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RESEARCH ARTICLE

Entry-regulation and corruption: grease or sand in the wheels of entrepreneurship? Fresh evidence according to entrepreneurial motives

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Abstract The relationship between entry-regulation, corruption, and entrepreneurship is controversial in the literature. Using a broad cross-country dataset to deepen the investigation, this paper distinguishes opportunity and necessity-motivated entrepreneurship in different development contexts. Corruption might grease the wheels of ineffective administrative machinery in developing countries with heavy entry-regulation. Yet, the marginal effect of corruption will generally be non-significant in other developing countries and in developed countries. Moreover, our results suggest that corruption deters opportunity-motivated entrepreneurship—the type of entrepreneurship that may contribute the most to productivity, economic growth, and development—in developed countries.

Plain English Summary Corruption and regulation can have ambiguous relationships with entrepreneurship unless you take a careful look at it. We examine the impact of corruption and entry-regulation on opportunity and necessity-motivated entrepreneurship within different economic development contexts. Corruption and entry-regulation correlate negatively with entrepreneurship but might have a tempering effect on each other. Thus, we consider whether corruption reduces the negative impact of entry-regulation on entrepreneurship while remaining globally negative (i.e., the "weak view") or if it completely counterbalance the negative effect (the "strong view"). Exploiting a cross-country dataset on 105 countries over the 2003–2016 period, we find that, while corruption might somewhat temper the negative impact of a heavy administrative machinery in developing countries, this tempering effect of corruption will generally be non-significant. Furthermore, our findings suggest that corruption deters opportunity-motivated entrepreneurship—the type of entrepreneurship that may contribute the most to productivity, economic growth and development. Corruption and regulation would then be particularly harmful for economic development. The policy-maker tackling these issues would do well to consider direct effects and possible interrelationships according to context.

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1 Introduction

While most of the economic literature supports a negative effect of corruption on economic growth, devel-

opment and welfare, a minor stream maintains that, in specific contexts of defective institutions, corruption may be beneficial by speeding up service delivery, thus improving the quality of public services, etc. That is, even if corruption is detrimental *per se*, it reduces the negative impact of inefficient institutions. This *greasing the wheels* hypothesis, which directly looks into the interconnections between institutional settings and corruption, was first put forward by Leff (1964), Leys (1965), and Huntington (1968). The counter argument, the *sand the wheels* hypothesis, hints that corruption does not temper institutional inefficiency, rather it adds new costs (Rose-Ackerman, 2004, 1978).

In the context of entrepreneurship, Dreher and Gassebner (2013) provides empirical evidence, using a panel of 42 countries from 2003 to 2005, that corruption tempers the negative effect of business regulation on early-stage entrepreneurship.[1] Like Djankov et al. (2002), they show that entry-regulation decreases the propensity of becoming an entrepreneur. Furthermore, when the level of regulation is high, the possibility for entrepreneurs to circumvent excessive administrative rules by bribing public servants would be beneficial. Their results support the idea that corruption greases the wheels of the administrative machinery. In contrast, Dutta and Sobel (2016), using World Bank data covering a panel of 104 countries between 2004 and 2011, conclude that corruption hurts entrepreneurship, even if the negative impact is smaller when the business climate is not conducive for economic activity.

In this paper, we qualify previous findings by testing whether the greasing the wheels hypothesis depends on types of entrepreneurs as well as on countries' economic and human development. We also propose to reconcile some previous diverging results by distinguishing between a weak and a strong interpretation of the greasing the wheels hypothesis. Corruption might reduce the negative impact of administrative burden on entrepreneurship, while remaining globally negative (weak view) or completely counterbalancing this negative effect (strong view).[2]

Using an expanded sample of countries over the 2003–2016 period, we first investigate whether types of entrepreneurs are differently affected by corruption and business entry-regulation. Because entrepreneurs have different motives—i.e., either to seize an opportunity in the market or by necessity—when establishing their own business, they might also react differently to the institutional environment.[3] Moreover, while entrepreneurship is conceptually well recognized as an engine for growth (Carree & Thurik, 2008; vanPraag & Versloot, 2007) and, consequently, is of particular interest for policy makers, it is also suggested that entrepreneurs contribute in a variety of ways to it (Ács & Varga, 2005; Wong et al., 2005; Ács, 2006; Hessels et al., 2008). Some individuals, with no choice but to create their own job, may only have a limited effect whereas a few others, responding to or creating new market opportunities, might contribute considerably to growth and development. As highlighted by Urbano et al. (2019), understanding the differences between entrepreneurs in their response to institutional features like business regulation and corruption would help foster better focused policies. By distinguishing between necessity- and opportunity-motivated entrepreneurs in different contexts, our results are specifically complementary to findings by Aparicio et al. (2016), Urbano et al. (2020), and Chowdhury and Audretsch (2021) regarding the sensitivity of opportunity-motivated entrepreneurs to different institutions.

Second, we consider whether the heterogeneity of the institutional framework, within which the productive processes are embedded, might affect the tested relationships between entrepreneurship, the quality of the business regulation, and corruption. Indeed, entry-regulation is only one measure of the institutional context within which entrepreneurs evolve and that determines their behavior. The question might be extended to the quality of the overall institutional context and its extended dimensions, including the development of social institutions—i.e., the public education system and the safety net or social security—that may affect how much creating a business is a necessity for individuals who are excluded from paid employment or how much a more equitable economy supports demand

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[1] The regulation of entry and its effects on entrepreneurship is a relatively old issue (see Klapper et al., 2006). It can also be noted that the quality of institutions and their favorable or deleterious effects on entrepreneurship have aroused interest in various ways. See Audretsch et al. (2022), Goel and Saunoris (2019), and Urbano et al. (2019) for a survey.

[2] See also Méon and Weill (2010) for a similar interpretation of the impact of corruption on countries' efficiency.

[3] See Ho and Wong (2007), McMullen et al. (2008), Gohmann (2010), Troilo Troilo2011 (2011), Levie and Autio (2010), Stenholm et al. (2015, 2013).

and opportunities for its residents. In brief, higher heterogeneity must be acknowledged in processes that go from the institutional context to economic development and vice versa (Rodrik, 2007). In the absence of more detailed data, this is tested by repeating the analysis for groups of countries distinguished according to their Human Development Index.

Our results show that corruption and regulation correlate negatively with entrepreneurship as well as that the two variables have a tempering effect on each other. However, we show that, while corruption might grease the wheels of ineffective administrative machinery in developing countries with strong entry-regulation, the marginal effect of corruption will generally be non-significant in other developing countries and developed countries. Furthermore, our results suggest that corruption deters opportunity-motivated entrepreneurship—the type of entrepreneurship that may contribute the most to productivity, economic growth, and development—in developed countries. Finally, this paper includes a broad discussion of the expected impacts of corruption and entry-regulation on entrepreneurship.

The remainder of the paper is as follow. We survey the literature and build testable propositions in Section 2. The data and methodology are reported in Section 3. Results are presented in Section 4. Section 5 concludes with a discussion of the paper's results and limitations.

2 Literature review

2.1 Business regulation, corruption, and entrepreneurship

The literature about entrepreneurship does distinguish between some environments that are conducive for entrepreneurship. For example, Johnson et al. (2002) show that the protection of property rights permits a long-term vision of business activities, while Estrin and Mickiewicz (2010) find that post-communist history is a brake on the desire to become an entrepreneur. However, research about the impact of (entry)-regulation and corruption are somehow controversial. We present these alternative theories and empirical results in this subsection then derive from them the hypotheses that are tested in Section 3.

Concerning corruption, most of the literature supports its negative effect on economic development and welfare (see hypothesis 1a at the end of this section). *Grand corruption*—intended as the corruption of high-level politicians—is seen as harmful for a long term, viable economy (see Bardhan, 1997; Rose-Ackerman, 2002, 2004; and Svensson, 2005, among others). In entrepreneurial literature, corruption is also generally considered to be detrimental. Anokhin and Schulze (2009) advance that corruption inhibits the level of entrepreneurial activities in a country. As it prevents the institutional trust that is necessary for entrepreneurial activities to flourish, corruption increases the uncertainty of a venture's expected returns. Since economic agents do not know whether agreements will be kept and/or whether they will be exposed to blackmail, they are driven to adopt short-term strategies. According to Berdiev and Saunoris (2018), corruption would also nudge entrepreneurs, eager to avoid interactions with corrupt government, into informal sectors.

Similarly, entry-regulation is generally considered to be an additive cost for potential entrepreneurs, deterring them from starting an activity (see hypothesis 1b at the end of this section). Dreher and Gassebner (2013) find empirical evidence that some measures of entry-regulation decrease the propensity of being an entrepreneur. These results feed a discussion about the intervention of the State that started in the 1920 s (Pigou, 1928, 1938; Coase, 1960). Frye and Shleifer (1997) "distinguish between the *invisible hand* of a benevolent state that guarantees property rights but minimizes intervention in the markets, and the *grabbing hand* of a state in which government does not enforce property rights rigorously but intervenes via corrupt officials who can expropriate value using government power" (Parker, 2009, p.338). According to Djankov et al. (2002), regulation may be inopportune if guided by insiders' interests. Pinotti (2012) and Aghion et al. (2010) question these findings that deregulation would be positive on the basis of estimation issues, while Iyigun and Rodrik (2004) highlight the rather negative effect of deregulation on growth. Duvanova (2014) also qualify the previous apparently conflicting results. She emphasizes the need to distinguish between official and effective regulation. If the institutional framework offers great bureaucratic autonomy, we might observe big differences between the regulatory policy and its implementation.

Additionally, some studies specifically focus on the interconnections between institutional settings and corruption in their impacts on development and

entrepreneurship. A minor stream of the corruption literature suggests that petty corruption—concerning small amount of money or implying low-ranking public officers—may, in specific contexts, be positive. This so-called *greasing the wheels* hypothesis maintains that "corruption may be beneficial in a second best world by alleviating the distortions caused by ill-functioning institutions" (Méon & Weill, 2010, p.244). In the particular context of defective institutions, corruption improves the system by speeding up service delivery and improving the quality of public services, among others. That is, even if corruption is detrimental *per se*, it reduces the negative impact of inefficient institutions. This stream of the corruption literature is widely discussed and its political implications put into perspective for various reasons. On the one hand, as these contributions relate to relatively low amounts of money and levels of power, budgetary consequences are minimal. On the other hand, the framework for analysis being considered is too restricted (one specific example and a very short-term perspective), which does not make it possible to incorporate the consequences that a tolerance for corruption would have on the whole economy and the political stability of a country. Even if corruption may be beneficial in a specific context, it becomes then impossible to bar it from other fields where it is harmful. Then, the risk is that corruption will extend to different economic and political spheres, thus becoming endemic. The system as a whole would then become inequitable and uncertain, which would jeopardize the legitimacy of the state (Rose-Ackerman, 2002).

Even if the *greasing the wheels* hypothesis is rather old (Leff, 1964; Leys, 1965; and Huntington, 1968), to the best of our knowledge, it is only since 2008 that some empirical findings support this theory (see Campos et al., 2010, for a meta-analysis about the impact of corruption on growth). For example, Aidt et al. (2008) and Méon and Weill (2010) find evidence that corruption greases the wheels of productivity or growth. Similarly, an empirical micro-analysis of Indonesian firms by Vial and Hanoteau (2010) documents that corruption is not an impediment to firm growth if the organization of the corruption is centralized and coordinated.

Regarding entrepreneurship measures, Bologna and Ross (2015) find that corruption is generally associated with less business activity in Brazilian municipalities, but that the correlation is insignificant or positive when

the quality of institutions is weak. Cross-country results by Dreher and Gassebner (2013) and Dutta and Sobel (2016) also suggest that, when the level of entry regulation is high, the possibility for entrepreneurs to bribe public servants would help reduce their excessive burden (see hypothesis 2b at the end of the section, where corruption tempers the negative impact of heavy regulation). The idea that the bribery might be supply-side rather than initiated by officials is illustrated by Reinikka and Svensson (2006) and Ufere et al. (2012) in highly-corrupted countries. Referring to Ufere et al. (2012), corruption becomes strategic and is initiated by entrepreneurs themselves in order to receive favorable government services and permits, to avoid inspection and taxes, or to obtain government contracts. In highly corrupted countries with weak institutions, this capture by the state becomes a dominant strategy for access to resources (see Auriol, 2006).

Although, if this strategy is optimal and necessary for the survival of the business activity, it might also restrict competition and deter the entry of new firms in the market. Further, incumbents, by bribing and lobbying, might use the regulatory process to restrict competition (hindrance to permits and access to credit, for example).

Hence, some empirical results support an alternative view of the interconnection between corruption and regulation. The *sanding the wheels* hypothesis argues that corruption has the greatest negative impact on those economies with poor quality institutions. The underlying idea is that the very quality of institutions may be endogenous to corruption. For example, Shleifer and Vishny (1993) argue that, when there is a free entry into the market of bribes' collection, politicians and bureaucrats are encouraged to increase regulatory burden with the sole purpose of increasing their own profits. They slow formalities down so as to be able to embezzle money or demand payment. Public employee corruption is then just an additional cost resulting from their abuse of power. Méon and Sekkat (2005) collect evidence corroborating this view. They find that corruption has a negative impact on growth and investment. This impact tends to be worse when the quality of governance is weak[4] (see hypothesis 2a at the end of this section).

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[4] See Rose-Ackerman (2004, 1978) for a review of the greasing and the sanding the wheels hypotheses.

Finally, some scholars study the inverse relationship and argue it is the regulation that is necessary when institutions are defective. In economics, corruption is also often used as a proxy of ineffective institutions (see for example Estrin et al., 2013) because it reflects the way formal institutions run (North, 1990). Regulation, from the opposite perspective, is a part of the constitutional framework that puts limits to the arbitrary behavior of politicians and officials. A highly corrupted country poorly operates and would need more regulation in order to restrain the misbehavior of officials and politicians. In a context of good institutions, regulation is not essential and hampers entrepreneurship, while it becomes beneficial in a context of defective institutions—highly corrupted contexts. This argument is also developed by Pinotti (2012) and Aghion et al. (2010) who indicate that market imperfections (in the sense of opportunist behavior of insiders) cause a general lack of trust and a growing aspiration for more regulation (see hypothesis 2b here below, where more regulation tempers the negative effect on entrepreneurship of a corrupted context).

Accordingly, we propose to test the following hypotheses about the links between corruption, regulation, and entrepreneurship.

Hypothesis 1a *Corruption is negatively correlated with entrepreneurship.*

Hypothesis 1b *Entry-regulation is negatively correlated with entrepreneurship.*

Hypothesis 2a *Corruption and entry-regulation are additive costs, that is the coefficient of their interaction term is significant and negative.*

Hypothesis 2b *Corruption and entry-regulation have a tempering effect on each other, that is the coefficient of their interaction term is significant and positive.*

Note that testing hypotheses 2a and 2b is not identical, as there is an implicit third hypothesis related to the non-significance of the coefficient.

Moreover, we also test for the existence of a *weak* and a *strong* view of the greasing the wheel hypothesis (Méon & Weill, 2010). The weak view only implies that corruption reduces the negative impact of an improper entry-regulation (hypothesis 2b), but does not impose anything on the total effect of corruption. That is, corruption can be a cost for entrepreneurship even if it softens the negative impact of regulation. Empirically,

we need to observe that the total marginal effect of corruption on entrepreneurship becomes less negative when regulation increases. On the contrary, the strong view holds when, for some levels of entry-regulation, the total impact of corruption on entrepreneurship is positive.

Hypothesis 2c *Corruption tempers the negative impact of entry-regulation—the coefficient of their interaction term is significant and positive—and the total marginal effect of corruption on entrepreneurship is positive (strong view).*

2.2 Individual responses

Summarized by Parker (2009), the various models of occupational choice theory consider entrepreneurship as an alternative to other career alternatives (employment, unemployment, rent-seeking activities). The key aspect of these models is that, by comparing the expected payoffs and the opportunity cost of opening a business, heterogeneous agents self-select into entrepreneurship.

Corruption and entry-regulation, because they determine the expected revenues of being entrepreneur, affect the incentives for individuals to start a business. As cost regulation increases, the expected payoffs of an activity drop and opening a business becomes less attractive with respect to other career alternatives. However, it does not necessarily change one's occupational preferences. The final impact actually depends on the alternatives that an individual agent has. Because they are heterogeneous in their capabilities for work (education, work experience, etc.) and in their socio-economic characteristics (Block & Wagner, 2010), individuals have different reservation wages—the minimum wage they are willing to accept for a paid employment—or reservation profits—the minimum expected profit that an activity must generate to be undertaken. In particular, Fonseca et al. (2001) argue that the longer an individual is unemployed, the lower is their reservation wage and, as a matter of fact, the lower their opportunity cost if they establish a firm.

Necessity-motivated entrepreneurs, who create an activity because they lack alternative career choices, are an extreme case by definition. Their opportunity cost equals either zero or the safety-nets for the unemployed (Ho & Wong, 2007). As a consequence, one might expect an increase in the entry-regulation cost

to deter fewer entrepreneurs if they are becoming one out of necessity. Because they have no outside option, necessity-motivated entrepreneurs must open a business, whatever the expected revenues.

On the contrary, opportunity-motivated agents— who open a business to seize a market opportunity— would be more sensitive to a decrease in their venture's expected benefit because their opportunity cost is higher. Indeed, Ardagna and Lusardi (2010) show that regulation plays a critical role in the decision to open a business, especially for somebody pursuing a business opportunity. Moreover, Murphy et al. (1993) assert that new firms and innovative firms (more profitable projects), because they need government supplied goods, are particularly vulnerable to corruption and taxation/regulation. Indeed, officials can extract higher rents during regular interactions or because those firms offer higher revenues. Accordingly, opportunity-motivated entrepreneurs, because they are more likely to run profitable activities, would bear higher entry-regulation and corruption costs than necessity-motivated entrepreneurs.

On the other hand, because they have more profitable projects and generally have more funding, opportunity-motivated entrepreneurs are best placed to initiate bribery (see Reinikka & Svensson, 2006, and Ufere et al., 2012).

Therefore, we test the following three hypotheses:

Hypothesis 3a *The impact of entry-regulation is higher on opportunity-motivated entrepreneurs than on necessity-motivated entrepreneurs.*

Hypothesis 3b *The impact of corruption is higher on opportunity-motivated entrepreneurs than on necessity-motivated entrepreneurs.*

Hypothesis 3c *The tempering effect of corruption and entry-regulation on each other is higher for opportunity-motivated entrepreneurs than for necessity-motivated entrepreneurs.*

2.3 Institutional, economic, and human development

Considering the general development context is also relevant when trying to identify the determinants of entrepreneurship (necessity or opportunity–motivated). Quatraro and Vivarelli (2015) underline the prevalence of necessity-motivated entrepreneurship in less developed countries, where entrepreneurs are generally

pushed by "regressive" (fear of unemployment and low wage) rather than "progressive" determinants (profits, technological opportunities). According to Gindling and Newhouse (2014), 85% of workers are wage workers in developed countries, while the proportion falls to less than 50% in developing countries. This supports the idea that most entrepreneurs in these countries are actually rationed out of employment. This trend is also present in middle-income countries (Mandelman & Montes-Rojas, 2009).

In the late 2000 s, the GEM Research Consortium started to contextualize GEM data with published figures that grouped countries according to the degree of economic welfare (i.e., high- *vis-à-vis* middle- and low-income countries) or regional dimension (Bosma et al., 2007); or by distinguishing factor-, efficiency- and innovation-driven countries, a classification that follows Bosma et al. (2008). Classifying countries in different groups reflects a concern for inter-group differences. In the case of entrepreneurship and development, these differences would refer particularly to the institutions' quality, including goods, labor and financial markets; infrastructure, health, and the education system (see Porter & Schwab, 2008).

Economic development is still commonly measured by GDP per capita. However, there is an increasing recognition of the variety of formal and informal institutional arrangements, within which the productive processes are embedded, that are conducive to economic development. It appears that not only are market institutions contributing, but also non-market institutions. These include public education and social security. Rodrik (2007) develops the above argumentation, also suggesting that the way entrepreneurs perceive the quality of institutions, whether those perceptions are fair or not, is a determining factor for their investment behavior.

By categorizing potential entrepreneurs according to their motive to open a business, we indirectly consider their perception of economic environment: relatively negative if they do not have job possibilities other than their own business (necessity), or relatively favorable if they perceive opportunities in the market (opportunity). However, their perception can be attributed to the general environment within which they evolve, or to their own capabilities (education, experience). Indeed, as individuals decide their occupational choice by comparing the benefits of different alternatives, they are influenced by their environment. First, the economic

environment will determine the degree of precariousness (lack of income and job security) in which necessity entrepreneurs evolve. While some countries offer safety-net for unemployed, others cannot afford this protection to their citizens or decide not to offer it. As a result, even if necessity entrepreneurs are rationed out of wage employment in both economic contexts, they do not progress in comparable situations. They are not in such a hurry to generate their own income if they receive some state intervention.

Secondly, the quality of institutions varies across countries. Because they evolve in different economic and institutional frameworks, necessity entrepreneurs will probably react differently to entry barriers like regulation or corruption constraints. In the emergency of generating subsistence income, individuals will probably undertake the activity whatever the current legislation, with the informal economy or corruption potential ways to circumvent the rules. Third, we also postulate that the economic context influences the cultural acceptance of corruption. The latter determines how people behave. Gardiner (2002) demonstrates that "citizens' values about corruption are likely to affect how they behave themselves—whether they will offer a bribe or will abide by the requirements of the law" (Gardiner, 2002, p.33). It is then more likely to observe a transgression of the law (use of bribes for personal interest) in countries where corruption is widespread and somehow tolerated.

In brief, (i) the meaning of necessity entrepreneurship might differ dramatically according to the economic environment, i.e., the latter including, or not, some form of safety-net; (ii) under imperious circumstances, necessity entrepreneurs might consider the informal economy or corruption as means to circumvent the rules more easily; and (iii) the more corruption would be (perceived as) widespread, the more its use would be facilitated and somehow tolerated. Following these arguments, and although an extensively-used corruption might also diminish its return in terms of greasing, we expect the tempering effect of corruption and regulation to be higher in developing countries.

Hypothesis 4 *The tempering effect of corruption and regulation is higher for opportunity-motivated and necessity-motivated entrepreneurs in developing than in developed countries.*

The remaining of the paper is devoted to empirically test these hypotheses.

3 Data and methodology

3.1 Data

We use a panel of 105 countries (29 developed and 76 less developed countries) over the 2003–2016 period. Appendix Table 8 presents the detailed list of countries included in the sample. The data used are collected from 4 distinct datasets. Detailed variable definitions and descriptive statistics are provided in Appendix Table 9.

From international adult population surveys, the Global Entrepreneurship Monitor (GEM) develops several indicators, from which we selected three dependent variables, to better discern the plurality of entrepreneurship: nascent entrepreneurship, opportunity-motivated entrepreneurship, and necessity-motivated entrepreneurship. Nascent entrepreneurship is defined as the percentage of individuals between 16 and 64 years old who have taken some action toward creating a business. Opportunity-motivated entrepreneurs are further defined as those who report that they chose the creation of a business among other career alternatives, while necessity-motivated entrepreneurs are those who had no outside option.

Like Dreher and Gassebner (2013) and Dutta and Sobel (2016), we consider four measures of entry-regulation from the World Bank's Doing Business dataset: (i) the number of procedures—any interaction with officials—required to start a business; (ii) the number of days required to start a new business; (iii) the official cost of starting a business (in percentage of GDP per capita); and (iv) the minimum capital required to start a business (in percentage of GDP per capita). As a fifth indicator, we use the Financial Freedom Index developed by Gwartney and Lawson (2006). This latter index measures the relative openness of countries' banking and financial systems. We invert this index so that a higher value reflects less openness. The correlation matrix of regulation measures is presented in Appendix Table 10.

We use two indexes to proxy corruption: the Transparency International Corruption Perceptions Index and the World Bank Control of Corruption Estimate.[5] In addition to these variables, we control for the per capita GDP up to order two, the unemployment rate, as well as for the communist history of countries under

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[5] See Svensson (2005) for a revision of these indicators and Ko and Samajdar (2010) for a discussion of their limits.

study. We categorize a country as having a communist history if it self-identifies as a Marxist-Leninist state in its constitutional text or did so for more than 25 years. The unemployment rate data comes from the International Labour Organization and is defined as the share of the labor force that is without work but available for and seeking employment.[6]

Finally, we use a dummy based on the United Nations Development Programme (UNDP) countries classification in order to control for the level of economic and social development. This classification relies on three indexes measuring each respective country's achievements in longevity, education, and income. We qualify countries as developing or developed depending on whether their 2002 Human Development Index is below or above 0.8. We select this indicator rather than the indicators of the World Bank or the IMF because the former only considers GDP per capita, which we already control for, while the latter does not have any explicit threshold (see Nielsen, 2011). We only consider two groups of countries to avoid inference issues due to few available data in less-developed countries and interpretation issues for the empirical results. In our sample, we tally 29 highly developed and 76 developing countries.[7] Appendix Table 11 displays the means of regulation measures and corruption indexes for the two groups of countries. The regulation burden and the level of corruption are both higher in developing countries. Figure 1 further illustrates the differences in the distributions of entry-regulation measures between the two groups.

3.2 Methodology

In a first step, we study the impact of entry-regulation and corruption on nascent entrepreneurship without any distinction about types of entrepreneurship or level of development. We then articulate the econometric methodology to investigate whether corruption, regulation, and their interaction differently affect opportunity- and necessity-motivated entrepreneurs. In a last step, we distinguish the effects according to countries' level of economic and social development.

Our dataset is an unbalanced panel comprising 105 developed and developing countries covering the 2003–2016 period. The data used were collected by GEM for only a short period of time (the earliest available data was collected in 2000) and are not consistently available across time for all countries in the sample. For these reasons, we use a pooled estimator, but correcting the disturbance for heteroskedasticity and contemporaneous correlation across country panels (linear regression with panel-corrected standard errors; Beck & Katz, 1996, and Beck & Katz, 1995). This method is appropriate if the inter-individual component explains almost all the model, while the intra-individual part is almost null. The analysis of variance, displayed in Appendix Table 12, confirms that a model considering the mean rather than the deviation to the mean better suits the data. Indeed, we cannot reject the null hypothesis that time does not explain any variance of the modeling. A fixed effect estimation would then have very little statistical power and variables that vary slightly over time (like some of our explanatory variables) would be poorly estimated. We use a pairwise deletion to include all available observations with non-missing pairs.[8]

We first study the impact of regulation and corruption on nascent entrepreneurship without any distinction about types of entrepreneurship or level of development. We estimate the following expression:

$$
\begin{aligned}
\text{Nascent entr}_{i,t} = {} & \alpha_0 + \alpha_1 GDP_{i,t-1} + \alpha_2 GDP_{i,t-1}^2 \\
& + \alpha_3 \text{Post-communist}_i + \alpha_4 \text{Unemployment}_{i,t} \\
& + \alpha_5 \text{Corruption}_{i,t} + \alpha_6 \text{Regulation}_{i,t} \\
& + \alpha_7 \text{Corruption}_{i,t} \times \text{Regulation}_{i,t} \\
& + \varepsilon_{i,t}
\end{aligned}
\tag{1}
$$

where i and t stand for country and year, respectively, while ε is for the error term and α_0 is a constant term. *Nascent entr* is nascent entrepreneurship (in % of the adult population). *GDP* denotes per capita gross domestic product in constant \$US, *Unemployment* the unemployment rate in percentage of the labor force, and the *Post-communist* dummy variable signals countries with a communist history. *Corruption* is one of the two corruption indexes and *Regulation* stands for one of the five entry-regulation measures. *Corruption* × *Regulation* captures the interaction between corruption and regulation. This term tests hypotheses 2a and 2b. If the interaction term has a positive and significant

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[6] See Dreher and Gassebner (2013) for an extreme bound analysis and the selection of the control variables.

[7] We also consider a threshold of 0.7. Although it offers a better balance of countries in the two groups, the number of observations is strongly unbalanced, especially with too few observations for the group of developing countries.

[8] We also run simple regressions with country-level clusters and introduce time fixed effects and trends; results are similar.
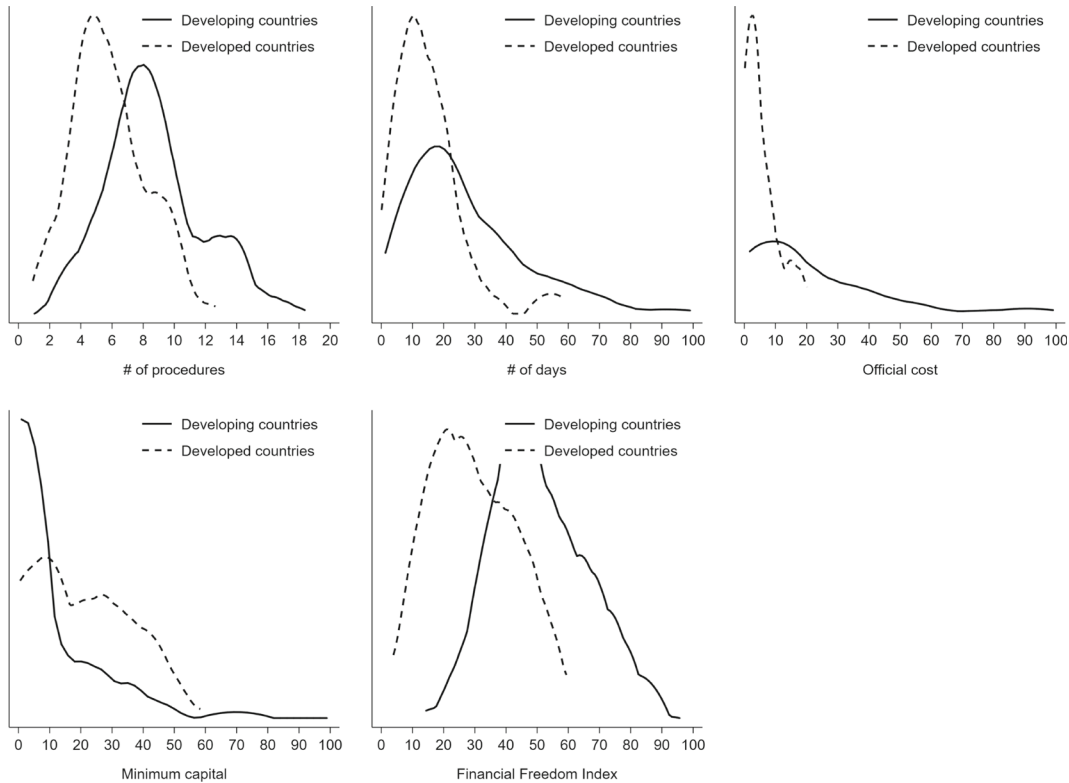
Fig. 1 Distributions of entry-regulation measures in developing and developed countries. Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). Distributions obtained using a kernel-density estimation on 100 points over the full range of data. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables

coefficient, it supports hypothesis 2b, hypothesis 2a if significant and negative, while none of them if non-significant. Tables 1 and 2 give the empirical results for the ten specifications (five entry-regulation measures combined with two corruption indicators) when the dependent variable is the nascent entrepreneur.

Secondly, in order to test whether the impacts of corruption and entry-regulation differ according to the types of entrepreneurship, we use the method of stacking data sets (see Mize et al. (2019) for a detailed description of the method). Covariance between the two estimates is computed and allows the comparison of explanatory variables' coefficients on the two dependent variables, opportunity- and necessity-motivated entrepreneurs, by testing restrictions on parameters of originally different equations. Moreover, it makes sense to consider that the two types of entrepreneurs face correlated country-wide or worldwide shocks that should be considered simultaneously. The specification of our estimation is as follows:

$$
\begin{cases}
\text{Necessity entr}_{i,t} = \beta_0 + \beta_1 GDP_{i,t-1} + \beta_2 GDP_{i,t-1}^2 + \beta_3 \text{Post-communist}_i \\
\qquad + \beta_4 \text{Unemployment}_{i,t} + \beta_5 \text{Corruption}_{i,t} + \beta_6 \text{Regulation}_{i,t} \\
\qquad + \beta_7 \text{Corruption}_{i,t} \times \text{Regulation}_{i,t} + \varepsilon_{1,i,t} \\
\\
\text{Opportunity entr}_{i,t} = \gamma_0 + \gamma_1 GDP_{i,t-1} + \gamma_2 GDP_{i,t-1}^2 + \gamma_3 \text{Post-communist}_i \\
\qquad + \gamma_4 \text{Unemployment}_{i,t} + \gamma_5 \text{Corruption}_{i,t} + \gamma_6 \text{Regulation}_{i,t} \\
\qquad + \gamma_7 \text{Corruption}_{i,t} \times \text{Regulation}_{i,t} + \varepsilon_{2,i,t}
\end{cases}
\tag{2}
$$

Table 1 Determinants of nascent entrepreneurship; measuring corruption with the World Bank Control of Corruption Estimate

Dependent variable: nascent entrepreneurship	(1)	(2)	(3)	(4)	(5)
Lagged per capita GDP	-0.283***	-0.314***	-0.254***	-0.281***	-0.294***
	(0.054)	(0.056)	(0.044)	(0.054)	(0.055)
Lagged per capita GDP^2	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment rate	-0.131***	-0.142***	-0.115***	-0.138***	-0.133***
	(0.032)	(0.035)	(0.030)	(0.029)	(0.030)
Communist history	-3.967***	-3.521***	-3.353***	-3.912***	-4.201***
	(0.333)	(0.362)	(0.512)	(0.345)	(0.325)
World Bank corruption index	-0.560*	-0.681**	-0.203	0.039	0.029
	(0.334)	(0.304)	(0.247)	(0.268)	(0.313)
# of procedures	-0.470***				
	(0.140)				
# of days		-0.074***			
		(0.018)			
Official cost			-0.003		
			(0.075)		
Minimum capital				-0.001	
				(0.008)	
Financial Freedom Index					-0.052***
					(0.017)
Corruption × Regulation	0.086**	0.018***	0.006	-0.001	0.003
	(0.035)	(0.004)	(0.010)	(0.001)	(0.004)
Constant	15.735***	15.698***	12.485***	12.729***	14.403***
	(1.898)	(2.078)	(1.640)	(1.984)	(1.749)
Observations	710	710	710	717	746
R-squared	0.384	0.403	0.395	0.381	0.386
# of countries	103	103	103	105	104

***$p <0.01$, **$p <0.05$, *$p <0.1$. Standard errors in parentheses. Estimates of expression Eq. 1 using World Bank Control of Corruption Estimate to measure corruption. See the text and Appendix Table for the definition of variables

Table 2 Determinants of nascent entrepreneurship; measuring corruption with the Transparency International Corruption Perceptions Index

Dependent variable: nascent entrepreneurship	(1)	(2)	(3)	(4)	(5)
Lagged per capita GDP	-0.261***	-0.282***	-0.234***	-0.255***	-0.269***
	(0.039)	(0.037)	(0.039)	(0.040)	(0.042)
Lagged per capita GDP^2	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment rate	-0.131***	-0.136***	-0.115***	-0.137***	-0.132***
	(0.031)	(0.033)	(0.030)	(0.028)	(0.029)
Communist history	-4.059***	-3.622***	-3.475***	-3.927***	-4.231***
	(0.344)	(0.362)	(0.498)	(0.344)	(0.332)
Transparency International corruption index	-0.376	-0.414**	-0.056	0.212	0.187
	(0.251)	(0.190)	(0.191)	(0.173)	(0.224)
# of procedures	-0.565***				
	(0.140)				
# of days		-0.083***			
		(0.017)			
Official cost			-0.064		
			(0.061)		
Minimum capital				0.002	
				(0.008)	
Financial Freedom Index					-0.061***
					(0.016)
Corruption × Regulation	0.087***	0.017***	0.014*	-0.001	0.004
	(0.030)	(0.003)	(0.007)	(0.001)	(0.004)
Constant	15.108***	14.406***	11.783***	11.463***	13.376***
	(1.369)	(1.387)	(1.594)	(1.405)	(1.312)
Observations	710	710	710	717	746
R-squared	0.387	0.401	0.398	0.382	0.388
# of countries	103	103	103	105	104

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors in parentheses. Estimates of expression Eq. 1 using Transparency International Corruption Perceptions Index to measure corruption. See the text and Appendix Table 9 for the definition of variables

where *Necessity entr* and *Opportunity entr* denote necessity- and opportunity-motivated entrepreneurship, respectively, and the error terms ϵ_1 and ϵ_2, are correlated. Other notations are as in expression Eq. 1. Empirical results are displayed in Table 3.

Finally, to better encompass the overall environment in which activities develop, we check the relevance of considering groups of countries. We divide the sample into two groups according to their Human Development Index level, a composite index of countries' achievement in longevity, education, and income, developed by the United Nations Development Programme (UNDP).

We test whether developing countries observe a different initial level of necessity or opportunity entrepreneurship and whether corruption and regulation, as well as their interplay, differently impact entrepreneurship in the two groups of countries. Accordingly, Eq. 2 is modified as follows:

bined with two corruption indicators) derived from Eq. 1 when the dependent variable is the nascent entrepreneur. When significant, our results align with those of Dreher and Gassebner (2013). For two regulation measures, namely the number of procedures and number of days, corruption and entry-regulation measures both have, at the zero value of the other variable, a significant and negative impact on early-stage entrepreneurs (see hypotheses 1a and 1b which state that corruption and regulation correlate negatively with entrepreneurship). Moreover, the interaction term between corruption and the entry-regulation measure has a positive coefficient, which implies a softening effect of corruption and regulation on each other (see hypothesis 2b).

The amount of paid-in minimum capital and the official cost of starting a business (in percentage of the GDP per capita) have, on the contrary, non-significant

$$
\left\{
\begin{aligned}
\text{Necessity entr}_{i,t} = {} & \beta_0 + \beta_1 GDP_{i,t-1} + \beta_2 GDP_{i,t-1}^2 + \beta_3 \text{Post-communist}_i \\
& + \beta_4 \text{Unemployment}_{i,t} + \beta_5 \text{Corruption}_{i,t} + \beta_6 \text{Regulation}_{i,t} \\
& + \beta_7 \text{Corruption}_{i,t} \times \text{Regulation}_{i,t} + \beta_8 \text{Developing}_i \\
& + \beta_9 \text{Developing}_i \times \text{Corruption}_{i,t} + \beta_{10} \text{Developing}_i \times \text{Regulation}_{i,t} \\
& + \beta_{11} \text{Developing}_i \times \text{Corruption}_{i,t} \times \text{Regulation}_{i,t} + \varepsilon_{1,i,t} \\[6pt]
\text{Opportunity entr}_{i,t} = {} & \gamma_0 + \gamma_1 GDP_{i,t-1} + \gamma_2 GDP_{i,t-1}^2 + \gamma_3 \text{Post-communist}_i \\
& + \gamma_4 \text{Unemployment}_{i,t} + \gamma_5 \text{Corruption}_{i,t} + \gamma_6 \text{Regulation}_{i,t} + \\
& + \gamma_7 \text{Corruption}_{i,t} \times \text{Regulation}_{i,t} + \gamma_8 \text{Developing}_i \\
& + \gamma_9 \text{Developing}_i \times \text{Corruption}_{i,t} + \gamma_{10} \text{Developing}_i \times \text{Regulation}_{i,t} \\
& + \gamma_{11} \text{Developing}_i \times \text{Corruption}_{i,t} \times \text{Regulation}_{i,t} + \varepsilon_{2,i,t}
\end{aligned}
\right.
\tag{3}
$$

where *Developing* is a dummy variable that signals developing countries and other notations are as in expressions Eqs. 1 and 2. Coefficients β_{9--11} and γ_{9--11} capture the differential impact of corruption and regulation in developing and developed countries on necessity- and opportunity-motivated-entrepreneurship, respectively. Empirical results are given in Tables 4 and 5.

4 Empirical results

4.1 Impact of corruption and entry-regulation on nascent entrepreneurship

Tables 1 and 2 present the empirical results for the ten specifications (five entry-regulation measures com-

coefficients. Further, corruption and these regulation measures do not have tempering effects on each other. The correlation matrices displayed in Appendix Table 10 may partly account for the disparity among results. The minimum capital variable is weakly correlated with other regulation measures, regardless of the sample of countries, as is the official cost in developing countries, an important part of the enlarged sample. While the two first regulation measures are various ways of measuring the administrative burden facing an entrepreneur when opening a business, the minimum paid-in capital is initially introduced to protect creditors and install confidence in credit market. Thus, it is not just an administrative procedure. Moreover, these two entry-regulation measures refer to official costs in cash rather than in time, which might be more difficult to reduce. Finally, the Financial Freedom index is

Table 3 Determinants of necessity- and opportunity-motivated entrepreneurship

	Transparency International corruption index			World Bank corruption index		
	(1) Necessity entrepr.	(2) Opportunity entrepr.	p-value for coeff. equality	(3) Necessity entrepr.	(4) Opportunity entrepr.	p-value for coeff. equality
Regulation measure: # of procedures						
Lagged per capita GDP	-0.192***	-0.316***	0.000	-0.191***	-0.347***	0.000
	(0.022)	(0.048)		(0.028)	(0.058)	
Lagged per capita GDP^2	0.002***	0.003***	0.000	0.002***	0.003***	0.000
	(0.000)	(0.000)		(0.000)	(0.000)	
Unemployment rate	-0.033***	-0.273***	0.000	-0.031***	-0.274***	0.000
	(0.012)	(0.034)		(0.011)	(0.034)	
Communist history	-1.402***	-4.762***	0.000	-1.369***	-4.634***	0.000
	(0.345)	(0.449)		(0.328)	(0.421)	
# of procedures	-0.279***	-0.651***	0.007	-0.270***	-0.573***	0.011
	(0.076)	(0.149)		(0.072)	(0.131)	
Corruption	-0.335**	-0.464	0.632	-0.394**	-0.755**	0.191
	(0.168)	(0.330)		(0.199)	(0.375)	
Corruption × # of procedures	0.060***	0.096***	0.111	0.067***	0.101***	0.139
	(0.020)	(0.027)		(0.022)	(0.029)	
Constant	7.848***	19.455***	0.000	7.820***	20.579***	0.000
	(0.835)	(1.873)		(1.051)	(2.130)	
Observations	710	710		710	710	
R-squared	0.712	0.712		0.715	0.715	
# of countries	103	103		103	103	

Table 3 continued

	Transparency International corruption index			World Bank corruption index		
	(1) Necessity entrepr.	(2) Opportunity entrepr.	p-value for coeff. equality	(3) Necessity entrepr.	(4) Opportunity entrepr.	p-value for coeff. equality
Regulation measure: # of days						
Lagged per capita GDP	-0.202***	-0.334***	0.000	-0.203***	-0.372***	0.000
	(0.022)	(0.048)		(0.028)	(0.061)	
Lagged per capita GDP^2	0.002***	0.003***	0.000	0.002***	0.003***	0.000
	(0.000)	(0.000)		(0.000)	(0.001)	
Unemployment rate	-0.043***	-0.276***	0.000	-0.043***	-0.283***	0.000
	(0.014)	(0.034)		(0.013)	(0.036)	
Communist history	-1.390***	-4.381***	0.000	-1.366***	-4.266***	0.000
	(0.304)	(0.399)		(0.291)	(0.380)	
# of days	-0.030***	-0.076***	0.004	-0.027***	-0.071***	0.004
	(0.009)	(0.018)		(0.008)	(0.018)	
Corruption	-0.120	-0.381	0.238	-0.150	-0.700**	0.037
	(0.087)	(0.265)		(0.130)	(0.347)	
Corruption × # of days	0.007***	0.015***	0.004	0.008***	0.016***	0.002
	(0.002)	(0.003)		(0.002)	(0.004)	
Constant	7.074***	17.970***	0.000	7.131***	19.609***	0.000
	(0.708)	(1.851)		(0.965)	(2.287)	
Observations	710	710		710	710	
R-squared	0.717	0.717		0.718	0.718	
# of countries	103	103		103	103	

Table 3 continued

	Transparency International corruption index			World Bank corruption index		
	(1) Necessity entrepr.	(2) Opportunity entrepr.	p-value for coeff. equality	(3) Necessity entrepr.	(4) Opportunity entrepr.	p-value for coeff. equality
Regulation measure: Official cost						
Lagged per capita GDP	-0.175***	-0.292***	0.001	-0.176***	-0.323***	0.000
	(0.021)	(0.046)		(0.024)	(0.046)	
Lagged per capita GDP^2	0.001***	0.002***	0.000	0.001***	0.003***	0.000
	(0.000)	(0.000)		(0.000)	(0.000)	
Unemployment rate	-0.027**	-0.259***	0.000	-0.027**	-0.262***	0.000
	(0.012)	(0.033)		(0.012)	(0.032)	
Communist history	-1.193***	-4.151***	0.000	-1.178***	-4.046***	0.000
	(0.307)	(0.456)		(0.297)	(0.477)	
Official cost	-0.031	-0.058	0.651	-0.014	-0.028	0.815
	(0.026)	(0.072)		(0.032)	(0.083)	
Corruption	-0.009	-0.123	0.556	-0.014	-0.357	0.094
	(0.092)	(0.240)		(0.125)	(0.270)	
Corruption × Official cost	0.008**	0.013	0.519	0.006	0.010	0.635
	(0.004)	(0.009)		(0.005)	(0.011)	
Constant	5.987***	15.808***	0.000	5.995***	17.117***	0.000
	(0.738)	(2.036)		(0.835)	(1.788)	
Observations	710	710		710	710	
R-squared	0.720	0.720		0.722	0.722	
# of countries	103	103		103	103	

Table 3 continued

	Transparency International corruption index			World Bank corruption index		
	(1) Necessity entrepr.	(2) Opportunity entrepr.	p-value for coeff. equality	(3) Necessity entrepr.	(4) Opportunity entrepr.	p-value for coeff. equality
Regulation measure: Minimum capital						
Lagged per capita GDP	-0.190***	-0.306***	0.001	-0.189***	-0.340***	0.000
	(0.023)	(0.047)		(0.028)	(0.056)	
Lagged per capita GDP^2	0.002***	0.003***	0.001	0.002***	0.003***	0.000
	(0.000)	(0.000)		(0.000)	(0.000)	
Unemployment rate	-0.040***	-0.270***	0.000	-0.038***	-0.273***	0.000
	(0.013)	(0.029)		(0.012)	(0.030)	
Communist history	-1.564***	-4.510***	0.000	-1.560***	-4.499***	0.000
	(0.314)	(0.355)		(0.311)	(0.360)	
Minimum capital	-0.002	0.006	0.208	-0.001	0.002	0.669
	(0.005)	(0.010)		(0.004)	(0.009)	
Corruption	0.138	0.143	0.973	0.157	-0.093	0.189
	(0.098)	(0.193)		(0.135)	(0.255)	
Corruption × Minimum capital	0.000	-0.002	0.053	-0.000	-0.001	0.327
	(0.001)	(0.001)		(0.001)	(0.001)	
Constant	5.951***	15.209***	0.000	5.930***	16.837***	0.000
	(0.752)	(1.642)		(0.937)	(1.954)	
Observations	717	717		717	717	
R-squared	0.706	0.706		0.704	0.704	
# of countries	105	105		105	105	

Table 3 continued

	Transparency International corruption index			World Bank corruption index		
	(1) Necessity entrepr.	(2) Opportunity entrepr.	p-value for coeff. equality	(3) Necessity entrepr.	(4) Opportunity entrepr.	p-value for coeff. equality
Regulation measure: Financial Freedom Index						
Lagged per capita GDP	-0.197***	-0.319***	0.000	-0.193***	-0.353***	0.000
	(0.024)	(0.049)		(0.028)	(0.057)	
Lagged per capita GDP^2	0.002***	0.003***	0.001	0.002***	0.003***	0.000
	(0.000)	(0.000)		(0.000)	(0.001)	
Unemployment rate	-0.038***	-0.265***	0.000	-0.036***	-0.268***	0.000
	(0.012)	(0.028)		(0.011)	(0.029)	
Communist history	-1.731***	-4.865***	0.000	-1.734***	-4.824***	0.000
	(0.308)	(0.358)		(0.307)	(0.347)	
Financial Freedom Index	-0.025***	-0.068***	0.006	-0.022***	-0.058***	0.033
	(0.009)	(0.016)		(0.008)	(0.018)	
Corruption	0.174	0.095	0.734	0.241	-0.140	0.140
	(0.142)	(0.257)		(0.183)	(0.290)	
Corruption × Financial Freedom Index	0.001	0.004	0.328	-0.000	0.004	0.368
	(0.003)	(0.003)		(0.003)	(0.003)	
Constant	6.679***	17.432***	0.000	6.497***	18.817***	0.000
	(0.795)	(1.740)		(0.941)	(1.867)	
Observations	746	746		746	746	
R-squared	0.704	0.704		0.705	0.705	
# of countries	104	104		104	104	

***$p<0.01$, **$p<0.05$, *$p<0.1$. Standard errors in parentheses. Estimates of expression eq. 2 using Transparency International Corruption Perceptions Index and World Bank Control of Corruption Estimate to measure corruption. "Entrepr." and "coeff." stand for "entrepreneurship" and "coefficients", respectively. See the text and Appendix Table 9 for the definition of variables

Table 4 Determinants of necessity- and opportunity-motivated entrepreneurship, allowing for a differential effect of regulation and corruption in developing countries; measuring corruption with the Transparency International Corruption Perceptions Index

	(1)	(2)
	Necessity entrepreneurship	Opportunity entrepreneurship
Regulation measure: # of procedures		
Lagged per capita GDP	-0.230***	-0.322***
	(0.028)	(0.063)
Lagged per capita GDP^2	0.002***	0.003***
	(0.000)	(0.001)
Unemployment rate	-0.033***	-0.271***
	(0.012)	(0.033)
Communist history	-1.392***	-4.728***
	(0.347)	(0.444)
Constant	8.412***	20.457***
	(1.045)	(2.139)
# of procedures	-0.063	-0.646***
	(0.047)	(0.138)
Corruption	-0.169	-0.614**
	(0.157)	(0.300)
Corruption × # of procedures	0.007	0.088***
	(0.016)	(0.032)
Developing country	0.455	-3.747**
	(1.484)	(1.841)
# of procedures × Developing country	-0.371*	0.253
	(0.208)	(0.257)
Corruption × Developing country	-0.279	0.595*
	(0.317)	(0.356)
Corruption × # of procedures × Developing country	0.075*	-0.032
	(0.042)	(0.042)
Observations	710	710
R-squared	0.715	0.715
# of countries	103	103
Regulation measure: # of days		
Lagged per capita GDP	-0.242***	-0.353***
	(0.030)	(0.069)
Lagged per capita GDP^2	0.002***	0.003***
	(0.000)	(0.001)
Unemployment rate	-0.046***	-0.274***
	(0.014)	(0.035)
Communist history	-1.297***	-4.347***
	(0.308)	(0.393)

Table 4 continued

	(1)	(2)
	Necessity entrepreneurship	Opportunity entrepreneurship
Constant	8.517***	19.504***
	(0.948)	(2.357)
# of days	0.004	-0.080***
	(0.010)	(0.029)
Corruption	-0.036	-0.584**
	(0.116)	(0.276)
Corruption × # of days	-0.006*	0.015
	(0.004)	(0.009)
Developing country	-1.792***	-2.908**
	(0.647)	(1.281)
# of days × Developing country	-0.024	0.026
	(0.026)	(0.048)
Corruption × Developing country	0.006	0.440
	(0.129)	(0.315)
Corruption × # of days × Developing country	0.012**	-0.003
	(0.005)	(0.011)
Observations	710	710
R-squared	0.716	0.716
# of countries	103	103
Regulation measure: Official cost		
Lagged per capita GDP	-0.190***	-0.264***
	(0.029)	(0.064)
Lagged per capita GDP^2	0.001***	0.002***
	(0.000)	(0.000)
Unemployment rate	-0.026**	-0.251***
	(0.011)	(0.033)
Communist history	-1.200***	-4.126***
	(0.304)	(0.457)
Constant	6.856***	15.871***
	(1.015)	(2.343)
Official cost	-0.025	-0.263***
	(0.026)	(0.053)
Corruption	-0.029	0.006
	(0.116)	(0.217)
Corruption × Official cost	-0.001	0.020*
	(0.008)	(0.012)
Developing country	-1.561***	-2.410*
	(0.476)	(1.430)
Official cost × Developing country	0.013	0.286***
	(0.041)	(0.097)

Table 4 continued

	(1) Necessity entrepreneurship	(2) Opportunity entrepreneurship
Corruption × Developing country	0.144	0.184
	(0.097)	(0.297)
Corruption × Official cost × Developing country	0.006	-0.018
	(0.009)	(0.016)
Observations	710	710
R-squared	0.725	0.725
# of countries	103	103
Regulation measure: Minimum capital		
Lagged per capita GDP	-0.217***	-0.307***
	(0.030)	(0.061)
Lagged per capita GDP^2	0.002***	0.002***
	(0.000)	(0.001)
Unemployment rate	-0.036***	-0.263***
	(0.013)	(0.030)
Communist history	-1.504***	-4.359***
	(0.315)	(0.351)
Constant	7.876***	18.017***
	(1.034)	(2.120)
Minimum capital	-0.009**	-0.061***
	(0.005)	(0.017)
Corruption	-0.161	-0.600***
	(0.101)	(0.211)
Corruption × Minimum capital	0.002*	0.013***
	(0.001)	(0.004)
Developing country	-2.673***	-4.589***
	(0.549)	(1.225)
Minimum capital × Developing country	0.007	0.077***
	(0.007)	(0.019)
Corruption × Developing country	0.440***	1.023***
	(0.098)	(0.242)
Corruption × Minimum capital × Developing country	-0.002	-0.016***
	(0.002)	(0.004)
Observations	717	717
R-squared	0.711	0.711
# of countries	105	105
Regulation measure: Financial Freedom Index		
Lagged per capita GDP	-0.221***	-0.300***
	(0.030)	(0.063)
Lagged per capita GDP^2	0.002***	0.002***
	(0.000)	(0.001)

Table 4 continued

	(1) Necessity entrepreneurship	(2) Opportunity entrepreneurship
Unemployment rate	-0.033***	-0.256***
	(0.013)	(0.028)
Communist history	-1.678***	-4.850***
	(0.316)	(0.368)
Constant	7.761***	16.668***
	(0.969)	(2.142)
Financial Freedom Index	-0.003	-0.022
	(0.007)	(0.023)
Corruption	0.012	0.107
	(0.106)	(0.242)
Corruption × Financial Freedom Index	-0.003	-0.008
	(0.003)	(0.007)
Developing country	-2.860	0.371
	(1.753)	(2.772)
Financial Freedom Index × Developing country	-0.005	-0.074
	(0.036)	(0.051)
Corruption × Developing country	0.512	0.088
	(0.350)	(0.526)
Corruption × Financial Freedom Index × Developing country	-0.000	0.015
	(0.007)	(0.011)
Observations	746	746
R-squared	0.700	0.700
# of countries	104	104

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors in parentheses. Estimates of expression Eq. 3 using Transparency International Corruption Perceptions index to measure corruption. See the text and Appendix Table 9 for the definition of variables

negatively correlated with entrepreneurship, but we do not observe any tempering effect of corruption on that regulation measure. Again, here it is a measure different from simple administrative interaction that might be more difficult to influence through bribery.

Turning to the control variables, our results align with the existing literature. As shown in Tables 1 and 2, we observe a non-linear relationship between nascent entrepreneurship and GDP per capita. Countries with a higher GDP per capita generally offer greater career and wage possibilities. Therefore, the negative sign highlights the opportunity cost of starting a new business over other career alternatives. Meanwhile, the convexity of the link reflects the increase in opportunities to start business when a country is more developed.[9] Regarding the control variable of unemployment rate, an economy on the decline will generally see it increase and will offer relatively fewer prospects for the development of paid employment; therefore, encouraging an increasing number of individuals to turn to entrepreneurship (the "recession-push" effect). However, a depressed economic context can also have

[9] We speak here about association between entrepreneurship and growth, rather than causality. Indeed, another growing stream of the entrepreneurship literature studies how entrepreneurship, through innovation processes, is an engine for growth (see Carree and Thurik, 2008, and Audretsch, 2015). Nevertheless, Dejardin and Fritsch (2011, p.377) also emphasize that "the most important growth effects of start-ups tend to occur with a time lag of up to ten years."

Table 5 Determinants of necessity- and opportunity-motivated entrepreneurship, allowing for a differential effect of regulation and corruption in developing countries; measuring corruption with the World Bank Control of Corruption Estimate

	(1) Necessity entrepreneurship	(2) Opportunity entrepreneurship
Regulation measure: # of procedures		
Lagged per capita GDP	-0.231***	-0.360***
	(0.036)	(0.075)
Lagged per capita GDP^2	0.002***	0.003***
	(0.000)	(0.001)
Unemployment rate	-0.032***	-0.276***
	(0.011)	(0.034)
Communist history	-1.361***	-4.628***
	(0.329)	(0.420)
Constant	8.639***	22.021***
	(1.244)	(2.329)
# of procedures	-0.114***	-0.709***
	(0.044)	(0.125)
Corruption	-0.272	-0.967***
	(0.185)	(0.349)
Corruption × # of procedures	0.025	0.132***
	(0.019)	(0.036)
Developing country	0.265	-3.421*
	(1.390)	(2.067)
# of procedures × Developing country	-0.290	0.379
	(0.197)	(0.253)
Corruption × Developing country	-0.258	0.573
	(0.338)	(0.457)
Corruption × # of procedures × Developing country	0.064	-0.072
	(0.046)	(0.048)
Observations	710	710
R-squared	0.716	0.716
# of countries	103	103
Regulation measure: # of days		
Lagged per capita GDP	-0.248***	-0.407***
	(0.038)	(0.085)
Lagged per capita GDP^2	0.002***	0.003***
	(0.000)	(0.001)
Unemployment rate	-0.047***	-0.285***
	(0.013)	(0.038)
Communist history	-1.271***	-4.226***
	(0.293)	(0.379)
Constant	8.688***	21.101***
	(1.198)	(2.754)

Table 5 continued

	(1) Necessity entrepreneurship	(2) Opportunity entrepreneurship
# of days	0.002	-0.070***
	(0.009)	(0.025)
Corruption	-0.039	-0.727**
	(0.143)	(0.327)
Corruption × # of days	-0.008*	0.013
	(0.004)	(0.010)
Developing country	-1.583***	-1.683
	(0.537)	(1.255)
# of days × Developing country	-0.023	0.009
	(0.022)	(0.046)
Corruption × Developing country	-0.064	0.094
	(0.126)	(0.378)
Corruption × # of days × Developing country	0.015**	0.002
	(0.006)	(0.013)
Observations	710	710
R-squared	0.718	0.718
# of countries	103	103
Regulation measure: Official cost		
Lagged per capita GDP	-0.192***	-0.299***
	(0.032)	(0.057)
Lagged per capita GDP^2	0.001***	0.002***
	(0.000)	(0.000)
Unemployment rate	-0.025**	-0.256***
	(0.012)	(0.033)
Communist history	-1.189***	-4.043***
	(0.296)	(0.475)
Constant	6.867***	17.032***
	(1.102)	(2.062)
Official cost	-0.030	-0.266***
	(0.027)	(0.048)
Corruption	-0.014	-0.073
	(0.144)	(0.245)
Corruption × Official cost	-0.001	0.026*
	(0.010)	(0.013)
Developing country	-1.418***	-1.599
	(0.466)	(1.310)
Official cost × Developing country	0.034	0.305***
	(0.046)	(0.096)
Corruption × Developing country	0.111	-0.050
	(0.114)	(0.311)

Table 5 continued

	(1) Necessity entrepreneurship	(2) Opportunity entrepreneurship
Corruption × Official cost × Developing country	0.004	-0.026
	(0.011)	(0.018)
Observations	710	710
R-squared	0.724	0.724
# of countries	103	103
Regulation measure: Minimum capital		
Lagged per capita GDP	-0.217***	-0.349***
	(0.035)	(0.070)
Lagged per capita GDP^2	0.002***	0.003***
	(0.000)	(0.001)
Unemployment rate	-0.035***	-0.268***
	(0.011)	(0.031)
Communist history	-1.508***	-4.417***
	(0.308)	(0.358)
Constant	7.872***	19.373***
	(1.192)	(2.293)
Minimum capital	-0.013***	-0.070***
	(0.004)	(0.015)
Corruption	-0.181	-0.776***
	(0.124)	(0.242)
Corruption × Minimum capital	0.003***	0.017***
	(0.001)	(0.004)
Developing country	-2.441***	-3.545***
	(0.491)	(1.170)
Minimum capital × Developing country	0.012**	0.080***
	(0.006)	(0.018)
Corruption × Developing country	0.453***	0.870***
	(0.096)	(0.285)
Corruption × Minimum capital × Developing country	-0.004***	-0.019***
	(0.001)	(0.004)
Observations	717	717
R-squared	0.710	0.710
# of countries	105	105
Regulation measure: Financial Freedom Index		
Lagged per capita GDP	-0.217***	-0.341***
	(0.034)	(0.071)
Lagged per capita GDP^2	0.002***	0.003***
	(0.000)	(0.001)
Unemployment rate	-0.030***	-0.263***
	(0.011)	(0.029)

Table 5 continued

	(1) Necessity entrepreneurship	(2) Opportunity entrepreneurship
Communist history	-1.659***	-4.822***
	(0.312)	(0.349)
Constant	7.685***	18.304***
	(1.148)	(2.342)
Financial Freedom Index	-0.009	-0.034
	(0.007)	(0.021)
Corruption	-0.027	-0.120
	(0.137)	(0.313)
Corruption × Financial Freedom Index	-0.001	-0.004
	(0.003)	(0.008)
Developing country	-3.590*	0.422
	(1.945)	(3.019)
Financial Freedom Index × Developing country	0.020	-0.037
	(0.040)	(0.057)
Corruption × Developing country	0.776*	0.011
	(0.409)	(0.569)
Corruption × Financial Freedom Index × Developing country	-0.006	0.009
	(0.008)	(0.012)
Observations	746	746
R-squared	0.701	0.701
# of countries	104	104

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors in parentheses. Estimates of expression Eq. 3 using World Bank Control of Corruption Estimate to measure corruption. See the text and Appendix Table 9 for the definition of variables

a negative effect on entrepreneurial intentions, when potential entrepreneurs serving local demand anticipate its weakness or find it difficult to identify business opportunities (the "prosperity-pull" effect, Parker, 2009). Thereby, the expected effects of unemployment intensity on entrepreneurship go in opposite directions.

Finally, we observe that countries with a communist history have a lower percentage of nascent entrepreneurs than comparable countries. Freytag and Thurik (2007) provide similar evidence, showing that the propensity to become self-employed is lower in post-communist countries. As outlined by Estrin and Mickiewicz (2010), those countries have particular formal and informal institutions that are not favorable for entrepreneurs. Even if formal reforms toward market openness have been made, the transition is seldom complete. Financial constraints and ineffective commercial law (lack of law enforcement) still discourage poten-

tial entrepreneurs. Moreover, even when the transition is completed, those countries may still suffer from a general lack of trust, thus reducing the effectiveness of institutions. Estrin and Mickiewicz (2010) point out that traditions and social norms take a long time to change, what they refer to as a "generational" effect.

In the following section, we deeper investigate how these first results may differ if we take the heterogeneity in entrepreneurship into account. We then qualify the results in a third subsection by introducing one additional dimension, the level of economic and human development.

4.2 Impact of corruption and entry-regulation according to entrepreneurial motives

Individuals may have heterogeneous responses to the institutional framework because of innate, different

personal characteristics and career alternatives. Table 3 displays the empirical results of Eq. 2, where we allow for this heterogeneity by distinguishing between opportunity- and necessity-motivated entrepreneurship.

We first state the common trends in the impacts of explanatory variables on opportunity- and necessity-motivated entrepreneurs. We then emphasize the divergence in magnitude of these effects.

4.2.1 Common trends

Table 3 presents evidence that the motivation to open a business does matter for the understanding of the corruption—regulation interplay. Each panel of Table 3 uses a different entry-regulation measure. In each panel, the left column reports the estimates obtained using the Transparency International Corruption Perceptions Index, while the right columns reports those obtained using the World Bank Control of Corruption Estimate. The coefficients related to necessity- and opportunity-motivatedentrepreneurship, jointly estimated, are reported in odd- and even-numbered columns, respectively. Additional unnumbered columns report the *p*-values of the explanatory variables' coefficients equality test across dependent variables (covariance between the two estimates being computed, the method of stacking data—see Section 3.2—allows testing restrictions on parameters of different equations).

As for nascent entrepreneurship, the number of procedures to open a business, the number of days to open a business, and the Financial Freedom Index reduce the propensity of becoming an entrepreneur whatever the motive, results being unaffected by the source of the selected corruption index. That is, in the absence of corruption, entry-regulation hinders the creation of firms. In a context of effective institutions (in the view of proper regulation), corruption is, on the contrary, detrimental or insignificant for entrepreneurship. Thus, empirical estimations generally validate hypothesis 1a—corruption is negatively correlated with entrepreneurship—, while hypothesis 1b—entry-regulation is negatively correlated with entrepreneurship—is only validated for select specifications.

For the number of days and the number of procedures required to open a business, we also find a positive and significant coefficient for the interaction term between corruption and entry-regulation, which supports hypothesis 2b. This *weak* view of the greasing the wheel hypothesis is equally illustrated by the positive slope of the marginal effects of corruption on entrepreneurship (with respect to the level of regulation) observed in Figs. 2 and 3.

Finally, we observe a positive marginal effect of corruption on entrepreneurship, for high values of regulation, which would support the *strong* view (see hypothesis 2c predicting that the total marginal effect of corruption on entrepreneurship is positive). For example, in the first column of the upper panel of Table 3, we observe that, at value zero of procedures required to start a business, a one-point increase in the corruption index decreases necessity-motivated entrepreneurship by 0.335 percentage points. That is a reduction of 11.32% of necessity-motivated entrepreneurship at the sample mean (see Appendix Table 9). In contrast, at the upper limit of the number of procedures, the same increase in the corruption index would enhance necessity-motivated entrepreneurship by 0.805 percentage points (increase of 27.20% at the sample mean). The strong view is also illustrated in Figs. 2 and 3 by the positive values of the marginal effects of corruption for high values of regulation.

However, distributions of entry-regulation measures plotted in Fig. 4 reveal that only a few countries in our sample actually have such high levels of regulation. For the majority of the sample, the marginal effect of corruption on opportunity- and necessity-motivated entrepreneurship is indeed negative or insignificant, as shown by Figs. 2 and 3.

Turning to the control variables, findings are consistent with existing literature. As shown by McMullen et al. (2008), the GDP per capita is a determinant of both opportunity- and necessity-motivated entrepreneurship. Further, we still have a non-linear relationship with GDP per capita. The negative sign reflects the attractiveness of creating a business with respect to the employment option, while the quadratic function illustrates the increase in opportunities when economic development is higher. Finally, communist history and unemployment rate are both negatively correlated to the two types of entrepreneurship.

(a) Effect of corruption on necessity-motivated entrepreneurship.
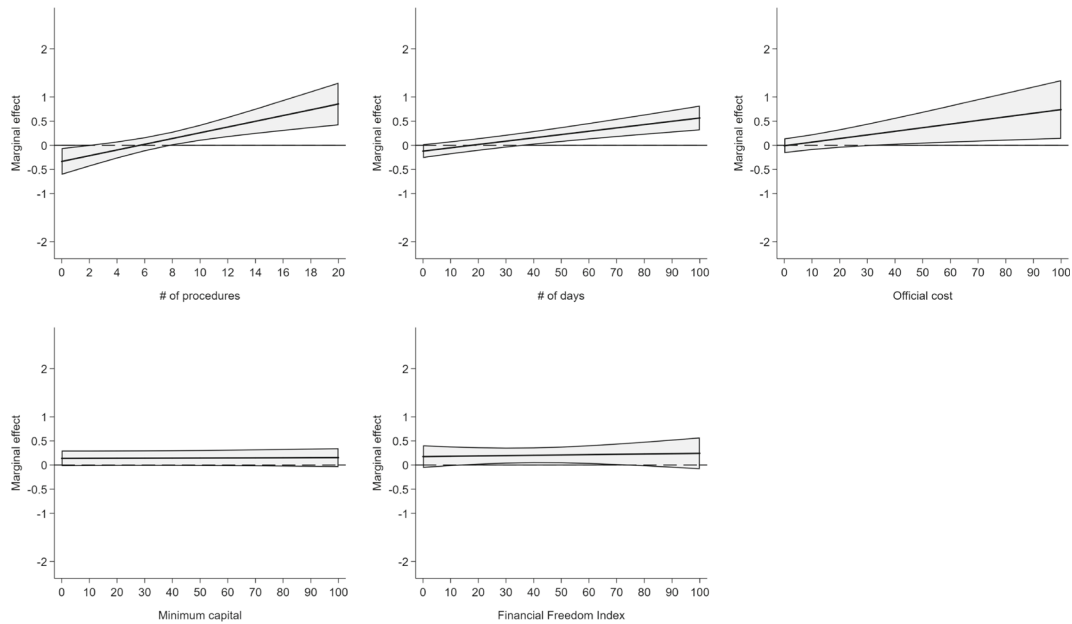
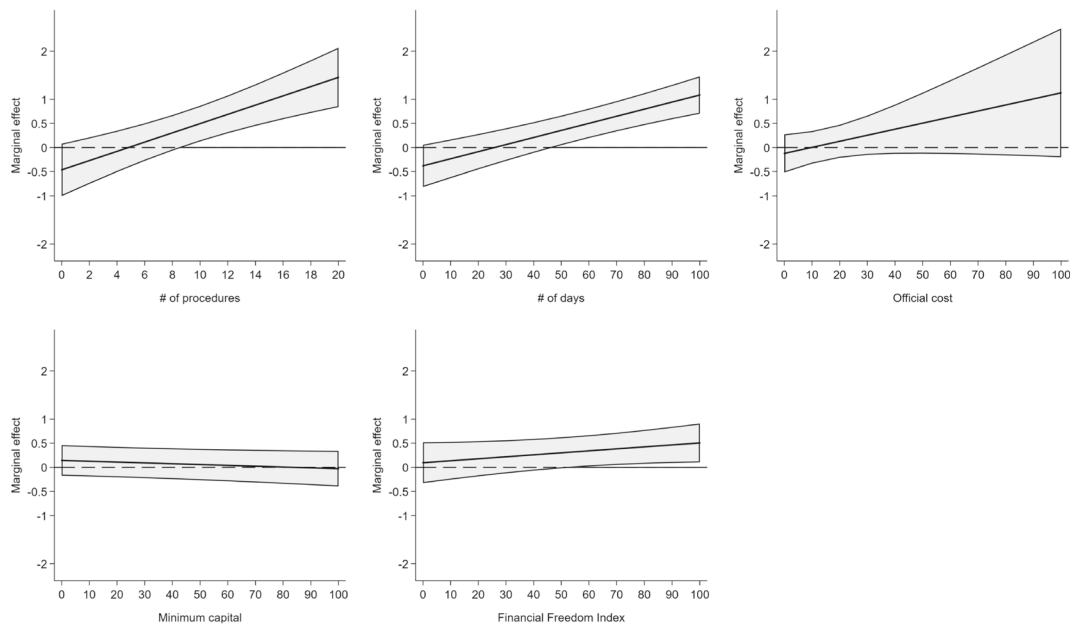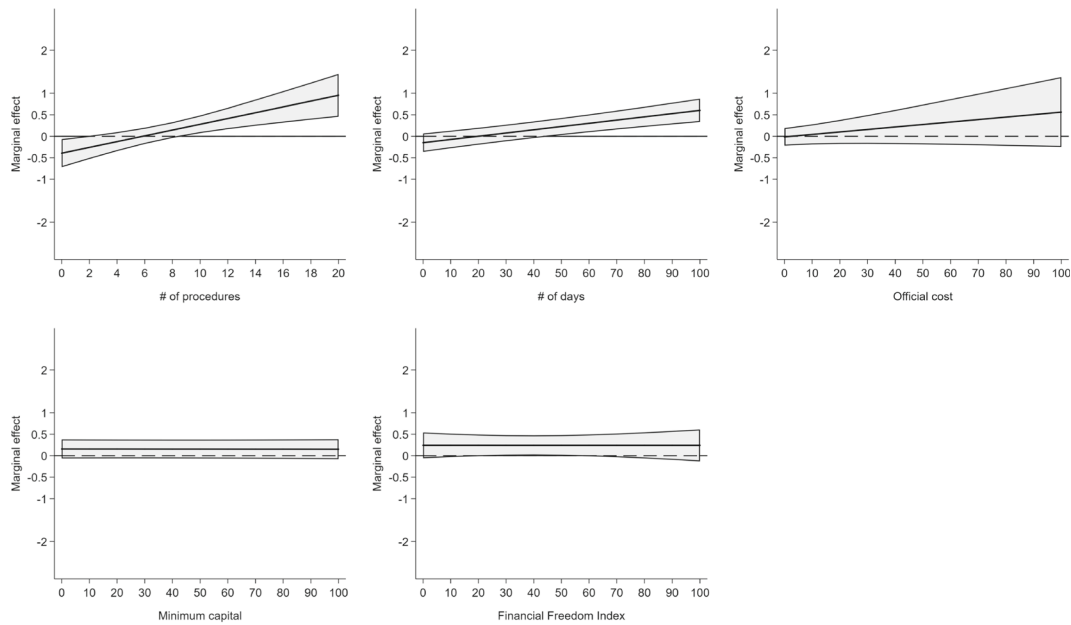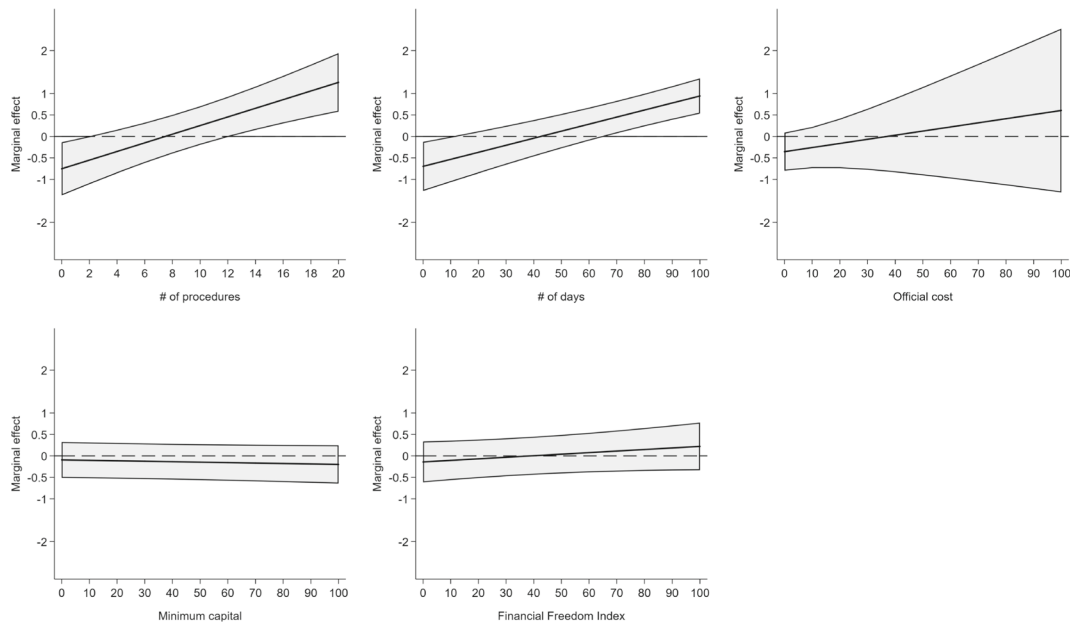(b) Effect of corruption on opportunity-motivated entrepreneurship.

Fig. 2 Marginal effect of corruption on necessity- and opportunity-motivated entrepreneurship at different levels of entry-regulation; measuring corruption with the Transparency International Corruption Perceptions Index. Marginal effects from expression Eq. 2 using Transparency International Corruption Perceptions Index to measure corruption. See Table 3 for raw coefficients. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables

(a) Effect of corruption on necessity-motivated entrepreneurship.

(b) Effect of corruption on opportunity-motivated entrepreneurship.

Fig. 3 Marginal effect of corruption on necessity- and opportunity-motivated entrepreneurship at different levels of entry-regulation; measuring corruption with the World Bank Control of Corruption Estimate. Marginal effects from expression Eq. 2 using World Bank Control of Corruption Estimate. to measure corruption. See Table 3 for raw coefficients. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables
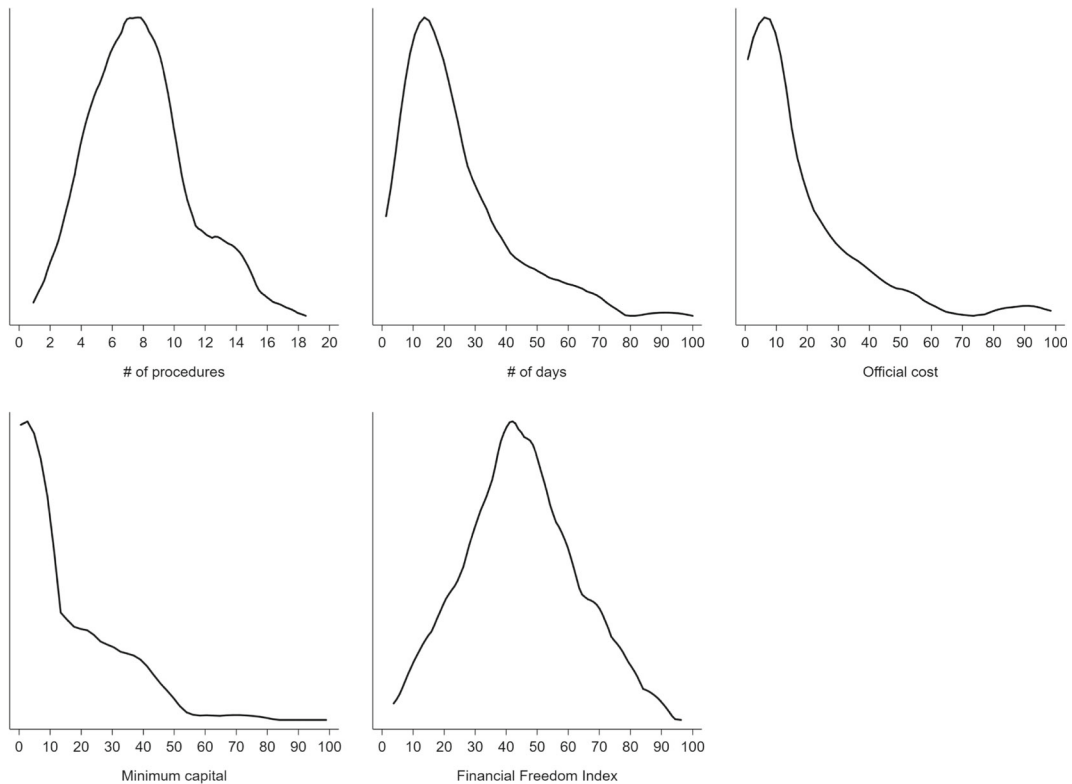
Fig. 4 Distributions of entry-regulation measures. Distributions obtained using a kernel-density estimation on 100 points over the full range of data. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables

4.2.2 Impacts of different magnitudes

If correlations between explanatory variables and the two types of entrepreneurship go in the same direction, the coefficients of explanatory variables generally differ in magnitude across the two dependent variables, as shown by the *p-value for coefficients equality* columns in Table 3. Opportunity-driven entrepreneurs are often more sensitive to the explanatory variables than necessity-motivated entrepreneurs.

For the three significant entry-regulation measures, the negative impact on opportunity-motivated entrepreneurship is bigger than the negative impact on necessity-motivated entrepreneurship (at value zero of corruption), which validates hypothesis 3a. Entry-regulation enters into the costs of an activity and reduces expected returns. The administrative procedures required to start a business are both time and money consuming for individuals. If the regulation is too heavy, expected returns may become too small relative to the alternative career options and the individual may prefer not to establish the firm. However, the administrative burden may be perceived differently by the two kinds of entrepreneurs. The opportunity cost of spending time in procedures (number of procedures or days) is presumably larger for opportunity-motivated entrepreneurs because they are more likely to be employed. This echoes Ardagna and Lusardi (2010), who show that different dimensions of regulation—regulation on product and labor markets, contract enforcement, and entry-regulation—can affect individual characteristics of entrepreneurs, like their social network and their attitude toward risks, that are correlated with the motivation to open a business.

On the contrary, at value zero of regulation, the coefficients of corruption on opportunity- and necessity-

motivated entrepreneurship are not statistically different. Accordingly, hypothesis 3b, which states that the impact of corruption would be higher on opportunity-motivated than on necessity-motivated entrepreneurs, is not supported by empirical findings. However, the tempering effect of corruption on regulation is statistically bigger for opportunity-motivated entrepreneurs than for necessity-entrepreneurs. For example, in the first two columns of the upper panel of Table 3, we observe that the marginal effect of corruption on necessity-motivated entrepreneurs becomes positive when the number of procedures exceeds 5.58, while the threshold is 4.83 for opportunity-motivated entrepreneurs. At the upper limit of the number of procedures, a one point increase in the corruption index would enhance necessity-motivated entrepreneurship by 0.805 percentage points, and opportunity-motivated entrepreneurship by 1.36 percentage points. This corresponds to an increase of 27.20 and 16.96% at the sample means of necessity- and opportunity-motivated entrepreneurship, respectively. This result supports hypothesis 3c—the tempering effect of corruption and entry-regulation on each other is higher for opportunity-motivated entrepreneurs than for necessity-motivated entrepreneurs. Thus, suggesting that supply-side corruption is more likely to be initiated by entrepreneurs running profitable projects. This is also illustrated by the marginal effects slopes that are slightly steeper in Fig. 2(b) than in Fig. 2(a). For the other regulation measure, the marginal effects are non-significant for the two types of entrepreneurship, just like for nascent entrepreneurship.

Concerning the control variables, we observe the same patterns. The levels of opportunity-motivated and necessity-motivated entrepreneurship depend on the economic development of the country. As the GDP per capita rises, the economy offers increasing paid employment possibilities and the benefit of becoming an entrepreneur relatively decreases (Gindling & Newhouse, 2014). Here a typical individual becomes more likely to prefer being an employee over starting an own activity. Moreover, a higher GDP per capita is generally associated with more generous unemployment benefits (Robalino et al., 2009), which subsequently reduces the need to resort to subsistence activity. Empirical results stress a higher impact on opportunity- than on necessity-motivated entrepreneurship, which reflect the increase in the opportunity cost of opening a business while individuals may choose between different career alternatives and wage opportunities. Similarly, the coefficients for unemployment rate seem to indicate a dominant "prosperity-pull" effect (Parker, 2009), which is, as one might expect, even more marked for opportunity entrepreneurship.

Finally, we find that the negative correlation of the dummy for communist history is higher for opportunity than for necessity entrepreneurship. This finding might be explained by different factors. Combining the works of Scott (2007) and Estrin and Mickiewicz (2010), the institutional dimensions of an entrepreneur may be divided in four pillars: regulative, normative, cognitive, and conducive. Countries with a communist history have shortfalls across all four. Concerning the normative pillar, Sztompka (1996) emphasizes that the norms and values inherited from communism are unfavorable to entrepreneurship because they promote dependence, conformity, and suffer from rigidity in beliefs over tolerance and innovation. The regulative dimension refers to regulation, rules, laws, and, as well, enforcement. The general high level of corruption and weak rule of law in these countries—like the security of property rights—(Estrin & Mickiewicz, 2010) hinder entrepreneurship. Even if formal reforms toward market openness have been made, transition is seldom complete and governments keep playing a significant role in business (authoritarian regimes in some countries). Politics of privileges and influence have been inherited from the past (DiFranceisco & Gitelman, 2009; and Miller et al., 2009), affecting opportunities to open and develop businesses. According to Ge et al. (2017), opportunities in transition economies often emerge from political markets and incumbent firms with existing ties to the state benefit from competitive advantages. The authors show that politically-connected firms will perceive more opportunities in the market and invest more than others. Hellman et al. (2003), studying 22 transition economies in Eastern Europe, show that large new firms developed state capture (thus implying bribery), while influence, as a strategy to compete with influential incumbent firms, does not work. Ultimately, only a few firms succeed in influencing or capturing the state, with some private returns, while consequences are negative for all other firms in the market. Thus, it is not surprising if bribery

and connections are perceived as a necessity for a business to survive in post-communist countries (DiFranceisco & Gitelman, 2009) with tolerance for corruption and illegal activities being the norm (Tonoyan et al., 2010). The features of the normative and regulative pillars entail a lower perception of opportunities to be seized in the market (cognitive pillar). Lastly, ex-communist countries do not create an environment conducive for innovation. Stenholm et al. (2013) underscore the need for high-impact entrepreneurs (often associated to opportunity-entrepreneurs) to evolve in an "environment providing support and interplay between innovation, skills and resources", what they refer to as "conducive pillar" (Stenholm et al., 2013, p.183). However, as pointed out by Estrin and Mickiewicz (2010), transition economies score poorly in access to credit. Many banks are still owned by the government and favor public companies over private ones, while informal networks substituting for this ineffective financial formal sector are limited. Additionally, the impediment to accumulate wealth under the communist regime generally left little recourse to this alternative.

In the next subsection, we assess the robustness of these results to the introduction of countries' level of development estimated through the Human Development Index.

4.3 Importance to distinguish among groups of countries

We test whether less developed countries observe a different initial level of necessity- or opportunity-entrepreneurship and whether the effects of corruption and regulation, as well as their interplay, differently impact entrepreneurship in the two groups of countries (see Eq. 3 for the specifications). Results obtained when using the Transparency International Corruption Perceptions Index and the World Bank Control of Corruption Estimate are displayed in Tables 4 and 5, respectively.

Figures 5 and 6 display the marginal effects of corruption on opportunity- and necessity-motivated entrepreneurs, according to the level of regulation and by group of countries for Transparency International

Corruption Perceptions Index.[10] To better take into account the distribution of entry-regulation measures in the two groups of countries, marginal effects evaluated at the mean and at the 25th and 75th percentiles of each entry-regulation measure are further tabulated in Tables 7 and 6.

At first glance, Figs. 5 and 6 provide reasonable support for the weak view of the greasing the wheels when we consider opportunity-motivated entrepreneurship. In most cases, we observe a positive slope, reflecting the fact that corruption would inflict less damage (perhaps even being beneficial) as the regulation burden increases. This is less obvious for necessity-motivated entrepreneurship: the slope is gentler in developing countries and almost null in developed countries, thus indicating no tempering effect of corruption on regulation. Additionally, we observe, for opportunity-motivated entrepreneurship, positive marginal effects of corruption for some extreme values of regulation, which would support a strong interpretation of the greasing the wheels hypothesis in those particular contexts. However, as we highlight in the previous section, very few countries have these regulation levels.

Tables 7 and 6 display marginal effect values at levels of entry-regulation measures that are relevant for developing and developed countries. Results indicate that corruption only has a positive marginal effect for some regulation measures for necessity-motivated entrepreneurship in developing countries. It partly validates hypothesis 4, which predicts a higher tempering effect of corruption and regulation in developing than in developed countries, for necessity- and opportunity-motivated entrepreneurs. In developing countries, the marginal effects for opportunity-motivated entrepreneurship are rather undetermined: positive for some regulation measures with the Transparency International Corruption Perceptions Index, but always non-significant with the World Bank Control of Corruption Estimate. In contrast, in developed countries, corruption does deter opportunity-motivated entrepreneurship or it is non-significant. In this development context, we never find a significant and positive coefficient at relevant regulation levels, which rejects

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[10] Marginal effects associated with the World Bank Control of Corruption Estimate are presented in Appendix Figs. 7 and 8.

(a) Effect of corruption on necessity-motivated entrepreneurship in developing countries.
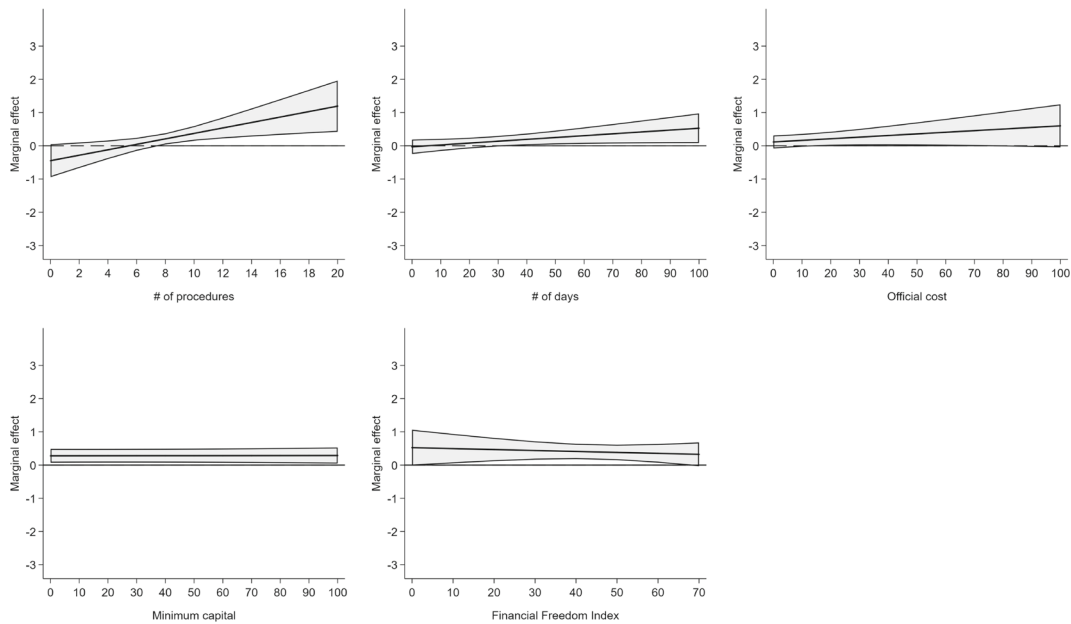
(b) Effect of corruption on necessity-motivated entrepreneurship in developed countries.
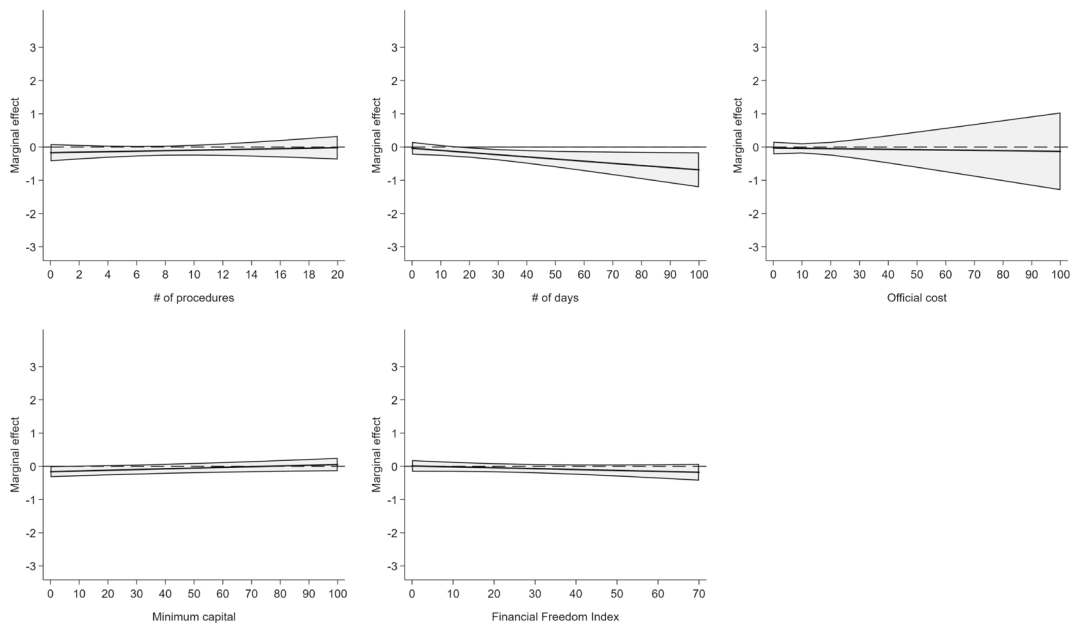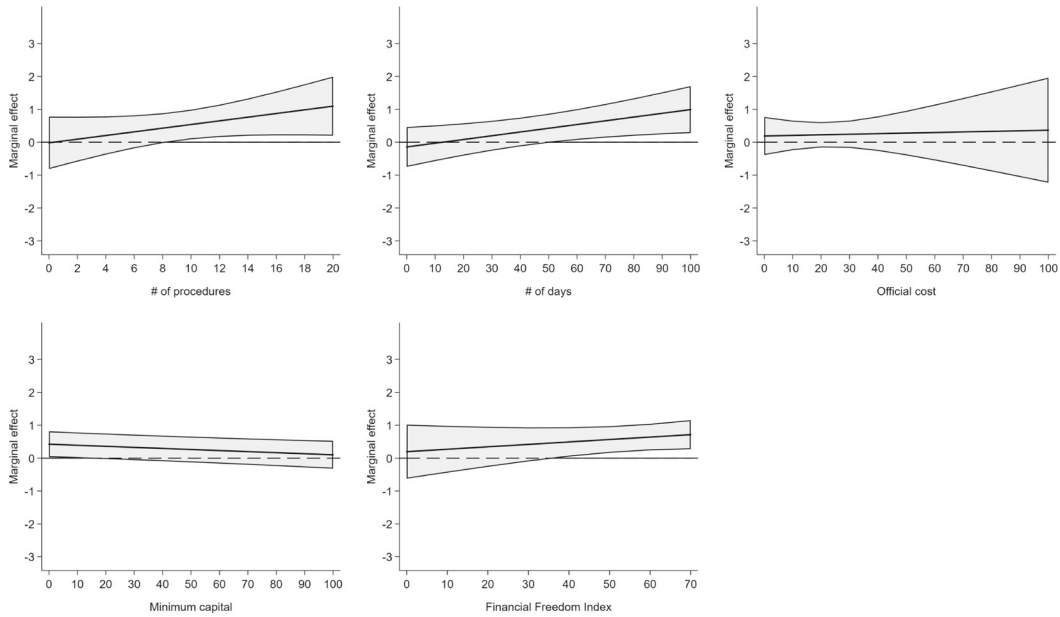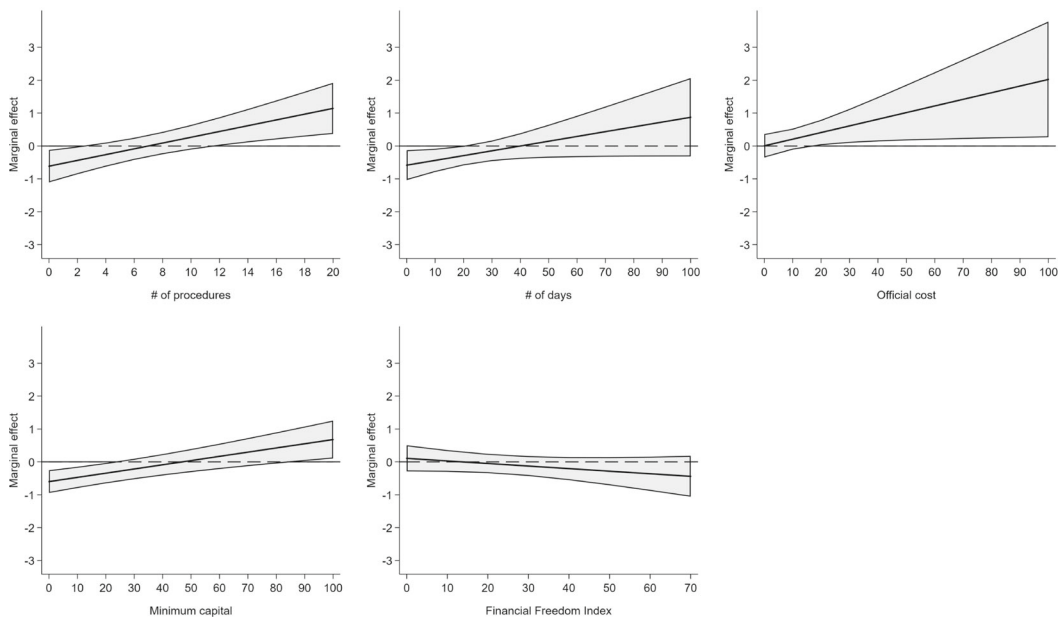

Fig. 5 Marginal effect of corruption on necessity-motivated entrepreneurship at different levels of entry-regulation in developing and developed countries; measuring corruption with the Transparency International Corruption Perceptions Index. Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). Marginal effects from expression Eq. 3 using Transparency International Corruption Perceptions Index to measure corruption. See Table 4 for raw coefficients. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables

(a) Effect of corruption on opportunity-motivated entrepreneurship in developing countries.

(b) Effect of corruption on opportunity-motivated entrepreneurship in developed countries.

Fig. 6 Marginal effect of corruption on opportunity-motivated entrepreneurship at different levels of entry-regulation in developing and developed countries; measuring corruption with the Transparency International Corruption Perceptions Index.s. Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). Marginal effects from expression Eq. 3 using Transparency International Corruption Perceptions Index to measure corruption. See Table 4 for raw coefficients. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables

Table 6 Marginal effect of corruption on necessity- and opportunity-motivated entrepreneurship at different levels of entry-regulation in developing and developed countries; measuring corruption with the Transparency International Corruption Perceptions Index

Level of reg.	Marginal effect of corruption on necessity-motivated entrepreneurship					Marginal effect of corruption on opportunity-motivated entrepreneurship				
	# of proc.	# of days	Official cost	Minimum capital	Financial Freedom	# of proc.	# of days	Official cost	Minimum capital	Financial Freedom
Developing countries										
25th percent.	0.044	0.031	0.135	0.278**	0.409***	0.315	-0.019	0.197	0.423*	0.492*
	[0.119]	[0.109]	[0.116]	[0.126]	[0.140]	[0.304]	[0.326]	[0.316]	[0.239]	[0.271]
Mean	0.279**	0.152	0.209*	0.280**	0.386***	0.475*	0.227	0.224	0.345	0.552**
	[0.111]	[0.097]	[0.127]	[0.125]	[0.138]	[0.271]	[0.271]	[0.234]	[0.235]	[0.249]
75th percent.	0.455***	0.199*	0.225*	0.279**	0.352**	0.594**	0.322	0.229	0.380	0.640***
	[0.160]	[0.107]	[0.132]	[0.125]	[0.171]	[0.282]	[0.264]	[0.232]	[0.236]	[0.245]
Developed countries										
25th percent.	-0.139	-0.075	-0.030	-0.161	-0.043	-0.262	-0.497**	0.020	-0.600***	-0.049
	[0.111]	[0.104]	[0.113]	[0.101]	[0.083]	[0.222]	[0.237]	[0.213]	[0.211]	[0.178]
Mean	-0.124	-0.137	-0.034	-0.122	-0.068	-0.090	-0.358*	0.109	-0.366*	-0.121
	[0.097]	[0.094]	[0.097]	[0.094]	[0.084]	[0.204]	[0.191]	[0.197]	[0.189]	[0.182]
75th percent.	-0.109	-0.153*	-0.036	-0.105	-0.097	0.089	-0.322*	0.145	-0.264	-0.205
	[0.092]	[0.093]	[0.094]	[0.092]	[0.094]	[0.206]	[0.184]	[0.194]	[0.187]	[0.213]

*** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors in parentheses. "Reg.", "percent.", "percent." and "proc." stand for "regulation", "percentile" and "procedures", respectively. Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). Marginal effects from expression Eq. 3 using Transparency International Corruption Perceptions index to measure corruption. See Table 4 for raw coefficients. See the text and Appendix Table 9 for the definition of variables

Table 7 Marginal effect of corruption on necessity- and opportunity-motivated entrepreneurship at different levels of entry-regulation in developing and developed countries; measuring corruption with the World Bank Control of Corruption Estimate

Level of reg.	Marginal effect of corruption on necessity-motivated entrepreneurship					Marginal effect of corruption on opportunity-motivated entrepreneurship				
	# of proc.	# of days	Official cost	Minimum capital	Financial Freedom	# of proc.	# of days	Official cost	Minimum capital	Financial Freedom
Developing countries										
25th percent.	0.004	-0.028	0.110	0.273*	0.465***	-0.038	-0.469	-0.123	0.094	0.102
	[0.147]	[0.151]	[0.147]	[0.158]	[0.180]	[0.363]	[0.431]	[0.335]	[0.303]	[0.326]
Mean	0.258**	0.118	0.155	0.267*	0.408**	0.132	-0.145	-0.125	0.032	0.145
	[0.124]	[0.128]	[0.170]	[0.155]	[0.175]	[0.296]	[0.338]	[0.355]	[0.298]	[0.325]
75th percent.	0.449***	0.174	0.165	0.269*	0.324	0.260	-0.020	-0.126	0.060	0.208
	[0.168]	[0.129]	[0.179]	[0.156]	[0.207]	[0.282]	[0.313]	[0.375]	[0.300]	[0.352]
Developed countries										
25th percent.	-0.172	-0.086	-0.014	-0.181	-0.042	-0.439	-0.647**	-0.054	-0.776***	-0.201
	[0.140]	[0.133]	[0.140]	[0.124]	[0.112]	[0.274]	[0.290]	[0.242]	[0.242]	[0.237]
Mean	-0.122	-0.160	-0.017	-0.118	-0.049	-0.180	-0.520**	0.061	-0.469**	-0.239
	[0.128]	[0.127]	[0.122]	[0.120]	[0.113]	[0.259]	[0.253]	[0.227]	[0.234]	[0.233]
75th percent.	-0.071	-0.180	-0.018	-0.091	-0.057	0.088	-0.487**	0.107	-0.335	-0.283
	[0.126]	[0.128]	[0.118]	[0.119]	[0.125]	[0.264]	[0.248]	[0.225]	[0.238]	[0.259]

***$p<0.01$, **$p<0.05$, *$p<0.1$. Standard errors in parentheses. "Reg.", "percent." and "proc." stand for "regulation", "percentile" and "procedures", respectively. Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). Marginal effects from expression Eq. 3 using World Bank Control of Corruption Estimate to measure corruption. See Table 5 for raw coefficients. See the text and Appendix Table 9 for the definition of variables

the strong greasing the wheels hypothesis for these entrepreneurs.

5 Conclusion

5.1 Discussion

Empirical papers provide conflicting evidence on the effect of corruption on entrepreneurship. Dreher and Gassebner (2013) demonstrate that corruption may sometimes be beneficial for entrepreneurship as it greases the wheels of the administrative machinery. Using a cross-country dataset, they find that when entry-regulation is too strict, corruption tempers its negative effect on entrepreneurship. Similarly, Bologna and Ross (2015) find, at the Brazilian municipality level, that corruption is generally associated with less business activity but that the correlation becomes insignificant or positive when the quality of institutions is weak. In contrast, Dutta and Sobel (2016) find that corruption always deters entrepreneurship. It is only less damaging when the business climate is bad.

This paper contributes to the literature by studying the impact of corruption and entry-regulation not just on different types of entrepreneurs but also across different economic development contexts. Using a broad, cross-country dataset (105 countries over the 2003–2016 period), we find that corruption and regulation correlate negatively with entrepreneurship; further, these generally have a tempering effect on each other. This supports a weak interpretation of the greasing the wheels hypothesis. If we consider the entry-regulation measures included in the analysis, some more than others may appear able to "be softened" by corruption. This is particularly the case for the number of procedures and the number of days required to start a new business, two measures affected by the interaction "quality" with officials. A little financial boost can indeed help put an application on top of the pile. On the contrary, corruption does not soften the official cost of starting a business or the minimum capital required to start a business, which indeed would hardly be changed. This is less clear for the Financial Freedom Index given its very synthetic nature.

We also underline that while corruption might grease the wheels of ineffective administrative machinery, the marginal effect of corruption will be insignificant or negative within the group of developed countries. We only find strong evidence of marginal positive effects for necessity-motivated entrepreneurs in developing countries. The argument, according to which *"corruption may be beneficial in a second best world by alleviating the distortions caused by ill-functioning institutions"* (Méon & Weill, 2010, p.244), would then find a limited application if we stick to the "strong view" that requires a positive net effect of corruption, capable of compensating for the inefficiency of the administration.

Though, the existence of a tempering effect between corruption and regulation advocates for considering corruption and regulation simultaneously. A policy aimed at reducing entry-regulation will only have a positive effect on entrepreneurship if it is effectively implemented, that is if officials do not have discretion to slow down procedures in order to seek rents. Thus, anti-bribery policies will probably not be successful if the institutional quality is weak. Before tackling corruption, which in some (extreme) cases would help entrepreneurs to soften rigid public authorities applying inappropriate rules or misusing their discretionary power, priority should be given to establishing a fair business context and regulations favorable to the creation and development of entrepreneurial activities. This is most likely how corruption can also be curbed thereafter.

Further, high levels of corruption might require more regulation in order to limit the opportunistic behavior of politicians and officials. Notwithstanding, we do believe that other measures of regulation would better reflect that dimension than entry-regulation. In particular, secure property rights (Johnson et al., 2002) and accountability of politicians (Aidt et al., 2008) are proven to be necessary to offer an environment conducive to business activities.

We also provide evidence that opportunity-motivated entrepreneurs react in higher proportions to corruption and entry-regulation than necessity-motivated entrepreneurs. Because opportunity-motivated entrepreneurs generally have outside career options, while necessity-motivated entrepreneurs do not, they are more sensitive to an increase in the switching cost to become entrepreneur—stricter entry regulation. Because they expect higher returns, they are also likelier to use bribes in order to speed-up the pro-

cedures. However, our results suggest that this "positive" effect of corruption is generally not sufficient to counterbalance the uncertainty of ventures' payoffs inherent to corrupted environment, which rather deters business activity. Indeed, corruption would deter opportunity-motivated entrepreneurship in the group of developed countries. This result is of particular interest given the collected evidence that most of the impact in terms of productivity, economic growth, and development that is linked to entrepreneurship can be expected from opportunity-entrepreneurs rather than necessity-entrepreneurs (Wong et al., 2005; Ács, 2006).[11]

Corruption and regulation would then be particularly harmful for economic development. Moreover, tolerance for corruption, because of its substituting effect to ineffective institution, is damaging for the whole society. "Clearly, if regulation is onerous and inefficient, then paying for an exemption seems efficient. However, permitting such individualized law compliance can be very harmful. [...] Endemic corruption has implications for the legitimacy of the state in the eyes of the citizens. [...] This can lead to vicious spirals" (Rose-Ackerman, 2004, p.18). Acemoglu (1995) and Acemoglu and Robinson (2008) suggest that problematic institutional and political situations may indeed be persistent, with economies stuck at a low, stationary, level. Rather than tolerating corruption because it substitutes for ineffective institutions (second best), one should rather try to achieve the first best by repealing the existing rules or legalizing payment (Rose-Ackerman, 2010).

5.2 Limitations and research avenues

The paper has several limitations. First, the data and methodology used do not allow to address a causality relationship, while our interpretation would tend to it. This limit comes from several potential issues. A first issue occurs when some omitted variables are correlated with dependent and explanatory variables, which could lead to spurious results. In particular, due to its cross-country analysis, we are not able to

control for all country-level variables, including formal and informal institutions (country fixed effect would impede the study of the relatively time-invariant explanatory variables) that could affect both corruption and entrepreneurship. For example, countries might have adopted policy-packages aimed at fighting corruption and enhancing entrepreneurship (IMF policies, OECD anti-bribery convention, United Nations convention against corruption, etc.), inducing a spurious negative correlation between both variables. If this is the case, the apparent negative correlation between corruption and regulation would either be overestimated or, in reality, non-existent. Norms and culture could also impact both corruption and the level of entrepreneurship. Gino and Wiltermuth (2014) show that the capacity to break rules (a measure of creativity that might be determined by norms and culture) positively affects both the propensity to become entrepreneurs and dishonesty. The negative correlation between corruption and entrepreneurship pointed out in our empirical analysis would be underestimated. One might also think that negative economic shocks—even if partly controlled by the level of GDP per capita and the unemployment rate—lead to more necessity-entrepreneurship and, simultaneously, to the development of the shadow economy and the practice of illegal behaviors. The negative impact of corruption on entrepreneurship would then be equally understated.

A second issue is endogeneity. For instance, Arend (2016) shows that entrepreneurs would be likelier than non-entrepreneurs to adopt dishonest behavior (to make untruthful declarations). Again, this reverse causality would underestimate the negative impact of corruption on the level of entrepreneurship. Moreover, within the lens of the set of occupational choice theories in which individuals choose between entrepreneurship and rent-seeking activities, one might consider that both variables are simultaneously co-determined by the aggregation of individual choices, an increase of one variable being associated with a lower value of the other. Though, while the choice between being self-employed or a paid worker is a binary choice, the choice between productive activity and rent-seeking is not mutually exclusive. Indeed, one individual might choose to be an entrepreneur but to spend some time in rent-seeking activities to receive favors from power-holders.

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[11] However, (Parker, 2018) asks for caution regarding results of studies linking growth and entrepreneurship, which may suffer from endogeneity issues.

Finally, the variable with which corruption is interacted—the level of entry-regulation—could also suffer from identification issues. Indeed, according to Parker (2018), the negative correlation between entry-regulation and entrepreneurship could be overstated due to omitted variables (countries' industry structure, legal system, conventions of transparency, and culture). Reverse causality could also bias the findings, as a population comprising a higher proportion of entrepreneurs is likelier to promote a softening of barriers to entry.

Moreover, empirical results rely on country-level perception indexes of public sector corruption by businessman and experts. These indexes have the advantage of offering good coverage, while the possibility to rely on more direct observations is very rare (see Reinikka & Svensson, 2006 for the collection of data at an individual firm level). In a literature review about corruption in developing countries, Olken and Pande (2012) stress a high correlation between perception measures and direct measures when experts or business people are interviewed. While we win in generality and in larger coverage, we unfortunately also lose in accuracy. We might not distinguish between "petty" and "grand" corruption or types of corruption (market or parochial corruption, clientelism, state capture,

political connections, etc.). For example, the Transparency International Corruption Perceptions Index covers bribery, diversion of public funds, the effective prosecution of corruption cases to adequate legal frameworks, access to information, and legal protections for whistleblowers, journalists, and investigators. However, the Transparency International Corruption Perceptions Index does not measure activities such as tax fraud, money laundering, financial secrecy, or illicit flows of money. The World Bank Control of Corruption Estimate captures perceptions 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. Disaggregated measures would shed lights on potentially diverging results. Petty corruption (small amounts of bribery at low administrative levels) could alleviate the administrative burden for individuals willing to open a business, while state capture or endemic corruption would rather be additive obstacles for entrepreneurship. Additionally, the paper only considers entry-regulation while other dimensions of the legal system, institutions, or law enforcement, could also affect entrepreneurship and interact differently with corruption. These gaps indicate the need for future research.

Appendix

Table 8 List of countries included in the sample

Algeria*	Ghana*	Philippines*
Angola*	Greece	Poland*
Argentina*	Guatemala*	Portugal*
Australia	Hong Kong	Qatar
Austria	Hungary*	Romania*
Bangladesh*	Iceland	Russia*
Barbados*	India*	Saudi Arabia*
Belgium	Indonesia*	Senegal*
Belize*	Iran*	Serbia
Bolivia	Ireland	Singapore
Bosnia and Herzegovina*	Israel	Slovakia*
Botswana*	Italy	Slovenia
Brazil*	Jamaica*	South Africa*
Bulgaria*	Japan	South Korea
Burkina Faso*	Jordan*	Spain
Cameroon*	Kazakhstan*	Suriname*
Canada	Latvia*	Sweden
Chile*	Lebanon*	Switzerland
China*	Libya*	Syria*
Colombia*	Lithuania*	Taiwan*
Costa Rica*	Luxembourg	Thailand*
Croatia*	Macedonia*	Tonga*
Cyprus	Malawi*	Trinidad and Tobago*
Czech Republic	Malaysia*	Tunisia*
Denmark	Mexico*	Turkey*
Dominican Republic*	Montenegro*	Uganda*
Ecuador*	Morocco*	United Arab Emirates*
Egypt*	Namibia*	United Kingdom
El Salvador*	Netherlands	United States
Estonia*	New Zealand	Uruguay*
Ethiopia*	Nigeria*	Vanuatu*
Finland	Norway	Venezuela*
France	Pakistan*	Vietnam*
Georgia*	Panama*	Yemen*
Germany	Peru*	Zambia*

* refers to countries with a HDI index lower than 0.8 in 2002

Table 9 Variables' description and summary statistics

	Source	Description
Nascent entrepreneurship	Global Entrepreneurship Monitor	Share of individuals (in adult population) who have taken some action toward creating a business
Necessity-motivated entrepreneurship	Global Entrepreneurship Monitor	Share of individuals (in adult population) who report that they established their firm in order to take advantage of a business opportunity
Opportunity-motivated entrepreneurship	Global Entrepreneurship Monitor	Share of individuals (in adult population) who report that they established their firm because they have no better choice for work
# of procedures	World Bank	Number of procedures to start a business
# of days	World Bank	Number of days required to start a business
Official cost	World Bank	Cost of starting a business, in percentage of per capita GDP
Minimum capital	World Bank	Capital required to start a business, in percentage of per capita GDP
Financial Freedom Index	Heritage Foundation	Index of the relative openness of each country's banking and financial system (the extent of government regulation of financial services; the extent of state intervention in banks and other financial services; the difficulty of opening and operating financial services firms (for both domestic and foreign individuals); and government influence on the allocation of credit). Inverted so that a higher value reflects less freedom and more intervention of the state in the financial system. 0–100 scale
Transparency International corruption index	Transparency International	Corruption Perceptions Index. Inverted so that a higher value reflects more corruption. 0–10 scale
World Bank corruption index	World Bank	Control of Corruption Estimate. Inverted so that a higher value reflects more corruption. Rescaled between 0 and 10

Table 9 continued

	Mean	Std	Min	Median	Max
Nascent entrepreneurship	6.51	4.97	0.45	5.02	32.34
Necessity-motivated entrepreneurship	2.96	2.88	0.09	1.90	19.55
Opportunity-motivated entrepreneurship	8.02	5.34	0.81	6.29	31.89
# of procedures	7.69	3.47	2.00	7.00	19.00
# of days	25.72	27.32	1.50	16.00	204.00
Official cost	13.57	22.67	0.00	6.69	226.61
Minimum capital	23.31	91.26	0.00	0.04	1236.46
Financial Freedom Index	40.25	17.64	10.00	40.00	90.00
Transparency International corruption index	4.44	2.21	0.30	4.90	8.50
World Bank corruption index	3.78	2.10	0.06	4.18	7.96

Table 10 Correlation matrices of entry-regulation measures

	# of procedures	# of days	Official cost	Minimum capital
All countries				
# of days	0.624			
Official cost	0.422	0.299		
Minimum capital	0.121	0.036	0.165	
Financial Freedom Index	0.501	0.343	0.312	0.146
Developed countries				
# of days	0.527			
Official cost	0.753	0.463		
Minimum capital	0.425	0.210	0.354	
Financial Freedom Index	0.397	0.186	0.334	0.214
Developing countries				
# of days	0.599			
Official cost	0.324	0.213		
Minimum capital	0.082	0.007	0.151	
Financial Freedom Index	0.345	0.238	0.186	0.152

See the text and Appendix Table 9 for the definition of variables

Table 11 Average of entry-regulation measures and corruption indexes in developing and developed countries

	Developed countries	Developing countries	p-value of difference
# of procedures	5.96	8.86	0.000
	(2.79)	(3.39)	
# of days	15.48	32.70	0.000
	(16.36)	(30.88)	
Official cost	5.14	19.31	0.000
	(6.24)	(27.51)	
Minimum capital	18.28	26.71	0.225
	(27.03)	(115.89)	
Financial Index	29.23	46.16	0.000
	(14.39)	(15.37)	
Transparency International corruption index	2.46	5.84	0.000
	(1.51)	(1.41)	
World Bank corruption index	1.89	5.12	0.000
	(1.34)	(1.41)	

Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). The last column tabulates the p-value associated with the difference across the two groups. We observe that the two groups of countries do statistically differ in both entry-regulation measures and corruption indexes. See the text and Appendix Table 9 for the definition of variables

Table 12 Analysis of variance

	Partial SS	df	MS	F	p-value
Nascent entrepreneurship					
Model	15122.12	117	129.25	25.45	0.000
Country	14492.18	104	139.35	27.44	0.000
Time	203.97	13	15.69	3.09	0.000
Residual	3041.69	599	5.08		
Total	18163.81	716	25.37		
Observations	717				
R-squared	0.833				
Necessity-motivated entrepreneurship					
Model	5160.63	117	44.11	29.56	0.000
Country	4975.45	104	47.84	32.06	0.000
Time	7.65	13	0.59	0.39	0.972
Residual	893.82	599	1.49		
Total	6054.45	716	8.46		
Observations	717				
R-squared	0.852				
Opportunity-motivated entrepreneurship					
Model	17489.41	117	149.48	26.32	0.000
Country	16361.73	104	157.32	27.70	0.000
Time	354.81	13	27.29	4.81	0.000
Residual	3401.51	599	5.68		
Total	20890.93	716	29.18		
Observations	717				
R-squared	0.837				

See the text and Appendix Table 9 for the definition of variables

(a) Effect of corruption on necessity-motivated entrepreneurship in developing countries.
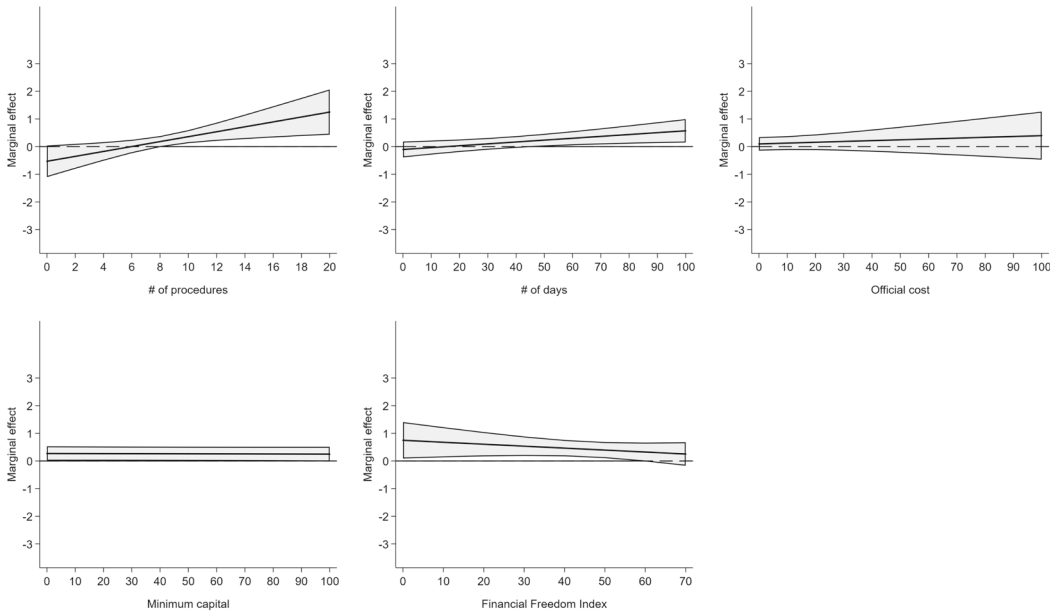
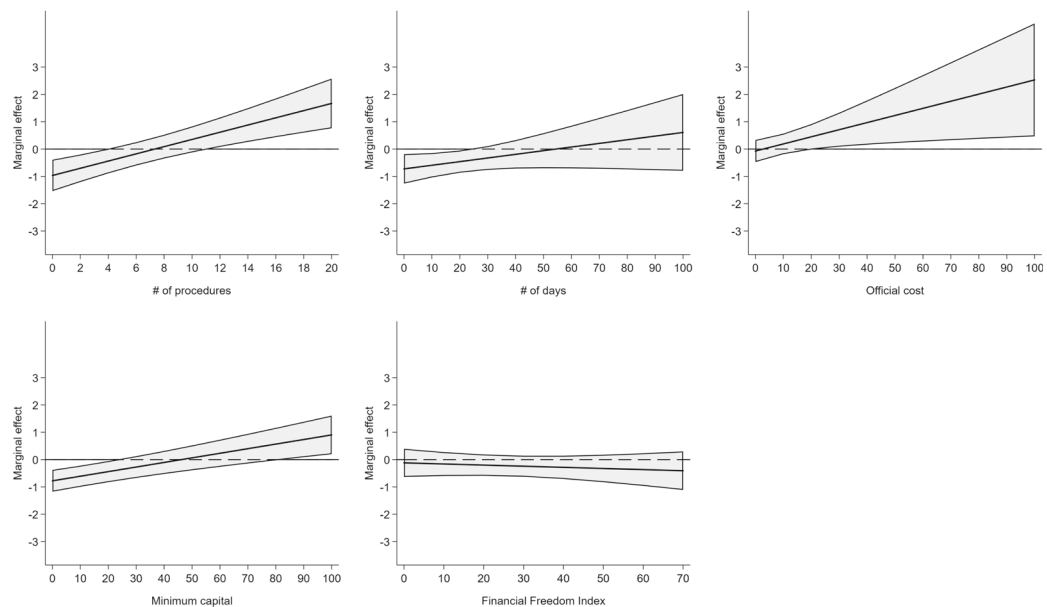(b) Effect of corruption on necessity-motivated entrepreneurship in developed countries.

Fig. 7 Marginal effect of corruption on necessity-motivated entrepreneurship at different levels of entry-regulation in developing and developed countries; measuring corruption with the World Bank Control of Corruption Estimate. Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). Marginal effects from expression Eq. 3 using World Bank Control of Corruption Estimate to measure corruption. See Table 4 for raw coefficients. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables

(a) Effect of corruption on opportunity-motivated entrepreneurship in developing countries.

(b) Effect of corruption on opportunity-motivated entrepreneurship in developed countries.

Fig. 8 Marginal effect of corruption on opportunity-motivated entrepreneurship at different levels of entry-regulation in developing and developed countries; measuring corruption with the World Bank Control of Corruption Estimate. Countries with a Human Development Index lower (higher) than 0.8 by 2002 are considered as developing (developed). Marginal effects from expression Eq. 3 using World Bank Control of Corruption Estimate to measure corruption. See Table 4 for raw coefficients. Top values of entry-regulation measures truncated for graphical representation. See the text and Appendix Table 9 for the definition of variables

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