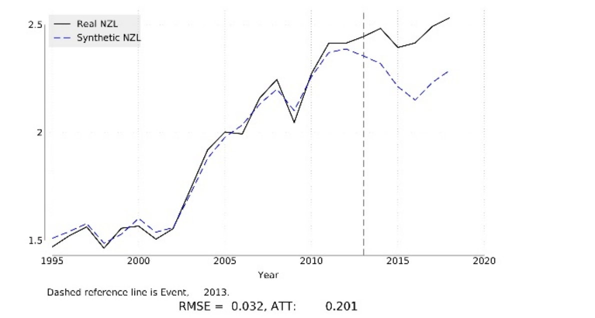
Annex Figure 3. *Synthetic Control Estimates: Argentina, SPX(4) definition of digital trade*

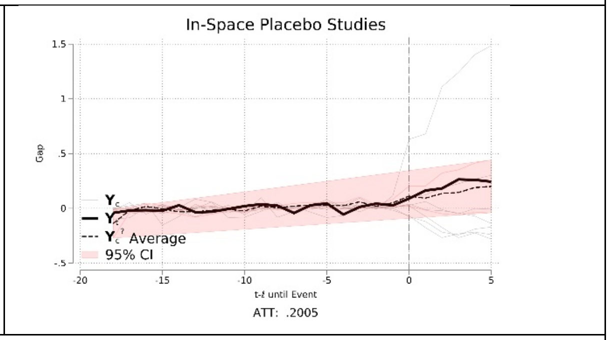


Note: The outcome of interest is total digital trade, which includes Information industries, Business services, Financial & Insurance services, Accommodation, Education, and Health services. See Annex Table 4 for the specific definition.

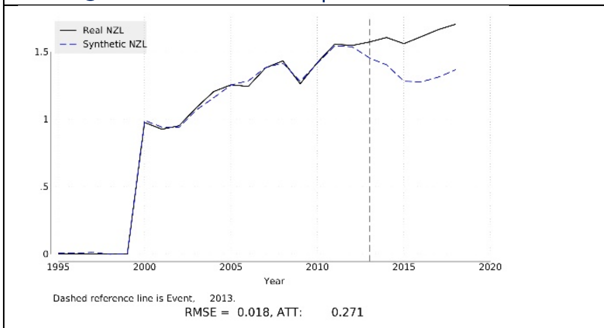
Annex Figure 4. *Synthetic Control Estimates: New Zealand, SPX(2) definition of digital trade*

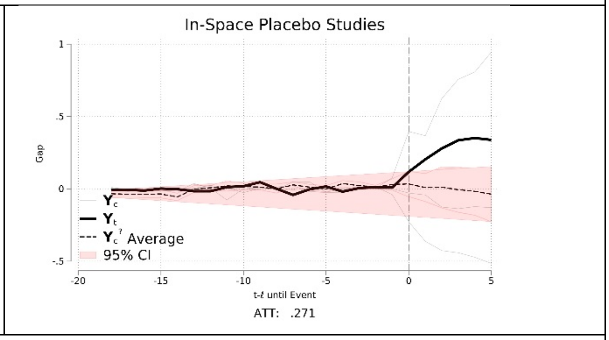
A: Total digital trade



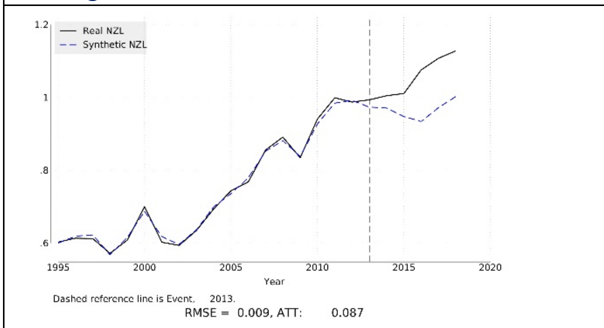


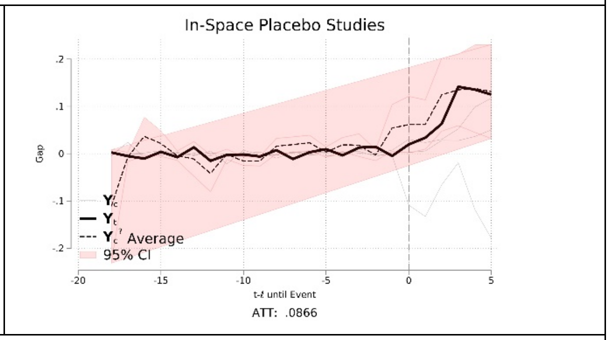
B: Digital trade to adequate countries



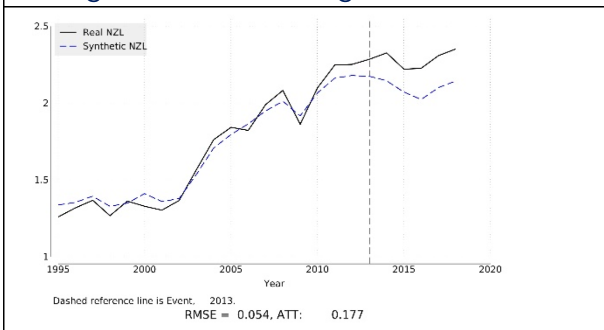


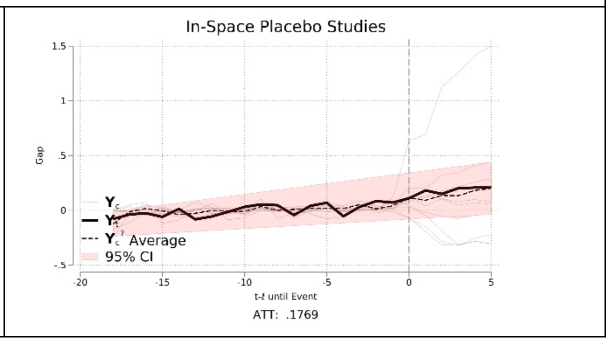
C: Digital trade to the U.S.





D: Digital trade excluding the U.S.

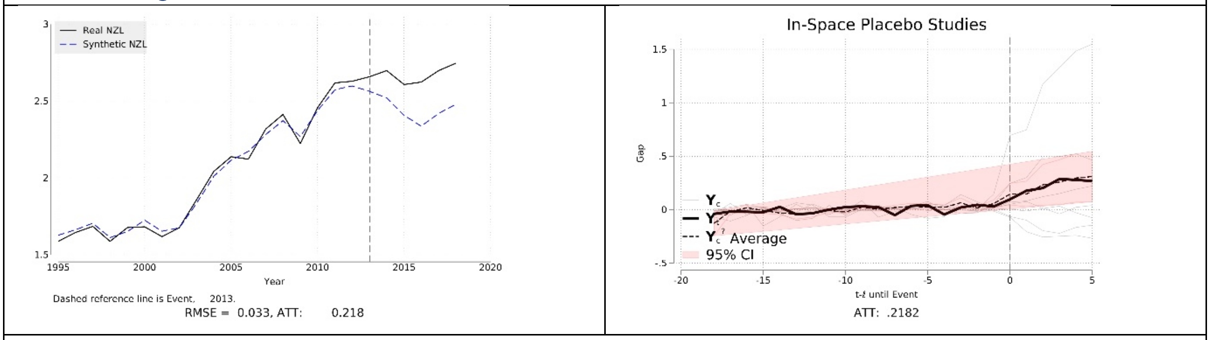




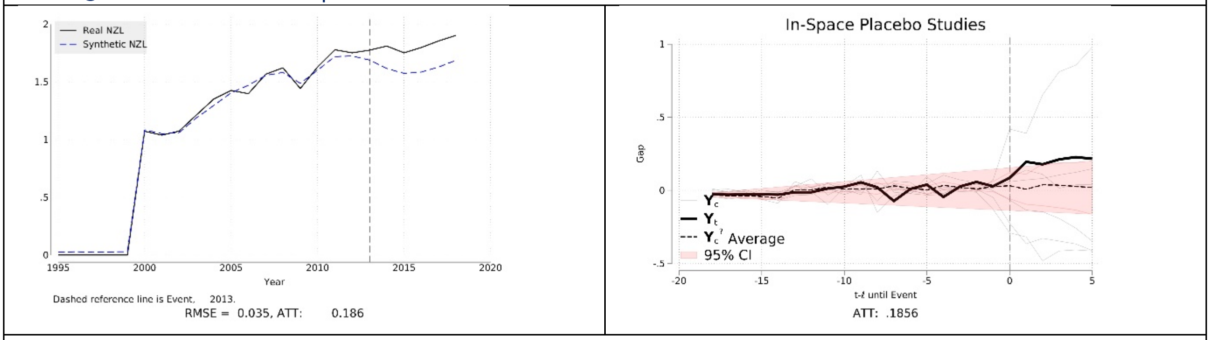
Notes: The outcome of interest is digital trade in Information and communication Industries and Business services. See Annex Table 4 for the specific definition.

Annex Figure 5. *Synthetic Control Estimates: New Zealand SPX(3) definition of digital trade*

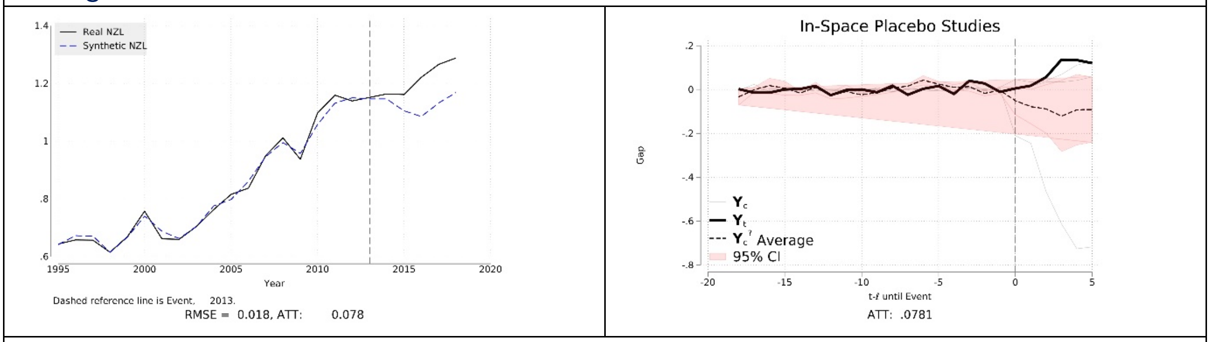
A: Total digital trade



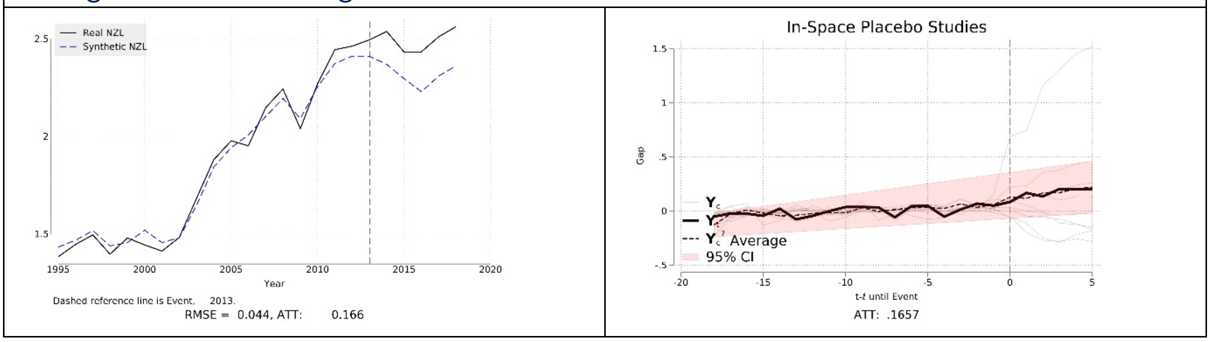
B: Digital trade to adequate countries



C: Digital trade to the U.S.



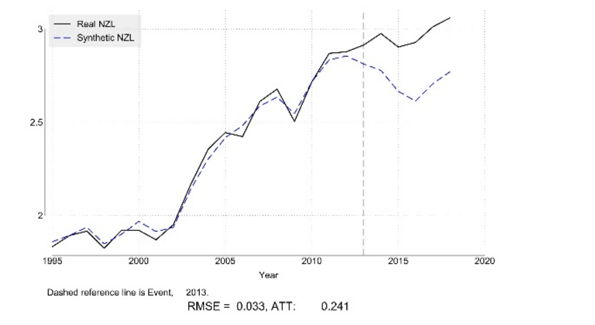
D: Digital trade excluding the U.S.

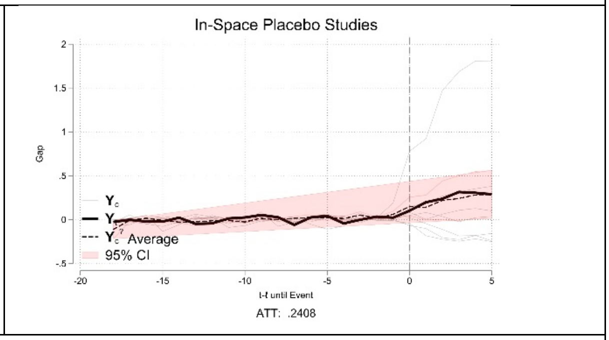


Notes: The outcome of interest is total digital trade which includes Information and communication industries, Business services, and Financial & Insurance services. See Annex Table 4 for the specific definition.

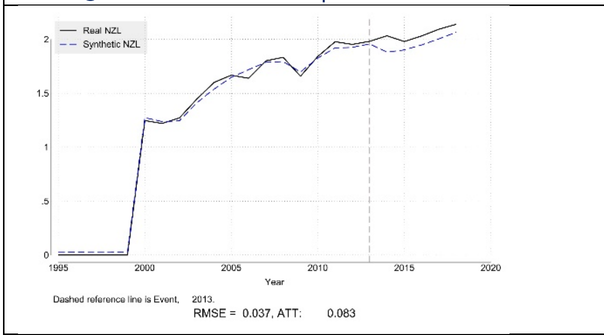
Annex Figure 6. *Synthetic Control Estimates: New Zealand, SPX(4) definition of digital trade*

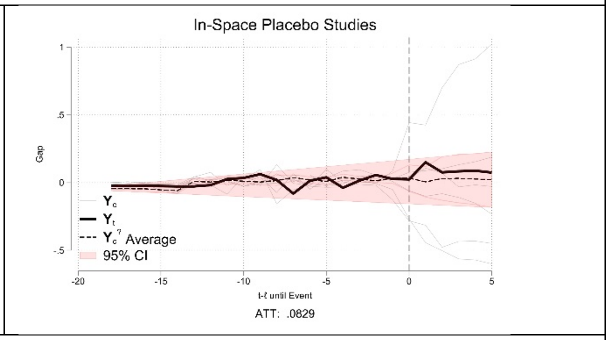
A: Total digital trade



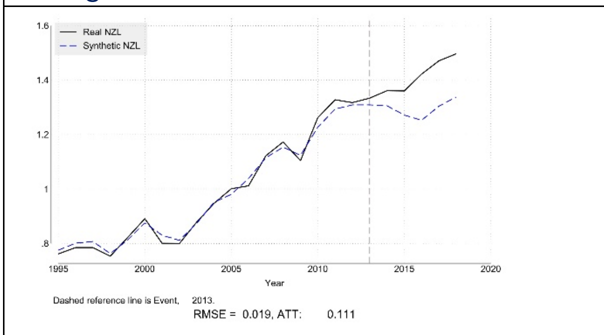


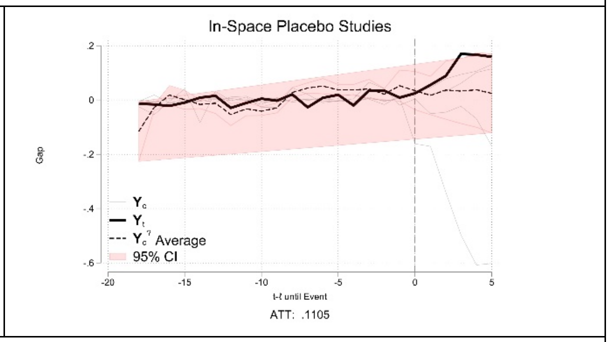
B: Digital trade to adequate countries



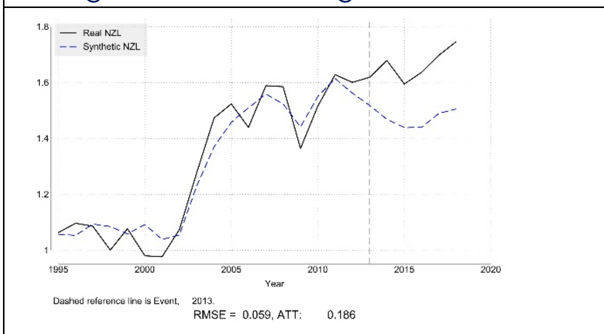


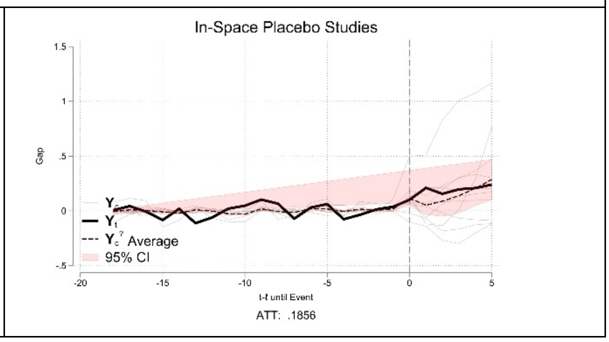
C: Digital trade to the U.S.





D: Digital trade excluding the U.S.





Notes: The outcome of interest is total digital trade which includes Information industries, Business services, Financial & Insurance services, Accommodation, Education, and Health services. See Annex Table 4 for the specific definition.