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Offshoring and Corruption: Does Corruption Matter

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Abstract

Corruption is often portrayed as a barrier to trade and investment capable of altering international investment patterns. Here, we analyze how firms' choice of country and the volume of offshored material inputs are affected by corruption in target economies. Taking stance from the gravity model of trade, the analysis suggests that corruption is a deterrent for offshoring. Firms avoid corrupt countries and, given that destination country has been chosen it reduces the volume of offshored inputs. The negative impact of corruption is largest in poor countries, and internationalized firms trading with many countries use their flexibility to avoid corrupt countries. Given the importance of these firms as international investors, this is yet another reason for why fighting corruption is important.

JEL: D22; F23; L24
Keywords: Corruption; Offshoring; Gravity; Firm level data

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1. Introduction

Since the creation of GATT in 1947, average tariffs for manufactured goods have declined from levels in the 30-70% bracket to just a few percentage points. As a consequence, other barriers to trade have become relatively more important. One factor that has received increasing attention is corruption. From the perspective of international economics, corruption is often portrayed as a barrier to trade and investment.

With an accelerating interest in corruption, there are now an increasing number of empirically oriented articles analyzing various aspects of corruption.[2] However, earlier studies have failed to analyze corruption and its impact on offshoring. This is surprising because offshoring is considered an activity that is sensitive to corruption and other factors that raise the contract cost. To be precise, 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 offshoring. That is, offshoring may be even more sensitive to corruption than the in-house alternative, FDI. It should also be borne in mind that the impact of corruption is likely to be greatest when sensitive information is involved. For standardized jobs, corruption is likely to be less of an issue.

When analyzing trade flows, the gravity model is a natural point of departure, and this study will use the gravity model to analyze a specific type of trade, i.e., offshoring of material inputs. Specifically, using detailed firm-level data including information on Swedish firms' offshoring and country selection, we analyze how the choice of offshoring destination and the amount of offshored inputs is affected by corruption. Our unit of observation is firm-country pairs, and we are therefore likely to encounter observations with zero trade flows (all firms do not offshore to all countries in the world). Therefore, we will consider offshoring a two-step procedure, where we first decide whether to offshore or not and to whom and, in the second step, decide on the volume of offshoring. This two-step decision procedure naturally involves selection and zero trade flows. A commonly used approach to handle this is to linearize the gravity model and estimate Heckman-type of selection models, see e.g., Helpman, Melitz and Rubenstein, (2008) (hereafter HMR).[3]

Much of the theoretical work on offshoring (and FDI) focuses on how the contract cost affects the choice between offshoring to an external agent (outsourced offshoring) and

[2] 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).

[3] An alternative approach is to turn to multiplicative models, such as the Poisson model and the negative binominal model, see, e.g., Burger *et al.* (2009). These models will be discussed below.

FDI. This trade-off is highlighted in Antràs and Helpman (2004), Grossman and Helpman (2002, 2003) and Chen *et al*. (2008). Antràs and Helpman (2006) explicitly discuss how the quality of contractual institutions has an impact on the choice between outsourced offshoring and integrating the production of an intermediate good. It is shown that better contracting institutions favor offshoring at the expense of FDI. In line with this, Wei (2005) portrays corruption as an obstacle to economic development, reducing the allocation efficiency of government spending. Hence, to the extent that corruption increases uncertainty and the contract cost, we expect corruption to be detrimental to offshoring. However, there might also be a positive side of corruption. For example, Huntington (1968) argues that in poor (developing) countries with cumbersome regulations, corruption may work like oil in the machinery, improving efficiency and growth (see also Lui, 1985 and Bardhan, 1997). However, the overall impression is that the negative aspects of corruption dominate.

There have been no empirical studies to date on the relationship between corruption and outsourced offshoring. However, there are a number of 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 of a non-uniform effect of corruption. Hakkala *et al*. (2008) find corruption to be more detrimental to horizontal FDI than to vertical FDI. Smarzynska and Wei (2000) find corruption to alter the composition of FDI by shifting investments 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. To conclude, the overall impression is that corruption is detrimental for FDI, and the negative impact is largest for developing countries. In addition, corruption does not only affect the volume of FDI but also the type and composition of FDI.

Based on theory and empirical findings on FDI and corruption, our prior expectation is to find a negative relationship between corruption and offshoring. Here, we explore this question further by asking whether corruption mainly affects the choice of country or, given choice of country, is it mostly a volume effect? In addition, firms may differ in their ability to handle a corrupt environment. Large firms, internationalized firms and experienced offshorers may be more capable of handling corruption than other firms. On the other hand, these firms can also use their network to relatively easily retreat from cumbersome markets. To some extent, it is therefore an empirical question whether relatively large and internationalized firms are more or less sensitive to corruption than 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 material inputs. The negative impact is strongest in heavily corrupt countries, and large firms, internationalized firms and firms already offshoring to several countries seem to use their flexibility to avoid corrupt countries. Taken together, this is yet another reason why fighting corruption is important.

The paper is organized at follows. In Section 2, definitions are presented, and the theoretical link between corruption and offshoring is discussed. In Section 3, we present data, the gravity model and discuss econometric considerations. The results are given in Section 4, and Section 5 concludes.

2. Outsourcing and Corruption

2.1 Outsourcing and offshoring: the concepts

When discussing outsourcing, we typically consider the subcontracting of an internal company function to an outside firm. Therefore, outsourcing can involve a transfer of management control, decision-making, and firm-specific knowledge to an external supplier. It is therefore easily understood that corruption can lead firms to hold back on offshoring to corrupt countries, especially when sensitive information is involved. Although outsourcing may involve subcontracting to either a domestic or a foreign supplier, most attention is focused on situations where an external foreign supplier is involved; this is often labeled "outsourced offshoring.[4]" In particular, theoretical models typically focus on *outsourced offshoring* because this naturally sets the subcontracting issue into focus, while empirical investigations often lack the possibility of disentangling *in-house offshoring* from *international outsourcing,* meaning that the analysis often covers (total) *offshoring*. In this paper our measures of offshoring capture total offshoring, although, as a robustness test, we exclude the possibility of in-house offshoring and analyze outsourced offshoring only.

2.2 Corruption: the concept

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 the misuse of public

[4] Offshoring or outsourcing to a foreign identity includes (i) outsourced offshoring (outsourcing to a foreign external supplier) and (ii) in-house offshoring (FDI – within the corporation).

office for private gain in a way that alters the rules.[5] Corruption has been further divided into grand corruption and petty corruption. Grand corruption refers to situations where the political elites exploit their power for economic gain and economic policies that are not in the interest of their principals. Petty corruption or bureaucratic corruption refers to how appointed bureaucrats handle their responsibilities (see, e.g., Kain, 2001). Schleifer and Vishny (1993) suggest an interesting distinction, arguing that "coordinated corruption" tends to be less harmful than "un-coordinated corruption," where the latter takes place when public officials and other involved agents act and make decisions independently of each other.

Corruption may also occur in daily business life without any direct intervention from public agents. Therefore, we may include a dimension in which corrupt behavior may occur among individuals who are in control of assets that not are 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).

For corruption to be sustainable, discretionary power and rents (associated with this power) and a sufficiently low risk of detection must co-exist. If the probability of detection is high, we are likely to see a fairly clean system, while the incentives to act against the system are limited if corrupt behavior is widespread. This dualism may contribute to explain the existence of so-called "corruption clubs," where countries are either fairly corrupt or rather clean.[6]

The argument that corruption is detrimental to an economy is that corruption leads to a misallocation of contracts and resources are moved from the most efficient agents to less efficient ones. Corruption also increases the uncertainty under which firms are working and increases the costs, in terms of time and money, spent on bribery. In addition, there are social, legal and moral dimensions of corruption.

The argument that corruption is beneficial rests on the assumption that governmental officials can be more helpful when paid directly, and it allows business people to avoid restrictions that would otherwise discourage investments.[7] Hence, the extent to which corruption is harmful for business life and growth is partially an empirical issue. In our analysis, we separate the impacts of corruption according to: (i) how it affects the probability

[5] See e.g. Kain (2001) and Svensson (2005).
[6] Herzfeld and Weiss (2007).
[7] See e.g. Shleifer and Vishny (1993) and Wei (2005).

of choosing a specific country and, (ii) given that a country has been chosen, what impact it has on the mass of outsourced production activities.

2.3 The link between corruption and offshoring

The primary driver for vertical specialization and offshoring is factor price differences.[8] However, in the case that a firm is about to go abroad and split production vertically, it can either choose to keep the activity in-house or offshore it to an external agent. This is where the contract cost enters the picture. Moreover, the contract issue does not only concern the offshoring part the receiving party also has concerns. The standard hold-up problem recognizes that the receiving party often must make contract-specific investments. When complete contracts cannot be enforced, this will lead to underinvestment. Here, it is understood that corruption may work as an obstacle, reducing the trust of the system, and therefore aggravate the problem of underinvestment (see, e.g., Ornelas and Turner, 2008).

Theoretical models that describe the conditions necessary for offshoring to take place and the relationships among FDI, offshoring and remaining at home are well-developed today. The north-south model by Grossman and Helpman (2003) shows that the cost advantage for a low-wage country as the 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, by Antras and Helpman (2006), shows 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. A conclusion drawn from Grossman and Helpman (2002), Antras (2003) and Feenstra and Hanson (2005) is that sensitive tasks are not easily outsourced. The reason is that to ensure IPRs, quality, deliveries and other important features of the transaction, the contract easily becomes complex, time-consuming and expensive to formulate. If the contract cost is a money issue, it may be argued that large firms are better equipped than small firms to handle a corrupt environment, partly because of their higher bargaining power but also because they have the ability to pay. To sum up, theoretical models suggest that corruption is likely to serve as a deterrent to firms' offshoring, and the sensitivity to corruption may vary across different types of firms. To empirically tackle similar issues, the gravity model of trade has proven to be a good point of departure and therefore we continue with a discussion of that model.

[8] 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 insufficient to generate offshoring. Other motives include technology sourcing and capacity motives.

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

Over the years, the gravity model has become the main vehicle for empirically analyzing trade flows, and the model has developed into 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 offshored material inputs. In its most elementary form, the gravity model can be expressed as $M_{ij} = \mathrm{T}(r)\frac{Y_iY_j}{d_{ij}^{-\varepsilon}}$ where M_{ij} is imports from country *i* to country *j*, Y_iY_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).

Recently, it has been shown that this specification has a couple of shortcomings. 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 omitted variable bias, as it does not take into account the effect of relative prices on trade patterns. Anderson and Van Wincoop (2003) show how the inclusion of a so-called "multilateral resistance term" (MRT) in the form of importer- and exporter-specific fixed effects is in line with the theoretical concerns and yields consistent parameter estimates.

Taking firm heterogeneity into account, Melitz (2003) and Chaney (2008) developed the model further and showed how the selection into exports 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, 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 margins of trade; they also demonstrate how to deal with the bias that will be induced if the margins are not 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 non-random selection into trade, and *w* can empirically be formalized as a combination of the Mills ratio and the probability of being an exporter, which, appended in higher order terms, controls for firm heterogeneity.

3.1. Firm-level gravity and empirical specification

Over the last few years, the heterogeneous firm model has emerged as the workhorse model of micro-patterns of trade. Taking firm heterogeneity into account, 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.

Greenaway *et al.* (2008), drawing on the heterogeneous firm model, estimate a firm-level gravity model analyzing trade in the food industry. In line with Bergstrand (1989), they highlight the relevance of per-capita income and how it can proxy factor prices and intensities. For a given GDP, a larger population implies a lower per capita income and lower wages. Considering that factor price differences are a key concern motivating offshoring, not including any measure that captures factor price differences may lead to 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 enterprise (MNE). The assumption is that firms that are already multinational have an advantage in arranging offshoring contracts. To account for firm-level gravity and size effects, we apply the log of firm sales.

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

The 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.[9] With this as a background, our baseline equation takes the following form:

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

Here, O_{ijt} is imports by firm *i* of offshored material inputs 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 non-

[9] 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.

random selection into offshoring, d_r is a region dummy, γ_t is a period dummy, and ε is the error term.[10]

3.1 Econometric considerations

3.1.1 Zeros and selection

The estimation of the gravity equation is complicated by at least two issues: fixed effects and selection. The unit of observation in this study is firm-country pairs, and thus the data contain observations with zero trade (because most firms either have no offshoring or only offshore to a handful of countries). To be precise, 97% of the observations are zero-valued. This means that if selection into offshoring is not random, not adjusting the regressions for selection may lead to biased results.

To adjust for selection and we follow the solution discussed by HMR (2008) and apply a Heckman type of estimation. The underlying motivation is that the decision to offshore can be decomposed into (i) the decision whether to offshore or not, and to whom, and (ii) the volume. Having selected a destination for offshoring, it is possible that there are differences between the alternatives (that all record zeros). Hence, for observed zeros, there are implicit non-zero probability trade flows. The selection is estimated by a probit model and captured by the inverse Mills ratio. To estimate the selection equation, in addition to covariates used in the equation for the intensive margin, we include variables that can be used as an exclusion restriction.[11] Variables related to sunk costs and productivity has been suggested as candidates. The motive 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 a tertiary education) because we expect that skill-intensive firms are more likely to be offshorers.[12] In addition to skill intensity, we also use export intensity because being an exporter captures that the firm has overcome the cost of trading across the border.

The HMR model is based on the assumption of heterogeneous firms, and HMR show how the inclusion of not only the Mills ratio but also a higher-order polynomial of a

[10] See the Appendix for variable definitions and sources.

[11] IMR is a non-linear function of the variables included in the first-stage probit, and the target equation can be identified because of this non-linearity alone. The non-linearity of IMR arises from the assumption of normality. For practical reasons, it is advisable to add variables to the selection not included in the target equation.

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

term "z," based on predicted probability of positive offshoring and the Mills ratio, captures selection and firm heterogeneity. We will apply both the standard Heckman approach and the HMR specification.

3.1.2 Fixed effects

Our second concern deals with fixed effects. Fixed effects and heterogeneity are related but not identical issues. As shown by Anderson and Van Wincoop (2003) and Feenstra (2004), country-specific fixed effects are in line with theoretical concerns and yield consistent parameter estimates. However, Benedicitis and Vicarelli (2009) show that attempts to fully control for cross-country heterogeneity and evaluate the effect of policy using dummy variables are hardly possible (almost all variation is swept out by the dummies). In addition, we easily end up with an extremely large number of coefficients to estimate.[13] 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- and unit-fixed effects: the question is how much of a problem this is. The inclusion of unit-fixed effects cancels out all cross-sectional variation, leaving us with time-series variation only. This makes the estimation of nearly time-invariant variables cumbersome.[14] Plumper Troeger (2007) suggest the Fixed Effect Variance Decomposition (FEVD) estimator as a solution to the problem. The FEVD model is a three-stage panel, fixed-effects, vector-decomposition model that allows for the inclusion of time-invariant variables and nearly time-invariant variables in a fixed-effects framework.

In the first two steps, unit-fixed effects are decomposed into one explained part (captured by dummy variables) and one unexplained part, *ETA* (η). This allows us to append η in the third step and thereby improve the control for unobservables and, at the same time, (efficiently) estimate the impact of time-invariant and slowly changing variables.[15] This procedure has been shown to be especially useful when dealing with variables with relatively little variation over time, such as many country-level characteristics. One key concern is therefore to analyze to what extent the results are changing when we improve the control of fixed effects. If countries within each of our 22 regions are fairly homogenous, we do not

[13] 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 suggested by Feenstra (2002, 2004).

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

[15] 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).

expect the standard Heckman and Heckman FEVD model to diverge to any large extent, whereas with strong intra-region country heterogeneity, the opposite may be true.

Here, we insert the FEVD model into a Heckman selection model and note that the Mills ratio is not a fixed variable but an estimated regressor, which 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, which 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.

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 datasets from Statistics Sweden. The financial statistics data (FS) and Regional Labor Market Statistics (RAMS) contain detailed information on firms' inputs and results, such as value-added, capital stock, number of employees, education, wages, ownership, sales and industry affiliation. For non-EU trade, data on material imports cover all transactions, and for intra EU-trade, import data are collected for all firms with a total import value above 2.2 million SEK (approx. 240 000 EUR).[16] Material imports are classified according to country of origin and item and are defined at the five-digit level according to NACE Rev 1.1 and grouped into Major Industrial Groups (MIG).[17] The MIG code classifies imports with respect to their intended use. In the analysis, we will use the MIG definition of intermediate and consumption inputs as our offshoring variable.

Country characteristics are collected from The World Bank. For corruption, we have 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.

[16] To reduce the potential bias induced by threshold values on imports, we only consider firms with at least 50 employees in the analysis.
[17] MIG – European Community classification of products: Major Industrial Groupings (NACE rev1 aggregates).

Due to its greater coverage, our first choice is the World Bank corruption index.[18] We have rescaled the WB corruption index (such that it cannot take on any negative values) to range from originally -2.5-2.5 to 1-6, an adjustment that allows us to apply the index in higher orders. The range of the TI corruption index is 0-10. 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 clean." 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 into account.[19] For details of the variables, see the Appendix. Due to different time frames for the datasets, we limit the analysis to the period 1997-2005.

4. Results

4.1. Description

Comparing offshorers with non-offshorers reveals that offshorers are relatively large, skill-intensive and overrepresented by MNEs. This is expected because becoming an offshorer requires the firm to overcome a number of obstacles (discussed above). A less-expected result is that they also tend to have relatively low productivity.[20] Though factor price differences are a primal driver for vertical specialization, 85% of material offshoring are directed to Europe, where Northern and Western Europe account for 75% of total offshoring. At large, this resembles the pattern of total trade and points at the EU as the most important market for Swedish firms. 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 offshoring to these regions being limited to areas where Sweden (the EU) has free trade agreements, such as the EBA 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.

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[18] Knack and Omar (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.

[19] More information on CEPII's distance measure is found in Magner and Zignago (2006).

[20]. Comparing offshorers with non-offshorers reveals that offshorers have approximately 6% higher labor productivity and half as high capital intensity as non-offshorers.

4.2 Basic models

Our starting point is OLS estimations with various controls for fixed effects. Hence, we initially pay no attention to the selection problem. With this as a basis, we can easily see the impact of various refinements. Estimation 1A in Table 1 is performed with regional dummies as the control for country-wise fixed effects, and in estimations 2A-3A, we step up the control for fixed effects and apply country and unit (firm-country pair) fixed effects, respectively. The estimation of models 1A-3A is performed on offshoring firms only, and in estimations 1B-3B we repeat estimations 1A-3A, now with the common strategy of replacing non-defined values (*ln*(0)) with a small number (0). It may be noted that replacing non-defined values can be regarded as inadequate, in particular if selection into offshoring is non-random. 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 non-random selection into offshoring.

[Table 1 about here]

When including zeros, the first thing to note is that out of 6.3 million observed trade flows, only about 0.2 million observations, or 3%, of the material are non-zeros. This reflects the fact that most firms offshore to no or only a handful of countries.[21] Comparing models with and without zeros, we see that the large infusion of zeros does not upset the results, although individual coefficients may change. Further, focusing on corruption, we see that the inclusion of fixed effects beyond regional dummies removes the significance of corruption. 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),[22] an issue that will be discussed below. Comparing models with country dummies with fixed-effect estimations indicates that further infusion of fixed effects from country dummies to the unit level (firm-country pairs) does not have any considerable impact. These initial results indicate that the modeling of fixed effects may be especially important for slowly changing country variables such as corruption.

[21] Fifty percent of the offshoring firms offshore to 1-5 countries, see Table A4.

[22] From Table 1 and Table A1, it may be noted that similar to corruption, GDP also has a relatively large between variation but remains significant when unit-fixed effects are imposed. This suggests that both the level and growth of countries' GDP is important in explaining offshoring.

4.3 Selection, non-linearity and fixed effects

In Table 2, we proceed to estimate models where non-randomness into offshoring is controlled for. Comparing models with control for selection with OLS estimation without zeros, we see that the significance of corruption increases when selection is accounted for.[23] Specifically, in Table 2, we first present a standard Heckman model showing both the selection and target equation. As seen in Table 2, corruption is found to be a deterrent both for the choice of target country and, given selection, for the volume of offshored material inputs. Hence, contrary to Hakkala *et al*. (2008), who for Swedish firms in some estimations find the effect of corruption to be of the opposite sign for different types of FDI, we do not find any such contradictions. Finally, out of the share of skilled labor and export intensity, used as exclusion restrictions, only the export variable is significant.

[Table 2 about here]

As pointed out by Helpman, Melitz and Rubenstein (2008), firm heterogeneity[24] adds to the complexity. HMR show that the inclusion of higher-order terms of a variable "z," defined as $z = \Phi^{-1}(\rho) + \rho$ where *p* is the predicted probability of positive offshoring and *n* is Mills ratio, controls for the selection and heterogeneity problem. As seen in Table 2, the HMR and Heckman specifications return similar results with the major difference being that the HMR specification returns estimates of the distance variable closer to unity and more in phase with what is commonly found.

As discussed above, unit-fixed effects can, to some extent, absorb firm heterogeneity. However, including country- or unit-fixed effects can be problematic, especially when dealing with slowly changing variables such as many country characteristics. We tackle the issue by applying the Fixed Effect Variance Decomposition (FEVD) estimator (see Plumper and Troger (2007)) here in a Heckman 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. 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 slowly changing variables. An

[23] The same selection equation is applied for the Heckman, HMR and Heckman FEVD models. To save space we suppress rho from the tables. Rho is positive and strongly significant in all Heckman models.

[24] In their framework, indicated by the share of exporting firms.

indication of the capacity of the variance decomposition variable to absorb unit effects is given by studying the (increased) R^2 value when shifting from HMR or OLS regressions with region dummies to the Heckman FEVD model. Generally, the variance decomposition model increases R^2 from values in the 25-30% bracket to almost 85%.[25]

Comparing the Heckman FEVD model with the HMR model and the standard Heckman specification, we see that the FEVD model does not upset the results. The estimated impact of corruption for the Heckman FEVD variable is between the corresponding estimate for the HMR and Heckman specification, though closer to estimates found by the Heckman model. From this, we may conclude that corruption is a deterrent for offshoring and that the applied 22 regional dummies pick up country-fixed effects to the extent that further inclusion of fixed effects does not alter any results. At the same time, it should be noted that using 22 region dummies implies that there is unobserved heterogeneity that is being ignored, which may lead to a bias of the estimated impact of offshoring.

For other control variables, we note that most of them are significant with the expected sign. Nearby countries with large markets attract offshoring, and multinational firms seem to be more prevalent as offshorers than non-MNEs. Some less-expected results include the relatively frequent negative relationship between firm TFP and offshoring and estimations suggesting a positive relationship between tariffs and offshoring. A possible explanation for the positive relationship between tariffs and offshoring may be found by first observing the population variable. The positive sign for the population variable indicates that offshoring, *ceteris paribus*, is positively correlated with low income, meaning that offshoring is conditionally biased toward low-wage countries.[26] In addition, Europe and the EU are Sweden's largest trading partners, regions with low or zero tariffs, while most low-wage countries are outside the EU area. Hence, the positive sign on tariffs may be driven by the (conditionally) negative relationship between income and offshoring and the fact that there may be tariffs for offshoring to low-wage countries that are not members of the EU.

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 non-linear relationship between offshoring and corruption. The non-linearity issue

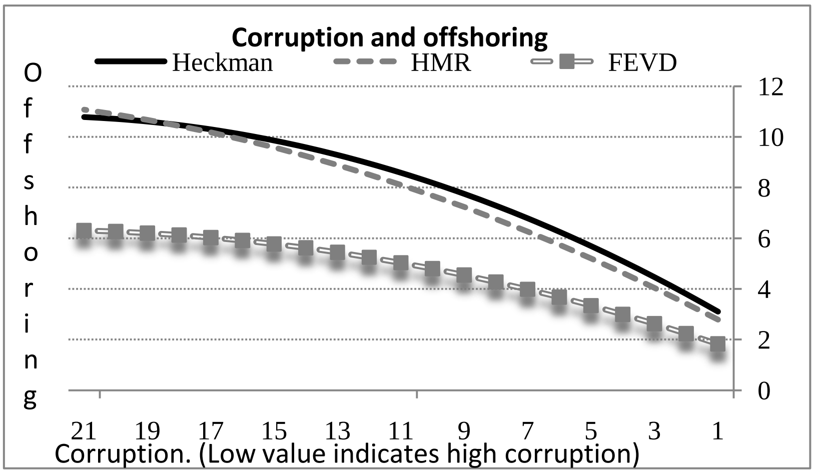
[25] The R^2 of the Heckman FEVD model is as high as fixed effect estimations with absorbed unit effects indicating that the variance decomposition variable absorb unit effects.
[26] For a given GDP, a larger population implies a lower per capita income.

is examined in Table 3. The results from Table 3 suggest a non-linear relationship between offshoring and corruption and that the non-linear relationship is robust across estimators.

[Table 3 about here]

By only observing the estimated coefficients, it can be cumbersome to judge what the curvature of the estimated non-linear relationship looks like over the empirically observed levels of corruption. Is it hump-shaped, or does the negative or positive part dominate? In Figure 1, we therefore depict the estimated relationship between corruption and offshoring over the empirically observed levels of corruption. The figure reveals a continuous negative relationship between offshoring and corruption and that the relationship becomes increasingly negative at higher levels of corruption. If we accept that among the most corrupt countries we also find relatively poor countries, this result is in line with Caetano and Calerio (2005), who found the impact of corruption on FDI to be negative and significant but only for developing countries.

Figure 1. Estimated relationship between offshoring and corruption.



4.4. Heterogeneity

As discussed above, corruption can be thought of either as a fixed cost (a one-time payment) or as an increased marginal cost requiring continuous action. In the first case, larger firms have an advantage because they are more capable of paying and have a higher bargaining power. 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. When exploring firm heterogeneity and firm characteristics, firm size therefore is a factor of interest. A hypothesis would therefore be that large firms, MNEs, and firms' offshoring to several countries should be relatively well equipped to handle a corrupt environment and therefore less sensitive to corruption. On the other hand, these relatively powerful firms can with relative ease use their network and relocate away from cumbersome markets. The alternative hypothesis is therefore that these firms are not less but more sensitive to corruption than other firms. This would be especially true if firms do not fully consider the downside of corruption when they enter a market, and the problems show up after the operation has been up and running for a while.

[Table 4 about here]

The results for different types of firms are presented in Table 4 and show an interesting but consistent pattern. Large firms, MNEs, and firms that already offshore to several countries are more sensitive to corruption than their counterparts (small firms, non-MNEs, and those who offshore to only one or a handful of countries). Although the differences between different types of firms are not dramatic, the results suggest that large and experienced offshorers use their networks and avoid corrupt countries. Given that large firms account for the broad mass of offshoring and we often find relatively high levels of corruption in poor countries, this further supports the argument that fighting corruption is important.[27]

The MNE *vs*. non-MNE division strengthens this analysis. For non-MNEs, with no affiliates abroad, our measure of offshoring cannot contain in-house offshoring. Because both the contract cost and contract uncertainty are lower for in-house offshoring than for offshoring to an external agent, it can be expected that non-MNEs should be more sensitive to corruption than MNEs. The reverse results found here therefore strengthen the finding that MNEs and other large firms use their network to avoid corrupt markets.

Finally, comparing manufacturing firms with the service sector, Table 4 shows that manufacturing firms are more sensitive to corruption than non-manufacturing firms. This is intuitive because material and material inputs are of less concern for service-sector firms (see, e.g., Fagerberg *et al*., 2004.)

[27] As a stability test, we estimated models with both the WB and the International Transparency corruption (IT) index giving close to identical results. Due to the greater coverage of the WB index, this is chosen as our prior choice. Estimations with the IT index are available upon request.

For a single firm, the level of corruption and other country characteristics are likely to be taken as given. Though endogeneity may be an issue, we apply the commonly used approach of using lagged covariates as a robustness test. The idea is that according to the definition of strong exogeneity, shocks in period (t) have no impact on (t-1) (which might be the case if there was perfect foresight). See, e.g., Hendry (1995) and Greenaway *et al*. (2008). Comparing Heckman FEVD estimations in Tables 2 and 5, we see that using lagged values decreases the estimated impact of corruption, and the effect remains positive and strongly significant.

[Table 5 about here]

Another issue is the sensitivity of the FEVD estimator with respect to the set of variables included in the set of fixed and slowly changing variables. As a robustness test, we therefore drop the 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 5 shows that excluding region dummies implies very minor differences in the results, indicating that the variance decomposition variable is capable of absorbing fixed effects (unit effects).

An alternative approach to estimate the gravity model that has become increasingly popular is to estimate multiplicative count data models, such as the Poisson model and negative binominal models. These models possess a number of attractive features. As pointed out by, e.g., Westerlund and Wilhelmsson (2009) and Burger *et al*. (2009), the gravity model is defined in multiplicative terms, which therefore naturally allows us to include zeros. Further, these models are relatively robust to non-homoscedasticity.[28] 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, this model is often recommended.[29] Finally, we have the issue of excess zeros. To handle excess zeros the zero inflated negative binominal (zinb) model 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.[30]

[28] Flowerdew and Aitkin (1982) and Santos and Tenreyro (2006).
[29] In our data, the variance of the dependent variable exceed the mean by a factor of 1.2 million times, and we therefore leave Poisson models aside and present results using negative binomial models.
[30] See, e.g., by Burger et al. (2009) and Westerlund and Wilhelmsson (2009).

As a robustness check, we estimate a set of count data models. Results from negative binomial models presented in Table 5 verify findings from log-linear models. 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 random-effect negative-binominal model with its fixed-effect counterpart, the fixed-effect model returns lower estimates for corruption. Finally, we note that for the zero-inflated negative-binomial (zinb) model, corruption is not significant in the target equation, and the inflation step suggests that being a corrupt country increases the probability of being selected.[31]

5. Summary and conclusion

In this paper, we analyze how corruption in target economies affects firms' offshoring of material inputs. 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. Taking stance from the gravity model, log-linear selection models suggest that corruption is a deterrent for both the choice of country and, given that a country has been selected, the amount of offshored materials. In addition, allowing for a non-linear impact of corruption results shows that the negative impact of corruption is growing with the level of corruption though the non-linearity is not dramatic. Hence, to the extent that there may be positive "oil in the machinery" effects of corruption, from the point of view of offshoring, these positive effects are overruled by the negative aspects of corruption.

Theory suggests that firms differ in their capacity to handle a corrupt environment. Specifically, large and financially strong firms are expected to be better equipped to handle corruption than small firms, partly because they can carry the costs but also because of their bargaining power. At the same time, large and internationalized firms may use their network to withdraw from cumbersome markets. Our results suggest that large firms, MNEs, and firms offshoring to several countries use their flexibility to avoid corrupt markets. Because this type of firms includes the large offshorers, and the negative aspects of corruption increase with corruption, this finding further supports the argument that fighting corruption is important.

In this analysis, we tackle the issue of selection and fixed effects. The results indicate that firms are not randomly drawn into offshoring and that both the standard

[31] Using non-clustered standard errors increases the significance of most variables and gives a significant estimate of corruption in the target equation, suggesting that corruption is a deterrent for offshoring.

Heckman and the HMR gravity model specification are superior to OLS. Furthermore, the HMR specification returns more realistic estimates of the distance variable than the standard Heckman specification. Analyzing 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 due to relatively low within-variation in most country-specific variables. To control for unit-fixed effects (unobserved heterogeneity) and extract cross-sectional information, we estimate Heckman models using the Fixed Effects Variance Decomposition estimator. This allows us to handle the selection problem and to control for unobserved heterogeneity at the unit level. Not controlling for these effects may lead to biased estimates. This problem is especially pronounced for slowly changing variables.

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 increase with corruption, thus making the issue especially important for highly corrupt countries. An interesting issue that we would like to see in future research, which is omitted here, is the effect of corruption on the composition of offshored materials.

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Appendix

Table 1. Material offshoring and corruption. Basic models.
Dependent variable, material import of offshored materials, 1997-2005.

Variable	1A. OLS no zeros	2A. OLS no zeros	3A. FE no zeros	1B. OLS with zeros	2B. OLS with zeros	3B. FE with zeros
***ln*(distance)**	-0.8826 (-2.92)***	2.9472 (6.51)***	--	-0.3794 (-2.71)***	-0.6424 (-19.68)***	--
***ln*(GDP)**	0.0616 (0.31)	0.9456 (2.79)***	1.8554 (3.94)***	0.0219 (1.10)	0.1010 (2.43)**	0.0572 (1.10)
***ln*(Population)**	0.4578 (2.12)**	-4.0547 (-3.56)***	-4.2786 (-2.39)**	0.0634 (2.54)***	0.0284 (0.46)	-0.2395 (-2.94)***
Corruption clean	0.3665 (1.81)*	-0.0163 (-0.09)	-0.1950 (-0.77)	0.1533 (3.77)***	-0.0016 (-0.13)	-0.0070 (-0.43)
MNE	0.2306 (4.47)***	0.2412 (4.78)***	0.0232 (1.01)	0.0746 (4.88)***	0.0746 (4.88)***	0.0024 (1.41)
***ln*(Firm size) sales**	0.4520 (13.25)***	0.4518 (14.07)***	0.5570 (20.54)***	0.0745 (6.25)***	0.0745 (6.25)***	0.0424 (5.02)***
***ln*(TFP)**	-0.0204 (-4.27)***	-0.0207 (-4.37)***	0.0083 (3.19)***	-0.0026 (-4.50)***	-0.0026 (-4.50)***	0.0007 (4.25)***
Tariffs	-4.1488 (-4.33)***	0.1014 (0.76)	0.3009 (1.59)	3.5894 (3.16)***	0.7631 (5.99)***	0.1697 (1.65)**
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
R^2	0.24	0.27	0.84	0.14	0.18	0.79
Obs.	202 449	202 449	202 449	6 328 268	6 328 268	6 328 268

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: Material offshoring and corruption. Dependent variable, material import of offshored materials, 1997-2005.

Variable	**Heckman** [(A)]		**HMR** [(B)]	**Heckman FEVD** [(C)]
	Selection	Target		
***ln*(distance)**	-0.7738 (-8.69)***	-1.5164 (-6.51)***	-1.0083 (-3.47)***	-0.8062 (-265.3)***
***ln*(GDP)**	0.2501 (4.04)***	0.2961 (1.57)	0.6687 (3.59)***	0.1357 (6.17)***
***ln*(Population)**	0.0772 (1.27)	0.4951 (2.46)**	0.7972 (3.94)***	0.6285 (28.99)***
Corruption clean	0.2834 (5.14)***	0.5845 (2.82)***	1.4062 (6.14)***	0.6847 (23.04)***
MNE	0.2576 (16.87)***	0.4763 (7.18)***	1.1394 (15.29)***	0.1140 (2.72)***
***ln*(Firm size) sales**	0.2447 (45.17)***	0.6514 (22.10)***	1.1998 (19.60)***	0.6317 (15.96)***
***ln*(TFP)**	-0.0082 (-8.46)***	-0.0270 (-5.58)***	-0.0439 (-8.74)***	0.0061 (1.37)
Tariffs	2.6767 (5.41)***	-2.3382 (-2.06)**	6.2451 (5.53)***	1.2944 (3.86)***
Share skill high	0.0400 (0.38)			
Export ratio	0.2578 (10.14)***			
ETA				1 (1692)***
Mills	1.1320 (5.90)***		4.1898 (13.41)***	1.1229 (158.6)***
Z			3.2e-07 (1.33)	
Z^2			-6.9e-15 (-0.96)	
Z^3			1.7 (0.96)	
Industry dum.	yes	yes	yes	yes
Period dum.	yes	yes	yes	yes
Region dum.	yes	yes	yes	yes
R^2	--		0.26	0.84
Obs.	6 328 126	202 449	202 449	202 449

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.

(A) Test of independent models, p-val = 0.000, rho = 0.39.

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

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

Table 3. Material offshoring and corruption. Non-linear in corruption.
Dependent variable, material import of offshored materials, 1997-2005.

Variable	Heckman [(A)]		HMR [(B)]	Heckman FEVD [(C)]
	Selection	Target		
***ln*(distance)**	-0.7772 (-8.51)***	-1.5660 (-6.89)***	-1.0479 (-3.61)***	-0.8489 (-199.8)***
***ln*(GDP)**	0.2390 (3.87)***	0.1986 (1.03)	0.5609 (2.92)***	0.0405 (1.93)*
***ln*(Population)**	0.0890 (1.49)	0.6068 (2.84)***	0.9158 (4.22)***	0.7242 (34.05)***
Corruption clean	0.5140 (2.34)**	2.0443 (2.30)**	2.9738 (3.18)***	1.9803 (16.17)***
Corruption clean ^{2}	-0.0289 (-1.02)	-0.1736 (-1.66)*	-0.1878 (-1.70)*	-0.1551 (-11.32)***
MNE	0.2586 (16.83)***	0.4769 (7.18)***	1.1372 (15.44)***	0.1056 (2.52) ***
***ln*(Firm size) sales**	0.2433 (44.99)***	0.6535 (22.20)***	1.1995 (19.83)***	0.6247 (15.63)***
***ln*(TFP)**	-0.0077 (-8.47)***	-0.0271 (-5.60)***	-0.0439 (-8.76)***	0.0063 (1.42)
Tariffs	2.6604 (5.53)***	-2.2338 (-1.90)*	6.3581 (5.47)***	1.1160 (3.52)***
Share skill high	-0.0331 (-0.39)			
Export ratio	0.2633 (10.17)***			
ETA				1 (1519)***
Mills		1.1391 (5.89)***	4.1834 (0.3089)***	1.0749 (0.0069)***
Z			3.1e-07 (0.98)	
Z^2			-6.1e-15 (0.98)	
Z^3			1.5e-24 (1.00)	
Industry dum.	yes	yes	yes	yes
Period dum.	yes	yes	yes	yes
Region dum.	yes	yes	yes	yes
R^2		--	0.26	0.84
Obs.	6 328 126	202 449	202 449	202 449

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.
(A) Test of independent models, p-val = 0.000, rho = 0.39.
(B) Following Helpman *et al*. (2008) we include higher order terms of z to control for firm heterogeneity where z is defined as $z = \Phi^{-1}(\rho) + \rho$ where *p* is the predicted probability of positive offshoring and Φ^{-1} is Mills ratio.
(C) Time invariant/slowly changing variables included in the FEVD estimation step two include: *ln*(distance), *ln*(GDP), *ln*(Population), Mills ratio, industry dummies, region dummies and corruption.

Table 4. Material offshoring and corruption. Heterogeniety.
Dependent variable, material import of offshored materials, 1997-2005.

Sample	HMR [(A)]	Heckman FEVD [(B)]		HMR [(A)]	Heckman FEVD [(B)]
	Estimates of corruption			*Estimates of corruption*	
MNEs	1.4850 (6.45)***	0.8703 (29.05)***	**Firms L < 500**	1.2909 (5.64)***	0.6349 (21.41)***
Non-MNEs	0.8652 (4.07)***	0.4312 (14.62)***	**Firms L > 500**	1.5731 (6.82)***	0.9182 (30.10)***
Offshore to max 8 source countries	1.3635 (3.94)***	1.6332 (35.96)***	**Manu firms**	1.6268 (6.82)***	0.8715 (28.96)***
Offshore to 9-16 Source countries	1.7113 (4.83)***	1.9399 (42.83)***	**Non-Manu firms**	0.7709 (3.72)***	0.2979 (10.14)***
Offshore to +17 Source countries	2.0481 (5.84)***	2.1912 (48.65)***			

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 a full variable set-up including firm-, country-, trade resistance variables and region-, industry, and period dummies, see 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 $z = \Phi^{-1}(\rho) + \rho$ where p is the predicted probability of positive offshoring and Φ^{-1} is Mills ratio.
[(B)] Time invariant/slowly changing variables included in the FEVD estimation step two include: *ln*(distance), *ln*(GDP), *ln*(Population), Mills ratio, industry dummies, region dummies and corruption.

Table 5. Robustness and multiplicative models

Variable	FEVD [(A)] no reg. dum.	FEVD [(A)] lagged vars.	Neg Binom. RE	Neg Binom. FE [(A)]	ZINB[(B)]	ZINB inflation
Corruption	0.7414 (60.31)***	0.3899 (27.15)***	0.2550 (26.83)***	0.0845 (8.10)***	0.0650 (0.48)	-0.5952 (-4.33)***
Industry dum.	yes	yes	yes	yes	Yes	yes
Period dum.	yes	yes	yes	yes	Yes	yes
Region dum.	no	yes	yes	yes	Yes	yes
R^2	0.84	0.85	*ln*(*L*) -1 927 541	*ln*(*L*) -1 274 627	*ln*(*L*) -2 052 720	*ln*(*L*) -2 052 720
Obs.	202 449	168 311	6 328 268	386 191	6 328 126	6 328 126

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)] Time invariant/slowly changing variables included in the FEVD estimation step two include: *ln*(distance), *ln*(GDP), *ln*(Population), Mills ratio, industry dummies, region dummies and corruption.
[(B)] ZINB = Zero inflated negative binomial model. p-val Vuong = 0.000. Inflation step estimated by a Probit.

Table A1. Variable description

Variable	Mean	Stdv(be/within)
	Country characteristics	
ln(GDP)	23.67246	24.7
ln(population)	15.85401	55.1
	Firm characteristics	
ln(offshoring)	5.421137	2.36
ln(sales)	12.06972	4.23
ln(TFP)	6.599014	1.79
Share skilled labor	.2465264	5.81
MNE	.398132	1.86
	Trade resistance	
Tariffs	.0043736	2.33
ln(distance)	8.429155	∞
Corruption clean (WB)	3.067855	8.95
Corruption clean (ITI)	4.55867	7.48

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
1. ln(offshoring)	1									
2. ln(distance)	-.20	1								
3. MNE	.08	.00	1							
4. ln(GDP)	.06	-.25	.00	1						
5. ln(pop)	.03	-.02	.00	.70	1					
6. Corruption clean(WB)	.10	-.34	.00	.44	-.21	1				
7. Corruption clean(IT)	.08	-.34	.00	.47	-.25	.97	1			
8. ln(Sales)	.17	.00	.33	-.00	-.00	-.00	-.01	1		
9. ln(TFP)	-.05	.00	-.02	.00	.00	.00	.02	.02	1	
10. Tariffs	-.14	-.03	.00	.36	.19	.25	.25	-.00	.01	1
11. Share skilled labour	-.18	.00	.08	-.00	-.00	-.00	-.01	.04	.29	-.01

Table A3. Regions, offshoring and tariffs.

Region	Average tariff	% of total offshoring	Region	Average tariff	% of total offshoring
Western Europe	0.0019	33.58	***Southern Africa***	0.0003	0.08
Northern Europe	0.0131	41.83	***Eastern Asia***	0.0401	5.74
Eastern Europe	0.0017	5.37	***Southern Asia***	0.0037	1.84
Southern Europe	0.0001	4.29	***South-Eastern Asia***	0.0033	0.97
Northern America	0.0351	3.39	***Central Asia***	0.0000	0.04
South America	0.0002	0.92	***Western Asia***	0.0006	0.89
Western Africa	0.0000	0.14	***Australia and New Zeeland***	0.0013	0.37
Central America	0.0001	0.04	***Caribbean***	0.0000	0.08
Eastern Africa	0.0000	0.05	***Polynesia***	0.0000	0.00
Northern Africa	0.0001	0.37	***Micronesia***	0.0000	0.00
Middle Africa	0.0000	0.01	***Melanesia***	0.0000	0.00

Table A4. Comparative firm characteristics

No. of offshoring destinations	Cumulative frequency	Comparative firm characteristics	Offshorers/ non-offshorers	MNE /non MNEs	Manu/ non-manu
1 destination	22 %	*ln*(offshoring)	n.a	3.54	2.94
5 destinations	52%	MNE	3.74	n.a.	1.74
10 destinations	74%	*ln*(sales)	1.08	1.08	1.02
20 destinations	95%	*ln*(TFP)	0.87	0.97	0.40
50 destinations	100%	Share skilled labour	1.13	1.16	0.61
Max no of simultaneous offshoring destinations observed by a single firm. 70					

Table A5. Variables, construction and data source

Variable	Definition	Source
	Country characteristics	
ln(GDP)	*ln*(GDP), constant 200 USD.	World Bank
ln(population)	*ln*(Total population).	World Bank
	Firm characteristics	
ln(offshoring)[(A)]	*ln*(imports); intermediate and consumption inputs according to MIG classification codes, unit by firm-country pair, constant prices.	Statistics Sweden - Trade statistics
ln(sales)	*ln*(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	Dummy variable indication foreign ownership, at least 50% of votes in foreign control.	Statistics Sweden - Financial statistics
	Resistance to trade	
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).