Corruption and Shadow Economy: Differences in the Relationship between Countries

Heli Virta
Helsinki School of Economics

Discussion Paper No. 171
June 2007
ISSN 1795-0562
Corruption and Shadow Economy: Differences in the Relationship between Countries*

Abstract

This paper examines the impact of corruption on the size of shadow economy. Unlike most of the previous literature, the paper accounts for the fact that some corrupt practices tend to be commonplace in some parts of the world, while other countries may be plagued by other types of corruption. First, a theoretical model is developed to show that bribes to get projects are likely to have different consequences with respect to shadow economy size than bribes that are paid to lower taxes. Second, the issue is examined empirically. Although cross-country data on different types of corruption are unavailable, an interaction term of the level of corruption and geography can capture differences in the consequences of corruption between countries. IV regressions and bootstrapping indicate that corruption does not affect shadow economy size outside tropics. Instead, the higher the tropical area fraction of a country, the more significant is the enlarging impact of a certain level of corruption on the size of shadow economy. Moreover, corruption and shadow economy seem to be substitutes in tropics, meaning that informal economic activities tend to increase, if corruption decreases. The result supports the conclusions drawn from the model.

JEL Classification: C31, D73, O17.

Keywords: corruption, shadow economy, instrumental variables.

Heli Virta

Department of Economics
Helsinki School of Economics
P.O. Box 1210
FI-00101 Helsinki
FINLAND

e-mail: heli.virta@hse.fi

* The author wishes to thank Pertti Haaparanta, Pekka Ilmakunnas, Laura Solanko and the participants of the FDPE Workshop on Macroeconomics and Political Economy in 2006 for valuable comments and insight. Financial support from Yrjö Jahnsson Foundation and the Academy of Finland is gratefully acknowledged.
1 Introduction

Recent years have witnessed a surge of interest in corruption-related issues. Even if this does not necessarily mean that corruption has become more common, it certainly implies that awareness of the risks associated with corrupt practices has risen. Corruption is a particularly acute problem in developing economies: in the 2003 Corruption Perceptions Index, 50 percent of developing countries scored less than three out of the no-corruption score of ten, and the level of corruption was “alarmingly high” in 90 percent of them (Transparency International 2003). Moreover, it has been estimated that the losses caused by corruption as a percentage of GDP have been not only high but also on the increase in various developing economies (Dreher et al. 2004, Tanzi 1998).

Many economists have tried to explain the prevalence of corruption in developing economies. Treisman (2000) categorizes the explanations into political, historical, social and cultural, and economic factors. As the classification implies, corruption is closely associated with every aspect of society. Therefore, it is not surprising that various studies imply that corruption inhibits productive investment or otherwise lowers GDP growth (Shleifer and Vishny 1993, Mauro 1995, Mauro 1997, Mauro 1998, Leite and Weidmann 1999, Mo 2001, Gyimah-Brempong 2002, and Méon and Sekkat 2005). Corruption may also decrease government expenditures on operations and maintenance, and possibly health and education, thereby lowering quality and returns of the existing public infrastructure (Tanzi and Davoodi 1997, Mauro 1998, and Gupta et al. 2000). Moreover, corruption seems to affect the distribution of wealth adversely (Gupta et al. 2002).

Corruption can also affect GDP - or its growth - indirectly by having an impact on the number of firms or individuals choosing to operate informally in shadow economy. According to Choi and Thum (2004) and Dreher et al. (2005), corruption and shadow economy are substitutes, meaning that correlation between the two is negative. This is the case if, for example, bureaucrats have to lower their bribe demands when firms have the outside option of fleeing into shadow economy. On the other hand, Johnson et al. (1997, 1998, 1999), Friedman et al. (2000) and Hindriks et al. (1999) claim that the two are complements. Because the evidence gathered so far is, therefore, rather mixed and in addition often based on questionable econometric techniques, more extensive discussion is necessary. The aim of this paper is to contribute to this literature. The most important contribution of the study is to acknowledge that the consequences of corruption might differ in different parts of the world and to account for this in the analysis.

Empirical research has tended to handle corruption on a general level, while those theoretical studies that have analyzed different manifestations of corruption have mostly focused on differences at institutional level. For example, the question of grand vs. petty corruption concentrates on the position of the bureaucrat being bribed: the former involves bribing high-ranking officials than the latter. Another important issue discussed e.g. by Shleifer and Vishny (1993) and Bardhan (1997) is the difference between centralized and decentralized corruption. The former is usually thought to have less severe consequences for efficiency, because the bribee then tends to (partly) internalize distortions caused by corruption. There are, however, other differences that could play a role in determining the consequences of corruption and that should, therefore, be taken into account. For example, bribing bureaucrats to avoid or lower taxes may, in principle, have quite different consequences than bribes that are paid to get licenses. It could be thought that bribes to lower taxes are much more common in developing economies than in industrialized countries, which have stronger institutions in place to prevent such corrupt practices. This implies that the income level of a country is important in determining the relationship between corruption shadow economy (Dreher and Schneider 2006 and Gërxhani 2004). The problem with the income level is that it is endogenous. There are, however, various studies that suggest that the geographic location of a country could be an important determinant of the income level. For example, Gallup et al. (1999) claim that geography and climate play major roles in economic development by affecting transport costs, disease burden, agricultural productivity and even economic policy choices. Sachs (2001) emphasizes also that economies situated in tropical climates face particularly problematic development challenges.

This paper attempts to shed more light on the role played by corruption through two models.
of an economy with formal and informal sectors. In both models, the size of shadow economy
is endogenously determined, as firms may freely choose to function either in formal or informal
economy. The firms operating in the formal sector pay taxes to government. In the first case,
they have to pay bribes to corrupt government officials to get projects or licences for the projects.
In the second case, they may attempt to lower the taxes they have to pay through bribes. In
both cases, the relative costs of corruption from the point of view of the firm depend on the size
and political connectedness of the firm. This reflects firm-specific features: some firms are better
equipped to deal with corruption and manage, therefore, to pay less. Some firms choose shadow
economy to avoid taxes and to benefit from the lower wage and social security payments of the
informal sector. This choice comes with costs, too: the firms operating in shadow economy face
an effective penalty rate reflecting payments to local police and bureaucrats in order to stay
informal. The relative sizes of the two sectors can be derived from the level of corruption, the
tax rate and the effective penalty rate, and the size of the formal sector then determines the total
formal-sector output at the optimum. The model indicates that it is necessary to differentiate
between the effects of corruption in different economic environments: with bribes paid to get
projects, more severe corruption always enlarges shadow economy meaning that the two are
complements but with bribes paid to lower taxes, the effect is ambiguous: in some extreme
cases, corruption can then decrease informal economic activity.

To examine the issue empirically, the study uses the technique of instrumental variables
for a cross-section of countries. The first results based on the traditional way of doing things
are not that promising and serve mainly to demonstrate that different proxies for corruption
and instruments used can have a large impact on results: while some regressions indicate that
corruption could have a positive impact on the size of shadow economy, others imply just the
opposite. Instead, strong rule of law, high GDP per capita in the previous period, and strict
regulation of wages and prices seem to be associated with smaller shadow economy more robustly.
When an interaction term of the level of corruption and the tropical area fraction of a country is
added to the analysis to account for the differing consequences of different types of corruption,
the results indicate again that stricter wage and price regulation decreases informal economic
activity. However, and in support of the idea of the paper, they suggest also that the higher
the share of a country’s area located in tropics, the more a certain level of corruption increases
informal economic activity.\textsuperscript{1} Moreover, although corruption and shadow economy do not appear
to be connected outside tropics, correlation between the two seems to be negative in tropics.
This result is in accordance with the conclusions of the theoretical part: if corruption and shadow
economy are more likely to be substitutes in a country with poor-quality institutions, countries
located in tropics fit the picture.

The paper is organized as follows. Section 2 discusses the role of corruption in economic
development. Emphasis is on the links between corruption and economic growth, and corruption
and shadow economy. Section 3 sets up the model of an economy with formal and informal
sectors and analyzes the connection between corruption and the scope of informal economic
activity. Section 4 analyzes the same question empirically. Finally, section 5 concludes.

2 Literature on Corruption

Corruption, defined as the exercise of public power for private gain, occurs if the expected
benefits of corrupt practices outweigh the expected costs. The benefits are generally associated
with the economic rents present in a society, while the expected costs depend on the probability
detection and the severity of punishments. For corruption to exist, it is also necessary that
someone has discretionary power over resource allocation (Jain 2001).

Recent years have witnessed a surge of interest in the causes and consequences of corruption.
This section concentrates on the issues that are relevant for the model developed in the next
section. The topics most important in this sense comprise the relationship of corruption with

\textsuperscript{1}The result is robust to various alternative measures of institutional quality and fiscal burden. It holds also
when bootstrapping is used to calculate the standard errors.
the scope of informal economic activity, i.e. shadow economy, and, through that, official-sector output.

2.1 Sand or Grease?

Although varying degrees of corruption can be found in developed countries, it is generally a more serious problem in developing economies: in the 2003 Corruption Perceptions Index, 50 percent of developing countries scored less than three out of the no-corruption score of ten, and the level of corruption was “alarmingly high” in 90 percent of them (Transparency International 2003). Moreover, it has been estimated that the losses caused by corruption as a percentage of GDP have been not only high but also on the increase in various developing economies (Dreher et al. 2004, Tanzi 1998).

Does the evidence that corruption is more common in developing countries necessarily mean that these countries are worse off? After all, it has been claimed that corruption can actually be beneficial in the second-best world with different political and economic distortions (see e.g. Bardhan 1997, Mauro 1995, and Tanzi 1998 for more comprehensive discussion). First, corruption might raise economic growth by removing rigidities detrimental to investment and by helping people to avoid bureaucratic delays, that is by “greasing the wheels”. Second, corruption could increase efficiency by assigning projects to the most efficient firms that are also capable of paying the highest bribes and in saving time for those for whom time is most valuable. Third, the possibility of bribes could spur government officials to work harder. Corruption could also result in more efficient provision of government services by introducing competition for scarce government resources (Aidt 2003). Particularly, it might be beneficial to institutionalize corruption instead of allowing it to be completely random.

The idea of beneficial corruption is highly controversial. If corruption is there to grease the wheels, it is probably simultaneously the reason for the need to keep greasing the very same wheels: after all, rigidities are generally endogenous (Tanzi 1998). On the very basic level, corruption is harmful because it results in the allocation of most able human capital resources in rent-seeking opportunities instead of productive activities (Ibid.). Moreover, it distorts markets by distorting incentives and makes it more difficult for the government to correct market failures. Shleifer and Vishny (1993) point out that the distortionary effects are magnified by the illegality of corruption. Aidt (2003) discusses, how the theoretical literature on the benefits of corruption is based on problematic assumptions, and Rose-Ackerman (1978) remarks that it is difficult to limit corruption to the areas in which it could be beneficial. The consequences of corruption are more difficult to deal with for the very same reason: the effects of corruption tend to reverberate throughout the economy instead of remaining confined to the corrupt transactions. This is an idea the model presented in this paper tries to capture: by affecting the production decisions of the firms, corruption first affects the relative sizes of formal and informal economies and has then an impact on official sector output.

After the increased interest of recent years, there is also empirical evidence of the negative effects of corruption. Even if the direction of causality between corruption and other variables is difficult to verify, numerous studies imply that corruption is harmful. Among the issues discussed in the literature are the relationship between corruption and output and that between corruption and the size of the shadow economy. The next two subsections give an overview of these topics. Other important areas that should not be forgotten are the impact of corruption on welfare in general and, more specifically, on the distribution of wealth (see Gupta et al. 2002).

2.2 Corruption and Output

One of the strongest links between corruption and economy is between corruption and economic development. The causality is likely to go both ways, but e.g. Treisman (2000) and Paldam (2002) find evidence that higher log per capita GDP decreases the level of corruption. A natural explanation is that it is so expensive to fight corruption that only rich countries have the necessary resources. Accordingly, most studies control for per capita GDP while trying to
find factors that could explain the level of corruption. On the other hand, Shleifer and Vishny (1993) argue from a theoretical point of view that corruption lowers economic growth by causing distortions. They find, in addition, that the need for secrecy due to the illegality of corruption increases the distortionary effects and makes corruption more costly.

Causality between corruption and economic development does, therefore, go both ways. The issue is difficult to solve empirically with current techniques. The method of instrumental variables is, at the moment, the most popular one, but the high interrelatedness of corruption and income makes it difficult to find valid instruments. Because of this, some researchers have chosen to focus on the effects corruption has on GDP growth, but particularly early evidence is mixed. More recent studies are, however, more convincing: the results of Mauro (1997), Leite and Weidmann (1999), Mo (2001), Gyimah-Brempong (2002), and Méon and Sekkat (2005) strongly indicate that corruption has a negative impact on GDP growth.

An issue often discussed in the context of corruption is particularly closely related to economic growth: Shleifer and Vishny (1993) find that corruption inhibits productive investment. Also Bardhan (1997) claims that corruption can have a negative effect on incentives to invest. More generally, corruption lowers investment relative to GDP by increasing risks (e.g. by lowering the security of property rights) and by increasing costs. Moreover, it has an impact on the allocation of resources by affecting the assessments of the relative merits of different investments in both public and private sectors.

Mauro (1995) was the first to verify empirically in a cross-section of countries that corruption lowers investment, “thereby lowering economic growth”, a result which has later gained support from Knack and Keefer (1995), Ades and Di Tella (1997), Brunetti et al. (1998), Mauro (1997), and Gyimah-Brempong (2002) among others. The detrimental effects of corruption do not depend solely on the level of overall corruption, but also on its predictability: countries with more predictable corruption tend to have higher investment rates (Campos et al. 1999 and Wei 1997 for foreign direct investment).

If domestic investors are sensitive to the level of corruption, it should not come as a surprise that foreign investors are equally - or even more - sensitive (see Lambsdorff 2005 for discussion). Moreover, Wei and Wu (2001) find that corruption is not equally harmful in obtaining bank loans, which results in a higher loan-to-FDI ratio meaning that the risk of a currency crisis escalates.

There are other indirect channels through which corruption might affect the growth rate of an economy. As Tanzi (1998) discusses, small firms, especially in developing countries, are particularly vulnerable to corruption, because they lack the resources and connections to fight it. The competitiveness of the markets they have to operate in makes it more difficult for them to pass on the costs of corruption to their customers. Because small firms are often the engine for growth, the negative effects of corruption gain further strength.

Corruption may also affect the allocation of public resources: although higher corruption seems to increase the volume of public investment as a ratio to GDP, it tends to lower government expenditures on operations and maintenance (and possibly health and education), thereby lowering the quality and the returns of existing public infrastructure (Tanzi and Davoodi 1997). Also Mauro (1998) and Gupta et al. (2000) find that corruption reduces government spending on education and possibly on health, which are areas in which it is difficult for government officials to gain from corrupt practices.

### 2.3 The Role of Shadow Economy

Corruption can also affect GDP - or its growth - indirectly by having an impact on the number of firms or individuals choosing to operate informally in the shadow economy, which can be defined

---


3 In accordance with this finding, the model presented in the next section accounts for the size of the firm.

4 Other terms used are informal and unofficial economy. The focus of this paper will be on such informal economic activities that involve monetary transactions and are not based on barter. The distinction is made, because the causes of barter-based informal economy tend to differ from those of the rest of shadow economy.
as those "legal value-added creating activities which are not taxed or registered" (Schneider and Enste 2000). This relationship between corruption and shadow economy is of particular interest here.

Unofficial economic activities tend to hinder smooth functioning of official economy and can, therefore, have a negative impact on growth. For example, firms operating in the informal sector avoid paying taxes, which decreases the government’s tax revenues and might thus have a negative impact on the quantity and quality of public spending. Loayza (1997) models this channel. However, opinions on the relationship differ: although larger underground economy might erode tax base and although several economists have found evidence on how corruption seems to lower government revenues (Tanzi and Davoodi 1997 and Friedman et al. 2000), a competing, neoclassical, view is that dynamic shadow economy intensifies competition and improves efficiency among other positive impacts (Schneider and Enste 2000). For example, Choi and Thum (2005) find that entrepreneurs’ option to flee into shadow economy mitigates corruption-related distortions by allowing such entrepreneurs to enter that would not have entered without shadow economy and by making the bureaucrats demand smaller bribes, which implies that the existence of informal sector actually supports official-sector growth. There is also some evidence that increased informal production has positive consequences on the formal sector at least in the form of increased demand: Schneider and Enste (2000) claim, based on Schneider (1998), that two-thirds of the income earned in shadow economy is spent in the official economy. However, as Schneider and Enste also point out, large shadow economy makes conducting effective economic policy more difficult, because official economic indicators, on which such policy should be based, are then inaccurate.

The varying opinions reflect the fact that the consequences - and causes - of shadow economy differ in different types of countries (Schneider and Enste 2000). According to the literature review of Gërxhani (2004), the relationship between formal and informal economy seems to be positive in developed countries, while a negative connection appears to be more likely in less developed countries. Even if it is difficult to verify a universally applicable relationship between shadow economy and GDP, the issue is particularly relevant in developing economies, where the size of shadow economy as percentage of GDP is typically larger than in industrialized countries. As the scope of informal activity seems to have been on the increase during the last 40 years or so (Schneider and Enste 2000.), it is more important than ever to take its effects into account.

So the size of shadow economy affects formal economy, even if the direction of the impact is difficult to deduce and might differ between countries. Because corruption has been found to affect the scope of informal economic activity, this is another channel through which it can affect growth. After the differences of opinion discussed above, existence of two competing views on the matter should not come as a surprise.

First, Rose-Ackerman (1997, p. 21) claims that corruption and shadow economy are substitutes, indicating negative correlation between the two. The model of Choi and Thum (2005) is an example of such a situation: in the model, corrupt government officials have to lower their bribe demands, if firms have an option of fleeing into shadow economy instead of entering the official market. Endogenous bribe demands are crucial in this framework. Building on Choi and Thum, also Dreher et al. (2005) compare economies with and without informal sector and find that corruption is lower in the former case, again due to a decrease in bribe demands in the presence of shadow economy. Dreher et al. also approach the question empirically by structural equation modeling, with shadow economy and corruption as latent variables, and conclude that the estimations are consistent with the theoretical framework, implying that corruption and shadow economy are indeed substitutes.

Yet, others find that corruption and shadow economy are complements: empirical evidence of e.g. Johnson et al. (1997, 1998, 1999) and Friedman et al. (2000) implies that bribery and corruption increase the share of unofficial economy of GDP. Friedman et al. (2000) also build a model that suggests that over-regulation and corruption discourage official-sector production

---

5 The figure applies to Austria and Germany. It might be lower in developing economies.
6 See Schneider and Enste (2000) for a literature review.
7 The problems associated with these empirical studies are discussed in section 4.
and are, therefore, associated with relatively larger shadow economy. Hindriks et al. (1999) take a different starting point and examine the implications of corruption, extortion and tax evasion in a three-stage game between taxpayer and tax inspector. If the tax payer colludes with the inspector, the inspector can underreport the taxable revenue of the tax payer in exchange for a bribe. Corruption and shadow economy are then positively correlated.

Different types of corruption might, however, have different consequences, which should also be accounted for. And, as Dreher and Schneider (2006) and Gërxhani (2004) point out, the relationship between corruption and shadow economy might well differ in high-income and low-income countries. This would be particularly natural, if the two groups of countries are characterized by different types of corrupt practices. Also, if geography is associated with the income level of a country, as Sachs (2001) and Gallup et al. (1999) claim, it could have an impact on the relationship between corruption and shadow economy through its effect on transportation costs, agricultural productivity, disease burden and economic policy choices.

The next sections analyze the relationship between corruption and the size of shadow economy. First, a simple theoretical model is developed to examine the link. Second, the question is approached empirically. The contribution of the study is to recognize that there are different types of corruption and that these might have different effects on the economy.

3 Corruption and Shadow Economy: A Simple Model

As discussed above, most, if not all, countries are affected by corruption, even if the intensity varies between countries. Previous research on the subject has emphasized that economic development plays a role here, as does cultural heritage of a country. A frequently neglected issue is that there are different kinds of corrupt practices in addition to petty vs. grand corruption and centralized vs. decentralized corruption. Particularly, the type of corruption prevalent in developing countries might differ from that of industrialized countries. What makes this relevant is that different kinds of corruption might have different consequences. In this section, the interest lies on two forms of corruption: first, the case where firms must pay bribes in order to get projects or licenses and second, the case where firms pay bribes in order to reduce the taxes they have to pay. Both cases fall under the definition of corruption as the exercise of public power for private gain, but it seems likely that the former type is more common in developed countries and the latter in developing countries, although both may also occur simultaneously. At a deeper level, the differences could be caused by differences in institutional quality.

The model economy consists of two sectors: formal (F) and informal (S). In the spirit of the aforementioned definition of shadow economy, informal sector is composed of all those firms that avoid paying taxes on total revenue and fail therefore to contribute to financing of public spending (which is, for simplicity, not incorporated in the model). Each firm bases its choice of sector on profit maximization. A key assumption is that firms can freely choose the sector to operate in, but they can only operate in one sector.\(^8\) It is also assumed that labor is indifferent between the two sectors, if both sectors pay equal wages, and that labor cannot afford not to work for a shadow-economy firm even if the wage was lower there than in the formal economy.

The focus is first on the case where bribes are necessary in order to get projects or licences, and then on the case where corruption is a way to lower taxes.

3.1 Bribes to Get Projects or Licenses

3.1.1 Formal Sector

In the formal sector, firms have to pay taxes \(\tau \in (0,1)\) on total revenue. The proceeds from taxation are used to finance infrastructure and public-sector institutions. In addition, corrupt government officials may demand bribes for their services e.g. if licenses are required to operate

\(^8\)Friedman et al. (2000) develop a model in which an entrepreneur can divert a chosen proportion of his resources to shadow economy.
a business. The bribe that has to be paid is a constant fraction of the turnover of the firm. The level of corruption, \( c \), is exogenous, which emphasizes the roots corruption has in culture and history as well as the self-reinforcing nature of the phenomenon. Modeling corruption as a kind of tax leakage connects its effects to the turnover of a firm to highlight, that the size of a firm has an impact on the scope of the effects of corruption (Beck et al. 2005). The total amount of corruption-related payments depends in addition on a firm-specific feature \( i \), which is uniformly distributed between 0 and 1: some firms are better equipped to deal with corruption and manage to pay less. Possible interpretations for \( i \) are political connectedness (higher \( i \) implying worse connections) or factors related to firm size (with \( i \) decreasing with the firm size). The results of Choi and Thum (2005) support this formulation of firm-size (or political connectedness) dualism in the economy: in their model, "the largest informal sector firm is smaller than the smallest formal sector firm". Also Dabla-Norris et al. (2006) find firm size to be negatively correlated with the propensity to go informal.

The production function is \( Y_i = L_i^\sigma \), and the profit function for the formal-sector firm of type \( i \) is:

\[
\Pi_F = (1 - \tau - ci)PL_i^\sigma - WL_i, \tag{1}
\]

with \( 0 < \sigma < 1 \). \( P \) is the price level, \( L_i \) is the labor employed by firm \( i \), and \( W \) is the nominal wage rate, which is thought to incorporate social security payments. Below, \( W \) is normalized at 1. At the optimum, a formal-sector firm then produces

\[
Y_F^* = [(1 - \tau - ci)\sigma P]^{1/1-\sigma} \tag{2}.
\]

### 3.1.2 Informal Sector

Shadow-economy firms face an effective penalty rate of \( q(c) \geq \tau \). The assumption of the relative size of \( q(c) \) and \( \tau \) is made for now to exclude the situation in which all the firms choose to enter shadow economy. The penalty rate reflects e.g. payments to local police and bureaucrats: the larger the turnover of a firm, the more it has to pay in order to stay in shadow economy. The payments to police can be made to guarantee protection that would otherwise be available to formal-sector firms only, while bureaucrats may demand bribes for not reporting about the firm. Although it is not assumed that the firm-specific feature \( i \) loses its significance in the shadow economy, it is assumed that its impact is incorporated into \( q(c) \). As in Loayza (1997), the revenues collected through the effective penalty rate are used to finance the government’s enforcement system. It is also assumed that high corruption decreases \( q \), i.e. \( q'(c) < 0 \). This is

---

9. Shleifer and Vishny (1993) and Choi and Thum (2005) also model corruption through license fees, even if in their cases the size of the bribe is not related to the turnover of the firm. In contrast, Friedman et al. (2000) use a deadweight over-regulation or bureaucracy cost per unit of output. This could, as they state, also be referred to as corruption.

10. Corruption might be self-reinforcing, so that long tradition of high corruption or a culture in which corrupt practices are the customary way of operating might explain the persistence of corruption. The theoretical background of this idea is discussed by Bardhan (1997) and Aftd (2003), who find that the higher level of corruption in some countries might result from multiple equilibria. According to the theory, one equilibrium is a high-corruption equilibrium, while the level of corruption is lower in the other equilibrium. Thus a history of high corruption might imply high corruption also in the future. Empirically, multiple equilibria have been explained by cultural determinants such as the level of trust among people (La Porta et al. 1997), religion (Alesina et al. 2003, La Porta et al. 1997, La Porta et al. 1999, and Treisman 2000), the level of hierarchy in the society (Husted 1999), ethnic and linguistic fractionalization (Alesina et al. 2003, La Porta et al. 1999, and Treisman 2000), and gender equality (Swamy et al. 2001 and Dollar et al. 1999). In the model developed here, bureaucrats understand that they could lower future corruption by their actions, thereby benefiting the society as a whole, but they are not willing to give up the extra revenue they get in the form of bribes.

11. The results of Dabla-Norris et al. (2006) imply in addition that finance constraints make small firms to choose the informal sector, while legal obstacles are a more important cause to large firms.

12. In general, both \( \tau \) and \( q(c) \) are higher in industrialized countries than in developing economies.

13. Another aspect that could be taken into account when comparing the returns in formal and informal sectors is that informal-sector firms cannot take full advantage of goods provided by the government. See Loayza (1997).
the case at least if each firm is in the territory of one corrupt bureaucrat (or police).\textsuperscript{14} The higher the level of corruption, the less the bureaucrat has to worry about getting caught of accepting bribes. Furthermore, the option to bribe superiors decreases the expected punishment even when caught. The bureaucrat or the police will therefore accept lower payment when the level of corruption in the society is high. Even if the government may have some control over $q$ in the long run e.g. through legislation, it is assumed that the current $q$ has been set in the past.

Informal-sector profit is
\[ \Pi_S = [1 - q(c)] P L_i^T - L_i, \]  
with wages again normalized at 1. In accordance with the formal sector, optimal informal-sector production is
\[ Y_S^* = \{[1 - q(c)] \sigma P \}^{-\frac{1}{\sigma + 1}}. \]  

3.1.3 Impact on Shadow Economy Size

As discussed above, a crucial feature of the model is that firms differ with respect to a firm-specific characteristic $i$. Setting optimal formal-sector profit equal to optimal informal-sector profit makes it possible to define the level of $i$ at which a firm is indifferent between formal and shadow economy. If $i$ is smaller than (or equal to) this level $\theta$, the firm enters the formal sector. Otherwise, it enters the informal economy. Thus $\theta$ is the size of the formal economy:
\[ \theta_1 = \frac{q(c) - \tau}{c}. \]  

Here $c > q - \tau$, which means that $\theta \in (0, 1)$. It was, after all, assumed earlier that $q \geq \tau$.

As expected, $\frac{\partial \theta}{\partial c} = -\frac{1}{c} < 0$, meaning that a higher tax rate on total revenue leads to a larger shadow economy. Also, $\frac{\partial \theta}{\partial q} = \frac{1}{c} > 0$, so that the institutional effects are also taken into account: the effective penalty rate, which partly reflects the efficiency of authorities as well as general regulations, decreases the scope of informal activities. These factors are in line with the literature.\textsuperscript{15}

The most interesting result concerns corruption:
\[ \frac{\partial \theta}{\partial c} = \frac{q'(c) c + \tau - q}{c^2} \]  

which is negative because it was assumed that $q'(c) < 0$ and that $q(c) \geq \tau$. Thus, the higher the level of corruption, and the higher the bribes necessary to get official-sector projects, the larger the shadow economy. Corruption and shadow economy are therefore complements.

3.1.4 But Wages and Social Security Payments Are Lower in Informal Sector

The situation becomes less straightforward, if the informal sector production function is altered to account for the fact that, from the point of view of a firm, the total of informal sector wages and social security payments is lower than in the formal sector. In fact, many informal sector jobs, particularly in developing economies, are of low quality, and the wage may well be low enough not to bring the worker above the poverty line. And, of course, a firm operating in shadow economy escapes social security payments completely. A realistic model should, therefore, assign a lower $W$ to shadow economy. In such a case,
\[ \Pi_S = [1 - q(c)] P L_i^T - \xi L_i, \]  
\textsuperscript{14}Also Bliss and Di Tella (1997) discuss such a case. In reality, jurisdictions of bureaucrats may well be overlapping.

\textsuperscript{15}According to Friedman et al. (2000), higher tax rates might in fact be associated with smaller shadow economy, because the benefits of remaining official outweigh the costs of high taxation in rich, less corrupt countries.
where $\xi < 1$. As lower informal sector wages now compensate partly for the effective penalty rate, it does not have to hold that $q \geq \tau$. After this addition, the size of the formal sector is

$$\theta_2 = \frac{1 - \tau - [1 - q(c)]\xi^{-\sigma}}{c}. \quad (8)$$

Because $\xi$ and $\sigma \in (0, 1)$, $\xi^{-\sigma} > 1$. The size of the formal sector $\theta \in (0, 1)$ iff $0 \leq 1 - \tau - [1 - q(c)]\xi^{-\sigma} \leq c$. This is assumed.

Taxation and the effective penalty rate now affect the size of the formal economy as follows:

$$\frac{\partial \theta_2}{\partial \tau} = \frac{1}{c} < 0$$

and

$$\frac{\partial \theta_2}{\partial \xi} = \frac{\xi^{-\sigma}}{c} > 0.$$

The effect of taxation remains unchanged, but the impact of the effective penalty rate is magnified by the presence of $\xi$, and the positive impact of good institutions on formal-sector size is larger. The effect of corruption on the size of the formal sector is

$$\frac{\partial \theta_2}{\partial c} = \frac{q'(c)\xi^{-\sigma}c - \{1 - \tau - [1 - q(c)]\xi^{-\sigma}\}}{c^2} < 0. \quad (9)$$

Because the first term in the numerator is negative and $1 - \tau - [1 - q(c)]\xi^{-\sigma}$ is positive by assumption, corruption has a negative impact on the size of formal economy and a positive effect on shadow economy size, implying again that corruption and shadow economy are complements. Therefore, the result obtained in the simpler framework of the previous section also holds in this more realistic setting.

The impact of $\xi$ is

$$\frac{\partial \theta_2}{\partial \xi} = \frac{\sigma[1 - q(c)]\xi^{-\sigma - 1}}{c} > 0.$$

meaning that the smaller informal-sector wage and social security payments are relative to those in the official sector, the smaller the official sector is.

### 3.2 Bribes to Lower Taxes

Bribes paid to get projects are not the only form of corruption. Bribes can also be paid to avoid or lower taxes. This section concentrates on such a case. More specifically, firms pay bribes to lower the tax rate they face. However, they are not able to totally escape taxes and stay therefore, according to the definition of shadow economy, within the formal economy.

#### 3.2.1 Framework 1

The framework presented here is based on the assumption that a firm can affect the tax rate it faces in reality, that is $\tau$, by bribing bureaucrats. The official tax rate is still predetermined and fixed. Moreover, the more corrupt the society is (i.e. the higher $c$ is), the lower is the tax rate faced by a firm: $\tau'(c) < 0$. The relationship follows simply from the type of corruption analyzed in this section. In accordance with the previous section, the formal sector profit function can now be modeled as (the wage is again normalized at 1):

$$\Pi_F = [1 - \tau(c) - ci] PL_i^\sigma - L_i. \quad (10)$$

In this formulation, the firm-specific feature $i$ does not affect the tax rate, it only affects the magnitude of bribes. The profit function of a firm operating within the shadow economy is the same as in (7):
meaning that the size of the formal economy is familiar from (8) with the exception that the
tax rate now depends on the level of corruption:
\[ \theta_3 = \frac{1 - \tau(c) - [1 - q(c)] \xi^{-\sigma}}{c} \]  

(12)

It is again assumed that \( 0 \leq 1 - \tau(c) - [1 - q(c)] \xi^{-\sigma} \leq c \). The impacts of taxation, effective
penalty rate, corruption, and the measure of wage and social security differential between official
and unofficial sectors on the size of the formal economy are then
\[
\frac{\partial \theta_3}{\partial \tau} = -\frac{1}{c} < 0, \\
\frac{\partial \theta_3}{\partial q} = \frac{\xi^{-\sigma}}{c} > 0, \\
\frac{\partial \theta_3}{\partial c} = \left[ -\tau'(c) + q'(c)\xi^{-\sigma} \right] \frac{c}{c^2} - \left\{ 1 - \tau(c) - [1 - q(c)] \xi^{-\sigma} \right\} \geq 0
\]

(13)

and
\[
\frac{\partial \theta_3}{\partial \xi} = \frac{\sigma [1 - q(c)] \xi^{-\sigma-1}}{c} > 0.
\]

The first two effects are familiar from above, as is also the last one. As to (13), the only
change in comparison to (9) is the addition of \(-\tau'(c)c\) to the numerator. As this is positive by
assumption, corruption could now, in an extreme case\(^{16}\), have a positive impact on the size of
the formal economy. Even if the impact was not positive, it would still be less severe than in
the case where bribes were paid to get projects. In other words, the greater the extent to which
a firm can use bribes to mitigate the negative effects of taxation, the smaller is the willingness
of the firm to go informal.

3.2.2 Framework 2

Formal-sector profit could also be modeled so that the firm-specific feature \( i \) affects the sum of
the tax rate and bribes:
\[ \Pi_F = \{1 - [\tau(c) + c] i\} PL_i^\sigma - L_i. \]  

(14)

The size of the formal economy is then
\[ \theta_4 = \frac{1 - [1 - q(c)] \xi^{-\sigma}}{\tau(c) + c}, \]  

(15)

which is between 0 and 1 iff \( 0 \leq 1 - [1 - q(c)] \xi^{-\sigma} \leq \tau(c) + c \). This condition coincides with
the one presented in the context of framework 1. In comparison to (12), the formal economy is
now larger.\(^{17}\) This is natural, because in framework 2 the firm-specific feature \( i \) helps to lower
the tax rate as well as bribes. The effects of the different factors on the size of the formal
economy are then
\[
\frac{\partial \theta_4}{\partial \tau} = -\frac{1 - [1 - q(c)] \xi^{-\sigma}}{[\tau(c) + c]^2} < 0, \\
\frac{\partial \theta_4}{\partial q} = \frac{\xi^{-\sigma}}{[\tau(c) + c]^2} \left\{ 1 - \tau(c) - [1 - q(c)] \xi^{-\sigma} \right\} \leq 0
\]

\(^{16}\) The impact is positive iff \( [\tau'(c)c] > [q'(c)c]\xi^{-\sigma}c - \left\{ 1 - \tau(c) - [1 - q(c)] \xi^{-\sigma} \right\} \). The stronger the reaction of
the actual tax rate to higher corruption, the more likely this is.

\(^{17}\) \( \theta_3 - \theta_4 = \frac{[\tau(c) + c]\{1 - \tau(c) - [1 - q(c)] \xi^{-\sigma} \} - \left( 1 - [1 - q(c)] \xi^{-\sigma} \right)}{[\tau(c) + c]^2} = \frac{\tau(c)\{1 - \tau(c) - [1 - q(c)] \xi^{-\sigma} \} - \left( 1 - [1 - q(c)] \xi^{-\sigma} \right)}{[\tau(c) + c]^2} \leq 0 \) because \( 0 \leq 1 - \tau(c) - [1 - q(c)] \xi^{-\sigma} \leq c \) by assumption.
\[ \frac{\partial q}{\partial q} = q' \xi^{-\sigma} [\tau(c) + c^2] - \frac{1 - [1 - q(c)] \xi^{-\sigma}}{[\tau(c) + c^2]} \geq 0 \] (16)

and

\[ \frac{\partial q}{\partial \xi} = \frac{\sigma [1 - q(c)] \xi^{-\sigma-1}}{\tau(c) + c} > 0. \]

The impact of the firm characteristic on taxation weakens the effects of \( q \) and \( \xi \) on formal-economy size. The first term of the numerator in (16) is again negative, but the second term can be either positive or negative depending on the term \( \tau'(c) + 1 \). If \( \tau'(c) < 1 \), i.e. the actual tax rate reacts strongly to corruption, the impact of corruption on the size of formal economy is ambiguous. In addition, the more the tax rate decreases with the level of corruption, the more likely it is that the effect on the official sector is positive. This could imply that corruption is more likely to decrease the scope of informal economic activity in countries with poor institutions, because it is then less risky to bureaucrats to accept bribes and allow small increases in bribes to decrease the actual tax rate more than in cases where the expected punishment is more severe. Finally, the smaller the difference in wage and social security payments between the two sectors, the larger the formal economy is, although this effect is also smaller than in framework 1.

### 3.3 From the Model to Figures

The model indicates that bribes to lower taxes have a less severe impact on the size of formal economy than bribes that are paid to get licences. In some extreme cases, the former type of corruption could actually enlarge formal economy, although the impact of bribes paid to get licences is always negative. The most important implication of the model, which is also the point emphasized in this paper, is therefore that the type of corruption matters and that the consequences of different corrupt practices may differ. This should be taken into account in empirical analysis. However, because data on different types of corruption are unavailable, some assumptions are necessary to tackle the issue. Particularly, it is assumed here that the type of corruption, and therefore its consequences, are associated with the geographical location of a country. This can be used as a starting point, because earlier literature (see Gallup et al. 1999 and Sachs 2001, among others) has pointed out that geography can have an impact on e.g. transportation costs, economic policy choices, and the quality of human resources.

In the next section, the question about the determinants of shadow economy size is analyzed empirically. In contrast to the model presented above, where it was for simplicity assumed that the level of corruption was inherited from the previous period, endogeneity of corruption is recognized and the issue is addressed via using instrumental variables. Another difference is that the empirical analysis tries to explain the size of shadow economy as percent of official GDP instead of the share of firms choosing to go informal.

### 4 Corruption and Shadow Economy in Real World

Because estimates of shadow economy sizes have been scarce, the existing empirical literature on the impact of corruption on the scope of informal economic activity is mostly based on rather small samples. Therefore, the results of Johnson et al. (1997), based on a cross-section of 15 countries, and Johnson et al. (1998), based on 39 countries, are hardly reliable. A particularly problematic aspect is that the small number of observations prevents the use of instrumental variables, even if it was recognized that the level of corruption is endogenous. Similarly, Loayza (1997) can be thought to show statistical correlation instead of causal relations (Schneider and Enste 2000). All in all, the results of the earlier literature are conflicting. This could be partly
explained by another weakness of the most studies so far: they do not account for the fact that the consequences of corruption might differ between countries. This issue has been brought up by Dreher and Schneider (2006), who point out that the type of corruption dominant in high-income countries mainly manifests itself as bribes, which are paid to be able to engage in more official economic activities. In contrast, Dreher and Schneider claim, shadow economy and corruption are more likely to reinforce each other in low-income countries, implying a complementary relationship between the two. The empirical results of Dreher and Schneider give some tentative support for this reasoning.

Other factors that have been found to play a role in determining shadow economy size include tax and social security burden, labor market restrictions and the strength and efficiency of government institutions and regulations. Another important determinant is tax morale and, more generally, attitudes towards shadow economy (Schneider 2006). Loayza (1997) finds that tax burden and labor market restrictions have a positive impact on the size of shadow economy, while high-quality government institutions have the opposite effect. The results of Johnson et al. (1999) indicate that the type of taxation matters as well. Because their results imply, in addition, that ineffective and discretionary application of a tax regime might have more significant consequences than the mere level of taxes, and that discretionary government regulations overall increase informal economic activities, taxation should perhaps be handled more widely as the combined burden of taxes and regulation in the official economy. In the same spirit, Johnson et al. (1997) and Friedman et al. (2000) conclude that the intensity of regulation leads to a higher share of unofficial economy of official economy. Johnson et al. (1998) emphasize, furthermore, that enforcement of regulation is much more important than the extent of regulation as such. Friedman et al. (2000) do not find any evidence on the impact of high tax rates but conclude instead that bureaucracy and corruption drive firms into shadow economy. Also, there is some evidence of multiple equilibria (Johnson et al. 1999): in the good equilibrium, the burden of taxation and regulation is light, tax revenue is high, corruption is under control and shadow economy is small. In the bad equilibrium, the situation is the opposite.

4.1 Data Description

Because reliable panel data on shadow economy sizes are unavailable, the analysis is based on a cross-section of countries. The data are averaged over 2000-2002 in order to minimize the impact of yearly fluctuations. Descriptive statistics and the list of countries included in the regressions are presented in Appendix.

**Shadow economy** The dependent variable is the size of shadow economy in percent of official GDP from Schneider (2006). Estimates are based on dynamic multiple indicators multiple causes model (DYMIMIC) and currency demand method (see Schneider 2006 for a more detailed description and Schneider and Enste 2000 for a discussion on different methods for estimating the size of shadow economy) and are available for 145 countries between 1999 and 2003. The sample is, therefore, much larger than most of the earlier studies have had at their disposal. However, because other methods have not been used for an equally large sample of countries, it is difficult to test for the robustness of the results. Moreover, other estimates of shadow economy sizes are mainly available for the early 1990s. Therefore, and despite the disadvantages of using a different time period, the figures for the years 1989 and 1990 from Schneider and Enste (2000) are also used. The estimates based on physical input method are chosen, because they are based on quite different data than the estimates of Schneider (2006): physical input method relies on figures on electricity consumption.

**Corruption** An important feature of an index is strong comparability across countries. As corruption is impossible to measure accurately, data on corruption are usually based on subjective assessments on the level of corruption in different countries. Among others, Treisman (2000) finds the indices of perceived corruption useful: the ratings are usually highly correlated with each other and also across time, and the subjective evaluations on which the indices are
based can themselves affect economic behavior. On the other hand, the use of perceptions-based measures of corruption has been criticized, because they might be correlated with the quality of a country’s institutions instead of its actual degree of corruption (Dreher et al. 2004).

A widely used measure of corruption is the Corruption Perceptions Index (CPI) of Transparency International (2006). The index measures the perceptions of the extent of corruption as seen by different groups such as business people, risk analysts and general public. Evaluation is done by non-resident experts and business leaders as well as resident business leaders. The first version of Corruption Index was compiled in 1995 for 41 countries, while the number of countries had risen to 159 by 2005. Another often used perceptions-based index of corruption is that of the International Country Risk Guide (ICRG) (2006). The index, based on subjective evaluation of corruption within the political system of a country, has been popular in cross-country studies, because it is the only index that provides a consistent time series back to the early 1980s. Due to the criticism against perceptions-based indices, I also use the index developed by Dreher et al. (2004). The index is based on a structural model and is only available for years 1980, 1985, 1990 and 1997, meaning that the missing years have to be extrapolated and interpolated. In both perceptions-based indices, a higher score means lower corruption, while the index of Dreher et al. has been built so that a higher score means higher corruption. Because this index is in addition smaller in absolute values, I multiply it by -10 to simplify the interpretation of results.

A particularly problematic aspect from the point of view of this study is that all the indices available measure corruption only at some general level. Thus, it is not possible to directly distinguish between different types of corruption. But, as Dreher and Schneider (2006) point out, it is very likely that the income level of a country is associated with the type of corruption prevalent in that country. The problem with income level is, however, that it is endogenous. On the other hand, if the views of Gallup et al. (1999) and Sachs (2001) are correct, the geographic location of a country plays a non-negligible role in economic development, meaning that it should also have an impact on the type and consequences of corruption. The empirical analysis of this section will, therefore, use an interaction term of corruption and geography to find out whether corruption indeed does have a different impact on shadow economy in different countries.

**Taxation**  
One possible proxy for taxation is the measure of fiscal burden from the Heritage Foundation (2006). The index is based on average and marginal corporate and income taxation and increases with more intense government interference in the economy, as do all the factors from the Heritage Foundation. Other options comprise the share of tax revenue of GDP from the World Bank (2006) and the measures of taxation from Gwartney and Lawson (2006).

**Effective penalty rate**  
The magnitude of the effective penalty rate is largely determined by institutions and their quality. Therefore, suitable proxies include rule of law and government effectiveness from Kaufmann et al. (2005): the former measures the quality of contract enforcement, the police, the courts, and the likelihood of crime and violence, while the latter concentrates on the competence of the bureaucracy and the quality of public service delivery. Other candidates for measuring the quality of institutions comprise bureaucracy quality and law and order from ICRG (2006) and the index of legal system and property rights from Gwartney and Lawson (2006).

**Wage and social security differential between formal sector and shadow economy**  
Many of the measures concerning labor market regulations coincide with the measures of the general burden of regulation: the index on price and wage regulations from the Heritage Foundation (2006) and the measure of minimum wage regulation from Gwartney and Lawson (2006) are relevant here, as is the index of labor market regulations from the latter. Bearing in mind the discussion on the significance of the combined burden of taxes and regulation, it becomes twice as important to control for the regulation in the labor market.

---

18The index presented in Kaufmann et al. (2005) is also based on multiple surveys, some of which are the same as those used in compiling the Corruption Perceptions Index.
Additional instruments  As is commonly done in studies on the consequences of corruption, I control for the log of per capita GDP. To avoid further endogeneity issues, I lag GDP per capita by one period so that the average of years 1997-1999 appears in the regressions. In addition, I use ethnic, linguistic, and religious fractionalization, country’s geographic location and legal origin of the country as instruments for corruption. Geographic location is measured either as the fraction of the country’s area that is located in tropics or the absolute value of the country’s latitude. The former has been found to affect e.g. effectiveness of development aid, while the latter is commonly used in cross-country studies of growth.\textsuperscript{19}

This paper suffers from the same problem as most of the empirical analyses on the impacts of corruption: it is difficult to find instruments that would only explain corruption and not the size of shadow economy directly. Because panel data on shadow economy size are unavailable, it is not possible to try to solve the problem by focusing on the growth of shadow economy, as has been done in the context of economic growth (see section 2.2). It is, therefore, assumed that the different types of fractionalization and geography affect the size of shadow economy only through their impact on corruption. Validity of this exclusion restriction can be disputed, but it has been a convention in the literature on corruption to account for these factors, while the literature on shadow economy has focused on other factors. Moreover, even if it can be claimed that fractionalization could drive minority groups into shadow economy, it seems that bribes, and therefore corruption, are always involved. And although geography has been found to significantly affect the quality of institutions and, thus, the level of corruption (e.g. La Porta et al. 1999), it seems reasonable to assume that the impact of geography on the size of shadow economy is already reflected in the other instruments.

4.2 Empirical Analysis

Because the level of corruption is endogenous, instrumental variables (IV) have to be used to analyze the impact of corruption on the size of shadow economy. An additional issue is whether it would be better to use GMM estimator rather than the simple IV estimator. To answer the question, a test for homoskedasticity developed by Pagan and Hall (1983) was used, with the result that the null hypothesis of homoskedasticity was not rejected in any of the cases discussed below. According to Baum et al. (2003), the result implies that IV is preferable to GMM, which can have poor small sample properties. After all, GMM requires estimates of fourth moments, which should be based on a large sample to be reasonable, as Hayashi (2000, p. 215) points out. Furthermore, due to the small sample size, results presented below are based on small-sample statistics.

To begin with, the aim is to explore the relationship between corruption and shadow economy worldwide. Later, the goal shifts to finding differences in the impact of corruption between countries.

4.2.1 Traditional Way of Doing Things

Even when accounting for endogeneity of corruption, traditional analysis has not interacted corruption with other variables. This section uses the same technique, first for all countries and then for high-income countries and other countries separately. For robustness, the same regressions are estimated for all three corruption indices.

The two-equation econometric specification is

\[
\begin{align*}
\text{Corr}_i &= \alpha_1 + \alpha_2 GDP_i + \alpha_3 Tax_i + \alpha_4 Instit_i + \alpha_5 WP_i + \alpha_6 LoB_i + \alpha_7 LoF_i \\
&\quad + \alpha_8 LoS_i + \alpha_9 LoG_i + \alpha_{10} Ef_i + \alpha_{11} Rf_i + \alpha_{12} Geog_i + \epsilon_{1,i} \\

\text{Shadow}_i &= \beta_1 + \beta_2 Corr_i + \beta_3 GDP_i + \beta_4 Tax_i + \beta_5 Instit_i + \beta_6 WP_i \\
&\quad + \beta_7 LoB_i + \beta_8 LoF_i + \beta_9 LoS_i + \beta_{10} LoG_i + \epsilon_{2,i}
\end{align*}
\]

\textsuperscript{19}See Roodman (2004), Gallup et al. (1999), and Sachs (2001).
where $Corr_i$ and $Shadow_i$ are the level of corruption and the size of shadow economy in country $i$, respectively, $\alpha_s$ and $\beta_s$ are the coefficients to be estimated, and $\epsilon_1$ and $\epsilon_2$ are stochastic error terms. Excluded instruments only used in the first-stage regression explaining the level of corruption are ethno-linguistic fractionalization $Ef$ and tropical area fraction of a country $Geog$ from Roodman (2004), and religious fractionalization $Rf$ from Alesina et al. (2003). It is assumed throughout, that fractionalization factors and geography only affect shadow economy size through their impact on corruption. As discussed above, this assumption is quite strong. It is, therefore, necessary to be careful with causal relationships. The set of included instruments used in both equations comprises log of GDP per capita lagged by one period ($GDP$) from the World Bank (2006), fiscal burden $Tax$, quality of institutions $Instit$ and wage differential $WP$, as well as dummies for the legal origin from La Porta et al. (1999). $LoB$ stands for British legal origin, $LoF$ for French, $LoS$ for socialist, and $LoG$ for German.\footnote{Scandinavian legal origin is dropped because of collinearity.} The measures of fiscal burden, institutional quality and wage differential come various sources.

According to the first-stage results, the quality of institutions correlates negatively with the level of corruption. This is in line with the earlier literature. Somewhat surprisingly, the negative connection between GDP per capita and corruption does not seem to be equally strong, even if it is significant in many of the regressions. It is, however, possible that the proxy for institutional quality partly captures the connection traditionally perceived between economic development and corruption. It is also noteworthy that the index of Dreher et al. (2004) seems to differ from the perceptions-bases indices with respect to the results and their implications.

The second-stage regressions imply that corruption could, in some rare cases, play a role in determining the scope of informal economic activity. However, depending on the corruption index and the set of instruments, corruption seems to enlarge shadow economy in some cases, while also the opposite effect is possible. Other factors seem to be far more important: strong rule of law, high GDP per capita in the previous period and strict regulation of wages and prices lead to smaller shadow economy. Of these, the connection between wage and price regulation and shadow economy size seems to be the strongest. Trying different combinations of the alternative proxies for fiscal burden, institutional quality and other instruments shows that the instruments and the corruption index in use can have a tremendous effect on the results. Moreover, statistical tests indicate that many of the regressions are problematic. All in all, it is not that surprising that the implications of the earlier literature tend to be conflicting.

The first way to address the question of whether the effects of corruption might differ between countries is to run IV regressions separately for high-income and other countries. Keeping the sample size in mind, it should not come as a surprise that the results are not very robust and that there are often problems with test statistics. Several regressions for both groups of countries indicate, however, that corruption has an increasing impact on shadow economy size.\footnote{Interestingly, the division of countries into two groups strengthens this impact in comparison to the analysis with all countries, where the sign of corruption tended to vary in second-stage regressions.} Regressions with insignificant corruption in second stage are even more numerous. Therefore, the division of countries into high-income and other countries neither supports nor discredits the hypothesis of the different consequences of corruption in different countries. The next section examines the issue further and introduces an interaction term between corruption and geography.

### 4.2.2 Does Geography Matter?

As mentioned, previous empirical literature on the impact of corruption on the size of shadow economy has hardly tried to account for different types of corruption. This section attempts to fill the void by assuming that the type of corruption prevalent in a country is associated with the geographic location of the country. Therefore, an interaction term $corruption \times geography$ is introduced.\footnote{Unlike income level, geography is exogenous and can therefore be used in this manner.} Here, geography is mostly approximated by the tropical area fraction of a country, because the absolute value of a country’s latitude proves not to be significant. The inclusion of the endogenous interaction term is a cause for building new instruments. The principle followed
is that if a variable such as ethnic fractionalization is a valid instrument for corruption, then the product of this variable and geography is a valid instrument for corruption × geography. 

There are now two endogenous terms: corruption (Corr) and the product of corruption and geography (CorrGeog). Because the endogenous regressors are projected on all the instruments in IV regressions, three equations to be estimated are

\[
\begin{align*}
\text{Corr}_i & = \alpha_1 + \alpha_2 \text{GDP}_i + \alpha_3 \text{Tax}_i + \alpha_4 \text{Instit}_i + \alpha_5 \text{WP}_i + \alpha_6 \text{LoB}_i + \alpha_7 \text{LoF}_i + \\
& + \alpha_8 \text{LoS}_i + \alpha_9 \text{LoG}_i + \alpha_{10} \text{Ef}_i + \alpha_{11} \text{Rf}_i + \alpha_{12} \text{Geog}_i + \\
& + \alpha_{13} \text{EfGeog}_i + \alpha_{14} \text{RfGeog}_i + \epsilon_{1,i} \\
\text{CorrGeog}_i & = \beta_1 + \beta_2 \text{GDP}_i + \beta_3 \text{Tax}_i + \beta_4 \text{Instit}_i + \beta_5 \text{WP}_i + \beta_6 \text{LoB}_i + \beta_7 \text{LoF}_i + \\
& + \beta_8 \text{LoS}_i + \beta_9 \text{LoG}_i + \beta_{10} \text{Ef}_i + \beta_{11} \text{Rf}_i + \beta_{12} \text{Geog}_i + \\
& + \beta_{13} \text{EfGeog}_i + \beta_{14} \text{RfGeog}_i + \epsilon_{2,i} \\
\text{Shadow}_i & = \gamma_1 + \gamma_2 \text{Corr}_i + \gamma_3 \text{CorrGeog}_i + \gamma_4 \text{GDP}_i + \gamma_5 \text{Tax}_i + \gamma_6 \text{Instit}_i + \gamma_7 \text{WP}_i + \\
& + \gamma_8 \text{LoB}_i + \gamma_9 \text{LoF}_i + \gamma_{10} \text{LoS}_i + \gamma_{11} \text{LoG}_i + \epsilon_{3,i} 
\end{align*}
\]

where Corr$_i$ stands for the level of corruption in country $i$ and Shadow refers again to the scope of informal economic activity. The coefficients to be estimated are now denoted by $\alpha$s, $\beta$s and $\gamma$s, while $\epsilon_1$, $\epsilon_2$ and $\epsilon_3$ are the stochastic error terms. Excluded instruments comprise ethno-linguistic (Ef) and religious fractionalization (Rf), tropical area fraction of a country (Geog) and the interaction terms of these (EfGeog and RfGeog), while included instruments are composed of lagged (log of) GDP per capita (GDP), fiscal burden (Tax), institutional quality (Instit), wage and price regulation (WP) and dummies for British (LoB), French (LoF), Socialist (LoS), and German (LoG) legal origins.

The first-stage results imply again that the connection between the quality of institutions and the level of corruption is the most important one, while the connection between GDP per capita and the level of corruption is somewhat weaker. Also religious fractionalization seems to be associated with a lower level of corruption, as are various other indicators in different cases. All other connections are less robust than the one between rule of law and corruption, though. 

The second-stage results for a representative set of instruments are presented in Table 1: the first regression uses CPI, the second ICRG’s index of political corruption and the third that based on a structural model of Dreher et al. (2004). The results with CPI and ICRG’s index imply that wage and price regulation significantly affect the size of the shadow economy at ten percent risk level: the negative coefficient implies that higher regulation leads to a smaller shadow economy. It is somewhat surprising that fiscal burden and institutional quality do not seem to play any role, although the most interesting result of Table 1, at least from the point of view of this paper, concerns the joint impact of the level of corruption and the tropical area fraction of a country. All three regressions indicate that the impact of corruption on the size of shadow economy is higher in tropics: the higher the share of a country’s area located in tropics, the more a certain level of corruption increases informal economic activity. According to the results, corruption does not have on impact on the size of shadow economy outside tropics. Also, bearing in mind that all the corruption indices decrease with the level of corruption, the regressions imply that corruption and shadow economy are substitutes in tropics, i.e. the lower the level of corruption (the higher the value of the index), the larger shadow economy is. This supports the conclusion drawn in section 3.2.2: if corruption and shadow economy are more likely to be substitutes in a country with poor-quality institutions, the relationship between the two should be negatively precisely in tropics, where the quality of institutions tends to be low.
Table 1. IV regression results with interaction terms: the impact of corruption on shadow economy size

<table>
<thead>
<tr>
<th>regression 1</th>
<th>regression 2</th>
<th>regression 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corruption (Transparency International)</strong></td>
<td><strong>-5.859</strong></td>
<td><strong>-5.859</strong></td>
</tr>
<tr>
<td><em>(1.63)</em>*</td>
<td><em>(1.63)</em>*</td>
<td><em>(1.63)</em>*</td>
</tr>
<tr>
<td><strong>Corruption * tropical area fraction</strong></td>
<td><strong>1.7</strong></td>
<td><strong>1.7</strong></td>
</tr>
<tr>
<td><em>(2.00)</em>*</td>
<td><em>(2.00)</em>*</td>
<td><em>(2.00)</em>*</td>
</tr>
<tr>
<td><strong>Corruption (ICRG)</strong></td>
<td><strong>-6.679</strong></td>
<td><strong>-6.679</strong></td>
</tr>
<tr>
<td><em>(1.51)</em>*</td>
<td><em>(1.51)</em>*</td>
<td><em>(1.51)</em>*</td>
</tr>
<tr>
<td><strong>Corruption * tropical area fraction</strong></td>
<td><strong>3.633</strong></td>
<td><strong>3.633</strong></td>
</tr>
<tr>
<td><em>(2.49)</em>*</td>
<td><em>(2.49)</em>*</td>
<td><em>(2.49)</em>*</td>
</tr>
<tr>
<td><strong>Corruption (Dreher et al.)</strong></td>
<td><strong>-7.18</strong></td>
<td><strong>-7.18</strong></td>
</tr>
<tr>
<td><em>(1.36)</em>*</td>
<td><em>(1.36)</em>*</td>
<td><em>(1.36)</em>*</td>
</tr>
<tr>
<td><strong>Corruption * tropical area fraction</strong></td>
<td><strong>5.213</strong></td>
<td><strong>5.213</strong></td>
</tr>
<tr>
<td><em>(2.12)</em>*</td>
<td><em>(2.12)</em>*</td>
<td><em>(2.12)</em>*</td>
</tr>
<tr>
<td><strong>(Log of ) GDP per capita, lagged</strong></td>
<td><strong>-0.54</strong></td>
<td><strong>-0.54</strong></td>
</tr>
<tr>
<td><em>(0.32)</em>*</td>
<td><em>(0.32)</em>*</td>
<td><em>(0.32)</em>*</td>
</tr>
<tr>
<td><strong>Fiscal burden (Heritage Foundation)</strong></td>
<td><strong>0.868</strong></td>
<td><strong>0.868</strong></td>
</tr>
<tr>
<td><strong>1.823</strong></td>
<td><strong>1.823</strong></td>
<td><strong>1.823</strong></td>
</tr>
<tr>
<td><em>(0.73)</em>*</td>
<td><em>(0.73)</em>*</td>
<td><em>(0.73)</em>*</td>
</tr>
<tr>
<td><strong>Rule of law (Kaufmann et al.)</strong></td>
<td><strong>1.715</strong></td>
<td><strong>1.715</strong></td>
</tr>
<tr>
<td><strong>-2.717</strong></td>
<td><strong>-2.717</strong></td>
<td><strong>-2.717</strong></td>
</tr>
<tr>
<td><em>(0.57)</em>*</td>
<td><em>(0.57)</em>*</td>
<td><em>(0.57)</em>*</td>
</tr>
<tr>
<td><strong>Wages and prices (Heritage Foundation)</strong></td>
<td><strong>-3.952</strong></td>
<td><strong>-3.952</strong></td>
</tr>
<tr>
<td><em>(1.85)</em>*</td>
<td><em>(1.85)</em>*</td>
<td><em>(1.85)</em>*</td>
</tr>
<tr>
<td><strong>Fiscal burden (Heritage Foundation)</strong></td>
<td><strong>(3.07)</strong>***</td>
<td><strong>(3.07)</strong>***</td>
</tr>
<tr>
<td><strong>-12.216</strong></td>
<td><strong>-12.216</strong></td>
<td><strong>-12.216</strong></td>
</tr>
<tr>
<td><em>(0.91)</em>*</td>
<td><em>(0.91)</em>*</td>
<td><em>(0.91)</em>*</td>
</tr>
<tr>
<td><strong>British legal origin (La Porta et al.)</strong></td>
<td><strong>-12.339</strong></td>
<td><strong>-12.339</strong></td>
</tr>
<tr>
<td><em>(1.45)</em>*</td>
<td><em>(1.45)</em>*</td>
<td><em>(1.45)</em>*</td>
</tr>
<tr>
<td><strong>French legal origin (La Porta et al.)</strong></td>
<td><strong>-18.22</strong></td>
<td><strong>-18.22</strong></td>
</tr>
<tr>
<td><em>(1.31)</em>*</td>
<td><em>(1.31)</em>*</td>
<td><em>(1.31)</em>*</td>
</tr>
<tr>
<td><strong>Socialist legal origin (La Porta et al.)</strong></td>
<td><strong>-18.22</strong></td>
<td><strong>-18.22</strong></td>
</tr>
<tr>
<td><em>(1.31)</em>*</td>
<td><em>(1.31)</em>*</td>
<td><em>(1.31)</em>*</td>
</tr>
<tr>
<td><strong>German legal origin (La Porta et al.)</strong></td>
<td><strong>-17.986</strong></td>
<td><strong>-17.986</strong></td>
</tr>
<tr>
<td><em>(1.5)</em>*</td>
<td><em>(1.5)</em>*</td>
<td><em>(1.5)</em>*</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td><strong>80.122</strong></td>
<td><strong>80.122</strong></td>
</tr>
<tr>
<td><strong>82.99</strong></td>
<td><strong>75.996</strong></td>
<td><strong>75.996</strong></td>
</tr>
<tr>
<td><strong>(2.77)</strong>*</td>
<td><em>(4.05)</em>**</td>
<td><em>(4.05)</em>**</td>
</tr>
</tbody>
</table>

Absolute value of t statistics in parentheses (* significant at 10%; ** significant at 5%; *** significant at 1%)

The significant and large negative coefficients of legal origin dummies in regressions 1 and 2 of Table 1 seem to imply that Scandinavian legal origin, which is used as the reference group, is associated with a larger shadow economy. Because the three-year averages of shadow economy sizes for Scandinavian countries are all rather small at below 20 percent of GDP (Schneider 2006), this is counterintuitive. A part of the potential explanation is given by the negative sign of corruption in all three regressions, even if the coefficients are insignificant: because Scandinavian countries are typically given high scores (implying low corruption) in these indices, the negative impact on shadow economy size through this channel could be large.

Table 1 also depicts the results of Anderson canonical correlation likelihood ratio test for the relevance of instruments. The rejection of the null hypothesis implies that the model is identified and that the instruments are relevant. The different nature of the index by Dreher et al. (2004) is again reflected in the results, which suggest that the instruments are not suitable for this index at 10 percent risk level even if they are that for the other two indices. The P-values of Sargan statistic, where the hypothesis tested is that the instrumental variables are uncorrelated with residuals, are likewise presented. Sargan statistic assumes conditional homoskedasticity, which does not seem to be a problem here: Pagan and Hall (1983) -test does not reject the null hypothesis of homoskedasticity in any of the regressions.

Replacing the measure of fiscal burden from the Heritage Foundation (2006) by that of the World Bank (2006) results in Table 2. Legal origin dummies are now insignificant, but the

---

23 See Baum et al. (2003) for detailed descriptions of the tests.
24 Results are available upon request.
implications are otherwise the same as in Table 1: strict wage and price regulation is associated with a smaller shadow economy, whereas the joint impact of corruption and tropical area fraction of a country is significant and positive in all three regressions. After this change in the set of instruments, the instruments are relevant at ten percent risk level also in regression 3.

Table 2. IV regression results with interaction terms: the impact of corruption on shadow economy size

<table>
<thead>
<tr>
<th></th>
<th>Regression 1</th>
<th>Regression 2</th>
<th>Regression 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corruption (Transparency International)</td>
<td>-3.067</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corruption * tropical area fraction</td>
<td>1.528</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.72)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corruption (ICRG)</td>
<td>-3.676</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.66)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corruption * tropical area fraction</td>
<td>3.057</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.85)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corruption (Dreher et al.)</td>
<td>-1.413</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corruption * tropical area fraction</td>
<td>3.869</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.17)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Log of) GDP per capita, lagged</td>
<td>-1.4</td>
<td>-1.853</td>
<td>-1.289</td>
</tr>
<tr>
<td></td>
<td>(0.73)</td>
<td>(1.21)</td>
<td>(0.64)</td>
</tr>
<tr>
<td>Fiscal burden (World Bank)</td>
<td>-0.025</td>
<td>0.033</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.17)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Rule of law (Kaufmann et al.)</td>
<td>-1.488</td>
<td>-3.635</td>
<td>-4.868</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.63)</td>
<td>(1.4)</td>
</tr>
<tr>
<td>Wages and prices (Heritage Foundation)</td>
<td>-5.509</td>
<td>-5.526</td>
<td>-4.786</td>
</tr>
<tr>
<td></td>
<td>(1.9)*</td>
<td>(2.58)**</td>
<td>(1.91)*</td>
</tr>
<tr>
<td>British legal origin (La Porta et al.)</td>
<td>-9.663</td>
<td>-10.964</td>
<td>-9.131</td>
</tr>
<tr>
<td></td>
<td>(1.29)</td>
<td>(1.23)</td>
<td>(0.97)</td>
</tr>
<tr>
<td>French legal origin (La Porta et al.)</td>
<td>-5.002</td>
<td>-5.436</td>
<td>-2.367</td>
</tr>
<tr>
<td></td>
<td>(0.58)</td>
<td>(0.7)</td>
<td>(0.26)</td>
</tr>
<tr>
<td>Socialist legal origin (La Porta et al.)</td>
<td>-9.873</td>
<td>-8.848</td>
<td>-6.706</td>
</tr>
<tr>
<td></td>
<td>(0.88)</td>
<td>(0.91)</td>
<td>(0.66)</td>
</tr>
<tr>
<td>German legal origin (La Porta et al.)</td>
<td>-11.42</td>
<td>-9.965</td>
<td>-5.752</td>
</tr>
<tr>
<td></td>
<td>(0.83)</td>
<td>(1.06)</td>
<td>(0.58)</td>
</tr>
<tr>
<td>Constant</td>
<td>75.891</td>
<td>75.204</td>
<td>57.836</td>
</tr>
<tr>
<td></td>
<td>(2.30)**</td>
<td>(2.87)**</td>
<td>(2.28)**</td>
</tr>
</tbody>
</table>

Absolute values of t statistics in parentheses (* significant at 10%; ** significant at 5%; *** significant at 1%)

<table>
<thead>
<tr>
<th></th>
<th>Regression 1</th>
<th>Regression 2</th>
<th>Regression 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>57</td>
<td>65</td>
<td>58</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.64</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td>First-stage F-test P-value (corruption)</td>
<td>0.2692</td>
<td>0.0488</td>
<td>0.1761</td>
</tr>
<tr>
<td>First-stage F-test P-value (corruption * tropical area fraction)</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Anderson canon. corr. likelihood ratio statistic (P-value)</td>
<td>0.0958</td>
<td>0.1042</td>
<td>0.0997</td>
</tr>
<tr>
<td>Sargan statistic (P-value)</td>
<td>0.2826</td>
<td>0.2727</td>
<td>0.2209</td>
</tr>
</tbody>
</table>

4.2.3 Robustness Checks

Alternative instruments Section 4.1 listed alternative proxies for the components of the theoretical model of Section 3. The result on the significance of the joint impact of corruption and tropical area fraction seems to hold with various other measures of institutional quality combined with other indicators of fiscal burden and price and wage regulation. The negative connection between wage and price regulation and the scope of informal economic activity seems to be equally robust. Otherwise, corruption sometimes appears in regressions with a significant negative coefficient, and also other factors such as institutional quality are significant in single regressions, but these results are far from robust.

As discussed above, other estimates of shadow economy sizes are mainly available for the early 1990s. The sample sizes are considerably smaller: the figures based on physical input method are available for 59 countries in 1990. Moreover, many of the series used as instruments in the above analysis do not go back to early 1990s, and the changes in the set of instruments due to the data availability problems result in large statistical problems, which undermine the significance of the regressions. All in all, the result on the joint significance of corruption and
tropical area fraction of a country does not seem to be robust to the use of shadow economy size estimates based on physical input method. It is, nevertheless, difficult to state the reason for this. First, it could follow from the statistical problems due to the few series and observations available. Second, a closer look at the countries for which physical input method estimates are available reveals that not that many of them are in tropics. This might, naturally, affect the results. Third, it could be that the relationship between corruption and shadow economy was different in 1990 than it was a decade later. It is, however, impossible to deduce which explanation is true based on the available data.

Recent literature on growth has paid plenty of attention to endowment of natural resources, debating whether so-called resource curse exists. The issue has been discussed in the context of corruption by Leite and Weidmann (1999), who argue that natural resource abundance is an important determinant of the level of corruption. Therefore, measures of natural resource abundance are added to the set of instruments. In contrast to the conclusion of Leite and Weidmann, the results imply that natural resources do not correlate with the level of corruption. Instead, they might play a role in determining the size of shadow economy. Particularly, it seems that the share of food and agricultural exports of total merchandise exports (World Bank 2006) is associated with a larger shadow economy. This connection does not seem to, however, overrule the joint impact of corruption and tropical area fraction on shadow economy size. Other measures of natural resource abundance used do not seem to have a significant impact on corruption or shadow economy. The discussion on whether the natural resource shares of exports really measure the level of natural resources or something completely else is beyond the scope of this paper. Whatever the conclusion, interaction terms of corruption and export shares cannot be used in the analysis, because export shares are endogenous.

**Methodological questions** Exclusion restrictions have commonly been problematic in IV regressions with corruption. To test the significance of the assumptions made here, they are relaxed one by one. First, the negative connection between wage and price regulation and the size of shadow economy seems to be robust to including tropical area fraction in second-stage regressions. The joint impact of corruption and tropical area fraction becomes, however, insignificant. On the other hand, tropical area fraction does not seem to have any direct connection with the size of shadow economy either, which implies that it is only necessary to include the variable in first-stage regressions. Second, including either ethno-linguistic or religious fractionalization in second-stage regressions does not affect the joint significance of corruption and tropical area fraction or that of wage and price regulation. However, because neither of the fractionalization measures seems to have a direct impact on the scope of informal economic activity, it seems justified to keep them as excluded instruments.

The results on the positive and jointly significant impact of corruption and tropical area fraction and the negative impact of price and wage regulation are robust to dropping the interaction terms of geography and other excluded instruments from the set of instruments. However, test statistics are then worse in a clear majority of the cases, which indicates that the interaction terms are necessary.

Because instrumenting for the interaction term of endogenous corruption and exogenous geography is somewhat unorthodox, some might prefer alternative procedures such as bootstrapping. First, corruption is the dependent variable. The results of this regression are used to get the predicted level of corruption, \( \hat{c} \), which is then interacted with tropical area fraction. In the second phase, these two predictions are used alongside with the included instruments from the IV regressions to explain the size of shadow economy. The whole procedure is bootstrapped. The results presented in Table 3 imply that the conclusions do not change in any major way. The interaction term of corruption and tropical area fraction is positive and significant at five percent risk level in regressions 2 and 3, while the term is positive and almost significant at 10

---

25The measures include 3-year averages of food and agricultural exports and fuel and mineral exports as a share of total merchandise exports from the World Bank (2006) and per capita subsoil assets, cropland and pastureland in 2000 from World Bank (2005). The results are available upon request.

26The results are available upon request.
percent risk level in regression 1. Furthermore, the impact of strict wage and price regulation on the size of shadow economy seems to be significant and negative. All in all, bootstrapping does not give any cause for rejecting the results based on IV regressions.

<table>
<thead>
<tr>
<th>Table 3. Bootstrapping results: the impact of corruption on shadow economy size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>regression 1</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Corr. (Transparency International)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Corr. * tropical area fraction</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Corr. (ICRG)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Corr. * tropical area fraction</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Corr. (Drehet al.)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Corr. * tropical area fraction</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>(Log of) GDP per capita, lagged</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Fiscal burden (Heritage Foundation)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Rule of law (Kaufmann et al.)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Wages and prices (Heritage Foundation)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>British legal origin (La Porta et al.)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>French legal origin (La Porta et al.)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Socialist legal origin (La Porta et al.)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>German legal origin (La Porta et al.)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Absolute value of z statistics in parentheses (* significant at 10%; ** significant at 5%; *** significant at 1%)

Observations 79 95 81

Finally, it should perhaps be highlighted again that the result of the joint significance of corruption and tropical area fraction cannot be replicated with the absolute value of a country’s latitude, and is therefore only associated with the tropical area fraction of a country and not any other measure of geography.

4.3 Empirical Implications

The regressions without interaction terms between corruption and geography seem to indicate that corruption could play some role in determining the size of shadow economy. Bearing the conflicting results of the earlier literature in mind, it is not surprising that the result does not seem to be robust to either direction. In fact, the use of different corruption indices with different proxies for institutions and other instruments may, and does, result in opposite results. Unfortunately, this makes it extremely difficult to verify whether corruption really has different consequences in different countries. Instead, the results indicate that some factors are quite robust determinants of informal economic activity: higher-quality institutions, higher level of economic development and stricter wage and price regulation seem to reduce the size of shadow economy.

Lagged GDP per capita and wage and price regulation continue to be important, when an interaction term of corruption and tropical area fraction is added to the analysis to account for the possibly different consequences of corruption between countries. In addition, the result on the significance of corruption * geography seems to be quite robust despite the potentially
problematic exclusion restriction: the larger the share of a country’s area that is located in
tropics, the larger is the increasing impact of the level of corruption on shadow economy size.
This seems to confirm the idea that discussion on corruption should allow for the possibility
that the consequences of corruption may differ in different parts of the world.

5 Conclusions

Hardly anyone disputes that corruption can have significant and sometimes severe consequences.
Moreover, corruption tends to be a particularly acute problem in those countries that are already
otherwise worse off. It is also alarming that the losses caused by corruption seem to have been
on the increase in various developing economies. Although consensus on the matter does not
exist, several studies conclude that corruption inhibits productive investment or otherwise lowers
GDP growth. Corruption can also affect GDP indirectly by having an impact on the number
of firms or individuals choosing to operate informally the shadow economy. This paper focused
on the last aspect.

The paper examined the relationship between corruption and shadow economy. It was as-
sumed that the level and type of corruption could have an impact on the size of shadow economy,
but reverse causality from shadow economy to corruption was not analyzed. The study empha-
sized the view that different manifestations of corruption, such as bribes to get projects or
licences or bribes to lower taxes, could have different consequences. Because some corrupt prac-
tices tend to be more commonplace in some countries than in others, the implication is that the
consequences of corruption could differ between countries.

To analyze the question, a theoretical model of an economy with formal and informal sectors
was developed. Two cases were analyzed: in the first one, bribes were paid to get projects
or licenses, while they were paid to lower taxes in the second case. In both models, the size
of shadow economy was endogenously determined, as firms could choose to function either in
formal or informal economy. Relative costs of corruption depended on the size and political
connectedness of the firm, so that some firms were better equipped to deal with corruption.
This helped to determine the relative sizes of formal and informal sectors. The results showed
that the impact of corruption on the size of shadow economy depends on the type of corruption.
If bribes were paid to get projects, more severe corruption always enlarged shadow economy
and corruption and shadow economy were complements. In contrast, if bribes were paid to
lower taxes, the effect of corruption on shadow economy size was ambiguous: in extreme cases,
corruption could actually decrease informal economic activity. It was concluded that such a
relationship would be more probable in the presence of low-quality institutions.

Second, the issue was examined empirically via instrumental variables regressions. The first
results based on the traditional way of doing things were not robust: while some regressions
seemed to indicate that corruption could have a positive impact on the size of shadow economy,
others implied just the opposite. Instead, strong rule of law, high GDP per capita in the previous
period and strict regulation of wages and prices seemed to lead to smaller shadow economy more
consistently. When an interaction term of the level of corruption and the tropical area fraction of
a country was added to the analysis, the picture changed somewhat. The results indicated again
that stricter wage and price regulation affect the size of shadow economy negatively, but they
implied also, and quite robustly, that the higher the tropical area fraction of a country, the more
significant the impact of corruption. That is, the higher the share of a country’s area located
in tropics, the more a certain level of corruption increases informal economic activity. On the
other hand, corruption does not seem to affect the size of shadow economy outside tropics.

As to the question of whether corruption and shadow economy are complements or substi-
tutes, the model assumed that higher corruption leads, in general and particularly when bribes
are paid to get licences, to higher share of informal economy. However, the model showed that
the type of the corruption matters so that, in some extreme cases, corruption and shadow econ-
omy could actually be substitutes with negative correlation between the two. According to the
empirical part of the paper, there is no evidence to either direction outside tropics. Instead, it
seems that corruption and shadow economy are substitutes in tropics. In terms of the model,
this implies that the type of corruption prevalent in tropics would be closer to bribes that are paid to lower taxes. Moreover, the model implied that corruption and shadow economy are more likely to be substitutes, if institutes are of poor quality. Empirical results support this, if it is assumed that the countries situated in tropics suffer generally from low-quality institutions. On the other hand, the result is in contrast with Dreher and Schneider (2006), who concluded that the relationship between corruption and shadow economy was likely to be positive in low-income countries.

There were some differences between the theoretical and empirical parts. First, the model assumed for simplicity that the level of corruption was fixed, but the empirical part recognized the endogeneity of corruption and used, accordingly, instrumental variables. Second, the empirical analysis explained the size of shadow economy as percent of official GDP instead of the share of firms choosing to go informal. In the model, larger shadow economy leads always to smaller formal economy, but the empirical part did not make such an assumption. All in all, the paper did not try to answer the question of the impact of corruption on GDP. However, its conclusion on the significance of geography in magnifying the impacts of corruption should also be tested in the context of GDP.

There are, in addition, various paths that future research on the relationship between corruption and shadow economy could follow. First, availability of panel data on shadow economy sizes would offer an interesting opportunity to examine how the relationship between corruption and shadow economy has evolved over time. Similarly, time aspect could be added to the model. This would be particularly useful by making it possible to endogenize the level of corruption. Finally, a model with more than just one type of corruption could give more insight on the nature of the relationship.

A Appendix

A.1 Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable (Source)</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shadow economy size (Schneider)</td>
<td>144</td>
<td>34.470</td>
<td>13.118</td>
<td>8.6</td>
<td>67.833</td>
</tr>
<tr>
<td><strong>Instrumented variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corruption (Transparency International)</td>
<td>103</td>
<td>4.511</td>
<td>2.355</td>
<td>0.8</td>
<td>9.867</td>
</tr>
<tr>
<td>Corruption (ICRG)</td>
<td>133</td>
<td>2.8</td>
<td>1.159</td>
<td>0.417</td>
<td>6</td>
</tr>
<tr>
<td>Corruption (Dreher et al.)</td>
<td>90</td>
<td>3.056</td>
<td>1.522</td>
<td>-0.175</td>
<td>10.115</td>
</tr>
<tr>
<td><strong>Included instruments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Log of ) GDP per capita, lagged</td>
<td>200</td>
<td>7.519</td>
<td>1.574</td>
<td>4.582</td>
<td>10.576</td>
</tr>
<tr>
<td>Fiscal burden (Heritage Foundation)</td>
<td>157</td>
<td>3.641</td>
<td>0.712</td>
<td>1.375</td>
<td>5</td>
</tr>
<tr>
<td>Fiscal burden (World Bank)</td>
<td>109</td>
<td>16.509</td>
<td>7.558</td>
<td>1.263</td>
<td>47.890</td>
</tr>
<tr>
<td>Rule of law (Kaufmann et al.)</td>
<td>179</td>
<td>-0.020</td>
<td>0.962</td>
<td>-1.838</td>
<td>2.090</td>
</tr>
<tr>
<td>Wages and prices (Heritage Foundation)</td>
<td>157</td>
<td>2.807</td>
<td>0.798</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>British legal origin (La Porta et al.)</td>
<td>169</td>
<td>0.337</td>
<td>0.474</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>French legal origin (La Porta et al.)</td>
<td>169</td>
<td>0.450</td>
<td>0.499</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Socialist legal origin (La Porta et al.)</td>
<td>169</td>
<td>0.154</td>
<td>0.362</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>German legal origin (La Porta et al.)</td>
<td>169</td>
<td>0.030</td>
<td>0.170</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Scandinavian legal origin (La Porta et al.)</td>
<td>169</td>
<td>0.030</td>
<td>0.170</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Excluded instruments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical area fraction (Roodman)</td>
<td>144</td>
<td>0.484</td>
<td>0.478</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Ethno-linguistic fractionalization (Roodman)</td>
<td>121</td>
<td>0.405</td>
<td>0.295</td>
<td>0</td>
<td>0.93</td>
</tr>
<tr>
<td>Religious fractionalization (La Porta et al.)</td>
<td>177</td>
<td>0.444</td>
<td>0.231</td>
<td>0.002</td>
<td>0.860</td>
</tr>
</tbody>
</table>

Note: Corruption index of Dreher et al. was extrapolated by the author before taking 3-year averages of all the variables.
A.2 Countries

Albania, Algeria, Angola, Argentina, Australia, Austria, Belgium, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Congo, Dem. Rep., Congo, Rep., Costa Rica, Côte d’Ivoire, Denmark, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Ethiopia, Finland, France, Ghana, Greece, Guatemala, Guinea, Haiti, Honduras, Hong Kong, China, Hungary, India, Indonesia, Iran, Islamic Rep., Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Rep., Kuwait, Lebanon, Madagascar, Malawi, Malaysia, Mali, Mexico, Mongolia, Morocco, Mozambique, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Syrian Arab Republic, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, United Kingdom, United States, Uruguay, Venezuela, RB, Zambia, Zimbabwe

Note: Data not available for all countries in all regressions of Table 1 (maximum number of countries 95 in regression 2, minimum 79 in regression 1)

References


[51] Schneider, Friedrich (1998). Stellt das Anwachsen der Schwarzarbeit eine wirtschaftspoliti-
ische Herausforderung dar? Einige Gedanken aus volkswirtschaftlicher Sicht. Mitteilungen
des Instituts für angewandte Wirtschaftsforschung (IAW), Linz, 98:1, 4-13.

Do We Really Know? Working Paper.


Cures. International Monetary Fund Staff Papers Vol. 45, No. 4, 559-594.

Working Paper 97/139.

Corruption Perceptions Index 2003. Retrieved in December 2005 from


Century.