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Bilateral Services Trade Flows in East Asia: Does Digitalization Matter?

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Abstract

The global economy has been shifting away from the manufacturing sector and towards services in recent decades. Empirical work has shown infrastructure to be enabling trade across countries. East Asia is regionally diverse and connected and is often at the forefront of technological innovation; however, the effects of digitalization on services trade in this region remains unexplored. I investigate the impacts of digitalization on bilateral flows of services trade between East Asian countries and find evidence that digitalization is positively associated with increases in bilateral services trade flows.

Key words: services trade, digitalization, gravity model, East Asia, bilateral trade flows

JEL codes: F1, F5, O2, O5

Introduction

Over two-thirds of global economic output stems from the services industry as the global structure of economic activities has shifted away from manufacturing in recent decades. Across both developed and developing economies, expansions of the services sector have contributed to job creations, increased standards of living, and created economic opportunities for many firms, including micro, small, and medium-sized enterprises (MSMEs) (WTO 2020).

The rapid growth in services has also led to increases in services trade at a faster rate in comparison with goods trade. The World Trade Organization (WTO) recorded an annual 5.4 percentage growth in global services trade between 2005 to 2017 and valued it at USD13.3 trillion in 2017 (WTO 2019a). By shifting towards services production, the global economy is seeing increases in export diversification, and lower income countries are also engaging in the opportunities by jumping over the manufacturing stage of development into participating in exporting services (Loungani et al. 2017).

An economy's decision to engage in international trade is primarily dictated by the costs associated with trade, and technological advancements in recent years have had significant impacts on reducing costs and improving efficiencies (WTO 2008). Information and transaction costs are some of the major costs associated with services trade, as opposed to tariff barriers for goods trade. Traditionally, the delivery of services frequently demanded physical interactions between the producer and consumer, making services trade heavily influenced by geographical and cultural distances (UNCTAD 2021). Advancements in information and communication technology (ICT) and other digital technologies reduce distance-driven costs by enabling virtual and instantaneous delivery. Additionally, with the aid of technology, cultural distances are narrowed as search and communication efficiencies are improved and information and transaction costs are lowered (WTO 2019b). The level of

digitalization – defined as the level of ICT infrastructure and access in this paper – in a country can significantly lower trade costs, promoting the bilateral flows of services trade between the origin and partner countries.

Most existing studies have explored the effects of the internet on total global trade. Although some have also investigated the impacts on services trade, the effects of digitalization on regional services trade have largely been ignored. I investigate the effects of digitalization on bilateral flows of services trade between East Asian countries. East Asia is regionally diverse and connected and have recently experienced a surge in technological advancements; however, the effects of digitalization on services trade in this region remains unexplored.

To capture multiple facets of digitalization, I use 4 core indicators of ICT infrastructure and access: fixed broadband subscriptions, fixed telephone subscriptions, mobile-cellular subscriptions, and internet usage (ITU 2005). I find evidence that digitalization has a positive effect on the bilateral flows of services trade between East Asian economies, and the results suggest internet usage in the home country has the largest impact on services trade flows.

Literature Review

Theoretical Background: Digitalization and Services Trade

Technological advances have been increasing countries' connectivity and the efficiency of international trade. ICT infrastructure and access have been the backbone to enabling countries to access other forms of digital technology, such as search engines, digital platforms, and artificial intelligence (ITU 2005). Digital infrastructure, particularly the internet, has transformed services trade by allowing virtual and instantaneous delivery of certain services, such as online education and telemedicine. With increasing digitalization, countries are becoming further interconnected, and it becomes easier to export and import services to and from other countries.

Services can be more efficiently outsourced at various stages across the global value chain (GVC). For example, with available ICT infrastructure in an economy, a financial services firm could source research and analytical services from abroad in order to focus on the end stage that requires direct engagement with the customer. Additionally, firms can also outsource customer services at lower costs, which has been commonly occurring in the after-sale of technological products and services (Heuser and Mattoo 2017). Digitalization has enabled services to be more easily traded through new avenues, and this theoretical understanding has paved way for empirical studies across international trade literature.

Empirical Literature: Impact of ICT on Trade and Services Trade

Research exploring the influence of digitalization on services trade began in the early 2000s and focused on examining the effects of internet access as it was a rising digital infrastructure enabling trade. For example, Freund and Weinhold (2002) provide an early investigation of the impacts of the internet on services trade, finding positive effects in the United States on services exports and imports. Working from the idea that telecommunications developments, such as internet, reduced communications costs, Fink, Mattoo, and Neagu (2005) investigate the costs of communication on trade, concluding that lowering communication costs is significantly associated with increases in trade flows. Following these findings, Choi (2010) applies generalized method of moments to a global sample and finds that doubling internet usage in a country increased services trade by 2 to 4 percent.

Lower levels of digital integration in developing countries have prompted investigations on the impacts of digitalization on trade in countries across various income levels. Clarke and Wallsten (2006) find internet usage increased exports from developing to developed countries but had an insignificant effect on exports to developing countries. Demirkan et al. (2009) find that high levels of internet penetration between both trading partners increased trade flows, with greater ICT effects in larger economies. Rodriguez-Crespo and Martinez-Zarzoso (2019) argue internet usage has had positive impacts on trade, and there is a higher magnitude of impact on trade flows in high income countries than low- and middle-income countries.

More recent studies have incorporated multiple dimensions of ICT in order to explore the effects of digitalization on services trade, looking beyond internet access. Nath and Liu (2017) investigate the effects of multiple indicators representing ICT access, use, and skills on different components of services trade, finding positive and significant impacts of ICT across most services items, with ICT use, proxied by internet users and broadband subscribers, appearing to be the most important ICT element affecting services trade. Across four ICT dimensions, Luong and Nguyen (2020) find mobile phone usage to have the most consistent positive effects on importing and exporting. Digitalization has impacted services trade differently than goods trade, and Tay (2020) concludes that ICT is more impactful for services trade than goods trade, again finding mobile phone and broadband usage to be the most important ICT components. Xing (2018) observes that the effects of ICT developments on trade are more pronounced in developing economies than in rich economies.

Socio-economic and geographical characteristics between countries can also influence trade and the effects of digitalization. Walsh (2006) and Yane (2013) both find that having a shared common language between trading partners as one of the most important elements for services trade facilitation. Regionally focused studies have also sought to unpack some of these effects. For example, among Economic Community of West African States Members, Azu and Nwauko (2021) find internet penetration and mobile subscriptions have long-run effects on both services imports and exports, while Abendin et al. (2022) observe positive effects from an index of digitalization progress on services trade. On the Pacific Rim, Chung et al. (2013) find telephone and internet access to increase trade among Asia-Pacific Economic Cooperation economies.

Empirically, researchers have handled ICT components in different ways: some have focused on a single facet of digitalization at a time, while others have included multiple ICT variables in the same model. Abendin et al. (2022) notably employ principal components analysis (PCA) to their ICT variables to reduce dimensionality. In general, while ICT indicators have been found to exert positive impacts on services trade, results from regional studies have been somewhat mixed. To contribute to the existing literature, I investigate the effects of digitalization on services trade flows across East Asia.

The impacts of digitalization on services trade within regions have been underexplored relative to goods trade and unexplored in the context of East Asia.

Contextual Background: Digitalization and Services Trade in East Asia

East Asia is a culturally diverse region consisting of economies spanning various stages of development. In spite of these differences, the region is extensively connected by physical and institutional infrastructure which has contributed to a major part of the growth in intra-regional trade across East Asia. The reductions in transport and logistics costs were initially driving the rise in connectivity amongst East Asian economies; with the recent developments in technology, ICT infrastructure and access have been initiating the current wave of globalization (Brooks 2016). Many economies had contributed to international and intra-regional trade through the global production network by manufacturing labor-intensive parts and components (ADB 2007); although some economies continue to do so, others have undergone economic structural shifts towards producing higher value-added products and services (Shepherd 2020).

Advancements in ICTs have reduced communication and coordination costs associated with offshoring portions of the production process and can increase outsourcing services. The growth in connectivity across East Asian economies promotes higher levels of engagement across the global and regional value chain (Brooks 2016). East Asia has one of the largest disparities of digitalization levels amongst economies as countries like Korea and Singapore have become leading innovators of digital technologies, while developing economies like Laos continues to fall behind in digital adoption (Sedik et al. 2019). Irrespective of economies' level of development, improvements in ICT infrastructure and access can boost services trade not only through leveraging extensive regional connectivity and increasing intra-regional trade and value chain participation, but also enabling participation across advanced category of services.

Argument

Services trade supply is classified into 4 modes by the General Agreement on Trade in Services: Mode 1: Cross-border supply – services distributed across international borders; Mode 2: Consumption abroad – a consumer travels outside their origin country to consume a service, such as medical tourism; Mode 3: Commercial presence – a supplier establishes a presence in country outside of their origin country to provide services to consumers, such as through subsidiaries; Mode 4: Presence of natural persons – a service provider travels outside their origin country to provide services to consumers (GATS 1995; as cited in WTO 2022). High costs are frequently associated with Mode 2, 3, and 4 of services trade; however, digital infrastructure has enabled shifts in the structure of services trade supply, and services conventionally distributed through these modes can be shifted to Mode 1. (WTO 2019b, 2020)

Trade costs are one of the primary elements influencing a producer's decision to engage in trade across international borders. These costs include tariff and non-tariff barrier policies, transport costs, information and communication costs, and regulatory cost, among many others (WTO 2008). Higher levels of digital integration in an economy can increase services trade flows by lowering trade costs by reducing the need for physical interactions to deliver services from producer to consumer and enabling producers to sell and deliver services across boundaries without the need to be physically present in a foreign country. In this study, I investigate the effects of digitalization on bilateral services trade flows between East Asian countries.

An increase in ICT infrastructure and access is expected to increase bilateral services trade flows between East Asian countries by reducing the costs of delivering to an international market, enabling improvements in operational efficiency, and creating a new generation of ICT-enabled services. Digital infrastructure allows producers and sellers to enter foreign markets more easily and avoid traditional regulatory processes associated with setting up subsidiaries in foreign markets. This has significantly altered the delivery of services and reduced the barriers to services trade and additionally, changed the business models of many firms and enhanced competition by also allowing MSMEs to participate in the international market (WTO 2019a). Small businesses and freelance service

providers are now able to reach customers internationally with the use of the internet through online platforms such as Fiverr (WTO 2019b).

Additionally, the consumption of foreign services is also furthered with digitalization as businesses and consumers are able to access services provided in the international market more easily and at lower costs. ICT infrastructure and access enhances firms' operational efficiencies by improving communications between producers and consumers (Nath and Liu 2017), and through infrastructures like the internet, enables easier access to information, such as on competitors and industry regulations (Meltzer 2014). Businesses, such as consulting and financial services firms, are able to outsource and offshore certain operations like marketing and design to producers abroad to enhance their operational productivity and increase their output (Brooks 2016). Finally, increases in digital infrastructure and access can stimulate services trade participation through innovation. Countries with advancements in technology can enable the tradability of a new generation of services, such as software development, cloud services, and technical training (World Bank 2002).

Geographical distance has been a major barrier of bilateral services trade as the requirement of physical interactions between producer and consumers have led to high transport costs. With ICT infrastructure and access, not only does it enable instantaneous delivery of services and lower transport costs, but it also increases connectivity among East Asian economies and further promotes intra-regional trade by increasing regional value chain participation and enabling trade across advanced services. Countries outsource and offshore production processes to reduce costs; however, information and transaction costs and transport costs associated with offshoring heavily increase firms' coordination costs.

As East Asian countries are economically and culturally diverse, their differences can translate to higher search and verification costs associated with carrying out production abroad. With improvements in digital technology, these costs can be effectively reduced by enhancing communication and monitoring efficiencies between firms and suppliers, increasing intra-regional trade (Brooks 2016). Services are often traded as inputs to goods trade as producers outsource parts of the production process, such as part that require distribution and communication services. With adequate

ICT infrastructure, economies can leverage existing regional value chains and shift away from manufacturing parts and components and towards producing higher value-added services (Urata and Kiyota 2003).

Improvements in digitalization across the exporting and importing countries are essential to enabling trade of advanced services. For example, internet access and broadband infrastructure is needed in the economies of both trading partners for the tradability of financial and software services, and with adequate digital infrastructure, economies can increase their trade in services by branching out across industries (Brooks 2016). By increasing digitalization, ICTs can have reductive effects on services trade costs and effectively allow East Asian economies to leverage existing regional connectivity to increase bilateral services trade within the region.

Data Selection and Methodology

Data Selection

To investigate the effects of digitalization on services trade flow in East Asia, I analyze an unbalanced panel spanning 2005 through 2018, covering aggregate services trade flows between five developed reporting East Asian countries and their trading partners within the region, according to data availability (list of countries displayed in Appendix: Table A1). The trade data are sourced from UNCTADStat. Similar to Luong and Nguyen (2020), I use four core indicators of ICT infrastructure from the International Telecommunication Unions (ITU) database (ITU 2005) to capture digitalization: fixed broadband subscription rates, fixed telephone subscription rates, mobile phone subscription rates, and internet usage rates. As additional control variables, I also employ GDP of the reporting and partner countries collected from the World Development Indicators (WDI), bilateral distance between the capital cities, dummy variables for preferential trade agreements in force, common colonizer, and common spoken language collected from CEPII in the World Economics and Politics Dataverse (WEP). The descriptions and summary statistics of the variables are presented in Tables 1 and 2.

Table 1: Descriptive Statistics

	Description	Source	# of			
			Obs.	Mean	Min	Max
<i>tradeflows</i>	Total services trade flows in millions (USD current)	UNCTAD	331	21777.995	38.248	141817.541
<i>distance</i>	Distance between capital cities in kilometers	WEP	331	2460.901	315.543	5791.627
Reporting Countries						
<i>GDP_constant</i>	GDP constant	WDI	331	1.354E+12	1.780E+11	1.180E+13
<i>fixedbbsub</i>	Fixed broadband subscriptions per 100 inhabitants	ITU	331	21.188	7.305	41.190
<i>fixedtelsub</i>	Fixed telephone subscriptions per 100 inhabitants	ITU	331	33.150	14.410	60.642
<i>mobcellsub</i>	Mobile-cellular subscriptions per 100 inhabitants	ITU	331	131.740	80.060	154.03
<i>internetusersper</i>	Internet usage as a percentage of the population	ITU	331	74.660	50.300	96.023
Partner Countries						
<i>GDP_constant</i>	GDP constant	WDI	331	2.020E+12	9.243E+09	1.350E+13
<i>fixedbbsub</i>	Fixed broadband subscriptions per 100 inhabitants	ITU	331	12.419	0.00051	41.190
<i>fixedtelsub</i>	Fixed telephone subscriptions per 100 inhabitants	ITU	331	20.282	0.190	60.642
<i>mobcellsub</i>	Mobile-cellular subscriptions per 100 inhabitants	ITU	331	106.636	0.270	175.878
<i>internetusersper</i>	Internet usage as a percentage of the population	ITU	331	48.113	0.065	96.023

Source: Author's calculations

Table 2: Dummy Variables

	Description	Source	# of Obs.
<i>inforce_PTA</i>	Number of preferential trade arrangements in forced	WEP	331
<i>comcol</i>	0 for no common colonizer; 1 for shared common colonizer	WEP	331
<i>comlang</i>	0 for no common spoken language; 1 for shared common spoken language	WEP	331

Correlation Among ICT Indicators

It is important to acknowledge that the four indicators of ICT infrastructure are not mutually independent of each other. Table 3 a correlation matrix across the four ICT variables, demonstrating high levels of correlation across several of the variables, raising concerns over multicollinearity, which have been raised in previous research (Freund and Weinhold 2004; Walsh 2006; Azu and Nwauko 2021). To circumvent this issue, some researchers have employed PCA (Abendin et al. 2022; Jiang and Jia 2022), while others have investigated individual ICT indicators separately (Liu and Nath 2013; Azu and Nwauko 2021) or have

carried on investigating the different components of ICT all together (Myovella et al. 2019; Xing 2017). However, no consensus has emerged on the most appropriate approach.

In this study, I employ four ICT indicators separately to address issues of multicollinearity and to examine the infrastructure with the greatest magnitude of impact. Additionally, I replicate the models with an index for digitalization using principal component analysis to assess the overall impact of ICT infrastructure and access.

Table 3: Correlation Matrix

	<i>fixedbbsub</i>	<i>fixedtelsub</i>	<i>mobcellsub</i>	<i>internetusersper</i>
<i>fixedbbsub</i>	1.000			
<i>fixedtelsub</i>	0.893	1.000		
<i>mobcellsub</i>	0.419	0.273	1.000	
<i>internetusersper</i>	0.846	0.794	0.617	1.000

Source: Author's calculations

Empirical Model: Gravity Model

The gravity model, introduced by Tinbergen (1962), is a widely popular empirical method to analyzing bilateral trade flows. The baseline model consists of bilateral trade flows, the GDP of the origin and partner countries, and geographical distance. Modifications of the model include incorporating country-pair effects to examine the effects of shared characteristics between the origin and partner countries, such as trade agreements in force, a common colonizer, and common language (Kabir et al. 2017).

To investigate the effects of digitalization on services trade between East Asian countries, I employ modified gravity models with the indicators of ICT infrastructure and country-pair characteristics and apply the estimation methods: ordinary least squares (OLS) and poisson pseudo maximum likelihood (PPML). I use the log of *trade flows* as the dependent variable; *distance* between the two trading countries and log of *GDP* of the origin and partner country as the gravity components; *inforce_PTA*, *comcol*, and *comlang* as the country-pair

characteristics; and log of all 4 indicators of ICT infrastructure *fixedbbsub*, *fixedtelsub*, *mobcellsub*, and *internetusersper* of both origin and partner.

Results and Analysis

The gravity model is frequently employed in empirical research on international trade and has been adapted to investigate the effects of ICT infrastructure and access on services trade (Freund and Weinhold 2002; Luong and Nguyen 2020; Azu and Nwauko 2021; among others). I follow this empirical approach and employ a pair of modified gravity models estimated using the ordinary least squares (OLS) and Poisson pseudo-maximum likelihood (PPML) methods. While OLS is commonly employed in the literature, its results are likely to be biased driven by unobserved heterogeneity in the panel data (Collischon and Eberl 2020). PPML, on the other hand, accounts for heteroscedasticity biases and allows for the zero value trade flows to be included (Larson et al. 2018). The regional focus of this study means that zero trade flows are not observed in the sample, but applying both estimation approaches enhances confidence in the robustness of the results and facilitates their generalizability to other studies.

Tables 4 and 5 present the results examining the effects of digitalization – proxied by four indicators of ICT infrastructure and access – on bilateral services trade flows between five reporting East Asian countries and its East Asian trading partners (list of countries displayed in Appendix: Table A1).

Table 4: Effect of Digitalization on Services Trade Between East Asian Countries - OLS

	Fixed Broadband (Model 1)	Fixed Telephone (Model 2)	Mobile Cellular (Model 3)	Internet Usage (Model 4)	ICT Index (Model 5)
Distance	-0.029*** (0.008)	-0.019* (0.008)	-0.028** (0.011)	-0.027** (0.010)	-0.025** (0.008)
GDP of Origin Country	0.854*** (0.159)	1.549*** (0.147)	2.043*** (0.206)	1.573*** (0.174)	1.101*** (0.151)
GDP of Partner Country	1.970*** (0.106)	2.185*** (0.100)	2.785*** (0.104)	2.473*** (0.106)	2.152*** (0.094)
Fixed Broadband Subscriptions (Origin)	0.370*** (0.029)				
Fixed Broadband Subscriptions (Partner)	0.139*** (0.015)				
Fixed Telephone Subscriptions (Origin)		0.384*** (0.030)			
Fixed Telephone Subscriptions (Partner)		0.106*** (0.015)			
Mobile Cellular Subscriptions (Origin)			0.306* (0.141)		
Mobile Cellular Subscriptions (Partner)			0.062* (0.026)		
Internet Usage (Origin)				0.702*** (0.099)	
Internet Usage (Partner)				0.058** (0.018)	
ICT Index (Origin)					0.083*** (0.006)
ICT Index (Partner)					0.031*** (0.004)
Trade Agreement In-force	0.039*** (0.004)	0.046*** (0.004)	0.026*** (0.005)	0.032*** (0.004)	0.042*** (0.004)
Common Colonizer	0.022 (0.018)	0.041* (0.019)	0.087*** (0.024)	0.043 . (0.022)	0.026 (0.019)
Common Spoken Language	0.109*** (0.013)	0.117*** (0.014)	0.104*** (0.017)	0.121*** (0.016)	0.128*** (0.013)
Observations	331	331	331	331	331
Number of Countries	14	14	14	14	14
Adjusted R-squared	0.872	0.862	0.788	0.818	0.871

Note: ***p<0.001, **p<0.01, *p<0.05, . p<0.1. Standard errors are reported in parentheses.

Source: Author's calculations

Table 4 uses the OLS estimator, and the coefficients fixed broadband, fixed telephone, mobile cellular, internet usage, and GDP in Models 1 to 4 are positive and significant across both origin and partner countries, while distance is negative and significant. I employ the principal component analysis (PCA) to create a digitalization index representing ICT infrastructure (results for PCA components displayed in Appendix: Table A2 and A3), and the coefficients of the index in Model 5 for both origin and partner countries are also positive and significant at the 0.1 percent level. The country-pair characteristics trade agreement in-force and common spoke language are positive and significant across all models in Table 3.

Aside from mobile cellular with an adjusted R-squared of 0.788, the adjusted R-squared across the ICT infrastructure indicators are above 0.8, an indication of a high goodness-of-fit across the OLS models. The models in Table 4 are employed to provide a benchmark for the comparison of the PPML models in Table 5 as the OLS results may be affected by unobserved heterogeneity (Collischon and Eberl 2020).

Table 5: Effect of Digitalization on Services Trade Between East Asian Countries – PPML

	Fixed Broadband (Model 6)	Fixed Telephone (Model 7)	Mobile Cellular (Model 8)	Internet Usage (Model 9)	ICT Index (Model 10)
Distance	-0.026*** (0.008)	-0.016* (0.007)	-0.026** (0.009)	-0.027** (0.008)	-0.023** (0.007)
GDP of Origin Country	0.034*** (0.005)	0.056*** (0.005)	0.070*** (0.006)	0.055*** (0.005)	0.041*** (0.005)
GDP of Partner Country	0.071*** (0.004)	0.078*** (0.004)	0.100*** (0.004)	0.086*** (0.004)	0.078*** (0.003)
Fixed Broadband Subscriptions (Origin)	0.337*** (0.028)				
Fixed Broadband Subscriptions (Partner)	0.130*** (0.014)				
Fixed Telephone Subscriptions (Origin)		0.354*** (0.028)			
Fixed Telephone Subscriptions (Partner)		0.112*** (0.014)			
Mobile Cellular Subscriptions (Origin)			0.263* (0.127)		
Mobile Cellular Subscriptions (Partner)			0.086** (0.027)		
Internet Usage (Origin)				0.667*** (0.087)	
Internet Usage (Partner)				0.080** (0.017)	
ICT Index (Origin)					0.075*** (0.006)
ICT Index (Partner)					0.030*** (0.003)
Trade Agreement In-force	0.039*** (0.004)	0.045*** (0.004)	0.026*** (0.005)	0.031*** (0.004)	0.042*** (0.004)
Common Colonizer	0.027 (0.020)	0.044* (0.019)	0.090*** (0.023)	0.038 . (0.022)	0.029 (0.019)
Common Spoken Language	0.096*** (0.012)	0.104*** (0.012)	0.080*** (0.015)	0.102*** (0.014)	0.114*** (0.012)
Observations	331	331	331	331	331
Number of Countries	14	14	14	14	14

Note: ***p<0.001, **p<0.01, *p<0.05, . p<0.1. Standard errors are reported in parentheses.

Source: Author's calculations

Table 5 presents the same results of the same models estimated via PPML. Models 6 to 9 display positive coefficients which are significant at the conventional level for fixed broadband subscriptions, fixed telephone subscriptions, mobile cellular subscriptions, and internet usage, across both origin and partner countries. The results of employing the PPML estimator are near identical to Models 1 to 4, aside from the slightly larger magnitude of GDP which could be driven by unobserved heterogeneity not accounted for using the OLS estimator, resulting in an overestimation of GDP (De Benedictis and Taglioni 2011).

The results across the four ICT indicators are consistent with Luong and Nguyen (2020)'s empirical findings and the theoretical expectations. The results in Table 5 illustrate that ICT infrastructure and access across both origin and partner countries is important for services trade. As outlined in the theoretical literature, increases in digitalization across both home and partner countries can allow East Asian countries to leverage existing regional connectivity and promote trade in advanced services, such as those within the business and financial industries (Brooks 2016).

Across the four indicators of ICT infrastructure and access, increases in ICTs have a larger impact on services in the origin countries, and an increase in internet usage in origin countries has the largest effect on services trade flows. A percent increase in internet usage in the origin country increases services trade by 0.667%. Internet usage has been the ICT infrastructure most commonly studied across empirical studies examining the effects of digitalization on services trade, and as discussed within the theoretical literature, internet is expected to have a greater effect on services trade as it is essential for services to be delivered virtually and instantaneously, reducing significant costs associated with trade (WTO 2019b).

Among the effect across the four ICT variables in partner countries, fixed broadband subscription has the largest impact on services trade flows, and a percent increase in fixed

broadband subscriptions increases services trade by 0.130%. As the observations for bilateral services trade flows is mainly comprised of high-income origin countries, while the partner countries consist of lower middle-, upper middle-, and high-income countries, the smaller magnitude in partner countries could potentially reflect the effects of countries' level of development, similar to Rodriguez-Crespo and Martinez-Zarzoso (2019)'s empirical findings concluding that ICT has greater impact in high income countries. Model 10 uses a PCA index for ICT to capture the overall effects of digital infrastructure and access on services trade flows, and the coefficients of the index for both origin and partner countries are positive and significant at the 0.1 percent level.

In line with Walsh (2006) and Yane (2013), the results show common language as the most important country-pair dummy for facilitating trade between countries among the common shared characteristics controlled for across the models. East Asia has one of the largest cultural diversities and having a shared linguistic similarity between two trading partners can reduce costs to trade and promote increases in bilateral trade flows, particularly impacting services trade as producers and consumers frequently need to interact (Guo 2006).

Additionally, the bilateral dummy variables for trade agreement in-force also have significant and positive impacts on services trade flows; however, the significance of the common colonizer is inconsistent across the models and is only significant to the 5% level in Model 7 and 8, suggesting that colonial similarities have minimal impact on services trade between two trading partners in East Asia in comparison with other indicators of cultural similarities.

Similar to Freund and Weinhold (2004), the results in Table 5 indicates the adoption of ICT does not eliminate the distance effect. Across Models 6 to 10, distance has a negative and significant relationship with services trade as trade costs increases, which is consistent with the

original gravity model developed by Tinbergen (1962). The other gravity component, GDP, is also consistent with the original gravity model as it is positive and significant, demonstrating larger economies engage in greater levels of services trade.

Conclusions and Implications

Digital technology and infrastructure have been enabling trade and services trade across countries globally, and in this study, I seek to contribute to understanding the effects of digital infrastructure and access on services trade specifically in East Asian countries. East Asian economies are extensively connected through physical and institutional infrastructure, and in recent decades, the surge in digitalization in the region has further increased connectivity between countries.

I argue digitalization is expected to increase services trade flows as ICT infrastructure and access lower the costs to trade by lowering the need for the producer and consumer to physically interact and improving the productivity and efficiency of trading services. Additionally, digitalization can enable economies to leverage existing regional value chains to contribute higher-value added services and trade new advanced services (Brooks 2016). These findings can produce policy implications for the governments of East Asian countries to increase investments in national ICT infrastructure and access to equip their economies with appropriate digital infrastructure to participate in intra-regional services trade.

The results demonstrate evidence that digitalization is positively associated with increasing bilateral services trade flows between East Asian countries. ICT infrastructure and access have positive effects on services trade across all 4 indicators, and the results show internet usage in the origin countries has the highest effect. This offers evidence consistent with

the theoretical argument that digital technology enables East Asian countries to engage in contributing higher-value added services and trading new advanced services (Brooks 2016).

The limited data available restricted the investigation of the effects of digitalization on services trade flows to five origin countries and their East Asian trading partners, and it is uncertain whether these findings would be externally valid across all East Asian countries and increases in data availability is needed to further investigate the effects across all economies. Although the results offer evidence of positive effects of digitalization on services trade amongst East Asian countries, endogeneity bias can cause limitations in these findings. As discussed by some scholars, there are potentials of reverse causality in digitalization and trade and also omitted variable bias linked to country characteristics (Rodriguez-Crespo and Martinez-Zarzoso 2019).

As an extension of this study, further research is needed to demonstrate a unidirectional causal effect of digitalization on bilateral services trade flows between East Asian countries. Services trade has been underexplored relative to goods trade, and the intangibility of services makes it likely that the quantity of services trade is often underestimated (OECD 2022). As services can be traded as stand-alone services or encompassed within the production process of products, the value of services can be difficult to quantify, and the estimated value is likely not able to reflect the actual volumes of services trade. Future developments in measurement techniques and methods could pave way for improving the accuracies of empirical studies of services trade.

Declaration of Interest Statement

The author reports there is no competing interests to declare.

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Appendix

Table A1: Country List for Gravity Models

Origin Countries	Partner Countries
Korea (Rep. of)	Brunei Darussalam
Singapore	China
Malaysia	Indonesia
China	Japan
Japan	Cambodia
	Korea (Rep. of)
	Lao P.D.R.
	Malaysia
	Myanmar
	Philippines
	Singapore
	Thailand
	Vietnam

Table A2: Principal Components Index Decomposition

Component	Eigenvalue	Difference	Proportion	Cumulative
Component 1	2.979	2.174	0.745	0.745

Source: Author's calculations

Table A3: Principal Component

	Component 1
<i>fixedbbsub</i>	0.546
<i>fixedtelsub</i>	0.517
<i>mobcellsub</i>	0.359
<i>internetusersper</i>	0.553

Source: Author's calculations