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Abstract

Submarine cables are undersea digital bridges that allow ideas and information to move across space. Submarine cables are expensive infrastructure investments and their high costs raise the question about their economic returns, especially in developing countries. Specifically, it is not known what laying submarine cables means for services trade which depends heavily on exchanging ideas and information. Using a novel data set for connecting the world countries by submarine cables, this study considers the variation in the cross-country variation in the number of submarine cables as well as the timing of connection to identify the effects of submarine cables. To deal with endogeneity, two novel instruments are developed. The results confirm that submarine cables stimulate services trade in some sectors. Benefits to developing countries are higher where more sectors expand their services trade and no sectors lose. This suggests a catch-up effect and higher gains from laying submarine cables in developing countries.

Keywords— Submarine cables, services trade, developing countries, infrastructure.

JEL code: F1, O1, O2

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1 Introduction

Ninety-nine percent of all international data are transmitted by wires lying at the bottom of oceans known as submarine cables[1]. Historically, submarine cables were made of copper and were first used to transmit telegraph signals. Modern submarine cables are fiber-optic cables that can carry broadband signals at extremely large speeds (the speed of light in glass). The laying of the new cables started in the late 1980's and continues today. The first fibre-optic cable entered service in 1988 and connected the US, the UK and France[2]. Submarine cables are the favored mode of transmitting telecommunication signals as they are more reliable than satellites and copper (coaxial) cables, are much faster, and offer much lower latency at multiples the bandwidth[3](Eichengreen et al. (2016)). Submarine cables enabled a revolution in telecommunications and serve as the backbone of the internet worldwide today[4]. While there are other ways to connect to the internet such as terrestrial cables and satellites, submarine cables are the most efficient and reliable way to introduce broadband internet and they produce the highest gains from the internet (Delaunay (2017)). Also, there would be no talk of 4G or 5G mobile networks without submarine cables. Because these cables allow for more competition, broadband costs have dropped drastically as a result (OECD (2014)). A study by the IFC (International Finance Corporation) concluded that the East African cable System (EASSy) - a 10,000-km submarine cable system off the coast of East Africa - lowered broadband costs by as much as 90%[5]. Table 2 summarizes the retail broadband prices in select Sub-Saharan African countries and shows much lower broadband retail costs (as a percentage of GNI per capita) for coastal African countries connected to submarine cables compared to landlocked African countries that rely on satellites and terrestrial cables.

Submarine cables are undersea digital bridges that connect individuals, firms, and societies much like physical bridges connect towns, cities, and more recently countries. While physical bridges allow people and goods to move between different geographic locations, submarine cables allow ideas and information to move between different locations with arguably much less restrictions. Submarine cables are however extremely expensive. One estimate of their costs hangs the price tag of 90,000 USD per km and the total cost of a single cable can be in the billions of dollars[6]. Such high costs can be extremely burdensome to some countries especially if the cost is seen relative to economic size or resources of some developing countries. Given the high costs, it is important to assess the economic benefits of these infrastructure investments to these countries. If submarine cables enable the exchange of information and ideas more efficiently, at lower costs, and at higher speed, this begs the question whether submarine cables result in higher levels of trade in services since services are information-intensive.

Many economists believe that the internet reduces search costs and prices, and makes markets more competitive (Brown and Goolsbee (2002)). One would therefore expect that submarine cables should promote the trade in services. It can, however, be argued that this is not the case sometimes. This is because the internet naturally reduces the need for some services and may render some other services obsolete such as some postal, telecommunication and travel services. Citizens and firms depending on foreign postal, telecommunication, and transport services may now replace their communication needs with email and video-conferencing, or may be able to find cheaper local alternatives. This implies that in some cases, submarine cables reduce the trade in service. In other cases, submarine cables, which enable cheaper and faster internet, may reduce domestic production costs and boost productivity (of local producers). This, in

[1]https://www.newsweek.com/undersea-cables-transport-99-percent-international-communications-319072

[2]This cable was attacked by sharks because it transmitted electric current which attracts sharks.

[3]Bandwidth refers to the amount of data that can flow through a cable within a given time and latency refers to the speed with which the information reaches the data recipient

[4]By definition, submarine cables connect countries that have access to the sea. Landing points for these cables are carefully chosen to minimize possible damage due to strong currents for example.

[5]Source: https://www.ifc.org/wps/wcm/connect/news$_{e}xt_{c}ontent/ifc_{e}xternal_{c}orporate_{s}ite/news + and + events/news/cm - stories/cm - connecting - africapage2$

[6]https://www.ibtimes.com/underwater-internet-cables-submarine-cable-map-shows-how-world-gets-online-1559604

turn, may enhance the competitiveness of domestic producers and that may lead to less foreign imports and more exports. Moreover, new services may be created such as digital marketing and cloud computing. The end result of the effect of submarine cables on services trade is, therefore, ambiguous.

Hence, the goal of the paper is to investigate the effects of laying submarine cables has on the trade in services. Of interest to this study is the marginal effect of deploying additional cables because many countries have multiple submarine cables (refer to Table 4). Also, industry experts are of the opinion that increasing the number of submarine cable connections increases capacity, speed, and reliability, and reduces internet access costs further due to higher competition (OECD (2014)). To investigate this question, a novel county-level data set is constructed based on a list of all submarine cables and the year that these were placed in operation. We then estimate the effects of the number of submarine cables that connect a country on the country's exports and imports of services. We consider aggregate trade in services as well as sector trade flows in all eleven services sectors according to the EBOPS 2002 classification (Extended Balance of Payments Services Classification). As usual in this type of estimations, endogeneity due to simultaneity and omitted-variable bias is an issue that we deal with using novel instrumental variables. To highlight developing aspects, we also consider developing countries separately. The results confirm that submarine cables stimulate the trade in services in some sectors but not others. Exports of communication and imports of IT services are negatively affected which could indicate that submarine cables replace the need for some services in these sectors such as postal services. The negative effects for communication and IT services are not observed for developing countries, however. Generally, the results confirm that developing countries benefit more from submarine cables in both service exports and imports and the number of sectors positively affected is also larger in developing countries. This suggests a catch-up effect due to lower initial trade values, possible larger productivity gains, and generally larger benefits from investing in submarine cables in developing countries. These results are new to the literature.

This study is relevant to several contemporary economic and development issues that many countries are having to deal with. As of June 2019, only 59% of the world population was online, which means around 3 billion people do not have internet access. In Africa, this percentage is much lower - only 39.6%[7]. These percentages are likely to be much lower for broadband access[8]. In many cases, the reason for this is the high costs of connecting to the internet. Submarine cables are the only way to bring down internet costs and bring broadband internet to communities around the world (IFC.org). At the same time, services trade grew at a faster pace than goods trade between 2006 and 2016[9]. Many countries, especially developing countries, look at services trade as a way to diversify their economies away from dependence on primary commodities (Newfarmer et al. (2009)). According to data we collect, while most developing countries were connected by at least one submarine cable by 2019, a few countries are yet to connect by at least one submarine cable such as El Salvador (Table 6). Also, many countries are only connected by one submarine cable which exposes them to disruptions, lower competition, and higher prices. This paper addresses the benefits of investing in multiple submarine cables.

This is the first paper that addresses the benefits of investing in submarine cables and its effect on the trade in services as far as we are aware. Research on submarine cables in the economics literature is scarce at best. The only other study that looks at submarine cables is the study by Eichengreen et al. (2016) where the authors study whether laying submarine cables stimulated electronic currency trading given that submarine cables reduce trading costs and more importantly, latency. This paper contributes to the literature on infrastructure investments and relates to the question about the benefits of major infrastructure developments. This literature has mostly focused on the transportation infrastructure such as roads and rail and, in many cases, in developing countries. There are many examples from this literature. Donaldson (2018) investigates the benefits of railroads in Raj India and finds that they lower trade costs, increase regional and international trade, and enhance welfare. Asturias et al. (2016) study the benefits

[7] Internet penetration varies sharply by region: from close to 90% in North American and Europe to only 39.6% in Africa. Source: www.internetworldstats.com/stats.htm

[8] The United Nations declared access to the internet as a human right in 2011.

[9] Source: https://www2.deloitte.com/us/en/insights/economy/issues-by-the-numbers/trade-in-services-economy-growth.html

of the Golden Quadrilateral road network in India and find real income and allocative efficiency gains[10]. Adamopoulos (2011) shows that investing in the transportation infrastructure reduces income disparities between developed and developing countries and Gollin and Rogerson (2014) show that transport productivity is important for welfare and allocation efficiency. Bernhofen et al. (2016) study the effects of investing in container ports and find high trade effects. Fewer studies focus on major infrastructure developments in communication technology. A few existing studies take the example of the predecessor of the submarine cable, the telegraph. These studies are interested in the effects of the telegraph on merchandise trade and market price convergence. Lew and Cater (2006) argue that the telegraphs improved the coordination of international shipping and that in turn stimulated international trade in goods. Ejrnæs and Persson (2010) show that the telegraph led to a convergence in grain prices across markets and more recently Juhász and Steinwender (2018) show how the telegraph stimulated trade in cotton through a reduction in information asymmetries.

Research on services trade has gained tract in recent years as this trade gains importance and more data become available. Nonetheless, the research on services trade remains limited compared to the vast quantity of research on goods trade. One reason for this remains problems with reporting because services trade do not cross a physical border. Reporting is also much less enforced than in goods trade. Recent contributions estimate the gravity model for services trade similar to goods trade and these include Walsh (2008), Ceglowski (2006), and Kimura and Lee (2006). This literature generally finds that the gravity equation, when applied to services trade, returns similar coefficients and results.

Another body of literature that this study contributes to is that of the effect of the internet on trade. While this paper does not measure internet penetration directly, it investigates a major investment in the communications infrastructure that allows the country to fully benefit from the internet (Carter (2010)) and represents the most efficient and cheapest way to introduce broadband internet (Delaunay (2017)). Two studies investigate the direct effects of internet penetration on services trade at the country level and these are Freund and Weinhold (2002) and Choi (2010). Freund and Weinhold (2002) use limited US services trade data with 31 (mainly developed) countries in 14 industries between 1995 and 1999. Their measure of the internet penetration is the number of domain names attributed to the partner country. A limitation to their measure is that domain names are not necessarily hosted in the corresponding country. This pioneering study was limited by the availability of the data at that early stage of internet penetration (which predates the age of broadband internet) and suffers from endogeneity and reverse causality as the authors argue. In a short study, Choi (2010) estimates the effects of the percentage of internet users on aggregate services trade in 151 countries. Both studies find support for a positive effect of internet penetration on services trade. Research on the effects of the internet on services trade benefited from the increasing availability of micro-data more recently. Studies that use micro-data to investigate the effects of ICT and the internet on services trade at the firm level generally find support for a positive effect. Abramovsky and Griffith (2006) was one of the first studies that use micro-data from the UK to consider whether ICT investments and the internet affect the firm's decision to outsource or offshore and they find support that the internet increases the firm's propensity to do both. Kneller and Timmis (2016) use UK services firm-level data to investigate the effects of adopting broadband internet by the firm on the firm's export of services. They instrument for broadband adoption by the firm using a novel instrument based on geographic distance to available internet switches in the area. They find support for a positive effect of adopting broadband internet in a sample of firms that export business services only and this effect is on the extensive margin. Other studies using firm-level data include Clarke (2008), Ariu and Mion (2010), and Fort (2017).

The remainder of the paper is structured as follows. Section 2 describes the data sources and sets up the identification strategy, section 3 presents the main results and the robustness exercises, and finally section 4 concludes.

[10] Alder (2016) also looks at the effects of India's new road network developments and compares them to the Chinese efforts to connect intermediate-size cities and finds that the Chinese strategy is superior in delivering higher gains.

2 Data and empirical approach

The data set for services trade comes from the 'OECD-WTO Balanced Trade in Services Database' (BATIS)[11]. This data set is the first complete data set for services trade covering 191 countries and the eleven main EBPOS 2002 services categories[12]. The time period it covers is 1995-2012 which will define the time period of this study. The data set is compiled to deal with many shortcomings that are rampant in services trade reporting such as internal inconsistencies and, in many cases, the lack of data. The data set and the methodologies used in compiling it are described in Fortanier et al. (2017). Since submarine cables only connect countries that have direct access to the sea by definition, we exclude landlocked countries from the sample. This leaves us with 143 countries (113 developing and 30 developed countries). Another advantage of this data set is that there are no zeros or missing observations. This eliminates the zeros problem in international trade data.

Raw data on submarine cables are obtained from *TeleGeography*. The raw data are then organized to create a country-level data set that lists the number of submarine cables that connect a country in any given year. The first modern submarine cable was constructed in 1988 and by 2019, around 400 submarine cables are in operation. Tables 5 and 6 show the first year of connection and the number of cables connecting the countries in 2012, the last year in the sample period. Figure 1 shows the number of submarine cables between 1988 and 2020 against total world services exports in the period 1995-2012. The figure shows that both series have increased over the respective periods in time.

We are interested in estimating the effects of submarine cables connecting a given country to the world network of submarine cables on services trade. Since some countries connect by more than one cable and these cables are introduced gradually, we use the number of submarine cables connecting a country as the variable of interest to capture the variation in the number of cables and the time of introduction of the first and subsequent cables. Hence, to identify the effects of submarine cables on services trade, we estimate the following equation:

$$\begin{aligned} Log\, trade_{it} = \beta_0 + \beta_1 Log\, Cables_{it} + \beta_2 Log\, GDP_{it} + \beta_3 Log\, goods\, trade_{it} \\ + \beta_4 Log\, Remoteness_{it} + \beta_5 GATS_{it} + \beta_6 Rule\, of\, Law_{it} + \mu_i + \mu_t + \epsilon_{it} \quad (1) \end{aligned}$$

In the above equation, $trade_{it}$ is services trade of country i and t is a time subscript that stands for the observation period. I consider both exports and imports separately as aggregate values and disaggregate values per sector. The main independent variable is the log of the number of cables that connect a country to the internet $Cables_{it}$[13]. The estimated log-log relationship is motivated by Figure 2, which sketches a LOWESS smoothing graph and shows a linear relationship between the logs of the number of cables and services export values[14]. In the robustness checks, we relax the log-log relationship by assuming a dummy variable that takes the value of 1 when the country first connects to the internet by the first submarine cable. The explanatory variables include the log GDP of the observation country, log value of goods trade, a dummy $GATS_{it}$ that captures whether the country is a member of the 'General Agreement on Trade in Services' which is a proxy for how restrictive the country is to services trade, and a 'Rule of Law' variable which measures the quality of institutions and how enforceable contracts are. These variables have been shown in the trade literature to matter in determining trade flows. We also control for remoteness which measures how far the country is from the rest of the world with distances from larger economies receiving higher weights. One expects remote countries to trade less with the world. Distance in the context of services trade is different from

[11] This data set is publicly available through the OECD website https://data.oecd.org/

[12] The eleven sectors according to the EBPOS 2002 classification are: transport, travel, communication, construction, insurance, finance, IT, royalties, business services, personal services, and governmental services.

[13] Since some countries have no submarine cables in some years, I add 0.001 to the number of cables before taking the log of the number of cables as done in the literature sometimes.

[14] Figure 3 shows that the relationship between the levels of the number of cable and export values is less linear.

that of goods trade; it captures transaction constraints such as information asymmetries and not transport costs (Gooris et al. (2015)). Remoteness is calculated as the weighted average of distances from the all trade partners with the shares of GDP of the partner countries in world GDP as weights. Mathematically, this is written as follows:

$$Remoteness_{it} = \sum_{i \neq j} \left(\frac{GDP_{jt}}{GDP_{WLD,t}} \right) distance_{ij}$$

The above specification is likely to suffer from endogeneity due to simultaneity and omitted variable bias. For instance, countries that are frequent traders of services are more likely to opt for faster and more reliable internet and they are, therefore, more likely to invest in submarine cables. In addition, there may be non-observable country factors that affect both services trade and the need for submarine cables such as the telecommunication and technology infrastructure and the level of development of the economy. To deal with this, we construct two instrumental variables (IV) that stem from the need to connect by submarine cables and the factors that encourage or discourage such a large investment. The first instrument is motivated by the prohibitively high costs of laying submarine cables. The cost of submarine cables is directly proportional to the length of the cable and hence, the sea distance between countries. The instrument we construct is the weighted average sea distances with the goods trade share of the partner in total world trade as weights. Ideally, we would want to use the countries' share of servers as weights because countries connect by submarine cables to connect to countries with lots of servers, especially countries with the highest concentration of servers. This is why most cables connect to the United States, the United Kingdom, and smaller European countries such as Denmark and Sweden (see Table 4). But we could not find data on servers before 2010. However, the share of trade is highly correlated with the share of servers. To show this, we calculate the coefficient of correlation between the trade shares and server shares for the years 2010-2015 and find it to be equal to 0.84 (Refer to Figure 4 in the appendix)[15]. The advantage of this instrument is that it does not include country i's trade which reduces any concerns for simultaneity bias. Thus, the more remote a country is, the more expensive it is to connect by submarine cables because longer submarine cables are more costly. The weight captures the idea that the farther a country is from countries with many servers and trade power, the more costly it is to connect it by submarine cables in a reliable and efficient way. Equation 2 is the mathematical equation of this instrument.

$$Weighted\ Sea\ Distances_{it} = Log \sum_{i \neq j} \pi_{jt}.sea\ distance_{ij} \tag{2}$$

In equation (2), j is an index for all countries other than country i, t is a year index, and the share of country j's trade in total world trade is given by:

$$\pi_{jt} = \frac{Trade_{jt}}{\sum_k Trade_{kt}}$$

The second instrument is the regional number of internet users excluding the observation country. This instrument is relevant because most submarine cables are built by consortia of governments and/or Telecom companies[16]. This is because the high costs of laying submarine cables can be shared among the regional partners. Higher number of internet users in the region places higher demand on existing telecommunication infrastructure, which justifies new regional investments in submarine cables. This in turn leads to higher likelihood that the country will connect by submarine cables because it can share costs with its neighbors. Here too, the instrument excludes the observation country i's internet users which reduces any concerns for

[15] It can also be argued that the trade share of a partner country influences the need for other countries to connect to that country because there is more to communicate with that country and trade share is a proxy for the country's interaction with the world.

[16] For instance, the first modern fiber-optic submarine cable was constructed in 1988 by a consortium of companies led by ATT Corporation, France Telecom, and British Telecom.

simultaneity bias. Equation 3 shows how this instrument is constructed.

$$Regional\ internet\ users_{it} = \sum_{j \epsilon R} internet\ users_{jt} \tag{3}$$

In equation (3), j stands for all countries other than the observation country i in the same region R. We use the World Bank regional classifications which divides the world into seven regions to define a world region[17].

3 Results

In this section, we present the results for estimating equation 1 for services exports and imports using the OLS and the two-stage-least-square (2SLS) estimators[18]. We also estimate the equation at the sector level using the 2SLS estimator. Sector divisions in the BATIS data set are done according to the EBPOS 2002 classification. Table 7 presents the results for exports and Table 8 for imports. In both tables, the first column presents the OLS estimation results, the second column presents the 2SLS estimator results for aggregate trade, and the subsequent columns present the 2SLS estimator results for the sector regressions. Starting with the control variables, all regressions return the expected signs on the coefficients; coefficients on the GDP, GATS, and rule of law variables are mostly positive and significant, while the coefficient on remoteness is mostly negative and significant. The trade in goods does not seem to matter in determining the trade in services. As for the variable of interest - the number of submarine cables, the OLS estimates return coefficients that are not significantly different from zero. Regarding the 2SLS estimations, the first stage returns the expected signs on the instruments and the coefficients of the instruments are significant at the 1% significance level in all columns[19]. In the second stage estimations, the coefficient on the submarine cables variable is positive and significant in the exports case but not in the imports case in columns (2) for aggregate trade flows. The coefficient is interpreted as elasticity and a doubling of the number of cables leads to an 8% increase in exports. The results also present the F-stat (Kleibergen-Paap F-stat) to test for weak instruments and the p-value of the Hansen test for the overidentifying restrictions. In columns (2) in both tables, the F-stat is much higher than the rule of thumb value of 10 and the p-value of the Hansen test suggests that we do not reject the null hypothesis that overidentifying restrictions are valid. At the sector level, and taking into account the Hansen J-stat test, the results suggest that submarine cables promote exports in transport and travel services. The elasticities suggest that a doubling of the number of cables leads to an increase of 6.7 and 11.3% in exporting transport and travel services respectively. On the other hand, the coefficient on the cables variable is negative and significant in the case of communications services exports. One possible explanation for this is that submarine cables reduce or replace some of the trade in postal and telecommunication services as we argue above. Submarine cables do not seem to affect the exports of insurance, finance, IT, and personal services, on the other hand. With respect to imports, the number of cables has a positive and significant effect on transport and governmental services imports with elasticities of 0.03 and 0.18 respectively[20]. On the other hand, the coefficient in the IT services import regression is negative and significant which suggests that submarine cables reduce the need for some IT service imports as well.

But are the effects different for developing countries? To answer this, we estimate 1 for the sample of developing (non-landlocked) countries in the data set only. Developing countries

[17] The World Bank divides the world into seven regions and these are: East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa.

[18] In the trade literature, the PPML (pseudo-poisson maximum likelihood) estimator is sometimes used to deal with zero-inflated trade data (see Silva and Tenreyro (2006)). While there are no zero trade values in the data set we use in this study, we are not aware of a way to estimate a poisson regression with instrumental variables and fixed effects in STATA. Attempting to use the ivpoisson command with instrumental variables and fixed effects leads to non-convergence issues.

[19] First stage results are available upon request.

[20] Governmental services include services supplied by international organizations, embassies, and other from the host economy

are defined as non-OECD countries and they constitute the majority of the observations in the data set (Table 6). The results are presented in Tables 9 and 10. Here too, the OLS estimates return coefficients that are not significantly different from zero. In the 2SLS estimates, both aggregate exports and imports are stimulated by connecting to submarine cables with estimated elasticities of 0.24 and 0.1 respectively. In other words, a doubling of the number of cables leads to 24 and 10% increase in aggregate exports and imports respectively. The sector regressions do not return any negative coefficients suggesting that the submarine cables did not reduce trade in any services sectors in developing countries. With respect to exports, and taking into account the Hansen test, increasing the number of submarine cables leads to higher exports in construction, business, governmental, travel and IT with the latter two being significant at the 10% significance level only. Exports of governmental services respond the most (elasticity of 0.94), followed by business and construction services (both with elasticity of 0.51), and then IT and travel services (elasticities of 0.22 and 0.12 respectively). Turning to imports, transport, communication, and business services are stimulated by submarine cables, and the elasticities are 0.13, 0.26, and 0.19 respectively. Generally, these results suggest that developing countries benefit more from laying submarine cables both in magnitude of the marginal effects and the number of sectors being affected positively. We interpret this as a catch-up effect in which developing countries that start with lower productivities and trade levels benefit more from the positive effects of laying submarine cables.

In terms of the economic impact of submarine cables, the average aggregate export value for developing countries is 10.32 billion USD. This means that doubling submarine cables would lead, on average, to an increase of close to 2.5 billion USD in aggregate services exports of the average developing country. At the sector level, considering business services for instance (elasticity of 0.51), a doubling of submarine cables leads to an average increase of around 1.3 billion USD in exports for the average developing country.

3.1 Robustness

We first test the robustness of the results to assuming a dummy variable instead of a count variable to identify the effects of the submarine cables. This deals with the concern about the assumed log-log relationship estimated in section 3 above. A dummy variable captures the first time that a country connects to the internet with a submarine cable. The results are presented in Tables 11 and 12 and generally confirm the results found in Tables 9 and 10. The coefficients are however much larger suggesting that the first connection has a much larger effect than subsequent submarine cable installations. The IV regression for aggregate exports in Table 11 column (2) returns a coefficient of 0.666. This means that deploying the first submarine cable leads to an increase of 95% ($e^{0.666} - 1$) in services export. This is a substantial effect reminiscent of the large effects of important technical changes such as introducing the steam engine (Pascali (2017)) and the container (Bernhofen et al. (2016)). Sectors that benefit from introducing the first submarine cable are travel and transport where the effects are 143 and 65% respectively. The results for imports in Table 12 are also consistent with the main results. Estimating the regressions with a dummy variable in developing countries are also consistent with the continuous variable estimates and the coefficients are also much larger. The only caveat is that the Kleibergen-Paap F-stat is slightly lower than 10 which suggests that the instruments do a worse job predicting the first time that a country connects by a submarine cable than predicting subsequent additions. This is because there is much less variation in the data when considering a dummy variable as the measure of submarine cables than in the case of a count variable[21].

Other robustness exercises include dropping micro nations such as Vanuatu, Grenada, and others. This does not have any impact on the results. We also estimate the regression equation with lagged (first lag) endogenous and exogenous variables and with lagged exogenous variables only and the results remain the same. Furthermore, we run a random effects model and the results are resilient to this change. We check the robustness of the results to clustering the standard errors by country and then region-year and the results come through. Finally, we deflate the services trade flows as well as the GDP and the goods trade flows with the country

[21] The results are available upon request from the author

GDP deflator and the results are still the same[22]. The results for the above robustness checks are available upon request.

4 Conclusion

Submarine cables are the cheapest, most reliable and most efficient way to bring broadband and high-speed internet to a country and allow the country to benefit from the internet the most. This paper deals with the question of whether investing in submarine cables stimulates the trade in services. The results suggest that this is the case in some sectors. The results also suggest that the effects are higher for developing countries where more sectors benefit and no sectors are affected negatively. The sectors that benefit the most are business, construction, and governmental services for exports and business, transport, and communication services for imports. The higher gains for developing countries can be attributed to larger productivity gains from submarine cables and hence, a catch-up effect comes into play. The results suggest that additional investments in submarine cables could be beneficial for promoting services trade and hence economic diversification in developing countries.

A limitation of this paper is that it doesn't account for terrestrial cables. Countries that connect to the internet can choose to connect by terrestrial cables if the neighboring countries are connected to the internet by submarine cables. Submarine cables are however the most efficient way because they provide direct access to servers worldwide and lead to higher internet price drops as suggested by the evidence we provide in this paper. Future research should provide more evidence on how terrestrial cables complement submarine cables to bring the internet to landlocked countries and more remote areas and the benefits thereof.

[22] Although the results come through, we noticed some data discrepancies in the GDP deflator data especially in the case of developing countries. For example, for the UAE, the GDP deflator suggests a very large deflation episode of 15% in 2009 followed by large inflation of 12% in 2010. This is not supported by information found on the internet. One needs to be careful about the quality of this data. Also, GDP deflator may not be the right index to deflate services trade with.

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Appendices

A Figures

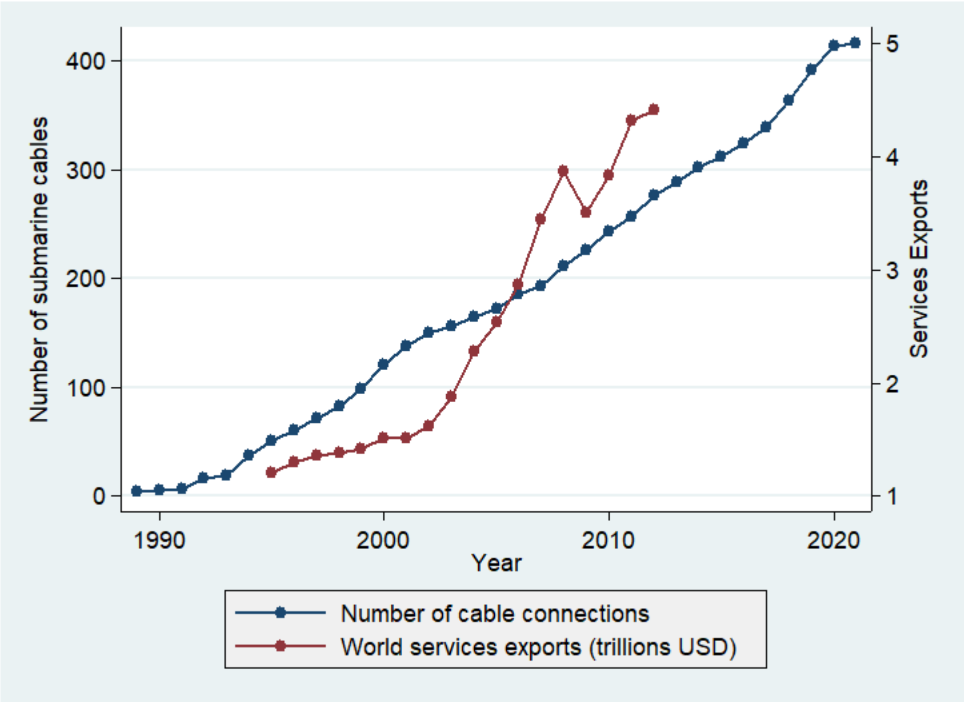

Figure 1. The number of submarine cables and world exports in services

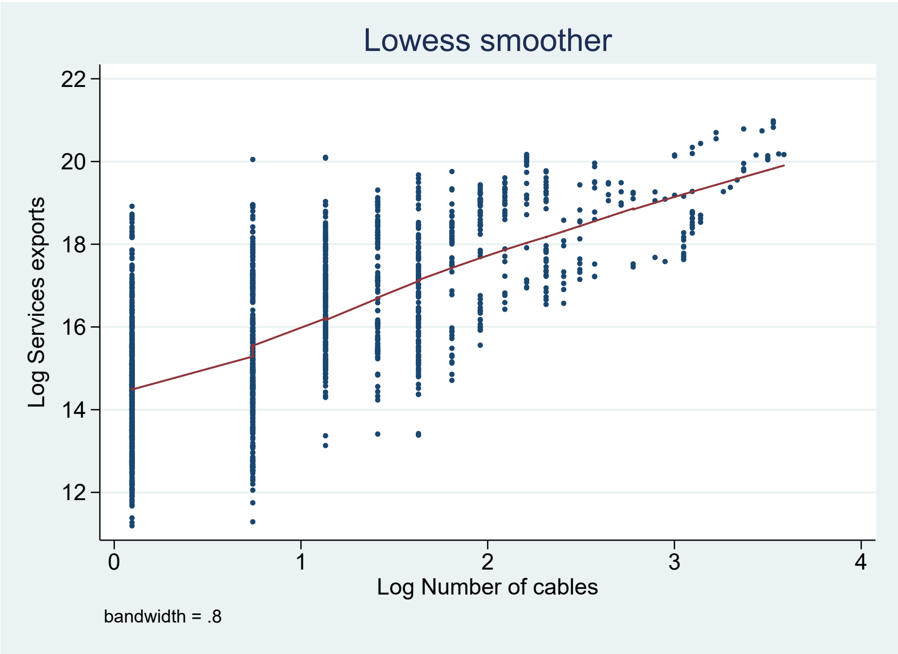

Figure 2. A LOWESS smoothing graph for the relationship between the log number of cables and log services export values. Each point represents the number of cables and export values for a given country-year combination in the sample.

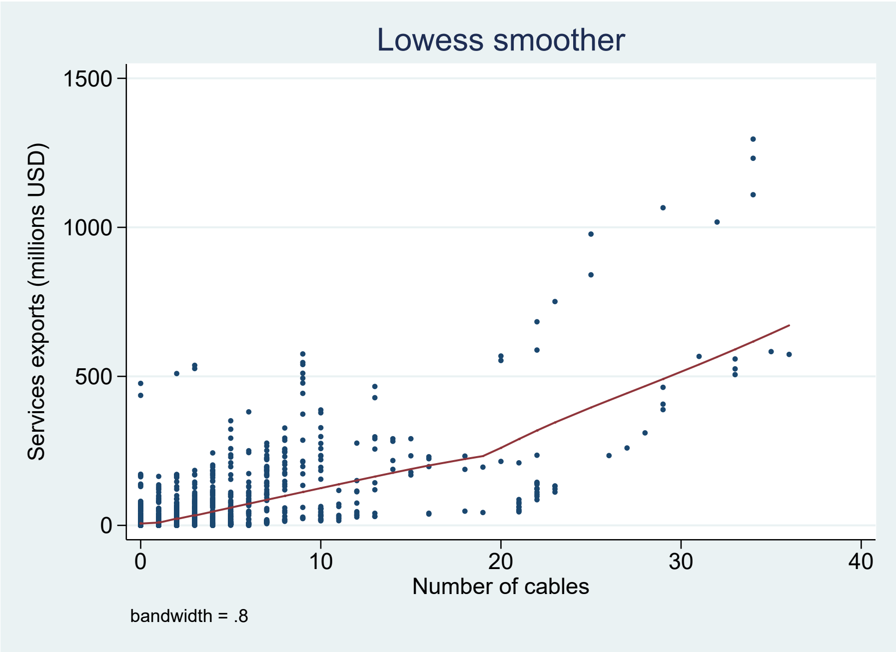

Figure 3. A LOWESS smoothing graph for the relationship between the number of cables and services export (million USD). Each point represents the number of cables and export values for a given country-year combination in the sample.

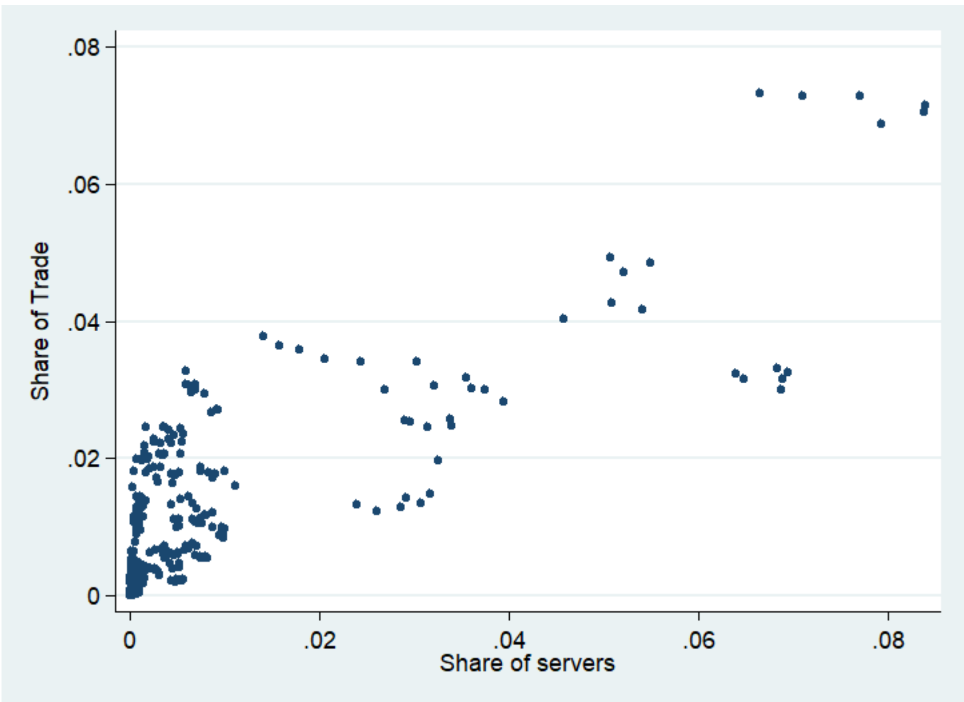

Figure 4. Scatter plot of the shares of trade and servers. Each dot represents a country-year observation between 2010 and 2015. Correlation coefficient is 0.84.

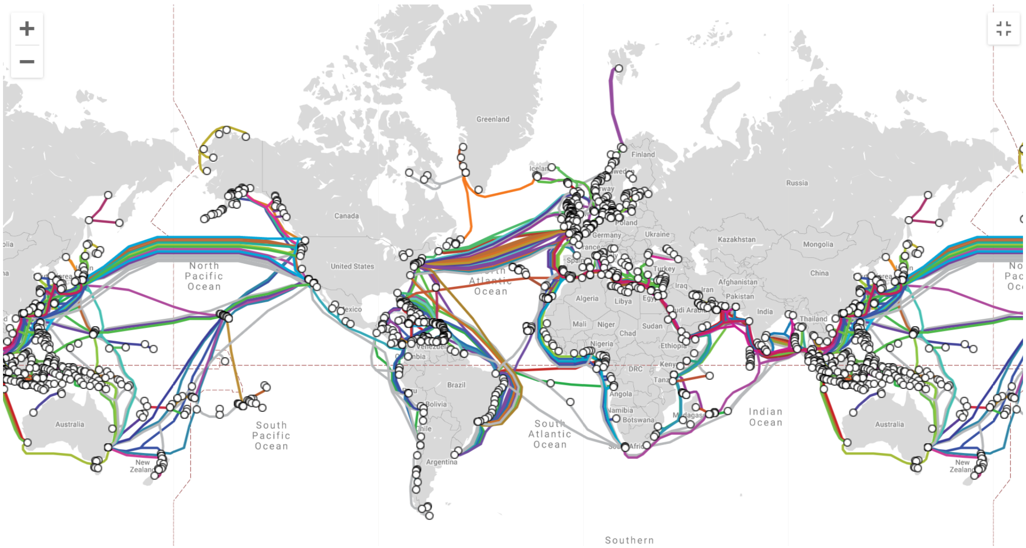

Figure 5. World map with submarine cables in 2019. Source: https://www.submarinecablemap.com/.

B Tables

Indicator	**Source**
Services exports and imports	BATIS dataset from the OECD and WTO
Submarine cables	Author built based on raw data from TeleGeography
Goods trade flows	BACI dataset from CEPII
GDP, Rule of Law, Internet users	World Bank
GATS, distances	CEPII
Sea distances	CERDI

Table 1. Data sources

Country	Cost	**Landlocked**
Mauritius	0.84	No
Seychelles	1.6	No
South Africa	2.85	No
Gabon	3.42	No
Cape Verde	3.54	No
Namibia	10.62	No
Niger	176.2	Yes
Burundi	220.5	Yes
Malawi	241.2	Yes
Rwanda	642.5	Yes
C. African Rep.	2193.6	Yes

Table 2. Fixed broadband cost as percentage of GNI per capita in select African countries. Source: International Telecommunication Union (ITU)[23].

Variable	Obs	Mean	Std. Dev.	Min	Max
Service exports (millions USD)	2,486	32,766.46	93,491.21	1.31	1,296,242
Number cables	2,486	2.47	4.28	0	36
GDP (millions USD)	2,486	318,420.30	1,216,176	57.61	16,200,000
Rule of Law	2,486	0.07	0.97	-2.01	2.01
Goods exports (millions USD)	2,486	63,854.56	168,014.70	0	2,106,645
GATS	2,486	0.81	0.40	0	1
Remoteness	2,486	8,359.76	1,851.52	5,452.93	13,987.05

Table 3. Summary statistics of variables used in the regressions.

	Submarine cables			Servers	
Rank	Country	Cable frequency	Rank	Country	servers
1	United Kingdom	36	1	United States	1,200,000
2	United States	34	2	Germany	176,527
3	Denmark	23	3	United Kingdom	159,285
4	Sweden	22	4	Japan	116,093
5	Italy	21	5	Netherlands	81,309
6	Japan	15	6	Canada	74,500
7	Singapore	15	7	Australia	72,472
8	India	13	8	France	40,871
9	United Arab Emirates	13	9	Sweden	22,775
10	France	13	10	Spain	18,879
11	Malaysia	12	11	Italy	18,058
12	Indonesia	12	12	Denmark	17,135
13	Cyprus	11	13	Turkey	16,733
14	Saudi Arabia	11	14	Poland	15,198
15	Egypt	10	15	Norway	15,056

Table 4. The top 15 countries by cable frequency and servers in 2012.

Country	Year first connection	Number cables in 2012	Country	Year first connection	Number cables in 2012	Country	Year first connection	Number cables in 2012
Australia	1999	7	Iceland	1995	4	New Zealand	2001	1
Belgium	1999	4	Ireland	1994	8	Norway	1992	3
Canada	2001	2	Israel	1999	4	Poland	1991	2
Chile	1999	3	Italy	1994	21	Portugal	1999	8
Denmark	1989	23	Japan	1998	15	Slovenia	-**	0
Estonia	1992	5	Korea	1998	7	Spain	1994	10
Finland	1992	10	Latvia	1994	3	Sweden	1989	22
France	1988	13	Lithuania	1995	2	Turkey	1993	4
Germany	1995	9	Mexico	2000	3	United Kingdom	1988	36
Greece	1994	6	Netherlands	1989	7	United States	1988	34

Table 5. Developed countries in the sample with submarine cable descriptive sample statistics. * denotes an expected date. **denotes no known plans for laying a submarine cable.

Developing countries in the sample

Country	Year first connection	Number cables in 2012	Country	Year first connection	Number cables in 2012	Country	Year first connection	Number cables in 2012
Albania	1996	2	Gambia	2013	0	Pakistan	1999	4
Algeria	2002	3	Georgia	2001	2	Panama	1999	5
Angola	2002	2	Ghana	2002	4	Papua New Guinea	2006	2
Argentina	1995	5	Grenada	1995	2	Peru	1999	3
Aruba	1999	2	Guatemala	2001	2	Philippines	1999	6
Bahamas	1997	4	Guinea	2013	0	Qatar	1998	5
Bahrain	1998	4	Guinea-Bissau	2013	0	Romania	2020*	0
Bangladesh	2006	1	Guyana	2010	1	Russia	2000	4
Barbados	1995	2	Haiti	2006	2	St. Kitts Nevis	1995	2
Belize	2001	1	Honduras	2001	2	St. Lucia	1995	2
Benin	2002	1	Hong Kong	2001	6	St. Vincent Gren.	1995	2
Bermuda	2001	4	India	1998	13	Samoa	2009	1
Bosnia Herz.	-**	0	Indonesia	1999	12	Sao Tome Principe	2013	0
Brazil	2000	5	Iran	1992	5	Saudi Arabia	1998	11
Brunei	1999	2	Iraq	2006	2	Senegal	2000	2
Bulgaria	2009	1	Jamaica	1997	5	Seychelles	2012	1
Cambodia	2017	0	Jordan	1998	1	Sierra Leone	2013	0
Cameroon	2002	2	Kenya	2009	4	Singapore	1999	15
Cape Verde	2000	2	Kiribati	2020	0	Solomon Islands	2020*	0
China	1998	6	Kuwait	1998	4	South Africa	2002	5
Colombia	1999	7	Lebanon	1995	3	Sri Lanka	1999	5
Comoros	2010	1	Liberia	2013	0	Sudan	2003	4
Congo	2012	1	Libya	1998	2	Suriname	2010	1
Costa Rica	2000	3	Macao	1999	1	Syria	1995	3
Croatia	1994	2	Madagascar	2010	2	Tanzania	2009	3
Cuba	2012	1	Malaysia	1998	12	Thailand	1998	5
Cyprus	1993	11	Maldives	2007	2	Togo	2012	1
Cote d'Ivoire	2002	2	Malta	1995	4	Tonga	2013	0
D.R. Congo	2012	1	Mauritania	2013	0	Trinidad Tobago	1995	5
Djibouti	1994	5	Mauritius	2002	2	Tunisia	1996	3
Dominica	1995	2	Montenegro	-**	0	Ukraine	2014	0
Dominican Rep.	1997	5	Morocco	1994	4	United Arab Em.	1992	13
Ecuador	1999	2	Mozambique	2009	2	Uruguay	1995	2
Egypt	1997	10	Myanmar	1999	1	Vanuatu	2014	0
El Salvador	-**	0	Namibia	2012	1	Venezuela	1999	6
Eq. Guinea	2013	0	Nicaragua	2001	1	Vietnam	1999	3
Fiji	2001	1	Nigeria	2002	4	Yemen	1994	2
Gabon	2002	1	Oman	1999	7			

Table 6. Developing countries in the sample with submarine cable descriptive sample statistics. * denotes an expected date. **denotes no known plans for laying a submarine cable.

	(1) OLS all sectors	(2) IV all sectors	(3) IV transport	(4) IV travel	(5) IV communic	(6) IV construct	(7) IV insurance
Log num cables	0.001	0.083***	0.067**	0.113***	-0.093**	0.478***	-0.106
	(0.004)	(0.021)	(0.027)	(0.031)	(0.046)	(0.090)	(0.081)
Log GDP	0.515***	0.482***	0.333***	0.729***	0.847***	-0.387**	-0.079
	(0.061)	(0.062)	(0.070)	(0.115)	(0.157)	(0.190)	(0.192)
Log trade value	0.022	0.030	0.050	0.010	0.147*	0.169	-0.027
	(0.052)	(0.051)	(0.037)	(0.073)	(0.083)	(0.129)	(0.069)
GATS	0.196***	0.243***	0.203***	0.334***	-0.642***	0.924***	0.658***
	(0.045)	(0.053)	(0.070)	(0.078)	(0.115)	(0.246)	(0.245)
Remoteness	-1.369***	-1.226***	-1.613***	-0.604	-3.271***	-5.177***	-4.474***
	(0.244)	(0.273)	(0.416)	(0.481)	(0.792)	(1.336)	(0.890)
Rule of Law	0.237***	0.244***	0.152**	0.283***	0.592***	0.074	0.588***
	(0.039)	(0.042)	(0.070)	(0.073)	(0.115)	(0.205)	(0.169)
Observations	2486	2486	2486	2486	2486	2486	2486
F statistic (Kleibergen-Paap)		42.353	42.353	42.353	42.353	42.353	42.353
Hansen J stat p-value		0.120	0.206	0.905	0.331	0.015	0.122

	(8) IV finance	(9) IV IT	(10) IV royalties	(11) IV business	(12) IV personal	(13) IV govern
Log num cables	0.031	0.018	-0.132*	0.216***	0.115	0.420***
	(0.068)	(0.063)	(0.078)	(0.056)	(0.079)	(0.070)
Log GDP	0.208*	-0.018	-0.245	0.359***	0.041	0.377**
	(0.115)	(0.133)	(0.190)	(0.130)	(0.126)	(0.162)
Log trade value	-0.043	0.149*	-0.009	-0.061	0.092**	0.152
	(0.058)	(0.083)	(0.112)	(0.071)	(0.042)	(0.134)
GATS	1.078***	0.876***	0.682***	1.067***	0.921***	1.174***
	(0.259)	(0.247)	(0.258)	(0.253)	(0.234)	(0.257)
Remoteness	-2.322***	-3.945***	-2.861**	-1.128	-4.322***	-2.310**
	(0.892)	(1.001)	(1.127)	(0.960)	(1.134)	(1.107)
Rule of Law	0.499***	0.672***	0.648***	0.350***	0.816***	0.134
	(0.141)	(0.164)	(0.174)	(0.127)	(0.156)	(0.154)
Observations	2486	2486	2486	2486	2486	2486
F statistic (Kleibergen-Paap)	42.353	42.353	42.353	42.353	42.353	42.353
Hansen J stat p-value	0.000	0.407	0.020	0.000	0.757	0.001

Table 7. Sample includes developing and developed countries. Dependent variable is log exports of services. F-stat is the Kleibergen-Paap F-stat to test for the weakness of the instruments. The Hansen p-value is for testing whether the overidentifying restrictions implied by the existence of more instruments than endogenous regressors are valid (null is that they are valid). Significance levels:* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard errors are robust standard errors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	IV	IV	IV	IV	IV	IV
	all sectors	all sectors	transport	travel	communic	construct	insurance
Log num cables	0.002	0.003	0.034**	0.020	0.026	0.198***	0.104***
	(0.003)	(0.013)	(0.015)	(0.025)	(0.034)	(0.073)	(0.039)
Log GDP	0.513***	0.513***	0.497***	0.612***	0.480***	0.079	0.664***
	(0.032)	(0.032)	(0.042)	(0.058)	(0.065)	(0.146)	(0.084)
Log trade value	0.048*	0.048*	0.101**	0.034	-0.028	0.123	-0.134
	(0.029)	(0.028)	(0.051)	(0.040)	(0.030)	(0.162)	(0.088)
GATS	0.129***	0.129***	0.175***	0.323***	0.045	-0.058	0.157*
	(0.033)	(0.033)	(0.039)	(0.084)	(0.101)	(0.173)	(0.094)
Remoteness	-1.084***	-1.083***	-1.518***	0.026	-3.541***	-2.540**	0.032
	(0.203)	(0.201)	(0.208)	(0.566)	(0.539)	(1.136)	(0.559)
Rule of Law	0.123***	0.123***	0.003	0.260***	-0.092	-0.149	0.019
	(0.031)	(0.031)	(0.052)	(0.079)	(0.087)	(0.194)	(0.094)
Observations	2486	2486	2486	2486	2486	2486	2486
F statistic (Kleibergen-Paap)		41.467	41.467	41.467	41.467	41.467	41.467
Hansen J stat p-value		0.662	0.209	0.385	0.473	0.000	0.000

	(8)	(9)	(10)	(11)	(12)	(13)
	finance	IT	royalties	business	personal	govern
Log num cables	-0.084	-0.157***	-0.008	0.010	-0.032	0.180***
	(0.054)	(0.050)	(0.052)	(0.030)	(0.068)	(0.045)
Log GDP	0.611***	0.100	0.167	0.428***	0.466***	1.266***
	(0.089)	(0.104)	(0.134)	(0.072)	(0.119)	(0.200)
Log trade value	-0.098	0.062	0.177	-0.011	0.175***	-0.023
	(0.063)	(0.044)	(0.120)	(0.033)	(0.056)	(0.040)
GATS	0.502***	0.454**	0.105	0.293***	0.716***	-0.066
	(0.175)	(0.185)	(0.202)	(0.093)	(0.226)	(0.111)
Remoteness	-2.556***	-3.650***	0.315	-2.056***	-0.453	2.462***
	(0.714)	(0.828)	(0.996)	(0.516)	(0.965)	(0.798)
Rule of Law	0.188*	0.654***	0.068	0.229***	-0.256	-0.265**
	(0.104)	(0.141)	(0.135)	(0.089)	(0.172)	(0.133)
Observations	2486	2486	2486	2486	2486	2486
F statistic	41.467	41.467	41.467	41.467	41.467	41.467
Hansen J stat p-value	0.963	0.154	0.032	0.135	0.007	0.949

Table 8. Sample includes developing and developed countries. Dependent variable is log imports of services. F-stat is the Kleibergen-Paap F-stat to test for the weakness of the instruments. The Hansen p-value is for testing whether the overidentifying restrictions implied by the existence of more instruments than endogenous regressors are valid (null is that they are valid). Significance levels:* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard errors are robust standard errors.

	(1) OLS all sectors	(2) IV all sectors	(3) IV transport	(4) IV travel	(5) IV communic	(6) IV construct	(7) IV insurance
Log num cables	0.004	0.238***	0.100*	0.117*	0.178**	0.510***	0.135
	(0.004)	(0.054)	(0.060)	(0.067)	(0.075)	(0.143)	(0.102)
Log GDP	0.554***	0.464***	0.329***	0.755***	0.774***	-0.346*	-0.233
	(0.066)	(0.087)	(0.082)	(0.129)	(0.161)	(0.202)	(0.209)
Log trade value	0.021	0.036	0.044	0.001	0.141**	0.136	0.019
	(0.053)	(0.050)	(0.037)	(0.072)	(0.071)	(0.119)	(0.065)
GATS	0.244***	0.287***	0.181**	0.348***	-0.550***	0.681**	0.636***
	(0.051)	(0.094)	(0.082)	(0.087)	(0.113)	(0.280)	(0.205)
Remoteness	-1.562***	-0.866*	-1.561***	-0.574	-1.510*	-4.726***	-4.825***
	(0.286)	(0.510)	(0.560)	(0.620)	(0.863)	(1.599)	(1.051)
Rule of Law	0.220***	0.219***	0.167**	0.308***	0.530***	0.144	0.390**
	(0.042)	(0.070)	(0.079)	(0.082)	(0.124)	(0.219)	(0.170)
Observations	1946	1946	1946	1946	1946	1946	1946
F statistic (Kleibergen-Paap)		14.79	14.79	14.79	14.79	14.79	14.79
Hansen J stat p-value		0.817	0.022	0.912	0.05	0.116	0.676

	(8) finance	(9) IT	(10) royalties	(11) business	(12) personal	(13) govern
Log num cables	0.238**	0.220*	0.288*	0.512***	0.055	0.939***
	(0.111)	(0.128)	(0.159)	(0.127)	(0.146)	(0.181)
Log GDP	0.218*	-0.239*	-0.252	0.260	-0.047	0.180
	(0.130)	(0.128)	(0.223)	(0.191)	(0.119)	(0.253)
Log trade value	-0.039	0.137*	0.012	-0.038	0.079*	0.191
	(0.055)	(0.074)	(0.107)	(0.077)	(0.041)	(0.141)
GATS	1.248***	0.899***	0.577**	1.070***	0.601***	1.085***
	(0.293)	(0.280)	(0.268)	(0.309)	(0.231)	(0.356)
Remoteness	-2.500**	-3.325***	-2.660*	-0.239	-5.631***	0.779
	(1.145)	(1.246)	(1.504)	(1.443)	(1.421)	(1.868)
Rule of Law	0.447***	0.644***	0.586***	0.362**	0.681***	0.091
	(0.158)	(0.182)	(0.198)	(0.171)	(0.163)	(0.254)
Observations	1946	1946	1946	1946	1946	1946
F statistic	14.79	14.79	14.79	14.79	14.79	14.79
Hansen J stat p-value	0.001	0.636	0.004	0.193	0.906	0.193

Table 9. Sample is restricted to developing countries only (non-OECD). Dependent variable is log exports of services. F-stat is the Kleibergen-Paap F-stat to test for the weakness of the instruments . The Hansen p-value is for testing whether the overidentifying restrictions implied by the existence of more instruments than endogenous regressors are valid (null is that they are valid). Significance levels:* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard errors are robust standard errors.

	(1) OLS all sectors	(2) IV all sectors	(3) IV transport	(4) IV travel	(5) IV communic	(6) IV construct	(7) IV insurance
Log num cables	0.007**	0.103***	0.130***	0.062	0.262***	0.033	0.147**
	(0.003)	(0.030)	(0.034)	(0.052)	(0.077)	(0.109)	(0.064)
Log GDP	0.518***	0.479***	0.472***	0.540***	0.400***	0.031	0.698***
	(0.034)	(0.044)	(0.052)	(0.067)	(0.094)	(0.140)	(0.093)
Log trade value	0.050*	0.064*	0.105**	0.035	0.007	0.051	-0.128
	(0.031)	(0.034)	(0.050)	(0.038)	(0.033)	(0.128)	(0.091)
GATS	0.150***	0.167***	0.187***	0.357***	-0.001	-0.232	0.262***
	(0.037)	(0.051)	(0.058)	(0.102)	(0.122)	(0.187)	(0.085)
Remoteness	-1.271***	-0.975***	-1.400***	0.227	-2.956***	-2.078	0.332
	(0.245)	(0.297)	(0.329)	(0.729)	(0.753)	(1.279)	(0.695)
Rule of Law	0.102***	0.101**	-0.015	0.300***	-0.128	-0.114	0.062
	(0.033)	(0.041)	(0.067)	(0.089)	(0.106)	(0.198)	(0.102)
Observations	1946	1946	1946	1946	1946	1946	1946
F statistic (Kleibergen-Paap)		14.326	14.326	14.326	14.326	14.326	14.326
Hansen J stat p-value		0.564	0.133	0.434	0.508	0.000	0.000

	(8) finance	(9) IT	(10) royalties	(11) business	(12) personal	(13) govern
Log num cables	0.079	-0.034	0.226**	0.190***	0.099	0.143
	(0.069)	(0.095)	(0.092)	(0.071)	(0.093)	(0.089)
Log GDP	0.671***	-0.002	-0.005	0.382***	0.362***	1.333***
	(0.087)	(0.107)	(0.135)	(0.092)	(0.126)	(0.218)
Log trade value	-0.059	0.054	0.197	0.018	0.178***	-0.040
	(0.048)	(0.036)	(0.126)	(0.038)	(0.058)	(0.039)
GATS	0.702***	0.476**	-0.286*	0.303**	0.406**	-0.003
	(0.203)	(0.189)	(0.168)	(0.118)	(0.190)	(0.112)
Remoteness	-1.932**	-3.347***	0.348	-1.530**	-0.931	2.562***
	(0.843)	(0.916)	(1.296)	(0.742)	(1.128)	(0.922)
Rule of Law	0.116	0.580***	-0.022	0.173*	-0.406**	-0.219
	(0.105)	(0.151)	(0.151)	(0.105)	(0.185)	(0.140)
Observations	1946	1946	1946	1946	1946	1946
F statistic	14.326	14.326	14.326	14.326	14.326	14.326
Hansen J stat p-value	0.721	0.752	0.018	0.453	0.004	0.304

Table 10. Sample is restricted to developing countries only (non-OECD). Dependent variable is log imports of services. F-stat is the Kleibergen-Paap F-stat to test for the weakness of the instruments. The Hansen p-value is for testing whether the overidentifying restrictions implied by the existence of more instruments than endogenous regressors are valid (null is that they are valid). Significance levels:* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard errors are robust standard errors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	IV	IV	IV	IV	IV	IV
	all sectors	all sectors	transport	travel	communic	construct	insurance
submarine	-0.012	0.666***	0.498**	0.886***	-0.697*	3.832***	-0.879
	(0.027)	(0.176)	(0.212)	(0.249)	(0.368)	(0.716)	(0.631)
Log GDP	0.517***	0.465***	0.322***	0.707***	0.863***	-0.488**	-0.054
	(0.061)	(0.064)	(0.072)	(0.117)	(0.159)	(0.202)	(0.197)
Log trade value	0.022	0.031	0.050	0.011	0.146*	0.176	-0.029
	(0.052)	(0.052)	(0.037)	(0.075)	(0.081)	(0.137)	(0.070)
GATS	0.195***	0.237***	0.196***	0.324***	-0.633***	0.890***	0.664***
	(0.045)	(0.054)	(0.070)	(0.078)	(0.113)	(0.252)	(0.245)
Remoteness	-1.371***	-1.317***	-1.689***	-0.729	-3.166***	-5.698***	-4.360***
	(0.244)	(0.282)	(0.414)	(0.484)	(0.785)	(1.398)	(0.903)
Rule of Law	0.237***	0.246***	0.154**	0.286***	0.590***	0.087	0.585***
	(0.039)	(0.043)	(0.070)	(0.074)	(0.116)	(0.212)	(0.169)
Observations	2486	2486	2486	2486	2486	2486	2486
F statistic		35.262	35.262	35.262	35.262	35.262	35.262
Hansen J stat p-value		0.213	0.154	0.934	0.273	0.056	0.156

	(8)	(9)	(10)	(11)	(12)	(13)
	IV	IV	IV	IV	IV	IV
	finance	IT	royalties	business	personal	govern
submarine	0.346	0.107	-0.926	1.785***	0.888	3.415***
	(0.529)	(0.496)	(0.614)	(0.456)	(0.618)	(0.596)
Log GDP	0.193*	-0.020	-0.227	0.309**	0.019	0.284*
	(0.116)	(0.136)	(0.190)	(0.137)	(0.131)	(0.172)
Log trade value	-0.042	0.148*	-0.010	-0.057	0.093**	0.159
	(0.058)	(0.083)	(0.110)	(0.075)	(0.043)	(0.141)
GATS	1.082***	0.872***	0.700***	1.055***	0.911***	1.147***
	(0.257)	(0.245)	(0.256)	(0.253)	(0.233)	(0.261)
Remoteness	-2.347***	-3.967***	-2.706**	-1.360	-4.450***	-2.763**
	(0.882)	(0.999)	(1.133)	(0.982)	(1.114)	(1.178)
Rule of Law	0.501***	0.672***	0.646***	0.357***	0.819***	0.146
	(0.140)	(0.164)	(0.173)	(0.130)	(0.157)	(0.161)
Observations	2486	2486	2486	2486	2486	2486
F statistic	35.262	35.262	35.262	35.262	35.262	35.262
Hansen J stat p-value	0.000	0.395	0.013	0.003	0.675	0.005

Table 11. The variable of interest is a dummy variable. The dependent variable is log exports of services. F-stat is the Kleibergen-Paap F-stat to test for the weakness of the instruments. The Hansen p-value is for testing whether the overidentifying restrictions implied by the existence of more instruments than endogenous regressors are valid (null is that they are valid). Significance levels:* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard errors are robust standard errors.

	(1) OLS all sectors	(2) IV all sectors	(3) IV transport	(4) IV travel	(5) IV communic	(6) IV construct	(7) IV insurance
submarine	-0.000	-0.172	0.343***	-0.147	0.073	2.504***	1.191***
	(0.020)	(0.109)	(0.127)	(0.268)	(0.300)	(0.795)	(0.362)
Log GDP country	0.553***	0.564***	0.514***	0.689***	0.479***	-0.061	0.675***
	(0.029)	(0.030)	(0.040)	(0.073)	(0.065)	(0.198)	(0.088)
Log trade value	0.028	0.026	0.063*	0.012	-0.017	0.112	-0.130***
	(0.020)	(0.020)	(0.036)	(0.029)	(0.020)	(0.147)	(0.043)
log num RTA	0.009***	0.011***	-0.005	0.020	0.011	-0.018	-0.021*
	(0.003)	(0.003)	(0.004)	(0.016)	(0.008)	(0.023)	(0.011)
GATT	0.128***	0.115***	0.188***	0.300***	-0.004	0.116	0.213**
	(0.033)	(0.032)	(0.040)	(0.086)	(0.100)	(0.284)	(0.101)
Remoteness	-1.150***	-1.167***	-1.707***	0.588	-3.611***	-2.345	0.059
	(0.200)	(0.204)	(0.213)	(0.827)	(0.536)	(1.671)	(0.843)
Observations	2513	2513	2513	2513	2513	2513	2513
F statistic		34.497	34.497	34.497	34.497	34.497	34.497
Hansen J stat p-value		0.670	0.268	0.415	0.502	0.000	0.000
	(8) IV finance	(9) IV IT	(10) IV royalties	(11) IV business	(12) IV personal	(13) IV govern	
submarine	-1.048*	-2.967***	0.409	-0.169	0.072	1.039**	
	(0.605)	(0.789)	(0.654)	(0.288)	(0.787)	(0.464)	
Log GDP country	0.637***	0.310*	0.149	0.540***	0.245	1.757***	
	(0.114)	(0.176)	(0.190)	(0.086)	(0.201)	(0.316)	
Log trade value	-0.066	-0.007	0.340***	-0.021	0.100*	-0.049	
	(0.047)	(0.032)	(0.103)	(0.024)	(0.061)	(0.040)	
log num RTA	0.024*	0.096***	-0.002	0.022***	0.028	0.052***	
	(0.014)	(0.023)	(0.021)	(0.008)	(0.025)	(0.017)	
GATT	0.844***	0.565*	0.143	0.262***	1.025**	-0.356**	
	(0.285)	(0.309)	(0.369)	(0.091)	(0.399)	(0.141)	
Remoteness	-2.560***	-4.325***	0.784	-1.899***	-1.843	3.963***	
	(0.902)	(1.415)	(1.542)	(0.571)	(1.487)	(1.154)	
Observations	2486	2486	2486	2486	2486	2486	
F statistic	34.497	34.497	34.497	34.497	34.497	34.497	
Hansen J stat p-value	0.934	0.219	0.034	0.139	0.007	0.761	

Table 12. The variable of interest is a dummy variable. The dependent variable is log imports of services. F-stat is the Kleibergen-Paap F-stat to test for the weakness of the instruments. The Hansen p-value is for testing whether the overidentifying restrictions implied by the existence of more instruments than endogenous regressors are valid (null is that they are valid). Significance levels:* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard errors are robust standard errors.