Institute of Management Accounting

Master's thesis

„R&D investments and corporate governance:

An empirical analysis"

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Abstract

The master's thesis investigates the corporate research and development (R&D) behavior in emerging markets based on the sample of 20 developing countries over the period 1997-2011. I find that, when compared to the Group of 7 (G7) countries, emerging markets' firms have lower likelihood of R&D disclosure and lower R&D intensity, which is sensitive to the level of intellectual property rights protection. Free float is significantly positively associated with R&D inputs in emerging economies. Among institutional factors, credit market depth and stock market efficiency significantly mitigate the R&D-cash flow sensitivity in emerging markets. The obtained results are robust to the application of the system generalized method of moments estimator.

Key words: emerging market, research and development (R&D), ownership, financial markets' development.

All errors and omissions are my own responsibility.

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List of Abbreviations

AIMA	Alternative Investment Management Association
BBVA	Banco Bilbao Vizcaya Argentaria
BRICS	Brazil, Russia, India, China, South Africa
CEO	Chief Executive Officer
EM	Emerging Market(s)
EMGP	Emerging Market Global Players
FTSE	Financial Times Stock Exchange
G7	Group of 7
GAAP	Generally Accepted Accounting Principles
GDP	Gross Domestic Product
GMI	Governance Metrics International
GMM	Generalized Method of Moments
IAS	International Accounting Standards
IFRS	International Financial Reporting Standards
IMD	Institute for Management Development
IMF	International Monetary Fund
IPR	Intellectual Property Rights
L1	The First Largest Shareholder
L3	The Three Largest Shareholder

MSCI	Morgan Stanley Capital International
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
P&L	Profit and Loss
PPP	Purchasing Power Parity
R&D	Research and Development
S&P	Standard and Poor's
SE	Standard Errors
S-GMM	System Generalized Method of Moments
SIC	Standard Industrial Classification
U.S.	United States
USD	United States Dollar

1. Introduction

More and more developing countries recognize research and development (R&D) as a part of their national strategy (OECD, 2012). Over the last few decades, emerging markets (EM) have uncovered the formula of success: innovation and growth go hand-in-hand and being innovative provides the only opportunity to transit from "developing" to "developed" state. A convincing example is given by the real world data: three out of the Forbes Top 10 world's most innovative companies are located in Indonesia, Thailand, and South Africa[1].· In terms of gross expenditure of R&D in purchasing power parity terms (PPP) in 2013, BRIC and South Korea ranged among the Top 10 most R&D-intensive countries spending 430 bn USD (27,6% of the world total) on innovation (Battelle, R&D Magazine, 2013).

Having established themselves as dynamic and creative market players, emerging economies achieved an enormous growth of 13 b.p. of global GDP in PPP terms in 13 years since millennium (Euromonitor International, 2013). Meanwhile, some emerging countries have ample yet spare resources which have not been fully used for growth: for instance, in 2013 GDP in Mexico, Russia, Poland, and Thailand increased by less than 1,8%, while in China and Philippines it grew by more than 7,0%.

Therefore, a clear understanding of factors that drive the *ability* to innovate and the propensity towards R&D investment is of a crucial importance for the emerging markets' "flourishing" (Edmund S. Phelps, Economics Nobel Laureate, 2006).

Although literature on R&D is quite elaborated, more work should be done with respect to innovation in emerging markets. To my knowledge, the only paper that involves cross-country data on innovation, finance, and governance in EM is the one of Ayyagari et al. (2011). A search in journals with clear focus on transition, developing, and emerging markets resulted in 45 single-country papers, 9 single-region papers, and 6 publications with worldwide samples (as of April 2014). Furthermore, the *Emerging Markets Review*, since its first release in 2000, has published only one study on R&D spillovers in China (Fan et al., 2013).

Based on the above, two novel surveys by Kearney (2012) and Claessens & Yurtoglu (2013) called for papers in EM domain, notably in data and methods (e.g. causality) and corporate and institutional governance (e.g. dynamics of ownership structures, remuneration, managerial labor market).

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[1] The full list is available at: http://www.forbes.com/innovative-companies/list/

This study aims to fill the gaps concerning the determinants of EM firms' R&D from firm-level and country-level perspectives while applying different econometric techniques. Hereinafter, three explicit empirical questions will be addressed: (i) how EM are different in comparison to the developed markets with respect to R&D disclosure and R&D levels; (ii) how do firm-specific mechanisms of corporate governance, in particular ownership concentration, affect corporate decisions regarding R&D in emerging economies; (iii) are there institutional conditions, as for instance financial markets' development, that shape and/ or moderate private sector R&D expenditures in EM.

At the beginning, the entire sample of 27 countries and 99,757 firm-year observations over 1997-2011 is used to analyze the presence of R&D inputs in financial statements of G7 and EM firms. As most of emerging economies are not yet highly developed in terms of national wealth, technologies, markets, legal and financial systems, they might be more eager for innovation and, at the same time, more risk averse. Thus, one may observe some systematic differences in R&D reporting over the sample countries. In turn, common practices of R&D accounting are closely connected with the *amount* of R&D efforts or, in other words, with the willingness of EM firms to take risks.

Despite the fact that R&D investment is important for EM to grow, its value is often overbalanced by costs associated with its high inherent riskiness. First, R&D results are non-rival partially excludable good which implies that other economic agents may profit from advanced products or technologies on terms of zero investment (Romer, 1990). Second, R&D is highly dependent on human capital, which is rival, mobile, and freely traded on international labor markets, i.e. adjustment costs of R&D are high (Hall, 2002). Third, R&D embrace high levels of uncertainty in pay-offs and overall success of a project. Hence, R&D decisions are – to a large extent – an outcome of risk-sharing consensus.

The appropriate risk-sharing is determined by firm-level governance and financing environment. On the one side, a firm may manage R&D risks *internally* by adjusting corresponding firm-level control mechanisms, e.g. remuneration schemes, board composition, distribution of voting rights etc. On the other side, a firm may diversify its risks *by external means*, i.e. by attracting minority investors to fund R&D projects.

Therefore, *the second part* of the research is devoted to the microeconomic point of view, namely ownership concentration. Using the sample of 20 emerging economies from 5 continents (27,273 firm-year observations) in 1997-2011, I aim to understand how do a firm's

shareholders distribute risks of R&D among themselves. While engaging in R&D projects are there a few blockholders that prefer to bear all success and failure all along or are there numerous minor investors who diversify? What size of ownership blocks is less likely to be associated with high R&D? The answers to these questions are of a special interest because emerging economies are known for the dominance of family firms but their impact on R&D is widely unaddressed.

In conclusion, the research proceeds with the macroeconomic perspective, i.e. financing conditions. The fundamental aspect here is whether market- or bank-based financing environment is favorable for R&D in emerging markets. The firms with high R&D intensity often need access to external financing by virtue of insufficient internal funds, thus, the research focuses on empirical evidence for the role of stock vs. credit markets. Proxies for stock market size and liquidity are incorporated to reveal whether volume or turnover matters. Since developed equity markets are often absent in EM, I integrate credit market depth to test its detrimental or fostering role for R&D. This approach helps to explore the meaning of financial markets to R&D investment and overall emerging markets' evolution.

The novelties of this study are manifold and include: (i) extending the available empirical findings on macro- and micro-level determinants of R&D, when devoting attention to EM as a separate group of interest (in contrast to worldwide or European samples); (ii) achieving better cross-country representation by involvement as many emerging economies as possible; (iii) taking advantage of the better data availability due to improved accounting standards, access to longer data spans, etc.; (iv) applying panel data models to exploit time and cross-sectional variation; (v) using advanced econometric methods, notably system generalized method of moments estimator, to address endogeneity and draw causal inference.

In a nutshell, the main contributions of this investigation are the following: First, when compared to firms from G7 countries, EM firms are less likely to report R&D; and in case R&D is disclosed, EM firms have on average lower innovation levels. Yet R&D investment is higher in countries with the strong protection of intellectual property rights. Second, in emerging markets, ownership concentration (measured by inequality of voting rights' distribution and aggregate blocks) has a negative impact on R&D intensity. This holds true for blocks owned by strategic investors (corporations, holding companies, individuals) in size of more than 25%. Third, credit market development and stock market turnover ratio – in

contrast to stock market size - are important determinants of institutional environment which mitigate R&D-cash flow sensitivity.

The remainder of the thesis is organized as follows. In Section 2, the hypotheses are derived based on the theoretical consideration. Section 3 describes the process of the sample construction and variables measurement and gives an overview of the summary statistics. In Section 4, the applied econometric methods are introduced and explained. Section 5 discusses the empirical results and their robustness. Section 6 concludes and suggests avenues for future research.

2. Theoretical framework and hypotheses development

2.1. The rationale for R&D disclosure and intensity: are emerging markets different?

Non-disclosure of R&D investment constitutes one of the most severe hurdles for any empirical investigation, sometimes, taking away a good half of the sample (Xiao, 2013). Although quite often substituted by zero, the missing P&L item does not necessarily refer to "null" R&D intensions but rather to diverse accounting standards which allow firm discretions in reporting.

In comparison to U.S. GAAP and IFRS – the prevailing practices of developed countries, – local regulations are less rigorous (Hsu et al., 2014), thus, corporate financial disclosure in emerging markets may be particularly exposed to the "structural deficit". Besides the willingness and capacity to improve existing practices, EM firms' reporting is driven by the regional attitude towards risk and the state of stock markets' development (Salter, 1998). Voluntary disclosure of intangibles in emerging economies is significantly dependent on belonging to a certain industry (IT/telecommunications vs. others), corporate price-to-book ratio, accepted level of intangibles recognition, and risks of judicial and economic environment (Kang, Gray, 2011).

Even if international accounting standards are adopted, diverse treatment of innovation activities is still possible. In some cases, more than half of R&D investment can be booked as

salaries to researchers (Hall, 2002). Or alternatively, given the subtlety of IAS interpretation, R&D may be capitalized rather than expensed[2].

Furthermore, the firms operating in emerging markets may have two additional motives for less transparent R&D which are: opacity towards outside investors' sentiment and prevention of information leakages. First, the cautious under-reporting behavior may be intended to reassure existing outside blockholders – those who consider R&D as "overinvestment" – and attract potential (myopic) capital providers (Schmid et al., 2014). In the meantime, conservatism is intrinsic to firms owned by founders and heirs (Anderson et al., 2009) – the dominant ownership structure of emerging markets (Fan et al., 2011). Second, proprietary data flows are a serious concern for R&D-intensive market players, in particular in presence of large R&D spillovers and weak property rights protection (Fan et al., 2013). As emerging markets have on average weaker laws and/or enforcement than G7, EM operators may find it preferable to keep R&D secret to maintain firm value and competitive advantages.

Overall, given shortcomings of institutions' and markets' quality, local accounting standards, peculiarities of R&D reporting, and hidden motives to keep innovation of EM firms less transparent, it is hypothesized:

H1a. Ceteris paribus, emerging markets' firms have lower probability or R&D disclosure.

However, it is also possible that firms in emerging economies do not disclose R&D because they do not conduct any[3]. Acemoglu and co-authors (2006) demonstrate that economies which are far from frontier implement the investment-based strategy with *existing* firms and managers, whereas well-developed countries cherish innovation, short-term partnership, younger firms, and better selection. This holds not least due to the fact that adoption and diffusion of new technologies requires a sufficient absorptive capacity (e.g. human capital), complementary assets, and an absence of institutional voids (Fu et al., 2011; Back et al., 2014). In the similar vein, Ayyagari et al. (2011) differentiate between "new-to-

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[2] Though research cannot be recognized as an intangible asset in any case (IAS 38.54), development may fall into this category if the entity asserts: the technical feasibility of completion, the availability of resources along with the intension to complete, use or sale the intangible asset, the ability to use or sale it, future economic benefits from the intangible asset and the expenditures attributable to it during the development stage (IAS 38.57). The full text of IAS 38 is available under:
http://ec.europa.eu/internal_market/accounting/docs/consolidated/ias38_en.pdf

[3] According to IMD World Competitiveness Database, in 2010 emerging markets evidenced rather low business expenditures on R&D (as % of GDP). In Brazil, Colombia, Hong Kong, India, Mexico, Poland, Thailand, Turkey, the relevant figures stayed below the ones of the least innovative G7 country, Italy (0,68%).

world" and "new-to-firm" innovation and argue that imitation activities – such as new plant, joint venture, new licensing agreement etc. – play a vital role in developing economies' growth.

The adherence of emerging markets to imitation might be explained by the nature of R&D that brings forth multiple obstacles (Bakker, 2013): (i) nested uncertainty that results from a product's integrity (technical), competitors' similar actions (strategic), customers' readiness to embrace new ideas (market), and possibility to extract reasonable pay-offs (profit); (ii) non-redeemable sunk costs; (iii) time lags between initial investment and potential profits; (iv) adverse selection, i.e. information asymmetries between insiders and outsiders; (v) moral hazard, i.e. ex-post hidden actions of both researchers and capital providers conditional on the results of innovation.

Based on the previous statements, the next hypothesis implies:

H1b. Ceteris paribus, emerging markets' firms have on average lower levels of R&D investment.

In search of the important country-level determinant of different R&D, academicians often pointed out the importance of innovators' protectability. To date, the scholars are inconclusive with respect to the effects of intellectual property rights protection (IPR). One strand of the literature argues that protection of property rights presents a shield that secures returns from R&D investment, saves the benefits of temporary monopoly status, and prevents competitors from harmful actions. It optimizes resource allocation, enhances R&D activity, favors new entrants, and speeds up the process of creative destruction (Varsakelis, 2001; Samaniego, 2013). The positive effects of good property rights protection are quantitatively compared with the ones of a well-developed financial system (Claessens and Laeven, 2003).

On the contrary, the designers of the index of patent rights, Ginarte and Park (1997), have stated that high scores in protection might not always be "fit for all" decision. In the case of countries with weak national innovative initiative, R&D expenditures should reach a certain critical threshold to make strict governance reasonable[4]. These findings were

[4] A following update of the data revealed a convergence in patent protection, a clear catch-up of increasing in wealth and size developing economies, and introducing appropriate regulations in countries where they did not even existed (Park, 2008).

supported by McAusland and Kuhn (2011) who considered a model of Nash equilibrium intellectual property rights policy choices[5].

All over, the output-oriented firm may have incentive to invest in R&D if technological rents are secured and human capital is available. As supportive IPR environment is capable to protect returns and attract brains, it is hypothesized:

H1c. Ceteris paribus, strong intellectual property rights protection is associated with larger R&D levels.

From now onwards, the focus of empirical analysis is shifted to R&D behavior of emerging markets' firms, notably to micro- and macroeconomic perspectives.

2.2. The peculiarities of ownership structure in EM firms and its impact on R&D

Several calls for papers were made in the recent literature surveys with regard to ownership in emerging markets (Fan et al., 2011; Claessens, Yurtoglu, 2013). The previous academic work has witnessed large discrepancies between cash flow and voting rights in EM firms. This divergence comes out in the complex networks of powerful business groups as chaebol (Korea), groupos economicos (Latin America), business houses (India) or in the direct substantial blockholdings concentrated in a few hands. The real numbers support this conjecture: in the East Asian and Latin American countries, more than half of the stock outstanding belongs to the largest shareholder, in most cases, a family with or without executive functions (Claessens, Yurtoglu, 2013).

The reasons for ownership structure to remain entrenched stem from the shared and private benefits of control, among others, superior oversight and decision making power, beneficial wealth distribution and unlimited access to pecuniary and non-pecuniary corporate benefits (Holderness, 2003). At the same time, blockholdings come at cost of enhanced agency II conflict[6], productive investment cuts in adverse financial conditions, higher costs of external borrowing, and larger financial constraints (Lin et al., 2011a; Lin et al., 2011b; Lins et al., 2013).

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[5] According to McAusland and Kuhn (2011), once a country recognizes that its IPR law has force to retain and/or attract global talent, it tends to set too high – rather than too low – standards of protection ("bidding-for-brains" effect). On the contrary, if the brains outflow is high, the innovations are not relevant for a domestic market, – a situation typical for poor or small countries – the government would better enjoy the benefits of free-riding ("expatriate brains" effect).

[6] A conflict between minority and controlling shareholders

With respect to advantageous or detrimental impact of blocks on R&D, the literature has not yet given an ultimate answer. On the one hand, Francis and Smith (1995) have been able to show that U.S. firms with CEO, insider, or outsider blockholder have higher R&D productivity, active involvement in growth acquisitions, and lower sensitivity of R&D expenditure to sales. These results were supported by Ayyagari et al. (2011) who reported that ownership by families, individuals, or managers is positively associated with core innovation in developing countries (i.e. new or advanced product line, new technology). Schmid et al. (2014) stated that family owners with managerial positions are more willing to invest in R&D because of long-term horizons, reputation and heritage concerns. Bushee (1998) and Brossard et al. (2013) argued that institutional blockholders favor R&D investment by providing "patient" funds and reducing the probability of CEO being hastily fired. But Aghion et al. (2013) suggested that effect of institutional ownership manifests itself mainly in R&D outputs, not inputs.

The positive view on ownership concentration was contradicted by the evidence from Western Europe and China. Choi et al. (2011) pointed out an insignificant or rather little impact of blockholdings on innovation and questioned the ability of controlling owners to mitigate agency costs. Likewise, Driver and Guedes (2012) revealed that block ownership in form of large institutional holdings decreased R&D. The authors saw the cause of eventual R&D "depression" in excessive caution, reduced executives' autonomy, demanding higher returns on R&D projects. Munari et al. (2010) identified a significant negative association between family ownership and R&D investment, presumably, because family owners are more risk-averse. Mahlich and Yurtoglu (2011) explained observed lower R&D intensity in family firms by higher exposure to information asymmetries and managerial discretion. Brossard et al. (2013) also demonstrated that "impatient" strategic blockholders have a negative impact on R&D.

Given the previously provided arguments the two-hold hypothesis is posited:

H2a. Ceteris paribus, ownership concentration is positively associated with R&D investment in emerging markets.

H2b. Ceteris paribus, free float is positively associated with R&D investment in emerging markets.

2.3. The role of financial markets development for emerging markets' innovativeness

Intuitively, the prevalence of ownership concentration might be tightly related to the level of financial development. For emerging economies, both credit and stock markets are important, though, the scholars are not unanimous concerning which financial sector plays a leading role for R&D financing.

Chowdhury and Maung (2012) came to the conclusion that both stock market capitalization and private credit are positively associated with effectiveness of R&D.

As shown originally by Demirgüç-Kunt and Maksimovic (1998), liquid equity markets and strong banking sector contributes to externally financed firm growth. For the sample of developing countries, Sharma (2007) documented that small firms would have higher probability and levels of R&D if credit markets are large. Consistent with the "control rights hypothesis", debt financing of marginal innovation might be more preferable since it does not force existing investors to give up a part of their voting rights after new equity issues (Aghion, 2004).

While Ayyagari et al. (2011) and Hillier et al. (2011) claimed that banking development along with good access to foreign and domestic loans are crucial for innovation and R&D-cash flow sensitivity, Hsu et al. (2014) provide evidence that credit markets discourage innovative efforts. Similar to the latter, Brown et al. (2013) show a positive R&D-friendly effect of developed stock markets, in particular for firms constrained in internal funds, and insignificant results for credit markets. As opposed to equity holders, banks are rather reluctant to fund projects with skewed and risky returns and lack of collateral value (Brown et al., 2009). In AIMA report on financing conditions, Kaserer and Rapp (2014) highlighted that the idiosyncratic risk inherent in R&D is primarily transferred via liquid stock markets, in particular in bank-based economies, in other words, R&D is more sensitive to equity financing in countries where financial flexibility is less possible.

Furthermore, dependence of R&D expense on equity or debt might be determined by a country's sectoral composition or stage of development. For instance, Gambacorta and colleagues (2014) found that innovative sectors such as "Professional, scientific, and technical activities" or "Information and communication" are significantly less prone to bank lending. In another major study, Demirgüç-Kunt et al. (2012) ascertained that in course of economic development as income levels increase and financial transactions become more customer-

specific and tied to intangible assets, security markets' services outweigh those provided by banks. Thus, with respect to financial system development, two hypotheses are drawn:

H3a. Ceteris paribus, stock market development is positively associated with R&D investment in emerging markets.

H3b. Ceteris paribus, credit market development is positively associated with R&D investment in emerging markets.

2.4. A note on R&D-cash flow sensitivity

The inherent riskiness of R&D implies that firms rely on internal funds on a first-priority basis (Hall, 1992)[7]. The existing research showed that corporate governance as well as financial environment might affect innovation *indirectly* through mitigating R&D-cash flow sensitivity (Hillier et al., 2011). That is why, further, moderating effects will be examined parallel to the main ones.

3. Sample

3.1. Sample construction

As a starting point, the accounting data were extracted from Thomson Reuters Datastream covering 94 countries from 1984 to 2012. Further, the firm-level data were merged with ownership data from Thomson One Banker available for 1997-2010[8]. In the last stage, country data from the World Bank Global Financial Development Database and World Economic Forum were added.

To define emerging markets, I primarily followed the Morgan Stanley Capital International (MSCI) Emerging Markets Index, whose composition remained relatively stable over the sample period[9]. In line with Ibragimov et al. (2013), Hong Kong, Saudi Arabia, and Singapore from *The Economist* list were defined as EM. In addition, the scope of relevant countries was broadened upon a country's inclusion in other indices, i.e. by IMF, BRICS,

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[7] Bakker (2013) provides an example that in 2012, Apple, Google, Facebook, and Amazon kept huge liquidity reserves in size of 121 bn USD, 47 bn USD, 11 bn USD, and 5 bn USD respectively to be able to conduct "expensive" R&D.

[8] This ownership data set was collected and used by Rapp and Walther-Merkwitz (2014).

[9] The index provided by MSCI was used as a base to identify emerging markets in the recent survey by Kearney (2012) as well as in other papers (Morey et al., 2009; Braga-Alves, Morey, 2012). The clear advantage of this provider is the comprehensive numeric benchmarks to differentiate between emerging, frontier, and developed markets. Details at: http://www.msci.com/products/indexes/country_and_regional/em.

Next Eleven, FTSE, S&P, Dow Jones, BBVA, Columbia University EMGP[10], which predominantly coincide with MSCI EM index.

Following the accepted academic practice, I omitted the firms from financial and utility sector (SIC codes 6000-6999 and 4900-4999) because their business models and accounting routines might be different from other industries. Next, observations with missing SIC codes, missing, negative or zero total assets, missing, negative or zero revenues were excluded. In order not to bias the model logic, firms with negative R&D expense and firms-bankrupts were dropped. Observations with missing accounting data or standards followed were excluded[11]. Finally, I apply 2 consecutive years' restriction (as the models are lagged) and restriction of minimum 10 firms in each category (country or industry)[12].

The obtained sample is used to test the Hypotheses 1. For Hypotheses 2 and 3, I restricted the sample of 99,757 firm-year observations to an EM sample of 27,273 observations. To carry out a robustness check with the system generalized method of moments estimator (S-GMM), the additional 5 consecutive years' criterion is applied to each firm (for reasons, please refer to the section *Empirical design*).

3.2. Variables definition

Dependent variable. The outcome is the firm-level R&D expense deflated by total assets. The corporate R&D is represented by the Worldscope item 01201 "Research and development expense" which includes "all direct and indirect costs related to the creation and development of new processes, techniques, applications and products with commercial possibilities" (Worldscope Database – Data Definitions Guide, p.624). Notably, the disclosure of R&D constitutes a tangible challenge for analyzed countries and reduces the total sample by 56,6% and the EM sample by 67,4%.

Independent variables. The dimension of research interest is two-fold: (i) ownership concentration, and (ii) financial markets. To measure inequality of ownership distribution, the following proxies are used (La Porta et al., 1998, Rapp, Trinchera 2013): (i) stake of the largest shareholder, (ii) stake of the three largest shareholders, (iii) free float, (iv) Herfindahl

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[10] Source: http://en.wikipedia.org/wiki/Emerging_markets

[11] For year 2011, I allow missing values for any accounting data except for R&D.

[12] Due to minimum 10 firms' criterion, a few observations from "Public Administration" and "Non-Identifiable Establishments" were dropped.

index, i.e. sum of squared equity holdings. Thereby, the latter captures unobservable *skewness* in the voting rights dispersion, e.g. $15^2 > 5^2 + 5^2 + 5^2$. Next, I disaggregated the overall blockholdings by type of owner: (i) strategic (corporation, holding company, individual investor), (ii) institutional (independent and grey), and (iii) government[13]. In conclusion, the dummies were constructed to reflect the conventional ownership thresholds: 5% (Seifert, Gonenc, 2012; Sapra et al., forth.), 10% (La Porta et al., 1999; Lins et al., 2013), 25% (Aghion et al., 2013), and 50% (La Porta et al., 1999; Ayyagari et al., 2011).

Interested in the diverse effects of financial system development, I involve the following measures (Cihak et al., 2012): (i) stock market depth (stock market capitalization to GDP, stock value traded to GDP, stock market capitalization to private credit), (ii) stock market efficiency (value traded over capitalization), (iii) credit market depth (private sector credit to the sum of private credit and capitalization). As Taiwan is not present in the World Bank Database, the data were collected and computed from IMF World Economic Outlook Database, Taiwan Stock Exchange Corporation, and Central Bank of the Republic of China[14].

Control variables. As R&D projects are highly persistent with average duration in excess of one year, some of the models will control for the previous-year R&D investment (Hillier et al., 2011; Brossard et al., 2013; Sasidharan et al., 2014). Next firm controls such as internally generated cash flow, leverage, and payout ratio will account for financial constrains (Bange, De Bondt, 1998; Xiao, 2013), whereas cash and cash equivalents - for liquidity constraints (Lins et al., 2013; Chen et al., 2014). Tobin's q is included to measure investment opportunities (Gupta et al., 2011), although it can also be a proxy for assets' intangibility or stock valuation, so it will be interpreted with caution. Firm size and tangibility ratio control for the level of innovativeness, as some researchers along with Schumpeter (1912) claimed that younger firms are more innovative (Brown et al., 2013). International accounting standards will help to fix discrepancies in reporting practices (Xiao, 2013).

Among the country-level measures, using the natural logarithm of GDP per capita will ascertain that the countries are "equalized" in terms of stage of development or knowledge stock (Furman et al., 2002; Hwang et al., 2010). Intellectual property rights index will control for the level of innovators' security and private sector credit to GDP – for credit market depth.

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[13] The informational content of the *Government* variable is too low (1,3% of total EM observations), so it will not be reported in further regressions.

[14] Own calculations were compared to Liu and Hsu (2006) who used the same sources.

However, the latter can be also treated as a determinant of quality of property rights institutions, especially in emerging market countries (Miletkov, Wintoki, 2012).

The detailed description of firm-level and country-level variables is given in Table 1.

3.3. Descriptive statistics

During the sample period, G7 countries outperformed all emerging markets, except for Israel and Taiwan, in terms of corporate R&D which reached on average 2% to 7% (see Figure 1). The remaining Asian tigers together with Brazil, China, and South Africa had quite moderate investment in innovation in size of 1%-2% that was still higher than in other developing economies.

Among the firms that comply with international accounting standards, EM firms reported the median R&D that is 80% to 88% (in positive R&D sample) smaller than the numbers of G7 firms, whereas ownership concentration in emerging markets was twice as large as the one observed in G7. Developed countries' firms are on average higher valued, more liquid and more levered, while the sample firms from EM are bigger in size and more profitable[15]. In terms of the financial development, G7 countries have more immense and efficient equity markets but lower credit market depth. Moreover, these seven economies have 122% bigger median income levels and 135% higher perceived intellectual property rights protection.

The emerging markets' sample consists of 27,273 firm-year observations from 20 countries from North and Latin America, Africa, Asia, and Europe. The most innovative economies have one of the highest GDP per capita, best IPR protection and largest financial sectors, albeit the stock liquidity varies. Surprisingly, Malaysia and South Africa with big stock markets and high IPR indices are relatively more reluctant to invest in innovation. The least innovative are Chile, Egypt, Mexico, and Thailand - with R&D less than 0,1%, - although Chilean stock market capitalization and Thai private credit are almost the size of GDP. From the industrial perspective, firms operating in "Manufacturing" and "Other services" are the most R&D-intensive.

The average firm in the analyzed sample has R&D intensity of 1,7%, liquidity of 16,1%, and cash flow of 7,5%. Almost one tenth of its total assets are funded with long-term debt and nearly one third is tangibles. Noticeably, ownership concentration is on the average

[15] The latter might be a sign for the selection bias. Provided that Thomson Reuters collects data on listed firms, the indicated fact can mean that in emerging markets, mainly large and profitable firms opt for IPO.

30% with the largest shareholder owning 19% of the stock. In the last quartile, investors hold controlling blocks of more than 50%.

4. Empirical design

4.1. Probit, Tobit, and ordinary least squares (OLS) estimator

In the first step, I predict what firms are more likely to report R&D. To test ***the Hypothesis 1a***, the cross-sectional Probit estimator is used. This procedure assumes that the outcome variable takes on two values:

(1)

Accordingly, the conditional *probability* estimated by Probit is expressed as:

(2)

where is a standard normal cumulative distribution function that ensures p to be in range [0;1], is an outcome, is a vector of explanatory variables, and β is a vector of parameters.

The model for cross-sectional Probit is defined by the following equation:

(3)

where *i, j, t* stand for firm, country, and year, are firm-level control variables from the base model, are ln(GDP per capita) and EM dummy, and are time and 1-digit SIC code industry fixed effects, is an error term.

Testing ***the Hypotheses 1b and 1c*** requires using the cross-sectional Tobit model because of the regressand left-censored at zero. In other words, R&D investment levels are distributed between 0 and what violates the normality assumption. That is why Tobit method implies the existence of a latent variable, , which stands behind the apparent ratios, namely:

(4)

To uncover what firms have higher expense on innovation, two models are specified:

(5)

(6)

where *i, j, t* represent firm, country, and year, are standard firm-level controls, are conventional country-level regressors, ia an index for a country's IPR protection, and are time and industry dummies, is an unobservable disturbance. In the equation (6), the credit market depth is included as an additional country-level control because this variable may influence both R&D and property rights.

For ***the Hypothesis 2***, the ordinary least squares (OLS) estimator is used as a regular scenario, while the system generalized method of moments is applied for a robustness check. To identify the effects of ownership concentration, I write the models as follows:

(7)

(8)

where each equation includes an accepted set of lagged firm-level and current country-level control variables, lagged ownership proxies (including different measures of voting rights' concentration, type of owner and threshold dummies), time, country, and industry fixed effects, and an unobservable error term.

The specifications for ***the Hypotheses 3*** incorporate supplementary financial variables:

(9)

(10)

It is worth mentioning that the equations (7) and (9) predict direct effects on the present R&D *levels*, while the equation (8) and (10) analyze *changes* in R&D expense compared to the previous year. The dynamic model with the lagged dependent variable is used to eliminate the effects of the past ("unobserved heterogeneity") and approach the genuine nexus of R&D with the variables of interest. However, while employing this technique, it is also expected that estimated coefficients of other regressors will be lower.

As explained before, some variables may exert an indirect influence on R&D investment, i.e. through altering R&D sensitivity to internal cash flow. As a consequence, I include an interaction term which allows obtaining different parameters for different groups. The regression model for moderating effects of financial markets looks like as follows:

(11)

(12)

4.2. System generalized method of moments (GMM) estimator

Notably, the proposed techniques may be limited in the ability to detect *causality* in dynamic panels. Flannery and Hankins (2013) warned of significant econometric biases in unfounded estimation of corporate finance panel data. The scholars advocated for fixed-effects model and system GMM as the most consistent estimators in presence of data limitations (unbalanced panels, missing or censored data), the second order serial correlation, and endogenous regressors. Correspondingly, Wintoki et al. (2012) promoted use of system

GMM in models dealing with internal corporate governance as otherwise, valid instruments are hard to find. In spite of this, the existing research is reluctant to addressing the issue. To my knowledge, the only papers that used system GMM in context of R&D expenditure were the ones of Brossard et al. (2013) and Hillier and et al. (2011).

In this study, system GMM is used to test the robustness of OLS results for the Hypotheses 2 and 3. Developed by Arellano and Bover (1995) and Blundell and Bond (1998), this method is applied in the empirical framework where: (i) a panel has small T and large N (e.g. the analyzed panel covers 15 years and 27,273 firm-year observations); (ii) a functional relationship is linear; (iii) an outcome variable exhibits state dependence, i.e. is dynamic (as in case of long-lasting R&D projects); (iv) some regressors are endogenous or predetermined (reverse causality issue); (v) fixed individual effects are present (unobserved heterogeneity issue); (vi) idiosyncratic error terms are heteroskedastic and autocorrelated *within* individuals. Such manifold data treatment is applied to free OLS inference from biases arising from data structure.

In addition, the main technical advantage of S-GMM is that explanatory variables that are not strictly exogenous are instrumented by their previous realizations. It follows from the assumption that:

(13)

Two more corrections to the sample size are undertaken before working in the S-GMM modus. First, S-GMM demands no less than five consecutive years of complete financial information for each firm – a hurdle that is especially difficult to pass in case of R&D. The specified restriction is caused by the peculiarities of *statistics* computed for the 2nd order serial correlation test. This test designed by Arellano and Bond (1991) estimates:

(14)

where is the estimator of the simple analogue of the covariance

(15)

where T is the number of time periods, l – the number of lags, and j – the order of correlation.

Second, the predominance of Taiwanese (38% of total) and South Korean (22% of total) firms might cause a selection bias. Therefore, to overcome this issue I discretely sort sample firms from Taiwan and South Korea by entity name and keep each fourth firm in the sample. As a result of these procedures, 10,707 observations are left over.

I implement system GMM method in specifications (8), (10), and (12) by using the user-written command *xtabond2* (Roodman, 2009a). To retain only instruments which possess enough explanatory power for current Xs, I use *three lags* of each independent variable in the difference equations and *one lag* – in the level equations. Recognizing that the large number of instruments (instrument proliferation) may lead to several problems such as overfitted endogenous variables, imprecise estimates of the optimal weighting matrix and standard errors, weak Hansen test (Roodman, 2009b), I *collapse* the instrument matrix. Furthermore, the options *twostep robust small* are used to request two-step estimation procedure with Windmeijer's standard errors correction for small samples (Windmeijer, 2005).

More details on the panel data linear models with and without the lag of the dependent variable as well as on the system GMM for models with the predetermined variables can be found in Appendix 1.

Before running regressions, the variables were scrutinized for the presence of multicollinearity. The highest variance inflation factor amounts to 3,57 in ownership models and 4,48 in finance models what is within tolerable limits.

5. Empirical results and discussion

5.1. Emerging markets' origin as a factor of R&D disclosure and intensity

Table 5 reports the results of multivariate Probit analyses regarding the characteristics of R&D-reporting firms. As the considered period (1997-2011) spans multiple global and local economic shocks as well as different intraindustry propensity to innovate, all specifications include year and industry fixed effects. Hence, it appears that R&D disclosure is *more likely* to be observed in large liquid firms that possess high Tobin's q, follow international accounting standards (IAS), and operate in high-income countries. Contrariwise, R&D is *less probable* to come out in a profit-and-loss statement of profitable and high-indebted firms which pay high dividends and/or have substantial amount of tangible assets.

More importantly, in accordance with the Hypothesis 1a, firms located in emerging markets disclose R&D significantly less frequently. This holds true even if the number of available observations is limited to only those of firms complying with IAS (specification (1)). Furthermore, this result remains robust under the assumption of possible serial correlation within and between groups (Petersen, 2009) in specifications (3)-(4). In other words, the high statistical significance (1% level) of EM dummy with a negative sign, i.e.

lower likelihood of disclosed R&D, clearly designates that emerging economies form a distinct environment for lower R&D transparency.

(Table 5 goes about here)

As an additional visual check, I draw two world maps which depict availability of R&D in the total sample of 27 countries. Figures 3 and 4 provide a complementary proof for highly significant statistical results.

Table 6 represents the findings of a multivariate Tobit regressions with the same set of standard firm- and country-level controls, year and industry dummies. The obtained coefficients indicate that for a group of firms which report according to IAS being located in EM translates into significantly lower average R&D levels. The outcome stays unchanged even for a larger sample of all firms and/or two-way clustered standard errors. Thus, Tobit regressions support the Hypothesis 1b and advocate for the view that EM firms: (i) may disclose zero R&D because they innovate less and/or imitate more; (ii) may have weaker innovation basement because of fewer resources, for instance human capital. In line with the latter, McAusland and Kuhn (2011, p.78) state that "many of the South's brains live in the North".

(Table 6 goes about here)

The previous results are supplemented and developed while acknowledging that in both developed and emerging economies' environments strong IPR protection is significantly and positively associated with innovation. The location in EM continues to exhibit negative correlation with the level of R&D investment, although, one must admit that EM dummy: (i) refers to only 6% of the total sample in regressions (1) and (3); (ii) remains weakly significant in regressions (2) and (4) involving all firms where EM firms constitute 30% of the sample. Being aware of the importance of the credit market depth for both R&D funding and institutional quality, I include *Private credit/ GDP* in specifications (3)-(4). The discussed results remain qualitatively unchanged which is the evidence in support of the Hypothesis 1c.

(Table 7 goes about here)

5.2. Ownership concentration and its effect on R&D in emerging markets

Hereafter, all variables – dependent and independent – are standardized by computing z-scores with mean of 0 and standard deviation of 1. This transformation is done to obtain

"scale-free" regressors whose effects on R&D intensity are relatively comparable within the sample. In addition, Tables 8-10 include year, *country* and industry fixed effects.

In Table 8, I examine the relation between innovation and different measures of ownership concentration. Compared to other regression coefficients, the effect of blockholdings is one of the smallest, though statistically significant at the 1 % level. Specifications (1)-(4) show that inequality in voting rights' distribution is highly negatively associated with corporate R&D intensity, holding all base model regressors constant. In contrast, free float enters the regression significantly positively. Quantitatively, one standard deviation increase in (lagged) ownership concentration (free float) leads to 0,0463-0,0515 (0,0434) standard deviations decrease (increase) in R&D expense which equals to app. 0,2%. In spite of the seemingly small magnitude of change in the predicted variable, this result is substantial given that the median value of R&D in the analyzed EM sample is 0,5%.

(Table 8 goes about here)

In specifications (5)-(8), the model of R&D *changes* is taken into account. The inclusion of R&D lag boosts R squared from 0,28 to 0,85 and, simultaneously, reduces other estimates[16]. All coefficients of ownership concentration still remain highly significant. However, it should also be noted that by considering R&D *change* instead of *level*, one might remove unobserved heterogeneity along with the possible effects of ownership distribution on *cumulative* R&D spending. Because it can also be the case that lagged ownership levels are (partially) depicted in lagged R&D (Brossard et al., 2013 and Schmid et al., 2014 confirmed the impact of *current* ownership proxies on *current* R&D inputs)[17].

Overall, highly significant coefficients of *L1*, *L3*, *Free float*, and *Herfindahl index* support the Hypothesis 2b and reveal that risky nature of R&D requires risk diversification which is realized through ownership dispersion. The higher the free float is, the less risk averse is firm behavior in developing economies. This suggestion is in line with Aghion et al. (2004) who postulate that once the innovation project reaches sufficient scope and/or sufficient involvement of intangible assets, a firm resolves upon new equity issuance.

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[16] As a side result, it ought to be remarked that the sign of cash flow coefficient is negative in models without the lag of R&D and positive – in models with the R&D lag. This points to the fact that R&D-intensive firms are indeed often financially constrained, although the level of additional R&D spending is directly connected to the amount of internal cash flow. The similar example is found with leverage what provides a compelling insight that emerging markets' firms may fund incremental innovation with debt and, thus, credit market development is probably important.

[17] The argumentation for all introduced models is based upon the rationale that blockholders determine the level of forthcoming R&D spending in the preceding year.

Table 9 reports coefficients for relative change in R&D intensity depending on the type of owner. Interestingly, the significant negative coefficients are found only in case of strategic investors. Quantitatively, they are similar to the effects of the aggregate blocks, namely one standard deviation increase in (lagged) blocks belonging to the corporation, holding company or individual investor results in 0,0451 standard deviations decrease in R&D intensity (app. 0,2% or 40% of the median R&D level). The estimate for institutional blockholdings is statistically insignificant in all specifications and even positive in the model for R&D level. This is another evidence for diversification rationale since institutional investors often hold better diversified portfolios than strategic investors, for instance, founders of the firm, and, consequently, may provide more "patient" funds. At the same time, strategic owners, specifically if they are not involved in a firm's management, may reject from too uncertain R&D projects to escape the large costs arising from agency conflicts, earnings management etc.

(Table 9 goes about here)

In the next step, I analyze the ownership thresholds starting from which an R&D-intensive firm diversifies. Thus, Table 10 reports significant results for large blocks in size of 25% and 50%[18] but again not in case of institutional blockholders. The outcomes are weaker for 25%-shareholdings in the specifications (7)-(8) that focus on R&D change but highly significant for controlling blocks of 50% and more. The relative importance of 50%-blocks is also twice as high as the one of 25%-blocks. From an economic perspective, this finding means that large entrenched owners which keep their interest in the firm even after its IPO will not be willing to put their capital at risk for the sake of uncertain innovation. On the contrary, once the R&D projects are approved, it is very unlikely that the largest investors will bear all costs associated with R&D single-handed; instead, one will observe multiple shareholders with stakes of less than 25%.

(Table 10 goes about here)

5.3. Financing conditions and R&D investment in emerging markets

Table 11 provides further insights into the direct relationship between R&D intensity and financial markets. As ownership concentration proved itself to be an important firm-specific factor of R&D, I include *Aggregate block* as an additional control in all

[18] The results for 5%- and 10%-blocks are insignificant, thus, I do not report them here.

specifications. As opposed to the Hypothesis 3a, all measures of stock market size evidence highly significant negative correlation with R&D[19]. In corroboration of the Hypothesis 3b, one standard deviation increase in *credit* market development is associated with 0,128 standard deviations increase in R&D expense, or alternatively, 0,4%. In specification (2) the discussed coefficient is almost twice as large as the significant negative coefficient of the *Aggregate block* that demonstrates that one standard deviation increase in (lagged) block is associated with 0,07 standard deviations decrease in R&D.

The same patterns are detected in specifications (6)-(10) for the dynamic R&D outcome. One standard deviation increase in *Pr.Credit/(Market Cap+Pr.Credit)* is associated with 0,02 standard deviations increase in R&D investment. In relative terms, this standardized coefficient of credit market depth (significant at the 1 % level) is higher that the corresponding estimates for size, leverage, ownership concentration, and the protection of intellectual property rights.

One more important remark refers to the stock market liquidity, which is insignificant in specification (3) but highly significant (at the 5% level) in specification (8). The positive sign of the turnover ratio coefficient leads to the conclusion that equity markets' *efficiency* – but *not size* – really matters for R&D-intensive firms what is yet in consonance with the Hypothesis 3a. This finding is quite intuitive as low efficiency of stock markets means their underdevelopment or immaturity[20]. Hence, on the equity markets with *higher* turnover an innovative firm has broader opportunities to attract outside investors and obtain lacking external financing, thus, as a result, these conditions may encourage innovative efforts.

(Table 11 goes about here)

In Table 12, the focus is laid on the difference in R&D-cash flow sensitivities of firms that operate in more vs. less developed financial environments. For this purpose, I split the analyzed sample by median values of all measures of stock (or credit) development. For example, a dummy *Market Cap/ Pr. Credit* takes on values of zero for a particular firm-year observation if a country's *Market Cap/ Pr. Credit* in this firm-year is below or equal the median, and one otherwise. Next, I create interaction terms by multiplying financial dummies

[19] Hillier et al. (2011) and Roodman (2009a) show that OLS coefficients might be biased (upward) compared to the ones from system GMM, so I refrain from definite conclusions until the robustness check.

[20] The economic significance of the turnover coefficient for direct effects is marginal, i.e. one standard deviation increase in turnover ratio equals to 0,001 standard deviation increase in R&D input. This observation is extended by the assessment of moderating impacts in Table 12.

with cash flow what allows the cash flow slope to vary dependent on the level of financial markets' development.

It is evident that turnover ratio and credit market depth mitigate R&D-cash flow sensitivity (specifications (3) and (7)). If stock markets are liquid, one standard deviation increase in cash flow is associated with 0,021 - instead of 0,175 – standard deviations decrease in R&D levels, while if private credit to domestic sector is substantial, one standard deviation increase in cash flow is followed by zero changes in R&D.

(Table 12 goes about here)

5.4. Robustness check: system GMM estimator

Finally, the obtained findings are challenged with the application of more refined econometric technique, system GMM. The evidence in favor of Hypothesis 2b sustained, as I find a significant negative effect of ownership concentration – expressed by *L1*, *L3*, and *Herfindahl index* – on corporate R&D levels. The Hansen test confirms that the null hypothesis of instrument validity cannot be rejected at all significance levels. Likewise, statistic reports no second order serial correlation and, thus, justifies the legitimacy of GMM estimates.

(Table 13 goes about here)

Moreover, not every regressor introduced in Table 13 is statistically significant what alleviates concerns with respect to overfitting. Thus, specifications (1)-(4) indicate that high internal cash flow, low Tobin's q, strong intellectual property protection, and dispersed voting rights determine higher R&D inputs[21]. The corresponding coefficients of ownership measures are lower than in OLS but, nevertheless, significant at the 5% level.

The following evidence from Tables 14 and 15 argues in support of the fact that (i) undiversified strategic owners *cause* possible cuts in spending on R&D projects; (ii) in order to innovate, shareholders are more likely to get rid of the large blocks (25%, 50%). Both tests for overidentifying restrictions and residual serial correlation tolerate the use of S-GMM.

(Table 14 goes about here)

(Table 15 goes about here)

[21] The negative sign of Tobin's q contradicts the previous findings which indicate that firms with high investment opportunities (measured by q) invest in R&D more. But taking as a premise the fact that Tobin's q may also be a proxy for stock valuation, it can be assumed that undervalued firm are innovate more in order to boost the market price of their shares.

Remarkably, family firms are very common in emerging markets and this is also a verifiable truth for the analyzed EM sample: out of 27,273 firm-year observations, 16,621 – have a strategic investor with 5%, 14,740 – with 10%, 10,790 – with 25%, and 4,972 – with 50%. For this reason, the detected negative *causal* relationship between ownership concentration and R&D may be a signal that emerging markets' firms are either *constrained* or *unwilling* to diversify risks originating from R&D. On the one hand, the descriptive statistics shows that emerging economies have lower mean (and median) stock market depth and turnover than G7 countries do, so it may be because of the immature equity markets that firms have limited access to potential outside financiers and do not regard equity issuance as a successful option to quickly obtain external funds. On the other hand, as discussed above, strategic owners may be intrinsically more risk averse and prefer more secure tangible investments (i.e. capital expenditures) to R&D. This view supports the argument of Anderson et al. (2012) who find that long-term horizons of family firms declare themselves in less capital deferred to future spending, larger inclination towards physical assets, and lower R&D productivity.

Subsequently, the results with respect to financial markets also withstand the robustness test. However, the direct effects of developed stock markets are only weakly significant in specifications (1) and (2) of Table 16. At the 10% significance level, one standard deviation increase in credit market depth is associated with 0,0263 standard deviations increase in corporate R&D what is relatively comparable with the coefficient delivered by OLS, i.e. 0.0210 (specification (7) Table 11).

(Table 16 goes about here)

On the other hand, with respect to the indirect influence of financial markets, i.e. R&D-to-cash flow sensitivity, it can be observed that amount of the domestic credit allocated to private sector and stock market liquidity exert negative impact on the positive relation between R&D expense and internally generated cash flows. Table 17 illustrates that the mitigated sensitivity of innovation to profitability quantitatively equals to: (i) 0,0136 instead of 0,0562 standard deviations increase in R&D with 1 standard deviation increase in cash flow in environment with highly developed banking sector; (ii) 0,0139 instead of 0,0692 standard deviations increase in R&D with 1 standard deviation increase in cash flow in countries with liquid stock markets. Simultaneously, the corresponding dummies, which equal 1 for the above-median financial sector development, have significant positive signs in favor

of encouraging direct effects of *Pr.Credit/(Pr.Credit + Market Cap)* and *Turnover ratio* on R&D. Hansen p-value and AR(2) p-value remain in the expected range (over 0,1) and evidence no inconsistencies with S-GMM method.

(Table 17 goes about here)

These concluding results are declarative of the findings of Demirgüç-Kunt and Maksimovic (1998) who ascertain that large intermediary sector and active stock markets lower a firm's dependence on established internal cash flow and enhance its ability to fund profitable growth opportunities either through long-term debt or through equity issues. Moreover, firms operating in those emerging markets that still reside in an infant stage of economic development and/or have immature securities markets may prefer to conduct incremental R&D relying on bank lending.

6. Conclusion

In this study, the novel large accounting, ownership and country-level data set covering 7 developed and 20 emerging economies in the period 1997-2011 is used to analyze the potential drivers of EM firms' innovative behavior.

The role of R&D investment in a nation's progress was highlighted by the world famous engineer, Nikola Tesla, who said: "All my money has been invested into experiments with which I have made new discoveries enabling mankind to have a little easier life"[22]. Expenditures on R&D are undoubtedly important, especially for the emerging world that still evolves. However, the nature of this immaterial investment is fraught with unquantifiable risks which need to be shared.

In emerging markets, risk-sharing is a milestone what is depicted in lower levels of R&D reporting and lower composite innovative activity. Even the firms which comply with international accounting standards report R&D significantly less frequently, if their origin is an emerging market. Furthermore, average R&D intensity of EM firms is lower, although positively influenced by the intellectual property rights protection.

As means to overcome risk aversion towards innovation, EM firms resort to equity issuance, as free float is significantly and positively associated with private sector R&D. The fostering effects of ownership dispersion in R&D-intensive firms in emerging economies are substantially complemented by large banking sector and liquid stock markets. Together with

[22] Source: http://www.woopidoo.com/business_quotes/research-quotes.htm#rcfgAxvtWQhwSlzo.99

high statistical significance, I find non-zero economic significance of obtained results: 1 standard deviation increase in credit market depth (free float) is associated with 0,128 (0,070) standard deviations increase in R&D expense, or alternatively, 0,4% (0,2%), while the sample's median R&D level is 0,5%. Going beyond simple correlations, the findings suggest that ownership concentration affect R&D directly, whereas developed financial markets lessen R&D-cash flow sensitivity.

Thus, it can be concluded that corporate R&D inputs in emerging markets are dependent on the quantity of (minor) outside investors involved in R&D projects' financing and ease to access these investors.

Notwithstanding, there remain many fruitful topics that future research might address with respect to R&D in emerging markets. First, the similar study is needed to analyze the role of ownership and financial markets on R&D productivity (patent activity, citations per patent etc.) in emerging economies. Second, it would be interesting to know what other aspects of firm-level governance, as for instance remuneration, board structure, antitakeover provisions, may have direct and/or indirect impact on R&D (see Appendix 2). Third, as the R&D projects are adopted by (top-) managers, the involvement of behavioral aspects in innovation analysis would augment the common-practiced neoclassical view.

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TABLES

Table 1. Variables definitions and sources

Variable	Definition
R&D	R&D expense deflated by total assets. *Source*: Thomson Reuters Datastream.
	Other firm-level variables
Cash flow	After-tax income before extraordinary items plus depreciation and amortization, deflated by total assets. *Source:* Thomson Reuters Datastream.
Tobin's q	The sum of market capitalization and book value of debt over the book value of total assets. *Source:* Thomson Reuters Datastream.
Size	The natural logarithm of a firm's market capitalization at the year end. *Source*: Thomson Reuters Datastream.
Leverage	Total long-term debt deflated by total assets. *Source:* Thomson Reuters Datastream.
Tangibility	Property, plant, and equipment (net) deflated by total assets. *Source:* Thomson Reuters Datastream.
Payout ratio	Total cash dividends deflated by total assets. *Source:* Thomson Reuters Datastream.
Liquidity	The sum of cash and cash equivalents over the total assets. *Source:* Thomson Reuters Datastream.
IAS dummy	A dummy variable which equals one if accounting standards followed do not belong to the category "Local and other standards", and zero otherwise. *Source:* Thomson Reuters Datastream.
	Ownership variables
L1	The percentage of shares owned by the largest shareholder. *Source:* Rapp, Walther-Merkwitz (2014).
L3	The percentage of shares owned by the three largest shareholders. *Source:* Rapp, Walther-Merkwitz (2014).
Free float	The percentage of shares that are publicly traded. *Source:* Rapp, Walther-Merkwitz (2014).
Herfindahl	The sum of squared equity holdings. *Source:* Rapp, Walther-Merkwitz (2014).
Aggregate block	Opposite to *Free float*. *Source:* Rapp, Walther-Merkwitz (2014).
Strategic block	The percentage of shares owned by the following investor types: "Corporation", "Holding company", or "Individual investor". *Source:* Rapp, Walther-Merkwitz (2014).
Institutional block	The percentage of shares owned by the following investor types: "Bank and Trust", "Endowment fund", "Foundation", "Hedge fund", "Independent research firm", "Insurance company", "Private equity", "Research firm", "Venture capital" . *Source:* Rapp, Walther-Merkwitz (2014).
	Financial variables
Stock market capitalization/ GDP	The price of shares outstanding of the listed companies divided by the gross domestic product (GDP). *Source:* Global Financial Development Database and Taiwan Stock Exchange Corporation.

Stock value traded/ GDP	The total value of shares traded during the period divided by the gross domestic product (GDP). *Source:* Global Financial Development Database and Taiwan Stock Exchange Corporation.
Stock turnover ratio	The ratio of the stock value traded during the period over the average stock market capitalization for the period. *Source:* Global Financial Development Database and Taiwan Stock Exchange Corporation.

Table 1. (continued)

Variable	Definition
Market capitalization/ Private credit	The ratio of the stock market capitalization over the domestic credit to private sector by banks. *Source:* Global Financial Development Database, Taiwan Stock Exchange Corporation, and The Central Bank of the Republic of China (Taiwan).
Market capitalization/ (Market capitalization + Private credit)	The ratio of the stock market capitalization over the sum of stock market capitalization and domestic credit to private sector by banks. *Source:* Global Financial Development Database, Taiwan Stock Exchange Corporation, and the Central Bank of the Republic of China (Taiwan).
Other country-level variables	
ln(GDP per capita)	The natural logarithm of the gross domestic product divided by midyear population in constant 2005 U.S.dollars (constant 2006 U.S. dollars for Taiwan). *Source:* The World Bank and IMF World Economic Outlook (for Taiwan).
Intellectual property protection	The level of intellectual property protection measured by answer to the following question: "In your country, how strong is the protection of intellectual property, including anti-counterfeiting measures?". The response ranges from 1 (extremely weak) to 7 (extremely strong). The data for 1997-2005 are the weigthed average of 2006-2010. *Source:* World Economic Forum (Global Competitiveness Report).
Private credit/ GDP	Domestic credit to private sector by banks divided by the gross domestic product (GDP). *Source:* Global Financial Development Database.
EM	A dummy variable which equals one if a country belongs to emerging markets, and zero otherwise. The definition of emerging markets is based on the MSCI Emerging Markets Index with inclusion of Hong Kong and Singapore (which are identified as *emerging* by The Economist). The emerging markets covered here are: Brazil, Chile, China, Egypt, Hong Kong, India, Indonesia, Israel, Malaysia, Mexico, Peru, Philippines, Poland, Russian Federation, Singapore, South Africa, South Korea, Taiwan, Thailand, and Turkey. *Source:* Morgan Stanley Capital International Emerging Markets Index, The Economist.

Notes: The table provides definitions and sources of the variables. Accounting data are obtained from Thomson Reuters Datastream, while ownership data originate from Rapp and Walther-Merkwitz (2014). All observations of firm-level variables, except for IAS dummy, are winzorized at the 1 % level in both tails, on the yearly basis. Country-level data were collected from The World Bank, Taiwan Stock Exchange Corporation, The Central Bank of the Republic of China, IMF, and World Economic Forum.

Table 2. A comparative analysis of developed and emerging markets' business environment

Panel A: All firms that report according to the International Accounting Standards (IAS)									
	All countries			Developed economies			Emerging economies		
	N	Mean	Median	N	Mean	Median	N	Mean	Median
R&D intensity	51,756	0.068	0.023	48,609	0.071	0.026	3,147	0.024	0.005
Cash flow	51,756	-0.024	0.065	48,609	-0.029	0.065	3,147	0.063	0.079
Tobin's q	51,756	2.249	1.517	48,609	2.298	1.544	3,147	1.503	1.148
Size	51,756	12.337	12.179	48,609	12.136	12.035	3,147	15.443	15.819
Leverage	51,756	0.125	0.056	48,609	0.127	0.058	3,147	0.083	0.037
Tangibility	51,756	0.218	0.156	48,609	0.214	0.151	3,147	0.286	0.259
Dividends	51,756	0.008	0.000	48,609	0.008	0.000	3,147	0.019	0.005
Liquidity	51,756	0.228	0.142	48,609	0.231	0.143	3,147	0.191	0.138
L1	41,538	0.167	0.116	40,238	0.162	0.114	1,300	0.314	0.275
L3	41,538	0.265	0.238	40,238	0.259	0.234	1,300	0.432	0.456
Aggregate block	41,538	0.298	0.257	40,238	0.292	0.253	1,300	0.460	0.506
Herfindahl index	41,538	0.068	0.025	40,238	0.065	0.025	1,300	0.174	0.112
Stock market depth	51,756	0.652	0.705	48,609	0.657	0.705	3,147	0.573	0.506
Stock turnover ratio	51,756	172.353	180.517	48,609	176.270	180.517	3,147	111.865	91.431
ln(GDP per capita)	51,756	3.648	3.721	48,609	3.716	3.721	3,147	2.598	3.055
IPR protection	51,756	5.440	5.498	48,609	5.513	5.498	3,147	4.302	4.072
Credit market depth	51,756	66.752	53.043	48,609	65.500	53.043	3,147	86.091	96.763

Panel B: R&D firms that report according to IAS and have positive R&D expenditures									
	All countries			Developed economies			Emerging economies		
	N	Mean	Median	N	Mean	Median	N	Mean	Median
R&D intensity	38,008	0.093	0.051	35,284	0.098	0.057	2,724	0.028	0.007
Cash flow	38,008	-0.036	0.063	35,284	-0.043	0.062	2,724	0.056	0.076

Tobin's q	38,008	2.373	1.603	35,284	2.441	1.646	2,724	1.497	1.143
Size	38,008	12.547	12.313	35,284	12.312	12.161	2,724	15.582	16.064
Leverage	38,008	0.107	0.037	35,284	0.109	0.038	2,724	0.079	0.034
Tangibility	38,008	0.183	0.138	35,284	0.176	0.133	2,724	0.277	0.249
Dividends	38,008	0.008	0.000	35,284	0.007	0.000	2,724	0.018	0.005
Liquidity	38,008	0.261	0.183	35,284	0.266	0.187	2,724	0.200	0.145
L1	30,644	0.162	0.113	29,579	0.157	0.112	1,065	0.308	0.270
L3	30,644	0.257	0.232	29,579	0.251	0.228	1,065	0.426	0.442
Aggregate block	30,644	0.290	0.249	29,579	0.284	0.244	1,065	0.456	0.496
Herfindahl index	30,644	0.065	0.024	29,579	0.061	0.023	1,065	0.167	0.109
Stock market depth	38,008	0.640	0.705	35,284	0.646	0.705	2,724	0.569	0.502
Stock turnover ratio	38,008	170.352	173.332	35,284	174.276	173.697	2,724	119.527	120.507
ln(GDP per capita)	38,008	3.639	3.713	35,284	3.710	3.721	2,724	2.719	3.055
IPR protection	38,008	5.448	5.498	35,284	5.527	5.498	2,724	4.434	4.072
Credit market depth	38,008	70.042	54.398	35,284	68.377	53.043	2,724	91.606	98.432

Notes: The table gives a comparative overview of the firm- and country-level characteristics of G7 and emerging economies over 1997-2011. The ownership data is available for 1997-2010. International accounting standards refer to U.S. GAAP, IFRS, and other international standards. All firm-level variables are annually winsorized at the 1st and 99th percentiles. For the variables definitions please refer to Table 1.

Table 3. Summary statistics by country and by industry

Panel A: Sample composition by country								
Country	N	%	R&D	ln(GDP per capita)	IPR protection	Private Credit/ GDP	Market Cap/ GDP	Turnover ratio
			Country mean					
Brazil	129	0.47%	0.012	1.622	3.200	39.937	53.368	57.321
Chile	117	0.43%	0.001	1.992	3.743	47.493	98.622	14.016
China	181	0.66%	0.011	1.089	4.001	120.415	71.626	172.858
Egypt	65	0.24%	0.000	0.415	3.516	34.567	44.752	45.008
Hong Kong	2,035	7.46%	0.018	3.318	5.364	150.090	414.343	94.691
India	5,216	19.13%	0.005	-0.124	3.749	41.508	74.634	96.922
Indonesia	193	0.71%	0.004	0.298	3.394	25.091	29.554	54.672
Israel	596	2.19%	0.057	3.036	4.574	89.339	86.727	57.161
Malaysia	662	2.43%	0.008	1.733	4.828	109.436	132.543	33.492
Mexico	78	0.29%	0.000	2.072	3.308	15.987	28.349	28.236
Peru	75	0.27%	0.003	1.220	2.565	21.287	54.314	6.476
Philippines	157	0.58%	0.002	0.198	2.934	31.462	50.189	25.121
Poland	96	0.35%	0.003	2.220	3.574	33.075	30.776	46.104
Russia	93	0.34%	0.002	1.826	2.617	36.860	60.275	86.061
Singapore	611	2.24%	0.017	3.367	6.159	95.799	174.545	70.113
South Africa	634	2.32%	0.009	1.634	5.140	67.725	182.383	45.869
South Korea	6,874	25.20%	0.013	2.905	4.504	91.059	75.056	218.694
Taiwan	8,476	31.08%	0.029	2.800	4.921	121.821	134.639	165.095
Thailand	220	0.81%	0.001	0.885	3.691	124.551	44.848	78.991
Turkey	765	2.80%	0.006	1.979	2.940	27.401	28.251	156.751
Total	27,273	100.00%						

Max	8,476	31.08%	0.057	3.367	6.159	150.090	414.343	218.694
Min	65	0.24%	0.000	-0.124	2.565	15.987	28.251	6.476
Median	207	0.76%	0.006	1.780	3.717	44.501	65.950	57.241

Panel B: Sample composition by industry

Industry by one-digit SIC code	N	%	Mean R&D
Agriculture, Forestry, and Fishing	252	0.92%	0.004
Mining	378	1.39%	0.004
Construction	899	3.30%	0.007
Manufacturing	21,613	79.25%	0.018
Transportation and Communications Services	590	2.16%	0.006
Wholesale Trade	892	3.27%	0.009
Retail Trade	376	1.38%	0.005
Other Services (except for utilities)	2,273	8.33%	0.028
Total	27,273	100.00%	

Notes: The table represents the summary statistics for the emerging markets' sample of 20 countries and 27,273 firm-year observations over the period 1997-2011. The country-level indicators are averages over 15 years. The value of R&D in Panel A and Panel B is country and industry mean, respectively. R&D investment is winsorized at the 1st and 99th percentiles on the annual basis.

Table 4. Summary statistics of firm-level and country-level variables

Variable	N	Mean	P50	Sd	Min	Max	P1	P25	P75	P99
R&D intensity	27,273	0.017	0.005	0.029	0.000	0.194	0.000	0.001	0.020	0.162
Accounting data										
Cash flow	27,244	0.075	0.079	0.105	-0.600	0.431	-0.337	0.037	0.127	0.312
Tobin's q	27,266	1.389	1.088	0.925	0.352	8.760	0.482	0.869	1.550	5.450
Size	27,266	15.470	15.210	2.589	9.701	23.505	10.325	13.589	17.341	22.054
Leverage	27,270	0.095	0.051	0.116	0.000	0.554	0.000	0.000	0.151	0.480
Tangibility	27,272	0.324	0.310	0.189	0.006	0.827	0.011	0.177	0.455	0.780
Dividends	27,239	0.019	0.007	0.030	0.000	0.202	0.000	0.000	0.023	0.160
Liquidity	27,272	0.161	0.114	0.153	0.001	0.751	0.003	0.047	0.227	0.681
Ownership data										
L1	23,948	0.190	0.130	0.194	0.000	0.997	0.000	0.000	0.291	0.752
L3	23,948	0.274	0.236	0.247	0.000	1.000	0.000	0.000	0.456	0.858
Herfindahl index	23,948	0.086	0.029	0.131	0.000	0.995	0.000	0.000	0.114	0.569
Aggregate block	23,948	0.300	0.246	0.261	0.000	1.000	0.000	0.049	0.510	0.897
Strategic block	23,948	0.261	0.201	0.248	0.000	1.000	0.000	0.029	0.453	0.863
Institutional block	23,948	0.032	0.000	0.077	0.000	0.912	0.000	0.000	0.027	0.368
Financial markets' data										
Market Cap/ Pr. Credit	27,273	1.354	1.112	0.705	0.144	4.436	0.357	0.852	1.488	3.709
Market Cap/ (Pr. Credit. + Market Cap)	27,273	0.543	0.526	0.114	0.126	0.816	0.263	0.460	0.598	0.788
Pr. Credit/ (Pr. Credit. + Market Cap)	27,273	0.457	0.474	0.114	0.184	0.874	0.212	0.402	0.540	0.737
Turnover	27,273	144.4	136.7	76.2	4.55	384.1	19.8	90.2	189.5	377.2
Value traded/CDP	27,273	153.6	162.1	116.6	1.4	726.5	9.4	73.4	195.2	667.9
Market Cap/GDP	27,273	122.7	96.2	96.0	9.3	569.5	21.5	71.2	134.9	524.4

Notes: The table above summarizes the dependent and independent variables for the emerging markets' (EM) sample firms. The analyzed EM sample is an unbalanced panel covering 4,584 firms and 27,273 firm-year observations from 20 countries during the period 1997-2011. The ownership data is available for 1997-2010. The number of observations, mean, median, standard deviation, minimum and maximum values, and values at the 1st, 25th , 75th , and 99th percentile are shown for each variable. All firm-level variables are winsorized at the 1st and

99th percentiles on the annual basis. In case of missing firm-level accounting data, the observations were omitted, i.e. not substituted by zero. In case of missing country-level data, the values were extrapolated as an average of the last 5 years. *L1*, *L3*, and *Herfindahl index* have the lower limit of 5%, whereas *Aggregate block*, *Strategic block*, and *Institutional block* are distributed between 0 and 1 (to mitigate censoring concerns). The variables definitions are provided in Table 1.

Table 5. Multivariate Probit regressions of R&D availability

Model	**(1)**	**(2)**	**(3)**	**(4)**
Method	**Multivariate Probit**		**Multivariate Probit**	
SE	**Clustered by firm**		**Clustered by firm and year**	
Dependent variable	**R&D available**	**R&D available**	**R&D available**	**R&D available**
Cash flow	-0.356***	-0.447***	-0.356***	-0.447***
	(-10.37)	(-17.34)	(-7.20)	(-10.63)
Tobin's q	0.0125***	0.0239***	0.0125*	0.0239***
	(2.87)	(7.04)	(1.71)	(4.38)
Size	0.0746***	0.103***	0.0746***	0.103***
	(15.08)	(39.10)	(10.02)	(18.37)
Leverage	-0.440***	-0.276***	-0.440***	-0.276***
	(-6.64)	(-5.86)	(-6.20)	(-5.47)
Tangibility	-0.345***	-0.297***	-0.345***	-0.297***
	(-5.85)	(-8.07)	(-5.92)	(-7.27)
Dividends	-1.557***	-2.220***	-1.557***	-2.220***
	(-3.42)	(-8.14)	(-3.17)	(-6.08)
Liquidity	0.823***	0.586***	0.823***	0.586***
	(13.97)	(14.93)	(10.59)	(11.48)
ln(GDP per capita)	0.428***	0.0820***	0.428***	0.0820***
	(10.13)	(8.70)	(9.48)	(3.86)
EM dummy	-0.333***	-0.398***	-0.333***	-0.398***
	(-5.47)	(-17.68)	(-4.41)	(-6.77)
IAS dummy		0.448***		0.448***
		(27.53)		(4.88)
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Firm years	86,651	244,930	86,651	244,930

Notes: The table provides the estimates of multivariate Probit regression of corporate R&D availability on the set of standard firm-level and country-level characteristics and the emerging markets' origin (*EM dummy*). The outcome is a binary variable that equals one if R&D is disclosed, and zero otherwise. The *IAS dummy* equals one if a firm complies with international accounting standards, and zero otherwise. The *EM dummy* equals one if a firm operates in one of the 20 specified emerging markets (see Table 1), and zero if it operates in G7 countries. All variables are current values, i.e. measured in period t. The accounting data from Thomson Reuters Datastream, except for IAS dummy, are winsorized at the 1st and 99th percentiles on the annual basis. The values in parentheses are t-statistics. All specifications include year and 1-digit SIC code industry dummies. Standard

errors are clustered at the company level in specifications (1) and (2), whereas specifications (3) and (4) use two-dimensionally clustered standard errors (by firm and year). The variables definitions are provided in Table 1. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 6. The analysis of association between R&D levels, firm- and country-level characteristics

Model	**(1)**	**(2)**	**(3)**	**(4)**
Method	**Multivariate Tobit**		**Multivariate Tobit**	
SE	**Clustered by firm**		**Clustered by firm and year**	
Dependent variable	**R&D level**	**R&D level**	**R&D level**	**R&D level**
Cash flow	-0.155***	-0.141***	-0.155***	-0.141***
	(-36.47)	(-40.69)	(-20.20)	(-25.09)
Tobin's q	0.00195***	0.00471***	0.00195***	0.00471***
	(4.74)	(14.21)	(7.39)	(21.18)
Size	0.00253***	-0.000193	0.00253***	-0.000193
	(6.38)	(-1.07)	(7.29)	(-1.21)
Leverage	-0.0697***	-0.0436***	-0.0697***	-0.0436***
	(-12.08)	(-12.75)	(-6.54)	(-6.44)
Tangibility	-0.0644***	-0.0309***	-0.0644***	-0.0309***
	(-10.91)	(-10.97)	(-12.72)	(-10.28)
Dividends	-0.171***	-0.0067	-0.171***	-0.0067
	(-4.31)	(-0.35)	(-3.93)	(-0.24)
Liquidity	0.149***	0.121***	0.149***	0.121***
	(28.31)	(33.20)	(17.09)	(21.66)
ln(GDP per capita)	-0.00510*	0.00633***	-0.00510*	0.00633***
	(-1.66)	(11.47)	(-1.90)	(12.78)
EM dummy	-0.0238***	-0.00592***	-0.0238***	-0.00592***
	(-5.81)	(-5.30)	(-4.82)	(-5.91)
IAS dummy		0.00861***		0.00861***
		(6.78)		(5.02)
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Firm years	51,756	119,450	51,756	119,450

Notes: The table provides the estimates of multivariate (left-censored) Tobit regression of corporate R&D investment levels on the set of standard firm-level and country-level characteristics and the emerging markets' origin (*EM dummy*). The outcome is *R&D deflated by the book value of total assets*. The *IAS dummy* equals one if a firm complies with international accounting standards, and zero otherwise. The *EM dummy* equals one if a firm operates in one of the 20 specified emerging markets (see Table 1), and zero if it operates in G7 countries. All variables are current values, i.e. measured in period t. The accounting data from Thomson Reuters

Datastream, except for IAS dummy, are winsorized at the 1st and 99th percentiles on the annual basis. The values in parentheses are t-statistics. All specifications include year and 1-digit SIC code industry dummies. Standard errors are clustered at the company level in specifications (1) and (2), whereas specifications (3) and (4) use two-dimensionally clustered standard errors (by firm and year). The variables definitions are provided in Table 1. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 7. Intellectual property rights protection as a factor of R&D investment: Tobit regressions

Model	**(1)**	**(2)**	**(3)**	**(4)**
Method	**Multivariate Tobit**		**Multivariate Tobit**	
SE	**Clustered by firm**		**Clustered by firm and year**	
Dependent variable	**R&D level**	**R&D level**	**R&D level**	**R&D level**
Cash flow	-0.156***	-0.142***	-0.156***	-0.142***
	(-36.62)	(-40.89)	(-36.64)	(-40.89)
Tobin's q	0.00199***	0.00468***	0.00207***	0.00470***
	(4.83)	(14.13)	(5.01)	(14.07)
Size	0.00266***	-0.0000152	0.00263***	-0.0000274
	(6.66)	(-0.08)	(6.56)	(-0.15)
Leverage	-0.0684***	-0.0441***	-0.0667***	-0.0439***
	(-11.85)	(-12.89)	(-11.52)	(-12.81)
Tangibility	-0.0639***	-0.0304***	-0.0633***	-0.0304***
	(-10.84)	(-10.82)	(-10.74)	(-10.81)
Dividends	-0.194***	-0.0177	-0.208***	-0.0189
	(-4.86)	(-0.91)	(-5.17)	(-0.97)
Liquidity	0.149***	0.121***	0.151***	0.121***
	(28.42)	(33.10)	(28.63)	(33.10)
ln(GDP per capita)	-0.0120***	0.00290***	-0.00800**	0.00274***
	(-3.60)	(4.16)	(-2.43)	(3.78)
IPR protection	0.0162***	0.00889***	0.00905***	0.00839***
	(6.74)	(8.28)	(3.68)	(7.78)
EM dummy	-0.0155***	-0.00204*	-0.0190***	-0.00240*
	(-3.70)	(-1.69)	(-4.52)	(-1.91)
IAS dummy		0.00999***		0.0107***
		(7.85)		(8.50)
Private credit/ GDP			0.000150***	0.0000158
			(5.32)	(1.09)
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Firm years	51,756	119,450	51,756	119,450

Notes: The table provides the estimates of multivariate (left-censored) Tobit regression of corporate R&D investment levels on the set of standard firm-level and country-level characteristics and the emerging markets' origin (*EM dummy*). The outcome is *R&D deflated by the book value of total assets*. *IPR protection* is the country index of intellectual property rights ranging from 1 to 7. The *IAS dummy* equals one if a firm complies with international accounting standards, and zero otherwise. The *EM dummy* equals one if a firm operates in one of the 20 specified emerging markets (see Table 1), and zero if it operates in G7 countries. *Private credit/ GDP* is a proxy for credit market depth. All variables are current values, i.e. measured in period t. The accounting data from Thomson Reuters Datastream, except for IAS dummy, are winsorized at the 1st and 99th percentiles on the annual basis. The values in parentheses are t-statistics. All specifications include year and 1-digit SIC code industry dummies. Standard errors are clustered at the company level in specifications (1) and (2), whereas specifications (3) and (4) use two-dimensionally clustered standard errors (by firm and year). The variables definitions are provided in Table 1. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 8. R&D investment and ownership concentration in emerging markets: OLS estimation

Model	**(1)**	**(2)**	**(3)**	**(4)**
Method	**OLS without the lag of R&D**			
SE	**Clustered by firm**			
Dependent variable	**R&D deflated by total assets**			
Cash flow *(t-1)*	-0.0904***	-0.0902***	-0.0901***	-0.0904***
	(-5.83)	(-5.80)	(-5.78)	(-5.83)
Tobin's q *(t-1)*	0.169***	0.168***	0.168***	0.170***
	(9.76)	(9.71)	(9.71)	(9.83)
Size *(t-1)*	-0.0971***	-0.0991***	-0.0993***	-0.0957***
	(-4.60)	(-4.71)	(-4.72)	(-4.53)
Leverage *(t-1)*	-0.0303***	-0.0299***	-0.0299***	-0.0307***
	(-2.98)	(-2.94)	(-2.94)	(-3.02)
Tangibility *(t-1)*	-0.0915***	-0.0913***	-0.0916***	-0.0913***
	(-6.95)	(-6.95)	(-6.98)	(-6.94)
Dividends *(t-1)*	0.024	0.024	0.023	0.024
	(1.49)	(1.49)	(1.46)	(1.49)
Liquidity *(t-1)*	0.210***	0.210***	0.210***	0.210***
	(10.96)	(10.93)	(10.92)	(10.98)
IAS dummy	0.0871*	0.0866*	0.0863*	0.0848*
	(1.76)	(1.75)	(1.74)	(1.72)
ln(GDP per capita)	-0.190	-0.177	-0.174	-0.200
	(-0.88)	(-0.81)	(-0.80)	(-0.92)
IPR protection	-0.023	-0.025	-0.023	-0.018
	(-1.09)	(-1.18)	(-1.10)	(-0.85)
Private credit/ GDP	-0.0875***	-0.0868***	-0.0862***	-0.0869***
	(-3.15)	(-3.13)	(-3.10)	(-3.13)
L1 *(t-1)*	-0.0472***			
	(-4.31)			
L3 *(t-1)*		-0.0463***		
		(-4.23)		
Free float *(t-1)*			0.0434***	
			(4.00)	
Herfindahl index *(t-1)*				-0.0515***
				(-4.88)
Year effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes

R squared	0.282	0.281	0.281	0.282
Firm years	22,123	22,123	22,123	22,123

Notes: The table reports the results of dynamic OLS regression that estimates the association of R&D with ownership concentration (please refer to Table 1 for definitions). Among all regressors, only IAS dummy and country-level variables are *not* lagged. Accounting data are winsorized at the 1% level in both tails annually. Z-scores are computed for all variables except for IAS dummy. (*continued on the next page*)

Table 8. (continued)

Model	**(5)**	**(6)**	**(7)**	**(8)**
Method	**OLS with the lag of R&D**			
SE	**Clustered by firm**			
Dependent variable	**R&D deflated by total assets**			
Cash flow *(t-1)*	0.0290***	0.0290***	0.0290***	0.0289***
	(5.03)	(5.03)	(5.04)	(5.03)
Tobin's q *(t-1)*	0.0020	0.0019	0.0019	0.0022
	(0.39)	(0.37)	(0.36)	(0.42)
Size *(t-1)*	0.0002	-0.0001	-0.0002	0.0003
	(0.03)	(-0.03)	(-0.04)	(0.07)
Leverage *(t-1)*	0.00711***	0.00719***	0.00716***	0.00706***
	(2.68)	(2.71)	(2.70)	(2.66)
Tangibility *(t-1)*	-0.0231***	-0.0231***	-0.0231***	-0.0231***
	(-7.90)	(-7.90)	(-7.91)	(-7.90)
Dividends *(t-1)*	-0.002	-0.002	-0.002	-0.002
	(-0.59)	(-0.60)	(-0.61)	(-0.59)
Liquidity *(t-1)*	0.0215***	0.0214***	0.0214***	0.0215***
	(4.59)	(4.58)	(4.58)	(4.60)
IAS dummy	0.0311**	0.0310**	0.0310**	0.0308**
	(2.25)	(2.24)	(2.24)	(2.23)
ln(GDP per capita)	0.164**	0.165**	0.167**	0.162**
	(2.25)	(2.26)	(2.29)	(2.23)
IPR protection	-0.015	-0.015	-0.015	-0.014
	(-1.35)	(-1.35)	(-1.38)	(-1.28)
Private credit/ GDP	-0.015	-0.015	-0.015	-0.015
	(-1.56)	(-1.55)	(-1.54)	(-1.55)
L1 *(t-1)*	-0.00682***			
	(-2.69)			
L3 *(t-1)*		-0.00596**		
		(-2.16)		
Free float *(t-1)*			0.00661**	
			(2.41)	
Herfindahl index *(t-1)*				-0.00719***
				(-3.12)
R&D *(t-1)*	0.915***	0.915***	0.915***	0.915***

	(95.36)	(95.39)	(95.39)	(95.34)
Year effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
R squared	0.853	0.853	0.853	0.853
Firm years	22,123	22,123	22,123	22,123

Notes (continued): The specifications (5) – (8) of Table 8 show the findings of OLS regression with the lag of the dependent variable. Both models, with and without the lag of R&D, control for year, country, and 1-digit SIC code industry fixed effects. Standard errors are clustered at the company level. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 9. The impact of type of owner on R&D intensity in emerging markets: OLS estimation

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Method	**OLS without the lag of R&D**			**OLS with the lag of R&D**		
SE	**Clustered by firm**			**Clustered by firm**		
Dependent variable	**R&D deflated by total assets**			**R&D deflated by total assets**		
Cash flow *(t-1)*	-0.0901***	-0.0895***	-0.0917***	0.0290***	0.0291***	0.0288***
	(-5.78)	(-5.75)	(-5.89)	(5.04)	(5.05)	(5.00)
Tobin's q *(t-1)*	0.168***	0.169***	0.171***	0.002	0.002	0.002
	(9.71)	(9.79)	(9.86)	(0.36)	(0.40)	(0.42)
Size *(t-1)*	-0.0993***	-0.106***	-0.100***	0.000	-0.001	0.000
	(-4.72)	(-5.06)	(-4.70)	(-0.04)	(-0.23)	(0.09)
Leverage *(t-1)*	-0.0299***	-0.0296***	-0.0288***	0.00716***	0.00723***	0.00734***
	(-2.94)	(-2.92)	(-2.84)	(2.70)	(2.73)	(2.77)
Tangibility *(t-1)*	-0.0916***	-0.0922***	-0.0950***	-0.0231***	-0.0232***	-0.0235***
	(-6.98)	(-7.03)	(-7.20)	(-7.91)	(-7.97)	(-8.08)
Dividends *(t-1)*	0.0231	0.0232	0.0211	-0.002	-0.002	-0.003
	(1.46)	(1.46)	(1.33)	(-0.61)	(-0.61)	(-0.69)
Liquidity *(t-1)*	0.210***	0.209***	0.210***	0.0214***	0.0213***	0.0214***
	(10.92)	(10.88)	(10.92)	(4.58)	(4.55)	(4.58)
IAS dummy	0.0863*	0.0860*	0.0856*	0.0310**	0.0309**	0.0308**
	(1.74)	(1.74)	(1.72)	(2.24)	(2.24)	(2.23)
ln(GDP per capita)	-0.174	-0.175	-0.281	0.167**	0.165**	0.151**
	(-0.80)	(-0.80)	(-1.30)	(2.29)	(2.26)	(2.08)
IPR protection	-0.0229	-0.0242	-0.000761	-0.0151	-0.0147	-0.0117
	(-1.10)	(-1.16)	(-0.04)	(-1.38)	(-1.35)	(-1.07)
Private credit/ GDP	-0.0862***	-0.0865***	-0.0862***	-0.0152	-0.0152	-0.0151
	(-3.10)	(-3.11)	(-3.10)	(-1.54)	(-1.54)	(-1.53)
Aggregate block *(t-1)*	-0.0434***			-0.00661**		
	(-4.00)			(-2.41)		
Strategic block *(t-1)*		-0.0451***			-0.00584**	
		(-4.13)			(-2.15)	
Institutional block *(t-1)*			0.006			-0.002
			(0.64)			(-0.60)
R&D *(t-1)*				0.915***	0.915***	0.915***
				(95.39)	(95.38)	(95.43)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes

Country effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.281	0.281	0.280	0.853	0.853	0.853
Firm years	22,123	22,123	22,123	22,123	22,123	22,123

Notes: The table reports OLS results regarding the association of R&D with block and type of owner (please refer to Table 1 for definitions). Among all regressors, only IAS dummy and country-level variables are *not* lagged. Accounting data are winsorized at the 1% level in both tails annually. Z-scores are computed for all variables except for IAS dummy. Each regression includes year, country, and 1-digit SIC code industry fixed effects. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 10. EM firms' R&D intensity and the ownership thresholds: OLS estimation

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Method	**OLS without the lag of R&D**					
SE	**Clustered by firm**					
Dependent variable	**R&D deflated by total assets**					
Cash flow *(t-1)*	-0.0910***	-0.0902***	-0.0918***	-0.0898***	-0.0892***	-0.0917***
	(-5.83)	(-5.78)	(-5.89)	(-5.79)	(-5.76)	(-5.88)
Tobin's q *(t-1)*	0.169***	0.169***	0.171***	0.169***	0.170***	0.171***
	(9.75)	(9.79)	(9.84)	(9.80)	(9.88)	(9.87)
Size *(t-1)*	-0.0994***	-0.103***	-0.0979***	-0.0977***	-0.103***	-0.0986***
	(-4.72)	(-4.92)	(-4.64)	(-4.64)	(-4.91)	(-4.68)
Leverage *(t-1)*	-0.0292***	-0.0293***	-0.0288***	-0.0308***	-0.0303***	-0.0288***
	(-2.87)	(-2.89)	(-2.84)	(-3.04)	(-3.00)	(-2.84)
Tangibility *(t-1)*	-0.0933***	-0.0932***	-0.0948***	-0.0915***	-0.0921***	-0.0949***
	(-7.08)	(-7.09)	(-7.19)	(-6.97)	(-7.02)	(-7.19)
Dividends *(t-1)*	0.022	0.022	0.021	0.023	0.023	0.021
	(1.38)	(1.41)	(1.33)	(1.43)	(1.45)	(1.33)
Liquidity *(t-1)*	0.210***	0.209***	0.210***	0.210***	0.209***	0.210***
	(10.91)	(10.89)	(10.92)	(10.94)	(10.92)	(10.92)
IAS dummy	0.0871*	0.0871*	0.0854*	0.0844*	0.0852*	0.0855*
	(1.75)	(1.75)	(1.71)	(1.71)	(1.73)	(1.72)
ln(GDP per capita)	-0.226	-0.214	-0.279	-0.200	-0.207	-0.281
	(-1.04)	(-0.98)	(-1.29)	(-0.92)	(-0.95)	(-1.30)
IPR protection	-0.014	-0.017	-0.001	-0.015	-0.014	-0.001
	(-0.65)	(-0.83)	(-0.03)	(-0.71)	(-0.67)	(-0.03)
Private credit/ GDP	-0.0845***	-0.0840***	-0.0859***	-0.0833***	-0.0848***	-0.0860***
	(-3.04)	(-3.02)	(-3.09)	(-3.01)	(-3.06)	(-3.09)
Block_25 *(t-1)*	-0.0500**					
	(-2.32)					
Strat_25 *(t-1)*		-0.0679***				
		(-3.13)				
Inst_25 *(t-1)*			-0.034			
			(-0.69)			
Block_50 *(t-1)*				-0.109***		
				(-5.01)		
Strat_50 *(t-1)*					-0.121***	

					(-5.02)	
Inst_50 *(t-1)*						0.001
						(0.01)
Year &Country &Industry	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.280	0.281	0.280	0.282	0.282	0.280
Firm years	22,123	22,123	22,123	22,123	22,123	22,123

Notes: The table reports OLS results regarding the association of R&D with 25%- and 50%-ownership thresholds. The variable definitions are given in Table 1. Accounting data are winsorized at the 1% level in both tails annually. Z-scores are computed for all variables except for the binary ones. (*continued on the next page*)

Table 10. (continued)

Model	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Method	**OLS with the lag of R&D**					
SE	**Clustered by firm**					
Dependent variable	**R&D deflated by total assets**					
Cash flow *(t-1)*	0.0289***	0.0290***	0.0288***	0.0291***	0.0291***	0.0288***
	(5.03)	(5.04)	(5.00)	(5.05)	(5.04)	(5.00)
Tobin's q *(t-1)*	0.002	0.002	0.002	0.002	0.002	0.002
	(0.38)	(0.40)	(0.44)	(0.39)	(0.44)	(0.44)
Size *(t-1)*	0.000	-0.001	0.000	0.000	-0.001	0.000
	(-0.04)	(-0.16)	(-0.00)	(0.02)	(-0.13)	(-0.01)
Leverage *(t-1)*	0.00727***	0.00726***	0.00734***	0.00697***	0.00715***	0.00735***
	(2.75)	(2.75)	(2.78)	(2.63)	(2.70)	(2.78)
Tangibility *(t-1)*	-0.0233***	-0.0233***	-0.0235***	-0.0230***	-0.0232***	-0.0236***
	(-7.96)	(-8.01)	(-8.09)	(-7.88)	(-7.98)	(-8.07)
Dividends *(t-1)*	-0.002	-0.002	-0.003	-0.002	-0.002	-0.003
	(-0.65)	(-0.64)	(-0.69)	(-0.61)	(-0.63)	(-0.68)
Liquidity *(t-1)*	0.0214***	0.0213***	0.0214***	0.0215***	0.0214***	0.0214***
	(4.57)	(4.56)	(4.57)	(4.59)	(4.57)	(4.57)
IAS dummy	0.0311**	0.0311**	0.0309**	0.0307**	0.0308**	0.0309**
	(2.25)	(2.25)	(2.23)	(2.22)	(2.23)	(2.23)
ln(GDP per capita)	0.161**	0.161**	0.151**	0.165**	0.160**	0.151**
	(2.20)	(2.20)	(2.08)	(2.27)	(2.20)	(2.08)
IPR protection	-0.014	-0.014	-0.012	-0.014	-0.013	-0.012
	(-1.27)	(-1.29)	(-1.07)	(-1.29)	(-1.20)	(-1.07)
Private credit/ GDP	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015
	(-1.50)	(-1.50)	(-1.53)	(-1.48)	(-1.52)	(-1.53)
Block_25 *(t-1)*	-0.009					
	(-1.51)					
Strat_25 *(t-1)*		-0.00967*				
		(-1.73)				
Inst_25 *(t-1)*			-0.001			
			(-0.11)			
Block_50 *(t-1)*				-0.0192***		
				(-3.25)		
Strat_50 *(t-1)*					-0.0142**	

					(-2.38)	
Inst_50 *(t-1)*						0.016
						(0.34)
R&D *(t-1)*	0.915***	0.915***	0.915***	0.915***	0.915***	0.915***
	(95.42)	(95.39)	(95.43)	(95.32)	(95.33)	(95.42)
Year &Country &Industry	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.853	0.853	0.853	0.853	0.853	0.853
Firm years	22,123	22,123	22,123	22,123	22,123	22,123

Notes (continued): Each regression includes year, country, and 1-digit SIC code industry fixed effects. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 11. Financial markets' development and R&D investment in emerging economies: OLS

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Method	**OLS without the lag of R&D**				
SE	**Clustered by firm**				
Dependent variable	**R&D deflated by total assets**				
Cash flow *(t-1)*	-0.0871***	-0.0890***	-0.0946***	-0.0918***	-0.0880***
	(-5.42)	(-5.49)	(-5.68)	(-5.63)	(-5.48)
Tobin's q *(t-1)*	0.164***	0.161***	0.152***	0.153***	0.164***
	(9.75)	(9.48)	(9.01)	(9.22)	(9.84)
Size *(t-1)*	-0.134***	-0.128***	-0.0928***	-0.0840***	-0.134***
	(-8.30)	(-7.63)	(-6.26)	(-5.93)	(-8.43)
Leverage *(t-1)*	-0.001	-0.002	-0.004	-0.003	-0.001
	(-0.10)	(-0.20)	(-0.37)	(-0.34)	(-0.05)
Tangibility *(t-1)*	-0.109***	-0.106***	-0.104***	-0.108***	-0.110***
	(-7.97)	(-7.72)	(-7.46)	(-7.82)	(-8.08)
Dividends *(t-1)*	0.0456***	0.0473***	0.0434***	0.0388**	0.0449***
	(2.88)	(2.99)	(2.71)	(2.45)	(2.84)
Liquidity *(t-1)*	0.207***	0.206***	0.206***	0.205***	0.209***
	(10.48)	(10.35)	(10.28)	(10.33)	(10.60)
IAS dummy	0.260***	0.219***	0.155***	0.154***	0.224***
	(4.67)	(3.89)	(3.02)	(2.94)	(4.19)
Aggregate block *(t-1)*	-0.0575***	-0.0701***	-0.0888***	-0.0838***	-0.0495***
	(-5.30)	(-6.36)	(-7.79)	(-7.54)	(-4.56)
ln(GDP per capita)	0.0560***	0.0695***	0.134***	0.129***	0.0927***
	(3.12)	(3.80)	(6.76)	(7.05)	(5.28)
IPR protection	0.0835***	0.0710***	0.014	0.014	0.0697***
	(4.25)	(3.52)	(0.78)	(0.76)	(3.60)
Private credit/ GDP	0.0448**	0.035	0.035	0.131***	0.155***
	(2.12)	(1.63)	(1.63)	(5.76)	(7.27)
Market Cap/ Pr. Credit	-0.163***				
	(-9.33)				
Market Cap/ (Pr. Credit + Market Cap)		-0.128***			
		(-6.85)			
Turnover ratio			0.009		
			(0.63)		
Value traded/ GDP				-0.116***	
				(-6.64)	

Market Cap/ GDP					-0.197***
					(-9.83)
Year & Industry	Yes	Yes	Yes	Yes	Yes
R squared	0.240	0.233	0.226	0.232	0.242
Firm years	22,123	22,123	22,123	22,123	22,123

Notes: The table reports OLS estimations concerning the association of R&D with financial markets' development. The variable definitions are given in Table 1. Non-binary accounting data are lagged and winsorized at the 1% level in both tails annually. All variables but dummies are standardized. (*continued on the next page*)

Table 11. (continued)

Model	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Method	**OLS with the lag of R&D**				
SE	**Clustered by firm**				
Dependent variable	**R&D deflated by total assets**				
Cash flow *(t-1)*	0.0302***	0.0303***	0.0298***	0.0297***	0.0300***
	(5.26)	(5.27)	(5.16)	(5.15)	(5.23)
Tobin's q *(t-1)*	0.002	0.002	0.001	0.001	0.002
	(0.50)	(0.47)	(0.20)	(0.17)	(0.48)
Size *(t-1)*	-0.00627**	-0.00693**	-0.004	0.000	-0.00563*
	(-2.01)	(-2.17)	(-1.42)	(-0.03)	(-1.82)
Leverage *(t-1)*	0.00993***	0.00988***	0.00983***	0.00963***	0.00993***
	(3.84)	(3.82)	(3.77)	(3.71)	(3.84)
Tangibility *(t-1)*	-0.0240***	-0.0237***	-0.0230***	-0.0236***	-0.0241***
	(-8.11)	(-8.01)	(-7.79)	(-7.91)	(-8.13)
Dividends *(t-1)*	-0.001	-0.001	-0.001	-0.002	-0.001
	(-0.31)	(-0.21)	(-0.21)	(-0.53)	(-0.34)
Liquidity *(t-1)*	0.0216***	0.0212***	0.0213***	0.0211***	0.0219***
	(4.79)	(4.72)	(4.73)	(4.69)	(4.84)
IAS dummy	0.0358***	0.0332***	0.0265**	0.0223**	0.0303***
	(3.19)	(3.02)	(2.52)	(2.15)	(2.82)
Aggregate block *(t-1)*	-0.00550**	-0.00622**	-0.00816***	-0.00884***	-0.00508**
	(-2.19)	(-2.47)	(-3.19)	(-3.46)	(-2.00)
ln(GDP per capita)	0.006	0.005	0.0117**	0.0154***	0.0114***
	(1.39)	(1.10)	(2.44)	(3.64)	(2.71)
IPR protection	0.0110**	0.0117**	0.004	0.002	0.00846*
	(2.34)	(2.42)	(1.00)	(0.50)	(1.83)
Private credit/ GDP	0.006	0.004	0.004	0.0129**	0.0176***
	(1.16)	(0.90)	(0.81)	(2.34)	(3.34)
Market Cap/ Pr. Credit	-0.0203***				
	(-5.23)				
Market Cap/ (Pr. Credit + Market Cap)		-0.0210***			
		(-4.99)			
Turnover ratio			0.00992**		
			(2.47)		
Value traded/ GDP				-0.0104**	

				(-2.55)	
Market Cap/ GDP					-0.0218***
					(-4.96)
R&D *(t-1)*	0.918***	0.919***	0.921***	0.920***	0.918***
	(102.78)	(103.51)	(103.68)	(103.05)	(102.22)
Year & Industry	Yes	Yes	Yes	Yes	Yes
R squared	0.853	0.853	0.853	0.853	0.853
Firm years	22,123	22,123	22,123	22,123	22,123

Notes (continued): Each regression includes year and 1-digit SIC code industry fixed effects. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 12. The moderating effects of financial markets on corporate R&D in emerging economies: OLS

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Method	**OLS without the lag of R&D**					**OLS with the lag of R&D**				
SE	**Clustered by firm**					**Clustered by firm**				
Dependent variable	**R&D deflated by total assets**					**R&D deflated by total assets**				
Cash flow *(t-1)*	-0.0766***	-0.0766***	-0.175***	-0.176***	-0.0947***	0.0200***	0.0200***	0.0253***	0.0129*	0.0214***
	(-3.86)	(-3.86)	(-7.41)	(-7.76)	(-4.87)	(3.09)	(3.09)	(3.20)	(1.73)	(3.24)
Aggregate block *(t-1)*	-0.0847***	-0.0847***	-0.0913***	-0.0761***	-0.0892***	-0.00778***	-0.00778***	-0.00924***	-0.0105***	-0.00992***
	(-7.45)	(-7.45)	(-8.12)	(-6.82)	(-7.90)	(-3.05)	(-3.05)	(-3.64)	(-4.00)	(-3.83)
Cash flow* Market Cap/ Pr. Credit	-0.034					0.0207*				
	(-1.46)					(1.91)				
Market Cap/ Pr. Credit (dummy)	-0.0963***					-0.0300***				
	(-3.78)					(-3.97)				
Cash flow*		-0.034					0.0207*			
Market Cap/ (Pr. Credit + Market Cap)		(-1.46)					(1.91)			
Market Cap/ (Pr. Credit + Market Cap)		-0.0963***					-0.0300***			
(dummy)		(-3.78)					(-3.97)			
Cash flow* Turnover ratio			0.154***					0.008		
			(1.91)					(0.89)		
Turnover ratio (dummy)			-0.0409*					0.005		
			(-1.75)					(0.66)		
Cash flow* Value traded/ GDP				0.154***					0.0317***	
				(5.19)					(2.97)	
Value traded/ GDP (dummy)				0.215***					-0.011	
				(6.12)					(-1.16)	

Table 12. (continued)

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Method	**OLS without the lag of R&D**					**OLS with the lag of R&D**				
SE	**Clustered by firm**					**Clustered by firm**				
Dependent variable	**R&D deflated by total assets**					**R&D deflated by total assets**				
Cash flow* Market Cap/ GDP					-0.001					0.014
					(-0.04)					(1.45)
Market Cap/ GDP (dummy)					0.022					-0.0178**
					(0.84)					(-2.07)
R&D *(t-1)*						0.921***	0.921***	0.920***	0.920***	0.921***
						(103.78)	(103.78)	(102.67)	(102.43)	(103.69)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.227	0.227	0.231	0.235	0.226	0.853	0.853	0.853	0.853	0.853
Firm years	22,123	22,123	22,123	22,123	22,123	22,123	22,123	22,123	22,123	22,123

Notes: The table presents the estimates obtained from dynamic OLS regressions that measure the moderating effects of emerging markets' financial system on the corporate R&D inputs. The outcome is *R&D deflated by the book value of total assets*. The definitions of all explanatory and control variables are provided in Table 1. The interaction terms are created by multiplying (standardized) lagged cash flow values with the current quality of financial environment. The country-level financial data, for instance *Market Cap/ Pr. Credit*, are converted into dummies via median split. Consequently, if the value of *Market Cap/ Pr. Credit* is above median, the dummy equals one, and zero otherwise. The accounting data from Thomson Reuters Datastream, except for IAS dummy, are lagged and winsorized at the 1st and 99th percentiles on the annual basis. All non-binary variables are standardized. The values in parentheses are z-statistics. All specifications include year and 1-digit SIC code industry dummies. Standard errors are clustered at the company level. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 13. R&D investment and ownership concentration in emerging markets: system GMM

Model	**(1)**	**(2)**	**(3)**	**(4)**
Method	**System GMM**			
Dependent variable	**R&D deflated by total assets**			
R&D *(t-1)*	0.725***	0.731***	0.735***	0.718***
	(11.52)	(12.16)	(12.37)	(11.32)
Cash flow *(t-1)*	0.0341***	0.0352***	0.0354***	0.0331***
	(2.90)	(3.02)	(3.04)	(2.81)
Tobin's q *(t-1)*	-0.0264**	-0.0284**	-0.0281**	-0.0255**
	(-2.31)	(-2.44)	(-2.41)	(-2.26)
Size *(t-1)*	0.019	0.020	0.020	0.019
	(1.00)	(1.07)	(1.10)	(1.01)
Leverage *(t-1)*	-0.012	-0.012	-0.012	-0.011
	(-1.27)	(-1.33)	(-1.32)	(-1.17)
Tangibility *(t-1)*	0.020	0.021	0.021	0.020
	(1.17)	(1.27)	(1.27)	(1.20)
Dividends *(t-1)*	0.003	0.004	0.004	0.004
	(0.41)	(0.56)	(0.54)	(0.44)
Liquidity *(t-1)*	0.022	0.021	0.021	0.022
	(1.17)	(1.13)	(1.11)	(1.15)
IAS dummy	0.003	-0.003	-0.003	0.010
	(0.11)	(-0.10)	(-0.09)	(0.30)
ln(GDP per capita)	0.014	0.019	0.016	0.010
	(0.71)	(0.97)	(0.84)	(0.51)
IPR protection	0.0608***	0.0589***	0.0580***	0.0635***
	(2.89)	(2.84)	(2.80)	(3.00)
Private credit/ GDP	-0.034	-0.037	-0.036	-0.033
	(-1.31)	(-1.44)	(-1.38)	(-1.30)
L1 *(t-1)*	-0.0179**			
	(-2.37)			
L3 *(t-1)*		-0.0184**		
		(-2.37)		
Free float *(t-1)*			0.0186**	
			(2.34)	
Herfindahl index *(t-1)*				-0.0178**
				(-2.48)
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Firm years	9,274	9,274	9,274	9,274

Hansen p	0.410	0.443	0.412	0.410
AR(1) p	1.95E-08	1.48E-08	1.43E-08	2.15E-08
AR(2) p	0.959	0.949	0.949	0.957

Notes: The table reports system GMM results estimating the impact of ownership concentration on R&D. The sample firms from Taiwan and South Korea are randomly selected. Non-binary accounting data are lagged, winsorized at the 1% level in both tails annually, and standardized. Year and industry fixed effects are included. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 14. The impact of type of owner on R&D intensity in emerging markets: system GMM

Model	**(1)**	**(2)**	**(3)**
Method	**System GMM**		
Dependent variable	**R&D deflated by total assets**		
R&D *(t-1)*	0.735***	0.734***	0.720***
	(12.37)	(12.23)	(11.72)
Cash flow *(t-1)*	0.0354***	0.0354***	0.0336***
	(3.04)	(3.03)	(2.85)
Tobin's q *(t-1)*	-0.0281**	-0.0276**	-0.0271**
	(-2.41)	(-2.37)	(-2.28)
Size *(t-1)*	0.020	0.020	0.017
	(1.10)	(1.09)	(0.96)
Leverage *(t-1)*	-0.012	-0.013	-0.012
	(-1.32)	(-1.40)	(-1.27)
Tangibility *(t-1)*	0.021	0.021	0.022
	(1.27)	(1.25)	(1.25)
Dividends *(t-1)*	0.004	0.004	0.003
	(0.54)	(0.50)	(0.37)
Liquidity *(t-1)*	0.021	0.021	0.024
	(1.11)	(1.14)	(1.33)
IAS dummy	-0.003	-0.002	0.014
	(-0.09)	(-0.06)	(0.43)
ln(GDP per capita)	0.016	0.013	0.007
	(0.84)	(0.67)	(0.33)
IPR protection	0.0580***	0.0577***	0.0683***
	(2.80)	(2.81)	(3.19)
Private credit/ GDP	-0.036	-0.034	-0.038
	(-1.38)	(-1.31)	(-1.46)
Aggregate block *(t-1)*	-0.0186**		
	(-2.34)		
Strategic block *(t-1)*		-0.0196**	
		(-2.16)	
Institutional block *(t-1)*			-0.001
			(-0.23)
Year effects	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes
Firm years	9,274	9,274	9,274
Hansen p	0.412	0.404	0.474

AR(1) p	1.43E-08	1.46E-08	1.92E-08
AR(2) p	0.949	0.956	0.944

Notes: The table reports system GMM results estimating the impact of aggregate blocksholdings (of particular owner types) on R&D. The sample firms from Taiwan and South Korea are randomly selected. Non-binary accounting data are lagged, winsorized at the 1% level in both tails annually, and standardized. Year and industry fixed effects are included. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 15. EM firms' R&D intensity and the ownership thresholds: system GMM

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Method	**System GMM**					
Dependent variable	**R&D deflated by total assets**					
R&D *(t-1)*	0.730***	0.725***	0.738***	0.724***	0.720***	0.728***
	(11.79)	(11.21)	(12.07)	(12.02)	(11.49)	(11.69)
Cash flow *(t-1)*	0.0329***	0.0315***	0.0332***	0.0324***	0.0329***	0.0332***
	(2.88)	(2.76)	(2.79)	(2.76)	(2.80)	(2.80)
Block_25 *(t-1)*	-0.0331**					
	(-2.07)					
Strat_25 *(t-1)*		-0.0360**				
		(-2.01)				
Inst_25 *(t-1)*			-0.029			
			(-1.16)			
Block_50 *(t-1)*				-0.0426**		
				(-2.44)		
Strat_50 *(t-1)*					-0.030	
					(-1.41)	
Inst_50 *(t-1)*						-0.073
						(-1.28)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm years	9,274	9,274	9,274	9,274	9,274	9,274
Hansen p	0.464	0.434	0.331	0.405	0.430	0.367
AR(1) p	1.71E-08	2.2E-08	1.52E-08	1.71E-08	1.90E-08	1.66E-08
AR(2) p	0.956	0.964	0.947	0.933	0.948	0.942

Notes: The table reports system GMM results estimating the impact of the presence of 25%- and 50%-ownership blocks (held by the particular type of owner) on R&D. The sample firms from Taiwan and South Korea are randomly selected. Non-binary accounting data are lagged, winsorized at the 1% level in both tails annually, and standardized. Each specification includes year and 1-digit SIC code industry fixed effects. P-values of the test for overidentifying restrictions (*Hansen p*) and the test for the 1st (*AR(1) p*) and 2nd (*AR(2) p*) order serial

correlations are reported. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

Table 16. Financial markets' development and R&D investment in emerging economies: system GMM

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Method	**System GMM**				
Dependent variable	**R&D deflated by total assets**				
R&D *(t-1)*	0.750***	0.741***	0.736***	0.714***	0.732***
	(12.18)	(12.34)	(12.64)	(11.17)	(11.12)
Cash flow *(t-1)*	0.0327***	0.0349***	0.0356***	0.0311***	0.0314***
	(2.83)	(3.04)	(2.99)	(2.62)	(2.66)
Aggregate block *(t-1)*	-0.0229***	-0.0162**	-0.0140*	-0.0181***	-0.0149**
	(-3.13)	(-2.18)	(-1.90)	(-2.60)	(-1.98)
Market Cap/ Pr. Credit	-0.0184*				
	(-1.73)				
Market Cap/ (Pr. Credit + Market Cap)		-0.0263*			
		(-1.83)			
Turnover ratio			0.007		
			(0.78)		
Value traded/ GDP				-0.011	
				(-1.28)	
Market Cap/ GDP					-0.009
					(-0.85)
Firm controls	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes
Firm years	9,274	9,274	9,274	9,274	9,274
Hansen p	0.181	0.279	0.492	0.500	0.325
AR(1) p	2.09E-08	1.75E-08	1.22E-08	2.02E-08	2.69E-08
AR(2) p	0.958	0.955	0.954	0.956	0.960

Notes: The table reports system GMM results estimating the impact of the country-level financial markets' development on corporate R&D intensity. The sample firms from Taiwan and South Korea are randomly

selected. Non-binary accounting data are lagged, winsorized at the 1% level in both tails annually, and standardized. Each specification includes year and 1-digit SIC code industry fixed effects. P-values of the test for overidentifying restrictions (*Hansen p*) and the test for the 1st (*AR(1) p*) and 2nd (*AR(2) p*) order serial correlations are reported. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

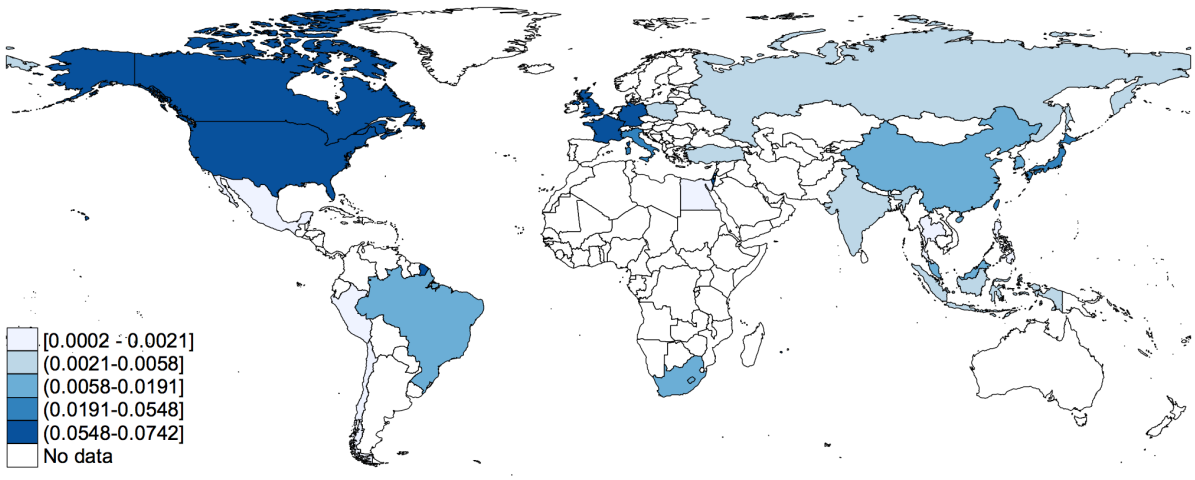
Table 17. The moderating effects of financial markets on corporate R&D in emerging economies: system GMM

Model	**(1)**	**(2)**
Method	**System GMM**	
Dependent variable	**R&D deflated by total assets**	
R&D *(t-1)*	0.783***	0.750***
	(13.92)	(11.28)
Cash flow *(t-1)*	0.0562***	0.0692***
	(3.29)	(3.82)
Aggregate block *(t-1)*	-0.0129*	-0.0158**
	(-1.78)	(-2.19)
Cash flow*	-0.0426**	
Pr. Credit/ (Pr. Credit + Market Cap)	(-2.39)	
Pr. Credit/ (Pr. Credit + Market Cap)	0.0455***	
(dummy)	(3.20)	
Cash flow*		-0.0553***
Turnover ratio		(-3.22)
Turnover ratio		0.0317**
(dummy)		(1.98)
Firm controls	Yes	Yes
Country controls	Yes	Yes
Year effects	Yes	Yes
Industry effects	Yes	Yes
Firm years	9,274	9,274
Hansen p	0.109	0.201
AR(1) p	9.87E-09	2.10E-08
AR(2) p	0.980	0.947

Notes: The table reports system GMM results estimating the *moderating* impact of the country-level financial markets' development on corporate R&D intensity, i.e. on the R&D-cash flow sensitivity. The sample firms from Taiwan and South Korea are randomly selected. Non-binary accounting data are lagged, winsorized at the 1% level in both tails annually, and standardized. The interaction terms are created by multiplying (standardized) lagged cash flow values with the current quality of financial environment. The country-level financial data, for instance *Turnover ratio*, are converted into dummies via median split. Consequently, if the value of *Turnover ratio* is above median, the dummy equals one, and zero otherwise. Each specification includes year and 1-digit SIC code industry fixed effects. P-values of the test for overidentifying restrictions (*Hansen p*) and the test for the 1st (*AR(1) p*) and 2nd (*AR(2) p*) order serial correlations are reported. Values in parentheses are z-statistics. *, **, *** stand for the significance at the 10%, 5%, and 1% level.

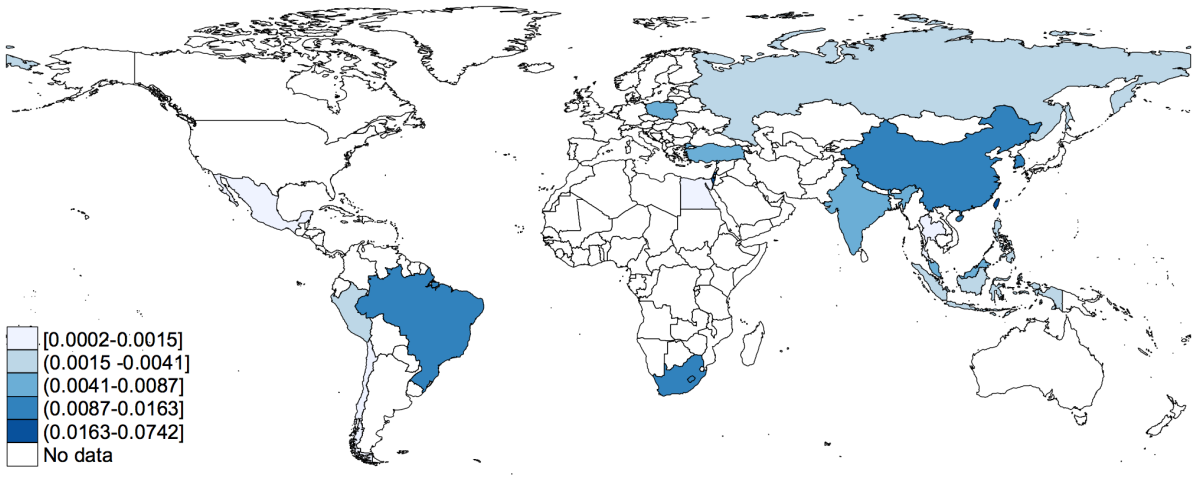
FIGURES

Figure 1. Average corporate R&D intensity in G7 and emerging economies



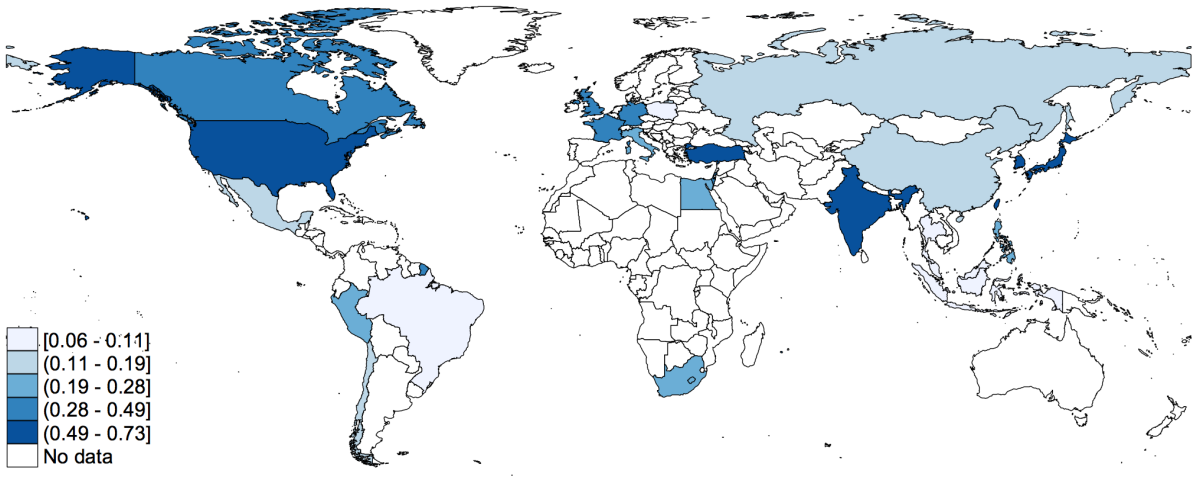
Notes: The figure illustrates mean corporate R&D investment in the analyzed G7 and emerging markets' economies over the period 1997-2011. The numbers in parentheses are R&D levels expressed in coefficients (for example, 0,0742 equals to 7,42% of the book value of total assets). The French territory is represented by France in Continental Europe and French Guiana in Latin America.

Figure 2. Average corporate R&D intensity in emerging economies



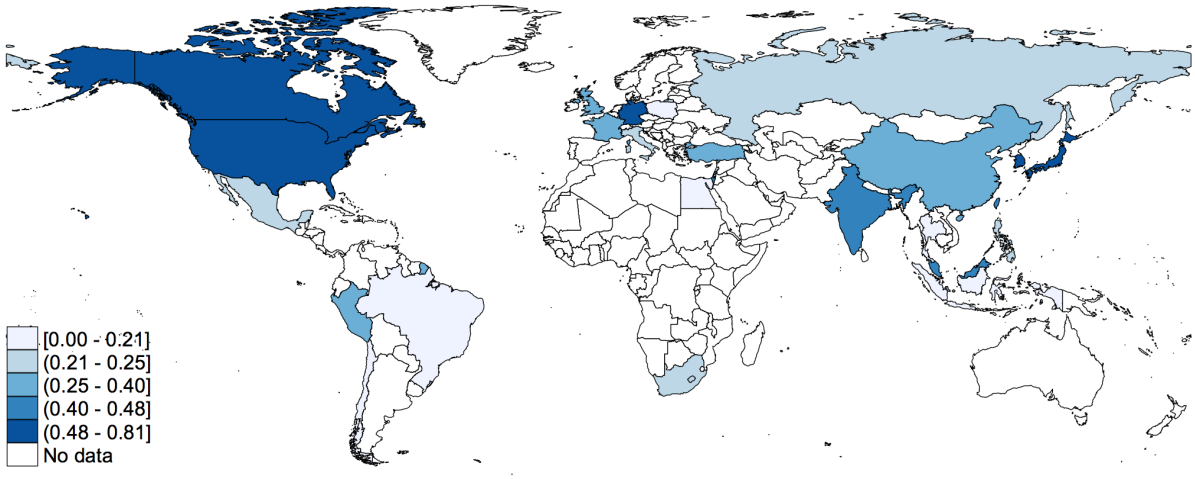
Notes: The figure illustrates mean corporate R&D investment in the specified 20 emerging markets' economies (provided in Table 1) over the period 1997-2011. The numbers in parentheses are R&D levels expressed in coefficients (for example, 0,0742 equals to 7,42% of the book value of total assets).

Figure 3. R&D disclosure in G7 and emerging economies: All firms



Notes: The figure illustrates the average availability of R&D expense in financial statements of the analyzed G7 and emerging markets' firms over the period 1997-2011. The numbers in parentheses are levels of R&D reporting expressed in coefficients (for example, 0,73 means that, on average, 73% of the firm-year observations from the specified country have non-missing R&D item). The French territory is represented by France in Continental Europe and French Guiana in Latin America.

Figure 4. R&D disclosure in G7 and emerging economies: Firms reporting according to international accounting standards



Notes: The figure illustrates the average availability of R&D expense in financial statements of the analyzed G7 and emerging markets' firms *that comply with international accounting standards* over the period 1997-2011. The numbers in parentheses are levels of R&D reporting expressed in coefficients (for example, 0,81 means that, on average, 81% of the firm-year observations from the specified country have non-missing R&D item). The French territory is represented by France in Continental Europe and French Guiana in Latin America.

APPENDIX

Appendix 1: A note on empirical models

The empirical design contains the sequence of panel data models, namely:

I. Linear static model for panel data

(16)

where is a vector of k×1 explanatory variables (e.g. standard control variables, independent variables, time/ country/ industry dummies); β is a vector of k×1 parameters; η is a time-constant variable (unobserved heterogeneity); is the error term (disturbance).

The underlying assumptions of this model are: (i) strict exogeneity which implies where and ; (ii) conditionally homoscedastic and not serially correlated standard errors, i.e. .

The latter will be relaxed by clustering standard errors on the company level, i.e. assuming the observations to be independent across groups (clusters) but not necessarily within groups.

II. Linear dynamic model for panel data

To filter out effects of the past along with unobserved heterogeneity on both right-hand and left-hand side, the model with the lag of dependent variable is introduced further. In technical terms,

, , i = 1,2,…,N, t = 2,3,…,T (17)

The model assumes that the following three assumptions hold: (i) regarding error components: ; (ii) there is no serial correlation in the disturbance term: for t≠s ; (iii) there is no correlation between the disturbance term and the individual effect: for t=2,…,T.

III. System GMM for models with predetermined variables

As strictly exogenous regressors are a very restrictive assumption which is typically unobservable in the real world, the attention is shifted to the system GMM method that works with two types of equations:

First-differenced equations: (18)

Moment conditions: (19)

(20)

Level instruments:

Level equations: : (21)

Moment conditions: (22)

(23)

First-differenced instrument:

Except for the previous assumptions from linear dynamic model, two additional restrictions are added, namely (i) expectation of the individual effect is equal zero, , and (ii) there is no correlation between disturbance term and dependent variable,

To justify the use of system GMM, specification tests is ran parallel to regressions: test for the absence of the second order serial correlation developed by Arellano and Bond (1991) where the null hypothesis assumes no serial correlation; test for overidentifying restrictions, i.e. the validity of instruments used, under the null hypotheses that instruments are uncorrelated with the error term.

IV. Interaction terms

Finally, the models is challenged by assuming unequal parameters for different environments. For example, in case of linear static model the equation will be written as follows:

(24)

Appendix 2: Supplementary results for firm-level corporate governance

The GovernanceMetrics International (GMI) data set was used to gain further insights on the association between firm-level corporate governance mechanisms and R&D intensity in emerging markets.

Hypotheses. As previously confirmed, ownership concentration, as one of the dimensions of internal governance, has negative impact on innovation. In this section, I extend the Hypothesis 2 to other mechanisms of firm-level control and deliberate:

H2c. Ceteris paribus, firm-level corporate governance is positively associated with R&D investment in emerging markets.

H2d. Ceteris paribus, firm-level corporate governance is negatively associated with R&D investment in emerging markets.

The above reasoning is inspired by Driver and Guedes (2012) who – in contrast to the well-established view about goodness of strong corporate governance – conjecture that well-protected shareholders impose higher “hurdles” on R&D returns and insecure non-autonomous managers cannot sustain risky investments.

Sample construction. At the beginning, I extracted the data from every *last* edition of GMI reports (for example, the 4th edition of year 2011) for specified emerging markets. Then, this set of observations was merged with the already analyzed EM sample (27,273 firm-years). Chile and Mexico were omitted because of insufficient number of observations (only 6) so that the final sample consisted of 1,075 firm-years from 13 countries over 2004-2011. As the empirical model introduced below is dynamic (includes the lag of explanatory variables), the number of observations used in regressions is reduced to 780.

Variables measurement. As before, the dependent variable is R&D deflated by total assets. The dimensions of firm-level governance are created according to GMI classification scheme, namely "Board Accountability" (21 attributes), "Financial Disclosure and Internal Controls" (18 attributes), "Remuneration" (16 attributes), "Shareholder Rights" (10 attributes), "Market for Control" (10 attributes), "Corporate Behavior" (16 attributes). In questions which implicate good firm behavior, "Yes" response is treated as "1" and "No" as "0", and vice versa for adverse questions. For a few questions with quantifiable answers, "50%" is used as a cut-off point. For scarcity reasons, Table 18 summarizes only those dimensions that were found to be correlated with R&D.

Table 18. GMI firm-level governance attributes

GovernanceMetrics International attributes	Yes	No
Financial Disclosure and Internal Controls		
Is the audit committee wholly composed of independent board members?	1	0
Is there at least one non-executive member of the audit committee with general expertise in accounting or financial management?	1	0
Do non-executive members of the audit committee with general financial expertise form a majority of that committee?	1	0
Is the chair of the audit committee non-executive with general expertise in accounting or financial management?	1	0
Is there at least one non-executive member of the audit committee who has substantial industry knowledge?	1	0
Do non-executive members of the audit committee with substantial industry knowledge form a majority of that committee?	1	0
Is the chair of the audit committee non-executive with substantial industry knowledge?	1	0
Has the board adopted a separate committee or subcommittee responsible for oversight of risk management?	1	0
Is there at least one non-executive member of the risk committee or the board who has general expertise in risk management?	1	0
Is there at least one non-executive member of the risk committee who has substantial industry knowledge?	1	0
Do any of the members of the audit committee serve on the boards of at least three other public companies?	0	1
Did the company pay its auditor less for audit and audit-related services than for other services in the last fiscal year?	0	1
Does the audit committee (or another body other than the management) have sole authority to hire and fire the outside auditors?	1	0
Does the audit committee have sole authority to approve any non-audit services from the company's outside auditor?	1	0
Has the company had a material earnings restatement within the last 3 years?	0	1
Is the company currently under investigation for accounting irregularities?	0	1
Has the company had 2 or more unusual non-recurring charges of at least 5% of revenue or net assets, or $500M in last 3 years?	0	1
Does the company make comprehensive disclosures on ERM policies in its annual report, or in other publicly available sources?	1	0
Shareholder Rights		
Do all common or ordinary equity shares have one-share, one-vote, with no restrictions?	1	0
Are voting rights capped at a certain percentage, no matter how many shares the investor owns?	0	1
Are voting rights different for domestic or non-resident investors?	0	1
Are voting rights different depending on the duration of ownership?	0	1
Does the company require a minimum holding period in order to vote?	0	1
Does the company allow cumulative voting in the election of directors?	1	0
Do shareholders have a right to convene an EGM with 10% or less of the shares requesting one?	1	0
Does the company provide confidential voting with no or with reasonable exceptions?	1	0
Do shareowners have a right to act in concert through written communication?	1	0
Are all vote results for the last shareholder meeting disclosed within 14 calendar days of the meeting?	1	0
Market for Control		
Is the company involved in a series of cross-shareholdings with other (related or unrelated) companies?	0	1
Can directors be removed without cause?	1	0
Is there a single shareholder or shareholder group which controls a majority of the voting power of the company (over 50%)?	0	1

Has the company's shareholder rights plan ("poison pill") been ratified by a shareholder vote?	1	0
Can the shareholder rights plan be redeemed by a majority vote of shareholders besides the potential acquirer ("chewable" pill)?	1	0
Does the company have a unilateral right to amend the by-laws / articles / constitution without shareholder approval?	0	1
Does the company have a staggered ("classified") board?	0	1
Does the company have a fair price provision in place or is it subject to fair price protection under applicable law?	1	0
Has the company adopted a shareholder rights plan ("poison pill")?	0	1
Does the company's shareholder rights plan include a TIDE provision or a three-year sunset provision?	1	0

To convert dimensions into indices I followed the method proposed by Ammann et al. (2011) and created two indices for overall quality of corporate governance and every dimension using the following principle:

Other firm and country control variables are standard with exception that *Aggregate block* is also included in every specification. The overview of the country-level compliance with good governance practices is given by Table 19.

Empirical design. The model used to test the Hypotheses 2c and 2d is described by the following equation:

(25)

Due to the limited number of years in this unbalanced panel, use of the system GMM is impossible, so the analysis proceeds with OLS estimator. To rule out the unobserved heterogeneity, the lag of dependent variable is included. Year, country, and (1-digit SIC) industry dummies control for fixed effects, whereas standard errors are clustered at the company level, i.e. assumed to be correlated within individuals.

Table 19. Summary statistics of EM firm-level corporate governance

Country	%	R&D	GMI_91	Board Accoun-tability	Fin. Discl. and Internal Controls	Remune-ration	Sharehol-der Rights	Market for Control	Corporate Behavior
Brazil	24	0.97%	0.483	0.506	0.354	0.190	0.721	0.571	0.688
Hong Kong	111	2.37%	0.407	0.320	0.470	0.092	0.700	0.521	0.511
India	139	0.98%	0.454	0.426	0.457	0.164	0.650	0.494	0.632
Indonesia	13	0.83%	0.449	0.608	0.427	0.135	0.562	0.308	0.596
Israel	33	2.59%	0.405	0.398	0.443	0.078	0.658	0.391	0.549
Malaysia	22	0.16%	0.429	0.517	0.442	0.128	0.536	0.464	0.509
Poland	20	0.04%	0.519	0.552	0.447	0.128	0.815	0.640	0.684
Russia	17	0.06%	0.473	0.423	0.464	0.121	0.882	0.512	0.621
Singapore	59	3.44%	0.413	0.355	0.457	0.136	0.649	0.466	0.535
South Africa	72	0.27%	0.463	0.444	0.563	0.087	0.572	0.442	0.695
South Korea	263	1.21%	0.402	0.326	0.396	0.119	0.607	0.529	0.583
Taiwan	278	2.87%	0.436	0.339	0.368	0.161	0.681	0.681	0.605
Turkey	24	0.08%	0.411	0.385	0.301	0.109	0.654	0.458	0.688

Results. Table 20 provides findings for the significant correlations between the firm governance attributes and R&D levels. In accordance with the Hypothesis 2c, effective oversight by independent competent auditors and risk management committee along with strong market for corporate control (for example, the presence of non-classified board, fair price provision, prohibition of bylaws amendments without shareholder approval etc.) exhibit significant positive association with R&D investment. Interestingly, the Hypothesis 2d cannot be completely rejected. The obtained results suggest that well-protected minority investors may indeed have a negative – although weakly significant – impact on R&D expense. Moreover, in this small sample, ownership concentration and liquidity are proven to be the

only significant firm-level determinants of R&D. Ceteris paribus, whenever a firm possesses enough cash and risks are well-diversified, corporate R&D intensity is higher.

Future research. Over the last years, GMI metrics underwent an improvement process and was complemented with new indicators (91 attributes vs. 64 attributes in the paper of Ammann et al. (2011)). Therefore, the using of longer and wider spans of GMI data and/or expanded worldwide samples may allow researchers to obtain even more compelling and robust findings.

Table 20. R&D investment and firm-level corporate governance in emerging markets

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Method	**OLS with the lag of R&D**					
SE	**Clustered by firm**					
Dependent variable	**R&D deflated by total assets**					
R&D *(t-1)*	0.911***	0.910***	0.906***	0.901***	0.908***	0.910***
	(16.04)	(16.03)	(15.95)	(15.90)	(16.21)	(16.06)
Cash flow *(t-1)*	0.029	0.030	0.032	0.035	0.031	0.031
	(0.64)	(0.67)	(0.71)	(0.80)	(0.68)	(0.69)
Liquidity *(t-1)*	0.0737***	0.0738***	0.0724***	0.0736***	0.0728***	0.0729***
	(2.66)	(2.64)	(2.62)	(2.67)	(2.63)	(2.62)
Aggregate block *(t-1)*	-0.0262*	-0.0257*	-0.0242*	-0.021	-0.023	-0.0247*
	(-1.81)	(-1.79)	(-1.71)	(-1.55)	(-1.60)	(-1.74)
Fin.Disc._1 *(t-1)*	0.0324*					
	(1.88)					
Fin.Disc._2 *(t-1)*		0.021				
		(1.53)				
Share.Rights_1 *(t-1)*			-0.031			
			(-1.13)			
Share.Rights_2 *(t-1)*				-0.0497*		
				(-1.83)		
Mark.Contr._1 *(t-1)*					0.0414**	
					(2.22)	
Mark.Contr._2 *(t-1)*						0.000
						(-0.02)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.884	0.884	0.885	0.886	0.885	0.884
Firm years	780	780	780	780	780	780

Notes: The table provides the estimates of dynamic OLS regression analyzing the association between corporate R&D investment and firm-level corporate governance mechanisms in 13 emerging markets over the period 2004-2011. The outcome is *R&D deflated by the book value of total assets*. *Fin.Disc._1* and *Fin.Disc._2* are indices for the dimension "Financial Disclosure and Internal Controls", *Share.Rights_1* and *Share.Rights_2* – for the dimension "Shareholder Rights", *Mark.Contr._1* and *Mark.Contr._2* – for the dimension "Market for Control". All firm-level variables are lagged 1 period. The accounting data from Thomson Reuters Datastream, except for IAS dummy, are winsorized at the 1st and 99th percentiles on the annual basis. Z-scores are computed for all variables. The values in parentheses are z-statistics. All specifications include year, country and 1-digit SIC code industry dummies. Standard errors are clustered at the company level. The variables definitions are provided in Table 1. *, **, *** stand for the significance at the 10%, 5%, and 1% level.