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Firm-level Evidence from the BEEPS Survey

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Corruption and Productivity Firm-level Evidence from the BEEPS Survey *

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Abstract: *Using enterprise data for the economies of Central and Eastern Europe and the CIS, this study examines the effects of corruption on productivity. Corruption is defined as a "bribe tax" and is compared to another form of institutional inefficiency, which is often believed to be closely linked with corruption: the "time tax" imposed on firms by red tape. When testing their effects in the full sample, only the bribe tax appears to have a negative effect on firm-level productivity, while the effect of the time tax is insignificant. At the same time, there is no evidence of a trade-off between the time and the bribe taxes, implying that bribing does not emerge as a second-best option to achieve higher productivity by helping circumvent cumbersome bureaucratic requirements. When the sample is split between EU and non-EU countries, the time tax turns out to have a negative effect only in EU countries and the bribe tax only in non-EU countries. This suggests that the institutional environment influences the way in which firm behaviour affects firm performance. In particular, the impact of bribing for individual firms appears to vary depending on overall institutional quality: in countries where corruption is more prevalent and the legal framework is weaker, bribery is more harmful for firm-level productivity.*

Keywords: . Keywords: corruption, firm performance, productivity, bribe tax

JEL classification: O14, P37

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I. INTRODUCTION

One of the most obvious facts about corruption is that poor countries tend to be the most corrupt. Available data at the country level support this view. For instance, there is a 0.81 correlation between GDP per capita and Transparency International's Corruption Perception Index, one of the most commonly used measures of corruption.

Beyond this simple observation, understanding corruption is not an easy task. For instance, it is debatable whether corruption is a cause of low incomes per capita, one of its consequences or, as it seems more likely, whether the relationship between corruption and income is an intricate one, made of a web of dynamic interactions, whereby some countries appear trapped in a condition of low incomes and high corruption.

An even more daunting task is to find a cure for corruption, since historical experience does not provide many obvious examples of countries that have been successful in eradicating it. Corruption may be endemic and linked to deep-rooted cultural or "institutional" features of a society, which are not easily overturned by specific policy measures. For example, increasing the wage of public officials may prove ineffective in the absence of credible mechanisms to sanction deviant behaviour. Furthermore, it is difficult to identify a reservation wage for public officials, beyond which their incentive to accept or demand bribes is reduced. From the point of view of researchers and policymakers, this is so because corruption is not easily measured or quantified. A crucial challenge, then, is to delimit the field of investigation by providing a working definition of corruption and to find adequate sources of information that allow quantifying its extent.

In common parlance and in academic research corruption can take many forms. Most often it is understood as *bribery*, whereby an official demands informal payments to perform an official task - e.g. issuing a license - or to circumvent laws and regulations. *State capture* may also qualify for the definition of corruption, when bureaucrats subject themselves to more or less legal forms of lobbying, involving monetary bribes or other forms of exchange of favours, to afford preferential treatment to certain private interests. *Political patronage*,

nepotism and *cronyism*, whether or not they involve monetary kickbacks, may also be included in a broad definition of corruption.

For our purposes, and to delimit the field of investigation, corruption is defined as a "bribe tax", necessary to enforce a contract between an individual and the state. In this asymmetrical relationship, the state –or its agents- define the property rights of individuals and enforce them with a monopoly on the legitimate use of force. The institutions that govern this type of "vertical" transactions between the state and its citizens are defined by Acemoglu and Johnson (2005) as property rights institutions and are distinguished from contracting institutions that regulate "horizontal" transactions among ordinary citizens. Property rights institutions are inefficient when they allow those who control the state to extract rents from producers (Acemoglu, 2006) and the extortion of bribes from firms may be viewed as a form of rent extraction perpetrated by bureaucrats (Shleifer and Vishny, 1998).

The second task is to identify a suitable data source to quantify the extent of corruption. A first type of data is based on *expert assessments*, such as the International Country Risk Guide. A second type takes the form of a *meta-database*, assembling the results of a number of perception-based surveys. Popular indicators in this group include the Corruption Perception Index (CPI) estimated by Transparency International or the indicator for Control of Corruption included in the World Bank's World Governance Indicators. All these assessments present a high degree of correlation, indicating that they concur in identifying levels of corruption across countries and are, therefore, virtually interchangeable for the purpose of cross-country econometric analysis. A third source of measurement of corruption is provided by *enterprise surveys*, which have the benefit of allowing to link the occurrence and effects of corruption to a number of firm-level and country characteristics.

Our analysis intends to exploit the advantages of the latter type of data by using the information contained in the 2009 Business Environment and Enterprise Performance Survey (BEEPS) of a large number of firms in countries of Central and Eastern Europe and Central Asia. The sample of countries is very diverse. It covers all the formerly communist countries of Europe and the Former Soviet Union, which have undergone the profound institutional

transformation connected with transition to a market economy. This group of formerly communist countries presents substantial variation, ranging from the low-income economies of Central Asia, to high income Central European countries, which, as members of the EU, tend to have a fully developed market system.

The objective of this study is to shed light on the consequences of corruption for economic performance. This is done by investigating the effects of the *bribe tax* on firm level productivity. Both variables can be obtained from the BEEPS database, which, in addition to information on the occurrence of bribing and other aspects of firm operation and performance, allows estimating a measure of total factor productivity (TFP) at the firm level.

The need to recur to bribery is often linked to the power of government officials to impose and enforce regulatory requirements on individuals and firms and to exact bribes in the process (see, for example, Djankov et al. 2002). In order to account for this possibility, it is necessary to identify some measure of the power that officials have over firms as enforcers of regulatory requirements. The BEEPS survey offers such a measure. It refers to the time that enterprise managers are required to spend complying with government regulations, amounting to a *time tax* imposed on firms. This may be interpreted as an opportunity cost borne by firms, which, in isolation or in combination with the bribe tax, potentially constitutes a drag on enterprise performance.

Results of econometric analysis, controlling for potential endogeneity of the corruption variables, highlight some differences between the effects of corruption *per se* and those of the time tax. Across the entire sample, whereas the time devoted to complying with government regulations has no effect on firm level productivity, corruption has a statistically significant negative effect. This result is robust to controlling for endogeneity of both variables.

The paper also finds no evidence in favour of the so-called “efficient grease” hypothesis, whereby bribing would be a second best option to achieve higher productivity levels by helping firms circumvent burdensome regulatory requirements. Namely, when bribing is made conditional on the time spent dealing with government regulations, the interaction term

has no effect on productivity, implying that no trade-off emerges between the time and the bribe tax.

When the sample is split between recent EU members from Central and Eastern Europe and non-EU countries, the time tax - which has no impact on productivity when considering the entire sample - turns out to have a negative effect on productivity, but *only* in EU countries. At the same time, the negative impact of the bribe tax on productivity is concentrated in non-EU countries. Observing that levels of institutional quality are generally higher in EU countries, this may suggest that the effects of corrupt behaviour on firm performance vary depending on broader country characteristics.

In order to test this environmental effect, bribery experienced by individual firms is made conditional on a country-wide indicator of corruption. This is proxied by the Transparency International Corruption Perception Index (CPI), which provides an independent measurement of perceived corruption in 180 countries, based on 13 different expert and business surveys. In order to probe the robustness of the environmental effect of corruption, the analysis also uses as second measure of institutional quality, the World Economic Forum (WEF) index of the effectiveness of the Legal Framework.[1]

Regression analysis shows that firms that do *not* pay bribes in environments with poor institutional quality - as measured by both the prevalence of corruption and the efficiency of the legal framework - experience higher productivity. Furthermore, below a certain threshold of institutional quality, the total effect of corruption on productivity - i.e. the combination of individual and country effects - is increasingly negative. This indicates that, whereas environmental circumstances are beyond the choice set of individual firms, managers still have some degree of autonomy in deciding whether to recur to bribery or not and this affects firm level productivity.

[1] North (1990) distinguishes between "informal norms," "formal rules" and "enforcement" as pillars of the institutional framework of an economy. For our purposes, the CPI might be viewed as a proxy of informal norms of behavior, while the WEF index of the efficiency of the legal framework might be interpreted as a proxy for the quality of formal rules or their enforcement.

The remainder of the study is structured as follows. The following section provides an overview of the literature on the possible causes of corruption and on its effects on economic performance. Next is a description of the BEEPS 2009 data, as well as an exposition of the econometric methodology. The fourth section demonstrates the effects of corruption on productivity, both unconditional and conditional on the time tax and on overall institutional quality. The final section concludes.

II. CAUSES AND CONSEQUENCES OF CORRUPTION

The occurrence of corruption can be directly linked to the quality of the overall institutional environment, which, in turn, is seen by several authors as the fundamental ingredient of economic development.[2] For example, Acemoglu, Johnson and Robinson (2001) focus on the persistence of inherited institutions, by maintaining that the disease environment determined different settlement patterns of European colonists, which, in turn, shaped subsequent institutions. Notably, where Europeans settled in large numbers they established solid "property rights" - as opposed to "extractive" - institutions aimed at benefiting residents of the colony, resulting in higher institutional quality and lower incidence of corruption today. In a similar spirit, other theories stress legal origin (La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1998 and 1999) as the source of institutional inefficiencies. According to this view, corruption is more likely to be observed in countries based on civil law systems, due to their greater tendency to regulate economic activity, which provides more frequent opportunities for corrupt behaviour.

Given the strong empirical association between various measures of institutional quality, including corruption, and incomes per capita, it is plausible to assume that institutions in general - and the extent of corruption in particular - develop in response to a country's *income level* and to the differential needs associated with various stages of development (Lipset, 1960). In this spirit, better institutional outcomes would emerge when, in response to economic development, the benefits of internalizing higher income opportunities - for

[2] See the seminal works of North (1981 and 1990), as well as Acemoglu, Johnson and Robinson (2005) for a comprehensive survey of theoretical foundations and empirical evidence on the fundamental role of institutions. Other authors - see for example Sachs (2003) – take issue with the institutional view by arguing that geography - with its implications in terms of natural endowments, human health and distance to markets - is the primal determinant of economic development.

instance by keeping corruption under control - exceed the transaction costs of doing so (Demsetz, 1967).

Institutional outcomes, including corruption, and levels of income per capita may crucially depend on the accumulated stock of *human capital* (Glaeser, La Porta, Lopez-de-Silanes and Shleifer, 2004). The central role of human capital becomes evident when considering that formal institutions - e.g. courts - require a high level of competence to effectively perform their function. Furthermore, together with a free press (Besley and Burgess, 2001; Brunetti and Weder, 2001), widespread literacy is a precondition for the population to be able to scrutinize government activity and prevent abuses.

Another possibility is that *economic growth* itself, rather than income *levels*, could play a role in determining the occurrence of corruption. For instance, a growing economy would have more resources available to keep corruption under control, thus generating better institutional outcomes and reducing observed levels corruption (Paldam, 2002). At the same time, economic growth can reduce corruption because corrupt elites have an interest in collecting bribes from a growing pie. This implies that, at least in the short term, they have to ensure that institutions are sufficiently immune to corruption to allow incomes to increase (Aidt and Dutta, 2008).

Policies aimed at increasing *competition* in product markets may be instrumental in reducing corruption, since competitive pressures leading to a reduction in mark-ups and profits of firms may limit the resources available to pay bribes. In support of this view, Ades and di Tella (1999) find that corruption levels are higher in countries where domestic firms are sheltered from foreign competition by the existence of barriers to trade, while economies dominated by a small number of firms, or with ineffective antitrust regulations experience higher degrees of corruption.

More generally, a *regulatory environment* that stifles market entry and competition is likely to increase opportunities for corruption. More stringent regulatory requirements pander to the discretionary power of regulators and enforcers to collect bribes from producers, thus

increasing the prevalence of corruption (Djankov, La Porta, Lopez de-Silanes and Shleifer, 2002). Such a view is in line with public choice theories, whereby regulation is pursued for the benefit of politicians and bureaucrats to create rents and extract them through political patronage or bribery (Shleifer and Vishny 1998). Rent extraction on the part of bureaucrats and politicians is inefficient because regulators are disorganized and their actions discretionary. As a consequence, more restrictive regulation may result in a "time tax" on entrepreneurs, which diverts entrepreneurial time and talent away from productive activities, with negative consequences for economic performance.

Corruption as "efficient grease"

Corruption is sometimes seen a second-best option when it helps overcome burdensome regulatory requirements. According to the proponents of the "efficient grease" hypothesis this would happen because, in spite of the transaction costs it entails, bribery would lead to lower effective red tape for the firm. A theoretical framework for this efficiency enhancing role of corruption is provided by Lui's (1985) queuing model, where the size of bribes by different economic agents reflects their different opportunity cost, with more efficient firms more able or willing to buy lower effective red tape. As a consequence, a license or contract awarded on the basis of bribe size could achieve Pareto-optimal allocation. Kaufmann and Wei (1999) identify a major shortcoming in Lui's (1985) assumptions, namely that the regulatory burden is treated as exogenous, independent of the incentive for officials to take bribes. This may not be the case since the incentives of bureaucrats can be modified by specific policy measures. Ultimately, because of this assumption, Lui's theory is partial equilibrium in nature, and may not hold in a general equilibrium.

More generally, Bardhan (1997) argues that red tape and corruption are not exogenous, as they are caused - or at least preserved or aggravated - by those who benefit from an overregulated and corrupt system. Hence, as argued by Aidt and Dutta (2008), even if corruption helps overcome cumbersome regulation in the short term, it creates incentives to create more such regulation in the long term. Empirical evidence, especially at the micro

level, is generally not supportive of the efficient grease hypothesis[3], with corruption found to increase the time spent by managers dealing with red tape (Kaufmann and Wei, 1999) and to hamper firm growth (Fisman and Svensson, 2007).

Corruption and economic performance

If corruption was a means to "greasing the wheels of commerce" it could possibly have positive effects on economic performance by reducing transaction costs in the vertical transactions between the state and its citizens. However, the theoretical and empirical evidence in favour of the opposite argument appears more convincing, highlighting the negative consequences of corruption for resource allocation, entrepreneurship, investment and innovation.[4]

The main argument is that the prevalence of corruption may distort *resource allocation* by increasing the returns to rent-seeking compared to those of productive activities (Baumol, 1990). An extremely corrupt environment may induce individuals to minimize interaction with the state by expanding more slowly, operating in the informal sector or even forgoing *entrepreneurial activity* altogether. Corroborating this point, Djankov et al. (2002) find that entry of new firms is more difficult in the presence of greater corruption and larger unofficial economies.

Corruption also affects the allocation of entrepreneurial *talent*, when, in highly corrupt environments, entrepreneurs may devote greater efforts to obtaining valuable licenses and preferential market access than to improving productivity (Murphy, Shleifer and Vishny, 1991). When entrepreneurial talent is directed towards productive activity, the rate of innovation and investment is likely to increase with positive consequences for productivity and income growth. In contrast, when talent is directed towards rent extraction, returns to talent are maximized by appropriating wealth rather than wealth creation (Murphy, Shleifer and Vishny, 1991, 1993; Acemoglu and Verdier 1998).

[3] One of few exceptions is Egger and Winner (2005) who, based on country-level evidence, argue that corruption can help overcome regulatory obstacles and stimulate FDI,

[4] For an overview of the consequences of corruption, see Svensonn (2005), Krueger (1974), Rose-Ackerman (1975 and 1999) and Shleifer and Vishny (1993 and 1998).

The sources of productivity enhancements, *technological progress* and *investment*, may be directly affected in corrupt environments. For instance, entrepreneurs may have incentives to adopt inefficient "fly-by-night" technologies of production with an inefficiently high degree of reversibility, which allows them to react more flexibly to future demands from corrupt officials—and more credibly threaten to shut down operations (Svensson, 2003). Additionally, vested interests may directly oppose the adoption of new technologies, which would threaten their position of influence by rendering obsolete the older technological vintages they control (Krusell and Rios-Rull, 1996). Finally, corruption may erect de facto entry barriers into otherwise competitive markets with discouraging effects for investment decisions, in a mechanism similar to the one proposed by Alesina et al. (2005). Alternatively, the monetary cost involved by the payment of bribes may simply limit the amount of resources available to expand productive capacity via investment.

In addition to distortionary allocation effects, the discretionary power of state officials will increase the *risk of expropriation* thus reducing the appropriability of returns to investment and innovation (Demsetz, 1967 and Alchian and Demsetz, 1973). This will further diminish rewards for entrepreneurial behaviour, while propping up inefficient firms engaged in corrupt practices.

Whereas corruption can affect economic performance through all these channels, its adverse effects may be non-linear and depend on the overall level of institutional quality (or governance) in the country. Two studies – both based on country level data - find such non-linearities in the relationship between corruption and growth, namely a *more negative effect when institutional quality is poor*. Méon and Sekkat (2005), based on sample of 71 countries between 1970 and 1998 and using various proxies for both corruption and governance,[5] find that corruption is most harmful to growth where governance is weak. Méndez and Sepúlveda (2006) examine country-level evidence by using different proxies for corruption[6], as well as

[5] The authors use the Transparency International CPI, as well as a number of indicators from the World Bank Governance Indicators, as proxies for corruption and governance.

[6] The authors use the International Country Risk Guide (ICRG), the IMD index of corruption is published by the Institute for Management Development (IMD) and the corruption perceptions index (CPI) compiled by Transparency International.

the Freedom House index of political freedom as a proxy for overall institutional quality. They find that the relationship between corruption and growth is non-monotonic with corruption having negative effects only at high levels of incidence.

III. DATA AND METHODOLOGY

To assess the effects of corruption on firm performance this paper uses the 2009 EBRD/World Bank Business Environment and Enterprise Performance Survey (BEEPS), a database covering firms in transition and developed countries.[7] The BEEPS was specifically conceived to assess the extent to which government policies and practices facilitate or impede business activity. It therefore provides a vast array of information on the behaviour and performance of firms, which allows to explicitly model the possible influence of various firm characteristics on the occurrence and impact of corruption at the firm level. The large number of questions contained in the BEEPS naturally leads to high non-response rates.

Table 1 lists the countries included in the sample. It shows that there is substantial variation in terms of income group (based on the World Bank classification for 2008) and EU membership.[8,9] Such high dispersion in income per capita provides a particularly rich sample, that allows controlling for specific country characteristics linked to the level of development and, in particular, to the quality of the institutional environment. The business environment is examined by asking firms to assess how various factors affect business operations, including infrastructure, financial services, government regulation, tax administration, judiciary functions. Corruption is also examined, allowing us to model its occurrence and impact on the operation and performance of firms. A list of variables used and their description is given in Table A.1, and their descriptive statistics are in given in Table A.2 in the appendix.

[7] Previous rounds of the BEEPS surveys were carried out in 1999, 2002 and 2005. Unfortunately, given the changes in survey design, a meaningful link between the 2009 and earlier versions is not feasible. Also, the survey nature of the data leads to the loss of many observations in multivariate regressions, owing to non-responses.

[8] Economies are divided according to 2008 GNI per capita. The groups are: low income, $975 or less; lower middle income, $976 - $3,855; upper middle income, $3,856 - $11,905; and high income, $11,906 or more. See http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html (accessed 15 October 2009).

[9] A number of other countries are included in the full BEEPS data, however, these are not included here as missing data prevented their use in the econometric analysis.

Table 1: List of countries in the sample

Economy	Income group	EU member
Croatia	High income	
Estonia	High income	✓
Slovenia	High income	✓
Czech Republic	High income	✓
Hungary	High income	✓
Slovak Republic	High income	✓
Bosnia and Herzegovina	Upper middle income	
Bulgaria	Upper middle income	✓
Kazakhstan	Upper middle income	
Latvia	Upper middle income	✓
Lithuania	Upper middle income	✓
Macedonia, FYR	Upper middle income	
Montenegro	Upper middle income	
Poland	Upper middle income	✓
Romania	Upper middle income	✓
Russian Federation	Upper middle income	
Serbia	Upper middle income	
Armenia	Lower middle income	
Azerbaijan	Lower middle income	
Moldova	Lower middle income	
Kyrgyz Republic	Low income	

Source: World Bank, see footnote 4.

A typical concern when using survey data is that of individual perception bias (Kaufman and Wei, 1999). Some firms may, for instance, consistently provide positive or negative answers depending on their overall perception of the business climate. In principle, assuming that the bias is uncorrelated among groups of respondents, individual perception bias contributes only to the standard error of estimates obtained from the survey responses. In cross-country surveys, such as the BEEPS, the group within which the bias is likely to be correlated is the particular country in which respondents operate. Perception bias at the country level could originate from different cultural norms and degrees of political freedom across countries, which may influence the choice of specific ratings and the willingness of business people to criticise state institutions. Fries et al. (2003) check for such perception bias in the BEEPS

2002 by statistically comparing measures obtained from the aggregation of survey responses to related objective measures and find no significant perception biases across the countries in the sample. Since the BEEPS 2009 follows a similar methodology, we may be reasonably confident that perception bias will not affect the results of the analysis. However, as a further control, the analysis that follows will make use of sector and country level fixed effects.

The bribe tax and productivity

The aim of this study is to evaluate the extent to which institutional inefficiencies experienced by firms –namely corrupt practices - may be a drag on their productivity. At the micro level, there are a number of reasons for expecting negative consequences of corruption for productivity. Firstly, as discussed in the previous section, corruption distorts the allocation of scarce resources away from the most productive use. This, all other things equal, should have a negative effect on productivity. Secondly, corruption may decrease firms incentives - or increase costs - of expanding productive capacity or investment (as in Alesina et al., 2005), which, again, would have a negative impact on productivity. On the other hand, as foreseen in the "efficient grease" hypothesis previously discussed, corruption may help a firm to cut through red tape and hence increase productivity. At the same time, both the occurrence and the effects of corrupt behaviour by individual firms may be linked to the quality of the institutional environment in the country. In this sense, a crucial role may be played by the degree to which corruption is a widely recurrent and accepted phenomenon, as well as by the ability of legal structures, such as courts or administrative recourse mechanisms within the public administration, to enforce contracts between individuals and the state and sanction deviant practices.

In order to capture the complexity of the phenomenon of corruption and its potentially varied effects on the performance of individual firms, the empirical methodology will proceed in three steps. First, is an analysis of the effects of the bribe tax and of the time tax on individual firms, controlling for firm, sector and country characteristics that may influence both phenomena. Second, we proceed with an explicit test of the "efficient grease" hypothesis. Possible trade-offs between time consuming compliance with government regulation and the payment of bribes are modelled by including an interaction term between the time and the

bribe tax and observing its effects on firm level productivity. Finally, the effect of individual corrupt conduct on firm level productivity is made conditional on the level of institutional quality in the country. That is, in addition to country fixed effects, the econometric specification includes an interaction term between the firm level bribe tax and independent assessments of the prevalence of corruption or the quality of the legal framework in the country.

Estimation of TFP at the firm level is a task fraught with methodological difficulties. Prime among these is the simultaneity problem in the estimation of factor inputs, which are likely to be endogenously determined with output (see, for example, Levinsohn and Petrin, 2003).[10] More generally, productivity estimates can be obtained by implementing two alternative methods. First, is the two-step approach, which implies estimating a simple production function in the first step only including factor inputs for land, equipment, labour and materials (K^{land}, $K^{equipment}$, L and M) and saving the estimated residual as TFP. In a second step, TFP is modelled as being determined by a number of firm, industry and country characteristics. The alternative is to estimate an augmented production function in one-step, including, in addition to factor inputs, the set of firm, industry and country characteristics that are assumed to have an effect on output. The one step approach is more efficient than the two step approach, since it makes explicit use of a more complete set of information on the production function. However, estimating TFP in two steps has the advantage that it allows to control for country level heterogeneity in productivity by estimating the first step production function separately for each country. [11]

For the purposes of our analysis, the two step approach is employed as a robustness check with results reported in Appendix 2, while the main empirical results rely on estimation of an augmented firm level production function in one step. The point of departure is, therefore, to include corruption explicitly in the determination of output, as in (1):

[10] Due to the cross section nature of our data we are not able to implement an approach a la Levinsohn and Petrin. This should be borne in mind in the interpretation of our empirical results.
[11] The two step approach allows estimating the average levels of TFP by country. Results are provided in Table A.2 in the Appendix.

$$y_{ijc} = \alpha_1 K^{land}_{ijc} + \alpha_2 K^{equipment}_{ijc} + \alpha_3 L_{ijc} + \alpha_4 M_{ijc} + \\ + \beta corruption_{ijc} + \gamma X_{ijc} + d_j + d_c + \varepsilon_{ijc} \quad (1)$$

where y_{ijc} is log output by firm *i* in industry *j* and country *c* and K^{land}, $K^{equipment}$, *L and M* are log of land, machinery, employment and materials, respectively.

The main variable of interest is $corruption_{ijc}$, which is the measure of corruption at the firm level. It is defined as a "bribe tax", in the form of a dummy equal to one if a firm replies "frequently", "usually" or "always" to the question "is it common to have to pay some irregular additional payment or gifts to get things done with regard to customs, taxes, licenses, regulations, services, etc." The same specification can be used to test the direct effects of the "time tax", defined as the percentage of senior management time devoted to dealing with bureaucratic requirements, by including it in the model as a substitute for the "bribe tax". Consideration of both variables allows verifying the extent to which the time and the bribe tax are different phenomena, with different implications for firm productivity.

$\mathbf{X_{ijc}}$ is a vector of control variables that serve to detect observable aspects of firm heterogeneity in our data to allow identification of the effect of the bribe tax on productivity. It consists of *sizeM, sizeL, age, exporter, innovator* and *foreign-owned*. *SizeM* and *sizeL* are dummy variables representing medium and large firms, respectively. Larger firms are expected to have higher productivity due to the effects of scale economies. The variable *age* represents the age of firms in 2008, capturing effects such as the vintage of the firm or learning by doing externalities on TFP.

Innovator, exporter, and *foreign-owned* are all dummy variables indicating whether the firm is engaged in innovation (in terms of having positive R&D expenditure), involved in exports and owned by foreign investors. These variables are expected to have a positive effect on productivity. In particular, innovation and R&D expenditures tend to positively affect firm productivity since they lead to the development of more efficient production technologies or to the more effective adoption of technologies developed outside the firm (Aw, Roberts and Xu,

2008).[12] At the same time, exporting activity has been found in several empirical studies to be positively associated with firm-level productivity.[13] FDI, on its part, is associated with various measures of firm performance, including investment, innovation and productivity, since foreign owners can be expected to transfer technology and know-how to domestic affiliates (see, for example, Girma and Görg, 2007).[14]

In order to account for the possibility that increased *competition* may act as a form of control on corruption, while, at the same time, affecting firm level productivity, $\mathbf{X_{ijc}}$ also includes a variable for the perceived intensity of competition. The variable is defined "How much of an obstacle are competitors to your operations?". Specifically, firms are asked to rank whether competition is an obstacle on a scale from 0 (no obstacle) to 4 (very severe obstacle). We define our variable as the difference between the individual firm's response and the country average. As mentioned earlier, the rationale for including the competition variable is that, as firms' profits are driven down by competitive pressure, there are no excess profits from which to pay bribes (Ades and Di Tella, 1999).

$\mathbf{X_{ijc}}$ also includes two measures of the firm's perception of the quality of the institutional environment. The first is a dummy variable equal to one if the firm responds that the *quality of courts* is a major or very severe obstacle to operating a business. The second is a dummy variable that is similarly defined if a firm sees *political instability* as a severe problem. Including these two measures allows us to capture some aspects of institutional quality that may be correlated with corruption and, if not controlled for, may therefore bias our results.

Finally, d_j and d_c include a full set of industry and country dummies, respectively, and u_{ijc} is the idiosyncratic error term, which allows for clustering at the country-industry level.

Efficient grease: Trade-offs between the bribe tax and the time tax

[12] Klette and Kortum (2004) provide a rationale for the effects of firm-level innovation on aggregate technological change and growth.
[13] Wagner (2007) offers an overview of the vast empirical evidence on the strong association between exporting and productivity.
[14] Hoekman and Smarzynska Javorcik (2006) present a number of instances of the interaction between innovation, trade and FDI. In particular, they show that the innovation activity associated with the technology transfer occurring with FDI and trade results in sizeable productivity gains at the firm level.

The model in equation (1) can be expanded to verify the extent to which bribes may be a second best outcome in a context where inefficient bureaucracy leads to a time tax for producers. In other words, when regulation is overly restrictive, corruption may aide entrepreneurs in their interaction with the state, thus leading to a beneficial impact on productivity. A direct way to test this hypothesis would be to include the bribe tax and the time tax jointly in the empirical specification, together with their interaction. The latter would test the extent to which the effect of bribes on productivity is conditional on time consuming dealings with bureaucracy; in other words, it would allow a direct test of the efficient grease hypothesis, as in equation (2):

$$y_{ijc} = \alpha_1 K^{land}_{ijc} + \alpha_2 K^{equipment}_{ijc} + \alpha_3 L_{ijc} + \alpha_4 M_{ijc} + \beta_1 corruption_{ijc} + \beta_2 timetax_{ijc} + \\ + \beta_3 (corruption_{ijc} * timetax_{ijc}) + \gamma X_{ijc} + d_j + d_c + \varepsilon_{ijc} \qquad (2)$$

The net effect of *corruption* (i.e., the bribe tax) on TFP is then given as

$$\partial y_{ijc} \Big/ \partial corruption_{ijc} = \beta_1 + \beta_3 timetax_{ijc} \qquad (3)$$

In equation (3) a significant coefficient for β_3 will indicate that the effect of corruption on productivity depends on the degree to which the firm is engaged in time consuming relations with the state. In particular, a positive coefficient for β_3 would indicate that a high *time tax* is accompanied with less negative - or even positive - effects of *corruption* on productivity, thus providing evidence in favour of "efficient grease", with corruption helping to mitigate the effects of burdensome regulation.

Institutional quality: Interaction between firm-level and country-level effects

As a further step in our analysis, in order to check whether the effect of corruption on firm level productivity differs depending on the level of institutional quality in the country, we extend equation (1) and interact *corruption* with country level measures of institutional quality. For this we use two alternative indicators. First is the *Transparency International Corruption Perception Index (CPI)* for the year 2008, which allows investigating whether the

prevalence of corruption at the country level has implications for firm behaviour and, consequently, productivity performance. CPI captures the perceived levels of public-sector corruption in a given country and is a composite index, drawing on different expert and business surveys. CPI ranges from zero (highly corrupt) to ten (highly clean). It varies across countries and is fixed across sectors for a given country.

As can be seen in Table 2, the average levels of productivity, bribe tax and CPI are different between low CPI and high CPI countries[15] and between EU and non-EU countries. These variations could imply that the impact of bribe tax on productivity could be different for high and low CPI countries as suggested by equation (5), as well as for EU and non-EU countries. No major differences can be depicted in the level of time tax, however.

Table 2: Summary statistics by group of countries

	Total		Non EU		EU		$CPI < \overline{CPI}$		$CPI > \overline{CPI}$	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
TFP	0.148	0.916	0.150	0.941	0.144	0.874	0.239	0.983	0.090	0.867
Bribe Tax	0.099	0.298	0.139	0.346	0.030	0.171	0.195	0.396	0.030	0.169
Time Tax	14.528	18.223	14.313	19.819	14.884	15.220	14.669	21.172	14.430	15.851
CPI	3.393	1.150	2.863	0.904	4.288	0.949	2.287	0.362	4.191	0.814

Note: TFP is calculated as a residual from a simple production function, see appendix

As a robustness check, we also use an alternative measure of institutional quality, namely the World Economic Forum's index of the *effectiveness of the legal framework* is solving legal disputes, which can be interpreted as a proxy for the ability of formal institutions to enforce contracts and prevent or sanction the occurrence of corrupt practices. This is also a country level index for the year 2008, where increases in the index imply better legal quality.

Including either of the indices in the model gives the following equation (4) as

[15] Low and high CPI countries are defined as countries with CPI below and above the mean level, respectively.

$$y_{ijc} = \alpha_1 K^{land}_{ijc} + \alpha_2 K^{equipment}_{ijc} + \alpha_3 L_{ijc} + \alpha_4 M_{ijc} +$$
$$+ \beta corruption_{ijc} + \lambda(corruption_{ijc} * institution_c) + \kappa\, institution_c +$$
$$+ \gamma X_{ijc} + d_j + d_c + \varepsilon_{ijc} \qquad (4)$$

In equation (4) a significant coefficient for λ will indicate that the effect of corruption on productivity depends on the country's level of institutional quality. In particular, a positive (negative) coefficient of λ will indicate that high *institutional quality* will lessen (strengthen) the negative effect of *corruption at the firm level* on productivity.

IV. ECONOMETRIC ANALYSIS

We now turn to the results of econometric analysis in the three stages outlined above. Namely, we examine the effects of corruption on productivity; of the interaction between corruption and the time tax; and of the relevance of overall institutional quality for firm level outcomes.

As discussed, the determinants of productivity are estimated using a one-step augmented production function. In order to address the potential endogeneity of firm level institutional variables, equation (1) is estimated with an instrumental variable (IV) approach Implementation of the IV method requires the utilization of adequate instrument that must fulfil two conditions, namely being correlated with the endogenous variable and being uncorrelated with the error term in equation (1).

The BEEPS data set offers a number of potential instruments. For instance, firms are asked whether they submitted an application for an electricity connection over the last two years. This allows us to generate a dummy variable equal to 1 if the firm did not submit an application and 0 if it did. This variable is arguably likely to be correlated with corruption, since it would imply interaction with public officials who have to grant the firm its right to be connected with the electricity grid. This would, hence, be a good opportunity for corrupt officials to demand a payment, either in cash or in terms of time. On the other hand, a dummy whether or not a firm submitted an application for electricity is unlikely to be correlated with the residual in a firm level production function (TFP). Since one may assume

that a firm needs some access to electricity to start operating, it appears reasonable that the application that is mentioned in the survey must relate to an additional or new connection. There is therefore no a priori reason why, conditional on the covariates in equation (1), there should be a correlation between the incidence of the application and TFP. It is also important to point out that this variable relates to the incidence of the application, not the actual connection to electricity. While this may of course lead to a new connection in the future, which may then possibly (but not necessarily) lead to an increase in productivity, this is unlikely to be the case in the current period.

The validity of the instrument is also verified by using a standard test of overidentification restrictions. In order to do so we employ two additional instruments. These are the country-industry averages of *bribe tax* and *time tax*. Firms' experiences and perceptions of corrupt practices or of the burden in terms of time associated with red tape are likely to be influenced by the experiences of other competitors in the same industry. Hence, we would expect our additional instruments to be correlated with the firm-level bribe tax and time tax variables. On the other hand, one firm's level of productivity is unlikely to be influenced by the sectoral average.

Table 3 shows the correlations between the three instrumental variable candidates and the explanatory variables in our regression models. As can be seen, there are no strong correlations between the instruments and the explanatory variables, which provides some initial support to our argument that they may be valid instruments.

Table 3: Correlation coefficients and significance levels (p-values)

	Industry level time tax	Industry level bribe tax	Application dummy
Industry level bribe tax	-0.035		
	0.145		
Application dummy	0.022	0.018	
	0.362	0.0465	
Exporter	0.085	-0.164	-0.021
	0.001	0	0.401
Age	0.055	0.009	0.04
	0.026	0.726	0.104
sizeM	-0.04	-0.003	-0.049
	0.106	0.904	0.044
sizeL	0.028	-0.014	0.006
	0.262	0.58	0.808
Foreign owned	-0.017	-0.013	-0.02
	0.0479	0.609	0.417
Innovator	0.037	0.041	-0.016
	0.134	0.095	0.522
Competition	-0.014	0.055	-0.018
	0.0565	0.025	0.469
Courts	0.059	0.079	-0.033
	0.016	0.001	0.178
Political stability	0.049	0.06	-0.005
	0.05	0.015	0.827

To check the relevance and validity of the instruments, further tests are needed. We test for the relevance of the instruments, using a joint F test to verify whether the instrument candidates are correlated with the endogenous variable (e.g., Staiger and Stock, 1997). As reported in Table 4, the F-statistics are higher than 20 in both cases confirming that the instruments are jointly highly correlated with the respective firm level corruption variable. We also report the partial R squared of the two excluded instruments as an alternative. Furthermore, we provide a Hansen J test of overidentification restrictions to check that the IV candidates are uncorrelated with the error term in equation (1). The p-values of the Sargan test confirm the validity of the chosen IV, as we cannot reject the null of instrument validity.

Table 4: Productivity regression results: baseline specifications

	OLS		*IV*	
	(1)	(2)	(3)	(4)
Time Tax	0.001		-0.012	
	[-0.002]		[-0.009]	
Bribe Tax		-0.031		-0.692***
		[-0.069]		[0.262]
L	0.311***	0.319***	0.314***	0.326***
	[0.046]	[0.045]	[0.046]	[0.047]
M	0.418***	0.420***	0.420***	0.418***
	[0.031]	[0.030]	[0.031]	[0.030]
$K^{Equipment}$	0.074***	0.070***	0.075***	0.072***
	[0.017]	[0.017]	[0.017]	[0.017]
K^{Land}	0.011	0.003	0.005	0.000
	[0.013]	[0.013]	[0.013]	[0.013]
Exporter	0.206***	0.219***	0.215***	0.238***
	[0.054]	[0.050]	[0.054]	[0.053]
Age	0.000	0.000	0.000	0.000
	[0.001]	[0.001]	[0.001]	[0.001]
SizeM	-0.454***	-0.440***	-0.465***	-0.401***
	[0.109]	[0.104]	[0.111]	[0.111]
SizeL	-0.257***	-0.254***	-0.250***	-0.243***
	[0.064]	[0.060]	[0.065]	[0.064]
Foreign Owned	0.183**	0.175***	0.178**	0.218***
	[0.073]	[0.067]	[0.072]	[0.074]
Innovator	0.072	0.068	0.059	0.080
	[0.056]	[0.054]	[0.056]	[0.053]
Competition	-0.016	-0.022	-0.007	-0.004
	[0.015]	[0.015]	[0.017]	[0.016]
Courts	-0.065	-0.039	-0.053	0.052
	[0.055]	[0.052]	[0.057]	[0.070]
Political Stability	0.037	0.056	0.039	0.083*
	[0.048]	[0.047]	[0.048]	[0.047]
Constant	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES
Sector Dummies	YES	YES	YES	YES
Wu-Hausman (p-value)		0.11		0.049
Hansen J (p-value)		0.83		0.57
F-Stat		28.38		85.6
Observations	1519	1519	1666	1666

*Note : Standard errors clustered by country-industry in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.*

The results of the effects of time and bribe taxes on productivity according to the baseline estimation of equation (1) are presented in Table 4. Columns (1) and (2) present the results using an OLS estimator, while columns (3) and (4) show IV estimates.

Note firstly that the coefficient on the production factors capital, labour, land and materials are all positive as expected. Furthermore, exporters and foreign-owned firms are more productive, *ceteris paribus*, as expected. Strikingly, larger firms tend to be less productive, perhaps a sign of incomplete restructuring that prevents firms from exploiting the benefits of scale economies. Whereas innovation would be expected to be associated with higher productivity, the innovation dummy appears as insignificant in all specifications. This may indicate that the innovation activities carried our within firms may be insufficient to have an impact on productivity. This result could indicate a prevalence of defensive as opposed to strategic restructuring by the firms in the sample, where the former is related to short-term cost-cutting measures, while the latter is focused on increasing the long-term efficiency and viability of the firm, by investing in labour training, fixed assets and other innovation related activities such as R&D (Grosfeld and Roland, 1997; Aghion et al., 1997; Frydman et al., 1999). The other controls are statistically insignificant.

Examination of the OLS results in columns 1 and 2 shows that the coefficients on both time and bribe tax are statistically insignificant. It is, however, unlikely that the corruption variables are exogenous in this productivity estimation. For example, highly productive firms may have a better ability to engage in bribing or may be preferred targets of bureaucrats aiming at exacting brines. This would introduce reverse causality in the equation or, more formally, a correlation between the right-hand-side variable and the error term. Another potential source of endogeneity is the impact of unobserved institutional characteristics at the firm level. We argue that our measures of perception of the quality of courts and political instability go some way to address these concerns.

The Wu-Hausman test is performed to check whether bribe is endogenous and the results are given at the bottom of Table 5. The significant p-value rejects the null hypothesis of exogeneity of bribe tax. This is not the case for time tax, however, where we cannot reject

exogeneity. However, in both cases we implement an instrumental variables (IV) technique to estimate equation (1) to check the implications this has for the coefficient on corruption.

The *bribe tax* has a negative and significant effect on productivity when adjusting for potential endogeneity bias (Table 4, column 4). The negative and significant coefficient of bribe tax indicates that firms that are hindered by the payment of kickbacks to officials experience lower productivity than other firms. At the same time, among our controls for institutional quality, only perception of political instability is significant, and is positively correlated with firm-level productivity, perhaps as sign that more productive firms are more likely to perceive the uncertainty associated with political instability as a problem.

By contrast, we still fail to find a statistically significant impact of time tax on firm level productivity (Column 3).

Trade-offs between the bribe tax and the time tax

The preceding analysis has shown that corruption proper and inefficient bureaucracy have differentiated effects on firm level productivity in our sample. Namely, while the payment of bribes is negatively associated with the productivity of the bribing firm, time spent dealing with bureaucratic requirements *per se* appears to be irrelevant. However, it has been argued that the occurrence of corruption may not be independent of the length of bureaucratic processes. These may, in fact, be deliberately established by state officials with the intent of exacting bribes. In this context, the payment of bribes might help "grease the wheels of commerce" by speeding up bureaucratic requirements, as captured by the time tax, and lead to a second best outcome for the bribing firm. The challenge is, therefore, to examine whether the (negative) effect of bribes on productivity is conditional on the time that firms have to spend dealing with red tape. A direct way to test this "efficient grease" hypothesis is to include the bribe tax and the time tax jointly in the empirical specification, together with their interaction. The interaction term would represent a direct measure of the extent to which the effect of corruption is conditional on time consuming dealings with bureaucracy.

Table 5: Trade-off between the bribe tax and the time tax

	(1) OLS	(2) IV	(3) OLS	(4) IV
Time tax	0.001	-0.011	0.001	-0.009
	[0.002]	[0.009]	[0.002]	[0.009]
Bribe tax	0.019	-0.564**	0.021	-1.213
	[0.075]	[0.269]	[0.099]	[1.017]
Time tax * Bribe tax			**0.000**	**0.049**
			[0.004]	**[0.074]**
L	0.311***	0.319***	0.311***	0.311***
	[0.046]	[0.049]	[0.046]	[0.049]
M	0.418***	0.417***	0.418***	0.415***
	[0.031]	[0.032]	[0.031]	[0.032]
$K^{Equipment}$	0.074***	0.077***	0.074***	0.085***
	[0.017]	[0.017]	[0.017]	[0.022]
K^{Land}	0.011	0.003	0.011	0.005
	[0.013]	[0.014]	[0.013]	[0.015]
Exporter	0.206***	0.234***	0.206***	0.245***
	[0.054]	[0.057]	[0.053]	[0.065]
Age	0.000	0.000	0.000	0.000
	[0.001]	[0.001]	[0.001]	[0.001]
SizeM	-0.455***	-0.437***	-0.455***	-0.442***
	[0.109]	[0.119]	[0.109]	[0.120]
SizeL	-0.257***	-0.244***	-0.257***	-0.238***
	[0.064]	[0.070]	[0.065]	[0.074]
Foreign Owned	0.181**	0.216***	0.181**	0.182*
	[0.073]	[0.080]	[0.073]	[0.094]
Innovator	0.072	0.065	0.072	0.071
	[0.056]	[0.056]	[0.056]	[0.056]
Competition	-0.016	0.006	-0.016	0.001
	[0.015]	[0.019]	[0.015]	[0.019]
Courts	-0.067	0.026	-0.067	0.002
	[0.055]	[0.075]	[0.055]	[0.089]
Political Stability	0.036	0.063	0.037	0.039
	[0.049]	[0.050]	[0.049]	[0.061]
Constant	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES
Sector Dummies	YES	YES	YES	YES
Wu-Hausman [p-value]		0.03		0.07
Hansen J [p-value]		0.48		0.55
F-Stat [time tax]		19.06		14.58
F-Stat [bribe tax]		50.91		38.89
F-Stat [time tax * bribe tax]				10.21
Observations	1519	1519	1519	1519

*Note : Standard errors clustered by country-industry in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Note : Instruments used in column (2) are the same as in Table 4. In column (4), we include the interaction of industry level bribe tax and industry level time tax as additional instrument in order to be able to test for overidentification restrictions using the Hansen J test.

The interaction of time tax and bribe tax, intended to explore potential trade-offs between the two variables, turns out to be insignificant, failing to provide evidence of a link between inefficient bureaucracy, corruption and productivity (Table 5). The time tax remains statistically insignificant, whereas the effect of the bribe tax continues being statistically significant and negative for productivity. The coefficient for factor inputs and other control variables remain largely unaltered compared to Table 4.

Does institutional quality matter?

An interesting question that can be answered with our data is whether there are any systematic variations in the effects of corruption on productivity across groups of countries. More specifically, we investigate whether there are any differences across countries that entered the EU recently and those that are not members, as well as among countries with various levels of institutional quality.

When examining determinants of firm level productivity based on EU membership, a number of differences emerge between EU and non-EU countries (Table 6). First, *age*, the vintage of the firm, has a positive effect on productivity in EU countries and a negative effect in non-EU countries. For all countries in our sample, except Turkey, older age is likely to be linked to the firm being active in centrally planned economies prior to the transition of the early1990s. Since most of the countries in our sample underwent a privatization process, the differentiated effect of age on productivity may lead to the conclusion that the process in non-EU countries was generally not accompanied by productivity-enhancing restructuring. Second, *foreign ownership* is consistently associated with productivity improvements only in EU countries. This seems to be an indication that knowledge and technology transfer associated with foreign investment *per se* does not automatically occur, and may stimulated or hampered by other country-specific factors. Third, in one of the specifications the perceived quality of *courts* is a significant determinant of productivity only in EU countries (column 1). Namely, when the judicial system is perceived as less problematic, firms have higher productivity. This is, perhaps, a reflection of the greater effectiveness of judicial recourse in EU countries.

Table 6: Productivity regression results: EU vs. Non-EU countries

	TIME TAX		BRIBE TAX	
	(1)	(2)	(3)	(4)
	EU	Non-EU	EU	Non-EU
Time Tax	-0.029**	-0.007		
	[0.013]	[0.010]		
Bribe Tax			-0.738	-0.814***
			[0.711]	[0.291]
L	0.165**	0.392***	0.182**	0.421***
	[0.077]	[0.039]	[0.072]	[0.045]
M	0.460***	0.394***	0.474***	0.387***
	[0.056]	[0.033]	[0.046]	[0.033]
$K^{Equipment}$	0.002	0.096***	0.002	0.093***
	[0.027]	[0.021]	[0.028]	[0.023]
K^{Land}	0.064**	-0.015	0.063***	-0.027
	[0.025]	[0.017]	[0.023]	[0.017]
Exporter	0.183*	0.224***	0.195***	0.259***
	[0.093]	[0.071]	[0.068]	[0.076]
Age	0.008***	-0.002*	0.005**	-0.002
	[0.003]	[0.001]	[0.002]	[0.001]
SizeM	-0.887***	-0.298***	-0.776***	-0.193
	[0.206]	[0.115]	[0.169]	[0.126]
SizeL	-0.427***	-0.168**	-0.431***	-0.138
	[0.117]	[0.083]	[0.095]	[0.086]
Foreign Owned	0.349***	0.090	0.318***	0.166*
	[0.124]	[0.083]	[0.109]	[0.100]
Innovator	-0.022	0.061	0.034	0.067
	[0.086]	[0.067]	[0.073]	[0.065]
Competition	0.028	-0.019	0.000	-0.002
	[0.036]	[0.019]	[0.025]	[0.021]
Courts	-0.174**	-0.019	-0.084	0.128
	[0.080]	[0.071]	[0.081]	[0.097]
Political Stability	0.098	0.011	0.088	0.098
	[0.080]	[0.066]	[0.067]	[0.065]
Constant	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES
Sector Dummies	YES	YES	YES	YES
Wu-Hausman [p-value]	0.02	0.37	0.19	0.01
Hansen J [p-value]	0.79	0.07	0.63	0.85
F-Stat	5.91	15.57	4.62	46.16
Observations	571	948	623	1041

Note : Instrumental variables estimations. Standard errors clustered by country-industry in brackets.
** significant at 10%; ** significant at 5%; *** significant at 1%*

Turning to the variables that are the focus of our interest, it emerges that the *time tax* has a statistically significant and negative effect on firm productivity when restricting the sample to recent EU members, while it remains insignificant for non-EU countries (columns 1 and 2). Interestingly, the *bribe tax* only hampers productivity of firms in non-EU countries, with an insignificant effect in EU countries (columns 3 and 4).

The finding that the bribe tax does not matter in EU countries may reflect the generally higher institutional quality in countries with higher incomes per capita. One may also try to detect a specific effect of EU accession, implying that the requirements of EU accession may induce countries to improve the process of formulation and enforcement of laws and regulations, thus reducing the occurrence of bribes as experienced by firms. However, such a conclusion would require a more detailed analysis, which takes account of the time series dimension to model pre- and post-accession environments and controls for observed and unobserved country characteristics.

The negative effect of the bribe tax on productivity in non-EU countries may be linked to generally poorer institutional quality and to the fact that, in high corruption environments, bribing could be regarded as the norm for most interactions with the State. Bribery will hence constitute a drag on productivity, without enabling firms to reap an efficiency advantage over competitors, as it is very likely that other firms are also paying bribes.

In order to examine the possibility of country-specific effects a step further, we explicitly consider the potential influence of institutional settings in different countries. For this purpose, two variables, obtained from sources other than the BEEPS, are used. The first is the Corruption Perception Index computed by Transparency International. The second is a measure of the quality of the legal framework taken from the Global Competitiveness Report. As shown in Table A3 in the Appendix, mirroring the large differences in income per capita, these two variables also present substantial variation across the countries in the sample. We, therefore, posit that the effect of bribe and time tax on productivity may depend on the overall quality of the institutional environment, as represented by the level of corruption in the

country. This assumption is tested by estimating model (3) and the results are given in Table 7.

Overall, our results indicate that the relationship between corruption and economic performance is conditional on the overall level of institutional quality. In particular, the coefficients on *time tax* and its interaction are statistically insignificant, the coefficient of *bribe tax* is still negative and significant, whereas the interactive term, *bribe*×*institution*, is positive and significant.

In order to illustrate the role of institutional quality, and specifically the level of corruption in the country as represented by the CPI, we can use the estimated coefficients of column 3 to calculate the total effect of bribe tax on productivity as

$$\partial tfp_{ijc} \Big/ \partial bribe\_tax_{ijc} = -5.733 + 1.950 CPI_{ic} \qquad (6)$$

Equation (6) demonstrates that in highly corrupt environments –i.e. for lower values of the CPI - bribes have higher negative impact on productivity. At the same time, as the value of the CPI increases (less corrupt environments), the total effect of bribe on productivity becomes less negative and, beyond a certain threshold, could even be positive. This could be because, in an environment that is generally free of corruption, paying a bribe might result in a competitive advantage, perhaps reflected in a marginal gain in firm level productivity. However, this is not confirmed in Table 6, where corruption has no significant association with productivity in EU countries, which may be assumed to have a higher level of institutional quality. On the other hand, in a highly corrupt environment, where most market players pay a bribe, there is no competitive edge or gain in productivity to be obtained by paying a bribe. Quite the opposite, paying even higher bribes allocates resources away from their most productive use, reducing productivity of the firm. Hence productivity gains are more likely to incur to the firms that do *not* bear the cost of bribes.

Table 7: Productivity regression results: Institutional Quality

	(1)	(2)	(3)	(4)
	Corruption	Legal framework	Corruption	Legal framework
Time Tax	-0.043	0.284		
	[0.082]	[0.223]		
Bribe Tax			-5.774*	-16.171*
			[3.441]	[8.302]
L	0.313***	0.285***	0.364***	0.322***
	[0.047]	[0.051]	[0.059]	[0.054]
M	0.426***	0.414***	0.413***	0.398***
	[0.034]	[0.037]	[0.034]	[0.042]
$K^{Equipment}$	0.075***	0.051*	0.104***	0.086***
	[0.017]	[0.026]	[0.030]	[0.026]
K^{Land}	0.007	0.019	-0.032	0.003
	[0.015]	[0.018]	[0.027]	[0.016]
Exporter	0.188***	0.212***	0.288***	0.165**
	[0.060]	[0.063]	[0.077]	[0.079]
Age	0.000	0.000	0.000	0.001
	[0.001]	[0.002]	[0.001]	[0.002]
SizeM	-0.449***	-0.632***	-0.250	-0.405***
	[0.105]	[0.157]	[0.155]	[0.135]
SizeL	-0.267***	-0.321***	-0.126	-0.246***
	[0.067]	[0.094]	[0.104]	[0.086]
Foreign Owned	0.197**	0.239***	0.200**	0.369***
	[0.081]	[0.090]	[0.090]	[0.134]
Innovator	0.058	-0.004	0.041	0.104
	[0.060]	[0.086]	[0.063]	[0.068]
Competition	-0.010	-0.014	-0.012	-0.005
	[0.021]	[0.021]	[0.019]	[0.021]
Courts	-0.051	-0.068	0.084	0.021
	[0.066]	[0.070]	[0.101]	[0.076]
Political Stability	0.031	0.035	0.053	0.103*
	[0.050]	[0.060]	[0.050]	[0.062]
Time tax * institution	**0.012**	**-0.098**		
	[0.022]	**[0.077]**		
Bribe tax * institution			**1.952***	**5.396***
			[1.206]	**[2.864]**
institution	-1.029***	-5.730**	-0.980***	-4.430**
	[0.354]	[2.412]	[0.188]	[1.831]
Constant	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES
Sector Dummies	YES	YES	YES	YES
Wu-Hausman (p-value)	0.56	0.12	0.01	0.01
Hansen J (p-value)	0.05	0.02	0.62	0.75
F-Stat	1.26	0.91	2.07	1.76
Observations	1519	1363	1664	1503

Note : Instrumental variables estimations. Standard errors clustered by country-industry in brackets.
** significant at 10%; ** significant at 5%; *** significant at 1%*

From these results we can calculate that the cut-off point at which the sign of the total effect changes is 2.95.[16] Table 8 shows the countries in the sample for which the total effect of corruption on productivity is positive and negative. Interestingly, based on the CPI, the total effect of corruption is negative in all former Soviet republics, with the exception of the Baltics and Georgia.

Table 8: Effects of corruption and legal quality on productivity

Negative (CPI < 2.95)	**Positive (CPI > 2.95)**	**Negative (legal quality < 2.99)**	**Positive (legal quality > 2.99)**
Russia	Poland	**Russia**	**FYROM**
Kazakhstan	Romania	**Armenia**	**Estonia**
Moldova	Serbia	**Kyrgyz**	**Czech Republic**
Azerbaijan	Bosnia	Croatia	**Hungary**
Armenia	**FYROM**	Bulgaria	**Latvia**
Kyrgyz	**Estonia**	Poland	**Lithuania**
	Czech Republic	Romania	**Slovakia**
	Hungary	Serbia	**Slovenia**
	Latvia	Bosnia	**Montenegro**
	Lithuania		Kazakhstan
	Slovakia		Moldova
	Slovenia		Azerbaijan
	Bulgaria		
	Croatia		
	Montenegro		

Of course, we can make similar calculations for the alternative measure of institutional quality, the legal framework in column (4), where the total effect of bribes is -16.17 + 5.40**legal_quality*. While the overlap of countries with negative and positive effects of firm level bribes is not complete, there are a number of countries that are in the same categories when using the two alternative indices. These are marked in bold in the table.

[16] Here we are of course assuming that the relationship is linear and there is only one cut-off point.

V. CONCLUSIONS

Corruption is often identified as one of the underlying causes for the underdevelopment of many economies. Nevertheless, some see corruption as a necessary evil that, by "greasing the wheels of commerce", mitigates the negative effects of inefficient bureaucracy, which may be seen as imposing a "time tax" on individuals and firms. At the same time, both the incentives for - and the impact of - corruption may be different across countries, depending on the nature of the surrounding environment.

Based on these premises, this study investigates the effect of corruption - interpreted as a "bribe tax" - on firm-level productivity across a diverse sample of countries in Central and Eastern Europe and the Former Soviet Union. The findings of econometric analysis corroborate the assumption that corruption has, on balance, negative consequences for enterprise performance. However, the relationship between corruption and economic performance presents some nuances.

First, a comparison of the effects of the bribe tax and the time tax across the entire sample indicates that only bribery negatively affects firm productivity while lengthy bureaucratic requirements *per se* have no significant consequences.

Second, an explicit test of the hypothesis that bribes help to mitigate the negative effects of time consuming dealings with bureaucracy does not find confirmation in our data.

Third, broader environmental circumstances turn out to play a significant role in determining the impact of firm level corruption on productivity. In fact, results indicate that the effects on firm productivity are different in EU and non-EU countries, with the bribe tax appearing relevant only in non-EU countries, and the time tax only in EU countries. Further consideration of country-wide measures of institutional quality leads to the conclusion that, in highly corrupt environments, firms that do *not* pay bribes are more productive. Furthermore, as the level of institutional quality decreases, the total effect of corruption is increasingly negative. This suggests that, whereas environmental circumstances are beyond the choice set

of individual firms, managers retain some degree of autonomy in deciding whether to recur to bribery or not and this affects enterprise performance.

A possible policy implication of these findings is that narrow measures to reduce the incentives for corruption, such as targeted wage increases for public officials, are likely to be ineffective if not embedded in a comprehensive strategy for institutional reform.

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APPENDIX 1: Variable definitions and summary statistics

Table A.1: Variable definitions

Variable	Definition
TFP	Total factor productivity, calculated as residual from a production function
Y	This establishment's total annual sales
K	This establishment spend on purchases of machinery, land and building
L	Total annual cost of labour (including wages, salaries, bonuses, social security payments)
M	Total annual cost of raw materials and intermediate goods used in production
Time Tax	Percentage of time spent by senior management with public officials in order to obtain favourable interpretation of regulations
Bribe Tax	Dummy = 1 if firm replies frequently, usually or always to the question "it is common to have to pay some irregular additional payment or gifts to get things done".
Courts	Dummy = 1 if firm replies that courts are a major obstacle or very severe obstacle to the operations of the firm
Political stability	Dummy = 1 if firm replies that political instability is a major obstacle or very severe obstacle to the operations of the firm
CPI	Corruption Perception Index at the country level. It relates to perceptions of the degree of corruption as seen by business people and country analysts, and ranges between 10 (highly clean) and 0 (highly corrupt).
Legal Framework	Indicator from the Global Competitiveness Report at the country level. It provides a measure of the efficiency of the legal framework in settling disputes (1 = extremely inefficient; 7 = highly efficient).
Exporter	Dummy = 1 if firm has positive exports
Foreign_Owned	Dummy = 1 if firm has foreign ownership
Innovator	Dummy = 1 if firm has positive expenditure on R&D
Age	Age of firm (years)
SizeS	Dummy = 1 for small firm (less than 20 employees)
SizeM	Dummy = 1 for medium firm (between 20 and 99 employees)
SizeL	Dummy = 1 for large firm (larger than 99 employees)
Competition	Difference between firm's perception and country level average on question "competition is an obstacle for operations of the establishment" (ranked between 0 and 4)

Table A.2: Descriptive statistics of variables used

Variable	Obs	Mean	Std. Dev.
TFP	1666	0.22	0.90
Time tax	1519	12.81	14.79
Bribe Tax	1666	0.11	0.31
Courts	1666	0.19	0.39
Political stability	1666	0.32	0.46
CPI	1666	3.57	1.29
Legal Framework	1504	2.98	0.51
Exporter	1666	0.49	0.50
Foreign_Owned	1666	0.11	0.30
Innovator	1666	0.21	0.41
Age	1666	20.34	20.33
SizeM	1666	0.29	0.45
SizeL	1666	0.37	0.48
Competition	1666	0.04	1.37

Table A.3: Descriptive statistics of variables used by country

	TFP		Bribe Tax		Time Tax		CPI		Legal Framework	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Albania	0.85	0.95	0.03	0.17	20.38	22.56	3.40	0.00	3.60	0.00
Belarus	0.12	0.83	0.09	0.29	19.00	20.20	2.00	0.00		
Georgia	0.22	0.89	0.03	0.18	2.00	6.84	3.90	0.00	3.20	0.00
Tajikistan	0.36	0.87	0.13	0.33	14.98	19.19	2.00	0.00	3.40	0.00
Ukraine	0.25	1.11	0.21	0.41	15.01	21.93	2.50	0.00	2.30	0.00
Uzbekistan	0.42	1.04	0.36	0.48	12.77	13.84	1.80	0.00		
Russia	0.02	0.83	0.23	0.42	20.17	25.66	2.10	0.00	2.90	0.00
Poland	-0.01	0.84	0.04	0.21	14.14	13.77	4.60	0.00	2.80	0.00
Romania	0.19	0.92	0.18	0.38	13.50	17.95	3.80	0.00	2.90	0.00
Serbia	-0.06	0.92	0.10	0.30	17.24	18.62	3.40	0.00	2.60	0.00
Kazakhstan	0.08	0.79	0.20	0.40	6.11	11.12	2.20	0.00	3.40	0.00
Moldova	0.47	0.96	0.09	0.29	10.49	17.24	2.90	0.00		
Bosnia	-0.21	0.69	0.09	0.29	14.02	17.63	3.20	0.00	1.80	0.00
Azerbaijan	0.03	0.64	0.21	0.41	2.66	4.95	1.90	0.00	3.80	0.00
FYROM	0.20	0.65	0.08	0.27	14.80	15.36	3.60	0.00	3.20	0.00
Armenia	0.38	0.97	0.08	0.27	13.95	16.90	2.90	0.00	2.80	0.00
Kyrgyz	0.86	1.46	0.19	0.40	4.03	8.03	1.80	0.00	2.60	0.00
Estonia	0.02	0.87	0.02	0.15	8.32	10.74	6.60	0.00	4.20	0.00
Czech Rep	0.85	1.77	0.03	0.18	13.46	14.67	5.20	0.00	3.40	0.00
Hungary	0.28	0.91	0.03	0.18	18.64	18.71	5.10	0.00	3.10	0.00
Latvia	-0.10	0.70	0.02	0.15	8.74	12.88	5.00	0.00	3.10	0.00
Lithuania	0.05	0.65	0.00	0.00	10.37	12.16	4.60	0.00	3.50	0.00
Slovakia	-0.04	0.74	0.07	0.26	7.38	12.44	5.00	0.00	3.00	0.00
Slovenia	-0.25	0.74	0.01	0.10	9.21	9.26	6.70	0.00	4.00	0.00
Bulgaria	0.20	0.61	0.01	0.07	17.23	15.20	3.60	0.00	2.80	0.00
Croatia	-0.19	0.73	0.00	0.06	13.17	15.67	4.40	0.00	2.60	0.00
Montenegro	0.28	1.12	0.03	0.16	9.85	11.33	3.40	0.00	3.90	0.00

APPENDIX 2

Alternative productivity regressions

As an alternative to the one step augmented production function we use an econometric approach and estimate TFP as the residual of a firm level production function

$$y_{ijc} = \alpha K^{land}_{ijc} + \beta K^{equipment}_{ijc} + \gamma L_{ijc} + \lambda M_{ijc} + \varepsilon_{ijc} \qquad \text{(A1)}$$

where y_{ijc} is log output by firm i in industry j and country c and K^{land}, $K^{equipment}$, L *and* M are log of land, machinery, employment and materials, respectively. We estimate equation (A1) separately for each country in order to allow for country level heterogeneity, and include a full set of sectoral dummies.[17] The estimated residual is saved as *tfp*. In a second step we then model total factor productivity (*tfp*) as being determined by a number of firm level characteristics including a measure of corruption. The model is given as

$$tfp_{ijc} = \alpha + \beta corruption_{ijc} + \eta \mathbf{X}_{ijc} + d_j + d_c + u_{ijc} \qquad \text{(A2)}$$

where the subscript denotes firm i operating in industry j in country c. All right hand side variables are defined as in the text.

The results of estimating equation (A1) are presented in Table A4. The second step estimations are shown in Table A5. As can be seen, the results concerning the corruption variables are similar to those presented in the one step estimation in Table 4.

[17] The current literature generally pays attention to the simultaneity problem in the estimation of production functions (e.g., Levinsohn and Petrin, 2003). We are not able to implement such an approach due to the cross section nature of our data. This should be borne in mind in the interpretation of our empirical results.

Table A.4a: Production Function Estimation by Country

	Russia	Poland	Romania	Serbia	Kaz'stan	Moldova	Bosnia	Azer'jan	FYROM	Armenia	Kyrgyz
L	0.63	0.41	0.55	0.36	0.47	0.56	0.48	0.39	0.60	0.77	0.23
	(0.12)***	(0.18)**	(0.07)***	(0.13)***	(0.13)***	(0.09)***	(0.08)***	(0.07)***	(0.08)***	(0.27)***	(0.13)*
M	0.40	0.41	0.43	0.59	0.48	0.39	0.44	0.58	0.43	0.27	0.63
	(0.07)***	(0.15)**	(0.08)***	(0.09)***	(0.13)***	(0.08)***	(0.08)***	(0.06)***	(0.08)***	(0.23)	(0.20)***
$K^{equipment}$	0.01	0.05	0.12	0.04	0.14	0.12	0.27	0.10	0.11	-0.06	0.10
	(0.05)	(0.10)	(0.06)*	(0.09)	(0.05)**	(0.07)	(0.09)***	(0.08)	(0.07)	(0.13)	(0.09)
K^{land}	0.05	0.23	0.02	0.09	-0.01	0.06	-0.09	0.04	-0.04	0.13	0.15
	(0.05)	(0.11)**	(0.04)	(0.08)	(0.04)	(0.06)	(0.11)	(0.07)	(0.07)	(0.09)	(0.13)
Observations	124	42	51	97	80	76	46	69	51	34	52

Table A.4b: Production Function Estimation by Country (cont'd)

	Czech	Hungary	Latvia	Lithuania	Slovakia	Slovenia	Bulgaria	Croatia	Monte'gro	Estonia
L	-0.01	0.32	0.44	0.61	0.94	0.50	0.47	0.53	0.22	0.66
	(0.06)	(0.10)***	(0.15)***	(0.08)***	(0.12)***	(0.09)***	(0.05)***	(0.07)***	(0.18)	(0.11)***
M	0.75	0.62	0.54	0.32	0.12	0.48	0.56	0.34	0.96	0.22
	(0.11)***	(0.14)***	(0.23)**	(0.06)***	(0.09)	(0.10)***	(0.04)***	(0.07)***	(0.11)***	(0.10)**
$K^{equipment}$	0.14	0.12	-0.06	0.08	0.05	-0.01	0.03	0.17	0.11	0.29
	(0.05)***	(0.10)	(0.12)	(0.09)	(0.10)	(0.09)	(0.03)	(0.05)***	(0.13)	(0.07)***
K^{land}	0.21	0.04	0.20	0.11	-0.01	0.14	0.06	0.05	-0.19	-0.05
	(0.08)**	(0.07)	(0.12)	(0.06)*	(0.05)	(0.10)	(0.03)**	(0.03)*	(0.13)	(0.07)
Observations	48	58	41	41	32	66	268	203	18	52

Table A5: Alternative productivity regressions

	OLS	IV	OLS	IV
Time Tax	0.001	-0.017*		
	[0.002]	[0.010]		
Bribe Tax			-0.067	-0.561**
			[0.074]	[0.260]
Exporter	0.094*	0.108*	0.099*	0.115**
	[0.055]	[0.058]	[0.052]	[0.054]
Age	-0.002*	-0.002	-0.002*	-0.002*
	[0.001]	[0.001]	[0.001]	[0.001]
SizeM	0.305***	0.286	0.318***	0.338***
	[0.068]	[0.070]	[0.064]	[0.067]
SizeL	0.167***	0.175***	0.165***	0.168***
	[0.055]	[0.057]	[0.051]	[0.050]
Foreign Owned	0.001	-0.006	0.007	0.041
	[0.084]	[0.083]	[0.077]	[0.081]
Innovator	0.018	0.001	0.019	0.029
	[0.063]	[0.064]	[0.061]	[0.060]
Competition	-0.013	-0.001	-0.018	-0.004
	[0.015]	[0.019]	[0.015]	[0.016]
Courts	-0.107*	-0.091	-0.08	-0.011
	[0.062]	[0.064]	[0.063]	[0.078]
Political Stability	0.036	0.04	0.061	0.082
	[0.055]	[0.055]	[0.051]	[0.052]
Constant	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES
Sector Dummies	YES	YES	YES	YES
Wu-Hausman [p-value]		0.062		0.049
Hansen J [p-value]		0.89		0.89
F-Stat		29.44		84.23
Observations	1519	1519	1666	1666

Note: Dependent variable is TFP. Instruments used are the same as in Tables 4 to 6. Standard errors clustered by country-industry in brackets.
** significant at 10%; ** significant at 5%; *** significant at 1%*