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Corruption and innovation: the mediating role of trade

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Corruption and innovation: the mediating role of trade

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Abstract

The paper aims to investigate the relationship among corruption, innovation and trade. We develop a model where a firm producing an innovation may pay some bribes to sell its own products in the domestic or international market. The government official may accept or not the bribes and choose whether or not to be honest, eventually, gaining some illegal beneficial. Firm's profit may be affected by the costs of innovation and on the cost of corruption. Firm's ability to sell new products in the foreign market also assumes a strategic role by playing a part in determining the efficient enterprises.

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1. **Introduction**

The analysis of the role of corruption within the path of economic growth of a country implies a complex analysis: as a matter of fact, several mediating mechanisms may be at work when the relationship between corruption and growth is studied. For example, the quality of institutions can both hamper and favour the advancement of a country along the growth path (e.g. Aidt et. al, 2008; Meon and Sekkat, 2005). Other types of variables, such as the amount of importing and exporting activities, the amount of Foreign Direct Investments (FDI) or the innovation rate can be influenced in some way with the rate of corruption of a country therefore affecting its rate of growth.

Our starting point is the debate relative to the link between corruption and innovation activities. As Anokhin and Schulze (2009) recognize, the entrepreneur is encouraged to purse an innovation activity when the probability of reaping the profits stemming from the commercial exploitation of the innovation is quite high: however, the presence of corruption can negatively influence this perception. This relationship can be influenced by a further variable: in our perspective, trade activities among countries can be considered to mediate between corruption and innovation. Indeed, as underlined by Andersson and Marcouiller (2002) the corruption rate of a country may badly impact on firm's business activities on international markets. This strand of literature has evolved quite independently by having as a main research question the investigation of the effect of corruption on trade activities (e.g. Thede and Gustafson, 2012).

The theoretical contribution we give to the literature is that of introducing the role played by foreign corruption, that is, the corruption level of countries with which the country under consideration has trade relationship. In this way, we are able to investigate whether the interplay between different degrees of domestic and foreign corruption may have a depressing or encouraging effect on the decision to innovate.

Thus, we devise a theoretical model in which anti-corruption policies affect the profits of an innovating firm. The key factor to take into consideration is that a corrupt country loads further costs on firms. In particular, Blackburn and Forges-Puccio (2009) put into evidence that the effects of higher costs of doing business reverberate on the evolution path of other variables such as price signals, incentives and opportunities; in the same way they contribute to increase uncertainty.

Our aim is not that of studying what happens at the macro-level, that is by solving a general equilibrium model, but rather it is that of using profit maximizing behaviour of firm to understand what happens when anticorruption policies are implemented.

We suppose that the life of the firm is made up of two periods: by producing an innovation and paying bribes, it has the opportunity of gaining the whole market and, also, getting the advantage of the leadership. Following Blackburn and Forgues-Puccio (2009), one of the main features of our model is that to start an innovation process, firms need to obtain several licences from public officials to engage in the activity of research and development (R&D). They all need to be owned as the lack of only one of them may cause the innovating firm not to start the activity. On the government side, we assume that corrupt public officials will ask for bribe to issue licenses, therefore fully exploiting the monopoly power over them. In the foreign country we may find bureaucrats that may display the same degree of corruption to the same extent as domestic one, they will ask for bribes to firms that want to export their innovation. Therefore corruption acts as a way to prevent the firm from start the innovation process or to sale its innovation, rather than being represented as a form of taxation. However, this process may have counterfactual scenarios depending on how corruption policies in the domestic and foreign markets are implemented. One of the main determinants to explain the firm's permanence in a market is its efficiency. We show that if the anti-corruption policies are weak in the domestic market and strong in the foreign one, the most efficient firm may force other firms to exit the market. Conversely, a strong anti-corruption policy in the domestic market may discourage inefficient firms. Nevertheless, even if higher costs are present, the efficient firm, if properly subsidized, may spur innovation and obtain a market share.

This paper contributes to the literature by attempting to throw new light on the multifold relationship among corruption, innovation and trade, by considering whether the similarity or difference among corruption policies of trading countries can play any role in affecting the link between corruption and innovation.

The paper is divided in three sections: in Section 2 we briefly revise the literature relative to the relationship among corruption, innovation and trade. We present the model, in Section 3 and we derive the equilibrium strategies in Section 4. In Section 5 we draw our conclusions.

2. Previous literature on corruption

The literature regarding the economic effects of corruption, which is usually defined as a way to abuse of public power for private benefits (Rodriguez et al., 2006), has grown in recent years. The main research question that previous studies have tried to answer concerns the relationship between corruption and growth or development. Two opposing views have emerged: according to the first, the so called "sand the wheel hypothesis", corruption is likely to exert a negative effect on growth (Mauro, 1995; Meon and Sekkat, 2005; Hodge et al., 2011). In a similar fashion, Blackburn et al. (2006) show how the interaction between corruption and economic development may produce multiple long run equilibria as well as poverty trap equilibria. Instead, other authors, such as Leff (1964), consider corruption as a way to go beyond the rules and regulations imposed by the bureaucratic. This view is supported by the so called "grease the wheel hypothesis", where bribery is not a stumbling block to growth but a way to overcome institutional hurdles of the government administration. Indeed, a large cross-country variation in empirical results has been detected. For instance, Wedeman (2002) has found that in East Asian countries, high growth and high levels of corruption may coexist[4], pointing to the need of a deeper investigation of the linkage between these two variables. As the path of growth of country is strictly intertwined with its innovation rate, the interrelationships between corruption and innovation are to be studied more in depth. From a theoretical point of view, Blackburn and Forgues-Puccio (2009) develop an equilibrium model in which growth occurs through R&D, and, to carry out such technological intensive activities, firms must acquire licenses from public officials who can ask for bribes. The approach followed in this paper gives extreme importance to the role played by institutions in mediating between corruption and economic growth. They find that the degree of centralization of corruption influences final results. In the same way, as Dzhumashev (2014) underlines in his theoretical analysis, the effects of corruption on growth are mainly driven by the way corruption affects the efficiency of public spending.

From an empirical point of view, Anokin and Schulze (2009) devised a macroeconomic analysis to investigate whether innovation and entrepreneurship are linked with the rate of

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[4] This is known as the so called "East Asian Paradox".

growth of countries by allowing corruption to be the mediating factor. They find that rising levels of innovation and entrepreneurship are associated with a better control of corruption.

At the microeconomic level, Mahagaonkar (2008) provides an empirical analysis with regard to the African continent, and shows that corruption negatively affects both product and organisational innovations, facilitates marketing innovations, while process innovations are not affected at all. In a similar way, De Waldemar (2012) analyzes the Indian case finding that corruption hinders new product innovation. The case of China over the years 1993-2004 is explored by Yiping (2010) who estimates that the contribution of corruption to disparities in innovation capability is significant and strengthening over time. On the theoretical side, Veracierto (2008) by using a game theory approach illustrates how corruption can affect the industry's rate of innovation and shows that large increases in product innovation rates may follow from small increases in the penalties associated with corruption.

However, inside this new strand of literature, no attention is paid to the relationships linking innovation, corruption and trade. Indeed, the possibility that corruption influences the level of innovation can be mediated by openness. As a matter of fact, the relationship between corruption and trade has received proper attention. For example, at the country level, Lalountas et al. (2011) find a positive correlation between corruption and globalization only for middle and high income countries while, for low income countries, no significant effect on corruption is detected. De Jong and Bogmans (2011) observe that corruption can act as a hurdle to trade, instead of bribes paid to customs that can cause rising imports activities. Baksi et al. (2009) show how higher trade liberalization can affect corruption by increasing the number of goods available into the economy and making bureaucrats (who are supposed to prefer variety) more prone to accept bribes. Analyzing the African context, Musila and Sigué (2010) find that corruption and, as a consequence, increasing transaction costs affect both the African countries and their trading partners and conclude that the effect is negative both for imports and exports[5]. To our knowledge, the factors that moderate the final effect of corruption on innovation remain mainly unexplored: this represents a gap in the literature that we aim to fill from a theoretical point of view.

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[5] A close type of literature is the one analyzing the reciprocal influence between trade barriers and corruption: for example, Dutt (2009) finds that corruption may act as a tax when the level of protection is low but after having passed a certain threshold, the contribution it gives is that of fostering higher trade levels . Hence, lower trade barriers can discourage corruption.

3. The Model

In this Section we try to model the relationship between:

1) a firm producing innovation and possible corruption practices;

2) the relationship between corruption and exporting activities.

In our modeling strategy we follow the approach by Shleifer and Vishny (1993) who assume that corrupt agents will change the allocation of resources. By studying the organization of the corruption activity, they consider that bureaucrats are suppliers in a monopolistic environment of a government good at a specific price, which in our case (Blackburn and Forgues-Puccio (2009) is the license to start the research and development activity. If they are corrupt, the price to which this good is sold is higher because the firm has to pay a bribe.

In addition, we also consider Veracierto's (2008) corruption game in which, differently from our case, the innovating firm has to receive a permit to enter the market because its technology need to be good for the environment.[6]

Departing from this framework and by considering some simplification, we employ a partial equilibrium model deriving profit maximization of a firm where corruption and innovation are present. However, since we intend to focus on corruption and costs deriving from it, we do not take into account transportation costs because in our opinion costs related to corruption are higher than those related to transport.

We suppose that innovation can occur only if it is possible to start a process of R&D which needs complimentary licenses issued by public officials that are assumed to be issued separately by different public officials. We suppose that the firm succeeds in its innovation activity, that is, the probability that the R&D activity will be successful is equal to 1. Therefore the streams of profit of the firm gained because of innovation will be at the net of fixed costs and costs of bribes.

A firm decides to invest in innovation (process or product's innovation) by assuming that a part of this innovation will be directed to the domestic market and the other to the foreign one. These last earnings should be used to recover part of the innovation's cost, particularly, when the domestic market share is too low.

We model our study by considering three agents: the firm who must receive permission to innovation activities; the government officials of the domestic and foreign markets, who

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[6] The corruption of the official is represented by the fact that he/she can hide the true pollution status of the new technology when writing the report to the central government.

may grant permissions (legally or illegally) and the central government which may ensure the observation of the law. On the one hand, producer may offer bribes when an enterprise decides to proceed with innovation activities both in the home and in the host country. In fact, it may happen when a product (even totally or partially) does not comply with internal and foreign regulations market[7].

Domestic and foreign corruption may have a depressing or encouraging effect on the firm's decision to innovate or not. Under these assumptions the total profits may be affected by: a) the costs of innovation; b) the domestic corruption; c) the bribes paid abroad; d) the revenues from being the leader in the home and foreign market.

We consider that behaviour of firm and government official may be similar or different, in the sense that they may implement transparent behaviours or not in their legal activities. When both are fair, corruption is tackled and implementation of transparent activities is reached. Otherwise, a lower degree of transparency and fairness is implemented. Therefore, if firms and government official implement the same anti-corruption policies, (that is firms do not offer bribes and the government does not ask any bribes), no interaction between the two agents is expected. But in the opposite case, we could observe the following scenarios:

a) a firm can decide to offer bribes in order to overcome some regulation and, the official may accept it (for instance, higher bribes may be associated with a high level of bureaucracy and with stricter regulations in terms of quality of products);

b) a firm can decide to offer bribes and the official does not accept: any attempt of corruption fails; the producer may decide to make another offer or exit the market;

c) a firm does not offer any bribe but the official asks for it. If this is the case, then the official has to set the amount of the bribe. The government official has a predominant role since she/he may declare that a particular product is complying with the domestic and/or foreign regulations or standards, for this reason he/she may decide how much demand.

In this study we will focus on point a).

In the next section we devise a model to analyze all these situations in order to understand what are the underlying mechanisms and its implications.

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[7] Indeed, national and international standards may act on innovation and therefore on trade. Blind (2001) finds that national and international standards affect Switzerland's export performance. Similar result are in Blind and Jungmittag (2005) where national and international standard affect exports of Germany, but, international standards exert a more significant impact on trade than national ones.

3.1 *Basic assumptions*

In order to simplify the reading of the paper, we start off with this section by presenting a graph including the direction of the studied relationships (Fig.1 see appendix). Following, Blackburn and Forgues-Puccio (2009), we assume that a firm, to introduce an innovation on the internal market, needs to get a license to give a boost to the research and development process. The probability the firm will introduce an innovation will depend not only on its efficiency (γ), but also on eventual bribes (B), asked by corrupt government officials. If this corruption process is discovered by the central government, the producer must pay a fare (*f*) and the official a penalty (*p)*.

On the contrary if it is not detected the producer may benefit by getting the entry permit and being the only innovator on the market for at least two periods. Therefore, for simplicity, we also assume that there are only two periods and that (φ) is the probability that the central government detects corruption. We indicate by (η) the innovation rate in the first period, while (δ) is the discounted rate for profits in the second period.

The production of innovation has obviously a cost *c(η),* only in the first period, which is a strictly growing functions of η.

Following Veracierto (2008), if the firm decides to pay bribes to the domestic government official, its payoff is represented by R^d , which is the remaining value to the producer in the domestic market after paying bribes and the potential penalty:

$$R^d = V^d - B^d - \varphi[V^d + fV^d] \qquad (1)$$

In other words, *V* is the value of being the product innovator leader in the domestic market, to which we need to remove *B,* that is the amount of bribes paid to the official; while $\varphi[V^d + fV^d]$ is the expected loss that firm should pay if detected.

Similarly, to sell innovations in the foreign market, producers must pay a bribe to the foreign official to get with certainty the license and also to be the only leader for at least two periods. The firm's payoff on the foreign market will be:

$$R^i = V^i - B^i - \varphi'[V^i + f'V^i] \qquad (2)$$

Where the foreign government applies a fare f' which can be equal or different from f, and φ' is the probability to be detected on the external/foreign market which also may be equal or different from φ, depending on how much similar the anti-corruption policies in the two countries are. A further assumption we make is that the amount of bribe to be paid in the domestic market is equal to the one paid in the foreign market.

It is easy to show that for the domestic official is convenient to ask for a bribe only if his payoff is positive, that is

$$B^d - \varphi p V^d = (1 - \varphi)V^d - \varphi f V^d - \varphi p V^d > 0 \qquad (3)$$

It means that the payoff that the government official can ask is represented by the value of bribes, B, minus the penalty pV multiplied by the probability of being uncovered by the central government. This implies that $p + f < \frac{1-\varphi}{\varphi}$. Similarly for the foreign official is convenient to ask for a bribe only when the following condition is satisfied: $p + f < \frac{1-\varphi'}{\varphi'}$.

3.2 Innovation Decisions

In this two period model, the profit maximization problem for a producer selling the innovation also abroad is:

$$max\left\{\eta\left[(R^d + R^i) + \left(\frac{1}{1-\delta}\right)(R^d + R^i)\right] - c(\eta)\right\} \qquad (4)$$

Where $\left(\frac{1}{1-\delta}\right)(R^d + R^i)$ represents the current values of the revenues in period two. Therefore the optimal innovation rate must satisfy the usual condition of total marginal costs $c'(\eta)$ equal to total marginal revenues $Mgr^d + Mgr^i$, that is:

$$c'(\eta) = (R^d + R^i) + \left(\frac{1}{1-\delta}\right)(R^d + R^i) = Mgr^d + Mgr^i \qquad (5)$$

where Mgr stands for marginal revenue of that firm.

For easiness of notation hereafter we will use only the first peak to identify the foreign market with respect to the domestic producer's market.

We denote by γ the probability to get the license according to the level of firm's efficiency on the internal market, which is $\gamma \leq 1$ if no bribes are paid, and $\gamma = 1$ otherwise. Similarly we use γ' to denote the probability to get the license abroad. This probability is higher for more efficient firms.

The marginal revenue on the internal market for the two periods is:

$$
\begin{cases}
V\gamma + \gamma \left[\dfrac{1}{1-\delta}\right]\left(\dfrac{V}{q}\right) & if\ p+f > \dfrac{1-\varphi}{\varphi} \\[2ex]
V - B\varphi[V + fV] + (1-\varphi)\left[\dfrac{1}{1-\delta}\right](V) & otherwise
\end{cases}
\tag{6}
$$

where q stands for the number of competitors in that market.

The equation 6 implies that if the firm does not pay any bribes, then the revenues will be equal to the sum of the present and discounted value V weighted with the probability of being selected. In a corrupt market if the firm pays bribes, at time 1 the earn will be equal to V minus the cost of bribes paid B, plus the benefits from $(1 - \varphi)\left[\dfrac{1}{1-\delta}\right](V)$ in case of no detection with probability $(1 - \varphi)$; yet, the losses are equal to $\varphi[V + fV]$ in case of detection with probability φ.

In brief, we assume that the more efficient the firm, the higher the probability of being selected in a corrupt environment.

Similarly the marginal revenue on the external market for the two periods will be:

$$
\begin{cases}
V'\gamma' + \gamma \left[\dfrac{1}{1-\delta}\right]\left(\dfrac{V'}{q'}\right) & if\ p'+f' > \dfrac{1-\varphi'}{\varphi'} \\[2ex]
V' - B - \varphi'[V' + f'V'] + (1-\varphi')\left[\dfrac{1}{1-\delta}\right](V') & otherwise
\end{cases}
\tag{7}
$$

However, we make the assumption that $B=B'$, so that the amount of bribes that foreign officials require are the same that domestic officials ask.

4. Similarity and dissimilarity in anticorruption policies

In this section we introduce some further level of analysis in our original framework, that is, we consider how the similarity or dissimilarity in corruption practises among countries may influence the decision to innovate. In fact, countries having the same quality of institutions or sharing the same level of corruption may have similar behaviours which may influence the choice of a firm and thus its efficiency. Differences in corruption policy are the salient source of divergence in terms of gains, market positions and efficiency.

4.1 Case I: Similar Countries.

We assume that in the internal and foreign markets there are similar anti-corruption policies and also the same ability to select efficient enterprises $\gamma=\gamma'$. That is, anti-corruption policies in both countries: a) discourages official from seeking bribes; or b) makes bribes convenient for the domestic and foreign officials. For simplicity we may assume that differences in penalties and in probabilities to be discovered are so low among countries than we can assimilate: $p=p'$, $f=f'$ and $\varphi=\varphi'$:

a) If $p + f > \frac{1-\varphi}{\varphi}$ and $p' + f' > \frac{1-\varphi'}{\varphi'}$ both countries are applying strong anti-corruption practise. Therefore, to get the total marginal revenues we must sum the first conditions in (6) and (7):

$$Mgr_{tot} = V\gamma + \gamma \left(\frac{1}{1-\delta}\right)\left(\frac{V}{q}\right) + V'\gamma + \gamma \left(\frac{1}{1-\delta}\right)\left(\frac{V'}{q'}\right)$$

$$= \gamma(V + V') \left(1 + \left(\frac{1}{1-\delta}\right)\left(\frac{1}{q} + \frac{1}{q'}\right)\right) \qquad (8)$$

According to the equation (8) if countries adopt anti-corruption policies equally effective, then *Mgr* from innovating, and therefore the rate of innovation of these businesses, will be greater depending on:

i)   the greater the probability of being selected γ (and thus the more efficient firms are);

ii)   higher level of sales of innovation on domestic and/or on foreign market (V+V');

iii)   as lower it is the potential competition from imitators on the domestic and/or on the foreign market (measured by q)

b) if $p + f < \frac{1-\varphi}{\varphi}$ and $p' + f' < \frac{1-\varphi'}{\varphi'}$,

the anti-corruption policies are weak in both countries. In this case, to get the total Marginal revenues we must sum the second conditions in (6) and (7):

$$Mgr_{tot} = V - B - \varphi[V + fV] + (1 - \varphi)\left(\frac{1}{1-\delta}\right)V + V' - B - \varphi[V' + fV']$$

$$+ (1 - \varphi)\left(\frac{1}{1-\delta}\right)(V')$$

$$= V + V' - 2B - \varphi(1 + f)(V + V') + (1 - \varphi)\left(\frac{1}{1-\delta}\right)(V + V') \quad (9)$$

And we get:

$$Mgr_{tot} = (V + V')\left((1 - 2B) - \varphi(1 + f) + (1 - \varphi)\left(\frac{1}{1-\delta}\right)\right) \quad (10)$$

Therefore, despite being efficient innovator, a firm will be discarded if any bribes will be paid. In fact, the total marginal revenue in the equation 9 does not depend on γ. Being selected is no longer dependent on efficiency and this may imply that corruption can foster innovation also at the expenses of the efficiency.

In this circumstance, the rate of innovation will be greater depending only on:

i)   an increased potential level of sales generated by the innovation on the domestic and foreign market;

ii)   the low amount of bribes required;

iii)   the low probability to be discovered φ and, obviously, the lower possible penalty f.

4.2 Case II: Dissimilar Countries.

The second case happens when the country with which the domestic firm has trade relationships have different anti-corruption policies. Two possibilities can verify: the first is that in the domestic country the anticorruption policies are stronger and enforced to a greater

extent than in foreign countries (iia), the second is that anticorruption policies are tougher in the foreign country (iib).

(iia) In the first case, we seek to understand whether it can be convenient for an exporting firm to gain the foreign market by paying bribes abroad, when anti-corruption policies on the domestic market are sufficient to deter corruption. In other words, we assume that the anti-corruption policies in the domestic country are more stringent, so that $p + f > \frac{1-\varphi}{\varphi}$ and $p' + f' < \frac{1-\varphi'}{\varphi'}$ and the foreign officials ask for bribes.

In this case, if for the firm it is impossible to obtain a license on the domestic market, then the revenues will come only from producing abroad that is by making a Foreign Direct Investment (FDI):

$$Mgr_{tot} = V' - B' - \varphi'(V' + f'V') + (1 - \varphi')\left(\frac{1}{1-\delta}\right)(V') \quad (11)$$

In particular for an inefficient firm with $\gamma=0$, the innovation rate will shift from zero to a positive value $\eta^*>0$, satisfying $Mgr=c'(\eta^*)$, becoming the foreign leader of the product innovation (see Fig.2 in appendix). It means that firm is able to innovate thanks to corruption practices abroad which may encourage firms to produce in the foreign market its own innovation rather than representing a reward for efficiency.

As we have seen above, if sales are low or the enterprises (even the efficient ones) are not selected, then the rate of innovation will be zero (if revenues fail to cover costs) or very low. Thus, corruption in a foreign country may encourage firms to innovate, because through bribes it is possible to obtain foreign market and get positive revenues whose value is represented in equation 11.

iib) The second case considers the situation in which domestic anticorruption policies are stronger than in the foreign country. It means that if $p + f < \frac{1-\varphi}{\varphi}$ and $p' + f' > \frac{1-\varphi'}{\varphi'}$, the firm does not pay any bribes and could obtain the license in the first period by splitting the profits with other imitating firms in the second period.

To see that, we start from the condition according to which it may be convenient for the producer pay bribes abroad if:

$$V' - B - \varphi'(V' + f'V') + (1 - \varphi')\left(\frac{1}{1-\delta}\right)(V') > V'\gamma' + \gamma'\left[\frac{1}{1-\delta}\right]\left(\frac{V'}{q'}\right) \quad (12)$$

If external anti-corruption policies are stronger and the firm is surely detected so that $\varphi'=1$:

$$V' - B \ - V' - f'V' > V'\gamma' + \gamma'\left(\frac{1}{1-\delta}\right)\left(\frac{V'}{q'}\right) \quad (13)$$

$$f'V' + B \ < V'\gamma' + \gamma'\left(\frac{1}{1-\delta}\right)\left(\frac{V'}{q'}\right) \quad (14)$$

Therefore, if the central government is strongly engaged in deterring corruption, the firm should not pay bribes to avoid losing the opportunity to trade in the future with that country.

In general, it is not convenient paying bribes in a foreign country when:

$$V' - B' - \varphi'(V' - f'V') + (1 - \varphi')\left(\frac{1}{1-\delta}\right)(V') > V'\gamma' + \gamma'\left[\frac{1}{1-\delta}\right]\left(\frac{V'}{q'}\right) \quad (15)$$

Dividing for *V'* and assuming that bribes are proportional to the innovation value and to the possible earnings, that is, *B'=b'V'* we get:

$$1 - b' - \varphi'(1 + f') + (1 - \varphi')\left(\frac{1}{1-\delta}\right) > \gamma' + \gamma'\left[\frac{1}{1-\delta}\right]\left(\frac{1}{q'}\right) \quad (16)$$

Therefore, we make the assumption that efficient enterprises will obtain their licences to make innovation possible and the efficient firm would get the license γ'=1 without bribes. In a clearer way:

$$1 - b' - \varphi'(1 + f') + (1 - \varphi')\left(\frac{1}{1-\delta}\right) > 1 + \left[\frac{1}{1-\delta}\right]\left(\frac{1}{q'}\right) \quad (16)$$

$$-b' - \varphi'(1 + f') > -(1 - \varphi')\left(\frac{1}{1-\delta}\right) + \left[\frac{1}{1-\delta}\right]\left(\frac{1}{q'}\right) \qquad (17)$$

$$-b' - \varphi'(1 - f') > \left(\frac{1}{1-\delta}\right) + \left(-1 + \varphi' + \frac{1}{q'}\right) \qquad (18)$$

this is possible only if: $1 - \varphi' - \frac{1}{q'} > 0 \ \ or \ 1 - \varphi' > \frac{1}{q'}.$

Despite the payment of bribes, protection against imitation cannot be assured for a firm. As a result, in the second period, there could be a decrease in potential profits due to the large number of potential imitators.

In this case, in fact, the enterprise needs to pay bribes to ensure the future protection against imitation q. There is the need to protect profits which would be greatly reduced in the second period because of the extremely high competition due to the high number of potential imitators.

Consequently this could stimulate the exit of the efficient firms from the domestic market to the foreign one, where obtaining the full market, by assuming here that there is still quite low competition, is possible.

To sum up, from the main results of our analysis cases I and II, we may conclude that when a firm, even efficient, does not get license on the domestic market, unless paying bribes, as a consequence only the inefficient one does by paying for corruption. Conversely, when the efficient firm paying bribes and makes innovation, its innovation rate will be lower because of the additional costs represented by the cost of corruption (bribes).

For that reason the main result in case of dissimilar anti-corruption policies is that not only inefficient firms will be able to carry out innovation, as in the case in which in both countries anticorruption policies are weak. Indeed, when anti-corruption policies are strong, the rate at which firms will introduce innovations only depends on their efficiency.

Furthermore, when the efficient firms are selected and anti-corruption policies are strongly deterring, the ideal solutions with the higher innovation rates realized by efficient firms would be present. Graphically, the curve of the marginal revenue will shift to the right towards the top, correspondingly to a higher value of η^*.

What we have seen above, leads us to consider the issue of patents or protection granted on innovations. Thanks to them the innovative firm may gain a large share of the domestic

market and be the leader for the two periods. However, if imitation is realized in a very short time, then the profit will be lower by reducing the incentive for innovations.

Behind the assumption that bribes allow the first-come to be unique on the market and remain exclusive in the market for at least two periods, we may assert that bribery act as a substitute for this protection preventing those who do not pay to enter the market.

Nevertheless, the drain of the most efficient firms to the foreign market will be determined both by the market and by the stringent anti-corruption policies.

As a result, we have found how the level of corruption must be combined with the level of the efficiency of a firm because the higher the level of efficiency the higher the ability to produce products compliant with standards or regulations, the lower the interaction with the activities of corruption. This relationship is reported in Table 1 (see appendix), which shows that anti-corruption policies have divergent effect in relation to a firm's efficiency. If anti-corruption policies are strong, in one or both markets the inefficient firm will go bankrupt, conversely if anti-corruption policies are weak in both markets, then the efficient firm will leave the markets. In an environment where anti-corruption policies are very strong, only the most efficient firm will gain a stake in the market. If an efficient firm expands its business (i.e. trade) in the foreign markets, progressively it will leave the home market where corruption is present, while the inefficient firm will continue to operate in the domestic one.

Conclusions

The present theoretical model has offered a possible way to model the relationship between corruption and growth at microeconomic and macroeconomic level. Some studies investigate what are the transmission channels through which corruption may influence growth (e.g. Hodge et al., 2011). Among them, scarce attention has been paid to the effects of corruption on innovation. Several gaps still remain in the literature, as corruption needs to be seen in relation to other economic dimensions such as trade activities.

In this paper we have proposed a model in which the amount of innovation that a firm is going to carry out is intertwined with the level of corruption of the home country and the country with which the firm has trade relationships. The starting point of our theoretical contribution is that a low quality of governance on the side of governmental officials, who ask bribes, may cause an increase of corruption practices, which, as a result, tend to influence the decision of a firm to innovate. The main reason is that firms' costs are higher. Since

corruption may represent a hurdle for the firm's activities both in the domestic and foreign markets, the official's behaviour will affect firms' investment decisions (in the home and foreign market) and, thus, on international trade. We also argue that the role of the central government is strategic in preventing corrupt activities: the stricter the control by the central government, the lower the incentive on the side of the officials to demand bribes.

Indeed, four different types of scenario can be observed within this framework, depending on the degree of corruption that the firm faces. To sum up, if the firm will face higher corruption at home then it will go abroad to innovate if and only if the rate of corruption in the host country is extremely lower. When the rate of corruption is high in both countries, the final outcome is likely to be an overall reduction of the innovation rate.

References

Aidt, T.S., Dutta, J., Sena, V., (2008) Governance regimes, corruption and growth: theory and evidence. *Journal of Comparative Economics*, 36 (2), 195–220.

Anderson E.J and Marcouiller D. (2002), "Insecurity and the Pattern of Trade: An Empirical Investigation". *Review of Economics and Statistics*, vol 84(2), pp.342-352.

Anokhin S. and Schulze W.S. (2009), "Entrepreneurship, innovation, and corruption". *Journal of Business Venturing*, vol. 24(5), pp. 465–476.

Baksi, S., Bose, P., Pandey, M. (2009), The impact of liberalization on bureaucratic corruption, *Journal of Economic Behaviour and Organization*, 72, 214-224.

Blackburn, K., Forgues-Puccio, G.F. (2009), Why is corruption less harmful in some countries than in others?, *Journal of Economic Behaviour and Organization*,72,797-810.

Blackburn, K., Forgues-Puccio, G.F. (2010), Financial liberalization, bureaucratic corruption and economic development, *Journal of International Money and Finance* 29,1321-1339.

Blackburn, K., Bose, N., Haque, M.E., (2006), The incidence and persistence of corruption in economic development. *Journal of Economic Dynamics and Control* 30, 2447–2467.

Blind, K. (2001), "The impacts of innovations and standards on trade of measurement and testing products: empirical results of Switzerland's bilateral trade flows with Germany, France and the UK". *Information Economics and Policy*, 13(4), pp. 439-460.

Blind, K., & Jungmittag, A. (2005), "Trade and the Impact of Innovations and Standards: The Case of Germany and the UK". *Applied Economics,* 37(12), pp. 1385-1398.

De Jong A., Bogmans, C. (2011), Does corruption discourage international trade?, *European Journal of Political Economy*, 27, 385-398.

De Waldemar, F.S. (2012), New products and corruption: evidence from Indian firms, *The Developing Economies* 50, 268–84.

Dutt, T. (2009), Trade protection and bureaucratic corruption: an empirical investigation, *Canadian Journal of Economics*, 42, 155-183

Dzhumashev, R. (2014), Corruption and growth: The role of governance, public spending, and economic development, *Economic Modelling*, 37, 202-215

Fisman R. and Svensson J.(2007), "Are corruption and taxation really harmful to growth? Firm level evidence". *Journal of Development Economics*, vol. 83 (1), pp.63-75.

Hodge, A., Shankar, S., Prasada Rao, D.S., Duhs, A. (2011), Exploring the Links Between Corruption and Growth, *Review of Development Economics*, 15(3), 474–490.

Leff, N. (1964), Economic development through bureaucratic corruption. *American Behavioral Scientist* 8, 8–14

Mahagaonkar P. (2008), "Corruption and Innovation: A Grease or Sand Relationship?". Max Planck Institute of Economics, *Jena Economic Research Paper* No. 2008-017.

Mauro P. (1995), "Corruption and Growth". *The Quarterly Journal of Economics*, vol.110 (3), pp. 681-712.

Meon, P., and Sekkat, K. (2005), Does corruption grease or sand the wheels of growth? *Public Choice*, 122, 69–97.

Mishra P., Subramanian A. and Topalova P. (2008), "Policies, Enforcement, and Customs Evasion: Evidence from India". *Journal of Public Economics*, vol.92, pp.1907–1925.

Mitaritonna C. and Sebastian J. (2010), "Determinants and Pervasiveness of the Evasion of Customs Duties", CEPII WP2010-26, November.

Musila, J.W., Sigué, S.P. (2010), Corruption and international trade: an empirical investigation of African countries, *The World Economy*, 33,129-146.

Rodriguez, P., Siegel, D.S., Hillman, A., Eden, L. (2006), Three lenses on the multinational enterprise: politics, corruption, and corporate social responsibility. *Journal of International Business Studies* 37, 733–746.

Shepherd B. (2009), "Speed Money: Time, Corruption, and Trade". *MPRA Paper* 17337,University Library of Munich, Germany.

Starosta De Waldemar F. (2011), "New products and corruption: evidence from Indian firms". Centre d'Economie de la Sorbonne, *Documents de travail du Centre d'Economie de la Sorbonne* n. 11033.

Veracierto M. (2008), "Corruption and Innovation". *Economic Perspectives*, vol. 32 (1), pp.29-39.

Wedeman, A., 2002. Development and corruption: the East Asian paradox. In: Gómez, E.T. (Ed.), Political Business in East Asia. Routledge, London, pp. 34–61.

Yiping W.(2010), "The Effect of Corruption on Disparities in Innovation Capability: Evidence from China". *Contemporary Economy & Management*, 2010-12

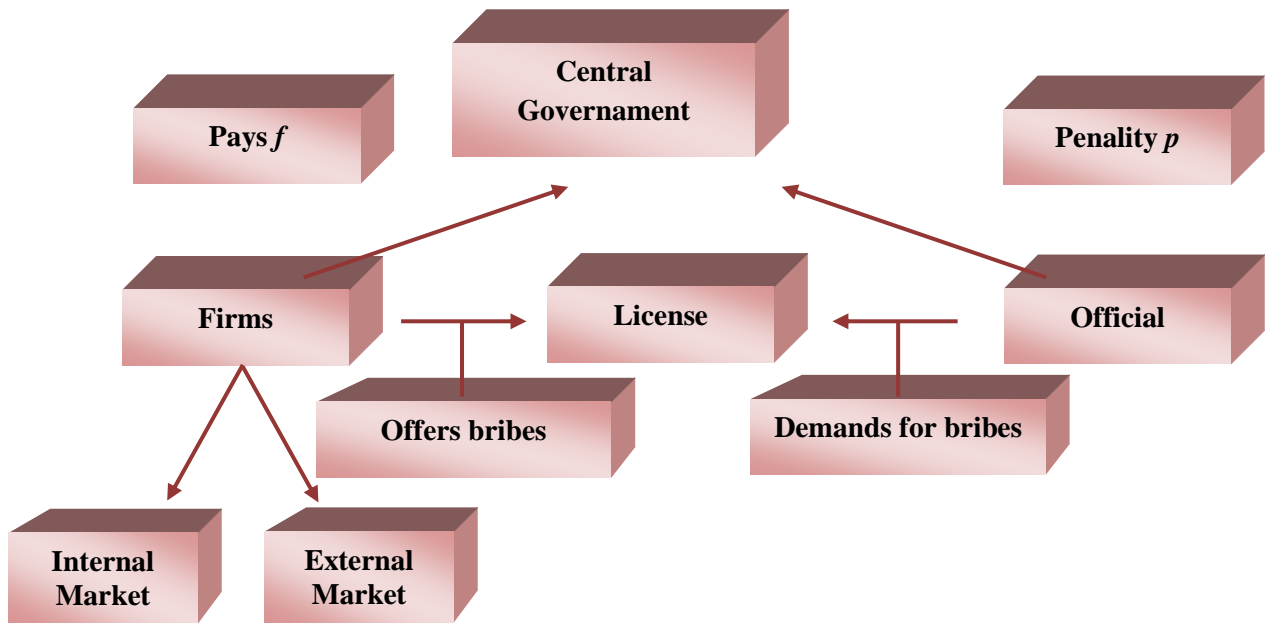## Appendix

Figure 1: Direction of the relationships
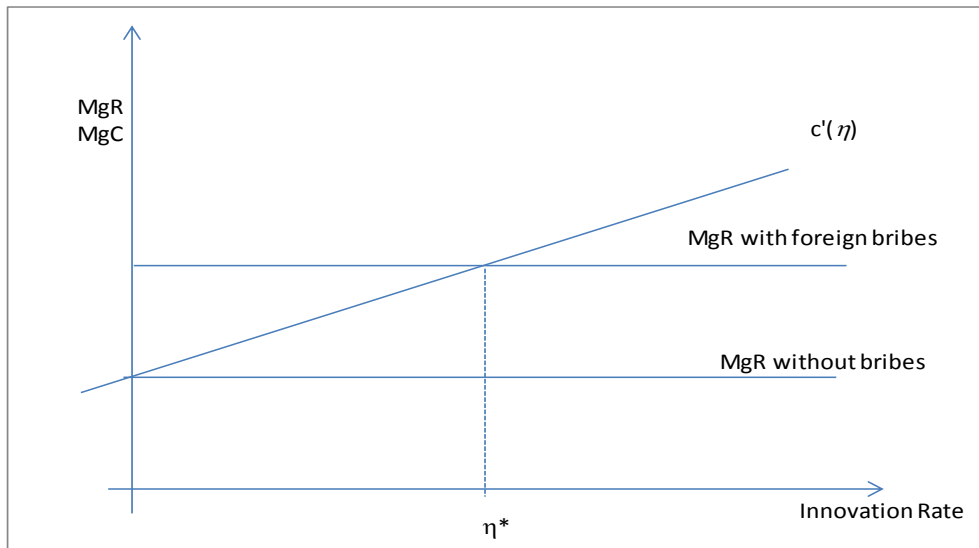

Figure 1: Marginal revenues with/without external bribes

Table 1: Combination between efficiency and corruption policies

	Weak Anti-Corruption Practices	Strong Anti-Corruption Practices	Weak foreign Anti-Corruption Practices & strong domestic	Strong foreign Anti-corruption Practices & weak domestic
Efficient firms	Efficient firms pay bribes to obtain licence (low level of innovation of discouraging effect in staying in the market)	Efficient firms innovate and gains market	Internal policy discourages corruption & efficient firms innovate and gain internal market	Internal policy encourages corruption & efficient firms innovate and gain external market thanks to strong policy abroad
Inefficient firms	Encouraging corruption & inefficient firms innovate and pay bribes to obtain licence	Discouraging corruption & inefficient firms stay away from market	Encouraging corruption & inefficient firms innovate and pay bribes to obtain licence abroad	Internal policy encourage corruption & inefficient firms innovate and gain internal market