

# DETERMINANTS OF EUROPEAN FIRM'S GROWTH: COMPREHENSIVE ANALYSIS OF FIRM LEVEL, INDUSTRY SPECIFIC, MACROECONOMIC AND INSTITUTIONAL FACTORS

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## ABSTRACT

Results reveal a significant role of firm-, industry- and country-determinants on a firm growth, however the relation between the selected determinants and firm growth varies across different specifications. Most consistent relationships are found for firm-level determinants, while country and institutional determinants showed lower consistency. Robust, positive and highly statistically significant relation is confirmed for labour productivity and intangible capital, while age and firm growth are related negatively. Among country determinants we consistently find highly significant and positive relationship between unemployment and inequality and firm growth, while higher tariffs are negatively related to firm growth. The intensity, direction as well as significance of relations between firm growth and selected determinants vary the most among institutional factors; apart from infrastructure, which consistently shows the highest and significant positive relation with firm growth, other factors require more detailed examination. The study brings new empirical evidence on determinants of firm growth, points out consistent determinants as well as suggestions for future research.

**JEL Classification:** D21, D22, D24

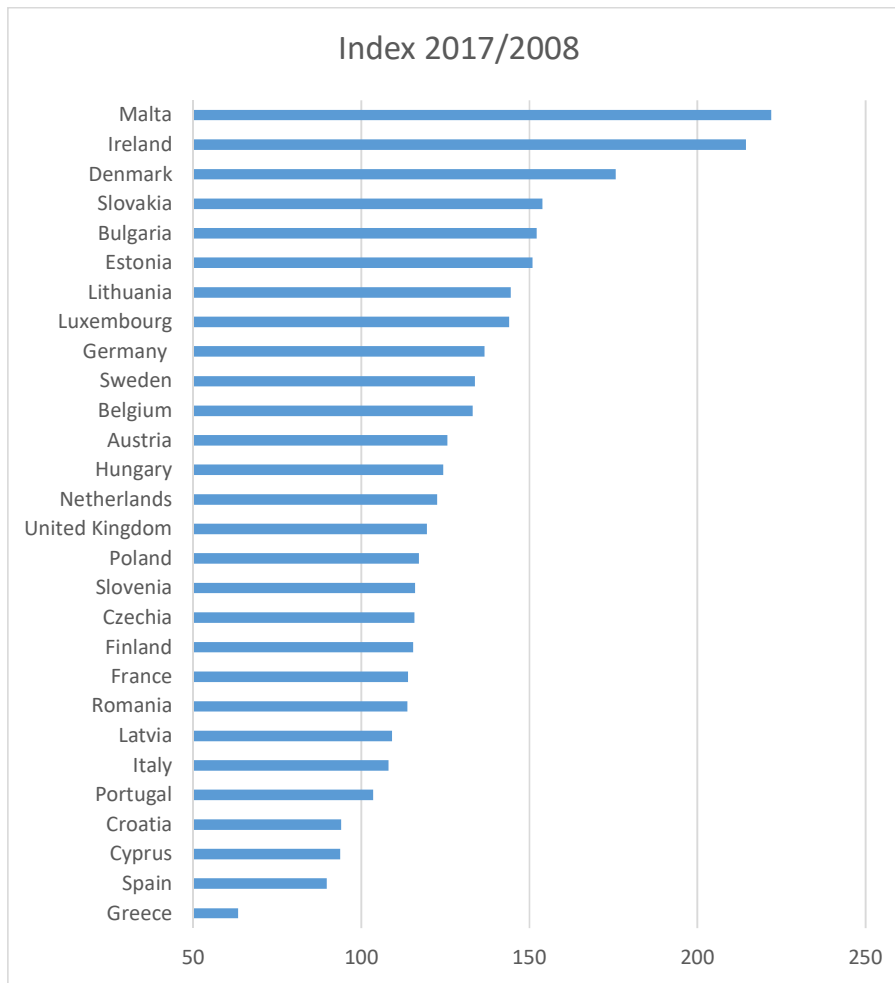
**Key words:** firm growth, firm-level determinants, country-level determinants, institutional determinants, OLS, FE, BE,

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## 1. Introduction

In the post great recession period EU countries experience huge differences in company growth. Figure 1 shows the increase of value added at factor costs of EU enterprises in the period 2008-2017. While in 2017, some countries have not yet achieved their 2008 level (Greece, Spain, Cyprus, Croatia), some others increased it by more than 50 percent (Denmark, Slovakia, Bulgaria and Estonia) or even more than doubled it (Ireland and Malta). What are the factors behind these differences?

**Figure 1:** Company growth in EU countries: 2017/2008 index of growth of value added at factor cost; total business economy, repair of computers, personal and household goods, except financial and insurance activities



Eurostat: <https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do> (accessed on April 6, 2020).

According to the resource-based theory of a firm, firm's growth depends primarily on inherent factors within the firm, such as technology, skilled personnel, efficient procedures, brand names, trade contacts etc. and their efficient combination (organizational capabilities). But the optimum firm size theory points that firm's growth also depends on a number of exogenous variables, such as country's macroeconomic environment, institutional setting and business environment. The objective of this paper is to identify those factors on a firm, industry and macro level that stimulate the growth of European enterprises, and the factors that impede it.

The paper is put in the context of the literature on firm's growth (see Coad, 2009, for an overview) which identifies the following main factors determining firm's growth: (i) firm's size, (ii) firm's age, (iii) firm's export propensity, (iv) intangible capital as an indicator of firm's innovation capacity, (v) type of firm where we distinguish between foreign-owned and locally-owned firms, (vi) firm's financial sources, i.e. the impact of financial constraints, and (vii) firm's productivity. Apart from firm specific factors of firms' growth empirical analyses also point to the importance of industry / sector in which firm operates and macroeconomic factors and institutional environment in a country. Industrial sector in which firm operates importantly co-determine its growth dynamics. Business environment and macroeconomic factors at large are obvious determinants of firms' growth. For any analysis of the determinants of firms' growth it is important to determine, to what extent firm's growth depends on industry and country specifics, and not on their own firm-level characteristics.

Based on the applied theoretical framework and empirical findings, we perform a regression model of firms' growth, i.e. a comprehensive analysis of firm level / industry specific / macroeconomic and institutional factors of firms' growth in European countries. To analyse the main factors that induce firm growth of revenue/employment we use the dynamic panel regression model which is traditionally used in empirical verification of the growth theory of the firm. To consistently estimate the expanded dynamic panel model with large cross-section dimension and short time span, we apply generalised method of moments models developed by Arellano and Bover (1995) and Blundell and Bond (1998). All the relevant firm level determinants of firm growth identified in the literature, and available in the Amadeus firm-level database, are taken into account (firm size and age, access to finance, productivity, human capital, dynamic of growth in the previous period). Apart from the above testable firm-level determinants, two other factors are taken into account. The first is industry/sector of firm's activity and the second home country of a firm. To include country specific factors in our analysis we follow the approach of Dall'Olio et al. (2013); in modelling the factors of productivity growth in Europe they combine Amadeus firm-level data on productivity and firm characteristics with various country-level data (business environment, FDI, infrastructure quality, credit availability). Following this approach and by the way of applying a multidimensional measure of the entrepreneurial environment, we test to what extent differences in firms' growth are due to country specific factors. Macroeconomic and institutional variables tested in analysing firms' growth are size of the domestic market, demand conditions in neighbouring countries, quality of institutional setting in the home country, regulatory, normative, and cognitive dimensions of entrepreneurial environment, trade and investment regulation and barriers and macroeconomic stability.

To the best of our knowledge the paper presents the first research of this kind in a comparative European setting that analyses micro firm level factors (based on individual firm-level data) and macroeconomic and institutional factors of firm growth in a really complex way. Combination of micro and macro factors is absolutely necessary for comprehending the importance of firm level determinants and of the systemic and policy framework for firm growth. The research will discern where European countries stand with their systemic and policy framework within the European context, as far as the environment for firm growth is concerned.

Empirical analysis highlights the interplay on a number of firm-, industry- and country-determinants on firm growth. Results revealed a significant role of firm-, industry- and country-determinants on a firm growth (measured as sales or employment growth), however the relation

between the selected determinants and firm growth varies across different specifications. Most consistent relationships are found for firm level determinants, while country and institutional determinants show lower consistency and require more detailed examination. Positive and statistically significant relation with firm growth among firm-level determinants was identified for labour productivity, skill intensity and the share of intangible capital, while age, size and level of debt influenced firm growth negatively. Among country determinants we found consistently negative relation between firm growth and tariffs, while unemployment and inequality contributes positively to firm growth. The significance, size and direction of relation varies the most among institutional determinants; except infrastructure, which robustly shows the highest and consistently positive and significant impact on firm growth.

We structured the paper in five parts. After introduction we review theory, so far identified determinants of firm growth and existing empirical evidence. In part three we describe data and methodological approach. Part four demonstrate results and discussion and summary conclusion are in part five.

## **2. Theoretical considerations and empirical evidence**

Our objective, i.e. to identify determinants of growth of European enterprises, puts the research in the context of the theory of the growth of firms. In his review of the main theories of firm growth, Geroski (2000) classifies them into models of optimum firm size predicting that firms will tend to grow to their optimum size (see, for instance, Viner, 1952), stage theories where firms evolve through several phases of growth (see, for instance, Greiner, 1972), and models based on Penrose (1959) theory of the growth of the firm. Penrose's (1959) theory contains two types of arguments. The first is 'managerial limits to growth' hypothesis saying that "firm growth is led by an internal momentum generated by learning-by doing" (Coad, 2007: 32) from the (existing) management, and the second is 'resource-based view' of the firm or models of organisational capabilities where "firms are composed of idiosyncratic configurations of resources" (Coad, 2007: 33) being basis of firm growth (for more see Geroski, 2000; Coad 2007). The purpose of our research can best be summarized by a combination of optimum size and resource-based theories. On the one hand, the model of optimum firm size basically says that optimum size depends on a number of exogenous variables (Geroski, 2000). On the other hand, resource-based theory says that firm growth depends on inherent factors within the firm, such as technology, skilled personnel, efficient procedures, brand names, trade contacts etc. (Coad, 2007; Wernerfelt, 1984) and their efficient combination (organizational capabilities). This is very much in line with the search for stochastic factors affecting firm behaviour and the recognition of Gibrat's Law that "the factors that can affect firm growth relate not only to firm, but also to its environment" (Carrizosa, 2007).

The purpose of our research can best be summarized by a combination of optimum size and resource-based theories of firm's growth. On the one hand, resource-based theory says that firm growth depends on inherent factors within the firm, such as technology, skilled personnel, efficient procedures, brand names, trade contacts etc. and their efficient combination (organizational capabilities). On the other hand, the model of optimum firm size basically says that optimum size depends on a number of exogenous variables.

Available empirical testing of the above theories discerns their low explanatory power and a strong stochastic element in explaining firm growth. According to Geroski (2000), very little in the theory is testable and different types of theories make different predictions about elements

of corporate performance. He claims that the main conclusions of empirical work are that (i) firm size follows a random walk, meaning that increases in firm size are driven by unexpected shocks, (ii) that the evidence against the proposition that firm sizes do not converge within or across industries is not very strong, (iii) that corporate growth rates are likely to be idiosyncratic; (iv) that many companies are not substantially affected and some actually prosper during cyclical downturns (Davis et al., 1996, Geroski and Gregg, 1997), (v) that corporate growth rates are not smoothed, meaning that firms do not appear to anticipate shocks, and (vi) that adjustment costs seem to be fixed and not variable to size (Geroski, 1999: 4-8). Similarly, Coad claims that the main result of empirical work on firm growth is that it is the stochastic element which is predominant, in other words that firm growth appears to be a idiosyncratic and fundamentally random process (Coad, 2007: 58). In such circumstances, »it is meaningful to follow Penrose and suppose that growth is not just a means to obtain a certain size, but rather it is an end in itself, a constructive application of spare resources. Indeed, in the presence of learning-by-doing and dynamic increasing returns, a lack of growth would be akin to stagnation« (Coad, 2007: 59). Consequently, he proposes that the way forward is through empirical analysis and quotes Starbuck (1971: 126) saying that the subject needs 'solid, systematic empirical research directed toward explicit hypotheses and utilizing sophisticated statistical methods' (Coad, 2007: 59-60).

In the above context, we look at the determinants of firms' growth as defined in the theoretical and empirical literature. Overview of existing empirical studies reveals the following determinants of firm's growth: firm's size, firm's age, firm's export propensity, type of firm where one distinguishes between foreign-owned and locally-owned firms, firm's R&D and innovation activity and human capital, firm's financial sources, that is the impact of financial constraints, firm's productivity, the dynamics of firm's growth in the previous period, as well as industry specific and macro-economic and institutional factors. Below we briefly look at the main findings of the literature on the scope and direction of the above factors' impact on firms' activity.

*Firm size* is one of the basic variables included in empirical analyses of firm's growth determinants. Conventional wisdom has claimed that expected firm growth rates are independent of size (Gibrat's Law) but more recent analyses tend to demonstrate a negative relationship between firm's size and growth (Cabral and Mata, 2003; Zhou and de Wit, 2009; Yasuda, 2005; Almus and Nerlinger, 2002; Bottazzi and Secchi, 2003; Calvo, 2006; Dunne and Hughes, 1994; Goddard et al., 2002; McPherson, 1996; Jensen, 2005). Smaller firms grow faster if for no other reason because they have to reach the size of minimal efficiency (Audretsch et al., 2004).

*Firm age* is the second basic variable included in empirical analyses of firm's growth determinants. The predominant finding is that there is a negative relationship between firm age and growth (Fizaine, 1968; Dunne et al., 1989; Evans, 1987; Geroski and Gugler, 2004, Glancey, 1998) although some analyses do not confirm this (Das, 1995; Barron et al., 1994). Fort et al. (2013: 27) who specifically analyse the role of firm's age and size in business cycles, find that young/small businesses are more cyclically sensitive so that the relative decline in employment during recession is greater for young and small businesses than for large and mature businesses.

Two other basic determinants with positive impact on firm's growth that are regularly put forward by the literature are *R&D and innovation activity* (see Coad, 2009; Dugal and Morbey, 1995; Mansfield, 1962; Geroski and Machin, 1992; Geroski and Toker, 1996; Roper 1997;

Freel, 2000; Hall and Mairesse, 2006; Rauch et al., 2005) and the level of *human capital* (Unger et al., 2011; Hamilton et al., 2003; Iranzo et al., 2008; Navon, 2009; Parrotta, 2012).

An alternative aspect of research of firm's innovation activity relates to *intangible capital*. The role of the accumulation of intangible capital as a source of SMEs has attracted increased attention. It has been shown (Corrado, Hulten, & Sichel, 2009, van Ark, Hao, Corrado, & Hulten, 2009, Corrado, Haskel, Jona-Lasinio, & Iommi, 2012, Piekkola, 2016) that intangible capital in the US, EU and Japan contributed up to 1/3 of overall productivity growth. As intangible capital largely comprises innovative capital, understanding the motivations and patterns of SME's investment into intangible capital is important. Still, the research that would link the intangible capital to growth and productivity of SMEs is rare and fragmented, focusing primarily on human capital, competencies or R&D.

As far as *export propensity* is concerned, the dominant conclusion of the literature is that export oriented firms are more productive and generally more successful than local market oriented firms (Bernard and Jensen, 1997a, 1997b, 1999a, 1999b; Bernard et al., 2005; Bernard and Wagner, 1997; Aw et al., 1997, 1998; Clerides et al., 1996; Hahn, 2004; Van Biesebroeck, 2003; Hallward-Driemeier et al., 2002; Criscuolo et al., 2005; Head and Ries, 2003; Burger et al., 2008; Bekes et al., 2011), therefore, one expects that they will be, in principle, more successful in terms of growth.

*Trade (exports) diversification* may have a specific impact on firm's growth. Most exporting firms serve multiple markets and export multiple products. Differences in market sizes, openness and geography generate differences in the toughness of competition across markets, which, as shown by Mayer, Melitz, and Ottaviano (2014), affects both a firm's exported product range and product mix. In turn, this within-firm change in exported product mix driven by the trading environment has important repercussions on firm performance. Dikova et al. (2016) found that both product and market diversification, as well as simultaneous diversification significantly improves productivity and sales performance. product Santarelli and Tran (2016) show that diversification exhibits a curvilinear effect and contributes to firms' profit up to an "optimal" level of product diversification beyond which expansion of their export-product offerings (beyond their core business) negatively impact firm profitability.

The literature suggest that firm's growth may also depend on the type of firm in terms of *foreign-owned firms versus locally-owned internationalised firms with subsidiaries abroad versus other (non-internationalised) locally-owned firms*. Foreign-owned and internationalised locally-owned firms are the most productive firms (Helpman et al., 2003) and have, in principle, better capabilities (ownership specific advantages including better access to financial resources, multinationality, economies of scale, capacity to optimise business processes based on geographical relocation of processes) to achieve higher performance and growth than locally-owned non-internationalised firms (see, for instance, Dunning, 1993; Head and Ries, 2003; Jaklič and Svetličič, 2003; Dunning and Lundan, 2008; Pfaffermayr and Bellak, 2000; Damijan et al., 2013; Hanousek et al., 2012).

This leads us to the issue of *complex internationalisation strategies*. Growth of enterprises in small economies (regardless of firm size) vitally depends on their capacities to internationalize, to integrate into global value chains or establish control over their own value chains. Rapid changes in global (and regional) environment along with competition from emerging markets have changed the patterns of internationalization. Strategic logic of economies of scale and sequential knowledge accumulation from the Uppsala type of international growth has been

replaced by economies of scope and economies of growth. In these circumstances, the probabilities to achieve permanent international growth is related to complex internationalization strategies. These include variety of market channels, entry to several (carefully selected) foreign markets at the same time as well the simultaneous use of several entry modes. Simultaneous entry to several markets, the use of different entry modes and complex product/service portfolio enable diversification of risks and growth synergies by markets/channels/product and service groups.

The literature suggests that firms with *lower level of indebtedness* and those which are *less dependent on external sources of financing* have better capacity to grow. This is especially important in the periods of economic recession when financial limitations are one of the main factors that restrain firms' growth (Kroszner et al., 2007; Braun and Larrain, 2005; Bugamelli et al., 2009; Desai et al., 2004; Manova et al., 2009; Bricogne et al., 2009; Luzzi, 2006).

Any model of firm's growth must contain *productivity* as a control variable (see Alvarez and Görg, 2009). According to Coad (2009: 25), it is logical to expect that more productive firms grow while less productive ones stagnate or reduce in size. Still, empirical analyses do not always confirm this (Bottazzi et al., 2006). One possible explanation is that firms may increase their productivity with increasing or decreasing the extent of their operations (Foster et al., 1998).

More recent research has brought attention to another potential determinant of firm's growth, i.e. *granularity* (i.e. firm heterogeneity). Granularity matters for understanding the impact of idiosyncratic shocks for the overall economy. For instance, an idiosyncratic shock to one particular product or firm may become important through its central role in the supply chain and hence the interlinkages between firms can amplify such shocks. In particular, the argument that firm-level shocks average out at the macro level has been shown to fail when the size distribution of firms is fat-tailed and large firms play a disproportionately large role in the economy (Davis, et al., 2007; Gabaix, 2011; Acemoglu, et al, 2012, Friberg, Sanctuary, 2016; Moscarini and Postel-Vinay, 2012; di Giovanni, Levchenkov, and Mejean, 2014; Bernard, Van Beveren and Vandenbussche, 2014; Damijan, 2016). This literature hence suggests that when size distribution of firms is relatively more skewed towards smaller firms the aggregate output dynamics might be more vulnerable to potential idiosyncratic shocks to large firms that spread across the network of small and micro firms through demand interlinkages.

*Industrial sector* in which a firm operates importantly co-determines its growth dynamics (see Coad, 2009; Audretsch, 1995; Gabe and Kraybill, 2002; Audretsch and Mahmood, 1994; Geroski and Toker, 1996). This is all more relevant in the times of economic recession (see Roubinchtein and Ayala, 2009; Jiang et al., 2009; Eaton et al., 2011; Bricogne et al., 2010; Levchenko et al., 2010; Chor and Manova, 2010; Bugamelli et al., 2009). Coad (2009) also puts forward the importance of *macro-economic factors* for firm's growth. Empirical evidence of the importance of macro setting is ample. Thus, Gorodnichenko et al (2018) show that due to differences in business, institutional and policy environment marginal products across firms in the EU is about twice as large as in the US. Gemmel et al (2018) claim that in countries with higher statutory tax rates productivity catch-up of small firms is slower. According to Ohanian (2018), the lagging of European productivity growth behind the US since mid-1970s is due to higher tax rates and increased regulatory barriers that have reduced competition and new business formation. Lack or slow structural reforms are another factor with negative impact on firms' growth (Masuch et al, 2018; Kouame and Tapsoba, 2018; Almeida and Balasundharam, 2018). Number of authors point to the importance of flexible enough setting that allows entries

and exits of firms (Acemoglu et al, 2017; Storz et al, 2017; Lewrick, Mohler and Weder, 2017; Foster et al, 2018), where exit of less productive firms frees up skilled labour for newly entering firms (Acemoglu et al, 2018).

To include country specific factors in our analysis we follow the approach of Dall’Olio et al. (2013). In modelling the factors of productivity growth in Europe they combine Amadeus firm-level data on productivity and firm characteristics with various country-level data (business environment, FDI, infrastructure quality, credit availability). They claim that in the new EU member states country characteristics are more important for productivity growth than firm level characteristics, and vice versa in old EU member states. Following this approach, we test to what extent differences in firms’ growth are due to country specific factors. Macroeconomic and institutional variables tested in analysing firms’ growth are size of the domestic market, demand conditions in neighbouring countries, quality of institutional setting in the home country, regulatory, normative, and cognitive dimensions of entrepreneurial environment, trade and investment regulation and barriers and macroeconomic stability.

Based on the above, our main hypothesis is that growth dynamics of firms’ sales and employment predominately depends on the main firm level factors of growth, but also on the industry in which firm operates and on macroeconomic and institutional characteristics of a country concerned. Thus, in modelling firm’s growth we take into account all those determinants of firm growth which have been identified as important by the empirical literature and which we are able to test with the available data. More precisely, we will analyse to what extent trends in sales and employment of European firms in the last ten years depend on the following factors: (i) firm’s size, (ii) age, (iii) firm intangible capital, (iv) indebtedness, (v) productivity, (vi) human capital, (vii) sector in which firm operates, (viii) set of country specific macroeconomic and institutional variables (size of the domestic market, demand conditions in neighbouring countries, quality of institutional setting in the home country, regulatory, normative, and cognitive dimensions of entrepreneurial environment, trade and investment regulation and barriers and macroeconomic stability) and (ix) year-specific effects.

### **3. Data and methodological approach**

#### ***3.1. Data***

Firm-level data. The empirical analysis combines firm-level data with country-level determinants of firm growth. Firm growth is measured by two indicators: growth of employment and growth of sales. According to the theory and previous empirical studies, the following firm level factors that may impact firm’s growth will be tested: firm’s initial size, age, export propensity, foreign versus domestic ownership, intangible capital, structure of firm’s financial sources (the impact of financial restraints), productivity, skill intensity, industry in which a firm operates.

The data on these variables is taken from the Bureau Van Dijk’s Amadeus database. Amadeus is a comprehensive firm-level database on European companies containing annual account items on approximately 21 million companies across Europe. Different historical waves of Amadeus were used so that non-surviving firms were included.<sup>1</sup> A database of financial and other relevant data was thus built for firms from all available European countries. Consolidated

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<sup>1</sup> We used the following Amadeus data vintages: 2017, 2015, 2012, 2009 and 2006.



and unconsolidated accounting data are available in Amadeus and we use unconsolidated accounts. We restrict the analysis to the period 2005-2017.

Country-specific data. Our aim in this study is to identify which macro-level determinants explain the variability of firm growth across different countries. Therefore, the following set of country-specific macroeconomic and institutional variables will be included in the model: size of the domestic market, rate of unemployment, share of inward FDI in GDP, natural resources abundance and income inequality. In addition, we construct a series of 12 synthetic indicators capturing the quality of institutional setting in the home country, regulatory, normative, and cognitive dimensions of entrepreneurial environment, trade and investment regulation and barriers and macroeconomic stability. Sources of data for the above mentioned variables include World Bank's Ease of Doing Business indicators, World development indicators, Education indicators, Health and population statistics and Worldwide Governance Indicators, data from the World justice project, Global Competitiveness Index indicators by World Economic Forum, and Centre for Business Research's Labour Regulation Index.

### **3.2. Methodological approach**

To analyse the above firm-, industry- and country-level factors that induce firm growth of revenue/employment we use the dynamic panel regression model which is traditionally used in empirical verification of the growth theory of the firm. Expanded dynamic specification of such autoregressive-distributed lag model can be written as follows:

$$y_{it} = \alpha y_{it-1} + \beta \mathbf{X}_{it} + \gamma \mathbf{C}_{it} + \eta_i + \delta_c + \lambda_j + \tau_t + v_{it} \quad i = 1, 2, \dots, N; \quad t = 2, 3, \dots, T \quad (1)$$

where  $y_{it}$  represents selected performance indicator, i.e. revenue and employment of firm  $i$  in year  $t$ ,  $y_{it-1}$  is lagged value of dependent variable,  $\mathbf{X}_{it}$  is a vector of firm-level control variables,  $\mathbf{C}_{it}$  denotes a vector of country-specific determinants,  $\eta_i$  is unobserved firm-specific fixed effect,  $\delta_c$  is a vector of country dummies that capture time-invariant country-specific effect,  $\lambda_j$  denotes a set of industry dummies to control for industry-specific growth trends,  $\tau_t$  are time dummies to control for region-wide common year shocks, and  $v_{it}$  is an error term. Revenue/employment in time  $t$  thus depends on revenue/employment in the previous period and is correlated with other control variables. Control variables  $\mathbf{X}_{it}$  include firm age, size, productivity, average wage, indebtedness share of intangibles in total assets, and possible other firm-level characteristics that the theory and past empirical studies suggest as factors of firm growth. Where appropriate, these variables enter specification lagged one year to avoid the problem of simultaneity. Time period studied is from 2005-2017, encompassing the entire business cycle.

To consistently estimate the above dynamic panel model with large cross-section dimension and short time span, we apply generalised method of moments models developed by Arellano and Bover (1995) and Blundell and Bond (1998). System GMM outlined by Arellano and Bover (1995) and fully developed by Blundell and Bond (1998) uses lagged levels as instruments for first-differences as in the original Arellano and Bond (1991) estimator, but it adds variables in levels equation and instruments them with suitable lags of their own first-differences. We also use Windmeijer's (2005) finite-sample correction for the two-step covariance matrix. Lagged dependent variable is treated as endogenous variables, age, time dummies, and country dummies are treated as strictly exogenous variables, while the rest of the variables enter the model as predetermined variables. To provide the benchmark for the sys-GMM estimates, we first run ordinary least squares (OLS) and fixed effects (FE) models that overestimates and

underestimates the true effect of lagged dependent variable, respectively. As a rule, coefficient of sys-GMM should lie between the boundaries of OLS and FE coefficients. Basic OLS and FE methods do not correct the problem of endogeneity on the lagged dependent variable neither; they ignore it (OLS) or treat it inadequately also for other control variables. Sys-GMM resolves the problem of endogeneity of explanatory variables by the instrumentalisation of these variables with their lagged differences and lagged levels. This partly reduces the problem and results in less biased estimates of the impact of factors on the growth of dependent variable, i.e. sales and export revenue.

Apart from OLS and FE estimation, we also report results of the between estimator (BE). Namely, if we expect current value of revenue and employment (conditional on their lagged values) to react differently to (i) changes in the average value of  $X$  and  $C$  for an individual firm compared to (ii) the temporary departures from the average  $X$  and  $C$ , our model could be rewritten as follows:

$$y_{it} = \alpha y_{it-1} + \beta_1 \bar{X}_i + \beta_2 (X_{it} - \bar{X}_i) + \gamma_1 \bar{C}_i + \gamma_2 (C_{it} - \bar{C}_i) + \eta_i + \delta_c + \lambda_j + \tau_t + v_{it}$$

where  $\bar{X}_i \equiv \sum_t X_{it} / T_i$  and analogously for  $\bar{C}_i$ . In this model,  $\beta_1$  and  $\gamma_1$  reveal how changes in the average value of  $X$  and  $C$  for an individual firm affect its size. Parameters  $\beta_2$  and  $\gamma_2$ , on the other hand, show how temporary departures from the average values of  $X$  and  $C$  affect firm size. The BE estimates  $\beta_1$  and  $\gamma_1$  while the within estimator FE estimates  $\beta_2$  and  $\gamma_2$ , and neither estimates the other. Thus even when estimating equations like (1), it is worth comparing the within and between estimators.

We complement the above AR(1) specification in Equation (1) with a more direct modelling of employment and revenue growth rate:

$$\dot{y}_{it} = \alpha y_{it-1} + \beta X_{it} + \gamma C_{it} + \eta_i + \delta_c + \lambda_j + \tau_t + v_{it} \quad i = 1, 2, \dots, N; \quad t = 2, 3, \dots, T \quad (2)$$

where  $\dot{y}_{it} \equiv \frac{2(Y_{it} - Y_{it-1})}{Y_{it} + Y_{it-1}}$  and  $Y_{it}$  ( $y_{it}$ ) denotes (log of) revenue or employment of firm  $i$  in year  $t$ . Growth rate  $\dot{y}_{it}$  is by construction bounded between -2 and 2, which tames down potential outliers, i.e. firms that increase employment or revenue from a very low base or those that decrease them to close to zero. Despite the transformation, ordinary rates of growth are very close to the values defined either by  $(y_{it} - y_{it-1})$  or  $\frac{Y_{it} - Y_{it-1}}{Y_{it-1}}$ .

In including country specific factors in the model we will follow the approach of Dall'Olmo et al. (2013). In modelling the factors of productivity growth in Europe they combine Amadeus firm-level data on productivity and firm characteristics with various country-level data. To this end we apply a multidimensional measure of the business/entrepreneurial environment that identify how differences in institutional arrangements across countries in our study influence firm growth in a country. We construct 12 synthetic institutional indices that are country-year-specific. Each of the synthetic indices is calculated from a series of sub-indicators that are listed in the Appendix Table 1. All sub-indicators were first normalized to the interval [0,1] and transformed in such a way that values closer to 1 indicate more favourable business environment for firms. Aggregate synthetic index is then calculated as a simple average of all normalized sub-indicators.

The first institutional index is Bureaucracy, which measures the ease of enforcing contracts, obtaining building permits, paying taxes, starting a business, trading across borders etc. The

second is Financial system, which measures the development of financial sector, protection of minority investments, ease of getting credit, quality of insurance and financial services, etc. Next is Regulation, which rates the quality of regulation, efficiency of regulatory enforcement and burden of government regulation. Fourth index is Labour market regulation, which quantifies the degree of labour regulation like severance pay, length of notice period, procedural constraints on dismissal and the like. The fifth index is Infrastructure and measures the quality of infrastructure such as roads, railroads, ports, air transport, internet and electricity. The sixth indicator is Healthcare, which rates the quality and accessibility of healthcare services, health expenditures, immunization, mortality rates, etc. Next in line is Taxes, which measures the level of taxes in a country with higher values of the index corresponding to lower taxes. Macroeconomic stability, the eighth indicator, measures the strength of the macroeconomic aggregates and lack of excessive imbalances such as trade deficit, income inequality, old age dependency, etc. The ninth index is Political environment, capturing the political stability, accountability, government power limits, trust in political institutions and absence of corruption. Rule of law is the tenth synthetic index, which measures the freedoms enjoyed by individuals and businesses, absence of discrimination and violence, effectiveness and timeliness of judiciary and the protection of property rights. The following indicator is Security, measuring the absence of crime, civil conflict, terrorism and organized crime and the reliability of police services. The twelfth synthetic indicator is Education and it quantifies the quality of education system, abundance of human capital, enrolment rates to different levels of education, internationally comparable test scores and aggregate expenditures on education and R&D.

#### **4. Results**

Empirical analysis highlights the interplay on a number of firm-, industry- and country-determinants. Most of the tested determinants revealed a significant influence on a firm growth, however their impact varies across different specifications. Table 1 shows the results for autoregressive-distributed (AR 1) lag model separately for sales revenues (columns 1, 2 and 3 for OLS, FE and BE estimates) and employment (columns 4, 5 and 6 for OLS, FE and BE estimates). Table 2 further shows the results for a more direct modelling of employment and revenue growth rate. In growth specification model, the selected determinants explain much less variation of sales and employment growth than in previous case.  $R^2$  in these regressions (Table 2) are much lower and range between 3 and 13% across different specifications, while autoregressive-distributed lag model explains between 19 and 95% of variation. Large number of variables in all used specifications is normally related also to their statistical significance, therefore we also consider t- values in interpretation of results.

Results revealed a significant role of firm-, industry- and country-determinants on a firm growth, however the relation between the selected determinants and firm growth varies across different specifications. Most consistent relations are found for firm level determinants, especially age, skills and productivity. Positive and highly statistically significant (with one of the highest t-value) relation to firm growth was confirmed for labour productivity, while age and firm growth are related negatively (older firms will less likely grow). Skills contribute positively to sales, but negatively to employment, and the relation is consistent whether we consider autoregressive-distributed lag model or growth specification model. Skilled personnel thus generate sales, but less likely new employees. The share of intangible capital, however, show positive relation to both, sales and employment across all specifications (but much lower t-value compared to skills, age or productivity). As predicted in theory, level of debt is consistently negatively related to both, sales and employment, across all specifications.

Among country determinants, unemployment turned out as the most significant determinant. Unemployment is positively related to firm sales or employment (higher employment negatively influences firm growth; higher unemployment may indicate lower labour cost). Nevertheless, cross-country differences matter, BE estimator changes the direction of relation, and higher employment in cross section analysis shows positive relation to employment growth. Further we found consistent relation between firm growth and equality and tariff; both, higher equality and higher tariff decelerate sales and employment growth regardless of specification. Availability of national resources also consistently (but with lower significance) accelerate sales and employment growth. Firm growth and its relation of GDP<sub>ppp</sub> and inward FDI on revenues and employment growth varies across different specifications. Market size and development is positively related to firm growth (t-value for GDP<sub>ppp</sub> lower than unemployment or inequality), however negative values in cross section BE estimators indicate difficulties to grow in more developed markets. Vice versa the level of inward FDI show negative relation to sales and employment growth; OLS and FE estimation may indicate that the level of inward FDI decelerate firm growth), while between estimator show positive coefficient (countries with more inward FDI may offer more opportunities for firm growth, in sales and employment).

**Table 1:** Revenue and employment growth determinants (AR(1) specification), 2005-2017.

|                                      | Revenue growth equations   |                           |                           | Employment growth equations |                            |                           |
|--------------------------------------|----------------------------|---------------------------|---------------------------|-----------------------------|----------------------------|---------------------------|
|                                      | (1)<br>OLS                 | (2)<br>FE                 | (3)<br>BE                 | (4)<br>OLS                  | (5)<br>FE                  | (6)<br>BE                 |
| $\ln(\text{revenue})_{t-1}$          | 0.671***<br>(0.000202)     | 0.187***<br>(0.000301)    | 0.727***<br>(0.000405)    | 0.0597***<br>(9.07e-05)     | 0.0684***<br>(0.000138)    | 0.0266***<br>(0.000151)   |
| $\ln(\text{emp})_{t-1}$              | 0.276***<br>(0.000265)     | 0.305***<br>(0.000522)    | 0.237***<br>(0.000548)    | 0.899***<br>(0.000119)      | 0.485***<br>(0.000240)     | 0.948***<br>(0.000205)    |
| $\text{age}_t$                       | -0.00198***<br>(1.86e-05)  | 0.0100***<br>(0.000495)   | -0.00268***<br>(4.09e-05) | -0.000686***<br>(8.33e-06)  | 0.0129***<br>(0.000227)    | -0.00124***<br>(1.53e-05) |
| $\ln(\text{avg.wage})_{t-1}$         | 0.190***<br>(0.000332)     | 0.208***<br>(0.000486)    | 0.165***<br>(0.000622)    | -0.0964***<br>(0.000149)    | -0.264***<br>(0.000223)    | -0.0275***<br>(0.000232)  |
| $\text{debtleverage}_t$              | -0.000663***<br>(0.000102) | -0.00169***<br>(0.000131) | -0.000334**<br>(0.000139) | -0.000279***<br>(4.57e-05)  | -0.000334***<br>(6.01e-05) | -9.38e-05*<br>(5.20e-05)  |
| $\ln(\text{lab.prod.})_{t-1}$        | 0.0528***<br>(5.98e-05)    | 0.0574***<br>(6.59e-05)   | 0.0528***<br>(0.000132)   | 0.00596***<br>(2.68e-05)    | 0.00763***<br>(3.02e-05)   | 0.00564***<br>(4.95e-05)  |
| $\text{intang.share}_t$              | 0.0344***<br>(0.00105)     | 0.0642***<br>(0.00177)    | 0.0279***<br>(0.00211)    | 0.0334***<br>(0.000472)     | 0.0530***<br>(0.000811)    | 0.0156***<br>(0.000788)   |
| Country-level determinants:          |                            |                           |                           |                             |                            |                           |
| $\text{GDP PPP}_t$                   | 0.00713<br>(0.0437)        | 0.551***<br>(0.0452)      | -1.273***<br>(0.0250)     | 0.709***<br>(0.0196)        | 0.468***<br>(0.0207)       | -0.284***<br>(0.00932)    |
| $\text{inwardFDI}_t$                 | -0.0723*<br>(0.0420)       | -0.283***<br>(0.0378)     | 4.533***<br>(0.0910)      | -0.209***<br>(0.0188)       | -0.181***<br>(0.0173)      | 0.739***<br>(0.0340)      |
| $\text{natur.resources}_t$           | 0.327***<br>(0.0231)       | -0.234***<br>(0.0240)     | 0.722***<br>(0.0194)      | 0.0996***<br>(0.0103)       | 0.0412***<br>(0.0110)      | 0.105***<br>(0.00726)     |
| $\text{unemployment}_t^b$            | -0.768***<br>(0.0126)      | -0.725***<br>(0.0116)     | 0.287***<br>(0.0126)      | -0.351***<br>(0.00566)      | -0.412***<br>(0.00533)     | 0.107***<br>(0.00470)     |
| Equality - GINI<br>coef <sup>a</sup> | -0.213***<br>(0.00748)     | -0.169***<br>(0.00724)    | 0.280***<br>(0.00813)     | -0.107***<br>(0.00335)      | -0.0946***<br>(0.00332)    | -0.0386***<br>(0.00304)   |
| $\text{avg.tariff}_t$                | -0.469***                  | -1.021***                 | 0.590***                  | -0.105***                   | -0.231***                  | 0.00513                   |

|                                  |            |            |            |            |            |            |
|----------------------------------|------------|------------|------------|------------|------------|------------|
|                                  | (0.0265)   | (0.0245)   | (0.0158)   | (0.0118)   | (0.0112)   | (0.00591)  |
| Synthetic institutional indices: |            |            |            |            |            |            |
| Education <sub>t</sub>           | -0.122***  | -0.190***  | 0.0212***  | -0.0445*** | -0.191***  | 0.0284***  |
|                                  | (0.0105)   | (0.0105)   | (0.00782)  | (0.00469)  | (0.00481)  | (0.00292)  |
| Taxes <sub>t</sub>               | 0.171***   | 0.184***   | 0.155***   | 0.108***   | 0.144***   | -0.0210*** |
|                                  | (0.00567)  | (0.00498)  | (0.0119)   | (0.00254)  | (0.00228)  | (0.00444)  |
| Healthcare <sub>t</sub>          | -0.113***  | 0.281***   | 0.478***   | -0.241***  | 0.0111     | -0.0122    |
|                                  | (0.0202)   | (0.0199)   | (0.0245)   | (0.00904)  | (0.00915)  | (0.00916)  |
| Bureaucracy <sub>t</sub>         | -0.103***  | -0.491***  | 0.335***   | -0.0528*** | -0.306***  | 0.0855***  |
|                                  | (0.0109)   | (0.0110)   | (0.0139)   | (0.00490)  | (0.00504)  | (0.00520)  |
| Infrastructure <sub>t</sub>      | 2.150***   | 2.933***   | 0.320***   | 0.896***   | 0.787***   | 0.219***   |
|                                  | (0.0481)   | (0.0495)   | (0.0191)   | (0.0215)   | (0.0227)   | (0.00713)  |
| Financial system <sub>t</sub>    | -0.194***  | 0.160***   | 0.0171     | -0.314***  | -0.107***  | -0.0287*** |
|                                  | (0.0128)   | (0.0127)   | (0.0128)   | (0.00575)  | (0.00582)  | (0.00478)  |
| Political enviro <sub>t</sub>    | 0.969***   | -0.839***  | 0.257***   | 0.724***   | 0.0480*    | -0.134***  |
|                                  | (0.0662)   | (0.0617)   | (0.0235)   | (0.0297)   | (0.0283)   | (0.00877)  |
| Rule of law <sub>t</sub>         | -1.490***  | 1.547***   | 0.550***   | -1.522***  | 5.362***   | 0.171***   |
|                                  | (0.280)    | (0.256)    | (0.0262)   | (0.125)    | (0.117)    | (0.00978)  |
| Regulation <sub>t</sub>          | 0.408***   | 0.602***   | -0.237***  | -0.201***  | 0.0608***  | 0.115***   |
|                                  | (0.0404)   | (0.0390)   | (0.0154)   | (0.0181)   | (0.0179)   | (0.00577)  |
| Security <sub>t</sub>            | -1.535***  | -6.128***  | -0.236***  | -2.582***  | -4.742***  | 0.00778**  |
|                                  | (0.257)    | (0.245)    | (0.00886)  | (0.115)    | (0.113)    | (0.00331)  |
| Labour market <sub>t</sub>       | -0.273***  | 0.225***   | -0.107***  | -0.0616*** | 0.375***   | 0.00956*** |
|                                  | (0.0161)   | (0.0156)   | (0.00611)  | (0.00720)  | (0.00714)  | (0.00228)  |
| Macro stability <sub>t</sub>     | 1.750***   | 2.375***   | -1.449***  | 0.912***   | 0.982***   | -0.290***  |
|                                  | (0.0267)   | (0.0249)   | (0.0293)   | (0.0119)   | (0.0114)   | (0.0109)   |
| Constant                         | 2.028***   | 12.04***   | -0.160***  | 2.630***   | 3.420***   | -0.244***  |
|                                  | (0.268)    | (0.462)    | (0.0238)   | (0.120)    | (0.212)    | (0.00890)  |
| Country effects                  | yes        | yes        | no         | yes        | yes        | no         |
| Year effects                     | yes        | yes        | yes        | yes        | yes        | yes        |
| Industry effects                 | yes        | yes        | yes        | yes        | yes        | yes        |
| Observations                     | 15,487,532 | 15,487,532 | 15,487,532 | 15,487,532 | 15,487,532 | 15,487,532 |
| R-squared                        | 0.823      | 0.189      | 0.837      | 0.929      | 0.383      | 0.951      |
| Number of id                     |            | 3,328,871  | 3,328,871  |            | 3,328,871  | 3,328,871  |

Notes: Dependent variable is log of revenue for (1)-(3) and log of employment for (4)-(5). Standard errors are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

a The interpretation for GINI coef. is reversed: higher value of indicator reflects higher equality.

b The interpretation for Unemployment is reversed: higher value of indicator reflects higher equality.

**Table 2:** Revenue and employment growth determinants (growth rate specification), 2005-2017.

|                                      | Revenue growth equations   |                            |                            | Employment growth equations |                            |                            |                           |
|--------------------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|----------------------------|----------------------------|---------------------------|
|                                      | (1)<br>OLS                 | (2)<br>FE                  | (3)<br>BE                  | (4)<br>OLS                  | (5)<br>OLS                 | (6)<br>FE                  | (7)<br>BE                 |
| $\ln(\text{emp})_{t-1}$              | -0.00919***<br>(7.52e-05)  | -0.117***<br>(0.000225)    | 0.000517***<br>(0.000135)  | -0.0327***<br>(6.77e-05)    |                            | -0.349***<br>(0.000182)    | -0.0164***<br>(0.000112)  |
| $\ln(\text{revenue})_{t-1}$          |                            |                            |                            |                             | 0.00689***<br>(5.20e-05)   |                            |                           |
| $\text{age}_t$                       | -0.00259***<br>(7.31e-06)  | 0.00341***<br>(0.000228)   | -0.00300***<br>(1.36e-05)  | -0.000615***<br>(6.57e-06)  | -0.00152***<br>(6.57e-06)  | 0.00564***<br>(0.000184)   | -0.00117***<br>(1.13e-05) |
| $\ln(\text{avg.wage})_{t-1}$         | 0.0163***<br>(0.000126)    | 0.0336***<br>(0.000223)    | 0.0199***<br>(0.000200)    | -0.0522***<br>(0.000113)    | -0.0660***<br>(0.000118)   | -0.192***<br>(0.000180)    | -0.0113***<br>(0.000166)  |
| $\text{debtleverage}_t$              | -0.000363***<br>(4.02e-05) | -0.000427***<br>(6.03e-05) | -0.000214***<br>(4.63e-05) | -0.000177***<br>(3.61e-05)  | -0.000237***<br>(3.64e-05) | -0.000269***<br>(4.87e-05) | -7.05e-05*<br>(3.84e-05)  |
| $\ln(\text{lab.prod.})_{t-1}$        | 0.0180***<br>(2.33e-05)    | 0.0205***<br>(3.02e-05)    | 0.0149***<br>(4.34e-05)    | 0.00648***<br>(2.10e-05)    | 0.00555***<br>(2.13e-05)   | 0.00645***<br>(2.45e-05)   | 0.00555***<br>(3.60e-05)  |
| $\text{intang.share}_t$              | 0.0334***<br>(0.000415)    | 0.0679***<br>(0.000814)    | 0.0306***<br>(0.000701)    | 0.0203***<br>(0.000373)     | 0.0126***<br>(0.000376)    | 0.0370***<br>(0.000658)    | 0.00572***<br>(0.000581)  |
| Country-level determinants:          |                            |                            |                            |                             |                            |                            |                           |
| $\text{GDP PPP}_t$                   | -0.363***<br>(0.0172)      | -0.142***<br>(0.0208)      | -0.676***<br>(0.00830)     | 0.738***<br>(0.0155)        | 0.557***<br>(0.0156)       | 0.523***<br>(0.0168)       | -0.220***<br>(0.00689)    |
| $\text{inwardFDI}_t$                 | -0.420***<br>(0.0165)      | -0.476***<br>(0.0174)      | 1.653***<br>(0.0303)       | -0.140***<br>(0.0149)       | -0.150***<br>(0.0150)      | -0.148***<br>(0.0141)      | 0.640***<br>(0.0251)      |
| $\text{natur.resources}_t$           | 0.142***<br>(0.00908)      | 0.136***<br>(0.0110)       | 0.222***<br>(0.00646)      | 0.131***<br>(0.00817)       | 0.132***<br>(0.00823)      | 0.0551***<br>(0.00892)     | 0.0708***<br>(0.00536)    |
| $\text{unemployment}_t^b$            | -0.564***<br>(0.00497)     | -0.550***<br>(0.00535)     | -0.112***<br>(0.00418)     | -0.308***<br>(0.00447)      | -0.257***<br>(0.00450)     | -0.349***<br>(0.00433)     | 0.0911***<br>(0.00347)    |
| Equality - GINI<br>$\text{coef}_t^a$ | -0.311***<br>(0.00294)     | -0.348***<br>(0.00333)     | -0.0534***<br>(0.00270)    | -0.0783***<br>(0.00265)     | -0.103***<br>(0.00267)     | -0.0697***<br>(0.00269)    | -0.0339***<br>(0.00224)   |
| $\text{avg.tariff}_t$                | -0.231***<br>(0.0104)      | -0.348***<br>(0.0113)      | 0.171***<br>(0.00527)      | -0.113***<br>(0.00936)      | -0.104***<br>(0.00943)     | -0.229***<br>(0.00913)     | 0.0210***<br>(0.00437)    |
| Synthetic institutional indices:     |                            |                            |                            |                             |                            |                            |                           |
| $\text{Education}_t$                 | -0.104***<br>(0.00412)     | -0.156***<br>(0.00482)     | 0.0419***<br>(0.00260)     | -0.0482***<br>(0.00371)     | -0.00310<br>(0.00373)      | -0.173***<br>(0.00390)     | 0.0188***<br>(0.00216)    |
| $\text{Taxes}_t$                     | 0.225***<br>(0.00223)      | 0.211***<br>(0.00229)      | -0.00844**<br>(0.00395)    | 0.0906***<br>(0.00201)      | 0.103***<br>(0.00202)      | 0.121***<br>(0.00185)      | 0.0186***<br>(0.00328)    |
| $\text{Healthcare}_t$                | -0.385***<br>(0.00794)     | -0.380***<br>(0.00918)     | 0.00337<br>(0.00816)       | -0.217***<br>(0.00715)      | -0.255***<br>(0.00720)     | -0.0358***<br>(0.00742)    | 0.0145**<br>(0.00677)     |
| $\text{Bureaucracy}_t$               | -0.0841***<br>(0.00431)    | -0.333***<br>(0.00505)     | 0.292***<br>(0.00463)      | -0.0358***<br>(0.00388)     | 0.0148***<br>(0.00390)     | -0.234***<br>(0.00409)     | 0.101***<br>(0.00384)     |
| $\text{Infrastructure}_t$            | 1.021***<br>(0.0189)       | 1.444***<br>(0.0228)       | 0.0653***<br>(0.00635)     | 0.958***<br>(0.0170)        | 0.839***<br>(0.0171)       | 0.825***<br>(0.0184)       | 0.182***<br>(0.00526)     |
| $\text{Financial system}_t$          | -0.491***<br>(0.00505)     | -0.452***<br>(0.00584)     | -0.230***<br>(0.00426)     | -0.237***<br>(0.00454)      | -0.295***<br>(0.00457)     | -0.0796***<br>(0.00472)    | -0.0581***<br>(0.00353)   |
| $\text{Political envir}_t$           | 1.425***<br>(0.0260)       | 0.176***<br>(0.0284)       | -0.103***<br>(0.00781)     | 0.599***<br>(0.0234)        | 0.879***<br>(0.0236)       | 0.138***<br>(0.0230)       | -0.102***<br>(0.00648)    |
| $\text{Rule of law}_t$               | -0.643***<br>(0.110)       | -0.683***<br>(0.118)       | 0.407***<br>(0.00871)      | -1.531***<br>(0.0989)       | -1.883***<br>(0.0996)      | 3.942***<br>(0.0952)       | 0.0985***<br>(0.00722)    |

|                              |                      |                        |                          |                         |                        |                       |                         |
|------------------------------|----------------------|------------------------|--------------------------|-------------------------|------------------------|-----------------------|-------------------------|
| Regulation <sub>t</sub>      | 0.147***<br>(0.0159) | 0.361***<br>(0.0179)   | 0.0210***<br>(0.00514)   | -0.185***<br>(0.0143)   | -0.194***<br>(0.0144)  | 0.0184<br>(0.0145)    | 0.109***<br>(0.00426)   |
| Security <sub>t</sub>        | -0.404***<br>(0.101) | -2.315***<br>(0.113)   | -0.0572***<br>(0.00295)  | -2.481***<br>(0.0909)   | -2.604***<br>(0.0915)  | -4.342***<br>(0.0913) | 0.0131***<br>(0.00244)  |
| Labour market <sub>t</sub>   | 0.00576<br>(0.00633) | -0.0163**<br>(0.00717) | -0.00874***<br>(0.00203) | -0.0633***<br>(0.00569) | 0.0357***<br>(0.00573) | 0.318***<br>(0.00580) | -0.0147***<br>(0.00169) |
| Macro stability <sub>t</sub> | 1.545***<br>(0.0105) | 1.757***<br>(0.0114)   | -0.235***<br>(0.00974)   | 0.817***<br>(0.00943)   | 0.807***<br>(0.00950)  | 0.891***<br>(0.00925) | -0.239***<br>(0.00808)  |
| Constant                     | -0.587***<br>(0.105) | 1.674***<br>(0.213)    | -0.508***<br>(0.00790)   | 2.713***<br>(0.0949)    | 2.885***<br>(0.0955)   | 2.069***<br>(0.172)   | -0.108***<br>(0.00655)  |
| Country effects              | yes                  | yes                    | yes                      | yes                     | yes                    | yes                   | yes                     |
| Year effects                 | yes                  | yes                    | yes                      | yes                     | yes                    | yes                   | yes                     |
| Industry effects             | yes                  | yes                    | yes                      | yes                     | yes                    | yes                   | yes                     |
| Observations                 | 15,487,532           | 15,487,532             | 15,487,532               | 15,487,532              | 15,487,532             | 15,487,532            | 15,487,532              |
| R-squared                    | 0.080                | 0.096                  | 0.138                    | 0.049                   | 0.036                  | 0.298                 | 0.054                   |
| Number of id                 |                      | 3,328,871              | 3,328,871                |                         |                        | 3,328,871             | 3,328,871               |

Notes: Dependent variable is growth rate of revenue for (1)-(3) and growth rate of employment for (4)-(7).

Standard errors are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

a The interpretation for GINI coef. is reversed: higher value of indicator reflects higher equality.

b The interpretation for Unemployment is reversed: higher value of indicator reflects higher equality.

Tests for institutional determinants also require deeper inquiry. The size and direction of impact varies the most among intuitional determinants; apart from infrastructure, that shows the highest and consistently positive and significant impact on firm growth. Lower taxes are in most models also positively and significantly related to firm growth. Financial system on the other hand shows statistically significant, mostly negative, but inconsistent relation to firm growth.

Higher significance was further identified for macroeconomic and political environment (macroeconomic environment shows much greater significance than political environment for firm growth). Stability in macroeconomic and political environment is positively related to firm growth, however BE specification indicate negative relation, cross –country differences relate both, macroeconomic and political stability with lower employment growth. Rule of law also requires deeper exploration; FE estimations show very high coefficients, so better rule of law should strongly accelerate individual firm’s growth in time and stimulate new employment. Higher security on the other hand indicates negative relation to firm growth (insecurity accelerate firm growth), positive relation is only found in BE specifications (safer countries may be positively related to firm growth).

Many institutional variables, for example education, healthcare, regulation, labour market regulation, bureaucracy and financial system have lower t-values, which may suggest their less significant (or more indirect) role in in firm growth. Looking at significance reveals that t-values for labour market regulation are for example the lowest among all determinants. Changing direction of relation across specification also calls for further analysis.

#### 4. Conclusions

Firm, industry and country determinants interplay in the process of firm growth. This analysis adds new empirical evidence on growth determinates of European firms in the period from 2005 to 2017. Empirical evidence is in line with theoretical prediction, firm-level determinants are identified as the most important and significant determinants of firm growth. Productivity and

skills, reflecting managerial and resource limits are identified as the most important and significant determinants of firm growth. Country level characteristics show that higher employment, higher equality and higher tariffs negatively influence firm growth. Institutional determinants require more complex analysis. Infrastructure consistently accelerate firm growth, there is also clear positive relation for taxes, but we can see that many institutional factor highlight importance of cross-country differences.

The results bring managerial and policy implications. In a complex interplay of many determinants at different levels, we can identify some determinant which unambiguously stimulate firm growth. These should be supported through managerial and policy incentives. Firm-level growth strategies thus include striving for productivity, high skills and creation of intangible resources. These efforts can be complemented by country policies. The results also indicate that business environment is always seen in a comparative perspective; while good infrastructure and low taxes are consistent accelerator of firm growth, the impact of many other factors depend on relative differences.



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## Appendix

Table A1: 12 synthetic indicators of business environment and their corresponding components.

| <b>I. Bureaucracy</b>       |  | Source |
|-----------------------------|--|--------|
| 1                           | Cost of building permits   | DB     |
| 2                           | Number of building permit procedures                             | DB     |
| 3                           | Time of build permit procedures                                  | DB     |
| 4                           | Cost of enforcing contracts                                      | DB     |
| 5                           | Number of procedures for enforcing contracts                     | DB     |
| 6                           | Time for enforcing contracts                                     | DB     |
| 7                           | Paying taxes: Payments (number per year)                         | DB     |
| 8                           | Paying taxes: time   | DB     |
| 9                           | Registering property: Cost (% of property value) score           | DB     |
| 10                          | Registering property: Procedures (number) – Score                | DB     |
| 11                          | Registering property: Time (days) – Score                        | DB     |
| 12                          | Starting a business: Cost - Men (% of income per capita) – Score | DB     |
| 13                          | Starting a business: Procedures required - Men (number) – Score  | DB     |
| 14                          | Starting a business: Time - Men (days) – Score                   | DB     |
| 15                          | Bureaucracy to trade across borders                              | DB     |
| 16                          | Cost of business start-up procedures (% of GNI per capita)       | WDI    |
| <b>II. Financial system</b> |  |        |
| 1                           | Getting credit total score                                       | DB     |

|                          |   |        |
|--------------------------|---|--------|
| 2                        | Protecting minority investment  | DB     |
| 3                        | Account ownership at a financial institution or with a mobile-money-service provider (% of population ages 15+) | WDI    |
| 4                        | Automated teller machines (ATMs) (per 100,000 adults)   | WDI    |
| 5                        | Commercial bank branches (per 100,000 adults)   | WDI    |
| 6                        | Bank capital to assets ratio (%)  | WDI    |
| 7                        | Bank nonperforming loans to total gross loans (%)   | WDI    |
| 8                        | Domestic credit provided by financial sector (% of GDP)   | WDI    |
| 9                        | Insurance and financial services (% of commercial service exports)  | WDI    |
| 10                       | Insurance and financial services (% of commercial service imports) Share of imports in exports INVERSE          | WDI    |
| 11                       | Net foreign assets (current LCU) per capita   | WDI    |
| 12                       | Strength of legal rights index (0=weak to 12=strong) (legal rights related to borrowing)                        | WDI    |
| 13                       | Protection of minority shareholders' interests  | WEFGCI |
| <b>III. Regulation</b>   |   |        |
| 1                        | Regulatory Quality  | WGI    |
| 2                        | Resolving insolvency score  | DB     |
| 3                        | Starting a business: Paid-in Minimum capital (% of income per capita) – Score                                   | DB     |
| 4                        | Factor 6: Regulatory Enforcement  | DB     |
| 5                        | Government regulations are effectively enforced   | DB     |
| 6                        | Government regulations are applied and enforced without improper influence                                      | DB     |
| 7                        | Administrative proceedings are conducted without unreasonable delay   | DB     |
| 8                        | Due process is respected in administrative proceedings  | DB     |
| 9                        | The government does not expropriate without lawful process and adequate compensation                            | DB     |
| 10                       | Burden of government regulation   | GCIWEF |
| 11                       | Efficiency of legal framework in settling disputes  | GCIWEF |
| 12                       | Efficiency of legal framework in challenging regs   | GCIWEF |
| 13                       | Strength of auditing and reporting standards  | GCIWEF |
| <b>IV. Labour market</b> |   |        |
| 1                        | Vulnerable employment, total (% of total employment) (modeled ILO estimate)                                     | WDI    |
| 2                        | Wage and salaried workers, total (% of total employment) (modeled ILO estimate)                                 | WDI    |
| 3                        | sub-indicator "Valid grounds for dismissals"  | ILO    |
| 4                        | sub-indicator "Prohibited grounds for dismissals"   | ILO    |
| 5                        | sub-indicator "Maximum probationary (trial) period"   | ILO    |
| 6                        | sub-indicator "Procedural requirements for dismissals"  | ILO    |
| 7                        | sub-indicator "Notice periods"  | ILO    |
| 8                        | sub-indicator "Severance pay"   | ILO    |
| 9                        | sub-indicator "Redundancy pay"  | ILO    |
| 10                       | sub-indicator "Redress"   | ILO    |
| 11                       | maximum probationary (trial) period, in months  | ILO    |
| 12                       | Average of notice period  | ILO    |
| 13                       | Average redundancy pay  | ILO    |
| 14                       | Average severance pay   | ILO    |
| 15                       | The law, as opposed to the contracting parties, determines the legal status of the worker                       | CCBR   |
| 16                       | Part-time workers have the right to equal treatment with full-time workers                                      | CCBR   |
| 17                       | Part-time workers have equal or proportionate dismissal rights to fulltime workers                              | CCBR   |
| 18                       | Fixed-term contracts are allowed only for work of limited duration  | CCBR   |
| 19                       | Fixed-term workers have the right to equal treatment with permanent workers                                     | CCBR   |
| 20                       | Maximum duration of fixed-term contracts  | CCBR   |
| 21                       | Agency work is prohibited or strictly controlled  | CCBR   |
| 22                       | Agency workers have the right to equal treatment with permanent workers of the user undertaking                 | CCBR   |



|    |  |      |
|----|--|------|
| 23 | Annual leave entitlements  | CCBR |
| 24 | Public holiday entitlements  | CCBR |
| 25 | Overtime premia  | CCBR |
| 26 | Weekend working  | CCBR |
| 27 | Limits to overtime working   | CCBR |
| 28 | Duration of the normal working week  | CCBR |
| 29 | Maximum daily working time   | CCBR |
| 30 | Legally mandated notice period   | CCBR |
| 31 | Legally mandated redundancy compensation   | CCBR |
| 32 | Minimum qualifying period of service for normal case of unjust dismissal   | CCBR |
| 33 | Law imposes procedural constraints on dismissal  | CCBR |
| 34 | Law imposes substantive constraints on dismissal   | CCBR |
| 35 | Reinstatement normal remedy for unfair dismissal   | CCBR |
| 36 | Notification of dismissal  | CCBR |
| 37 | Redundancy selection   | CCBR |
| 38 | Priority in re-employment  | CCBR |
| 39 | Right to unionisation  | CCBR |
| 40 | Right to collective bargaining   | CCBR |
| 41 | Duty to bargain  | CCBR |
| 42 | Extension of collective agreements   | CCBR |
| 43 | Closed shops   | CCBR |
| 44 | Codetermination: board membership  | CCBR |
| 45 | Codetermination and information/consultation of workers  | CCBR |
| 46 | Unofficial industrial action ( The legality of industrial action does not depend on trade union involvement or authorisation   | CCBR |
| 47 | Political industrial action (Political strikes are regarded as contra bonos mores under the general criminal and civil law, and hence prohibited.<br>Strikes must be directed against the primary employer)                      | CCBR |
| 48 | Secondary industrial action (Secondary and solidarity strikes are viewed as unlawful for the same reason as political strikes)   | CCBR |
| 49 | Lockouts (prohibition)   | CCBR |
| 50 | Right to industrial action   | CCBR |
| 51 | Waiting period prior to industrial action  | CCBR |
| 52 | Peace obligation (Strikes may not be called while a collective agreement, which generally implies a contractual peace obligation, is in force.)<br>Compulsory conciliation or arbitration (There is no requirement of compulsory | CCBR |
| 53 | conciliation or arbitration although a strike is unlawful if its object is subject to compulsory arbitration under codetermination law   | CCBR |
| 54 | Replacement of striking workers  | CCBR |

---

#### V. Infrastructure

|    |   |     |
|----|---|-----|
| 1  | Getting electricity score   | DB  |
| 2  | Air transport, freight (million ton-km) per capita  | WDI |
| 3  | Air transport, passengers carried per capita  | WDI |
| 4  | Air transport, registered carrier departures worldwide per capita   | WDI |
| 5  | Fixed telephone subs per 100  | WID |
| 6  | Mobile cellular subscriptions (per 100 people)  | WID |
| 7  | Internet users (per 100 people)   | EI  |
| 8  | Personal computers (per 100 people)   | EI  |
| 9  | Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (per 100,000 population) | HPS |
| 10 | People practicing open defecation (% of population)   | HPS |
| 11 | People practicing open defecation, rural (% of rural population)  | HPS |
| 12 | People practicing open defecation, urban (% of urban population)  | HPS |
| 13 | People using at least basic drinking water services (% of population)                                     | HPS |
| 14 | People using at least basic drinking water services, rural (% of rural population)                        | HPS |

|    |   |        |
|----|---|--------|
| 15 | People using at least basic drinking water services, urban (% of urban population)  | HPS    |
| 16 | People using at least basic sanitation services (% of population)   | HPS    |
| 17 | People using at least basic sanitation services, rural (% of rural population)  | HPS    |
| 18 | People using at least basic sanitation services, urban (% of urban population)  | HPS    |
| 19 | People using safely managed drinking water services (% of population)   | HPS    |
| 20 | People using safely managed sanitation services (% of population)   | HPS    |
| 21 | Electric power consumption (kWh per capita)   | WDI    |
| 22 | Electric power transmission and distribution losses (% of output)   | WDI    |
| 23 | Electricity production from coal sources (% of total)   | WDI    |
| 24 | Electricity production from hydroelectric sources (% of total)  | WDI    |
| 25 | Electricity production from natural gas sources (% of total)  | WDI    |
| 26 | Electricity production from nuclear sources (% of total)  | WDI    |
| 27 | Electricity production from oil sources (% of total)  | WDI    |
| 28 | Electricity production from oil, gas and coal sources (% of total)  | WDI    |
| 29 | Fixed broadband subscriptions (per 100 people)  | WDI    |
| 30 | Logistics performance index: Ability to track and trace consignments (1=low to 5=high)  | WDI    |
| 31 | Logistics performance index: Competence and quality of logistics services (1=low to 5=high)                                     | WDI    |
| 32 | Logistics performance index: Ease of arranging competitively priced shipments (1=low to 5=high)                                 | WDI    |
| 33 | Logistics performance index: Efficiency of customs clearance process (1=low to 5=high)  | WDI    |
| 34 | Logistics performance index: Frequency with which shipments reach consignee within scheduled or expected time (1=low to 5=high) | WDI    |
| 35 | Logistics performance index: Overall (1=low to 5=high)  | WDI    |
| 36 | Logistics performance index: Quality of trade and transport-related infrastructure (1=low to 5=high)                            | WDI    |
| 37 | Quality of port infrastructure, WEF (1=extremely underdeveloped to 7=well developed and efficient by international standards)   | WDI    |
| 38 | Rail lines (total route-km) per capita  | WDI    |
| 39 | Railways, goods transported (million ton-km) per capita   | WDI    |
| 40 | Railways, passengers carried (million passenger-km) per capita  | WDI    |
| 41 | Water productivity, total (constant 2010 US\$ GDP per cubic meter of total freshwater withdrawal)                               | WDI    |
| 42 | Quality of overall infrastructure   | GCIWEF |
| 43 | Quality of roads  | GCIWEF |
| 44 | Quality of railroad infrastructure  | GCIWEF |
| 45 | Quality of port infrastructure  | GCIWEF |
| 46 | Quality of air transport infrastructure   | GCIWEF |

## VI. Healthcare

|    |   |     |
|----|---|-----|
| 1  | Specialist surgical workforce (per 100,000 population)                                    | WDI |
| 2  | Adolescent fertility rate (births per 1,000 women ages 15-19)                             | HPS |
| 3  | Completeness of birth registration (%)  | HPS |
| 4  | Completeness of death registration with cause-of-death information (%)                    | HPS |
| 5  | Current health expenditure per capita, PPP (current international \$)                     | HPS |
| 6  | Current health expenditure (% of GDP)   | HPS |
| 7  | Domestic general government health expenditure (% of current health expenditure)          | HPS |
| 8  | Domestic general government health expenditure (% of GDP)                                 | HPS |
| 9  | Domestic general government health expenditure (% of general government expenditure)      | HPS |
| 10 | Domestic general government health expenditure per capita (current US\$)                  | HPS |
| 11 | Domestic general government health expenditure per capita, PPP (current international \$) | HPS |
| 12 | Hospital beds (per 1,000 people)  | HPS |

|                                  |  |     |
|----------------------------------|--|-----|
| 13                               | Immunization, DPT (% of children ages 12-23 months)                                    | HPS |
| 14                               | Immunization, Hib3 (% of children ages 12-23 months)                                   | HPS |
| 15                               | Immunization, measles (% of children ages 12-23 months)                                |     |
| 16                               | Immunization, Pol3 (% of one-year-old children)  | HPS |
| 17                               | Incidence of tuberculosis (per 100,000 people)   | HPS |
| 18                               | Lifetime risk of maternal death (%)  |     |
| 19                               | Maternal mortality ratio (modeled estimate, per 100,000 live births)                   | HPS |
| 20                               | Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)           | HPS |
| 21                               | Number of deaths ages 5-14 years per capita  | HPS |
| 22                               | Number of infant deaths per capita   | HPS |
| 23                               | Nurses and midwives (per 1,000 people)   | HPS |
| 24                               | Out-of-pocket expenditure (% of current health expenditure)                            | HPS |
| 25                               | Out-of-pocket expenditure per capita (current US\$)                                    | HPS |
| 26                               | Out-of-pocket expenditure per capita, PPP (current international \$)                   | HPS |
| 27                               | Physicians (per 1,000 people)  | HPS |
| 28                               | Maternal leave benefits (% of wages paid in covered period)                            | HPS |
| 29                               | Number of weeks of maternity leave   | HPS |
| 30                               | Risk of catastrophic expenditure for surgical care (% of people at risk)               | HPS |
| 31                               | Risk of impoverishing expenditure for surgical care (% of people at risk)              | HPS |
| <b>VII. Taxes</b>                |  |     |
| 1                                | Other taxes (% of profit)  | DB  |
| 2                                | Paying taxes: Labor tax and contributions (% of commercial profits)                    | DB  |
| 3                                | Profit tax   | DB  |
| 4                                | Social contributions (% of revenue)  | WDI |
| 5                                | Tax revenue (% of GDP)   | WDI |
| 6                                | Taxes on goods and services (% of revenue)   | WDI |
| 7                                | Taxes on goods and services (% value added of industry and services)                   | WDI |
| 8                                | Taxes on income, profits and capital gains (% of revenue)                              | WDI |
| 9                                | Taxes on income, profits and capital gains (% of total taxes)                          | WDI |
| <b>VIII. Macro stability</b>     |  |     |
| 1                                | External balance on goods and services (% of GDP)                                      | WDI |
| 2                                | Final consumption expenditure (% of GDP)   | WDI |
| 3                                | Birth rate   | WDI |
| 4                                | Employment   | WDI |
| 5                                | GDP per capita, PPP (constant 2011 international \$)                                   | WDI |
| 6                                | Foreign direct investment, net inflows (% of GDP)                                      | WDI |
| 7                                | Labour force participation rate  | WDI |
| 8                                | Life expectancy  | WDI |
| 9                                | Ratio of female to male labor force participation rate (%) (national estimate)         | WDI |
| 10                               | Total natural resources rents (% of GDP)   | WDI |
| 11                               | Unemployment, total (% of total labor force) (national estimate)                       | WDI |
| 12                               | Age dependency ratio (% of working-age population)                                     | HPS |
| 13                               | General government final consumption expenditure (% of GDP)                            | WDI |
| 14                               | GINI index (World Bank estimate)   | WDI |
| 15                               | Gross fixed capital formation (% of GDP)   | WDI |
| 16                               | Refugee population by country or territory of asylum                                   | WDI |
| 17                               | Share of youth not in education, employment or training, total (% of youth population) | WDI |
| 18                               | Tariff rate, applied, simple mean, all products (%)                                    | WDI |
| <b>IX. Political environment</b> |  |     |
| 1                                | Control of Corruption: Estimate  | WGI |
| 2                                | Government Effectiveness: Estimate   | WGI |
| 3                                | Political Stability and Absence of Violence/Terrorism: Estimate                        | WGI |
| 4                                | Voice and Accountability: Estimate   | WGI |

|    |   |        |
|----|---|--------|
| 5  | Factor 1: Constraints on Government Powers  | WJP    |
| 6  | Government powers are effectively limited by the legislature                                  | WJP    |
| 7  | Government powers are effectively limited by the judiciary                                    | WJP    |
| 8  | Government powers are effectively limited by independent auditing and review                  | WJP    |
| 9  | Government officials are sanctioned for misconduct  | WJP    |
| 10 | Government powers are subject to non-governmental checks                                      | WJP    |
| 11 | Transition of power is subject to the law   | WJP    |
| 12 | Factor 2: Absence of Corruption   | WJP    |
| 13 | Government officials in the executive branch do not use public office for private gain        | WJP    |
| 14 | Government officials in the judicial branch do not use public office for private gain         | WJP    |
| 15 | Government officials in the police and the military do not use public office for private gain | WJP    |
| 16 | Government officials in the legislative branch do not use public office for private gain      | WJP    |
| 17 | Factor 3: Open Government   | WJP    |
| 18 | Publicized laws and government data   | WJP    |
| 19 | Right to information  | WJP    |
| 20 | Civic participation   | WJP    |
| 21 | Complaint mechanisms  | WJP    |
| 22 | Diversion of public funds   | GCIWEF |
| 23 | Public trust in politicians   | GCIWEF |
| 24 | Irregular payments and bribes   | GCIWEF |
| 25 | Favoritism in decisions of government officials   | GCIWEF |
| 26 | Efficiency of government spending   | GCIWEF |
| 27 | Transparency of government policymaking   | GCIWEF |

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**X. Rule of law**

|    |  |        |
|----|--|--------|
| 1  | Rule of Law: Estimate  | WGI    |
| 2  | Factor 4: Fundamental Rights   | WJP    |
| 3  | Equal treatment and absence of discrimination                                      | WJP    |
| 4  | The right to life and security of the person is effectively guaranteed             | WJP    |
| 5  | Due process of law and rights of the accused                                       | WJP    |
| 6  | Freedom of opinion and expression is effectively guaranteed                        | WJP    |
| 7  | Freedom of belief and religion is effectively guaranteed                           | WJP    |
| 8  | Freedom from arbitrary interference with privacy is effectively guaranteed         | WJP    |
| 9  | Freedom of assembly and association is effectively guaranteed                      | WJP    |
| 10 | Fundamental labor rights are effectively guaranteed                                | WJP    |
| 11 | Factor 7: Civil Justice  | WJP    |
| 12 | People can access and afford civil justice   | WJP    |
| 13 | Civil justice is free of discrimination  | WJP    |
| 14 | Civil justice is free of corruption  | WJP    |
| 15 | Civil justice is free of improper government influence                             | WJP    |
| 16 | Civil justice is not subject to unreasonable delay                                 | WJP    |
| 17 | Civil justice is effectively enforced  | WJP    |
| 18 | Alternative dispute resolution mechanisms are accessible, impartial, and effective | WJP    |
| 19 | Factor 8: Criminal Justice   | WJP    |
| 20 | Criminal investigation system is effective   | WJP    |
| 21 | Criminal adjudication system is timely and effective                               | WJP    |
| 22 | Correctional system is effective in reducing criminal behavior                     | WJP    |
| 23 | Criminal system is impartial   | WJP    |
| 24 | Criminal system is free of corruption  | WJP    |
| 25 | Criminal system is free of improper government influence                           | WJP    |
| 26 | Due process of law and the rights of the accused                                   | WJP    |
| 27 | Property rights  | GCIWEF |
| 28 | Intellectual property protection   | GCIWEF |

|                       |   |        |
|-----------------------|---|--------|
| 29                    | Judicial independence   | GCIWEF |
| <b>XI. Security</b>   |   |        |
| 1                     | Intentional homicides (per 100,000 people)  | WDI    |
| 2                     | Losses due to theft and vandalism (% of annual sales of affected firms)   | WDI    |
| 3                     | Factor 5: Order and Security  | WJP    |
| 4                     | Crime is effectively controlled   | WJP    |
| 5                     | Civil conflict is effectively limited   | WJP    |
| 6                     | People do not resort to violence to redress personal grievances   | WJP    |
| 7                     | Business costs of terrorism   | GCIWEF |
| 8                     | Business costs of crime and violence  | GCIWEF |
| 9                     | Organized crime   | GCIWEF |
| 10                    | Reliability of police services  | GCIWEF |
| <b>XII. Education</b> |   |        |
| 1                     | Scientific and technical journal articles per capita  | WDI    |
| 2                     | Adjusted net enrolment rate, lower secondary, both sexes (%)  | EI     |
| 3                     | Adjusted net enrolment rate, primary, both sexes (%)  | EI     |
| 4                     | Barro-Lee: Average years of primary schooling, age 15+, total   | EI     |
| 5                     | Barro-Lee: Average years of secondary schooling, age 15+, total   | EI     |
| 6                     | Barro-Lee: Average years of tertiary schooling, age 15+, total  | EI     |
| 7                     | Barro-Lee: Average years of total schooling, age 15+, total   | EI     |
| 8                     | Barro-Lee: Percentage of female population age 15+ with no education  | EI     |
| 9                     | Barro-Lee: Percentage of female population age 15+ with primary schooling. Completed Primary                            | EI     |
| 10                    | Barro-Lee: Percentage of female population age 15+ with primary schooling. Total (Incomplete and Completed Primary)     | EI     |
| 11                    | Barro-Lee: Percentage of female population age 15+ with secondary schooling. Completed Secondary                        | EI     |
| 12                    | Barro-Lee: Percentage of female population age 15+ with secondary schooling. Total (Incomplete and Completed Secondary) | EI     |
| 13                    | Barro-Lee: Percentage of female population age 15+ with tertiary schooling. Completed Tertiary                          | EI     |
| 14                    | Barro-Lee: Percentage of female population age 15+ with tertiary schooling. Total (Incomplete and Completed Tertiary)   | EI     |
| 15                    | Barro-Lee: Percentage of population age 15+ with no education   | EI     |
| 16                    | Barro-Lee: Percentage of population age 15+ with primary schooling. Completed Primary                                   | EI     |
| 17                    | Barro-Lee: Percentage of population age 15+ with primary schooling. Total (Incomplete and Completed Primary)            | EI     |
| 18                    | Barro-Lee: Percentage of population age 15+ with secondary schooling. Completed Secondary                               | EI     |
| 19                    | Barro-Lee: Percentage of population age 15+ with secondary schooling. Total (Incomplete and Completed Secondary)        | EI     |
| 20                    | Barro-Lee: Percentage of population age 15+ with tertiary schooling. Completed Tertiary                                 | EI     |
| 21                    | Barro-Lee: Percentage of population age 15+ with tertiary schooling. Total (Incomplete and Completed Tertiary)          | EI     |
| 22                    | Cumulative drop-out rate to the last grade of lower secondary general education, both sexes (%)                         | EI     |
| 23                    | Cumulative drop-out rate to the last grade of primary education, both sexes (%)   | EI     |
| 24                    | Duration of compulsory education (years)  | EI     |
| 25                    | Early school leavers from primary education, both sexes (number)  | EI     |
| 26                    | Effective transition rate from primary to lower secondary general education, both sexes (%)                             | EI     |
| 27                    | Enrolment in early childhood education, both sexes per capita   | EI     |
| 28                    | Enrolment in early childhood education, public institutions, both sexes share   | EI     |

|    |  |     |
|----|--|-----|
| 29 | Enrolment in lower secondary education, both sexes (number) Per capita                             | EI  |
| 30 | Enrolment in lower secondary education, public institutions, both sexes Share                      | EI  |
| 31 | Enrolment in post-secondary non-tertiary education, both sexes (number) per capita                 | EI  |
| 32 | Enrolment in post-secondary non-tertiary education, public institutions, both sexes (number) Share | EI  |
| 33 | Enrolment in pre-primary education, both sexes (number) per capita                                 | EI  |
| 34 | Enrolment in pre-primary education, public institutions, both sexes (number) Share                 | EI  |
| 35 | Enrolment in primary education, both sexes (number) per capita                                     | EI  |
| 36 | Enrolment in primary education, public institutions, both sexes (number) Share                     | EI  |
| 37 | Enrolment in secondary education, both sexes (number) per capita                                   | EI  |
| 38 | Enrolment in secondary education, public institutions, both sexes (number) share                   | EI  |
| 39 | Enrolment in secondary vocational, both sexes (number) share                                       | EI  |
| 40 | Enrolment in tertiary education, all programmes, both sexes (number) per capita                    | EI  |
| 41 | Enrolment in upper secondary education, both sexes (number) per capita                             | EI  |
| 42 | Enrolment in upper secondary education, public institutions, both sexes (number) share             | EI  |
| 43 | Enrolment in upper secondary vocational, both sexes (number) share                                 | EI  |
| 44 | Expenditure on education as % of total government expenditure (%)                                  | EI  |
| 45 | Government expenditure on education as % of GDP (%)  | EI  |
| 46 | Graduates from tertiary education, both sexes (number) per capita                                  | EI  |
| 47 | Harmonized Test Scores, Total  | EI  |
| 48 | Labor force with advanced education (% of total labor force)                                       | EI  |
| 49 | Labor force with basic education (% of total labor force)  | EI  |
| 50 | Labor force with intermediate education (% of total labor force )                                  | EI  |
| 51 | Lower secondary completion rate, both sexes (%)  | EI  |
| 52 | Official entrance age to compulsory education (years)  | EI  |
| 53 | Out-of-school adolescents of lower secondary school age, both sexes (number) per capita            | EI  |
| 54 | Out-of-school children of primary school age, both sexes (number) per capita                       | EI  |
| 55 |  |     |
| -  | PISA: 15-year-olds RESULTS Below Level 1   |     |
| 77 |  | EI  |
| 78 | Primary completion rate, both sexes (%)  | EI  |
| 79 | Pupil-teacher ratio in lower secondary education (headcount basis)                                 | EI  |
| 80 | Pupil-teacher ratio in pre-primary education (headcount basis)                                     | EI  |
| 81 | Pupil-teacher ratio in primary education (headcount basis)   | EI  |
| 82 | Pupil-teacher ratio in secondary education (headcount basis)                                       | EI  |
| 83 | Pupil-teacher ratio in tertiary education (headcount basis)  | EI  |
| 84 | Pupil-teacher ratio in upper secondary education (headcount basis)                                 | EI  |
| 85 | Rate of out-of-school children of primary school age, both sexes (%)                               | EI  |
| 86 | Rate of out-of-school youth of upper secondary school age, both sexes (%)                          | EI  |
| 87 | Expenditure on secondary education (% of government expenditure on education)                      | WDI |
| 88 | Expenditure on tertiary education (% of government expenditure on education)                       | WDI |
| 89 | Research and development expenditure (% of GDP)  | WDI |
| 90 | Researchers in R&D (per million people)  | WDI |

Notes: DB – Doing Business; WDI – World Development Indicators by World Bank (WB); EI – WB Education Indicators; HPS – WB Health and Population Statistics; WGI – Worldwide Governance Indicators; WJP – World Justice Project; GCIWEF – Global Competitiveness Index by World Economic Forum; CCBR - Labour Regulation Index (Cambridge: Centre for Business Research).