This paper studies the effect of trade liberalization on corruption using Melitz’s model. We find that corruption is reduced because of an increase in total revenues when exporting cost is lower. Moreover, when home country trades with a less corrupt foreign country, fewer domestic firms will stay active than in the symmetric case but many of them will become exporters. In the case where foreign firms have to pay higher exporting cost, home country will have more firms operating domestically but only a smaller number of them will export. Effect on corruption level is determined by changes in total revenues due to these changes in home country’s market environment.
1 Introduction

Corruption and its effect on economic growth have been a popular topic of debates among economists. The general consensus is that corruption affects growth negatively. Mauro (1995) is one of the first papers using systematic cross-country empirical analysis to study corruption, measured by indicators of bureaucratic honesty, and efficiency to economic growth. He found that corruption lowers private investment and reduces economic growth. A popular explanation for this negative effect is that corruption allows inefficient usage of resources and distorts economic activities.

Some have found that other variables play an important role in determining the relationship between corruption and economic growth. Ehrlich and Lui (1999) study the investments in accumulating human capital and accumulating political capital and their consequences on long-term growth under two political regimes. Neeman, Paserman, and Simhon (2008) have found evidence that the relationship between corruption and output per capita is strongly related to a country’s degree of openness. That is in open economies, corruption and GNP per capita are negatively correlated, but closed economies show no relationship. Other empirical studies, including Ades and Di Tella (1999), Fisman and Gatti (2002), Goldsmith (1999), Treisman (2000), and Wei (2000), have found that higher trade intensity and/or small populations are associated with lower corruption levels. On the other hand, Dutt and Traca (2010) show that in high tariff environments, corruption can actually enhance trade flows between countries by allowing firms to evade these tariff barriers.

This paper contributes to the literature on corruption by establishing a theoretical model based on Melitz (2003) to study the effect of trade liberalization on corruption. Melitz models how international trade reallocates resources among heterogeneous firms in a monopolistically competitive industry. In this paper, corruption is modelled as the fraction of total revenues from firms across the economy spent on bribery to government officials to reduce their variable costs in production. Examples of this type of bribery include bribing a public
official to gain significant advantage over its competitors or to skim on required production protocols. In 2009, William Jefferson, a Louisiana representative, was found guilty of corruption. He took at least $100,000 in bribes and recommended a tech company named iGate, Inc. to the U.S. Army and officials in Nigeria, Ghana, and Cameroon. The article "For Bribing Officials, Chinese Give the Best" in the New York Times in March 2009 describes the situation in China where businessmen lavish government officials with luxury goods year round. Stores carrying these luxury products even admitted that they have special accounts for government officials, their relatives, and sometimes their mistresses. The expenses on these bribes are considered an increase in fixed costs that may help reduce variable costs in production for businesses involved in bribery. For example, firms can bribe government officials to evade taxation. Sequeira and Djankov (2010) call this type of corruption "collusive corruption" since public officials and private agents collude to share rents generated by involving in illegal transactions. Public officials, such as health inspectors, safety inspectors, and fire inspectors, can also create unnecessary troubles to force firms to pay bribes. Sequeira and Djankov call this "coercive corruption". However, in both types of corruption, paying bribes help firms reduce their variable costs. The approach used in this paper is similar to the innovation literature which includes several studies showing how firms choose to spend more on fixed costs to reduce variable costs in Melitz’s international trade model, such as Bustos (2011) and Yeaple (2005). Bustos shows that more productive firms will choose higher technology and trade openness encourages more firms to upgrade their technology. Falvey et al (2007) studying the case where home country has a superior technology compared to foreign country concludes that the home survival cutoff is lower and the home export cutoff is higher than the foreign ones.

The main research question here is whether a country will experience more or less corruption with trade openness. We find that trade liberalization does reduce corruption and increase social welfare. Departing from the symmetric case, this paper also studies the situation where foreign country is less corrupt than home country and shows that home country
will have fewer firms but many of them will be exporters. When foreign firms have to pay higher exporting cost, home country has more firms but only a small number of them will export. The effect on corruption level depends on how total revenues change due to these changes in the home country’s market. The paper is organized as follows. Section 2 provides the basic setup of Melitz’ model with CES preferences demand and Cobb-Douglas production function. Section 3 introduces an option for firms to produce and export goods to foreign markets. Section 4 analyzes firms’ decisions on whether to export or not and whether to use a low or high level of bribery. Section 5 analyzes the case where countries are asymmetric. Lastly, section 6 summarizes key results from the model.

2 The Setup

2.1 Demand

We have an economy with homogeneous consumers and heterogeneous firms. A representative consumer has income $I$ and CES preferences over a set of differentiated goods $x \in X$, where $X$ is a set of all potentially available goods. Income consists of wages normalized to 1 paid for inelastically supplied amount of labor $L$ and firm profits $\pi$ which are equally distributed among all consumers.

Consumer maximizes his utility as follows:

$$
\max_{q(x)} U = \left( \int_{x \in X} q(x)^\rho dx \right)^{\frac{1}{\rho}}, 0 < \rho < 1 \\
\text{s.t. } \int_{x \in X} p(x)q(x)dx = I = L + \pi
$$

where $q(x)$ is the demand for good $x$, $p(x)$ is the price of good $x$, $\sigma$ is the elasticity of substitution between any two goods with $\sigma > 1$ and $\rho \equiv \frac{\sigma - 1}{\sigma}$. We define the aggregate price index $P$ as:

$$
P = \left[ \int_{x \in X} p(x)^{1-\sigma} dx \right]^{\frac{1}{1-\sigma}}.
$$
The demand for good \( x \) is derived from the consumer maximization problem:

\[
q(x) = \left( \frac{I}{P} \right) \left[ \frac{p(x)}{P} \right]^{-\sigma},
\]

and the price elasticity of demand is:

\[
\varepsilon_p = \frac{dq}{dp} \frac{p}{q} = \sigma.
\]

### 2.2 Production

We consider a monopolistically competitive market with \( N \) firms where each firm produces a differentiated good \( x \). They can choose to involve in a low or high level of bribery to government officials to reduce their variable costs. The increasing returns technologies for low and high level of bribery are defined as follows

\[
TC^{lb}(\varphi) = f + \frac{1}{\varphi} q,
\]

\[
TC^{hb}(\varphi) = f \eta + \frac{1}{\varphi r} q.
\]

where \( f > 0 \) is the fixed cost of production which is the same for all firms, \( \varphi \geq 1 \) is a firm’s productivity level, \( r \) is the amount of variable cost that can be reduced by involving a high level of bribery to government officials, and \( \eta \) is the additional fixed cost associated with a high level of bribery. \( r \) and \( \eta \) are greater than 1.

Each firm draws its productivity from a Pareto distribution with the cumulative distribution function:

\[
F(\varphi) = 1 - \varphi^{-\gamma}, \gamma > Max\{1, \sigma - 1\}.
\]  

The assumption \( \gamma > Max\{1, \sigma - 1\} \) assures that in equilibrium the size distribution of firms has a finite mean. Firms also face an exogenous probability of exit \( \delta \).
Firm maximizes its profits:

\[
\max_p \pi_{lb}^{\varphi} = pq - \frac{1}{\varphi}q - f,
\]

or

\[
\max_p \pi_{hb}^{\varphi} = pq - \frac{1}{\varphi_f}q - f, \quad \text{s.t. } \pi_{lb} \geq 0, \pi_{hb} \geq 0.
\]

Solving the firm’s problem, we have:

\[
\begin{align*}
\pi_{lb}^{\varphi} &= \frac{1}{\rho_f}, \\
\pi_{hb}^{\varphi} &= \frac{1}{\rho_f^r}, \\
q_{lb}^{\varphi} &= IP^{\sigma-1}(\rho_f)^\sigma, \\
q_{hb}^{\varphi} &= IP^{\sigma-1}(\rho_f^r)^\sigma, \quad \text{and} \\
\pi_{lb}^{\varphi} &= \frac{I(P\rho_f)^{\sigma-1}}{\sigma} - f, \\
\pi_{hb}^{\varphi} &= \frac{I(P\rho_f^r)^{\sigma-1}}{\sigma} - f.
\end{align*}
\]

3 Model with International Trade

Let the economy as described above trade with another economy that has the same parameters as the domestic economy, except that it does not have corruption.

3.1 Production in the Domestic Market

The equilibrium price \( p_d \), quantity \( q_d \), and profits \( \pi_d \) in the domestic market given the aggregate price index in the open economy \( P_T \) and consumer income \( I_T \) are as follows:

\[
\begin{align*}
\pi_{lb}^{\varphi} &= \frac{1}{\rho_f}, \\
\pi_{hb}^{\varphi} &= \frac{1}{\rho_f^r}, \\
q_{lb}^{\varphi} &= IP^{\sigma-1}(\rho_f)^\sigma, \\
q_{hb}^{\varphi} &= IP^{\sigma-1}(\rho_f^r)^\sigma, \quad \text{and} \\
\pi_{lb}^{\varphi} &= \frac{I(P_T\rho_f)^{\sigma-1}}{\sigma} - f, \\
\pi_{hb}^{\varphi} &= \frac{I(P_T\rho_f^r)^{\sigma-1}}{\sigma} - f.
\end{align*}
\]
3.2 Exports

Following Melitz (2003), we model international trade with two new cost parameters. Let \( \tau > 1 \) be a per-unit costs for exporting such as transportation costs and tariffs. Also, let \( f_x \) be the fixed cost of exporting and \( f_x > f \). Then, the total cost of an exporting firm is:

\[
TC_{lb}^x(\varphi) = f_x + \left(\frac{\tau}{\varphi}\right) q_x, \\
\text{or } TC_{hb}^x(\varphi) = f_x + \left(\frac{\tau}{\varphi_{FG}}\right) q_x.
\]

An exporting firm maximizes its profits in the foreign market as follows:

\[
\max_{p_x} \pi_{lb}^x(\varphi) = p_x q_x - \frac{\tau}{\varphi} q_x - f_x, \\
\text{or } \max_{p_x} \pi_{hb}^x(\varphi) = p_x q_x - \frac{\tau}{\varphi_T} q_x - f_x \\
\text{s.t. } \pi_x \geq 0.
\]

Then, the equilibrium price, quantity, and profits for an exporting firm are:

\[
p_{lb}^x(\varphi) = \frac{\tau}{\rho \varphi}, \quad p_{hb}^x(\varphi) = \frac{\tau}{\rho \varphi_T}, \\
q_{lb}^x(\varphi) = I_T P_T^{\sigma-1} \left(\frac{\rho \varphi}{\tau}\right)^\sigma, \quad q_{hb}^x(\varphi) = I_T P_T^{\sigma-1} \left(\frac{\rho \varphi_T}{\tau}\right)^\sigma, \quad \text{and} \\
\pi_{lb}^x(\varphi) = \frac{I_T}{\sigma} \left(\frac{P_T \rho \varphi}{\tau}\right)^{\sigma-1} - f_x, \quad \pi_{hb}^x(\varphi) = \frac{I_T}{\sigma} \left(\frac{P_T \rho \varphi_T}{\tau}\right)^{\sigma-1} - f_x.
\]

Since exporting firms operate both in the domestic market and the foreign market, their profits are \( \pi_X(\varphi) = \pi_d(\varphi) + \pi_x(\varphi) \). Note that exporting firms do not have an additional bribery for their exporting production if they choose the high level of bribery since it is already paid in the domestic market. We also have that \( I_T = I = \frac{\gamma}{\gamma - \rho} L \). Here, all costs are paid to domestic labor so it does not make a difference whether firms pay to a public official in the form of bribes or to labor in the form of wages.
4 Corruption in An Open Economy

4.1 Firms’ Exporting and Bribery Decisions

From the above sections, we can summarize the profit functions for firms depending on their choices of whether to export or not and whether to use a low or high level of bribery.

\[
\begin{align*}
\pi_d^{lb} &= \frac{I_T}{\sigma} (\rho \varphi P_T)^{\sigma-1} - f, \\
\pi_d^{hb} &= \frac{I_T}{\sigma} (\rho \varphi P_T r)^{\sigma-1} - f \eta, \\
\pi_X^{lb} &= (1 + \tau^{1-\sigma}) \frac{I_T}{\sigma} (\rho \varphi P_T)^{\sigma-1} - (f + f_x), \\
\pi_X^{hb} &= (1 + \tau^{1-\sigma}) \frac{I_T}{\sigma} (\rho \varphi P_T r)^{\sigma-1} - (f \eta + f_x).
\end{align*}
\]

Since only firms that earn non-negative profits will produce, the cut-off level of producing firms \( \varphi_d \) satisfies \( \pi(\varphi_d^{lb}) = 0 \), so

\[
\varphi_d = \frac{1}{P_T \rho} \left( \frac{f \sigma}{I_T} \right)^{\frac{1}{\sigma-1}}. \tag{2}
\]

Producing firms face two decisions: bribery level and exporting choices. Let \( \varphi_b \) and \( \varphi_x \) denote the cut-off level of firms using high level of bribery and exporting firms. As represented in Figure 1, we assume that \( \varphi_b < \varphi_x \), that means that firms with productivity level between \( \varphi_b \) and \( \varphi_x \) find it more profitable to only operate in the domestic market with a high level of bribery than operate in both domestic and foreign markets with a low level of bribery.

The firm with productivity level \( \varphi_b \) is indifferent between a low level of bribery and a higher level:

\[
\frac{I_T}{\sigma} (\rho \varphi_b P_T)^{\sigma-1} - f = \frac{I_T}{\sigma} (\rho \varphi_b P_T r)^{\sigma-1} - f \eta.
\]
\[ \varphi_b = \left[ \frac{f(\eta - 1)^\sigma}{I_T(r^\sigma - 1)} \right]^{\frac{1}{\sigma - 1}} \frac{1}{P_T \rho} \]  

\[ = \varphi_d \left( \frac{\eta - 1}{r^\sigma - 1} \right)^{\frac{1}{\sigma - 1}}. \]  

If \( \left( \frac{\eta - 1}{r^\sigma - 1} \right)^{\frac{1}{\sigma - 1}} > 1 \), then \( \varphi_b > \varphi_d \). That means only the more productive firms choose a high level of bribery. It is a reasonable assumption since firms have to make the decision whether to stay in business first before deciding whether to export or not. We also observe from empirical studies that not all firms in the market are exporters.

Similarly, the firm with productivity level \( \varphi_x \) is indifferent between only producing in the domestic market and producing in both markets using a high level of bribery

\[ \frac{I_T}{\sigma} (\rho \varphi_x P_T r)^{\sigma - 1} - f \eta = (1 + r^{1-\sigma}) \frac{I_T}{\sigma} (\rho \varphi_x P_T r)^{\sigma - 1} - (f \eta + f_x). \]

\[ \varphi_x = \varphi_d \left[ \frac{f \varphi_x r^{\sigma - 1}}{f r^{\sigma - 1}} \right]^{\frac{1}{\sigma - 1}}. \]  

If \( \left[ \frac{f \varphi_x r^{\sigma - 1}}{f r^{\sigma - 1}} \right]^{\frac{1}{\sigma - 1}} > 1 \), then only more productive firms choose to export. We also assume that \( \varphi_b < \varphi_x \). That means \( \frac{\varphi_x}{\varphi_b} = \left[ \frac{f \varphi_x r^{\sigma - 1}(\varphi_x - 1)}{f r^{\sigma - 1}(\eta - 1)} \right]^{\frac{1}{\sigma - 1}} > 1. \)
4.2 Market Equilibrium

The market equilibrium price, the distributions of productivity level for active firms, and the fractions of firms exporting and firms choosing a high level of bribery are determined by the free entry condition. This condition requires that fixed entry cost equals the present value of expected profits:

\[ f_e = [1 - F(\varphi_d)]^{1/\delta} \tilde{\pi}, \quad (6) \]

where \( 1 - F(\varphi_d) = (\varphi_d)^{-\chi} \) is the probability of firms remaining active and \( \tilde{\pi} \) is the expected profits of active firms.

\[ \tilde{\pi} = \bar{\pi}_d + p_x \bar{\pi}_x, \]

where \( \bar{\pi}_d \) is the expected profit from domestic market, \( p_x = \frac{1 - F(\varphi_x)}{1 - F(\varphi_d)} \) is the probability of
exporting conditional on survival, and \( \bar{\pi}_x \) is the expected profit from foreign market. Using the cut-off productivity levels obtained in the previous section, we can derive \( \bar{\pi} \):

\[
\bar{\pi} = \frac{\sigma - 1}{\gamma - \sigma + 1} f \Delta, \tag{7}
\]

where \( \Delta = 1 + (\eta - 1) \frac{\sigma - 1}{\sigma - 1} (r^{\sigma - 1} - 1) \frac{\gamma}{\gamma - 1} + \left[ \frac{f r^{\sigma - 1}}{f x^{\sigma - 1}} \right] \frac{f_x}{f}. \]

By substituting the solution for \( \bar{\pi} \) in equation (6) and using equations (3) (5), we can obtain all the cut-off productivity levels:

\[
\varphi_d = \left[ \frac{\sigma - 1}{\gamma - \sigma + 1} \frac{f \Delta}{\delta f e} \right]^{\frac{1}{\gamma}}, \tag{8}
\]

\[
\varphi_b = \left[ \frac{\sigma - 1}{\gamma - \sigma + 1} \frac{f \Delta}{\delta f e} \right]^{\frac{1}{\gamma}} \left( \frac{\eta - 1}{r^{\sigma - 1} - 1} \right)^{\frac{1}{\gamma - 1}}, \tag{9}
\]

\[
\varphi_x = \left[ \frac{\sigma - 1}{\gamma - \sigma + 1} \frac{f \Delta}{\delta f e} \right]^{\frac{1}{\gamma}} \left[ \frac{f x^{\sigma - 1}}{f r^{\sigma - 1}} \right] \frac{1}{\gamma - 1}. \tag{10}
\]

Note that \( \gamma > \max\{1, \sigma - 1\} \) from expression (1), so \( \gamma - \sigma + 1 > 0 \). Finally, the price index \( P_T \) can be derived from equation (2):

\[
P_T = \left[ \frac{\sigma - 1}{\gamma - \sigma + 1} \frac{f \Delta}{\delta f e} \right]^{\frac{1}{\gamma}} \frac{1}{\rho} \left( \frac{\sigma f}{\gamma - \rho - L} \right)^{\frac{1}{\gamma - 1}}. \tag{11}
\]

When the variable exporting cost, \( \tau \), decreases, the cut-off level of existing firms, \( \varphi_d \), increases and the cut-off level of exporting firms, \( \varphi_x \), decreases. That means, there are fewer firms producing in the market due to more competition from foreign firms but the fraction of firms exporting is larger because exporting firms earn additional profits from exporting goods to foreign market.

**Proposition 1** When a country opens up its economy, the cut-off productivity level for firms choosing a high level of bribery, \( \varphi_b \), increases.
When $\tau$ decreases, firms face two changes: a reduction in their domestic profits and an increase in their foreign profits. If their total profits are lowered, they can choose to bribe government officials more aggressively. However, the result in this specification shows that although the fraction of firms choosing a high level of bribery out of the total number of active firms remains unchanged, higher productivity firms choose to bribe more aggressively when an economy opens up. That is because firms have to choose whether to use a high or low level of bribery before they have to choose whether to export or not. The bribery decision in this case does not depend on business in foreign markets. Therefore, when the competition is more aggressive in open economy and only more productive firms can survive, the cut-off productivity level of firms involved in a high level of bribery also increases.

**Proposition 2** The bribery expense to firms as a fraction of their total revenues decreases when the exporting costs, $\tau$, decrease.

Total revenues across all firms increase since firms face lower exporting costs. Because the total bribery expense conditional on probability of survival remains unchanged, it takes a smaller proportion of the total revenues firms receive from their production. Therefore, we can say that bribery level or corruption in the economy as a whole decreases when the country liberalizes trades with foreign markets.

**Proposition 3** If we assume that $\varphi_x < \varphi_b$, the cut-off productivity level of firms choosing a high level of bribery decreases when $\tau$ decreases. Since $\varphi_d$ increases due to more competition in domestic market, the fraction of surviving firms choosing to bribe aggressively increases. However, the total bribery expense as a fraction of their total revenues still decreases since total revenues increase more than total bribery expense does.

Based on the results derived in Bustos (2011), we have

$$\bar{\pi} = \frac{\sigma - 1}{\gamma - \sigma + 1} f \Delta,$$

where

$$\Delta = 1 + \left(\tau^{\sigma - 1} \frac{f_x}{f}\right) \frac{\sigma - 1}{\gamma - \sigma + 1} f_x + \left[\eta - 1 \left(1 + \tau^{1-\sigma}(\tau^{\sigma - 1} - 1)\right) \frac{\sigma - 1}{\gamma - \sigma + 1} \right] (\eta - 1).$$
\[
\varphi_d = \left( \frac{\sigma - 1}{\gamma - \sigma + \delta f_e \Delta} \right)^{\frac{1}{\tau}}, \\
\varphi_x = \left( \frac{\sigma - 1}{\gamma - \sigma + \delta f_e \Delta} \right)^{\frac{1}{\tau}} \tau \left( \frac{f_x}{f} \right)^{\frac{1}{\sigma - 1}}, \\
\varphi_b = \left( \frac{\sigma - 1}{\gamma - \sigma + \delta f_e \Delta} \right)^{\frac{1}{\tau}} \left[ \frac{\eta - 1}{(1 + \tau^{\sigma - 1})(\tau^{\sigma - 1} - 1)} \right]^{\frac{1}{\sigma - 1}}.
\]

We see that the assumption on the relationship between \( \varphi_x \) and \( \varphi_b \) changes some results on the effect of \( \tau \) on \( \varphi_b \) but the final conclusion on the fraction of bribery expense out of total revenues, or the corruption level in the economy as a whole, is the same. When a country opens up its economy for trading with other countries, corruption tends to decrease.

5 Analysis on Asymmetric Countries

The discussion so far has assumed that the foreign country is identical to the home country. Therefore, the cut-off levels of surviving firms, exporting firms, and firms with a high level of bribery from the home country can be applied to the foreign country. However, when we assume different characteristics of the home country, these results do not hold anymore.

5.1 Foreign Country Is Less Corrupt Than Home Country

First, we can look at the case where foreign country is less corrupt than home country. Then, in the case of "coercive corruption", that means foreign firms receive the benefit of high level of bribery in the home country without having to pay its costs. The total cost for foreign firms is

\[
\tilde{TC} = f + \frac{1}{\varphi_r} \tilde{q},
\]

Let \( M = \left( \frac{\sigma}{\overline{p_t}} \right)^{\tau - 1} \frac{1}{\overline{p_{f_r}}} \) denote the market environment in home country and \( \tilde{M} \) denote
the market environment in foreign country. If $\varphi_x < \varphi_b$, we can write the cut-off productivity levels as

$$\varphi_d = Mf^{\frac{1}{\sigma-1}}, \quad \varphi_x = \widetilde{M}\tau(f_x)^{\frac{1}{\sigma-1}}$$

$$\tilde{\varphi}_d = \frac{\widetilde{M}}{r} f^{\frac{1}{\sigma-1}}, \quad \tilde{\varphi}_x = \frac{M\tau}{r} (f_x)^{\frac{1}{\sigma-1}}.$$

Then, $\frac{\varphi_d}{\tilde{\varphi}_d} = \frac{\varphi_d}{\varphi_x} = \left[ \frac{(r)}{\tau} \right]^{\frac{1}{\sigma-1}} = \mu^{-1}$. $\mu > 1$ as long as $r < \tau$.

$$\tilde{\varphi}_x = \mu \varphi_d,$$

$$\varphi_x = \mu \tilde{\varphi}_d.$$

We also have $\varphi_d < \varphi_x$ and $\tilde{\varphi}_d < \tilde{\varphi}_x$. From Figure 2, the ordering of these cut-off productivity levels is as follows

$$\tilde{\varphi}_d < \varphi_s < \varphi_d < \varphi_x < \varphi_{xs} < \tilde{\varphi}_x,$$

where $\varphi_s$ and $\varphi_{xs}$ are cut-off level of survival and of exporting in the symmetric case.

**Proposition 4** When foreign country is less corrupt than home country, home country has fewer active firms than in the symmetric case but a larger number of them are exporters.

Since firms in foreign country do not have to pay a high level of bribery to have the cost reduction, this market is less competitive. So, less productive firms can survive in foreign country. However, when these firms want to export to home country, they face competition with more productive firms in home country. Therefore, it requires very high productivity level of firms in foreign country to make a profit from exporting to home country. On the other hand, firms in home country have to pay more bribes and face competition from foreign firms; so, the number of active firms is less than that in foreign country. But,
those surviving firms in home country can easily make a profit from exports due to a less competitive environment in foreign country. The result also holds for the case where $\varphi_b < \varphi_x$ as long as $r < \tau$.

\[
\varphi_d = M f^{\frac{1}{\sigma - 1}}, \quad \varphi_x = \frac{M^T (f_x)^{\frac{1}{\sigma - 1}}}{r};
\]

\[
\bar{\varphi}_d = M f^{\frac{1}{\sigma - 1}}, \quad \bar{\varphi}_x = \frac{M (f_x)^{\frac{1}{\sigma - 1}}}{r}.\]

Then, \[
\frac{\bar{\varphi}_d}{\varphi_x} = r \frac{\bar{\varphi}_d}{\varphi_x} = \left[ \left( \frac{\tau}{r} \right)^{\frac{1}{\sigma - 1}} f \right]^{\frac{1}{\sigma - 1}} = \mu^{-1}.
\]

\[
\bar{\varphi}_x = \mu \varphi_d; \quad \varphi_x = \mu r \bar{\varphi}_d.
\]

In summary, when trading with a less corrupt country, home country has fewer active firms but these firms have a higher chance of being exporters. Similarly, when trading with a more corrupt country, home country will have more active firms but only the very productive firms can export.

5.2 Firms From Foreign Country Pay Higher Exporting Cost Than Firms From Home Country

In this section, firms in foreign country have to pay more exporting cost when they want to export to home country than when firms in home country export to foreign country.

\[
\begin{align*}
\varphi_d &= M f^\frac{1}{\pi - 1}, \quad \varphi_x = \tilde{M} \tau(f_x)^\frac{1}{\pi - 1} \\
\bar{\varphi}_d &= \tilde{M} f^\frac{1}{\pi - 1}, \quad \bar{\varphi}_x = M \tau'(f_x)^\frac{1}{\pi - 1},
\end{align*}
\]

where \( \tau' > \tau > 1 \).
We have \( \frac{\bar{d}}{\bar{s}} = \left( \frac{\tau}{\sigma} \right) \frac{\bar{d}}{\bar{s}} = \left( \frac{\sigma - 1}{\tau} \right) \frac{\bar{d}}{\bar{s}} = \lambda^{-1} \).

\[
\bar{p}_x = \lambda \bar{p}_d,
\]

\[
\varphi_x = \left( \frac{\tau}{\sigma} \right) \lambda \bar{p}_d = \lambda' \bar{p}_d,
\]

where \( \lambda' < \lambda \).

From Figure 3, the ordering of these cut-off productivity levels is:

\[
\varphi_d < \varphi_s < \bar{p}_d,
\]

\[
\frac{\lambda'}{\lambda} \bar{p}_x < \varphi_{xs} < \varphi_x.
\]

**Proposition 5**  When foreign firms have to pay higher exporting cost, home country will have more active firms than in the symmetric case but a smaller number of them are exporters.

Market in home country is less competitive due to higher importing restrictions; so the cut-off level of survival in home country is lower than in foreign country. Market in foreign country, on the other hand, is more competitive because home country’s firms have to pay less exporting cost to have their products in foreign country. Therefore, exporters in home country are those with very high productivity level. On the other hand, exporters in foreign country face less competition in home country but have to pay higher exporting cost; so it is ambiguous whether \( \bar{p}_x \) is lower or higher than in the symmetric case.
5.3 Corruption in Asymmetric Countries

We have from Section (4.1) that \( \varphi_b = \varphi_d \left( \frac{c-1}{\sigma - 1} \right)^{\frac{1}{\sigma - 1}} \) in the case of \( \varphi_b < \varphi_x \) and \( \varphi_b = \varphi_d \left[ \frac{c^e}{(1+r^e - r^e)(c^e - 1)} \right]^{\frac{1}{\sigma - 1}} \) in the case of \( \varphi_b > \varphi_x \). So, when home country trades with a less corrupt foreign country, the cut-off productivity level of firms choosing a high level of bribery in home country increases due to an increase in the cut-off productivity level of active firms. However, given the probability of survival, the total bribery expense stays the same. On the other hand, depending on the magnitude of the increase in \( \varphi_d \) and the decrease in \( \varphi_x \), if total revenues across home country’s firms decrease, then corruption, measured by the fraction of total revenues spent on bribery, in home country is higher than when two countries are identical, and vice versa.

When foreign country’s firms have to pay higher exporting cost than home country’s firm do when exporting to foreign country, the cut-off productivity level of firms choosing a high level of bribery in home country decreases due to a decrease in the cut-off productivity level
of active firms. The total bribery expense increases, given the probability of survival. If total revenues across home country’s firms decrease, then corruption, measured by the fraction of total revenues spent on bribery, in home country is higher than when two countries are identical, and vice versa.

6 Conclusion

Economists have established that corruption, in general, is detrimental to economic growth. It pushes economies even further away from efficiency than they normally are. This paper has shown the benefits of trade liberalization. When a country opens up its economies, firms’ revenues from domestic market are reduced but they have an opportunity to export to foreign countries and gain additional revenues. With the assumption $\varphi_b < \varphi_x$, only the most productive firms choose to bribe more aggressively. When we assume $\varphi_x < \varphi_b$, more firms choose a high level of bribery. However, since total revenues increases when bribery expense remains unchanged (in the first case) or decreases by less than the increase in total revenues (in the second case), firms tend to spend a smaller fraction of their revenues on bribery. Therefore, trade liberalization can help reduce corruption.

Moreover, the paper extends to the study of asymmetric countries. In particular, when foreign country is less corrupt than home country, home country has fewer firms but a larger number of them are exporters. In the case where foreign firms have to pay higher exporting cost, home country have more firms since it can protect its market but a smaller number of those firms are exporters. The conclusion on whether corruption is lower or higher than in the symmetric case depends on how total revenues change due to the changes in the market environment.
7 Appendix

A. The expected profits include both the expected profits in domestic market and foreign market given that firms are exporters: \( \bar{\pi} = \bar{\pi}_d + p_x \bar{\pi}_x \), where \( p_x = \frac{1 - F(\varphi_x)}{1 - F(\varphi_d)} = \left( \frac{\varphi_d}{\varphi_x} \right)^{-\gamma} \).

The expected profits in domestic market is calculated as follows

\[
\bar{\pi}_d = \frac{I_T}{\sigma} \left( \frac{P_T \rho \overline{\varphi}_d}{\tau} \right)^{\sigma - 1} - f - f(\eta - 1) \frac{1 - F(\varphi_b)}{1 - F(\varphi_d)},
\]

where \( \overline{\varphi}_d = \left\{ \begin{array}{l}
\left[ \int_{\varphi_d}^{\varphi_b} \varphi^{\sigma - 1} \left( \frac{\gamma \varphi^{1 - \gamma} - 1}{1 - F(\varphi_d)} \right) \right]^{\frac{1}{\gamma - \sigma}} + \left[ \int_{\varphi_d}^{\infty} r^{\sigma - 1} \varphi^{\sigma - 1} \left( \frac{\gamma \varphi^{1 - \gamma} - 1}{1 - F(\varphi_d)} \right) \right]^{\frac{1}{\gamma - \sigma}} \\
\left[ \frac{\gamma}{\gamma - \sigma + 1} (\varphi_d)^{\sigma - 1} \left( r^{\sigma - 1} - 1 \right) \left( \frac{\eta - 1}{r^{\sigma - 1} - 1} \right)^{\frac{\sigma - \gamma + 1}{\sigma + 1}} \right]^{\frac{1}{\gamma - \sigma}} \end{array} \right. \]

The expected profits from exporting is calculated as follows

\[
\bar{\pi}_x = \frac{I_T}{\sigma} \left( \frac{P_T \rho \overline{\varphi}_x}{\tau} \right)^{\sigma - 1} - f_x,
\]

where \( \overline{\varphi}_x = \left\{ \begin{array}{l}
\left[ \int_{\varphi_x}^{\varphi_b} \varphi^{\sigma - 1} \left( \frac{\gamma \varphi^{1 - \gamma} - 1}{1 - F(\varphi_d)} \right) \right]^{\frac{1}{\gamma - \sigma}} \end{array} \right. \]

So, we can obtain \( \bar{\pi} \) as in equation (7).

B. In the case where \( \varphi_b < \varphi_x \), total bribery expense is

\[
B = \int_{\varphi_b}^{\infty} f(\eta - 1) \frac{\gamma \varphi^{1 - \gamma} - 1}{1 - F(\varphi_d)} d\varphi
\]

\[
= f(\eta - 1) \left( \frac{\eta - 1}{r^{\sigma - 1} - 1} \right)^{\frac{\gamma}{\sigma + 1}}.
\]

Total revenues across the economy are

\[
TR = \frac{\gamma}{\gamma - \sigma + 1} r^{\sigma - 1} \left\{ f \left[ 1 + (r^{\sigma - 1} - 1) \left( \frac{\eta - 1}{r^{\sigma - 1} - 1} \right)^{\frac{\sigma - \gamma + 1}{\sigma - 1}} \right] + f_x \left[ \frac{fr^{\sigma - 1}}{fx^{\sigma - 1}} \right]^{\frac{\gamma}{\sigma + 1}} \right\}.
\]
Total bribery expense is independent of \( \tau \) when we take into account the probability of survival. However, total revenues decrease in \( \tau \). Therefore, when \( \tau \) decreases, the fraction of total revenues spent by firms in the form of bribery decreases.

C. In the case where \( \varphi_x < \varphi_b \), we have

\[
B = \int_{\varphi_b}^{\infty} f(\eta - 1) \frac{\gamma \varphi^{\gamma-1}}{1 - F(\varphi_d)} d\varphi = f(\eta - 1) \left[ \frac{(1 + \tau^{1-\sigma})(r^{\sigma-1} - 1)}{\eta - 1} \right]^{\frac{\gamma}{\sigma-1}},
\]

\[
TR = \frac{\sigma - 1}{\gamma - \sigma + 1} f \sigma \Delta + f + f(\eta - 1) \left[ \frac{\eta - 1}{(1 + \tau^{1-\sigma})(r^{\sigma-1} - 1)} \right]^{\frac{\gamma}{\sigma-1}} + f_x \left( \frac{\tau^{\sigma-1}}{f_x} \right)^{\frac{\gamma}{\sigma-1}}.
\]

We see that \( B \) is a term in \( TR \). Therefore, when \( \tau \) decreases, both \( B \) and \( TR \) decrease but \( TR \) decreases by a larger amount. The end result is a decrease in the fraction of total revenues spent for bribery.

D. From Section 4.2, we can write the expected profits for firms in foreign country when it is identical to home country:

\[
\tilde{\kappa}_0 = \frac{I_T}{\sigma} (P_T \rho)^{\sigma - 1} \left\{ \frac{\sigma - 1}{\gamma - \sigma + 1} (\varphi_d)^{\sigma - 1} \left[ 1 + (r^{\sigma-1} - 1) \left( \frac{\eta - 1}{r^{\sigma-1} - 1} \right)^{\frac{\gamma}{\sigma-1}} \right] \right\}^{\frac{1}{\sigma-1}}
\]

\[
+ \frac{I_T}{\sigma} \left( \frac{P_T \rho}{\tau} \right)^{\sigma - 1} \left\{ \frac{\sigma - 1}{\gamma - \sigma + 1} (\mu \varphi_d)^{\sigma - 1} \left[ f \tau^{\sigma-1} \right]^{\frac{\gamma}{\sigma-1}} \right\}^{\frac{1}{\sigma-1}}.
\]

\[
\frac{\partial \varphi_d}{\partial \varphi_d} = - \frac{1 + (r^{\sigma-1} - 1) \left( \frac{\eta - 1}{r^{\sigma-1} - 1} \right)^{\frac{\gamma}{\sigma-1}}}{\mu \left[ \left( \frac{f \tau^{\sigma-1}}{f_x \tau^{\sigma-1}} \right)^{\frac{\gamma}{\sigma-1}} \right]^{\frac{1}{\sigma-1}}}.
\]

We see that the slope of the zero-profit curve for foreign firms as a function of \( \varphi_d \) and
\( \varphi_d \) is negative and the curve is downward sloping. If more firms can stay in business, then it takes fewer firms exporting to have expected profits equal zero. Similarly, the expected profits for firms in foreign country when it is less corrupt than home country are:

\[
\tilde{\eta} = \frac{\bar{I}_T}{\sigma} (\bar{P}_T \rho r)^{\sigma-1} \left( \frac{\gamma}{\gamma - \sigma + 1} \left( \bar{\varphi}_d \right)^{\sigma-1} - f \right) \\
+ \left( \frac{\mu \varphi_d}{\bar{\varphi}_d} \right)^{-\gamma} \left[ \frac{\bar{I}_T}{\sigma} \left( \frac{\bar{P}_T \rho r}{\tau} \right)^{\sigma-1} \frac{\gamma}{\gamma - \sigma + 1} \left( \mu \varphi_d \right)^{\sigma-1} - f_x \right].
\]

When foreign firms do not have to involve in a high level of bribery, their expect profits are higher than before. The zero-profit curve shifts to the left, resulting in lower \( \tilde{\varphi}_d \) and higher \( \varphi_d \) compared to the original cut-off productivity level of survival in the symmetric case, \( \varphi_s \). Similarly, when foreign firms have to pay higher exporting cost, the zero-profit curve for foreign country has a non-parallel shift to the right, as in Figure 3.
References


