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Abstract

This thesis examines the relationship between different aspects of governance and economic outcomes. In particular, it studies the relation between bureaucratic corruption and firm performance; one mechanism to reduce entry barriers; and the propensity of countries to experience fiscal and political stress events.

In the first chapter I focus on bureaucratic corruption and examine how it affects the performance of firm in Central and Eastern European countries. While most previous research relies solely on data from the BEEPS (Business Environment and Enterprise Performance Survey), which suffers from excessive non-reporting of firm performance, I combine the data on bribery practices from the BEEPS with large, reliable firm performance data from the Amadeus database. Focusing on within-firm variation, I find that a higher bribery level negatively affects both the sales and labor productivity growth of firms. Nevertheless, conditional on a given level of bureaucratic corruption in a narrowly defined local market, a higher unevenness of firms' bribing behavior within such a market appears to facilitate firm performance. The chance to receive benefits from bribery may be one reason why corruption does not vanish in spite of its overall damaging effect.

In the second chapter, coauthored with Vahagn Jerbashian, we concentrate on the diffusion of telecommunication technologies as an instrument to reduce the costs of entry into markets. Utilizing the difference-in-difference strategy of Rajan and Zingales (1998), we empirically show that more intensive use and wider adoption of telecommunication technologies significantly increases the level of product market competition in services and goods markets. This result is consistent with the view that the use of telecommunication technologies can lower entry costs. In addition, we show that the estimated effect is stronger in countries with higher quality telecommunications infrastructure. The finding is robust to various measures of competition and a range of specification checks.

In the third chapter (with Carlos Caceres) we consider the quality of the governance and institutions of countries in a broad sense and analyze their relationship to countries' incidence to fiscal and political stress events. We introduce two innovative indicators to measure stress events. The results suggest that weaker governance quality, measured by the Worldwide Governance Indicators, is associated with a higher incidence of both fiscal and political stress events. In particular, internal accountability, which measures both corruption and the ability of governments to improve the quality of the provision of public services, is associated with fiscal stress events. All aspects of governance, especially external accountability capturing government accountability before the public through elections and the democratic process, seem to be important for political stress events.

Abstrakt

Tato disertační práce z různých úhlů pohledu zkoumá vztah mezi způsobem vlády a ekonomickým výkonem. Týká se také soukromého sektoru a ekonomického vývoje zemí.

V první kapitole se zaměřuji na byrokratickou korupci a zkoumám, jak ovlivňuje výkonnost firem ve střední a východní Evropě. Zatímco se předchozí výzkum spoléhá výhradně na údaje získané od BEEPS (Průzkum podnikatelského prostředí a výkonnosti firem), které trpí tím, že mnoho zpráv o výkonnosti firem chybí, já kombinuji údaje o způsobech korupce získaných z průzkumu BEEPS se spolehlivými a rozsáhlými údaji o výkonnosti firem získanými z databáze Amadeus. Pokud se soustředím na rozdíly v rámci firmy, zjišťuji, že vyšší úroveň korupce negativně ovlivňuje jak odbyt tak i růst produktivity práce firem. Nicméně v závislosti na dané úrovni byrokratické korupce na úzce definovaném lokálním trhu se větší nevyrovnanost korupčního chování firem na tomto trhu jeví jako faktor usnadňující výkonnost firmy. Šance získat výhody z uplácení může být jedním z důvodů, proč korupce nemizí navzdory svému celkově škodlivému vlivu.

Ve druhé kapitole, jejímž spoluautorem je Vahagn Jerbashian, jsme se soustředili na rozšíření telekomunikačních technologií jako nástroje pro snižování nákladů spojených se vstupem na trh. S využitím metody "rozdílů v rozdílech" [difference-in-difference] podle Rajan and Zingales (1998) empiricky ukazujeme, že čím je užívání intenzívnější a rozsáhlejší, tím přijetí telekomunikačních technologií významněji zvyšuje úroveň tržní konkurence výrobku na trzích služeb a zboží. Tento výsledek je konzistentní s názorem, že využití telekomunikačních technologií může snížit náklady spojené se vstupem na trh. Toto zjištění platí pro různou míru konkurence a různý rozsah prověřování požadavků.

Ve třetí kapitole, jejímž spoluautorem je Carlos Caceres, zvažujeme kvalitu vlády a institucí zemí v širokém smyslu a analyzujeme jejich vztah k četnosti fiskálně a politicky stresových událostí v těchto zemích. Zavádíme dva inovativní indikátory pro měření těchto stresových událostí. Výsledky naznačují, že špatná kvalita vládnutí, odhadovaná podle ukazatelů WGI, je spojena s častějším výskytem jak fiskálních, tak politických stresových událostí. Zvláště se jedná o interní zodpovědnost, která poměřuje citlivost vlád na zlepšující se kvalitu poskytování veřejných služeb a o korupci, které jsou spojeny s fiskálními stresovými událostmi. Všechny aspekty vládnutí, a zvláště externí zodpovědnost zachycující odpovědnost vlády před veřejností během voleb a demokratický proces se zdají být pro politické stresové události důležitější.

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Preface

This thesis examines the relationship between different aspects of governance and economic outcomes. In particular, it studies the relation between bureaucratic corruption and firm performance; one mechanism to reduce entry barriers; and the propensity of countries to experience fiscal and political stress events.

In the developing world, corruption, presumably, is among the most traumatic weaknesses of governance. It is considered a heavy constraint to the economic functioning of countries, and their growth and development. Leaving aside grand and legislative forms of corruption (Jain, 2001), in the first chapter of this thesis I focus on bureaucratic corruption as a hindrance to private sector development. I empirically examine how it affects firm performance in Central and Eastern European countries. I thereby contribute to the ongoing debate about two opposing consequences of corruption on economic performance. Previous research on this topic relies mostly on data from the BEEPS (Business Environment and Enterprise Performance Survey), which suffers from excessive non-reporting of firm performance characteristics. To mitigate this problem, I combine the data on bribery practices from the BEEPS with large, reliable firm performance data from the Amadeus database. Focusing on within-firm variation, I find that a higher bribery level negatively affects both the sales and labor productivity growth of firms. Nevertheless, conditional on a given level of bureaucratic corruption in a narrowly defined local market, a higher unevenness of firms' bribing behavior within such a market appears to facilitate firm performance. This result implies that in more uneven local markets, negative externalities from bureaucratic corruption are negligible. Bribery helps favored firms and/or those with greater willingness to pay to overcome operational and growth constraints. Non-bribing firms in such environments seem to be more efficient in production and growth, so that both types of firms generate increasing growth rates on average. The chance to receive benefits from bribery may be one reason why corruption does not vanish in spite of its overall damaging effect. The task for policymakers, therefore, could be to increase the transparency of interactions between firms and policy officials to ensure fairness of public services provision.

Another important aspect of private sector development is barriers to entry and entry costs. In countries with complex bureaucracy systems, inefficient provision of public services, high levels of state control over markets, political connections corruption contributing to monopolistic market structure, high entry costs more often impede competition and job creation and undermine overall productivity and development. In the second chapter, coauthored with Vahagn Jerbashian, we explore one of the mechanisms to reduce the costs of entry and, consequently, to increase competition – higher use and wider adoption of telecommunication technologies. The relationship between the diffusion of telecommunication technologies and competition is not straightforward. On the one hand, they can be positively related, since telecommunication technologies lower information acquisition and consumer search costs. On the other hand, telecommunication technologies can help increase product market differentiation and therefore can help some companies gain market power, which eventually undermines competition. Utilizing the difference-in-difference strategy developed by Rajan and Zingales (1998) to alleviate the endogeneity problem, we empirically show that more intensive use and wider adoption of telecommunication technologies significantly increases the level of product market competition in services and goods markets. In addition, we show that the estimated effect is stronger in countries with higher quality telecommunications infrastructure. Thus, policies aiming to motivate higher diffusion of telecommunication technologies can complement competition and antitrust policies. Our inference is based on 21 countries from European Union, however, it can be fairly extrapolated to developing countries, where the barriers to entry are a greater concern.

In the third chapter, coauthored with Carlos Caceres, we concentrate on fiscal and political stress events at the country level. These events certainly are painful for countries, since they often provoke a sharp drop of growth rates, economic stagnation and various sacrifices that are usually borne primarily by the poorest members of population. We analyze the linkages between quality of governance, institutions, and business environments, approximated by the Worldwide Governance Indicators, and propensity to experience fiscal or political stress events. For this purpose, we introduce two innovative indicators to measure stress events, which are less restrictive than those used in the previous literature (Kaminsky and Reinhart, 1996; Manasse, Roubini, and Schimmelpfennig, 2003; Alesina, Ozler, Roubini, and Swagel, 1996; Dutt and Mitra, 2008). Applying a simple methodology to compare the governance quality of countries that have and have not undergone stress events, and estimating logistic regression, we confirm that weaker governance quality is associated with a higher incidence of both fiscal and political stress events. In particular, only corruption and internal accountability, which measures the responsiveness of governments to improving the quality of the public service provision, are associated with fiscal stress events. All aspects of governance, and especially external accountability, capturing government accountability before the public through elections and the democratic process, seem to be important for political stress events.

Úvod

Tato disertační práce z různých úhlů pohledu zkoumá vztah mezi způsobem vládnutí a ekonomickým výkonem. Týká se konkrétně vývoje soukromého sektoru a ekonomického vývoje zemí.

Korupce je v rozvojovém světě pravděpodobně tou nejtraumatičtější slabostí způsobu vládnutí. Je považována za velkou brzdu ekonomického fungování zemí, jejich růstu a vývoje. Ponechávám stranou a legislativní formy korupce (Jain, 2001) a v první kapitole této dizertační práce se zaměřuji na byrokratickou korupci jako na brzdu vývoje privátního sektoru. Empiricky zkoumám, jak korupce ovlivňuje výkon firem v zemích střední a východní Evropy. Tím přispívám k probíhající diskusi o dvou protichůdných důsledcích korupce na ekonomický výkon. Předchozí výzkum této problematiky se spoléhá výhradně na údaje získané od BEEPS (Průzkum podnikatelského prostředí a výkonnosti firem), které trpí tím, že mnoho zpráv o výkonnosti firem chybí. Abych tento problém odstranila, kombinuji údaje o způsobech korupce získaných z průzkumu BEEPS se spolehlivými a rozsáhlými údaji o výkonnosti firem získanými z databáze Amadeus. Pokud se soustředím na rozdíly v rámci firmy, zjišťuji, že vyšší úroveň korupce negativně ovlivňuje jak odbyt tak i růst produktivity práce firem. Nicméně v závislosti na dané úrovni byrokratické korupce na úzce definovaném lokálním trhu se větší nevyrovnanost korupčního chování firem v rámci takového trhu jeví jako faktor usnadňující výkonnost firmy. Tento výsledek naznačuje, že v prostředí velmi nevyvážených lokálních trhů jsou negativní externality pramenící z byrokratické korupce zanedbatelné. Korupce pomáhá překonat provozní a růstová omezení zvýhodněným firmám anebo těm, které jsou ochotnější platit. Nepodplácející firmy se v takovém prostředí jeví jako efektivnější při výrobě i růstu, takže oba typy firem vytvářejí v průměru zrychlující se tempo růstu. Šance získat výhody z uplácení může být jedním z důvodů, proč korupce nemizí navzdory svému celkově škodlivému vlivu. Úkolem pro politické stratégy by tedy mohlo být zlepšení transparentnosti vzájemného působení mezi firmami a politickými představiteli s cílem zajistit rovnoměrnost poskytování veřejných služeb.

Dalším důležitým aspektem vývoje privátního sektoru jsou překážky vstupu na trh a náklady s tím spojené. V zemích se složitým byrokratickým systémem, nevýkonným poskytováním veřejných služeb, vysokou úrovní kontroly ze strany státu, politickými konexemi vedoucími k monopolistické tržní struktuře, vysoké náklady spojené se vstupem na trh brání konkurenci a vytváření pracovních míst, oslabují produktivitu a celkový vývoj. Ve druhé kapitole, jejímž spoluautorem byl také Vahagn Jerbashian, jsme zkoumali jeden z mechanismů snižující náklady spojené se vstupem na trh a následně zvyšující konkurenci – větší míru využití a širší přijetí telekomunikačních technologií. Vztah mezi rozšiřováním telekomunikačních technologií a konkurencí není přímočarý. Na jedné straně může být jejich spojení pozitivní, neboť telekomunikační technologie snižují náklady na získávání informací a vyhledávání klientů. Na druhé straně mohou telekomunikační technologie přispět k větší diferenciaci na produktovém trhu a získávat tak tržní sílu. S využitím metody "rozdílů v rozdílech" [difference-in-difference] podle Rajan and Zingales (1998) ke zmírnění endogenního charakteru problému empiricky ukazujeme, že intenzívnější využití a širší zavedení telekomunikačních technologií výrazně zvyšuje úroveň tržní konkurence výrobku na trzích služeb a zboží. Postupy, jejichž cílem je motivovat k většímu rozšíření telekomunikačních technologií tudíž mohou doplňovat konkurenci a antimonopolní postupy. Naše závěry jsou založeny na 21 zemích z Evropské Unie, nicméně mohou být snadno extrapolovány na rozvojové země, ve kterých bariéry vstupu na trh představují větší obavy.

Ve třetí kapitole, jejímž spoluautorem je Carlos Caceres, jsme se soustředili na fiskální a politické stresové události zemí. Tyto události jsou pro země jistě bolestné, neboť způsobují velký pokles tempa růstu, ekonomickou stagnaci a vyžadují různé oběti, které obvykle za velkých útrap přináší nejchudší obyvatelstvo. Analyzujeme spojitost mezi úrovní vlády v těchto zemích a jejich institucemi a obchodním prostředím, jak jsou odhadovány WGI, a se sklonem k fiskálním nebo politickým stresovým událostem. Pro tento účel zavádíme dva inovativní indikátory k měření stresových událostí, které jsou méně restriktivní, než indikátory použité v předchozí literatuře (Kaminsky and Reinhart, 1996; Manasse et al., 2003; Alesina et al., 1996; Dutt and Mitra, 2008). Při uplatnění jednoduché metodologie pro srovnání kvality vlády zemí, jež stresovými událostmi prošly a zemí, které stresové události nemají, a při odhadování logistické regrese jsme potvrdili, že horší kvalita vládnutí je spojena s vyšším výskytem jak fiskálních, tak politických stresových událostí. Konkrétně pouze interní odpovědnost, která poměřuje citlivost vlád na zlepšující se kvalitu poskytování veřejných služeb a korupce, jsou spojeny s fiskálními stresovými událostmi. Všechny aspekty vládnutí, a zvláště externí zodpovědnost vystihující odpovědnost vlády před veřejností během voleb a demokratický proces se zdají být pro politické stresové události důležitější.

Chapter 1

The Impact of Bribery on Firm Performance: Evidence from Central and Eastern European Countries

Abstract

I examine the relation between bureaucratic corruption (to “get things done”) and firm performance in Central and Eastern European countries. While previous research relies on data from the BEEPS survey, which suffers from excessive non-reporting of corporate performance, I combine the information on bribery practices from the BEEPS with reliable firm performance data from the Amadeus database. The estimates, identified from within-firm variation, suggest that bureaucratic corruption negatively affects both the sales and labor productivity growth of firms. However, conditional on a given level of bribery in a narrowly defined local market, a higher dispersion of firms' bribing behavior within such a market appears to facilitate firm performance. I provide an explanation for this finding and also investigate the effects of bribery with respect to the heterogeneity of firms in terms of their size, inclusion in the manufacturing or service sector, stability, and countries' overall institutional environments.

JEL Codes: D22; D73; O12; P37.
Keywords: Bureaucratic corruption; Firms' bribing behavior; Firm performance; CEE countries.

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1.1 Introduction

In countries with weak policies and legal systems, corruption is considered a strong and painful constraint to their economic functioning, growth, and development. It is a central and problematic topic for the governments of these countries and for international organizations (such as the World Bank, the IMF, the UN or the OECD), whose job it is to uncover the source of this disease and help overcome it (Kaufmann, 2005; Khan, 2006).

This study contributes to the ongoing debate about two opposing consequences of corruption on economic performance and, to some extent, attempts to reconcile them. One strand of the literature considers corruption a "grease the wheels" instrument that helps overcome cumbersome bureaucratic constraints, inefficient public services, and rigid laws (Leff, 1964; Huntington, 1968; Lui, 1985; Lein, 1986), especially when countries' institutions are weak, and ill functioning (Acemoglu and Verdier, 2000; Meon and Weill, 2010; De Vaal and Ebben, 2011). Another strand argues that corruption curbs economic performance owing to rent seeking, increase of transaction costs and uncertainty, inefficient investments, and misallocation of production factors (Murphy, Shleifer, and Vishny, 1991; Shleifer and Vishny, 1993; Rose-Ackerman, 1997; Kaufmann and Wei, 2000).

A vast amount of empirical evidence from cross-country analysis generally confirms that corruption harms investments, economic growth, and development (Mauro, 1995; Svensson, 2005; Campos and Kinoshita, 2010). In these papers corruption reflects public and manager perceptions of both bureaucratic and grand corruption in a country.[2,3] Empirical firm-level research, in turn, utilizes measures of bureaucratic corruption (bribery) such as the amount of bribes paid or the frequency of paying bribes to public officials to "get things done". This research mostly finds a negative or insignificant relation between bribery and firm performance (Gaviria, 2002; McArthur and Teal, 2004; Fisman and Svensson, 2007; De Rosa, Gooroochurn, and Gorg, 2010). Only a few papers, such as Vial and Hanoteau's (2010) plant-level study for Indonesia, report a positive relation. To date, however, firm-level research has remained scarce due to the lack of available data and limited capacity to address the endogeneity of bribery measures.

In this paper I aim to fill a gap in firm-level empirical research on bureaucratic corruption by overcoming data and methodological shortcomings of previous literature. I study the impact of bribery, measured as the frequency of making extra unofficial payments to public officials to "get things done", on the real sales and labor productivity growth of firms in Central and Eastern European (CEE) countries. In addition, I investigate

[2] See, for example, Jain (2001) for a discussion of different forms of corruption. The focus of this paper is solely bureaucratic or, in other words, petty corruption.

[3] The most commonly used measures are the Control of Corruption indicator produced by the World Bank and the Corruption Perception Index published by Transparency International.

this impact with respect to the heterogeneity of firms in terms of their size, inclusion in the manufacturing or service sector, stability, and countries' overall institutional environments. Existing research has had limited opportunities to explore this direction.

Information on firm-level bribery practices usually comes from anonymous surveys, in which firms may be reluctant to reveal their financial information. In the often used BEEPS or WBES databases[4] 40-50% of firms do not report their performance. Responses to the survey questions are generally also subject to managers' pessimism or optimism. These features likely cause erroneous inferences from the data. Further, due to sampling requirements and limited ability to follow firms over time, existing studies mostly deal with cross-sectional data, an invitation for endogeneity problems.

To overcome these data shortcomings, I combine reliable and large firm-level data (more than 500,000 firms) on balance sheets and profit/loss account items from the Amadeus database with firm-level data on bribery practices from the BEEPS. In the new dataset (hereafter, the BEEPS-Amadeus dataset), the bribing behavior of individual firms is unobserved, because it is impossible to exactly match firms from the two databases. Instead, I compute the averages and standard deviations of the bribery measure for country – survey wave – industry (2 digit ISIC code) – firm size (micro, small and large) – location size (capital, city with population over 1 mil and below 1 mil) cells using the BEEPS and assign them to every individual firm from Amadeus belonging to the same cell. These two statistics fully describe the average bribery level and (un)evenness of firms' bribing behavior within cells, which I term 'local bribery environments'. It is thus important to bear in mind that I examine the impact of 'local bribery environments' in narrowly defined local markets rather than firms' actual bribing behavior on firm performance.

Handling of the average bribery measure at the cell-level is not ad hoc. It is in line with the arguments of Svensson (2003) and Fisman and Svensson (2007) that bribery is industry and region specific in a country. It is also a common way to reduce endogeneity between bribery or subjective obstacles of doing business and firm performance in papers solely utilizing the BEEPS or similar datasets, given the lack of instrumental variables availability (Dollar, Hallward-Driemeier, and Mengistae, 2005; Kinda, Plane, and Veganzones-Varoudakis, 2009).

To date, I am aware of only two papers, Anos-Casero and Udomsaph (2009) and Commander and Svejnar (2011), that have attempted to combine the BEEPS and Amadeus. They analyze the effect of subjective business environment constraints on firm performance. My main departure from the approach of these papers to link the two databases

[4] The BEEPS (Business Environment and Enterprise Performance Survey) is a part of the global WBES (World Bank Enterprise Survey).

is that I use less aggregate dimension of cells. In particular, I separate micro firm with fewer than 10 employees from small firms with fewer than 50 employees. This is motivated by the fact that nearly 45% of firms in the BEEPS are micro, and that they generally tend to be exempted from some bureaucratic regulations and taxes (EC, 2011).

The BEEPS-Amadeus dataset consists of large firm-level panel data for 14 CEE countries over the 1999-2007 time span. It has more accurate information on firms' economic activity and bribery[5] than the BEEPS alone. The panel structure and the possibility to account for firm fixed effects help mitigate the endogeneity between bribery and firm performance. The use of the two independent data sources jointly further reduces this problem.

The results of the empirical analysis, identified from-within firm variation, suggest that a higher bribery level impedes both the real sales and the labor productivity growth of an average firm. This is generally consistent with the existing firm- and macro-level empirical research. The impact is more pronounced in the case of labor productivity growth, possibly because it is subject to rigid contracts with employees and can better reflect the rent-seeking behavior of firms.

Nevertheless, I find evidence in support of the "grease the wheels" hypothesis. Conditional on a given level of bureaucratic corruption in a local environment, a higher unevenness of firms' bribing behavior within such an environment appears to facilitate firm performance. Moreover, average firm performance in uneven environments seems to be higher than in environments that are more free of bribery. This result implies that in more uneven local bribery environments negative externalities from bureaucratic corruption are negligible, and bribery likely helps overcome operational and growth constraints for favored firms and/or for those with stronger willingness to pay. Non-bribing firms in such environments, in turn, seem to be more efficient in production and growth, so that both types of firms generate increasing growth rates on average. The chance of receiving benefits from bribery may be one reason why corruption does not vanish in spite of its overall damaging effect. The task for policymakers, therefore, is to increase the transparency of interactions between firms and public officials and ensure the fairness of public service provision.

Further results suggest that micro firms and incumbent firms (those that are present in the sample overall years) are the least affected by bureaucratic corruption. Firms from the construction, wholesale, and retail trade sectors are able to gain the most in more uneven local environments. Finally, in countries with weaker institutions, proxied by the Rule of Law indicator, the effects of bribery level and (un)evenness of firms bribing behavior are the least pronounced.

[5] The latter is true assuming that firm-specific perceptions and measurement error are averaged out.

The next section describes the theoretical background and empirical evidence on the possible relation between bribery and firm performance, and introduces the notion of 'local bribery environments'. Section 3 describes the data and merging of the two databases. Section 4 outlines the empirical methodology, section 5 presents the results and robustness checks, and section 6 concludes.

1.2 Links between bribery and firm performance

Theoretical background and some empirical evidence

According to the "grease the wheels" hypothesis, firms can benefit from bribery if it helps to overcome bureaucratic constraints, inefficient public services, rigid or bad laws (Leff, 1964; Huntington, 1968). Using the "queue model," Lui (1985), for instance, shows that bribes can expedite obtaining public services. In line with that, Beck and Maher (1986) and Lein (1986) suggest that bribing is similar to bidding in a competitive auction, which results in an efficient allocation of public services, licenses, and permits.

The "grease the wheels" hypothesis, however, has been extensively criticized. In his later work Lein (1990), for example, shows that outcomes in the "auction model" can be inefficient if there is discrimination among firms. Kaufmann and Wei (2000) argue that the "grease the wheels" hypothesis holds only when the amount of public services and time of their provision are exogenous. But in a general equilibrium framework public officials have incentives to increase the burden of bureaucracy in order to extract more bribes, thereby eliminating the possible benefits to firms. Rose-Ackerman (1997) suggests that less efficient firms, but with better connections with public officials and/or larger market power, may offer higher bribes and obtain public services faster. In the same way, incumbent firms may prevent the entrance of new firms into markets, leading to an increase in barriers to entry and undermining competition.[6]

Further, bribing can be too costly and undermine firms' profit (Sanyal, 2004), subsequent production, and growth. It also creates even greater market distortions than taxation, because of the need to keep illegal transactions secret and the uncertainty of delivering public services in exchange for a bribe on time, as Shleifer and Vishny (1993) demonstrate. Murphy et al. (1991) show that corruption forces the reallocation of talent from production to rent-seeking. As a result, firms may not be managed by the best talent, and hence expand less or be less productive. Applying the authors' arguments to the employment structure of a firm, we can also see that higher bribery can result in

[6] The present paper, however, does not directly deal with firm entry; firms therefore can benefit if bribes help to preserve or gain market power.

a larger share of employees being occupied in non-productive activities, including bargaining with public officials and searching for ways to overcome bureaucratic constraints. This can undermine the labor productivity of firms.

The development of institutional economics (North, 1990) has encouraged academics to distinguish the effects of corruption and bribery in different institutional environments. Acemoglu and Verdier (2000), for instance, show that when the government intervenes to correct market failures, a certain amount of corruption may exist as part of an optimal allocation. Infante and Smirnova (2009) introduce institutions directly into the model of Acemoglu and Verdier (2000) and demonstrate that in weaker institutional environments, rent-seeking bureaucrats can help improve the productivity of entrepreneurs. Similarly, De Vaal and Ebben (2011) suggest that when the initial quality of institutions is below a certain threshold, bureaucratic corruption facilitates economic performance. In a cross-country empirical analysis Meon and Weill (2010) show that corruption helps improve aggregate efficiency, especially in countries with weaker institutions.

The empirical firm-level evidence on the relationship between bureaucratic corruption and firm performance is inconclusive. Some research finds either an insignificant or negative impact of bribery on the sales growth or productivity of firms: Gaviria (2002) for Latin America, McArthur and Teal (2004) for Africa, Fisman and Svensson (2007) for Uganda. For CEE and the former Soviet Union region, De Rosa et al. (2010) find that bribery more negatively affects firm productivity in non-EU countries, and, generally, in those with weaker overall institutional environments. For empirical analysis, De Rosa et al. (2010) use the last wave of the BEEPS, and the other mentioned authors use similar anonymous datasets. Vial and Hanoteau (2010), in contrast, employ a unique plant-level panel data and report a positive impact of bribery on firm growth in Indonesia during the Suharto era, which was characterized by high corruption, cronyism, and patronage.

Both theoretical arguments and empirical evidence regarding the consequences of bribery on firm performance, thus, are ambiguous. The present study attempts to shed light on this issue and contribute to the empirical literature by utilizing an improved dataset and methodology.

Local bribery environments

The institutional environment of a country largely determines its economic level of development (Acemoglu, 2003), overall corruption level and the tolerance to corruption, behavior and performance of firms. However, a country, may consist of many narrow local markets that can be quite heterogeneous with respect to economic conditions as well as bribery practices. A small furniture firm located in a rural area, for instance, may face a different demand for and provide a different supply of bribes than a large retail firm located in a capitol city. In this paper, I focus on a local market which is comprised of firms sharing a similar size, area of economic activity (industry) and location. This local market can be characterized by a specific bribery level and the bribing behavior of firms, which I term 'local bribery environment'.

The notion of 'local bribery environment' is aligned with the arguments of Svensson (2003) and Fisman and Svensson (2007) that bribery is industry and region specific. They suggest that a firm depends more on public officials, and therefore might have to pay higher bribes (or more often), if it requires more permits and licenses due to the specifics of its economic activity, and/or if it is located in a place with a monopolistic (Drugov, 2010) or greedy public office. Hence, in a local market, firms likely meet a specific average local bribery level.[7] If the "grease the wheels" hypothesis is valid, then one would expect a positive relationship between local bribery level and firm performance.

However, it is unlikely that all firms in a local market always bribe equally. For illustration, two types of bribing behavior can be broadly distinguished: even and uneven. Even behavior would assume that all firms participate in bribery equally. Uneven behavior would suggest that there are both firms that bribe frequently and firms that bribe rarely or not at all in a local environment.

There can be various reasons for the (un)evenness of firms' bribing behavior. Among them are firms' differences in "willingness to pay" bribes (Bliss and Tella, 1997; Svensson, 2003). These can be related to their profitability and value of outside options as well as differences in the costs of paying bribes. The latter may be largely associated with ties to public officials and political parties (Collins, Uhlenbruck, and Rodriguez, 2009). In countries with pervasive corruption, such as Russia and Ukraine, the tendency or even necessity to follow other firms in bribing in order to survive, can support the evenness of bribing behavior. Further, in these countries, the presence of firms with foreign ownership or with foreign partners can contribute to unevenness, because they usually have better management standards and stricter attitudes towards corruption. The existing literature reports that firms with foreign ownership, and those that engage in importing or exporting tend to bribe less (Svensson, 2003; Luo and Han, 2008). Among other factors defining (un)evenness can be differences in the presence of honest and dishonest firms and/or public officials, and asymmetry of information about a local environment. All these factors, however, are not necessarily independent of those that determine average bribery level, making the bribing level and behavior of firms interrelated in a local environment.

To see the possible impact of local bribery environment on firm performance, consider the following cases. If, in an even local environment, firms do not bribe, they operate in

[7] This can be thought of as some equilibrium level of bribery, defined as the bribery demand from public officials and average firms' ability to supply bribes in a local market.

a market virtually without "frictions," and therefore can perform naturally at their best. They wait an average time to obtain public services. However, if all firms bribe with the same non-zero frequency, bribes can be seen as an additional fee for public services. These firms again wait an average time to obtain public services, but because the costs are higher, they may perform worse when compared to a bribe-free situation.

The performance of firms in an uneven local environment is less straightforward. If bribery works as a "grease the wheels" instrument by decreasing the waiting time to obtain public services and thereby improving firm performance, at least for the majority of bribing firms, then bribing should be the best response to bribery demands from public officials. But, given that a percentage of firms does not bribe in an uneven environment, it can be hypothesized that bribing firms are competing with more productive non-bribing firms.[8] Of course this does not exclude a situation in which bribing firms are also more productive. In this case, aggregated firm performance in more uneven environments can be higher than in bribe-free environments. However, if bribery helps only a minority of firms, yet induces red tape and negative externalities, then firms may perform worse in more uneven environments. In the paper I test these conjectures.

1.3 Data and datasets merging

Data sources

The firm-level financial data comes from the Amadeus database and data on bribery is taken from the BEEPS.

The Amadeus database is a product of Bureau van Dijk. It consists of full and standardized information from the balance sheets and profit-loss account items, industry codes and exact identification of European firms.[9] Amadeus has a specific feature regarding the exclusion of firms from the database. If a firm exits the market or stops reporting its financial data, this firm is kept in the database for four years, then excluded. For example, in the 2010 edition of Amadeus, the data for 2006 does not include firms that exited in 2006 or before. To preserve the full sample of firms, therefore, I combine several editions of Amadeus: November 2010, May 2010 and June 2007 downloaded from WRDS (Wharton Research Data Services) as well as the August 2003 DVD update from Bureau van Dijk.

The coverage of firms varies by country in the database. Based on the number of

[8]Hanousek and Palda (2009) make a similar conjecture and report some evidence of it by evaluating a displacement deadweight loss from tax evasion. They also show a possible crowding out effect by the majority of either honest or tax evading firms.

[9]Details of the Amadeus database can be found at `http://www.bvdep.com`.

available observations, I chose 14 CEE countries for the analysis: Slovenia, Hungary, Poland, Czech Republic, Slovakia, Estonia, Latvia, Lithuania, Bulgaria, Romania, Serbia, Croatia, Russia and Ukraine. These countries are similar in that they started the transition to a market economy at approximately the same time. However, they are quite different in overall corruption levels, as Figure 3.1 shows for the Control of Corruption indicator obtained from the Worldwide Governance Indicators database compiled by the World Bank. Before starting the empirical analysis, I clean the data of severe outliers and potential errors in variables (see Appendix A: Data cleaning for details). From Amadeus I use operational revenue, total assets, number of employees, EBIT (earnings before interest and taxes), cash flow, current liabilities and long term debt, industry identification, city/town names, and exchange rates.

The BEEPS is an anonymous survey of a stratified random sample of firms, collected jointly by the World Bank and the European Bank for Reconstruction and Development for Central and Eastern European and former Soviet Union countries.[10] It consists of a rich set of questions about firms' activity, market orientation, financial performance and employment as well as infrastructural, criminal, corruption, financial, and legal environments. Each wave of the BEEPS covers three preceding years; I use the last three waves completed in 2002, 2005 and 2008.[11]

The disadvantage of the BEEPS is missing data, especially for questions related to bribery and to a greater extent to accounting information (sales, assets, costs, etc.). Despite the anonymity of firms, specific formulations of the questions ("typical firm like yours"), and timing of asking (questions regarding firm performance are asked at the end of the interview), respondents answer such sensitive questions reluctantly, or not at all. Thus, non-responses to various questions about bribery account for 10-20% of the data, and to questions about financial performance – 40-50%. This can imply biased inferences from the data analysis.For instance, worse performing firms may not report their accounting information and may complain more about corruption. Answers to questions may also be subject to perception bias, such as managers' tendencies to complain or to be optimistic, or responses can be simply untruthful.[12] To overcome these limitations, I use firms' financial data from Amadeus and enrich it with the bribery measure from the BEEPS.

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[10] The data are available online either at `http://www.ebrd.com/pages/research/economics/data/beeps.shtml` or `https://www.enterprisesurveys.org`. Data for this paper was downloaded from the latter source.

[11] The last wave was completed in 2008 or 2009 for different countries, but its questionnaire covers the same time period, 2005-2007. The first wave was completed in 1999, but as it does not include the industry codes of firms, I do not use it.

[12] Jensen, Quan, and Rahman (2010), for example, find that in the WBES, firms in countries with less press freedom tend not to respond or to give false answers to the question about how much corruption is an obstacle to firm growth and operation.

The bribery measure used in this paper is derived from answers to the following question: *"Thinking about officials, would you say the following statement is always, usually, frequently, sometimes, seldom or never true: "It is common for firms in my line of business to have to pay some irregular "additional payments/gifts" to get things done with regard to customs, taxes, licenses, regulations, services etc."* This question is the most general and neutral, and virtually the only one that occurs consistently by across all three waves.[13] It also has the smallest number of non-responses relative to other questions about corruption – 10% overall. The original variable that measures bribery is categorical and takes values from 1 to 6; for convenience I rescale it to a variable that varies from 0 to 1.[14] In this way it can be interpreted as the intensity of bribing, probability to bribe, or size of bribes of measure one. Figure 3.2 shows the time variation of the bribery measure across countries. It is heterogeneous across countries and decreases over time, but not significantly for some countries.

Neither the BEEPS nor the Amadeus databases, however, seem to be representative. Appendix B compares these databases with data for the whole population of firms retrieved from the OECD STAN database for eight OECD countries from my sample. The BEEPS and Amadeus significantly underrepresent micro firms with fewer than 10 employees. The distribution of firms by industry and country also differs from the OECD data. Such non-representativeness is the result of stratification rules in the BEEPS's sampling, and of the tendency to capture more visible firms in Amadeus. To observe the possible bias of the effect of bribery on firm performance due to this non-representativeness, I conduct the analysis for different subsamples of firms.

Merging the BEEPS and Amadeus databases

Given that the BEEPS is an anonymous survey of firms, it is not possible to exactly match the firms from the two databases; a more general criterion for their merging is therefore needed. To date, only two papers have attempted to combine the BEEPS and Amadeus: Anos-Casero and Udomsaph (2009) and Commander and Svejnar (2011). The former paper examines the impact of subjective business environment constraints on total factor productivity, and the latter on efficiency to generate revenue (it uses the combined dataset only as a robustness check of their main findings from the analysis of the BEEPS). Both papers use the 2002 and 2005 waves of the BEEPS and merge the data for 7-8 CEE countries. To combine the databases, the authors compute means of business constraints

[13]The structure of the questionnaire and sampling method of firms changed in the latest 2008 wave compared to the 2002 and 2005 waves. This change encumbers the analysis of the three waves together, and is another reason for merging of the BEEPS with Amadeus.

[14]I rescale it by subtracting 1 from the original variable and dividing the result by 5.

within defined cells and assign them to every firm from Amadeus belonging to the same cell. Anos-Casero and Udomsaph (2009) define cells at the country – survey wave – size of location (capital, city with population over 1 mil, and below 1 mil) – firm size (2-49 and 50+ employees) dimension for all manufacturing firms together. Commander and Svejnar (2011) define cells at the country – survey wave – industry (2-digit code) – firm size (2-49, 50-249 and 250+ employees) level.

In this paper, I merge the databases in a similar fashion as these authors, but employ more complex merging criteria that combine the approaches of both papers. Specifically, I use both the size of location and 2-digit industry codes to define the merging criteria, since they might be equally relevant for determining a local bribery level (Svensson, 2003; Fisman and Svensson, 2007). In contrast to these authors, I separate micro firms with fewer than 10 employees from small firms with 11-49 employees. This is motivated by the fact that, originally, nearly 45% of firms in the BEEPS and 40% of firms in Amadeus are micro (see Appendix B: Data representativeness). Moreover, micro firms might be exempted from some bureaucratic regulations and taxes (EC, 2011), and consequently they might meet public officials less often. Finally, in contrast to Commander and Svejnar (2011) and in line with Anos-Casero and Udomsaph (2009), I join together firms with 50-249 and greater than 250 employees to capture more cells with the adequate number of firms for averaging.

The merging criteria are the following:

- country;
- time period – 1999-2001, 2002-2004, 2005-2007 corresponding to the three waves from the BEEPS;
- industry – two-digit ISIC rev 3.1 industry identification;
- firm size – micro firms with 2-10 employees, small firms with 11-49 employees, and medium and large firms with more than 50 employees;
- location size – capital, city with population above 1 mil, and all others below 1 mil.

These merging criteria explain 40% of the total variation of the bribery measure in the BEEPS.[15] Each cell is required to have at least 4 firms; there are 1137 cells in total. I compute the mean and standard deviation[16] of the bribery measure for each cell defined on the intersection of country – time period – industry – firm size – location size from the BEEPS, and assign them to every firm from the same cell from Amadeus.[17] Given

[15] This result is R^2 obtained from the analysis-of-variance (ANOVA) with bribery measure as a dependent variable and all interactions between country, year, industry, firm size, and location size as independent variables.

[16] Anos-Casero and Udomsaph (2009) and Commander and Svejnar (2011) do not deal with the standard deviation of business constraints within cells.

[17] Ideally, it is important to ensure a similar structure of the BEEPS and Amadeus data within cells. This can be done by re-weighting the bribery level and dispersion measures to reflect the composition of

the nature of the data, the mean and standard deviation are the best ways to describe bureaucratic corruption in a local market – bribery level and dispersion or (un)evenness of the bribing behavior of firms.[18] A small standard deviation suggests more even bribing behavior of firms – they either do not bribe, or bribe with the same frequency. A high standard deviation indicates more uneven behavior – some firms never or seldom bribe, while others bribe very often. As an example, all firms with more than 50 employees, located in Prague and occupied in retail trade (this defines the local market) during 1999-2000 are assumed to face the same bribery level (the mean of the bribery measure) and bribe evenly (if the standard deviation of the bribery measure is small) or unevenly (if the standard deviation is high).

The merging criteria defining a local bribery environment coincide with the arguments of Svensson (2003) and Fisman and Svensson (2007), that bribery is industry and region specific, although with one caveat. Instead of region, I use size of location and basically distinguish between capitals and all other towns,[19] because the identification of regions is not consistently available in the BEEPS. This assumes that the characteristics of public officials are the same across towns in the countryside. While this assumption may be plausible for small countries such as Slovenia or Estonia, it is unlikely to hold in large countries such as Russia or Ukraine. As a robustness check, therefore, I show that the results of this study hold for a subsample of firms located in the capitals of countries only and for the case when size of location is omitted from the merging criteria. In addition to industry and location, I use firm size as a criterion, since firms of different sizes may face different bribery demands and are able to supply different bribes.

Besides recovered financial data of firms, the advantage of the BEEPS-Amadeus dataset is the reduction of measurement error and firm-specific perception in the bribery level measure by averaging them out. Averaging, however, does not solve the problem of missing values in the bribery measure. As a robustness check, therefore, I estimate weighted regressions with weights equal to the proportions of non-missing to total number of observations in the cells defined above. Another advantage of the BEEPS-Amadeus dataset is the alleviation of the endogeneity between firm performance and bribery by utilizing independent datasets and controlling for firm fixed effects, which I discuss in the methodology section.

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firms from Amadeus. However, there is not much room for this, since Amadeus consists of the financial characteristics of firms and the BEEPS suffers from their extensive non-reporting. I attempted to re-weight bribery data using only the distribution of young and old firms from Amadeus; as demonstrated in the Robustness check section, this does not affect the results much.

[18]Mean and standard deviation, however, are dependent on each other. A higher mean tends to be associated with a higher standard deviation, but if, for instance, the mean approaches to one (all firms bribe at the highest frequency in a local market) the standard deviation decreases to zero.

[19]There are cities with a population above 1 mil only in Russia and Ukraine.

The BEEPS-Amadeus dataset results in unbalanced panel data for nine years 1999-2007, where the bribery measure remains constant over three-year periods: 1999-2001, 2002-2004 and 2005-2007. Only 2 cells out of 1337 from the BEEPS have no counterparts in Amadeus. About 48.2% of observations from Amadeus have merged.[20] Table 1.2 compares the composition of the Amadeus and BEEPS-Amadeus datasets by firm size and country. After merging, the distribution of firms shifts towards micro and small firms for nearly all countries, and also shifts slightly towards Poland, Romania, Russia and Ukraine, because there are more cells from the BEEPS corresponding to these size classes and countries.

Tables 3.1 and 3.2 compare the distribution of the number of observations, the local bribery level and bribery dispersion measures by each category included in the merging criteria in the BEEPS and BEEPS-Amadeus datasets. These tables show again, for example, that the distribution of firms shifts towards Romania, Russia and Ukraine, smaller firms, and the wholesale trade industry in the BEEPS-Amadeus dataset. This shift occurs due to higher coverage of firms in Amadeus belonging to these countries, size classes and industry. The last two columns of Tables 3.1 and 3.2 show the average real sales and labor productivity growth. Tables 1.5 and 1.6 offer further summary statistics of the employed variables and pairwise correlations between them. Detailed definitions of the variables are in Appendix C: Definitions of variables.

1.4 Empirical methodology

Theoretical reasoning suggests the possibility of both positive and negative consequences of bribery on firm performance depending on various firm characteristics, country, and local environments. This paper aims to assess empirically which effect prevails in CEE countries on average. Identification of the relation between bribery and firm performance, however, is not straightforward because of possible endogeneity. On the one hand, bribery may influence firm performance by increasing or reducing constraints to operation and growth. On the other hand, better performing firms may have a greater willingness and ability to pay bribes. This reverse causality may likely be induced by a third unobservable factor that correlates with both firm performance and bribing practices, such as managerial talent or firm culture.

[20] 48.2% of merged observations from Amadeus is a large number given the number of available cells from the BEEPS. If the number of 2-digit industries is 30, the number of countries is 14, the number of firm size classes is 3, the number of location types is 2 (3 for Russia and Ukraine) and the number of time periods is 3, then the total number of cells should be 7520 to cover virtually all firms from Amadeus. However, the limited coverage of firms in the BEEPS and the requirement of having at least 4 firms in a cell give only 1337 cells in total.

In the context of the present paper, this endogeneity problem is reduced due to several factors. First, the bribing behavior of individual firms is unobserved. Instead, I employ more aggregated measures of bribery, namely its average level and the (un)evenness of the bribing behavior of firms in a local market, as defined by industry, firm size, and location size characteristics. Arguably, an individual firm may have only a negligible influence on these aggregate measures.[21] This influence is decreased further when firm performance and bribery measure come from different independent data sources (Anos-Casero and Udomsaph, 2009). More importantly, the panel structure of the data allows me to use firm fixed effects and remove time-invariant unobservable factors that could potentially cause both firm performance and bribing behavior.[22] The short length of the panel increases the likelihood of these unobservables being fixed over time. Nevertheless, in the next section I first compare the estimates identified from within-firm variation with the estimates identified from within-cell variation to demonstrate the reduction of the endogeneity bias. In the within-cell dimension, average firm performance more likely affects cell-level bribery, inducing upward bias of the estimates (if better performing firms are ready to bribe more frequently). It is worth mentioning, however, that firm fixed effects estimation does not account for temporal reverse causality, since firms may endogenously choose their location and their area of economic activity at start-up depending on how bad corruption environments are. This limitation remains open.

Before starting the regression analysis, I transform the data from a nine-year span to a three-period span and consider dependent variables as averages over three time periods 1999-2001, 2002-2004, and 2005-2007 and control variables at the beginning of each period (i.e. at 1999, 2002, or 2005). This aligns the financial data with the measures of bribery level and (un)evenness of bribing behavior, which change only over these three time periods.

The empirical specification is a typical growth equation, originally proposed by Evans (1987), where the dependent variable is the growth rate and the independent variables

[21] In view of the difficulties to find appropriate instruments for bribery measures, the use of industry–location or industry–location–firm size average measures of bribery or obstacles to firm growth and operation instead of firm-specific measures is a handy approach to reduce the endogeneity problem in existing research, which employs cross-sectional data from the BEEPS, WBES or IC (Investment Climate). See, for example, Dollar et al. (2005), Kinda et al. (2009), Aterido, Hallward-Driemeier, and Pages (2011) and Commander and Svejnar (2011).

[22] Controlling for firm fixed effects is a general approach in studies involving financial panel data analysis due to the huge heterogeneity of individual firms and possible endogeneity between variables (see, for example, Chi, 2005; Hanousek, Kocenda, and Svejnar, 2007; Del Carpio, Nguyen, and Wang, 2012).

are lagged to control for initial conditions,[23] as follows:

$$y_{it} = \beta_0 + \beta_1 Bribery\ Level_{ct} + \beta_2 Bribery\ Dispersion_{ct} + \gamma X_{it-1} + \upsilon_i + \nu_t + \varsigma_s + \varepsilon_{it}, \quad (1.1)$$

where y_{it} is the performance measure of firm i at time period t; it is either real sales or labor productivity average growth rates. $Bribery\ Level_{ct}$ and $Bribery\ Dispersion_{ct}$ are the mean and standard deviation of the bribery measure from the BEEPS in cell c respectively; they reflect the bribery level and the (un)evenness of bribing behavior of firms in a local market c.[24] X_{it-1} is the vector of control variables. The term υ_i removes unobserved firm fixed effects that can create across-time correlation of the residuals of a given firm (e.g. managerial skills). The term ν_t removes unobserved time fixed effects that can be responsible for correlation of the residuals across different firms in a given year (e.g. aggregate shocks or business cycle). The term ς_s captures unobserved firm size fixed effects (micro, small, and medium-large firms)[25] that can lead to correlation of the residuals across firms of a given size class due to, e.g., specific regulations attached to firms of a particular size; ε_{it} is the i.i.d. random component. I use demeaning of the variables to remove firm fixed effects, which is equivalent to the inclusion of firm identification dummies into regression, and I use dummies for time periods and firm sizes to remove corresponding fixed time and firm size effects.

The coefficients of interest are β_1 and β_2. Their positive signs would favor the "grease the wheels" hypothesis of corruption. It has to be emphasized, however, that these coefficients show the effect of a local bribery environment on firm performance, while the bribing behavior of individual firms is unknown.

To construct firm performance measures, I first take the natural logarithms of real sales (approximated by operational revenue in 2000 prices) and labor productivity (real sales per employees).[26] Then I compute first differences of these logarithms, which stand for the logarithmic approximation of the yearly growth rates of sales and labor productivity. y_{it} is the average of yearly growth rates over the three-year periods 1999-2001, 2002-2004

[23] Similar specifications are also widely used in the literature that study the effects of privatization, political connections, and other events on firm performance (e.g. see Hanousek et al., 2007; Boubakri, Cosset, and Saffar, 2008)

[24] These two statistics, the mean and standard variation of the bribery measure from the BEEPS, jointly work as the coefficient of variation ($c_v = \sigma/m$). I do not use the coefficient of variation variable instead, since it is less clear to interpret the estimates of this variable.

[25] I control for firm size fixed effects, because firm size is included in the merging criteria. The remaining factors from the merging criteria are removed when firm fixed effects are taken into account. Exclusion of firm size fixed effects, however, does not affect the final results since the number of employees is among the independent variables.

[26] I do not measure productivity as TFP (total factor productivity) or value added per employee, because Amadeus has many missing values in the intermediate material and staff cost variables for CEE countries; Russia, Latvia and Lithuania do not report them at all. I use a simplified version of productivity, which allows firms' capital and intermediate costs to be flexible.

and 2005-2007. I expect that a local bribery environment may have a somewhat different effect on these performance measures. Sales is a more "visible" and immediate outcome, and unaffected directly by other financial incomes and taxes of a firm. Bribery can retard or speed sales growth, for example, through delaying or expediting investments in developing or selling new products, or export opportunities. Labor productivity, in addition, reflects employment structure, and therefore can be seen as performance on a longer horizon.

Vector X_{it-1} is the set of firms' characteristics. They are not actually lagged, but are measured at the beginning of each time period (i.e. at 1999, 2002, and 2005) to control for the initial conditions, to reduce possible endogeneity between them and firm performance measures and to keep all three time periods in the analysis. X_{it-1} includes logarithms of total assets and number of employees as well as their squares to control for firm size and its possible non-linearity; market share (at the 4-digit industry level); firm profitability (EBIT over total assets); book leverage ratio (total debt over total assets); and cash flow also scaled by total assets. These variables can correlate with firm performance and with bribery level and its dispersion, thus reducing omitted variable bias of the coefficients of interest. Firms with lower market shares, for instance, can be more engaged in bribery in order to survive on the market. Luo and Han (2008) report such a correlation in a study of the determinants of bribery and graft using the BEEPS for several developing countries. More profitable firms may have a higher "willingness to pay" and can pay bigger bribes and/or more frequently (Bliss and Tella, 1997; Svensson, 2003). Firms' leverage can also correlate with bribery if unofficial payments are needed to borrow finance (Beck, Demirguc-Kunt, and Maksimovic, 2005). Availability of cash can also open greater opportunities for bribe payments. Controlling for these firm-specific variables also eliminates differences between firms across countries and restricts the sample to those that report all essential financial information.

Although controlling for firm fixed effects reduces the endogeneity bias of the estimates, they might still be biased because of measurement errors in the bribery level and dispersion variables. Under the assumption of classical measurement error, the coefficients are biased toward zero,[27] and they can be biased in any direction if this assumption is violated. If measurement error of the bribery measure from the BEEPS has zero mean within cells, then in the bribery level variable this error is eliminated. This is not the case, however, for the bribery dispersion variable. Therefore, possible bias in the coefficients should be kept in mind when interpreting the results.

[27] It assumes that measurement error does not correlate with error from a regression. For within estimator $plim\ b = \beta(1 - \frac{T-1}{T}\frac{\sigma_v^2}{var(\tilde{x})})$, where β is a true estimate, T is a maximum time dimension, σ_v^2 is a variance of measurement error and $var(\tilde{x})$ is a variance of demeaned variable x (Griliches and Hausman, 1986).

I estimate specification (1) using standard errors robust to heteroskedasticity and clustered at the firm level (Petersen, 2009). In addition, I account for influential observations using Cook's distance,[28] as the data for CEE countries is highly volatile. Observations for which this distance exceeds $4/N$, where N is the number of observations used in the regression, are removed as outliers. This procedure improves the fit of the regressions, but does not affect the estimates much, as is shown in the Robustness check section.

The estimates from the fixed effects regression capture firms' dynamics. Therefore, it is important to see why the local bribery level and the (un)evenness of firms' bribing behavior in a local market can change over time. On the one hand, changes may come from the local government side, in cases when it imposes stricter law enforcement and reduces the opportunity for public officials to extract bribes. The changes, of course, can move in the other direction, when the local government exposes opportunistic behavior due to some exogenous shocks. There may be also changes occurring in the local political party or government which can lead to losing (or gaining) connections between firms and public officials. On the other hand, firms themselves can change their attitudes towards bribery over time. For example, they may strategically increase their involvement in bribery to gain competitiveness, or might decrease this involvement to preserve their reputation.

Yet another factor adding noise to changes in a local bribery environment over time may be a change in the distribution of firms, including firms with foreign ownership and foreign partners, in the BEEPS database. This can be especially problematic in the last time period, since the sample stratification of the BEEPS has been changed. To see whether this affects the results, I estimate specification (1) separately for the first and second, and the second and third time periods. In addition, I compute the local bribery level variable from the BEEPS's bribery measure, keeping constant such firm characteristics as foreign ownership, export and firm age to ensure a stable structure of the BEEPS data within cells, and then use it instead of the usual bribery level variable in the regression.[29] The results of these estimations are reported in the Robustness check section.

[28] Cook's distance is a measure based on the difference between the regression parameter estimates $\hat{\beta}$ and what they become if the ith data point is deleted $\hat{\beta}_{-i}$, see Cook (1977) for details.

[29] This correction, however, does not work for the bribery dispersion variable, since it is available on the cell-level an attempt to correct for the stable structure of the BEEPS would take out too much variation from the original variable.

1.5 Results and discussion

General results

Table 1.7 reports the results of the estimation of specification (1) for the whole sample of firms. Odd columns present the results for the dependent variable, real sales growth, and even columns, for labor productivity growth. The last rows of the table show the average effects of bribery level and dispersion on firm performance as well as their sum.[30] In columns I-IV, only time, country, industry, location, and firm size fixed effects (those that are in the merging criteria) are controlled. In columns V-VIII, firm, time, and firm size fixed effects are controlled. If better firm performance is generally associated with higher participation in bribery, then the coefficients on bribery level in within-cell regressions (columns I-IV) should be biased upward, because cell-average firm performance may more likely affect cell-level bribery.[31] Controlling for firm fixed effects should remove or at least reduce this bias. Indeed, the coefficients on bribery level are smaller in columns V-VIII than in columns I-IV, advocating for the use of firm fixed effects regressions. Further, the comparison of columns I-II with III-IV and of columns V-VI with VII-VIII shows that the inclusion of bribery dispersion does not affect the sign and significance of the coefficient on bribery level, although these variables are well correlated (see Table 1.6).

Having the regressions from columns VII and VIII as benchmarks, all else being equal, the jump from zero bribery level to unity in a local environment over time is associated with a 9.6% and 13.9% decrease in real sales and labor productivity growth respectively. The increase in the bribery level by its average value is associated with a 3.0% and 4.3% decrease in corresponding firm performance measures. These numbers are relatively large, since the average real sales growth is 4.7% and the average labor productivity growth is -3.0%. The results thus show that bribery is a burden for an average firm, which is consistent with most previous findings at both the micro (Fisman and Svensson, 2007; De Rosa et al., 2010) and macro (Mauro, 1995; Campos and Kinoshita, 2010) levels.

The estimates of the coefficients on bribery dispersion, in contrast, are positive for both dependent variables. They are also highly significant. For a given level of bribery, the move from zero bribery dispersion (even bribing behavior) to unity (fully uneven bribing behavior of firms, although bribery dispersion never reaches unity given that the original bribery measure from the BEEPS varies from 0 to 1) in a local environment over

[30] The average effect of the variable is a product of the corresponding estimated coefficient and the average value of bribery level or bribery dispersion. For example, the average effect of the bribery level on sales growth is $(-0.096 \cdot 0.311) \cdot 100\% \approx -2.97\%$, where -0.096 is the estimate of the coefficient on bribery level and 0.311 is the mean of bribery level variable.

[31] For the bribery dispersion measure the direction of bias is more difficult to determine, therefore, I do not discuss it.

time is associated with a 17.4% and 21.9% increase in real sales and labor productivity growth respectively. The average bribery dispersion effects are 4.7% and 5.9% for the two performance measures. The sum of the average bribery level effect and the average bribery dispersion effect (in other words, the trade-offs between these two effects) is positive and equal to 1.7% for sales growth and to 1.6% for labor productivity growth.[32]

The results suggest that while a higher bribery level retards sales and labor productivity growth, firms benefit from bribery, on average, if they operate in more uneven local environments. In other words, bribery helps and "greases the wheels" for individual firms, but still harms firms' collective economic performance. An explanation for this result could be the following. In a more uneven local environment, under a given level of bribery, firms that are more efficient in bribery – that is, those that have more information about opportunities to grease the business, with lower costs or higher willingness to bribe – apparently bribe more frequently than their peers. Owing to bribes and overcoming bureaucratic constraints, they most likely generate higher sales and labor productivity growth rates than if they were not to bribe (this does not exclude the situation, however, when bribing firms are efficient in both bribing and production). Their non-bribing (or less frequently bribing) counterparts must be more efficient in production and growth to compete with bribing firms. In this case, both types of firms together are able to generate, on average, increasing sales and labor productivity growth rates. Public officials, in turn, could be less monopolized in such an environment. Due to these facts, negative externalities from bribery seem to be negligible in uneven local bribery environments. This explanation, however, should be treated with caution, since we do not observe the bribing behavior of individual firms. It still might be the case that bribing firms exhibit increasing growth rates while their non-bribing counterparts exhibit decreasing rates, or the other way around, but on average these rates are increasing.

For another way to see why the growth rates may be slower in more even environments, recall that for a given level of bribery, either the number of bribing or non-bribing firms dominates. If the number of bribing firms prevails, a negative externality from bribery (such as, for instance, incentives to induce bureaucratic burden by public officials) can occur slowing down the average growth rates. If the number of non-bribing firms dominates, then there can be fewer incentives for firms to be more efficient in production, grow fast and compete aggressively with occasionally bribing firms.

The results also show that the effects of bribery level and (un)evenness of bribing behavior seem to be sounder for labor productivity than for sales growth rates. This suggests that participation in bribery affects the employment structure of firms. In highly

[32] These trade-off positive numbers are rather conservative. Given that bribery level and dispersion are dependent on each other, when bribery level is at its average value, bribery dispersion is higher by 0.04 than its average value as reported in Table 3.1.

corrupt environments, firms likely employ a non-optimal number of workers due to the misallocation of talent, in accordance with Murphy et al.'s (1991) theory. A percentage of employees may be engaged in unproductive activity: searching for ways to circumvent rigid laws and bureaucratic constraints, and bargaining with public officials. It may also be the case that public officials, having established a connection with a firm, do not allow the firm to dismiss its workers in order to keep high employment figures in the region and voters loyal to the current government. However, bribing firms that have an opportunity to gain a competitive edge over their non-bribing counterparts (in more uneven local environments), are able to adjust the employment structure to an optimal level and increase effectiveness.

The results thus show that bribery can work as the "grease the wheels" instrument, in spite of its overall damaging effect. This fact, perhaps, keeps bribery attractive for some firms. The following subsections examine the effect from bribery with respect to the heterogeneity of firms and environments to understand better what drives the relation between bribery and firm performance. The last subsection describes several robustness checks.

Heterogeneity of firms

Manufacturing and service firms

In the BEEPS-Amadeus dataset, firms from manufacturing sectors represent only 14.5% of the sample. On average, they tend to have lower sales growth, much higher labor productivity growth, and pay bribes less often than firms from service sectors (see Table 3.2). Columns I-IV, Panel A in Table 1.8 present the results of the estimation of specification (1) for manufacturing and service firms separately (construction industry is not included). The estimated coefficients on bribery level and its dispersion are drastically different for the two subsamples of firms.

Higher levels of bribery in local environments significantly retard the performance of manufacturing firms, especially real sales growth. Operating in more uneven environments does not bring benefits either (see columns I-II, Panel A in Table 1.8). Large size of manufacturing firms can make them more visible and attractive to public officials eager for additional, though unofficial, incomes. At the same time it can make them less flexible in responding to the bribery level and leave a lower capacity to extract benefits in uneven local environments. Manufacturing firms also tend to have a larger share of foreign ownership, which is usually associated with higher management standards, leading to stricter attitudes against corruption and hence, perhaps, a poorer ability to deal with it.[33]

Another explanation for the result may be that the utilized bribery measure does not reflect well the nature of bribing practices among manufacturing firms, if any. These firms arguably require fewer permits, licences, and inspections than do service firms (compare, for instance, a furniture firm with a restaurant that has to comply with food quality standards), but might depend more heavily on the relationships with customers and supply chains. Their corruption practice, therefore, might instead consist of kickbacks between businesses. Service firms, in contrast, are smaller, more flexible, and likely interact more often with public officials. Although on average they suffer as well from higher bribery levels, they are able to gain significantly in local markets with more uneven bribing behavior of firms (columns III-IV, Panel A in Table 1.8). This story, however, does not end for service firms.

As Table 3.2 demonstrates, approximately half of the sample belongs to the wholesale and retail trade industries (79% of service firms), and 15% belongs to the construction sector. Construction, and to a lesser extent, wholesale trade firms tend to pay bribes more frequently than service firms on average; retail trade firms, slightly less. Columns V-VI, Panel A in Table 1.8 show the results of the estimation of specification (1) for the subsample of service firms excluding these sectors, and Panel B in Table 1.8 displays the results for the subsamples of these sectors separately. The estimates show that construction, wholesale, and retail trade firms, particularly, drive the results for the whole sample, i.e. losses in growth rates from the higher bribery level and gains from the uneven bribing behavior of firms in local environments. For the remaining service firms the outcome is the opposite.

Given that the BEEPS-Amadeus dataset is not representative (for OECD countries, for example, firms from the construction and wholesale sectors are overrepresented in comparison with OECD STAN data, see Appendix B: Data representativeness and Table 3.2) it seems that the estimated magnitudes of the coefficients on bribery level and its dispersion presented in Table 1.7 are biased upward in absolute values.

Firm size

The literature usually documents that corruption is a bigger obstacle for micro and small firms than for large firms, and hence impedes the performance of smaller firms more (e.g. UNIDO/UNODC, 2007; Beck et al., 2005; Aterido et al., 2011). This is explained, for example, by the fact that smaller firms have weaker bargaining power and influence on public officials. They also have more difficulties obtaining finance due to having smaller collateral. In this paper, however, the bribery level variable measures the frequency of

[33] Unfortunately, data limitations do not allow to control for firms' ownership structure in the analysis.

paying bribes 'to get things done' and may not reflect corruption as an obstacle. Indeed, Table 3.1 reports that the bribery level increases with firm size. Therefore, I do not expect the same results as the cited literature suggests.

Panel A in Table 1.9 presents the results of the estimation of specification (1) for three subsamples of micro, small and medium plus large firms. The signs of the coefficients on bribery level and its dispersion are the same as in the case for the whole sample; the magnitudes, however, are different for the three subsamples. It turns out that the growth rates of micro firms are the least affected by bribery, large firms suffer the most from higher bribery levels, and small firms are able to extract the greatest benefits in more uneven local environments.

One explanation for this finding is that firms of different class size carry different levels of regulatory burden. These differences usually are designed to promote the growth and development of small businesses and encourage entrepreneurship (World Bank, 2004). Thus, smaller (micro) firms are often required to comply with softer regulatory standards and requirements such as reporting and keeping records for inspections. They may also be exempted from some taxes, or have lower tax rates. Labor, health, and safety inspections can also have a negligible effect on smaller firms. In addition, smaller amounts of bribes can be extracted from firms with smaller numbers of employees and turnover. The opposite holds for the large firms.

These outcomes confirm the conjecture in section 5.2.1 that the estimated coefficients on bribery level and its dispersion presented in Table 1.7 are likely biased upward in absolute values. This is because the actual share of micro firms is at least twice as big in the representative OECD data than in the BEEPS-Amadeus dataset (see Appendix A: Data cleaning).

Firm dynamics

As Table 3.1 shows, the number of firms increases over time in the BEEPS-Amadeus dataset. This short panel dataset also captures some dynamics of firms. Taking advantage of this feature, I examine whether bribing practices affect the performance of new entering, exited and stable firms differently. About 8.5% of firms remain in the sample during all three periods, 24.8% of the sample are new firms that appear in the second period and stay in the third, and only 3.3% are those that have exited from the sample in the last period. The remaining firms are present in the sample only in the one time period, or only in the first and the third, are not considered in this subsection. The number of entering and exited firms in the BEEPS-Amadeus dataset, however, is a rough approximation of actual firms' dynamics.

Table 1.1 below presents summary statistics for three subsamples of firms: stable, entering, and exited. Entering and exited firms on average pay bribes more frequently, have lower sales growth, and more volatile growth rates. Entering firms have negative and exited firms have large positive labor productivity growth rates, suggesting that the former are increasing (hiring) and the latter are decreasing (firing) the number of employees.

Table 1.1: Firms' dynamics

	Stable			New entering			Exited		
	Mean	Median	S.D.	Mean	Median	S.D.	Mean	Median	S.D.
Sales growth	3.55%	3.55%	30.42%	2.08%	1.89%	48.43%	0.89%	2.82%	43.78%
Lab. prod. growth	1.98%	1.80%	28.70%	-5.20%	-5.23%	41.67%	7.04%	5.56%	42.70%
Bribery Level	0.29	0.27	0.13	0.30	0.28	0.14	0.33	0.34	0.17
Bribery Dispersion	0.26	0.27	0.07	0.26	0.27	0.08	0.28	0.29	0.09

Panel C in Table 1.9 reports the results of the estimation of specification (1) for these three subsamples. The coefficients on bribery level and its dispersion are significant and have the same signs as for the whole sample. However, bribery seems to have a stronger effect on the performance of firms that are at the beginning or at the end of their business experience. The strong negative impact of bribery levels on the growth rates of exited firms could be associated with costly bureaucratic exit procedures related to bankruptcy or retreat from the market, and final tax administrations. These firms might also attempt to fight for survival in the early stages of exit. Costly bribes paid by new entering firms might help them to becoming established. It is notable that the trade-off between the effects of the bribery level and of the (un)evenness of bribing behavior is negative for stable firms. This fact potentially should incite incumbent firms to protest against corruption.

Heterogeneity of environments

Countries' institutional environments

Despite countries from the CEE region having undergone transition at approximately the same time, they are quite heterogeneous with respect to overall corruption levels, as Figures 3.1 and 3.2 show. Unsurprisingly, countries that entered the European Union in 2004 (Slovenia, Hungary, Poland, the Czech Republic, Slovakia, Estonia, Latvia, Lithuania) tend to have the lowest corruption levels, while Russia and Ukraine are the most corrupt. This section determines whether bribery affects firm performance differently in countries with different levels of institutional strength.

I first estimate specification (1) allowing for the coefficients on bribery level and its dispersion to vary for three regions: first – Slovenia, Hungary, Poland, the Czech Republic, Slovakia, Estonia, Latvia and Lithuania (15.5% of the sample); second – Croatia, Serbia, Bulgaria and Romania (30.5% of the sample); and third – Russia and Ukraine (54.0%

of the sample). The first region is the least corrupt and has stronger institutions, while the third region is the opposite case. Second, I use the Rule of Law indicator from the Worldwide Governance Indicators database to proxy for countries' institutions. It captures the incidence of crime, effectiveness of the judiciary, and enforcement of contracts. I rescale this indicator to a variable that varies from 0 to 1, where higher values stand for weaker Rule of Law. I include into specification (1) interaction terms between Rule of Law and bribery measures to see how country institutions are indirectly associated with the bribery-firm performance relationship.

Table 1.10 reports the results from the estimation of these specifications. Panel A shows that in all three regions firm performance deteriorates with higher levels of bribery. This impact is strongest for firms from the first region. A higher probability of being caught and stricter law enforcement make bribery more painful. In more uneven local environments, however, firms from this region are able to gain the most benefits. The trade-offs between bribery level and the (un)evenness of bribing behavior, meanwhile, are positive only for the second and third regions (these are not reported in the table).

The results presented in Table 1.10, Panel B generally complement the finding above. They suggest that although bribery level has a negative impact on firm performance, in countries with weaker institutions, this impact is less pronounced. In countries with the weakest Rule of Law indicator, such as in Serbia between 1999-2001, the effect of bribery level even becomes positive. The weakening of institutions also decreases growth gains from the more uneven bribing behavior of firms in local markets; however, they never become negative in my sample of countries since the Rule of Law indicator does not exceed unity. Table 1.10 thus provides some empirical evidence for the theoretical conjectures of Infante and Smirnova (2009) and De Vaal and Ebben (2011), but it contradicts the empirical evidence of De Rosa et al. (2010).

Local bribery environments

The general results show that, *ceteris paribus*, more uneven local environments lead to higher economic performance of firms. In this final subsection I examine how the bribery level affects firm performance depending on the extent of the unevenness of local environments.

To do so, I roughly separate local environments into even and uneven. A dummy variable indicating an even (uneven) environment is equal to one if bribery dispersion is less than or equal to the 25th percentile (is greater than or equal 75th percentile) of its distribution for each country, and zero otherwise. Second, I interact these dummies with bribery level and include them in specification (1) instead of bribery level and dispersion. Columns I-II in Table 1.11 report the results of estimating this regression. A higher bribery level worsens both sales and labor productivity growth rates in even environments. Bribes, therefore, seem to increase the costs of operation and/or undermine incentives to grow in environments where everyone uniformly participates in bribery. In contrast, in uneven environments, the possibility for some firms to bribe more often allows firms to perform better on average.

For completeness, I also test whether average firm performance is significantly different for firms that operate in uneven environments, and for those that have low and high bribery levels in even environments, than it is for all other firms that are in the middle. For this exercise, first I roughly distinguish two types of bribery levels. A dummy variable indicating a low (high) level is equal to one if the bribery level is less than or equal to the 25th percentile (is greater than or equal to the 75th percentile) of its distribution for each country, and zero otherwise. Second, I interact the even environment dummy variable with each type of bribery level, and include these dummies and a dummy for the uneven environment in specification (1) instead of bribery level and dispersion.

Columns III-IV in Table 1.11 report the estimates from the regression. The coefficients show that those firms that operate in even environments and pay bribes rarely, i.e. inhabit close to a bribe-free situation, have -1.1% and 0.6% conditional average sales and labor productivity growth rates. In even environments with a high bribery level, these rates decrease to -6.2% and -3.6% respectively. Finally, those firms that operate in uneven environments demonstrate moderately positive rates – 1.0% and 1.1%. Widespread corruption, therefore, largely decreases average firm performance, but unevenness of local bribery environments increases it.

Robustness check

As a robustness check I use two additional bribery measures constructed as dummy variables from the original frequency of paying bribes. The first measure takes value one if firms report that they bribe public officials sometimes, frequently, usually or always to "get things done", and zero otherwise, as in De Rosa et al. (2010); the second measure takes value one if firms report that they bribe seldom, sometimes, frequently, usually, or always, and zero if never. These variables only indicate participation in bribery, but not its intensity as does the measure used in the main analysis. In the BEEPS-Amadeus dataset, these measures are again averaged within country–time period–industry–firm size–location size cells and proxied for bribery levels in local environments. The (un)evenness of bribing behavior is computed as before, since the standard deviations of dummy variables do not appropriately reflect dispersion. Table 1.12, Panel A displays the results of the estimation of specification (1) with these new bribery measures. The estimates of the coefficients of interest are qualitatively the same as for the main bribery measure, only their magnitudes are slightly smaller. Hence, the results are not driven by the choice of bribery measure.

Although the bribery measure is consistent across all three waves of the BEEPS, the structure of the questionnaire and stratification of surveyed firms were changed in the last wave. These changes might have an impact on the results. The number of firms registered in the Amadeus database is also increases over time, which can potentially have an effect on the results as well. To rule out these possibilities, I estimate specification (1) separately for the first and second, and for the second and third, time periods. The estimates presented in columns I-IV, Panel B in Table 1.12 suggest that these changes do not affect the main outcome.

Further, to ensure a stable structure of the BEEPS within cells, instead of unconditional averaging of the bribery measure from the BEEPS, I compute the local bribery level measure, keeping constant such firm characteristics as foreign ownership, export, and firm age. I then use this conditional bribery level variable to estimate specification (1). The bribery dispersion variable, meantime, remains the same. As columns I-II, Panel C in Table 1.12 demonstrate, the main results qualitatively are the same. Taking further care of the structure of the BEEPS and Amadeus data within cells, I compute the local bribery level and dispersion variables using the bribery measure from the BEEPS multiplied by the proportions of young and old firms within corresponding cells from Amadeus. I then use these weighted bribery measures to estimate specification (1). The coefficients of interest have only increased in absolute values; see columns III-IV, Panel C, Table 1.12.

The main analysis assumes growth rates averaged over three years and control variables measured at the beginning of three-year periods. As a robustness check I estimate specification (1) on yearly data (nine years in total) with lagged control variables, using two methods. First, I use conventional firm, firm size and time fixed effects estimation as before. Second, I include a lag of the dependent variable among the regressors to control for autocorrelation in residuals and apply Arellano and Bond's (1991) dynamic panel data estimation technique, i.e. estimate specification (1) in first differences and use second lags of independent variables (except bribery level and its dispersion, since they do not change across the three-year periods) as instruments. Panel A in Table 1.13 presents the results of such estimations. The coefficients of interest are not qualitatively different from the main results, meaning that neither data structure nor possible autocorrelation drive the results.

In the main analysis, I use country–time period–industry–firm size–location size cells with no fewer than 4 observations in each cell to compute the means and standard deviations of the bribery measure. The higher the number of observations in a cell, the better the accuracy of these statistics. Panel B in Table 1.13 shows the results of the estimation of specification (1) when I use no fewer than 3 observations (columns I and II) and no fewer than 5 observations (columns III and IV) in a cell. The results are qualitatively the same. The magnitudes of the coefficients of interest, however, become larger when bribery level and its dispersion are computed more accurately.

I check for sensitivity of the results to the inclusion of location size in the merging criteria. Columns I-II, Panel A in Table 1.14 present the results of the specification (1) estimation on the subsample of firms located in the capitals of countries (13% of the sample). Capitals are the only cities exactly identified from both the BEEPS and the Amadeus databases. Although firms located in capitals can differ from their counterparts in the rest of the country – they tend to have higher sales growth and smaller labor productivity growth than an average firm located outside a capital – it is notable that the signs of the estimated coefficients on bribery level and its dispersion remain the same as in the results for the whole sample. I further estimate (1) on the merged BEEPS-Amadeus dataset, for which location size is omitted from the merging criteria. Columns III-IV, Panel B in Table 1.14 demonstrate that the results in this case again are qualitatively the same. These outcomes show that location size, generally, is not terribly important, but its inclusion in the merging criteria improves the fit of the models and seems to be plausible.

In the BEEPS-Amadeus dataset, the measurement error and perception bias of the original bribery measure are likely reduced by averaging out while computing the bribery level variable. This aggregation, however, does not solve the problem of missing data (about 10% of the sample in BEEPS), which could be reflected in an inaccurate bribery level and (un)evenness of the bribing behavior of firms. To check whether missing values affect the main results, I estimate specification (1), putting higher weights on cells with a higher number of non-missing observations (weight is equal to the ratio of the number of non-missing values to the total number of observations in a cell). Columns V-VI, Panel A in Table 1.14 show that the estimated coefficients of interest are nearly identical to those from the main analysis, ruling out the problem of missing data in the original bribery measure.

In all estimations, I use Cook's distance to account for outliers and influential observations. Columns I-II, Panel B in Table 1.14 report the estimates without using Cook's distance. The results are qualitatively the same as before, though accounting for outliers slightly increases the magnitudes of the coefficients on bribery level and its dispersion and doubles the overall fit of the regressions.

As an addition robustness check, I use the dataset without severe outliers in variables defined as exceeding the top 5% and below the bottom 5% of the distribution, instead of the top and bottom 1% (see Appendix A: Data cleaning). I also use the dataset without data imputation (see also Appendix A: Data cleaning). Columns III-VI, Panel B in Table 1.14 present the results of the estimations of specification (1) using these datasets. The estimates of the coefficients of interest remain virtually the same as before and, therefore, robust to the definition of outliers and imputation procedure.

Finally, I add in specification (1) variables that measure different obstacles to firms' operation and growth obtained from the BEEPS. These measures are averaged within country–time period–industry–firm size–location size cells in the same way as bribery level. By including these obstacles, I check whether bribery level and the (un)evenness of bribing behavior explain the participation of firms in bribery, but not other phenomena. If obstacles and bribery variables explain the same phenomena, then the significance of the coefficients of interest should decrease. Table 1.14, Panel C presents the results when corruption, tax administration, and obtaining business licenses and permits are used as obstacles. The standard errors of the estimated coefficients of interest remain the same. Similar conclusions can be made for other obstacles from the BEEPS such as access to finance, cost of finance, infrastructure, tax, trade with customers, and labor regulation; the results for these regressions are not reported.

1.6 Conclusion

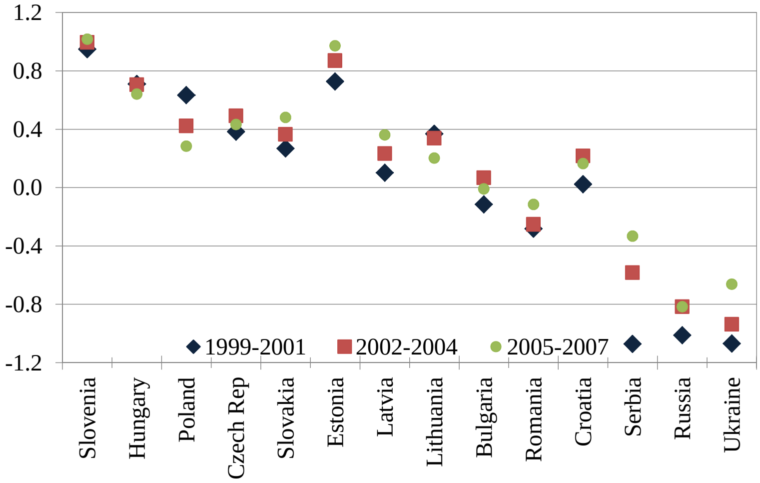
This paper empirically studies the relation between 'local bribery environments' and firm performance in Central and Eastern European countries. To assess this relation and overcome data and methodological limitations of previous research, I combine reliable and large firm-level data from the Amadeus database with bribery practices data from the BEEPS. The latter reflects the frequency of paying bribes to public officials to "get things done". I compute the means and standard deviations of the bribery measure for country – survey wave – industry – firm size – location size cells using the BEEPS and assign them to individual firms from the Amadeus database belonging to the same cell.

Exploring within-firm variation, the results of the empirical analysis suggest that a higher local bribery level retards both real sales and labor productivity growth, making bribery a burden for an average firm. The increase in the bribery level by its average value is associated with a 3.0% and 4.3% decrease in corresponding firm performance measures. This outcome complements most of the existing literature that examines the consequences of corruption on the macro and micro levels. This paper, however, also finds that conditional on a given level of bureaucratic corruption, a higher unevenness of firms' bribing behavior in local environments facilitates firm performance. The average bribery dispersion effects are positive and equal to 4.7% and 5.9% for the two performance measures, so that the trade-offs between bribery level and dispersion are positive too. In such environments, bribery likely helps firms which are favoured or are more efficient in bribery to overcome bureaucratic constraints. Non-bribing firms there, in turn, seem to be more efficient in production and growth. In this way, firms are able to generate increasing growth rates in more uneven local bribery environments. A further finding is that the performance of firms in an uneven environment appears to be higher than in a bribe-free one. The unevenness of firms' bribing behavior in some environments can thus explain the persistence of corruption and advocate the "grease the wheels" hypothesis.

The main findings of the paper hold most strongly for construction, wholesale, and retail trade firms that comprise approximately 70% of the entire sample. The effects of a local bribery environment appear to be less sound in countries with weaker institutions, to some extent supporting theoretical conjectures of Infante and Smirnova (2009) and De Vaal and Ebben (2011). These effects also seem to be more important for firms with more than 10 employees, and for those that are at the beginning or at the end of their business experience. Although the scope of this paper does not allow me to address directly the impact of bribery on firm survival, this would be an area open to future research.

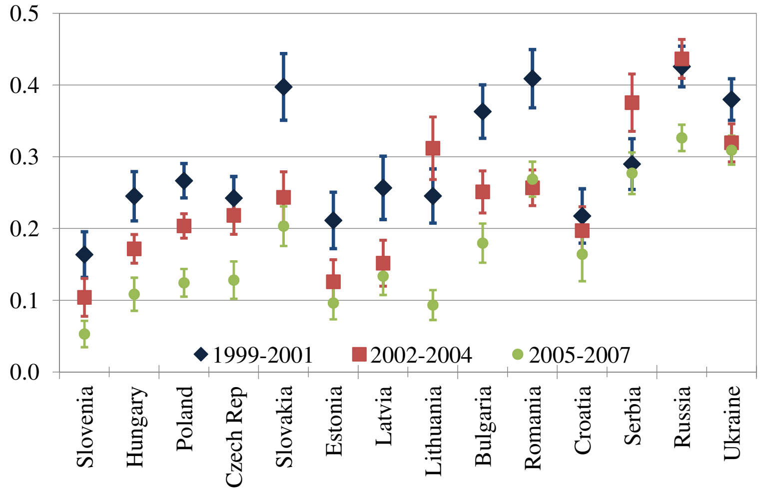
Figures and Tables

Figure 1.1: Control of Corruption



Note: Figure shows variation of the Control of Corruption indicator across countries and time periods. For each time period the average value over three years is taken. Higher values stand for lower overall corruption levels.

Figure 1.2: Bribery measure



Note: Figure shows variation of the bribery measure constructed from the BEEPS, across countries and time periods. Spikes stand for confidence intervals. Higher values indicate a higher frequency of bribing, and therefore higher overall bribery levels.

Table 1.2: Frequency distribution of the number of observations, in %

Country	Amadeus				BEEPS-Amadeus			
	2-10 empl	11-49 empl	50+ empl	Total	2-10 empl	11-49 empl	50+ empl	Total
Slovenia	51.47	32.47	16.06	100	68.66	20.61	10.74	100
	1.17	0.94	0.82	1.02	1.15	0.43	0.48	0.77
Hungary	36.69	42.74	20.58	100	35.51	47.23	17.27	100
	1.71	2.53	2.14	2.08	1.49	2.48	1.93	1.93
Poland	13.07	32.34	54.59	100	16.41	33.59	50	100
	1.09	3.41	10.14	3.72	1.37	3.53	11.14	3.85
Czech Rep.	47.27	31.53	21.2	100	56.62	26.79	16.59	100
	5.79	4.9	5.81	5.48	5.88	3.49	4.59	4.78
Slovakia	28.1	37.19	34.71	100	30.96	41.93	27.11	100
	0.46	0.78	1.28	0.74	0.4	0.68	0.93	0.59
Estonia	60.02	31.81	8.17	100	67.59	27.37	5.04	100
	3.9	2.63	1.19	2.91	2.8	1.42	0.56	1.91
Latvia	29.05	43.48	27.47	100	35.42	49.37	15.2	100
	0.63	1.2	1.34	0.98	0.65	1.13	0.74	0.84
Lithuania	26.34	46.16	27.51	100	27.95	51.52	20.53	100
	0.58	1.29	1.35	0.98	0.53	1.22	1.03	0.87
Bulgaria	50.38	34.82	14.8	100	57.64	34.25	8.12	100
	6.1	5.35	4.01	5.42	6.31	4.71	2.37	5.04
Romania	64.18	26.75	9.08	100	63	28.66	8.34	100
	25.74	13.62	8.14	17.95	27.08	15.46	9.54	19.78
Croatia	60.4	28.73	10.87	100	71.61	20.72	7.67	100
	4.63	2.8	1.86	3.43	4.21	1.53	1.2	2.7
Serbia	58.45	26.68	14.87	100	70.5	18.79	10.7	100
	4.1	2.37	2.33	3.14	4.56	1.53	1.84	2.98
Russia	30.34	41.3	28.36	100	28.09	45.81	26.11	100
	21.29	36.79	44.51	31.4	19.61	40.13	48.53	32.14
Ukraine	49.16	36.3	14.54	100	50.59	37.42	11.99	100
	22.81	21.38	15.08	20.76	23.97	22.26	15.13	21.82
Total	44.75	35.24	20.01	100	46.03	36.68	17.29	100

Note: Table reports frequency distributions in % of the number of observations by firm size (2-10 employees, 11-9 employees and more than 50 employees) and country in the Amadeus and BEEPS-Amadeus datasets. The data is cleaned of outliers (see Appendix B: Data representativeness). Each white row for each country in each dataset sums to 100%, and each grey column for each size category sums to 100%.

Table 1.3: Distribution of the number of observations, means and standard deviations of the bribery measure, and firm performance by country, year, firm size and location size

	BEEPS			BEEPS-Amadeus				
	N, freq. distr.	Bribery Level	Bribery Dispersion	N, freq. distr.	Bribery Level	Bribery Dispersion	Sales Growth	Lab. prod. Growth
Country								
Slovenia	4.1%	0.12	0.18	0.8%	0.13	0.18	16.0%	8.1%
Hungary	8.2%	0.17	0.20	1.9%	0.15	0.18	1.3%	-2.9%
Poland	15.4%	0.20	0.22	3.9%	0.17	0.21	6.8%	4.5%
Czech Rep.	5.2%	0.20	0.21	4.8%	0.18	0.18	4.6%	-0.9%
Slovakia	3.4%	0.24	0.21	0.6%	0.23	0.21	14.3%	-4.1%
Estonia	3.5%	0.12	0.17	1.9%	0.15	0.19	7.1%	4.3%
Latvia	3.6%	0.18	0.22	0.8%	0.19	0.24	12.1%	1.2%
Lithuania	3.9%	0.22	0.23	0.9%	0.20	0.21	17.5%	10.0%
Bulgaria	5.3%	0.25	0.24	5.0%	0.29	0.25	9.2%	1.5%
Romania	10.5%	0.27	0.27	19.8%	0.28	0.27	6.1%	-0.3%
Croatia	2.8%	0.21	0.23	2.7%	0.22	0.25	6.4%	-1.0%
Serbia	5.0%	0.31	0.25	3.0%	0.34	0.25	8.0%	2.3%
Russia	15.5%	0.38	0.29	32.1%	0.38	0.29	4.0%	-11.3%
Ukraine	13.8%	0.32	0.29	21.8%	0.34	0.29	0.8%	1.5%
Time period								
1999-2001	21.1%	0.32	0.27	12.3%	0.37	0.29	8.1%	3.4%
2002-2004	38.0%	0.25	0.25	39.7%	0.33	0.28	7.0%	1.0%
2005-2007	41.0%	0.22	0.23	47.9%	0.27	0.25	1.9%	-7.8%
Firm size								
2-10 empl	37.9%	0.25	0.25	46.0%	0.29	0.27	2.4%	-3.3%
11-49 empl	29.7%	0.26	0.25	36.7%	0.32	0.27	7.8%	-4.1%
50+ empl	32.4%	0.25	0.24	17.3%	0.34	0.26	3.9%	0.3%
Location size								
Capital	18.3%	0.28	0.24	12.8%	0.34	0.26	6.8%	-4.6%
Over 1 mil	5.1%	0.39	0.31	5.2%	0.40	0.34	7.2%	-7.8%
Below 1 mil	76.6%	0.24	0.24	82.0%	0.30	0.26	4.2%	-2.4%
Total	10093	0.25	0.24	701894	0.31	0.27	4.7%	-3.0%

Note: Table reports frequency distribution of the number of observations, bribery measures and firm performance by country, year, firm size and location size for the BEEPS and BEEPS-Amadeus datasets. Bribery Level and Bribery Dispersion are the means and standard deviations of the bribery measure from the BEEPS within country–time period–industry–firm size–location size cells respectively. The last row reports the total number of observations, and overall averages of corresponding variables. The BEEPS-Amadeus dataset is reduced to three time periods corresponding to the three BEEPS waves.

Table 1.4: Distribution of the numbers of observations, means and standard deviations of the bribery measure, and firm performance by industry code

		BEEPS			BEEPS-Amadeus				
ISIC	Industry	N, freq. distr.	Bribery Level	Bribery Dispersion	N, freq. distr.	Bribery Level	Bribery Dispersion	Sales Growth	Lab. prod. Growth
15	Food products and beverages	9.1%	0.26	0.25	5.6%	0.29	0.26	0.7%	-0.4%
17	Textiles	0.5%	0.16	0.13	0.1%	0.21	0.19	-8.9%	-3.8%
18	Wearing apparel; fur	6.0%	0.26	0.26	1.3%	0.30	0.27	-0.4%	-4.4%
19	Luggage, handbags, footwear	0.0%	0.40	0.37	0.0%	0.40	0.37	-15.2%	-13.4%
20	Wood, except furniture	1.2%	0.21	0.22	0.7%	0.32	0.31	-1.5%	1.3%
21	Pulp and paper	0.0%	0.10	0.20	0.0%	0.10	0.20	3.6%	0.5%
22	Publishing; printing	0.7%	0.23	0.28	0.6%	0.27	0.29	3.1%	3.1%
24	Chemicals	1.3%	0.30	0.26	0.4%	0.32	0.29	6.4%	-4.9%
25	Rubber and plastic products	0.6%	0.17	0.16	0.4%	0.12	0.13	11.9%	0.0%
26	Non-metallic mineral products	0.7%	0.23	0.23	0.6%	0.24	0.25	4.5%	5.6%
27	Basic metals	0.1%	0.34	0.22	0.0%	0.43	0.25	8.1%	6.5%
28	Fabricated metal products	7.1%	0.20	0.22	2.3%	0.23	0.21	9.2%	1.6%
29	Machinery and equipment n.e.c.	5.0%	0.24	0.24	1.7%	0.25	0.24	7.2%	2.1%
31	Electrical machinery	0.4%	0.18	0.18	0.1%	0.19	0.16	6.9%	5.0%
35	Other transport equipment	0.1%	0.18	0.22	0.0%	0.17	0.22	1.5%	0.5%
36	Furniture; manufacturing n.e.c.	1.0%	0.26	0.25	0.6%	0.30	0.24	7.5%	-2.8%
45	Construction	12.7%	0.31	0.26	15.3%	0.35	0.27	9.5%	0.0%
50	Sale and repair of motor vehicles	2.2%	0.29	0.24	2.6%	0.33	0.28	6.2%	-6.1%
51	Wholesale trade	11.6%	0.26	0.23	28.5%	0.33	0.26	3.5%	-8.0%
52	Retail trade	22.9%	0.24	0.24	26.7%	0.29	0.27	2.5%	-4.7%
55	Hotels and restaurants	4.6%	0.25	0.24	3.5%	0.23	0.21	2.8%	1.5%
60	Land transport	3.2%	0.25	0.25	2.4%	0.34	0.29	11.0%	4.7%
63	Supporting transport activities	1.0%	0.29	0.25	0.4%	0.35	0.31	7.5%	4.2%
70	Real estate activities	1.8%	0.27	0.25	2.2%	0.36	0.31	4.0%	10.3%
71	Renting of machinery, equipment	0.1%	0.19	0.17	0.0%	0.16	0.11	11.8%	-1.4%
72	Computer and related activities	0.4%	0.22	0.21	0.2%	0.39	0.31	0.7%	-0.8%
73	Research and development	0.2%	0.08	0.14	0.0%	0.15	0.19	10.0%	18.0%
74	Other business activities	3.3%	0.25	0.27	2.7%	0.30	0.30	10.4%	6.1%
92	Recreational, cultural and sport	0.5%	0.24	0.25	0.1%	0.28	0.29	18.0%	15.7%
93	Other service activities	1.8%	0.28	0.26	0.8%	0.32	0.29	8.9%	17.7%

Note: Table reports frequency distribution of the number of observations, bribery measures and firm performance by 2-digit industry code ISIC rev 3.1. Bribery Level and Bribery Dispersion are the means and standard deviations of the bribery measure from the BEEPS within country–time period–industry–firm size–location size cells respectively. The BEEPS-Amadeus dataset is reduced to three time periods corresponding to the three BEEPS waves.

Table 1.5: Summary statistics

	1999-2001			2002-2004			2005-2007			1999-2007		
	Mean	Median	S.D.	Mean	Median	S.D.	Mean	Median	S.D.	Mean	Median	S.D.
Sales Growth	8.10%	6.72%	39.65%	6.96%	5.62%	55.99%	1.86%	1.88%	50.32%	4.65%	3.93%	51.58%
Lab. Prod. Growth	3.36%	3.15%	38.30%	0.99%	-1.34%	49.94%	-7.84%	-5.29%	44.72%	-2.95%	-2.81%	46.40%
Total Assets	4.55	4.31	2.09	3.99	3.91	2.06	4.29	4.23	2.03	4.20	4.11	2.06
Employment	2.78	2.30	1.64	2.49	2.30	1.35	2.66	2.48	1.28	2.61	2.40	1.36
Total Assets Squared	25.04	18.60	21.48	20.13	15.32	18.18	22.47	17.86	18.86	21.86	16.91	19.01
Employment Squared	10.44	5.30	11.44	8.04	5.30	8.49	8.72	6.17	8.48	8.66	5.75	8.93
Profitability	0.08	0.06	0.22	0.12	0.07	0.47	0.10	0.07	0.25	0.11	0.06	0.36
Market Share	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02
Leverage	0.61	0.63	0.34	0.68	0.69	0.48	0.68	0.68	0.49	0.67	0.67	0.47
Cash Flow	0.03	0.02	0.17	0.07	0.03	0.49	0.07	0.03	0.27	0.06	0.03	0.37
Bribery Level	0.37	0.37	0.15	0.33	0.30	0.16	0.27	0.29	0.12	0.31	0.30	0.15
Bribery Dispersion	0.29	0.30	0.08	0.28	0.28	0.09	0.25	0.27	0.09	0.27	0.28	0.09
N observations		86672			278773			336449			701894	

Note: Table reports mean, median and standard deviation of employed variables by three time periods and for the whole sample. Definitions of the variables are in Appendix C: Definitions of variables. The last row shows the number of observations for each time period and the whole sample.

Table 1.6: Pairwise correlations

		1	2	3	4	5	6	7	8	9	10	11
1	Sales Growth											
2	Lab. Prod. Growth	0.60*										
3	Total Assets	-0.03*	0.04*									
4	Employment	-0.08*	0.07*	0.66*								
5	Total Assets Squared	-0.02*	0.04*	0.95*	0.69*							
6	Employment Squared	-0.06*	0.06*	0.66*	0.96*	0.72*						
7	Profitability	0.03*	-0.02*	-0.06*	-0.02*	-0.05*	-0.03*					
8	Market Share	0.001	0.01*	0.19*	0.17*	0.25*	0.21*	-0.002				
9	Leverage	0.01*	-0.02*	-0.12*	-0.11*	-0.10*	-0.10*	-0.25*	-0.03*			
10	Cash Flow	0.04*	-0.01*	-0.01*	-0.02*	-0.02*	-0.02*	0.65*	-0.0004	-0.25*		
11	Bribery Level	0.0004	-0.02*	-0.08*	0.12*	-0.09*	0.12*	0.01*	-0.05*	0.01*	-0.003*	
12	Bribery Dispersion	-0.002	-0.003*	-0.17*	-0.04*	-0.17*	-0.03*	0.02*	-0.05*	0.004*	-0.01*	0.58*

Note: Table reports pairwise correlations between employed variables. Definitions of the variables are in Appendix C: Definitions of variables. * denotes significance at the 5% level or less.

Table 1.7: General results

	(I) Sales	(II) Productivity	(III) Sales	(IV) Productivity	(V) Sales	(VI) Productivity	(VII) Sales	(VIII) Productivity
Bribery Level	-0.039***	-0.016***	-0.057***	-0.033***	-0.042***	-0.072***	-0.096***	-0.139***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Bribery Dispersion			0.056***	0.054***			0.174***	0.219***
			(0.007)	(0.006)			(0.008)	(0.007)
Total Assets	-0.019***	0.003***	-0.019***	0.003***	-0.075***	-0.038***	-0.076***	-0.040***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Employees	-0.260***	0.085***	-0.260***	0.084***	-0.072***	-0.005*	-0.070***	-0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Total Assets Squared	0.003***	-0.002***	0.003***	-0.002***	0.003***	-0.002***	0.003***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employees Squared	0.017***	-0.001***	0.017***	-0.001***	-0.009***	0.021***	-0.009***	0.020***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	0.009***	-0.053***	0.010***	-0.053***	0.003	-0.024***	0.001	-0.028***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Market Share	-0.046***	-0.406***	-0.048***	-0.407***	-0.928***	-1.108***	-0.916***	-1.045***
	(0.012)	(0.015)	(0.012)	(0.016)	(0.081)	(0.085)	(0.078)	(0.080)
Leverage	0.042***	0.008***	0.042***	0.008***	0.032***	0.040***	0.031***	0.039***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Cash Flow	0.126***	0.047***	0.124***	0.048***	0.074***	0.031***	0.076***	0.037***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Firm FE	no	no	no	no	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	–	–	–	–
Industry FE	yes	yes	yes	yes	–	–	–	–
Location size FE	yes	yes	yes	yes	–	–	–	–
Firm size FE	yes	yes	yes	yes	yes	yes	yes	yes
N observations	653,460	651,849	652,950	651,415	628,239	627,758	627,459	627,067
N group					446,205	446,280	445,678	445,807
R2 within	0.081	0.074	0.081	0.074	0.218	0.111	0.224	0.117
Average bribery effect	-1.22%	-0.49%	-1.79%	-1.02%	-1.29%	-2.22%	-2.97%	-4.32%
Average dispersion effect			1.49%	1.45%			4.66%	5.87%
Average total effect			-0.30%	0.42%			1.70%	1.55%

Note: Table reports the results of the estimation of specification (1) for two performance measures as dependent variables – real sales growth and labor productivity growth. All control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Average effects are the products of the estimated coefficients and average value of bribery level or bribery dispersion respectively; average total effect is the sum of these two effects. Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Table 1.8: Results for different types of firms

	(I) Sales	(II) Productivity	(III) Sales	(IV) Productivity	(V) Sales	(VI) Productivity
	Panel A: Manufacturing and service firms					
	Manufacturing		Services		Services w/o wholesale and retail trade	
Bribery Level	-0.258***	-0.146***	-0.035***	-0.115***	0.001	0.161***
	(0.010)	(0.010)	(0.006)	(0.006)	(0.009)	(0.010)
Bribery Dispersion	-0.027	-0.094***	0.136***	0.234***	-0.058***	-0.090***
	(0.017)	(0.017)	(0.009)	(0.009)	(0.015)	(0.017)
Controls not reported						
N observations	88 917	88 960	442 567	441 964	92 658	92 174
N group	68 456	68 475	311 164	311 008	76 603	76 368
R2 within	0.362	0.201	0.231	0.124	0.342	0.253
Average bribery effect	-6.99%	-3.95%	-1.08%	-3.57%	0.03%	5.00%
Average dispersion effect	-0.68%	-2.37%	3.65%	6.30%	-1.55%	-2.41%
Average total effect	-7.67%	-6.32%	2.57%	2.73%	-1.52%	2.59%
	Panel B: Construction and service firms					
	Construction		Wholesale trade		Retail trade	
Bribery Level	-0.107***	-0.145***	-0.115***	-0.178***	-0.144***	-0.323***
	(0.013)	(0.012)	(0.014)	(0.013)	(0.010)	(0.012)
Bribery Dispersion	0.381***	0.285***	0.242***	0.302***	0.183***	0.396***
	(0.020)	(0.017)	(0.018)	(0.016)	(0.015)	(0.016)
Controls not reported						
N observations	96 137	96 402	177 475	176 808	170 735	171 817
N group	65 960	66 195	134 149	133 939	99 572	99 948
R2 within	0.176	0.081	0.270	0.109	0.201	0.129
Average bribery effect	-3.74%	-5.05%	-3.82%	-5.91%	-4.15%	-9.30%
Average dispersion effect	10.42%	7.79%	6.41%	8.00%	4.97%	10.75%
Average total effect	6.68%	2.74%	2.59%	2.10%	0.82%	1.45%

Note: Table reports the results of the estimation of specification (1) for different subsamples of firms for two performance measures as dependent variables – real sales growth and labor productivity growth. In Panel A firms are divided into subsamples of manufacturing (ISIC code 15-36), services (ISIC code 51-93) and services excluding wholesale and retail trade sectors (ISIC code 51, 52). In panel B firms are divided into subsamples of construction (ISIC code 45), retail trade (ISIC code 51) and wholesale trade (ISIC code 52) sectors. All control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Average effects are the products of the estimated coefficients and average value of bribery level or bribery dispersion respectively; average total effect is the sum of these two effects. Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Table 1.9: Results for different types of firms

	(I) Sales	(II) Productivity	(III) Sales	(IV) Productivity	(V) Sales	(VI) Productivity
	Panel A: Micro, small and large firms					
	2-10 employees		11-49 employees		50+ employees	
Bribery Level	-0.026***	-0.095***	-0.118***	-0.118***	-0.201***	-0.150***
	(0.008)	(0.009)	(0.011)	(0.010)	(0.010)	(0.010)
Bribery Dispersion	0.032*	0.104***	0.284***	0.271***	0.159***	0.148***
	(0.018)	(0.019)	(0.013)	(0.011)	(0.015)	(0.014)
Controls not reported						
N observations	291 283	291 513	228 848	228 688	107 719	107 728
N group	218 455	219 066	179 598	179 491	76 147	76 463
R2 within	0.207	0.104	0.247	0.124	0.238	0.097
Average bribery effect	-0.76%	-2.79%	-3.80%	-3.79%	-6.78%	-5.04%
Average dispersion effect	0.87%	2.83%	7.55%	7.20%	4.11%	3.83%
Average total effect	0.11%	0.04%	3.74%	3.41%	-2.67%	-1.21%
	Panel B: Stable, new entrants and exited firms					
	Stable		New entrants		Exited	
Bribery Level	-0.151***	-0.097***	-0.098***	-0.177***	-0.290***	-0.168***
	(0.008)	(0.009)	(0.009)	(0.008)	(0.020)	(0.021)
Bribery Dispersion	0.151***	0.098***	0.222***	0.235***	0.219***	0.414***
	(0.013)	(0.014)	(0.013)	(0.011)	(0.045)	(0.047)
Controls not reported						
N observations	101 841	101 859	212 722	213 066	28 004	28 072
N group	33 947	33 953	106 361	106 533	14 002	14 036
R2 within	0.198	0.147	0.196	0.093	0.118	0.101
Average bribery effect	-4.36%	-2.79%	-2.93%	-5.29%	-9.69%	-5.63%
Average dispersion effect	4.01%	2.60%	5.74%	6.07%	6.20%	11.73%
Average total effect	-0.35%	-0.19%	2.80%	0.77%	-3.49%	6.10%

Note: Table reports the results of the estimation of specification (1) for different subsamples of firms for two performance measures as dependent variables – real sales growth and labor productivity growth. In panel A firms are divided into subsamples of micro (2-10 employees), small (11-49 employees) and medium and large (more than 50 employees) firms. In Panel B firms are divided into subsamples of stable (present in the sample during all three time periods), new entrant (present in the sample in the second and third periods), and exited (present in the sample in the first and second periods) firms. All control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Average effects are the products of the estimated coefficients and average value of bribery level or bribery dispersion respectively; average total effect is the sum of these two effects. Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation. * p<0.1; ** p<0.05; *** p<0.01.

Table 1.10: Country institutions and impact of bribery

	(I) Sales	(II) Productivity		(I) Productivity	(II) Sales
	Panel A			*Panel B*	
Bribery Level×Region 1	-0.452***	-0.467***	Bribery Level	-0.274***	-0.438***
	(0.013)	(0.015)		(0.014)	(0.015)
Bribery Level×Region 2	-0.086***	-0.149***	Bribery Level×	0.284***	0.441***
	(0.007)	(0.007)	Rule of Law	(0.020)	(0.020)
Bribery Level×Region 3	-0.062***	-0.075***			
	(0.007)	(0.007)	Bribery Dispersion	0.312***	0.284***
Bribery Dispersion×Region 1	0.224***	0.347***		(0.019)	(0.020)
	(0.016)	(0.018)	Bribery Dispersion×	-0.202***	-0.081***
Bribery Dispersion×Region 2	0.183***	0.159***	Rule of Law	(0.027)	(0.027)
	(0.012)	(0.012)			
Bribery Dispersion×Region 3	0.190***	0.252***	Rule of Law	0.822***	0.181***
	(0.011)	(0.010)		(0.020)	(0.019)
Controls not reported			Controls not reported		
N observations	627 857	627 053	N observations	627 634	626 869
N group	445 816	445 703	N group	446 004	445 806
R2 within	0.228	0.123	R2 within	0.240	0.127

Note: Table reports the results of the estimation of modified specification (1) for two performance measures as dependent variables - real sales growth and labor productivity growth. In Panel A the coefficients on Bribe and Bribe Dispersion vary for three regions: Region 1 – Slovenia, Hungary, Poland, Czech Republic, Slovakia, Estonia, Latvia and Lithuania; Region 2 – Croatia, Serbia, Bulgaria and Romania; and Region 3 – Russia and Ukraine. In Panel B interactions between Bribery Level and Rule of Law, and between Bribery Dispersion and Rule of Law as well as the Rule of Law indicator are included into specification (1). The Rule of Law indicator varies from 0 to 1, where higher values stand for weaker institutions. All control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation. * p<0.1; ** p<0.05; *** p<0.01.

Table 1.11: Local environments and impact of bribery

	(I) Sales	(II) Productivity	(III) Sales	(IV) Productivity
Bribery Level×Even Environment	-0.053***	-0.067***		
	(0.004)	(0.004)		
Bribery Level×Uneven Environment	0.029***	0.012***		
	(0.003)	(0.003)		
Uneven Environment			0.010***	0.011***
			(0.001)	(0.001)
Low Bribery Level×Even Environment			-0.011***	0.006***
			(0.002)	(0.002)
High Bribery Level×Even Environment			-0.062***	-0.036***
			(0.002)	(0.002)
Controls not reported				
N observations	627 446	627 191	627 098	626 858
N group	445 786	446 027	445 627	445 787
R2 within	0.221	0.111	0.223	0.114

Note: Table reports the results of the estimation of modified specification (1) for two performance measures as dependent variables - real sales growth and labor productivity growth. Even (uneven) environment is equal to one if Bribery Dispersion is less than or equal to the 25th percentile (greater than or equal to the 75th percentile) of its distribution for each country. Low (High) Bribery Level is equal to one if Bribery Level is less than or equal to the 25th percentile (greater than or equal to the 75th percentile) of its distribution. All control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation. * p<0.1; ** p<0.05; *** p<0.01.

Table 1.12: Robustness check

	(I) Sales	(II) Productivity	(III) Sales	(IV) Productivity
	Panel A: Other bribery measures			
Bribery Level 1	-0.057***	-0.082***		
	(0.003)	(0.003)		
Bribery Level 2			-0.071***	-0.092***
			(0.003)	(0.003)
Bribery Dispersion	0.152***	0.186***	0.100***	0.105***
	(0.007)	(0.007)	(0.007)	(0.006)
Controls not reported				
N observations	627 487	627 157	627 706	627 084
N group	445 676	445 846	445 778	445 801
R2 within	0.224	0.117	0.224	0.120
	Panel B: Other time period			
	1999-2004		2002-2007	
Bribery Level	-0.205***	-0.184***	-0.089***	-0.151***
	(0.009)	(0.009)	(0.006)	(0.006)
Bribery Dispersion	0.156***	0.286***	0.192***	0.220***
	(0.017)	(0.018)	(0.008)	(0.008)
Controls not reported				
N observations	327 286	327 245	551 173	551 245
N group	281 027	281 670	422 653	422 371
R2 within	0.098	0.085	0.244	0.141
	Panel C: Conditional bribery level and weighted bribery measures			
	Conditional		Weighted	
Bribery Level	-0.103***	-0.144***	-0.243***	-0.280***
	(0.005)	(0.005)	(0.010)	(0.010)
Bribery Dispersion	0.180***	0.221***	0.322***	0.307***
	(0.008)	(0.007)	(0.013)	(0.013)
Controls not reported				
N observations	626 626	626 263	626 566	625 974
N group	445 599	445 770	444 780	444 859
R2 within	0.226	0.118	0.221	0.112

Note: Table reports the results of the estimation of specification (1) for two performance measures as dependent variables – real sales growth and labor productivity growth. In Panel A two other measures on the bribery level are used. Bribery Level 1 is computed from the dummy variable that takes value one if firms report that they bribe public officials sometimes, frequently, usually and always to 'get things done,' and zero otherwise; Bribery Level 2 is computed from the dummy variable that takes value one if firms report that they bribe seldom, sometimes, frequently, usually and always, and zero if never. Columns I-IV, Panel B present the results for two time periods separately. In columns I-II, Panel C, Bribery Level variable is computed as the mean of the bribery measure from the BEEPS but conditional on firm characteristics such as the dummy variables for foreign ownership and exporter status, and the logarithm of firm age. In columns III-IV, Panel C, Bribery Level and Dispersion variables are reweighted to account for composition of young and old firms within cells in Amadeus. All control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Table 1.13: Robustness check

	(I) Sales	(II) Productivity	(III) Sales	(IV) Productivity
	Panel A: Other data structure and method of estimation			
	Firm and year FE		Arrelano-Bond	
Bribery Level	-0.085***	-0.088***	-0.100***	-0.109***
	(0.005)	(0.005)	(0.011)	(0.012)
Bribery Dispersion	0.138***	0.157***	0.134***	0.047***
	(0.007)	(0.007)	(0.018)	(0.018)
Sales/Lab. prod. growth$_{t-1}$			-0.016***	-0.059***
			(0.003)	(0.002)
Controls not reported				
N observations	1 276 553	1 271 603	676 877	676 877
N group	455 427	455 661	262 300	262 300
R2 within	0.143	0.192		
N instruments			74	74
A-B test for AR(1)/p-value			-97.58/0.00	-118.91/0.00
A-B test for AR(2)/p-value			0.80/0.42	-0.94/0.347
	Panel B: Different number observations in a cell			
	N obs. in a cell 3+		N obs. in a cell 5+	
Bribery Level	-0.058***	-0.095***	-0.131***	-0.161***
	(0.004)	(0.004)	(0.006)	(0.006)
Bribery Dispersion	0.083***	0.073***	0.242***	0.280***
	(0.006)	(0.006)	(0.011)	(0.010)
Controls not reported				
N observations	739 280	740 722	552 053	552 877
N group	506 834	508 011	397 446	398 761
R2 within	0.196	0.101	0.208	0.112

Note: Table reports the results of the estimation of specification (1) for two performance measures as dependent variables – real sales growth and labor productivity growth. In Panel A yearly firm-level data is used, control variables are lagged one year back. The estimates in columns I-II are obtained using conventional firm, firm size, and time fixed effects estimation. The estimates in columns III-IV are obtained using Arellano and Bond's (1991) dynamic panel data estimation technique. Panel B presents the results for the datasets, when no fewer than 3 observations (columns I-II) and no fewer than 5 observations (columns III-IV) are kept in a country–time period–industry–firm size–location size cell. In Panel B control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation (not in columns III-IV, Panel A). * p<0.1; ** p<0.05; *** p<0.01.

Table 1.14: Robustness check

	(I) Sales	(II) Productivity	(III) Sales	(IV) Productivity	(V) Sales	(VI) Productivity
	Panel A: Firms in capitals, other merging criteria and weighted regressions					
	Subsample of firms located in capitals		Merging criteria w/o location size		Weighted OLS	
Bribery Level	-0.034***	-0.131***	-0.138***	-0.078***	-0.098***	-0.138***
	(0.005)	(0.019)	(0.005)	(0.005)	(0.005)	(0.005)
Bribery Dispersion	0.165***	0.102***	0.100***	0.157***	0.179***	0.219***
	(0.022)	(0.022)	(0.008)	(0.008)	(0.008)	(0.007)
Controls not reported						
N observations	79 701	79 568	868 233	869 682	627 459	627 067
N group	65 389	65 349	584 781	585 773	445 678	445 807
R2 within	0.250	0.054	0.180	0.092	0.223	0.117
	Panel B: Sensitivity to outliers and data imputation					
	No Cook's distance		Outliers 5% and 95%		No imputation	
Bribery Level	-0.075***	-0.148***	-0.107***	-0.079***	-0.119***	-0.126***
	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.007)
Bribery Dispersion	0.136***	0.198***	0.274***	0.195***	0.248***	0.203***
	(0.013)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)
Controls not reported						
N observations	678 381	678 381	157 057	156 485	309 742	307 334
N group	464 634	464 634	144 969	144 772	274 938	273 268
R2 within	0.133	0.065	0.448	0.149	0.364	0.130
	Panel C: Inclusion of obstacles					
	Corruption		Tax administration		Licences and permits	
Bribery Level	-0.064***	-0.114***	-0.075***	-0.150***	-0.082***	-0.130***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Bribery Dispersion	0.180***	0.224***	0.155***	0.231***	0.171***	0.215***
	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)
Obstacle	-0.062***	-0.049***	-0.072***	0.047***	-0.119***	-0.090***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Controls not reported						
N observations	627 181	626 526	627 253	626 910	627 276	626 526
N group	445 548	445 542	445 632	445 804	445 601	445 673
R2 within	0.228	0.120	0.229	0.120	0.228	0.120

Note: Table reports the results of the estimation of specification (1) for two performance measures as dependent variables – real sales growth and labor productivity growth. In columns I-II, Panel A the sample is restricted to firms located in capitals of the countries. In columns III-IV, Panel A location size is omitted from the merging criteria of combining the BEEPS and the Amadeus databases. Columns V-VI, Panel A present the results from weighted regressions with weights equal to the ratios of the number of non-missing (in the original bribery measure from the BEEPS) observations to the total number of observations in cells. In columns I-II, Panel B Cook's square distance is not used, in columns III-IV, Panel B an other definition of severe outliers is used; in columns V-VI, Panel B the dataset without imputation is used. Panel C presents the results with additional variables included: corruption, tax administration, and obtaining business licences and permits respectively. All control variables are measured at the beginning of each time period (i.e., at 1999, 2002 or 2005). Definitions of the variables are in Appendix C: Definitions of variables. Standard errors are robust to heteroskedasticity and clustered at the firm level, reported in parentheses. Cook's distance is used to account for influential observation (except columns I-II, Panel B). * p<0.1; ** p<0.05; *** p<0.01.

Appendix

Appendix A: Data cleaning

In order to reduce potential selection bias and measurement errors, to deal with severe outliers, and to provide a better comparison of firms across CEE countries, I proceed with the following data cleaning:[34]

- drop firms with data from consolidated statements to avoid double counting of firms or subsidiaries, and duplicates; keep observations for which financial information is reported for a 12 month period;
- transform all industry codes to ISIC rev. 3.1 to align the BEEPS and Amadeus, and drop firms that do not report industry codes;
- convert all key financial variables into US dollars using period average exchange rates from the IMF, and deflate to 2000 constant prices using countries' GDP deflators;
- impute the missing values of key variables using linear interpolation by years in order to restore possibly erroneously missing data, and to have more observations;[35]
- drop firms with an average number of employees fewer than three to exclude, for instance, phantom firms created for tax evasion, and drop firms with age less than one;
- drop severe outliers: 1st and 99th percentiles in operational revenue over number of employees, total assets over number of employees, operational earning over total assets, and total debt over total assets for each country, 2-digit industry code, and year. If an outlier is at the beginning or at the end of the time span for a firm, then only the first or last observation is dropped. If the outlier is in the middle of the time period, then the whole firm is dropped;
- drop severe outliers: 99th percentile of the absolute value of relative yearly changes in operational revenue, operational revenue over number of employees, and total assets for each country and 2-digit industry code. If an outlier is at the beginning or at the end of the time span for a firm, then only the first or last observation is dropped. If the outlier is in the middle of the time period, then the whole firm is dropped.

[34] Data cleaning follows other research that uses the Amadeus database (e.g. Klapper, Laeven, and Rajan, 2006; Anos-Casero and Udomsaph, 2009).

[35] As a robustness check the analysis is also done using the data without imputation; in either way the results are virtually the same.

Appendix B: Data representativeness

Table reports frequency distributions (in percent) of the number of firms by industry, firm size and country for a subsample of CEE countries which are members of the OECD. In column (I) the data is from the 2005 BEEPS wave; in column (II) the data is from the Amadeus database after excluding severe outliers, 2004; and in column (III) the data is from the OECD STAN database, 2004. Column (III) is a benchmark, since the data from OECD STAN cover the whole market for a given subsample. For more accurate comparison, industries with 2-digit ISIC codes 01-14, 16, 37, 40-41, 65-67 and 75-95 are excluded, since they are either not presented in the BEEPS or OECD STAN. Each number in a column is the relative coverage of the number of firms to the entire sample, numbers in columns for a given category are summed to 100%. For instance, the table shows that micro and small firms are significantly underrepresented in both BEEPS and Amadeus; Poland and Hungary are underrepresented in Amadeus while Czech Republic is overrepresented; wholesale trade industry is overrepresented in Amadeus; and so on.

		(I) BEEPS	(II) Amadeus	(III) OECD STAN
	Industry			
15	Food products and beverages	6.29	3.47	1.06
17	Textiles	1.23	0.99	0.39
18	Wearing apparel; fur	7.56	1.16	1.21
19	Luggage, handbags, footwear	0.32	0.35	0.26
20	Wood, except furniture	1.05	2.01	2.01
21	Pulp and paper	0.21	0.58	0.13
22	Publishing; printing	1.48	1.91	1.26
23	Coke and petroleum products	0.07	0.07	0.00
24	Chemicals	0.63	1.04	0.16
25	Rubber and plastic products	0.91	1.85	0.53
26	Non-metallic mineral products	0.98	1.34	0.72
27	Basic metals	0.63	0.5	0.06
28	Fabricated metal products	11.07	4.13	2.63
29	Machinery and equipment n.e.c.	6.26	2.54	0.99
30	Office machinery and computers	0.04	0.2	0.06
31	Electrical machinery	0.56	1.29	0.69
32	Communication equipment	0.04	0.57	0.28
33	Instruments, watches and clocks	0.32	0.77	0.64
34	Motor vehicles and trailers	0.39	0.5	0.08
35	Other transport equipment	0.11	0.39	0.14
36	Furniture; manufacturing n.e.c.	1.41	1.63	1.50
45	Construction	10.26	10	12.94
50	Sale and repair of motor vehicles	2.99	4.12	4.42
51	Wholesale trade	7.42	20.2	8.18
52	Retail trade	12.9	12.06	22.04
55	Hotels and restaurants	5.66	2.56	4.92
60	Land transport	4.53	4.12	6.57
61	Water transport	0.11	0.08	0.03
62	Air transport	0.04	0.05	0.01
63	Supporting transport activities	2.43	2.04	1.08
64	Post	0.56	0.58	0.25
70	Real estate activities	3.16	4.41	3.18
71	Renting of machinery, equipment	0.88	0.55	0.44
72	Computer and related activities	1.34	2.17	2.50
73	Research and development	0.56	0.36	0.15
74	Other business activities	5.62	9.42	18.50
	Firm size			
1-9 employees		45.31	37.93	93.94
10-49 employees		27.73	36.18	3.97
50-249 employees		18.31	19.89	0.94
250+ employees		8.65	5.29	0.17
	Country			
Slovenia		6.96	6.24	2.80
Hungary		20.53	11.15	17.79
Poland		33.15	19.07	45.97
Czech Republic		11.04	33.80	27.76
Slovakia		7.24	3.03	1.09
Estonia		7.21	15.78	1.12
Latvia		6.96	5.03	1.83
Lithuania		6.92	5.89	1.64

Appendix C: Definitions of variables

Name	Definition and Source
Bribery Level	Bribery level in a local environment. Computed as the average of frequency to bribe (scaled to [0,1] variable) within country–time period–industry–firm size–location size cells. Higher values stand for higher bribery level. Source: the BEEPS.
Bribery Dispersion	(Un)evenness of firms bribing behavior in a local environment. Computed as the standard deviation of frequency to bribe (scaled to [0,1] variable) within country–time period–industry–firm size–location size cells. Higher values stand for higher heterogeneity of local environments. Source: the BEEPS.
Sales Growth	Change of yearly logarithms of operational revenue (in real prices), and averaged over three-year time periods. Source: Amadeus.
Labor Productivity Growth	Change of yearly logarithms of operational revenue (in real prices) over number of employees, and averaged over three-year time periods. Source: Amadeus.
Total Assets	Logarithm of total assets. Source: Amadeus.
Total Assets Squared	Logarithm of total assets squared. Source: Amadeus.
Employees	Logarithm of number of employees. Source: Amadeus.
Employees Squared	Logarithm of number of employees squared. Source: Amadeus.
Profitability	Profitability is EBIT (earnings before interest and taxes) divided by total assets. Source: Amadeus.
Market Share	Market share is the operational revenue of a firm divided by the sum of operational revenue on a 4-digit industry level. Source: Amadeus.
Leverage	Book leverage ratio is the total debt (current liabilities plus long term debt) divided by total assets. Source: Amadeus.
Cash Flow	Book cash flow is the cash flow divided by total assets. Source: Amadeus.
Control of Corruption	Variable showing the overall level of corruption in a country. Higher values stand for lower corruption levels. Source: the Worldwide Governance Indicators, World Bank.
Rule of Law	Variable showing the overall quality of institutions in a country. Original indicator is a scaled to [0, 1] variable. Higher values stand for weaker institutions. Source: the Worldwide Governance Indicators, World Bank.

Chapter 2

How Telecommunication Technologies Affect Product Market Competition: Empirical Evidence

(with Vahagn Jerbashian)

Abstract

In this paper we empirically show that more intensive use and wider adoption of telecommunication technologies significantly increases the level of product market competition in services and goods markets. Our result is consistent with the view that the use of telecommunication technologies can lower the costs of entry into these markets. This finding is robust to various measures of competition and a range of specification checks.

JEL Codes: L16; O33; O25
Keywords: Telecommunication technologies; Product market competition; Entry costs

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2.1 Introduction

"...[I]n most of the economy IT will help to increase competition. Broadly speaking, the Internet reduces barriers to entry, because it is cheaper to set up a business online than to open a traditional shop or office. The Internet also makes it easier for consumers to compare prices. Both these factors increase competition." (*The Economist*, September 21, 2000). Statements like this in *The Economist* indicate that there can be a positive relationship between the more intensive use and the wider adoption (hereafter, diffusion) of telecommunication technologies and competition in services and goods markets (for similar arguments see also Leff, 1984; McFarlan, 1984; Czernich, Falck, Kretschmer, and Woessmann, 2011; OECD, 2008). Another mechanism behind such a positive relation is that telecommunication technologies can lower information acquisition costs, which are arguably significant for the decision on entry into a market (e.g., see Geroski, 1995b).

These arguments are certainly not conclusive, however. It can be argued as well that the diffusion of telecommunication technologies can help firms loosen competition. For example, firms can use the internet and other types of telecommunication networks for (extensive) advertisement of their products. The advertisement, then, can increase product differentiation and help firms to gain market power (Comanor and Wilson, 1974).

In this study we empirically investigate the relation between the country-wide diffusion of telecommunication technologies and the competition in services and goods markets. In order to alleviate endogeneity concerns we use a difference-in-differences framework in the spirit of Rajan and Zingales (1998). More specifically, we ask whether in countries where, *a priori*, the diffusion of telecommunication technologies is higher, the intensity of product market competition is disproportionately different in the industries that depend more on these technologies compared to the industries that depend less. We use evidence from 21 EU countries to establish our results.

The results suggest that the diffusion of telecommunication technologies has a strong positive effect on the intensity of competition in services and goods markets. This supports conjectures such as in the quote above from *The Economist*. According to the standard theoretical inference, thereby, the results of this paper suggest that the diffusion of telecommunication technologies increases allocative efficiency in the economy. Moreover, in line with many empirical studies (e.g., Nickell, Wadhwani, and Wall, 1992; Nickell, 1996; Disney, Haskel, and Heden, 2003), these findings imply significant productivity gains due to the diffusion of telecommunication technologies (e.g., Hart, 1983). Further, according to, for example, Aghion, Bloom, Blundell, Griffith, and Howitt (2005), this diffusion may also imply higher innovative activity (see also Geroski, 1995a; Blundell, Griffith, and van Reenen, 1999).[2]

This paper also contributes to the ongoing debate about the impact of telecommunication technologies, as well as of information and communication technologies (ICT), on economic performance. Macro-level empirical studies suggest that the diffusion of these technologies has a positive impact on development level and growth (e.g., Madden and Savage, 1998; Röller and Waverman, 2001; Datta and Agarwal, 2004; Czernich et al., 2011). In turn, micro-level empirical studies suggest that the use of telecommunication technologies and ICT can reduce price dispersion and average prices in online markets (e.g., Jensen, 2007; Lee, 1998; Strader and Shaw, 1999; Brynjolfsson and Smith, 2000). There can be various drivers behind these results. For instance, the literature on the economics of ICT (e.g., Jorgenson, Ho, and Stiroh, 2005; Vourvachaki, 2009) emphasizes the productivity improvements/cost reductions that stem from the "direct" application of ICT (for example, the switch from mail to e-mail). The literature on the economics of telecommunications, in addition, argues that the use of these technologies can improve access to information. In line with Stigler (1961), this literature further argues that it would reduce distortions and frictions in the markets (e.g., Leff, 1984; Jensen, 2007; Brynjolfsson and Smith, 2000). Our empirical findings offer support for these conjectures, and imply that the diffusion of telecommunication technologies intensifies the competition in services and goods markets (i.e., reduces mark-ups). Meanwhile, given that the latter can matter, for example, for allocative and productive efficiency, this paper suggests another driver behind the results of above cited macro- and micro-level empirical studies. In this respect, it also adds to the suggestions of the literature on general ICT, and indicates that the economic benefits from a particular type of ICT, telecommunication technologies, may come not only from direct use but also from intensified competition.

The results of this study can be interesting also for policymakers. They imply that policies motivating the diffusion of telecommunication technologies can complement competition/antitrust policies.

Having mentioned what we identify in this paper, it is also worth mentioning what we do not intend to identify. The diffusion of telecommunication technologies can reduce some of the costs of entry. However, it is ultimately the corresponding changes in the behavior of firms and consumers that would affect the competition in services and goods markets. Given the data we have, we neither can nor intend to identify through which channels those changes would happen.

In addition to the literature on the economics of ICT and particularly on the economics of telecommunications, this paper is related to studies that try to identify the

[2] Aghion et al. (2005) finds an inverted U-shape relationship between the number of patents issued and the intensity of competition. Therefore, according to this paper our results imply higher innovative activity at least for lower levels of competition.

determinants of product market competition. Although competition seems to be an important engine of economic activity, to our best knowledge, there are very few such studies. There is evidence, for example, that railroad networks intensified competition in the US shipping industry in the 19th century (Holmes and Schmitz, 2001). There is also evidence that policies, including but not limited to those that intend to promote entry and competition, can affect the intensity of competition in various markets (see, for instance, Creusen, Minne, and van der Wiel, 2006; Feldkircher, Martin, and Wörz, 2010; Fisman and Allende, 2010). Our study is related to these studies to the extent that telecommunication technologies, similarly to railroads, are general purpose technologies. Moreover, according to our results, the policies that promote the diffusion of telecommunication technologies should affect the intensity of competition in services and goods markets.

Another vast amount of theoretical literature analyzes the effect of search frictions on price dispersion (see, for instance, Salop and Stiglitz, 1977; Reinganum, 1979; Varian, 1980). The typical model assumes that consumers know only the distribution of prices and have search costs, which are argued to be lower in electronic marketplaces compared to others (e.g., Bakos, 1991). This motivates many empirical studies to find whether there is a significant difference in terms of price dispersion, as well as average prices, between electronic and regular market places (e.g., Lee, 1998; Strader and Shaw, 1999; Brynjolfsson and Smith, 2000; Brown and Goolsbee, 2002). To the extent that the diffusion of telecommunication technologies can also lower consumers' search costs and, therefore, intensity of competition, our paper is related to these studies as well. However, while they focus on particular markets (e.g., books, CDs, and life insurance) and market places, our inference is for (virtually) the entire economy.

The next section describes the theoretical background, motivates the methodology, and formally defines the objective of this study. The third section describes the data and its sources. The fourth section summarizes the results. The last section concludes.

2.2 Theoretical background and methodology

How telecommunications can matter

The entry (and the potential entry) of firms can strengthen competition and reduce relative price distortions, which are due to monopolistic pricing.

It is argued that information acquisition costs matter for firms' decision to enter into a market (see, for instance, Demsetz, 1982; Geroski, 1995b). Further, this decision can be affected by transaction and initial investment costs. For instance, a firm which considers entry into a market would need to gather information about that market and allocate resources for initial investments in office equipment and software.

It seems that it is a common thought in the literature that the use of telecommunication technologies can reduce the information acquisition and transaction costs (e.g., see Leff, 1984; Norton, 1992; Röller and Waverman, 2001; Jensen, 2007; Czernich et al., 2011). Some of the contemporary observations which can support these arguments are that these technologies enable internet and, particularly, internet banking. The internet in many cases can serve as a very cheap source of information. Meanwhile, internet banking can reduce some transaction costs. In turn, following Etro (2009) it can be argued that the diffusion of telecommunication technologies can reduce initial investment costs in computer software and hardware. This can be the case since these technologies support and enable cloud computing.

These arguments indicate that there can be a positive link between the diffusion of telecommunication technologies and the (potential) entry of firms into the markets. Therefore, they indicate that the diffusion can intensify the competition in services and goods markets. However, these arguments are certainly not conclusive. In this regard, it may be argued as well that the diffusion of telecommunication technologies can help firms gain market power. An example of such actions can be the (extensive) advertisement of products over the internet and other types of telecommunication networks. The advertisements may help to increase product differentiation, thus, it may help firms to gain market power (see, for instance Comanor and Wilson, 1974). Another related example would be that lower information acquisition costs would help firms to learn about the demand and the general market environment. Therefore, they can help in increasing product differentiation and price discrimination. A quite recent example is that, currently, online firms are able to track, for instance, via search keywords, visited web sites, and IP address the preferences and location of the users. They use that information for targeting marketing appeals. In Appendix A: The model we offer a very stylized and simplistic model that delivers predictions in line with our inferences.

Methodology

Having contrasting theoretical arguments in hand, in this study we try to identify the relation between the diffusion of telecommunication technologies and the competition in services and goods markets. Doing so is not straightforward, however. According to many theoretical models, the level of competition in services and goods markets matters for resource allocation in an economy (see, for instance, van de Klundert and Smulders, 1997; Jerbashian, 2011).[3] This in its turn can matter for the country-wide diffusion of telecommunication technologies, which is largely a market outcome. Therefore, according to the theory, there can be a reverse causality between the diffusion of telecommunication technologies and competition in the services and goods markets.

Nevertheless, there is a seemingly intuitive variation that can be used to alleviate the reverse causality problem. The effect of the diffusion of telecommunication technologies on the costs of entry would be different for industries that depend more heavily on these technologies compared to industries that depend less. Such variation can arise because the industries that depend more heavily on telecommunication technologies *ceteris paribus* would increase their demand for these technologies due to that diffusion. In turn, in line with the arguments offered in Leff (1984) or Jensen (2007), the increased demand can result in more information about the industry. An observation that supports these arguments is that telecommunication technologies are used exactly for transmitting and disclosing information. A further supporting observation is that these days, for instance, computer producers and retailers seem to be more widely known than core manufacturers, when the former use significantly more of these technologies.[4] According to these arguments the diffusion will alter the information acquisition costs disproportionately in industries that depend more heavily on telecommunication technologies.

Our test looks for exactly such a disparity. We test whether in countries where, *a priori*, the diffusion of telecommunication technologies is higher, the intensity of product market competition is different in the industries that depend more on these technologies. Such a test also permits country and industry fixed effects. These can be important for capturing, for instance, regulatory differences and the variation in the fixed costs of entry into different industries. Moreover, with such a test our inference would not depend on a particular country-level model of competition. This can allow us to avoid using country-level variables and instead to focus on the varying effects of those variables across industries that are expected to be the most responsive to them. Country-level variables included in regressions can create ambiguities in the interpretation of the results since, for instance, they can absorb some of the variation in the data that is actually attributable to the direct effect of the variable of interest.

For constructing the test we need to identify industries' dependence on telecommunication technologies. In a country, a naive measure of an industry's dependence would be its share of expenditures on telecommunications out of total expenditures on intermedi-

[3] See also Nickell (1996); Blundell et al. (1999); Aghion et al. (2005) for empirical papers that utilize similar arguments.

[4] In addition, Jensen (2007) argues that the diffusion of telecommunication technologies has increased the availability of information about the fishing industry/market in Kerala, India, through increased communication between fishermen.

ates. The problem with this measure is that it reflects both the supply and the demand of those technologies, when we need only the demand.

In order to alleviate this problem we try to identify the industries' dependence on telecommunication technologies from US data. This involves three important assumptions. The first and second are that in the United States the supply of telecommunication technologies is perfectly elastic and frictionless, respectively. The first assumption can be supported by an argument that the marginal cost of production in the telecommunications industry is very low (for a similar argument see Noam, 1992; Laffont and Tirole, 2000). Meanwhile, the second can find support in the observation that the US has one of the most developed information and communication technologies sectors. Moreover, it tends to have exemplary regulations/reforms for the telecommunications industry and the lowest market prices for telecommunication goods in the world. The second assumption also requires the demand for telecommunication technologies to be largely unaffected by frictions in the supply of other goods/services, if any. This seems realistic given the seemingly low substitutability of telecommunication goods with other types of goods and the relatively frictionless environment in US markets. The third assumption is that the dependence identified from the US data also holds in other countries. More rigorously, we assume that there is some technological reason which creates variation in the industries' dependence on telecommunication technologies. Further, we assume that these technological differences persist across countries so that the dependence identified from the US data would be applicable for the countries in our sample.

These assumptions may seem to be rather strong. All we actually need, however, is that the rank ordering of the expenditure share on telecommunications in the United States corresponds to the rank ordering of the technological need/dependence of the industries. We need as well that rank ordering to carry over to the rest of the countries in our sample.[5] This would mean that, for example, the retail trade industry depends more on telecommunication technologies than the mining of metal ores in all of the countries in our sample.

There is at least one argument that can motivate why this rank ordering, perhaps together with the actual dependence level, can carry over to rest of the countries. The share of expenditures on telecommunications is virtually constant in the steady state equilibrium. Therefore, much of the variation within industries may arise from shocks that would change the relative demand for telecommunication technologies.[6] An example of such a shock would be a factor-biased technological innovation. As long as, however, there is technological convergence across countries and these shocks are worldwide, our

[5]Rajan and Zingales (1998) have similar assumptions in the context of capital markets.
[6]Clearly, the shocks also can generate variation out of the steady state equilibrium.

measure would be a valid proxy. From another perspective, if our proxy is noisy, our findings may only suffer from attenuation bias.

We, nevertheless, perform several robustness checks. Given that the shocks may not be worldwide, for a robustness check we also employ the shares of expenditures on telecommunications in Japan and the United Kingdom. These countries tend to have relatively well developed ICT sectors and relatively high telecommunication technologies diffusion. Therefore, it may be reasonable to expect that our assumptions are also valid for them. At the same time, these countries tend to have a different industrial composition than the United States, which would be another type of robustness check.

For the same purpose, we also employ the share of expenditures on telecommunications in 1994 in the United States since it can be argued that European countries tend to be somewhat behind it in terms of the use of ICT.[7]

The basic test

Our hypothesis is that in countries where, *ex ante*, the diffusion of telecommunication technologies is higher, *ex post*, the level of product market competition is different in industries that depend more on these technologies compared to the industries that depend less. One of the advantages of trying to test exactly this hypothesis is that we need not explain the drivers behind the diffusion of telecommunication technologies, economic/market or regulatory. In order for the diffusion to matter in such a setup, we need only to have a "world" where the diffusion cannot happen instantaneously or is costly. Either of these assumptions seems plausible given that the diffusion requires building infrastructure.

Given the hypothesis, our dependent variable is the level of product market competition in industry i and country c (averaged over the time/sample period). Assuming that we are able to measure the level of competition, industry i's dependence on telecommunication technologies, and the diffusion of those technologies in country c, after controlling for industry and country effects, in our empirical specifications we should find that the coefficient of the interaction between the diffusion and dependence is different from zero. Therefore, in the empirical specification we need only to take into account the explanatory variables that vary with industry and country. These are the interaction between the initial/*ex ante* level of the diffusion of telecommunication technologies in country c and the dependence on those technologies of industry i – the variable of interest – and the initial level of the share of an industry in a country in total sales/revenue (industry

[7] We could use any date prior to 1997 and after 1993. It turns out that as we go towards 1993 our results become more pronounced and significant. This may partly stem from the technological lag between the European Union countries and the United States.

share).[8] The last one can capture potential convergence effects. For instance, it can correct for the possibility that the larger industries in a country experience lower entry rates (see, for instance, Klapper et al., 2006). This then can affect the intensity of competition.

Our (baseline) empirical specification is then

$$\begin{aligned} \text{Competition}_{i,c} &= \alpha_{1,i} + \alpha_{2,c} \\ &+\alpha_3 \cdot (\text{industry } i\text{'s dependence} \times \text{the diffusion in country } c) \\ &+\alpha_4 \cdot \text{industry share}_{i,c} + \varepsilon_{i,c}, \end{aligned} \tag{2.1}$$

where $\varepsilon_{i,c}$ is the error term and our focus is on the coefficient of the interaction term α_3. If we follow, for instance, Leff (1984) and Jensen (2007), and believe that cheaper information reduces the costs of entry, then we expect to have positive α_3 (negative if we use an inverse measure for competition).

2.3 Measures and data

Our empirical analysis is for 21 countries from the European Union. It focuses on the period 1997–2006. We concentrate on this set of countries since we use the OECD STAN and Amadeus databases and want to focus on a somewhat coherent sample. We need these databases in order to construct the measures of competition, for instance. Particularly, we need the Amadeus database for constructing competition measures such as the Herfindahl index and the market share of the four largest firms, which require firm-level data and tend to be widely used both in the literature and by regulatory institutions. Although we could employ data starting from 1993, we do not do so since we have very few (firm-level) observations in the Amadeus database for the period 1993–1996. We could as well employ data until 2008. We do not do so since we want to avoid incorporating data from the recent financial crisis.[9]

That we use data from a rather homogenous set of countries involves tradeoffs. It can eliminate the influence of various unobservable factors on our inference, for example. However, at the same time it can weaken our inference from cross-country comparisons.

In order to estimate the specification we need appropriate measures for the diffusion of telecommunication technologies, the level of industries' dependence on these technologies, and the competition in services and goods markets.

[8] Our results are not qualitatively different if instead of the share in sales we use the share in value-added.

[9] The telecommunication goods consumption patterns indicate strong differences between pre- and post-financial crisis periods, and no visible differences around the dot-com bubble period 1999–2001.

Country-level variables

Measures for the diffusion of telecommunication technologies

Our primary measure for the diffusion of telecommunication technologies (hereafter, telecom diffusion) is the number of fixed lines and mobile telephone subscribers per capita (hereafter, telecom subscribers).[10] This variable may also measure the availability of the telecommunications infrastructure and is extensively applied in that context (see, for instance, Röller and Waverman, 2001). However, it may not fully reflect the use and the quality of the telecommunication technologies, which can matter for the costs associated with information transmission.

For a robustness check of our main results, we also use the revenue of the telecommunications industry per capita (hereafter, telecom revenue) as the telecom diffusion measure, which can better account for use and quality. Nevertheless, from the between-countries-comparison perspective, this measure may fail to correctly reflect the amount of telecommunication goods produced since it could be higher, for instance, simply because prices are higher.[11]

These measures can indicate the adoption and use of telecommunication technologies in the entire economy. This is important for us since potential entrepreneurs can use their personal/private telecommunications for acquiring information, while entrepreneurs and firms can use corporate ones. However, clearly at least some part of the use if measured in this manner will be hard to associate with the competition in goods and services markets. An example would be cheat-chat over the phone. From this perspective, therefore, using these measures can play against us since it can bias our results towards zero. In other words, we would find the interaction term to be insignificant in some of the cases when it is significant.

We obtain the data for these measures from the GMID and ITU databases. Tables 2.1 and 2.2 offer the country-level variables and correlations between them.

[10] Adding internet subscribers can lead to significant double counting since, for example, fixed lines are used extensively for dial-up and DSL internet. However, as a robustness check we use internet subscribers separately as a telecom diffusion measure. Our results remain qualitatively the same.

[11] This problem may be alleviated with a purchasing power parity index for the telecommunications industry. We are not aware of any source of such data. Nevertheless, we have checked that our results are qualitatively not different if we adjust the revenue measure by a price measure such as the price of a 3-minute local mobile phone call.

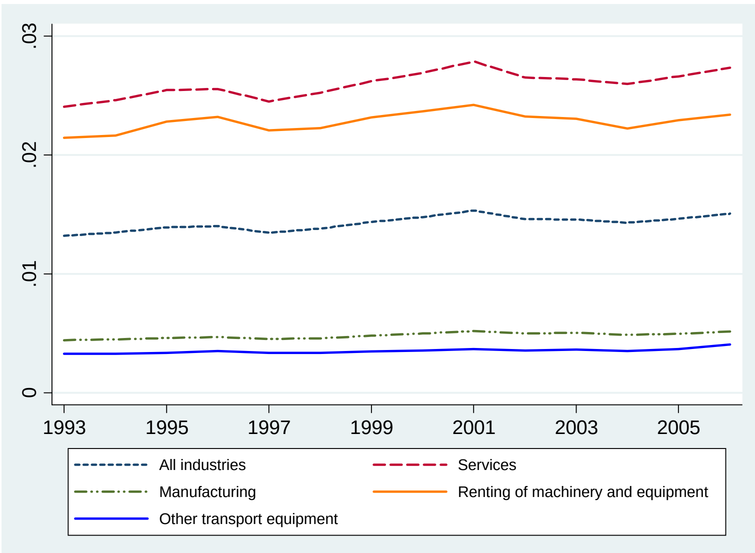
Industry-level variables

Measures for the dependence on telecommunication technologies

To identify the dependence on telecommunication technologies (hereafter, telecom dependence) we use data for the share of expenditures on telecommunications from the United States. Our most disaggregated data for that is at the 2-digit industry level. We obtain these data from the input-output tables of the Bureau of Economic Analysis (BEA). The original data are in NAICS 2007 and have a time span 1993–2007. We transform it to ISIC rev. 3.1 (hereafter, ISIC), in order to align it with the rest of our data and exclude the industries that are expected to have large state involvement (80, 85, 90, and 91 of ISIC).[12] Further, we average it over the period 1997–2006 and use the average as a measure for the dependence. [13]

Figure 2.1 provides further support for the validity of this measure. It suggests that the share of expenditures on telecommunications in the United States virtually has not changed. A simple ANOVA exercise on our sample confirms this observation and shows that the industry-level variation accounts for 99.48% of the total, while time variation accounts for only 0.52%.[14]

Figure 2.1: The share of expenditures on telecommunications in the US



Note: This figure shows the share of expenditures on telecommunications (our measure of dependence on telecommunication technologies) in all industries in the US in the goods/manufacturing sector, the services sector, the renting of machinery and equipment industry, and the other transport equipment industry in the period 1993–2006. The data are from the Bureau of Economic Analysis.

[12] Our results are robust to their inclusion.

[13] We have to acknowledge that this is far from a perfect measure, since it may not be representative for industries where there are significant outliers in terms of telecommunication goods consumption. However, it seems to be the best given the data that we were able to obtain.

[14] The same exercise for services industries yields virtually the same results (98.59% instead of 99.48%), even though Figure 1 seems to visually suggest that there was time variation in these industries.

For a robustness check we also obtain data for Japan and the United Kingdom. The data is from the input-output tables from the OECD STAN database. It has a structure similar to the 2-digit ISIC, though it is slightly more aggregated. Moreover, it is only for 1995, 2000, and 2005. In our specifications we use the average of these three years. For a comparison, we have also obtained data from the OECD STAN database for United States industries.

Table 2.3 offers the industry level variation of these measures. It also offers the share of expenditures on telecommunications in industries averaged for all the European Union countries in our sample (see also Table C in Appendix D: Statistics and correlations for the industry-time variation in the US). We derived the latter from the OECD STAN database. We use these data for computing rank correlations between our dependence measures and the shares of expenditures on telecommunications in industries in the European Union countries. Table 2.4 reports the rank correlations. They are highly significant and range from 0.6 to 0.9 with a mean 0.8, which provides further support for our telecom dependence measures.

Measures for competition and the share of sales

We use five measures of product market competition averaged over the period 1997–2006. These measures tend to be the most widely applied and/or theoretically robust.

Following Nickell (1996) and Aghion et al. (2005), our primary (inverse) measure of product market competition is the price cost margin (PCM). Under the assumption of constant marginal cost, it is the empirical analogue of the Lerner index. Therefore, it tends to be the reference competition measure and is widely applied in the recent empirical literature.

Using industry-level data, PCM is a weighted sum of Lerner indices in the industry across firms, where the weights are the market shares of the firms. In industry i, country c, and at time t, PCM is given by

$$PCM_{i,c,t} = \frac{(Revenue - Variable\ cost)_{i,c,t}}{Revenue_{i,c,t}}, \tag{2.2}$$

where the variable costs include labor compensation and intermediate inputs.[15]

[15] We follow Collins and Preston (1969) and Boone, Griffith, and Harrison (2005) while specifying PCM. In contrast, if we followed Aghion et al. (2005), we would have in the numerator net operating surplus minus financial costs. We do not prefer that measure since we have much less data for it. Meanwhile, it is highly correlated with our measure (0.7) and our results are qualitatively the same with it.

According to Carlin, Schaffer, and Seabright (2006), PCM is highly correlated with the perceived measures of competition such as the number of competitors that the firms report. Moreover, it tends to reflect the industry/market structure fairly well according to, for instance, Collins and Preston (1969).

Our second (inverse) measure for the intensity of competition is the profit elasticity (PE), introduced in Boone, van Ours, and van der Wiel (2007) and Boone (2008). Profit elasticity captures the relation between profits and efficiency. It can be argued that this relation becomes steeper as competition intensifies, since in a more competitive environment, the same percentage increase in costs reduces the profits more. In a given pair of industry and country and for all time periods, PE is estimated using the following empirical specification

$$\ln Profit_{f,t} = \beta_{1,f} + \beta_{2,t} + \beta_{3,t} \ln \left(\frac{Variable\ cost}{Revenue} \right)_{f,t} + \eta_{f,t}, \tag{2.3}$$

where f stands for firm-level observations and $\eta_{f,t}$ is an error term. PE in industry i, country c, and time t is the estimated coefficient $\hat{\beta}_{3,i,c,t}$.[16]

The third and fourth (inverse) measures that we use are concentration measures. The third one is the Herfindahl index (HI), which is defined as the sum of the squared market shares of firms within an industry. Formally,

$$HI_{i,c,t} = \sum_{f=1}^{N_{i,c,t}} \left(\frac{Revenue_{f,i,c,t}}{\sum_{f=1}^{N_{i,j,t}} Revenue_{f,i,c,t}} \right)^2, \tag{2.4}$$

where N is the number of firms. The fourth one is the market share (MS) of the four largest firms in terms of revenues in each industry. Formally,

$$MS_{i,c,t} = \frac{\sum_{\tilde{f}=1}^{4} Revenue_{\tilde{f},i,c,t}}{\sum_{f=1}^{N_{i,c,t}} Revenue_{f,i,c,t}}, \tag{2.5}$$

where $\tilde{f} = 1, 2, 3, 4$ are the largest firms in industry i and country c at time t.

The fifth measure of competition is the number of firms in each industry, $N_{i,c,t}$. It may seem to be the most simplistic and the most disputable at the same time. It may relatively firmly approximate the intensity of competition in situations close to symmetric equilibrium.

Even though these measures are widely applied, it has to be acknowledged that in certain cases they may not fully reflect the intensity of product market competition. For instance, when the competition intensifies from more aggressive conduct some firms may leave the market. In such a situation the Herfindahl index, being a concentration measure, can fail, suggesting that the intensity of competition has decreased. In the same situation a similar problem can arise with the market share of the four largest firms

[16] Clearly, it can be argued that due to simultaneity there is an identification problem here. We do not intend to solve that problem in this study.

when, for instance, one or several of the largest firms leave the market.[17] Meanwhile, the price cost margin may fail in such a case when, for instance, inefficient firms leave the market. This would increase the weight of more efficient firms and, therefore, can increase the price cost margin (for further discussion see Tirole, 1988; Boone et al., 2007). Given its definition, this problem is not present, however, in the measure of competition PE. Nevertheless, given that all our measures have a somewhat different nature (i.e., can reflect different forces behind the intensity of competition) it seems reasonable to use them for robustness checks of our results. It is worth noting also that averaging over time would alleviate some of these concerns since in such a case we focus on a rather long-term level of competition.

The data for the price cost margin and number of firms we take from the OECD STAN database. We use the Amadeus database for the Herfindahl index, the market share of the four largest firms, and the profit elasticity since we need firm-level data for these measures.

The Amadeus database has several features that need to be highlighted. First, in this database there is virtually no data for the financial intermediation and insurance and pension funding industries. Therefore, our analysis for competition measures from Amadeus does not contain those industries.[18] Second, the industry classifications vary over time and across countries. In order to align them with the rest of our data, we have transformed them to the 2-digit ISIC format. Third, this database does not cover the universe of firms and may not have a representative sample. For instance, according to Klapper et al. (2006), it tends to overstate the percentage of large firms. This can affect the competition measures identified from that database.

Our industry and country fixed effects are likely to reduce such biases, nevertheless, we perform several robustness checks. Klapper et al. (2006) compare their data from Amadeus with data from Eurostat in terms of the within-industry distribution of the size of the firms. They keep only the industries and countries which are sufficiently close to the data from Eurostat. We check that all our results hold for the sample of countries and industries which were employed in Klapper et al. (2006). This sample excludes Portugal and Ireland and ISIC industries 10-14, 40, 41, 90-93. We also calculate the price cost margin from firm-level data from the Amadeus database (PCMa) and check that all our results hold for the sample of countries and industries that have sufficiently close PCM

[17] Another possible criticism that applies to concentration measures such as MS and HI is that these are more tied to the geographic and product boundaries of the market in which the firms operate (Aghion et al., 2005).

[18] We could use the Bank Scope database for these industries. We do not do so since in this database, similar to the Amadeus database, the firms that have exited prior to the release/edition of the database are excluded from the sample. We are able to tackle that problem in the Amadeus database by combining several releases.

and PCMa [i.e., the square of the percentage difference, $\left(\frac{PCM-PCMa}{PCM}\right)^2$, is less than its median in the entire sample, 0.21].[19]

In the same spirit, we calculate the number of firms from the Amadeus database and check that all our results hold also for that measure. We describe further that database and our data cleaning procedure in Appendix C: Data cleaning.

Finally, the share of an industry in a country in total sales in 1997 we obtain from the OECD STAN database.

Tables 2.5–2.6 report the descriptive statistics and correlations between the competition measures. Tables 2.7–2.8 report the descriptive statistics and correlations between the remaining industry level variables. Table A in Appendix B: Definitions of variables further details the variable definitions and the sources of all variables.

2.4 Results

In Table 2.9, column (I), we present our main results from the baseline specification (2.1). The dependent variable is our main (inverse) measure of product market competition PCM, averaged over the period 1997–2006. Meanwhile, in the interaction term we have our main measures of telecom dependence and telecom diffusion. These are the share of expenditures on telecommunications in the US, which we identify from the BEA database and average over the period 1997–2006, and the logarithm of the fixed and mobile telephone subscribers per capita in 1997.

The estimate of the coefficient on the interaction term is negative and significant at the 1% level and equals -2.72.[20] Given that smaller values of PCM correspond to higher competition intensity, this indicates that in industries that depend more on telecommunication technologies, competition is more intensive in countries with higher telecom diffusion. Telecom diffusion, therefore, has a positive effect on the intensity of competition in the services and goods markets.

Since we have a difference-in-differences estimate, one way to compute the magnitude of our result is as follows. We take the countries that rank in the 25th and 75th percentiles of the level of telecom diffusion and compute the difference between the logarithms of telecom diffusion levels. The countries are Estonia (25th) and France (75th) in our sample. Further, we take the industries that rank in the 25th and 75th percentiles of the level of dependence on telecommunication technologies and compute the difference between dependence levels. In our sample these industries are other transport equipment (25th)

[19] Table B in Appendix D: Statistics and correlations offers the frequency of having a higher-than-median (0.21) squared percentage difference between PCM and PCMa for the industries in our sample. The highest frequency is in the services industries and industries associated with mining.

[20] The major part of the high R-squared is attributable to industry and country dummy variables.

and renting of machinery and equipment (75th). Finally, we compute

$$\hat{\alpha}_3 \times \Delta\text{telecom dependence} \times \Delta \log\left(\text{telecom diffusion}\right), \tag{2.6}$$

where Δ stands for the difference operator between the 75th and 25th percentiles. The computed number is -0.023. This means that the difference in PCM (the intensity of competition) between renting of machinery and equipment and other transport equipment is lower (higher) by 0.023 in France as compared to Estonia. This difference is relatively large compared to the mean of PCM, 0.190 (12%).

In an attempt to rule out other explanations of our main result we conduct a range of robustness checks.

Robustness checks

Alternative measures for competition

In order to check whether our results are robust in terms of the competition measure we estimate our baseline specification (2.1) for the remaining four competition measures. Columns (II)-(V) in Table 2.9 report the results where, all else equal, the dependent variable is correspondingly the profit elasticity, the Herfindahl index, the market share of the four largest firms, and the total number of firms in an industry. Column (VI) reports the results for the price cost margin, which is derived from the Amadeus database.[21]

All the estimates of the coefficients on the interaction terms have the expected signs and are significant at least at the 5% level. The estimated coefficient in the specification for PCMa is considerably smaller, though, than our main result. The predicted magnitude of the effect according to this estimate is also smaller, -0.005. However, relative to the mean of this measure, 0.094, the predicted magnitude is still comparably large at 5%.

We have also estimated the baseline specification (2.1) for all competition measures for a subsample where the square of the percentage difference between PCM and PCMa is smaller than its median. Our results remain qualitatively the same, but are not reported.[22]

We further report the estimation results exclusively for PCM. We have checked, however, that all our results stay qualitatively the same for other measures of competition.[23]

[21] We have also checked that this result holds when we take the number of firms from the Amadeus database, which, in contrast to the OECD STAN database, does not have a full coverage.
[22] The results from all robustness checks are available upon request.
[23] We have also used import penetration (imports over sales) as a competition measure. The estimated coefficient is positive, though not significant at the 10% level and is not reported. The positive coefficient is consistent with the rest of our estimates. Meanwhile, the estimate is not significant, perhaps because we have few data for that measure.

Alternative measure for telecom diffusion

Column (I) in Table 2.10 offers the results where we use the (logarithm of) telecom revenue in 1997 for measuring telecom diffusion, while for competition and telecom dependence we use our main measures. The estimated coefficient is negative and significant at the 1% level, which complements the result reported in column (I) of Table 2.9. Although the coefficient is somewhat smaller, -1.49, the predicted magnitude of the effect is very close, 0.035 (Hungary is at the 25th percentile and Finland is at the 75th percentile in terms of telecom revenue).

In what follows we report the results only for telecom subscribers. We have, nevertheless, checked that all our results are qualitatively the same for the telecom revenue measure.

Alternative measures for telecom dependence

Thus far we have reported the results for our main measure of telecom dependence. In columns (II)-(IV) of Table 2.10 we check whether identifying the dependence measure from 1994 data for the US and from data for Japan and the UK improves or alters our results.

Given that EU countries tend to be behind in terms of the application of ICT, we could expect that in the regression where the dependence measure is from the US data for 1994, the coefficient on the interaction term is higher. It is so, although very marginally, -.2.74. The magnitude of the effect does not change, either. An explanation for this can be the maturity of telecommunication technologies in the US already by 1994, which is consistent with the observation of virtually no time variability in our measure of dependence.[24]

We retrieve the data for Japan and the UK from the OECD STAN database. All the estimates are again negative and significant at least at 5%, which reaffirms our main result. These estimates, however, smaller than the main result, since the OECD STAN database has slightly higher industry aggregation.[25] The magnitudes of the effects also vary, though not considerably.

One reason for such variation can be higher noise in the UK and Japanese data. For instance, the dependence measures identified from the data for these countries have lower rank correlations with the share of telecommunications expenditures in the industries in the European Union countries compared to the measures identified from the data for the US (see Table 2.4).

[24] One way to explore further our conjecture is to use sufficiently dated data. We do not have such data.

[25] We also estimated baseline specification (2.1) for the overlapping sample of industries of BEA and OECD STAN for the US measures. The estimates are very close: -1.8 (SE 0.30) and -1.1 (SE 0.20), respectively.

The last column of Table 2.10 reports the results when we use as a measure for dependence the country-time average of the expenditure share on telecommunications in industries in the EU countries in our sample. The estimate of the coefficient on the interaction term is not qualitatively different from the main one [-1.54 (SE 0.35)]. We further report exclusively the results for our main measure of telecom dependence. We have, nevertheless, checked that all our results are qualitatively the same for the remaining measures.

Alternative estimators and robustness to outliers

The competition measure PCM varies from 0 to 1. We estimate the baseline specification (2.1) with Tobit and report the results in column (I) of Table 2.11 [-2.72 (SE 0.35)]. Further, in order to alleviate the influence of outliers, if any, we estimate the baseline specification using quantile regression. We estimate it also on a sample that excludes the first and the last percentiles of the dependent variable, PCM. The results are reported in columns (II) and (III) of Table 2.11 [-2.20 (SE 0.40) and -2.63 (SE 0.36), respectively].

In our difference-in-differences estimation we essentially divide the countries into high diffusion (HDIFF) and low diffusion (LDIFF) and the industries into high dependence (HDEP) and low dependence (LDEP). Abstracting from the control variables, our estimate is

$$[\text{HDEP(HDIFF)-LDEP(HDIFF)}]\text{-}[\text{HDEP(LDIFF)-LDEP(LDIFF)}],$$

which captures the average effect only. The effect that we compute with this nonparametric estimator is -0.018. This result reassures us that the effect that we have identified previously is generally present in all countries and industries.

When appropriate we have checked that all our results are qualitatively the same with these alternative estimators. In the remaining reported regressions we have used OLS.

Alternative explanations: Varying sample restrictions

Time period - Do we capture integration processes?

We also test whether our results are robust to various sample restrictions. First, we restrict our sample to 2000–2006 in order to check whether the integration processes in the European Union affect our results. Column (I) in Table 2.12 reports the results from the baseline specification. The dependent variable is PCM and, together with the measure of telecom dependence, it is averaged over the period 2000–2006. The measure of telecom diffusion and the industry share variable are from 2000. The estimate of the coefficient on the interaction term is negative and highly significant [-3.34 (SE 0.56)].[26] Its magnitude has increased in comparison with the main results, but not considerably. This suggests that the integration processes are not likely to be the drivers behind our results.

Country level - Are new and old EU member countries and the UK different?

The former transition countries the Czech Republic, Slovakia, Estonia, Slovenia, Poland, and Hungary, which joined the EU in 2004, can be different from the remaining countries in our sample. In these countries the privatization process has resulted in the emergence of a large number of private firms (Klapper et al., 2006). Moreover, these countries have gone through large structural/industry changes. The latter can affect the intensity of competition, whereas the former can affect the patterns of the use of telecommunication technologies. We want to make sure that our results are not driven by this. Column (II) in Table 2.12 reports the results when we exclude these countries from the sample [-3.67 (SE 0.82)]. Column (III) reports the estimates exclusively for these countries [-4.11 (SE 0.92)]. Both estimates are statistically indistinguishable from our main results and from each other, though the estimate for the new members tends to be somewhat greater in absolute value.[27]

In this respect, the UK also can be expected to be different from the remaining countries, in terms of the use of telecommunication technologies and its development level. Column (IV) in Table 2.12 excludes the UK from the sample. The result is the same as our main result [-2.72 (SE 0.37)]. We have also estimated our baseline specification (2.1) for the subsample of countries (and industries) that was employed in Klapper et al. (2006). Our results remain qualitatively the same, but are not reported.

We further check whether sectorial or industry differences drive or affect our results.

Sector/Industry level - Are the services industries different?

The processes behind our results may be different in the services sector compared to the goods/manufacturing sector. This is because, given their nature, services products can be more easily marketed and delivered over telecommunication networks. In such a case, first, in line with the literature on electronic versus regular market places, it seems reasonable to expect that the role of consumers' search costs is different for these industries. These costs can be important since they can affect the intensity of competition

[26] Our results are virtually the same if we consider the period 1997–1999. Our results also do not change when we add to our specification the interaction of telecom dependence and the ratio of imports and/or exports to GDP. Similarly, they do not change when we add the interaction of telecom diffusion with the ratio of imports and/or exports to sales at the industry level.

[27] For a formal test we add to baseline specification (2.1) the interaction term multiplied by a dummy for the new member countries and check if that additional term is significant. We have done this in all the appropriate cases.

(e.g., Bakos, 1991). Although theory does not have a clear-cut inference, the empirical studies seem to point out that the relationship is likely to be negative (Brynjolfsson and Smith, 2000; Brown and Goolsbee, 2002). Second, if transportation costs are a significant part of the fixed costs that the services firms incur in their operations, then the diffusion could motivate entry while reducing those costs (i.e., it would create room for entry). The entry then would intensify the competition.

Columns (I) and (II) of Table 2.13 report the results when we restrict the sample to the services or goods sectors. The estimate of the coefficient for the goods sector is basically the same as our main estimate [-2.79 (SE 1.71)]. Meanwhile, the estimate of the coefficient in the services sector is slightly lower [-3.24 (SE 0.65)], which is in line with the suggested effect of the search and transportation costs. However, this estimate is not significantly different from the main one, either.[28]

Sector/Industry level - Are those that use telecommunications the least different?

We have also checked that our results are not qualitatively different from the main result for the industries that, most likely, affect telecom diffusion the least. We try to identify such industries in two ways. First, we take the interaction between the variables industry share and telecom dependence and for a country take those industries that have a value lower than the median in the country. Second, in a country we take those industries that have below the median expenditures on telecommunications in 1995 in the country. We obtain the data for this measure from the input-output tables from the OECD STAN database. We use the dependence measure identified from that database in the estimation for this group of industries since the OECD STAN database has a slightly different aggregation.

Columns (III) and (IV) of Table 2.13 report the results. The coefficient for the industries that have lower-than-median interaction between telecom dependence and industry share is essentially the same as our main result [-2.93 (SE 1.97)]. Meanwhile, the coefficient for the industries that have lower-than-median expenditures on telecommunications in 1995 is very close to the result which we have obtained using OECD STAN data for the dependence measure [-1.38 (SE 0.51)]. This exercise suggests that our results are not likely to be driven by reverse causality. Nevertheless, we continue to explore such a possibility.

Alternative explanations: Reverse casuality

Instrumental variables

[28] The result for services industries is essentially the same if we exclude the transport industries, ISIC 60-62.

Our inference would be incorrect if a third factor is responsible for the intensity of competition and is correlated with the interaction between telecom dependence and diffusion. In this section we attempt to rule out such an explanation of our results.

First, we try to further alleviate the reverse causality concerns and instrument the predetermined level of the diffusion of telecommunication technologies. The set of instruments that we use consists of dummy variables for country groups: New members of the EU (post-transition countries), Scandinavian countries, and France and Germany. The first set of countries inherited its (antiquated) telecommunications infrastructure from the socialist regime. Scandinavian countries, in turn, were very effective in promoting universal access via state control and subsidies after deregulation, according to Gruber and Verboven (2001); ITU (2002). Meanwhile, France and Germany had the best access to mobile technologies through industry leaders such as La Compagnie Generale d'Electricite and Siemens. These dummy variables explain approximately 70% of our diffusion measures. Column (I) in Table 2.14 reports the results [-2.76 (SE 0.40)]. They are no different from our main results.[29]

Our country-group-level instrumental variables may not solve the endogeneity problem, however. It might be that they are correlated with some omitted variables and therefore do not satisfy the exclusion restrictions.

Omitted variables - Do we identify other costs of entry?

According to, for example, Klapper et al. (2006), the countries identified with our instruments are quite different in terms of variables that matter for the entry (and potential entry) and size distribution of firms and, thus, for the intensity of competition. Following Klapper et al. (2006) and Scarpetta, Hemmings, Tressel, and Woo (2002), these variables are the bureaucratic costs of entry, human capital development (or the availability of qualified personnel), financial development, employment law, and property rights and market regulations (see Tables 2.1 and 2.2 for basic statistics and correlations). To the extent that the diffusion of telecommunications is correlated with these variables (e.g., because it reflects the business environment) and the rank of telecom dependence is correlated with the rank of the industries that are mostly affected by these variables, our inference would be incorrect.

One way to check whether these variables matter in our setup is the following. First, we find a measure that identifies the ranking of industries according to the effect these variables should have on them (i.e., on the competition in those industries). Next, we interact this measure with a proxy of a variable and add it to the baseline specification (2.1). In case these variables drive our results, the coefficient of the interaction between

[29]Our results remain qualitatively the same if we do not use the dummy for the new members of the EU.

telecom dependence and diffusion should become insignificant.

A. Identifying the ranking of the industries according to the effect

The bureaucratic costs of entry, according to Klapper et al. (2006), have a higher impact on entry in "naturally" high-entry industries. It would be reasonable to expect that market regulation matters in these industries in a similar way. Meanwhile, financial development, according to Rajan and Zingales (1998), has a higher impact on the creation of new establishments in industries that depend more on external finance. Further, property rights regulation and human capital development would have a disproportionate impact on the industries that have high R&D intensity. In turn, the strictness of employment law could be expected to have a disproportionate impact on the industries that have high labor intensity.

We use the measure and the data of Klapper et al. (2006) to identify the "naturally" high-entry industries. In an industry in the US, it is defined as the percentage of new corporations (firms that are not more than one year old). In Klapper et al. (2006) it is averaged over the period 1998–1999. We take the measures and the data for dependence on external finance and R&D intensity from Bena and Ondko (2012). The first is defined as the industry median of the average of the ratio of capital expenditures minus cash flows from operations to capital expenditures over the period 1996–2005. Meanwhile, R&D intensity is defined as the industry median of the ratio of averages of R&D expenditures to capital expenditures over the period 1996–2005. As a measure for labor intensity we use the ratio of the number of employees to sales in US industries.[30] We take these data from the OECD STAN database and average them over the period 1997–2006. Tables 2.7 and 2.8 offer the basic statistics and correlations.

B. Measuring the costs

We obtain he measure and the data for bureaucratic costs of entry from Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2002). According to the authors, these costs include all identifiable official expenses in a country.[31] In turn, in order to measure the country-wide market regulation we use the product market regulation indicator from OECD Stat. This indicator takes into account the public control of business, bureaucratic barriers to entrepreneurship, trade, and investment. Higher values stand for higher product market regulation. The level of financial development we measure as stock market capitalization over GDP.[32] We take the data from the WDI database. The measure for the strictness

[30] The results are essentially the same when we use labor income share instead of the number of employees over sales.

[31] We have also tried adding the interactions of entry rate and labor intensity variables with the overall economic freedom index (in 1997) from the Heritage Foundation. Our results remain virtually the same.

[32] Our results are the same when we use private credit over GDP and GDP per capita instead of market capitalization over GDP.

of the employment law, and its data, we obtain from Botero, Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2004). This is an index that takes into account job security, the conditions of employment, and the provisions in laws regarding alternative employment contracts. Higher values mean higher protection for a worker. Further, in order to proxy the property rights regulation we use the property rights index constructed by the Heritage Foundation. It measures the protection of private property in a country. Higher values stand for higher private property protection. Given availability, the data for these measures are for 1999, 1997, 1997, 1998, 1997 respectively. As a measure of human capital development we use the average years of schooling for the population older than 25. The data are for 1995, and we obtain it from the Barro-Lee tables, the World Bank.[33,34]

C. Answering the question

Columns (II)–(VII) of Table 2.14 report the results. Clearly, the fact that we use data for the years 1999 and 1998 for entry costs and market regulation can raise further endogeneity concerns. However, as we have already reported, our results are no different when we use data for competition, dependence, and diffusion measures from the period 2000–2006, for instance.[35]

The coefficient on the interaction term between telecom dependence and diffusion remains virtually the same in all cases. It somewhat, though, reduces in absolute value when we insert the interaction between employment law and labor intensity, column (V). However, this effect is neither significant nor driven by that interaction term. The estimate of the baseline regression on the subsample where we have values for the latter interaction term is virtually the same. Generally, the signs of the coefficients of these additional interaction terms are intuitive, although the estimates are not significant. For instance, higher entry costs and stricter market regulation are likely to hinder entry (and potential entry) in naturally high-entry industries. Therefore, they might reduce the intensity of competition in these industries. The strictness of the employment law can reduce the future expected value of the entrant more in labor-intensive industries. Therefore, it may hinder entry (and potential entry) and competition in such industries. The respective estimates are correspondingly positive. The estimates of the coefficients on interaction terms for financial development and property rights are also positive. A possible explanation for this is that the incumbents use, for example, patent protection and finance for deterring entry and/or escaping competition. Exploring these conjectures

[33]We have experimented with various measures of human capital development. None of them affects our inference differently.

[34]See Table D in Appendix D: Statistics and correlations for correlations between the main interaction terms and the interaction terms that we use for specification/robustness checks.

[35]We have also tried to adjust our sample to the period 1996–2005 when using data from Bena and Ondko (2012). Our results remain qualitatively the same.

is well beyond the scope of this study.

All these additional interaction terms, as well as our main interaction term, may proxy for the business environment in the country. Another rough way to proxy for that, together with the entrepreneurial culture in the country, is to include an interaction term of telecom dependence with the average intensity of competition for the country. Our main result is not affected by such inclusion; it also remains unaffected if we include all these interaction terms at once, but these results are not reported.

It may also be argued that the ranking of the industries according to their dependence on telecommunication technologies corresponds to the ranking of industries according to the effect these variables have on them. In columns (I)–(VI) of Table 2.15 we include the interactions of the telecom dependence measure with the respective variable together with our main interaction term one-by-one. Our main result, again, stays basically unchanged. The estimates of the coefficients on interactions with bureaucratic costs of entry, market regulations, and employment law are positive, though insignificant. This result suggests that in countries where either the entry costs are higher or market regulation or employment law are tougher the competition is lower in industries that depend more on telecommunication technologies. The coefficients on the interactions with financial development/market capitalization and human capital availability are negative, although only the former is significant. This suggests that (potential) entrants and/or the intensity of competition may indeed benefit from financial development and the availability of human capital. This would be especially true for industries that depend more on telecommunication technologies. Meanwhile, the estimate for property rights is positive and highly significant. This is in line with our previous conjecture that the incumbents may enforce their patents and loosen the competition.

Omitted variables - Does our measure of dependence simply identify the growth potential of the industries?

It could also be that the measure of dependence on telecommunication technologies identifies the industries that have high growth potential/opportunities. Meanwhile, such industries could depend on the availability of modern technologies, which can be proxied by the telecom diffusion variable, and face tougher competition due to attractiveness.

In order to measure the growth potential of the respective industries, following Fisman and Svensson (2007), we use the growth rate of US industries averaged over 1998–2007. We obtain this data from the sales figures from the Bureau of Economic Analysis. This measure seems to be the most appropriate given the relatively low market imperfections in the United States. However, it could fail if there are important preference differences in the US compared to our sample countries. Therefore, we also use the growth rates of industries in the three most developed EU countries (measured by GDP per capita) in our sample averaged over 1998–2007.[36]

We interact the measures of growth potential with the telecom diffusion variable and include those in the baseline specification. Columns (I) and (II) of Table 2.16 report the results. The estimate of the coefficient on the interaction between telecom dependence and diffusion remains virtually unaffected. The estimated coefficients on the interactions between telecom diffusion and the measure of growth potential are negative. This suggests that in countries where the diffusion of telecommunication technologies is higher the competition is more intensive in industries with higher growth potential. A specific explanation for this can be that these industries depend more on such (modern) technologies (see Table 2.8 for the correlation between the measure of telecom dependence and growth potential).[37]

Omitted variables - Does the shadow economy matter?

Finally, we are concerned that countries with bigger shadow economies could have lower reporting of output and lower competition due to adherence to rather informal agreements.[38] Meanwhile, it could be that the industries that depend more on telecommunication technologies have a higher share in the shadow economy (e.g., services).

We take the measure of the size of the shadow economy and the data for it from Schneider (2002). This variable is in percentage of GNP and is averaged over 1999–2000. Column (III) of Table 2.16 includes the interaction of this variable with the telecom dependence measure and reports the results. The estimate of the coefficient on the interaction between telecom diffusion and dependence is virtually not affected. Meanwhile, the estimate of the coefficient on the interaction between the measure of the size of shadow economy and telecom dependence is positive, although not significant. This suggests that the economies with a larger shadow economy tend to have lower competition in the industries that are more dependent on telecommunication technologies.

In the same vein, in the baseline specification (2.1) we have also included the interactions between GDP per capita and telecom dependence and CPI and telecom dependence [see columns (IV) and (V) in Table 2.16]. The main result is, again, virtually unaffected. In the case of CPI it is slightly, though not significantly, higher. The change in the value, however, is not due to the inclusion of the new interaction term since it is virtually the same for the subsample where we have observations for CPI.[39]

[36] The countries are Denmark, Norway, and Sweden.

[37] Tables E, F, and G in Appendix E: Further results report the results for the additional interaction terms when we do not include our main interaction term.

[38] For example, in our sample PCM is 6% higher in countries where the shadow economy is more than the median compared to the remaining countries.

[39] In line with Klapper et al. (2006) we have also checked if the coefficient on the interaction term in the baseline specification is different for countries with a higher development level and lower corruption level. We have found no systematic and significant differences.

For a further robustness check, we included in the baseline specification the principal components of the matrix of all additional interaction terms, which explain more than 90% of the variation in the data. We have used principal components due to high collinearity between the variables. Our main result is virtually the same, but is not reported.

Does the quality matter?

Recently, there have been extensive developments in the quality of telecommunications infrastructure. For example, the medium speed of information flow in telecommunication networks has increased from several kilobits per second at the beginning of the 90s to several megabits per second nowadays. While increasing the speed of information transmission, this progress can reduce the costs associated with information acquisition. Therefore, it seems reasonable to expect that in countries where the quality of the telecommunications infrastructure is higher, the impact of these technologies on competition is also higher.

To proxy for quality, we use the percentage of digital fixed-lines and mobile phone subscribers in 1997 in countries in our sample (Digitalization Rate). This measure is justified to the extent that quality differences in telecommunications in the 90s and in the early 2000s can be largely attributed to the deployment of digital technologies which replaced analogue technology. For example, the switch from analogue to digital technology in mobile telephony has allowed providers to increase significantly the efficiency of radio bandwidth, both in terms of the number of calls and the rates of data transfer. Meanwhile, in fixed-line telephony this switch has allowed reduction of noise in the signal and increased the capacity of telephone switches. Further, digital service lines (DSL), which tend to be one of the major ways of delivering broadband internet in Europe, are a direct result of the deployment of digital technologies. This quality measure also seems to be well suited for our measure of the diffusion of telecommunication technologies, Telecom Subscribers.[40]

In order to test our prediction we divide countries in our sample into two groups according to the level of our quality measure. Table 2.17 offers the results when we divide countries into high and low levels of quality according to the median and 60th, 70th, 80th, and 90th percentiles of the Digitalization Rate.

The results clearly suggest that in countries where the quality of telecommunications infrastructure is higher, the diffusion of these technologies has a larger positive effect on the intensity of competition in services and goods markets. To the extent that more intensive competition can improve welfare, these results support, for example, the European

[40] Our results are qualitatively the same if we use as a measure of quality the ratio of fixed broadband subscribers to fixed-line telecommunications subscribers in 2000, not reported.

Commission's Digital Agenda and its plans to invest in high-quality telecommunication networks in 2014–2020.

2.5 Conclusion

In this study, we use industry-country-level data to identify the effect of the wider adoption and more intensive use (diffusion) of telecommunication technologies on the intensity competition in services and goods markets. Taken together, our results offer a robust inference that the diffusion of telecommunication technologies significantly increases competition. It does so especially in the industries that depend more on these technologies. Moreover, the estimated effect is stronger in countries with a higher quality of telecommunications infrastructure.

According to the theory and empirical evidence, the intensity of product market competition matters for allocative and productive efficiency. Our empirical results, therefore, highlight a mechanism for how the use of a particular type of ICT, telecommunication technologies, can contribute to economic performance. This complements, for example, the productivity improvement mechanism that is extensively emphasized in the literature.

Our results also suggest that the policies aiming to promote the diffusion of telecommunication technologies can complement competition policies.

Tables

Summary statistics and correlations

Table 2.1: Country-level variables

Country	Telecom subscribers	Telecom revenue	GDPC	CPI	B.Entry cost	Market regulation	Market capi- talization	Employ- ment law	Property rights	Human capital	Shadow economy
Austria	0.64	389.13	21616.62	7.61	0.27	2.33	0.06	0.50	90	8.65	0.10
Belgium	0.56	377.41	20858.04	5.25	0.10	2.18	0.12	0.51	90	9.72	0.23
Czech Republic	0.37	147.74	5280.83	5.2	0.08	2.99	0.12	0.52	70	11.45	0.19
Denmark	0.91	573.82	27928.02	9.94	0.10	1.59	0.28	0.57	90	9.97	0.18
Estonia	0.44	116.75	3517.05	-	-	-	0.29	-	70	10.48	-
Finland	0.98	512.43	20601.65	9.48	0.01	2.08	0.30	0.74	90	9.17	0.18
France	0.68	389.85	19976.97	6.66	0.14	2.52	0.28	0.74	70	8.30	0.15
Germany	0.65	460.63	21553.48	8.23	0.16	2.06	0.25	0.70	90	9.42	0.16
Greece	0.59	290.06	10431.71	5.35	0.59	2.99	0.15	0.52	70	8.18	0.29
Hungary	0.37	156.29	3996.52	5.18	0.86	2.30	0.16	0.38	70	10.39	0.25
Ireland	0.57	562.44	20016.94	8.28	0.12	1.65	0.20	0.34	90	10.90	0.16
Italy	0.66	380.37	18078.85	5.03	0.2	2.59	0.17	0.65	70	8.43	0.27
Netherlands	0.68	453.77	21819.39	9.03	0.18	1.66	0.74	0.73	90	10.51	0.13
Norway	1.01	863.10	35325.19	8.92	0.05	1.85	0.29	0.69	90	11.14	0.19
Poland	0.22	85.44	3873.72	5.08	0.25	3.97	0.05	0.64	70	9.05	0.28
Portugal	0.55	351.83	10207.43	6.97	0.18	2.25	0.18	0.81	70	6.82	0.23
Slovakia	0.30	105.28	5038.39	-	0.15	-	0.08	0.66	50	11.17	0.19
Slovenia	0.40	135.86	8791.17	-	0.21	-	0.02	0.74	50	8.67	0.27
Spain	0.51	316.32	12761.84	5.9	0.17	2.55	0.79	0.74	70	7.73	0.23
Sweden	1.06	682.45	24527.46	9.35	0.03	1.93	0.70	0.74	70	10.51	0.19
UK	0.70	653.39	22743.77	8.22	0.01	1.07	0.61	0.28	90	8.47	0.13

Note: The first two columns of this table offer the telecom diffusion measures, telecom subscribers and telecom revenue, for every country from our sample. These measures are from 1997. The remaining columns offer the values of country-level variables that we use for robustness checks. See Table *A* in Appendix B: Definitions of variables for complete definitions and sources of variables.

Table 2.2: Country-level variables - rank correlations

	Variable	1	2	3	4	5	6	7	8	9	10
1	Telecom subscribers										
2	Telecom revenue	0.92*									
3	GDPC	0.88*	0.93*								
4	CPI	0.75*	0.83*	0.78*							
5	B.Entry costs	-0.55*	-0.64*	-0.56*	-0.57*						
6	Market regulation	-0.62*	-0.85*	-0.79*	-0.80*	0.57*					
7	Market capitalization	0.63*	0.60*	0.47*	0.64*	-0.52*	-0.56*				
8	Employment law	0.17	0.002	-0.02	0.21	-0.08	0.14	0.37			
9	Property rights	0.59*	0.73*	0.75*	0.63*	-0.41	-0.74*	0.352	-0.34		
10	Human capital	-0.05	0.09	0.08	0.32	-0.37	-0.42	0.005	-0.28	0.14	
11	Shadow economy	-0.47*	-0.60*	-0.59*	-0.63*	0.43	0.62*	-0.43	0.09	-0.60*	-0.21

Note: This table shows the pairwise Spearman's rank correlation coefficients between all country-level variables. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. * indicates 5% significance.

Table 2.3: Telecom dependence measures

ISIC	Industry	US 1994	US 1997–2006	ISIC	Japan	UK	US	EU
10	Coal mining	0.0032	0.0032	10-14	0.0146	0.0104	0.0076	0.0112
11	Oil and gas extraction	0.0089	0.0085					
13	Mining of metal ores	0.0020	0.0022					
14	Other mining and quarrying	0.0061	0.0064					
15	Food products and beverages	0.0021	0.0022	15-16	0.0025	0.0103	0.0079	0.0060
16	Tobacco products	0.0006	0.0004					
17	Textiles	0.0030	0.0039	17-19	0.0072	0.0082	0.0066	0.0100
18	Wearing apparel	0.0041	0.0057					
19	Luggage, handbags, footwear	0.0020	0.0024					
20	Wood, except furniture	0.0037	0.0044	20	0.0028	0.0076	0.0058	0.0079
21	Pulp and paper	0.0026	0.0030	21-22	0.0104	0.0131	0.0245	0.0245
22	Publishing, printing	0.0143	0.0168					
23	Coke and petroleum products	0.0010	0.0010	23	0.0024	0.0037	0.0024	0.0031
24	Chemicals	0.0026	0.0028	24	0.0084	0.0142	0.0098	0.0099
25	Rubber and plastic products	0.0057	0.0066	25	0.0048	0.0099	0.0079	0.0102
26	Non-metallic mineral products	0.0050	0.0057	26	0.0047	0.0131	0.0093	0.0107
27	Basic metals	0.0024	0.0027	27	0.0025	0.0062	0.0039	0.0055
28	Fabricated metal products	0.0066	0.0072	28	0.0103	0.0096	0.0102	0.0107
29	Machinery and equipment n.e.c.	0.0057	0.0061	28	0.0063	0.0083	0.0145	0.0111
30	Office machinery and computers	0.0040	0.0039	30	0.0042	0.0065	0.0142	0.0137
31	Electrical machinery	0.0038	0.0040	31	0.0052	0.0091	0.0091	0.0095
32	Communication equipment	0.0060	0.0057	32	0.0046	0.0068	0.0160	0.0116
33	Instruments, watches and clocks	0.0087	0.0088	33	0.0072	0.0106	0.0182	0.0149
34	Motor vehicles and trailers	0.0013	0.0015	34	0.0018	0.0051	0.0066	0.0054
35	Other transport equipment	0.0033	0.0036	35	0.0037	0.0057	0.0086	0.0083
36	Furniture manufacturing n.e.c.	0.0078	0.0091	36-37	0.0061	0.0082	0.0164	0.0099
40	Electricity, gas, hot water	0.0023	0.0023	40-41	0.0090	0.0055	0.0074	0.0145
41	Distribution of water	0.0250	0.0290					
45	Construction	0.0138	0.0164	45	0.0178	0.0085	0.0225	0.0083
50	Sale and repair of motor vehicles	0.0283	0.0324	50-52	0.0660	0.0380	0.0480	0.0447
51	Wholesale trade	0.0245	0.0264					
52	Retail trade	0.0232	0.0251					
55	Hotels and restaurants	0.0175	0.0193	55	0.0248	0.0338	0.0305	0.0234
60	Land transport	0.0129	0.0140	60-63	0.0210	0.0246	0.0302	0.0238
61	Water transport	0.0105	0.0118					
62	Air transport	0.0321	0.0351					
63	Supporting transport activities	0.0250	0.0275					
64	Post and telecommunications	0.0177	0.0197					
65	Financial intermediation	0.0250	0.0262	65-67	0.0586	0.1548	0.0344	0.0803
66	Insurance and pension funding	0.0074	0.0071					
67	Activities auxiliary to financial intermediation	0.0602	0.0544					
70	Real estate activities	0.0175	0.0187	70	0.0088	0.0298	0.0267	0.0207
71	Renting of machinery, equipment	0.0216	0.0230	71	0.0115	0.0379	0.0405	0.0411
72	Computer and related activities	0.0642	0.0658	72	0.0421	0.0337	0.0960	0.0766
73	Research and development	0.0168	0.0185	73	0.0654	0.0214	0.0672	0.0431
74	Other business activities	0.0449	0.0485	74	0.0887	0.0488	0.0878	0.0512
80	Education	0.0271	0.0298	80	0.0289	0.0322	0.0467	0.0346
85	Health and social work	0.0244	0.0268	85	0.0107	0.0172	0.0475	0.0258
90	Sewage, disposal, sanitation	0.0129	0.0141	90-93	0.0415	0.0293	0.0426	0.0515
91	Activities of membership organizations n.e.c.	0.0191	0.0187					
92	Recreational, cultural and sporting activities	0.0152	0.0176					
93	Other service activities	0.0293	0.0345					

Note: This table offers the measures of telecom dependence for 2-digit ISIC industries. In the first two columns this measure is computed from the US data using input-output tables obtained from the Bureau of Economic Analysis for 1994 and averaged over 1997–2006. The last four columns present this measure for Japan, the United Kingdom, the US and the average within the EU countries from our sample. These are computed using input-output tables obtained from the OECD STAN database and are averaged over 1995–2005. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables.

Table 2.4: Telecom dependence measures - rank correlations

Telecom dependence	US	US94	USOECD	EU	Japan	UK
US94	0.99					
USOECD	0.89	0.91				
EU	0.88	0.90	0.87			
Japan	0.88	0.88	0.84	0.87		
UK	0.80	0.80	0.82	0.83	0.84	
Austria	0.74	0.77	0.81	0.87	0.78	0.76
Belgium	0.81	0.84	0.85	0.93	0.80	0.68
Czech Republic	0.92	0.92	0.89	0.92	0.87	0.87
Denmark	0.84	0.83	0.84	0.88	0.83	0.81
Estonia	0.80	0.80	0.82	0.83	0.76	0.71
Finland	0.82	0.82	0.74	0.87	0.80	0.77
France	0.89	0.88	0.84	0.88	0.86	0.81
Germany	0.71	0.74	0.73	0.87	0.74	0.69
Greece	0.87	0.88	0.83	0.94	0.80	0.77
Hungary	0.90	0.89	0.84	0.87	0.89	0.81
Ireland	0.58	0.54	0.45	0.65	0.63	0.62
Italy	0.78	0.81	0.77	0.84	0.79	0.68
Netherlands	0.85	0.85	0.84	0.87	0.78	0.81
Norway	0.67	0.67	0.66	0.78	0.66	0.55
Poland	0.82	0.83	0.86	0.87	0.81	0.78
Portugal	0.89	0.88	0.82	0.91	0.90	0.87
Slovakia	0.86	0.89	0.88	0.93	0.84	0.78
Slovenia	0.85	0.88	0.85	0.93	0.82	0.77
Spain	0.77	0.80	0.79	0.91	0.81	0.82
Sweden	0.73	0.76	0.79	0.88	0.69	0.73

Note: This table offers the pairwise Spearman's rank correlation coefficients between the telecom dependence measures identified from the data for the US, the UK, and Japan and the share of telecommunications expenditures in industries in the European Union countries. See Table A in Appendix B: Definitions of variables for the definitions and the data sources of Telecom dependence US, Telecom dependence US94, Telecom dependence USOECD, and Telecom dependence EU. All correlation coefficients are significant at the 1% level.

Table 2.5: Competition measures - descriptive statistics

						Percentiles		
	Nobs	Mean	S.D.	Min	Max	25th	50th	75th
PCM	902	0.190	0.135	0.010	0.889	0.101	0.151	0.234
PE	892	-5.289	3.465	-20.558	-0.032	-7.126	-4.415	-2.653
HI	928	0.138	0.171	0.001	1	0.021	0.070	0.188
MS	928	0.447	0.270	0.021	1	0.216	0.392	0.650
logN	863	7.239	2.634	1.386	13.488	5.439	7.307	9.165
PCMa	928	0.094	0.061	0.019	0.519	0.059	0.078	0.110

Note: This table offers the descriptive statistics of competition measures, where Nobs is the number of country-industry observations in the sample. All measures are averaged over 1997–2006. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables.

Table 2.6: Competition measures - correlations

	PCM	PE	HI	MS	logN
PE	0.27*				
HI	-0.01	-0.24*			
MS	-0.06	-0.29*	0.88*		
logN	0.16*	0.29*	-0.66*	-0.74*	
PCMa	0.49*	0.31*	0.15*	0.16*	-0.19*

Note: This table offers the pairwise correlation coefficients between competition measures. All measures are averaged over 1997–2006. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. * indicates the 5% level of significance.

Table 2.7: Industry-level variables - descriptive statistics

	Nobs	Mean	S.D.	Min	Max	Percentiles		
						25th	50th	75th
Telecom dependence US	987	0.014	0.015	0.000	0.066	0.004	0.007	0.023
Telecom dependence US94	987	0.013	0.014	0.001	0.064	0.003	0.007	0.022
Telecom dependence USOECD	630	0.023	0.023	0.002	0.096	0.008	0.014	0.030
Telecom dependence JP	630	0.017	0.022	0.002	0.089	0.005	0.008	0.018
Telecom dependence UK	630	0.020	0.028	0.004	0.155	0.008	0.010	0.025
Telecom dependence EU	630	0.021	0.020	0.003	0.080	0.010	0.011	0.024
Industry share	926	0.021	0.025	0.000	0.244	0.005	0.013	0.027
Entry US	924	6.155	1.740	1.740	10.730	5.250	5.935	7.055
Ext. fin. dependence US	966	0.325	0.710	-1.548	2.949	-0.117	0.228	0.665
R&D intensity US	966	0.695	1.150	0.000	4.171	0.018	0.163	0.755
Labor intensity US	672	0.006	0.004	0.001	0.020	0.003	0.005	0.007
Growth potential US	987	0.011	0.033	-0.086	0.087	0.003	0.012	0.023
Growth potential EU	987	0.026	0.040	-0.074	0.215	0.010	0.025	0.039

Note: This table offers the descriptive statistics of industry-level variables, excluding the competition measures. Nobs is the number of country-industry observations. See Table A in Appendix D.1 for complete definitions and sources of variables.

Table 2.8: Industry-level variables - correlations

		1	2	3	4	5	6	7
1	Telecom dependence US							
2	Industry share	0.08*						
3	Entry US	0.33*	0.11*					
4	Ext. fin. dependence US	0.14*	-0.09*	0.05				
5	R&D intensity US	0.15*	-0.11*	0.42*	0.60*			
6	Labor intensity US	0.35*	0.07	0.21*	-0.13*	-0.15*		
7	Growth potential US	0.53*	0.19*	0.20*	0.43*	0.44*	0.44*	
8	Growth potential EU	0.25*	0.04	-0.26*	0.27*	-0.04	-0.04	0.32*

Note: This table offers the pairwise correlation coefficients between industry-level variables, excluding the competition measures. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. * indicates the 5% level of significance.

Regression results

Table 2.9: The main result and the results for alternative competition measures

	(I) PCM	(II) PE	(III) HI	(IV) MS	(V) logN	(VI) PCMa
Telecom dependence US × Telecom subscribers	-2.72*** (0.37)	-28.23** (12.85)	-1.56*** (0.56)	-1.82*** (0.62)	16.94*** (3.86)	-0.59** (0.26)
Industry share	0.69*** (0.27)	17.27*** (4.81)	-0.25 (0.22)	-0.59* (0.34)	10.57*** (2.15)	0.37*** (0.09)
Observations	902	844	876	876	818	876
R2	0.72	0.56	0.62	0.75	0.93	0.53

Note: This table reports the results from the of baseline specification (2.1) for all our measures of product market competition. All measures are averaged over 1997–2006. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.10: Alternative measures of diffusion and dependence

	(I) Revenue	(II) US94	(III) JP	(IV) UK	(V) USOECD	(VI) EU
Telecom dependence US × Telecom revenue	-1.49*** (0.24)					
Telecom dependence [ ] × Telecom subscribers		-2.74*** (0.37)	-1.18*** (0.23)	-0.65** (0.30)	-1.69*** (0.24)	-1.54*** (0.35)
Industry share	0.70*** (0.29)	0.69*** (0.271)	0.87*** (0.34)	0.90*** (0.34)	0.93*** (0.33)	0.93*** (0.33)
Observations	902	902	618	618	618	618
R2	0.71	0.72	0.73	0.73	0.74	0.73

Note: This table reports the results from the baseline specification (2.1) for various measures of telecom diffusion and dependence. The dependent variable is the competition measure PCM averaged over 1997–2006. In column (I) the diffusion measure is the (logarithm of) telecom revenue in 1997. In columns (II)-(VI) we vary the dependence measure. In column (II) the dependence measure is identified from BEA data for 1994 for the US. In columns (III)-(IV) the telecom dependence measure is identified from the data for Japan and the United Kingdom. These data are from OECD STAN. In column (V) the dependence measure is identified from OECD STAN data for the US. In column (VI) the dependence measure is constructed as the average of the industry's share of expenditures on telecommunications in all EU countries from our sample. The data are from the OECD STAN database. All measures from this database are averaged over 1995–2005. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.11: Alternative estimators

	(I) Tobit	(II) Quantile	(III) OLS w/o 1 & 100%
Telecom dependence US	-2.72***	-2.20***	-2.63***
× Telecom subscribers	(0.35)	(0.40)	(0.36)
Industry share	0.76***	0.42	0.46**
	(0.27)	(0.26)	(0.22)
Observations	902	902	884
R2	-	0.50	0.68

Note: This table reports the results from the baseline specification for alternative estimators. The dependent variable is the competition measure PCM, which is averaged over 1997–2006. Column (I) reports the estimates from Tobit regression with censoring at 0 and 1, column (II) reports the estimates from quantile regression, and column (III) reports the results from OLS regression for the sample that excludes the first and last percentiles of PCM. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Pseudo R2 is reported for quantile regression. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.12: Various restrictions on the time period and sample of countries

	(I) 2000-2006 sample	(II) W/o new EU members	(III) New EU members	(IV) W/o UK
Telecom dependence US	-3.34***	-3.67***	-4.11***	-2.72***
× Telecom subscribers	(0.56)	(0.82)	(0.92)	(0.37)
Industry share	0.81**	0.67**	0.29	0.69**
	(0.33)	(0.29)	(0.39)	(0.28)
Observations	900	637	265	861
R2	0.71	0.70	0.80	0.72

Note: This table reports the results from the baseline specification for various sample restrictions. The dependent variable is the competition measure PCM. In column (I) PCM and telecom dependence are averaged over 2000–2006, and telecom subscribers and industry share are for 2000. In column (II) new EU members (Czech Republic, Estonia, Hungary, Poland, Slovakia, and Slovenia) are excluded from the sample. In column (III) only new EU members are included. In column (IV) the United Kingdom is excluded from the sample. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.13: Restrictions on sectors and telecom dependence level

	(I) Services	(II) Goods	(III) Less telecom dependent (interaction)	(IV) Less telecom dependent (expenditure)
Telecom dependence US	-3.24***	-2.79*	-2.93**	
× Telecom subscribers	(0.65)	(1.71)	(1.97)	
Telecom dependence USOECD				-1.38***
× Telecom subscribers				(0.51)
Industry share	0.68**	0.74**	-0.43	0.35
	(0.36)	(0.35)	(0.41)	(0.61)
Observations	411	491	445	307
R2	0.68	0.55	0.634	0.678

Note: This table reports the results from the baseline specification for various sample restrictions. The dependent variable is the competition measure PCM averaged over 1997–2006. In column (I) the sample includes exclusively the services industries and in column (II) the sample includes exclusively the goods/manufacturing industries. Column (III) excludes the industries in a country that have a higher-than-median telecom dependence times industry share in the country. Column (IV) excludes the industries in a country that have higher-than-median expenditures on telecommunications in the country in 1995. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.14: Specification check - new variables

	(I) IV	(II) B.Entry cost	(III) Market regulation	(IV) Market capitalization	(V) Employment law	(VI) Property rights	(VII) Human capital
Telecom dependence US	-2.76***	-2.68***	-3.18***	-3.01***	-2.12***	-2.97***	-2.98***
× Telecom subscribers	(0.40)	(0.43)	(0.53)	(0.37)	(0.33)	(0.37)	(0.36)
Entry US		0.01					
× B.Entry cost		(0.01)					
Entry US			0.01				
× Market regulation			(0.01)				
Ext. fin. dependence US				0.02			
× Market capitalization				(0.02)			
Employment intensity US					0.76		
× Employment law					(5.42)		
R&D intensity US						0.00	
× Property rights						(0.01)	
R&D intensity US							-0.02
× Human capital							(0.02)
Industry share	0.69***	0.74***	0.83***	0.69***	0.52**	0.70***	0.73***
	(0.26)	(0.26)	(0.27)	(0.27)	(0.24)	(0.27)	(0.27)
Observations	902	803	721	882	616	882	882
R2	0.74	0.75	0.74	0.75	0.81	0.75	0.75

Note: This table reports the results from specifications that augment the baseline with additional interaction terms. The dependent variable is the competition measure PCM averaged over 1997–2006. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.15: Specification check - new variables

	(I) B.Entry cost	(II) Market regulation	(III) Market capitalization	(IV) Employment law	(V) Property rights	(VI) Human capital
Telecom dependence US	-2.56***	-3.10***	-2.64***	-2.76***	-3.50***	-2.76***
× Telecom subscribers	(0.40)	(0.71)	(0.40)	(0.38)	(0.47)	(0.36)
Telecom dependence US	1.04					
× B.Entry cost	(1.07)					
Telecom dependence US		0.24				
× Market regulation		(0.47)				
Telecom dependence US			-0.32			
× Market capitalization			(0.73)			
Telecom dependence US				0.11		
× Employment law				(1.31)		
Telecom dependence US					4.05***	
× Property rights					(1.46)	
Telecom dependence US						-2.32*
× Human capital						(1.22)
Industry share	0.72***	0.79***	0.69***	0.72***	0.67***	0.69***
	(0.26)	(0.27)	(0.27)	(0.28)	(0.28)	(0.28)
Observations	857	769	902	857	902	902
R2	0.72	0.71	0.71	0.71	0.72	0.72

Note: This table reports the results from specifications that augment the baseline with additional interaction terms. The dependent variable is the competition measure PCM averaged over 1997–2006. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.16: Specification check - new variables

	(I) Growth potential US	(II) Growth potential EU	(III) Shadow economy	(IV) GDPC	(V) CPI
Telecom dependence US × Telecom subscribers	-2.33*** (0.43)	-2.60*** (0.40)	-2.68*** (0.43)	-2.53*** (0.77)	-3.59*** (0.72)
Growth potential US × Telecom subscribers	-0.34** (0.16)				
Growth potential EU × Telecom subscribers		-0.16 (0.14)			
Telecom dependence US × Shadow economy			1.40 (3.66)		
Telecom dependence US × GDPC				-0.13 (0.43)	
Telecom dependence US × CPI					0.06 (0.16)
Industry share	0.68*** (0.27)	0.69*** (0.27)	0.80*** (0.28)	0.69*** (0.27)	0.79*** (0.28)
Observations	90	902	857	902	769
R2	0.72	0.72	0.71	0.72	0.71

Note: This table reports the results from specifications that augment the baseline with additional interaction terms. The dependent variable is the competition measure PCM averaged over 1997–2006. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2.17: High versus low quality - broadband subscription rate

	(1) 50th perc.	(2) 60th perc.	(3) 70th perc.	(4) 80th perc.	(5) 90th perc.
Telecom Dependence × Telecom Subscribers	-2.23*** (0.68)	-2.22*** (0.68)	-2.66*** (0.63)	-2.99*** (0.58)	-2.94*** (0.57)
Telecom Dependence × Telecom Subscribers × High Broadband	-3.75*** (1.38)	-3.81*** (1.37)	-2.77** (1.31)	-1.92 (1.56)	-3.30* (1.90)
Industry Share	0.71** (0.29)	0.71** (0.29)	0.72** (0.29)	0.72** (0.29)	0.72** (0.29)
Observations	900	900	900	900	900
R2	0.71	0.71	0.71	0.71	0.71

Note: This table reports the results from specifications that augment the baseline with an additional interaction term. The dependent variable is PCM averaged over 1997–2006. In column (1), variable High Broadband is equal to one for countries where Broadband Subscription Rate is higher than the median and zero otherwise. In columns (2)-(5), High Broadband is equal to one in countries where Broadband Subscription Rate is greater than the 60th, 70th, 80th and 90th percentiles of its between-countries distribution correspondingly, and zero otherwise. See Table A in Appendix B: Definitions of variables for complete definitions and sources of variables. All regressions include industry and country dummies and use the least squares estimation method. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Appendix

Appendix A: The model

A very stylized and simplistic model that delivers predictions in line with our inference is as follows. Assume that there are two industries which produce differentiated goods $\{x_1\}$ and $\{x_2\}$. Further, consumption good (Y) is produced with a Cobb-Douglas production technology,

$$Y = \lambda_Y X_1^{\sigma_1} X_2^{\sigma_2}, \tag{2.7}$$

where $\sigma_1 + \sigma_2 = 1$, $\lambda_Y > 0$, and X_1 and X_2 are Dixit-Stiglitz aggregates of the goods produced in these industries,

$$X_i = \left(\sum_{f=1}^{N_i} x_{i,f}^{\frac{\varepsilon_i - 1}{\varepsilon_i}} \right)^{\frac{\varepsilon_i}{\varepsilon_i - 1}}, i = 1, 2. \tag{2.8}$$

Here i indexes the industries, N stands for the number of firms, f indexes the firms, and ε is the (actual) elasticity of substitution between the products of the firms in these industries ($\varepsilon > 1$).

Normalizing aggregate demand to 1 and taking the consumption good as the numeraire, it follows that the demand for $x_{i,j}$ is

$$p_{x_{i,j}} x_{i,j} = \sigma_i \frac{x_{i,j}^{\frac{\varepsilon_i - 1}{\varepsilon i}}}{\sum_{f=1}^{N_i} x_{i,f}^{\frac{\varepsilon_i - 1}{\varepsilon_i}}}, \tag{2.9}$$

where p_x is the price of x.

Further, assume that x_1 and x_2 are produced using telecommunication technologies (T) and some other good (L) with Cobb-Douglas production technologies,

$$x_i = \lambda_i T_i^{\alpha_i} L_i^{1-\alpha_i}, \tag{2.10}$$

where $\lambda > 0$ and $\alpha_1 > \alpha_2$: Industry 1 depends on telecommunication technologies more than industry 2. For simplicity, let the firms live for one period. Meanwhile, the entrants pay a fixed cost F_i for entry into the respective industry, and there is free entry into the industries (where $F_i < \frac{\sigma_i}{\varepsilon_i}$ for $i = 1, 2$ since aggregate demand is equal to 1). In order to cover the costs of entry, these firms set prices. In an industry each firm internalizes its effect on the demand for the goods of the remaining firms in the industry.

The problem of firm j in industry i is

$$\max_{T_{i,j},L_{i,j}} \pi_{i,j} = p_{x_{i,j}} x_{i,j} - p_T T_{i,j} - p_L L_{i,j} - F_i \qquad (2.11)$$
$$s.t.$$
$$(2.9)\,,$$

where p_T and p_L are the prices of T and L. Therefore, firm j's demands for T and L are given by

$$p_T = p_{x_{i,j}} \left(1 - \frac{1}{e_{i,j}}\right) \frac{\partial x_{i,j}}{\partial T_{i,j}}, \qquad (2.12)$$
$$p_L = p_{x_{i,j}} \left(1 - \frac{1}{e_{i,j}}\right) \frac{\partial x_{i,j}}{\partial L_{i,j}}, \qquad (2.13)$$

where $e_{i,j}$ is firm j's perceived elasticity of substitution between goods in its industry

$$e_{i,j} = \varepsilon_i \left[1 + (\varepsilon_i - 1) \frac{x_{i,j}^{\frac{\varepsilon_i - 1}{\varepsilon_i}}}{\sum_{f=1}^{N_i} x_{i,f}^{\frac{\varepsilon_i - 1}{\varepsilon_i}}}\right]^{-1}.$$

In this framework competitive pressure in an industry can be expressed in terms of the Lerner index (LI). For firm j from industry i this index can be derived from (2.10), (2.12), and (2.13) setting $x_{i,j} = 1$. It is given by

$$LI_{i,j} = \frac{1}{e_{i,j}}.$$

Ceteris paribus, in an industry it declines with actual elasticity of substitution ε and the number of firms N.

Assuming symmetric equilibrium in each of the industries, the perceived elasticity of substitution is given by

$$e_i = \frac{\varepsilon_i}{1 + \frac{\varepsilon_i - 1}{N_i}}.$$

In turn, the demands for T and L in each industry can be written as

$$N_i p_T T_i = \sigma_i \alpha_i \left(1 - \frac{1}{e_i}\right), \qquad (2.14)$$
$$N_i p_L L_i = \sigma_i (1 - \alpha_i) \left(1 - \frac{1}{e_i}\right). \qquad (2.15)$$

Given that there is free entry, the number of firms in each industry is determined by a zero profit condition $\pi_i = 0$. Using (2.9), (2.11), (2.14), and (2.15) it can be easily shown that this condition is equivalent to

$$\sigma_i \frac{1}{N_i} = \sigma_i \left(1 - \frac{1}{e_i}\right) \frac{1}{N_i} + F_i.$$

Therefore, the number of firms in each industry is

$$N_i = \frac{\frac{\sigma_i}{\varepsilon_i} + \sqrt{\left(\frac{\sigma_i}{\varepsilon_i}\right)^2 + 4F_i \sigma_i \frac{\varepsilon_i - 1}{\varepsilon_i}}}{2F_i}. \tag{2.16}$$

From this expression, it is straightforward to show that the number of firms N in each industry declines with entry cost F. This implies that decreasing entry cost F in industry i reduces LI_i or, equivalently, increases competition. After tedious algebra, it is also possible to show that increasing elasticity of substitution ε in industry i reduces LI_i or, equivalently, increases competition.

In turn, allocations of T and L can be solved using (2.14), (2.15), and market clearing conditions:

$$\begin{aligned} N_1 T_1 + N_2 T_2 &= T, \\ N_1 L_1 + N_2 L_2 &= L. \end{aligned}$$

These allocations are given by

$$\begin{aligned} N_i T_i &= \frac{1}{1 + \frac{\alpha_{-i}}{\alpha_i} \frac{\sigma_{-i}}{\sigma i} \left(1 - \frac{1}{e_{-i}}\right) \left(1 - \frac{1}{e_i}\right)^{-1}} T, \\ N_i L_i &= \frac{1}{1 + \frac{1-\alpha_{-i}}{1-\alpha_i} \frac{\sigma_{-i}}{\sigma_i} \left(1 - \frac{1}{e_{-i}}\right) \left(1 - \frac{1}{e_i}\right)^{-1}} L. \end{aligned}$$

Let industries have equal shares ($\sigma_i \equiv \sigma$), then increasing T increases $N_1 T_1$ more than $N_2 T_2$. Following, for example, Geroski (1995b) and Leff (1984) and assuming that $F_i = F_i (N_i T_i)$ and $F_i' < 0$ implies that N_1 increases more than N_2. Therefore, increasing T increases competition more in the industry that depends more on telecommunication technologies (industry 1).

In an industry, firms might also use telecommunication technologies to increase product differentiation and reduce competition [i.e., $\varepsilon_i = \varepsilon_i (N_i T_i)$ and $\varepsilon_i' < 0$]. In such a case, the effect of increasing T on competitive pressure depends on the functional forms of $\varepsilon (.)$ and $F (.)$; therefore, *a priori* it can be ambiguous.

Increasing T may also increase the productivity of firms, λ. In this model, however, this would not affect LI given that we have assumed perfectly flexible prices. Relaxing this assumption can give another mechanism that can generate a positive relation between LI and T.

Finally, this model can be easily extended so that the firms live for more than one period and have operational fixed costs. In such a case, assuming free entry, firms' discounted value of revenue streams net of variable costs will be equal to the sum of entry and (the discounted value of) operational fixed costs. The decline of any of these fixed costs will intensify competition. Therefore, as long as increasing T reduces operational fixed costs and/or entry costs, increasing T will increase competition.

Appendix B: Definitions of variables

Table A: Definitions and sources of variables

Name	Definition and source
	Country-level variables .
Telecom subscribers	The sum of fixed and mobile telephone subscribers per capita. The data are for 1997. Source: GMID and ITU databases.
Telecom revenue	The revenue of the telecommunications industry per capita in constant 2000 US$. The data are for 1997. Source: GMID and ITU databases.
GDPC	GDP per capita in constant 2000 US$. The data are for 1997. Source: WDI, World Bank.
CPI	Corruption perception index. The data are for 1997. Source: Transparency International.
B.Entry cost	The bureaucratic cost of obtaining legal status to operate a firm as the share of per capita GDP in 1999. Source: Djankov et al. (2002).
Market regulation	Product market regulation indicator in 1998. Source: OECD Stat.
Market capitalization	The ratio of stock market capitalization to GDP in 1997. Source: WDI, World Bank.
Employment law	Index of labor regulations in 1997. Source: Botero et al. (2004).
Property rights	Property rights index in 1997. Source: The Heritage Foundation.
Human capital	Average years of schooling of population of age over 25. The data are for 1995. Source: Barro-Lee, World Bank.
Shadow economy	Size of the informal economy as the share of GNP, averaged over 1999-2000. Source: Schneider (2002).

Table A: Definitions and sources of variables, continued

Name	Definition and source
	Industry-level variables/competition measures
PCM	Price cost margin is computed as sales (revenue) minus intermediate cost and labor costs divided by sales, averaged over 1997–2006. Source: Authors' calculations using data from OECD STAN.
PE	Profit elasticity in an industry-country pair is the estimate of the coefficient β_3 in the empirical specification (3), averaged over 1997–2006. Source: Authors' calculations using data from Amadeus.
HI	Herfindahl index is defined as the sum of squared market shares of firms within an industry, averaged over 1997–2006. Source: Authors' calculations using data from Amadeus.
MS	Market share of four largest firms in an industry, averaged over 1997–2006. Source: Authors' calculations using data from Amadeus.
logN	Logarithm of the total number of firms in an industry, averaged over 1997–2006. Source: OECD STAN.
PCMa	Price cost margin is defined as the weighted average of firm-level price-cost margins computed as operational profit over operational revenue within an industry, averaged over 1997–2006. Source: Authors' calculations using data from Amadeus.
	Industry-level variables/telecom dependence
Telecom dependence US	The share of telecommunication inputs in US industries, averaged over 1997–2006. Source: Bureau of Economic Analysis, I-O tables.
Telecom dependence US94	The share of telecommunication inputs in US industries, for 1994. Source: Bureau of Economic Analysis, I-O tables.
Telecom dependence USOECD	The share of telecommunication inputs in US industries, averaged over 1995–2005. Source: OECD STAN, I-O tables.
Telecom dependence UK	The share of telecommunication inputs in UK industries, averaged over 1995–2005. Source: OECD STAN, I-O tables.
Telecom dependence JP	The share of telecommunication inputs in Japanese industries, averaged over 1995–2005. Source: OECD STAN, I-O tables.
Telecom dependence EU	The share of telecommunication inputs in industries in the European Union countries from our sample, averaged over the countries and over 1995–2005. Source: OECD STAN, I-O tables.

Table A: Definitions and sources of variables, continued

Name	Definition and source
	Industry-level variables/other
Industry share	The ratio of sales (revenue) in an industry in a country to the total sales in the country. Source: OECD STAN.
Entry US	Entry rates for US corporations, averaged over 1998–1999. Source: Klapper et al. (2006) using Dun & Bradstreet.
Ext. fin. dependence US	The median of the ratio of capital expenditures minus cash flow from operations over capital expenditures (where both are averaged over 1996–2005 for a firm). Source: Bena and Ondko (2012) using Compustat.
R&D intensity US	The ratio of median R&D expenditures over median capital expenditures. Both components are for the US and averaged over 1996–2005. Source: Bena and Ondko (2012) using Compustat.
Labor intensity US	The ratio of number of employees to production in an industry, in $1000. Source: Authors' calculations using data from OECD STAN.
Growth potential US	The annual growth rate of sales of US industries, averaged over 1998–2007. Source: Authors' calculations using data from BEA.
Growth potential EU	The annual growth rate of sales of industries from the three most developed European countries in terms of real GDP per capita in 1997 (Norway, Denmark, and Sweden), averaged over the countries and over 1998–2007. Source: Authors' calculations using data from OECD STAN.

Appendix C: Data cleaning

The Amadeus database (Analyse Major Databases from European Sources) is a product of Bureau van Dijk. It consists of full and standardized information from balance sheets and profit-loss account items, identification information, and the industry codes (NACE) of European firms.

Amadeus has a specific feature regarding the exclusion of firms from the database. If a firm exits or stops reporting its financial data, Amadeus keeps this firm four years, and then excludes it from the database. For example, in the 2010 edition of Amadeus, the data for 2006 do not include firms that exited in 2006 or before. For our analysis, we need to have as full a dataset as possible in order to obtain competition measures that better approximate the real intensity of competition. Therefore, we combine and use several Amadeus editions: March 2011, May 2010, and June 2007 downloaded from WRDS, and August 2003 and October 2001 DVD updates from Bureau van Dijk.

From the Amadeus database we take operational revenues (for computing the Herfindahl index and the market share of the four largest firms), operational profit/losses (for computing the PCM), and the industry codes of the firms. We transform all industry codes into ISIC rev. 3.1, to have coherence across countries and other databases. We perform basic data cleaning in order to reduce potential selection bias and measurement errors:

• Drop "empty" firms that do not report operational revenue or total assets at all.

• Drop firms that report their data in consolidated statements in order to avoid double counting of firms and/or subsidiaries, similar to Klapper et al. (2006).

• Impute the missing values of key variables using linear interpolation across years. This helps to restore possibly erroneously missing values.

• Drop industries which have less than four firms in a given year.

• Define severe outliers: the first and the last percentiles of relative yearly changes in operational revenue and total assets for each country and the two-digit industry code. If an outlier is at the beginning or at the end of the time period for a firm, then only the first or last observation is dropped. If an outlier is in the middle of the time period, the whole firm is dropped.

• For the computation of PCM we also exclude observations with negative operational profit/losses, because a negative Learner index does not have a theoretical interpretation, and observations where profit/losses are bigger than operational revenue in order to have PCM that varies from zero to one.

Appendix D: Statistics and correlations

Table B: Frequency of having a squared percentage difference between PCM and PCMa larger than the sample median

ISIC	Industry	Frequency
10	Coal mining	0.64
11	Oil and gas extraction	0.76
13	Mining of metal ores	0.64
14	Other mining and quarrying	0.60
15	Food products and beverages	0.36
16	Tobacco products	0.64
17	Textiles	0.20
18	Wearing apparel	0.40
19	Luggage, handbags, footwear	0.44
20	Wood, except furniture	0.36
21	Pulp and paper	0.16
22	Publishing, printing	0.24
23	Coke and petroleum products	0.44
24	Chemicals	0.20
25	Rubber and plastic products	0.20
26	Non-metallic mineral products	0.24
27	Basic metals	0.12
28	Fabricated metal products	0.24
29	Machinery and equipment n.e.c.	0.04
30	Office machinery and computers	0.48
31	Electrical machinery	0.08
32	Communication equipment	0.16
33	Instruments, watches and clocks	0.20
34	Motor vehicles and trailers	0.16
35	Other transport equipment	0.28
36	Furniture manufacturing n.e.c.	0.36
40	Electricity, gas, hot water	0.68
41	Distribution of water	0.68
45	Construction	0.64
50	Sale and repair of motor vehicle	0.84
51	Wholesale trade	0.84
52	Retail trade	0.80
55	Hotels and restaurants	0.48
60	Land transport	0.64
61	Water transport	0.32
62	Air transport	0.64
63	Supporting transport activities	0.72
67	Activities auxiliary to financial intermediation	0.52
70	Real estate activities	0.72
71	Renting of machinery, equipment	0.80
72	Computer and related activities	0.56
73	Research and development	0.52
74	Other business activities	0.48
92	Recreational, cultural and sporting activities	0.52
93	Other service activities	0.87

Note: This table offers the frequency of having a higher-than-median-squared percentage difference between PCM and PCMa for the industries in our sample. Industries ISIC 64, 80, 85, 90, 91 were excluded from the sample. We do not have data for industries ISIC 65 and 66 from the Amadeus database.

Table C: Telecom dependence, US - industry and time variation

ISIC	Industry	Year 1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	1997-2006
10	Coal mining	0.0032	0.0032	0.0033	0.0032	0.0030	0.0031	0.0034	0.0035	0.0032	0.0033	0.0032	0.0029	0.0031	0.0032
11	Oil and gas extraction	0.0089	0.0091	0.0091	0.0087	0.0084	0.0086	0.0088	0.0092	0.0085	0.0085	0.0081	0.0081	0.0081	0.0085
13	Mining of metal ores	0.0020	0.0020	0.0020	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0023	0.0024	0.0022	0.0025	0.0022
14	Other mining and quarrying	0.0061	0.0063	0.0064	0.0062	0.0062	0.0063	0.0067	0.0069	0.0064	0.0065	0.0062	0.0060	0.0063	0.0064
15	Food products and beverages	0.0021	0.0022	0.0022	0.0021	0.0021	0.0023	0.0023	0.0024	0.0022	0.0021	0.0021	0.0022	0.0023	0.0022
16	Tobacco products	0.0006	0.0005	0.0004	0.0004	0.0004	0.0003	0.0004	0.0003	0.0005	0.0004	0.0004	0.0003	0.0003	0.0004
17	Textiles	0.0030	0.0032	0.0034	0.0032	0.0034	0.0037	0.0040	0.0042	0.0040	0.0040	0.0039	0.0041	0.0044	0.0039
18	Wearing apparel	0.0041	0.0043	0.0047	0.0046	0.0047	0.0050	0.0053	0.0055	0.0057	0.0062	0.0063	0.0067	0.0069	0.0057
19	Luggage, handbags, footwear	0.0020	0.0021	0.0023	0.0020	0.0021	0.0023	0.0023	0.0023	0.0026	0.0026	0.0025	0.0026	0.0026	0.0024
20	Wood, except furniture	0.0037	0.0040	0.0041	0.0041	0.0043	0.0045	0.0046	0.0046	0.0043	0.0044	0.0042	0.0043	0.0044	0.0044
21	Pulp and paper	0.0026	0.0027	0.0029	0.0028	0.0029	0.0030	0.0031	0.0032	0.0030	0.0031	0.0029	0.0030	0.0032	0.0030
22	Publishing, printing	0.0143	0.0148	0.0153	0.0148	0.0153	0.0162	0.0169	0.0176	0.0170	0.0171	0.0169	0.0175	0.0183	0.0168
23	Coke and petroleum products	0.0010	0.0010	0.0011	0.0010	0.0012	0.0012	0.0012	0.0011	0.0009	0.0008	0.0007	0.0009	0.0006	0.0010
24	Chemicals	0.0026	0.0028	0.0029	0.0027	0.0028	0.0030	0.0030	0.0031	0.0028	0.0028	0.0026	0.0026	0.0029	0.0028
25	Rubber and plastic products	0.0057	0.0059	0.0063	0.0060	0.0062	0.0065	0.0068	0.0071	0.0067	0.0066	0.0064	0.0065	0.0069	0.0066
26	Non-metallic mineral products	0.0050	0.0052	0.0054	0.0053	0.0054	0.0057	0.0059	0.0061	0.0057	0.0058	0.0056	0.0056	0.0059	0.0057
27	Basic metals	0.0024	0.0025	0.0026	0.0025	0.0025	0.0027	0.0028	0.0029	0.0027	0.0028	0.0026	0.0026	0.0027	0.0027
28	Fabricated metal products	0.0066	0.0068	0.0069	0.0067	0.0068	0.0072	0.0074	0.0078	0.0074	0.0075	0.0070	0.0072	0.0073	0.0072
29	Machinery and equipment n.e.c.	0.0057	0.0058	0.0058	0.0056	0.0057	0.0059	0.0061	0.0064	0.0063	0.0063	0.0061	0.0062	0.0063	0.0061
30	Office machinery and computers	0.0040	0.0037	0.0032	0.0031	0.0032	0.0036	0.0037	0.0042	0.0043	0.0044	0.0041	0.0042	0.0045	0.0039
31	Electrical machinery	0.0038	0.0039	0.0039	0.0038	0.0038	0.0040	0.0041	0.0042	0.0041	0.0041	0.0039	0.0040	0.0042	0.0040
32	Communication equipment	0.0060	0.0059	0.0055	0.0052	0.0054	0.0055	0.0054	0.0057	0.0060	0.0061	0.0059	0.0058	0.0061	0.0057
33	Instruments, watches and clocks	0.0087	0.0088	0.0087	0.0085	0.0084	0.0088	0.0089	0.0094	0.0089	0.0088	0.0084	0.0086	0.0090	0.0088
34	Motor vehicles and trailers	0.0013	0.0012	0.0016	0.0014	0.0014	0.0011	0.0015	0.0014	0.0016	0.0017	0.0016	0.0016	0.0016	0.0015
35	Other transport equipment	0.0033	0.0034	0.0035	0.0034	0.0034	0.0035	0.0036	0.0037	0.0035	0.0036	0.0035	0.0037	0.0040	0.0036
36	Furniture manufacturing n.e.c.	0.0078	0.0082	0.0084	0.0081	0.0082	0.0088	0.0093	0.0099	0.0092	0.0092	0.0089	0.0092	0.0095	0.0091
40	Electricity, gas, hot water	0.0023	0.0023	0.0024	0.0023	0.0026	0.0026	0.0026	0.0025	0.0022	0.0020	0.0020	0.0023	0.0018	0.0023
41	Distribution of water	0.0250	0.0269	0.0263	0.0261	0.0272	0.0288	0.0296	0.0308	0.0287	0.0303	0.0297	0.0300	0.0290	0.0290
45	Construction	0.0138	0.0143	0.0147	0.0143	0.0150	0.0154	0.0163	0.0182	0.0170	0.0171	0.0167	0.0163	0.0175	0.0164
50	Sale and repair of motor vehicles	0.0283	0.0292	0.0300	0.0291	0.0302	0.0311	0.0327	0.0344	0.0332	0.0331	0.0324	0.0331	0.0344	0.0324
51	Wholesale trade	0.0245	0.0256	0.0259	0.0247	0.0253	0.0266	0.0274	0.0280	0.0267	0.0263	0.0256	0.0264	0.0272	0.0264
52	Retail trade	0.0232	0.0237	0.0242	0.0231	0.0235	0.0247	0.0256	0.0267	0.0257	0.0255	0.0250	0.0253	0.0260	0.0251
55	Hotels and restaurants	0.0175	0.0183	0.0186	0.0179	0.0182	0.0192	0.0199	0.0203	0.0192	0.0190	0.0188	0.0195	0.0205	0.0193
60	Land transport	0.0129	0.0134	0.0135	0.0131	0.0138	0.0143	0.0145	0.0149	0.0141	0.0140	0.0135	0.0137	0.0144	0.0140
61	Water transport	0.0105	0.0109	0.0111	0.0105	0.0110	0.0113	0.0116	0.0125	0.0119	0.0119	0.0120	0.0124	0.0128	0.0118
62	Air transport	0.0321	0.0332	0.0334	0.0319	0.0349	0.0357	0.0356	0.0361	0.0355	0.0348	0.0345	0.0343	0.0377	0.0351
63	Supporting transport activities	0.0250	0.0260	0.0262	0.0252	0.0261	0.0272	0.0283	0.0291	0.0277	0.0274	0.0270	0.0280	0.0287	0.0275
64	Post	0.0177	0.0184	0.0185	0.0179	0.0191	0.0197	0.0203	0.0210	0.0200	0.0196	0.0191	0.0194	0.0207	0.0197
65	Financial intermediation	0.0250	0.0261	0.0262	0.0252	0.0258	0.0265	0.0269	0.0277	0.0263	0.0260	0.0253	0.0262	0.0265	0.0262
66	Insurance and pension funding	0.0074	0.0077	0.0069	0.0068	0.0068	0.0071	0.0074	0.0075	0.0069	0.0068	0.0070	0.0074	0.0076	0.0071
67	Activities auxiliary to financial interm.	0.0602	0.0612	0.0588	0.0556	0.0553	0.0549	0.0544	0.0569	0.0533	0.0529	0.0523	0.0539	0.0541	0.0544
70	Real estate activities	0.0175	0.0180	0.0182	0.0175	0.0181	0.0190	0.0197	0.0199	0.0189	0.0187	0.0182	0.0185	0.0187	0.0187
71	Renting of machinery, equipment	0.0216	0.0228	0.0232	0.0221	0.0223	0.0232	0.0237	0.0242	0.0233	0.0231	0.0222	0.0229	0.0234	0.0230
72	Computer and related activities	0.0642	0.0648	0.0648	0.0620	0.0628	0.0653	0.0666	0.0690	0.0666	0.0660	0.0651	0.0668	0.0682	0.0658
73	Research and development	0.0168	0.0174	0.0174	0.0168	0.0174	0.0183	0.0192	0.0196	0.0186	0.0188	0.0183	0.0187	0.0190	0.0185
74	Other business activities	0.0449	0.0462	0.0466	0.0445	0.0460	0.0481	0.0495	0.0512	0.0490	0.0485	0.0478	0.0493	0.0511	0.0485
80	Education	0.0271	0.0282	0.0285	0.0274	0.0279	0.0293	0.0304	0.0313	0.0298	0.0297	0.0298	0.0308	0.0316	0.0298
85	Health and social work	0.0244	0.0255	0.0261	0.0250	0.0256	0.0270	0.0280	0.0284	0.0262	0.0261	0.0260	0.0270	0.0285	0.0268
90	Sewage, disposal, sanitation	0.0129	0.0130	0.0133	0.0128	0.0132	0.0140	0.0146	0.0149	0.0143	0.0145	0.0140	0.0141	0.0143	0.0141
91	Activities of membership organizations n.e.c.	0.0191	0.0198	0.0197	0.0186	0.0187	0.0188	0.0185	0.0196	0.0186	0.0186	0.0182	0.0188	0.0189	0.0187
92	Recreational, cultural and sporting activities	0.0152	0.0158	0.0162	0.0157	0.0166	0.0177	0.0187	0.0189	0.0176	0.0173	0.0173	0.0180	0.0184	0.0176
93	Other service activities	0.0293	0.0310	0.0321	0.0305	0.0314	0.0334	0.0349	0.0368	0.0347	0.0346	0.0351	0.0361	0.0374	0.0345

Note: This table shows the within-industry variation of the telecom dependence measure for the 2-digit ISIC rev. 3.1 industries. This measure is computed for the US using input-output tables obtained from the Bureau of Economic Analysis.

Table D: Correlations between interaction terms

	Telecom dependence US ×Telecom subscribers	Telecom dependence US ×Telecom revenue
Telecom dependence US×Telecom revenue	-0.60*	
Entry rates US×B.Entry cost	-0.14*	-0.20*
Entry rates US×Market regulations	-0.43*	0.17*
Ext. fin. dependence×Market capitalization	0.01	0.12*
Labor intensity US×Employment law	-0.34*	0.52*
R&D intensity US×Property rights	-0.07*	0.15*
R&D intensity US×Human capital	-0.11*	0.15*
Telecom dependence US×B.Entry cost	-0.63*	0.52*
Telecom dependence US×Market regulations	-0.82*	0.88*
Telecom dependence US×Market capitalization	-0.23*	0.71*
Telecom dependence US×Employment law	-0.63*	0.94*
Telecom dependence US×Property rights	-0.60*	0.99*
Telecom dependence US×Human capital	-0.71*	0.98*
Growth potential US×Telecom subscribers	0.55*	-0.37*
Growth potential EU×Telecom subscribers	0.38*	-0.14*
Telecom dependence US×Shadow economy	-0.76*	0.90*
Telecom dependence US×GDPC	-0.64*	0.99*
Telecom dependence US×CPI	-0.47*	0.97*

Note: This table offers the pairwise correlations between our main interaction terms and the interaction terms that we use for robustness checks. The diffusion measures are in logarithms. See Table A in Appendix D.1 for complete definitions and sources of variables. * indicates the 5% level of significance.

Appendix E: Further results

Table E: Additional interaction terms: Other entry costs and dependence measures

	(I) B.Entry cost	(II) Market regulation	(III) Market capi- talization	(IV) Employ- ment law	(V) Property rights	(VI) Human capital
Entry US × B.Entry cost	0.004*** (0.002)					
Entry US × Market regulation		0.01*** (0.00)				
Ext. fin. dependence US × Market capitalization			0.01 (0.02)			
Employment intensity US × Employment law				-0.30 (5.64)		
R&D intensity US × Property rights					-0.000 (0.000)	
R&D intensity US × Human capital						-0.02 (0.02)
Industry share	0.68** (0.27)	0.79*** (0.28)	0.62** (0.28)	0.45* (0.24)	0.63** (0.28)	0.65** (0.28)
Observations	803	721	882	616	882	882
R2	0.714	0.700	0.712	0.791	0.712	0.712

Note: This table reports the results for additional interaction terms. The dependent variable is the competition measure PCM averaged over 1997–2006. See Table A in Appendix D.1 for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table F: Additional interaction terms: Other entry costs and telecom dependence measure

	(I) B.Entry cost	(II) Market regulation	(III) Market capitalization	(IV) Employment law	(V) Property rights	(VI) Human capital
Telecom dependence US × B.Entry cost	3.08*** (1.04)					
Telecom dependence US × Market regulation		1.70*** (0.30)				
Telecom dependence US × Market capitalization			-2.45*** (0.77)			
Telecom dependence US × Employment law				-1.42 (1.43)		
Telecom dependence US × Property rights					-2.81** (1.18)	
Telecom dependence US × Human capital						-1.94 (1.32)
Industry share	0.66** (0.27)	0.79*** (0.28)	0.64** (0.27)	0.64** (0.27)	0.64** (0.27)	0.61** (0.27)
Observations	857	769	902	857	902	902
R2	0.703	0.697	0.705	0.698	0.703	0.702

Note: This table reports the results for additional interaction terms. The dependent variable is the competition measure PCM averaged over 1997–2006. See Table A in Appendix D.1 for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table G: Additional interaction terms: Growth potential, shadow economy, development and corruption levels and telecom dependence measure

	(I) Growth potential US	(II) Growth potential EU	(III) Shadow economy	(IV) GDPC	(V) CPI
Growth potential US × Telecom subscribers	-0.90*** (0.17)				
Growth potential EU × Telecom subscribers		-0.48** (0.19)			
Telecom dependence US × Shadow economy			10.37*** (3.53)		
Telecom dependence US × GDPC				-1.40*** (0.22)	
Telecom dependence US × CPI					-0.55*** (0.10)
Industry share	0.63** (0.27)	0.62** (0.28)	0.67** (0.27)	0.71*** (0.27)	0.76*** (0.28)
Observations	902	902	857	902	769
R2	0.710	0.704	0.702	0.714	0.695

Note: This table reports the results for additional interaction terms. The dependent variable is the competition measure PCM averaged over 1997–2006. See Table A in Appendix D.1 for complete definitions and sources of variables. All regressions include industry and country dummies, which are not reported. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Chapter 3

Country Stress Events: Does Governance Matter?

(with Carlos Caceres)

Abstract

This paper analyzes the linkages between governance quality and country stress events. It focuses on two types of events: fiscal and political stress events, for which two innovative stress indicators are introduced. The results suggest that weaker governance quality is associated with a higher incidence of both fiscal and political stress events. In particular, *internal* accountability, which measures the responsiveness of governments to improving the quality of the bureaucracy, public service provision, and respect for the institutional frameworks in place, is positively associated with fiscal stress events. However, *external* accountability, which captures government accountability before the public in general, through elections and the democratic process, seems to be more important for political stress events. These results hold when using balanced country samples where region, oil-exporter status, income level, and time are taken into account.

JEL Codes: A12, E02, E62, G38, K00.
Keywords: Governance; Business environment; Fiscal crises; Political crises.

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3.1 Introduction

Good governance plays an important role in implementing successful economic policies and sustaining inclusive growth. It provides transparency and predictability in policy-making, efficiency and equity in access to government services and resources, as well as equity in civil and political rights. Governance weaknesses, in turn, can involve onerous, ineffective and predatory regulatory procedures, and corruption that discourages entrepreneurial talent and undermines economic performance. They can also be reflected in poor public financial management, and, in the extreme, macroeconomic instability. Other associated concerns are weak tax policy or tax and custom administration, and excessive, wasteful, or poorly targeted public spending. Along with its inefficient policies and regulations, bad governance tends to restrict civil rights and freedoms, which may lead eventually to political instability and crises.

Recent events in different parts of the world provide examples of possible interrelations between governance quality and instability. The sovereign debt crisis in Greece in 2010-2011 has dramatically destabilized the European Union and affected many other countries. The government of Greece misreported its economic statistics entering the eurozone in 2000, then it run unprecedentedly large public spending and hid its actual level of borrowings. Inefficient pubic policies, non-transparency and corruption in Greece can be fairly associated with this event. The Arab Spring events of 2011 also occurred in a region characterized by relatively weak governance and unequal access to the benefits from economic growth recorded in those countries.

Country level stress events – fiscal, financial, balance of payments or even those that are political in nature – can develop into full-blown crises, with important adverse consequences for macroeconomic stability, such as a severe and permanent loss of output. There is a vast literature that analyzes the negative impact of such crises on the economy. For instance, Reinhart and Rogoff (2010), Kumar and Woo (2010) study the relationship between public debt and economic growth. Alesina et al. (1996) find that during periods of political instability, economic growth is significantly lower than at other times.[2]

This paper shows that the quality of governance matters for the incidence of fiscal and political stress events. We focus on these two types of stress events because they may be seen as occurring in areas generally under the control of the public sector or directly related to actions taken by policymakers. In this way, fiscal and political stress events differ from, for instance, financial crises, which tend to have their origins in actions and decisions made by private-sector agents. We expect that countries with weaker governance are more likely to be subject to fiscal and political stress events. Another important

[2]See also Arellano (2008), Kaminsky and Reinhart (1996), Kaminsky, Lizondo, and Reinhart (1998) amongst others.

contribution of this study is the identification of these stress events. We suggest a new methodology that helps to endogenously determine stress events; the events so determined seem to be less restrictive (or less arbitrary) than those usually used in the literature.

There are studies that consider a “fiscal stress event” to be characterized by instances of outright default or debt restructuring. For instance, Detragiache and Spilimbergo (2001) define public debt crises as events of outright default or rescheduling, while Manasse et al. (2003) add the provision of a large-scale official financing support to the definition of a fiscal crisis. Yet a country might experience severe fiscal stress, which could be reflected in significant constraints in their market access and increases in the cost of funding, long before default or restructuring occurs. Even if such stress does not ultimately result in debt default or restructuring, it may still have significant macroeconomic consequences. For example, a sharp increase in sovereign yields can significantly raise funding costs, debt-servicing costs, and roll-over risk, but may also lead to a widespread increase in long-term interest rates in the rest of the economy, affecting both investment and consumption decisions.[3] A more realistic measure of fiscal stress does not necessarily need to be characterized by outright public debt default and restructuring, but should include near-default events as well.

Similarly, other studies confine the definition of “political stress events” to cases of government collapse or regime change (say, from dictatorship to democracy). For example, Alesina et al. (1996) define “political instability” as the propensity of a government to collapse. Dutt and Mitra (2008) define such events using movements between democratic and dictatorial regimes. A country, however, may experience instances of increased “political stress,” which can be characterized, for example, by an increase in the number of protests, anti-government demonstrations, riots, or street violence that could destabilize the effectiveness of the government and even the overall macroeconomic ambit, without necessarily leading to collapse of the government or a change of regime. These distinctions are captured in the stress measures that we develop.

Empirical research typically uses a “signaling” approach to attempt to identify the main variables that help to predict stress events. The seminal papers by Kaminsky and Reinhart (1996) and Kaminsky et al. (1998) use the “noise-to-signal” ratio to determine the variables tend to predict currency and banking crises.[4] Although this method is transparent and easy to implement, it also seems to have important drawbacks. In particular, it does not allow standard inference and testing to assess the statistical validity

[3] This can be illustrated by the current situation in the euro area. Indeed, several countries in the euro area periphery have been experiencing significant impairments to their access to funding during the past few years - with potential consequences for their macroeconomic stability. Yet, none of these countries have defaulted or restructured their debt during this period.

[4] Baldacci, Petrova, Belhocine, Dobrescu, and Mazraani (2011) use the same approach to assess the determinant of episodes of fiscal stress.

of inclusion of variables in the model. The other studies use limited dependent variable estimation techniques to quantify the link between a stress indicator and its determinants. Manasse et al. (2003), for example, use logit and binary recursive tree analysis to identify macroeconomic variables that help to predict a debt-crisis episode one year in advance.

In this study, we start with a simple comparison of average governance measures (and other relevant variables) between countries that undergo a stress event and those that do not, and test their statistical difference. Then we proceed with the same comparison but on balanced samples, meaning that countries are combined into groups that share similar observed characteristics such as geographical region, income level, or oil exporter status. We repeat this last step also grouping the data by years. After a comparison of averages, we estimate parsimonious conditional logistic regressions on the balanced samples to see whether governance measures have any predictive power, while controlling for other macroeconomic variables.[5]

The results of the analysis suggest that countries with weaker governance tend to be more prone to political stress events. It is notable that statistically, the averages of all governance measures are different for the two groups of countries on a balanced sample (when region, oil resources, income level, and year are taken into account), while the averages of most of the other socioeconomic variables are not significantly different, except for real GDP growth, inflation, and trade openness. All governance measures remain significant in conditional logistic models when our political stress indicator is the dependent variable. In the case of fiscal stress events, however, only governance effectiveness and control of corruption seem to be associated with the incidence of such events.

Overall, this study confirms the importance of governance quality for the incidence of both political and fiscal stress events, although we do not infer a causal relationship between them. Policymakers, thus, should pay greater attention to improving governance in order to minimize the probability of stress events that can have severe consequences, damaging economic welfare and society as a whole.

This paper is organized as follows. Section 2 introduces the data and focuses on the construction of the governance, business environment, fiscal stress, and political stress measures. Section 3 presents the estimation methodology and empirical results, while Section 4 assesses the main findings. Section 5 concludes the paper.

[5]Our logistic models, however, should not be perceived as Early Warning Systems (due to their high persistence, governance measures embed relatively little information regarding the precise timing of a potential stress event taking place), but they are, rather, used as robustness checks vis-à-vis the comparison of the means on the balanced sample mentioned above.

3.2 Data and contraction of the main variables

Governance measures

To analyze the relationship between governance quality and stress events, and to determine which aspects of governance are more important, we use governance measures obtained from the Worldwide Governance Indicators (WGI).[6] The WGI database includes six broad measures of governance and the business environment: Voice & Accountability, Political Stability (and Absence of Violence), Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. Using a model of unobserved components, these indicators are constructed from perception-based cross-country surveys and expert opinions that come from more than 30 data sources. The indicators cover the period from 1996 to 2009, for about 200 countries.

The indicator for Voice & Accountability measures the degree to which citizens can participate in the selection of the government and hold it accountable through various aspects of political processes, civil liberties, and political rights. The Political Stability indicator relates to the probability of disposing of or destabilizing the government in a lawless or violent way, such that citizens are not able to select or remove a government peacefully. These two indicators, in effect, describe the public's ability to hold the government accountable through elections and voting processes, and may broadly be considered as a measure of *External Accountability*.

The Government Effectiveness indicator captures the quality and credibility of the bureaucracy and the provision of public services, and the competence of public officials to implement good policies and to deliver public goods. The indicator for Regulatory Quality relates directly to the quality of public policies such as tendency to control prices, bank and business supervision, and other regulations. Government effectiveness and regulatory quality, therefore, are linked to the government's ability to create and implement good and fair policies.

The last two indicators measure the respect of both the public and the government for institutions that control interactions between them. Rule of Law captures the incidence of crime, effectiveness of the judiciary, and enforcement of contracts. Finally, Control of Corruption measures perceptions of various aspects of corruption, from petty to grand corruption. These four indicators may be regarded as a measure of *Internal Accountability*, in the sense that the government establishes various institutions and incentives to govern the behavior of agencies and agents within the state.[7]

[6] These indicators are produced by the World Bank Institute, and were initiated by Kaufmann, Kraay, and Zoido-Lobaton (1999). See, for example, Kaufmann, Kraay, and Mastruzzi (2010) for description of the data sources and the methodology of the construction of the indices.

[7] See also Bank (2003) for a discussion of external versus internal accountability.

All six governance indicators are highly correlated with each other as well as with income levels, measured by GDP per capita in PPP terms (see Table 3.1). The high correlation is not surprising, since governance aspects tend to be interrelated. For example, poor government efficiency and burdensome regulations may induce higher corruption. Richer and more developed countries historically tend to have better institutions (Acemoglu, Johnson, and Robinson, 2001). Further, by construction some indicators share common data sources but with different weights, which naturally leads to higher correlation among indicators. To account for these features and to assess the broader aspects of governance quality, we also consider two aggregate indicators, reflecting external accountability and internal accountability (we refer them to External Accountability (WGI) and Internal accountability (WGI), respectively) as described above. These two indicators we construct using principal component analysis (PCA).

The PCA procedure consists of searching for orthogonal linear combinations (principal components) of potentially correlated variables. The combination that produces the highest variation in the available data is called the first principal component. The principal component is extracted as the eigenvector associated with the largest eigenvalue of the correlation matrix of the underlying variables. Effectively, there can be as many principal components as the total number of variables. The practical idea behind PCA, however, is to have one or a few components explain a large portion of the total variance in the data. This renders the interpretation of the results relatively easy in any practical application.[8] Since governance measures that constitute external and internal accountability share similar characteristics, construction of the first principal component is the best way to preserve the highest variation in the data, which is essential for estimation purposes.

As a robustness check, we also employ several governance measures from the International Country Risk Guide (ICRG) rating agency.[9] These measures are constructed using opinions of experts only. The data cover a longer time period, from 1985 to 2011, but include a smaller number of countries. In our sample, ICRG indices cover about 30 fewer countries than WGI. We choose seven components out of twelve that comprise the ICRG political risk rating, group them into external and internal accountability as we have done for the WGI indicators, and constrict them using PCA. Governance quality related to External Accountability (ICRG) includes Democratic Accountability, Internal Conflict, and Military in Politics; and governance quality related to Internal Accountability (ICRG) involves Bureaucracy Quality, Investment Profile, Law & Order, and Corruption.

[8] See Jolliffee (2002) for a detailed discussion on the PCA methodology, and Behar (2009) and Caceres and Beer (2008) for practical applications of this methodology.

[9] A description of the data can be found at `http://www.prsgroup.com/ICRG_Methodology.aspx#PolRiskRating`.

These indices are similar to the WGI indicators, and are briefly described in Appendix A: Definitions of variables. Table 3.1 presents correlations between External Accountability (ICRG), Internal Accountability (ICRG), WGI indicators and levels of income.

Finally, and again for robustness check, we use the Cross-National Time Series (CNTS) data archives[10] to construct a measure that relates to external accountability. In our sample the data range from 1970 to 2006 and cover only eight countries fewer than the WGI data. From CNTS we use five measures:[11] Type of Regime, Effective Executive (type), Effective Executive (selection), Legislative Effectiveness, and Legislative Selection (see Appendix A: Definitions of variables for details), and combine them into a single indicator, External Accountability (CNTS), using PCA. In comparison with WGI and ICRG indicators, this measure is objective.

To make our governance measures more comparable with each other, we standardize them to z-score, that is, we transform them into variables with zero mean and unit standard deviation. Higher values indicate better governance quality. The descriptive statistics of all governance measures are presented in Table 3.2. The largest part of the variation in these measures is explained by cross-country (between standard deviation) variation. Figure 3.1 shows the average values of the external and internal accountability indicators grouped by regions, income level, and oil-exporting status. Oil-exporting countries tend to have lower governance quality. Similarly, poorer countries have worse governance. The Middle East and North Africa and Sub-Saharan African regions also tend to have weaker governance quality than other regions; advanced countries significantly outperform all other regions (Appendix B: Grouping of countries describes the division of countries by region and oil-exporting status).[12]

Fiscal stress indicator (FSI)

To identify episodes of "fiscal stress," we construct a Fiscal Stress Indicator (FSI), which is equal to 1 when a country is under stress in a given year and 0 otherwise.

The literature usually defines a fiscal stress event as an episode in which the sovereign defaults on its debt obligations – that is, default or restructuring of the debt. This definition seems to be restrictive because there are several instances in which countries experience stress for a prolonged period of time (i.e., years) before default occurs, or, in

[10] Banks (2010) describes the CNTS data in detail.

[11] Original values of these measures have been slightly modified to satisfy the purposes of the paper. For example, all values have been rearranged so that higher value indicates better external accountability; President and Premier are combined together in Effective Executive (type); Direct and Indirect elections are also combined in Effective Executive (selection).

[12] As an exception, and given their relatively low number, we consider all the advanced countries in our sample as belonging to the same "region".

some cases, without ever defaulting on its debt obligations. Fiscal stress can be visible when a country encounters difficulty in gaining normal access to funding. To broaden this definition, Manasse et al. (2003) add the provision of large-scale official financing support, measured as access to non-concessional IMF financing exceeding 100 percent of quota. Baldacci et al. (2011) further develop the definition of fiscal stress by including the concept of severe market-based financing constraint, or sovereign yield pressure, as indicated when sovereign spreads exceed 1000 basis points or two standard deviations from the country average. Although the inclusion of these innovations into the definition of stress events is welcome, the thresholds used in those studies may be seen as arbitrary, and are exogenous to the underlying characteristics of the data. In order to overcome this shortcoming, we present a methodology in which the thresholds for the IMF financing and sovereign spreads are determined endogenously. Our measure of fiscal stress is constructed in the three following steps:

(i) We take non-concessional IMF financing being accessed as a share of countries' quotas (refer to "IMF-financing") and sovereign spreads. Due to the lack of available consistent data for all countries, we employ three types of sovereign spreads. First, we use five-year sovereign swap-spreads, which are available mainly for advanced countries and cover a maximum of 25 years. Second, we use EMBI blended spreads, which exist for about 30 emerging markets and cover a maximum of 18 years. Third, for other developing and low-income countries (around 15 countries in our sample) we use the spread of a country's 10-year sovereign bond yield relative to the 10-year US Treasury bond. For the remaining countries (mostly low-income), there are no spreads available or liquid enough to be used. As a result, we have four sets of countries that do not overlap each other according to availability of sovereign spread data.

(ii) For the three sets of countries with available sovereign spreads, we extract the first principal component from the IMF-financing and sovereign spreads using PCA. For those countries that do not have sovereign spreads, we use only IMF-financing, and transform them into a zero mean and unit standard deviation variable. This step results in four continuous variables, labeled PCF_i, for the four country groups i = 1, 2, 3, 4.

(iii) We use PCF_i to compute a dichotomous Fiscal Stress Indicator. For this purpose we define thresholds τ_i such that when PCF_i exceeds it ($\mathrm{PCF}_i \geq \tau_i$) we treat this situation as a fiscal stress event. Using each of the four PCF_i separately, we try to predict the actual episodes of debt default or restructuring (based on the S&P definition).[13] The

[13] There is one caveat concerning defining the threshold for PCF in the case of advanced countries. Advanced countries have never defaulted (according to S&P definition) within our sample period, in spite of some of them having had significant problems with sovereign debt. Therefore, we posited that Iceland experienced a "default" in 2008 and 2009 and Ireland, Portugal, and Greece in 2010 and 2011. Note, however, that the exclusion of these countries from the sample virtually does not change the results of the whole analysis. (These results are available from the authors upon request).

thresholds τ_i are defined as the level of PCF_i at which the number of type I and type II errors of the prediction are equalized. A type I error (false positive) occurs when a statistical test rejects a true null hypothesis (an actual stress event occurring); while a type II error (false negative) occurs when the test fails to reject a false null hypothesis (an actual stress event is not occurring).

This procedure yields an FSI that is endogenously determined and based on sovereign spreads and IMF-financing data. While constructing the threshold, we use actual default and restructuring episodes, since market interest rates tend to increase sharply before these events. Using the information on IMF-financing and/or spreads increase, we estimate the stress threshold, which is afterwards applied to country-year not in default. The FSI, therefore, does not necessarily coincide perfectly with actual instances of default; rather, it captures stress reflected in the increase in IMF-financing and/or spread variables.

FSI has captured a total number of 583 fiscal stress events (16% of the sample), 10 of which took place in advanced countries and 573 in developing countries over the period 1970-2011. The results can be compared, for example, with 41 and 135 fiscal stress events found in Baldacci et al. (2011) for advanced and emerging economies, respectively, over the period 1970-2010, and with 54 instances found in Manasse et al. (2003) over the period 1970-2002.[14]

Figure 3.2 shows the distribution of FSI by oil-exporting status, income quartiles, and region for two time periods, 1985-2011 and 1996-2011, since our governance measures from ICRG and WGI start from 1985 and 1996 respectively. Countries that are not oil exporters, and/or with lower income levels, tend to experience fiscal stress events more frequently. Countries from Sub-Saharan Africa are more often under fiscal stress than other regions.

Political stress indicator (FSI)

To characterize "political stress" events, the literature generally uses episodes of government collapse or transitions between nondemocratic and democratic regimes. However, a country might also experience significant political stress marked, for example, by anti-government demonstrations, violence, riots, etc. – without necessarily implying an outright collapse of the government or a change in regime. This political stress, meanwhile, may reflect a general dissatisfaction of the public with, for example, inadequate gover-

[14] Under the S&P definition a country can be in "default" for several consecutive years until the country repays or reaches a settlement on its debt obligations, even if the country is no longer experiencing fiscal stress. In fact, this is one of the reasons why the FSI does not coincide with actual episodes of default or debt restructuring (as per the S&P definition) for 65 percent of cases.

nance, and may lead to socioeconomic dislocations, hindering macroeconomic stability and growth. In order to capture these notions of political stress, we construct an endogenous dichotomous measure, a Political Stress Indicator (PSI), which is equal to 1 when a country is in a situation of "political stress" in a given year, and 0 otherwise. Using a similar methodology to that employed for the computation of the FSI, we construct the PSI in the three following steps:

(i) From the CNTS database we take four variables: Major Government Crises, Purges, Revolutions, and Anti-government Demonstrations. These variables include the number of named events actually taking place (see Appendix A: Definitions of variables for the details) and can potentially describe periods of political instability. The data cover about 175 countries over a century until 2008.

(ii) We extract the first principal component from these four variables using PCA, and refer it to PCP.

(iii) We use PCP to compute a dichotomous Political Stress Indicator. For this purpose we define a threshold τ such that when PCP exceeds it (PCP $\geq \tau$) we treat this situation as a political stress event. Using PCP we try to predict actual episodes of regime change – transition from autocracy to democracy. These actual events come from the "Democracy Dictatorship" database developed by Cheibub and Vreeland (2009). The threshold τ is estimated as the level of PCP which equalizes the number of type I and type II prediction errors.

By analogy with the case of fiscal stress events, we expect that the incidence of government crises, purges, revolutions, and anti-government demonstrations increases significantly around periods of actual regime change. Episodes of political stress captured by the PSI and actual regime changes constitute only 2% of the whole sample as rare events. Figure 3.3 shows the distribution of the PSI by oil-exporting status, income quartiles, and region for the periods 1985-2008 and 1996-2008, as our governance measures from ICRG and WGI are defined over these two periods. Countries that are not oil exporters, and/or with income levels from the second and third quartiles (this suggests a nonlinearity with respect to development level), tend to experience political stress events more frequently. The same is true for countries from Latin America and, to a lesser extent, the Asia-Pacific region. During 1985-2008 Central and Eastern European countries experienced a relatively high number of political stress events, connected with the collapse of the Soviet Union and the socialist bloc.

Other variables

In addition to the various governance indicators, we employ other socioeconomic and demographic measures that can potentially be related to fiscal and political stress events.

Nonetheless, it is important to emphasize that we are not trying to identify all possible relevant variables that can be associated with these events, but rather we use them to observe whether they are as important as the governance indicators in relation to stress events. We also use some of these other variables as controls when estimating logistic models with the stress event indicators as dependent variable.

The first set of variables is related to fiscal stress events and includes standard budgetary aggregates, such as the overall fiscal balance, the public debt-to-GDP ratio, and the share of total gross debt denominated in foreign currency. These variables are directly related to countries' fiscal pressure, and are commonly used in the literature on fiscal stress events (Baldacci et al., 2011; Manasse et al., 2003). We also include demographic variables such as the old-age dependency ratio and the fertility rate, which can be associated with long-term fiscal pressures.

The second set of variables that can be related to political stress events includes the following: unemployment rate and youth unemployment rate, education level, infant mortality rate,[15] the poverty rate, the young-age dependency ratio, and inequality measures. These variables describe country demographic structure, poverty, and economic environments that seem to be important for life satisfaction and welfare. For example, high youth unemployment, inequality, and poverty together with a high share of youth in the population, may lead to higher levels of dissatisfaction among the general public and increase the possibility of political stress or instability. For some of these variables data are available only for certain non-consecutive years. In those cases we interpolate the data to fill missing yearly observations.

Finally, consumer price inflation, real GDP growth, and GDP per capita in PPP terms are included in both sets of variables to capture general macroeconomic conditions, as well as the level of economic development. All the variables employed, together with the governance measures, are considered at time (t - 1), while the stress (fiscal or political) variables are considered at time t, since we expect that the former should signal the incidence of a stress event before the event takes place. The definitions and data sources for these variables are presented in Appendix A: Definitions of variables. Descriptive statistics and correlations among variables are included in Tables 3.3-3.5.

[15] Using a case-control methodology, Goldstone, Bates, Epstein, T. Gurr, Marshall, Ulfelder, and Woodward (2010) find that infant mortality has a statistically significant effect on the incidence of episodes of adverse regime change and civil war.

3.3 Empirical methodology

To study the relationship between governance and stress events we proceed in two steps. First, we combine all countries into groups that share similar important characteristics.[16] Within each group there are countries that are under "stress" and countries that are "stable" (i.e. not under stress). If a country that is under stress does not have a stable pair(s), it virtually drops out of the sample (in other words, it has zero weight in the analysis). Each country under stress receives a unit weight, and its stable matches receive weights uniformly distributed within a group. This procedure results in a balanced sample (countries are grouped in strata, and each observation has a proper weight). Then we test on the balanced sample whether the average values of our governance indicators and other relevant variables significantly different for countries that have experienced a stress event and those that have not.

Second, for completeness we extend analysis by estimating logistic regressions on the balanced samples to assess whether governance indicators have any predictive power for political and fiscal stress events conditional on other variables. These models should not be seen as an Early Warning System (EWS), because governance indicators – our main variables of interest – exhibit a high degree of persistence and explain mainly cross-country variation rather than variation over time.

The comparison of the means of variables for the stressed and stable countries on a balanced sample can be contrasted to a standard fixed-effect regression analysis with a number of fixed effects (region, income, oil, and year). Our approach has several advantages. First, fixed effect regressions require the inclusion of dummy variables and, more importantly, interactions among them to control for all fixed effects.[17] These dummies consume many degrees of freedom, which can lead to inefficient standard errors, and thus need to be adjusted. Second, in a balanced sample, more weight is assigned to groups with higher probability of experiencing stress (higher share of "stressed" countries) and zero weight if such probability is zero, while linear regression gives more weight to cells where portions of "stressed" and "stable" countries are the same, which can create a bias (see, e.g. J.D., 1998). Therefore, although the results from comparing the means on a balanced sample and using fixed-effect regression can be, in certain cases, relatively similar, our approach is more robust. Finally, estimation of regressions with country fixed effects

[16] For this purpose we use the STATA command "cem," developed for the Coarsened Exact Matching (CEM) technique; see Iacus, King, and Porro (2009) and Iacus, King, and Porro (2011) for details. Although CEM and other matching techniques are usually used for policy evaluation analysis, we use it only for combining countries into groups and obtaining particular weights for observations to form balanced samples. In general, classic matching techniques are somewhat limited for macroeconomic analysis because of the relatively small number of available country-year observations.

[17] Simple fixed effects without interaction terms remove only average values that are associated with, for example, region and income level, but not those that are associated with region-income groups.

may be inappropriate for governance measures, because the variation of these variables is explained mostly by cross-country differences. Fixed effects, thus, may account for all available variation, leaving no room for significance of the differences in the average levels of the governance variables between stressed and stable countries.

We start with a simple comparison of the means of the variables of interest for the two groups of countries: the countries that have experienced a stress event and those that have not. Then, we sequentially combine countries in groups that share such characteristics as region, oil exporter status, income level, and year, and compare the means of the variables for the two groups of countries on the balanced samples. Appendix B: Grouping of countries shows the division of all countries by region and oil-exporting status. To divide countries by their income level, we create four categorical variables, each of which contains 25 percent of the observations sorted by GDP per capita in PPP terms (four quartiles). These categories can move for a country over time. As an example, if we consider grouping by region, oil-exporting status and income, then we may have a maximum of 48 (6 x 2 x 4) strata. The number of strata reduces if some of them do not contain countries that are under stress. In one of these strata, we compare, for example, stress years in Djibouti, Jordan, Pakistan, and Mauritania with stable years in other countries from the MENAP region, which are non-oil exporters, and with an income from the second quartile. If we add the year dimension into the grouping, then we can only compare observations belonging to the same year.

Grouping by region allows us to control for regional characteristics, and implicitly, at least partially, for important idiosyncratic characteristics (e.g., shared culture, common colonial history, similar population traits, or geographic dynamics) that tend to be persistent and generally associated with a given region. Similarly, we might expect that resource-rich countries within a given region would differ significantly from their non-oil-exporting neighbors located in the same region. Resource-rich countries might be better able to finance government expenditures that reduce the probability of fiscal or political stress, in spite of relatively weak governance (see Figures 3.1-3.3). Income level, measured by GDP per capita in PPP terms, is highly correlated with governance quality; richer countries tend to have better governance and business environments. The grouping of the countries along these factors strips out the effect of important characteristics that could otherwise bias the results. Therefore, we expect that this selection of characteristics is able to capture the major macroeconomic differences between groups of countries, while maintaining a sufficient number of observations for the analysis.

After comparing the means of the governance indicators and other variables, we estimate the following logistic model on the balanced data, separately for the two types of stress events:

$$P(stress_{it} = 1) = \Lambda(\beta' X_{it}) = \frac{e^{\beta' X_{it}}}{1 + e^{\beta' X_{it}}} \quad (3.1)$$

where $stress_{it}$ is either fiscal or political stress event in a country i and year t, $\Lambda(\cdot)$ denotes the logistic distribution function, X is a vector containing the variables of interest and controls, and β is a vector of parameters to be estimated. We use a logistic regression because it usually performs better if the limited dependent variable is not equally distributed, that is, if the number of "zeros" differs greatly from (and far exceeds) the number of "ones". In the case of political stress events, for example, the number of "ones" only represents 10 percent of all observations-even on the balanced samples. The maximum likelihood estimation is sensitive to the presence of heteroskedasticity. Therefore, in spite of the fact that our data are relatively homogeneous in the balanced samples, we estimate the logistic regression with robust standard errors clustered at the level by which we group countries.

3.4 Results and discussion

Tables 3.6 and 3.7 offer the results of the comparison of the means of the variables for the countries that have experienced a stress event and those that have not for the case of fiscal stress events and political stress events, respectively. This comparison is repeated for the different groupings of countries; these are based on income, region, oil-exporter status, and year (each column in the tables represents a particular type of grouping). Hence, we can observe how each type of grouping affects the statistical significance of differences in the means.

Tables 3.8 and 3.9 present the results of the conditional logistic regression estimations (on the balanced sample), using the fiscal and political stress event indicators as dependent variables. These regressions include only those variables that, statistically, appear to be significantly different for countries that undergo a stress event and those that do not. We expect that only these variables could stay significant in these regressions (once several variables are simultaneously included); moreover, such parsimonious models allow us to preserve as many observations as possible.[18]

Fiscal stress

The simple comparison of the means (before grouping of countries) of the different governance measures shows that, on average, countries that have experienced a fiscal stress

[18] The full set of regressions on different balanced samples, with all set of governance measures among controls, are available from the authors upon request.

event tend to have worse governance than countries which have not experienced such an event (Table 3.6). These results are statistically significant at the 1 percent level, and are relevant for all governance measures, except for External Accountability constructed using the CNTS database. The statistically significant difference in the means is also found for other variables, such as income, real output growth, inflation, trade openness, and fiscal fundamentals. Essentially, countries that have experienced a fiscal stress event tend to have lower income per capita and higher inflation, and tend to be less open. As expected, they have a larger budget deficit, a higher debt-to-GDP ratio and a higher share of debt denominated in foreign currency. The signs of the differences in the means seem to be correct according to economic rationale.

A large part of the high statistical significance of these differences, however, could be attributed to cross-country heterogeneity explained by, e.g., regional or income characteristics. For instance, richer countries, which exhibit better macroeconomic performance, tend to be less prone to stress events. Thus, comparing the average governance levels on the unbalanced sample does not allow us to determine whether the observed difference between stressed and stable countries is due to differences in governance quality or simply reflects income disparities, as both variables are highly correlated. In order to disentangle the effect of governance quality from that of income level (or that of geographical location and oil-exporting status), we repeat this analysis using the balanced samples instead.

Columns II and III in Table 3.6 shows the results of comparing the means when countries are grouped by region and oil-exporting status, and also by year. The averages of most variables are still statistically different for the two types of countries, "stressed" and "stable", but the magnitudes of the differences have become smaller. Grouping the observations in addition by years seems to be a more important factor for the macroeconomic variables than for the governance indicators, because the latter tend to be much more persistent over time.

The inclusion of income level among the grouping characteristics changes the results dramatically (Table 3.6, columns IV and V). In column V only Government Effectiveness is significantly different at the 5% significance level for "stressed" and "stable" countries.[19] When controlling for the year, the significance level in the differences of the governance measures from the ICRG database is reduced, probably because these variables cover a larger time period and present a higher variability. The differences in the means of the macroeconomic variables remain significant only for variables directly related to fiscal stance: budget balance, public debt-to-GDP ratio, and the share of debt denominated in foreign currency.

[19] Control of Corruption, Bureaucracy Quality, Investment profile and External Accountability (CNTS) are marginally significant at the 15 percent level.

These results indicate that income level (or development level), in particular, explains a large part of the differences between the countries that have experienced a fiscal stress event and those that have not. As noted, governance indicators are highly correlated with income level. Demographic indicators as well as inflation and openness can also be associated with income level. Richer countries, for example, tend to have older populations and a lower fertility rate, lower inflation rates and higher trade openness and have lower incidence to fiscal stress events. It is notable, however, that while average values of continuous GDP per capita and other socioeconomic variables become insignificantly different once we control for income level quartiles, average values of Government Effectiveness (and, marginally, Control of Corruption, Bureaucracy Quality and Investment Profile) are still statistically different for "stressed" and "stable" countries. This means that countries with weaker credibility and less efficient bureaucracy and public services provision together with higher corruption levels are more likely to experience fiscal stress events. The statistically significant difference in the means of fiscal variables for the two types of countries is not surprising, and it confirms the fact that fiscal fundamentals are indeed associated with the incidence of fiscal stress events.

The estimation of logistic regressions on the balanced sample, where countries are grouped according to their region, oil-exporting status, income level, and year, are presented in the Table 3.8. We include only Government Effectiveness and Control of Corruption, as well as external and internal accountability measures computed using the WGI, ICRG, and CNTS databases. We use the budget balance and public debt-ratio as control variables. We do not consider the share of debt denominated in foreign currency in these regressions given that is has only a small number of observations.

The results confirm that better Government Effectiveness and Control of Corruption are associated with a lower probability of experiencing a fiscal stress event. The same conclusion is relevant for the Internal Accountability (WGI) and both External and Internal accountability (ICRG) measures. As expected, variables related to fiscal stance are significant in almost all specifications. Pseudo R^2, however, are very low for all specifications and do not exceed 4%, indicating low predictive power of the models.

Political stress

In the case of political stress events, the results concerning governance measures are different from those obtained in the case of fiscal stress events. Regardless of grouping criteria for balancing the sample, average values of almost all governance indicators are significantly different in countries that have experienced a political stress event from those that have not. Countries with worse governance, hence, seem to be more prone to experience political stress events. Only the Democratic Accountability and Bureaucracy

Quality measures from the ICRG database are insignificantly different for the two types of countries. These results show that within a group sharing the same region, oil-exporting status, income quartile, and year, there is still enough variation between "stressed" and "stable" countries, which can be largely attributed to differences in governance quality among these countries (Table 3.7). It is notable that in spite of the high correlation between per capita income and governance measures, the latter still contain enough information (other than that embedded in per capita income) that can be associated with the incidence of political stress events.

Most of the socioeconomic variables potentially relevant for political instability are not significantly different for "stressed" and "stable" countries, column V in Table 3.7. Unemployment and youth unemployment as well as poverty and inequality variables seem not to be associated with political stress events at all. Correlations between level of education, infant mortality, age dependence, population growth and incidence of political instability seem to be well explained by time differences.

Macroeconomic variables such as GDP growth, inflation, and trade openness are significantly different between countries that have experienced a political stress event and those that have not. Countries with lower economic growth, higher inflation, and smaller trade openness tend to be more prone to these events. Therefore, poor macroeconomic performance and in less open economies may lead to a sharp increase in the discontent of the public, followed by unrest and, thus, a higher probability of political stress, which is consistent with findings from the previous research.[20]

Table 3.9 presents the estimation results from the logistic regressions on the balanced sample, where countries are grouped according to their region, oil-exporting status, income level, and year.[21] We include all the governance indicators from the WGI database as well as the external and internal accountability measures from the WGI, ICRG, and CNTS databases separately in the regressions. As control variables we use real GDP growth, inflation, and trade openness. The results confirm that better quality of governance is associated with a lower probability of experiencing a political stress event. Regarding the other controls, only real GDP growth and, in a few cases, inflation, are significantly associated with political stress events.

[20] For instance, Arezki and Bruckner (2011) find that, in low-income countries, increases in food prices lead to a significant deterioration of democratic institutions and a significant increase in political instability. See also Alesina et al. (1996) and Collier and A.Hoeffler (2004).

[21] In comparison with Table 3.8 we observe a large drop in number of observations used for estimations. This is due to fewer years in the sample (till 2006, while for the fiscal stress exercise we have till 2010). In addition, political stress events occur in a smaller number of countries.

3.5 Conclusion

The main objective of this study is to analyze whether governance quality can be associated with fiscal and political stress events. For this purpose, we first construct two innovative indicators of fiscal and political stress, which have a more endogenous nature than those usually used in the literature. Using our indicators to classify countries into those that have experienced a stress event and those that have not (i.e. the 'controls'), we test whether governance quality – measured by various governance indicators – in these two groups of countries is significantly different from a statistical point of view. We test these differences on the balanced samples, grouping countries by important country characteristics, such as income, geographical region, the possession of oil resources, and the year from which the observations are derived.

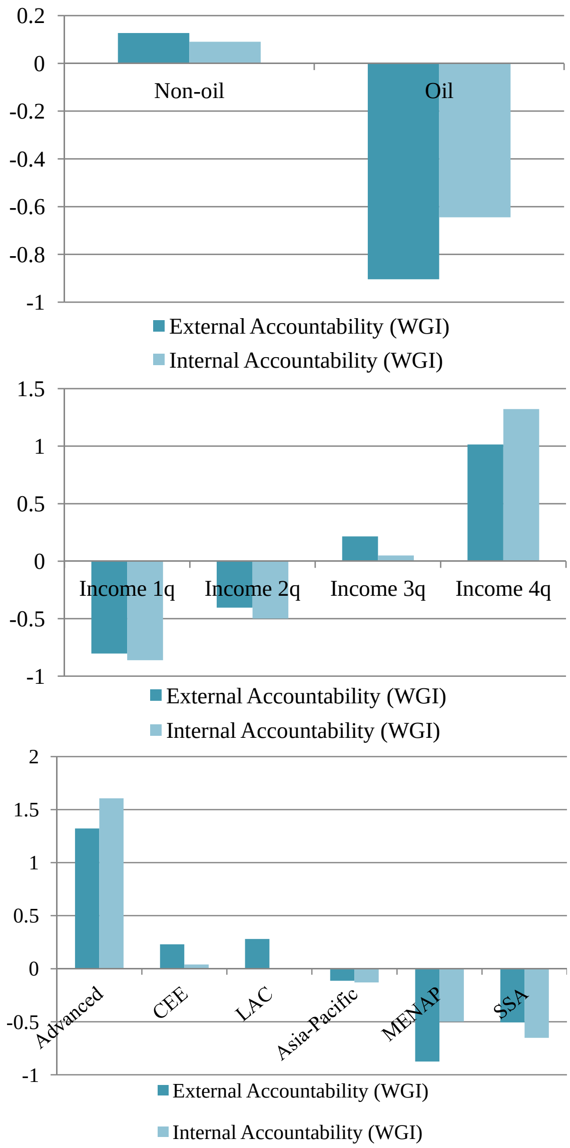
The results suggest that income levels play an important role in explaining the differences in governance quality between countries that have undergone a fiscal stress event and those that have not. Particularly, once income level is taken into account, only Governance Effectiveness and (marginally) Control of Corruption are significantly different for the two types of countries. Countries with higher corruption, inefficient bureaucracy, and burdensome public services provision, consequently, are more prone to fiscal stress events. Nevertheless, governance quality seems to be better associated with political stress than with fiscal stress events - almost all governance indicators are significantly different for two groups of countries on the balanced sample where region, oil exporting status, income and year are taken into account. In particular, External Accountability, that is the ability of the public to hold the government accountable through election and voting processes, seems to be strongly associated with the incidence of political stress events. In fact, a country with a strong macroeconomic performance (exhibiting, say, a strong and output growth and low inflation rate) is likely to be politically stable. However, if economic well-being does not benefit all segments of the population, nor addresses the general public's grievances and concerns regarding equality of opportunity or the fair application of the law (both of which can be linked to governance and political accountability), tensions may appear, and over time, lead to a political crisis.

The results from parsimonious conditional logistic regressions to assess the likelihood of a stress event taking place in a given country at every point in time for both types of stress events also confirm that weaker governance quality is associated with a higher probability of experiencing stress events.

In summary, this study underscores the importance for policymakers to strengthen the quality of governance, and to improve institutional and business environments that seem to be associated with an incidence of both political and fiscal stress events.

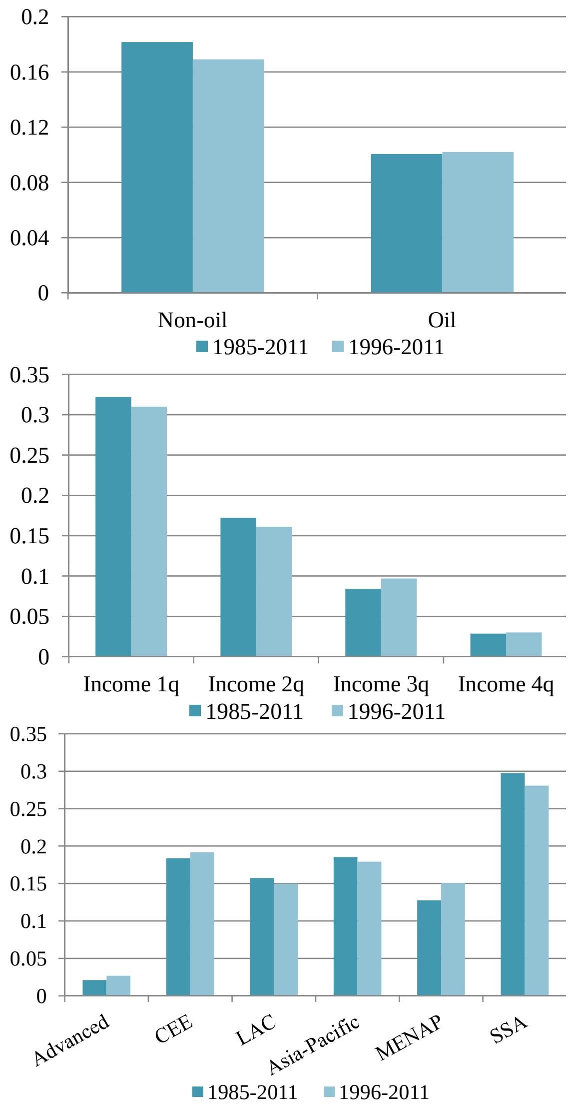
Figures and Tables

Figure 3.1: External and Internal Accountability (WGI), by categories



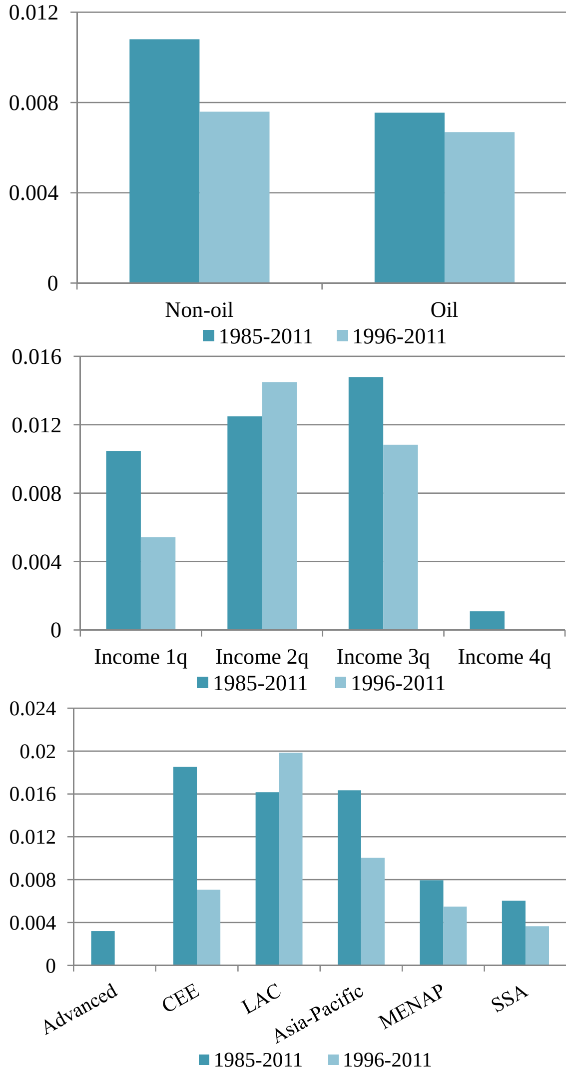
Note: Figure shows means of External and Internal Accountability (WGI) indicators by various categories. Definitions of the variables and grouping of countries by regions are in Appendix A: Definitions of variables and Appendix B: Grouping of countries correspondingly. Higher values stand for higher quality of governance indicators. For income distribution 1q is the lowest and 4q is the highest quartile.

Figure 3.2: Fiscal Stress Index, by categories



Note: Figure shows means of Fiscal Stress Index, averaged over two time periods and over various categories. Definitions of the variables and grouping of countries by regions are in Appendix A: Definitions of variables and Appendix B: Grouping of countries correspondingly. Higher values stand for higher quality of governance indicators. For income distribution 1q is the lowest and 4q is the highest quartile.

Figure 3.3: Political Stress Index, by categories



Note: Figure shows means of Political Stress Index, averaged over two time periods and over various categories. Definitions of the variables and grouping of countries by regions are in Appendix A: Definitions of variables and Appendix B: Grouping of countries correspondingly. Higher values stand for higher quality of governance indicators. For income distribution 1q is the lowest and 4q is the highest quartile.

Table 3.1: Pairwise correlations between governance indicators and income level

		1	2	3	4	5	6	7	8	9	10	11
1	Voice & Accountability											
2	Political Stability	0.71*										
3	Government Effectiveness	0.80*	0.75*									
4	Regulatory Quality	0.81*	0.70*	0.92*								
5	Rule of Law	0.81*	0.81*	0.95*	0.89*							
6	Control of Corruption	0.78*	0.76*	0.94*	0.87*	0.94*						
7	External Accountability (WGI)	0.93*	0.93*	0.84*	0.82*	0.88*	0.83*					
8	Internal Accountability (WGI)	0.83*	0.78*	0.98*	0.95*	0.98*	0.97*	0.87*				
9	External Accountability (ICRG)	0.86*	0.81*	0.78*	0.77*	0.79*	0.74*	0.90*	0.79*			
10	Internal Accountability (ICRG)	0.77*	0.77*	0.92*	0.87*	0.93*	0.92*	0.83*	0.94*	0.81*		
11	External Accountability (CNTS)	0.59*	0.34*	0.35*	0.42*	0.34*	0.31*	0.51*	0.36*	0.51*	0.36*	
12	GDP per capita	0.63*	0.65*	0.81*	0.76*	0.78*	0.76*	0.70*	0.80*	0.66*	0.74*	0.29*

Note: Table reports pairwise correlations between governance indicators and income level. Definitions of the variables are in Appendix A: Definitions of variables. * denotes the significance at the 1% level.

Table 3.2: Summary statistics of governance indicators

	Nobs	Standard Deviation		Min	Max
		Between	Within		
Voice & Accountability	2496	0.98	0.19	-2.17	1.97
Political Stability	2465	0.95	0.31	-3.07	1.73
Government Effectiveness	2426	0.98	0.2	-2.41	2.35
Regulatory Quality	2454	0.97	0.25	-2.9	3.48
Rule of Law	2467	0.98	0.2	-2.28	2.09
Control of Corruption	2429	0.97	0.22	-2.45	2.51
External Accountability (WGI)	2465	0.97	0.23	-2.66	1.94
Internal Accountability (WGI)	2424	0.98	0.17	-2.26	2.27
Democratic Accountability	3490	0.85	0.54	-2.32	1.36
Internal Conflict	3491	0.73	0.68	-3.55	1.25
Military in Politics	3492	0.89	0.44	-2.09	1.24
Bureaucracy Quality	3493	0.9	0.43	-1.85	1.58
Investment Profile	3494	0.63	0.78	-2.9	1.84
Law & Order	3495	0.85	0.52	-2.52	1.58
Corruption	3496	0.83	0.55	-2.26	2.24
External Accountability (ICRG)	3497	0.87	0.49	-3.12	1.52
Internal Accountability (ICRG)	3498	0.91	0.39	-2.73	2.22
External Accountability (CNTS)	5716	0.72	0.68	-3.43	0.77

Note: Table reports summary statistics of governance indicators. Definitions of the variables are in Appendix A: Definitions of variables.

Table 3.3: Summary statistics of socio-economic variables

	Nobs	Mean	Standard Deviation			Min	Max
			Overall	Between	Within		
GDP per capita	6368	8.45	1.28	1.23	0.32	5.46	11.82
Population	6443	15.57	1.98	1.90	0.26	10.60	21.02
GDP growth	6432	3.58	5.55	1.77	5.29	-37.51	36.80
Inflation	6271	12.86	28.97	14.69	25.96	-19.41	353.61
Openness	6062	4.20	0.70	0.59	0.36	-1.65	7.13
Budget Balance	3496	-0.02	0.07	0.04	0.06	-1.51	0.58
Debt-to-GDP	2771	0.65	0.73	0.54	0.51	0.00	13.19
Share of FCD debt	972	0.62	0.27	0.24	0.11	0.00	1.12
Age dependency (old)	6667	10.15	6.02	5.84	1.55	1.25	33.92
Fertility rate	6608	4.00	1.98	1.75	0.91	0.90	8.73
Unemployment	3218	8.60	6.38	7.80	3.03	0.00	59.50
Youth Unemployment	2038	16.60	9.61	11.14	4.43	0.70	69.22
Schooling	4729	6.95	3.02	2.85	1.19	0.12	13.27
Infant Mortality	2735	38.93	40.58	37.93	17.39	1.80	214.10
Age dependency (young)	6667	62.41	23.95	21.88	9.85	15.95	112.38
Population growth	6905	1.77	1.65	1.20	1.13	-44.41	17.74
Poverty gap	1743	9.69	12.17	12.12	3.84	0.00	63.34
High income share	1677	32.86	7.21	7.63	2.68	15.44	65.00
GINI	1677	41.77	9.55	9.73	3.21	19.40	74.33

Note: Table reports summary statistics of employed socio-economic variable. Definitions of the variables are in Appendix A: Definitions of variables. The statistics are reported for the entire available sample of country-years. Analyzing fiscal and political stress events we use two different and somewhat smaller samples, their descriptive statistics, however, are similar to the reported ones.

Table 3.4: Pairwise correlations between Fiscal Stress Indicator, governance indicators and other variables

	FSI	Default (S&P)	External Accountability (WGI)	Internal Accountability (WGI)
Default (S&P)	0.22*			
External Accountability (WGI)	-0.18*	-0.23*		
Internal Accountability (WGI)	-0.25*	-0.29*	0.87*	
External Accountability (ICRG)	-0.23*	-0.45*	0.90*	0.80*
Internal Accountability (ICRG)	-0.27*	-0.42*	0.85*	0.95*
External Accountability (CNTS)	-0.02	-0.07*	0.56*	0.45*
GDP per capita	-0.26*	-0.28*	0.75*	0.87*
Population	0.02	0.05*	-0.23*	-0.01
Real GDP growth	-0.03	-0.14*	-0.12*	-0.12*
Inflation	0.07*	0.23*	-0.31*	-0.31*
Openness	-0.10*	-0.21*	0.29*	0.26*
Budget Balance	-0.11*	-0.08*	0.12*	0.14*
Debt-to-GDP	0.17*	0.33*	-0.23*	-0.23*
Share of FCD debt	0.21*	0.32*	-0.20*	-0.37*
Age dependency (old)	-0.16*	-0.22*	0.70*	0.75*
Fertility rate	0.12*	0.23*	-0.59*	-0.66*

Note: Table reports pairwise correlations between Fiscal Stress Indicator, governance indicators and other variables. Definitions of the variables are in Appendix A: Definitions of variables. * denotes the significance at the 1% level.

Table 3.5: Pairwise correlations between Political Stress Indicator, governance indicators and other variables

	PSI	Regime change	External Accountability (WGI)	Internal Accountability (WGI)
Regime change	0.07*			
External Accountability (WGI)	-0.10*	-0.12*		
Internal Accountability (WGI)	-0.07*	-0.10*	0.87*	
External Accountability (ICRG)	-0.08*	-0.14*	0.90*	0.79*
Internal Accountability (ICRG)	-0.08*	-0.11*	0.83*	0.94*
External Accountability (CNTS)	-0.07*	-0.09*	0.51*	0.36*
GDP per capita	-0.02	-0.08*	0.70*	0.80*
Population	0.08*	0.02	-0.30*	-0.11*
Real GDP growth	-0.07*	-0.03*	-0.10*	-0.10*
Inflation	0.04*	0.02	-0.27*	-0.28*
Openness	-0.10*	-0.04*	0.26*	0.21*
Unemployment	-0.01	-0.01	-0.18*	-0.24*
Youth Unemployment	0.01	-0.01	-0.14*	-0.22*
Schooling	-0.04*	-0.06*	0.57*	0.62*
Infant Mortality	0.03	0.05*	-0.67*	-0.71*
Age dependency (yougn)	0.02	0.06*	-0.60*	-0.68*
Population growth	0.01	0.02	-0.38*	-0.31*
Poverty gap	-0.01	0.09*	-0.37*	-0.43*
High income share	0.03	-0.02	-0.11*	-0.10*
GINI	0.03	-0.02	-0.06	-0.07*

Note: Table reports pairwise correlations between Political Stress Indicator, governance indicators and other variables. Definitions of the variables are in Appendix A: Definitions of variables. * denotes the significance at the 1% level.

Table 3.6: Differences of means between countries that have fiscal stress events and those that have not

	I		II		III		IV		V	
	D	t-stat	D	t-stat	D	t-stat	D	t-stat	D	t-stat
Voice & Accountability	-0.50	-7.70***	-0.19	-3.54***	-0.17	-2.99***	-0.01	-0.19	-0.02	-0.36
Political Stability	-0.43	-6.47***	-0.19	-3.07***	-0.16	-2.48**	0.00	0.00	-0.02	-0.37
Government Effectiveness	-0.77	-11.19***	-0.31	-5.95***	-0.31	-5.78***	-0.09	-1.81*	-0.11	-2.15**
Regulatory Quality	-0.60	-9.20***	-0.22	-3.97***	-0.21	-3.70***	-0.01	-0.11	-0.03	-0.42
Rule of Law	-0.68	-10.06***	-0.26	-5.09***	-0.25	-4.72***	-0.05	-1.11	-0.07	-1.30
Control of Corruption	-0.72	-10.41***	-0.29	-5.82***	-0.27	-5.38***	-0.08	-1.84 *	-0.08	-1.57^
External Accountability (WGI)	-0.50	-7.48***	-0.20	-3.47***	-0.17	-2.82***	0.00	-0.05	-0.02	-0.37
Internal Accountability (WGI)	-0.72	-10.58***	-0.28	-5.49***	-0.27	-5.19***	-0.06	-1.27	-0.08	-1.41
Democratic Accountability	-0.58	-9.25***	-0.21	-3.77***	-0.13	-2.15**	-0.17	-3.11***	-0.07	-1.09
Internal Conflict	-0.40	-6.86***	-0.12	-2.20**	-0.06	-0.89	-0.02	-0.30	0.09	1.35
Military in Politics	-0.65	-10.49***	-0.25	-4.48***	-0.21	-3.36***	-0.15	-2.59***	-0.05	-0.79
Bureaucracy Quality	-0.85	-13.28***	-0.31	-5.87***	-0.31	-5.47***	-0.13	-2.66***	-0.09	-1.55^
Investment Profile	-0.67	-10.83***	-0.37	-6.57***	-0.26	-4.08***	-0.21	-4.00***	-0.10	-1.59^
Law & Order	-0.62	-10.04***	-0.15	-3.07***	-0.15	-2.70***	-0.07	-1.32	-0.01	-0.13
Corruption	-0.42	-6.48***	-0.01	-0.11	-0.02	-0.29	0.05	0.96	0.06	0.94
External Accountability (ICRG)	-0.65	-10.30***	-0.23	-4.17***	-0.16	-2.56**	-0.13	-2.34**	-0.01	-0.20
Internal Accountability (ICRG)	-0.80	-12.41***	-0.26	-5.23***	-0.23	-4.13***	-0.11	-2.38**	-0.04	-0.77
External Accountability (CNTS)	-0.05	-1.05	0.07	1.42	0.02	0.33	0.11	2.07**	0.10	1.61^
GDP per capita	-0.94	-15.20***	-0.32	-6.08***	-0.38	-6.85***	-0.04	-0.95	-0.05	-0.87
GDP growth	-0.39	-1.65*	-0.30	-1.20	0.11	0.41	-0.17	-0.67	-0.10	-0.32
Inflation	4.49	3.92***	3.44	3.02***	1.69	1.22	1.02	0.75	1.67	1.21
Openness	-0.19	-5.82***	-0.16	-4.85***	-0.15	-4.32***	-0.07	-2.10**	-0.01	-0.30
Budget Balance	-0.02	-4.84***	-0.01	-3.50***	-0.01	-2.43**	-0.01	-3.04***	-0.01	-2.48**
Debt-to-GDP	0.24	7.07***	0.22	6.13***	0.22	5.71***	0.18	4.68***	0.18	4.10***
Share of FCD debt	0.13	5.17***	0.15	5.42***	0.16	6.34***	0.09	3.44***	0.11	4.11***
Age dependency (old)	-2.65	-9.25***	-0.39	-1.97**	-0.52	-2.40**	-0.14	-0.69	-0.11	-0.47
Fertility rate	0.66	6.71***	-0.02	-0.27	0.15	1.65*	-0.15	-1.72*	-0.02	-0.20

Note: This table reports differences of means between countries that have fiscal stress events and those that have not. D stands for difference of means, t-stat is a t-statistic of the significance test, and stars denote the level of significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$, ^ $p<0.15$. In column I we present simple comparison of means without grouping; in column II – grouping is done by region and oil-exporting status; in column III – grouping is done by region, oil-exporting status, and year; in column IV – grouping is done by region, oil-exporting status, and income; in column V – grouping is done by region, oil-exporting status, income, and year. Definitions of the variables are in Appendix A: Definitions of variables and grouping of countries by region and oil-exporting status is in Appendix B: Grouping of countries. All variables are measured at time t-1, while fiscal stress events are at time t.

Table 3.7: Differences of means between countries that have political stress events and those that have not

	I		II		III		IV		V	
	D	t-stat	D	t-stat	D	t-stat	D	t-stat	D	t-stat
Voice & Accountability	-0.57	-2.33**	-0.70	-3.10***	-0.63	-3.03***	-0.58	-2.63***	-0.51	-2.21**
Political Stability	-1.48	-6.10***	-1.55	-7.01***	-1.52	-7.24***	-1.37	-6.24***	-1.36	-6.07***
Government Effectiveness	-0.77	-3.07***	-0.85	-3.74***	-0.66	-3.61***	-0.67	-3.28***	-0.45	-2.63***
Regulatory Quality	-0.67	-2.76***	-0.77	-3.53***	-0.63	-3.21***	-0.60	-2.83***	-0.41	-1.90*
Rule of Law	-0.95	-3.92***	-1.02	-4.60***	-0.84	-4.37***	-0.82	-4.01***	-0.61	-3.29***
Control of Corruption	-0.86	-3.43***	-0.92	-3.96***	-0.76	-3.83***	-0.74	-3.56***	-0.53	-2.80***
External Accountability (WGI)	-1.11	-4.51***	-1.21	-5.40***	-1.15	-5.67***	-1.05	-4.74***	-1.00	-4.51***
Internal Accountability (WGI)	-0.84	-3.35***	-0.92	-4.03***	-0.74	-3.88***	-0.73	-3.49***	-0.51	-2.77***
Democratic Accountability	-0.18	-1.05	-0.28	-1.79*	-0.05	-0.36	-0.20	-1.34	-0.13	-0.74
Internal Conflict	-0.94	-5.23***	-1.00	-6.00***	-0.89	-5.02***	-0.84	-4.94***	-0.80	-3.82***
Military in Politics	-0.71	-4.04***	-0.78	-4.92***	-0.69	-4.22***	-0.62	-4.02***	-0.51	-2.70***
Bureaucracy Quality	-0.38	-2.18**	-0.41	-2.60***	-0.21	-1.36	-0.30	-1.99*	-0.11	-0.65
Investment Profile	-0.75	-4.40***	-0.77	-4.80***	-0.46	-2.94***	-0.63	-4.16***	-0.42	-2.42**
Law & Order	-0.75	-4.30***	-0.78	-4.79***	-0.55	-3.38***	-0.59	-3.80***	-0.44	-2.27**
Corruption	-0.55	-3.10***	-0.57	-3.49***	-0.52	-3.23***	-0.47	-3.12***	-0.44	-2.34**
External Accountability (ICRG)	-0.73	-4.14***	-0.83	-5.08***	-0.66	-4.11***	-0.67	-4.17***	-0.58	-3.07***
Internal Accountability (ICRG)	-0.73	-4.20***	-0.77	-4.75***	-0.53	-3.52***	-0.60	-4.01***	-0.41	-2.58**
External Accountability (CNTS)	-0.53	-4.99***	-0.62	-6.51***	-0.57	-4.76***	-0.62	-6.35***	-0.63	-4.19***
GDP per capita	-0.18	-1.25	-0.34	-2.85***	-0.24	-1.75*	-0.20	-1.85*	-0.11	-0.77
Population	1.29	6.07***	1.30	6.31***	1.32	5.65***	1.15	5.52***	1.31	4.69***
Real GDP growth	-3.62	-5.32***	-3.59	-5.90***	-3.24	-4.34***	-3.80	-5.94***	-3.24	-3.19***
Inflation	10.71	2.66***	9.91	2.45**	8.14	2.04**	8.29	2.01**	10.28	2.51**
Openness	-0.59	-7.30***	-0.60	-8.00***	-0.49	-5.39***	-0.52	-6.83***	-0.49	-4.50***
Unemployment	-0.58	-0.63	-0.75	-0.83	0.69	0.74	-0.82	-0.96	-0.11	-0.09
Youth Unemployment	0.57	0.25	0.21	0.09	0.91	0.43	0.12	0.06	1.78	0.68
Schooling	-0.89	-2.43**	-1.22	-3.71***	-0.46	-1.16	-1.00	-3.20***	-0.44	-0.99
Infant Mortality	11.76	1.68*	17.70	3.01***	4.30	0.47	12.69	2.07**	6.61	0.66
Age dependency (Young)	3.46	1.40	6.99	3.10***	1.90	0.72	5.10	2.34**	0.47	0.14
Population growth	0.04	0.21	0.25	1.64^	0.09	0.39	0.33	2.38**	0.11	0.50
Poverty gap	-0.64	-0.27	2.50	1.32	1.46	0.65	2.41	1.30	0.54	0.20
High income share	1.45	1.00	1.50	1.01	0.99	0.58	0.90	0.64	0.92	0.48
GINI	1.87	0.98	1.84	0.93	1.44	0.64	0.98	0.52	1.40	0.54

Note: This table reports differences of means between countries that have political stress events and those that have not. D stands for difference of means, t-stat is a t-statistic of the significance test, and stars denote the level of significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$, ^ $p<0.15$. In column I we present simple comparison of means without grouping; in column II – grouping is done by region and oil-exporting status; in column III – grouping is done by region, oil-exporting status, and year; in column IV – grouping is done by region, oil-exporting status, and income; in column V – grouping is done by region, oil-exporting status, income, and year. Definitions of the variables are in Appendix A: Definitions of variables and grouping of countries by region and oil-exporting status is in Appendix B: Grouping of countries. All variables are measured at time t-1, while political stress events are at time t.

Table 3.8: Logit estimation, Fiscal Stress Indicator is dependent variables

	I	II	III	IV	V	VI	VII	VIII
Government Effectiveness		-0.28***						
		(0.09)						
Control of Corruption			-0.19**					
			(0.08)					
External Accountability (WGI)				-0.06				
				(0.08)				
Internal Accountability (WGI)					-0.17*			
					(0.09)			
External Accountability (ICRG)						-0.26**		
						(0.11)		
Internal Accountability (ICRG)							-0.20*	
							(0.11)	
External Accountability (CNTS)								0.10
								(0.14)
Debt-to-GDP	0.42***	0.26	0.34**	0.36**	0.32*	0.27	0.31*	0.74***
	(0.16)	(0.17)	(0.17)	(0.17)	(0.18)	(0.18)	(0.18)	(0.27)
Budget Balance	-3.70**	-3.67*	-3.66*	-3.73*	-3.52	-8.57**	-8.04**	-3.57
	(1.82)	(2.23)	(2.14)	(2.19)	(2.14)	(3.38)	(3.44)	(2.48)
Observations	842	729	729	733	729	603	603	483
Pseudo LogL	-427.74	-356.84	-358.11	-360.81	-358.30	-275.61	-277.01	-251.65
Pseudo R2	0.021	0.024	0.021	0.020	0.020	0.038	0.033	0.040

Note: This table reports the results from weighted logit regressions with Fiscal Stress Indicator as a dependent variable. Weights comprise a balanced sample, where countries are grouped according to their region, oil-exporting status, income level, and year. Definitions of the variables are in Appendix A: Definitions of variables and grouping of countries by region and oil-exporting status is in Appendix B: Grouping of countries. All variables are measured at time t-1, while political stress events are at time t. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3.9: Logit estimation, Political Stress Indicator is dependent variables

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Voice & Accountability		-0.87***										
		(0.28)										
Political Stability			-1.93***									
			(0.39)									
Government Effectiveness				-1.54***								
				(0.58)								
Regulatory Quality					-0.84*							
					(0.46)							
Rule of Law						-1.99***						
						(0.60)						
Control of Corruption							-1.42**					
							(0.67)					
External Accountability (WGI)								-1.85***				
								(0.40)				
Internal Accountability (WGI)									-1.61***			
									(0.60)			
External Accountability (ICRG)										-0.62**		
										(0.24)		
Internal Accountability (ICRG)											-0.50*	
											(0.30)	
External Accountability (CNTS)												-0.52***
												(0.16)
Population	0.56***	0.36***	0.31*	0.51***	0.44***	0.55***	0.42***	0.35**	0.51***	0.50***	0.50***	0.63***
	(0.09)	(0.11)	(0.19)	(0.17)	(0.14)	(0.19)	(0.16)	(0.15)	(0.18)	(0.13)	(0.12)	(0.10)
Real GDP growth	-0.12***	-0.18***	-0.15**	-0.15***	-0.17***	-0.18***	-0.15***	-0.17**	-0.16***	-0.13***	-0.14***	-0.12***
	(0.02)	(0.05)	(0.07)	(0.05)	(0.04)	(0.05)	(0.05)	(0.07)	(0.05)	(0.04)	(0.04)	(0.02)
Inflation	0.00**	0.00	-0.01	-0.00	-0.00	-0.01	-0.00	-0.01	-0.01	0.00	0.00*	0.01**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Openness	0.01	-0.17	-0.02	-0.13	-0.20	-0.16	-0.18	0.05	-0.06	0.50*	0.37	0.12
	(0.24)	(0.27)	(0.32)	(0.35)	(0.33)	(0.31)	(0.37)	(0.30)	(0.36)	(0.27)	(0.28)	(0.19)
Observations	631	197	193	183	191	195	183	193	183	303	303	617
Pseudo LogL	-159.71	-45.84	-35.88	-42.95	-45.96	-42.36	-43.50	-39.55	-42.64	-83.62	-85.22	-144.29
Pseudo R2	0.165	0.262	0.420	0.271	0.257	0.317	0.262	0.360	0.276	0.175	0.160	0.195

Note: This table reports the results from weighted logit regressions with Political Stress Indicator as a dependent variable. Weights comprise a balanced sample, where countries are grouped according to their region, oil-exporting status, income level, and year. Definitions of the variables are in Appendix A: Definitions of variables and grouping of countries by region and oil-exporting status is in Appendix B: Grouping of countries. All variables are measured at time t-1, while political stress events are at time t. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix

Appendix A: Definitions of variables

Variable Name	Definition and Source
GDP per capita	Log of GDP per capita in PPP terms, in constant prices 2005. Source: WEO
GDP growth	Annual growth rate of real GDP. Source: WEO
Inflation	Consumer price inflation. Source: WEO
Openness	Log of Exports plus Imports to GDP ratio. Source: WEO
Unemployment	Unemployment rate. Source: WEO
Youth unemployment	Unemployment rate for those under 25 years of age. Source: WDI
Schooling	IIASA/VID Projection: Mean years of schooling, age 25+, male. Source: WDI
Infant Mortality	Mortality rate, infant (per 1,000 live births). Source: WDI
Age dependency (young)	Age dependency ratio, young (% of working-age population). Source: WDI
Age dependency (old)	Age dependency ratio, old (% of working-age population). Source: WDI
Fertility rate	Fertility rate, total (births per woman). Source: WDI
Population growth	Population growth (annual %). Source: WDI
Poverty gap	Poverty gap at $1.25 a day (PPP) (%). Source: WDI
High income share	Income share held by highest 10% . Source: WDI
GINI	GINI coefficient. Source: WDI
Budget Balance	Overall fiscal balance (general government revenues minus general government expenditures) to GDP ratio. Source: WEO
Debt-to-GDP	General government gross debt-to-GDP ratio. Source: WEO
Share of FCD debt	Share of public debt denominated in foreign currency (in percent of total public debt). Source: WEO
Voice & Accountability	Perception of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Source: WGI
Political Stability	Perception of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including domestic violence and terrorism. Source: WGI
Government Efficiency	Perception of the quality of public and civil service, and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Source: WGI
Regulatory Quality	Perception of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Source: WGI
Rule of Law	Perception of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Source: WGI

Variable Name	Definition and Source
Control of Corruption	Perception of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Source: WGI
Internal Accountability (WGI)	First principal component of Voice & Accountability and Political Stability. Source: WGI
External Accountability (WGI)	First principal component of Government Efficiency, Regulatory Quality, Rule of Law, and Control of Corruption. Source: WGI
Democratic Accountability	A measure of how responsive government is to its people. Source: ICRG
Internal Conflict	Assessment of political violence in the country and its actual or potential impact on governance. Source: ICRG
Military in Politics	Assessment of military's involvement in politics, even at a peripheral level, treated as a diminution of democratic accountability. Source: ICRG
Bureaucracy Quality	The institutional strength and quality of the bureaucracy, expertise to govern without drastic changes in policy or interruptions in government services. Source: ICRG
Investment Profile	Assessment of factors affecting the risk to investment that are not covered by other political, economic and financial risk components. Source: ICRG
Law & Order	Assessment of the strength and impartiality of the legal system, and of popular observance of the law. Source: ICRG
Corruption	Assessment of corruption within the political system. Source: ICRG
External Accountability (ICRG)	First principal component of Democratic Accountability, Military in Politics and Internal Conflict. Source: ICRG
Internal Accountability (ICRG)	First principal component of Bureaucracy Quality, Investment Profile, Law and Order, and Corruption. Source: ICRG
Type of Regime	4-Civilian, 3-Military Civilian, 2-Military, 1-Other. Source: CNTS
Effective Executive (type)	2- President or Premier, 1-Monarch or Military. Source: CNTS
Effective Executive (selection)	2-Direct or Indirect election, 1-Nonelective. Source: CNTS
Legislative Effectiveness	3-Effective, 2-Partially Effective, 1-Ineffective, 0-none. Source: CNTS
Legislative Selection	2-Elective, 1-Nonelective, 0-none. Source: CNTS
External Accountability (CNTS)	First principal component of all components from CNTS. Source: CNTS
Swap spread	Spread between the bond yield and the interest rate on the swap of the same maturity. Source: Bloomberg
EMBI spread	Emerging Markets Bond Index spread developed by JPMorgan. Source: Bloomberg
Bond spread	Government bond spreads (relative to 10-year US Treasury bond). Source: WEO
IMF-financing	IMF program-supported non-concessional financing (in percent of quota). Source: IMF
Major Government Crises	Any rapidly developing situation that threatens to bring the downfall of the present regime - excluding situations of revolt aimed at such overthrow. Source: CNTS

Variable Name	Definition and Source
Purges	Any systematic elimination by jailing or execution of political opposition within the ranks of the regime or the opposition. Source: CNTS
Revolutions	Any illegal or forced change in the top government elite, any attempt at such a change, or any successful or unsuccessful armed rebelion whose aim is independence from the central government. Source: CNTS
Anti-government Demonstrations	Any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature. Source: CNTS

Note:WDI is the World Development Indicators database; WEO is the World Economic Outlook database; WGI is the Worldwide Governance Indicators database; CNTS is the Cross-National Time Series data archives.

Appendix B: Grouping of countries

Oil/non-oil	Asia-Pacific	CCE	LAC	MENAP	SSA	Advanced*
Not oil exporting countries	Bangladesh	Albania	Antigua	Afghanistan	Benin	Australia
	Bhutan	Armenia	Argentina	Djibouti	Botswana	Austria
	Cambodia	Belarus	Bahamas	Egypt	Burkina Faso	Belgium
	China	Bosnia-H.	Barbados	Jordan	Burundi	Canada
	Fiji	Bulgaria	Belize	Kyrgyzstan	Cape Verde	Cyprus
	Hong Kong	Croatia	Bolivia	Lebanon	C.A.R.	Denmark
	India	Czech Rep.	Brazil	Mauritania	Comoros	Finland
	Indonesia	Estonia	Chile	Morocco	Congo, D.R.	France
	Kiribati	Georgia	Colombia	Pakistan	Cote d'Ivoire	Germany
	Laos	Hungary	Costa Rica	Syria	Eritrea	Greece
	Malaysia	Kosovo	Dom. Rep.	Tajikistan	Ethiopia	Iceland
	Maldives	Latvia	Dominica	Tunisia	Gambia	Ireland
	Mongolia	Lithuania	Ecuador^	Uzbekistan	Ghana	Israel
	Myanmar	Macedonia	El Salvador		Guinea	Italy
	Nepal	Moldova	Grenada		Guinea-Bissau	Japan
	P.N.G.	Montenegro	Guatemala		Kenya	Korea, South
	Philippines	Poland	Guyana		Lesotho	Luxembourg
	Samoa	Romania	Haiti		Liberia	Malta
	Singapore	Russia^	Honduras		Madagascar	Netherlands
	Solomon Is.	Serbia	Jamaica		Malawi	New Zealand
	Sri Lanka	Slovakia	Mexico		Mali	Norway^
	Taiwan	Slovenia	Nicaragua		Mauritius	Portugal
	Thailand	Turkey	Panama		Mozambique	Spain
	Tonga	Ukraine	Paraguay		Namibia	Sweden
	Vanuatu		Peru		Niger	Switzerland
	Vietnam		St. Kitts & N.		Rwanda	UK
			St. Lucia		Sao Tome P.	USA
			St. Vincent		Senegal	
			Suriname		Seychelles	
			Uruguay		Sierra Leone	
			Venezuela^		South Africa	
					Swaziland	
					Tanzania	
					Togo	
					Uganda	
					Zambia	
					Zimbabwe	

Oil/non-oil	Asia-Pacific	CCE	LAC	MENAP	SSA	Advanced*
Oil exporting countries				Algeria	Angola	
				Azerbaijan	Cameroon	
				Bahrain	Chad	
				Iran	Congo-Braz.	
				Iraq	Eq. Guinea	
				Kazakhstan	Gabon	
				Kuwait	Nigeria	
				Libya		
				Oman		
				Qatar		
				Saudi Arabia		
				Sudan		
				Turkmenistan		
				UAE		
				Yemen		

Note: CCE is Central and Eastern Europe; LAC is Latin-America and the Caribbean; MENAP is Middle-East, North Africa and Pakistan; SSA is Sub-Saharan Africa. * All the advanced countries were aggregated in a single group. ^ Ecuador and Venezuela are oil-exporting countries, but cannot be placed in a separate group (LAC oil exporters) with only two elements, so instead of dropping them, they are lumped together with the other Latin-American countries. By the same logic we keep oil-exporter Norway with all advanced countries, and Russia with all CEE countries. The results do not change when we drop these countries.

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