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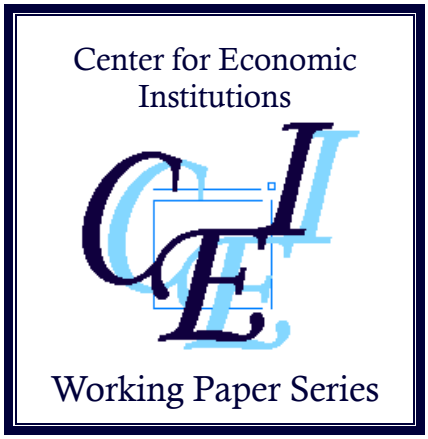

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Institutions and Determinants of Firm Survival in European Emerging Markets †

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Abstract: We analyze the impact of institutional quality on firm survival in 15 Central and Eastern European (CEE) countries. We employ the Cox proportional hazards model with a large dataset of firms from 2006–2015 and control for firm-specific determinants and country differences. Our results show that institutional quality (IQ) is a significant preventive factor for firm survival, and the result is robust to different measures of IQ and industry sectors. Furthermore, we document the existence of diminishing productivity of IQ, as the economic effect upon institutions is largest for low-level IQ countries and smallest for high-level IQ countries. In terms of firm-specific controls, ownership structure plays a vital role in strengthening the probability of firm survival. Notably, foreign ownership helps firms survive in all three country groups, and the effect is again larger for countries with low- and mid-level IQs. ROA, profit margin, solvency ratio, and firm age represent additional significant preventive factors, albeit with smaller economic effects.

Keywords: firm survival; CEE countries; survival and exit determinants; hazards model

JEL Classification: D22, G01, G33, G34, P34

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1. Introduction

The quality of institutions has been empirically shown to affect economic growth (Hall and Jones, 1999; Acemoglu et al., 2001; Eicher and García-Peñalosa, 2006; Hasan et al., 2009). On a corporate level, institutions were identified as impacting firm performance (Porter, 1998; Yasar et al., 2011; Faruq and Weidner, 2018; Ghoul et al., 2017). Despite the above evidence, the role of institutions has, thus far, largely been neglected with respect to firm survival (Che et al., 2017). What is the potential channel of such an effect? Égert (2016) shows that the quality of institutions positively affects firm productivity, and Dosi et al. (2017) demonstrates that productivity plays an important role in a firm's ability to survive.[1] Furthermore, the link between institutions and firm survival might be even more important for firms in emerging markets or developing countries where the institutional quality is lower than in developed economies (Acemoglu et al., 2005).

In this paper, we aim to bridge the gap in the empirical research in two ways. First, we contribute to the literature by analyzing how institutional quality impacts on firms' survival chances while controlling for standard firm characteristics. Second, we analyze firm survival in an under-researched region of European emerging markets, where the importance of institutional quality represents an important issue (Fan et al., 2011).

We chose the emerging European markets because their firms represent an ideal basis for empirical assessment. The economic reforms of the 1990s in Central and Eastern Europe (CEE) were aimed at creating competitive market economies and more efficient enterprises by firm restructuring, privatization, and reform of supporting institutions (Aussenegg and Jelic, 2007; Kočenda and Hanousek, 2012). Large numbers of new firms were entering the market at that time, and while firms' entry might be quite easy, their survival in the market was often difficult (McDermott, 2004). This fact is particularly important for firms from the new member states of the EU that first had to go through an uneasy transformation process before their EU accession (Estrin et al., 2009) and almost immediately had to cope with the global financial crisis (GFC) that, in general, negatively affected their performance (Hanousek et al., 2015).

[1] New firms tend to be less productive than incumbent firms. A new firm remains in a less competitive position unless it is able to raise its productivity fast enough to either catch up or exceed that of incumbent firms.

In our analysis, we adopted the following research strategy. First, in order to analyze the impact of institutions with the Cox proportional model, we select several characteristics of institutional quality in each country under research. It is argued that the level of legal protection of private property represents a key aspect of institutional quality (North, 1990; Acemoglu et al., 2001; Besley and Ghatak, 2009). Hence, we use the Rule of Law index as a representative proxy. Institutional quality cannot be fully captured by a single characteristic, though. For that reason, we also perform our analysis with individual alternative measures to capture the extent of corruption control, banking and enterprise reforms, plus levels of democracy, national governance, and civil society. We are aware that our sample of 15 CEE countries exhibits some heterogeneity in economic, social, and political characteristics. For that reason, we performed a principal component analysis and used it to create a comprehensive institutional quality index formed from our measures of institutional quality. This step has two advantages: (i) we can analyze the aggregate impact of institutions without omitting any particular institutional variable, and (ii) with the various measures listed above, we are able to control for cross-country differences in country characteristics.

Second, D'Souza et al. (2005) showed that institutional factors are quite significant with respect to firm performance in developing countries; however, Goddard et al. (2009) argued that firm-specific factors are most important in explaining variations in firm performance. This empirical evidence is the basis for our parallel study of firm survival. Despite the fact that in our analysis we accentuate the impact of institutions on firm survival, we must control for firm-specific as well as industry-level factors. We employ a number of representative controls to account for legal, ownership, governance, performance, financial, and other aspects of firms to effectively account for the impact of firm-specific characteristics on firm survival.

Due to the general lack of analysis linking institutions with firm survival, we have formulated our key hypotheses as an analogy to firm performance literature; we are aware of only one exception—an expertly conducted analysis of the impact of institutions on the survival of Chinese firms by Che et al. (2017). Since the quality of institutions is positively linked with productivity, which enhances firms' ability to survive, we expect that better institutions should enhance firms' survival chances. Furthermore, based on the fundamental principle of decreasing marginal productivity, we also hypothesize that in

countries with high institutional quality levels, the contribution of institutions to firm survival should be lower than in countries with institutions of lower quality. We have also formulated additional hypotheses related to firm-specific control variables in Section 2.

Our paper contributes to the existing literature on firm survival by utilizing an extensive database of 79,591 companies with their firm-level characteristics from 15 countries of Central and Eastern Europe (CEE). As a key issue, we have assessed the effect of institutions, proxied by a number of relevant variables that reflect the quality of institutions in the CEE region. Apart from the baseline estimation of the Cox proportional hazards model, we also have re-estimated our model on different country groups and different industries. The main results show that institutional quality is an important factor positively affecting firm survival and that institutions exhibit decreasing marginal returns. Furthermore, we show that ownership concentration and corporate governance are key economically significant factors that increase the probability of firm survival. These results are robust across country groups and industries.

The remainder of the paper is organized as follows. In Section 2, we review relevant literature and formulate testable hypotheses. Section 3 describes the data and applied methodology. In Section 4, we bring forth extensive and detailed results. Section 5 is the conclusion.

2. Hypotheses and related research

In Section 2, we perform two tasks. We review literature relevant to our analysis and, on its basis, we formulate the hypotheses that we will test later.

2.1 Institutions

The idea of a country's institutional quality affecting the local business environment, competition, and firm profitability—and as a direct consequence firm bankruptcy—is certainly not new. In one of his classical works, Porter (1998, p. 80) states: "Businesses cannot operate efficiently under onerous regulatory red tape or under a court system that fails to resolve disputes quickly and fairly." Obviously, some aspects of the business environment (for example, the legal system) affect all industries. A closely related topic is corruption, which is widely believed to prevent poor countries from catching up with

developed countries (De la Croix and Delavallade, 2009). Economic freedom in general is a significant factor determining overall economic growth (Gwartney et al., 1999).

In terms of firms, Égert (2016) shows that the quality of institutions positively affects firm productivity in OECD countries. When new firms enter a market, they tend to be less productive than incumbent firms. A new firm remains in a less competitive position unless it is able to raise its productivity fast enough to either catch up with or exceed that of incumbent firms. Using the U.S. data, Dosi et al. (2017) demonstrates that productivity plays an even more important role than profitability in a firm's ability to survive. The potential link between institutions and firm survival can be supplemented further by empirical evidence relevant specifically to the CEE countries being researched. Hanousek and Kočenda (2014) show that geographical, cultural, and institutional factors affect trade in primary goods, parts and components, capital goods, and consumer goods between ten new EU members and old EU countries. Since their analysis was conducted on disaggregated data, the impact of institutional factors on firm performance, represented by their bilateral international trade, might be considered as potentially impacting their ability to survive in the market as well. A similar analogy can be drawn from the empirical evidence presented by Kafouros and Aliyev (2016), who showed that domestic firms in 16 CEE economies benefit from improvements in institutional environments.

The above evidence forms the basis for our assessment of the quality of institutions as a determinant of firm survival. We will employ several comprehensive indices that capture various aspects of what we refer to as the "quality of institutions" (although we use this term in a broader sense). Our main research hypothesis is:

H1: *The quality of institutions does not have a positive impact on firm survival.*

Institutional quality is usually measured through some complex index. As no index captures all aspects of the quality of institutions, we utilized quite a wide range of institutional variables to control for legal system, democracy, national governance, corruption, or banking and enterprise reforms. Table 1 contains definitions and descriptive statistics of the variables used in our empirical analysis.

Institutions are the rules of the game in a society that induce economic growth (North, 1990); as such, the quality of institutions is different in specific countries, and its impact on firm survival might differ as well. Acemoglu et al. (2015) also argued that institutions play a vital role in explaining differences in economic growth among countries. Hence, we also focus on a possible unequal effect of institutional quality on firm survival in different countries based on differences in the existing levels of their institutional quality, which is a pressing issue in emerging markets (Fan et al., 2011). Thus, our second hypothesis is:

H2: *The effect of institutions on firm survival does not change with the existing level of institutional quality.*

2.2 Firm-specific factors

In Table 1, we further listed our firm-specific controls. We can see from Table 1 that the limited liability company is the most numerous type of firm in our sample, followed by the joint-stock company. Other corporate legal forms we examine in our sample—partnerships, cooperatives, and other corporate legal forms—are less frequent and are grouped into one category. A firm's corporate legal form is quite likely to play a significant role in its survival, as confirmed by Harhoff et al. (1998), who found that German firms with limited liability have (as opposed to their counterparts with full liability) higher growth but also higher insolvency rates. Hence, out fourth hypothesis is:

H3: *Various corporate legal forms do not have different impacts on firm survival.*

Apart from institutional quality and corporate legal form, we are interested in firms' ownership structure and corporate governance, which are both often neglected in survival literature. Several studies have addressed the impact of ownership concentration on firm performance; however, as shown in a meta-analysis of 42 studies (Wang and Shailer, 2015), in emerging markets, the literature presents conflicting and inconclusive empirical results. In fact, there are two theoretical hypotheses that explain both a positive relationship between large shareholders and firm failure (the alignment hypothesis; see Shleifer and Vishny, 1986) and negative relationship between large shareholders and firm

failure (the expropriation hypothesis; see Claessens et al., 2000). Taking this ambiguity into account, our fourth hypothesis is:

H4: *Ownership concentration does not positively influence firm survival.*

Within the ownership structure, we also introduce the variable of foreign ownership. After the transition from centrally planning to market orientation, in economies such as those in our sample, we expect foreign ownership to increase the probability of firm survival. Since the 1980s, literature on industrial organization concentrated on how foreign direct investments affect market dynamics. Generally speaking, two outcomes are possible: (i) foreign ownership increases overall sector efficiency, causing less efficient domestic firms to exit, or (ii) a spillover effect transmits higher productivity to domestic firms, allowing them to survive even with increased competition (Franco and Gelübcke, 2015). Again, empirical findings are not that persuasive. For example, Taymaz and Özler (2007) found that foreign ownership does not significantly impact the survival of domestic firms. However, after the recent global financial crisis, Alfaro and Chen (2012) showed that foreign firms had better survival chances than their local counterfactuals with similar economic characteristics. However, this result does not hold in non-crisis periods. Thus, in our fifth hypothesis, we link the foreign ownership to firm survival as:

H5: *Foreign ownership does not increase the probability of firm survival.*

Within the category of corporate governance, we will consider two main factors: the number of board directors and employment of an international audit firm. The composition of boards of directors has been studied extensively, since the agency theory explains why the separation of ownership and control can be an efficient form of economic organization (e.g., Fama, 1980). Early on, the literature did not offer full consensus about the relationship of the number of board directors and firm performance. Daily and Dalton (1994) confirmed that there are differences in proportions of affiliated directors between the bankrupted and non-bankrupted firms. The extensive meta-analysis of Dalton et al. (1999) also showed evidence for a positive relationship between board size and performance. However, later empirical findings tell us a different story. Results

of Boone et al. (2007) indicate that board size varies across firms and has a changing nature over time due to specific characteristics of individual firms. Coles et al. (2008) challenged the idea that one board size could possibly fit all firms. For example, small and large firms have dramatically different board structures (Linck et al., 2008). Therefore, our sixth hypothesis to verify is:

H6: *The number of board directors does not positively impact firm survival.*

The body of research on audit quality and its impact on firm performance increased significantly after the Enron–Andersen affair. Some indication that audit quality may have declined in the 1990s was provided by Francis (2004). After the financial crisis, Aldamen et al. (2012) found in a sample of US listed firms that a smaller (more experienced) audit committee is more likely to be positively associated with firm performance. Recent findings of Bajra and Čadež (2018) suggested that the formal existence of an audit committee in large EU listed firms is a necessary, but not a sufficient condition for enhancing the quality of financial reporting. As noted by Fan et al. (2011, p. 207), "there are important organizational and behavioral differences between firms in emerging markets and those in developed ones." As such, what holds true for large firms from developed markets (US, EU) might not necessarily be true for CEE countries. Sucher and Kosmala-MacLullich (2004) raised a concern about the nature of auditors' independence in transitional economies. Baumöhl et al. (2017) found that for firms operating in the Czech Republic, Poland, and Slovakia, employing an international audit firm is associated with lower probability of firm survival. Our seventh hypothesis is:

H7: *Employing an international audit firm does not impact firm survival.*

Most research in bankruptcy and firm survival literature focuses on financial aspects and variables of businesses (Kumar and Ravi, 2007). Although we are deviating from the mainstream literature by employing a wider set of possible firm survival determinants, we also add categories of control variables: firm performance, linkage with capital market, and firm size and age. Financial performance, or financial variables in general, is obviously among the most prominent determinants of firm survival and, thus,

should be present in any empirical work within this area of research (Görg and Spaliara, 2014). The ability to access external funds should also have a positive impact on firm growth and survival (Musso and Schiavo, 2008). Even though stock markets in CEE countries have various specific characteristics (as emerging markets), solvency as a ratio of share shareholders' funds to total assets should be positively associated with firm survival (as recently found by, e.g., Guariglia et al., 2016). The recent financial crisis influenced listed and bond-issuing firms roughly by reducing their capital (Iwasaki, 2014), and, as found by Guariglia et al. (2016), during and after the crisis, chances of survival for bank-dependent, younger, and non-exporting firms are most affected by changes in the interest burden. Our eighth hypothesis is:

H8: *Neither firm performance nor linkage with a capital market is positively associated with firm survival.*

The last two variables included in our models are firm size and age. The large body of empirical literature challenged Gibrat's Law (Gibrat, 1931), which assumed that firm growth is independent of its size. Geroski (1995) found that both firm size and age are positively related to firm survival, convincingly refuting Gibrat's Law. This is something we may refer to as a "stylized result." However, Agarwal and Audretsch (2001) showed that this contradicts the theory of strategic niches proposed by Porter (1979). They suggested that both views are actually correct, but firm survival depends on industry life cycle and its technology intensity. Therefore, even smaller firms could remain small and take advantage of their size in the mature phase of the life cycle and in high-tech industries. Results of Agarwal and Gort (2002) also indicated that small firms are positively related to hazard rates, as opposed to firm age. Our ninth hypothesis is formulated as:

H9: *Firm size and age do not positively impact firm survival.*

Our review of the related literature is far from exhausted.[2] One of our main conclusions is that conflicting results are common in governance literature, as well as in

[2] For further reading, please see relevant reviews, such as Santarelli and Vivarelli, 2007; and Manjón-Antolín and Arauzo-Carod, 2008.

literature on firm survival and bankruptcy. In our analysis, we aimed to present results relevant to firms in emerging markets and to eliminate some discrepancies by our comprehensive assessment.

3. Data and methodology

3.1 Data coverage

Our dataset comprises 79,591 companies from 15 countries in the Central and Eastern Europe (CEE), namely those from: (a) Central EU countries (36,743 obs.)—the Czech Republic, Hungary, Poland, and Slovakia; (b) Baltic countries (8,804 obs.)—Estonia, Latvia, and Lithuania; and (c) Balkan countries (34,044 obs.)—Bosnia, Bulgaria, Croatia, Macedonia, Moldova, Montenegro, Romania, and Serbia.

The entire set of company-specific variables that can be considered firm survival determinants is extracted from the Bureau van Dijk's Orbis database. Companies included in our dataset had to satisfy two conditions: (i) they were in business at the end of 2006 (i.e., before the global financial crisis), and (ii) they provided information about their survival status at the end of 2015. We consider failed firms to be those with the explicit status of dormant/inactive, in liquidation/bankruptcy, and/or dissolved. We do not consider firms in the category of mergers/acquisitions as having failed.

We further compile a set of several indices that capture well various aspects of the institutional environment and institutional quality (IQ). The Rule of Law Index (RofL) published within the Worldwide Governance Indicators of the World Bank database captures perceptions of the extent to which agents have confidence in and abide by the rules of society and, in particular, the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence (info.worldbank.org). The RofL index provides a country's score on a scale of -2.5 to 2.5 and is commonly used to capture the degree of institutional quality across countries (Kočenda and Poghosyan, 2018).

We also use four indices obtained from Freedom House (freedomhouse.org): democracy (Freedom House index of democracy), national governance (Freedom House index of national democracy governance), civil society (Freedom House index of civil society), and corruption control (Freedom House index of corruption). All indices are based on ratings on a scale of 1 to 7, with 1 representing the highest and 7 the lowest level

of democratic progress. The ratings follow a quarter-point scale and are assessed by the report authors, a panel of academic advisors, and a group of regional expert reviewers. As such, these ratings (more or less) indicate how democratic or authoritarian a country is.

Finally, we employ two additional indices from the European Bank for Reconstruction and Development (EBRD): banking reform (EBRD index of banking sector reform), and enterprise reform (EBRD index of enterprise reform). Both indices are published as transition indicators on a scale of 1 to 4+, based on the judgment of the EBRD's Office of the Chief Economist about country-specific progress during transition.

Due to potential multicollinearity problems, we estimate our models with each IQ variable separately. However, we also include in our estimation a first principal component extracted from seven individual IQ variables. We call this synthetic IQ variable a "Comprehensive IQ index." Additional details and descriptive statistics are presented in Table 1.

3.2 Cox proportional hazards model

To estimate the effects of our variables (in Table 1) on firm survival, we utilized the Cox proportional hazards model (Cox, 1972). It is the most commonly used model in empirical firm survival literature (Manjón-Antolín and Arauzo-Carod, 2008) and allows for an easy comparison of our results to those in other studies.

The Cox proportional hazards model assumes that the hazard denoting the probability of an event (firm exiting the market) $h_0(t)$ depends on time t and a set of relevant covariates x_{in}:

$$h(t \mid x_{i1},\mathrm{K}\ ,x_{in}) = h_0(t)\exp(\beta_1 x_{i1} + \beta_2 x_{i2} + \mathrm{K}\ + \beta_n x_{in}) = h_0(t)\exp\left(\mathbf{x}^{\mathrm{T}}\boldsymbol{\beta}\right), \quad h_0(t) > 0 \qquad , \tag{1}$$

where β_1, β_2,…, and β_n are the parameters to be estimated. Specification (1) defines the hazard rate at time t for subject i, which depends on a vector of covariates $\boldsymbol{x}$. Considering two observations, i and i', that differ in their covariates (values of x_i), with the following linear representation:

$$\eta_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \mathrm{K} + \beta_n x_{in}$$

(2)

and

$$\eta_i' = \beta_1 x_{i1}' + \beta_2 x_{i2}' + \mathrm{K} + \beta_n x_{in}' \quad ,$$

(3)

then the so-called hazard ratios for these two observations are defined as (note that they are independent of time *t*):

$$\frac{h_i(t)}{h_{i'}(t)} = \frac{h_0(t)\exp(\eta_i)}{h_0(t)\exp(\eta_{i'})} = \frac{\exp(\eta_i)}{\exp(\eta_{i'})} \quad .$$

(4)

Estimates of parameters β are obtained from the maximum likelihood estimation of the logarithmic transformation of specification (1), which is represented by the following linear model:

$$\ln h(t \mid x_{i1}, \mathrm{K}\ , x_{in}) = \ln h_0(t) + \sum_{j=1}^{n} b_j x_{ij} + \varepsilon_j \quad .$$

(5)

In our results, we will present each parameter β in the form of a hazard ratio, due to its straightforward interpretation—a hazard ratio indicates how the probability of a firm exiting the market is multiplied when a specific covariate *x* (e.g., a firm survival determinant in a form of an independent variable) changes by one unit. If an estimate is over 1, we may consider a determinant (covariate *x*) to be a risk factor, increasing the probability of firm exit. Similarly, if an estimate is below 1, such a determinant (covariate) is considered to be a preventive factor inhibiting a firm's exit from the market. Statistically significant estimates below 1 are economically more (less) significant preventive factors if they are further from (closer to) 1, respectively. Our estimation strategy follows examples of approaches adopted by Esteve-Pérez et al. (2004), Taymaz and Özler (2007), and Iwasaki (2014).

Finally, we are aware of the fact that an endogeneity issue may arise in the survival analysis under certain conditions if: (i) an independent variable is a future variable, (ii)

the estimation period is very short, or (iii) the dependent variable is continuous (Liu, 2012). Under these circumstances, an instrumental variable (IV) method or a two-stage residual inclusion method (2SRI) should be applied (Liu, 2012; Carlin and Solid, 2014). However, as we showed earlier in this section, all independent variables in our analysis are predetermined, which rules out the endogeneity problem arising from simultaneity between dependent and independent variables (Iwasaki, 2014). Furthermore, the estimation period of 9 years is sufficiently long, and the dependent variable observed on a yearly basis is, thus, a discretional variable. On the basis of the above arguments that follow those of Liu (2012), we conclude that our survival analysis is not plagued by endogeneity.

4. Results

The number of failed firms during the analyzed period is captured in Figure 1. We can see the evolution of exit rates and Nelson-Aalen estimates of the cumulative hazard functions are distinct in different country groups, as well as in different industries. This motivates us to re-estimate our baseline model for country groups and industries separately, in Section 4.3 and 4.4, respectively. Figure A.1 in Appendix shows Kaplan-Meier survival functions of the firm survival probability for each variable studied. This gives a better perspective as to which variables should affect firm survival significantly, both from statistical and economic perspectives. For example, survival rates of firms in countries with lower levels of rule of law decrease as firms become older (Figure A.1; d). A remarkable difference is visible with respect to the survival chances of firms with more large shareholders, which are significantly better than those with fewer large shareholders (Figure A.1; f); the difference is striking after the second year. All in all, a visual inspection of Figure A.1 provides a first and basic outlook on possibly significant preventive and risk factors.

4.1 Baseline estimation

Our baseline estimation of the Cox proportional hazards model is presented in Table 2. Institutional quality is our key independent variable and a covariate in the Cox proportional hazards model. Since the level of legal protection of private property represents a key aspect of institutional quality (North, 1990; Acemoglu et al., 2001;

Besley and Ghatak, 2009), we use the Rule of Law Index as our main reference variable. The results are presented for a full dataset, i.e., all countries and all industries, and indicate that institutional quality as represented by the Rule of Law is an economically significant preventive factor for firm survival, as the estimated hazard ratio is 0.83 (e.g., the distance from the threshold of 1 is non-marginal).

All other variables are statistically significant as well, but their economic impact varies. The corporate legal form of a company appears to be the most economically significant preventive factor, especially limited liability, partnership, and cooperative forms. This finding is in line with previous research (e.g., Esteve-Pérez and Mañez-Castillejo, 2008).

As for ownership structure and corporate governance, many and foreign shareholders decrease the probability of firm failure quite significantly (0.90 and 0.60, respectively), and the same applies to larger boards of directors. However, here the effect is not that straightforward, as the squared term of the number of board directors is slightly over 1. The relationship between this variable and probability of firm survival appears to have an inverted U-shaped pattern: i.e., the probability of exit for firms with larger boards is low, but it increases to reach a peak and eventually prompts an increase in the probability of failure as the board grows larger.

Surprisingly, employing an international audit firm appears to be a risk factor for firms operating in the CEE region. Based on the research of Sucher and Kosmala-MacLullich (2004), which raised a concern about the nature of auditors' independence in transitional economies, such a finding is, perhaps, not that surprising at all. Apart from the prevailing socioeconomic and cultural background over professional integrity and competence, there is an alternative explanation provided by Baumöhl et al. (2017), who found the same results for firms operating in the Czech Republic, Poland, and Slovakia where the international auditors' market in the region is practically monopolized by Big Four auditing firms (Deloitte, Ernst & Young, KPMG, PricewaterhouseCoopers). The Big Four provides auditing services mostly to large and medium-sized firms. Because of several past auditing scandals, these international auditors might be more cautious in issuing "no objection" statements. This approach could put more pressure on audited firms that might not be in the best shape in the first place. On the other hand, the Big Four

auditors do not necessarily provide higher quality audits, as these depend to a large extent on client characteristics (Lawrence et al., 2011).

Another statistically and economically (with a hazard ratio of 1.44) significant risk factor is whether the firm is listed on a stock exchange. It is worth mentioning that emerging stock markets in the CEE region have several peculiarities. After the transition process from centrally planned to market-oriented economies, national stock exchanges ended up with a large number of listed firms (as a result of mass privatization). These firms, however, are not necessarily the most efficient and profitable ones. Moreover, as Iwasaki (2014) noted, the recent global financial crisis caused severe damage to listed and bond-issuing companies through a significant capital crunch and/or unrealized losses on assets.

The last quite surprising result is the firm size, which, again, is a risk factor for firm survival, although with a negligible economical effect (a hazard ratio only slightly over the threshold of 1). Firm size is usually considered to be a preventive factor (e.g., Geroski, 1995, 2010), which intuitively is straightforward, as it is expected that larger firms have lower hazard rates of exiting than smaller firms. Nevertheless, markets in the CEE region are still quite distinct from those of developed countries; thus, obtained results are just confirming such specifics. Our finding is indirectly supported by Hanousek et al. (2015), who found that larger EU firms can be associated with less efficiency in general.

All remaining variables (ROA, profit margin, solvency ratio, and firm age) have an expected effect, even though from the perspective of economic significance, their impact on firm survival is rather low. Estimated hazard ratios are very close to 1.

4.2 Effect of different measures of institutional quality

As all institutional quality (IQ) variables are highly correlated, we estimated the same baseline model with each IQ variable separately. The set of all control variables is always included as well. In Table 3, we present the estimated hazard ratios for individual IQ variables; all of them are less than 1 and statistically significant. We do not present estimates for other control variables, as their hazard ratios are practically identical, no matter what IQ variable is used. Thus, we can say that our results are consistent across different IQ variables, and, at the same time, the inclusion of a country-level IQ variable does not affect estimates of firm-level variables.

All alternative measures of institutions can be considered as preventive factors, lowering the probability of a firm's exit. The three institutional quality variables with the strongest positive impact on firm survival are national governance, corruption control, and enterprise reform. Democracy, civil society, and banking reform are somewhat less economically significant.

In order to gauge the aggregate effect of institutions on firm survival, we construct a comprehensive IQ index from all seven IQ variables. First, we perform a principle component analysis to capture the potential structure behind institutional quality. Its results are presented in Table A.1. All IQ variables exhibit similar eigenvector values. Furthermore, the results of the principal component analysis show that the first component alone explains more than 92 percent of all variance among the seven IQ variables. Hence, we can confidently say that the first component is a suitable proxy for the aggregate IQ level in countries under research.

We estimate our baseline model with the comprehensive IQ variable, along with all firm-level controls, and present the result in Table 3. The estimated hazard ratio associated with the comprehensive IQ variable is 0.948, which means that the aggregate effect of institutions decisively helps to lower a firm's exit probability. This aggregate result is in line with a general argument that institutional quality is mirrored in the level of legal protection of private property (North, 1990; Acemoglu et al., 2001; Besley and Ghatak, 2009) as well as with a specific result of Che et al. (2017), who show a positive effect of property right protection on firm survival in China.

4.3 Differences in institutional quality and firm survival

The group of 15 CEE countries in our sample exhibits some degree of heterogeneity in terms of their economic and political development. The differences among countries also apply to the institutional environment. In Table A.2, we present the values of employed IQ variables that illustrate the institutional quality differences among countries. These differences are summarized by the values of the comprehensive IQ index introduced in Section 4.2.

Based on the comprehensive IQ index, we divided 15 CEE countries into three country groups according to their comprehensive IQ index levels. The three groups distinguish countries (alphabetically) with high (Czech Republic, Estonia, Hungary,

Latvia, Slovakia), mid-level (Bulgaria, Croatia, Lithuania, Poland, Romania), and low institutional quality (Bosnia, Macedonia, Moldova, Montenegro, Serbia). Grouping of the countries based on the institutional quality indirectly accounts for potential differences in internal factors (tax system etc.) among countries as countries with similar level of institutional quality are expected to exhibit similar level of development of various internal factors. We then re-estimate the Cox model for each country group and present our results in Table 4. Again, we see that the quality of the institutional environment is a factor that is associated with improving a firm's chances of survival. Hence, evidence presented in Tables 2, 3, and 4 enables us to reject our key hypothesis *H1*, as the institutions are shown to be a contributing factor to firm survival.

We can go even further in our inferences. Based on the values of the coefficients associated with the comprehensive IQ indicator, it is evident that the economic significance of institutions is highest in countries with low quality of institutions. On the contrary, countries with high institutional quality exhibit the smallest effect economically. Thus, estimation results indicate the presence of diminishing returns from improvement in country-level IQ. As the effect of institutions on firm survival visibly changes with the level of institutional quality, we are able to reject our hypothesis *H2*. In countries with a low IQ, a marginal increase in IQ has a strong impact on firm survival. In countries with a high IQ, a marginal increase in IQ causes a much smaller effect. In other words, the effort to refine institutions brings more fruit to developing economies than developed ones.

Finally, when we compare the results presented in Tables 2 and 4, the effect of firm-specific control variables remains, in principle, the same. Ownership structure plays a vital role in strengthening the probability of firm survival; especially foreign ownership helps firms to survive significantly in all three country groups, although the effect is larger for low and middle IQ countries. Other statistically significant preventive factors (although not that economically significant) that remained unchanged from our baseline estimation are: the number of board directors (its squared term was still slightly higher than 1), ROA, profit margin, solvency ratio, and firm age. Firm size is still a risk factor, but its economic significance is negligible. Exceptions, where the effect of control variables differs across groups of countries as well as with respect to Table 2, are covariates: joint-stock companies, cooperatives, international audit firms, and listed

companies. These few exceptions are not materially important, though, and probably reflect country-specific differences that cannot be captured by country-level fixed effects.

4.4 Breakdown of firm survival by industry

As argued by Audretsch and Mahmood (1995), business survival rates may vary across industries. For this reason, we estimate our baseline model irrespective of the country in which a firm operates, but instead, for different industries according to NACE Rev. 2 classification combined into four groups—agriculture, forestry, and fishing (Section A); mining and manufacturing (Sections B–E); construction (Section F); and services (Sections G–S). These results are available in Table 5.

First, our comprehensive IQ index is statistically significant for all industries except services. In agricultural industries, it became an even much more economically significant preventive factor, as opposed to our previous results.

All other results remained practically the same, although some variables are now not statistically significant, preventing us from drawing some general conclusions. This is true even for industries that are well-represented in our sample, i.e., with more than 30,000 observations (Sections B–E and Sections G–S). Ownership structure and corporate governance factors still appear to lower the probability of firm exit. The same holds for firm performance and solvency ratio. As in the previous results, whether a firm is listed, as well as the firm size, does not help a firm survive.

4.5 Robustness checks

In order to verify the validity of our results, we performed various robustness checks. Some can be drawn from previous subsections. In Table 3, we report results of the Cox proportional hazards model with alternative measures of institutional quality and show that the results are robust with respect to different IQ indicators. Furthermore, because of the variety of IQ variables, we constructed a synthetic IQ indicator and showed that the beneficial impact of institutions is robust with respect to the level of the institutional environment in different country groups (Table 4) as well as across different industries (Table 5). The country grouping is robust with respect to individual IQ variables because the comprehensive IQ indicator is highly correlated with individual IQ variables, and

country ranking remains stable irrespective of differences in individual IQ variables. More details are provided in Table A.2.

Further, we re-estimated the Cox proportional hazards model for different periods for which we also adjusted the number of analyzed (failed and survived) firms. Despite that in the crisis period our comprehensive IQ index was not statistically significant, our results show that effect of the institutions does not vary with time period analyzed (Table A.3). The effect of the firm-specific controls is largely time-invariant as well.

Finally, we re-estimated the Cox hazards model with different assumptions on survival distribution. These include the exponential, Weibull, Gompertz, log-normal, log-logistic, and generalized gamma distributions. The results are presented in Table A.4, showing that effect of the institutions is invariant with respect to assumptions of survival distribution. This is also largely true in terms of firm-specific controls.

5. Concluding remarks

We analyzed the effects of institutional quality on firm survival. We employed the Cox proportional hazards model on a large sample of 79,591 companies from 15 countries in Central and Eastern Europe (CEE) from 2006–2015. Furthermore, we employed an extensive set of firm-specific characteristics as controls and also accounted for country-specific differences.

Our results show that institutions and their quality play an important role as a preventive factor helping firms improve their probability of survival. In terms of specific indicators, the rule of law represents a key institutional impact that is in line with relevant literature on institutional quality. Other measures—national governance, corruption control, enterprise and banking reforms, civil society, and democracy—economically impact firm survival significantly.

In addition, we created a synthetic comprehensive indicator of institutional quality based on the principal component analysis of individual institutional measures and assessed the effect of institutions on groups of countries with different levels of institutional quality. We show that the economic significance of institutions is highest in countries with the lowest quality of institutions. Estimation results clearly indicate that returns from improving institutions diminish as the quality of institutions increases.

Assessing firm-specific controls brings also interesting outcomes. Ownership structure and corporate governance lower the probability of firm exit. Foreign ownership and many shareholders are factors with the most significant impact. Other significant preventive factors (although not that economically significant) are: ROA, profit margin, solvency ratio, and firm age. The size of the firm appears to be a risk factor for firm survival, although with a negligible economic effect (a hazard ratio only slightly over the threshold of 1). The corporate legal form and the fact of whether the firm is listed provide mixed results, depending on the country group and individual industries.

Overall, our results are robust with respect to institutional quality indicators, country groups, industries, and assumptions of survival distributions.

Our results also can be used as a basis for direct policy decisions. Building an institutional environment similar to that of developed countries is directly linked with better survival chances for firms in CEE countries. The greatest benefits of improved institutions can be expected in those countries that lag behind most.

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Table 1. Definitions and descriptive statistics of variables used in the empirical analysis

Variable name	Definition	Descriptive statistics				
		Mean	S.D.	Median	Max.	Min.
Rule of law	2006 value of the World Governance Indicator of the rule of law	0.294	0.499	0.405	1.141	-0.532
Democracy	Adjusted 2006 value of the Freedom House index of democracy [a]	3.330	0.826	2.75	5.04	2.04
National governance	Adjusted 2006 value of the Freedom House index of national democracy governance [a]	2.888	0.884	2.25	5.00	1.25
Civil society	Adjusted 2006 value of the Freedom House index of civil society [a]	4.538	0.496	4.25	5.50	3.25
Corruption control	Adjusted 2006 value of the Freedom House index of corruption [a]	2.067	1.090	1.25	4.50	1.00
Banking reform	2006 value of the EBRD index of banking sector reform	3.079	0.485	3.0	4.0	2.7
Enterprise reform	2006 value of the EBRD index of enterprise reform	2.556	0.534	2.3	3.7	2.0
Comprehensive IQ index	First principal component score of the seven IQ variables above	0.000	1.962	3.658	5.256	-3.388
Remoteness from EU capital	Log of the direct distance from Brussels to the capital of the country in question (Km)	7.466	0.323	7.516	7.721	6.576
Joint-stock company	Dummy variable for open joint-stock companies	0.196	0.397	0	1	0
Limited liability company	Dummy variable for limited liability companies	0.553	0.497	1	1	0
Partnership	Dummy variable for partnerships	0.108	0.311	0	1	0
Cooperative	Dummy variable for cooperatives	0.045	0.208	0	1	0
Other legal forms (default category)	Dummy variable for companies with a corporate form other than listed above	0.097	0.296	0	1	0
Number of large shareholders	Total number of dominant and block shareholders	1.802	1.715	1	5	0
Foreign ownership	Dummy for ultimate ownership of foreign investors	0.042	0.200	0	1	0
Number of board directors	Number of recorded members of the board of directors	1.877	2.200	1	110	0
International audit firm	Dummy for firms that employ an international audit firm as external auditor	0.013	0.115	0	1	0
ROA	Return on total assets (%) [b]	8.606	19.394	4.950	100.000	-100.000
Gross margin	Gross margin (%) [c]	3.316	14.185	2.330	100.000	-100.000
Listed	Dummy variable for listed companies	0.024	0.154	0	1	0
Solvency ratio	Solvency ratio (%) [d]	36.220	33.879	33.550	100.000	-100.000
Firm size	Natural logarithm of total assets in euros	6.718	1.877	6.695	19.281	-3.547
Firm age	Years in operation	10.828	11.982	9	643	1

Notes :

[a] Computed by 7 minus the value of the original index, which ranges between 1.00 (best) and 7.00 (worst)

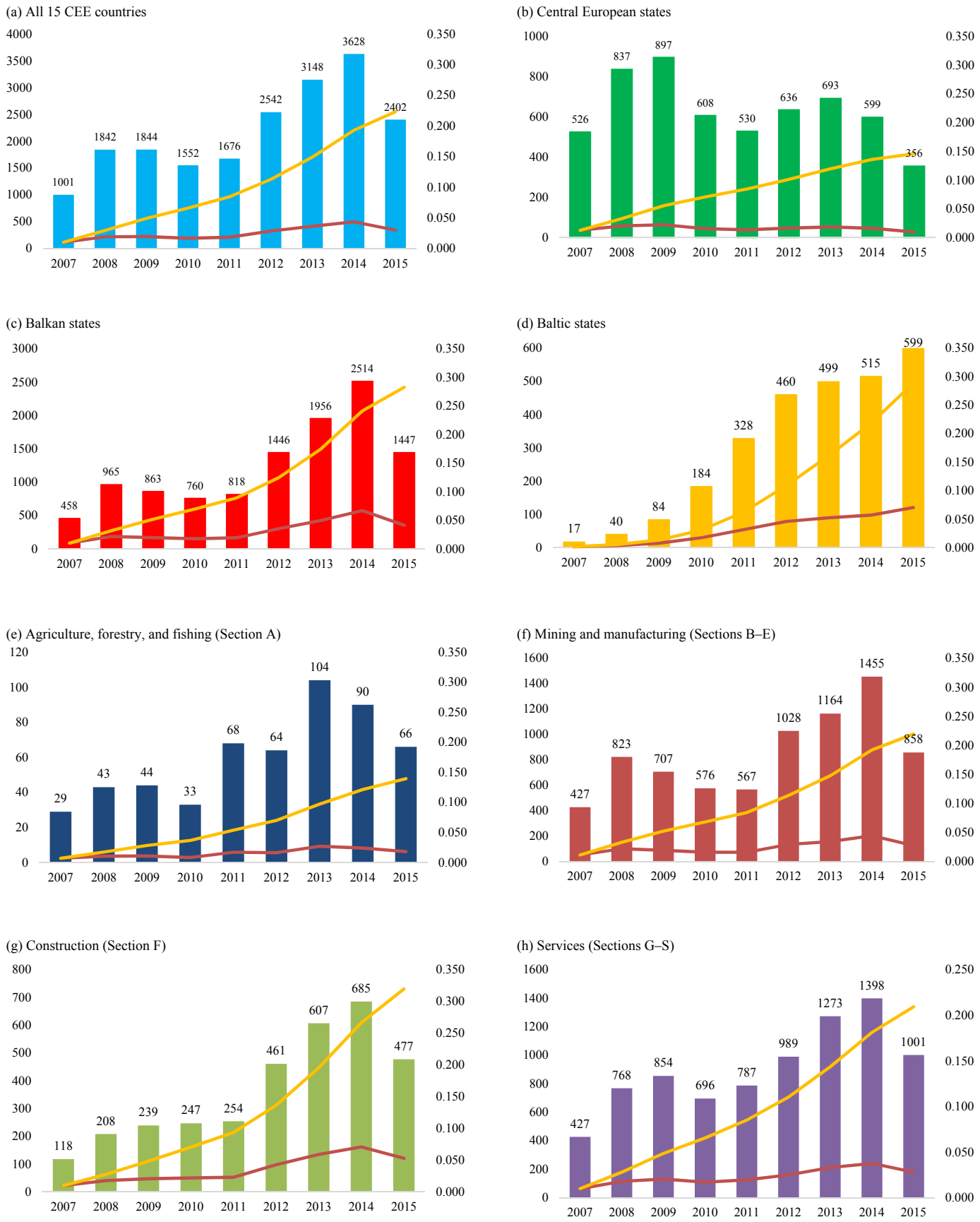
[b] Computed using the following formula: (profit before tax/total assets) × 100

[c] Computed using the following formula: (gross profit/operating revenue) × 100

[d] Computed using the following formula: (shareholder funds/total assets) × 100

Source : Country-level data from Rule of Law to Enterprise Reform was obtained from the website of the World Bank, the Freedom House, and EBRD (http://info.worldbank.org/governance/wgi/#home; https://freedomhouse.org/; http://www.ebrd.com/home). Remoteness from the EU capital was calculated using Google Maps (https://maps.google.co.jp/). Firm-level raw data was extracted from the Bureau van Dijk (BvD) Orbis database (https://webhelp.bvdep.com).

Figure 1. Number of failed firms, exit rate, and Nelson-Aalen estimate of the cumulative hazard function by region, industry, and year, 2007–2015



Notes :

Number of failed firms (left axis)

Exit rate (right axis)

Nelson-Aalen estimate of the cumulative hazard function (right axis)

Source : Illustrated by the authors

Table 2. Determinants of firm survival: Baseline estimation of the Cox proportional hazards model

Target industry (NACE Rev2 section classification)	All industries (Sections A-S)
Target country	All 15 CEE countries
Institutional quality	
Rule of law	0.83222 *** (-5.96)
Legal form (default category: other legal forms)	
Joint-stock company	0.90044 * (-1.87)
Limited liability company	0.73739 *** (-5.45)
Partnership	0.45460 *** (-13.70)
Cooperative	0.69453 *** (-5.63)
Ownership structure	
Number of large shareholders	0.90260 *** (-3.92)
Foreign ownership	0.60060 *** (-14.11)
Corporate governance	
Number of board directors	0.91163 *** (-15.08)
Number of board directors ^{2}	1.00097 *** (12.47)
International audit firm	1.11921 * (1.92)
Firm performance	
ROA	0.99545 *** (-5.98)
Profit margin	0.99409 *** (-7.20)
Linkage with capital market	
Listed	1.44165 *** (4.65)
Solvency ratio	0.98931 *** (-32.13)
Firm size and age	
Firm size	1.02596 *** (4.06)
Firm age	0.99710 *** (-2.85)
Country-level fixed effects	Yes
NACE division-level fixed effects	Yes
N	79591
Log pseudolikelihood	-170960.46
Wald test (χ^2)	8826.12 ***

Notes: This table contains the results from the survival analysis using the Cox proportional hazards model. Table 1 provides detailed definitions and descriptive statistics of the independent variables. Regression coefficients are hazard ratios. Standard errors are computed using the Huber-White sandwich estimator. z statistics are reported in parentheses beneath the regression coefficients. The Wald test examines the null hypothesis that all coefficients are zero. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimations

Table 3. Estimation of Cox proportional hazards model with alternative IQ variables

IQ variable	Hazard ratios	Firm-level characteristics	Country-level fixed effects	NACE division-level fixed effects	*N*
Rule of law	0.83222 ***	Yes	Yes	Yes	79591
Democracy	0.83495 ***	Yes	Yes	Yes	79591
National governance	0.70898 ***	Yes	Yes	Yes	79591
Civil society	0.81355 ***	Yes	Yes	Yes	79591
Corruption control	0.77264 ***	Yes	Yes	Yes	79591
Banking reform	0.82003 ***	Yes	Yes	Yes	79591
Enterprise reform	0.77264 ***	Yes	Yes	Yes	79591
Comprehensive IQ index	0.94774 ***	Yes	Yes	Yes	79591

Note : Table 1 provides detailed definitions and descriptive statistics of the independent variables. Regression coefficients are hazard ratios. Standard errors are computed using the Huber-White sandwich estimator. *** denotes statistical significance at the 1% level.

Source : Authors' estimations

Table 4. Estimation of the Cox proportional hazards model by the level of institutional quality

Model	[1]	[2]	[3]
Target industry (NACE Rev2 section classification)	All industries (Sections A–S)		
Target country	High IQ countries [a]	Middle IQ countries [b]	Low IQ countries [c]
Institutional quality			
Comprehensive IQ index	0.98241 *	0.70549 ***	0.67486 **
	(-1.88)	(-6.64)	(-2.21)
Legal form (default category: other legal forms)			
Joint-stock company	0.56089 ***	0.98233	1.88734 ***
	(-7.30)	(-0.15)	(3.77)
Limited liability company	0.55376 ***	0.98028	0.74390 **
	(-7.38)	(-0.21)	(-2.00)
Partnership	0.26065 ***	0.81865 **	0.23900 ***
	(-17.16)	(-2.35)	(-8.83)
Cooperative	0.37786 ***	1.17264 *	0.72351
	(-5.94)	(1.76)	(-0.92)
Ownership structure			
Number of large shareholders	0.79286 ***	0.78933 ***	0.99839
	(-12.19)	(-10.58)	(-1.04)
Foreign ownership	0.70042 ***	0.57947 ***	0.50672 ***
	(-5.56)	(-11.87)	(-4.27)
Corporate governance			
Number of board directors	0.84626 ***	0.99607 *	0.95802 *
	(-14.35)	(-1.81)	(-1.67)
Number of board directors ^{2}	1.00159 ***	1.09816 **	1.00145
	(13.43)	(2.02)	(0.92)
International audit firm	0.85966 *	1.82279 ***	0.42245
	(-1.88)	(7.01)	(-1.23)
Firm performance			
ROA	0.99314 ***	0.99620 ***	0.98033 ***
	(-4.68)	(-3.81)	(-6.01)
Profit margin	0.99460 ***	0.99720 **	0.99565 **
	(-2.83)	(-2.32)	(-2.50)
Linkage with capital market			
Listed	1.72368 *	1.25354 ***	0.46600 ***
	(1.82)	(2.96)	(-7.02)
Solvency ratio	0.98956 ***	0.98973 ***	0.99004 ***
	(-18.05)	(-23.51)	(-8.04)
Firm size and age			
Firm size	1.05054 ***	1.01038	1.07697 ***
	(4.16)	(1.29)	(3.44)
Firm age	0.99547	0.99571 ***	0.99734
	(-1.54)	(-3.20)	(-1.58)
Country-level fixed effects	Yes	Yes	Yes
NACE division-level fixed effects	Yes	Yes	Yes
N	28003	43590	7998
Log pseudolikelihood	-52932.69	-93492.76	-9897.84
Wald test (χ^2)	13513.78 ***	34251.51 ***	88617.34 ***

Notes : This table contains results from the survival analysis using the Cox proportional hazards model. Table 1 provides detailed definitions and descriptive statistics of the independent variables. Regression coefficients are hazard ratios. Standard errors are computed using the Huber-White sandwich estimator. z statistics are reported in parentheses beneath the regression coefficients. The Wald test examines the null hypothesis that all coefficients are zero. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

[a] Czech Republic, Estonia, Hungary, Latvia, Slovakia

[b] Bulgaria, Croatia, Lithuania, Poland, Romania

[c] Bosnia, Macedonia, Moldova, Montenegro, Serbia

Source : Authors' estimations

Table 5. Estimations of the Cox proportional hazards model in different industries

Model	[1]	[2]	[3]	[4]
Target industry (NACE Rev2 section classification)	Agriculture, forestry, and fishing (Section A)	Mining and manufacturing (Sections B–E)	Construction (Section F)	Services (Sections G–S)
Institutional quality				
Comprehensive IQ index	0.78053 ***	0.93951 ***	0.91498 ***	0.99206
	(-4.18)	(-4.73)	(-3.10)	(-0.56)
Legal form (default category: other legal forms)				
Joint-stock company	0.25850 ***	1.04971	1.08629	0.87393
	(-6.82)	(0.53)	(0.39)	(-1.55)
Limited liability company	0.24040 ***	0.74565 ***	0.82204	0.83330 **
	(-6.21)	(-3.37)	(-0.95)	(-2.16)
Partnership	0.17325 ***	0.44500 ***	0.71208	0.48808 ***
	(-7.90)	(-8.57)	(-1.45)	(-8.61)
Cooperative	0.27940 ***	0.71665 ***	1.18813	0.73057 ***
	(-5.82)	(-3.18)	(0.65)	(-3.22)
Ownership structure				
Number of large shareholders	0.96817	0.89360 ***	0.96333	0.86982 ***
	(-0.86)	(-4.85)	(-0.49)	(-3.70)
Foreign ownership	0.66068	0.51752 ***	0.70106 **	0.68117 ***
	(-1.37)	(-11.94)	(-2.49)	(-7.46)
Corporate governance				
Number of board directors	0.85128 ***	0.90563 ***	0.90092 ***	0.89454 ***
	(-5.02)	(-10.09)	(-4.50)	(-11.28)
Number of board directors ^{2}	1.00328 ***	1.00247 ***	1.00262 ***	1.00109 ***
	(4.79)	(9.48)	(2.76)	(11.53)
International audit firm	1.42885	1.19194 *	0.78326	1.10548
	(0.47)	(1.94)	(-1.00)	(1.21)
Firm performance				
ROA	0.98841	0.99561 ***	0.99701	0.99319 ***
	(-1.57)	(-3.34)	(-1.45)	(-6.10)
Profit margin	0.99187 **	0.99315 ***	0.99473 *	0.99725 **
	(-1.97)	(-5.83)	(-1.70)	(-2.09)
Linkage with capital market				
Listed	1.13018	1.38803 ***	0.92204	1.86350 ***
	(0.37)	(3.93)	(-0.34)	(5.05)
Solvency ratio	0.99124 ***	0.98847 ***	0.98541 ***	0.99157 ***
	(-3.96)	(-22.84)	(-13.21)	(-16.52)
Firm size and age				
Firm size	1.06039	1.00399	1.07287 ***	1.03124 ***
	(1.24)	(0.39)	(4.35)	(3.21)
Firm age	0.99075	1.00191 *	0.98791 ***	0.98820 ***
	(-1.08)	(1.93)	(-3.06)	(-5.50)
Country-level fixed effects	Yes	Yes	Yes	Yes
NACE division-level fixed effects	Yes	Yes	Yes	Yes
N	3327	31564	9889	34811
Log pseudolikelihood	-3135.27	-60048.80	-23982.58	-65623.95
Wald test (χ^2)	40660.37 ***	3615.16 ***	1346.19 ***	3430.19 ***

Notes : This table contains results from the survival analysis using the Cox proportional hazards model. Table 1 provides detailed definitions and descriptive statistics of the independent variables. Regression coefficients are hazard ratios. Standard errors are computed using the Huber-White sandwich estimator. z statistics are reported in parentheses beneath the regression coefficients. The Wald test examines the null hypothesis that all coefficients are zero. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source : Authors' estimations

Appendix

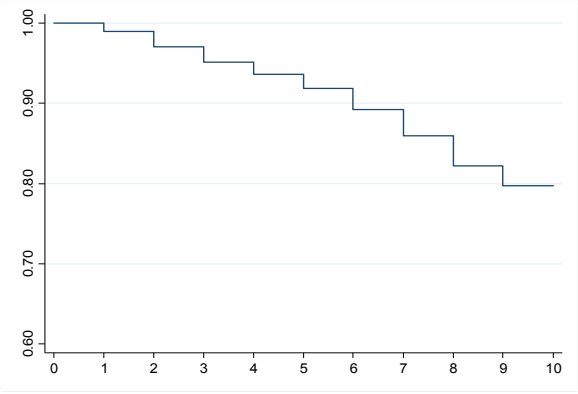
Table A.1. Estimation results of principal component analysis of the IQ variables

Eigenvalue of the correlation matrix				Eigenvectors of the first component	
Component no.	Eigenvalue	Difference	Cumulative percentage of total variance	Variables	Eigenvector
1	6.4675	6.247	0.924	Rule of law	0.3872
2	0.2208	0.062	0.956	Democracy	0.3909
3	0.1589	0.082	0.978	National governance	0.3787
4	0.0767	0.037	0.989	Civil society	0.3711
5	0.0397	0.010	0.995	Corruption control	0.3802
6	0.0298	0.023	0.999	Banking reform	0.3649
7	0.0065	-	1.000	Enterprise reform	0.3720

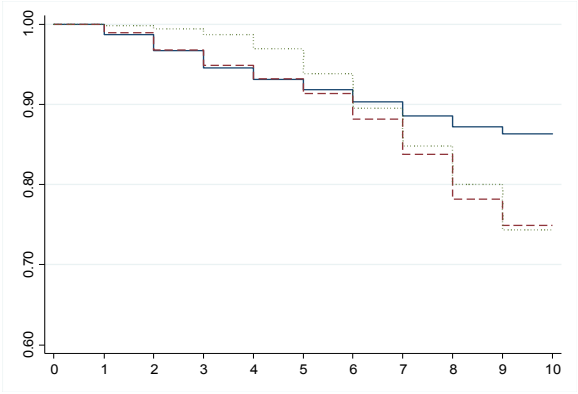
Source : Author's estimations. For definitions and descriptive statistics of the variables, see Table 1.

Figure A.1. Kaplan-Meier survival function of firm survival probability[a]

(a) All 15 CEE countries

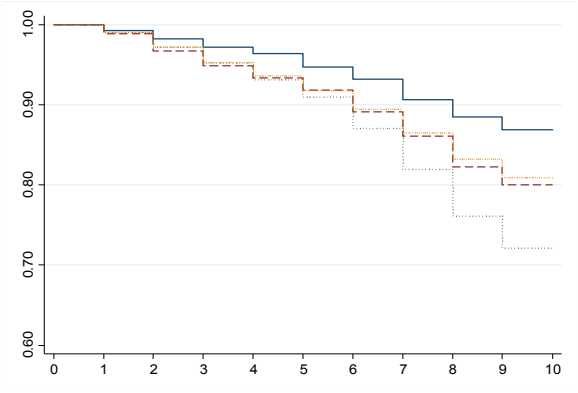


(b) Country group—Central European states (solid); Balkan states (dashes); Baltic states (dots)



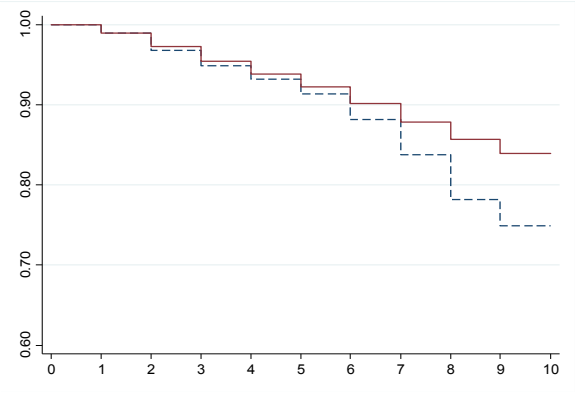
Log-rank test for equality of survivor functions: χ^2=7563.38, p =0.000

(c) Industry—Agriculture, forestry, and fishing (solid); Mining and manufacturing (dashes); Construction (dots); Services (tight dots)



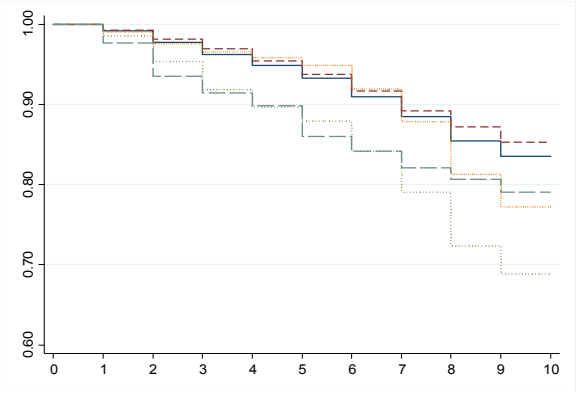
Log-rank test for equality of survivor functions: χ^2=562.16, p =0.000

(d) Institutional quality—Countries with upper level of rule of law (solid); Countries with lower level of rule of law (dashes)



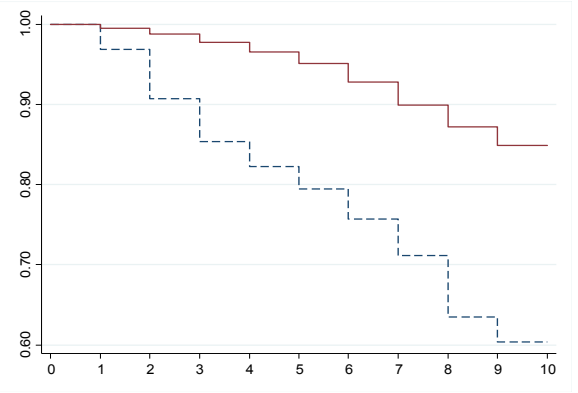
Log-rank test for equality of survivor functions: χ^2=1106.88, p =0.000

(e) Legal form—Joint Stock Company (solid); Limited liability company (dashes); Partnership (dots); Cooperative (tight dots); Others (long dashes)



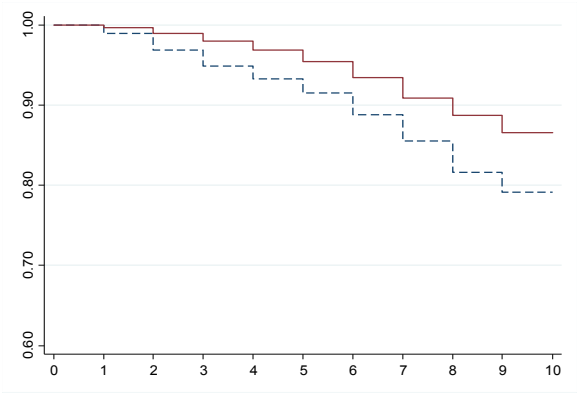
Log-rank test for equality of survivor functions: χ^2=2948.69, p =0.000

(f) Ownership concentration—Companies with upper number of large shareholders (solid); Companies with lower number of large shareholders (dashes)



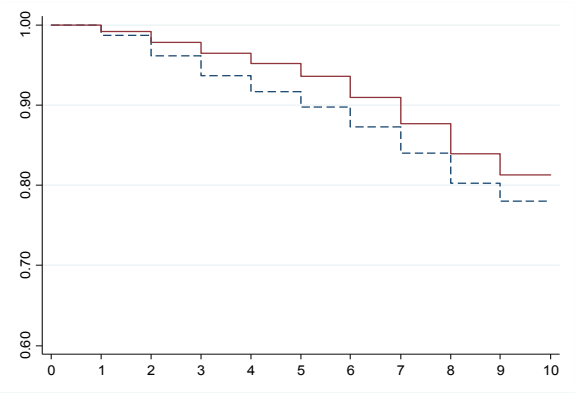
Log-rank test for equality of survivor functions: χ^2=6940.38, p =0.000

(g) Foreign ownership—Companies with foreign ownership (solid); Others (dashes)



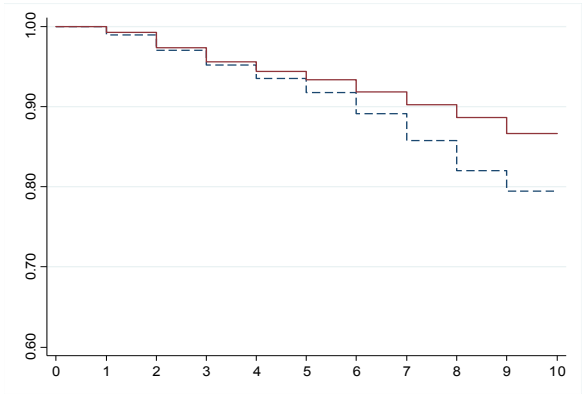
Log-rank test for equality of survivor functions: χ^2=256.93, p =0.000

(h) Number of board directors—Companies with upper number of board directors (solid); Companies with lower number of board directors (dashes) [b]



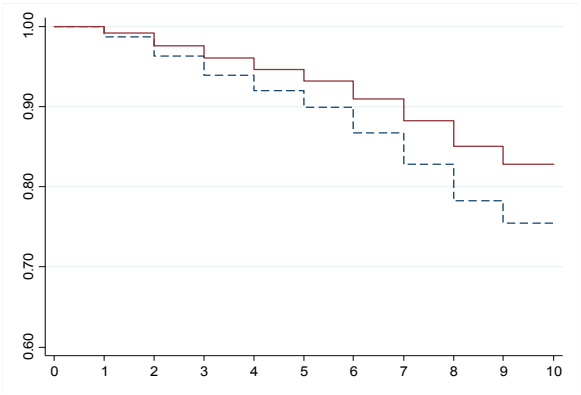
Log-rank test for equality of survivor functions: χ^2=3708.26, p =0.000

(i) Quality of external audit—Companies contracted with an international audit firm (solid); Others (dashes)



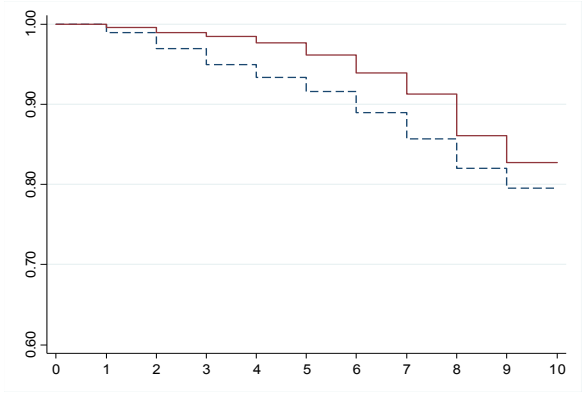
Log-rank test for equality of survivor functions: χ^2=91.33, p =0.000

(j) Firm performance—Companies with upper ROA (solid); Companies with lower ROA (dashes) [b]



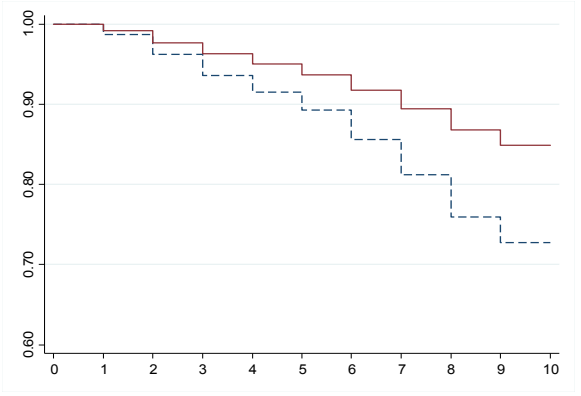
Log-rank test for equality of survivor functions: χ^2=4164.06, p =0.000

(k) Dependence on stock market—Listed companies (solid); Unlisted companies (dashes)



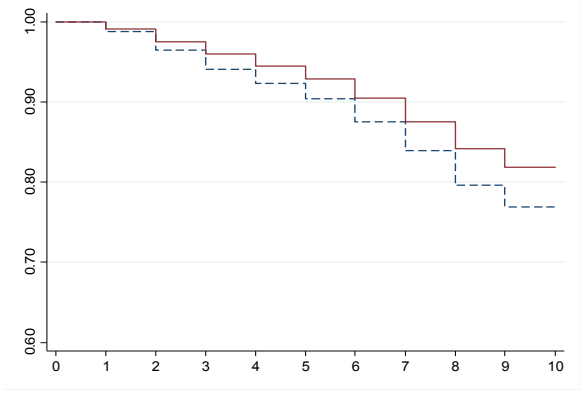
Log-rank test for equality of survivor functions: χ^2=464.26, p =0.1020

(l) Dependence on fund procurement from outside—Companies with upper solvency ratios (solid); Companies with lower solvency ratios (dashes) [b]



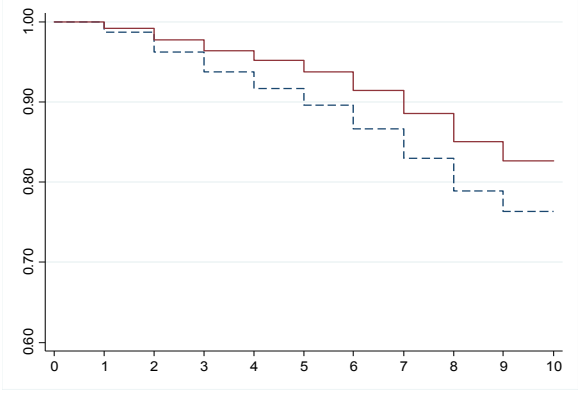
Log-rank test for equality of survivor functions: χ^2=5679.02, p =0.000

(m) Firm size—Upper-scale companies in terms of total assets (solid); Lower-scale companies (dashes) [b]



Log-rank test for equality of survivor functions: χ^2=4058.80, p =0.0000

(n) Firm age—Upper-age companies (solid); Lower-age companies (dashes) [b]



Log-rank test for equality of survivor functions: χ^2=4646.37, p =0.000

Notes :

[a] See Table 3 for definitions and descriptive statistics of variables used for comparisor

[b] Observations are divided by medium value of the variable in questio

Source : Authors' illustrations and estimations

Table A.2. Country score and correlation matrix of IQ variables

(a) Country score

Country	Rule of law	Democracy	National governance	Civil society	Corruption control	Banking reform	Enterprise reform	Comprehensive IQ index
Bosnia	-0.496	2.960	2.250	3.500	2.750	2.700	2.000	-1.712
Bulgaria	-0.094	4.110	4.000	4.500	3.250	3.700	2.700	1.988
Croatia	0.006	3.250	3.500	4.250	2.250	4.000	3.000	1.326
Czech Republic	0.873	4.750	4.000	5.500	3.500	4.000	3.300	4.354
Estonia	1.141	5.040	4.750	5.000	4.500	4.000	3.700	5.228
Hungary	0.998	4.860	4.750	5.500	4.000	4.000	3.700	5.256
Latvia	0.669	4.930	5.000	5.250	4.000	4.000	3.000	4.523
Lithuania	0.716	4.710	4.500	5.250	3.000	3.700	3.000	3.658
Macedonia	-0.532	3.180	3.250	3.750	2.250	2.700	2.700	-0.701
Moldova	-0.520	2.040	1.250	3.250	1.000	2.700	2.000	-3.388
Montenegro	-0.271	3.070	2.500	4.000	1.500	2.700	2.000	-1.479
Poland	0.405	4.640	3.750	5.500	4.000	3.700	3.700	4.139
Romania	-0.118	3.710	3.500	4.750	3.000	3.000	2.700	1.143
Serbia	-0.532	3.320	3.250	4.250	2.500	2.700	2.300	-0.452
Slovakia	0.547	4.860	4.750	5.500	3.750	3.700	3.700	4.670

(b) Correlation matrix

	Rule of law	Democracy	National governance	Civil society	Corruption control	Banking reform	Enterprise reform	Comprehensive IQ index
Rule of law	1.000							
Democracy	0.905	1.000						
National governance	0.762	0.841	1.000					
Civil society	0.848	0.912	0.677	1.000				
Corruption control	0.732	0.885	0.688	0.807	1.000			
Banking reform	0.840	0.798	0.728	0.669	0.634	1.000		
Enterprise reform	0.813	0.840	0.627	0.880	0.838	0.744	1.000	
Comprehensive IQ index	0.938	0.975	0.829	0.925	0.872	0.861	0.916	1.000

Source : Authors' estimations. For definitions and descriptive statistics of the variables, see Table 1.

Table A.3. Estimation of Cox proportional hazards model in different periods

Model	[1]	[2]	[3]	[4] [a]	[5] [a]	[6] [a]
Estimation period	2007–2008	2007–2010	2007–2013	2009–2010	2011–2013	2014–2015
Institutional quality						
Comprehensive IQ index	1.00935	0.98400	0.97016 ***	0.95764 **	0.96264 ***	0.86451 ***
	(0.43)	(-1.14)	(-2.96)	(-2.30)	(-2.58)	(-7.83)
Legal form (default category: other legal forms)						
Joint-stock company	0.37965 ***	0.52871 ***	0.76197 ***	0.81033 *	1.11672	2.07903 ***
	(-9.39)	(-8.27)	(-4.49)	(-1.84)	(1.13)	(5.49)
Limited liability company	0.57461 ***	0.66145 ***	0.66331 ***	0.83661	0.89320	1.53409 ***
	(-5.58)	(-5.64)	(-7.27)	(-1.64)	(-1.26)	(3.18)
Partnership	0.14828 ***	0.26752 ***	0.37992 ***	0.51889 ***	0.70299 ***	1.11449
	(-18.01)	(-17.22)	(-16.10)	(-5.71)	(-3.65)	(0.83)
Cooperative	0.30074 ***	0.43484 ***	0.57136 ***	0.64631 ***	0.88253	1.57151 ***
	(-9.20)	(-8.55)	(-7.84)	(-2.99)	(-1.15)	(3.22)
Ownership structure						
Number of large shareholders	0.39152 ***	0.50609 ***	0.83085 ***	0.60892 ***	0.96949 ***	0.97532
	(-19.31)	(-18.47)	(-9.67)	(-10.01)	(-2.68)	(-0.76)
Foreign ownership	0.39830 ***	0.53048 ***	0.63872 ***	0.64375 ***	0.78697 ***	0.53717 ***
	(-6.77)	(-8.31)	(-10.23)	(-4.80)	(-4.52)	(-10.11)
Corporate governance						
Number of board directors	0.78929 ***	0.80275 ***	0.89100 ***	0.81664 ***	0.94844 ***	0.94913 ***
	(-10.27)	(-14.87)	(-14.65)	(-10.66)	(-6.02)	(-5.24)
Number of board directors ^{2}	1.00221 ***	1.00202 ***	1.00113 ***	1.00184 ***	1.00062 ***	1.00068 ***
	(10.49)	(13.19)	(12.77)	(9.74)	(7.34)	(4.23)
International audit firm	1.74303 ***	1.56921 ***	1.23888 ***	1.46685 ***	0.93435	0.83984
	(4.28)	(4.87)	(3.15)	(3.15)	(-0.69)	(-1.60)
Firm performance						
ROA	0.99378 ***	0.99438 ***	0.99559 ***	0.99515 ***	0.99739 **	0.99527 ***
	(-3.22)	(-4.37)	(-4.92)	(-2.97)	(-2.29)	(-3.73)
Profit margin	0.99584 *	0.99497 ***	0.99375 ***	0.99419 ***	0.99267 ***	0.99433 ***
	(-1.76)	(-3.32)	(-6.28)	(-2.99)	(-5.84)	(-4.28)
Linkage with capital market						
Listed	1.63122 **	1.39996 **	1.32754 ***	1.19396	1.10278	1.57881 ***
	(2.11)	(2.18)	(3.68)	(0.88)	(1.04)	(3.93)
Solvency ratio	0.99247 ***	0.99190 ***	0.98962 ***	0.99164 ***	0.98841 ***	0.98892 ***
	(-9.16)	(-14.41)	(-26.40)	(-11.02)	(-21.94)	(-19.14)
Firm size and age						
Firm size	0.96231 **	0.95410 ***	0.99196	0.94766 ***	1.02365 **	1.09993 ***
	(-2.33)	(-4.12)	(-1.03)	(-3.38)	(2.29)	(9.06)
Firm age	0.99024 ***	0.98585 ***	0.99547 ***	0.98192 ***	0.99918	0.99889
	(-2.87)	(-5.39)	(-3.24)	(-4.73)	(-0.53)	(-0.71)
Country-level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
NACE division-level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	79591	79591	79591	77416	74724	68834
Log pseudolikelihood	-22474.43	-51572.07	-117107.06	-28808.28	-63904.65	-52856.06
Wald test (χ^2)	538991.17 ***	4724.55 ***	5694.68 ***	2160.58 ***	195767.70 ***	43553.09 ***

Notes : This table contains results from the survival analysis using the Cox proportional hazards model. Models [4], [5], and [6] show estimates without the observations of firms that failed before the period in question. Table 1 provides detailed definitions and descriptive statistics of the independent variables. Regression coefficients are hazard ratios. Standard errors are computed using the Huber-White sandwich estimator. z statistics are reported in parentheses beneath the regression coefficients. The Wald test examines the null hypothesis that all coefficients are zero. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source : Authors' estimations

Table A.4. Estimation of parametric survival model for robustness check

Model	[1]	[2]	[3]
Assumption of survival distribution	Exponential	Weibull	Gompertz
Institutional quality			
Comprehensive IQ index	0.94787 ***	0.94596 ***	0.94574 ***
	(-6.06)	(-6.06)	(-6.09)
Legal form (default category: other legal forms)			
Joint-stock company	0.90964 *	0.90405 *	0.90948 *
	(-1.75)	(-1.75)	(-1.66)
Limited liability company	0.74822 ***	0.73926 ***	0.74388 ***
	(-5.34)	(-5.25)	(-5.18)
Partnership	0.46544 ***	0.45087 ***	0.45546 ***
	(-13.85)	(-13.35)	(-13.33)
Cooperative	0.70567 ***	0.70205 ***	0.70900 ***
	(-5.56)	(-5.28)	(-5.18)
Ownership structure			
Number of large shareholders	0.90620 ***	0.89595 ***	0.89667 ***
	(-3.85)	(-4.04)	(-4.03)
Foreign ownership	0.60605 ***	0.58955 ***	0.59022 ***
	(-14.03)	(-14.32)	(-14.29)
Corporate governance			
Number of board directors	0.91387 ***	0.90970 ***	0.91008 ***
	(-15.04)	(-15.02)	(-15.01)
Number of board directors ^{2}	1.00094 ***	1.00100 ***	1.00100 ***
	(12.31)	(12.68)	(12.72)
International audit firm	1.11857 *	1.11370 *	1.11154 *
	(1.94)	(1.80)	(1.77)
Firm performance			
ROA	0.99558 ***	0.99528 ***	0.99533 ***
	(-6.01)	(-5.99)	(-5.97)
Profit margin	0.99422 ***	0.99395 ***	0.99394 ***
	(-7.28)	(-7.13)	(-7.18)
Linkage with capital market			
Listed	1.43556 ***	1.46740 ***	1.46750 ***
	(4.64)	(4.80)	(4.79)
Solvency ratio	0.98955 ***	0.98900 ***	0.98902 ***
	(-32.19)	(-32.17)	(-32.21)
Firm size and age			
Firm size	1.02770 ***	1.02793 ***	1.02882 ***
	(4.44)	(4.22)	(4.37)
Firm age	0.99720 ***	0.99701 ***	0.99704 ***
	(-2.83)	(-2.86)	(-2.84)
Country-level fixed effects	Yes	Yes	Yes
NACE division-level fixed effects	Yes	Yes	Yes
N	79591	79591	79591
Log pseudolikelihood	-45298.38	-43483.01	-43979.44
Wald test (χ^2)	9323.21 ***	8691.67 ***	8702.12 ***

Notes : This table contains the results from a survival analysis using 3 parametric estimators for a robustness check. Table 1 provides detailed definitions and descriptive statistics of the independent variables. Standard errors are computed using the Huber-White sandwich estimator. z statistics are reported in parentheses beneath the regression coefficients. The Wald test examines the null hypothesis that all coefficients are zero. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source : Authors' estimations