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## Is corruption efficiency-enhancing? A case study of nine Central and Eastern European countries

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## 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 countries in the period 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: the link between corruption and input misallocation dynamics is larger the smaller the country, the lower the degree of political stability and of 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 relationship between changes in corruption and TFP growth is indeed negative. Our results 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).



**Keywords**: bribes, capital misallocation, labour misallocation, total factor productivity
**JEL codes:** D24, D73, O47

## Non-technical summary

In this paper we investigate how changes in corruption in the business environment may affect total factor productivity (TFP) growth by influencing the efficiency of the allocation of both capital and labour across firms in nine Central and Eastern European (CEE) countries in the period 2003-2012.

The macroeconomic impact of corruption is well documented in the literature. Empirical studies show mixed results, supporting both the view that (i) corruption has the potential to foster economic development in that it constitutes the necessary "grease" to lubricate the stiff wheels of rigid government administration and legal framework, as well as the alternative view that (ii) the rent-seeking behaviour of corrupt officials might reduce economic performance, as promoted by the "sand-the-wheels" advocates. There is also a vast, yet inconclusive, literature on the possible impact of corruption on TFP via the input allocation channel. While some authors argue that corruption may promote allocative efficiency since only the most efficient and profitable firms can afford to pay bribes to obtain government services, others point out that corruption might promote sub-optimal choices with regard to resource allocation by allowing the most well-connected, and not necessarily efficient, firms to survive and to expand.

In contrast to other related empirical studies on the impact of corruption, our analysis explains sectorial developments on the basis of firm-level data which, within Europe, are mainly available for transition economies. We focus on nine CEE countries that joined the EU in the 2000s, namely the Czech Republic, Estonia, Hungary, Lithuania, Poland, Slovakia, Slovenia (all 2004), Romania (2007) and Croatia (2013).

The measurement of input misallocation is not trivial. Frequently employed, albeit imperfect, measures are the dispersion in the marginal revenue productivity of labour (MRPL) or capital (MRPK) across firms, which are available in the ESCB CompNet micro-aggregated database. In a static environment the returns to capital and to labour should be equalised across firms facing the same marginal cost of inputs, operating within the same sector. Firm-specific or business environment distortions, including corruption, may however avert the productivity-enhancing flow of resources and induce differences in the marginal revenue productivity of inputs across enterprises, thereby implying resource misallocation. Since 2003 in most CEE countries aggregate labour misallocation mildly rose until the recent recessionary phase and declined thereafter, although only temporarily in some economies. Conversely, aggregate capital misallocation has been increasing sharply in most countries since the mid-2000s. The service sectors are the main drivers of these aggregate developments in input misallocation.

This paper next uses data from the Business Environment and Enterprise Performance Survey (BEEPS), taken in 2002, 2005, 2009 and 2013 by the World Bank and the European Bank for Reconstruction and Development. BEEPS provides information on both the frequency and amount of bribes paid by similar firms in the same line of business of the interviewed enterprise to generally "get things done"; it also offers data on the frequency of bribes paid to conduct specific administrative practices, in particular to deal with courts, to pay taxes and to handle customs. According to these survey data, starting from relatively high levels in 2002, corruption has decreased in CEE countries over the past decade, although the intensity of the general decline has been different across countries. In addition to cross-country differences, within the countries under study there is large heterogeneity in the frequency of paying bribes across sectors and across firm size classes.

By combining the corruption measures from BEEPS with the CompNet input misallocation indicators we explore the link between corruption and input misallocation, in a neoclassical conditional convergence framework. We find evidence that in small countries, in countries with low political stability and civil liberties, and with weak quality and effectiveness of its regulations, increases in corruption are associated with rising misallocation of both capital and labour across firms. We further show that changes in corruption are negatively related to TFP growth. Our results are robust to the adoption of instrumental variables for corruption, notably the share of seats held by women in Parliament and the degree of freedom of the press.

In conclusion we bring evidence that targeted action against corruption in the CEE region would be efficiency-enhancing, in particular in small, politically unstable or more autocratic economies. Furthermore, our results suggest that improving the quality and the effectiveness of the regulatory environment could be a means to boost TFP growth directly, but also indirectly by fostering a more efficient allocation of resources across firms.

## 1. Introduction

There is a vast, yet inconclusive, theoretical and empirical literature exploring the link 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, 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 delay in order to attract more bribes. The advocates of the "sand-the wheels" hypothesis argue that corruption reduces economic performance due to rent-seeking, increases of transaction costs and uncertainty, inefficient investment and misallocation of production factors. Moreover, the size of a country and the "industrial organization" of corruption, as in the degree of centralization of control and the time horizon of 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 induce substitution into the 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 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 the most productive, projects (Tanzi and Davoodi 1997). The demands of secrecy can also cause bureaucrats to maintain monopolies, to prop up inefficient firms, to prevent entry, to discourage innovation, 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, to organize production to minimize the need for public services and therefore interaction with public officials, thus leading to a sub-optimal size of their enterprise; conversely, the better connected firms, which successfully pay bribes to obtain government services, can operate with far from optimal input combinations and still survive (Garcia-Santana et al. 2016). More in general, enormous time is lost by entrepreneurs engaged in corrupt activities, at the expense of firms productively running their business. On the other hand, it has been argued that corruption could guarantee efficient outcomes in competitions for government procurement contracts: more productive entrepreneurs can afford higher bribes, so that licenses and government contracts are assigned to the most efficient firms (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 demanding 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 (for example, 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 (for instance, Mauro 1995; Tanzi and Davoodi 1997). In this paper, instead, we use firm-level data on corruption and investigate its relationship with a measure of within-sector misallocation of inputs, in turn a driver of sectorial TFP growth. To our knowledge, this is the first attempt in the literature to employ corruption data, collected at firm level and appropriately aggregated at the sector level, in order to explain sectorial 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 a fascinating case study for the analysis of the link between corruption and capital and labour misallocation. First, following their entry into the EU, action was undertaken to fight corruption, albeit to a varying extent across countries and sectors. Second, corruption is still high in CEE countries relative, for example, to core euro-area countries, suggesting large scope for improvement still. Finally, to our knowledge, with the exception of Benkovskis (2015) which focuses on Latvia, not included in our sample, this is the first cross-country/sector 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. In contrast, CompNet data show a significant increase in within-sector 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 measure of corruption, focusing on a synthetic indicator we construct based on the frequency and amount of bribes to engage in productive activities reported by private non-financial firms, in turn taken from the World Bank and the European Bank for Reconstruction and Development's Business Environment and Enterprise Performance Survey (BEEPS). We therefore 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 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 price. 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 substitute the types of goods that make hiding corruption easier. Finally, also for bureaucrats corruption is a time-intensive activity as it requires a continual search of "partners" to bribe. IMF (2016) provides an analysis of the economic and social costs of corruption in its more comprehensive definition of "the abuse of public office for private gain", to which we refer.

In our empirical analysis, framed within 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 changes in 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 freedom 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 results referring to the relationship between changes in corruption and in 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 $\alpha_s$ denotes the share of capital in the production process. Capital and labour shares are thus allowed to differ across sectors (but not across firms within a sector) 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 $\tau_y$ distortions that increase the marginal products of capital and labour by the same proportion as an output distortion and $\tau_k$ as distortions that raise the marginal product of capital relative to labour. Assuming that all firms in the same sector 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 relative size of firms depends therefore not only on firm productivity levels (with capital and labour increasing the more productive the firm), but also (negatively) on the output and capital distortions firms face. This also translates into differences in the marginal revenue products of labour and capital 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 $TFPR_{si} = P_{si}A_{si}$. Only the availability of firm-specific price deflators allows the computation of TFPQ, whereas $TFPR_s$ is computed on the basis of the more frequently available sector-specific price deflators. This distinction allows deriving 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) $$TFPR_{si} \propto MRPK_{si}^{\alpha_s}MRPL_{si}^{1-\alpha_s} \propto \frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}}$$

and sectorial productivity $A_s$ as follows:

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

where $\overline{TFPR_s}$ is a geometric average of the 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) $$logA_s = \frac{1}{\sigma-1} log\left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right) - \frac{\sigma}{2} var(logTFPR_{si})$$

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 higher the within-sector dispersion of marginal products, in value terms, of inputs across firms.

Although this paper focuses on the Hsieh-Klenow measure of resource misallocation, we have also analysed an alternative statistics used by the literature on labour misallocation, in particular the Olley and Pakes (1996) gap indicator. The (log) labour productivity of a sector is equal to the weighted average of the labour productivity of the firms active in the sector, where the weights are the firm's share in sectorial employment. Sectorial labour productivity can be decomposed into two parts: *a)* the unweighted average of firm-level productivity and *b)* the within-sector 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) $$p_t = \sum_{i=1}^{N} s_{it} p_{it} = \overline{p_t} + \sum_{i=1}^{N} \Delta s_{it} \Delta p_{it}$$

where $p_t$ is the industry labour productivity, $\overline{p_t}$ represent 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 each firm. The relative size, in relation to the unweighted sector average, is given by $\Delta s_{it}$=$s_{it}$-$\overline{s_t}$ where $s_{it}$ is the employment of firm *i* and $\overline{s_t}$ 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.

Both the Hsieh and Klenow and the Olley and Pakes measures of input misallocation are subject to criticism and to possible mismeasurement issues. In Gamberoni, Giordano and Lopez-Garcia (2016) we discuss advantages and disadvantages of both indicators. The fact the main findings of this paper are confirmed whatever the measure employed is a relevant and reassuring result.

## 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 across countries, 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). Data are available for nine 1-digit 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 |
| Czech Republic | none | 5% | 3% | - | - | 2008-2012 | 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 1-digit 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 weighted sector-level input dispersions first 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 the same figure as dotted lines.[1] 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 are the following. First, time-varying weighted dispersions are similar to time-invariant weighted dispersion figures, suggesting that structural changes in the economy in the years 2003-2012 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 to 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 lower 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 the alternative proxy of labour misallocation discussed in Section 2.1, i.e. the OP gap, broadly confirms these findings, with the minor exceptions of Croatia, Czech Republic and Slovakia during the Great Recession where developments appear to be less favourable than those registered by the dispersion in MRPL.

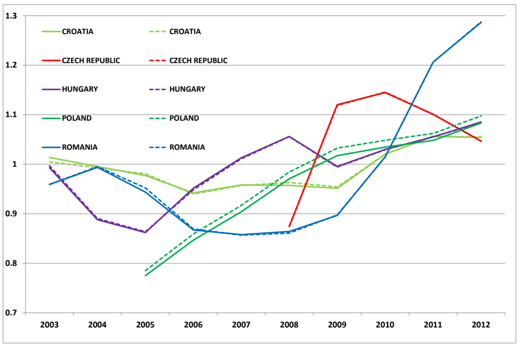
[1] The year 2011 was chosen as it was the last year for which data for all countries and sectors were available.

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

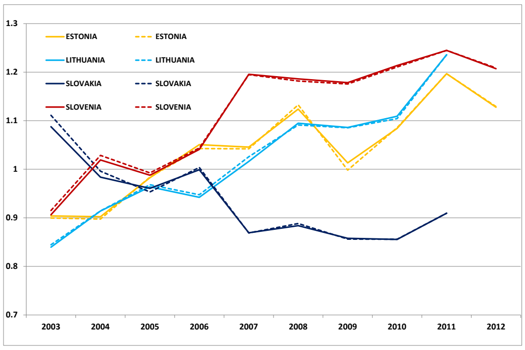
(country-specific weighted averages across sectors)

**Dispersion in MRPK**

**Non-euro area countries**

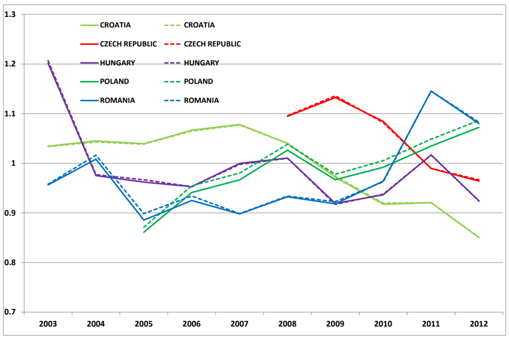



**Euro-area countries**

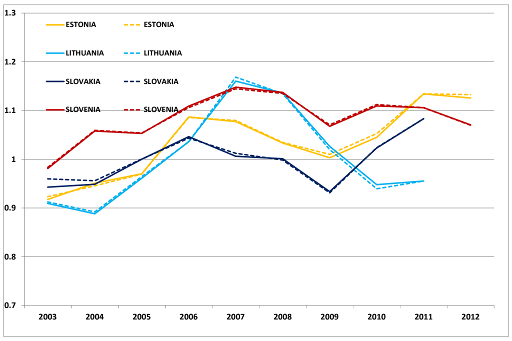



**Dispersion in MRPL**

**Non-euro area countries**




**Euro-area countries**



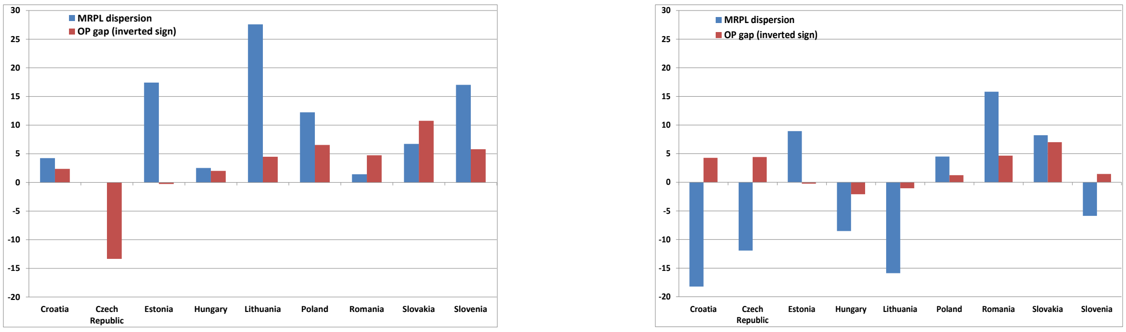

Source: Authors' calculations based on CompNet data.

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.

**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.

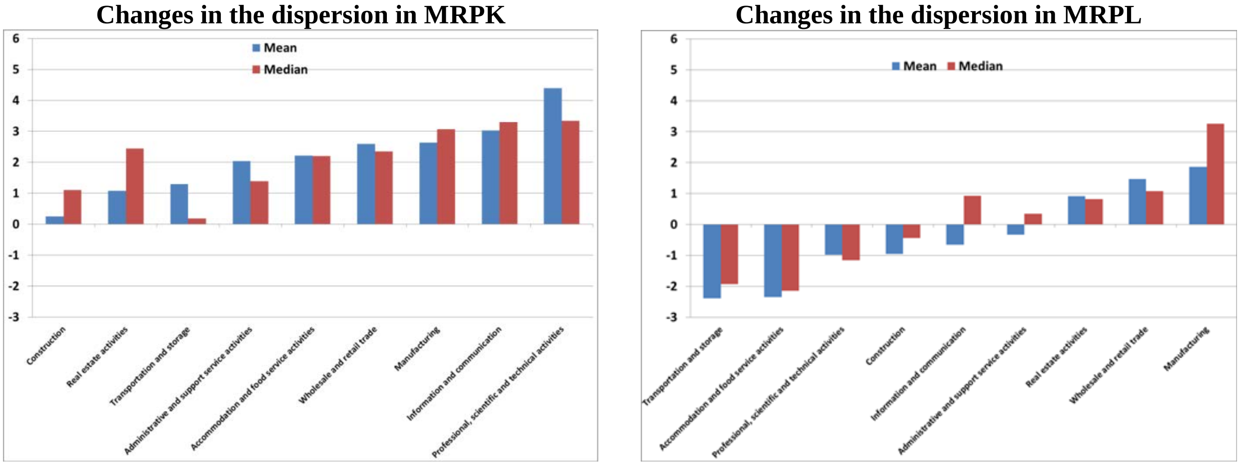
Note: Weighted average values, where the weights are the time-varying country-specific sectorial shares of value added. The sign of the OP gap is inverted so that an increase in this indicator signals a rise in labour misallocation.

Turning to the sector averages of yearly growth rates between 2003 and 2012 across the countries under analysis, 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 side 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 side panel). Labour misallocation has actually declined during 2003-2012 in at least four sectors.

**Figure 3. Changes in misallocation in the CEE region by sector**

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

**Changes in the dispersion in MRPK** **Changes in the dispersion in MRPL**




Source: Authors' calculations based on CompNet data.

Note: Simple averages of the yearly 2003-2012 growth rates across CEE countries, excluding the Czech Republic for which data are available since 2008. 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.[2] 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 rise in corruption.[3] 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 are views on corruption.

In this paper we instead employ measures based on firm-level surveys, 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.[4] 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.[5] BEEPS provides information on both the frequency and the amount of bribes paid by firms in the same line of business of the interviewed enterprise to generally "get things done", as well as the

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

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

[4] 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.

[5] 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 consistent over the different 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 inference 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 aggregated to the sector level with comparable CompNet data on sectorial performance, while 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. This break in firm sample coverage is not tackled in this paper nor in any other, to our knowledge.

frequency of bribes paid to, more specifically, deal with courts, pay taxes and handle customs. In our empirical section we construct and employ a synthetic indicator of these five variables.[6]

The drawback of survey-based corruption measures is that mis- or non-reporting by firms may be a serious issue (Jensen, Li and Rahman 2010). Indeed there is evidence that corruption is 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 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 irregular payments occur for "establishments like this one". By avoiding a direct questioning, they increase the ability of the interviewee to potentially reply honestly.[7]

Despite the design of the survey questions, not all firms replied to the BEEPS bribery-related questions, which present "no-response" or "I do not know" options. Figure 4 summarizes the percentages of missing data in each country for these questions. First, across countries fewer respondents provide a reply to the question related 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 frequency question (panel a) and Hungary, Poland and Slovakia for the bribery amount question (panel b).[8] Third, in many countries non-response rates spiked in 2009, the worst year of the recent recessionary phase. Fourth, non-response rates for the question related to the frequency of payments to deal with customs are generally the highest across countries (panel c).

[6] We therefore measure the "intensity" of bribery at the country-sector level rather than simply the "participation" in bribery, which is what De Rosa, Gooroochurn and Görg (2010) instead capture by taking binary 1/0 variables on the basis of these questions.

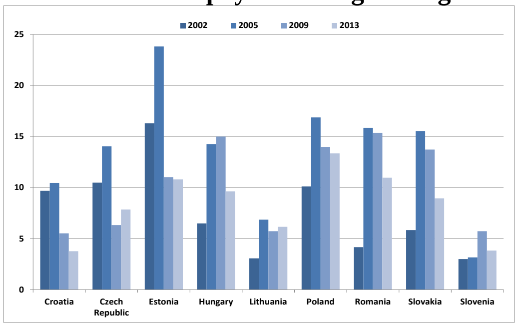
[7] Fungacova, Kochanova and Weill (2015) and Hanousek and Kochanova (2015) define the BEEPS questions on bribery we employ in this paper as the most neutral and less subject to perception bias. The BEEPS questionnaire also includes a question asking whether the interviewed firm perceives corruption as a major obstacle for the operation and growth of its business. The results to this question in particular may be object of misreporting, since the question relates directly to the interviewed firm's activity. Moreover, it is explicitly 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) who explicitly exclude it.

[8] The high non-response rate 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 also 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.

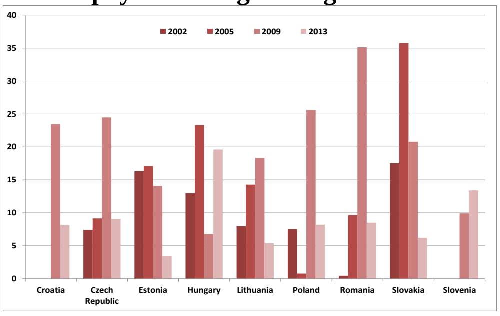
## Figure 4. Non-response rates to various BEEPS questions

(percentage shares)

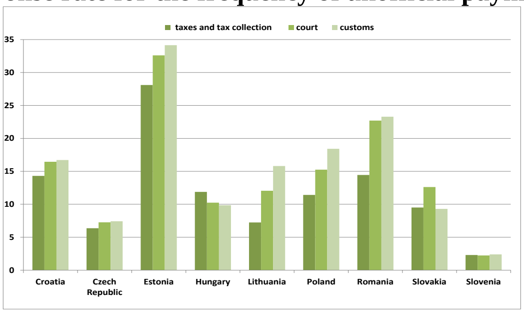
**a) Non-response rate for the frequency of unofficial payments to get things done**




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




**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 concern 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.[9] In Table 2 we provide the estimated correlations between the main firm characteristics (namely employment, sales, exports and 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 in a statistically significant sense based on their observable characteristics.

[9] 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) |
| *Adjusted R-squared* | *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* |
| *Number of observations* | *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** | | | | |
| *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) |
| *Adjusted R-squared* | *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* |
| *Number of observations* | *3248* | *3248* | *3248* | *3248* | *3265* | *3265* | *3265* | *3265* | *3265* | *2277* | *2277* | *2277* | *2277* | *2277* | *3268* | *3268* | *3268* | *3268* | *3268* |

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.

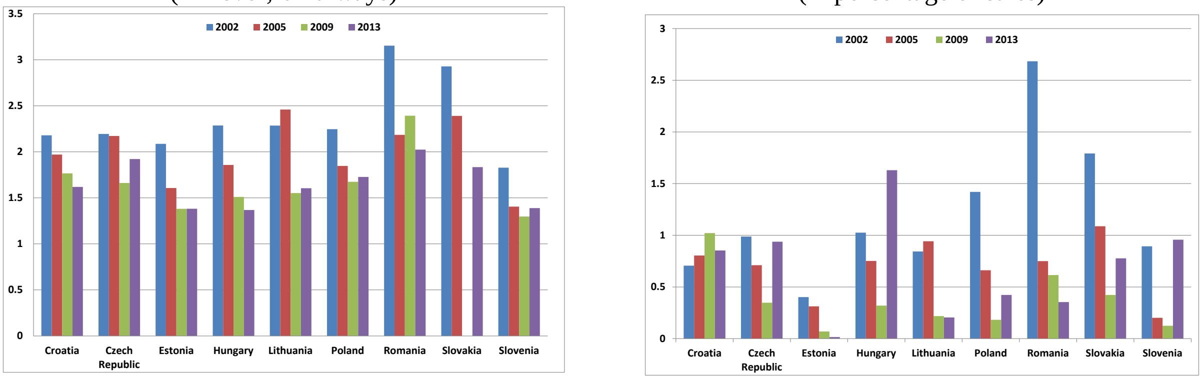
Discarding the non-response items, there is evidence of a general fall in the frequency of bribe payments, between 2002 and 2013 (Figure 5, left hand side panel).[10] Furthermore, we observe an overall decline in the percentage of sales spent for unofficial payments in all countries but Croatia and Hungary (Figure 5, right hand side panel).[11] 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 amount of bribes. The reason of 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 bureaucrats 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 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 or more frequent bribes.

[10] Owing to our narrow measure 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 or kickbacks between businesses for example linked by supply chains). 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 also by more aggregate indicators (see Appendix B).

[11] 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, standing at 0.7 per cent).

**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.

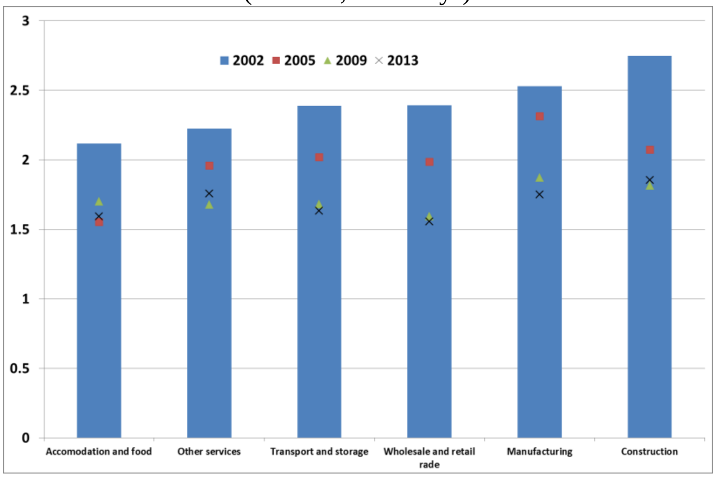
The overall decline recorded in the CEE region is also confirmed by alternative perception-based indicators of corruption, as shown in Appendix B. This general trend has followed a significant strengthening of the anti-corruption framework in the CEE region. At international level this framework was enhanced 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 B2), suggesting large scope for improvement still.

In addition to total-economy developments described thus far, firms operating in different industries interact with public officials to a different extent, 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.[12] 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 end of the spectrum, firms in hotels and restaurants, trade and “other” service sectors are, on average, amongst the least affected by bribery. The country-wide decline in corruption is

[12] On sectorial evidence of bribery see also Beck, Demirgüc-Kunt and Maksimovic (2005); Reinikka and Svensson (2006); Dugato et al. (2013); European Commission (2014).

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.[13]

**Figure 6. Frequency of bribes "to get things done" by sector**
(1=never; 6= always)



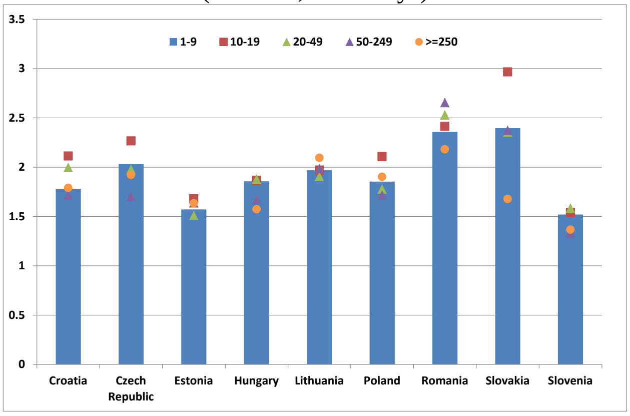

Source: Authors' calculations on BEEPS data.
Note: Average across all firms and all countries for each sector and year.

Finally, BEEPS provides bribe data disaggregated also by firm size. The existing evidence on corruption and firm size is inconclusive. On the one hand, there is some evidence that smaller firms are less affected by bribes, possibly because they are exempt from some regulatory standards (such as reporting and keeping records for inspection, but also labour market legislation) 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 pay less frequently bribes to get things done than all the rest of firms, similarly to the very large 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 to believe that there exists an inverted-U relationship between bribery frequency and firm size.

[13] These charts, together with country-sector averages, are shown in Gamberoni et al. (2015b). Sectorial patterns are very similar across CEE countries, therefore we only show 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

After having discussed the developments in both capital and labour misallocation, on the one hand, and in corruption on the other in the CEE region, the aim of the paper is to explore the links between these dynamics.

### 4.1 The conditional convergence framework

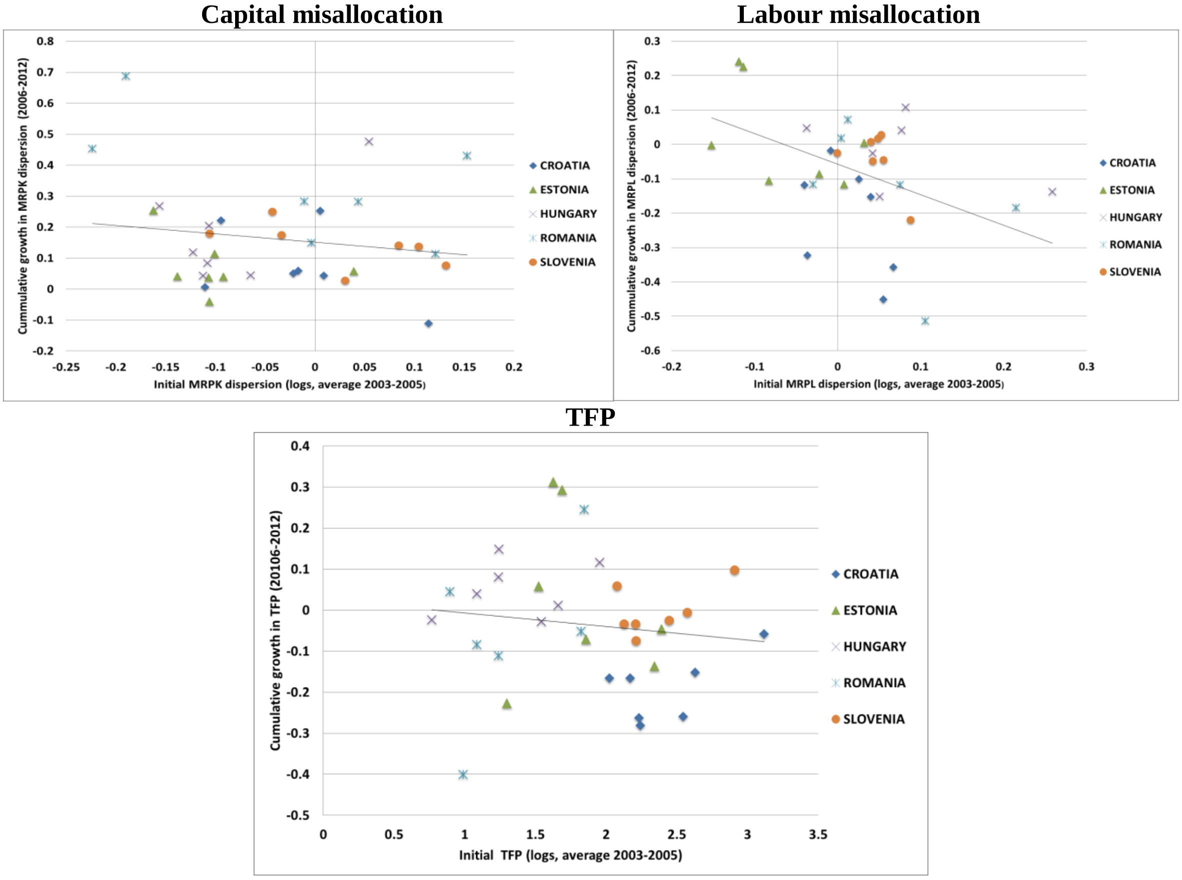
The conditional convergence framework (Barro and Sala-i-Martin 2004) implies a negative correlation between the growth rate of GDP per capita in a given country and its initial level, after having "conditioned" on the country's steady-state level. This type of convergence is called $\beta$–convergence and follows from the assumption of diminishing returns to capital which implies higher marginal productivity of capital in countries where capital is scarce. However, amongst others, Friedman (1992) and Quah (1993) have emphasised that β–convergence can be the result of a more general statistical, not economic, phenomenon of regression to the mean (the so-called Galton fallacy) and that actual convergence concerns the reduction in the dispersion of the cross-sectional distribution of economic performance. This second type of cross-country convergence, called σ-convergence, requires, as a necessary although not sufficient condition, a process of $\beta$–convergence. The reduction in the cross-sectional standard deviation of GDP per capita is a joint outcome of capital deepening and TFP growth convergence. The later will depend among other things on the dynamics of allocative efficiency across countries.

Figure 8 shows that there is descriptive evidence of an (unconditional) $\beta$–convergence process of capital and, mostly, labour allocative efficiency in our sample of countries, seen as their inverse, i.e. input misallocation: the further away a sector is from maximum allocative efficiency, the faster the subsequent growth in allocative efficiency. A similar result is found for TFP.[14] Regarding some direct evidence on σ-convergence, Figure 9 shows that the average

[14] We computed growth rates for the whole period excluding the first sub-period in order to avoid endogeneity, as suggested by our referee.

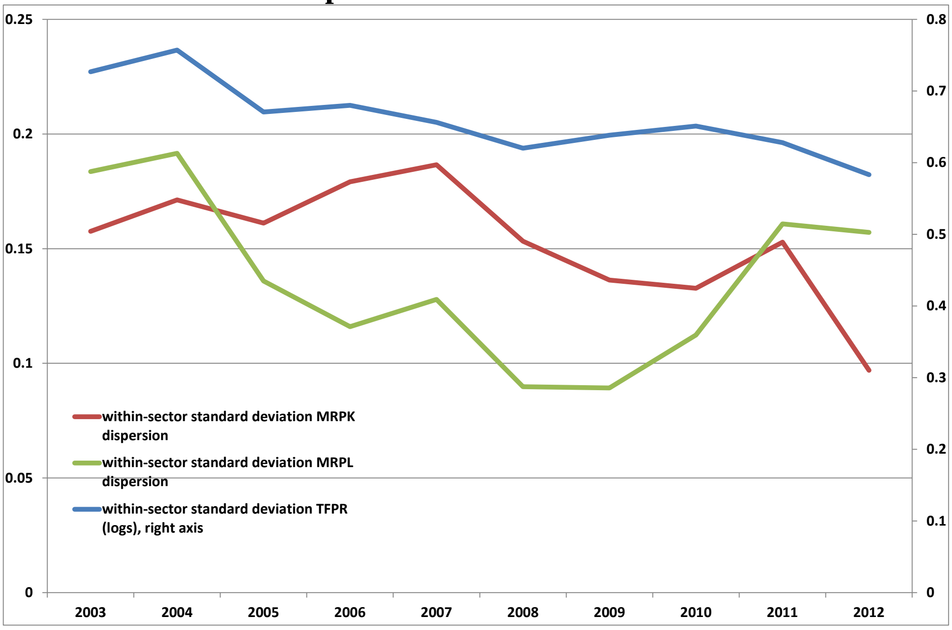
cross-country and cross-sector dispersion in both capital and labour misallocation as well as in TFP, has decreased, albeit not monotonically, with a possible pick-up in divergence in labour misallocation (and therefore in TFP) after 2009. Hence, the observed $\beta$–convergence in input misallocation seems to have been related to σ-convergence at least until the Great Recession. We next verify the (conditional) $\beta$–convergence hypotheses in a more formal, empirical framework.

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




Source: Authors' calculations on CompNet data.
Note: The Czech Republic is excluded from the sample owing to data unavailability for the first years of the period.

**Figure 9. Average cross-country and cross-sector standard deviation in input misallocation and TFP**




Source: Authors' calculations on CompNet data.

Given these descriptive findings, we 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) $$\Delta outcome_{t/t-1,i,j} = \alpha_{t,i,j} + \beta outcome_{t0,i,j} + \mu_{t,i,j}$$

where the outcome variable is either TFP or input misallocation (measured by the dispersion in either MRPK or MRPL), $\Delta$ 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 consumers' 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.[15] In this context, we consider the changes in bribes paid by firms, described in Section 3, as changes to the business environment and therefore captured by the shocks $\mu_{t,i,j}$, whereas the steady-state level of TFP and input

[15] If all countries share the technological progress equally and do not differ by any other framework variable, then they all grow at the same rate in the steady-state. We however find evidence of different framework conditions within the CEE region, better documented in Appendix C; moreover, by adopting a panel approach, we allow for technological differences across countries, captured by the country fixed effects.

misallocation may be affected by other constant or slowly varying country and sector-specific variables.[16]

### 4.2 The detailed empirical specification

The most recent cross-country convergence literature has emphasized the role of nonlinearities and interactions amongst covariates in explaining economic development (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. We take these finding into account in order to select our control "steady state" variables when investigating the link between changes in corruption and changes in input misallocation.

In particular, 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 accept bribes as a means to access the large local goods and labour markets. Corruption is therefore found to be less harmful for economic performance in larger countries. 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 and flourish. 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 Ehrlich and Lui (1999) argue that autocratic regimes, which centralize the direction of the administration in a country, similarly 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; Aidt, Dutta and Sena 2008) confirm that the link between corruption and economic growth depends on the type of political regime in power, although results are more nuanced. Proxies of country size, political stability and the degree of autocracy 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 regulation* 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).

[16] As discussed in Islam (2003), the three/four year spans in our analysis should not be too short to study growth processes, especially because we combine three sub-periods to produce our estimates.

Another strand of the literature points to corruption being beneficial for growth when the quality of institutions is poor and 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 therefore attempt to test the "grease-the-wheel" hypothesis empirically.[17]

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

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

where sector-level TFP growth is dependent on its initial level, on shocks in the business environment, captured by changes in corruption and on a number of framework conditions, and where $\gamma_j$ are sector fixed effects, $\theta_i$ are country fixed effects, $\tau_t$ are time dummies, $\varepsilon_{t,i,j}$ are regression errors and $t$ is again 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). [18]

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

$$(16) \quad \Delta var(MRPI)_{t/t-1,i,j} = \beta_0 + \beta_1\, var(MRPI)_{2003,i,j} + \beta_2\, \Delta corruption_{t-1/t-2,i,j} + \beta_3\, pop_{t-1,i} + \beta_4\, pop_{t-1,i} * \Delta corruption_{t-1/t-2,i,j} +$$

[17] A recent study (Aghion et al. 2016) has investigated the effects of the interplay between political corruption (measured as the number of convictions of public officials) 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 possibly sectorial data on corporate income tax are not available to our knowledge to allow us to test the contribution of taxation together with corruption to input misallocation growth for our sample of countries, although this remains an interesting field of research to explore.

[18] 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.

$$\beta_5\, politicalorg_{t-1,i} + \beta_6\, politicalorg_{t-1,i} * \Delta corruption_{t-1/t-2\,,i,j} + \beta_7 regul_{i,t-1} + \beta_8\, regul_{t-1,i} * \Delta corruption_{t-1/t-2\,,i,j} + \gamma_j + \theta_i + \tau_t + \varepsilon_{t,i,j}$$

where notation is the same as in Equation (15) and I denotes either capital (K) or labour (L). Differentiating Equation (16) with respect to changes in corruption, we obtain the marginal effect of changes in corruption on changes in input misallocation:

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

In order to investigate the empirical relationship between corruption, TFP growth and input misallocation, we use BEEPS corruption data, aggregated at the country-sector level, and CompNet data on input misallocation and TFP growth, available at the same country-sector level. In particular, 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 implies 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. As contextual variables, we employ population to measure country size, political stability to proxy the time horizon of public officials, civil freedom to measure the extent to which citizens of a country are able to participate in the selection of the government and therefore influence policy choices indirectly. Moreover, we consider two different dimensions of regulation: the restrictiveness of product market regulation and the quality and effectiveness of overall government regulation. Sources and details concerning the mentioned contextual variables are displayed in Appendix C.

### 4.3 The baseline results

First, we find evidence of TFP convergence across the country/sectors included in our sample, in particular in our richer empirical specification (Table 2). Next, we find a sound negative correlation between changes in bribes and sectorial TFP growth, alone or when we also include the contextual variables in the specification. The latter also enter the regressions independently 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 a worse TFP performance.[19] In regressions here not shown, when we augment the specification in Table 2 with changes in both capital and labour misallocation, corruption loses statistical 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

[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.

productivity (e.g. Hanousek and Kochanova 2015; De Rosa, Gooroochurn and Görg 2010), our contribution to the literature is to assess whether bribes may affect TFP growth via the alternative misallocation channel, which we next focus on.[20]

**Table 3. Sectorial TFP growth estimation results**

| **Dependent variable: Sectorial TFP growth**<br><br>**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.<br>*** p<0.01, ** p<0.05, * p<0.1 | | |

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity. Standard errors are reported in brackets.

We therefore explore how corruption affects one of the determinants of TFP growth, input misallocation, according to alternative model specifications. Regression results, referring to Equation (16), are presented in Tables 4a and 4b, where the dependent variable is respectively capital and labour 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 also political stability and its interaction with corruption are included. Column 4 replaces the political stability variable with the indicator of democracy. Column 5 also 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

[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 however to be considered as conclusive, and we refer to the mentioned two studies for an assessment of the impact on bribes, measured using BEEPS data as in this paper, on actual firm-level performance.

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.

Column 1 shows a statistically significant and negative link between changes in corruption and both labour and capital misallocation in CEE countries, which would bring evidence in favour of studies such as Lui (1985) and Beck and Maher (1986) which support the view that corruption can lead to efficient outcomes. However, as also 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 organization and regulation 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 10 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 Ehrlich 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. Anyhow, corruption also affects labour misallocation in that in a highly corrupt environment firms likely employ a non-optimal amount of labour, owing to the fact that a share of workers is engaged in unproductive activities, such as bargaining with public officials (see also Hanousek and Kochanova 2015 on this point). 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,

[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.

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]

## Table 4a. Capital misallocation estimation results

| Dependent variable: change in dispersion of MRPK<br>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. Standard errors are reported in brackets.

[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 there may be some role in these countries for a "grease-the-wheel" function of bribes, relatively however 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 World Economic Forum) the overall positive effect of corruption on input misallocation was found to be larger relative to the less restricted sectors.

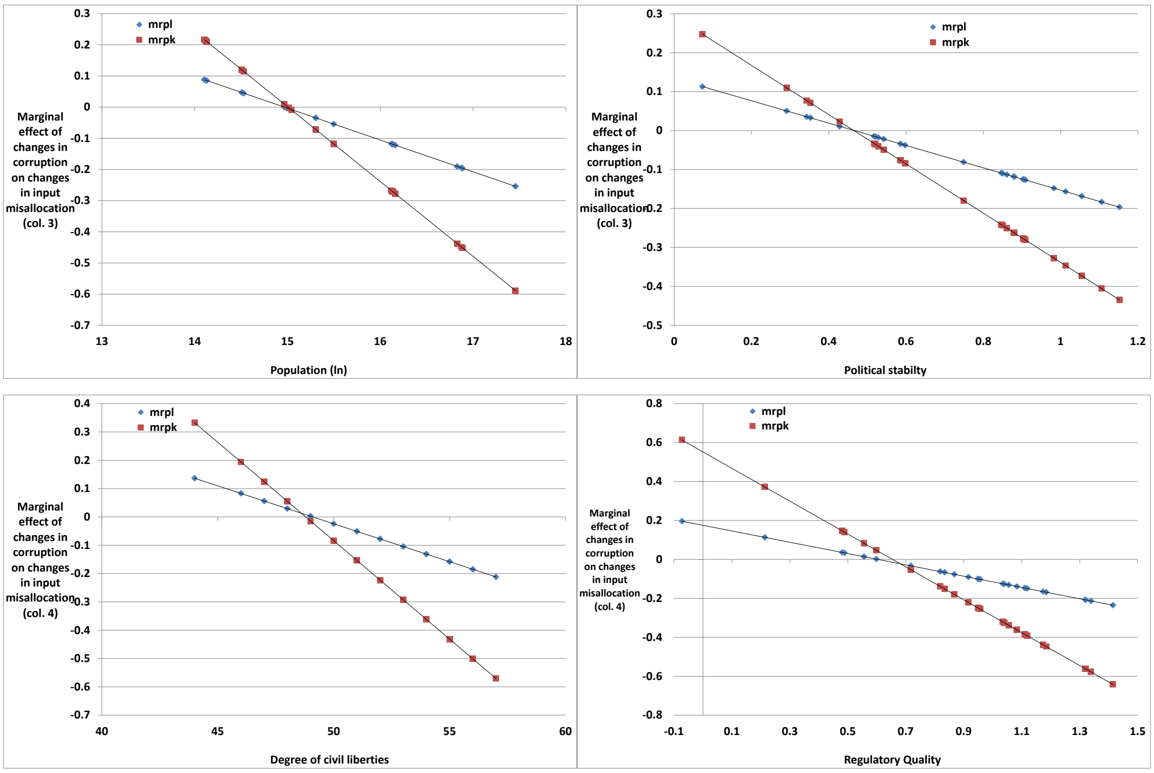
## Table 4b. Labour misallocation estimation results

| Dependent variable: change in dispersion of MRPL<br>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. Standard errors are reported in brackets.

**Figure 10. The marginal effect of corruption on input misallocation dynamics**




Notes: See text for explanation.

Concerning the other covariates, labour misallocation growth is found to be dependent on initial values of misallocation, suggesting a significant convergence effect also for this component of TFP growth; this result is only significant at the margin for capital misallocation, as seen also by the weaker correlation in Figure 8. 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 taking value 1 for the years in which each country was a member, and 0 otherwise in all specifications.[24] The act of joining the euro area however does not appear to affect input misallocation dynamics, although it is worth reminding that euro area membership was very recent for the few affected countries in our sample, which may therefore not be representative in this sense.[25]

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

[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, Estonia in 2011 and Lithuania in 2015 (which falls outside the 2003-2012 range of this paper).

in the same period (Gopinath et al. 2015). Indeed, a rise in the share of capital inflows in GDP (Figure C5 in 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.

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. What fosters input misallocation appears therefore to be the time lost in engaging in bribery practices, rather than the amount of resources spent

### 4.4 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 90 from 105 in each attempt. Second, in order to exclude endogeneity linked to the fact that the first sub-period (2003-2005) input misallocation growth rates depend on the initial level 2003, we excluded the first sub-period from our sample. Our baseline results were confirmed, although some explanatory variables lost statistical significance owing to the few observations (57) in the sample. Third, we examined whether our results are robust to the bribery metric: we excluded the country-sector cells in which the number of firms was less than 4 for the BEEPS corruption measures, in that the higher the number of observations in each cell the better is the measurement accuracy of the bribe variables. Our findings were unchanged.[27]

In Section 3 we mentioned some alternative corruption measures, available however at the total economy level. In order to check the soundness of our results to an alternative measure of corruption to BEEPS, we use an appropriately sectorialised measure of the Control of Corruption Index, sourced from the World Bank. In particular, in the vein of Rajan and Zingales (1998), in order to measure the different degree of risk of each sector being exposed to corruption, we relied on the sectorial indicator of dependence on government services, developed by Pellegrino and Zingales (2014), and which we aggregated up to the 1-digit sector level considered in this paper (again see Appendix B). Our main findings are confirmed also by this alternative measure of corruption (Appendix D) although the goodness of fit of the model is lower with respect to that estimated on BEEPS data.

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

[27] 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) and in Fungacova, Kochanova and Weill (2015). The confirmation of our baseline results in this case is unsurprising considering that we dropped only three observations as a result.

Moreover, we construct an alternative measure of corruption exploiting the information on the non-response rates in BEEPS.[28] On the back of the assumption that the non-response rates on the bribery questions in BEEPS may be higher when corruption is higher, we construct a measure based on the difference between the non-response rate by country-sector on either the frequency or the amount of bribes paid questions and the non-response rate on a standard question such as that on the firm's sales. The higher this relative difference the higher is the assumed corruption. Focusing for the sake of brevity solely on the specifications in columns 5 of Tables 4a and 4b, our baseline results are again confirmed (Appendix D), with a better goodness of fit than the previously described alternative corruption measure.

In Section 2 we discussed an alternative measure of labour misallocation to dispersion in MRPL, i.e. the OP gap. 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 least misallocation and which are more competitive have more resources to control and to 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 sector level is determined by underlying technologies and the rent-extraction inclinations and talents of bureaucrats and is therefore exogenous to firms. Within-sector misallocation across firms should not therefore affect average corruption in that sector. Group averaging is also useful to mitigate measurement error, since errors are largely idiosyncratic to firms and uncorrelated with average bribery values. Second, by merging two independent datasets the endogeneity concern is further reduced. Third, the repeated cross-section structure of the data 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 previous three-year period relative to the year the survey was conducted, so that they are in

[28] We thank our referee for this suggestion.

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

fact lagged relative to the dependent variables. Finally, all contextual variables are measured at the beginning of each time period to control for initial conditions and to reduce possible endogeneity between them and changes in input misallocation.

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 still 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 in 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 greater political participation of women is associated with lower levels of corruption, owing to their greater risk aversion or fear of punishment in the case of detection, or owing to the fact that bribe seeking and paying is a male 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 to simplify regulatory and administrative requirements and through the selection of lower-level government officials. A general trend of increasing women empowerment and 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, by raising public awareness and by reducing information asymmetries, free press can increase the cost of corrupt behaviour for government officials, thereby reducing bribery (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 media freedom 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.

*A priori* there is no reason why either female representation in Parliament or freedom of the press, conditional on the covariates in Equation (16), should be correlated with changes in input misallocation. Indeed, first we verify that no correlation exists, by including these two variables in the baseline regressions: they 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

[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).

[31] Also, Durbin and Wu-Hausman 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.

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 press implies less corruption) until a certain threshold of freedom of the press, 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.<br>*** 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. Standard errors are reported in brackets.

[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 the freedom of 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<br>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.<br>*** p<0.01, ** p<0.05, * p<0.1 | | |

## Table 6b. IV estimation results for labour misallocation

| Dependent variable: change in dispersion of MRPL<br>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.<br>*** 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. Standard errors are reported in brackets.

## 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 mildly rose until the recent recessionary phase and declined thereafter, although only temporarily in some countries. Conversely, capital misallocation has been generally increasing 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 generally "get things done", as well as the frequency of bribes paid to specifically deal with courts, pay taxes and handle customs. Starting from quite high levels 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 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, changes in corruption boost input misallocation dynamics. 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 increases in corruption foster higher input misallocation in countries with a lower degree of civil liberties within the CEE region, a result which is at odds with Ehrlich 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 dynamics 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 bring evidence to the fact 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 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 changes in corruption exert on input misallocation dynamics.

## 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 $\beta_0$ representing the mean-efficient level across firms and over time and $\omega_{it} + u_{it}$ 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 explanatory variables.

Equation (A2) could be consistently estimated by OLS only if firms' 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 to use 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 for this variable. 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 can be claimed to be strictly increasing in productivity and, therefore, can be inverted out to factor productivity. 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:

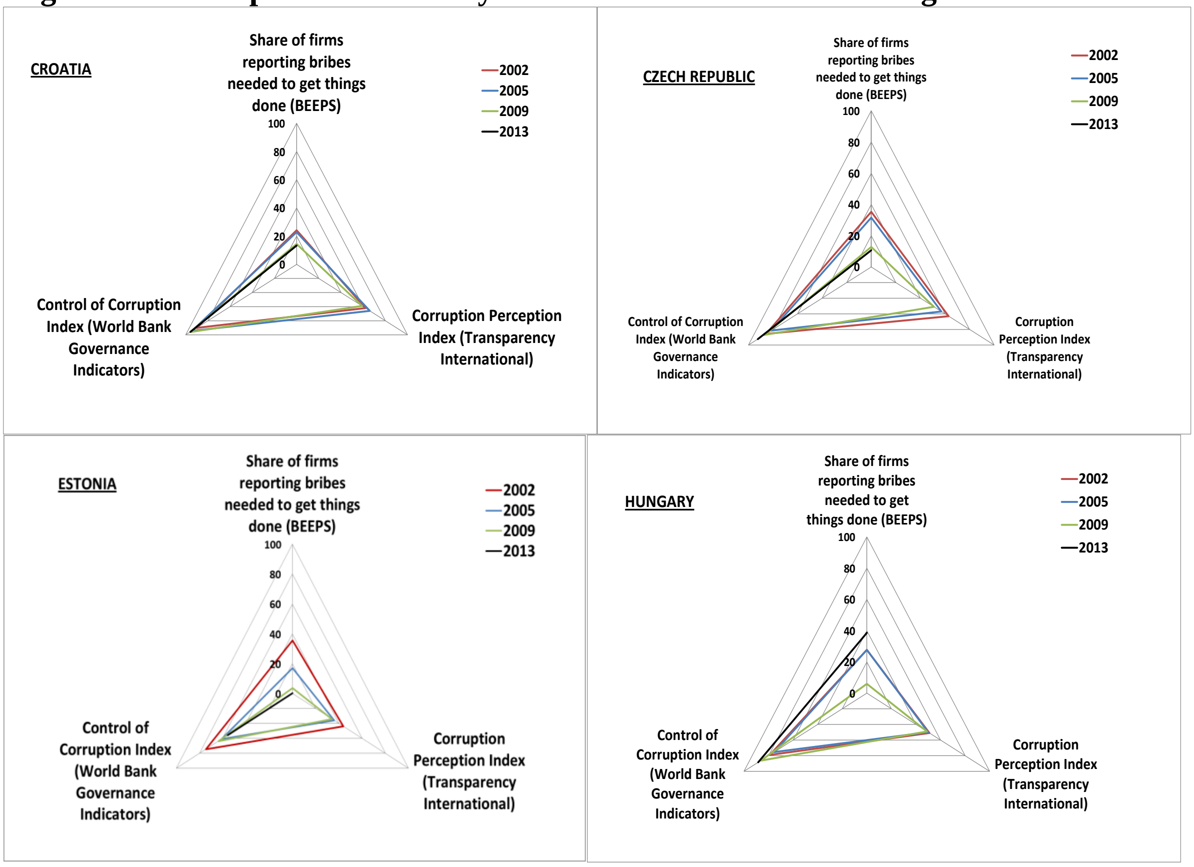
(A4) $\text{MRPL}_i = \beta_L \frac{Y_i}{L_i}$

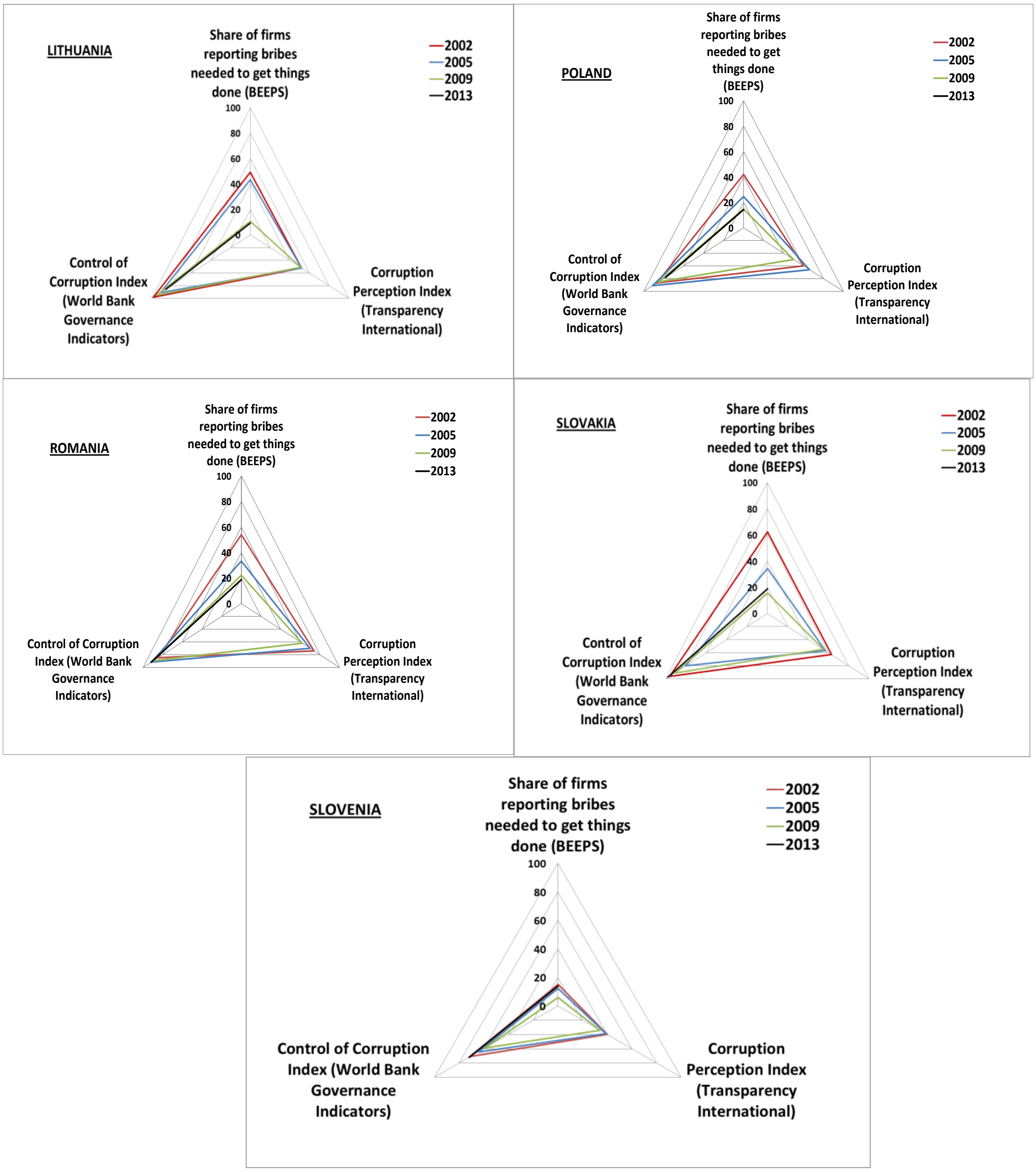
In particular, the real stock of capital is defined as the book value of fixed tangible assets deflated with the GDP deflator and labour as the full-time-equivalent average number of employees in year *t*. Next, we purge the time-variation of the marginal productivity of the input at the firm level from 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 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 gifts disbursed 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**

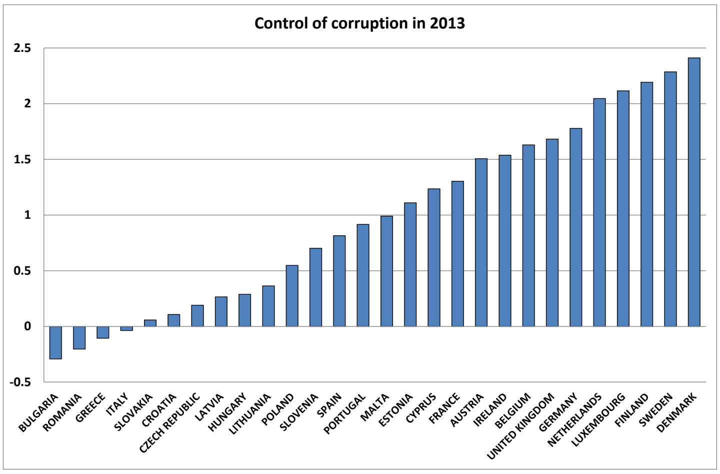





Sources: Authors' calculations on Transparency International, World Bank Governance Indicators and BEEPS data. Note: All measures have been adjusted to range between 0 and 100 and a rise in all indicators indicates an increase in corruption. The selected years are those for which the BEEPS was taken.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

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 scope for improvement still.

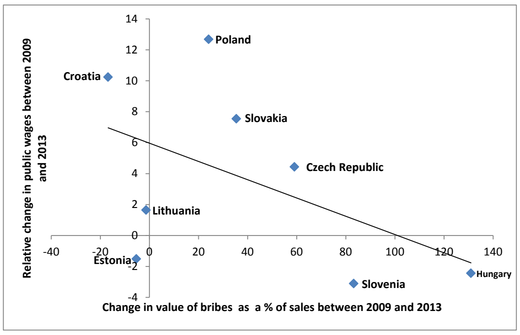
**Figure B2. The cross-country ranking of corruption in 2013 within the EU**




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 wage growth of employees in the public sector in 2009-2012 and the amount of bribes requested to firms 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**

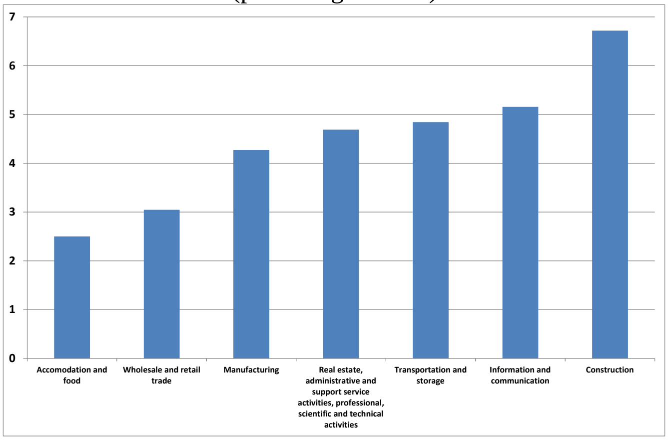



Source: Authors' calculations on Eurostat and BEEPS data.
Note: Compensation per employee refers to the public administration and defence, compulsory social security, education, human health and social work activities. Series are at current prices and expressed in national currency.

Pellegrino and Zingales (2014) compute the percentage of articles on a certain sector containing the words "government", "regulation" and "aid" in the Factiva News Search Database over the period 2000-2012 as an indicator of sectorial dependence of government services. 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.

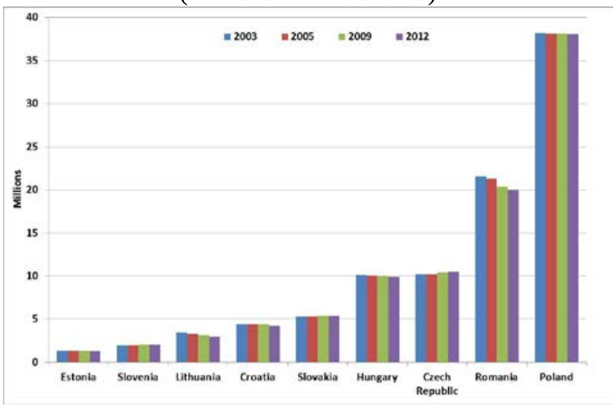
Note: Unweighted averages across the sub-sectors provided by Pellegrino and Zingales (2014).

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

Population, sourced from Eurostat, is heterogeneous across CEE countries, yet broadly stable across 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.

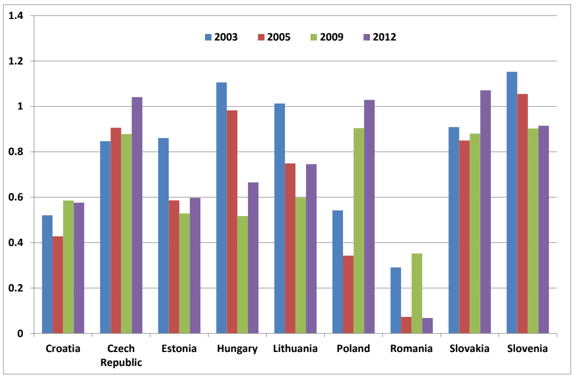
The time horizon of public officials is measured by an indicator of political stability from the World Bank Governance Indicators,[35] whereas the civil freedom indicator is sourced from Freedom House. Romania and Croatia score very badly in terms of both political stability and civil freedom (Figures 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 Doing Business indicators of the time and number of procedures it takes to start a new limited liability business 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 use the U.S. figures to proxy 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 considered European countries. 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.

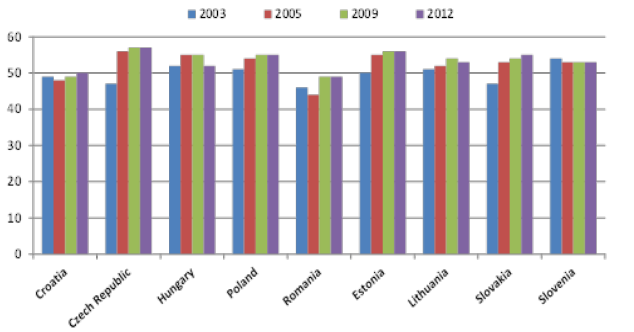
that there is much scope for improvement concerning the stringency and quality of regulation in the CEE region. Although barriers to entry have fallen in the whole area since 2003, the quality of overall regulation still remains weak in some countries such as Croatia and Romania (Figure C4).

**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).

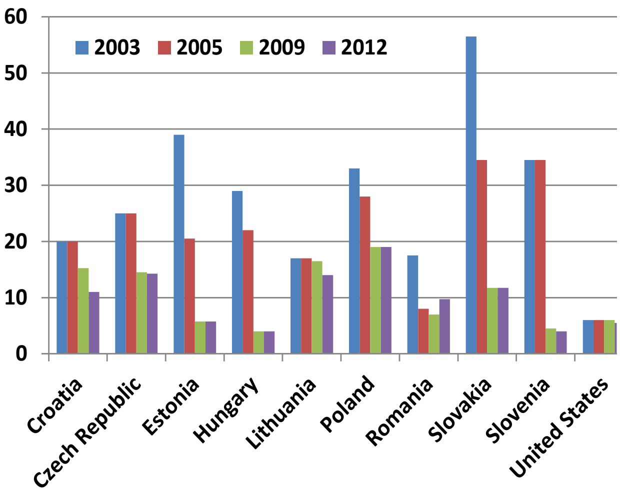
**Figure C3. Civil freedom**




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

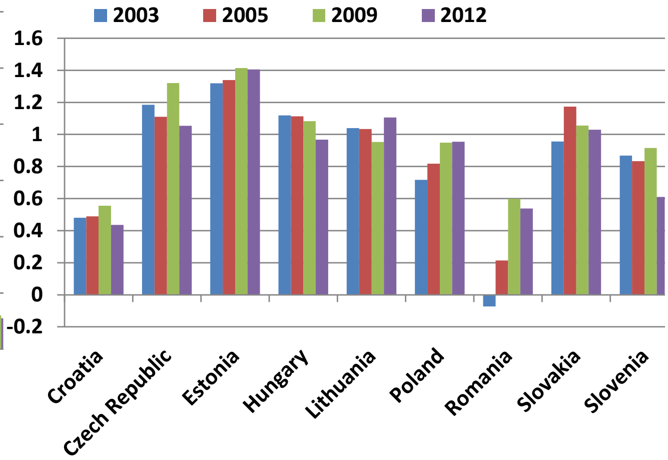
**Figure C4. Regulation**

**Start-up costs**




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.

**Quality of regulation**

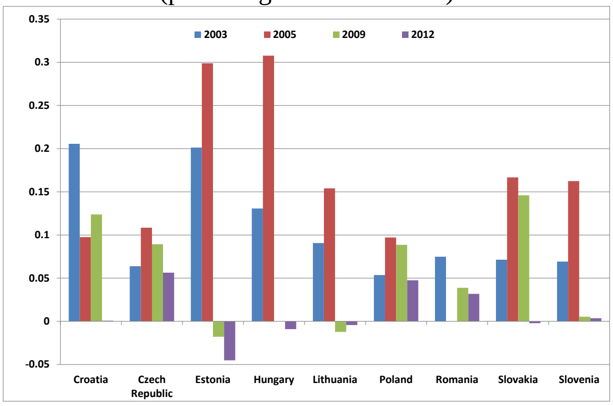



Source: World Bank Governance Indicators.
Note: The regulatory quality indicator captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. It varies between -2.5 (weak) and +2.5 (high).

In the run-up to the global financial crisis capital inflows, sourced from the IMF, reached 30 per cent share in GDP in Estonia and in 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)



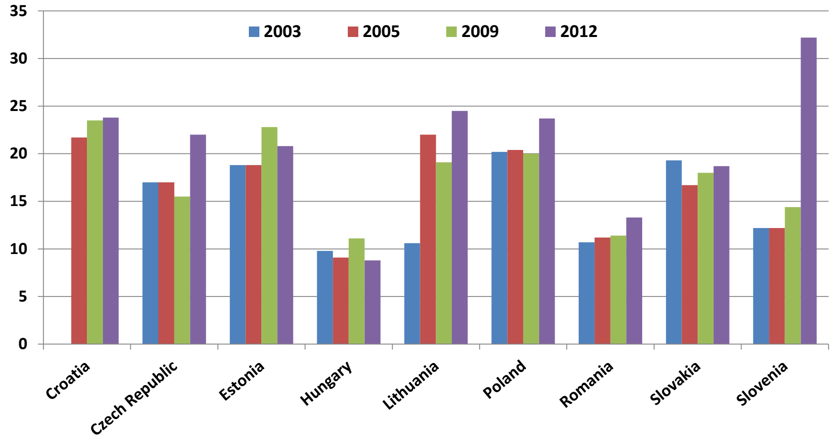

Source: IMF.

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

The share of women in Parliament, taken from Inter-Parliamentary Union, has increased since 2003 in the CEE region (Figure C6). Two notable exceptions are however 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**

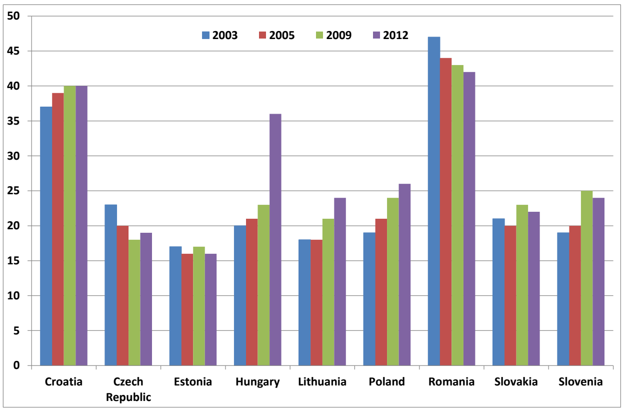
(percentage shares)




Source: Inter-Parliamentary Union.

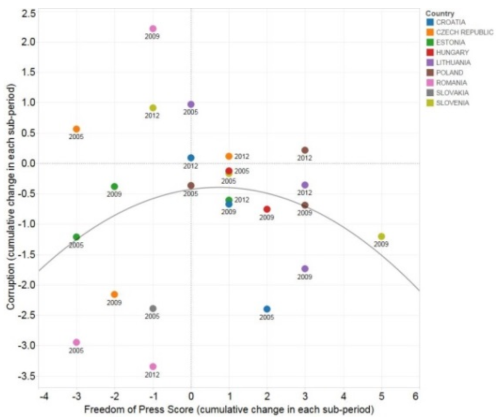
Freedom of press, sourced from Freedom House, is currently lowest in Romania and in Croatia (Figure C7). However, in Romania it has increased since 2003, whereas in Croatia it has diminished. The country in the sample with the highest freedom of the press is Estonia, followed by the Czech Republic. Churchill, 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 too find that in CEE countries a decrease in the 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 on 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 higher 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 Press Score implies higher freedom of 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<br>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.<br>*** p<0.01, ** p<0.05, * p<0.1 | | | |

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity. Standard errors are reported in brackets.

## 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. Standard errors are reported in brackets.

## 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<br>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.<br>*** 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<br>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.<br>*** p<0.01, ** p<0.05, * p<0.1 | | | | | | | | |

Notes: Estimates are obtained via OLS with White's correction for heteroskedasticity. Standard errors are reported in brackets.

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

| Dependent variable: change in dispersion of MRPL<br>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 sectorialised Control of Corruption indicator and changes in capital misallocation

| Dependent variable: change in dispersion of MRPK<br>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. Standard errors are reported in brackets.

## Table D5a. Correlations between the relative difference in non-response rates to bribery questions and those to sales questions changes in labour misallocation

| **Dependent variable:** change in dispersion of MRPL<br>Corruption measure: relative non-response on bribe frequency (1) or amount (2) questions (t-1) | 1 | 2 |
|---|---|---|
| **corruption (change t/t-1)** | 16.9518*** | 16.0279*** |
| | (4.3452) | (3.9566) |
| dispersion in mrpl in 2003 (ln) | -0.4000* | -0.3372 |
| | (0.2198) | (0.2516) |
| population (t-1) (ln) | -3.8377 | -7.4098** |
| | (3.2542) | (3.5992) |
| **population (t-1) (ln) * corruption (change t/t-1)** | -0.9854*** | -0.9750*** |
| | (0.2607) | (0.2443) |
| political stability (t-1) | 0.8069*** | 0.4759* |
| | (0.2679) | (0.2790) |
| **political stability (t-1) * corruption (t/t-1)** | -0.7571 | -0.5371 |
| | (1.0656) | (0.7832) |
| regulatory quality (t-1) | -0.2385 | -1.0571** |
| | (0.4261) | (0.5084) |
| **regulatory quality (t-1) * corruption (t/t-1)** | -2.0741*** | -1.3901** |
| | (0.7282) | (0.5350) |
| Constant | YES | YES |
| Time dummies | YES | YES |
| Country dummies | YES | YES |
| Sector dummies | YES | YES |
| Observations | 125 | 125 |
| R-squared | 0.55 | 0.46 |
| Adjusted R-squared | 0.46 | 0.33 |

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

## Table D5b. Correlations between the relative difference in non-response rates to bribery questions and those to sales questions changes in capital misallocation

| **Dependent variable:** change in dispersion of MRPK<br>Corruption measure: relative non-response on bribe frequency (1) or amount (2) questions (t-1) | 1 | 2 |
|---|---|---|
| **corruption (change t/t-1)** | 38.5966*** | 33.5328*** |
| | (6.5039) | (6.6014) |
| dispersion in mrpk in 2003 (ln) | -0.6998* | -0.5417 |
| | (0.3675) | (0.4389) |
| population (t-1) (ln) | -6.8288 | -14.4642** |
| | (5.3237) | (6.3065) |
| **population (t-1) (ln) * corruption (change t/t-1)** | -2.2453*** | -2.0095*** |
| | (0.3828) | (0.3942) |
| political stability (t-1) | 3.0945*** | 2.5360*** |
| | (0.5510) | (0.5920) |
| **political stability (t-1) * corruption (t/t-1)** | -1.0049 | -0.9771 |
| | (2.0531) | (1.5625) |
| regulatory quality (t-1) | -1.0523 | -2.9031*** |
| | (0.6562) | (0.8466) |
| **regulatory quality (t-1) * corruption (t/t-1)** | -4.9042*** | -3.1189*** |
| | (1.2738) | (0.9201) |
| Constant | YES | YES |
| Time dummies | YES | YES |
| Country dummies | YES | YES |
| Sector dummies | YES | YES |
| Observations | 125 | 125 |
| R-squared | 0.64 | 0.51 |
| Adjusted R-squared | 0.56 | 0.40 |

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. Standard errors are reported in brackets.

## Table D6. Baseline estimation results with the OP gap as the labour misallocation measure

| Dependent variable: cumulative change in dispersion of lopgap<br>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. Standard errors are reported in brackets.

## Table D7a. Baseline estimation results for the labour misallocation regression with corruption levels

| Dependent variable: cumulative change in dispersion of MRPL<br>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 D7b. Baseline estimation results for the capital misallocation regression with corruption levels

| Dependent variable: cumulative change in dispersion of MRPK<br>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. Standard errors are reported in brackets.

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**Competitiveness Research Network**
This paper presents research conducted within the Competitiveness Research Network (CompNet). The network is composed of economists from the European System of Central Banks (ESCB) - i.e. the 29 national central banks of the European Union (EU) and the European Central Bank – a number of international organisations (World Bank, OECD, EU Commission) universities and think-tanks, as well as a number of non-European Central Banks (Argentina and Peru) and organisations (US International Trade Commission). The objective of CompNet is to develop a more consistent analytical framework for assessing competitiveness, one which allows for a better correspondence between determinants and outcomes. The research is carried out in three workstreams: 1) Aggregate Measures of Competitiveness; 2) Firm Level; 3) Global Value Chains CompNet is chaired by Filippo di Mauro (ECB). Workstream 1 is headed by Pavlos Karadeloglou (ECB) and Konstantins Benkovskis (Bank of Latvia); workstream 2 by Antoine Berthou (Banque de France) and Paloma Lopez-Garcia (ECB); workstream 3 by João Amador (Banco de Portugal) and Frauke Skudelny (ECB). Monika Herb (ECB) is responsible for the CompNet Secretariat. The refereeing process of CompNet papers is coordinated by a team composed of Filippo di Mauro (ECB), Konstantins Benkovskis (Bank of Latvia), João Amador (Banco de Portugal), Vincent Vicard (Banque de France) and Martina Lawless (Central Bank of Ireland). The paper is released in order to make the research of CompNet generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the ones of the author(s) and do not necessarily reflect those of the ECB, the ESCB, and of other organisations associated with the Network.

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