Can Trade Barriers Explain Productivity Differences Between Foreign and Domestic Services Firms?

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ECONOMICS WORKING PAPER SERIES

Working Paper 2020-05-B

U.S. INTERNATIONAL TRADE COMMISSION
500 E Street SW
Washington, DC 20436

May 2020

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Abstract

Modern trade theory posits that foreign firms are more productive than those that only serve the domestic market. By combining a rich firm-level dataset with measures of trade barriers in services sectors at the country and sector level, we examine if productivity differences between domestic and foreign services firms are related to the regulatory barriers foreign firms face to enter the domestic market. Overall, at both the firm- and sector-level, we find a significant and positive relationship between services trade barriers and observed differences in productivity between domestic and foreign firms. Our findings support the view that only the most productive foreign firms incur the significant costs associated with regulatory barriers to serve the domestic markets through their foreign affiliates.

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1 Introduction

Modern trade theory places a strong emphasis on firm productivity as the driver of trade and investment flows, with only the most productive firms exporting (Melitz, 2003) or investing in foreign operations (Helpman et al., 2004). As a consequence, there has been a renewed interest in the trade literature in the analysis of the differences in firm productivity across countries and sectors and the role policy barriers play in accentuating these differences. A significant hurdle impeding this research endeavor, however, is finding readily accessible firm-level databases that cover a large set of countries, industries, and firms.

In conjunction with firm-level productivity analysis, there has also been a growing effort to understand trade and investment in the services sector generally, as services become more significant contributors to global commerce. Advances in digital platforms and technologies along with relaxation of investment barriers have greatly expanded the scope of services that can be provided either through cross-border trade or through a foreign affiliate. In fact, services are the fastest growing sector of the global economy, with trade and foreign direct investment (FDI) in services growing much faster than goods trade in recent years. From 1995 to 2014, exports in commercial services grew by 17.4 percent per year in value terms, while merchandise exports grew by 14.9 percent per year on average over the same time period. Commercial services exports also represented over 20 percent of all world exports in 2014 (World Trade Organization, 2015, 14).

As is the case with trade in goods, policy barriers can also inhibit trade and foreign investment in services. For services sectors, non-tariff measures, such as restrictions on foreign ownership or labor mobility, rather than say tariffs or quotas, are the main policy instruments restricting the delivery of services to foreign markets. In attempts to measure the extent of this phenomenon, data limitations have again proven to be a major obstacle, this time regarding country- and sector-specific policy barriers on foreign providers of services.

Building on these developments, we focus on whether foreign affiliates of multinational services firms (hereafter foreign firms) in a given national market are more productive than their domestically owned counterparts and whether trade barriers can explain such differences in productivity. Firms that set up affiliates in foreign markets have to incur a number of fixed costs, from physical infrastructure and personnel costs to fulfilling the foreign country's administrative and licensing requirements for starting a business. In order to be a profitable investment, these foreign affiliates need to earn operating profits in excess of these aforementioned fixed costs. Since a firm's operating profits depend on its productivity, only firms whose productivity levels are sufficiently high will successfully incur the fixed costs associated with setting up a foreign affiliate.

To better examine the relationship between trade policy barriers and productivity differences across domestic and foreign firms in services, we combine a rich firm-level dataset with measures of trade barriers at the country and sector level. Firm-level data is obtained from Bureau van Dijk's Orbis database, allowing for a total factor productivity (TFP) measure to be computed for services firms across countries and sectors. Notably, the Orbis database provides information on firm ownership, which enables us to distinguish between domestic firms and foreign-owned affiliates serving a particular country and sector. The OECD Services Trade Restrictiveness Index (STRI) is then used to proxy the regulatory costs associated with setting up a foreign affiliate in that particular market.

We find that country-sectors with high barriers to trade in services and provision of services by foreign firms (as denoted by high STRI scores) are also the ones where foreign firms are significantly more productive than domestic firms on average. This result holds even after accounting for country and sector fixed effects. We also find evidence of reduced foreign participation in country-sectors with high STRI scores. Reduced foreign participation can potentially explain the higher productivity premium for foreign firms in markets where the STRI is high, since highly productive firms may be the only foreign firms that can overcome the costs of entering a relatively closed market. Conducting the empirical analysis at the firm level, rather than the country-sector level, does not change our findings. We continue to see a productivity premium associated with foreign firms and that a foreign firm's productivity is less adversely affected than a domestic firm's productivity in sectors with high trade barriers.

The remainder of this paper is divided into four sections. Section 2 provides an overview of the previous literature that relies on firm-level data, including data from the Orbis database, to analyze productivity. Section 3 describes the firm-level data gathered from Orbis and the STRI data from the OECD. Section 4 provides an overview of the methodologies used in the empirical analysis and the main findings. Section 5 concludes.

2 Related Literature

Three strands of related literature inform our analysis in this paper: analysis of productivity using firm-level data, analysis of characteristics of firms serving foreign markets, and the relationship between barriers to trade in services and firm productivity. Each of these strands is discussed separately below.

2.1 Firm-level Productivity Analysis

There is a growing consensus in the literature around the advantages of using firm-level data in conducting productivity analysis (Bartelsman and Doms (2000); Syverson (2004); Bartelsman et al. (2009)). As discussed

in Bartelsman et al. (2009), firm-level data can be used to establish stylized facts about the dispersion of productivity across firms, the uniformity of changes in productivity, the persistence of productivity differentials, the consequences of firm entry and exit, and the importance of changes in resource reallocation across firms to aggregate productivity growth.

Several studies have drawn upon the Orbis database to create firm-level datasets for the purposes of estimating productivity. Some recent works that rely on Orbis as their main data source include Gal (2013), which looks at OECD countries from 2000-2008; Kalemli-Ozcan et al. (2015), which looks at European firms from 1999-2012; and Gopinath et al. (2017), which looks at manufacturing firms in Spain from 1999-2012. Our paper follows in the direction of Gal (2013), which examines Orbis in the context of firm productivity analysis and proposes several imputation strategies to account for coverage issues in Orbis when measuring TFP, along with other methods such as re-sampling and purchasing power parity conversion adjustments to make these productivity measures internationally comparable.

2.2 Domestic vs. Foreign Firms

As discussed in Helpman et al. (2004), modern trade theory predicts a natural self-selection of firms in terms of their productivity, with only the most productive firms able to serve foreign markets through an affiliate and incur the higher fixed costs of foreign direct investment. Empirical studies using micro-level data have found support for firms self-selecting into different modes of delivery, for both specific services and manufacturing sectors as well as more generally. In the banking sector, studies examining different modes of banking services delivery found that banks that are more profitable (Buch and Lipponer, 2007) and are willing to take on higher levels of risk (Buch et al., 2014) are more likely to be active internationally. Using a sample of German manufacturing firms, Arnold and Hussinger (2010) found that non-exporting domestic firms had the lowest observed productivity, followed by domestic firms that export, while firms setting up foreign affiliates were observed to be the most productive.

A number of studies have also tested whether foreign-owned firms have a performance advantage over domestic firms in the same country-sector.[1] Using firm-level data for the UK manufacturing sector, Davies and Lyons (1991) find that foreign firms are on average 48.6 percent more productive, with 23.5 percent of this productivity stemming from foreign ownership and 20.3 percent due to the structural effect of foreign firm investment targeting more productive industries. Doms and Jensen (1998) use U.S. plant level data to show that multinational firms, either domestically owned or foreign-owned, perform better than non-multinational U.S. firms, indicating that serving multiple markets has a strong effect on productivity. Using

[1] See Bellak (2004) for a survey on the performance gaps arising between multinational enterprises and firms serving only domestic markets in productivity, technology, profitability, wages, skills and growth.

data from the UK's Annual Business Inquiry Respondent Database for firms in the motor vehicle industry, Griffith (1999) demonstrates that German and U.S. subsidiaries have a significant productivity premium over UK domestic firms. In a study of UK firms in the chemicals industry, Greenaway and Yu (2004) show that exporting firms were more efficient than purely domestic firms and that they paid higher wages on average than non-exporting firms. More recently, Temouri et al. (2008) use the Orbis database for the years 1995-2004 to identify a foreign ownership advantage in productivity for high-tech manufacturing sectors.

Most of the empirical studies that examine difference among foreign and domestic firms concentrate on the manufacturing sector, with considerably less information available about foreign-owned firms in the services sector. For the UK, Griffith et al. (2004) find a productivity gap for foreign firms in services, but it is smaller than what is observed for manufacturing firms. Similarly, Gelübcke (2013) found that foreign-owned enterprises in the German services sector were characterized by more employees, higher wage payments, and substantially higher productivity than domestic affiliates. These differences persisted, although smaller in magnitude, when foreign firms were compared with both domestically controlled exporters and domestically owned exporters with at least 30 percent of sales abroad.

2.3 Services Barriers and Effects on Productivity

The relationship between barriers to trade in services and services sector productivity has also been explored in previous work, which tends to find that services sector liberalization and productivity at the firm level are positively related. Using panel data on EU firms in Orbis and a variety of productivity measures, Van der Marel et al. (2016) find that lowering service restrictions to the average level of the three most deregulated EU economies increases the productivity performance of firms in both services and manufacturing sectors. Gal and Hijzen (2016) find that for a subset of services sectors, including network services (transportation and telecommunications), retail services, and professional services, product market reforms lead to an increase in total output, investment, and employment two years after they are implemented. Focusing on a specific type of barrier to trade, restrictions related to the electronic transmission of data, Ferracane et al. (2019) find that data-intensive services and manufacturing firms in more restrictive data regulatory environments are significantly less productive than data-intensive firms in less restrictive environments. Similarly, Arnold et al. (2011) and Arnold et al. (2016) find that service sector liberalization has a positive impact on downstream manufacturing productivity in the Czech Republic and India, respectively, while Beverelli et al. (2017) find that lower services trade restrictiveness, conditional on institutional capacity, has a positive effect on downstream manufacturing productivity.

There is also a related literature that considers the impact of barriers to trade in services and firm-level profitability. This literature is consistent with the modeling framework developed by Melitz and Ottaviano (2008), which finds that larger markets that are more open to trade tend to be more competitive, and firms in these markets charge smaller mark-ups than firms in smaller and less open markets. Applied to services trade, as in Rouzet and Spinelli (2016), when barriers to services trade increase the marginal profitability of firms in a particular sector, these regulations can be considered rent-creating: domestic firms charge higher mark-ups in sectors where there is weaker foreign competition due to trade barriers. Using firm-level data from Orbis, papers including Rouzet and Spinelli (2016),Khachaturian (2015), Oliver (2017), Chambers and Peterson (2019) test this relationship empirically.[2]

3 Data

3.1 Firm-level data

The Orbis dataset reports detailed firm-level financial data that varies in coverage based on the reporting requirements of particular countries (Bureau van Dijk, 2017). The coverage of firms within a country depends upon reporting requirements and the difficulty of accessing information on businesses' financial data.[3] In their comparison of the 2008 Orbis database to the OECD Structural and Demographic Business Statistics (SDBS) database, Ribeiro et al. (2010) found much poorer coverage for certain countries in Orbis, while for other countries, like the United States, there were more business records in Orbis than were reported in official figures from the SDBS.

For our sample, we only include firms in Orbis where revenue and employment data is available, and our overall coverage of these firms is from 2012-2017.[4] To match coverage of the OECD STRI, this paper restricts our initial sample to 2014-2017. We use the EU's statistical classification of economic activities (NACE) codes to classify firms by industry at the two digit-level, analyzing services sectors codes that correspond to the sectors covered by the OECD STRI, under NACE 41-93, excluding public service (84) and banking and insurance activities (64-66) where revenue is not a good predictor of productivity.[5] To adjust for differences

[2]Rouzet and Spinelli (2016) covers all services where an OECD STRI is available, while Khachaturian (2015) focuses on telecommunication services, Oliver (2017) focuses on banking services, and Chambers and Peterson (2019) considers maritime transport services

[3]For example, in the United States, only publicly traded companies are required to report financial data, and as a result, coverage of the U.S. market tends to be limited.

[4]The initial sample was downloaded for the years 2012-2016 in October 2017 and included all firms in Orbis where revenue and employment data was non-missing for 2013-2015. In August 2019, we supplemented this data with additional financial data that had become available in Orbis for the same sample of firms, which allowed us to add 2017 to the data in this paper, and supplement the existing 2016 data with additional observations.

[5]NACE codes correspond with the International Standard Industrial Classification (ISIC) at the two-digit level maintained by the United National Statistics Division. The OECD STRI also uses ISIC two-digit codes to differentiate sectors.

in prices of goods and services across countries, we convert all monetary variables to purchasing power parity (PPP)-adjusted U.S. dollar figures, using the World Bank PPP conversion rate for each year.

Among firm-level datasets, Orbis is also unique in its coverage of the corporate ownership structure of firms, providing a Global Ultimate Owner (GUO) indicator to determine foreign ownership. A GUO owns at least 51 percent of a company, either directly or through at least 51 percent ownership of a subsidiary that owns the company.

In addition to identifying the GUO, the Orbis dataset includes information on the GUO country of origin, which allows us to classify subsidiaries as either domestic or foreign-owned. Firms for which the firm country and the GUO country match are considered domestic firms, while firms for which the firm country and the GUO country do not match are considered foreign firms. One limitation of the Orbis database's prioritization of up-to-date information over historical information is that the GUO variable only reflects the latest ownership information, so we do not know whether firms have changed ownership during our sample timeframe. Additionally, we are unable to distinguish between foreign acquisitions of companies and greenfield investment. This methodology can also be misleading in cases where large multinational companies have GUOs that are holding companies in a separate country for tax purposes. To help correct for this problem, we considered firms to be domestic if the GUO was a holding company (classified under four-digit NACE code 6420) located in either the Cayman Islands or Bermuda.

The final sample consists of around 2.8 million firm-year observations, covering 33 countries. Table 1 summarizes data availability by country, combining all four years of the sample. The majority of the sample are firms in the European Union, which reflects their relatively better coverage in the Orbis database, as well as the availability of the OECD STRI.[6] However, the sample does include some non-European economies, such as Japan, South Korea, and Australia, as well as emerging markets China and Russia. The best-covered countries, both in terms of number of observations and sectors covered, are Italy and Spain. Foreign firms make up 3.6 percent of the sample, with around 100,000 observations. The share of foreign firms in our sample varies by country, with some countries, like Japan having very few foreign firms (0.1 percent of all firms located in Japan), while others, such as the United Kingdom and Belgium, about 30 percent of the sample of firms in these countries are foreign owned affiliates.

[6]Compared to other firm-level datasets, Orbis' country coverage is more exhaustive and more current. The World Bank Enterprise Surveys, for example, have data for over 143 countries, but focus on firms in emerging economies, and the years for which panel data is collected vary from country to country (World Bank, 2020). The European Central Bankâs CompNet collects data directly from central banks and national statistical agencies, but its most recent database vintage is limited to 18 European countries with full data coverage for all countries spanning 2009-2014 (Lopez-Garcia et al., 2018).

Table 1: Data coverage by country (in firm-years, 2014-17)

Country	Total observations	Foreign firm observations	Foreign firm share
Spain	604,511	13,709	2.3
Italy	594,390	14,556	2.4
Russia	294,307	6,972	2.4
Portugal	280,347	6,831	2.4
Japan	258,381	357	0.1
Hungary	251,549	2,567	1.0
Slovakia	82,601	7,489	9.1
Germany	67,263	2,518	3.7
Slovenia	63,260	2,150	3.4
South Korea	56,314	1,407	2.5
Finland	55,868	2,656	4.8
United Kingdom	48,991	13,697	28.0
Czechia	32,350	3,747	11.6
Estonia	28,350	847	3.0
Belgium	24,645	8,977	36.4
Latvia	22,215	899	4
Austria	16,420	2,363	14.4
France	13,962	910	6.5
Lithuania	13,508	1,273	9.4
Greece	7,281	778	10.7
Poland	6,289	496	7.9
China	5,849	366	6.3
Denmark	4,123	1,194	29
Netherlands	3,599	1,886	52.4
Iceland	2,834	40	1.4
Sweden	2,823	1,083	38.4
Ireland	2,311	1,120	48.5
Australia	1,723	1,169	67.8
Luxembourg	577	263	45.6
Israel	330	6	1.8
Norway	129	0	0
India	74	4	5.4
Canada	11	0	0
Total	**2,847,185**	**102,330**	**3.6**

Source: Author's sample from Bureau van Dijk Orbis database.

3.2 OECD STRI

This paper focuses on 13 service sectors for which information on non-tariff barriers is available from the OECD Services Trade Restrictiveness Index (STRI), excluding banking and insurance, for which total factor productivity may not be an accurate measure of efficiency.[7] The OECD STRI is a useful tool for assessing the extent to which barriers to trade in services increase the cost to foreign firms of establishing affiliates and negatively impact productivity. The STRI catalogues regulations that potentially limit trade in services at the country-sector level, including limitations on foreign entry and movement of people, barriers to competition, and regulatory transparency. Measures are given weights to reflect their importance in limiting trade, producing an index that ranges from 0 to 1, where 0 indicates a completely open market, and 1 indicates a completely closed market.[8] In addition to OECD member countries, the STRI is available for Brazil, China, Costa Rica, India, Indonesia, Lithuania, Russia, and South Africa, and has been updated annually since its first publication in 2014. There is a one-year lag implicit in the STRI, as the 2014 values represent policies in place in 2013.

Because the OECD STRI is designed to show a particular country's openness to services trade with the rest of the world, it does not account for preferential trade agreements (PTAs) between particular countries. As a result, this index likely overstates the magnitude of the impact that non-tariff measures (NTMs) have on a country that exports services to a PTA partner. While we cannot correct for all PTAs, one major potential source of regulatory harmonization of services trade regulations is the European Single Market. To account for economic integration in Europe, this paper substitutes the OECD STRI Database for the Intra-European Economic Area (EEA) STRI Database for GUO-foreign affiliate pairs within the EEA area.[9] The Intra-EEA STRI (available for 2014 to 2018), as presented in Benz and Gonzales (2019), uses the same methodology to calculate the Intra-EEA STRI as the main OECD STRI, and indicates that the level of services trade restrictiveness of the intra-EEA STRI tends to be lower than the country-sector indices in the main OECD STRI.

Table 2 presents the NACE 2-digit codes and corresponding STRI service sectors that are used in this analysis along with the significant sector-specific measures that are scored by the OECD as part of the STRI calculation. As illustrated in the fourth column of table 2, the types of non-tariff measures that firms face vary based on the type of service provided. For example, for professional services firms, such as those providing legal, accounting, architecture and engineering services, professionals typically require licenses in order to provide services. Thus, the primary types of barriers that these firms face are related to the mutual

[7] In both banking and insurance, risk management also contributes to firm efficiency, as banks rely on interest income, while insurance companies rely on insurance premiums written exceeding insurance claims paid.

[8] See Grosso et al. (2014) for a complete description of the methodology used to create the OECD STRI.

[9] The EEA includes EU member states, as well as Iceland, Norway and Liechtenstein.

recognition of credentials, and restrictions on whether foreign nationals can obtain domestic credentials. In intellectual property-intensive services, such as audiovisual services, barriers are related to local content and sufficient IP protection. There are also barriers that can affect service providers across many different sectors: in particular, foreign equity restrictions are cited as major contributors to the overall STRI score in sectors such as road and rail transportation, telecommunication, and logistics.

Lastly, while we have STRI data for the years 2014-2018, we find very little within-variation of STRIs at the country-sector level in our sample. In fact, less than 1 percent of total variation in the STRIs in our data is a result of variability across years, with the rest being a result of variation across country-sectors.[10] Given that country-sector STRIs typically do not vary over time, we decide to pool the data and collapse the country-sector STRIs across the sample years, focusing only on the STRI variation across country-sectors in the subsequent empirical analysis.

[10]The overall standard deviation of STRIs in our sample is 0.1214, the between standard deviation of 0.1209 and a within standard deviation of 0.0112.

Table 2: OECD Service Sectors

STRI sector	NACE 2 digit codes	Significant barriers
Construction	41-Construction of buildings 42-Civil engineering 43-Specialized construction activities	Limitations on temporary entry, foreign acquisition of land and real estate,public procurement restrictions
Distribution	46-Wholesale trade, except of motor vehicles and motorcycles 47-Retail trade, except of motor vehicles and motorcycles	Commercial presence required to provide cross-border services, limits to e-commerce provision
Rail and road freight transport	49-Land transport and transport via pipelines	Government ownership, foreign equity restrictions, licensing requirements
Maritime transport	50-Water Transport	Registration of vessels, cargo sharing agreements
Air transport	51-Air transport	Limits on foreign investment and ownership, and leasing of foreign aircraft
Logistics	52-Warehousing and support activities for transportation	Limits on foreign ownership, no competitive bidding
Courier	53-Postal and courier activities	Statutory monopoly for letter delivery or express delivery, limits on foreign investment in government owned-enterprises
Motion pictures and sound recording	59-Motion picture, video and television program production sound recording and music publishing activities	Quotas for local motion pictures, music or television, copyright protections
Broadcasting	60-Programming and broadcasting activities	Foreign equity restrictions, quotas for local content, commercial presence
Telecommunications	61-Telecommunications	Limits on cross-border mergers and acquisitions, foreign branch limits, data flow restrictions
Computer	62-Computer programming, consultancy and related services 63-Information service activities	Data flow restrictions, limitations on temporary entry
Legal and accounting	69-Legal and Accounting activities	Lack of recognition of foreign qualifications
Architecture and engineering	71-Architectural and engineering activities; technical testing and analysis	Limitations on temporary entry, licensing requirements

Note: Characterizations of significant STRI barriers are based on 2018 OECD Sector notes, available at `https://www.oecd.org/trade/topics/services-trade/`

4 Methodology and Results

We explore a number of different approaches to better understand the productivity differences between foreign and domestic services firms. In our analysis, we only compare domestic firms with their foreign counterparts; the average firm productivity across all firms (both domestic and foreign) is never utilized. After defining our measure of productivity in section 4.1, section 4.2 explores productivity differences between foreign and domestic firms at the country-sector level. We first examine whether the unconditional mean and rank differences in productivity between foreign and domestic firms are statistically significant across country-sectors and if these productivity differences can in turn be related to the country-sector's observed STRI. Since unconditional comparisons are only helpful in determining certain patterns in the data, a systematic empirical analysis is also conducted to identify the effects of the STRIs at the country-sector level. After considering average productivity by country-sector and ownership, section 4.3 examines the impact of policy barriers on productivity differences at the firm-level.

4.1 Constructing firm-level TFP

A Cobb-Douglas production function is used for calculating individual firm-level TFP with the Orbis data. Index-based methods of calculating TFP have been found to be among the best measures for estimating productivity levels, particularly in cases when measurement error is small or there is a great deal of variation in the production technology across firms within a sector (van Biesebroeck, 2007). While more sophisticated measures of computing TFP exist in the literature, notably estimates based on semiparametric methods first introduced by Olley and Pakes (1996), we use the index approach for calculating TFPs in order to maximize the number of possible country and sector observations in our data.[11]

With firms operating under perfect competition and constant returns to scale, the TFP for a given firm i at time t is simply computed as:

$$TFP_{it} = \ln(Revenue_{it}) - \alpha \ln(Employees_{it}) - (1-\alpha)\ln(Assets_{it}) \tag{1}$$

The number of employees is used as the firm's labor input while tangible fixed assets as the firm's capital inputs.[12] The coefficient α represents labor's contribution to production at the country-sector level,

[11] The Olley-Pakes methodology requires firm depreciation rate, while the Levinsohn-Petrin requires material costs (Levinsohn and Petrin, 2003). Both methodologies also require panel data to estimate total factor productivity. See Ahmad et al. (2018) for a full comparison of the data requirements and country-sector coverage in Orbis for the different methods of calculating total factor productivity.

[12] We use the reported number of employees in Orbis as our proxy for labor input as in Gal (2013), despite the fact that this may be a biased measure of firm's labor costs, as it does not account for the share of part-time vs. full-time employees or different labor skill types. This decision reflects differences in methodology for collecting and reporting data on labor costs across countries and sectors in Orbis. The use of tangible fixed assets to approximate capital goods also follows Gal (2013).

and is taken from either the World KLEMS data, or the OECD Structural Analysis Database (OECD STAN).[13] Industry labor shares are defined as specifically as possible: at the two-digit ISIC level (an identical correspondence to NACE 2-digit codes) at its finest level of detail, or at the ISIC section or range of sections where specification at the two-digit was not provided.[14] Equation 1 also assumes that the rest of the value of total output comes from capital, and that the composition of capital is similar across the country-sectors.

4.2 Analysis at Country-Sector Level

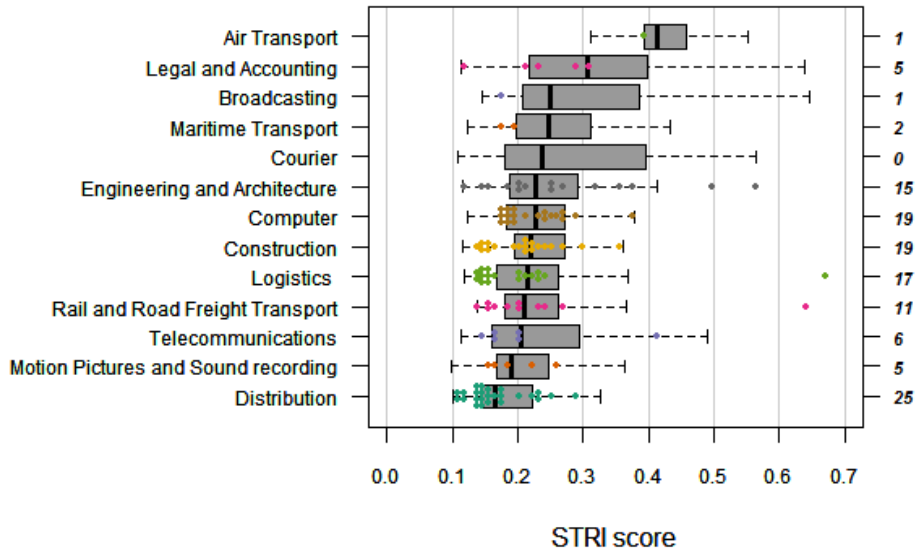
A number of country-sectors in our Orbis sample do not have an adequate number of firms to allow for a meaningful comparison between domestic and foreign firms on productivity measures. In order to ensure adequate firm coverage, we thus restrict our analysis in 4.2 to country-sectors which have at least 30 domestic firms and 20 foreign firms in our database. This reduces the number of country-sectors to 122 in the subsequent analysis.

Figure 1 compares the distribution of OECD STRI scores across countries within a sector to the average STRI score faced by foreign firms in our sample for the same country-sector. The box and whisker plots show the distribution of the overall STRI in each sector (excluding Intra-EEA STRI scores) and are sorted based on the average restrictiveness within each country-sector, with air transport tending to have the highest STRI scores on average, and distribution sectors having the lowest average score. Within each sector, the dots represent the average STRI (including Intra-EEA STRI scores) faced by foreign firms at the country-level in our sample. These dots take into account both the impact of the Intra-EEA STRI on average STRI scores as well as our country coverage of a given sector. For instance, in some sectors such as distribution and computer services, firms in our sample tend to face lower barriers than what the overall OECD STRI would have predicted if all countries had been represented. However, in other sectors, such as engineering and architecture, our sample is skewed to countries with high barriers and so leads to firms in our sample having higher STRI scores than what the overall OECD STRI would have predicted. Moreover, some sectors such as courier, broadcasting and air transport are not very well represented in our sample. Overall, figure 1 shows there is variation in STRI across the country-sectors in our sample, which we can exploit to determine if there is a relationship between STRI and productivity differences between domestic and foreign firms.

[13] World KLEMS was the first choice for this data, as data prepared by national statistical agencies under this methodology follows SNA 2008 and assures a higher degree of international comparability (Jorgenson and Sickles, 2018). If industry labor shares were not available for a country in World KLEMS, data was sought from the OECD STAN database which is primarily based on member countries' SNA 2008 national accounts and is supplemented with data from other sources (national business surveys/censuses etc.) to estimate missing values (OECD, 2014).

[14] ISIC divisions perfectly correspond with NACE codes at the 2-digit level. ISIC codes are also used to delineate sectors in the OECD STRI.

Figure 1: OECD STRI Sectors



Source: Authors' illustration from OECD STRI and Intra-EEA STRI data.
Note: Box and whisker plots reflect distribution of OECD STRI scores by sector averaged on a country basis across the years of our sample. Dots reflect the STRI level to which foreign firms in our sample are subject, which is an average of OECD STRI and Intra-EEA STRI weighted by firm ownership within the country-sector across all the years of our sample. Numbers on the right side of the figure reflects the number of dots per sector, i.e. the number of countries per sector in the data sample that have more than 30 firms and more than 20 foreign firms across all years of the dataset.

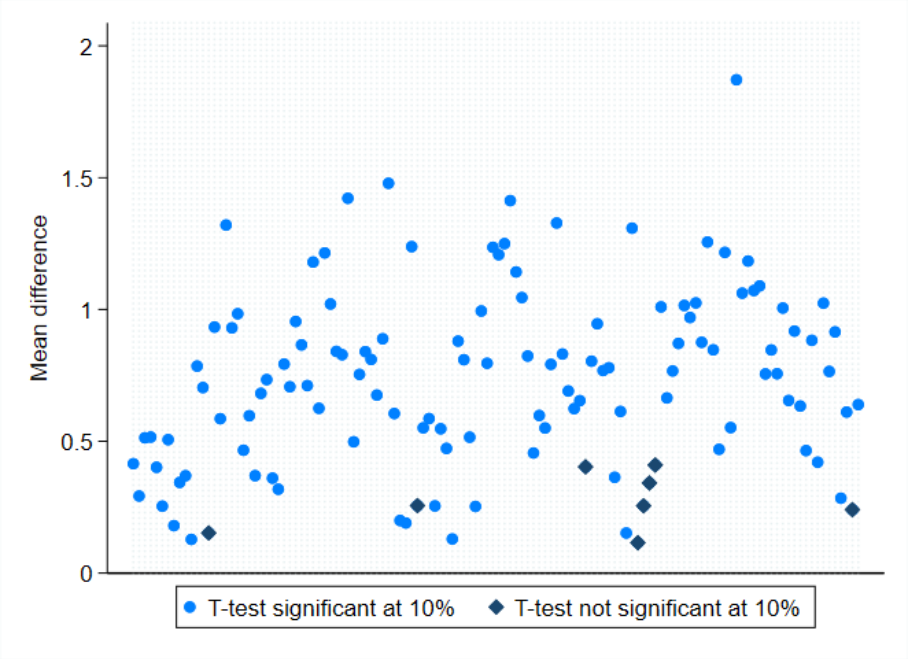
4.2.1 An Unconditional Perspective

As discussed in Section 2, numerous studies have shown that foreign firms are more productive than their domestic counterparts.[15] We explore whether this holds true for the services firms in our Orbis dataset using two simple comparisons: comparing mean TFP of foreign and domestic firms at the country-sector level using a two-sample t-test, and comparing the distribution of TFP within domestic and foreign firm samples through a Mann-Whitney rank test.

Figure 2 shows the unconditional mean differences in foreign and domestic firm TFP at the country-sector level. A simple t-test is used to check if these mean differences in TFP are statistically significant. We see from Figure 2 that an overwhelming majority of country-sectors in our sample have statistically significant differences in mean TFP, with foreign firms tending to be more productive than domestic firms on average.

[15] As discussed in Gelübcke (2013), such comparisons with foreign firms are often done with a reference group comprising all units that could be labeled as domestically owned. For robustness, we have also removed small domestic firms from the reference group and see similar results when using the full sample of domestic firms.

Figure 2: Mean differences in TFP across countries and sectors

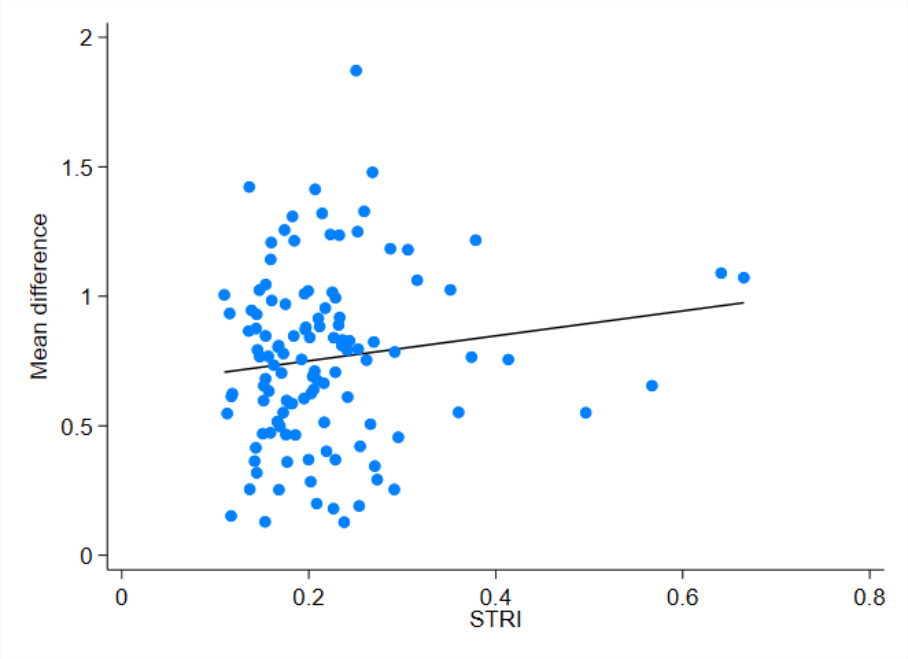


Note: Each dot represents the mean difference in productivity for all firms in one country-sector in our sample. Dots are arranged along the x-axis by country-sector indicator

We next take into account the effect of policy barriers on the productivity gap between domestic and foreign firms. Figure 3 plots country-sector differences in mean TFPs that were found to be significant at the 10 percent level with the corresponding STRIs in that particular country-sector. The figure shows a positive correlation between mean differences in TFP and policy barriers at the country-sector level.

Along with simple averages, we also explore differences in distributions between these two groups by using the non-parametric Mann-Whitney rank test. Figure 4 shows the probability that a random draw from the group of foreign firms has a larger TFP than a random draw from the group of domestic firms for a given country-sector level. We see that for a large number of country-sectors, there is a greater probability of finding a foreign firm with a higher TFP than a domestic firm. We also see that for most country-sectors, the Mann-Whitney rank test easily rejects the null that the two groups of firms come from the same population.

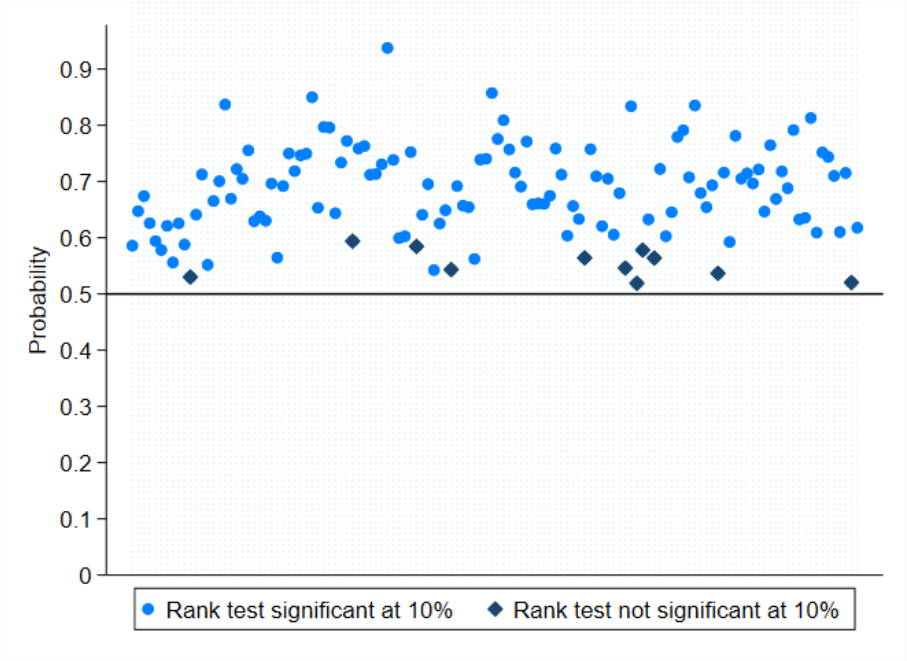
Figure 3: Differences in TFP and STRI (across all countries and sectors)



Note: Each dot represents the mean difference in productivity for all firms in one country-sector in our sample.

Figure 5 shows the corresponding scatter plot for these computed Mann-Whitney probabilities and the STRIs. Again, we see some evidence that it is more likely for foreign firms to have a higher TFP than domestic firms in country-sectors that have significant policy barriers. Based on figures 3 and 5, there seems to be some rudimentary relationship between productivity differences and policy barriers in our data. We explore this relationship in a more systematic manner in the next section.

Figure 4: Probability Foreign TFP > Domestic TFP (across all countries and sectors)



Note: Dots are arranged along the x-axis by country-sector indicator

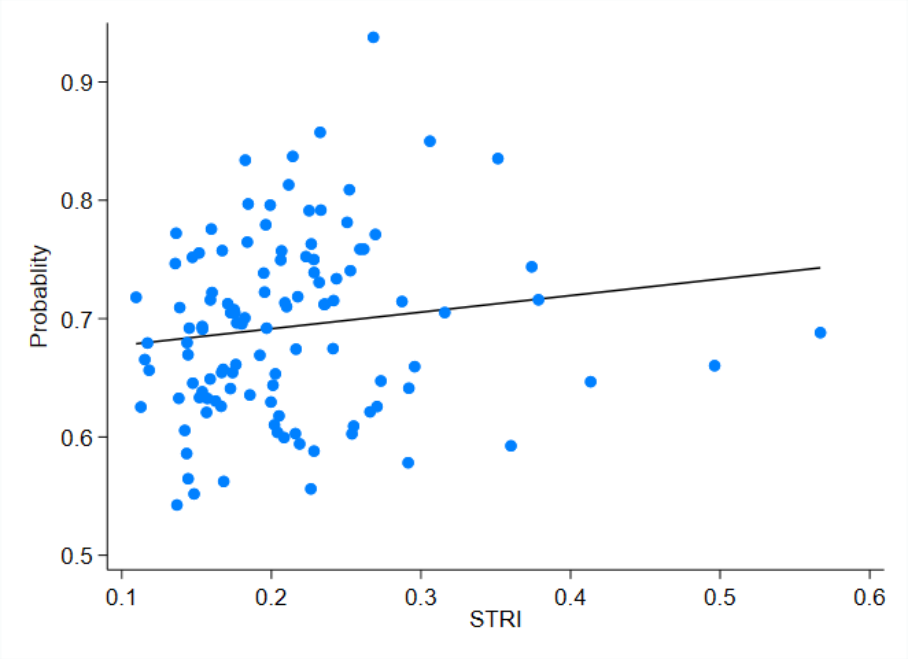
4.2.2 Conditional Analysis

We next move to formally quantify the impact of trade barriers on foreign and domestic firms observed in the previous section. The effects of STRI at the country-sector level, with all firms pooled by their ownership status, are examined on three main variables of interest: $\ln(\frac{\text{Mean Foreign TFP}}{\text{Mean Domestic TFP}})$, $\ln(\frac{\text{Number of Foreign Firms}}{\text{Number of Domestic Firms}})$ and $\ln(\frac{\text{Revenue of Foreign Firms}}{\text{Revenue of Domestic Firms}})$. The first variable captures the average TFP premium for foreign firms, positive values in a given country-sector indicating that foreign firms are more productive than domestic firms on average. The second variable looks at the raw count of foreign firms relative to domestic firms, positive values indicate more foreign firms serve the market than domestic firms. The last variable is for total revenues generated by the foreign firms relative to domestic firms, positive values here showing that foreign firms combined have higher overall revenues than domestic firms in a given country-sector. These three variables should allow us to have a better understanding of the different channels through which STRI can affect both productivity and participation of foreign affiliates in a particular market.

The impact of trade restrictions at the country-sector level for our variables of interest is then estimated using a simple linear equation:

$$\ln(\frac{Foreign_{sc}}{Domestic_{sc}}) = \beta_0 + \beta_1 \ln STRI_{sc} + \theta_s + \varepsilon_{sc} \tag{2}$$

Figure 5: Mann-Whitney Rank Differences in TFP and STRI



STRI is the value of the STRI index corresponding to sector s in country c, averaged over the four years of the sample. θ_s controls for unobserved sector-specific determinants of differences between foreign and domestic firms in a given country and sector, and also helps to capture the differences in the primary types of trade barriers that affect different services sectors in our sample (see Table 2). Lastly ε_{sc} represents the least squares error term.

Table 3 reports the regression results from equation 2. We find a significant and positive relationship between the STRI and the foreign TFP premium, a 1 percent increase in the STRI increases the TFP premium of foreign firms by around 0.1 percent. This result suggests that country-sectors with high barriers are also the ones where foreign firms are significantly more productive than domestic firms on average. We continue to see this positive effect after accounting for sector effects in our regression.[16]

We next take into account the effect of barriers to trade on the participation of foreign firms in the domestic market. Table 3 shows that higher trade barriers reduce the foreign firm participation in the market, based on both the number of foreign firms over domestic firms and the aggregate foreign revenues over domestic revenues. However, only the STRI's effect on raw firm counts is found to be statistically significant, a 1 percent increase in the STRI decreasing the ratio of foreign to domestic firms by around 1.5 percent. Depending on the specific measure, higher barriers to services trade may increase both labor

[16]Since the STRI is designed to compare across countries, rather than sectors, sector-fixed effects are more appropriate controls than country fixed effects. However, results using country fixed effects are consistent with the estimates presented in table 3.

Table 3: Foreign and domestic differences, country-sector results

	No fixed effects			Sector-fixed effects		
For/Dom	TFP	Count	Revenue	TFP	Count	Revenue
STRI	0.074**	-1.520***	-0.496	0.089***	-1.363***	-0.478
	[0.03]	[0.35]	[0.34]	[0.02]	[0.30]	[0.33]
Number of Observations	122	122	122	122	122	122
Adjusted R-squared	0.08	0.11	0.02	0.12	0.25	0.15

Robust standard errors in brackets. Intercept and fixed effects not reported.
*** p<0.01, ** p<0.05, * p<0.1

and capital costs for services firms and thus limit the entry of foreign firms in a particular country-sector. For example, if a foreign affiliate has to comply with a new data privacy regime in a particular country (such as the 2018 EU General Data Privacy Regulations), they may need to hire additional lawyers to bring the firm into compliance. Similarly, if a foreign affiliate has to comply with a data localization measure, it may need to increase capital investment in order to build the required data center infrastructure. Because of the variety of possible effects of barriers on firm costs, only the most productive foreign firms may be able to meet the regulatory costs and serve the domestic market. The reduced participation of foreign firms in country-sectors with high STRI values can also potentially explain the higher productivity premium for foreign firms as these are the only firms that can overcome the given policy barriers in the market.

4.3 Analysis at the Firm-level

Our second empirical approach considers the impact of barriers to trade on productivity differences between foreign and domestic firms at the firm, rather than the country-sector level. Equation 3 estimates the impact of the OECD STRI on individual firm productivity, separating the impact of the STRI on foreign versus domestic firms.

$$TFP_{isc} = \beta_0 + \beta_1 STRI_{sc} + \beta_2 ForFirm_{isc} + \beta_3 STRI_{sc} * ForFirm_{isc} + X_{isc} + \theta_s + \gamma_c + \varepsilon_{sc} \qquad (3)$$

Here TFP_{isc} is the productivity of firm i in sector s and country c, $STRI_{sc}$ is the value of the STRI index corresponding to the country and sector of a given firm observation, $ForFirm_{isc}$ equals 1 when the firm is a foreign affiliate, $STRI_{sc} * ForFirm_{isc}$ is the interaction between the STRI and the Foreign Firm dummy, X_{isc} are controls for the size of the firm, and θ_s and γ_c control for unobserved sector-specific and country-specific determinants of firm productivity (such as level of technology, size of country market, and other types of trade barriers not captured by the STRI). The specification is similar to ones used in recent

Table 4: Firm level regression results, STRI and firm productivity

	TFP	TFP	TFP	TFP
Log(Number of employees)	0.093*	0.108**	0.085***	0.085***
	[0.05]	[0.03]	[0.001]	[0.001]
STRI		-0.367***		-0.059***
		[0.07]		[0.001]
Foreign Firm	0.621***	0.557***	0.516***	0.526***
	[0.11]	[0.08]	[0.01]	[0.01]
STRI*Foreign Firm		0.161**		0.05***
		[0.06]		[0.01]
Country FE	No	No	Yes	Yes
Sector FE	No	No	Yes	Yes
Number of Observations	815,200	815,200	815,200	815,200
Adjusted R-Squared	0.026	0.157	0.354	0.356

Standard errors clustered by country-sector in brackets. Intercept and fixed effects not reported.
*** p<0.01, ** p<0.05, * p<0.1

works considering the relationship between firm productivity and ownership status (Gelübcke, 2013) as well as studies exploring effects of services trade policies on mark-ups at the firm level (Rouzet and Spinelli, 2016).

Table 4 presents the results for equation 3, which considers the impact of the STRI on productivity at the firm level. To ease interpretation, all continuous variables are first standardized,i.e., re-scaled to have a mean of zero and a standard deviation of one, so that we can compare the relative importance of each coefficient in the model. Moreover, potential correlations between firms in a given market is accounted for by clustering all standard errors at the country-sector level.

Reinforcing previous empirical studies, Table 4 shows that foreign firms tend to be significantly more productive than domestic firms. The average foreign firm is around 0.5-0.6 standard deviations more productive than domestic firms, depending on whether country and sector fixed effects are included in the regression. Firm size, as captured by the firm's number of employees, also has a positive and significant effect on the firm's productivity.

Focusing on the impact of trade barriers, we find that increases in the STRI in a country-sector (moving from a service sector with fewer and/or less restrictive barriers to one with more numerous and more restrictive barriers) is associated with a significant decrease in the productivity of domestic firms. Increasing the STRI by one standard deviation reduces a domestic firm's productivity by 0.37 standard deviations, more than three times as effective in magnitude as the impact of firm size on productivity. Foreign firms

on the other hand, see a small significant negative effect of increases of STRI on their productivity with the magnitude of the effect (-0.0043 standard deviations) over 10 times smaller than the effect observed for domestic firms in our sample. These estimates indicate that the presence of higher trade barriers in certain sectors are associated with greater differences in productivity between domestic and foreign firms. These effects remain significant, though smaller in magnitude, when we control for country and sector fixed effects. Again, if only the most productive firms are able to incur the high fixed costs of setting up foreign affiliate, then we should expect to see a widening gap in productivity between domestic and foreign firms. Thus, our findings indicate that policy barriers can help explain some of the observed productivity premium for foreign affiliates in services sectors.

5 Conclusion

Using Orbis as a source of firm-level data, we distinguish between domestic and foreign-owned services firms operating in particular country-sector markets. Parametric and non-parametric tests show that foreign firms in services sectors tend to be more productive than domestic firms on average. We then relate barriers to trade in services to differences between foreign and domestic firms in terms of average productivity, total firm count and aggregate revenues at the country-sector level. We find that country-sectors with high policy barriers are also the ones where foreign firms are significantly more productive than domestic firms on average. These results are consistent with modern trade theory that only the most productive firms are able to incur the significant costs associated with serving the domestic markets through their foreign affiliates.

In our analysis, we have focused on the productivity differences between foreign affiliates and domestic firms without accounting the productivity of the parent firm. Our estimates here should be viewed with this caveat in mind. Our hope for future work in this area is to build on these findings by testing whether the extent of foreign affiliate involvement (as measured by the count of foreign affiliates), the volume of foreign affiliate sales, and foreign markets served, is related to the foreign parent company's productivity.

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