CorrShadow.doc
First Draft
February 23, 2009

Corruption and the Shadow Economy: A Structural Equation Model Approach

Andreas Buehn[a] and Friedrich Schneider[b]

Abstract:

Since no consensus exists, this paper aims to sheet more light on the ongoing debate about the dual relationship between corruption and the shadow economy. From a theoretical point of view both can either exhibit a negative relationship as predicted by Choi and Thum (2005) or being complements as recently demonstrated in Echazu and Bose (2008). Presenting a structural equation model with two latent variables we provide empirical evidence for the hypothesis that a large shadow economy and corruption go hand in hand. Corruption and the shadow economy are two sides of the same coin.

JEL-Classification: O17; O5; D78; H11, H26

Keywords: Shadow economy, Corruption, SEM models

[a] Andreas Buehn, Department of Economics, TU Dresden, Dresden, Germany, e-mail: andreas.buehn@tu-dresden.de.
[b] Friedrich Schneider, Department of Economics, Johannes Kepler University of Linz, A-4040 Linz, Austria, e-mail: friedrich.schneider@jku.at.

Corruption and the Shadow Economy: A Structural Equation Model Approach

Abstract:

Since no consensus exists, this paper aims to sheet more light on the ongoing debate about the dual relationship between corruption and the shadow economy. From a theoretical point of view both can either exhibit a negative relationship as predicted by Choi and Thum (2005) or being complements as recently demonstrated in Echazu and Bose (2008). Presenting a structural equation model with two latent variables we provide empirical evidence for the hypothesis that a large shadow economy and corruption go hand in hand. Corruption and the shadow economy are two sides of the same coin.

JEL-Classification: O17; O5; D78; H11, H26

Keywords: Shadow economy, Corruption, SEM models

1. Introduction

The hidden underworld of corruption and the shadow economy are facts around the world but are difficult to measure or detect at all. The little systematic evidence we have yet often comes from surveys by leading international organization such as the World Bank. But economists should be skeptical of what people say when surveyed on delicate topics such as bribery or illegal income sources. Often responses to questions like, "Did you yourself carry out any undeclared activities in the last 12 month?" or "How much did you receive or pay in bribes last year?" are "cheap talk" or – at least – of questionable accuracy.

While doing research in these two fields is already a scientific passion of knowing the unknown, the analysis of the relationship between corruption and the shadow economy is even more complex: from a theoretical point of view both can be either substitutes or complements. But what exactly is this relationship? This paper analyzes the link between corruption and the shadow economy empirically using a structural equation model (SEM). Modeling the two phenomena as latent variables we hope to sheet more light on the ongoing debate on whether the shadow economy increases corruption or mitigates the bureaucrat's scope for taking bribes.

In their seminal paper, Shleifer and Vishny (1993) contrast two corruption scenarios: corruption in a centralized bureaucracy versus corruption in a decentralized bureaucracy. They find that a centralized bureaucracy results in lower bribes than a decentralized one as an official in a centralized bureaucracy takes into account the negative impact of his action on another official thereby lowering bribes. Later, a number of papers have explored the link between corruption in the official economy and the size of the shadow economy. Johnson, Kaufmann, and Shleifer (1997) present a full-employment model where individuals can be either employed in the official or in the shadow economy. Thus, in their model both economies are substitutes as an

increase of the shadow economy must always decrease official economic activity. Higher corruption in the official economy increases the size of the shadow economy as it functions like a higher effective tax on firms in the official economy driving them underground. In a model where taxpayers collude with tax inspectors, Hindriks, Muthoo, and Keen (1999) also find this positive (complementary) relationship between corruption and the shadow economy (see also Johnson, Kaufmann, and Zoido-Lobaton 1998b and Friedman et al. 2000).

In contrast, Choi and Thum (2005) present a model where the entrepreneur's option to go underground constrains the corrupt official's ability to ask for bribes. The shadow economy mitigates distortions to the official economy and disables officials from realizing personal gains. Thus, the existence of the shadow economy increases the official economy and reduces corruption, in particular bribes charged by the bureaucrat. Dreher, Kotsogiannis, and McCorriston (2005) extend this model by explicitly specifying institutional quality. While institutional quality reduces the shadow economy it is ambiguous with respect to the level of corruption, depending on the relative effectiveness on combating the shadow economy and corruption. They also show that corruption and the shadow economy are substitutes as the shadow economy imposes a constraint on officials. When firms have the option of going underground, officials reduce the equilibrium level of grafts. Thus, like in Choi and Thum (2005), corruption is lower in presence of a shadow economy.

In a recent paper, published in this journal, Echazu and Bose (2008) widen the analysis of Shleifer and Vishny (1993) and consider corrupt bureaucrats in the official and the shadow economy. While sectoral (horizontal) centralization with two different bureaucrats operating in the official and the shadow economy lowers corruption, corruption increases when the same bureaucrat is in charge to monitor activities in the official and the shadow economy (vertical

centralization). Although this more in-depth analysis is not contradictory to Shleifer and Vishny (1993), it contrasts Choi and Thum (2005). Centralization across the two sectors may induce higher corruption and a smaller size of the official economy. Thus, the complementarity between the official and the shadow economy found in Choi and Thum (2005) does no longer hold.

Since theoretical relationship between corruption and the shadow economy is ambiguous, empirical investigations are helpful. While Dreher, Kotsogiannis, and McCorriston (2005) focus on the impact of institutional quality, Dreher and Schneider (2006) analyze the complex relationship between corruption and the shadow economy in a broad panel data study finding mixed evidence depending on the indicators chosen and the specification employed. To our knowledge no study exists that explicitly models both hidden phenomena simultaneously in a structural equation model with latent variables and a set of different causes and indicators. This framework allows us to analyze whether corruption and the shadow economy exhibit a negative relationship as predicted by Choi and Thum (2005) or if the relationship is positive as shown in Johnson, Kaufmann, and Shleifer (1997) or Echazu and Bose (2008).

The rest of the paper is organized as follows. Section 2 defines the shadow economy and corruption. Section 3 introduces the SEM. Causes and indicators are discussed in section 4 and 5 for the shadow economy and corruption, respectively. While Section 6 presents the empirical application and the results, Section 7 concludes.

2 Defining the Shadow Economy and Corruption

2.1 The shadow economy

The shadow economy is a per se unobservable economic phenomenon. Thus, authors dealing with the shadow economy face, first of all, the difficulty of an appropriate working definition.[1] Smith (1994, p. 18) defines it as, "market-based production of goods and services, whether legal or illegal that escapes detection in the official estimates of GDP". Broader definitions of the shadow economy refer to those economic activities and the income derived from them that circumvent government regulation, taxation or observation. As these definitions still leave some wiggle room, Table 1 might be helpful to develop a reasonable consensus on the definition of the shadow economy.

[Insert Table 1 about here]

From Table 1, it becomes clear that the shadow economy includes unreported income from otherwise official trade in goods and services, e.g. through monetary or barter transactions – and thus includes all economic activities that would generally be taxable were they reported to governmental (tax) authorities. In this paper, the following, more narrow definition of the shadow economy is used: the shadow economy includes all market-based, lawful trade in goods and services that are deliberately concealed from public authorities for one of the following reasons:

(1) to avoid payment of income, value added or other taxes;

(2) to avoid payment of social security contributions;

[1] In this paper we do not discuss aspects of measurement of shadow economic activities. For an excellent survey on different measurement methodologies see e.g. Schneider and Enste (2000, 2002).

(3) to avoid certain legal labour market standards, such as minimum wages, maximum working hours, safety standards, etc.; or,

(4) to avoid compliance with administrative procedures, such as filling in statistical questionnaires or other administrative forms.

Consequently, this paper shall not deal with typical, underground criminal activities, such as burglary, robbery, or drug dealing, which are all illegal.

2.2 Corruption

Corruption – like the shadow economy – is an, in general, illegal activity which cannot be observed but perceived. The most general definition of corruption is the abuse of public power for private gains. A more focused definition is given by the World Bank: "[corruption] distorts the rule of law, weakens a nation's institutional foundation, and severely affects the poor who are already the most disadvantaged members of our society". Consequently, corruption is seen "among the greatest obstacle to economic and social development (Word Bank 2009). Fighting corruption may reduce its corrosive impact and would then, in turn, improve a country's economic performance substantially.

The cost of corruption is manifold. Firstly, it constitutes a major obstacle to democracy as institutions lose their legitimacy when they are misused for private advantage. Secondly, corruption is often responsible for the redistribution of scarce public resources to high-profile projects at the expense of less spectacular but more necessary public infrastructure projects such as schools and hospitals. It also hinders the development of fair market structures and distorts competition. Although the political and economic costs of corruption are severe, the most damaging effect is on the society's social structure. Corruption undermines people's trust in

institutions and political leadership that, in turn, allows unscrupulous leaders to transfer national assets into personal wealth. Finally, demanding and paying bribes becomes the social norm and those unwilling to comply often emigrate, leaving the country drained of its most able and honest citizens (Transparency International 2009).

3 A Structural Equation Model for Corruption and the Shadow Economy

While fighting corruption is forcefully demanded by international organizations like the World Bank, actions might be less efficient if one neglects the existing reciprocal relationship between corruption and the shadow economy. This link has to be taken into account for the formulation of effective policy advice. A SEM – modeling corruption and the shadow economy as two distinct latent variables – allows us to derive such information by analyzing the covariance structures between the latent variables' observable causes and indicator.

Formally, such a model consists of two parts: the structural equation model and the measurement model. The structural equation model can simply be represented as:

$$\boldsymbol{\eta} = \mathbf{B}\boldsymbol{\eta} + \boldsymbol{\Gamma}\mathbf{x} + \boldsymbol{\varsigma}, \tag{1}$$

where each x_i , $i = 1,\ldots,q$ in the vector $\mathbf{x}' = (x_1, x_2, \ldots, x_q)$ is a potential manifest cause of one of the two latent variables. The individual coefficients $\boldsymbol{\gamma}' = (\gamma_1, \gamma_2, \ldots, \gamma_q)$ in matrix $\boldsymbol{\Gamma}$ describe the relationships between the respective latent variable and its causes. Thus, each latent variable is determined by a set of exogenous causes. The error terms in vector $\boldsymbol{\varsigma}$ represent the unexplained components. Their covariance matrix is abbreviated by $\boldsymbol{\Psi}$ and $\boldsymbol{\Phi}$ is the $(q \times q)$ covariance matrix of the causes. The coefficient matrix $\mathbf{B}$ shows the influence of the two latent variables on each other, i.e. the impact of the shadow economy on corruption and vice versa.

The measurement model links the latent variable to its multiple observable indicators; i.e. it

is assumed that the latent variable determines its indicators. The measurement model conveys a richness of information that would lack with a single indicator only and is specified by:

$$\mathbf{y} = \mathbf{\Lambda\eta} + \boldsymbol{\varepsilon}, \tag{2}$$

where $\mathbf{y}' = (y_1, y_2, \ldots, y_p)$ is the vector of indicators for corruption and the shadow economy. $\mathbf{\Lambda}$ is a matrix of regression coefficients and $\boldsymbol{\varepsilon}$ is a $(p \times 1)$ vector of white noise disturbances. Their $(p \times p)$ covariance matrix is given by $\mathbf{\Theta}_{\boldsymbol{\varepsilon}}$.

The parameters of the model are estimated using the information contained in the observed variables' variance and covariance matrices.[2] Thus, the goal of the estimation procedure is to find values for the parameters and covariances that produce an estimate for the SEM model's covariance matrix $\boldsymbol{\Sigma}(\boldsymbol{\theta})$, $\hat{\boldsymbol{\Sigma}} = \boldsymbol{\Sigma}(\hat{\boldsymbol{\theta}})$, that is as close as possible to the sample covariance matrix of the observed causes and indicators and to confirm the hypothesized theoretical relationships between causes and indicators and the latent variables in the empirical analysis. Figure 1 displays the SEM model used to analyze the relationship between corruption and the shadow economy.

[Insert Figure 1 about here]

This model has the following matrix notation:

[2] For a detailed description of the methodology see Bollen (1989).

$$\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix}=\begin{bmatrix}0 & \beta_{12}\\ \beta_{21} & 0\end{bmatrix}\cdot\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix}+\begin{bmatrix}\gamma_1 & \gamma_2 & \gamma_3 & 0 & 0 & \cdots & 0\\ 0 & 0 & 0 & \gamma_4 & \gamma_5 & \cdots & \gamma_q\end{bmatrix}\cdot\begin{bmatrix}x_1\\ x_2\\ x_3\\ x_4\\ x_5\\ \vdots\\ x_q\end{bmatrix}+\begin{bmatrix}\varsigma_1\\ \varsigma_2\end{bmatrix}, \quad (3)$$

$$\begin{bmatrix}y_1\\ y_2\\ y_3\\ y_4\\ y_5\\ \vdots\\ y_p\end{bmatrix}=\begin{bmatrix}1 & 0\\ \lambda_2 & 0\\ \lambda_3 & 0\\ 0 & 1\\ 0 & \lambda_5\\ \vdots & \vdots\\ 0 & \lambda_p\end{bmatrix}\cdot\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix}+\begin{bmatrix}\varepsilon_1\\ \varepsilon_2\\ \varepsilon_3\\ \varepsilon_4\\ \varepsilon_5\\ \vdots\\ \varepsilon_p\end{bmatrix}, \quad (4)$$

where η_1 and η_2 are the latent variables for the shadow economy and corruption, respectively. While equation (3) represents the structural part of the SEM, equation (4) shows the measurement model. By estimating the parameters β_{12} and β_{21} the SEM model discloses whether corruption and the shadow economy and vice versa.

4 Causes and Indicators of the Shadow Economy

4.1 Causes of the shadow economy

4.1.1 Tax burden

Our selection of the shadow economy's causes is based on theoretical and empirical evidence from the corresponding literature. High tax and social security burdens are one important reason

for the existence of the shadow economy.[3] They affect labor-leisure choices and stimulate labor supply in the shadow economy since the greater the difference between the total cost of labor in the official economy and the after-tax earnings from work, the greater the incentive to avoid this difference by working in the shadow economy.

While Neck, Hofreither, and Schneider (1989) find that, under an additive-separable utility function and a two-stage decision setup of the consumer, higher marginal (income) tax rate imply a higher labor supply in the shadow economy, Schneider (1994b, 2000) and Johnson, Kaufmann, and Zoido-Lobatón (1998a,b) provide statistically significant empirical evidence of the influence of taxes on the shadow economy.

Unfortunately, information about marginal tax rates is typically not available on a broad basis. Appropriate proxies for the size of a country's tax system are thus variables that measure government spending or – more generally – the size of the government since government activities rely on taxes. Therefore our first hypothesis is:

(1) The higher government consumption or the bigger the size of the government, the larger the shadow economy, *ceteris paribus*.

4.1.2 Intensity of regulation

The intensity of regulation – often measured by the amount of laws and regulations, such as licensing restrictions, or by the size of staff at regulatory agencies – is another important factor. An increase reduces the freedom (of choice) for individuals engaged in the official economy.

[3] See Thomas (1992), Schneider (1986, 1997, 2003, 2005), Johnson, Kaufmann, and Zoido-Lobaton (1998a,b), Tanzi (1999), Giles, Tedds, and Werkneh (2002), and Dell'Anno and Schneider (2003).

Examples would be labor market regulations such as minimum wages or hiring and firing regulations, trade barriers, and labor restrictions on foreigners. Also the time it takes to meet all administrative requirements when starting a business is an important determinant for entrepreneurs to go underground. In general, regulations lead to a substantial increase in labor costs in the official economy, but since most of these costs can be shifted onto employees they provide an incentive to work in the shadow economy – where they can be avoided.

The model of Johnson, Kaufmann, and Shleifer (1997) shows, that those countries with a more regulated economy have a larger shadow economy. Significant empirical evidence of the influence of (labor) market regulations on the shadow economy is presented in Johnson, Kaufmann, and Zoido-Lobatón (1998b). We hypothesize:

(2) The higher the regulation density in an economy, the greater the incentive is to work in the shadow economy, *ceteris paribus*.

4.1.3 Labor market

Unemployment also affects the size of the shadow economy. Although consensus exists that unemployment in OECD (Organization for Economic Co-operation and Development) countries is caused to a large extent by high labor costs, in the end the effect is ambiguous. On the one hand, the higher unemployment is the higher the incentive to demand goods and services in the shadow economic as they are often considerably cheaper.

On the other hand, unemployed have less money for purchasing goods and services, even in the shadow economy. Thus, whether the chosen measure of unemployment exhibits a positive or negative relationship to the shadow economy depends on the income and substitution effect.

Income losses due to unemployment reduce demand in the shadow as well as the official economy. A substitution takes place as unemployed workers turn to the shadow economy where cheaper goods make it easier to countervail utility losses. This may stimulate additional demand there. If the income effect exceeds the substitution effect, a negative relationship develops. Likewise, if the substitution effect exceeds the income effect, the relationship is positive. In developed countries, however, unemployment benefits are often remarkably and, in turn, largely compensate a decrease of the disposable income caused by unemployment. We therefore believe that the substitutions effects prevails and formulate the following hypothesis:

(3) The higher the unemployment rate, the more individuals engage in shadow economic activities, *ceteris paribus*.

4.2 Indicators for the shadow economy

In addition to the variables which contribute to the size and development of the shadow economy, we have three indicator variables: a ratio of M0 to M1, the growth rate of official GDP, and the labor force participation rate. As explained in the methodology section, the challenge in the measurement part of the structural equation model is to select those indicators that appear to be influenced, *ceteris paribus*, by the latent variable. The selected three indicator variables are particularly suitable to mirror activities in the shadow economy as a result of the following considerations.

Transactions in the shadow economy are typically carried out using cash in order to protect principal and agent in their shadow economic activities, so cash holdings mirror these activities.

We therefore expect a positive relationship between the shadow economy and currency in circulation and formulate the following hypothesis:

(5) The larger the shadow economy, the more currency circulates, *ceteris paribus*.

The effects of the shadow economy on resource allocation and, thus, on the official economy are ambiguous. On the one hand the shadow economy can be seen as positive response to the demand for a dynamic environment and the creation of new markets. It can enhance entrepreneurship, increase efficiency and, in turn, stimulate growth in the official economy. This positive relationship was theoretically derived by Adam and Ginsburgh (1985) under the assumption of low entry costs and a low probability of enforcement in the shadow economy.

On the other hand, it is often argued that economic activities in the shadow economy are not subject to taxation. Shifting them to the official economy leads to an increase in governmental tax revenues increasing the quality and quantity of public goods. As public infrastructure is a key element of economic growth, a larger (smaller) shadow economy thus reduces (increases) growth in the official economy. Empirical evidence for this hypothesis is, for example, provided in Loayza (1996). We follow his reasoning and hypothesize:

(6) The greater the shadow economy, the smaller official economic growth, *ceteris paribus*.

The labor force participation rate might also serve as an important indicator for the shadow economy. If changes in the participation rate reflect shadow economic activities, this indicator empirically determines a flow of resources between the official and the shadow economy. The

expected sign is however ambiguous as there is no consensus in the literature whether the shadow economy really affects the labor force participation rate. Bajada and Schneider (2005) argue that this is not the case. Contrary to this view, Giles (1998) brings forward the argument that the labor force participation rate reflects a movement of the workforce from the official to the shadow economy.

Although this indicator is widely used in empirical studies, the expected relationship is debatable. Over the last thirty years the composition of the labor force has considerably changed and the ratio can also be biased by a growing female participation in the workforce (Dell' Anno 2007). For these reasons we do not formulate a concrete hypothesis regarding the effect of the shadow economy on the labor force participation rate.

5 Causes and Indicators of Corruption

Similar to the shadow economy, selection of causes and indicators for corruption is based on previous findings of the relevant theoretical and empirical literature. We start our discussion with the causal variables and then turn to the indicators. To present the explanation more clearly, the causes have been categorized into three main groups: political and judicial factors, social and cultural factors, and economic factors.

5.1 Causes of corruption

5.1.1. Political and judicial factors

These factors should capture the democratic and institutional environment as well as the performance of the judicial system in a country. It is widely believed that corruption is related to the deficiencies of the political system. Hence, sound administrative systems, clear rules, and a

long tradition in institution-building are strong deterrents to corruption. Promoting political competition and increasing transparency and accountability, can reduce the scope for bribery. Other characteristics of the political environment like electoral rules and the degree of decentralization (Shleifer and Vishny 1993; Echazu and Bose 2008) also explain the extent of corruption in a society.

Political and judicial factors featured prominently in many recent studies on the importance of governance for economic development (see, among others North 1990; Easterly and Levine 1997). While strong legal foundations and efficient legal systems protect property rights and provide a stable framework for economic activity, failure of the legal system to enforce contracts are harmful. It undermines market operations and reduces agents' incentives to participate in productive activities but encourages unproductive activities like corruption. Therefore we hypothesize:

(7) The less impartial courts and the more derogations of the rule of law occur, the higher the level of corruption, *ceteris paribus*.

5.1.2. Social and cultural factors

Many individuals in poor countries with low levels of literacy have only little understanding of governmental operations (Rose-Ackerman 1999). For them, it is often not clear what they should expect from a legitimate government. Thus, corruption becomes more likely because it is supposed that one ought to present gifts as gratitude for favorable decisions (Pasuk and Sungsidh 1994). Corruption is then less a matter of bargain but more a matter of culture and social exchange. As highly corrupt countries often under-invest in education (Mauro 1998) and neglect

the creation of human capital the understanding for governmental operations is adversely affected. To control for the social and cultural influence on society's level of corruption, we employ the primary school enrolment rate, and formulate the following hypothesis:

(8) The lower the school enrolment rate, the more scope for corruption in a society, *ceteris paribus*.

5.1.3. Economic factors

Governments often interfere into economics in terms of the regulatory environment and the fiscal burden imposed on individuals. Consequently, societies with less government interventions are claimed to be more economically free. The general belief is that greater economic freedom reduces a country's level of corruption because it entails freedom of choice in doing business and less red tape, bureaucratic hassles and government interference and, thus, less lucrative rent-seeking opportunities.[4] Greater government involvement induces both bribe takers and bribe seekers to engage into corrupt activities to circumvent restrictive rules and inefficiencies. Such exogenous economic constraints also spur corruption for another reason: individuals would find creative ways, legal or illegal ones, to circumvent existing rules (Graeff and Mehlkopp 2003).

Some studies also put emphasize on the size of the public sector as it offers bureaucrats some degree of discretion in the allocation of goods and services (Tanzi 1998, and Dreher, Kosogiannis, and McCorriston 2007). Thus, the more significant the role of the public sector, the higher the likelihood of corruption. While this mechanism – according to Van Rijckeghem and

[4] The argument that economic freedom affects corruption has been already made elsewhere (see e.g. Bardan 1997; Goel and Nelson 2005).

Weder (2001) – is reinforced further if wages public officials receive are relatively low, Treisman (2000) finds rather inconclusive evidence for this relation. Following our considerations we hypothesize that:

(9) The less economically free – i.e. the higher governmental inefficiency or the more bureaucratic hassles exist – an economy is, the higher the likelihood of corruption, *ceteris paribus*.

5.2 Indicators for corruption

The existing literature also offers some guidance with respect to appropriate indicators for corruption. An obvious indicator variable that should be incorporated into the measurement model is GDP per capita as conventional wisdom says that it is corruption what makes poor countries poor. It is detrimental for economic development and seen as responsible for Africa's lasting poverty and Latin America's stagnation. Indeed, almost all available evidence suggests that corruption varies inversely with development (see, among others, Mauro 1995 and Paldam 2003). Thus we expect:

(10) The higher corruption, the lower economic development measured by GDP per capita, *ceteris paribus*.

Empirical studies on the consequences of corruption have also focused on the negative impact of corruption on the composition of investment. A natural variable that would capture the distortion of corruption on resource allocation might be a measure of financial development. According to

Hillman and Krausz (2004), corruption reduces the volume of financial intermediation and is, thus, one critical source of inefficiencies in the financial system. Therefore, we hypothesize:

(11) The financial development of a country is the lower the higher corruption is, *ceteris paribus*.

A final set of indicators are those variables which aim to measure the extent of corruption in a society. A natural choice would be to use one of the regularly published corruption indices, e.g. the control of corruption index presented in Kaufmann, Kraay, and Mastruzzi (2007) or the freedom from corruption index presented in Gwartney, Lawson, and Norton (2008).

Another variable that fits into this category is the index of bribes and extra payments derived from responses to the following question: "In your industry, how commonly would you estimate that firms make undocumented extra payments or bribes (Gwartney, Lawson, and Norton 2008). For these types of variables – which aim to measure corruption by some means or other – we expect of positive correlation to the latent variable of corruption.

6 Empirical Application

6.1 Data

In the application of the structural equation model, we consider annual data for about 50 countries from 2000 to 2005. We are restricted to annual data since many of the variables are not available at a higher frequency. Because some of them were levied every second year only in the early 2000's, our sample is unbalanced. All data are publicly available and provided by international organizations such as the World Bank or are taken from published research papers.

Table A.1 in the Appendix presents a comprehensive overview of the variables, definitions, and data sources. The Appendix also shows the list of countries covered.

6.2 Results

As explained in section 3, application of a structural equation model implies that the shadow economy and corruption are 'indicated' by observable variables. According to our theoretical considerations in section 4, we employ the growth rate of real GDP, the ratio of the monetary aggregates M0 to M1 as transaction measure, and the labor force participation rate to make shadow economic activities 'visible'. We expect a positive sign for the transaction variable and negative ones for both the growth rate of GDP and the labor force participation rate.

For corruption we use the real GDP per capita, an index that indicates how common it is in a country to bribe officials, and an index that measures failures of integrity. For the real GDP per capita we expect a negative sign as corruption is inversely related to economic development. One would also expect a negative relationship between corruption and the bribe payer's index and the index of freedom from corruption, respectively as higher values of the indices indicate that less failures and bribe payments occur. Thus, the more corruption prevails the lower the values of each index.

As causes for the shadow economy we use the unemployment rate of the male population, indices that measure labor market and business regulations, and government consumption. The latter is used to proxy the tax burden imposed on individuals in a country. For the unemployment rate we expect a positive sign. For the labor market and business regulation indices as well as for government consumption the expected signs are all negative as these variables have lower scores the more the government interferes into markets.

As explained in section 5 we use political, social, and economic factors as causes for corruption. In our benchmark specification (1), political and social aspects are captured by the rule of law and school enrollment, respectively. We expect that higher school enrollment rates and a better rule of law reduce the extent of corruption in a society. With respect to the economic aspects of corruption we employ measures for bureaucracy costs and administrative requirements. For both indices the scores are the higher the more demanding the rules and, in turn, the higher costs to meet them are. Thus, we expect a positive sign in the empirical analysis as more stringent standards create more incentive for corruption. Figure 2 shows the structural equation model's path diagram for the benchmark specification where the small squares attached to the arrows indicate the expected sign in the empirical analysis.

[Insert Figure 2 about here]

Once causes and indicators have been selected, the model can be estimated to derive the values for the parameters that link both latent variables to each other and to its causes and indicators. The estimation results are presented in Table 2. To ease this presentation, the goodness-of-fit statistics for each specification are shown separately in Table A.2 in the Appendix.

[Insert Table 2 about here]

In the following we first discuss causes and indicators for the shadow economy and then turn to corruption. It is important to note that estimation and identification of the structural equation model requires the normalization of one of the indicators of each latent variable to an *a priori*

value. Typically one selects that indicator variable that loads most heavily on the construct represented by the latent variable. Thus, we set the coefficient of both indicators real GDP growth and real GDP per capita to -1 according to our theoretical considerations.[5]

Most of the estimated coefficients of the shadow economy's causes are statistically significant at conventional levels and have the theoretically expected sign. They reveal that labor market and business regulations are the most important determining factors for shadow economic activities. Also the tax burden imposed on individuals is important as demonstrated by the significant coefficient of the government consumption variable. In specification (4) however, this effect becomes insignificant when government consumption is substituted for the variable 'size of government'. Although the coefficient for the unemployment rate has the expected sign it is of mediocre statistical significance only.

Turning to the shadow economy's indicators we find, as hypothesized, a positive relationship between the shadow economy and the transaction measure. The relationship between the shadow economy and the growth rate of real GDP as well as the labor force participation rate are as expected negative. Thus, our findings are in line with previous theoretical and empirical research in this field.

With respect to corruption we employ the rule of law as political factor. Taking account for the economic reasoning of corruption we considered administrative requirements and bureaucracy costs as further causes in the estimations. The highly statistically significant coefficients of both variables indicate that a less economically free environment increases the extent of corruption. School enrollment is used to proxy social factors. This variable is also used

[5] This is a convenient and widely accepted way of normalization which does not affect the qualitative results (see Bollen 1989 for details concerning this issue).

by Treisman (2000). While he argues that a more educated and literate population is less prone for corruption we find no evidence for this relation. While the coefficient for the rule of law is also not statistically significant, the coefficient for government effectiveness in specification (2) is and has the theoretically expected sign as higher scores of this variable indicate a better policy formulation. Thus, countries with weak democratic institutions will be expected to have higher levels of corruption. In specification (3) we consider fiscal freedom instead of the rule of law. We find that, as hypothesized, individuals' incentives to circumvent fiscal restrictions by bribing officials increase, the less fiscal free a country is.

Turning to the indicator variables, it can be seen that they are fairly consistent across all model specifications and have the anticipated sign. Lower levels of real GDP per capita, i.e. a lower level of economic development is associated with higher corruption. The bribe payer's index shows, as expected, that corruption is the higher the more common undocumented extra payments or bribes to firms or officials are. The effect of corruption on failures of integrity in the system, captured by the freedom from corruption index, is, however, not statistically significant.

In specification (5) we used judicial independence instead of the freedom from corruption index. This variable measures whether the judiciary in a country is independent from political influences of members of government, citizens, or firms with lower values indicating more influence on the judiciary. Although the coefficient's magnitude increases compared to the freedom from corruption index and has the expected sign, it is still not significant.

Since our findings for both latent variables are pretty much line with previous theoretical and empirical research, we consider to interpret the mutual relationship between corruption and the shadow economy. Both estimated coefficients - from the shadow economy to corruption and vice versa – have a positive sign and are statistically significant. Thus, our structural equation

model presents empirical evidence for the most recent theoretical model presented in Echazu and Bose (2008) and contradicts Choi and Thum (2005) where corruption and the shadow economy are substitutes rather than complements. But the interactions differ in their magnitude: while the shadow economy is an important determinant for corruption, the effect of corruption on the shadow economy is much smaller.

7 Summary

This paper aims to sheet more light on the ongoing debate about the dual relationship between corruption and the shadow economy using a structural equation model. We do not hypothesize whether the shadow economy and corruption are complements or substitutes, i.e. whether both hidden illegal activities are positively or negatively related to each other. Rather we test this relationship empirically.

Our findings reveal that a large shadow economy and corruption go hand in hand. In economies with a large shadow economy firms and individuals often completely rely on shadow economic activities and are easier to detect the bigger they are or get. In order to escape detection and taxation and to avoid punishment they bribe officials. Small tax revenues reduce the quality of public services and infrastructure further reducing the incentives to remain official. A weaker legal environment, i.e. more corruption, also fosters the motivation for hiding activities. Thus, corruption and the shadow economy are two sides of the same coin corresponding to the models of Johnson, Kaufmann, and Shleifer (1997), Johnson, Kaufmann, and Zoido-Lobaton (1998b), Hindriks, Muthoo, and Keen (1999), and Friedman et al. 2000. Clearly, the structural equation model presented in this paper is only an additional step in furthering our understanding about corruption and the shadow economy.

References

Adam, Markus C. and Victor Ginsburgh (1985): The Effects of Irregular Markets on Macroeconomic Policy: Some Estimates for Belgium, *European Economic Review* 29(1), 15-33.

Bajada, Christopher and Friedrich Schneider (2005): The shadow economies of the Asia-Pacific, *Pacific Economic Review* 10, 379-401

Bardan, P. (1997): Corruption and Development: A Review of Issues, Journal of Economic Literature 35, 1320-1346.

Bollen, Kenneth A. 1989. *Structural equations with latent variables*. Wiley.

Choi and Thum (2005): Corruption and the Shadow Economy, *International Economic Review*, 46, 817-836.

Dell' Anno, Roberto and Friedrich Schneider (2003): The shadow economy of Italy and other OECD countries: What do we know?, *Journal of Public Finance and Public Choice*, 21/2-3, pp. 97-120.

Dell' Anno, Roberto (2007): The shadow economy in Portugal: An analysis with the MIMIC approach, *Journal of Applied Economics* 10: 253-277.

Dreher, Axel and Friedrich Schneider (2006): Corruption and the Shadow Economy: An Empirical Analysis, Paper presented at the 2006 Annual Meeting of the Public Choice Society, New Orleans, Louisiana, March 30-April 2, 2006.

Dreher, Axel, Christos Kotsogiannis, and Steve McCorriston (2005): How do Institutions Affect Corruption and the Shadow Economy?, University of Exter Discussion Paper.

Dreher, Axel, Christos Kosogiannis, and Steve McCorriston (2007):Corruption around the world: Evidence from a structural Model, *Journal of Comparative Economics* 35, 443-446.

Easterly, W. and Ross Levine (1997): Africa's growth tragedy: Policies and ethnic divisions. *Quarterly Journal of Economics*, 112, 1203–1250.

Echazu, Luciana and Pinaki Bose (2008): Corruption, Centralization, and the Shadow Economy, *Southern Economic Journal*, 75(2), 524-537.

Friedman, Eric, Simon Johnson, Daniel Kaufmann, and Pablo Zoido-Lobatón (2000): Dodging the grabbing hand: the determinants of unofficial activity in 69 countries, *Journal of Public Economics*, 76, 459-493.

Giles, David, E.A. (1998): The underground economy: Minimizing the size of government, Econometrics Working Paper 9801, Department of Economics, University of Victoria.

Giles, David, E.A., Lindsay, M. Tedds, and Gugsa Werkneh (2002): The Canadian underground and measured economies, *Applied Economics*, 34/4, pp. 2347-2352.

Goel, Rajeev K. and Michael A. Nelson (2005): Economic versus Political Freedom: Cross-Country Influences on Corruption, *Australian Economic Papers* 44(2), 121-133.

Graeff, P. and G. Mehlkopp (2003): The impact of economic freedom on corruption: different patterns for rich and poor countries, *European Journal of Political Economy* 19, 605-620.

Gwartney, James and Robert Lawson, with Seth Norton (2008). Economic Freedom of the World: 2008 Annual Report. : The Fraser Institute. Data retrieved from www.freetheworld.com.

Hillman, A.L. and M. Krausz (2004): Development failure, corruption, and the financial system. Paper presented at the European Public Choice Society Conference in Berlin, April 15–18.

Hindriks, J., A. Muthoo, and M. Keen (1999): Corruption, extortion and evasion, *Journal of Public Economics*, 74, 395-430.

Johnson, Simon, Daniel Kaufmann, and Andrei Shleifer (1997): The unofficial economy in transition, Brookings Paper on Economic Activity, 2, 159-221.

Johnson, Simon, Daniel Kaufmann, and Pablo Zoido-Lobatón (1998a): Regulatory discretion and the unofficial economy. *The American Economic Review*, 88/ 2, pp. 387-392.

Johnson, Simon, Daniel Kaufmann, and Pablo Zoido-Lobatón (1998b): Corruption, public finances and the unofficial economy. Discussion paper, The World Bank, Washington DC.

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi (2007): Governance Matters VI: Governance Indicators for 1996-2006, World Bank Policy Research, Working Paper WPS 4280.

Lippert, Owen and Michael Walker (eds.) (1997): *The Underground Economy: Global Evidences of its Size and Impact*, Vancouver: The Frazer Institute.

Loayza, Norman V. (1996): The Economics of the Informal Sector: A Simple Model and Some Empirical Evidence from Latin America, *Carnegie-Rochester Conference Series Public Policy* 45, 129-162.

Miller, Terry, Kim R. Holmes, with Anthony B. Kim, Daniella Markheim, James M. Roberts, and Caroline Walsh (2008): 2008 Index of Economic Freedom, Washington, DC.

Mauro, P. (1995): Corruption and growth. *Quarterly Journal of Economics*, 110, 681–712.

Mauro, P. (1998): Corruption and the composition of government expenditure, *Journal of Public Economics* 69, 263–279.

Neck, Reinhard, Markus Hofreither, and Friedrich Schneider (1989): The Consequences of Progressive Income Taxation for the Shadow Economy: Some Theoretical Considertions,

in Boes, Dieter and Bernhard Felderer (eds): *The Political Economy of Progressive Taxation*, Berlin: Springer, pp. 149-176.

North, D. (1990): Institutions, Institutional Changes and Economic Performance. Cambridge Univ. Press, Cambridge, UK

Paldam, M. (2003): The cross-country pattern of corruption: Economics, culture and the seesaw dynamics. *European Journal of Political Economy*, 18, 215–240.

Pasuk, P. and P. Sungsidh (1994): Corruption and Democracy in Thailand. The Political Economy Centre, Faculty of Economics, Bangkok.

Rose-Ackerman, S. (1999): Corruption and Government, Cambridge Univ. Press, Cambridge.

Schneider, Friedrich (1986): Estimating the Size of the Danish Shadow Economy Using the Currency Demand Approach: An Attempt, *Scandinavian Journal of Economics* 88(4), 643-668.

Schneider, Friedrich (1997): The shadow economies of Western Europe, *Economic Affairs*, 17/3, pp. 42-48.

Schneider, Friedrich (2003): The shadow economy, in: Charles K. Rowley and Friedrich Schneider (eds.), *Encyclopedia of Public Choice*, Dordrecht: Kluwer Academic Publishers.

Schneider, Friedrich (2005): Shadow economies around the world: what do we really know?, *European Journal of Political Economy*, 21(3), September, pp. 598-642.

Schneider, Friedrich and Dominik Enste (2000): Shadow economies: Size, causes, and consequences, *The Journal of Economic Literature*, 38/1, pp. 77-114.

Schneider, Friedrich and Dominik Enste (2002): *The Shadow Economy: Theoretical Approaches, Empirical Studies, and Political Implications*, Cambridge: Cambridge University Press.

Shleifer, Andrei and Robert W. Vishny (1993): Corruption, Quarterly Journal of Economics, 108, 599-618.

Smith, P. (1994): Assessing the size of the underground economy: the Canadian statistical perspectives, Canadian Economic Observer, Cat. No. 11-010, 3.16-33, at 3.18.

Tanzi, Vito (1998): Corruption around the world-causes, consequences, scope and cures. International Monetary Fund Staff Papers 45, 559–594.

Tanzi, Vito (1999): Uses and abuses of estimates of the underground economy, *The Economic Journal*, 109/456, pp. 338-340.

Transparency International (2009): http://www.transparency.org/news_room/faq/corruption_faq, accessed 9 January.

Treisman, D. (2000): The causes of corruption: A cross-national study. *Journal of Public Economics*, 76, 399–457.

Thomas, Jim J. (1992): *Informal Economic Activity*, LSE, Handbooks in Economics, London: Harvester Wheatsheaf.

Van Rijckeghem, C. and Beatrice Weder (2001): Bureaucratic corruption and the rate of temptation: Do wages in the civil service affect corruption and by how much? *Journal of Development Economics* 65, 307–331.

World Bank (2008): World Development Indicators, CD-Rom, Washington DC.

Tables

Table 1. *A Taxonomy of Types of Shadow Economic Activities*

Type of activity	**Monetary transactions**		**Non-monetary transactions**	
Illegal activities	Trade in stolen goods, drug dealing and manufacturing, prostitution, gambling, smuggling, fraud, etc.		Barter of drugs, stolen goods, smuggling, etc., production or growing of drugs for own use, theft for own use.	
	Tax evasion	**Tax avoidance**	**Tax evasion**	**Tax avoidance**
Legal activities	Unreported income from self-employment, wages, salaries and assets from unreported work related to official/ lawful goods and services.	Employee discounts, fringe benefits.	Barter of official/lawful goods and services.	All do-it-yourself work and neighbourly help.

Note: The Structure of the table is taken from Lippert and Walker (1997, p. 5) with additional remarks.

Table 2. *Estimation Results (Standardized Coefficients)*

Specification	**(1)**		**(2)**		**(3)**		**(4)**		**(5)**	
Latent variables	SE	C	SE	C	SE	C	SE	C	SE	C
Causes										
Labor market	-0.20**		-0.15*		-0.23***		-0.19**		-0.23***	
regulations	(2.24)		(1.87)		(2.49)		(2.05)		(2.54)	
Unemployment	0.05		0.04		0.06		0.06		0.06	
	(1.35)		(1.17)		(1.31)		(1.39)		(1.35)	
Business regulations	-0.20**		-0.16**		-0.23***		-0.21**		-0.23***	
	(2.32)		(1.92)		(2.61)		(2.15)		(2.65)	
Government	-0.07*		-0.07*		-0.09*				-0.09*	
consumption	(1.74)		(1.66)		(1.83)				(1.85)	
Size of Government							-0.04			
							(1.13)			
Administrative		0.26***		0.23**		0.25***		0.25***		0.27***

requirements	(2.55)	(2.21)	(2.97)	(2.43)	(3.08)
Rule of law	-0.00			-0.04	
	(0.04)			(0.76)	
School enrolment	-0.05	0.03	0.00	0.00	0.01
	(0.92)	(0.57)	(0.10)	(0.05)	(0.12)
Bureaucracy costs	0.37***	0.34**	0.35***	0.38***	0.36***
	(2.88)	(2.34)	(3.34)	(2.67)	(3.43)
Government		-0.16**			
effectiveness		(1.99)			
Fiscal Freedom			-0.11*		-0.12**
			(1.96)		(2.01)
Indicators					
GDP growth	-0.51	-0.50	-0.51	-0.50	-0.51
Labor force	-0.41***	-0.45***	-0.39***	-0.40***	-0.39***
participation	(3.97)	(3.96)	(4.03)	(3.92)	(4.06)

Ratio M0 to M1	0.30***	0.31***	0.29***	0.31***	0.29***	
	(3.17)	(3.07)	(3.17)	(3.21)	(3.16)	
Real GDP per capita	-0.61	-0.53	-0.70	-0.58	-0.69***	
Bribes	-0.16***	-0.15***	-0.16**	-0.15***	-0.16**	
	(2.52)	(2.72)	(2.33)	(2.58)	(2.26)	
Freedom from	-0.04	-0.07	-0.00	-0.04		
corruption	(0.60)	(1.37)	(0.00)	(0.74)		
Judicial					-0.02	
independence					(0.32)	
Latent variables						
Shadow economy →	1.67***	1.90***	1.42***	1.81***	1.45***	
corruption	(5.06)	(4.79)	(5.19)	(4.87)	(5.24)	
Corruption →	0.27**	0.30***	0.26**	0.24**	0.25*	
shadow economy	(2.36)	(3.04)	(1.98)	(2.09)	(1.90)	

Absolute z-statistics appear in parenthesis. * = significance at 10% level, ** = significance at 5 % level, *** = significance at 1% level.

Note: SE = shadow economy; C = corruption.

Figures

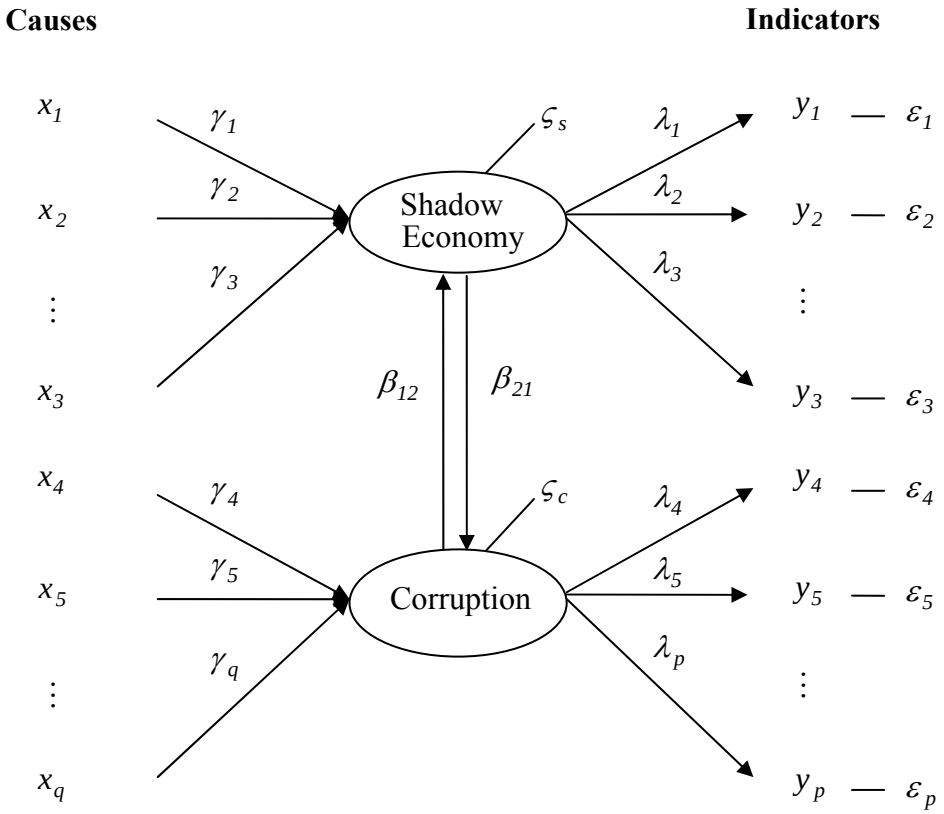

Figure 1. *The Structural Equation Model*

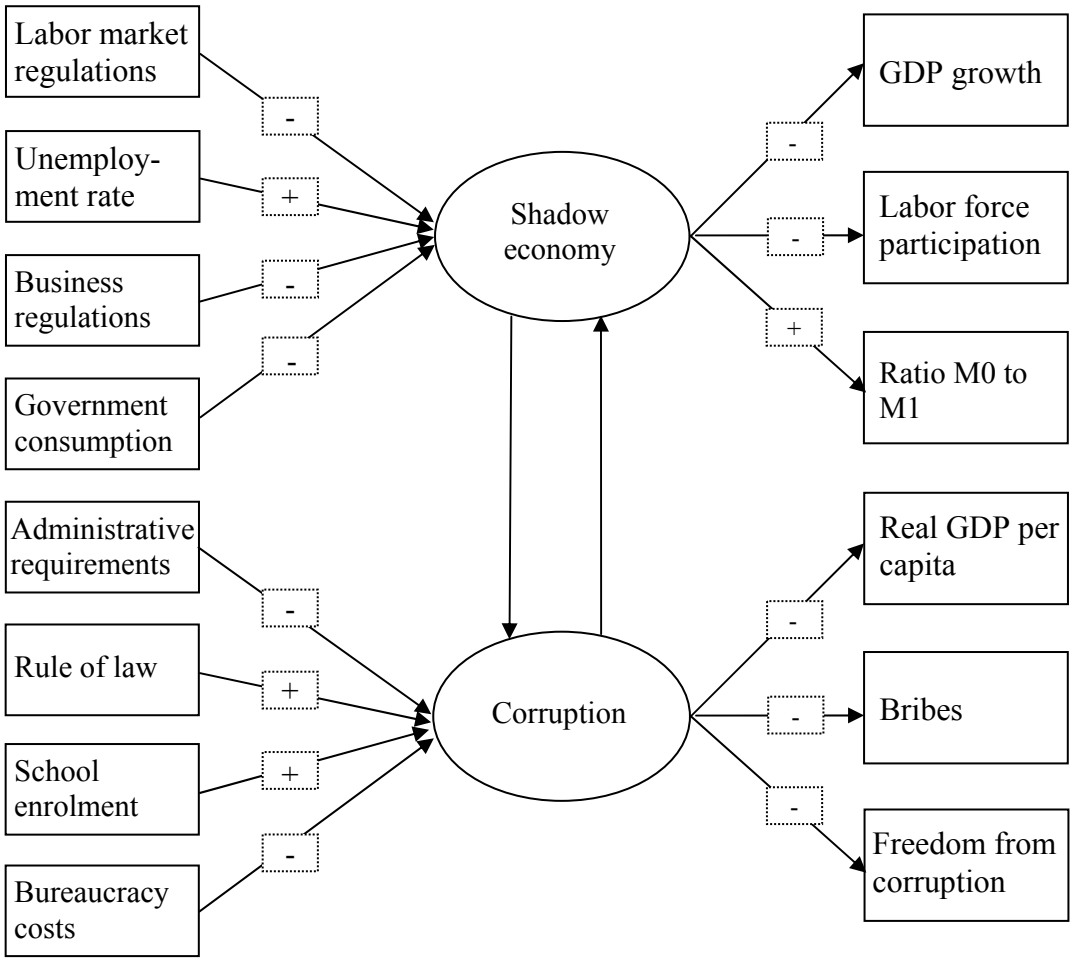

Figure 2. *Path Diagram of the Benchmark Model*

Appendix

Table A.1. *Data Sources and Definitions*

Category	Variable and Definition	Source
Causes for the shadow economy		
Tax burden	**Government consumption** measured as general government consumption spending as a percentage of total consumption. Higher values indicate less government activities.	Gwartney, Lawson, and Norton (2008)
	Size of Government indicates the extent to which countries rely on the political process to allocate resources and goods and services, i.e. government decision-making is substituted for personal choice and economic freedom is reduced. Higher values indicate more freedom of choice for individuals.	Gwartney, Lawson, and Norton (2008)
Regulation	**Labor market regulations** limit the economic freedom of employees and employers. Among the more prominent are e.g. minimum wages and dismissal regulations. High scores show that a country has less regulated labor markets.	Gwartney, Lawson, and Norton (2008)
	Business regulations measure the extent of unnecessary regulatory barriers and the administrative costs of doing business. The higher index scores the less regulatory activities	Gwartney, Lawson, and Norton (2008)

	occur.	
Labor market	**Unemployment rate** (male) refers to the share of the labor force that is without work but available for and seeking employment	World Bank (2008)
Indicators for the shadow economy		
Transaction measure	Ratio of the monetary aggregate M0 to the monetary aggregate M1 (**Ratio of M0 to M1**)	International Monetary Fund (IMF), International Financial Statistics (IFS)
Official economic activity	**Growth rate of real GDP**	World Bank (2008)
	Labor force participation rate is the proportion of the population ages 15-64 that is economically active	World Bank (2008)
Causes of corruption		
Political and judicial factors	**Administrative requirements** how burdensome it is to comply with permits and regulations issued by the government. Higher values indicate less demanding rules in a country.	Gwartney, Lawson, and Norton (2008)
	The **Rule of Law** measures the extent to which agents have confidence in and abide by the quality of contract enforcement, the police, and the courts. Higher scores indicate a better rule of law.	Kaufmann, Kraay, and Mastruzzi (2007)
Social and cultural	Gross **school enrollment** is the ratio of total	World Bank (2008)

factors	enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	
Economic factors	**Government effectiveness** measures inter alia the independence of public services from political pressures, the quality of policy formulation, and the credibility of the government's commitment to such policies. Higher values mean a better quality of policy formulation.	Kaufmann, Kraay, and Mastruzzi (2007)
	Bureaucracy costs measure how stringent standards on product/service quality, energy and other regulations in a country are. Higher values of this index indicate more stringent standards.	Gwartney, Lawson, and Norton (2008)
	Fiscal freedom is the freedom of individuals and businesses to keep and control their income and wealth for their own benefit and use. Higher values correspond to more fiscal freedom.	Miller et al. (2008)
Indicators for corruption		
Economic development	**Real GDP per capita**	World Bank (2008)
Measures of corruption	**Freedom from corruption** index measures failures of integrity in the system, i.e. the distortion by which individuals are able to achieve personal gains at the expense of the	Miller et al. (2008)

general public. Higher index values indicate less failures of integrity.	
The index '**Extra payments / payment of bribes**' indicates individuals' perceptions about how common it is in a country that firms make undocumented extra payments or bribes. The lower the index values the more common is the payment of bribes.	Gwartney, Lawson, and Norton (2008)
Judicial independence shows if the judiciary in a country is independent from political influences of members of government, citizens, or firms. Lower values indicate more influence on the judiciary.	Gwartney, Lawson, and Norton (2008)

Table A.2. *Goodness-of-fit measures*

Specification	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Chi-square	91.00	97.73	98.45	94.31	97.60
Degrees of freedom	83	83	83	83	82
P-value	0.26	0.13	0.12	0.19	0.12
Root mean squared error of approximation (RMSEA)	0.02	0.03	0.03	0.03	0.03
Goodness-of-fit index (GFI)	0.93	0.93	0.92	0.93	0.93
Adjusted goodness-of-fit index (AGFI)	0.91	0.91	0.90	0.91	0.90

Note: The goodness-of-fit statistics for the estimated model specifications show an acceptable fit. If the model fits the data perfectly and the parameter values are known, the sample covariance matrix equals the covariance matrix implied by the model, i.e. $\mathbf{S} = \boldsymbol{\Sigma}(\theta)$. The null hypothesis of perfect fit corresponds to a p-value of 1. Thus, the chi-square test of exact fit accepts all models. Also, the RMSEA is smaller than 0.05 in the specifications. Other measures such as GFI and AGFI also provide evidence of an acceptable fit.