Corruption and growth

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I. Introduction

Most policymakers, civil society organizations, and especially entrepreneurs would agree - corruption is a major obstacle to economic prosperity. World Bank considers anti-corruption policies as fundamental to its poverty alleviation programs. Combating corruption is also part of the International Monetary Fund's effort to ensure accountability of its member countries. But the excessive and corrupt government regulations worldwide continues to hamper business activities making it a prime concern for domestic and foreign investors alike (Tanzi, 1998). In many developing countries entrepreneurs are coerced to pay bribes when trying to register their businesses and move out of the informal economy (De Soto, 1989). Corruption is known to distort incentives, to impede innovation and to foster the allocation of talented labour and other productive resources to rent-seeking activities (Murphy, Shleifer & Vishny, 1991). All these detrimental effects are likely to slow growth rather than enhance it. While there is a limited literature linking corruption and growth explicitly, none of these studies illustrate analytically how reduction in corruption can at the same time boost growth and reduce optimal tax rate. The model presented here addresses this gap in order to explain Ghana's successful anti-corruption policies of 1980's and subsequent economic recovery accompanied by lower tax rates.

The theoretical literature on the link between corruption and growth does not reach an agreement. Some authors advocate the view that bribe plays the role of speed money, allowing entrepreneurs to bypass excessive red-tape and reduce uncertainty, thus "greasing" the wheels of the economy (Braguinsky, 1996; Leff; 1964; Rashid, 1981)[1]. The latter view is commonly known in the literature as the grease hypothesis. Recent empirical studies, however, have not supported this view (Mauro, 1995; Habib & Zurawicki, 2001; Seligson, 2002). A study by Kaufmann and Wei (1999), for example, demonstrated using firm-level surveys that firms paying more bribes are more likely to face cumbersome red tape and spend more time negotiating with bureaucrats. In addition, critics of the grease hypothesis indicate that corruption is detrimental not only to efficiency but also to growth (Asiedu & Freeman, 2009; Mauro, 2004).

According to Mo (2001), there are three main transmission channels through which corruption reduces growth. First, corruption creates incentives such that labour and talent are diverted from directly productive activities to rent-seeking activities (Murphy et al., 1991; Mauro,

[1]There are very few adherents of the "grease" hypothesis in the recent literature. Most supporters of this hypothesis suggest that widespread corruption is a feature of economic underdevelopment and is, at best, a transitory phenomenon. For example, Rashid (1981) emphasizes how ephemeral efficiency gains from bribery are exhausted as soon as bribery becomes systematized.

2004). In such circumstances inefficiencies arise and output growth is lower. Mo (2001) calls it the human capital channel.

Second, corruption goes hand in hand with favouritism and nepotism, creating circumstances of socio-political instability (Mauro, 1998). The secret and illegal nature of corrupt behaviour leads to frustration and undermines the reputation of public institutions leading to institutional malfunction (Mo, 2001). Meanwhile, poor performance of institutions is strongly associated with slow growth in the long run (Acemoglu, Johnson & Robinson 2005; Hall & Jones, 1999). This transmission mechanism can be called the channel of political instability or, more broadly, the institutional channel[2]. The causal direction in the link between corruption and institutions, however, is not entirely clear. Crumbling or radical change of institutional structures may *cause* corruption as well. As institutions become less strong they lose their monopoly power over bribe collection. Multiple independent bribe collectors emerge causing corruption to become more pervasive (Shleifer & Vishny, 1993). Such is the case of transition economies during *perestroika* years, where arguably the surge in bribery *followed* institutional failures (Tanzi, 1998; Cheloukhine & King, 2007)[3]. Della Porta (2000) suggests that corruption is simultaneously a cause and an outcome of bad governance.

Third, corruption depresses investment and hampers innovative activities thereby slowing growth. New investors and innovators are often in need of licences, registrations, permits and, therefore, are more likely to fall victims of corrupt public officials (Mo, 2001). Public rent-seekers tend to target investment rather than finished product because investors lack the lobbying power of already established producers (Murphy et al., 1993). This effect has been substantively supported by empirical evidence (Mauro, 1995; Aseidu and Freeman, 2009; Mo, 2001). It is often suggested in passing that corruption acts as an arbitrary tax on investment, lowering marginal product of capital (Mauro, 2004), particularly when investing and innovating are closely linked activities (Murphy et al., 1993).

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[2] It is important to note that these transmission channels are interlinked. Empirical disentanglement and measurement of these transmission channels is well performed in Mo's (2001) econometric study, which is discussed in more detail later.

[3] As an example of the institutional channel at play Cheloukhine and King (2007) present an overview of how in post-Soviet Russia corruption is strongly linked with political system's inefficiency and inefficiency of the rule of law.

Literature concerned primarily with corruption uses these three channels to demonstrate the detrimental nature of corruption for welfare, but does not relate corruption to growth explicitly. Meanwhile, literature concerned primarily with endogenous growth addresses corruption only slightly. For instance, Barro (1990) presents a model where government levies flat-rate tax on output and spends its tax revenues on public capital. Public capital is used as an input into private production. In his setting tax rate has two opposing effects on growth: it lowers growth directly and raises growth indirectly through increase in private marginal product of capital. As a result, growth is a single-peaked function of the tax rate and, hence, a positive tax in necessary for growth maximization. As an extension of his model Barro also shows how with kleptocratic government collecting taxes revenues and *not* spending some part of it on public services, the same positive tax rate maximizes growth. This result is surprising; it implies that if a country undergoes a successful reduction in corruption, its government should levy the same tax as before, but achieves greater growth. This prediction, however, does not explain the cases where reduction in corruption translated into the reduction of the tax rate. The Ghanaian experience in 1980's is an interesting case that is worth signalling to illustrate the inability of these models to explain the historical decline in the tax rate after a significant reduction on the corruption level. Indeed, in the early 1980's radicals anti-corruption reforms took place in Ghana. They were spearheaded by Jerry Rawlings and his Armed Forces Revolutionary Council (AFRC). It is plausible that these reforms helped to resuscitate stagnating Ghanaian economy. In addition, the average tax rate levied was decreased substantially.

There are several other theoretical papers that focus squarely on both corruption and growth (Aidt, Dutta & Sena, 2008; Del Monte & Papagni, 2001; Ehrlick & Lui, 1999; Mauro, 2004), but none of them demonstrates how decrease in corruption can at the same time increase growth and lower growth-maximizing tax rate. This paper proposes a theoretical model to solve this puzzle. In this model corruption plays a role of hindrance on capital accumulation by lowering private marginal product of capital. Therefore, in terms of transmission mechanism the link between corruption and investment is addressed. The simple model considers two cases in which corruption operates: linear and non-linear. In the first case *increase* in corruption shifts down the single-peaked growth function. Alternatively, *reduction* in corruption stretches "growth- possibility frontier" upward leaving growth-maximizing tax unaltered. In the second case, corruption operates non-linearly and results in slightly different impact on growth. Curbing corruption not only raises maximum possible growth rate, but lowers growth- maximizing tax rate by stretching "growth-possibility frontier" upward and to the left. To our knowledge, this

theoretical illustration of Ghanaian success story is novel and has not been presented in endogenous growth literature or in the literature focusing chiefly on corruption.

Before presenting the model in greater detail, it is illustrative to critically review selected literature on economics of corruption[4]. This paper is organized as follows. Section II reviews theoretical and empirical literature on the link between corruption and growth according to transmission mechanisms involved. Section III describes the basic model and the last Section concludes.

II. Literature review

The majority of theoretical studies of economics of corruption uses agency framework, where emphasis is placed on incentive structures, asymmetry of information, and conflicts of interests (Mishra, 2005). Although welfare reducing impacts of corruption are acknowledged, this type of literature rarely relates effects of corruption neither to levels of living standards nor to growth explicitly because of its partial equilibrium, micro-theoretic framework. The theoretical literature that does relate corruption to growth or at least to impacts on general welfare can be classified according to three different mechanisms mentioned above, namely, the human capital channel, the institutional channel and the investment channel. This typology of channels is borrowed from Mo's (2001) empirical analysis. While useful in empirical work, it is also valuable for analysing corruption conceptually from these three different angles.

2.1. The human capital channel: how corruption distorts human capital allocations

There are a number of authors that focus primarily on the human capital channel (Murphy et al. 1991; Murphy et al.1993; Acemoglu & Verdier 1998; Acemoglu & Verdier, 2000). Corruption slows growth because of sub-optimal allocation of labour and talent is the recurrent result in this stream of literature. For instance, Murphy et al. (1991) demonstrate how increasing returns to ability may divert human capital away from entrepreneurial sector to rent-seeking sector. Their model posits that each worker chooses among three occupations: rent-

[4] Definitions and manifestations of corruption are multifaceted and highly context-specific. For this reason, in the literature concerned with economics of corruption, the usual working definition is narrowed to "misuse of public office for private gains" (Mishra, 2005, p.4). Thus, for the purpose of this paper, the focus is solely on bureaucratic corruption. Bribery is a common example of such practice.

seeker, entrepreneur and employee. Rent-seekers collect taxes and produce nothing[5]. Entrepreneurs manage firms, advance technology and foster growth[6]. Employees are simple workers earning wage income. Growth rate of the economy is driven solely by the talent of the ablest person in the entrepreneurial sector. If rent-seeking sector captures the most talented person, then growth rate and level of income are reduced. Such outcome is due to relatively higher increasing returns to ability in the rent-seeking sector. Better growth outcome is possible if entrepreneurial sector exhibits higher returns to ability and less rapidly diminishing returns. Thus, in this setting the allocation of the ablest to entrepreneurial sector and not to rent-seeking is most beneficial to growth.

The occupational choice in this model is also determined by the firm size, market size, and relative elasticity of output with respect to labour as well as the nature of contracts. The nature of contracts is the extent to which a rent-seeker or an entrepreneur can capture his quasi-rents. Thus, for example, when entrepreneurs work in teams, it is very hard to reward them according to their exact merit. If, on the other hand, an entrepreneur is the sole manager of a firm he can capture all quasi-rents or profits. Conversely, if rent-seeking sector becomes less meritocratic from the individual point of view, talented workers would wish to leave it thereby lowering corruption and boosting growth. The particularity and novelty of this model is in its focus on allocation of *talent* between rent-seeking and efficiency-enhancing activities as opposed to allocation of mere labour. Although corruption is explicitly related to growth, production function has diminishing returns and therefore is not entirely consistent with endogenous growth setting.

In the later work by Murphy et al. (1993) misallocation of labour still plays a crucial role in demonstrating how corruption can reduce welfare via human capital channel. However, in this model rent-seeking technology exhibits naturally increasing returns relative to returns to productive activities[7]. This difference in returns creates multiple equilibria. At the optimum the benefit of marginal increase in rent-seeking is greater than the cost of doing so. In the model corruption is introduced as lump-sum tax on output, which effectively is stealing. Equilibrium is achieved by allocation of productive labour among three activities: cash-crop production,

[5] Taxes in this model are not effectively different from bribes because they represent simple resource extraction from productive agents. Thus, no benevolent public sector is present in this setting.
[6] Authors admit that the distinction between rent-seekers and entrepreneurs is exaggerated because in reality there are no activities that are pure rent-seeking or pure efficiency-improving.
[7] Returns to both types of activities may be decreasing, but Murphy et al. (1993) assume that for at least some range returns to productive activities should be diminishing faster.

subsistence production and rent-seeking. Depending on parameters of production curves one or more equilibria take place. In case of multiple equilibria, the "bad" equilibrium is characterised by high corruption and low *level* of living standards. Although this model makes a brief recognition that public rent-seeking is a tax on innovative activities, it does not formally relate corruption to *growth.*

In Acemoglu & Verdier (1998) corruption also results from allocating some fraction of all talented workers towards bureaucracy where bribery occurs with some probability. However, model specification emphasizes that rent-seeking is not the only bureaucratic activity. Indeed, corruption cannot be analyzed in isolation from other functions performed by bureaucracy such as protection of property rights. Thus, authors construct a general equilibrium model where bureaucrats, albeit possibly corrupt, secure property rights and enforce contracts among two types of entrepreneurs: suppliers and producers. Only suppliers invest and reap the returns to their investment if the level of output realized by producers is high. Hence, producers have an incentive to lie about their output level (if it is high) and keep the returns themselves. For this reason a bureaucrat is needed to ensure that *ex-ante* contract is enforced between supplier and producer, otherwise the former would not invest.

This general equilibrium model captures both the human capital and the investment channel at play in the interaction among public sector wage, property rights enforcement, investment and corruption. The result of this model differs from previous literature in its condemnation of corruption. In fact, some level of corruption is desired in order to ensure property rights protection and, hence, the possibility of higher investment. In that respect, free-lunch effect is a particularly interesting feature of the model. It goes as follows. Increase in public sector wage forces bureaucrats to be more honest; if caught taking bribes they lose their public office. This effect stimulates investment in three ways. First, higher wage attracts talent into public sector and fosters better enforcement of property rights. Secure property rights create better investment climate. Second, more honest bureaucracy also improves investment climate because entrepreneurial rents are less likely to be extracted as bribes. Third, as soon as higher returns to investment are realized more agents have incentives to leave public sector and become entrepreneurs. Accounting for strategic interaction, this model is highly insightful about links

between corruption and human capital allocation. It is also valuable in its assessment of general welfare under corruption. However, growth outcomes are not part of the analysis[8].

In Acemoglu and Verdier (2000) corruption results from the necessity of state intervention to correct externalities associated with technological spillovers. The benevolent central planner does so by withdrawing some workers from productive private sector and turning them into monitoring bureaucrats. Bureaucrats try to identify and subsidize firms that adopt the technology with positive spillovers. If a firm does not invest into a better technology, it is taxed. This bureaucratic intervention creates possibilities for corruption because bureaucrats are more informed than central planner.

Thus, if bureaucratic intervention is necessary society faces a trade-off between correcting market failures and combating corruption. In this general-equilibrium setting there is an optimal mix of partial corruption and externality-correcting bureaucracy. Magnitude and valuation of externality becomes important because it is costly for society to misallocate labour in such a way. Moreover, for some parameter values, heterogeneity of bureaucrats (corruptible and honest) yields an optimum where both government intervention and partial corruption coexist. This equilibrium is preferred to laisser-faire with no corruption. In other words, similarly to their earlier work Acemoglu and Verdier (2000) point out that bribery is a necessary by-product of government intervention if it is indeed aimed at correcting externality. The model's comparative statics indicate the inferiority of general welfare under corruption, but growth is rate is not analyzed.

Motivated by concurrent observation of corruption persistency and slow output growth, Mauro (2004) presents two complementary models, where corrupt behaviour is related to growth. The first model sheds light on the human capital channel as a transmission mechanism. The second model relates corruption to growth through the institutional channel which will be discussed in the next subsection. In the first model labour hours are allocated between legal work and theft from productive government expenditures. Following Barro (1990), government expenditures are used as an input in private production. Furthermore, corruption persistency is reflected by the stability of the "bad" equilibrium[9]. This stability is due to strategic complementarities in the sense that everyone would be better off collectively if corruption is

[8] As a suggestion for further research Acemoglu and Verdier (1998) recommend to extend their model into dynamic settings.

[9] There are two possible equilibria. "Bad" equilibrium is characterized by low investment and low growth and the opposite for the "good" equilibrium. Only the "bad" equilibrium is stable. Whether "good" or "bad" equilibrium takes place depends on comparison between legal wage and its best alternative: marginal product of stealing from government.

reduced, but from the individual point of view fighting corruption is too costly. The concept of strategic complementarities is useful in emphasizing the relationship between an individual behaviour and a group's behaviour. Moreover, strategic complementarities imply that for some range there are increasing returns to corruption; if many people steal corruption is too widespread and "accepted". In this case the probability of being caught is low. Also, "bad" equilibrium features low growth and low investment which are due to two factors. First, time spent stealing is a waste of productive labour hours. Second, resources stolen from the government do not reach the productive process and lower private marginal product of capital. This is the first theoretical paper that at the same time endogenizes corrupt behaviour and relates it to growth formally and extensively. Unlike in the model presented in Section III, in this setting the government is benevolent and does not induce corruption per se. Corruption is the result of private agents' dishonest misallocation of labour.

Given the importance of the human capital channel some developing countries undertook a variety of wage and tax reforms to ensure more honesty among bureaucrats. As mentioned before, one prominent example is Ghana in 1980's, where implementation of incentive-based schemes proved to be relatively successful in containing corruption from the perspective of the human capital channel. Chand and Moene (1999) provide an interesting analytical illustration of why such reform was successful and how bonus payments to tax collectors may have helped to reduce corruption. Their model focuses on fiscal officer's behaviour and his corruptibility relative to that of upper-level official. The model comprises a taxpayer, a fiscal officer and a manager. Taxpayer wishes to evade taxes if the cost of doing so is less than paying taxes in full. Fiscal officer is underpaid and, hence, asks for bribes if he detects tax evasion. When bribe is too high, taxpayer may appeal to the manager in which case fiscal officer looses. Also, if fiscal officer claims to detect tax evasion, but taxpayer disagrees, the case is taken up by the manager who may be corrupt himself. In this case the manager is assumed to have no information barriers in finding out taxpayer's actual profit.

In addition, fiscal officer can receive a bonus, which is a fraction of taxes collected. The higher the bonus, the higher the bribe taxpayer must pay in order for fiscal officer to be willing to forgo this bonus by underreporting taxpayer's true profit. With the bonus scheme fiscal officer would scrutinize taxpayer's profits harder and would be less likely to ask for a bribe. Thus, provided the manager is sufficiently honest, bonus scheme reduces equilibrium bribe rate. In addition, narrower amount between true and reported profits means lesser gain to the taxpayer

from appealing to manager. In other words, manager's corruption opportunities are curbed with the introduction of bonus scheme that also reduces corruption at the level of fiscal officer.

In sum, theoretical literature elucidating the nature of corruption through the human capital channel points in the same general direct: corruption is unambiguously distortive. However, only some studies acknowledge that it is a necessary evil.

2.2. The institutional channel: how corruption and governance are linked

In the theoretical literature distortions resulting from the inefficient allocation of human capital is probably the most obvious and well-noted outcome in the presence of corruption. The institutional channel, on the other hand, is more conceptually challenging, but no less important in understanding how corruption hinders welfare and growth[10]. Corruption and malfunction of public institutions are known to be closely linked (Gould & Amaro-Reyes, 1983). Meanwhile, institutional malfunction is considered among the most important impediments to long-run growth.

Rose Ackerman (1975) is one among the first to explore the relationships between government and private firms with explicit reference to corruption. Her partial equilibrium model comprises a government as a buyer and firms competing for a contract to sell to the government. A senior-level policymaker instructs a lower-level bureaucrat about government's preferences, which are effectively price-quality combinations such that they are equally desirable[11]. Bureaucrat then considers firms' offers and picks one winning firm[12]. Three cases are examined: i) well-defined governmental preferences with many sellers, ii) vaguely-defined preferences and many sellers and iii) vaguely-defined preferences and one seller. In all three cases institutional features are captured by various structures of penalty and moral cost functions faced by the bureaucrat and by each firm. The relative structure of these functions determines how high, if any, the resulting bribe would be.

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[10] The literature reviewed in this subsection is concerned with institutions defined in its broad sense: as the nature and rules of interaction either between private agents and the state or interaction among private agents.

[11] If there is competition among many firms who sell products of different quality, a firm offering a product of low quality simply lowers its price in order for the government to be indifferent between this product and another product of better quality, but higher price.

[12] His decision is then reviewed by the policy maker

In the first case, with the government as a sole buyer, equivalent firms have incentives to bribe the bureaucrat to win the contract. The winning firm pays the highest bribe, which depends on the difference between its revenues from the sale and total costs (production, penalty and moral costs). Thus if the leading firm's is highly efficient, has few moral scruples and enjoys political influence it may become the successful "bribee".

In the second case, vagueness of government's preferences translates into increase in expected punishment for both the wining firm and for the bureaucrat if the negotiated unit price increases. In other words, if contracting bureaucrat is found accepting a price-quality combination inferior to one offered by another firm, then he is not punished with certainty. Firms now seek to offer optimal price-bribe combinations. If penalty for the bureaucrat depends on the size of the bribe and if his gain function is single peaked, there may be a finite equilibrium bribe. Rose-Ackerman's analysis also suggests that penalties should be tied to *either* firm's revenues *or* to bureaucrat's bribes to prevent corruption with finite penalty. If penalty depends on both, fines may be ineffective remedies provided that the probability of detection depends negatively on the severity of punishment.

On one hand, stability of a competitive bribery market can be sustained. A firm that offers a bribe but is not offered a contract in return may wish to remain silent if laws punishe attempts to bribe public officials. On the other hand, competing firms may wish to collude and act as a monopolist. In this third case of bilateral monopoly the level of corruption is determined by the bargaining strength of firm relative to that of a bureaucrat. Thus, bribery will take place if firm finds it costly to wait, while bureaucrat is relatively more patient. In addition, this market structure is believed to create best incentives for corruption to take place. If government refines its purchasing policy by better specifying its preferences and if price fall sharply, then, according to this analysis, one should suspect pre-existing corrupt relationships. The collapse of pervasively corrupt Chrisitan Democratic party in Italian *tangentopoli,* as argued by Tanzi and Davoodi (1997), is a case in point. Rose-Ackerman's analysis aims to pinpoint contractual relations as well as its nuances that may foster corruption. However, it abstracts from corruption's explicit impact on general welfare.

Emphasising institutional and governance aspects, Shleifer and Vishny (1992) suggest that bribery may explain systemic shortages and underpricing in socialist regime[13]. Their analysis

[13] In a market economy shortage of output is accompanied with high market-clearing prices, while in socialist economy prices are kept artificially low. Therefore, "excess demand" is a distinctive feature of socialism. Prime historical example of such shortages took place in Russia in 1990's. Another episode of

is chiefly premised on self-interestedness of bureaucrats and firm managers, who collude to act as a single social industry in order to extract bribes. They do so because profits of publicly owned firms cannot be appropriated by those who run them. In addition, the social industry does not pay for its input costs because inputs are supplied by the state in centrally planned economy. Thus, revenues collected from consumers by charging an official price are the real costs to the industry because, just like a very high excise tax, they are taken away by the treasury. Therefore, members of the social industry find it worthwhile to create artificial shortage to induce quantity-constrained consumers to pay a bribe on top of the artificially low price. In short, the question of property rights, more specifically the right to appropriate profits, is central in understanding how corruption can exacerbate shortages of consumer goods and, hence, reduce welfare.

In their later work Shleifer and Vishny (1993) analyse corruption in the context of institutionally determined market structures. Unlike, Rose-Ackerman, corruption's impacts on welfare and growth are discussed in more detail. The authors compare three regimes with different government institutions determining the level of bribe extraction from private agents by bureaucrats. The first regime is characterized by a monolithic bribe collection system, where a single bureaucrat sets up a monopoly of public good provision. He charges a mark-up over a unit price of public good. If profits from selling the public good arrive to the treasury and do not stay in a bureaucrat's pocket, then bribery is not different from taxation. Historical example of such regime occurred in Communist Russia and in Philippines under Marcos.

The second regime takes place in a setting where multiple non-cooperative monopolists emerge as bribe collectors. In this case entrepreneur can be asked to pay a bribe any time. This regime features weak or collapsing central government, where independently run corruption rackets are not easily punished or detected by central authority. The prime example of this regime is Russia during its post-Communists era.

Finally, under the third regime each public good is provided by at least two public agencies; because of this competition citizens have the power to drive bribe rate to zero. Bureaucrats compete, but not collude. Moreover, this regime assumes substantial public pressure to punish deviant behaviour of bureaucrats if they dare to ask for bribes. Evidently, this regime reflects how most OECD economies enjoy low and rare corruption. Bribe rate is highest under the second regime, lowest under the third regime and intermediate under the first. This view of

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food shortages happended in Chile in 1970s. March of the Empty Pots in December 1971 was revelatory of how drastic supply of basic goods was under Allende's policies of collectivization. Popular discontent escalated into the well-known military coup of September 11, 1973 (Winn, 1999).

institutional impact on corruption through industrial organization perspective is supplemented with abundant historical and numerical examples. However, *formal* illustration of corruption-institutions-growth nexus is not extensive in Shleifer and Vishny (1993). Economic growth and development are used almost always synonymously throughout the partial equilibrium discussion.

Another insightful analysis of the corruption-institutions-growth linkages is carried out by Ehrlich and Lui (1999). The analysis is motivated by the following stylized fact. While command economies generally exhibit lower *levels* of living standards than democracies, growth *rates* are nearly similar or even higher in strongly established and stable autocratic regimes. The model aims to explain diverse corruption experiences and relate it to long-term through the nature of political regime.

The model assumes government's role as neutral; neither socially productive, nor unproductive. Agents chose how much to invest into human capital, into political capital or into both types of capital. While the former is the engine of growth, the latter hampers growth because its sole purpose is to enable agents to extract rents. Agents are either workers or bureaucrats depending on the initial endowments of each type of capital[14]. In addition, two cases are considered: decentralized (competitive) bureaucracy, where bureaucrats compete, and centralized (monopolistic) bureaucracy, where bureaucrats cooperate as a single monopoly. In the case of competitive equilibrium bribes are high the higher the government's intervention, the higher bureaucrats' relative stock of political capital and the lower relative size of workers. Furthermore, economy has three steady states: stable poverty trap, unstable "development" equilibrium and stable "growth" equilibrium. Only in the third equilibrium the economy grows.

In the case of monopolistic equilibrium, however, only "growth" equilibrium is technically feasible. This result is intuitive: bureaucrats' rents depend on workers' productivity. Acting as a single monopoly, bureaucrats take this into account when they choose how much to invest into their political capital. Moreover, the model's central prediction is that monopolistic bureaucracy may enjoy same output growth rates as the competitive bureaucracy. If each agent specializes in accumulating only one kind of capital, corruption lowers only *level* of income and not the growth rate.

[14] Authors present two models. In the first model agents are homogeneous; each is at the same time a worker and a bureaucrat. Those with above-average political capital are net earners of bribe income. Otherwise, they are net payers of bribe. Only the second model is discussed in the text because both models yield similar predictions regarding growth outcomes.

Ehrlick and Lui (1999) test these insights with two regressions. The first estimation suggests that government size has adverse effect on growth, but long-run growth rates in high-income democratic economies are not dramatically different from those in efficient autocratic states. The second estimation points out that increase in the government size and corruption incidence may reduce income level but not so much grows rates in these two types of economies. In sum, while corruption and income *levels* are negatively associated, causal relationship between corruption and growth may not be so straightforward. Similarly to arguments of Shleifer and Vishny (1993), this analysis alludes to the possibility that a collapse of autocratic regimes gives way to a surge in corruption.

While Mauro's (2004) first model illustrates corruption-growth linkage through misallocation of labour, his second model links corruption, political instability and growth in the two-period setting. Here politicians strategically decide whether to set up high or low bribe rate in the first period. They know that this choice ultimately affects output growth. In addition, politicians decide whether to collect bribes cooperatively or non-cooperatively. Citizens, however, can not observe exactly which politicians are corrupt and which are honest, but they do observe the growth rate of the economy and the general corruption level. Depending on the level of corruption observed, citizens choose whether or not to have a revolution in the second period. However, corruption-induced institutional change such as revolution comes at an efficiency cost.

Citizens are also responsible for production described by a simple CRTS production function. Thus, the coercion to pay bribes higher than the efficiency cost of revolution results in lower growth and causes eventual ousting of all politicians. Conversely, if bribes are low and growth is high the government is not overthrown. The upshot is that bribery and political instability are concurrent phenomena. Clearly, in this model, political stability and growth capture the institutional channel, illustrating formally the interactions between producing consumers and bureaucrats in the endogenous growth setting. Similarly to Mauro's first model, strategic complementarities produce two equilibria. "Good" equilibrium has higher investment, growth, welfare, and low level of corruption, while the opposite occurs in the "bad" equilibrium.

Aidt, Dutta and Sena (2008) focus on two types of regimes (Regime G and Regime B) to show that corruption's effect on growth is regime-specific and may produce multiple equilibria. To contrast with Ehrlick and Lui (1998) this model analyses political accountability. Whether citizens can hold politicians accountable and whether citizens are volatile or apathetic in their voting habits determine the type of regime. In Regime G, institutions allow citizens to replace

corrupt rulers. The ruler is aware that if he performs well during his mandate he will be rewarded with reappointment. Small rent extraction is still possible with citizens' approval as long as minimum performance standards are met[15]. The threat of replacement provides incentives for ruler to restrain his current rent extraction if low corruption today boosts growth and allows rent extraction in the future. There is also a feedback loop from high growth to corruption. Rent extraction plays the role of a fee to enter into the formal sector. If growth is high because well-functioning institutions discipline rulers, informal workers may wish to enter into formal sector. This inflow of "bribe-payers" widens ruler's tax/bribe base and bribe per capita gradually diminishes[16]. In sum, in Regime G lower corruption boosts growth which in turn lowers corruption further.

In Regime B, on the other hand, institutions are weak so that citizens are neither able to enforce political accountability on their leaders nor can they promise to re-elect a well-performing leader with certainty. In such a regime ruler extracts maximum rents. Marginal institutional improvements aimed at reducing corruption do not improve growth performance as much as in Regime G. In addition, growth does not reduce corruption at all. Only radical change in institutions can trigger regime change and push the economy out of this corruption trap. Therefore, there are three equilibria analogous to the case of Ehrlick and Lui (1999): high growth with low corruption (stable), low growth and high corruption (unstable) and an instable equilibrium "in-between".

Moreover, the theoretical prediction that relationship between corruption and growth is regime-specific motivates empirical investigation. Aidt et al. (2008) use a sample of 67-71 countries and consider short-run (1995-2000 period) and long-run (1970-2000 period) growth to estimate the threshold beyond which regime is good enough to a have a favourable feedback loop as described in Regime G. They estimated significant threshold effect using World Bank's "voice and accountability" index as proxy for the threshold variable. Their empirical results suggest that if a country's "voice and accountability" index scores 0.5 or higher, there is a negative and significant relationship between corruption and growth. Otherwise, this relationship is insignificant, in which case institutions are too weak.

It is widely acknowledged in the growth literature that institutions play a crucial role in determining cross-country long-run growth performance. The nature of corrupt practices and their

[15] Here rent extraction is the difference between tax revenues and effective public spending.
[16] Authors assume that the size of the formal sector is non-decreasing in growth.

pervasiveness shapes institutional character of economies. Therefore, corruption's impact on growth necessarily passes through institutional landscape of each country whether this country is hopelessly corrupt or whether its public officials are exemplarily honest.

2.3. The investment channel: how corruption reduces incentives to invest

Corruption dampening investment is a recurrent *mention* in the theoretical literature, but this literature rarely focuses exclusively and extensively on this transmission channel. However, numerous empirical studies document corruption's corrosive effect on investment in almost all regions of the world. These studies are reviewed in the next subsection. Literature concerned mainly with growth addresses corruption to some degree via investment mechanism. For example, as an extension of his baseline model of endogenous growth with government spending, Barro (1990) illustrates how kleptocratic government causes the reduction of marginal product of capital and thereby lowers growth. Government spending on public goods is financed through income tax. Public goods act as an input into production function. Government collects flat-rate income tax and runs a balanced budget if it is honest. If the government is corrupt it collects net revenues for its own consumption. In the model with honest government tax has two opposing effects on growth: increase in tax reduces output growth, but government spending raises marginal product of capital, which raises output growth. With kleptocratic government the second beneficial effect is muted – lower marginal product of capital lowers growth. However, because public spending is productive in this setting, growth-maximizing tax is positive with honest and corrupt governments.

Not only private investment is hindered by corruption. Del Monte & Papagni (2001) argue that corruption impedes growth because it lowers the amount and the quality of public goods and because it reduces efficiency of public investments. Informational asymmetry between central planner and bureaucrats allows bureaucrats to provide the government with goods of lower quality, but charge higher price than would be fetched in the private market for equivalent goods. This discretionary power of bureaucrats is the source of inefficiency in public expenditures, especially when it comes to infrastructural investment.

Furthermore, authors argue that effect of corruption on efficiency of public expenditures is very difficult to estimate in a cross-country regression since countries differ greatly in many aspects. However, regional data within the same country can yield more reliable estimates of this relationship. The regression result using data from 20 Italian regions indicates negative association between corruption and efficiency of public expenditures, which in turn produces an

adverse effect on growth. The econometric analysis also indicates adverse effect on growth through private investment.

According to Shleifer and Vishny (1993), corruption in developing countries causes unavoidable distortions due to its secret nature skewing investment away from projects with high social returns such as education to less useful projects such as defence or infrastructure projects which, in developing countries especially, appear to never be finished. In addition, corruption attracts investments into sectors where there are more possibilities for ensuring secrecy and not necessarily where social returns are high. This claim is supported by Mauro's (1998b) cross-country regressions measuring impacts of corruption on the composition of government expenditures. Results of this study strongly emphasize that corrupt governments invest considerably less in education and health.

2.4. Empirical literature on corruption and growth

The inconclusiveness of the theoretical literature pertaining to the effects of corruption on growth makes some authors suggest that this issue can only be resolved empirically (Asiedu and Freeman, 2009; Mauro, 1995; Mo, 2001). The majority of empirical studies conclude that corruption indeed slows down growth via several channels, three most important of which are discussed above. The landmark study by Mauro (1995) investigated extensively the relationship between corruption, investment and growth using indices of corruption perception, red tape and efficiency of judicial system from Business International for 70 countries in periods 1980-1983. OLS and 2SLS estimation methods were used. In the latter estimation method the index of ethnolinguistic fractionalization is used as an instrumental variable. The results from both estimations indicate negative and significant effect of corruption on investment and on growth, although OLS tends to understate its magnitude. In both high-red-tape and low-red-tape countries, one-standard deviation increase in corruption index (corresponding to increased bureaucratic honesty) raises investment rate by 2.9 % of GDP. This result is robust regardless whether institutional inefficiency or bureaucratic inefficiency is used as a proxy for corruption.

More recent study by Aseidu and Freeman (2009) uses firm-level data as well as country-level data to evaluate the effect of corruption on investment *growth* across three regions: Latin America, Sub-Saharan Africa and transition economies of Eastern Europe. OLS and IRLS (Iteratively Reweighted Least Squares) methods are applied. Regressions constitute micro and semi-micro analyses, where firm characteristics, industry features and macroeconomic variables are controlled for. Two key results emerged from this study. First, while in transition economies

corruption is significant and negative obstacle to improving investment climate, it may not be so in Latin America or Sub-Saharan Africa. Second, in macro studies corruption's impact on investment is almost always estimated negative, whereas in micro or semi-micro studies it is not always so.

The link between corruption and growth with particular emphasis on the three transmission mechanisms is estimated by Mo (2001). Corruption is a tacit tax on investment; it fosters inequality in opportunity, rent-seeking and socio-political instability. All of the above are harmful to growth. By estimating the effect of each transmission mechanism separately, the study concludes that only 28% of reduction in growth is due to investment channel, while the effect of political stability on growth accounts for 64% and that of human capital misallocation accounts for only 9.7% of growth slowdown.

Estimations of the relationship between corruption and foreign direct investment (FDI) echo those estimated for domestic investment. Controlling for official taxes, Wei's (2000) estimates suggest that FDI is negatively and significantly affected by corrupt practices in host countries. The result is robust to various changes in regression model specifications and yields same qualitative predictions whether OLS or Modified Tobit estimation methods are used. In similar vein, Lombsdorff (2003) breaks down investment into two parts: domestic savings and net capital inflows. The results of his study confirm that high level of corruption affects more adversely net capital inflows than domestic investment.

Habib and Zurawicki (2001) estimate the influence of corruption on FDI and on local direct investment (LDI), separating corruption from political stability variables. They conclude that the impact of corruption is negative and significant for both types of investment, but is weaker for LDI due to local investors being more informed about home bribery. Although data suggests that corruption affects private investment negatively, high corruption tends to increase public investment, but at the same time it decreases its productivity. This result is evidenced by Tanzi and Davodi's (1997) regression analysis using cross-country data.

Using time-series cross-section data on college enrolment in law and engineering Murphy et al. (1991) augment Barro's (1991) well-known cross-country regressions. In total, 91 observations are used for 1970-1985 time-span. Enrolment into engineering program is a proxy measure for entrepreneurship, while enrolment into law is a proxy, albeit far from perfect, for rent-seeking career choice. Main result is that that there is positive and significant effect of engineering enrolment on growth and negative, but insignificant one of law-school enrolment on growth,

which is consistent with the model's predictions discussed in Section 2.1. Authors also decomposed direct and indirect effects of both degrees, but the main result remains: negative relationship between rent-seeking and growth is not rejected by evidence.

Seligson (2002) generated survey data in four Latin American countries on individual experience with corruption as opposed to perception of it. Over 9000 face-to-face interviews were conducted in El Salvador, Nicaragua, Bolivia and Paraguay. This data, more direct than Corruption Perception Index (CPI), was used to test the effect of corruption occurrence on the belief in legitimacy of political system as opposed to opinion of the incumbent governments[17]. OLS regression results suggest that corruption erodes institutional legitimacy and interpersonal trust. In other words, Seligson's result is a rejection of a grease hypothesis to which political scientists had been attached longer than economists, as Seligson asserts.

As corruption data becomes increasingly available, empirical studies grow more and more sophisticated in their estimation methodologies. To date, however, the common empirical upshot emphasizes detrimental nature of corruption rather than confirms its benefits.

III. Basic Model

3.1 *Overview of the model*

The baseline specification of this model is borrowed heavily from Barro (1990). The model comprises three actors: representative consumer, representative firm and the government. Consumer wishes to maximize his intertemporal utility subject to his budget constraint. He also owns the representative firm. The firm uses two inputs, private capital and public capital, to produce output. Consumer spends his after-tax income on consumption and investment into future private capital. The government collects flat-rate income taxes and seeks to run a balanced budget. If the government is honest all taxes collected are transmitted into private productive process in the form of public capital, which, in turn, is used as a productive input. If the government is corrupt, part of the tax revenues is diverted towards purposes other than investment in public capital. Thus, only a fraction of tax revenues is passed on to the private

[17] Corruption Perception Index (CPI) is considered the most reliable and most popular proxy for corruption measure. Transparency International has been producing Corruption Perception Index since 1995. The index is based on several surveys. Over the years the number of countries sampled has grown from 41 in 1995 to 178 in 2010. The score of 0 is obtained by highly corrupt countries, while a score of 10 denotes highly clean countries.

productive process in the form of public capital, while bribe becomes an implicit consumption, which representative consumer takes as given. The model presents two cases featuring two functional specifications of corruption intensity: linear and non-linear. In each case corruption lowers marginal product of capital differently. In both cases high corruption intensity hurts growth, but "growth-possibility frontier" is not modified in the same way. Furthermore, two cases yield different growth-maximizing tax rates depending on the level of corruption intensity.

Consumer

The economy is populated by an infinitely-lived representative consumer who derives utility from consumption. The size of the population is normalized to one and, therefore, the subsequent analysis can be viewed in per-capita terms. In addition, for simplicity the model abstracts from labour supply. Consumer's intertemportal utility function is the following:

$$U = \int_0^{\infty} e^{-\rho t} \left(\frac{C_t^{1-\sigma}-1}{1-\sigma}\right) dt \qquad (1)$$

where ρ is the rate of time preference, σ is the inverse of the intertemporal elasticity of substitution and C_t is consumption at time *t*.

Firm

The consumer owns a representative firm with access to Cobb-Douglas production technology. Firm's production function is

$$Y_t = K_t^{1-\alpha} G_t^{\alpha} \qquad (2)$$

The two inputs K_t and G_t are private capital and public capital respectively. Traditional functional form usually includes a constant technology parameter A as in $Y_t = AK_t^{1-\alpha} G_t^{\alpha}$. Here A is assumed to be 1. Production function exhibits constant marginal returns and has diminishing marginal returns to each input taken separately. Public capital is funded by tax revenues which come from proportional tax levied on output. Following Barro (1990), government spending on public capital is productive and serves as an input for the firm. This specification is motivated by the fact that public goods and services such as infrastructure and their maintenance are essential for private production. As far as this model is concerned, government spending may even encompass spending on the rule of law enforcement or on property rights protection as long as this public spending is necessary for private production. Furthermore, as pointed out by

Acemoglu and Verdier (1998; 2000), corruption should not be analyzed in separation from positive externalities associated with state intervention such as simple public spending as in the present model.

The government

The government levies proportional tax on output with the objective to run a balanced budget

$$G_t = \tau Y_t \quad , \qquad 0 < \tau < 1 \tag{3}$$

The expression in (3) simply states that government spending on public capital is equal the amount collected from taxation. If the government is honest, nothing is pocketed by corrupt bureaucrats; all tax revenues are spent on public capital.

Assume that the representative firm cannot influence the government's decision and takes tax as given. Therefore, production function can be rewritten using (3) as $Y_t = K_t^{1-\alpha}(\tau Y_t)^{\alpha}$. Isolating Y_t production function is

$$Y_t = \tau^{\frac{\alpha}{1-\alpha}} K_t \tag{4}$$

This is a familiar AK-type production function consistent with endogenous growth settings. Here the private marginal product of capital is $\tau^{\frac{\alpha}{1-\alpha}}$. Consumer spends his after-tax income on consumption goods and savings, which are subsequently invested. Formally, $(1-\tau)Y_t = C_t + \dot{K}$. Since $G_t = \tau Y_t$, from consumer's budget constraint it is possible to rewrite aggregate budget constraint for this economy as

$$Y_t = C_t + \dot{K} + G_t$$

Private capital evolves according to the following law of motion

$$\frac{dK_t}{dt} \equiv \dot{K} = (1-\tau)Y_t - C_t \tag{5}$$

The consumer wants to maximize his utility defined in (1) subject to his budget constraint (5). Using (4) this constraint can be rewritten as $\dot{K} = (1-\tau)\tau^{\frac{\alpha}{1-\alpha}} K_t - C_t$. This maximization problem can be easily solved with the use of Hamiltonian. Denoting $\varphi \equiv e^{-\rho t}$, the Hamiltonian for this maximization problem is

$$H = \varphi\left[\frac{C_t^{1-\sigma}-1}{\sigma-1}\right] + \lambda\left[(1-\tau)\tau^{\frac{\alpha}{1-\alpha}}K_t - C_t\right]$$

To solve for the optimal consumption path first-order conditions (F.O.C.) require that

$$\frac{\partial H}{\partial C} = 0 \Longrightarrow \varphi C_t^{-\sigma} = \lambda \text{ and } \frac{\partial H}{\partial K} + \dot{\lambda} = 0 \Longrightarrow \dot{\lambda} = -\lambda(1-\tau)(1-\alpha)\left[\frac{G_t}{K_t}\right]^{\alpha}$$

Differentiating with respect to time and combining the above F.O.C the well-known Euler equation is

$$\frac{\dot{C}}{C} = \gamma = \frac{1}{\sigma}\left\{(1-\tau)\tau^{\frac{\alpha}{1-\alpha}} - \rho\right\} \tag{6}$$

With constant returns technology all variables grow at the same rate. Thus, γ is the general growth rate, corresponding to the growth rate of output, which is a variable of main interest here.

Growth expression in (6) is similar to Barro's specification

$$\frac{\dot{C}}{C} = \gamma = \frac{1}{\sigma}\left\{(1-\tau)(1-\alpha)\phi\left(\frac{G_t}{K_t}\right) - \rho\right\}$$

By inspection of (6) it is evident that tax has two opposing effects on growth. Tax lowers growth directly because it enters negatively in the first term within curly brackets. However, since tax-financed government spending is productive and essential, tax raises growth indirectly by increasing private marginal product of capital. According to this result, there is a positive tax rate that maximizes growth. As shown by Barro: $\frac{d\gamma}{d\tau} = \frac{1}{\sigma}\phi\left(\frac{G_t}{K_t}\right)(\phi' - 1)$

where growth-maximizing condition requires $\phi' = 1$. If $\phi' \times \left(\frac{G_t}{Y_t}\right)$ is the elasticity of output with respect to government spending, which is constant and equal to α in the case of Cobb-Douglas technology, then this condition implies that growth maximizing tax rate is $\frac{G_t}{Y_t} = \tau = \alpha$.

Now consider the government that is corrupt in somewhat similar manner to Barro's self-interested government. Suppose that if the government is corrupt not all tax revenues collected are channelled back into private production in the form of public capital. Instead, only a *specific* fraction of tax revenues collected is used in the productive process as public capital G_t. The remainder ε is a distortion associated with governmental intervention (here: taxation) which is bribery.

In practice citizens or firm owners often realize the difference between paying a bribe and paying a tax. In fact they may even initiate it with the aim to conceal their own illegal transactions or business practices in the first place. In this setting, however, when representative consumer pays his taxes he is not aware that some portion of it is diverted from its way to public treasury and that this portion is implicitly consumed. Following Tanzi and Davoodi (1997), corruption is associated with large public spending, but makes this spending less productive. Arguably in the context of this model such loss of productivity can be captured by a corruption parameter which generates a drag on private capital accumulation and, hence, on investment. In addition, Tanzi and Davoodi found that corruption decreases public expenditures on operation and maintenance of existing infrastructure and worsens its quality. This observation again can translate into corruption lowering *effective* public capital for the same level of tax revenues. More formally, consider the following government's budget constraint

$$G_t = \tau Y_t - \varepsilon_t \tag{7}$$

where G_t is effective government spending on public capital, τY_t is the legally collected tax revenues, and ε_t represents total bribes collected and diverted from production[18]. Consider the following two possible cases representing two different ways in which corruption may operate. The first case features "linear" corruption, while in the second case corruption diverts resources from public spending in a non-linear way. The two cases have different effects on growth-maximization.

Case 1

Suppose that bribe is linear in tax revenues collected

$$\varepsilon_t = \mu \tau Y_t, \qquad 0 < \mu < 1 \tag{8}$$

where μ is corruption intensity. Increase in μ means increase in corruption. No matter how high or low of a tax the government decides to levy for a given level of output there is always a constant fraction of tax revenues "pocked away". Combining (7) and (8) corrupt government's budget constraint becomes:

$$G_t = (1 - \mu)\tau Y_t, \tag{9}$$

[18] As discussed, but not extensively formalized, by Shleifer and Vishny (1993), bribe is more distortionary than taxation and more harmful to growth because secrecy requires additional efforts to conceal the illegal money transfer in order to avoid punishment.

Only fraction$(1-\mu)$ of tax revenues is used for public capital. The rest is consumed by rent-seekers, who are part of the population. Loosely speaking, since population is normalized to one, in the presence of corrupt government apparatus the representative consumer implicitly steals from himself by consuming more and thereby reducing his savings. Furthermore, in reality bribes are more likely to be secretly consumed rather than conspicuously invested into projects with high social returns.

Similarly to the case with honest government, firm lacks the necessary lobbying power to influence not only the tax rate, but also the level of corruption intensity. How plausible is the latter assumption? Many researchers emphasize persistent and self-replicating nature of corruption in a sense that individuals resent corruption, but feel powerless when it comes to rooting it out. Therefore, citizens of countries with particularly widespread corruption continue to tolerate it. Thus, to reflect this circumstance in the model, the firm takes both tax and corruption intensity parameter as given. Expression (9) can be substituted into production function (2) to obtain

$$Y_t = [(1-\mu)\tau]^{\frac{\alpha}{1-\alpha}} K_t \tag{10}$$

Notice how corruption intensity lowers private marginal product of capital $[(1-\mu)\tau]^{\frac{\alpha}{1-\alpha}}$. To better illustrate this mechanisms Figure 1 plots marginal product of capital as a function of tax for four different values of corruption intensity ($\mu = 0, \mu = 0.5,\ \mu = 0.75,\ \mu = 0.99$), where, again following Barro (1990), the elasticity of output with respect to public capital α is assumed to equal 0.25. Note that increase in corruption intensity shifts down marginal product of capital in a parallet fashion.

It is important to reiterate that bribe is windfall consumption for representative consumer. Thus, maximizing consumer decides upon his consumption and saving levels, but bribe is not his decision variable. His after tax income is spent on consumption and savings as before. However, since now $\tau Y_t = G_t + \varepsilon$ output is spent on consumption, investment, effective public spending and a total bribe as can be shown in the aggregate budget constraint below

$$Y_t = C_t + \dot{K} + G_t + \varepsilon_t \tag{11}$$

Going back to the budget constraint of the consumer $(1-\tau)Y_t = C_t + \dot{K}$ and taking note of (10), capital evolves according to the new equation of motion

$$\dot{K} = [1-\tau][(1-\mu)\tau]^{\frac{\alpha}{1-\alpha}}K_t - C_t \tag{12}$$

Expression (12) reveals how corruption acts as hindrance on capital accumulation. Since bribe is windfall consumption, consumer's momentary utility function is modified in the following way

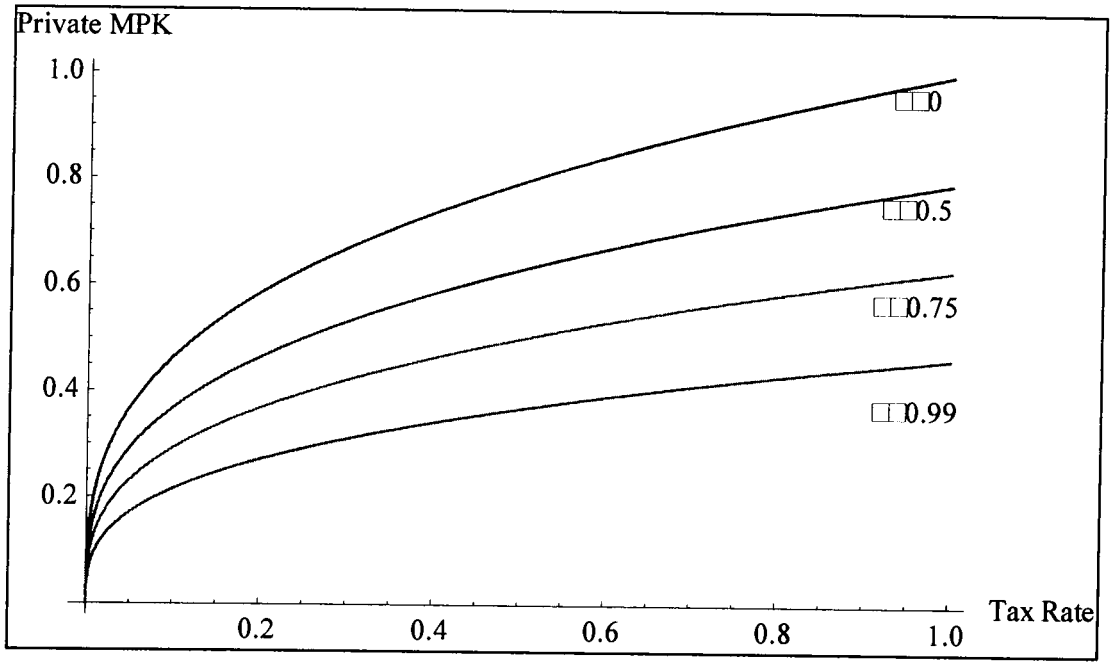
$$U(C_t) + V(\varepsilon_t)\text{ , where } U(C_t) = \frac{C_t^{1-\sigma}-1}{1-\sigma} \tag{13}$$

As mentioned before, ε_t is considered as given and, therefore, does not enter the original utility function, neither does it affect utility maximization. In addition, additivity is assumed for convenience.Consumer maximizes (13) subject to (12). Again, by the use of Hamiltonian

$H = \varphi\left[\frac{C_t^{1-\sigma}-1}{\sigma-1}\right] + \lambda\left[[1-\tau][(1-\mu)\tau]^{\frac{\alpha}{1-\alpha}}K_t - C_t\right]$ and the same F.O.C. as in the case without corruption, growth rate can be derived:

$$\gamma = \frac{1}{\sigma}\left\{[1-\tau][(1-\mu)\tau]^{\frac{\alpha}{1-\alpha}} - \rho\right\} \tag{14}$$

Figure 1: Private marginal product of capital as a function of tax rate for diffent values of corruption intensity $\mu = 0, \mu = 0.5,\ \mu = 0.75,\ \mu = 0.99$



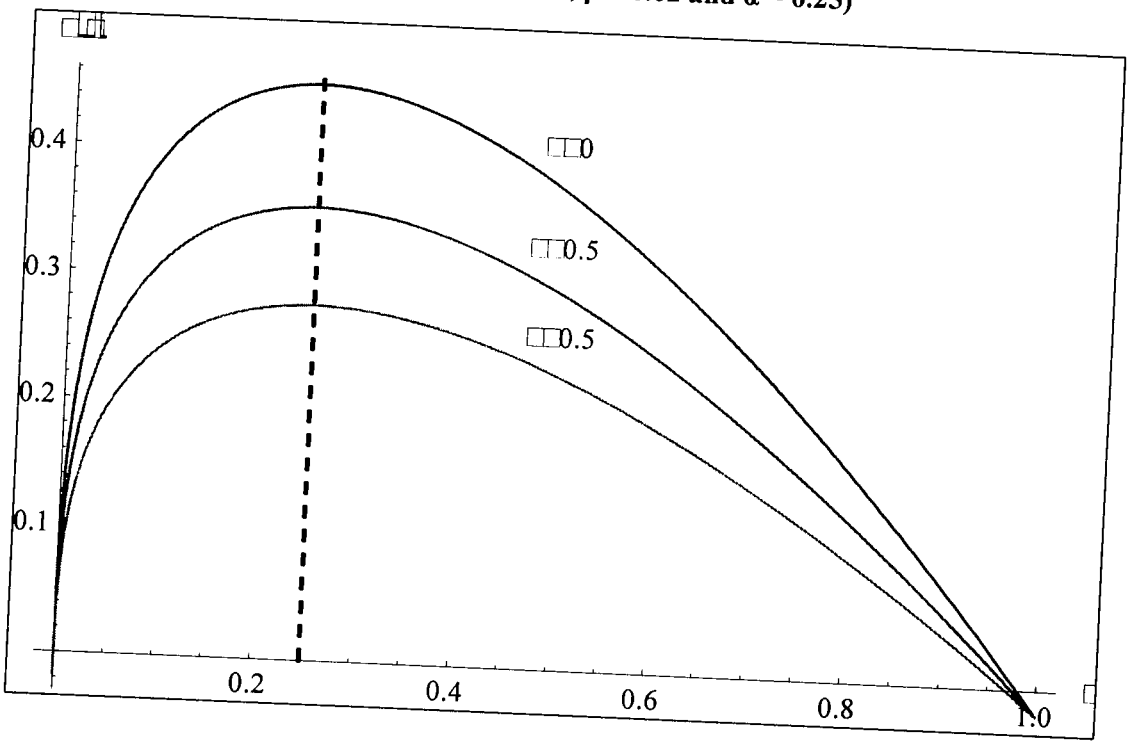
From expression (14) it is evident that corruption intensity μ lowers private marginal product of capital thereby lowering growth. Optimization condition $\frac{d\gamma}{d\tau} = 0$ yields growth-maximizing tax rate $\tau = \alpha$, which, surprisingly, does not depend on corruption parameter . Graphical illustration of this result is presented in Figure 2, where "growth-possibility frontier" is graphed for three values of corruption intensity ($\mu = 0$, $\mu = 0.5$, $\mu = 0.75$). Tax has two opposing effects on growth discussed earlier. The second beneficial effect is weaker because corruption intensity lowers marginal product of capital. Furthermore, growth rate is a single peaked function of tax. In the presence of constant returns to rent-seeking, "growth-possibility frontier" shifts down leaving growth-maximizing tax unaffected and independent of μ. Alternatively, if corruption acts "linearly", successful policies aimed at curbing corruption effectively stretch out "growth possibility frontier" vertically. The main feature of Figure 2 is that increase in corruption intensity lowers highest possible growth rate, but optimizing tax remains the same.

This result contrasts to some extent with that of Barro's self-interested government, where growth-maximizing tax rate is $\tau > \alpha$. Unlike the present model, Barro does not impose any functional relationship between ε_t and G_t. Mauro (2004), who also uses the same production function, arrives to similar conclusion that marginal product of capital is lowered by stealing from public productive input. In contrast with the present model, in Mauro's setting the amount stolen becomes a windfall *income* for the representative firm entering positively in the capital accumulation equation. Here, on the other hand, bribe is an impediment for capital accumulation.

Figure 2: Growth rate as a function of tax for different values of corruption intensity

$\mu = 0, \quad \mu = 0.5, \quad \mu = 0.75$

(Assuming $\sigma = 1$, $\rho = 0.02$ and $\alpha = 0.25$)



Case 2

Another possibility is to introduce corruption intensity in a non-linear fashion. A recent study by Aidt et al. (2008) recognizes that the link between corruption and growth if far from simple linear relationship and that there are many sources of non-linearity considering how complex and multifaceted growth experience of any economy is. Although in the case of Aidt et al. (2008) non-linear dynamics govern the relationships in the corruption-institutions-growth nexus, the present model postulates non-linearity such that corruption affects private marginal product of capital non-linearly (that is, via exponent). Furthermore, if there is a non-linear impact on private marginal product of capital there would be a non-linear impact on the growth rate. This possibility grants some additional complexity to the relationship between corruption and growth in the present model. Thus, consider the following expression for government's budget constraint

$$G_t = \tau^{\theta} Y_t \ , \qquad \theta \equiv 1 + \mu \tag{15}$$

where μ is corruption intensity such that when $\mu = 0$ government is honest and spends all tax revenues on public capital. However, as soon as $\mu > 0$ the government is corrupt in the sense that a lower fraction of tax revenues is used for public capital. Although there are other functional forms that can be used, the functional form in (15) is most mathematically convenient to introduce non-linear impact of corruption on marginal product of capital and, hence, on growth. In *Case 1* a positive amount $\varepsilon_t = (1 - \tau^{\mu})\tau Y_t$ is wasted on unproductive windfall consumption. In the previous case a constant fraction of tax revenues (μ) was diverted away from productive public spending. In this case this fraction is $(1 - \tau^{\mu})$ and it is increasing in corruption intensity at a decreasing rate. More formally, let $F(\mu) \equiv (1 - \tau^{\mu})$ be the fraction of tax revenues allocated to consumption via corruption,

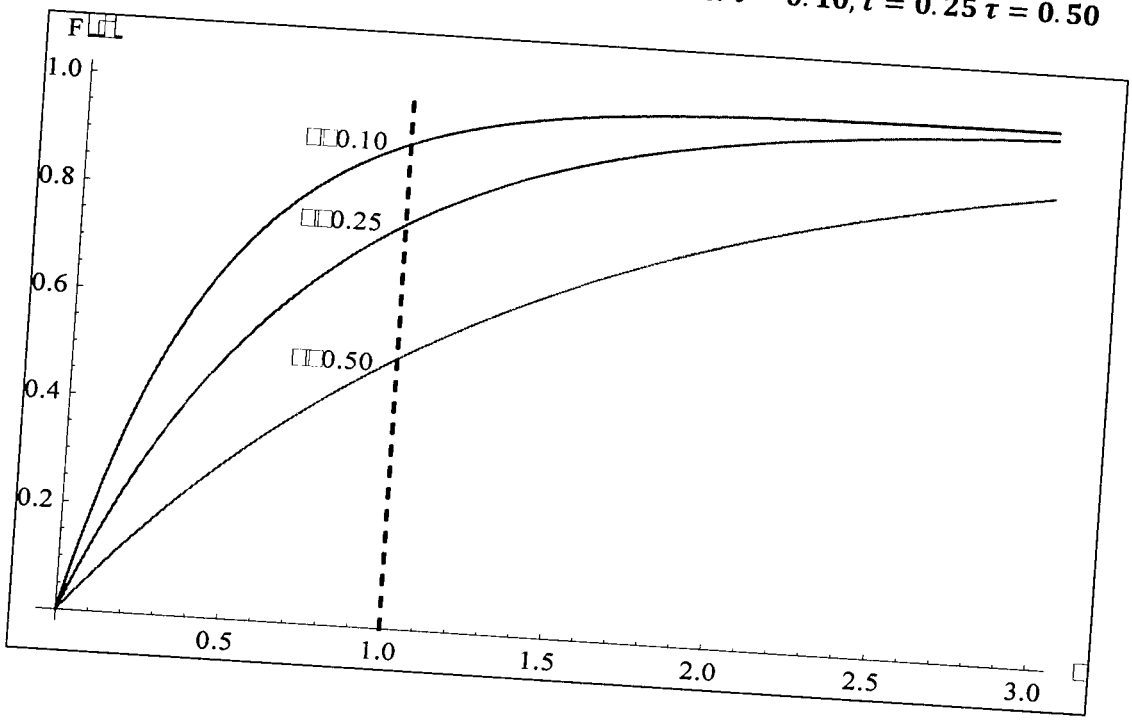
then $\frac{\partial F}{\partial \mu} = -\tau^{\mu} \ln \tau > 0$ and $\frac{\partial^2 F}{\partial \mu^2} = -\tau^{\mu}(\ln \tau)^2 < 0$.

Figure 3 plots this fraction as a function of μ for several values of tax rates ($\tau = 0.10, \tau = 0.25\ \tau = 0.50$). An interesting feature regarding tax rates emerges from this graph. For a given level of corruption intensity, say $\mu = 1$, smaller tax rates result in a higher share of total tax revenues diverted from productive public spending. One possible intuition for this outcome goes as follows. When tax rate is small, *ceteris paribus*, by definition smaller portion of total output ends up in the government's hands. These tax revenues can be easier "mismanaged" and diverted from its intended purpose at government's discretion. This may happen because citizens are unlikely to be concerned with such small tax revenue "losses" because tax rate is small in the first place. Now consider an *equally corrupt* country, but with a higher tax rate. When larger portion of output is at the disposal of government, "losses" are too conspicuous and the corrupt government or bureaucratic network may wish to restrain itself more by consuming a lesser fraction of total tax revenues.

Moreover, the choice of this functional relationship between corruption intensity and total amount of distortion aims to reflect the observation that when corruption is very low, as in most OECD countries, very small fraction of tax revenues is spent unproductively. Alternatively, when corruption intensity increases, this fraction of tax revenues "wasted" increases more than proportionally. Furthermore, decreasing *marginal* returns to corruption intensity suggest a kind of congestion effect in a sense that there are limits to what can be "extracted" from finite tax revenues. Thus when corruption intensity becomes arbitrarily large, nearly all tax revenues are diverted from spending on public capital. Note, however, that $F(\mu)$ approaches 1 only

asymptotically to ensure some minimal availability of public capital for private production in order to have positive output.

Figure 3: Fraction of tax revenues diverted from expenditure on public capital as a function of corruption intensity for three values of tax rates: $\tau = 0.10, \tau = 0.25\ \tau = 0.50$



There is an alternative way to illustrate intuitively the choice of this functional relationship between corruption intensity and the level of ε_t. Upon rearranging (15) consider the ratio of effective public spending to total amount of tax collected.

$$\frac{G_t}{\tau Y_t} = \tau^{\mu} \equiv R \tag{16}$$

If government is honest ($\mu = 0$), this ratio is 1. As soon as there is some corruption in the government this ratio becomes a positive fraction. Put differently, corruption reduces productivity associated with government's provision of a necessary input. Note that

$$\frac{\partial R}{\partial \mu} = \tau^{\mu} \ln \tau < 0 \qquad \text{and} \qquad \frac{\partial^2 R}{\partial \mu^2} = \mu \tau^{\mu} \ln \tau < 0$$

that is corruption intensity decreases this ratio at a decreasing rate.

Firm continues to take both tax rate and corruption intensity as given and its production function becomes

$$Y_t = [\tau]^{\frac{(1+\mu)\alpha}{1-\alpha}} K_t \tag{17}$$

Notice that, as predicted, private marginal product of capital is lower than that in the corruption-free model $[\tau]^{\frac{(1+\mu)\alpha}{1-\alpha}} < [\tau]^{\frac{\alpha}{1-\alpha}}$. In contrast to *Case 1*, corruption intensity reduces private marginal product of capital in a non-linear fashion. Figure 4 plots marginal product of capital as a function of tax for four values of corruption intensity ($(\mu = 0, \mu = 0.5,\ \mu = 0.75,\ \mu = 3)$. Increase in corruption intensity affects marginal product's curvature differently from what is observed in Figure 1.

Consumer faces optimization problem similar to that of *Case 1*, but now he maximizes (13) subject to a new capital accumulation equation

$$\dot{K} = (1-\tau)\tau^{\frac{(1+\mu)\alpha}{1-\alpha}} K_t - C_t \tag{18}$$

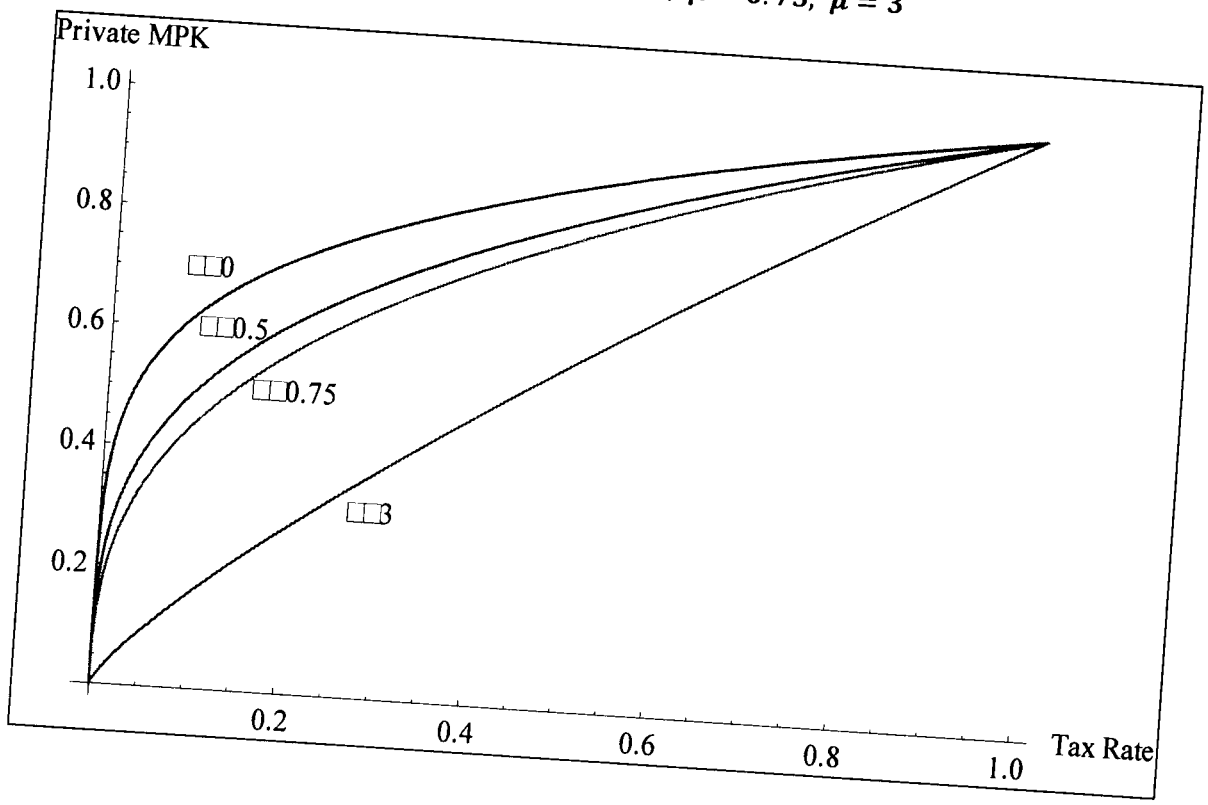
Again by the same procedure output growth rate is calculated

$$\gamma = \frac{1}{\sigma}\left\{(1-\tau)\tau^{\frac{(1+\mu)\alpha}{1-\alpha}} - \rho\right\} \tag{19}$$

Tax rate that maximizes (19) can again be easily computed

$$\tau^* = \frac{(1+\mu)\alpha}{1+\mu\alpha} \tag{20}$$

Figure 4: Marginal product of capital as a function of tax for four values of corruption intensity $\mu = 0, \mu = 0.5, \mu = 0.75, \mu = 3$

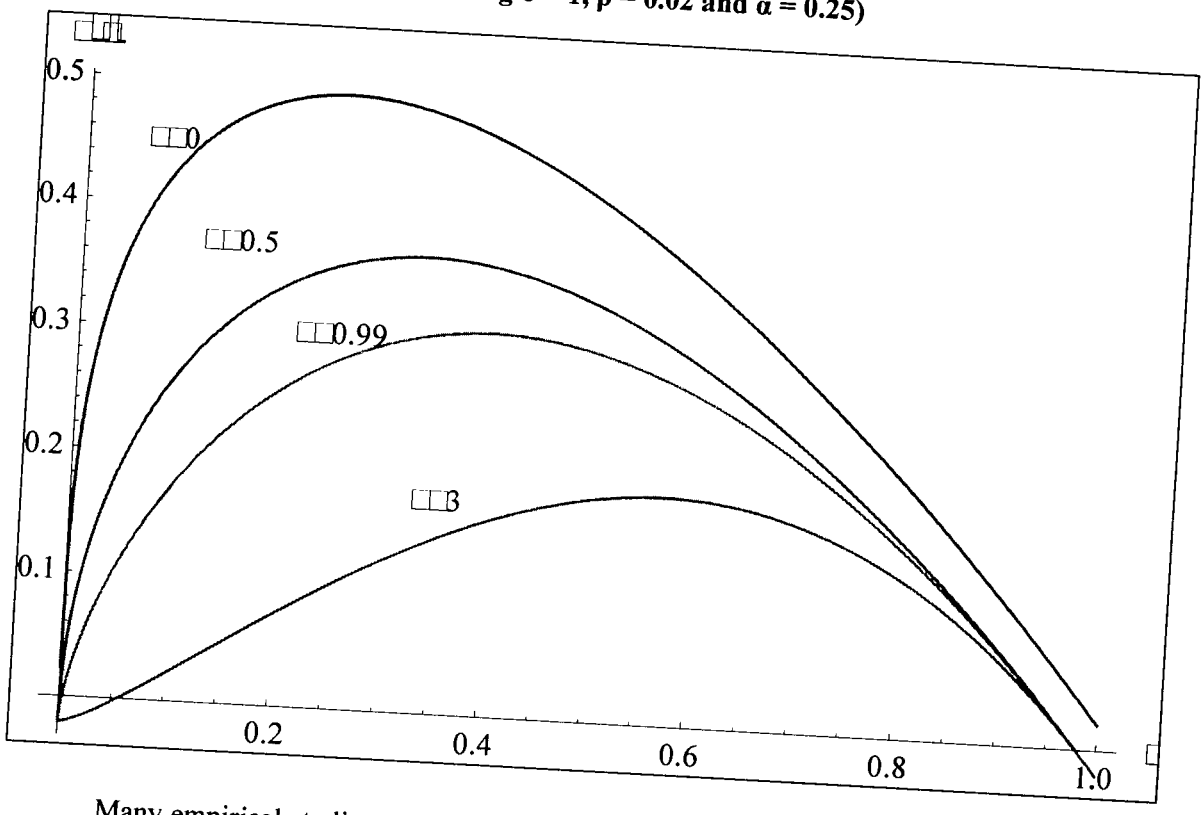


Expression (20) reduces to $\tau = \alpha$ with $\mu = 0$. As long as $\mu > 0$, $\tau^* > \tau = \alpha$. This result suggests that in the presence of non-linear corruption intensity the single-peaked growth as a function of tax is skewed and flattened rightward as shown in Figure 5. Furthermore, $\frac{\partial \tau^*}{\partial \mu} > 0$ as long as $0 < \alpha < 1$, meaning that greater corruption intensity flattens and skews grow function further. Thus, the model with corruption specification of *Case 2* yields the following suggestions. If a country manages to successfully reduce its corruption intensity not only it raises its maximum possible growth rate, but it reduces the necessary tax rate needed to maximize growth. Graphically, reduction in μ corresponds to an upward and leftward stretch in the "growth possibility frontier". A natural question arises: with an equal reduction in corruption intensity, say $\Delta\mu$ such that $0 < \Delta\mu < \mu$, how do growth outcomes in *Case 1* and *Case 2* compare? With reduction of corruption intensity by $\Delta\mu$ growth rates in both cases become

$\gamma_1 = \frac{1}{\sigma}\left\{[1-\tau][(1-(\mu-\Delta\mu))\tau]^{\frac{\alpha}{1-\alpha}} - \rho\right\}$ and $\gamma_2 = \frac{1}{\sigma}\left\{(1-\tau)\tau^{\frac{[1+(\mu-\Delta\mu)]\alpha}{1-\alpha}} - \rho\right\}$ where subscripts refer to growth rates in *Case 1* and *Case 2* respectively. It can be easily seen that

with an equal corruption intensity reduction $\gamma_1 < \gamma_2$ if and only if $1 - (\mu - \Delta\mu)\tau < \tau^{1+(\mu-\Delta\mu)}$ and vice versa.

Figure 5: Growth rate as a function of tax for different values of corruption intensity (Assuming σ = 1, ρ = 0.02 and α = 0.25)



Many empirical studies point out that corruption is associated with slow growth. Growth predictions in *Case 1* and in *Case 2* are consistent with this observation. Moreover, result of *Case 2* is reminiscent of Ghanaian experience of effective anti-corruption policies in 1980's. This case study is well-documented by Chand and Moene (1999). Ghana's economic stagnation from 1960s to 1980s was characterized by interventionist policies eroding Ghanaian tax base and forcing business into informal sector. What followed were numerous quasi-fiscal measures enforced at a considerable discretion of tax officers favouring some at the expense of the others. Rent-seeking became widespread. As tax collection and administration became more corrupt and disorganized, official tax revenues dwindled. By 1983 public servants' wages had to be cut significantly. In 1981 President Rawlings stepped up with a promise to contain corruption by means of radical reforms, which did not produce the desired outcome at first. The solution to this fiscal crisis, Chand and Moene (1999) argue, must be comprehensive, that is, it should incorporate three

elements. First, gradually induce informal economy to "formalize" and start paying taxes. Second, curb tax evasion. And third, motivate tax officers to collect taxes instead of bribes. This solution to drastic deficit problem may not be adequate if some elements are missing. Only combination of all three can trigger what Ghand and Moene (1999) call a "virtuous cycle". In 1984 a more integrated policy reflected this collection of remedies. Tax bases emerged from underground economy, tax rates were gradually reduced and the entire tax system was simplified in order to make it more transparent. Discretionary powers of tax officers were circumscribed. From 1986 to 1992 a temporary bonus system was in place serving as a successful incentive-based mechanism for officers to raise tax revenues more effectively and honestly.

This integrated reform strategy in Ghana produced several noticeable outcomes. While tax rate was lowered, tax base broadened and tax revenues increased making government (or at least its revenue agencies) more efficient. Other African countries attempted to replicate this experience.

In sum, improvements in Ghanaian tax administration are due to corruption containment. In this model such improvement can be reflected with a significant decrease in μ, which, as in Ghanaian case, is accompanied with lower τ^*. It is also is noteworthy that Ghana's GDP started growing in 1986 until it began declining 1988, although it is difficult to attribute this short improvement in growth experience entirely to successful anti-corruption policy as growth process is complex and multifaceted. Nonetheless, in addition to analysis of incentives by Chand and Moene, the model of *Case 2* provides another possible analytical illustration of how Ghana's corruption eradication boosted growth and reduced its average tax rate.

IV. Conclusion

The goal of this paper was two-fold. First, it aimed to provide a critical overview of the literature concerned with economics of corruption. Three main messages emerge from this literature: i) corruption plagues human capital resources with distortionary incentives to choose rent-seeking activities over more socially productive ones; ii) corruption undermines performance of public institutions and iii) corruption acts an implicit tax on investment thereby lowering marginal product of capital. Corruption operates through a complex interrelation of these three channels hurting rather than helping growth.

The second goal of this paper was to present a basic model of endogenous growth where corruption acts as an impediment through the investment channel. In the presence of corruption government diverts some part of tax revenues from investing into public capital, which in turn is a necessary input in the private production. Consequently as public capital becomes more and more scant, private marginal product of capital diminished. Two possible scenarios have been analysed. In the first case, linearly operating corruption intensity shifts "growth-possibility frontier" downwards and leaves growth-maximizing tax unaffected. Such linear specification of corruption fails to explain successful anti-corruption reforms in Ghana that lead at the same time to higher growth and lower taxes. The second case, however, offers a better explanation of how fighting corruption can be beneficial not only to growth but to an average taxpayer in the economy, whereby decrease in corruption intensity necessarily reduces growth-maximizing tax.

Noticeably successful outcomes of anti-corruption policies are rare because corruption is inherently persistent. While corrupt practices in some countries have been deeply imbedded for decades, other countries have demonstrated stable and exemplary record of relatively honest public institutions[19]. Nonetheless, today with more available and more reliable corruption measures it would be easier to track and analyse anti-corruption efforts and, more importantly, appraise their impact on growth. Thus, to assess the validity of the model presented in this paper against evidence it would be useful to track some fundamental anti-corruption reforms taking place after mid-1990s. One such reform is currently taking place in Russia, who joined OECD Anti-Bribery Convention in May 2011 and where innovative efforts to combat corruption are becoming increasingly more visible.

[19] For instance, Denmark, Finland and Singapore have consistently been assigned a grade 9 or higher by Transparency International's Corruption Perception Index (CPI).Alternatively, among the most corrupt are Bangladesh, Haiti and Nigeria scoring below 2.5 on CPI. CPI data dates back only to mid-1990s, so one needs to rely on case studies or anecdotal evidence of anti-corruption policies that took effect prior to that decade.

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