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Offshoring of Services and Corruption: Do Firms Escape Corrupt Countries?

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ABSTRACT

In this paper, we analyze how the offshoring of services by Swedish firms is affected by corruption in target economies. Taking stance from the gravity model of trade, we analyze how the choice of country, volume and composition of offshored services is affected by the presence of corruption in target economies. The results suggest that corruption is a deterrent for service offshoring. Firms avoid corrupt countries, and corruption reduces the amount of offshored services. In addition, the sensitivity to corruption is highest for poor countries, and large and internationalized firms are the ones that tend to be the most sensitive to corruption. Given the importance of large firms as international investors and subcontractors, this adds yet another argument for fighting corruption.

JEL: C23; D22; F23; L24

Keywords: Corruption; Services; Offshoring; Gravity model; Firm level data

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1. Introduction

In many countries, the service sector today accounts for at least two thirds of GDP, and services account for about twenty percent of world exports (Lejour and Smith 2008, UNCTAD 2009). The relatively low share of services in world exports can partly be explained by the fact that only ten percent of service output is traded, while the corresponding number for materials is over fifty percent. Lejour and Smith (2008) argue that this is not only due to non-tradability in services. They claim that services constitute a larger share than the directly measurable twenty percent of trade because services implicitly enter into trade as inputs in the production of traded goods. As an example, Lejour and Smith (2008) argue that in OECD countries, almost forty percent of the employment in the manufacturing sector can be considered as working with services.²

Despite the large and growing importance of the service sector, trade in services is relatively unexplored. Here, we analyze a specific type of trade in services, namely, imports of offshored services and how that trade is affected by corruption in the target economies.

From the perspective of international economics, corruption is often portrayed as a barrier to trade and investment, and there is an increasing body of empirically oriented articles analyzing various aspects of corruption.³ However, earlier studies have failed to analyze corruption and its impact on offshoring, in general, and the offshoring of services, in particular.

Offshoring is considered to be an activity that is sensitive to corruption and other factors that raise the contract cost. If there are difficulties in finalizing a contract that ensures deliveries, protection of intellectual property rights, quality, and other important dimensions of the transaction, firms tend to favor foreign direct investment (FDI) or staying home to offshore outsourcing (the “make-or-buy” decision). Antràs (2005) claims that as a product or service becomes routinized, the firm first considers FDI, and when the product has become sufficiently standardized, the firm may decide to outsource to an external supplier. Moreover, firms are not randomly drawn into FDI and offshoring. According to Antràs and Helpman (2004) and Grossman and Helpman (2002, 2005), low-productivity firms outsource domestically, while mid-productivity firms can outsource from foreign suppliers. At the top of the ladder, we find the highest-productivity firms that may chose vertical FDI.

² In the year 2000, the service sector’s contribution to total value added in the OECD countries was 70%, which was close to the service sector share for Sweden (69.4 percent) in the same year. The share of services in world exports has stayed around 20% during the last two decades (Lejour and Smith 2008, UNCTAD 2009).

³ Examples of topics within the “corruption literature” include: corruption and economic growth, FDI, trade, determinants of corruption and how to fight corruption. See, e.g., Dreher and Herzfeld (2005).

The mass of FDI and offshoring streaming into a country is dependent on its contractual institutions and because corruption is associated with dysfunctional institutions both FDI and offshoring is expected to decrease with the level of corruption. In addition, we expect firms to primarily consider offshoring of routinized and simple tasks to heavily corrupt countries (Antràs and Helpman, 2006).

Turning to the service sector, it is argued that knowledge in that sector is closely related to people and, therefore, relatively difficult to protect by patents (Miles, 2006).⁴ Moreover, for services to be tradable, it is likely that they have the potential to be codified, standardized and modulated (fragmented), all factors which make services sensitive to information leakage. Hence, for the offshoring of services containing sensitive information to take place, a key issue to consider is how to protect the knowledge from leakage. From this, we may conclude that the decision to outsource services to a foreign entity is likely to be affected by the content of sensitive information and the degree to which it is possible to codify and modulate the service (we may call this the degree of tradability).

When analyzing trade flows, the gravity model is a natural point of departure. Using detailed firm-level data on Swedish firms, their offshoring of services and information on the target countries, we analyze how the choice of offshoring destination and the amount and composition of services to be produced offshore are affected by corruption. Our unit of observation is firm-country pairs, and we are therefore likely to encounter observations with zero trade flows. Consequently, we will consider offshoring as a two-step procedure, where the firm first decide whether to offshore or not to offshore and to whom, and in the second step, the firm decide on the volume. This two-step decision procedure naturally involves selection and zero trade flows. A commonly used approach to handle selection is to estimate Heckman-type of models, see, e.g., Helpman, Melitz and Rubenstein, (2008) hereafter (HMR). Issues of concern when estimating the gravity model include fixed effects, selection and zero-valued trade flows, and we will evaluate how various adjustments of these factors affect the results.

There are no extant empirical studies on the relation between corruption and offshoring of services. However, there are numerous papers focusing on the sister activity of offshoring, FDI. For example, Habib and Zurawicki (2002) and Egger and Winner (2006) both find corruption to be detrimental to FDI. There seems to be evidence suggesting that the effect of corruption is nonuniform. Hakkala *et al.* (2008) find corruption to be more detrimental to

⁴ Even though reverse engineering of physical products is a problem in some countries, there remain substantial fixed costs associated with reverse engineering and setting up a production establishment to copy products.

horizontal FDI than to vertical FDI, and Smarzynska and Wei (2000) find corruption to alter the composition of FDI by shifting investment toward joint ventures rather than wholly owned affiliates. Dahlström and Johnson (2007) and Caetano and Calerio (2005) both find the impact of corruption on FDI to be negative and significant, but only for developing countries. Turning to services, Amiti and Wei (2005, 2006) find limited productivity and employment effects in the US due to the offshoring of services and materials.

To conclude, the overall impression is that corruption is detrimental for FDI and that the negative impact is the largest for developing countries. In addition, corruption affects not only the volume of FDI but also the type and composition of foreign direct investments.

Based on theory and empirical findings on FDI and corruption, our prior expectation is to find a negative relation between corruption and offshoring of services. We explore this question further by asking whether corruption mainly affects the choice of country or whether, for a given choice of country, corruption has mostly a volume effect. We also investigate what type of services that is most affected by corruption. Large and internationalized firms may be more capable of handling corruption than other firms, but at the same time, these firms can also use their network to retreat from cumbersome markets. To some extent, it is therefore an empirical question whether these firms are more or less sensitive to corruption than are other firms.

The results of this study suggest that corruption is a deterrent for both the choice of destination country and the volume of offshored services, where services defined as “not easily traded” are affected more negatively than other services. In addition, the negative impact of corruption is higher for poor countries, while large and internationalized firms seem to use their flexibility to avoid corrupt countries. Taken together, this adds yet another argument for the importance of fighting corruption.

The paper is organized as follows. In section 2, outsourcing, services, corruption and the theoretical link between corruption and service offshoring are discussed, and in section 3, we present the data and the gravity model and discuss econometric considerations. The results are given in section 4, and section 5 concludes.

2. Services, outsourcing and corruption

2.1 Services

When thinking about services, one should note that the service sector contains a wide set of industries including, for example, retail trade, telecommunication, transportation, renting of

machinery, finance, insurance, real estate, hotels and restaurants. The diversity of the service sector has been highlighted by Miles (2006) and Howells and Tether (2004), who even claim that some services are more like manufacturing in the sense that they are technology intensive or involved in the production of materials.⁵ Despite the heterogeneity, however, there are some fundamental differences between manufacturing and services. As is well known, many services are intangible, invisible and perishable (Mattoo and Stern 2008). This means that service activities often are non-storable and less tradable than material goods (Mattoo and Stern 2008; Miles, 2006). However, many business services including technical drawings, call centers, computer programs and engineering designs, are highly tradable.

Among the characteristics that are recognized to increase the tradability of a service is the possibility to codify, standardize and fragment the service into modules (we may call this the degree of tradability). These trade-enhancing characteristics also enhance the possibility to vertically fragment the production and outsource parts of the production of a service. The creation of Internet webpages, rather than IT services in general, can be taken as one such example (Miles, 2006). We might here note that progress made in the IT sector has played a key role for the growing trade in services and that in contrast to the manufacturing sector, knowledge in the service sector is closely related to people and, therefore, relatively difficult to protect by patents (Miles, 2006).⁶ Hence, for offshoring of services containing sensitive information to take place, a key issue to consider is how to protect the knowledge from leakage, which leads us to corruption.⁷

2.2 Corruption

Although the term corruption is well known, it is difficult to find a precise and commonly accepted definition of it. A common theme is that corruption involves misuse of public officials for private gain in a way that alters the rules. Corruption is often divided into grand corruption and petty corruption, where grand corruption refers to situations where the political elite exploit their power for economic gain, while petty corruption refers to how appointed bureaucrats handle their responsibilities.⁸ Schleifer and Vishny (1993) suggest another distinction, arguing that “coordinated corruption” tends to be less harmful than

⁵ As Drucker (1977) points out, non-technological innovations “are at least as important as technological innovation.”

⁶ Even though reverse engineering of physical products is a problem in some countries there remain substantial fixed costs associated with reverse engineering and setting up a production establishment to copy products.

⁷ For example, Knowledge Intensive Business Services (KIBS) that rely on professional knowledge should be more sensitive to a bad contractual environment. Examples of KIBS include market research, design, engineering and technical services, Howells and Tether (2004).

⁸ See e.g., Kain (2001) and Svensson (2005).

“uncoordinated corruption”, where the latter takes place when public officials and other involved agents make decisions independently of each other and maximize profits in an uncoordinated game. If the cost of corruption is about money and the ability to pay, it may be argued that large firms are better equipped than small firms to handle a corrupt environment because they have the ability to pay and have greater bargaining power.

Corruption may also occur in daily business life without any direct intervention from public agents. Therefore, we may add a dimension where corrupt behavior occurs among individuals who are in control of assets that are not their own (e.g., business people that make decisions on behalf of the owners of capital). This wider scope of corruption is reflected in the perceived corruption measures we use here—the World Bank corruption index and Transparency International’s corruption index.

Arguments that corruption is detrimental to an economy include the ideas that corruption leads to a misallocation of contracts and that resources are reallocated from the most efficient agents to less efficient ones. Corruption also increases the uncertainty under which firms are working, increases the costs in terms of time and money spent on bribery and complicates contractual relations. In addition, there is a social, legal and moral dimension of corruption. Hence, corruption not only increases the cost of operating in a country but also affect subcontracting relations. The opposite view, that corruption may be beneficial for an economy, rests on the assumptions that governmental officials can be more helpful when paid directly and that corruption allows business people to avoid restrictions that would otherwise discourage investments.⁹ Hence, the extent to which corruption is harmful for business life and growth is partly an empirical issue.

2.3 Offshoring and the link between service offshoring and corruption

The primary drivers for vertical specialization and offshoring are factor price differences.¹⁰ Given that a firm is about to offshore a service activity, it can either choose to keep the activity in-house or offshore the service to an external agent.¹¹ Subcontracting an internal company function to an outside firm may involve a transfer of management control and firm-specific knowledge to an external supplier. This is where the contract cost enters into the

⁹ See e.g., Shleifer and Vishny (1993) and Wei (2005).

¹⁰ Although factor price differences are of key concern, Grossman and Rossi-Hansberg (2008) show in their “Trading Tasks” model that price differences between countries alone are not sufficient to generate offshoring. Other motives include technology sourcing and capacity motives. As Markusen and Strand (2008) notice, the H-O model is simply not sufficient to explain why firms in the North offshore services such as call centers or reading and interpreting X-rays to firms in the South where skilled labor is a scarce factor

¹¹ Offshoring or outsourcing to a foreign entity includes (i) outsourced offshoring (outsourcing to a foreign external supplier) and (ii) in-house offshoring (vertical FDI—within the corporation).

picture. For in-house offshoring, the protection of sensitive information is less of an issue, as compared with offshoring to an external agent where the formulation of a contract can be costly and time consuming. It is therefore understood that corruption can lead firms to refrain from offshoring to corrupt countries, particularly when sensitive information is involved.

The contract issue concerns not only the offshoring partner but also the receiver. The standard hold-up problem recognizes that the receiving partner must often make contract-specific investments, Williamson (1979) and Hart (1986). When complete contracts cannot be enforced, this will lead to underinvestment. Here, it is understood that corruption works as an obstacle, reducing the trust of the system, and therefore, aggravating the problem of underinvestment, see, e.g., Ornelas and Turner (2008). Another way to look at this issue is to consider who the legal proprietor is. If the *supplier* is the legal proprietor of a service product, then it is the supplier who takes the risk that intellectual property rights may be foregone. In a corrupt country, this risk is typically higher than in less corrupt countries. If, however, the *client* is the legal proprietor, the risk of taking damage mainly falls on the client. In any case, corruption reduces the probability that a corrupt country will be chosen as a target country. Corruption not only makes the country less attractive, but it also affects the pool of firms that are able to compete for offshoring contracts.

Theoretical models that describe conditions for offshoring to take place are well developed today and usually take the view of the offshoring agent. The north-south model by Grossman and Helpman (2003) shows that the cost advantage of a low-wage country as a receiver of offshoring contracts may be offset by such factors as corruption and a poor legal environment. A more recent model pointing in the same direction is Antràs and Helpman (2006), who show that the prevalence of offshoring increases with the quality of the contractual institutions of the recipient countries. Corruption may also be considered to have composition effects, namely, it affects the kind of services being outsourced. A conclusion drawn from Grossman and Helpman (2002), Antràs (2003) and Feenstra and Hanson (2005) is that sensitive tasks are not easily outsourced. As seen above, models predicting a negative impact of corruption focus on outsourced offshoring. However, as discussed above, in-house offshoring (vertical FDI) is also negatively affected by corruption because in this case, the investing firm itself will be facing the local administration (empirical evidence points at a negative relation between corruption and FDI, see the introduction). As a matter of fact, while in-house offshoring minimize the subcontracting problem and the risk of information leakage, it is likely that the time and cost related to negotiations with public officials and administrative issues are higher for in-house offshoring than for outsourced offshoring. That

said, we conclude that in comparison to in-house offshoring, corruption is most likely to be an issue for outsourced offshoring of services when sensitive information is involved. To empirically tackle similar issues where trade is involved, the gravity model of trade has proven to be a good point of departure, and therefore, we continue with a discussion of that model.

3. The gravity model, firm-level gravity, data and empirical strategy

The gravity is today a well-established vehicle for empirically analyzing trade flows, and the model has developed into other trade-related areas such as analyses of FDI (see, e.g., De Mello-Sampayo, (2005, 2009), Hejazi, (2005, 2009), and Shigeru and Umemura (2003)). Here, we analyze a specific type of trade, namely firms' imports of offshore services. In its elementary form, the gravity model can be expressed as $M_{ij} = T(r) \frac{Y_i Y_j}{d_{ij}^{-\varepsilon}}$, where M_{ij} are imports from country i to country j , $Y_i Y_j$ is the joint economic mass, d_{ij} is distance between countries, and $T(r)$ —in the simple specification—is a proportionality constant (Overman *et al.*, 2003).

Formulations of the gravity model derived from general equilibrium modeling (such as Anderson and Van Wincoop (2003)) have shown that the traditional specification suffers from an omitted variable bias, as it does not take into account the effect of relative prices on trade patterns. This falls under the issue of multilateral trade resistance (MRT). Anderson and Van Wincoop (2003) show how the inclusion of fixed effects in the form of importer and exporter fixed effects is in line with the theoretical concerns and yields consistent parameter estimates.

The next major leap forward for the gravity model includes selection and deals with firm heterogeneity. Melitz (2003) and Chaney (2008) showed how selection into trade is affected by sunk costs. To overcome sunk costs, the productivity level of a firm must exceed a minimum threshold value. As a consequence, productivity and the size of barriers and the margins of trade were highlighted. In an important paper, Helpman, Melitz and Rubenstein (HMR) (2008) describe how changes in trade are related to changes in both the intensive and the extensive margin of trade, and they explain how to deal with the bias that will be induced if the margins not are controlled for. Suppressing time indices, the log linear model estimated by HMR takes the form: $\ln(X)_{ij} = \alpha + \lambda_i + \zeta_j + \beta_1 \ln(d_{ij}) + w_{ij} + \Omega + u_{ij}$. In this formulation, i and j refer to countries, X refers to trade(export), ζ and λ are fixed importer and exporter

effects, d is the distance between i and j , w controls for the fraction of exporting firms (firm heterogeneity), Ω is the inverse Mills ratio, and u_{ij} is the error term. The inverse Mills ratio adjusts for the selection into trade, and w can be empirically formalized as a combination of the Mills ratio and the probability of being an exporter that appended in higher order terms controls for firm heterogeneity.

Today, the heterogeneous firm model has emerged as the workhorse model of micro patterns of trade. For example, Melitz (2003), Bernard, Eaton, Jensen and Kortum (2003) and Chaney (2008) show how the interaction between firm-level productivity, fixed costs and barriers to trade governs the penetration into export markets. Following this tradition, Greenaway *et al.* (2008) estimate a gravity model at the firm level analyzing international trade in the food sector.

Bergstrand (1989) discusses the relevance of factor prices in the gravity model and shows how per capita incomes can proxy factor prices and intensities. For a given GDP, a larger population implies a lower per capita income and wages.¹² Given that factor price differences are a key concern for offshoring, not including a measure that captures factor price differences may lead to an omitted variable bias. Therefore, we follow the common principle of including population in the model. Following Greenaway *et al.* (2008), we also include an ownership variable indicating whether a firm is a multinational (MNE). The assumption is that firms that are already multinational (and have overcome the cost of crossing the border) have an advantage over purely national firms in arranging offshoring contracts. To account for firm-level gravity and size effects, we apply the log of firm sales.

To capture trade resistance terms, we include our key variable corruption as well as distance and various dummy variables (discussed below) and tariff rates defined at the most disaggregated (product) level.

Direct inclusion of the full set of country-fixed effects makes it hard to estimate the impact of time-invariant effects. Instead, we take the commonly used approach and apply region-fixed effects (22 regions) to the model.¹³ With this as a background, our baseline equation takes the following form:

$$\ln(O)_{ijt} = \alpha + \sum_f \beta_f \Gamma_{fit} + \sum_c \beta_c T_{cit} + \sum_r \beta_r \Omega_{rjt} + \lambda \Phi_{ijt} + d_r + \gamma_t + \varepsilon_{ijt} \quad (1.)$$

¹² For example, Greenaway *et al.* (2008) estimate a firm-level gravity model analyzing trade within the food industry and follow the now well-established route of including population as a proxy for factor prices

¹³ See the Appendix for details on the 22 regions. The issue of unit and country-fixed effects will be further analyzed using Fixed Effect Variance Decomposition models, see below.

Here, O_{ijt} are imports by firm i of offshored services from country j , and Γ is a set of F firm characteristics including total factor productivity, MNE status and sales. Target country characteristics T include GDP and population. Ω contains measures of trade resistance including distance, tariffs, and corruption, Φ is the Mills inverse ratio controlling for nonrandom selection into offshoring, d_r is a region dummy, γ_t is a period dummy and ε is the error term.¹⁴

3.1 Econometric considerations

As noted above, the estimation of the gravity equation is complicated by nonrandom selection into offshoring, firm heterogeneity and fixed effects. The Heckman model is a natural point of departure for handling nonrandom selection into offshoring. To estimate the selection equation, we need variables that can be used as an exclusion restriction, and variables related to sunk costs and productivity have been suggested as candidates.¹⁵ The reasoning is that these variables are closely related to the selection into trade. Here, we follow Bernard and Jensen (2004) and add a measure of the skill intensity of the firm (the share of workers with at least tertiary education) because we expect skill intensive firms to be more likely to go offshore.¹⁶ In addition, exporting firms are more likely to go offshore than nonexporting firms (being an exporter captures the idea that the firm has overcome the cost of trading across the border), and we therefore also apply export intensity to the selection model.

As shown by HMR (2008), the heterogeneous firm model suggests that additional control for firm heterogeneity (the share of firms that go offshore) can be appended by adding higher orders of a variable “ z ” where z consists of a combination of Mills ratio and the probability of positive offshoring.¹⁷

We will apply both the standard Heckman approach and the HMR specification. Estimating models with varying degrees of control for selection and firm heterogeneity gives us an indication of the strength of these mechanisms.

¹⁴ See the Appendix for variable definitions and sources.

¹⁵ Note that IMR is a nonlinear function of the variables included in the first-stage probit and that the target equation can be identified because of this nonlinearity alone. The nonlinearity of IMR arises from the assumption of normality. For practical reasons, it is therefore advisable to add variables to the selection not included in the target equation.

¹⁶ Both Roberts and Tybout (1997) and Bernard and Jensen (2004) include lagged trading status as a proxy for fixed costs. To bypass possible endogeneity, we leave this variable outside the model.

¹⁷ For details about the construction of “ z ”, see notes to the regressions Tables.

To some extent, firm heterogeneity can be absorbed by fixed effects, and fixed effects are perhaps the most-discussed issue in the estimation of the gravity model. As noted above, Anderson and Van Wincoop (2003) and Feenstra (2004) show that the inclusion of exporter and importer (country-specific) fixed effects yields consistent parameter estimates.¹⁸ Here, we start by following the commonly used approach of applying region-fixed effects. The drawback of region dummies is that, by definition, they are not able to pick up all country-fixed effects: the question is how much of a problem this actually is. As discussed by Plumper and Troeger (2007), the inclusion of unit-fixed effects cancels out all cross sectional variation, leaving us with time series variation only and making the estimation of nearly time-invariant variables cumbersome. Thus, they suggest the Fixed Effect Variance Decomposition (FEVD) estimator as a solution to the problem.¹⁹ The FEVD model is a three-stage panel fixed effects vector decomposition model that, by decomposing unit effects into one explained part (captured by dummy variables) and one unexplained part (η), allows us to efficiently estimate and include time-invariant variables and nearly time-invariant variables in a fixed effects framework.²⁰ This procedure has been shown to be especially useful when dealing with variables with relatively little within variation (variation over time), as is the case for many country-level characteristics. Here, we apply the FEVD model in a selection model framework.²¹ A key concern, therefore, is to analyze to what extent the results are changing when we improve the control of fixed effects.

3.2 Data

The analysis is based on Swedish firm-level data that are matched with a set of country characteristics. Firm-level data consist of a set of linked register-based data sets from Statistics Sweden: the financial statistics data (FS) and Regional Labor Market Statistics

¹⁸ Other approaches to control for MRT include a two-step approach suggested by Anderson and Van Wincoop (2003) that solves for MRT as a function of observables. Other suggestions include calculating a GDP-weighted remoteness index, and finally, a fixed effects regression approach is suggested by Feenstra (2002, 2004).

¹⁹ In addition, the distribution of the fixed effect estimator is unknown for the Heckman model (see, e.g., Green 2001).

²⁰ Monte Carlo simulations have shown that, as a rule of thumb, if the cross sectional (be) standard variation is at least 1.5 times larger than the within standard deviation, the FEVD model is superior to the standard fixed effect model, see Plumper and Troeger (2007).

²¹ We may note that the Mills ratio is not a fixed variable but an estimated regressor that adds uncertainty to the model. Murphy and Topel (1985) suggest a standard error correction when estimated variables are included. More recently, Hardin (2002) has shown that the sandwich estimator that is built under less restrictive assumptions and is efficient against a wide range of non-spherical distortions is asymptotically identical to the Murphy-Topel estimator. We might also consider the hierarchical structure of our data and adjust (cluster) standard errors by country. The cluster adjustment used here also imposes the Sandwich correction and therefore adjusts for the built-in uncertainty in estimated variables.

(RAMS) provide us with information on firms' inputs and results, such as sales, value added, capital stock, number of employees, education, ownership and industry affiliation.

Data on imports of services cover all service transactions and all firms. Trade in services is collected by the Swedish Riksbank and is separated into eleven categories. Our analysis deals not with all services but with imports of offshore services, and we therefore exclude; public services, insurances, personally delivered services, cultural services, travel funds and transportation services from our definition of offshored services. Following Crinò (2007) (except for the exclusion of insurances), we measure offshored services as imports of; communication services, financial services, computer and information services, royalties and license fees and other business services. To these groups, we also append construction services (which has become increasingly internationalized).²²

Prior to 2002, data on trade in services was collected by the Swedish Riksbank and covered all firms, but since 2002 the data collection is overtaken by Statistics Sweden, and since then, only for a sample of firms. In addition, the matching of the different service categories registered by the Swedish Riksbank and Statistics Sweden is uncertain. For these reasons, we end the analysis in 2002.

Country characteristics are collected from the World Bank. For corruption, we use the World Bank *Corruption Index (WB)* and the *Corruption Perception Index* collected by Transparency International (*TI*). Both corruption indices are based on perceived corruption. The major differences between the indices are in terms of coverage and time span. Due to its greater coverage, our first choice is the World Bank corruption index.²³ We have rescaled the WB corruption index (such that it cannot take on any negative values) to range from originally -2.5 to 2.5 to a new range of 1.0 to 6.0, an adjustment that allows us to apply the index in higher orders. The range of the TI corruption index is 0.0-10.0. For both indices, a higher value indicates a cleaner system and less corruption, and we therefore label the corruption variable used in the regressions as “*corruption cleanness*”. Additional country characteristics include population and GDP collected from the World Bank database. Tariff data are obtained from the UNCTAD/TRAINS database, and for distance, we use the CEPII distance measure, which is weighted so as to take internal distances and population dispersion

²² As a robustness test, we will consider different sub-groups of service offshoring (see Table A7)

²³ Knack and Azfar (2002) discuss a set of corruption indices where, in all practical terms, they show that despite methodological differences, the difference between the indices is minor.

into account.²⁴ For details of the variables, see the Appendix. Due to different time frames for the data sets, we limit the analysis to the 1997-2002 period.

4. Results

Description

Comparing firms that enter into service offshoring relationships and those that do not, Table A5 reveals that offshoring firms are relatively large, productive²⁵, skill intensive and overrepresented by MNEs. This is expected because entering into service offshoring relationships requires the firm to overcome a number of obstacles associated with entering international markets. Although factor price differences are a primary driver for vertical specialization, Table A3 shows that about eighty percent of offshore services are directed to northern and western Europe and to North America. Hence, service offshoring is heavily concentrated to rich countries. It may also be noted that trade with some relatively distant and poor regions such as the Caribbean and Polynesia shows both relatively low flows and low trade-weighted tariff numbers. This may be explained by the fact that offshoring to these regions is limited to areas where Sweden (the EU) has free trade agreements. Finally, in Table A2, we note that multicollinearity is not much of an issue here and that the WB and TI corruption indices are highly correlated.

4.1 Basic models

The first thing to note is that out of 3.6 million observed firm-country pairs, only about 40,000 observations (or 1.1 percent) are nonzero trade flows. This reflects that most firms offshore services to none or to only a handful of countries (see Table A5).

We start with OLS estimations with various controls for fixed effects. With this as a basis, we can easily see the impact of various refinements. Our first results in Table 1 suggest that corruption is a significant deterrent to service offshoring. However, when stepping up the control for fixed effects from regional dummies to country- or unit-fixed effects (firm-country pairs), the significance of corruption is eliminated. This might not come as a surprise, as most of the variation in this variable is driven by cross-country differences and not by variation over time (see Table A1). This is an issue closely related to the properties of the fixed effect estimator and persistent series (as discussed above) and an issue that will be

²⁴ More information on CEPII's distance measure is found in Mayer and Zignago (2006).

²⁵ TFP is measured by the Törnquist index. For details about the index, see the appendix and Karpaty and Tingvall (2010).

further considered. One may also note that further inclusion of fixed effects from country dummies to the unit level does not have any considerable impact. Our interpretation of this result is that country-specific effects are rather uniform across firms. These initial results indicate that the modeling of fixed effects is important, especially because many of our core variables (such as corruption) are characterized by larger between than within variance.²⁶

[Table 1 about here]

Models 1-3 are performed on firms that has a service offshoring relationships only, and in estimations 4-6 we repeat estimations 1-3, now employing the common strategy of replacing nondefined values ($\ln(0)$) with a small number (0). It may be noted that replacing nondefined values can be regarded as inadequate, particularly if selection into offshoring is nonrandom. In addition, Flowerdew and Aitkin (1982) and King (1988) show that the choice of the selected constant can greatly distort the results. Here, we include zeros mainly as a robustness check and as an indication of nonrandom selection into service offshoring. Comparing models with and without zeros, we see that the inclusion of a large number of observations with zero trade does not upset the results, although individual coefficients may change.

4.2 Selection, fixed effects and nonlinearity

In Table 2, we proceed and estimate models where nonrandom selection into offshoring is controlled for. Both variables used as exclusion restrictions are highly significant, and the Mills ratio and the test of independent equation ($\rho = 0$) are both strongly significant, suggesting that selection into service offshoring is not random and that the selection models are justified.

The selection equation suggests that corruption is a deterrent for the choice of the target country. All models in Table 2 use the same selection equation and the target equations differ only with respect to how fixed effects and heterogeneity are controlled for (and therefore, also differ in the estimated impact of corruption).

Analyzing the intensive margin, the results from the target equation from the standard Heckman model suggest that corruption does not decrease but rather increases the volume of offshored services. However, as we improve the control for heterogeneity and/or fixed effects this result disappears.

²⁶ See Table A1.

[Table 2 about here]

In other words, as suggested by Helpman, Melitz and Rubenstein (2008), we improve the control of firm heterogeneity by adding a variable “ z ” defined as $\hat{z} = \Phi^{-1}(\hat{p}) + \hat{n}$, where p is the predicted probability of positive offshoring and n is Mills ratio to the model, the impact of corruption turns from negative significant to positive and insignificant.

To some extent, firm heterogeneity can be captured by fixed effects, and the results in Table 1 suggest that control for country- and unit-fixed effects is an issue of concern, particularly when dealing with persistent series such as corruption and country characteristics. We tackle (unit) fixed effects by applying the Fixed Effect Variance Decomposition (FEVD) estimator, suggested by Plumper and Troger (2007), here in a Heckman selection model framework. Comparing results from the Heckman-FEVD model with the standard fixed effect (FE) model in Table 1, we see that (by using both cross sectional and within variation in data) the Heckman-FEVD model returns more efficient estimates than the standard FE estimator. In particular, insignificant results for the corruption variable become significant when using the FEVD framework, a result that highlights the efficiency problem attached to the standard fixed effect model in the presence of persistent series. Comparing results using the standard fixed effect estimator (with unit effects absorbed) with models using region or country dummies only (Table 1) we note that the R^2 is higher in the fixed effect model ($R^2 = 0.79$ vs. 0.15 and 0.17 respectively), indicating that unit effects do contain necessary information. In addition, R^2 in the Heckman FEVD model is exactly as high as it is for the FE estimation without zeros in Table 1 (0.79), indicating that the variance decomposition variable (η) is capable of absorbing unit effects properly. In addition, the Heckman FEVD model returns the expected value of unity for the strongly significant η . In summary, these results suggest that unit effects are of importance and that the FEVD model efficiently picks up such effects.

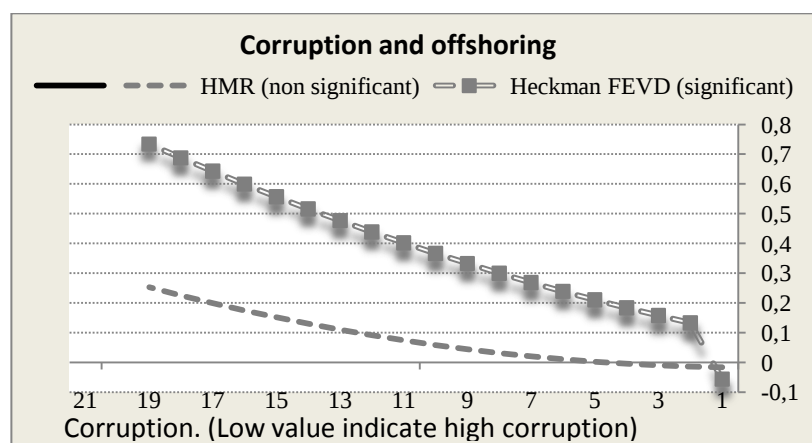
Focusing on results using the Heckman-FEVD estimator, we note that most of the control variables are significant with the expected sign. Nearby countries with large markets attract offshoring; tariffs mitigate offshoring; and large and productive firms seem to be more prevalent to enter into service offshoring relationships than are other firms. The negative sign for the population variable indicates that service offshoring is positively correlated with income, meaning that service offshoring is conditionally biased toward

relatively rich countries.²⁷ A less expected result is that MNE status is found to be negatively associated with offshoring, an issue that we will come back to in the analysis of heterogeneous response.

There are arguments suggesting positive effects of corruption—that it can work as oil in the machinery in a stiff and bureaucratic system. That is, at moderate levels of corruption, the positive effects may dominate in certain environments. This suggests that there may exist a nonlinear relation between offshoring and corruption. Examining the nonlinearity issue, results in Table A4 are inconclusive regarding the significance of the nonlinearity with many insignificant results. Only the Heckman FEVD model suggests a significant and increasingly negative relation between corruption and service offshoring.

It is cumbersome to judge from the estimated coefficients what the curvature of the estimated nonlinear relation looks like. In Figure 1, we therefore depict the estimated relation between corruption and offshoring over the empirically observed levels of corruption. The Heckman FEVD model reveals a continuous, negative and almost linear relation between offshoring and corruption, suggesting that the linear model may be appropriate as a description of the functional relationship between service offshoring and corruption.

Figure 1. Estimated relation between offshoring and corruption.



The estimated relation between service offshoring and corruption, depicted over the empirically observed range of corruption. Nonlinear specification.

4.3. Heterogeneity

To the extent that corruption works as a fixed cost, this means that large firms should be better equipped than small firms to handle corruption, not only because they can afford to

²⁷ For a given GDP, a larger population implies a lower per capita income.

pay, but also because of their bargaining power.²⁸ A hypothesis would therefore be that large firms, MNEs and experienced firms that enters into service offshoring relationships should be relatively well equipped to handle a corrupt environment. On the other hand, these relatively powerful firms can, with relative ease, use their networks and relocate away from difficult markets. The alternative hypothesis is therefore that they are not *less* but in fact *more* sensitive to corruption than are other firms. This would be especially true if firms do not fully consider the downside of corruption before they enter a market. To some extent, it is therefore an empirical question whether the sensitivity to corruption differs between various types of firms.

[Table 3 about here]

The results for different types of firms are presented in Table 3. An interesting but consistent pattern is that large firms, MNEs and firms offshoring services to many markets are all relatively sensitive to corruption. The estimated sensitivity (coefficient) is about seven times larger for large firms than for small firms. This holds irrespective of estimation method. Comparing MNEs and non-MNEs, the difference is even greater because non-MNEs seem to be (significantly) attracted to corrupt countries, while the opposite is true for MNEs. Given that the sample of non-MNES, by definition, excludes the possibility of in-house offshoring, all offshoring by these firms is with external agents, and we would therefore expect these firms to be *more* rather than *less* sensitive to corruption than are other firms. Hence, these results strengthen our previous findings that large and internationalized firms use their experience and networks to avoid corrupt countries.

If there is an asymmetry between small and large firms and large firms are the ones that enter into large scale service offshoring relationships, an economically more adequate picture of the aggregate relation between offshoring and corruption may be given using firm size-weighted regressions. Firm size-weighted regressions in Table 3 confirm the above indicated pattern, returning both larger and more significant coefficients against corruption than did the nonweighted regression. In fact, when we are using firm size-weighted regressions, even the standard fixed effect estimator returns a significant estimate on corruption.²⁹

²⁸ To the extent that the cost of “keeping up relations” increases less than 1:1 with firm size, the same can be true for the increasing marginal cost type of corruption, an advantage for large firms.

²⁹ See table note (a) for Table 3.

To some extent, these results suggest that inexperienced firms do not fully consider the downside of corruption when choosing target country. Some support for this line of reasoning is found in the selection equation for the negative binomial model in Table 4, where “corruption cleanness” enters with a negative sign, which indicates a selection preference for corrupt countries, whereas the volume effect signals aversion for corruption.

Separating countries with respect to income levels reveals that the sensitivity to corruption is greatest for the poorest countries. Because large firms and MNEs are the ones that enter into large scale service offshoring relationships and these firms are the ones that are the most sensitive to corruption, this adds yet another argument for the importance of fighting corruption, especially in poor and heavily corrupt countries.³⁰

For an individual firm, the level of corruption and the other country characteristics are likely to be taken as given. Although endogeneity may be an issue, we apply the commonly used approach of using lagged covariates as a test of robustness. The idea here is that according to the definition of strong exogeneity, shocks in period (t) have no impact on (t-1) (which could be the case if there was perfect foresight). See, e.g., Hendry (1995) and Greenaway *et al.* (2008). As seen in the FEVD estimations in Table 2, using lagged values reduces the number of observations (we lose one year), and in comparison with estimations with no lags, the estimate of corruption is almost unaffected and remains positive and strongly significant.

Another issue related to the robustness of the results is the sensitivity of the FEVD estimator with respect to the set of variables included in the set of fixed and persistent series. As a robustness test, we therefore drop the twenty-two region dummies from the model. This increases the burden of the variance decomposition variable (η) to pick up unobservables. A comparison of the FEVD estimations in Tables 2 and 4 shows that excluding region dummies has very small impact on the results, indicating that the variance decomposition variable is capable of absorbing fixed effects (unit effects).

[Table 4 about here]

An alternative approach to estimate the gravity model that has become increasingly popular is to estimate multiplicative count data models such as the Poisson

³⁰ As a stability test, we estimated models with both the WB and the Transparency International corruption (TI) index and achieved nearly identical results. Due to the greater coverage of the WB index, this is chosen as our prior choice. Estimations with the TI index are available upon request.

model and negative binominal models. These models possess a number of attractive features. As pointed out by, for example, Westerlund and Wilhelmsson (2009) and Burger *et al.* (2009), the gravity model is defined in multiplicative terms, which naturally allows us to include zeros. Furthermore, these models are relatively robust to non-homoscedasticity.³¹ Weaknesses of the Poisson model include that the mean and variance of the dependent variable should have the same value. Because the negative binominal model allows mean and variance to differ, the negative binomial model is often recommended and is also applied here.³²

To handle zeros beyond what the distribution can absorb while keeping its properties intact (excess zeros), the zero-inflated negative binominal models may be helpful. The inflation step is similar to the selection step in the Heckman model, although these models do not depend on an exclusion restriction.³³ We therefore estimate a set of negative binomial models. Results from these models displayed in Table 4 verify our previous findings: corruption is found to be a deterrent for offshoring. It may also be noted that contrary to the standard fixed effect model in Table 1, the impact of corruption remains significant when estimating the fixed effect negative binominal model. Comparing the negative binominal random effect model with its fixed effect counterpart, the fixed effect model returns lower estimates for corruption. To be precise, the results from the negative binomial model suggest that not taking unobserved heterogeneity into account may lead to an upward bias in the estimated impact of corruption. Finally, we note that for the zero-inflated negative binomial model, in the selection step, results suggest that corruption attracts offshoring, while the standard results arguing that corruption is a deterrent for the volume of offshoring are verified in the target equation (although not significant in the Zero Inflated Negative Binomial (zinb) model).³⁴ It may be worth notice that the estimated coefficients of corruption in the negative binomial models are found to be of similar magnitude to those in the log-linear counterpart models.

As discussed above, high tech services are likely to be more sensitive to corruption than services not containing sensitive information. However, the tradability of services also matters. For a given level of sensitive information, services that are easily traded are more likely to be offshored than services that are difficult to trade. We therefore, a priori,

³¹ Flowerdew and Aitkin (1982) and Santos and Tenreiro (2006).

³² In our data, the variance of the dependent variable exceeds the mean with a factor of about 1.2 million times, and we therefore only present count data models using various formulations of the negative binomial estimator.

³³ See, e.g., by Burger *et al.* (2009).

³⁴ Using nonclustered standard error increases gives a strongly significant estimate of corruption in the zinb regression model.

expect services that contain sensitive information and/or are relatively difficult to trade to be more sensitive to corruption than are other goods. We therefore construct three groups of services: high tech, easily traded, and not easily traded services and compare estimates from these estimations with results in Table 2.³⁵

[Table 5 about here]

Results in Table 5 support some of the arguments put forward previously. Most noticeable is the relatively high sensitivity to corruption found for services that are classified as not easily traded. Comparing coefficients, the estimate coefficient for the Heckman FEVD model for “not easily traded services” is about four times larger than for “easily traded services”. However, no significant estimates are found using the HMR estimator, considering the indicated significance of fixed effects, our preferred estimator is the Heckman-FEVD model. We are therefore inclined to suggest that “not easily traded services” are more sensitive to corruption than “easily traded services”. Finally, for offshoring of high tech services, the results are less clear with insignificant estimates.

5. Summary and conclusion

In this paper, we analyzed how corruption in target economies affects offshoring of services by Swedish firms. To be precise, we analyzed how corruption affects the choice of country and the volume and composition of offshored services. To this end, we used detailed Swedish firm-level data combined with a set of country characteristics. To the best of our knowledge, this is the first paper tackling this issue empirically.

Using the gravity model as a workhorse, the analysis shows that corruption is a deterrent for both the choice of country and, given that a country has been selected, for the amount of services offshored. Dividing service offshoring into different categories reveals that services that are not very easy to trade are relatively more sensitive to corruption. Testing for a nonlinear relationship between (the log of) offshoring and corruption indicates that the relation is rather linear, suggesting that (log) linear approximation probably is sufficient.

Analyzing heterogeneity, we find that the impact of corruption is most severe for poor countries. In addition, large firms, MNEs and firms offshoring to several countries are found to be more sensitive to corruption than are other firms. Considering that many

³⁵ For details on the constructed service categories, see Table A7 and the description section.

heavily corrupt countries also are relatively poor, this adds to the list of arguments for the importance of fighting corruption.

During the analysis, we tackle the selection and “zero-valued trade” problem and the fixed effects issue. The results indicate that firms are not randomly drawn into offshoring and that both the standard Heckman and the HMR gravity model specification are therefore superior to OLS. To some extent, firm heterogeneity can be absorbed by fixed effects. However, analysis of fixed effects indicates that the estimation of fixed- and country-specific variables becomes problematic if fixed country effects or unit-fixed effects are introduced. This problem is well known and is due to relatively low within variation (persistent series) in most country-specific variables. However, not controlling for fixed effect may lead to biased results. To both control for unit-fixed effects (unobserved heterogeneity) and extract cross-sectional information, we estimate Heckman models using the Fixed Effects Variance Decomposition (FEVD) estimator. This allows us to handle the selection problem and control for unobserved unit-level heterogeneity. Comparing R^2 Heckman FEVD estimations with the standard fixed effect estimation (with absorbed unit effects) reveals that the variance decomposition variable is able to absorb unit effects and that not controlling for these effects may lead to an upward bias of the impact of corruption. Considering the large gain in R^2 and the significance of the variance decomposition variable (η) the Heckman FEVD variance decomposition model turned out to be our preferred estimator.

To sum up, addressing both the selection and the fixed effects issue and testing the robustness of the results, we conclude that corruption is a deterrent for offshoring. This has been proven to hold for different types of firms and is rather robust with respect to model specification. Moreover, the negative effect of corruption seems to be greatest in poor countries, a result that adds to the list of arguments for the importance of fighting corruption.

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Appendix

Table 1. Service offshoring and corruption.
Dependent variable, imports of offshored services, 1997-2002.

Variable	1. OLS no zeros	2. OLS no zeros	3. FE no zeros	4. OLS with zeros	5. OLS with zeros	6. FE with zeros
<i>ln(distance)</i>	-0.1352 (-2.13)**	-1.6563 (-8.00)***	--	-0.0710 (-1.08)	0.1016 (1.53)	--
<i>ln(GDP)</i>	0.2582 (4.37)***	0.8338 (1.78)*	1.1236 (2.00)**	0.0089 (1.11)	0.0247 (1.18)	0.0219 (0.76)
<i>ln(Population)</i>	-0.0263 (-0.49)	-1.0398 (-1.52)	-1.0435 (-0.67)	0.0282 (2.58)***	-0.1864 (-2.84)***	-0.2559 (-2.55)***
Corruption clean	0.1479 (2.56)***	-0.0207 (-0.14)	0.0092 (0.04)	0.0610 (3.43)***	0.0075 (0.91)	0.0103 (0.82)
MNE	0.1118 (2.31)**	0.1131 (2.35)**	-0.0695 (-1.54)	0.0235 (3.30)***	0.0235 (3.30)***	0.0057 (2.54)***
<i>ln(Firm size) sales</i>	0.2656 (12.96)***	0.2755 (14.01)***	0.1964 (4.89)***	0.0741 (6.86)***	0.0741 (6.86)***	0.0184 (3.28)***
<i>ln(TFP)</i>	0.0147 (4.82)***	0.0143 (4.67)***	0.0100 (2.01)**	0.0014 (3.66)***	0.0014 (3.66)***	0.0009 (5.01)***
Tariffs	-0.0504 (-0.16)	-0.2909 (-3.37)***	-0.2345 (-1.26)	1.2858 (2.77)***	0.3328 (0.60)	0.3848 (0.58)
Industry dum.	yes	yes	yes	yes	yes	yes
Period dum.	yes	yes	yes	yes	yes	yes
Region dum.	yes	..	..	yes	..	..
Country effects	no	yes	..	no	yes	..
Unit fixed effects	no	no	yes	no	no	yes
R²	0.17	0.17	0.79	0.06	0.08	0.58
Obs.	39 305	39 305	39 305	3 636 012	3 636 012	3 636 012

Note. t-values within parenthesis (.), *, **, ***, indicates significance at the 10, 5 and 1 percent level, respectively. Firms with at least 50 employees. Robust standard errors clustered by country.

Table 2. Heckman, HMR and Heckman-FEVD models: Service offshoring and corruption. Dependent variable, imports of offshored services, 1997-2002.

Variable	Heckman ^(A)		HMR ^(B)	Heckman FEVD ^(C)	Heckman FEVD ^(C)
	Selection	Target			Lagged RHS
<i>ln(distance)</i>	-0.3969 (-42.38)***	0.2403 (6.94)***	-0.1453 (-2.28)**	-0.1442 (-121.2)***	-0.1157 (-5.19)***
<i>ln(GDP)</i>	0.2574 (37.12)***	-0.0120 (-0.41)	0.2094 (3.45)***	0.17990 (29.82)***	0.2096 (10.27)***
<i>ln(Population)</i>	0.0157 (2.26)**	-0.0463 (-1.67)*	-0.0413 (-0.75)	-0.0444 (-7.43)***	-0.0543 (-2.75)***
Corruption clean	0.2247 (27.07)***	-0.0839 (-2.50)**	0.0806 (1.29)	0.0538 (6.18)***	0.0504 (2.10)**
MNE	0.1230 (18.25)***	-0.0745 (-3.09)***	0.0666 (1.22)	-0.1161 (-2.65)***	0.0259 (1.51)
<i>ln(Firm size)</i> sales	0.3472 (166.2)***	-0.1119 (-7.45)***	0.1768 (4.68)***	0.1154 (2.86)***	0.1415 (17.60)***
<i>ln(TFP)</i>	0.0038 (5.83)***	0.0035 (1.63)	0.0121 (4.12)***	0.0086 (2.02)**	0.0120 (8.17)***
Tariffs	0.5674 (8.99)***	-0.5452 (-2.74)***	-0.3626 (-1.15)	-0.5406 (-3.19)***	0.4641 (3.53)***
Share skill high	1.3726 (81.48)***				
Export ratio	0.6463 (61.84)***				
ETA				1 (895.6)***	1 (244.8)***
Mills	-1.294165 (28.37)***		-0.3137 (-4.03)***	-0.4649 (-89.08)***	-0.4415 (-18.44)***
Z			1.5e-06 (0.82)		
Z ²			-2.9e-13 (-0.47)		
Z ³			1.5e-20 (0.39)		
Industry dum.	yes	yes	yes	yes	yes
Period dum.	yes	yes	yes	yes	yes
Region dum.	yes	yes	yes	yes	yes
R ²	p-val = 0.000		0.15	0.79	0.64
Obs.	3 635 884	39 303	39 303	39 303	32 392

Note. t-value within parenthesis (). *, **, *** indicates significance at the 10, 5 and 1 percent level, respectively. Standard errors clustered by firm. Firms with at least 50 employees. ^(A) p-val independent equations = 0.000.

^(B) Following Helpman *et al.* (2008) we include higher order terms of z to control for firm heterogeneity where z is defined as $\hat{z} = \Phi^{-1}(\hat{p}) + \hat{n}$, p is the predicted probability of positive R&D and n is Mills ratio.

^(C) Time invariant/persistent series included in the FEVD estimation step two include: *ln(distance)*, *ln(GDP)*, *ln(Population)*, Mills ratio, industry dummies, region dummies, and institutional variables.

Table 3. Service offshoring and corruption. Heterogeneity.
Dependent variable, imports of offshored services, 1997-2002.

Heterogeneity	HMR ^(B)	Heckman FEVD ^(C)	Heterogeneity	HMR ^(B)	Heckman FEVD ^(C)
↓ Selection	Corruption clean	Corruption clean	↓ Selection	Corruption clean	Corruption clean
Sample. MNEs	0.1493 (2.29)**	0.1235 (13.86)***	Sample L < 500	-1.4e-05 (-0.00)	-0.0119 (-1.31)
Sample. Non-MNEs	-0.1736 (-2.70)***	-0.1462 (-16.44)***	Sample L > 500	0.1610 (2.50)***	0.1675 (19.34)***
Sample. Poor countries	0.1964 (1.49)	0.1708 (9.11)***	Sample 1- 8 destinations	0.4355 (3.41)***	0.3143 (13.64)***
Sample Middle income countries	-0.0269 (-0.20)	-0.0534 (-0.92)	Sample 9-16 destinations	0.5803 (4.74)***	0.4841 (23.78)***
Sample Rich countries	0.0578 (0.86)	0.0308 (3.20)***	Sample +17 destinations	0.9473 (6.93)***	0.8824 (32.38)***
Full sample. Employment weighted regressions ^(A)	0.3314 (2.23)***	0.0829 (9.54)***			

Note. t-value within parenthesis (). *, **, ***, indicates significance at the 10, 5 and 1 percent level, respectively. Standard errors clustered by firm. Firms with at least 50 employees. All models include a full variable set-up including firm-, country-, trade resistance variables and region-, industry, and period dummies, see Table 2.

^(A) Using firm size weighted regression, the estimated coefficient for corruption cleanliness is positive and significant using the fixed effect estimator and standard errors clustered by country (coef = 0.12, t-val = 1.80*).

^(B) Following Helpman *et al.* (2008) we include higher order terms of z to control for firm heterogeneity where z is defined as $\hat{z} = \Phi^{-1}(\hat{p}) + \hat{n}$, p is the predicted probability of positive R&D and n is Mills ratio.

^(C) Time invariant/persistent series included in the FEVD estimation step two include: $\ln(\text{distance})$, $\ln(\text{GDP})$, $\ln(\text{Population})$, Mills ratio, industry dummies, region dummies, and institutional variables.

Table 4. Service offshoring and corruption. Robustness and multiplicative models
Dependent variable, import of offshored services, 1997-2002.

Variable	Heckman FEVD ^(A) no regional dum.	Neg Binom. RE	Neg Binom. FE ^(A)	ZI neg Binom. inflation ^(B)	ZI Neg Binom.
Corruption	0.0889 (5.09)***	0.4208 (23.05)***	0.1292 (5.11)***	-0.4641 (-5.32)***	0.1725 (1.69)*
Industry dum.	yes	yes	yes	yes	yes
Period dum.	yes	yes	yes	yes	yes
Region dum.	no	yes	yes	yes	yes
R ²	0.79	..	..	..	..
Obs.	39 303	3 636 012	81 886	3 635 884	

Note. t-value within parenthesis (). *, **, ***, indicates significance at the 10, 5 and 1 percent level, respectively. Standard errors clustered by country. Firms with at least 50 employees. All models include full variable set-up including firm-, country-, trade resistance variables and region-, industry, and period dummies, see Table 2. In the negative binomial models, the dependent variable is expressed in levels. ^(A) Test independent equations, p-val = 0.000. ^(B) p-val Vuong = 0.000.

Table 5. Service offshoring and corruption. By type of offshored services.
Dependent variable, import of offshored services, 1997-2002.

Sample	HMR ^(B) Estimates on corruption	Heckman FEVD ^(C) estimates on corruption	Selection estimates on corruption ^(A)
Total service offshoring (from Table 2)	0.0806 (1.29)	0.0538 (6.18)***	0.2247 (27.07)***
Not easily traded services	0.2019 (0.96)	0.4349 (6.03)***	0.3451 (4.50)***
Easily trade services	0.1928 (1.34)	0.1080 (6.15)***	0.2522 (4.11)***
Hi-tech services	0.1085 (0.64)	0.0192 (0.95)	0.2356 (3.38)***

Note. t-value within parenthesis (). *, **, *** indicates significance at the 10, 5 and 1 percent level, respectively. Standard errors clustered by country. Firms with at least 50 employees. All models include full variable set-up including firm-, country-, trade resistance variables and region-, industry, and period dummies, see Table 2.

^(A) Heckman p-val independent equations = 0.000, all equations.

^(B) Following Helpman *et al.* (2008) we include higher order terms of z to control for firm heterogeneity where z is defined as $\hat{z} = \Phi^{-1}(\hat{p}) + \hat{n}$, p is the predicted probability of positive R&D and n is Mills ratio.

^(C) Time invariant/persistent series included in the FEVD estimation step two include: $\ln(\text{distance})$, $\ln(\text{GDP})$, $\ln(\text{Population})$, Mills ratio, industry dummies, region dummies, and institutional variables.

Description

Table A1. Variable description

Variable	Mean	Stdv(be/within)
Country characteristics		
<i>ln(GDP)</i>	23.99	37.0
<i>ln(population)</i>	16.05	82.1
Firm characteristics		
<i>ln(service offshoring)</i>	6.555	1.70
<i>ln(sales)</i>	12.01	4.92
<i>ln(TFP)</i>	6.946	2.18
Share skilled labor	0.231	7.72
MNE	0.406	2.08
Export ratio	0.176	2.59
Trade resistance		
Tariffs	0.006	2.36
<i>ln(distance)</i>	8.368	--
Corruption clean (WB)	3.633	14.0
Corruption clean (ITI)	4.772	8.35

Note: World Bank corruption index is rescaled to take positive values only [1-6], The International Transparency (IT) corruption index range [0-10], for both indices, a high value indicates less corruption.

Table A2. Correlation

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. <i>ln(service offshoring)</i>	1										
2. <i>ln(distance)</i>	-.04	1									
3. MNE	.03	.00	1								
4. <i>ln(GDP)</i>	.13	-.17	.00	1							
5. <i>ln(pop)</i>	.07	.06	.00	.68	1						
6. Corruption clean(WB)	.11	-.32	.00	.44	-.24	1					
7. Corruption clean(IT)	.09	-.33	.00	.43	-.32	.97	1				
8 <i>ln(Sales)</i>	.19	.00	.31	-.00	-.00	-.00	-.00	1			
9. <i>ln(TFP)</i>	.03	-.00	-.04	-.00	.00	.00	.01	.01	1		
10. Tariffs	.04	-.05	.00	.36	.18	.25	.25	-.00	.00	1	
11. Share skilled labour	.09	.00	.08	-.00	-.00	-.00	-.00	.03	.33	-.00	1
12. Export ratio	.02	-.00	.43	.00	.00	.00	.00	.23	-.22	.00	.02

Table A3. Regions, offshoring and tariffs.

Region	Average tariff	% of total offshoring	Region	Average tariff	% of total offshoring
<i>Western Europe</i>	0.003	23.71	<i>Southern Africa</i>	0.000	0.19
<i>Northern Europe</i>	0.020	27.69	<i>Eastern Asia</i>	0.061	4.03
<i>Eastern Europe</i>	0.003	2.07	<i>Southern Asia</i>	0.005	0.58
<i>Southern Europe</i>	0.000	3.93	<i>South-Eastern Asia</i>	0.004	1.42
<i>Northern America</i>	0.045	29.40	<i>Central Asia</i>	0.000	0.03
<i>South America</i>	0.000	0.94	<i>Western Asia</i>	0.001	3.59
<i>Western Africa</i>	0.000	0.05	<i>Australia and New Zealand</i>	0.001	0.77
<i>Central America</i>	0.000	1.00	<i>Caribbean</i>	0.000	0.16
<i>Eastern Africa</i>	0.000	0.01	<i>Polynesia</i>	0.000	0.00
<i>Northern Africa</i>	0.000	0.28	<i>Micronesia</i>	-	0.00
<i>Middle Africa</i>	0.000	0.02	<i>Melanesia</i>	0.000	0.77

Table A4. Service offshoring and corruption. Non-linear in corruption.

Dependent variable, import of offshored services, 1997-2002.

Variable	Probit selection ^(C)	HMR ^(A)	Heckman FEVD ^(B)
Corruption clean	-0.1510 (-4.15)***	-0.0287 (-0.10)	-0.0387 (-1.03)
Corruption clean ²	0.0424 (10.59)***	0.0118 (0.36)	0.0098 (2.50)***
Obs.	3 635 884	39 303	39 303

Note. t-value within parenthesis (). *, **, *** indicates significance at the 10, 5 and 1 percent level, respectively. Standard errors clustered by firm. Firms with at least 50 employees. The full set of control variables are included in all estimations (see e.g. Table 2). ^(A) Following Helpman *et al.* (2008) we include higher order terms of z to control for firm heterogeneity where z is defined as $\hat{z} = \Phi^{-1}(\hat{p}) + \hat{n}$, p is the predicted probability of positive R&D and n is Mills ratio. ^(B) Time invariant/ persistent series included in the FEVD estimation step two include: *ln(distance)*, *ln(GDP)*, *ln(Population)*, Mills ratio, industry dummies, region dummies, and institutional variables. ^(C) p-val independent equations = 0.000

Table A5. Firm characteristics.

No. of offshoring destinations (offshoring firms)	Cumulative frequency	Comparative firm characteristics	Offshorers/ non-offshorers	MNE /non MNEs	Manu/ non-manu
1 destination	38	<i>ln(service offshoring)</i>	--	3.79	1.62
5 destinations	78	MNE	2.06	--	1.80
10 destinations	91	<i>ln(sales)</i>	1.08	1.07	1.02
20 destinations	98	<i>ln(TFP)</i>	1.03	0.95	0.37
50 destinations	100	Share skilled labour	1.78	1.56	0.60

Max no of simultaneous offshoring destinations observed by a single firm. 119

Table A6. Variables, construction and source

Variable	Definition	Source
<i>Country characteristics</i>		
ln(GDP)	<i>ln</i> (GDP), constant 200 USD.	World Bank
ln(population)	<i>ln</i> (Total population).	World Bank
<i>Firm characteristics</i>		
ln(service offshoring)^(A)	<i>ln</i> (imports); of services, aggregated from eleven service categories.	The Swedish Riksbank
ln(sales)	<i>ln</i> (sales), , constant prices.	Statistics Sweden - Financial statistics
ln(TFP)	Törnquist index, for details, see table note.	Statistics Sweden – Financial statistics
Share skilled labor	Share of employees with at least tertiary education.	Statistics Sweden – RAMS
MNE	Swedish MNE or foreign owned firms (at least 50% of votes in foreign control).	Statistics Sweden - Financial statistics
<i>Resistance to trade</i>		
Tariffs	Weighted tariff rate by industry and country of origin.	UNCTAD/TRAINS
ln(distance)	CEPII weighted distance measure.	CEPII
Corruption clean (WB)	Perceived corruption index, rescaled to [1-6], higher value indicates less corruption.	World Bank
Corruption clean (ITI)	Perceived corruption index, scale [0-10], higher value indicates less corruption.	International Transparency

Note: *Total factor productivity*. We use the Divisia Törnqvist to calculate changes in firms' input mix (a non parametric approach which corresponds to a Translog production function. We calculate TFP as the ratio of deflated sales value to an index of input volumes (a Törnqvist quantity index of inputs). This index fulfills important properties such as invariance and independence; see e.g., Diewert (1976, 1978). Rental prices for capital are computed according to Harper Berndt and Wood (1989). Capital stocks are calculated according to the Gelos and Isgut (2001) method. For details of the calculation of the productivity index, see Karpaty and Tingvall (2010).

Table A7: Breakdown of offshored services.

Breakdown of total service offshoring	Service categories	Share of total service offshoring
Subgroup 1: Business services N.E.C.	Business services N.E.C.	74 percent
Subgroup 2: Easily traded services	Licenses, information-, financial- and communication services	23 percent
Subgroup 3: Not easily traded services	Construction services	3 percent
- Hi-tech services: Part of subgroup 2	Licences, information- and financial services	18 percent