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IS CORRUPTION EFFICIENCY-ENHANCING?
A CASE STUDY OF NINE CENTRAL AND EASTERN EUROPEAN COUNTRIES

by Elisa Gamberoni[1], Christine Gartner[1], Claire Giordano[2] and Paloma Lopez-Garcia[1]

Abstract

We investigate the role of corruption in the business environment in explaining the efficiency of within-sector production factor allocation across firms in nine Central and Eastern European (CEE) countries in 2003-2012. Using a conditional convergence model, we find evidence of a positive relationship between corruption growth and both labour and capital misallocation dynamics, once country framework conditions are controlled for: this link is larger the smaller the country, the lower the degree of political stability and civil liberties, and the weaker the quality of its regulations. As input misallocation is one of the determinants of productivity growth, we further show that the correlation between changes in corruption and TFP growth is indeed negative. Our results also hold when we tackle a possible omitted variable bias by instrumenting corruption with two instrumental variables (the percentage of women in Parliament and freedom of the press). In conclusion, targeted action against corruption in the CEE region would be efficiency-enhancing.

JEL Classification: D24, D73, O47.
Keywords: bribes, capital misallocation, labour misallocation, total factor productivity.

Contents

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1. Introduction[1]

There is vast, yet inconclusive, theoretical and empirical literature exploring the links between corruption and economic growth, measured by a whole range of indicators (GDP, total factor productivity growth, investment rates). Some authors argue that corruption has the potential to foster economic development in that it constitutes the necessary "grease" to lubricate the wheels of stiff government administration, helping to overcome bureaucratic constraints, the inefficient provision of public services, and rigid laws. Others point out that the direction of the impact depends on the context in which corruption takes place because instead of speeding up procedures, corrupt officials have an incentive to cause greater administrative delays in order to attract more bribes. The advocates of the "sand the wheels" hypothesis argue that corruption reduces economic performance due to rent-seeking behaviour, increases in transaction costs and uncertainty, inefficient investment and misallocation of production factors. Moreover, the size of the country and the "industrial organization" of corruption, as in the degree of autocracy and the time horizon of the bureaucrats in power, can also influence the significance and sign of the relationship between corruption and economic growth, suggesting that non-linearities are at play.

The incidence of corruption in the business environment can affect aggregate total factor productivity (TFP) growth both directly and indirectly. Corruption influences individual firm performance *directly* by favouring or constraining productive activities. *Indirectly*, corruption may condition the degree of efficiency with which production factors are allocated across firms operating in a given sector by diverting or channeling resources from the most to the least productive units. The reasons are manifold. On the one hand, since corruption is illegal and must be kept secret, government officials will tend to steer it towards those goods on which bribes can be more easily collected, shifting a country's investments away from the highest value projects to less useful projects if the latter offer better opportunities to collect lucrative bribes and avoid detection (Shleifer and Vishny 1993). If irregular payments by firms to public officials to win investment contracts are proportional to the investment projects' costs, then a distorted incentive may be created for larger, and not necessarily more productive, projects (Tanzi and Davoodi 1997). The need for secrecy can also cause bureaucrats to maintain monopolies, to prop up inefficient firms, to prevent entry, to discourage innovation, and to allocate talent, technology and capital away from their most productive uses (Murphy, Shleifer and Vishny 1991; 1993). When profits are extracted from firms via corruption, entrepreneurs may choose to expand less rapidly or to forgo entrepreneurial activity altogether, to shift their savings towards the informal sector, and/or to organize production to minimize the need for public services and therefore interaction with public officials, thus leading to an enterprise that is of sub-optimal dimension. Conversely, the better connected firms, which successfully pay bribes to obtain government services, can operate with input combinations that are far from optimal and still survive (Garcia-Santana et al. 2015). More generally, enormous time is lost by entrepreneurs engaged in corrupt

[1] We are grateful to Benjamin Bluhm and Rebekka Bellmann for data assistance and Diana Rocco for editorial assistance for this paper. We also thank Juan Luis Diaz del Hoyo, Ettore Dorrucci, Alessandro Giovannini, Maurizio Habib, Pavlos Karadeloglou, Klaus Masuch, Lucia Rizzica, Fabiano Schivardi, Marcel Tirpak, Roberta Zizza and all participants at the 2015 Non-Euro Area Surveillance Report Workshop and a DED seminar at the ECB, a seminar at the IMF and a meeting at the European Commission for valuable suggestions on previous versions of the paper. Any errors remain the responsibility of the Authors. The views here expressed are those of the Authors and not of the Institutions represented.

activities at the expense of firms being able to productively run their business. On the other hand, it has been argued that corruption could guarantee efficient outcomes in competitions for government procurement contracts: the more productive entrepreneurs can afford higher bribes so that licenses and government contracts are assigned to the most efficient firms, similar to a perfect competition situation (Lui 1985; Beck and Maher 1986). Corruption therefore introduces competition for scarce government resources with the result that resources are provided more efficiently than they otherwise would have been. Moreover, bureaucrats themselves have an incentive to drive the most inefficient firms out of business, thereby enhancing the profitability of remaining firms, which in turns allows for the demanding of higher bribes (Bliss and Di Tella 1997). More generally, corruption may promote allocative efficiency by allowing firms to correct pre-existing government failures, such as weak institutions or stiff regulations. Ultimately, the impact of corruption on input allocation is an empirical question that we intend to explore in this paper.

Most of the empirical literature has focused either on the effect of firm-level bribery on within-firm productivity (De Rosa, Gooroochurn and Görg 2010; Hanousek and Kochanova 2015) or on the impact of total-economy corruption on a country's aggregate economic performance (Mauro 1995; Tanzi and Davoodi 1997). In this paper, instead, we use firm-level data on corruption and investigate its relationship to a measure of within-sector input misallocation, in turn a driver of sectorial TFP growth. To our knowledge, this is the first attempt in the literature to employ firm-level corruption data in order to explain more aggregate economic developments.

We focus on nine Central and Eastern European (CEE) countries, namely Croatia, the Czech Republic, Estonia, Hungary, Lithuania, Poland, Romania, Slovakia and Slovenia. These countries represent an interesting sample for analyzing the link between corruption and capital and labour misallocation. First, following their entry into the EU, actions were taken to fight corruption, albeit to varying extents across countries and sectors. Second, corruption is still high in CEE countries relative to core euro-area countries, suggesting that there is still large room for improvement. Finally, to our knowledge, with the exception of Benkovskis (2015) which focuses on Latvia (not included in our sample) this is the first comparative study on input misallocation in the CEE region.

Based on the Hsieh and Klenow (2009) model, input misallocation can be measured by the dispersion in the marginal productivity of inputs across firms within a sector. In the absence of distortions and assuming all firms in the sector face the same marginal costs, in equilibrium the marginal productivity of a given input should be the same across firms, i.e. the dispersion should be zero. CompNet data show a significant increase in input dispersion in CEE countries over the period 2003-2012, albeit with different time patterns according to the type of production factor (labour or capital).

We adopt a narrow definition of corruption, focusing solely on the frequency and amount of bribes paid by private non-financial firms to engage in their productive activities, taken from the World Bank and the European Bank for Reconstruction and Development's Business Environment and Enterprise Performance Survey (BEEPS). For the purpose of our analysis, we also clearly distinguish corruption from organized crime and from industrial fraud by outsiders or by employees of the firms involved. Moreover, to the extent that we are focusing solely on the "input misallocation channel", we are probably underestimating the overall impact corruption has on aggregate TFP growth. First we do not consider the effect that corruption can have on within-firm productivity growth. Second, we disregard the fact that corruption can also have efficiency consequences through its effects on government provisions of goods and services (Olken and Pande 2012). For example, if corruption increases the cost of government goods, this could have an effect similar to raising their prices. The efficiency loss would arise if government projects that would be cost-effective at the true costs are no longer cost-effective once the costs of corruption are included. The need to keep corrupt activity secret could also introduce distortions, as procurement officials may opt for the types of goods that make hiding corruption easier. Finally, corruption is a time-intensive activity for bureaucrats as well as it requires a continual search for "partners" to bribe.

In our empirical analysis, framed in a neoclassical conditional convergence model, we find that changes in corruption were a significant drag on sectorial TFP growth in the CEE region in 2003-2012. In particular, corruption is found to negatively affect the efficiency with which both capital and labour are allocated across firms within given sectors, especially in economies which are small and politically unstable, with lesser civil freedoms and with a weaker regulatory framework. These results are robust to the use of two instrumental variables for corruption: the share of female representation in Parliament and the degree of freedom of the press.

This paper is structured as follows. Section 2 provides the theoretical and empirical framework underpinning the measures of input misallocation used herein and presents some evidence on resource misallocation in CEE countries since 2003. Section 3 provides a detailed analysis of BEEPS bribe data in the CEE region in the same period. Section 4 presents our econometric estimates referring to the relationship between changes in corruption and input misallocation. Section 5 concludes.

2. Labour and capital misallocation dynamics in CEE countries

2.1 A theoretical model of input misallocation

To measure input misallocation we adopt the theoretical approach developed by Hsieh and Klenow (2009), based on an economy with S sectors. Each sector is a CES aggregate of *M* differentiated products:

$$(1)\ Y_s = \left(\sum_{i=1}^{M} Y_{si}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma-1}{\sigma}}$$

where $\sigma > 1$ is the elasticity of substitution across varieties of goods. The production function for each differentiated product/firm is given by a Cobb-Douglas production technology:

$$(2)\ Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$$

where α_s denotes the share of capital in the production process. Capital and labour shares are thus allowed to differ across industries (but not across firms within an industry) and sum to one under constant returns to scale. As in Melitz (2003) firms differ in terms of their productivity level A_{si}. Additionally, firms differ in the types of output and input constraints they face. We denote with τ_y distortions that increase the marginal products of capital and labour by the same proportion as an output distortion and τ_k as distortions that raise the marginal product of capital relative to labour. Assuming that all firms in the same industry face the same wage (w_s) and cost of capital (r_s), profits are defined as:

(3) $\pi_{si} = (1-\tau_{Ysi})P_{si}Y_{si} - w_s L_{si} - (1+\tau_{Ksi})r_s K_{si}$

Profit maximization yields the standard condition that the firm's output price is a fixed mark-up over its marginal cost:

(4) $P_{si} = \frac{\sigma}{(\sigma-1)}\left(\frac{r_s}{\alpha_s}\right)^{\alpha_s}\left(\frac{w_s}{1-\alpha_s}\right)^{(1-\alpha_s)}\frac{(1+\tau_{Ksi})^{\alpha_S}}{A_{si}(1-\tau_{Ysi})}$

Manipulations of the first order conditions yield the following expressions for the capital-labour ratio, labour and output:

(5) $\frac{K_{si}}{L_{si}} = \frac{\alpha_s}{(1-\alpha_s)}\frac{w_s}{r_s}\frac{1}{(1+\tau_{ksi})}$

(6) $L_{si} \propto \frac{A_{si}{}^{\sigma-1}(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s(\sigma-1)}}$

(7) $Y_{si} \propto \frac{A_{si}{}^{\sigma-1}(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s\sigma}}$

The allocation of resources across firms depends therefore not only on firm productivity levels (with capital and labour increasing the more productive the firm is), but also (negatively) on the output and capital distortions they face.

This also translates into differences in the marginal revenue products of labour and capital (i.e. the change in total revenue earned by a firm which results from employing one more unit of capital or labour) across firms. Specifically, the marginal revenue product of labour ($MRPL_{si}$) is proportional to revenue per worker:

(8) $MRPL_{si} = (1-\alpha_s)\frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{L_{si}} = w_s\frac{1}{1-\tau_{Ysi}}$

and the marginal revenue product of capital ($MRPK_{si}$) is proportional to the revenue-capital ratio:

(9) $MRPK_{si} = \alpha_s\frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{K_{si}} = r_s\frac{1+\tau_{Ksi}}{1-\tau_{Ysi}}$

Hsieh and Klenow (2009) further define physical total factor productivity as $TFPQ_{si} = A_{si}$ and the revenue total factor productivity as $TFPR_{si} = P_{si}A_{si}$. The availability of firm-specific price deflators allows the computation of TFPQ, whereas $TFPR_s$ is computed on the basis of industry-specific price deflators. This distinction allows us to derive an expression that links firm physical total factor productivity to the dispersion in the marginal product of capital and labour. Specifically, using equations 8 and 9, we can express $TFPR_{si}$ as follows

$$(10) \qquad TFPR_{si} \propto MRPK_{si}^{\alpha_s} MRPL_{si}^{1-\alpha_s} \propto \frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}}$$

and sectorial productivity A_s as follows:

$$(11) \qquad A_s = \left(\sum_{i=1}^{M}\left(A_{si}\frac{\overline{TFPR_s}}{TFPR_{si}}\right)^{\sigma-1}\right)^{\frac{1}{\sigma-1}}$$

where $\overline{TFPR_s}$ is a geometric average of the average marginal revenue product of capital and labour in the sector. If marginal products were equalized across plants, TFPQ= $\overline{A_s} = (\sum_{i=1}^{M} A_{si}^{\sigma-1})^{\frac{1}{\sigma-1}}$. When TFPQ and TFPR are jointly log-normally distributed, A_s can be expressed as:

$$(12) \quad logA_s = \frac{1}{\sigma-1}log\left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right) - \frac{\sigma}{2}var(logTFPR_{si})$$

In this special case, the negative effect of distortions on sectorial TFP can be summarized by the variance of log$TFPR_{si}$. Intuitively, input and output constraints lead firms to produce different amounts than what would be optimal according to their different capital-labour ratios, leading to differences in the marginal revenue of inputs across firms. The extent of input misallocation is worse the greater the within-sector dispersion of marginal products, in value terms, of inputs across firms.

Although the paper focuses on the Hsieh-Klenow measure of resource misallocation, we have also analysed an alternative statistic used by the literature on labour misallocation, in particular the Olley and Pakes (1996) gap indicator.[2] The (log) labour productivity of an industry is equal to the weighted average of the labour productivity of the firms active in the industry, where the weights are the firm's share in total industry employment. An industry's labour productivity can be decomposed into two parts: *a)* the unweighted average of firm-level productivity and *b)* the within-industry cross-sectional covariance between the relative productivity of a firm and its relative weight, given by its size (the so-called OP gap). Given the unweighted industry mean, the higher the covariance the larger the contribution of the allocation of resources across firms to the industry productivity level, relative to a situation in which resources had been allocated randomly across firms (in that instance, the covariance would be zero). Mathematically, this is defined as:

$$(13) \quad p_t = \sum_{i=1}^{N} s_{it}p_{it} = \overline{p_t} + \sum_{i=1}^{N} \Delta s_{it}\Delta p_{it}$$

where p_t is the industry labour productivity, $\overline{p_t}$ represents the unweighted average productivity of all firms in the sector and the second term in the right-hand side represents the covariance between the relative size and productivity of the firm. The relative size, in relation to the unweighted sector average, is given by Δs_{it}=s_{it}-$\overline{s_t}$ where s_{it} is the employment of firm *i* and

[2] For the advantages and disadvantages of both the input dispersion measures and the OP gap see Gamberoni, Giordano and Lopez-Garcia (2016).

$\overline{s_t}$ is the unweighted employment average. The relative productivity, again with respect to the unweighted sector average, is given by $\Delta p_{it} = p_{it}$-$\overline{p_t}$ where p_{it} is firm-level productivity.

2.2 The measurement of input misallocation using CompNet data

The general description of the Competitiveness Network (CompNet) micro-based database, which we use in this paper, can be found in Lopez-Garcia et al. (2015). We have further acquired data for the Czech Republic. CompNet data sources are different although most countries rely on administrative data (firm registries). The period under study is generally 2003-2012, with some country or sector exceptions. The samples include firms with employees in the non-financial private sector consistent with the definition of category S11 in the European System of Accounts (i.e. excluding sole proprietors). We consider nine sectors of the economy, namely manufacturing, construction and seven service sectors (wholesale and retail trade; information and communication; transportation and storage; food and accommodation services; real estate; professional, scientific and technical services; administrative and support services).

Table 1 provides an overview of the sample coverage and characteristics for the countries under study. In our analysis we consider firms with at least one employee in all countries but Poland and Slovakia, where only firms with at least 20 employees are taken into account.

Table 1. CompNet data coverage

	Exclusion rule?	Coverage *vis-a-vis* population of firms (1)		Coverage *vis-a-vis* National Accounts (2)		Time and sector coverage	
Country		**No. of firms**	**Employment**	**VA**	**Employment**	**Sample period**	**Sectors excluded (deviations from default)**
Croatia	none	32%	36%	-	46%	2002-2012	Tobacco products
Estonia	none	73%	95%	25%	56%	1995-2012	Tobacco products
Hungary	none	44%	88%	20%	50%	2003-2012	Tobacco products
Lithuania	Excluded a few very large firms for confidentiality reasons	27%	43%	20%	46%	2000-2012	Tobacco products
Poland (3)	>9 employees	77%	80%	15%	24%	2005-2012	Veterinary services
Romania	none	70%	47%	29%	37%	2003-2012	Postal and courier services
Slovakia (3)	>19 employees, or total assets>5M.€	91%	95%	-	29%	2001-2011	Tobacco products, Water transport, Warehousing and support activities for transportation, Postal and courier services, Video and television programme production, sound recording and music publishing, Programming and broadcasting services, Insurance services
Slovenia	none	31%	85%	-	46%	1995-2012	Tobacco products

Notes: (1) Source: OECD – Structural Business Statistics; averages over 2004-2007. (2) Source: Eurostat – National Accounts Series; coverage computed for 2005. (3) Coverage computed over the population of firms with 20 or more employees.

In order to compute the dispersion in marginal productivity of inputs we estimate a Cobb-Douglas production function *à la* Levinsohn and Petrin (2003) and Wooldridge (2009) pooling all firms operating in a given country and 2-digit industry over the period of analysis. Details are provided in Appendix A. Using this framework, the average technology coefficients of labour and capital of firms operating in a given country and 2-digit industry are estimated. The next step is to compute MRPK or MRPL, obtained as the product between the estimated coefficients and the average productivity of capital and labour, respectively. Then we purge the time-variation of the marginal productivity of the input at the firm level from developments common to all firms in the 2-digit industry (driven by price dynamics or technology improvements for example) and compute its within-sector standard deviation. Lastly, we compute the dispersion of marginal productivity in the nine mentioned sectors as the median of the standard deviation of marginal revenue productivity of the input across all 2-digit industries in the sector.

2.3 Input misallocation in the CEE region, 2003-2012

In order to analyse country developments, aggregate resource misallocation is computed as a weighted average of the sector-specific MRPK and MRPL dispersions. In particular, we first weighted sector-level input dispersions with the country-specific time-varying sectorial share in total value added shown as solid lines in Figure 1 and then with the 2011 country-specific sectorial share in total value added in order to isolate the “pure” misallocation effect, shown in Figure 1 as dotted lines.[3] The use of both types of weights allows us to assess whether input misallocation in a given country increased because more misallocated sectors increased their weight over time, or because misallocation increased in each of the economic sectors.

The results during the 2003-2012 period are the following. First, time-varying weighted dispersions are close to time-invariant weighted dispersion figures, suggesting that structural changes in the economy over the period considered mattered little in explaining overall misallocation trends. Second, dispersion in MRPK has been on an upward trend at least since the mid-2000s in all countries with the exception of Slovakia, where dispersion was lower at the end compared with the beginning of the period. In particular, this trend appears to have steepened in several countries during the Great Recession, whereas it inverted in the Czech Republic. Third, the dispersion in MRPL increased, albeit to a lesser extent than that in MRPK, in all countries (with the exception of Croatia and the Czech Republic, where it was set on a downward trend since the beginning of the period) and declined after the global financial crisis in the Czech Republic and Lithuania. In contrast, in the remaining countries, during the recessionary phase we observe a decline followed by a resumed growth in labour misallocation. Finally, the descriptive evidence in Figure 1 does not point to any significant difference in input misallocation trends in CEE euro-area vs. non-euro-area countries, a hypothesis we further investigate in our empirical analysis.

Figure 2 shows that an alternative proxy of labour misallocation, i.e. the OP gap, broadly confirms these findings, with the minor exceptions of Croatia, the Czech Republic and Slovakia during the Great Recession where developments appear to be less favourable than those registered by dispersion in MRPL.

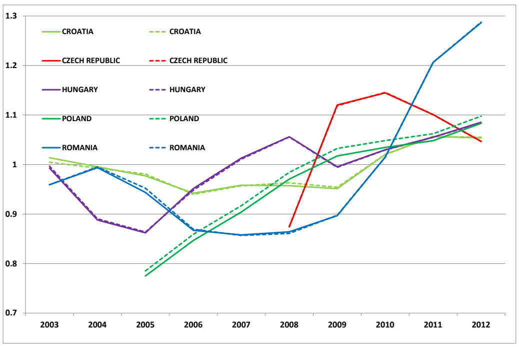
[3] The year 2011 was chosen as it was the last year for which data for all countries and sectors were available.

Figure 1. Capital and labour misallocation in the CEE region by country

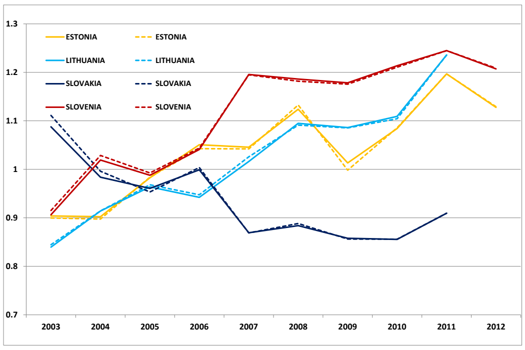
(country-specific weighted averages across sectors)

Dispersion in MRPK

Non-euro-area countries

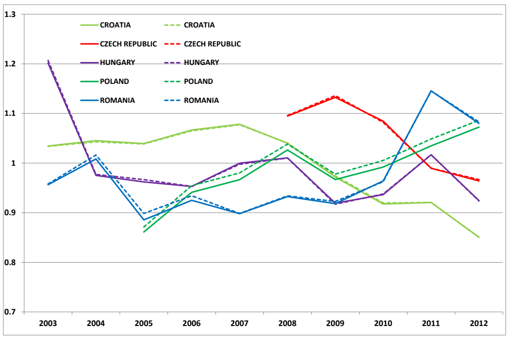


Euro-area countries

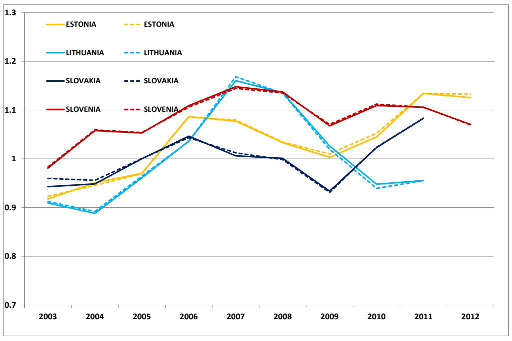


Dispersion in MRPL

Non-euro-area countries



Euro-area countries



Source: Authors' calculations based on CompNet data.

Note: Weighted average values, where the weights are the time-varying country-specific sectorial shares of value added (solid line) or the 2011 country-specific sectorial shares (dotted lines). Data for the Czech Republic are available starting in 2008, for Poland in 2005, while data for Lithuania and Slovakia end in 2011. Data for Poland and Slovakia are based on samples of firms with more than 20 employees.

Turning to the sector averages of yearly growth rates between 2003 and 2012 across the countries under analysis,[4] professional, scientific and technical activities, information and communication technologies, and the wholesale and retail trade sectors display the largest increases in MRPK dispersion (Figure 3 left-hand panel). Average and median values are quite similar across sectors and no sector recorded a decrease in capital misallocation. The largest positive yearly average growth rate in MRPL dispersion is observed instead in manufacturing followed by wholesale and retail trade, and real estate (when looking at the mean) or the information and telecommunication technology (when looking at the median value; Figure 3 right-hand panel). Labour misallocation has actually declined during 2003-2012 in at least four sectors, including

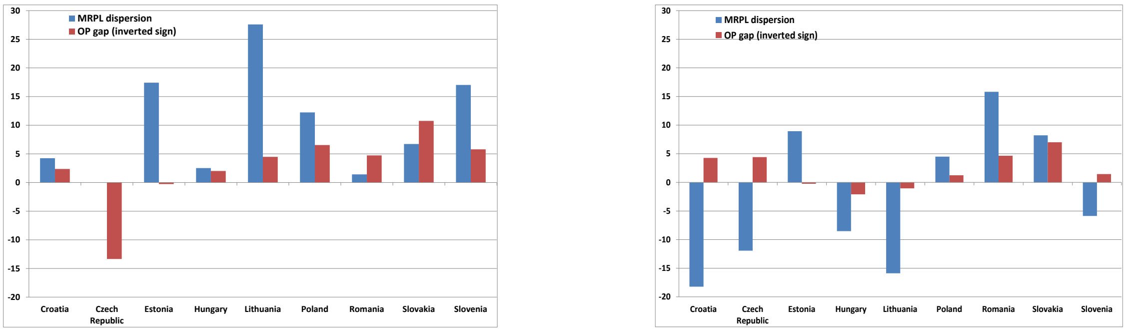
[4] Excluding the Czech Republic for which data are available starting in 2008 and the average rate of the control group. For Poland the cumulative growth rate is calculated using the 2005 and 2012 values.

transportation and storage and construction.

Figure 2. Labour misallocation: a comparison of two alternative measures

(average annual growth rates)

2003-2007 | **2008-2012**



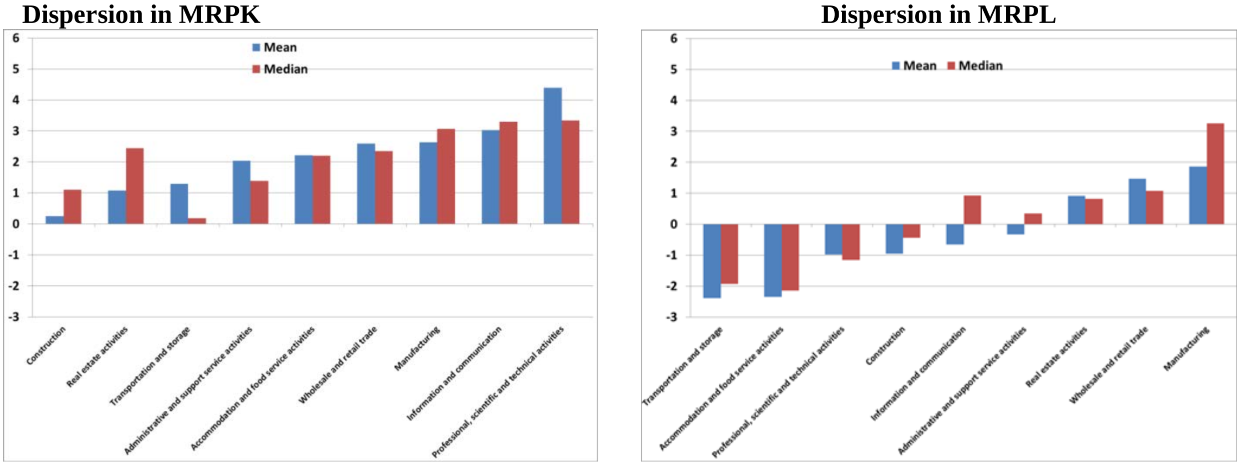
Source: Authors' calculations based on CompNet data.

Note: Weighted average values, where the weights are the time-varying country-specific sectorial shares of value added. The sign of the OP gap is inverted so that an increase in this indicator signals a rise in labour misallocation.

Figure 3. Capital and labour misallocation in the CEE region by sector

(sector-specific unweighted averages across countries; annual average growth rates)

Dispersion in MRPK | **Dispersion in MRPL**



Source: Authors' calculations based on CompNet data.

Note: Simple averages of the yearly 2003-2012 growth rates across CEE countries. Growth rates for Hungary were calculated using the years 2004-2011, for Poland using the years 2005-2012, and for Lithuania and Slovakia using the years 2003-2011. Data for Poland and Slovakia are based on samples of firms with more than 20 employees.

3. Corruption in the CEE region, 2002-2013

Given its illegal nature, the measurement of corruption is not straightforward. Perception-based total-economy indicators, published for example by Transparency International or by the World Bank, are composite measures based on various sources. They have the advantage of good cross-country coverage but they are mainly ordinal measures, providing the relative rankings of each country considered. Moreover, perceptions on corruption may be inaccurate for many reasons. First, Olken (2009) shows that individual characteristics, such as education and gender, have much more power in predicting perceived corruption than actual corruption itself.[5] Second, the perception of corruption is affected by public awareness, public expectations and political bias issues (European Commission 2014). For example, if a country takes stronger action against corruption as a result of a scandal widely covered by the media, thereby contributing to reduce it, perception measures could erroneously signal a negative development in corruption.[6] Moreover, individuals in countries where government consistently underperforms will probably expect less from public officials and therefore provide a more benign view on corruption. Furthermore, the more unpopular the running government the greater dissatisfaction with respect to its policies and the more negative the perceptions on corruption.

In this paper we instead employ firm-level survey-based measures, which, as well as having the advantage of being granular, should also capture actual corrupt transactions between public officials and firms as declared by the latter in interviews.[7] In particular, we use the Business Environment and Enterprise Performance Survey (BEEPS), taken jointly by the World Bank and the EBRD. This survey was carried out on a representative sample of firms in the non-financial private sector in 1999, 2002, 2005, 2009 and 2013 for transition economies.[8]

The drawback of this kind of corruption measure is that mis- or non-reporting may be a serious issue (Jensen, Li and Rahman 2010). Indeed there is evidence that corruption and bribery are amongst the least reported crimes in surveys in that they imply an active involvement of the businesses themselves in the illegal activity (Dugato et al. 2013). However, careful interview techniques and an accurate design of survey questions help in building trust towards the interviewer and avoid implicating the respondent of wrongdoing, thereby encouraging accurate reporting. In particular, BEEPS questions are formulated indirectly by asking whether payments occur for "establishments like this one". By avoiding direct questioning, they increase the ability of the interviewee to potentially reply honestly. BEEPS provides information on both the frequency and the amount of bribes paid by similar firms in the same line of business as the

[5] However, a recent study by Charron (2015) shows that, limited to Europe, perception indicators and citizen survey data on actual corruption are highly consistent.

[6] For instance, Rizzica and Tonello (2015) find that in Italy there is a positive causal relationship between exposure to corruption news and corruption perceptions.

[7] However, entrepreneurs' responses may also reflect their perceptions on corruption. In our paper we partially tackle this problem by disregarding the more perception-based questions in the survey, as explained further on.

[8] We are able to consider the different waves of the BEEPS, although the overall design in the survey has changed over time, since we only draw the measures of bribery, which are consistent across waves, from this source. Accounting information on sales, assets, costs is also missing for 40-50 per cent of the surveyed units in BEEPS, possibly leading to biased inferences on the links between corruption and firm performance, in that firms remain reluctant to provide accounting data that would jeopardize anonymity (Jensen, Li and Rahman 2010; Hanousek and Kochanova 2015). To solve this issue we match the BEEPS corruption data with comparable CompNet data on sectorial performance (Fungacova, Kochanova, and Weill 2015 and Hanousek and Kochanova 2015 match BEEPS with the Amadeus database for the same reason). Another issue in the survey is due to the fact that prior to 2008 only registered companies with 2 or more employees and at least 3 years of activity were eligible for interview, whereas after that year the minimum number of employees was raised to 5 and the age restriction was removed.

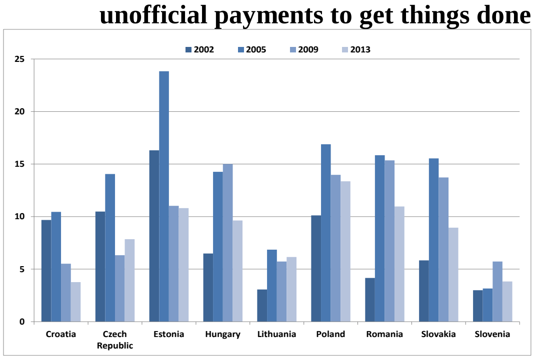
interviewed firm to "get things done", as well as the frequency of bribes paid to deal with courts, pay taxes and handle customs.[9]

Despite the design of the survey questions, not all firms reply to the bribery-related questions, which present "no-response" or "I do not know" options. Figure 4 summarizes the percentage of missing data in each country for these questions. Various findings stand out. First, across countries fewer respondents provide a reply to the question relating to the amount of bribes (panel b) compared to the frequency question (panel a). Second, the countries with the highest non-response rates are Estonia, Poland and Romania for the question relating to the frequency of payments (panel a) and Hungary, Poland and Slovakia for the question relating to the amount of bribes paid (panel b).[10] Third, non-response rates spiked in 2009 in many countries. Fourth, no response rates for the questions relating to the frequency of payments to deal with customs are generally the highest across countries, with the exception of Hungary where bribes to deal with tax administration are highest and in Slovakia where bribery referring to dealings with courts are more likely (panel c).

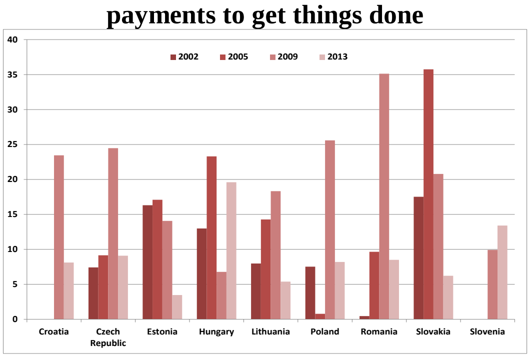
Figure 4. Non-response rates to various BEEPS questions

(percentage shares)

a) Non-response rate for the frequency of unofficial payments to get things done



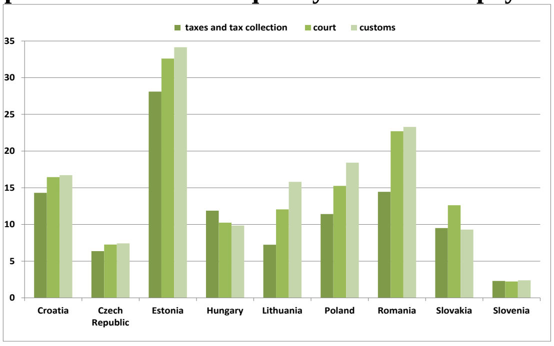
b) Non-response rate for the amount of unofficial payments to get things done



[9] BEEPS also includes a question asking whether the interviewed firm perceives corruption as a major obstacle for the operation and growth of its business. The results to this question in particular may be the object of misreporting, since the question relates directly to the interviewed firm's activity. Moreover, it is based on perceptions rather than on actual experience with bribery. In our empirical analysis we therefore do not consider this variable, similarly to Anos-Casero and Udomsaph (2009).

[10] The high non-response rates in Estonia to the frequency of payments questions in 2005 (which also affect the mean values shown in panel c) is driven mainly by non-responses by firms in the manufacturing, trade and food and accommodation sectors. In the same year the non-response rate of Estonian firms to other BEEPS questions, such as those referring to the perception of the court system or of laws and regulations, was much higher relative to firms in other CEE countries, suggesting low trust in the BEEPS questionnaire as a whole.

c) Non-response rate for the frequency of unofficial payments to deal with…(1)



Source: Authors' calculations based on BEEPS data.
Note: Country averages in the four BEEPS vintages considered in this paper. (1) Averages across the four BEEPS vintages.

Since the non-negligible non-response rate raises concerns about possible selection bias in replying, we estimate whether observable firm characteristics are correlated with missing bribery data. In particular, because the BEEPS sample of firms was selected using stratified random sampling techniques with strata based on firm size, sectors and regions, we here focus only on the 2009 and 2013 survey wave, which contains sample weights to increase the precision of the point estimates.[11] In Table 2 we provide the estimated correlations between the main firm characteristics (namely size, sales, exports, and firm age) and a dummy variable, which takes the value of one if a firm refused to reply to a bribery question. We further control for country and sector fixed effects. As in Svensson (2003), on average we do not find any significant difference between the two groups of firms, answering and refusing to reply to the bribery questions, in either 2009 or 2013, suggesting that the respondents and non-respondents do not differ based on their observable characteristics.

[11] With stratification the probability of selection of each unit is, generally, not the same. Consequently, individual observations must be weighted by the inverse of their probability of selection.

Table 2. Statistical correlations between response rates to alternative BEEPS questions and firm characteristics

2009	Export share				Size (employees)					Size (sales)					Firm age				
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Frequency of bribes to get things done	-1.13				-2.76					-0.03					-0.46				
	(1.84)				(3.69)					(0.16)					(0.69)				
Amount of bribes to get things done		-1.38				-4.14					-0.17					0.146			
		(1.31)				(2.65)					(0.12)					(0.54)			
Frequency of bribes to deal with courts			-0.86				-0.78					-0.06					0.622		
			(1.64)				(2.93)					(0.15)					(0.61)		
Frequency of bribes to deal with taxes				0.654				-3.3					-0.08					0.689	
				(1.44)				(3.48)					(0.17)					(0.62)	
Frequency of bribes to deal with customs									1.546					0.041					-0.21
									(2.63)					(0.13)					(0.66)
R2	*0.18*	*0.18*	*0.18*	*0.18*	*0.065*	*0.065*	*0.064*	*0.065*	*0.065*	*0.142*	*0.143*	*0.142*	*0.142*	*0.142*	*0.073*	*0.072*	*0.073*	*0.073*	*0.072*
N	*2895*	*2895*	*2895*	*2895*	*2866*	*2866*	*2866*	*2866*	*2866*	*2375*	*2375*	*2375*	*2375*	*2375*	*2866*	*2866*	*2866*	*2866*	*2866*
2013	**Export share**				**Size (employees)**					**Size (sales)**					**Firm age**				
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Frequency of bribes to get things done	2.088				0.125					0.22					-0.45				
	(1.78)				(4.16)					(0.18)					(0.65)				
Amount of bribes to get things done		-0.68				-7.321*					-0.13					-0.75			
		(1.77)				(3.83)					(0.16)					(0.63)			
Frequency of bribes to deal with courts			0.858				3.416					0.191					-0.49		
			(1.87)				(3.84)					(0.14)					(0.64)		
Frequency of bribes to deal with taxes				1.808				2.16					0.158					-0.4	
				(1.62)				(3.86)					(0.15)					(0.66)	
Frequency of bribes to deal with customs									1.696					0.177					-0.81
									(3.79)					(0.14)					(0.65)
R2	*0.258*	*0.257*	*0.257*	*0.258*	*0.116*	*0.118*	*0.117*	*0.116*	*0.116*	*0.138*	*0.137*	*0.138*	*0.138*	*0.138*	*0.097*	*0.098*	*0.097*	*0.097*	*0.098*
N	*3248*	*3248*	*3248*	*3248*	*3265*	*3265*	*3265*	*3265*	*3265*	*2277*	*2277*	*2277*	*2277*	*2277*	*3268*	*3268*	*3268*	*3268*	*3268*

* p<0.10, ** p<0.05, *** p<0.01

Weighted least squares regressions controlling for country and sector fixed effects, here not displayed

Notes: Weighted Least Squares regressions controlling for country and sector fixed effects, here not displayed. * p<0.10, ** p<0.05, *** p<0.01. Standard errors are reported in brackets.

Discarding the non-response items, there is evidence of a general fall in the share of firms facing bribes in their sector, as well as a general decrease in the frequency of bribe payments, between 2002 and 2013 (Figure 5, left-hand panel).[12] Furthermore, we observe an overall decline in the percentage of sales spent for unofficial payments in all countries but Croatia and Hungary (Figure 5, right-hand panel).[13] However, in several countries (Bulgaria, Hungary, Poland and to a lesser extent the Czech Republic and Croatia), the frequency of unofficial payments increased between 2009 and 2013, although in 2013 they were lower than in 2002. This increase was even sharper when considering the size of the bribes rather than the frequency. The reason for this hike can be either demand- or supply-driven. One possible explanation could be the concurrent fall in public officials' incomes owing to fiscal consolidation after the global financial crisis which led to them requesting higher amounts. Indeed in Appendix B we show that there is a negative correlation across CEE countries between the change in the amount of unofficial payments and the change in public sector unit wages in the period 2009-2012. Another possible

[12] Owing to our narrow definition of corruption, namely monetary bribes or easily quantifiable bribes in monetary terms, such as irregular gifts, we are not considering a possible substitution effect with other types of harder-to-detect, non-monetary bribes (such as an exchange of favours). Therefore a decrease in monetary bribes could be offset by an increase in alternative non-monetary bribes, for which data are not available. The general decline in corruption is anyhow confirmed by more aggregate indicators (see Appendix B).

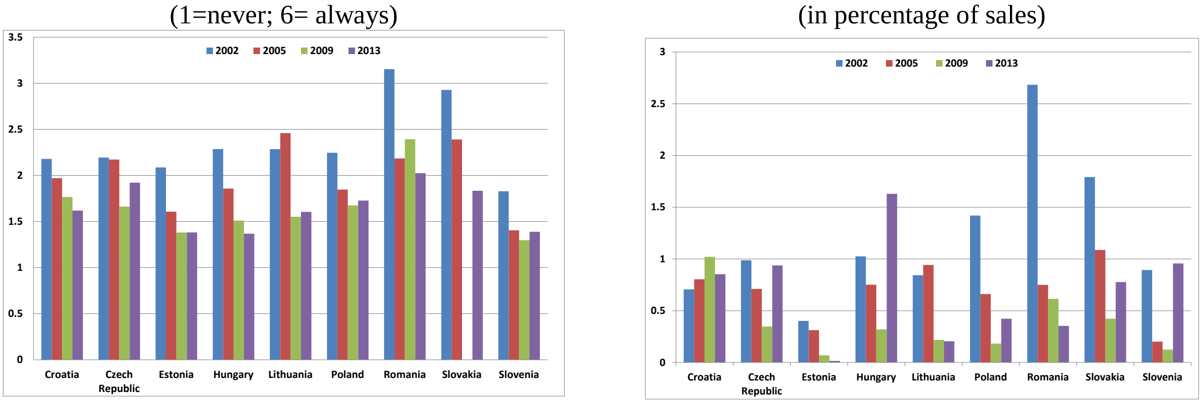
[13] On average over the whole period and across all countries and sectors, 1.8 per cent of total sale revenues were allocated to pay bribes (the median is instead lower, at 0.7 per cent).

explanation is that during the recent recessionary phase firms had to compete more aggressively to obtain more scarce government goods and services, thereby offering to pay higher bribes.

Figure 5. Frequency and amount of bribes to get things done in CEE countries, 2002-2013

Frequency
(1=never; 6= always)

Amount
(in percentage of sales)



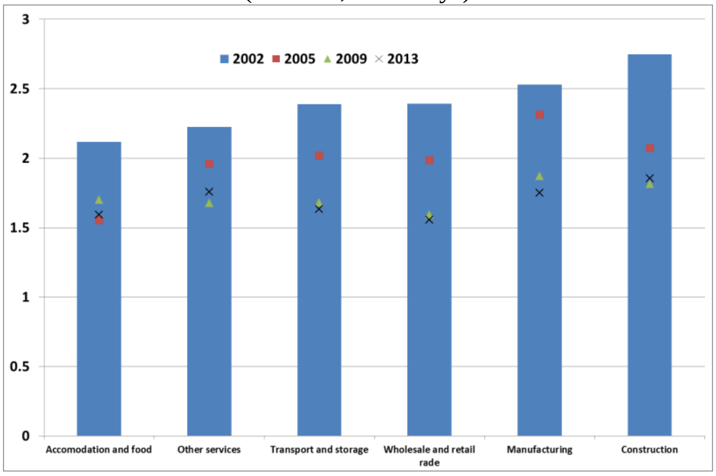
Sources: Authors’ calculations on BEEPS data.
Note: Averages across all firms in a given country and year.

The overall decline recorded in the CEE region is also confirmed by alternative perception-based indicators of corruption, as shown in Appendix B. This general trend has followed a significant strengthening of the anti-corruption framework in the CEE region. At international level this framework was strengthened by joining the United Nations Convention against Corruption. Also the Treaty on the Functioning of the European Union recognises that corruption is a serious crime with a cross-border dimension which Member States are not fully equipped to tackle on their own. In particular, when Bulgaria and Romania joined the EU in 2007, a special "cooperation and verification mechanism" was established to help them address their large shortcomings in the fields of judicial reform, corruption and organised crime in order to favour institutional convergence in the region. Despite the joint effort at the EU level, the implementation of the anti-corruption legal framework remains uneven among CEE countries, as our data show. Moreover, in comparison to all other EU countries, in 2013 the World Bank Control of Corruption indicator was still more unfavourable in CEE countries (Figure B3), suggesting large room for improvement still.

In addition to the total-economy developments described thus far, firms operating in different industries interact with public officials in different ways, as they require different amounts and types of licenses and permits due to the specific characteristics of their production processes which could result in sector differences in terms of corruption (on sectorial evidence of bribery see also Beck, Demirgüc-Kunt and Maksimovic 2005; Reinikka and Svensson 2006; Dugato et al. 2013; European Commission 2014). BEEPS data show that there are indeed significant differences in terms of corruption across sectors, which are broadly consistent with the indicator of sectorial dependence on the public sector constructed by Pellegrino and Zingales (2014), reported in Appendix B. Construction is the sector with both the highest government dependence (Figure B4) and the highest frequency of bribe payments (Figure 6). On the other extreme end of the spectrum, firms in the hotel and restaurant sector, the trade sector and other service sectors are, on average, amongst those least affected by bribery. The country-wide decline in corruption is found to be widespread across sectors, although rarely monotonic. Similarly, amounts paid in bribes, here not shown, are generally higher in the construction and transportation and storage sectors.[14]

Figure 6. Frequency of bribes "to get things done" by sector

(1=never; 6= always)



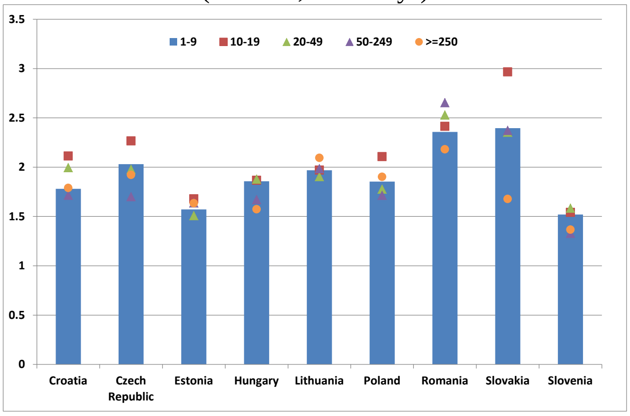
Source: Authors' calculations on BEEPS data.
Note: Average across all firms and all countries for each sector and year.

Finally, BEEPS allows for a disaggregation of bribe data also by firm size. The existing evidence on corruption and firm size is not conclusive. On the one hand, there is some evidence that smaller firms are less affected by bribes, possibly because they are exempted from some regulations and taxes, and therefore encounter demands for bribes less frequently (Hanousek and Kochanova 2015), or simply because larger organizations are more visible to bureaucrats and cannot evade regulations easily (Fisman and Svensson 2007). On the other hand, small and medium-sized firms may operate in markets that are local in nature and therefore this reduces their ability to use a relocation threat in dealing with corrupt officials (O'Toole and Tarp 2014). Beck, Demirgüc-Kunt and Maksimovic (2005) also find that the smallest firms are consistently the most adversely affected by corruption. Figure 7 shows that firms with less than 10 employees and those with more than 250 pay bribes to get things done less frequently than all other firms. Conversely, small to medium-sized firms (depending on the country) are the ones that pay bribes with the highest frequency. This could be because they are not exempt from regulatory procedures, unlike the micro-firms, and they do not have the bargaining power or influence of the large firms. This evidence leads us to believe that there is an inverted-U relationship between bribery frequency and firm size.

[14] These charts, together with country-sector averages, are shown in Gamberoni et al. (2015b). Sectorial patterns are very similar across CEE countries, therefore we computed the average across countries in Figure 6.

Figure 7. Frequency of bribes to get things done by country and by firm size

(1=never; 6= always)



Sources: Authors' calculations on BEEPS data.
Note: Average across all firms in a sector and across all years in a given country.

4. Investigating the links between corruption, input misallocation and TFP growth in the CEE region

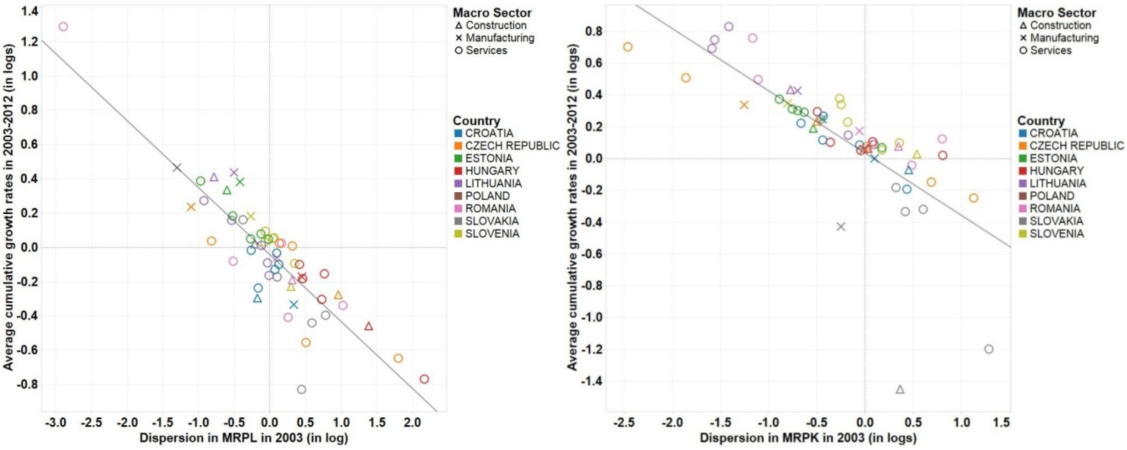
4.1 The structure of the empirical model and OLS baseline results

After having discussed the developments in the CEE region in both capital and labour misallocation on the one hand and in corruption on the other, the paper explores the links between these dynamics. First, we find descriptive evidence of a negative relationship between the growth in capital and labour misallocation and their initial misallocation levels (Figure 8). As well as the fully documented finding of TFP convergence in the literature, we find evidence of a convergence process for allocative efficiency: the further away a sector is from maximum allocative efficiency, the faster the growth in allocative efficiency. Seen from an inverse perspective, the higher the level of misallocation, the lower the subsequent growth in input misallocation.[15]

[15] Convergence in allocative efficiency is also found in the largest euro-area countries in Gamberoni, Giordano and Lopez-Garcia (2016).

Figure 8. Correlations between average annual growth in input misallocation and the initial level of misallocation

Capital misallocation **Labour misallocation**



Source: Authors' calculations on CompNet data.

We therefore consider an equation for total factor productivity and within-sector resource misallocation based on the neoclassical conditional convergence literature (Barro and Sala-i-Martin 2004):

$$(14) \quad \Delta outcome_{t/t-1,i,j} = \alpha_{t,i,j} + \beta outcome_{t0,i,j} + \mu_{t,i,j}$$

where the outcome variable is either TFP or input misallocation (measured by the variance of either capital or labour marginal revenue productivity), Δ indicates cumulative sub-period growth rates, i indicates the country, j indicates the sector, t the time dimension (in particular, 2003, 2005, 2009, 2012 if the variables are in levels and 2003-2005, 2005-2009, 2009-2012 if the variables are expressed in growth rates) and $\mu_{t,i,j}$ are shocks reflecting changes in production conditions or in consumer preferences. The theory implies that the intercept $\alpha_{t,i,j}$ is a function of the steady-state level of the dependent variable and of the rate of exogenous technological progress, which for simplicity may be assumed constant across countries. The model is therefore defined as a "conditional convergence" model in that the growth rate of TFP or input misallocation depends on its initial level, "conditioned" on the steady-state level. β is expected to be negative if there is convergence. In this context, we consider the changes in bribes paid by firms, described in Section 3.2, as changes to the business environment and therefore as the shocks $\mu_{t,i,j}$, whereas the steady-state level of TFP and input misallocation may be affected by other constant or slowly varying country and sector-specific variables. Therefore in the long-run, country-sectors do not necessarily converge to the same misallocation/productivity level but to a common growth rate (Aghion and Howitt 2006); the extent of convergence in the levels is conditioned on country and sector-specific factors, including the institutional, political and geographical setting.

The aim of our empirical analysis is to assess the significance and sign of the link between changes in corruption affecting firms' production processes and within-sector changes in input misallocation. However, the most recent cross-country convergence literature has emphasized the role of nonlinearities and interactions amongst covariates in explaining economic development (see for example Tan 2010). Moreover, the recent corruption literature has suggested that an interplay between corruption and the geographical, political and institutional setting in which bribes take place is common, thereby affecting the impact of corruption on economic growth. In this respect, Rock and Bonnett (2004) find that the relationship between corruption and economic growth depends on the size of the country. Larger countries have relatively big domestic markets and labour supply, which make them less reliant on foreign markets and may help resist pressures from international institutions and from foreign investors to fight corruption. Also, the large size of certain countries may make them more appealing for international investors, who could see bribes as a means to access the large pool of local goods and the labour market. A second, concurrent factor that matters for the empirical relationship between corruption and economic growth is the political economy of corruption. As suggested by Olson (1993), "stationary bandits" in power will monopolize theft (i.e. corruption) in their country while limiting what they steal since they realise their future profits will depend on the incentives of their subjects to invest, flourish and grow. Conversely "roving bandits" have short time horizons and no incentive to limit corruption since seizing assets will be a dominant strategy if their position is unstable. Moreover, from a theoretical standpoint Erlich and Lui (1999) argue that autocratic regimes, which centralize the direction of the administration in a country, similar to governments with a long time horizon, wish to maximize their rents but at the same time internalize the deadweight loss associated with corruption. These regimes therefore have incentives to avoid impairing firms' productivity, incentives that do not exist in more decentralized, democratic regimes where there is a coordination problem. Empirical studies (Mendez and Sepulveda 2006 and Aidt, Dutta and Sena 2008) confirm that the link between corruption and economic growth depends on the type of political regime in power, although the results are more nuanced. Proxies of country size, political stability and the degree of democracy are therefore included in our regressions, also interacted with changes in corruption, in order to verify whether the theoretical findings in the literature are robust in our set of countries.

Moreover, the quality and tightness of the regulations may play a critical role in defining the relationship between corruption and input misallocation. As explained in Section 1, the "grease-the-wheel" theory of corruption mainly rests on the assumption that bribes foster productive activity by speeding up administrative processes and circumventing red tape (e.g. Leff 1964). Another strand of the literature points to corruption being beneficial for growth when the quality of the public institutions is poor and the corruption allows firms to overcome misguided government policies. Méon and Weill (2010), for example, find evidence that corruption is an efficient grease in the economy for countries with less effective institutions, whereas Méon and Sekkat (2005) find the opposite result, that corruption is detrimental under the same conditions. Focusing specifically on CEE countries, De Rosa, Gooroochurn and Görg (2010) show that bribery does not emerge as a second-best option to achieve higher firm productivity in order to circumvent institutional deficiencies. We too attempt to test the "grease-the-wheel" hypothesis.[16]

We first assess whether changes in corruption in a sector are ultimately correlated with sectorial TFP growth. Using OLS we estimate the following regression, in logarithms:

$$(15) \quad \Delta TFP_{t/t-1,i,j} = \beta_0 + \beta_1\, TFP_{2003,i,j} + \beta_2\, \Delta corruption_{t-1/t-2,i,j} + \beta_3\, pop_{t-1,i} + \beta_4\, politicalorg_{t-1,i} + \beta_5 regul_{i,t} + \gamma_j + \theta_i + \tau_t + \varepsilon_{t,i,j}$$

where sector-level TFP growth is dependent on its initial level as well as on shocks in the business environment, captured by changes in business corruption, and on a number of framework conditions, and where γ_j are sector fixed effects, θ_i are country fixed effects, τ_t are time dummies and $\varepsilon_{t,i,j}$ are regression errors.[17]

Once the link between corruption and TFP growth is established, we next explore one of the possible channels which could explain this link, namely the effect of corruption on input misallocation, one important driver of TFP dynamics. We do this by regressing the change in input misallocation on the change in corruption, controlling for framework conditions which might alter this link. More concretely, we run the following OLS regression:

$$(16) \quad \Delta var(MRPI)_{t/t-1,i,j} = \beta_0 + \beta_1\, var(MRPI)_{2003,i,j} + \beta_2\, \Delta corruption_{t-1/t-2,i,j} + \beta_3\, pop_{t-1,i} + \beta_4\, pop_{t-1,i} * \Delta corruption_{t-1/t-2,i,j} + \beta_5\, politicalorg_{t-1,i} + \beta_6\, politicalorg_{t-1,i} * \Delta corruption_{t-1/t-2,i,j} + \beta_7 regul_{i,t} + \beta_8\, regul_{t-1,i} * \Delta corruption_{t-1/t-2,i,j} + \gamma_j + \theta_i + \tau_t + \varepsilon_{t,i,j}$$

where the notation is the same as in Equation (19) and I denotes either capital (K) or labour (L). Differentiating Equation (20) with respect to changes in corruption, we obtain the marginal effect of changes in corruption on changes in input misallocation:

$$(17) \quad (\frac{\delta \Delta MRPI_{i,j}}{\delta \Delta corruption_{i,j}} = \beta_2 + \beta_4\, pop_i + \beta_6\, politicalorg_i + \beta_7\, regul_i$$

[16] Finally, a recent study (Aghion et al. 2016) has investigated the effects of the interplay between political corruption (measured as the number of public officials convicted of crimes) and taxation on GDP across states in the U.S. Whereas corruption per se is not significant in explaining the level of economic development, its interaction with taxation is significant and negative, suggesting that there is an inverted-U relationship between taxation and growth, with corruption reducing the optimal taxation level. Unfortunately cross-country and sectorial data on corporate income tax are not available to our knowledge to allow us to test its contribution together with corruption to input misallocation growth.

[17] The inclusion of fixed effects is known to bias upward the speed of convergence parameter (Barro and Sala-i-Martin 2004; Barro 2015). However, fixed effects are crucial in our analysis to avoid large omitted variable bias as they capture unobserved and persistent country or sector characteristics that affect long-run input misallocation and are also correlated with observed input misallocation dynamics. Moreover, if we do exclude fixed effects from our baseline regressions presented herein, the size of the convergence coefficient does not change significantly in our sample.

In order to investigate the relationship between corruption, TFP growth and input misallocation, we create a new dataset by matching the BEEPS corruption data with similarly disaggregated CompNet data on misallocation and TFP growth within country-sector cells. In particular, as in Fisman and Svensson (2007) and Hanousek and Kochanova (2015), we cluster firms at the year, country and sector level.[18] The sectors we consider are those reported in Section 2.2 with the exception of real estate, professional, scientific and technical services, and administrative and support services, which are grouped together as "other services". In order to match the two datasets, BEEPS data are calibrated as close as possible to the time period covered by CompNet data, which means that BEEPS data for 2002 are assigned to 2003 and BEEPS data for 2013 to 2012. We therefore have data for three sub-periods 2003-2005, 2005-2009, 2009-2012.

Changes in corruption are measured as the changes in a synthetic indicator of the five BEEPS variables on bribes described in Section 3. In particular we compute the first component in a principal component analysis. Since the BEEPS survey questions on corruption refer to the previous three years, changes in corruption are lagged relative to the corresponding changes in input misallocation.

We next include a whole range of contextual variables, for instance, population to measure country size, political stability to proxy the time horizon of public officials, and civil freedom to measure the extent to which citizens of a country are able to participate in the selection of government officials and therefore influence policy choices indirectly (see Appendix C for sources and details). Moreover, we consider two different dimensions of regulation: the restrictiveness of product market regulation and the quality and effectiveness of overall government regulation.

Table 2, column 1 points to a negative correlation between changes in bribes and sectorial TFP growth. Column 2 includes the contextual variables just discussed, which enter the regressions with their expected signs: larger countries or countries with greater political stability have higher TFP growth, whereas countries with more burdensome start-up costs have lower TFP growth.[19] The negative relationship between changes in corruption and TFP growth is also confirmed. In regressions here not shown, when we augment the specification in column 2 with changes in both capital and labour misallocation, the corruption variable loses significance, suggesting the latter affects TFP growth via the input misallocation channel. Moreover, since the existing literature has largely focused on how corruption affects within-firm productivity (e.g. Hanousek and Kochanova 2015; De Rosa, Gooroochurn and Görg 2010), our contribution to the

[18] Unlike the mentioned studies we cannot consider the location or the firm size classes due to data unavailability.

[19] As an alternative explanatory variable to political stability, we also find that countries with more civil liberties have higher TFP growth, whereas the quality of overall regulation does not enter this regression significantly.

literature is to assess whether bribes may affect TFP growth via the alternative misallocation channel.[20]

Table 3. Sectorial TFP growth estimation results

Dependent variable: Sectorial TFP growth **Corruption measure: synthetic indicator of frequency and amount of bribes paid**		
	1	2
corruption (change t/t-1)	-0.0580***	-0.0710***
	(0.0219)	(0.0222)
TFP level in 2003 (ln)	-0.1142	-0.1287*
	(0.0928)	(0.0759)
population (t-1) (ln)		6.1591*
		(3.1625)
political stability (t-1)		1.3637**
		(0.5294)
startup costs (t-1)		-0.1346**
		(0.0661)
Constant	YES	YES
Time dummies	YES	YES
Country dummies	YES	YES
Sector dummies	YES	YES
Observations	105	105
R-squared	0.28	0.39
Adjusted R-squared	0.15	0.25
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1		

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity.

We therefore next explore how corruption affects one of the determinants of TFP growth, input misallocation, according to alternative model specifications. Regression results, referring to Equation 15, are presented in Tables 4a and 4b, where the dependent variable is respectively labour or capital misallocation growth. Column 1 presents the simplest specification, in which corruption dynamics are included on their own with no interaction terms, together with initial misallocation and time, country and sector fixed effects. Column 2 reflects the inclusion of population and its interaction with corruption amongst the explanatory variables. Column 3 provides a richer specification in which political stability and its interaction with corruption are included. Column 4 replaces the political stability variable with the indicator of democracy. Column 5 includes the quality of regulation and its interaction with corruption, whereas column 6 includes start-up costs and their interaction with corruption. The inclusion of one contextual variable and its interaction with corruption at a time is also a way to check the robustness of our results to the choice of control variables.

[20] Micro-aggregated CompNet data do not allow a satisfactory assessment of the effect of corruption on firm-level productivity. The database provides a decomposition of TFP growth *à la* Foster, Haltiwanger and Krizan (2000), but we find no significant effect of changes in corruption on within-firm productivity. This evidence is not to be considered as conclusive however, and we refer to the abovementioned two studies for an assessment of the impact on bribes, measured using BEEPS data as in this paper, on firm-level performance.

Column 1 shows a statistically significant and negative link between changes in corruption and both labour and capital misallocation in CEE countries, which would support the view proffered in studies such as Lui (1985) and Beck and Maher (1986) that corruption can lead to efficient outcomes. However, as shown by the low goodness of fit of the model, this specification is not capturing other significant variables. All other augmented specifications show a statistically significant and positive correlation between changes in corruption and changes in resource misallocation, assuming the conditioning variables size, political stability/degree of democracy and regulation (stringency or quality) are zero.

Since the latter variables are different from zero and most interaction terms are significant and with a negative sign, the overall marginal effect of corruption growth on resource misallocation dynamics, shown in Equation 17, can be better represented graphically. In Figure 9 we plot the point estimates of the marginal impact of growth in corruption on input misallocation dynamics, conditioned respectively on population, on political stability, on the degree of democracy and on regulatory quality, holding all other interacted framework variables constant at their sample mean.[21] Confirming the theoretical predictions in Olson (1993) and the empirical evidence in Rock and Bonnett (2004), in small CEE countries and in those with higher political instability, the overall effect of corruption on input misallocation is positive, thereby suggesting that an increase in bribery leads to an inefficient allocation of resources across firms within a given sector. Our results instead are at odds with Erlich and Lui's (1999) argument, showing that the fewer the civil liberties in a country the larger the positive marginal impact of corruption on input misallocation, implying that in more autocratic regimes the internalization of the deadweight loss of corruption appears to be an excessively benign view on how autocratic political leaders and bureaucrat appointees act in a corrupt environment. Moreover, we can see that in countries with low regulatory quality changes in corruption positively affect input misallocation growth. Across all specifications considered, the marginal effect of changes in corruption is larger on capital, rather than labour, misallocation. This may be due to the fact that bribes are often paid out by firms to obtain permits authorising the expansion of existing productive capacity, thereby affecting investment first and foremost. Finally, columns 6 in Tables 4a and 4b point to the effect of bribery on resource misallocation not depending on the intensity of the regulatory burden in starting up a business, leading to no evidence in favour of the "grease-the-wheel" hypothesis and confirming the comparable finding for a similar set of countries by De Rosa, Gooroochurn and Görg (2010).[22]

[21] In particular, we refer to specifications in column 3 in Table 4a and Table 4b for the first two charts, to column 4 for the third chart and to column 5 for the fourth chart. Charts on the marginal effect of corruption on input misallocation based on actual values for all interacted framework variables simultaneously are also available upon request.

[22] This result is also confirmed when we use an alternative measure of product market regulation, bureaucracy costs taken from the World Economic Freedom (results available upon request). Gamberoni et al. (2015a), focusing on the non-euro-area countries in this sample and using a comparable, yet simplified, specification, found that in sectors with higher start-up costs, the marginal effect of corruption on input misallocation is significantly smaller, suggesting that in these countries bribes may serve a "grease-the-wheel" function relative solely to regulatory barriers to entry. Conversely, in sectors in non-euro-area countries with more restrictive labour market regulation (measured by the hiring regulation indicator sourced from the World Economic Forum) the overall positive effect of corruption on input misallocation was found to be larger relative to the less restricted sectors.

Table 4a. Capital misallocation estimation results

Dependent variable: change in dispersion of MRPK Corruption measure: synthetic indicator of frequency and amount of bribes paid	1	2	3	4	5	6
corruption (change t/t-1)	-0.1328***	1.5976**	4.0580**	6.0503***	2.5755*	4.1695**
	(0.0406)	(0.7430)	(1.6253)	(1.5589)	(1.3720)	(1.6993)
dispersion in mrpk in 2003 (ln)	-0.9057	-0.8279	-0.8353	-0.7417*	-1.0352*	-0.7659
	(0.7612)	(0.7242)	(0.6275)	(0.4154)	(0.6010)	(0.6381)
population (t-1) (ln)		9.3093*	9.5407**	14.1490***	5.0461	11.7994**
		(5.5107)	(4.5819)	(4.5488)	(7.1812)	(5.5087)
population (t-1) (ln) * corruption (change t/t-1)		-0.1095**	-0.2402**	-0.1697***	-0.1511*	-0.2484**
		(0.0474)	(0.0940)	(0.0503)	(0.0797)	(0.0990)
political stability (t-1)			1.5466**		2.4348***	1.8774*
			(0.6558)		(0.8759)	(0.9581)
political stability (t-1) * corruption (t/t-1)			-0.6325**		0.4809	-0.7894**
			(0.2760)		(0.3212)	(0.3325)
civil liberties (t-1)				0.1964***		
				(0.0417)		
civil liberties (t-1) * corruption (t/t-1)				-0.0695***		
				(0.0176)		
regulatory quality (t-1)					-3.5298**	
					(1.3886)	
regulatory quality (t-1) * corruption (t/t-1)					-0.8443***	
					(0.2350)	
startup costs (t-1)						-0.1279
						(0.1130)
startup costs (t-1) * corruption (t/t-1)						0.0437
						(0.0341)
Constant	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES
Observations	105	105	105	105	105	105
R-squared	0.26	0.31	0.44	0.65	0.51	0.45
Adjusted R-squared	0.12	0.17	0.30	0.57	0.38	0.31

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity.

Concerning the other covariates, labour misallocation growth is found to be dependent on initial misallocation values, suggesting a convergence effect amongst sectors and countries; this result is only significant at the margin for capital misallocation. Moreover, both labour and capital misallocation growth is higher in countries with a lower regulatory quality *per se*.[23] Furthermore since a subset of countries has recently joined the euro area, we include a euro-area accession dummy, assigning a value of 1 for the years in which each country was a member, and 0 otherwise.[24] The act of joining the euro area does not appear to affect input misallocation dynamics, although it is worth noting that euro area membership was very recent for the few interested countries in our sample which may therefore not be representative in this sense.[25]

[23] In the case of labour, the regulatory quality coefficient is marginally significant at a 14 per cent confidence level.

[24] Results available upon request.

[25] Slovenia joined the euro area in 2007, Slovakia in 2009 and Estonia in 2011.

Table 4b. Labour misallocation estimation results

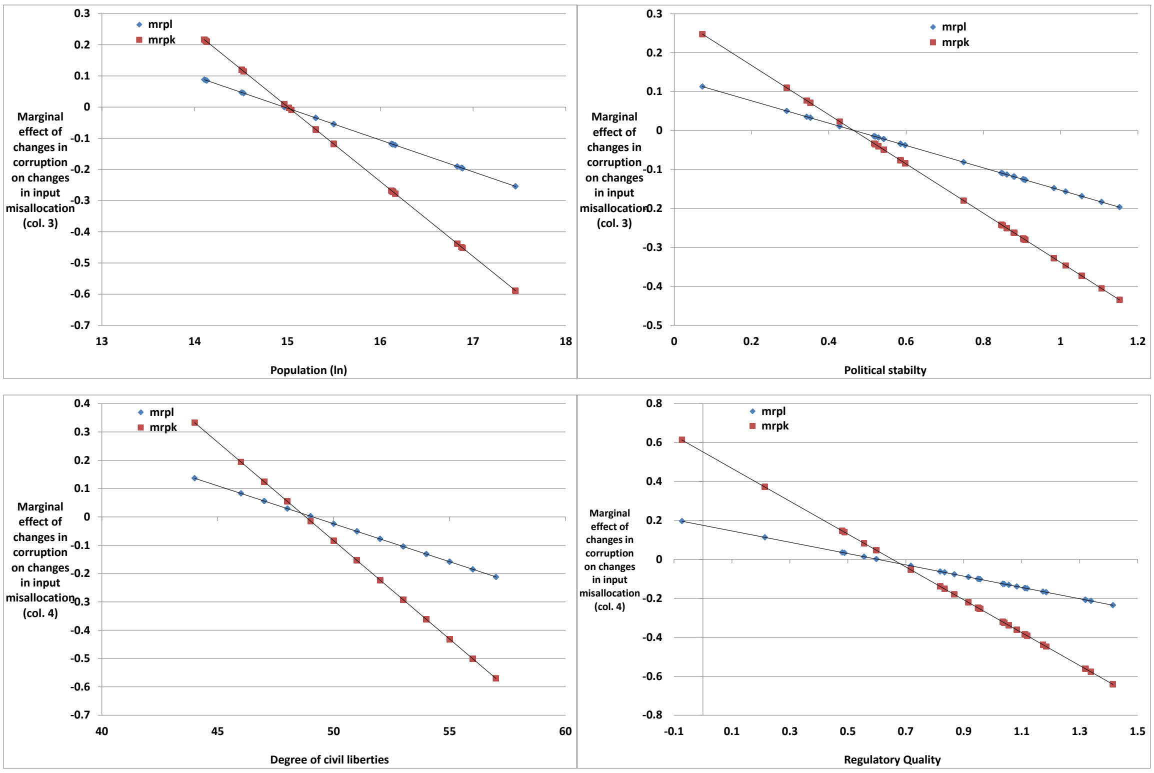
Dependent variable: change in dispersion of MRPL Corruption measure: synthetic indicator of frequency and amount of bribes paid	1	2	3	4	5	6
corruption (change t/t-1)	-0.0470**	0.4718	1.7388*	2.1260*	1.2276	1.7369*
	(0.0203)	(0.3633)	(0.9455)	(1.1324)	(0.8049)	(0.9754)
dispersion in mrpl in 2003 (ln)	-0.5206*	-0.5015	-0.5268*	-0.4695*	-0.5193*	-0.5109*
	(0.2878)	(0.3030)	(0.2802)	(0.2439)	(0.2945)	(0.2858)
population (t-1) (ln)		3.4174	3.1249	5.0592	1.4623	3.7649
		(3.1645)	(2.9829)	(3.2865)	(4.3888)	(3.4196)
population (t-1) (ln) * corruption (change t/t-1)		-0.0330	-0.1021*	-0.0517	-0.0713	-0.1025*
		(0.0233)	(0.0547)	(0.0358)	(0.0466)	(0.0568)
political stability (t-1)			0.1936		0.5105	0.4002
			(0.3428)		(0.4685)	(0.4889)
political stability (t-1) * corruption (t/t-1)			-0.2868*		0.0980	-0.3408*
			(0.1582)		(0.1931)	(0.1828)
civil liberties (t-1)				0.0900***		
				(0.0236)		
civil liberties (t-1) * corruption (t/t-1)				-0.0268**		
				(0.0125)		
regulatory quality (t-1)					-1.2340	
					(0.8175)	
regulatory quality (t-1) * corruption (t/t-1)					-0.2903*	
					(0.1567)	
startup costs (t-1)						-0.0709
						(0.0555)
startup costs (t-1) * corruption (t/t-1)						0.0152
						(0.0171)
Constant	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES
Observations	105	105	105	105	105	105
R-squared	0.26	0.29	0.34	0.54	0.38	0.35
Adjusted R-squared	0.13	0.14	0.19	0.43	0.21	0.18

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity.

Furthermore, capital misallocation dynamics are also positively correlated with size and with political stability/democracy *per se*. This result may reflect the fact that these countries received greater capital inflows (in proportion to GDP) during the 2000s, which for selected euro area countries (Italy, Portugal and Spain) has been found to have increased capital misallocation in the same period (Gopinath et al. 2015). Indeed, a rise in the share of capital inflows in GDP (Appendix C) is found to be positively associated with capital (but not labour) misallocation dynamics when included in the specification in column 1 in Table 4b. However this variable loses significance once we control for population and political stability/democracy, suggesting it suffers from a collinearity problem. We therefore do not include it in our baseline regressions but we show these results in Appendix D.

Figure 9. The marginal effect of corruption on input misallocation dynamics



Notes: See text for explanation.

In Appendix D we also provide regression results for our five alternative BEEPS corruption measures underlying the synthetic measure in the baseline regressions. Changes in the frequency of paying bribes to deal with taxes and to more generally get things done are significantly correlated with input misallocation, as in the case of the synthetic indicator used in our baseline regressions. Conversely, the change in the average amount of bribes paid to get things done, both *per se* and interacted with population and political stability, is not significantly correlated with the dispersion in either MRPL or MRPK. Therefore, what fosters misallocation appears to be the time lost in engaging in bribery practices rather than the amount of resources spent.

4.2 Robustness analysis

Sensitivity analyses conducted on our sample confirms our baseline results.[26] First, we excluded one country or one sector at a time, in order to rule out the possibility of any outliers driving our overall results. Our findings were confirmed with a sample size dropping to around

[26] All results described in this paragraph are available on request.

90 from 105 in each attempt.[27] Second, we excluded the country-sector cells in which the number of firms was less than 4 for the BEEPS corruption measures, with unchanged findings.[28]

In Section 3 we also discussed some total-economy corruption measures, whose impact is likely to differ across sectors despite their aggregate nature. We therefore test whether sectors whose technical and organizational characteristics make them more "exposed" to corruption are relatively worse or better off in countries with a high level of economy-wide corruption, in the vein of Rajan and Zingales (1998). To measure each sector's degree of risk of being exposed to corruption we relied on the indicator of sectorial dependence on the public sector, developed by Pellegrino and Zingales (2014; see Appendix B). We then interacted this measure with the Control of Corruption Index sourced from the World Bank. This alternative sectorial measure of corruption was then included *in lieu* of the BEEPS measures. Our main findings are confirmed (Appendix D) although the goodness of fit of the model is lower with respect to that estimated on BEEPS data.

In Section 2 we also discussed an alternative measure of labour misallocation to dispersion in MRPL. We find that changes in corruption, when conditioning variables are zero, lead to lower OP gap growth, which implies larger labour misallocation growth (Appendix D). In small economies or in economies with a low degree of civil liberties we find that the marginal effect of corruption on the OP gap is negative, suggesting that corruption fosters labour misallocation, as found when using the Hsieh and Klenow (2009) measure.

We also obtain similar findings when we consider corruption in levels, which affect the steady-state of the countries, instead of its changes (Appendix D). The marginal effect of the level of corruption on changes in input misallocation is positive the smaller the country and the weaker the regulatory framework. The interactions with the political variables are instead not significant when considering corruption levels.

Finally, the presented baseline results may be affected by different econometric issues. First, one may be concerned with the reverse causality between input misallocation and corruption. If labour and capital are allocated to the least productive firms, the payment of bribes may be a way for these firms to preserve the *status quo* and to avoid a more efficient allocation of inputs which would damage them. Moreover, changes in corruption could be affected by changes in input misallocation, in that countries with the least misallocation and which are more competitive have more resources to control and combat corruption. We attempt to reduce this possible reverse causality in various ways. First, by considering variables at the cell level we exclude that individual firms can influence market-level outcomes. As argued in Fisman and Svensson (2007), the average amount of bribes at the industry level is determined by the underlying technologies and the rent-extraction inclinations and talents of bureaucrats and is therefore exogenous to firms. As a result, within-sector misallocation across firms should not affect average corruption in that sector. Group averaging is also useful in mitigating

[27] Excluding one sub-period at a time instead led to too few observations to conduct a significant robustness analysis.

[28] On average the number of firms per cell for the corruption variables is approximately 44. A similar threshold of 4 firms was used in Hanousek and Kochanova (2015). The confirmation of our baseline results in this case is unsurprising considering that we dropped only three observations as a result.

measurement error, since errors are largely idiosyncratic to the firm and uncorrelated with average bribery values. Second, by merging two independent datasets the endogeneity concern is further reduced. Third, the data's panel structure allows us to control for sector fixed effects and therefore remove time-invariant sectorial factors that could affect both corruption and resource misallocation.[29] Fourth, our BEEPS corruption measures are backward-looking as they refer to the three-year period preceding the year the survey was conducted, so that they are in fact lagged relative to the dependent variables.

Furthermore, owing to the low goodness of fit of even our richest baseline regressions – which however is in line with that available in the existing literature – our results could be plagued by an omitted variable bias. In particular, it is possible that changes in both input misallocation and in bribes respond simultaneously to an omitted factor in the specification. We attempt to overcome this issue by constructing valid instruments for corruption, that is to say variables that are significantly correlated with our corruption measure but uncorrelated with the error term of equation 16. Moreover, these instrumental variables should have no direct effect on input misallocation growth, except through the corruption variable we are instrumenting.

Our first instrument is the share of women in Parliament. There is evidence in the literature that higher levels of participation of women in politics is associated with lower levels of corruption, either because of their greater risk aversion, fear of punishment in case they get caught, or because bribe seeking and paying is a male-dominated network that excludes women.[30] Since we do not consider legislative corruption, what is relevant for our analysis is the fact that members of Parliament may influence the incidence of bureaucratic corruption through the passage of laws to deter bribery, or the simplification of regulatory and administrative requirements, and through the selection of lower-level government officials. A general trend of increasing female empowerment and greater representation in the CEE region clearly stands out (Appendix C).

Our second, alternative instrument is the degree of freedom of the press. By increasing the threat of exposure, raising public awareness and reducing information asymmetries, freedom of the press can increase the cost of corrupt behaviour for government officials, thereby reducing corruption (Ahrend 2002; Brunetti and Weder 2003). Churchill, Agbodohu and Arhenful (2013) however show that there is a non-linear relationship between freedom of the press and corruption, suggesting the inclusion of a quadratic term in our IV regressions. Figure C7 points to some countries gaining freedom of the press over time, such as the Czech Republic and Romania, and others losing freedom, such as Croatia, Hungary, Lithuania, Poland and Slovenia. Moreover, we find that even for CEE countries there is a non-linear relationship between freedom of the press and corruption.

First, we verify that both female representation in Parliament and freedom of the press do not correlate with changes in input misallocation by including them in the baseline regressions.

[29] Given the short time span of our analysis the likelihood that these sectorial unobservable factors are constant is quite high.

[30] See, for example, Dollar, Fisman and Gatti (1999), Swamy et al. (2001), who also find a significant relationship between changes in female representation and changes in corruption, as in our paper, and, more recently, Brollo and Troiano (2016).

The variables are not significant and the significance and sign of all other covariates are preserved.[31] Next, in the first stage of a two-stage least squares (2SLS) framework we find that both instruments, expressed in changes, are significantly correlated with changes in corruption and with the expected negative sign predicted by the literature (Table 5).[32] In the case of freedom of the press, it is found to correlate negatively with corruption (i.e. higher freedom of the press implies less corruption) until a certain threshold, confirming Churchill, Agbodohu and Arhenful's (2013)'s findings.[33] Our second-stage results – referring only to the specification in column 3 of Table 4a and Table 4b for the sake of brevity – are presented in Table 6a and Table 6b, confirming all our baseline findings concerning the relationship between corruption and input misallocation.[34]

Table 5. Correlations between corruption and female representation in Parliament and (the square) of freedom of the press

Dependent variable: synthetic indicator of frequency and amount of bribes paid		
	1	2
dispersion in mrpk in 2003 (ln)	-0.7255	-0.8672
	(-1.017)	(0.9699)
population (t-1) (ln)	-1.7518	30.65768*
	(-18.3739)	(18.0966)
political stability (t-1)	-5.2647***	-6.52277**
	(-1.7821)	(2.4598)
female representation in Parliament	-2.1465**	
	(1.0217)	
female representation in Parliament* political stability	0.9983**	
	(0.4976)	
female representation in Parliament*population	0.0944	
	(0.0628)	
press freedom		-11.4087**
		(-4.8250)
press freedom*political stability		2.2515**
		(0.8830)
press freedom*population		0.5173*
		(0.2738)
press freedom squared		0.0291**
		(0.0118)
Constant	YES	YES
Time dummies	YES	YES
Sector dummies	YES	YES
Country dummies	YES	YES
Observations	99	105
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1		

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity. Column 1 is based on the share of women in Parliament and column 2 on freedom of the press as an instrumental variable, respectively.

[31] Also, Durbin's and Wu-Hausman's tests reject the null hypothesis at a 5 per cent confidence level that corruption is an exogenous indicator, suggesting OLS is not an efficient estimator.

[32] Shea's partial adjusted R-squared is approximately 0.2 in both cases, which is satisfactory given the limited number of observations and therefore the degrees of freedom.

[33] Since we consider both the level and the square of freedom of the press, we also conduct a Sargan test of overidentifying restrictions, which categorically cannot reject the null hypothesis that our instruments are valid (p-value 0.82).

[34] As both instruments are total-economy variables, we include the Pellegrino and Zingales (2014) sectorial dependence on Government services variable *in lieu* of sectorial dummies amongst the control variables, although results do not change significantly when keeping the sector fixed effects. The charts reporting the marginal impact of corruption instrumented by female representation in Parliament or by freedom of the press on input misallocation are available upon request.

Table 6a. IV estimation results for capital misallocation

Dependent variable: change in dispersion of MRPK **Corruption measure: synthetic indicator of frequency and amount of bribes paid**	1	2
corruption (change t/t-1)	10.1532**	16.2387***
	(4.0176)	(6.2050)
dispersion in mrpk in 2003 (ln)	-1.0618*	-1.4971
	(0.5975)	(1.0689)
population (t-1) (ln)	11.4808	14.3117
	(7.2821)	(9.2743)
population (t-1) (ln) * corruption (change t/t-1)	-0.5739**	-0.8968***
	(0.2306)	(0.3454)
political stability (t-1)	0.8815	-0.8821
	(0.9404)	(1.4189)
political stability (t-1) * corruption (t/t-1)	-2.1390***	-4.1869***
	(0.6920)	(1.5321)
Constant	YES	YES
Time dummies	YES	YES
Sector dummies	YES	YES
Country dummies	YES	YES
Observations	99	105

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6b. IV estimation results for labour misallocation

Dependent variable: change in dispersion of MRPL **Corruption measure: synthetic indicator of frequency and amount of bribes paid**	1	2
corruption (change t/t-1)	4.1890*	7.5188**
	(2.2724)	(3.0646)
dispersion in mrpl in 2003 (ln)	-0.5926**	-0.7265**
	(0.2474)	(0.3568)
population (t-1) (ln)	2.6642	4.8446
	(3.9395)	(5.5478)
population (t-1) (ln) * corruption (change t/t-1)	-0.2338*	-0.4129**
	(0.1299)	(0.1712)
political stability (t-1)	0.1076	-0.9124
	(0.4380)	(0.6876)
political stability (t-1) * corruption (t/t-1)	-0.8948**	-1.9684***
	(0.3956)	(0.7474)
Constant	YES	YES
Time dummies	YES	YES
Sector dummies	YES	YES
Country dummies	YES	YES
Observations	99	105

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Note: Estimations are run using a 2SLS procedure. See the text and Appendix C for details on the instruments used.

5. Conclusions

Aggregate TFP growth reflects both within-firm competitiveness and the contribution stemming from the degree of (in)efficiency with which production factors in a sector are allocated across firms. Corruption may affect competitiveness both directly, by enhancing or deteriorating firm performance, and indirectly by affecting input misallocation. This paper focuses on how corruption influences TFP growth via the input misallocation channel in CEE countries. Both the theoretical and empirical literature provides inconclusive results.

An indicator of input misallocation widely used in the recent literature is the dispersion in the marginal revenue productivity of labour (MRPL) or capital (MRPK) across firms within a given sector. According to CompNet data, dispersion in MRPL rose slightly until the recent recessionary phase and declined thereafter, although only temporarily in some countries. Conversely, capital misallocation has increased sharply since the mid-2000s. To measure corruption we employ BEEPS, a survey taken in 2002, 2005, 2009 and 2013, to derive information on both the frequency and amount of bribes paid to "get things done" in general, as well as the frequency of bribes paid specifically to deal with courts, pay taxes and handle customs. Starting from levels that were quite high in 2002, economy-wide corruption has decreased, although not monotonically and with varying intensity in CEE countries. The frequency of bribery, and its changes, also varies across sectors and firm size classes.

By combining BEEPS and CompNet data we create a unique dataset employed to investigate the link between corruption and TFP growth and, in particular, input misallocation in a neoclassical conditional convergence framework. First, higher corruption growth is found to be negatively correlated with TFP dynamics. Next we explore whether this correlation is partially explained by the effect of bribery on resource allocation across firms. We find that in small countries and in countries with low political stability, corruption boosts input misallocation. This is consistent with the fact that in small countries corruption cannot be offset by other productivity-enhancing factors and because bribe-seeking governments who stay in power for longer are more interested in the growth performance of their economy with respect to "roving bandits". Moreover, we find that corruption fosters input misallocation in countries in the CEE region with a lower degree of civil liberties, a result which is at odds with Erlich and Lui's (1999) theoretical argument that the negative impact of corruption on economic development is smaller in autocratic countries. Finally, the positive impact of changes in corruption on input misallocation is a decreasing function of the general quality of the regulatory environment, providing evidence against the general argument that corruption may be beneficial when institutions are weak. Our results are robust also to the adoption of instrumental variables for corruption, in particular the share of seats held by women in Parliament and the degree of freedom of the press.

In conclusion, we provide evidence that the link between corruption and input misallocation is conditional on the geographical, institutional and political setting: targeted action against corruption should therefore be embedded in a more comprehensive strategy of institutional reform. Anti-corruption measures appear to be more efficiency-enhancing when implemented in small, politically unstable or more autocratic economies. Furthermore, improving the quality and the effectiveness of the regulatory environment is a means to foster faster TFP growth directly, but also indirectly by reducing the positive marginal impact corruption exerts on input misallocation.

Appendix A. The measurement of input misallocation using CompNet data

As a first step in order to compute the dispersion in marginal productivity of inputs we estimate a Cobb-Douglas production function *à la* Levinsohn-Petrin-Wooldridge, pooling all firms operating in a given country and 2-digit industry over the period of analysis. This methodology tackles the simultaneity bias emerging from the fact that the firm observes productivity and then chooses the amount of inputs to produce. The choice of labour and capital therefore depends on the unobserved (for the econometrician) productivity shock. To understand the simultaneity bias, consider the following Cobb-Douglas production function:

(A1) $Y_{it} = A_{it}K_{it}^{\beta_K}L_{it}^{\beta_L}$

Where Y is value added of firm i at time t, K and L are inputs and A is the Hicksian neutral efficiency level of the firm. Y, L and K are econometrically observed whereas A is not, although it is known by the firm i .

Taking equation (A1) in logs:

(A2) $y_{it} = \beta_0 + \beta_K k_{it} + \beta_L l_{it} + \omega_{it} + u_{it}$

where $\ln(A_{it}) = \beta_0 + \omega_{it} + u_{it}$, with β_0 representing the mean-efficient level across firms and over time and $\omega_{it} + u_{it}$ representing a firm-specific deviation from that mean. The first component refers to an unobserved firm-level time-variant productivity level, known by the firm, and the second component is an i.i.d. error term representing unexpected (by the firm) shocks, and therefore independent of the rest of the explanatory variables.

Equation (A2) could be consistently estimated by OLS only if the firm's variable input choices are independent of the unobserved shocks, including firm-level productivity. This is very unlikely since productivity is observed by the firm. Therefore it will influence the choice of the optimal bundle of inputs. If this endogeneity issue is ignored, the technology coefficients of labour will be upward biased. If labour is the only freely available input and capital is quasi-fixed (Levinsohn and Petrin 2003), the technology coefficient of capital will be downward biased. One of the solutions provided for solving this problem was introduced by Olley and Pakes (1996). They proposed using observed input choices to instrument for unobserved productivity. Although their initial choice was to use investment, Levinsohn and Petrin (2003) noted that the strict monotonicity of the investment function, with respect to productivity and capital, was broken given the many zeroes reported by firms. Hence they proposed as an alternative solution to proxy productivity with the demand for intermediate inputs, instead of investment demand, that is $m_{it} = \mathrm{h}(k_{it}, \omega_{it})$, which is strictly increasing in productivity and, therefore, from which productivity can be inverted out. Moreover, there are few missing or zero observations in variables such as energy or some other intermediate input consumption at the firm level. Finally, Wooldridge (2009) showed a method to implement this approach in a Generalised Methods of Moments (GMM) framework which can deliver more efficient estimators.

Using this framework, the average technology coefficients of labour and capital of firms operating in a given country and 2-digit industry are estimated. The next step is to compute the marginal revenue productivity of capital or labour. Starting from Equation A2, it is easy to show that the marginal productivity revenue of capital (MRPK) is equal to:

(A3) $\mathrm{MRPK}_i = \beta_K \frac{Y_i}{K_i}$

and the marginal productivity revenue of labour (MRPL) is equal to:

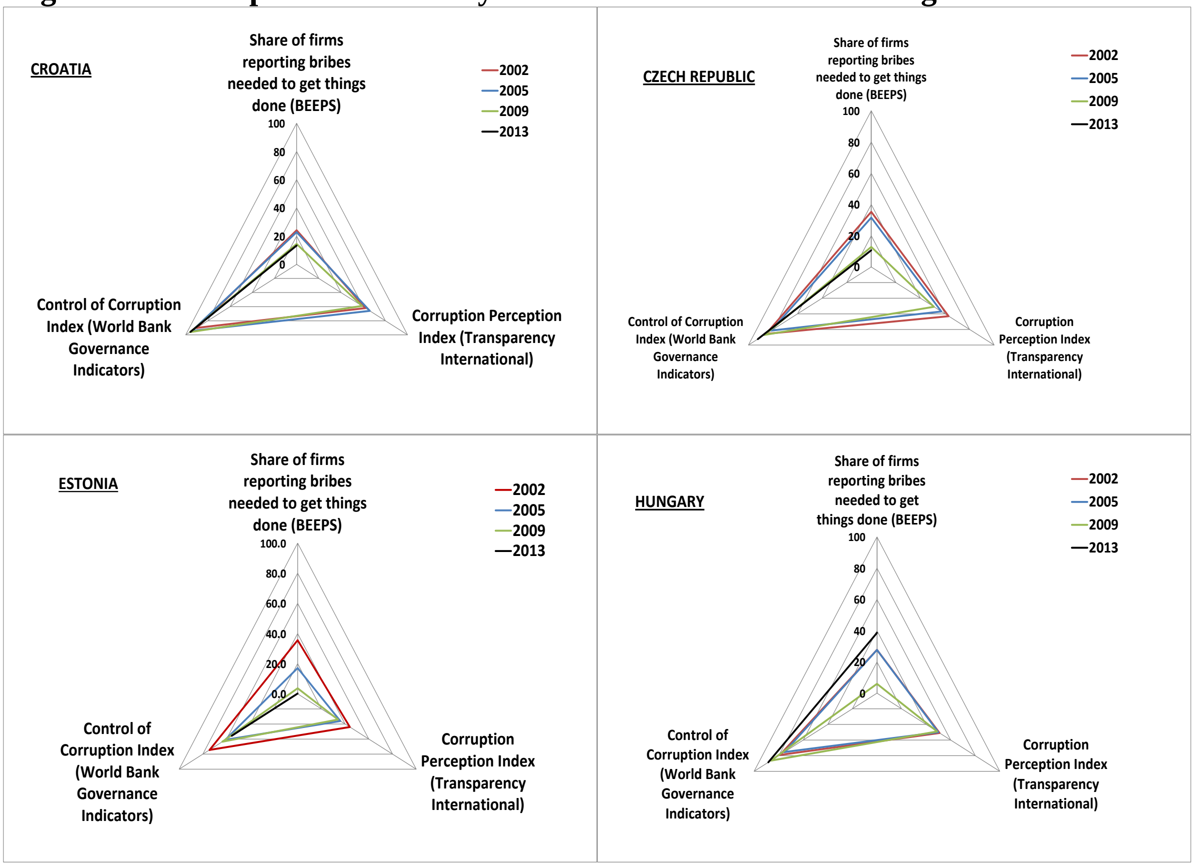
(A4) $\mathrm{MRPL}_i = \beta_L \frac{Y_i}{L_i}$

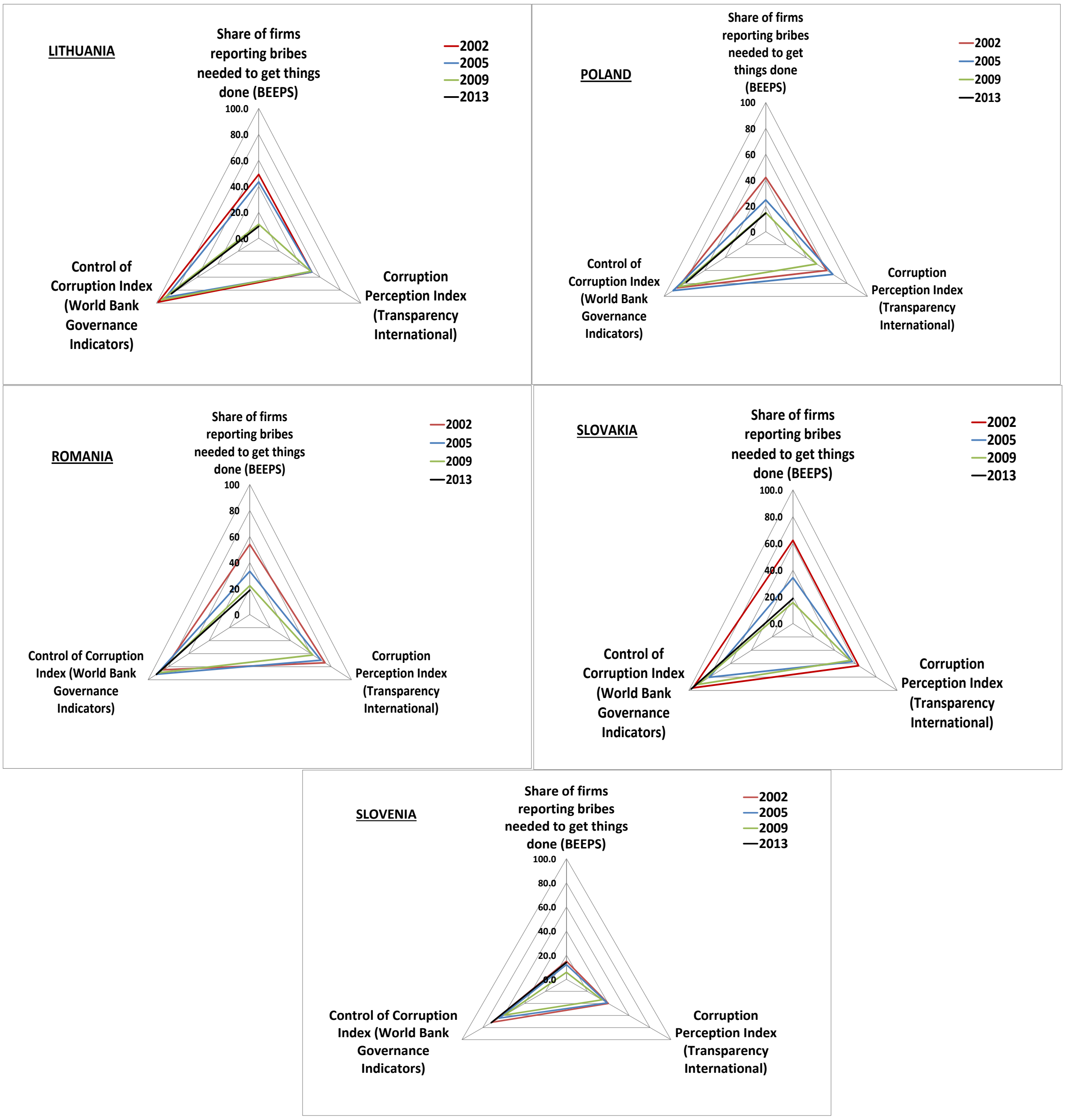
In particular, the real stock of capital is defined as the book value of fixed tangible assets deflated with the GDP deflator and labour as the full-time-equivalent average number of employees in year *t*. Next, we purge the time-variation of the marginal productivity of the input at the firm level from developments common to all firms in the 2-digit industry (driven by price dynamics or technology improvements for example) and compute its within-sector standard deviation. Lastly, we compute the dispersion of marginal productivity in a given macro-sector as the median of the standard deviation of marginal revenue productivity of the input across all 2-digit industries in the macro-sector.

Appendix B. Aggregate developments in corruption in CEE countries

Based on the available indicators with satisfactory time and country coverage, we can analyse the broad developments in corruption in the countries under study. In particular, we adjust the World Bank's Control of Corruption and Transparency International's Corruption Perception indices so that they vary between 0 and 100 and signal a rise in corruption when they increase. On the basis of BEEPS data, we also consider the share of firms that pay additional, irregular payments or give gifts to officials to "get things done" with regards to customs, taxes, licences, regulations etc. in the surveyed firm's line of business. Country charts that include these three measures in Figure B1 show that in general corruption declined over the past decade in most CEE countries (with the black lines representing 2013 generally contained within the others referring to previous years), with the exception of Hungary. The pace of progress in reducing corruption was, however, different across countries, generally decreasing more in countries with higher initial levels, and not necessarily monotonically over time.

Figure B1. Corruption in selected years in CEE countries according to alternative measures

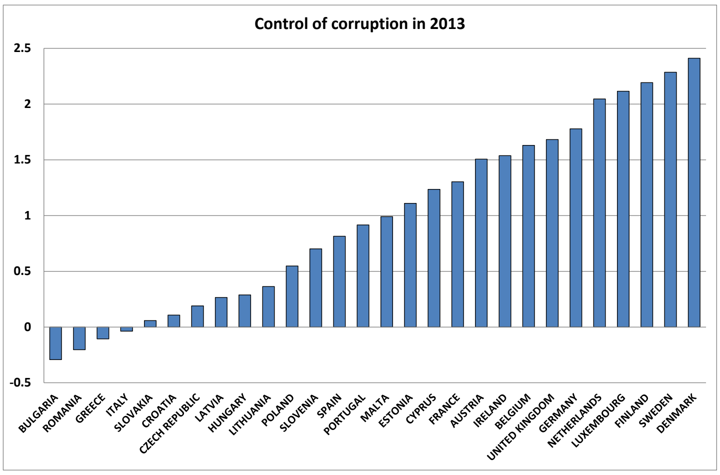




Sources: Authors' calculations on Transparency International, World Bank Governance Indicators and BEEPS data. Note: All measures have been adjusted to range between 0 and 100 and a rise in all indicators indicates an increase in corruption. The selected years are those for which the BEEPS was taken. The Corruption Perception Index in 2013 is not comparable with that referring to the previous years so it is not reported here.

Moreover, as shown in Figure B2, in 2013, the last year for which data are available, the ranking of CEE countries within the EU was still unfavourable, suggesting large room for improvement remains.

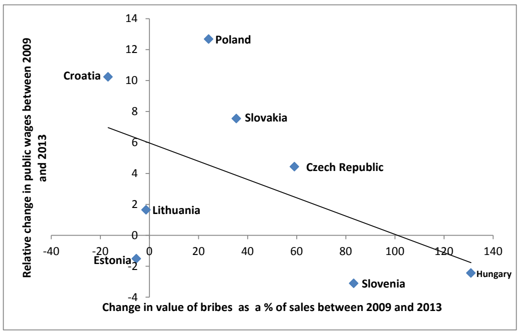
Figure B2. The cross-country ranking of corruption in 2013 within the EU



Sources: World Bank Governance Indicators.
Note: The bars are point estimates of the quality of governance in controlling corruption, which range from -2.5 (weak) to 2.5 (strong).

In Figure B3 we find a negative correlation between the wage growth of employees in the public sector in 2009-2012 and the amount of bribes that firms were requested to make across CEE countries. This descriptive evidence points to a possible explanation of the increase in corruption, according to this measure, during the recent recessionary phase. It is noteworthy, however, that the amount of bribes paid in 2013 was anyhow lower than that reported in 2002.

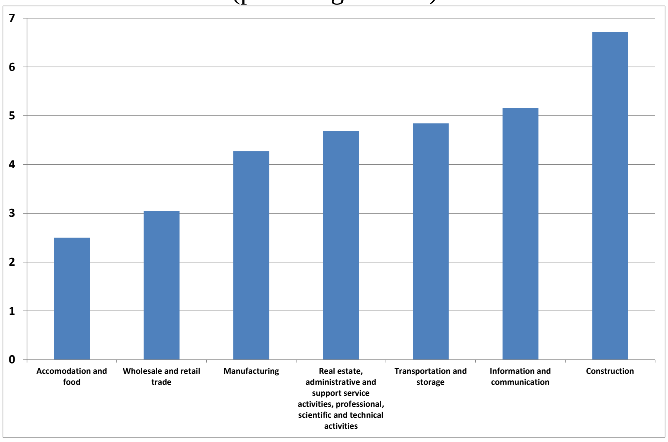
Figure B3. Correlation between the amount of bribes and changes in public sector wages



Source: Authors' calculations on Eurostat and BEEPS data.
Note: Compensation per employee refers to the public administration and defence, compulsory social security, education, human health and social work activities. Series are at current prices and expressed in national currency.

Pellegrino and Zingales (2014) compute the percentage of news articles on a certain sector containing the words "government", "regulation" and "aid" in the Factiva News Search Database over the period 2000-2012. We aggregated their indicators on 21 sub-sectors to obtain the macro-sectors considered in this paper and plotted them in Figure B4. We find a similar ranking to the frequency of paying bribes by sector according to BEEPS, described in Section 3.

Figure B4. Dependence on public services by sector
(percentage shares)

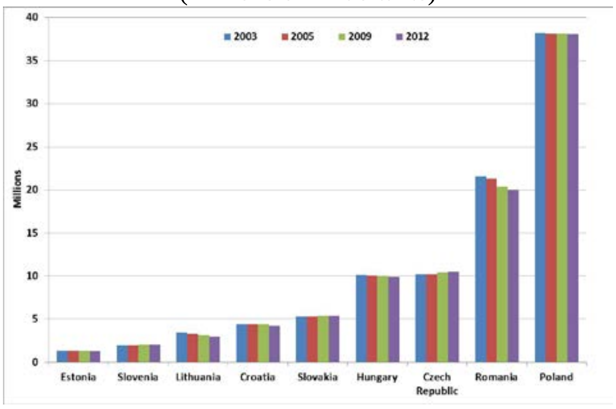


Source: Authors' calculations on Pellegrino and Zingales' (2014) data.
Note: Unweighted averages across the sub-sectors provided by Pellegrino and Zingales (2014).

Appendix C. Further information on contextual variables in our regression analysis

Population, sourced from Eurostat, is heterogeneous across CEE countries, yet broadly stable across the years, with the exception of Romania where it visibly decreased owing to emigration (Figure C1). The smallest country in the sample is Estonia, whereas Poland is by far the largest, followed by Romania.

Figure C1. Population
(millions of inhabitants)



Source: Eurostat.

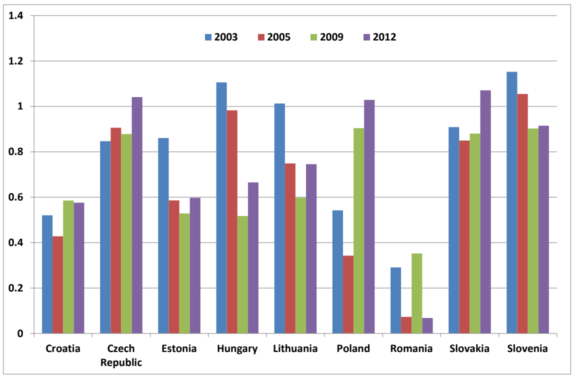
The time horizon of public officials is measured by an indicator of political stability from the World Bank Governance Indicators,[35] whereas the civil freedom indicator is taken from Freedom House. Romania and Croatia score very badly in terms of both political stability and civil freedom (Figures C2 and C3). Conversely, the CEE countries that stand out best are Slovakia for political stability and the Czech Republic and Estonia for civil liberties.

Concerning the measure of regulatory stringency, we take the average of the time and number of procedures it takes to start a new limited liability business from the Doing Business database thereby capturing barriers to entry and *ex ante* anti-competitive practices. These indicators are available at the country level. To disentangle start-up costs' sector-specific impact we follow Andrews and Cingano (2012), who use the U.S. establishment entry rate, sourced from the Census Bureau's Longitudinal Business Database, as an index of "natural" sectorial exposure to entry barriers (since industries with high natural entry barriers will also present low entry). We consider the U.S. numbers to provide the technologically-driven "natural" entry rate of a given sector because the U.S. is a country with low barriers to entry relative to the European countries considered in this paper. We therefore interact the aggregate start-up cost variable and the 2003-2007 sector-specific U.S. firm entry rate to obtain a sectorial measure of the stringency of product market regulation. The second dimension of regulation we consider is the World Bank's Governance Indicator on regulatory quality. As this is a more general assessment of the soundness of government regulations and policies we include it at the aggregate level. We find

[35] We are implicitly assuming that top bureaucrats are political appointees and not independent career civil servants, which is the case at least for some high-level positions also in democratic countries.

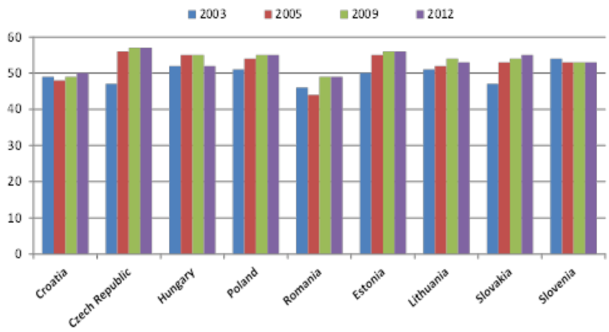
that there is much scope for improvement concerning the stringency and quality of regulation in the CEE region. Although barriers to entry have fallen in the area as a whole since 2003, the quality of overall regulation still remains weak in some countries such as Croatia and Romania (Figure C4).

Figure C2. Political stability



Source: World Bank Governance Indicators.
Note: The indicator measures perceptions of the likelihood of political instability and politically-motivated violence. It varies between -2.5 (weak political stability) and +2.5 (high political stability).

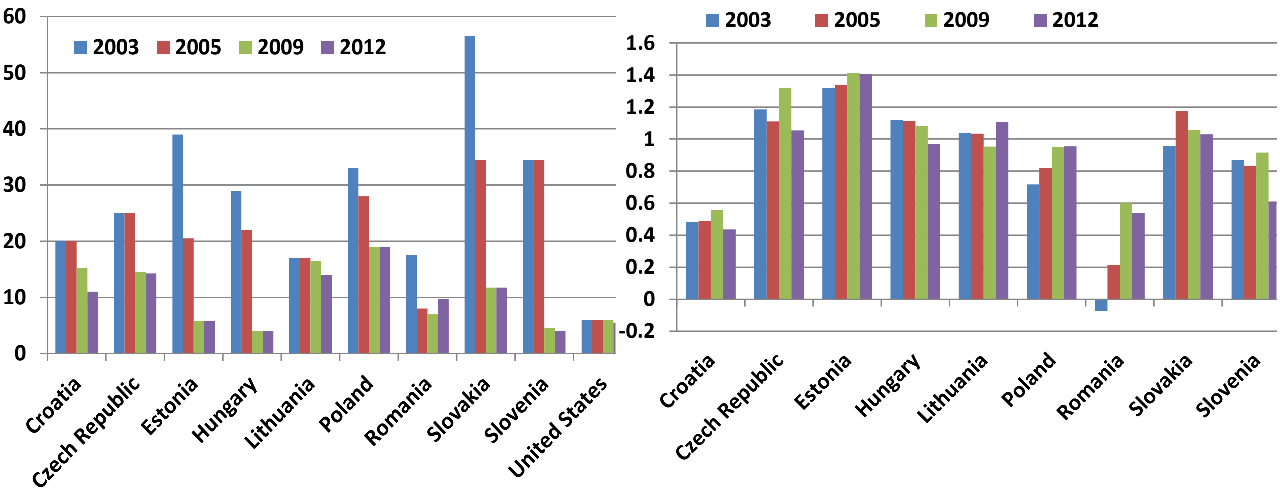
Figure C3. Civil freedom



Source: Freedom House.
Note: The indicator varies from 0 to 60 and an increase signals an improvement in civil liberties.

Figure C4. Regulation

Start up-costs | **Quality of regulation**



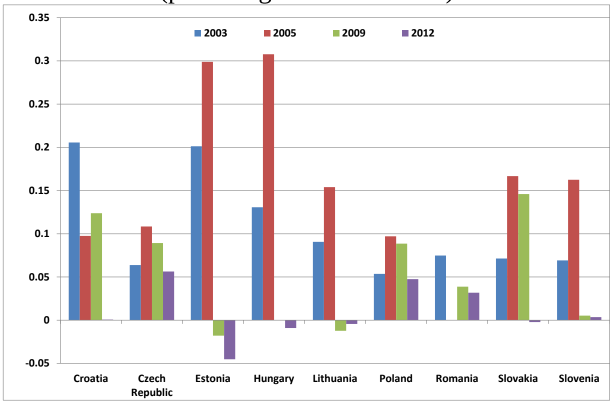
Source: Authors' calculations on Doing Business and on Census Bureau's Longitudinal Business Database.
Note: Data on start-up costs in the U.S. refer to U.S. NYC.

Source: World Bank Governance Indicators.
Note: The regulatory quality indicator captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. It varies between -2.5 (weak) and +2.5 (high).

In the run-up to the global financial crisis, capital inflows sourced from the IMF represented 30 per cent of the GDP in Estonia and Hungary and under 20 per cent in all other CEE countries (Figure C5). During the recent recessionary phase inflows dropped dramatically and in some countries, such as Estonia, Hungary and Lithuania, disinvestment ensued.

Figure C5. Capital inflows

(percentage shares of GDP)



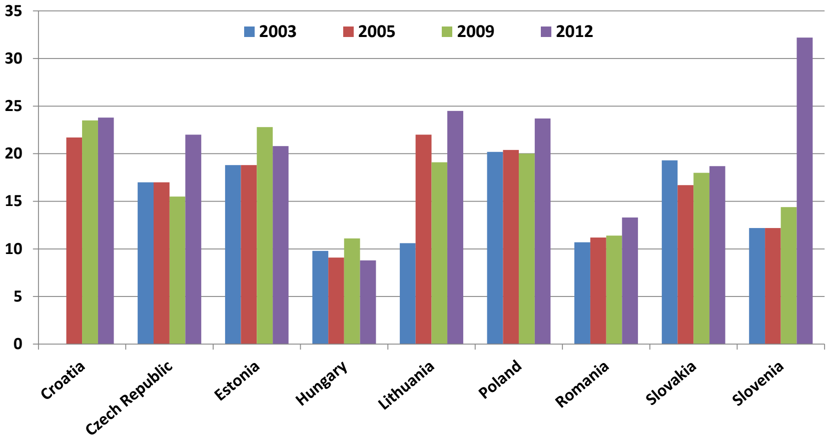
Source: IMF.

Notes: Data for the Czech Republic and Slovenia for 2009 refer to 2010; data for Estonia for 2012 refer to 2011; data for Hungary and Poland for 2005 refer to 2006; data Romania for 2009 and 2012 refer to 2010 and 2011, respectively.

The share of women in Parliament, taken from the Inter-Parliamentary Union, has increased since 2003 in the CEE region (Figure C6). Two notable exceptions are Hungary and Slovakia, where it slightly decreased over the whole period considered. In Hungary female representation is currently the lowest in the sample.

Figure C6. Seats in Parliament occupied by women

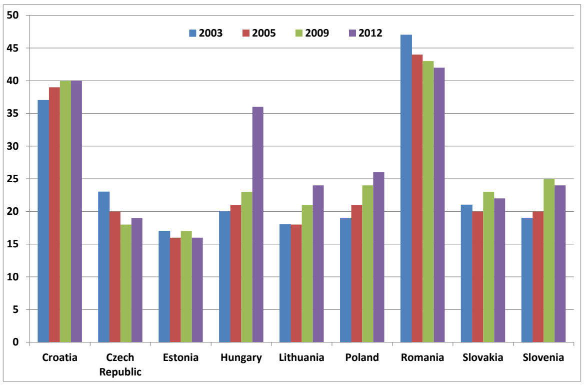
(percentage shares)



Source: Inter-Parliamentary Union.

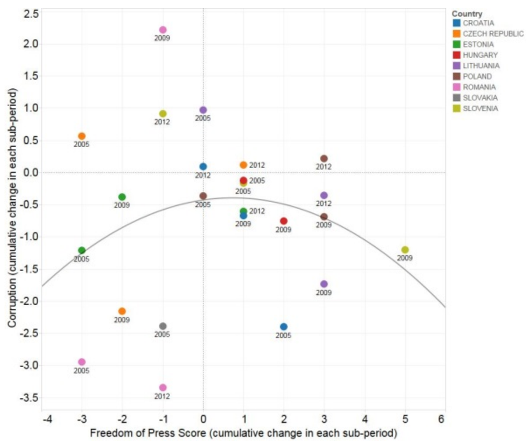
Freedom of the press, sourced from Freedom House, is currently the lowest in Romania and Croatia (Figure C7). However, in Romania it has increased since 2003, whereas in Croatia it has diminished. The country in the sample where the media is afforded the most freedom is Estonia, followed by the Czech Republic. Churchill, Agbodohu and Arhenful (2013) show that in a sample of 133 countries there is a quadratic relationship between freedom of the press and corruption. Indeed we also find that in CEE countries a decrease in freedom of the press (i.e. moving to the right along the horizontal axis in Figure C8) is associated with higher growth in corruption until a certain threshold after which decreases in freedom of the press are associated with decreases in corruption.

Figure C7. Freedom of the press



Source: Freedom House.
Note: The indicator is based 23 questions, divided into three broad categories: legal, political and economic environment. The final indicator (from 0 to 100) represents the total of the scores allotted for each question, with lower scores indicating greater freedom. The legal environment category encompasses laws and regulations that could influence media content and the extent to which they are used in practice to restrict the media’s ability to operate. The degree of political control over the content of news media is also evaluated. The economic environment includes the structure of media ownership, the cost of establishing media, impediments to news production and distribution and the extent to which the economic situation in a country affects the development of the media.

Figure C8. Correlation between freedom of the press and corruption



Source: Authors’ calculations on BEEPS and Freedom House data.
Note: A decrease in the Freedom of the Press Score implies higher freedom of the press.

Appendix D. Robustness checks on our regression results

This Appendix contains a range of robustness checks on our baseline regression results presented in Section 4 and commented therein.

Table D1. Controlling for capital inflows in the capital misallocation regression

Dependent variable: **change in dispersion of MRPK** **Corruption measure: synthetic indicator of frequency and amount of bribes paid**			
	1	2	3
corruption (change t/t-1)	-0.1338***	3.9388**	2.5473*
	(0.0404)	(1.6193)	(1.3832)
dispersion in mrpk in 2003 (ln)	-0.8934	-0.8337	-1.0300*
	(0.7511)	(0.6266)	(0.6030)
population (t-1) (ln)		9.3419**	4.9167
		(4.5246)	(7.1460)
population (t-1) (ln) * corruption (change t/t-1)		-0.2329**	-0.1493*
		(0.0936)	(0.0804)
political stability (t-1)		1.5312**	2.4221***
		(0.6442)	(0.8752)
political stability (t-1) * corruption (t/t-1)		-0.6315**	0.4595
		(0.2767)	(0.3267)
regulatory quality (t-1)			-3.4847**
			(1.3896)
regulatory quality (t-1) * corruption (t/t-1)			-0.8271***
			(0.2393)
capital inflows (t/t-1)	1.2916*	0.8111	0.3231
	(0.7599)	(0.6783)	(0.6227)
Constant	YES	YES	YES
Time dummies	YES	YES	YES
Country dummies	YES	YES	YES
Sector dummies	YES	YES	YES
Observations	105	105	105
R-squared	0.28	0.44	0.51
Adjusted R-squared	0.13	0.30	0.37
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1			

Notes: Estimates are obtained via OLS with White’s correction for heteroskedasticity.

Table D2a. Correlations between changes in the frequency of paying bribes for specific purposes and changes in labour misallocation

Dependent variable: change in dispersion of MRPL												
Corruption measure: various BEEPS measures	FREQ COURTS				FREQ TAXES				FREQ CUSTOMS			
	1	2	3	4	1	2	3	4	1	2	3	4
corruption (change t/t-1)	-0.1344**	4.8413	4.8369	1.6978	-0.2863***	6.0187**	7.8616***	4.8101*	-0.2410***	2.8165	2.2715	3.4076
	(0.0629)	(3.3126)	(4.1336)	(3.2936)	(0.0925)	(2.7534)	(2.7572)	(2.6459)	(0.0826)	(1.9109)	(2.6622)	(2.2113)
dispersion in mrpl in 2003 (ln)	-0.5157*	-0.5427*	-0.5382**	-0.5571*	-0.5393**	-0.5271**	-0.4980**	-0.5485**	-0.5073*	-0.4968*	-0.5584**	-0.4944*
	(0.2715)	(0.2819)	(0.2383)	(0.2823)	(0.2563)	(0.2539)	(0.2231)	(0.2580)	(0.2658)	(0.2711)	(0.2278)	(0.2780)
population (t-1) (ln)		1.6279	0.6411	-3.7499		1.9244	2.0806	-2.1949		0.9752	2.0832	-2.3492
		(2.8683)	(2.5330)	(3.9177)		(2.5341)	(2.1734)	(3.2617)		(2.7050)	(2.4663)	(3.5697)
population (t-1) (ln) * corruption (change t/t-1)		-0.2922	-0.0811	-0.0968		-0.3549**	-0.2084*	-0.2755*		-0.1705	-0.0055	-0.2023
		(0.1916)	(0.1179)	(0.1893)		(0.1619)	(0.1126)	(0.1546)		(0.1101)	(0.0881)	(0.1281)
political stability (t-1)		0.0922		0.5827		0.3392		0.7603**		0.0035		0.2668
		(0.2851)		(0.4188)		(0.2637)		(0.3787)		(0.2454)		(0.3283)
political stability (t-1) * corruption (t/t-1)		-0.5707		1.0969		-1.0624**		-0.4260		-0.5920		0.3189
		(0.5962)		(0.7044)		(0.4127)		(0.4387)		(0.4159)		(0.3949)
civil liberties (t-1)			0.0913***				0.0871***				0.0844***	
			(0.0241)				(0.0224)				(0.0213)	
civil liberties (t-1) * corruption (t/t-1)			-0.0711				-0.0921***				-0.0459	
			(0.0522)				(0.0254)				(0.0289)	
regulatory quality (t-1)				-1.7525**				-1.0590*				-1.2691**
				(0.6855)				(0.5416)				(0.5530)
regulatory quality (t-1) * corruption (t/t-1)				-1.3178***				-0.5149**				-0.8345**
				(0.4997)				(0.2386)				(0.3292)
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	130	130	130	130	130	130	130	130	130	130	130	130
R-squared	0.2051	0.2278	0.4016	0.3007	0.2639	0.3346	0.4885	0.3678	0.2561	0.2795	0.4161	0.3454
Adjusted R-squared	0.0844	0.0776	0.285	0.149	0.152	0.205	0.389	0.231	0.143	0.139	0.303	0.203

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table D2b. Correlations between changes in the frequency of paying bribes for specific purposes and changes in capital misallocation

Dependent variable: change in dispersion of MRPK												
Corruption measure: various BEEPS measures	FREQ COURTS				FREQ TAXES				FREQ CUSTOMS			
	1	2	3	4	1	2	3	4	1	2	3	4
corruption (change t/t-1)	-0.4325***	10.1572	12.5428	2.7932	-0.7304***	17.1447***	19.1592***	14.5385***	-0.5579***	6.4362	8.2624	7.1147
	(0.1449)	(7.5271)	(7.7934)	(6.9641)	(0.2210)	(5.4056)	(5.2409)	(5.1087)	(0.1799)	(4.2977)	(5.6803)	(4.9657)
dispersion in mrpk in 2003 (ln)	-0.4036	-0.4065	-0.4888	-0.4070	-0.4903	-0.5123	-0.7295**	-0.5746	-0.6512	-0.7072	-0.7235	-0.7151
	(0.6316)	(0.5988)	(0.4734)	(0.5345)	(0.5635)	(0.4204)	(0.3242)	(0.4073)	(0.6174)	(0.6092)	(0.4568)	(0.5557)
population (t-1) (ln)		7.4317	5.3645	-6.8846		8.5523*	8.0933**	-1.0138		5.4155	7.4428*	-4.4843
		(5.2817)	(4.3837)	(6.9633)		(4.3847)	(3.8295)	(5.9910)		(4.9939)	(4.1107)	(6.7577)
population (t-1) (ln) * corruption (change t/t-1)		-0.6230	-0.3243	-0.1701		-1.0219***	-0.6528***	-0.8469***		-0.3992	-0.1460	-0.4289
		(0.4374)	(0.2318)	(0.4017)		(0.3175)	(0.2058)	(0.2980)		(0.2449)	(0.1857)	(0.2866)
political stability (t-1)		1.2658**		2.5968***		1.8112***		2.8482***		1.1673**		2.0039**
		(0.5579)		(0.7944)		(0.4723)		(0.6694)		(0.5547)		(0.8087)
political stability (t-1) * corruption (t/t-1)		-1.1044		1.7013		-2.6481***		-0.8018		-1.0137		0.8793
		(1.2342)		(1.3445)		(0.8603)		(0.9603)		(0.9730)		(0.8012)
civil liberties (t-1)			0.2246***				0.2166***				0.2176***	
			(0.0453)				(0.0379)				(0.0413)	
civil liberties (t-1) * corruption (t/t-1)			-0.1502				-0.1797***				-0.1237**	
			(0.0933)				(0.0496)				(0.0618)	
regulatory quality (t-1)				-3.9917***				-2.5747***				-3.3101***
				(1.2465)				(0.9410)				(1.0683)
regulatory quality (t-1) * corruption (t/t-1)				-1.9890*				-1.5415**				-1.7185**
				(1.0240)				(0.6017)				(0.6637)
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	130	130	130	130	130	130	130	130	130	130	130	130
R-squared	0.1767	0.2644	0.4863	0.3551	0.2589	0.4557	0.5863	0.5095	0.2254	0.3033	0.5113	0.3965
Adjusted R-squared	0.0517	0.121	0.386	0.215	0.146	0.350	0.506	0.403	0.108	0.168	0.416	0.266

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates are obtained via OLS with White’s correction for heteroskedasticity.

Table D3a. Correlations between changes in the frequency/amount of paying bribes to get things done and changes in labour misallocation

Dependent variable: change in dispersion of MRPL								
Corruption measure: frequency of bribes to get things done a	**FREQUENCY BRIBES**				**AMOUNT BRIBES**			
	1	2	3	4	1	2	3	4
corruption (change t/t-1)	-0.1357**	4.1813**	5.3452**	4.0590**	0.0023**	-0.1446	-0.3118	-0.1313
	(0.0679)	(1.8297)	(2.2026)	(1.7863)	(0.0010)	(0.1352)	(0.2130)	(0.1567)
dispersion in mrpl in 2003 (ln)	-0.4883*	-0.4975*	-0.5071**	-0.4674*	-0.5143*	-0.5121*	-0.4699*	-0.5114*
	(0.2725)	(0.2646)	(0.2335)	(0.2733)	(0.2994)	(0.2829)	(0.2425)	(0.2869)
population (t-1) (ln)		1.5974	3.4543	-3.4435		1.8701	1.0835	-4.3311
		(2.6820)	(2.5061)	(3.9140)		(2.7619)	(2.5155)	(3.9665)
population (t-1) (ln) * corruption (change t/t-1)		-0.2510**	-0.1514*	-0.2273**		0.0086	0.0173*	0.0085
		(0.1077)	(0.0767)	(0.1042)		(0.0085)	(0.0100)	(0.0099)
political stability (t-1)		0.1649		0.7513*		0.5626		1.0813**
		(0.2583)		(0.4157)		(0.4033)		(0.5165)
political stability (t-1) * corruption (t/t-1)		-0.6073*		-0.2056		0.0322		0.0298
		(0.3205)		(0.2746)		(0.0210)		(0.0197)
civil liberties (t-1)			0.0809***				0.1057***	
			(0.0208)				(0.0250)	
civil liberties (t-1) * corruption (t/t-1)			-0.0609***				0.0010	
			(0.0229)				(0.0019)	
regulatory quality (t-1)				-1.5607**				-1.3296**
				(0.7469)				(0.6184)
regulatory quality (t-1) * corruption (t/t-1)				-0.5229**				-0.0194
				(0.2398)				(0.0223)
Constant	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES	YES	YES
Observations	130	130	130	130	105	105	105	105
R-squared	0.2216	0.2800	0.4560	0.3344	0.2260	0.2716	0.5002	0.3226
Adjusted R-squared	0.103	0.140	0.350	0.190	0.0853	0.0981	0.381	0.141
Robust standard errors in parentheses.								
*** p<0.01, ** p<0.05, * p<0.1								

Table D3b. Correlations between changes in the frequency /amount of paying bribes to get things done and changes in capital misallocation

Dependent variable: change in dispersion of MRPK								
Corruption measure: frequency of bribes to get things done and amount of bribes	**FREQUENCY BRIBES**				**AMOUNT BRIBES**			
	1	2	3	4	1	2	3	4
corruption (change t/t-1)	-0.2876*	7.7276**	10.1198**	6.2803	-0.0009	-0.2192	-0.7679*	-0.1998
	(0.1462)	(3.8979)	(4.5105)	(4.0379)	(0.0021)	(0.3118)	(0.4597)	(0.3622)
dispersion in mrpk in 2003 (ln)	-0.5761	-0.6638	-0.6752	-0.5439	-0.7587	-0.7449	-0.6225	-0.7211
	(0.6350)	(0.5857)	(0.4234)	(0.5352)	(0.8194)	(0.7283)	(0.5236)	(0.6470)
population (t-1) (ln)		5.9149	9.2597**	-8.7642		6.2704	3.5763	-9.1554
		(5.0983)	(4.4851)	(7.2872)		(4.5641)	(3.9572)	(7.1315)
population (t-1) (ln) * corruption (change t/t-1)		-0.4736**	-0.2802*	-0.3456		0.0121	0.0348	0.0127
		(0.2285)	(0.1626)	(0.2364)		(0.0192)	(0.0228)	(0.0225)
political stability (t-1)		1.5584***		3.0876***		2.4283***		3.6807***
		(0.5665)		(0.8638)		(0.8158)		(1.0073)
political stability (t-1) * corruption (t/t-1)		-0.9339		-0.2705		0.0694		0.0578
		(0.6940)		(0.5772)		(0.0505)		(0.0460)
civil liberties (t-1)			0.2180***				0.2499***	
			(0.0396)				(0.0453)	
civil liberties (t-1) * corruption (t/t-1)			-0.1175**				0.0048	
			(0.0459)				(0.0043)	
regulatory quality (t-1)				-4.0558***				-3.2815***
				(1.3381)				(1.1550)
regulatory quality (t-1) * corruption (t/t-1)				-0.9187**				-0.0404
				(0.4594)				(0.0493)
Constant	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES	YES	YES
Observations	130	130	130	130	105	105	105	105
R-squared	0.1738	0.2929	0.5334	0.3716	0.1702	0.3125	0.5732	0.3899
Adjusted R-squared	0.0484	0.155	0.443	0.235	0.0193	0.149	0.472	0.226
Robust standard errors in parentheses.								
*** p<0.01, ** p<0.05, * p<0.1								

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity.

Table D4a. Correlations between changes in the sectorialized Control of Corruption indicator and changes in labour misallocation

Dependent variable: change in dispersion of MRPL Corruption measure: Sectoralized control of corruption	1	2	3	4
corruption (change t/t-1)	0.0155	2.2208***	3.1604**	2.5985**
	(0.0356)	(0.7337)	(1.2106)	(1.0060)
dispersion in mrpl in 2003 (ln)	-0.5146**	-0.5201**	-0.5177**	-0.4986**
	(0.2566)	(0.2515)	(0.2253)	(0.2451)
population (t-1) (ln)		-0.7008	-0.5833	-10.9071***
		(2.5199)	(2.6202)	(3.4886)
population (t-1) (ln) * corruption (change t/t-1)		-0.1295***	-0.0855*	-0.2100***
		(0.0461)	(0.0473)	(0.0696)
political stability (t-1)		-0.0169		1.1199**
		(0.2256)		(0.4570)
political stability (t-1) * corruption (t/t-1)		-0.2922		0.4022
		(0.1838)		(0.4102)
civil liberties (t-1)			0.0583***	
			(0.0193)	
civil liberties (t-1) * corruption (t/t-1)			-0.0348**	
			(0.0168)	
regulatory quality (t-1)				-2.5442***
				(0.7348)
regulatory quality (t-1) * corruption (t/t-1)				0.0598
				(0.2134)
Constant	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES
Observations	154	154	154	154
R-squared	0.1520	0.1810	0.3057	0.3223
Adjusted R-squared	0.0460	0.0507	0.195	0.202

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table D4b. Correlations between changes in the sectorialized Control of Corruption indicator and changes in capital misallocation

Dependent variable: change in dispersion of MRPK Corruption measure: Sectoralized control of corruption	1	2	3	4
corruption (change t/t-1)	0.1164	2.7854*	6.7703***	3.7114*
	(0.0758)	(1.4524)	(2.2544)	(2.1163)
dispersion in mrpk in 2003 (ln)	-0.3796	-0.3706	-0.3640	-0.3958
	(0.5549)	(0.5076)	(0.3930)	(0.3881)
population (t-1) (ln)		2.3278	2.4499	-20.2619***
		(4.5270)	(4.1686)	(5.7859)
population (t-1) (ln) * corruption (change t/t-1)		-0.1430	-0.1519	-0.3270**
		(0.0925)	(0.1026)	(0.1414)
political stability (t-1)		1.2652***		3.7753***
		(0.4613)		(0.9106)
political stability (t-1) * corruption (t/t-1)		-0.5865*		1.0072
		(0.3515)		(0.7819)
civil liberties (t-1)			0.1794***	
			(0.0381)	
civil liberties (t-1) * corruption (t/t-1)			-0.0806***	
			(0.0300)	
regulatory quality (t-1)				-5.6198***
				(1.3336)
regulatory quality (t-1) * corruption (t/t-1)				0.0792
				(0.4586)
Constant	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES
Observations	154	154	154	154
R-squared	0.1272	0.2096	0.4258	0.3773
Adjusted R-squared	0.0181	0.0838	0.334	0.267

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity.

Table D5. Baseline estimation results with the OP gap as the labour misallocation measure

Dependent variable: cumulative change in dispersion of lopgap **Corruption measure: synthetic indicator of frequency and amount of bribes paid**	1	2	3	4	5	6
corruption (change t/t-1)	0.0016	-0.2083***	-0.4223**	-0.6169**	-0.4954**	-0.3786*
	(0.0048)	(0.0784)	(0.2012)	(0.2377)	(0.2217)	(0.2091)
dispersion in lopgap in 2003 (ln)	-0.1029	-0.1034	-0.1061	-0.0942	-0.1094	-0.1109
	(0.0991)	(0.0966)	(0.0938)	(0.0867)	(0.0938)	(0.0939)
population (t-1) (ln)		-1.2727**	-1.1736*	-2.1764***	-2.0041*	-0.7527
		(0.6365)	(0.6570)	(0.6006)	(1.0571)	(0.7743)
population (t-1) (ln) * corruption (change t/t-1)		0.0133***	0.0253**	0.0242***	0.0298**	0.0225*
		(0.0048)	(0.0115)	(0.0077)	(0.0129)	(0.0121)
political stability (t-1)			0.0805		0.1507	0.1014
			(0.0693)		(0.1002)	(0.0926)
political stability (t-1) * corruption (t/t-1)			0.0394		0.0434	0.0147
			(0.0330)		(0.0425)	(0.0413)
civil liberties (t-1)				0.0066		
				(0.0055)		
civil liberties (t-1) * corruption (t/t-1)				0.0049*		
				(0.0026)		
regulatory quality (t-1)					-0.1399	
					(0.1406)	
regulatory quality (t-1) * corruption (t/t-1)					0.0018	
					(0.0382)	
startup costs (t-1)						-0.0143
						(0.0193)
startup costs (t-1) * corruption (t/t-1)						0.0062
						(0.0065)
Constant	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES
Observations	91	91	91	91	91	91
R-squared	0.2812	0.3499	0.3714	0.3966	0.3804	0.3964
Adjusted R-squared	0.126	0.187	0.192	0.224	0.180	0.201

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity. An increase in the OP gap signals a fall in labour misallocation, therefore results present opposite signs to those in Table 3a in the text.

Table D6a. Baseline estimation results for the labour misallocation regression with corruption levels

Dependent variable: cumulative change in dispersion of MRPL **Corruption measure: synthetic indicator of frequency and amount of bribes paid**	1	2	3	4	5
corruption (t-1)	-0.0659***	1.2120**	1.3548**	0.2841	1.6076***
	(0.0212)	(0.5453)	(0.5564)	(0.8511)	(0.5739)
dispersion in mrpl in 2003 (ln)	-0.4572*	-0.3758	-0.3655	-0.4753*	-0.3611
	(0.2747)	(0.2732)	(0.2718)	(0.2504)	(0.2765)
population (t-1) (ln)		1.7361	1.2108	1.5549	-4.7924
		(2.5531)	(2.4071)	(2.2880)	(3.6624)
population (t-1) (ln) * corruption (t-1)		-0.0802**	-0.0862**	-0.0183	-0.0941***
		(0.0348)	(0.0343)	(0.0338)	(0.0336)
political stability (t-1)			0.1336		0.7425*
			(0.2330)		(0.4159)
political stability (t-1) * corruption (t-1)			-0.0690		0.0722
			(0.0651)		(0.0809)
civil liberties (t-1)				0.0826***	
				(0.0265)	
civil liberties (t-1) * corruption (t-1)				-0.0002	
				(0.0081)	
regulatory quality (t-1)					-1.0394*
					(0.6012)
regulatory quality (t-1) * corruption (t-1)					-0.2365***
					(0.0888)
Constant	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES
Observations	121	121	121	121	121
R-squared	0.2607	0.2942	0.2996	0.4228	0.3633
Adjusted R-squared	0.139	0.161	0.151	0.300	0.212

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table D6b. Baseline estimation results for the capital misallocation regression with corruption levels

Dependent variable: cumulative change in dispersion of MRPK Corruption measure: synthetic indicator of frequency and amount of bribes paid	1	2	3	4	5
corruption (t-1)	-0.1676***	3.7028***	3.7469***	1.0345	4.4620***
	(0.0571)	(1.1110)	(1.2105)	(1.4807)	(1.1126)
dispersion in mrpk in 2003 (ln)	-0.7475	-0.8708	-0.9067*	-0.7093	-1.0844**
	(0.6023)	(0.5538)	(0.5226)	(0.4420)	(0.4572)
population (t-1) (ln)		7.0197	5.9282	6.7671*	-9.6667
		(4.7577)	(4.1176)	(3.6687)	(6.5527)
population (t-1) (ln) * corruption (t-1)		-0.2428***	-0.2351***	-0.0853	-0.2589***
		(0.0712)	(0.0737)	(0.0631)	(0.0653)
political stability (t-1)			1.3933***		2.9867***
			(0.4343)		(0.7476)
political stability (t-1) * corruption (t-1)			-0.2297		0.1333
			(0.1487)		(0.1645)
civil liberties (t-1)				0.2043***	
				(0.0424)	
civil liberties (t-1) * corruption (t-1)				0.0055	
				(0.0131)	
regulatory quality (t-1)					-2.7208**
					(1.0490)
regulatory quality (t-1) * corruption (t-1)					-0.6219***
					(0.1621)
Constant	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES
Observations	121	121	121	121	121
R-squared	0.2350	0.3226	0.3814	0.5303	0.4960
Adjusted R-squared	0.109	0.195	0.250	0.431	0.377

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity.

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