DISENTANGLING CORRUPTION EFFECTS ON EXPORT VERSUS FDI: A THEORY

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Abstract

Based on the empirical literature on corruption, trade, and FDI, this paper modifies Helpman et al. (2004) to include two mechanisms through which corruption may influence the export versus FDI decision: through a corruption premium on trade costs and a corruption cost to productivity. This paper then demonstrates that anti-corruption provisions in trade agreements can increase trade and FDI flows by reducing home levels of corruption, foreign levels of corruption, or both.

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1 Introduction

Recent international trade policy negotiations, including some bilateral trade agreements and the recent adoption of the "Fair Economy" Pillar of the Indo-Pacific Economic Framework for Prosperity (IPEF), have aimed to improve the control of corruption in member countries, among other objectives. For example, in text of the Fair Economy Pillar of the IPEF, the anti-corruption goal is to ensure member countries pursue provisions and initiatives to "prevent, combat, and sanction domestic and foreign bribery and other related corruption offenses." It also aims to "strengthen transparency and implementation of existing anti-corruption review mechanisms."[1]

In theory, improving controls on corruption can improve a country's productivity and openness to trade. It can lower barriers and encourage investment. There is a large empirical literature on the relationship between corruption and trade or corruption and FDI. In this paper, I use findings from the existing literature to motivate a theoretical model that predicts the influence of corruption on firm's decision of how to supply a foreign market. I then apply qualitative predictions from the theoretical model to econometric analysis of the impact of corruption on trade and FDI.

The theoretical model builds from Helpman et al. (2004) in which heterogeneous firms in a monopolistically competitive industry make decisions about whether or not to supply a foreign market. I adjust their model by adding in costs of corruption that reduce productivity (by augmenting the unit-labor-input requirement) and increase trade costs.

Including a corruption cost on productivity is motivated by Lambsdorff (2003) and De Rosa et al. (2010). Measuring productivity as the ratio of GDP to the capital stock, Lambsdorff (2003) shows for a cross section of 69 countries that capital productivity is decreasing in corruption and increasing in trade openness. The author also shows for context

[1] Full text available online at `ustr.gov/ipef`.

that bringing Tanzania's level of corruption to that of the United Kingdom would increase Tanzania's productivity by 10 percent and lead to a 20 percent increase in GDP. De Rosa et al. (2010) use firm-level data to test for the impact of bribes and red tape on firm productivity, showing that a "bribe tax" has a negative impact on firm-level productivity, but the effect of the "time tax" (red tape) is insignificant.

Including a cost of corruption on trade is motivated by several studies. Bandyopadhyay and Roy (2007) examine the impact of corruption on trade protection. The authors argue that corruption leads to increases in trade protection, because corrupt lawmakers are more susceptible to lobbying. Using a panel of 88 countries between 1982 and 1997, the authors find that trade protection (as measured by import taxes) is increasing in corruption, and trade openness is decreasing in corruption.

Dutt and Traca (2010) examine the impact of corruption on trade flows, looking specifically at how extortion by customs officials and evasion of tariff barriers impact trade. The authors find that for most of the sample corruption reduces trade, but in high-tariff environments corruption enhances trade.

de Jong and Bogmans (2011) and Horsewood and Voicu (2012) also examine the impact of corruption on trade, showing that corruption limits both imports and exports. First, de Jong and Bogmans (2011) do cross-sectional gravity analysis of average trade between 1999 and 2002, showing longer border wait times and poorer quality customs institutions decrease trade, and the frequency of payments to customs officials (which they describe as bribery "greasing the wheels") increase trade. Horsewood and Voicu (2012) use a bilateral, dynamic trade model to show that distance between trading partners' corruption levels decreases trade.

With the inclusion of corruption in the original Helpman et al. (2004) model, I discuss how adopting an anti-corruption policy may impact firms' trade and investment decisions. Using the theory, I demonstrate that the effect of an anti-corruption agreement on firms in the home country depends on which parties of the agreement actually reduce corruption. First, if only the home country reduces corruption, the theory predicts an increase in the range of productivity levels for which firms will choose to export. The theory also predicts there will be a range of productivities for which firms now choose to supply the foreign market that would not have chosen to do so without the reduction in corruption. If only the foreign country reduces corruption, firms with a larger range of productivities will choose to supply the foreign market through FDI as the minimum productivity level for FDI to be profitable is decreased. The range of productivities for which exports is the most profitable option will shift down overall and shrink, with FDI overtaking exports as most profitable for higher productivities. Finally, if both countries simultaneously reduce corruption, the range of productivities for which firms prefer to export shifts down and may either increase or decrease, and the range of productivities for which firms prefer to supply the foreign market through FDI grows larger.

These predictions are not directly translatable to standard trade and FDI data: these predictions are on the extensive margin. The final part of the theoretical analysis examines how a unilateral reduction in corruption would impact the value of imports, exports, and sales by foreign affiliates, showing that the corruption reduction would increase imports and sales by foreign affiliates, with the effect on the value of exports potentially being positive or negative. The final proposition in section 2 makes predictions regarding how these impacts of corruption on trade would appear in the data. The three key predictions are: (1) less corrupt countries import more, because firms exporting to the low-corruption country benefit from a lower corruption premium on trade costs; (2) less corrupt countries export more, though the increase in the value of exports is partially offset by a decrease in prices from lowering firm production costs; (3) less corrupt countries attract more FDI, again due to a lower corruption premium on production costs in the low-corruption country.

While I have already discussed the literature supporting the link between corruption and trade, the literature also supports the relationship between corruption and FDI. Most notably, Wei (2000) is among the first papers to have established empirically that increasing corruption leads to a decrease in FDI. Wei estimates the effect of tax rates, corruption, and other controls (like GDP and country fixed effects) on FDI stock. The author also shows that an increase in corruption from Singapore's corruption levels to those of Mexico has an equivalent negative effect on inward FDI as raising the tax rate by 50 percentage points.

Also worth mentioning, there are a few papers that examine the effect of anti-corruption enforcement specifically. Goldman and Zeume (2020), Beck et al. (1991), and Christensen et al. (2022) examined the impact of enforcement of the U.S. Foreign Corrupt Practices Act (FCPA).[2] Goldman and Zeume (2020) show that FCPA enforcement levels the playing field for firms that are unwilling to use bribery to secure contracts. They find that FCPA enforcement actions can be tied to an increase in revenue and productivity of firms operating in the same industry as a prosecuted violator. Beck et al. (1991) show that the enactment of the FCPA led to a decrease in market share of U.S. firms in bribery-prone non-Latin-American countries. More recently, Christensen et al. (2022) show that an early 2000s increase in enforcement of the FCPA led to a significant decrease in FDI in high-corruption countries, both from U.S. and non-U.S. investors.

The rest of the paper proceeds as follows: first in section 2, I setup the theoretical model.[3] In section 3, I derive the firm's supply decisions consistent with the model setup. The qualitative predictions based on the theory constructed in this section frame expectations for future empirical work. Section 4 concludes.

[2]The U.S. Foreign Corrupt Practices Act (1977) makes it illegal for U.S. companies to engage in corrupt activities anywhere abroad. The reach of the FCPA is somewhat unclear, often being used for firms without any ties to the U.S., including being used for firms just banking in the U.S. More information on FCPA: https://knowledgehub.transparency.org/assets/uploads/helpdesk/Anti-corruption-and-transparency-provisions-in-trade-agreements-2018.pdf.

[3]An expansion of the model is included in appendix A.

2 Model Setup

Given the large empirical literature demonstrating a wide variety of effects of corruption on trade and FDI and vice versa, building a theoretical model can help form expectations about what I will find in the data and why those results might present themselves. In this section, I first derive the model, demonstrating how corruption impacts profits. I then show how the level of corruption impacts a firm's decision to supply the domestic and foreign markets. Finally, I show how a unilateral reduction in corruption affects the value of a country's imports, exports, and foreign affiliate sales.

Beginning with the Helpman et al. (2004) model with heterogeneous, monopolistically competitive producers choosing whether to supply the foreign market through exports or FDI, I incorporate a country-specific corruption cost that impacts productivity and trade costs. I then demonstrate the effect of three scenarios: (1) a reduction in domestic corruption, (2) a reduction in foreign corruption, and (3) a reduction in both domestic and foreign corruption. This allows for differing effects of different reductions in corruption, potentially leading to an increase or decrease in the share of firms choosing exports versus those choosing FDI.

The model is a static model with N countries and $H+1$ goods, H differentiated goods and one homogeneous good, produced using only labor. The homogeneous good is the numeraire good, with one unit produced by one unit of labor. The differentiated good is also produced using only labor. Country i is endowed with L^i units of labor. An exogenous fraction of income, β_h is spent on differentiated goods from sector h, $1 - \sum_{h \in H} \beta_h$ is spent on the numeraire good.

Consider a differentiated sector, dropping the subscript h to simplify notation. In a differentiated sector, upon entering the industry and paying fixed entry cost f_E, a firm draws a labor-per-unit-output coefficient a from distribution $G(a)$.[4] Once observing a, the firm makes a decision to remain in the industry or exit. If it chooses to remain in the industry and produce, it pays fixed cost f_D to supply the domestic market, which covers overhead labor costs of establishing domestic production.

When choosing if and how to supply a foreign market, the firm faces fixed costs of exporting, f_X, and fixed costs of horizontal FDI, f_I. The fixed cost of exporting represents the costs of forming a distribution and servicing network in a foreign country. The fixed cost of FDI includes the same costs as f_X plus the additional costs of forming a subsidiary, including duplicate overhead production costs. For an exporting firm, it faces an iceberg trade cost, $\tau > 1$, such that for τ units of output exported, only one unit arrives at the destination.

Corruption is assumed to be present in both the domestic and foreign markets. Denote corruption in country j as $\chi^j > 0$, with 0 representing the least amount corruption. I allow corruption to enter the model in two ways, representing findings in the empirical literature. First, the findings of de Jong and Bogmans (2011), Dutt and Traca (2010) suggest that there is a transaction-level cost to firms of conducting trade with a corrupt nation, representing things like bribery at the border. Therefore, the iceberg trade cost τ is augmented by the corruption premium, so that a firm in country i must export $\tau^{ij}(1 + \chi^j)$ units of its product for one unit to arrive in country j.

Second, multiple authors have established the link between corruption and productivity. For example, Goldman and Zeume (2020) and Lambsdorff (2003) show that anti-corruption enforcement increases productivity of firms operating in the industry receiving anti-corruption protection. Additionally, De Rosa et al. (2010) shows having to bribe customs officials decreases productivity. In terms of this model, suppose corruption changes the firm-level productivity such that firms in country i and j have unit-labor-input requirements

[4] $G(a)$ is a Pareto distribution with shape parameter $k > 0$.

$(1+\chi^i)a$ and $(1+\chi^j)a$, respectively.[5]

Consumers have CES preferences across varieties of a differentiated good with elasticity of substitution $\varepsilon = 1/(1-\alpha) > 1$ resulting in demand function $A^i p^{-\varepsilon}$ in country i, where A^i is exogenous from the perspective of the firm.[6] Therefore, a firm with labor coefficient a sells its variety at price $p^i = w^i(1+\chi^i)a/\alpha$, where $1/\alpha$ is the markup over marginal cost, and consumers in country i pay $w^i(1+\chi^i)a/\alpha$ for domestically-produced varieties and $p^{ji} = (\tau^{ji}(1+\chi^i))p^j = (\tau^{ji}(1+\chi^i))(w^j(1+\chi^j)a/\alpha)$ for varieties imported from country j.

The firm-level profits from domestic production, exporting, and FDI are:

$$\Pi_D = p^i q_D - w^i\,(1+\chi^i)\,a\,q_D - f_D, \tag{1}$$

$$\Pi_X = (\tau^{ij}(1+\chi^j)\,p^i)q_X - w^i\,(1+\chi^i)\,a\,((1+\chi^j)\,\tau^{ij}\,q_X) - f_X, \tag{2}$$

$$\Pi_I = p^j q_I - w^j\,(1+\chi^j)\,a\,q_I - f_I. \tag{3}$$

where $\chi^i > 0$ is the level of corruption in country i and $\chi^j > 0$ is the level of corruption in country j.

In Helpman et al. (2004), the authors place some assumptions on the fixed costs and other model parameters to ensure there are values of a for which each mode of supplying the foreign market is preferable. With the addition of corruption to the model, this assumption is

$$\left(\frac{w^j(1+\chi^j)}{w^i(1+\chi^i)}\right)^{\varepsilon-1} f_I > \big((1+\chi^j)\tau^{ij}\big)^{\varepsilon-1} f_X > f_D. \tag{4}$$

Given equation (4) and assuming unit wages worldwide (which results from the numeraire good being produced in all countries and freely traded) and equal demand across countries

[5]Note that an extension in the future would be to allow the corruption coefficient on tariffs to differ from the coefficient on productivity, $\chi^i_\tau \neq \chi^i_a$. For simplicity, I assume the effect is the same, $\chi^i_\tau = \chi^i_a = \chi^i$.

[6]A^i is actually a function of the total expenditure on varieties of the good and the sector's price index, $\beta E^i (P^i)^{\varepsilon-1}$, where E^i is total expenditure in country i and P^i is the price index in country i for good h.

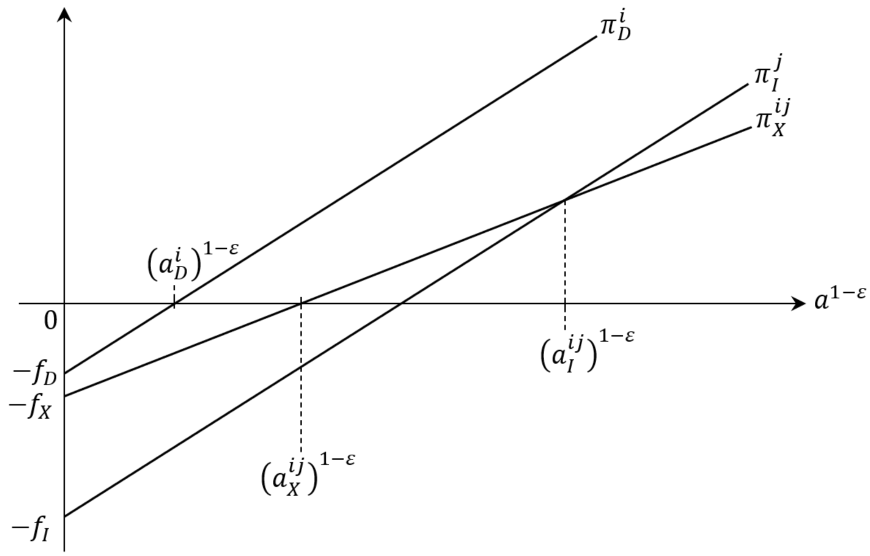

Figure 1: Profits from domestic sales, exports, and FDI when wages are equal to one and $A^i = A^j$ (Helpman et al.; 2004, Figure 1).

$(A^i = A^j)$, the trade off between supply methods is depicted by figure 1.[7] Generally, the least productive firms $(a > a_D^i)$ exit the industry, firms with unit-labor-input requirements $a_D^i > a > a_X^{ij}$ choose to only sell domestically, firms with unit-labor-input requirements $a_X^{ij} > a > a_I^{ij}$ choose to sell domestically and to export, and firms with unit-labor-input requirements $a < a_I^{ij}$ choose to sell domestically and to invest in foreign production through horizontal FDI.

The cutoff values of a can be implicitly defined using three different profit conditions: (1) zero profits for domestic production defines $(a_D^i)^{1-\varepsilon}$; (2) zero profits for exports defines $(a_X^{ij})^{1-\varepsilon}$; and (3) equal profits between exports and FDI defines $(a_I^{ij})^{1-\varepsilon}$. The implicit defi-

[7]The is figure is equivalent to Figure 1 in Helpman et al. (2004).

nitions of $(a_D^i)^{1-\varepsilon}$, $(a_X^{ij})^{1-\varepsilon}$, and $(a_I^{ij})^{1-\varepsilon}$ are:

$$B^i(w^i(1+\chi^i))^{1-\varepsilon}(a_D^i)^{1-\varepsilon} = f_D, \quad \forall i, \tag{5}$$

$$B^j((1+\chi^j)\tau^{ij})^{1-\varepsilon}(w^i(1+\chi^i))^{1-\varepsilon}(a_X^{ij})^{1-\varepsilon} = f_X, \quad \forall j \neq i, \tag{6}$$

$$B^j(1+\chi^j)^{1-\varepsilon}\left[(w^j)^{1-\varepsilon} - (\tau^{ij})^{1-\varepsilon}(w^i(1+\chi^i))^{1-\varepsilon}\right](a_I^{ij})^{1-\varepsilon} = f_I - f_X, \quad \forall j \neq i, \tag{7}$$

where $B^i \equiv A^i(1-\alpha)/\alpha^{1-\varepsilon}$ and $B^j \equiv A^j(1-\alpha)/\alpha^{1-\varepsilon}$.

3 Effect of Changes in Corruption

Now, the question is how corruption impacts each of the cutoff values. To simplify the analysis, suppose that the fixed costs are proportional to the size of the market (specifically, I assume $f_D = F_D^i A^i$ with $F_D^i \in (0,1)$ and $f_y = F_y^i A^j$ with $F_y^i \in (0,1)$, $y \in \{X, I\}$).[8] The effect of the corruption in country i on the cutoff values of a is:

$$\frac{\partial (a_D^i)^{1-\varepsilon}}{\partial \chi^i} = -(1-\varepsilon)\frac{1}{1+\chi^i}(a_D^i)^{1-\varepsilon} > 0, \tag{8}$$

$$\frac{\partial (a_X^{ij})^{1-\varepsilon}}{\partial \chi^i} = -(1-\varepsilon)\frac{1}{1+\chi^i}(a_X^{ij})^{1-\varepsilon} > 0, \tag{9}$$

$$\frac{\partial (a_I^{ij})^{1-\varepsilon}}{\partial \chi^i} = (1-\varepsilon)\frac{1}{1+\chi^i}\frac{(\tau^{ij})^{1-\varepsilon}(w^i(1+\chi^i))^{1-\varepsilon}}{\left[(w^j)^{1-\varepsilon} - (\tau^{ij})^{1-\varepsilon}(w^i(1+\chi^i))^{1-\varepsilon}\right]}(a_I^{ij})^{1-\varepsilon} < 0. \tag{10}$$

If this is the case, $(a_D^i)^{1-\varepsilon}$ and $(a_X^{ij})^{1-\varepsilon}$ are affected similarly: because equations (8) and (9) are both greater than zero, a *reduction* in corruption decreases $(a_D^{ij})^{1-\varepsilon}$, which is equivalent to increasing the cutoff value of the unit-labor-input requirement for which firms choose to supply the domestic market, a_D^i. Similarly, lower corruption is associated with a lower cutoff unit-labor-input requirement for which firms supply the foreign market through exports, a_X^{ij}.

[8] In appendix A, I relax this assumption and discuss how it affects the model results. Generally, under reasonable assumptions about the size of any one trading partner, the results of the model are unchanged.

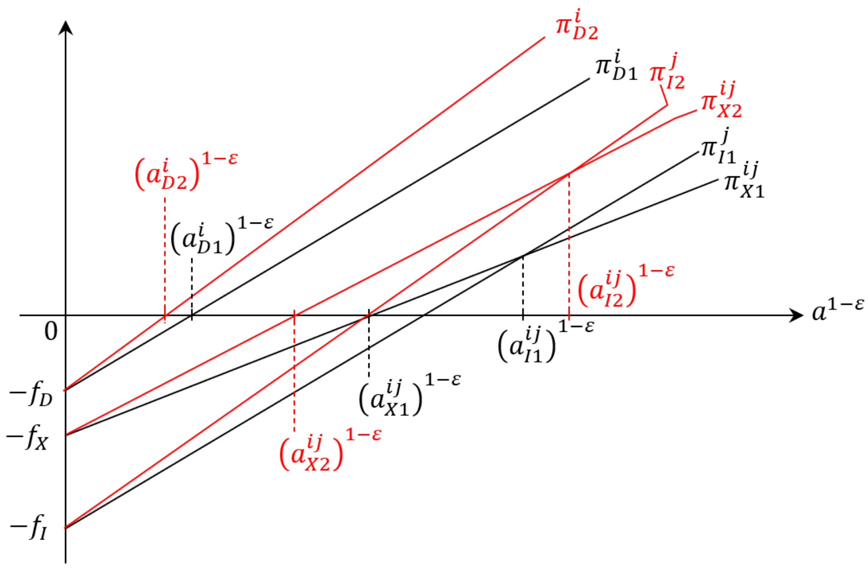

Figure 2: Profits from domestic sales, exports, and FDI when wages are equal to one and $A^i = A^j$ following a decrease in domestic corruption, χ^i.

Given that $(a_D^i)^{1-\varepsilon} < (a_X^{ij})^{1-\varepsilon}$, the effect on $(a_X^{ij})^{1-\varepsilon}$ is larger than the effect on $(a_D^i)^{1-\varepsilon}$, indicating that lower corruption increases the share of firms that supply the foreign market.

Next, with unit wages it is straightforward to show that the denominator of equation (10) is positive and the overall derivative is negative. This means that lower corruption in the home country increases the minimum productivity value for which FDI is preferable to exports. Figure 2 depicts how the profit function shifts lead to an increase in exports and decrease in FDI.

Proposition 1 *Reducing corruption in country i leads to an increase the range of firms choosing to export, both due to lower productivity firms now finding it profitable to export and due to firms that would previously have chosen FDI now instead choosing to export. Additionally, some firms that before a change in corruption would not have supplied the foreign market will now choose to export (firms with productivities between $(a_{X2}^{ij})^{1-\varepsilon}$ and $(a_{X1}^{ij})^{1-\varepsilon}$). This is depicted in Figure 2.*

If country j reduces corruption, on the other hand, then $(a_X^{ij})^{1-\varepsilon}$ and $(a_I^{ij})^{1-\varepsilon}$ are impacted

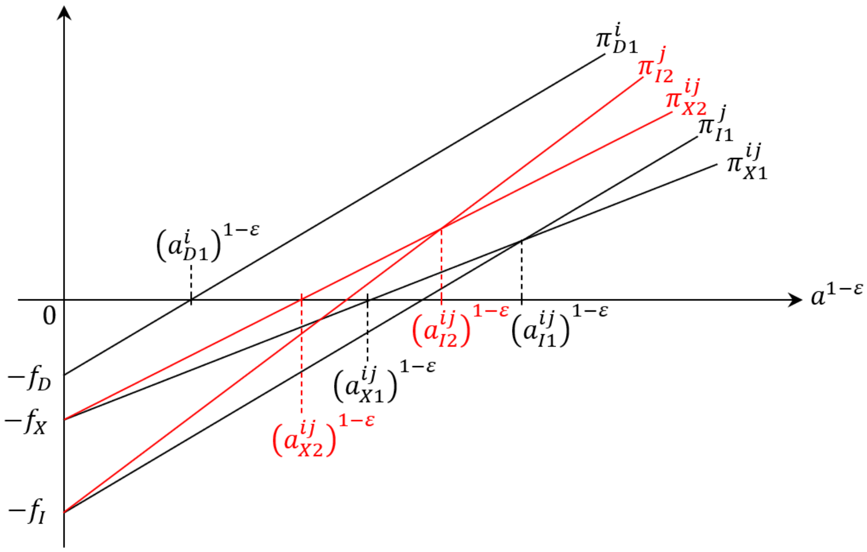

Figure 3: Profits from domestic sales, exports, and FDI when wages are equal to one and $A^i = A^j$ following a decrease in foreign corruption, χ^j.

and $(a^i_D)^{1-\varepsilon}$ is unchanged. The derivatives of the cutoff values for exports and FDI with respect to χ^j are

$$\frac{\partial (a^{ij}_X)^{1-\varepsilon}}{\partial \chi^j} = -(1-\varepsilon)\frac{1}{1+\chi^j}(a^{ij}_X)^{1-\varepsilon} > 0, \tag{11}$$

$$\frac{\partial (a^{ij}_I)^{1-\varepsilon}}{\partial \chi^j} = -(1-\varepsilon)\frac{1}{1+\chi^j}(a^{ij}_I)^{1-\varepsilon} > 0. \tag{12}$$

Equations (11) and (12) are functionally the same the derivatives of $(a^i_D)^{1-\varepsilon}$ and $(a^{ij}_X)^{1-\varepsilon}$ with respect to χ^i. Because the value of $(a^{ij}_I)^{1-\varepsilon}$ is larger, a decrease in χ^j leads to a larger shift in the cutoff for FDI than in the cutoff for exports. As a result, decreasing only foreign corruption leads to an overall increase in the range of firms choosing FDI and a decrease in the range of firms exporting. This change, however, is accompanied by an increase in the range of firms that choose to supply the foreign market overall as the value of $(a^{ij}_X)^{1-\varepsilon}$ decreases. This is depicted in figure 3.

Proposition 2 *Reducing corruption in country j increases the total range of productivities* *for which firms choose to supply the foreign market. Lower corruption in country j increases the overall range of firms that choose FDI and decreases the range of firms that choose to export. Additionally, firms that would not have supplied the foreign market at a higher corruption level now find it profitable to do so (for productivities between $(a_{X2}^{ij})^{1-\varepsilon}$ and $(a_{X1}^{ij})^{1-\varepsilon}$). This is depicted in Figure 3.*

Given the impact from each unilateral change in corruption, consider now how a reduction in corruption both at home and abroad impacts the market. To keep this problem from growing too complex, suppose that through an anti-corruption agreement, country i and country j's corruption levels become linked, such that $\chi^i = \chi^j = \chi$. The derivatives of the three cutoff values of $a^{1-\varepsilon}$ with respect to this new χ are:

$$\frac{\partial(a_D^i)^{1-\varepsilon}}{\partial\chi} = -(1-\varepsilon)\frac{1}{1+\chi}(a_D^i)^{1-\varepsilon} > 0, \tag{13}$$

$$\frac{\partial(a_X^{ij})^{1-\varepsilon}}{\partial\chi} = -2(1-\varepsilon)\frac{1}{1+\chi}(a_X^{ij})^{1-\varepsilon} > 0, \tag{14}$$

$$\frac{\partial(a_I^{ij})^{1-\varepsilon}}{\partial\chi} = -(1-\varepsilon)\frac{1}{1+\chi}\frac{(w^j)^{1-\varepsilon} - 2(\tau^{ij})^{1-\varepsilon}(w^i(1+\chi))^{1-\varepsilon}}{\left[(w^j)^{1-\varepsilon} - (\tau^{ij})^{1-\varepsilon}(w^i(1+\chi))^{1-\varepsilon}\right]}(a_I^{ij})^{1-\varepsilon}, \tag{15}$$

The derivatives of the cutoff values for supplying the domestic market and for supplying the foreign market through exports (equations (13) and (14), respectively) are both again positive, indicating that decreasing overall corruption leads to a larger range of firms choosing each. Also note the derivative for exports is now double what it was previously: the exporting firm benefits from an increase in productivity from facing less corruption at home *and* from a reduction in trade costs abroad.

Next, consider equation (15), the impact of reducing overall corruption on the range of firms choosing FDI. Again assuming unit wages, the denominator of equation (15) is positive. The sign of the numerator depends on how large the trade cost is and how extreme corruption is. If corruption is relatively low or if the iceberg trade cost is close to one (free trade), then

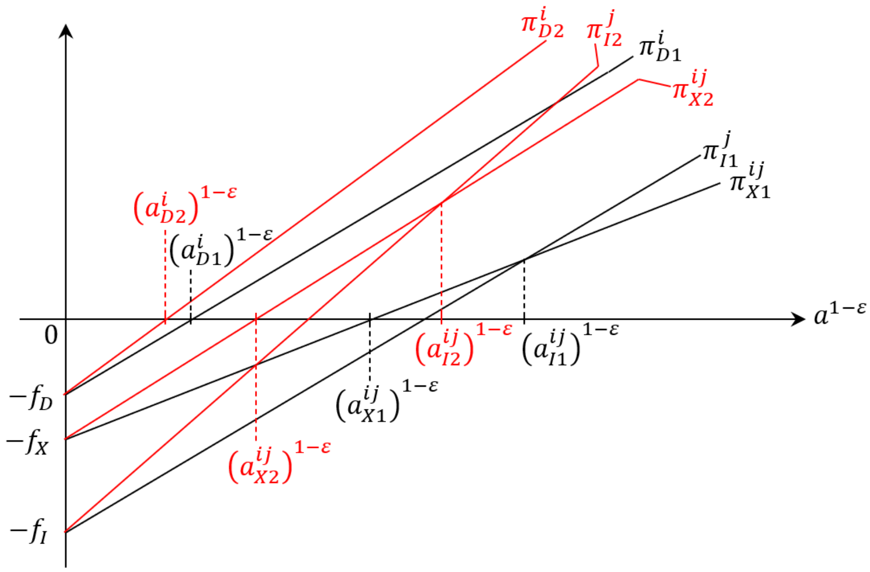

Figure 4: Profits from domestic sales, exports, and FDI when wages are equal to one and $A^i = A^j$ following a decrease in all corruption, χ, assuming $(\tau(1+\chi))^{1-\varepsilon} < 1/2$.

the numerator of equation (15) is negative and the overall derivative is negative. This means that decreasing corruption in both countries would lead to an increase in a_I^{ij} and a decrease in the range of firms choosing FDI over exports. This would appear similar to Figure 2.

If, on the other hand, τ^{ij} is large or the combination of the tariff and the corruption are adequately high (specifically, if $(\tau(1+\chi))^{1-\varepsilon} < 1/2$), then the numerator is positive and the overall derivative is positive, implying that decreasing corruption in both countries leads to a decrease in $(a_I^{ij})^{1-\varepsilon}$ and an increase in the range of firms choosing FDI. Figure 4 depicts the impact of a decrease in χ on the profit functions in the scenario where the iceberg trade cost or the corruption levels are high, such that $(\tau(1+\chi))^{1-\varepsilon} < 1/2$ (where equation (15) is positive).

This result makes intuitive sense if framed around the size of the iceberg trade cost: when trade is costly (if the iceberg trade cost is large), an overall reduction in corruption skews in favor of increasing the range of firms choosing FDI. If the iceberg trade cost is low, the effect skews toward and increase in the range of firms choosing to export.

Proposition 3 *Reducing corruption in both the home country, country i, and the foreign country, country j, leads to the following:*

(3.1) If $(\tau(1+\chi))^{1-\varepsilon} > 1/2$: the range of productivities for which firms choose to export increases, as firms with lower productivities supply the foreign market through exports and firms that previously would have supplied the foreign market through FDI now choose to export. This would appear similar to the scenario in figure 2. Additionally, some firms that before a change in corruption would not have supplied the foreign market will now choose to export (firms with productivities between $(a^{ij}_{X2})^{1-\varepsilon}$ and $(a^{ij}_{X1})^{1-\varepsilon}$).

(3.2) If $(\tau(1+\chi))^{1-\varepsilon} < 1/2$: the net effect on the range of firms choosing to export is indeterminate (a potential scenario is depicted in figure 4). The range of firms choosing to supply the foreign market through FDI increases. Some firms that before a change in corruption would not have supplied the foreign market will now choose to export (firms with productivities between $(a^{ij}_{X2})^{1-\varepsilon}$ and $(a^{ij}_{X1})^{1-\varepsilon}$).

The differing ways in which corruption and trade and FDI interact in the theoretical model can shed light on the mixed findings in the empirical literature. Both domestic and foreign corruption reductions change the profitability of firms, leading to either an increase in firms choosing to export to or an increase in firms choosing FDI.

Thus far, the predictions here are largely extensive margin predictions: predictions regarding the number of firms in a market choosing exporting, FDI, or neither. To make the model more applicable for readily available trade data, it's important to continue the analysis, considering the impact of corruption on the value of exports and FDI. Maintaining the assumption that the homogeneous good is numeraire and freely traded to ensure unit wages (and dropping the dependence of all equations on the wages to simplify), the total exports from country i to country j and sales from foreign affiliates from country i operating in country j:

$$X^{ij} = \beta E^j (P^j)^{\varepsilon-1}(\tau^{ij}(1+\chi^j))^{1-\varepsilon}((1+\chi^i)/\alpha)^{1-\varepsilon}(V(a_X^{ij}) - V(a_I^{ij})), \tag{16}$$

$$I^{ij} = \beta E^j (P^j)^{\varepsilon-1}((1+\chi^j)/\alpha)^{1-\varepsilon} V(a_I^{ij}), \tag{17}$$

where $V(a) = \int_0^a y^{1-\varepsilon} dG(y)$ and P^j is defined as

$$P^j = \frac{1}{\alpha}\left(\sum_{n\neq j} V(a_I^{nj}) + \sum_{n\neq j}(\tau^{nj}(1+\chi^j))^{1-\varepsilon}\left(V(a_X^{nj}) - V(a_I^{nj})\right) + V(a_D^j)\right)^{\frac{1}{1-\varepsilon}}, \tag{18}$$

with country $n \in N$. The distribution of unit-labor-input requirements follows the Pareto distribution, with shape parameter $k > \varepsilon - 1 > 0$, meaning $\int_{c_1}^{c_2} y^{1-\varepsilon} dG(y) = \frac{k}{k-(\varepsilon-1)}\left((c_2)^{k-(\varepsilon-1)} - (c_1)^{k-(\varepsilon-1)}\right)$. Using the Pareto distribution to simplify, equations (16)–(18) become:

$$X^{ij} = z^j (P^j)^{\varepsilon-1}(\tau^{ij}(1+\chi^j))^{1-\varepsilon}(1+\chi^i)^{1-\varepsilon}\left((a_X^{ij})^{k-(\varepsilon-1)} - (a_I^{ij})^{k-(\varepsilon-1)}\right), \tag{19}$$

$$I^{ij} = z^j (P^j)^{\varepsilon-1}(1+\chi^j)^{1-\varepsilon}(a_I^{ij})^{k-(\varepsilon-1)}, \tag{20}$$

$$\begin{aligned} P^j = {} & \frac{1}{\alpha}\left(\frac{k}{k-(\varepsilon-1)}\right)^{\frac{1}{1-\varepsilon}} \\ & * \left(\sum_{n\neq j}(a_I^{nj})^{k-(\varepsilon-1)} \right. \\ & \left. + \sum_{n\neq j}(\tau^{nj}(1+\chi^j))^{1-\varepsilon}\left((a_X^{nj})^{k-(\varepsilon-1)} - (a_I^{nj})^{k-(\varepsilon-1)}\right) + (a_D^j)^{k-(\varepsilon-1)}\right)^{\frac{1}{1-\varepsilon}}, \end{aligned} \tag{21}$$

with $z^j = \beta E^j \left(\frac{1}{\alpha}\right)^{1-\varepsilon}\frac{k}{k-(\varepsilon-1)}$.

Taking the derivative of the total exports and total FDI with respect to country j's corruption allows me to demonstrate how a reduction in corruption impacts the value of country j's imports and the value of sales in country j from foreign affiliates of country i.

The derivatives of X^{ij} and I^{ij} are:

$$\frac{dX^{ij}}{d\chi^j} = X^{ij}(\varepsilon-1)\left(\frac{dP^j}{d\chi^j}(P^j)^{-1} - \frac{1}{1+\chi^j} - \frac{(k-(\varepsilon-1))}{(\varepsilon-1)}\frac{1}{1+\chi^j}\right), \tag{22}$$

$$\frac{dI^{ij}}{d\chi^j} = I^{ij}(\varepsilon-1)\left(\frac{dP^j}{d\chi^j}(P^j)^{-1} - \frac{1}{1+\chi^j} - \frac{(k-(\varepsilon-1))}{(\varepsilon-1)}\frac{1}{1+\chi^j}\right), \tag{23}$$

with the derivative of the price index equal to

$$\frac{dP^j}{d\chi^j} = P^j\frac{1}{1+\chi^j}\left(\frac{(k-(\varepsilon-1))}{(\varepsilon-1)} + m_X^j\right), \tag{24}$$

where m_X^j is the market share of exports in country j's domestic market. For both exports and FDI, the derivative is made up of three terms: (1) the effect on aggregate prices, (2) the direct effect on the tariff level, and (3) the indirect effect on the measures of firms choosing each mode of supplying the foreign market.

With some simple algebra using the derivative of country j's price index (equation (24)), it is clear that equations (22) and (23) are both negative. This means that the value of exports and sales from foreign affiliates are decreasing in corruption of the destination country, so a reduction in corruption in country j will increase both the value of exports to country j and the value of foreign affiliate sales in country j. This is true for all countries $i \neq j$.

To determine the impact on the value of a country's exports from reducing its own corruption, consider the derivative of country i's exports, X^{ij}, with respect to χ^i:

$$\begin{aligned}\frac{dX^{ij}}{d\chi^i} = X^{ij}(\varepsilon-1)\Bigg(&\frac{dP^j}{d\chi^i}(P^j)^{-1} - \frac{1}{1+\chi^i} \\ &-\frac{(k-(\varepsilon-1))}{(\varepsilon-1)}\frac{1}{1+\chi^i}\Bigg(\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon}}{1-(\tau^{ij}(1+\chi^i))^{1-\varepsilon}}\frac{(a_I^{ij})^{k-(\varepsilon-1)}}{(a_X^{ij})^{k-(\varepsilon-1)}-(a_I^{ij})^{k-(\varepsilon-1)}} \\ &+\frac{(a_X^{ij})^{k-(\varepsilon-1)}}{(a_X^{ij})^{k-(\varepsilon-1)}-(a_I^{ij})^{k-(\varepsilon-1)}}\Bigg)\Bigg)\end{aligned} \tag{25}$$

with the derivative of country j's price index with respect to χ^i equal to:

$$\frac{dP^j}{d\chi^i} = -P^j \frac{1}{1+\chi^i} \frac{(k-(\varepsilon-1))}{(\varepsilon-1)} \left(\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon} - (\tau^{ij}(1+\chi^j))^{1-\varepsilon}}{1-(\tau^{ij}(1+\chi^i))^{1-\varepsilon}} m_I^{ji} - m_X^{ji} \right), \qquad (26)$$

where m_I^{ji} is the share of country j's sales from foreign affiliates from country i, and m_X^{ji} is the share of country j's sales coming from exports from country i. The first term of equation (25) is the effect on the price index of reducing corruption. The sign of this term depends on equation (26), and will be discussed further shortly. The second and third terms, the effect of reducing corruption on productivity and the effect of reducing corruption on the mass of firms choosing export and FDI, respectively, are both negative. Returning to the price index term, looking at equation (26), the price index in country j is decreasing in χ^i if

$$\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon} - (\tau^{ij}(1+\chi^j))^{1-\varepsilon}}{1-(\tau^{ij}(1+\chi^i))^{1-\varepsilon}} m_I^{ji} - m_X^{ji} > 0. \qquad (27)$$

The denominator of the coefficient on m_I^{ji} will fall between zero and one. The numerator may be either positive or negative, depending on whether country i or country j's corruption is greater: if country j is more corrupt, then the numerator will be negative and the price index effect on exports X^{ij} will be negative overall. If country i is more corrupt or if the difference in the corruption levels of the two countries is small, then the price index term will be positive and the net impact on exports from i to j is unclear. Overall, however, the price effect is likely very small, given m_I^{ji} and m_I^{ji} are country-pair specific, meaning that they likely make up a small overall share of country j's market. Therefore, there may be variation in the empirical findings regarding the effect on a country's exports of reducing its own corruption, though overall I expect to observe decreasing corruption leading to an increase in the value of exports.

Translating the structural model into predictions for an empirical examination of the relationship between corruption and trade, I can make the following predictions based on how a country's corruption compares to its potential trading partner:

Proposition 4 (Model Implications) *Looking at data on trade, FDI, and corruption, the following qualitative results would be consistent with the theoretical model:*

(4.1) Less corrupt countries import more: Compared to similar countries, countries with lower levels of corruption have less of a corruption premium on trade costs (lower corruption in country j corresponds with lower $\tau^{ij}(1+\chi^{j})$*), encouraging firms abroad to export to the less corrupt destination. This was demonstrated mathematically in equation (22).*

(4.2) Less corrupt countries may export more: Lower domestic corruption decreases the cutoff productivity for which firms find it profitable to export to the foreign market in all of the scenarios examined. However, lowering corruption costs decreases the value of each unit exported. As a result, one would expect this to be the weakest of the three findings (either being less positive, not significantly different from zero, or negative). The discussion of equation (25) demonstrated this finding.

(4.3) Less corrupt countries attract more FDI: When a firm operating in a corrupt country has the choice between supplying a foreign market through exports or supplying it through FDI, FDI is made more attractive as the firm seeks to escape the corruption premium on the unit-labor-input requirement in its home country. This is demonstrated in proposition 2. Further, equation (23) demonstrated there would be an increase in foreign affiliate sales as well.

4 Conclusions

Given the breadth of empirical research, in this paper I build a theoretical model to better understand the relationship between corruption, trade, and FDI. I demonstrate that the effect of anti-corruption efforts on the market are dependent upon whether the home country, foreign country, or both countries make an effort to reduce corruption.

There is room to expand both the theory of this paper. Currently, I focus on the effect of changing corruption levels on new entrants to the market. A simple extension would be to consider what parameter values would lead to firms already operating in the export or FDI markets to switch modes of supply. Another extension would be to allow the value of the corruption cost to differ for trade and for productivity. Additionally, the model can be more closely tied to the empirical literature, examining how model predictions compare to specific papers, especially those looking at sector level or firm level data.

Second, there is room to apply these findings to future econometric analysis, both estimating the effects predicted by the model and to do simple policy analysis. For the policy analysis, future work can consider the likely impact of anti-corruption agreements on measures of corruption available from sources like the World Bank. Additionally, calibrating parameters from the theoretical model to generate predictions would provide even more insight.

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A Expanded Model Results

The theory in section 2 places a simplifying assumption on the fixed costs in order to allow the cutoff values to be independent of the price index. In this section, I relax that assumption. Note also that in this section, I drop the dependence of all equations on wages, taking unit-wages as given.

First, the profit functions (equations (1)–(3)) are

$$\Pi_D = \beta E^i (P^i)^{\varepsilon-1}(1-\alpha)((1+\chi^i)a/\alpha)^{1-\varepsilon} - f_D, \tag{28}$$

$$\Pi_X = \beta E^j (P^j)^{\varepsilon-1}((1+\chi^j)\tau^{ij})^{1-\varepsilon}(1-\alpha)((1+\chi^i)a/\alpha)^{1-\varepsilon} - f_X, \tag{29}$$

$$\Pi_I = \beta E^j (P^j)^{\varepsilon-1}(1-\alpha)((1+\chi^j)a/\alpha)^{1-\varepsilon} - f_I, \tag{30}$$

where P^i and P^j can be written

$$P^i = \frac{1}{\alpha}\left(\sum_{n\neq i} V(a_I^{ni}) + \sum_{n\neq i}(\tau^{ni}(1+\chi^i))^{1-\varepsilon}\left(V(a_X^{ni}) - V(a_I^{ni})\right) + V(a_D^i)\right)^{\frac{1}{1-\varepsilon}}, \tag{31}$$

$$P^j = \frac{1}{\alpha}\left(\sum_{n\neq j} V(a_I^{nj}) + \sum_{n\neq j}(\tau^{nj}(1+\chi^j))^{1-\varepsilon}\left(V(a_X^{nj}) - V(a_I^{nj})\right) + V(a_D^j)\right)^{\frac{1}{1-\varepsilon}}, \tag{32}$$

with $V(a) = \int_0^a y^{1-\varepsilon} dG(y)$ and country $n \in N$. Note that the price indexes are dependent on χ directly through the effect on the iceberg trade cost and indirectly through the cutoff values of a.

Now, suppose that country i reduces corruption. In this scenario, the derivatives of the cutoff values of a, $(a_D^i)^{1-\varepsilon}$, $(a_X^{ij})^{1-\varepsilon}$, $(a_I^{ij})^{1-\varepsilon}$, with respect to χ^i (equations (8)–(10)) become:

$$\frac{da_D^i}{d\chi^i} = -\left(\frac{1}{1+\chi^i} - \frac{dP^i}{d\chi^i}\frac{1}{P^i}\right)(a_D^i), \tag{33}$$

$$\frac{da_X^{ij}}{d\chi^i} = -\left(\frac{1}{1+\chi^i} - \frac{dP^j}{d\chi^i}\frac{1}{P^j}\right)(a_X^{ij}), \tag{34}$$

$$\frac{da_I^{ij}}{d\chi^i} = \left(\frac{1}{1+\chi^i}\frac{(\tau^{ij})^{1-\varepsilon}(1+\chi^i)^{1-\varepsilon}}{\left[1-(\tau^{ij})^{1-\varepsilon}(1+\chi^i)^{1-\varepsilon}\right]} + \frac{dP^j}{d\chi^i}\frac{1}{P^j}\right)(a_I^{ij}), \tag{35}$$

and the derivatives of the cutoff values with respect to χ^j (equations (11) and (12)) become:

$$\frac{da_D^i}{d\chi^j} = \left(\frac{dP^i}{d\chi^j}\frac{1}{P^i}\right)(a_D^i), \tag{36}$$

$$\frac{da_X^{ij}}{d\chi^j} = -\left(\frac{1}{1+\chi^j} - \frac{dP^j}{d\chi^j}\frac{1}{P^j}\right)(a_X^{ij}), \tag{37}$$

$$\frac{da_I^{ij}}{d\chi^j} = -\left(\frac{1}{1+\chi^j} - \frac{dP^j}{d\chi^j}\frac{1}{P^j}\right)(a_I^{ij}). \tag{38}$$

The derivatives of the price indexes with respect to χ^i are equal to:

$$\begin{aligned}\frac{dP^i}{d\chi^i} = &-\left(\frac{k-(\varepsilon-1)}{\varepsilon-1}\right)P^i(\rho^i)^{-1} \\ &* \left(\sum_{n\neq i}(a_I^{ni})^{k-\varepsilon}\frac{\partial a_I^{ni}}{\partial \chi^i} + \sum_{n\neq i}(\tau^{ni}(1+\chi^i))^{1-\varepsilon}\left((a_X^{ni})^{k-\varepsilon}\frac{\partial a_X^{ni}}{\partial \chi^i} - (a_I^{ni})^{k-\varepsilon}\frac{\partial a_I^{ni}}{\partial \chi^i}\right) + (a_D^i)^{k-\varepsilon}\frac{\partial a_D^i}{\partial \chi^i}\right. \\ &\left. -\frac{\varepsilon-1}{(k-(\varepsilon-1))}\sum_{n\neq i}(\tau^{ni}(1+\chi^i))^{1-\varepsilon}\left(\frac{1}{1+\chi^i}\right)\left((a_X^{ni})^{k-(\varepsilon-1)} - (a_I^{ni})^{k-(\varepsilon-1)}\right)\right),\end{aligned} \tag{39}$$

$$\begin{aligned}\frac{dP^j}{d\chi^i} = &-\left(\frac{k-(\varepsilon-1)}{\varepsilon-1}\right)P^j(\rho^j)^{-1} \\ &* \left(\sum_{n\neq j}(a_I^{nj})^{k-\varepsilon}\frac{\partial a_I^{nj}}{\partial \chi^i} + \sum_{n\neq j}(\tau^{nj}(1+\chi^j))^{1-\varepsilon}\left((a_X^{nj})^{k-\varepsilon}\frac{\partial a_X^{nj}}{\partial \chi^i} - (a_I^{nj})^{k-\varepsilon}\frac{\partial a_I^{nj}}{\partial \chi^i}\right) + (a_D^j)^{k-\varepsilon}\frac{\partial a_D^j}{\partial \chi^i}\right),\end{aligned} \tag{40}$$

where $\rho^i \equiv \sum_{n\neq i}(a_I^{nj})^{k-(\varepsilon-1)} + \sum_{n\neq i}(\tau^{ni}(1+\chi^j))^{1-\varepsilon}\left((a_X^{ni})^{k-(\varepsilon-1)} - (a_I^{ni})^{k-(\varepsilon-1)}\right) + (a_D^i)^{k-(\varepsilon-1)}$. Using the derivatives in equations (33)–(38) to simplify equations (39) and (40), the derivatives become:

$$\frac{dP^i}{d\chi^i} = P^i\frac{1}{1+\chi^i}\left(\frac{(k-(\varepsilon-1))}{k}m_I^i + m_X^i\right), \tag{41}$$

$$\frac{dP^j}{d\chi^i} = -P^j\frac{1}{1+\chi^i}\frac{(k-(\varepsilon-1))}{k}\left(\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon} - (\tau^{ij}(1+\chi^j))^{1-\varepsilon}}{\left[1-(\tau^{ij})^{1-\varepsilon}(1+\chi^i)^{1-\varepsilon}\right]}m_I^{ji} - m_X^{ji}\right), \tag{42}$$

where m_I^{ji} is the share of country j's sales coming from foreign affiliates from country i, and m_X^{ji} is the share of country j's sales coming from exports from country i. Equation (41) is positive and equation (42) may be either positive or negative. Plugging the price index equations into the derivatives of the cutoff values of a with respect to χ^i,

$$\frac{da_D^i}{d\chi^i} = -\frac{1}{1+\chi^i}\left(1-\left(\frac{(k-(\varepsilon-1))}{k}m_I^i + m_X^i\right)\right)(a_D^i) < 0, \tag{43}$$

$$\frac{da_X^{ij}}{d\chi^i} = -\frac{1}{1+\chi^i}\left(1+\frac{(k-(\varepsilon-1))}{k}\left(\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon}-(\tau^{ij}(1+\chi^j))^{1-\varepsilon}}{\left[1-(\tau^{ij})^{1-\varepsilon}(1+\chi^i)^{1-\varepsilon}\right]}m_I^{ji} - m_X^{ji}\right)\right)(a_X^{ij}), \tag{44}$$

$$\frac{da_I^{ij}}{d\chi^i} = \frac{1}{1+\chi^i}\left(\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon}}{\left[1-(\tau^{ij}(1+\chi^i))^{1-\varepsilon}\right]} - \frac{(k-(\varepsilon-1))}{k}\left(\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon}-(\tau^{ij}(1+\chi^j))^{1-\varepsilon}}{\left[1-(\tau^{ij}(1+\chi^i))^{1-\varepsilon}\right]}m_I^{ji} - m_X^{ji}\right)\right)(a_I^{ij}). \tag{45}$$

First, equation (43) is negative: the term in parentheses is positive, given the sum of the two shares is less than one and the coefficient on the share m_I^i is also less than one. This means that, as was the case with the simplifying assumption, a_D^i is decreasing in χ^i and the cutoff $(a_D^i)^{1-\varepsilon}$ is decreasing in χ^i. Equations (44) and (45) are less clear cut. Including the indirect effect on the price indexes can be shown to have no effect on the original findings (where $\frac{\partial a_X^{ij}}{\partial \chi^i}$ is negative and $\frac{\partial a_I^{ij}}{\partial \chi^i}$ is positive), if

$$-1 < \underbrace{\frac{(k-(\varepsilon-1))}{k}}_{<1}\left(\underbrace{\frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon}-(\tau^{ij}(1+\chi^j))^{1-\varepsilon}}{1-(\tau^{ij}(1+\chi^i))^{1-\varepsilon}}}_{?}\underbrace{m_I^{ji}}_{<1} - \underbrace{m_X^{ji}}_{<1}\right) < \frac{(\tau^{ij}(1+\chi^i))^{1-\varepsilon}}{\left[1-(\tau^{ij}(1+\chi^i))^{1-\varepsilon}\right]}, \tag{46}$$

which similar to equation (27), has the tariff term dependent on both corruption levels. That term may be either positive or negative, depending on whether country i or country j's corruption is greater: if country j is more corrupt, then the numerator will be negative and the inequality in equation (46) will hold. If country i is more corrupt, then the sign of the tariff term is unclear. Generally, however, it is likely the overall effect remains unchanged for a_X^{ij} and a_I^{ij} in cases that are not extreme, given that m_I^{ji} and m_X^{ji} are likely small.

The derivatives of the cutoff values with respect to χ^j (equations (11) and (12)) become:

$$\frac{da_D^i}{d\chi^j} = -\frac{1}{1+\chi^j}\frac{(k-(\varepsilon-1))}{k}\left(\frac{(\tau^{ji}(1+\chi^j))^{1-\varepsilon}-(\tau^{ji}(1+\chi^i))^{1-\varepsilon}}{\left[1-(\tau^{ji})^{1-\varepsilon}(1+\chi^j)^{1-\varepsilon}\right]}m_I^{ij}-m_X^{ij}\right)(a_D^i), \quad (47)$$

$$\frac{da_X^{ij}}{d\chi^j} = -\frac{1}{1+\chi^j}\left(1-\left(\frac{(k-(\varepsilon-1))}{k}m_I^j+m_X^j\right)\right)(a_X^{ij})<0, \quad (48)$$

$$\frac{da_I^{ij}}{d\chi^j} = -\frac{1}{1+\chi^j}\left(1-\left(\frac{(k-(\varepsilon-1))}{k}m_I^j+m_X^j\right)\right)(a_I^{ij})<0. \quad (49)$$

Equations (48) and (49) are both negative, consistent with the findings in the simplified version of the model. Equation (47) is of interest. In the simplified version of the model, this derivative is equal to zero. In this scenario, the derivative depends only on the impact of the reduction in χ^j on the price index, though again the overall effect will likely be small, given the shares m_I^{ij} and m_X^{ij} are country-pair specific.

Moving on to the effect of reducing both countries' corruption, using the assumption that $\chi^i = \chi^j = \chi$, the derivatives of the cutoff values with respect to χ (equations (13)–(15) become:

$$\frac{da_D^i}{d\chi} = \frac{1}{1+\chi}\left(-1+\left(\frac{(k-(\varepsilon-1))}{k}m_I^i+m_X^i\right)+\frac{(k-(\varepsilon-1))}{k}m_X^{ij}\right)(a_D^i), \quad (50)$$

$$\frac{da_X^{ij}}{d\chi} = \frac{1}{1+\chi}\left(-2+\left(\frac{(k-(\varepsilon-1))}{k}m_I^j+m_X^j\right)+\frac{(k-(\varepsilon-1))}{k}m_X^{ji}\right)(a_X^{ij})>0, \quad (51)$$

$$\frac{da_I^{ij}}{d\chi} = \frac{1}{1+\chi}\left(-\frac{1-2(\tau^{ij}(1+\chi))^{1-\varepsilon}}{\left[1-(\tau^{ij}(1+\chi))^{1-\varepsilon}\right]}+\left(\frac{(k-(\varepsilon-1))}{k}m_I^j+m_X^j\right)+\frac{(k-(\varepsilon-1))}{k}m_X^{ji}\right)(a_I^{ij}). \quad (52)$$

Previously, without the indirect effect of the change in χ on the price indexes, equations (50) and (51) were negative, indicating that reducing corruption in both countries would lead to an increase in the cutoff value of a (and a decrease in $a^{1-\varepsilon}$), which implies an increase in the range of firms entering the market (decrease in $(a_D^i)^{1-\varepsilon}$) and an increase in the range of firms supplying the foreign market (decrease in $(a_X^{ij})^{1-\varepsilon}$). The indirect effect of the decrease in corruption here is positive, indicating that it is working against the direct effect. The size of the indirect effect is likely small enough that it does not change the sign of the overall effect for equation (50) (true as long as m_X^{ij} is not close to one). In equation (51), the indirect effect can be easily shown to not exceed the direct effect, indicating the sign of equation (51) remains the same as in the simplified version of the model.

The sign of $\frac{da_I^{ij}}{d\chi}$ was unclear in the simplified version of the model, depending on whether the numerator, $1-2(\tau^{ij}(1+\chi))^{1-\varepsilon}$, was positive or negative. With the addition of the indirect effect, which is positive, it is now true that for a larger range of values of $(\tau^{ij}(1+\chi))^{1-\varepsilon}$, the overall effect of the change in corruption in both countries i and j will be positive. This means that for a larger range of values of $(\tau^{ij}(1+\chi))^{1-\varepsilon}$, a reduction in country i and country j corruption will result in a decrease in a_I^{ij} and therefore an increase in $(a_I^{ij})^{1-\varepsilon}$, which implies an increase the range of firms choosing exports overall and a decrease in FDI (figure 2).

Generally, as has been discussed in this section, removing the simplifying assumption that the fixed costs are proportional to the size of the market (that $f_D = F_D^i A^i$ with $F_D^i \in (0,1)$ and $f_y = F_y^i A^j$ with $F_y^i \in (0,1)$, $y \in \{X, I\}$), does not change the results for four of the nine derivatives of the cutoff values, and is unlikely to change the signs of the remaining five under reasonable assumptions about the size of the market share of a single partner country in any one country's domestic market.