JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS Vol. 55, No. 2, Mar. 2020, pp. 517–547
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doi:10.1017/S002210901800159X

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

Competition and Operating Volatilities around the World

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Abstract

Numerous papers have shown that developing economies are more volatile. We show that, despite greater aggregate and industry stability, performance and size of individual firms in developed countries are more volatile. In developing countries, market imperfections insulate incumbent firms from competition. Consistent with this, firms in developing countries have higher profit, higher market concentration, and less capital raising. Cross-country differences in operating risk and competition intensity are greater in industries that are dependent on external finance, where we expect higher impacts of capital-market imperfections. We show the inverse relation between aggregate and firm-level volatilities has important implications for international studies of cash holding.

I. Introduction

Starting with seminal work by Lucas (1988), numerous authors have shown that developed countries tend to exhibit stable output growth over extended periods of time, while emerging markets are more prone to sharp fluctuations and frequent financial crises (see, e.g., Lucas (1988), Harvey (1995), Acemoglu, Johnson, Robinson, and Thaicharoen (2003), Prasad, Rogoff, Wei, and Kose (2006), Aguiar and Gopinath (2007), and Koren and Tenreyro (2007)). At the industry level, prior studies have shown that poor institutions make financially dependent industries in emerging markets more volatile (Raddatz (2006)) and more vulnerable to recessions (Braun and Larrain (2005)). As a result, it would be natural to assume that firms in emerging markets are riskier. In this article, we show

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https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

that this intuitive conjecture is not true. We find that at the firm level, good institutions make incumbent firms more volatile, especially in financially dependent industries.

We first show that firms in financially developed countries with higher market capitalization per gross domestic product (GDP) have higher operating risk. Firm-level growth rates in assets, sales, and profit are more volatile in developed countries. The cross-sectional dispersions of these variables also increase with financial development. However, we find completely opposite results at aggregate levels. After being averaged across firms, we find that sector- and country-level growth rates are less volatile in developed countries.

We propose that firm-level risk in developing countries is lower due to imperfections in capital markets. To test this hypothesis, we examine whether the cross-country differences in firm-level risk are more pronounced in industries that are more sensitive to capital-market imperfections: specifically, industries that depend more on external financing (Rajan and Zingales (1998)) and on economies of scale (Beck, Demirguc-Kunt, Laeven, and Levine (2008)). In underdeveloped capital markets, firms in industries dependent on external finance and economies of scale may not be able to raise the optimal amount of external capital to compete with rival firms. The effect of such capital-market imperfections may be to lower the operating risk of incumbents in those industries. Our results support the notion that capital-market imperfections act to insulate incumbent firms from competitive risk.

Next, we provide direct evidence that developed economies are more competitive. We find that financial development is associated with lower firm profit margin, lower market concentration (Herfindahl–Hirschman Index), and younger incumbents. Equity offerings are also more prevalent in developed countries. Similar to firm-level risk, the cross-country differences in competition are more pronounced in industries dependent on external finance.

We conclude the empirical analysis by showing that our volatility results have important implications on cross-country studies of cash holding. For the United States, existing literature provides evidence for precautionary demand for cash by showing a positive relation between firms' cash holdings and the cash-flow volatility of the industry in which the firm operates. We show that such aggregate volatility should not be used as a proxy for risk confronting the firm in an international framework. Not only does the misspecification underestimate the effect of risk on cash holding, but the inverse relation between aggregate and firm-level volatilities also leads to a coefficient estimate with the incorrect sign.

We contribute to several strands of international finance literature. Our article complements the recent research on volatilities of stock returns. Morck, Yeung, and Yu (2000) show that idiosyncratic return volatilities are higher in developed countries. Bartram, Brown, and Stulz (2012) find that U.S. stocks are more volatile than stocks of similar foreign firms. The authors show that return volatilities are higher in the United States because they increase with investor protection, stock market development, and innovation, suggesting that the high return volatilities of U.S. stocks increase economic welfare. Since return volatilities are computed from stock prices, they are driven both by real and financial factors. In this article, we focus on real factors by studying volatilities of real variables: sales, assets,

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and profit. Using real volatilities abstracts the operational side of the firm from pricing issues. For example, volatilities of stock returns could be influenced by pricing inefficiency, stock illiquidity, noise trading, transaction costs, government restrictions on trading activities, stock market sentiment, or any fluctuation in risk premium component that is unrelated to firm cash flows. All of these pricing issues can vary across countries. More importantly, we take a further step to identify the sources of risk by showing that capital-market imperfections in developing countries shield incumbent firms from competition. The international differences in operating risk and intensity of competition are more pronounced in industries that are more sensitive to capital-market imperfections.

Studies of cash holdings across countries show that firms in developed countries hold more cash but firms in developing countries hold more fixed assets. Caprio, Faccio, and McConnell (2013) suggest that cash can easily be expropriated by politicians and bureaucrats. Therefore, firms in developing countries, where the threat of political extraction is high, have an incentive to hold less cash to shelter their assets from extractions. Pinkowitz, Stulz, and Williamson (2003) suggest that the Keynesian transaction demand for money drives this result. Since cash holding can reduce costs of business transactions, firms in developed countries with higher cost of labor hold more cash. Kalcheva and Lins (2007) study the value implications of cash holdings and find that corporate cash holdings are less valuable in countries with weak shareholder protection. Although the current literature focuses on the direct effects of poor institutions such as political expropriation and agency costs, this article shows that capital-market imperfections can also affect financial policies indirectly through real competition. Cash holding may differ across countries because the nature of product markets is different. It is rational for firms in developing countries to hold less cash simply because they face lower competitive risk.

There is a large literature on the cash holding of firms in the United States (see, e.g., Faulkender and Wang (2006), Gamba and Triantis (2008), Harford, Mansi, and Maxwell (2008), Bates, Kahle, and Stulz (2009), Fresard (2010), Dittmar and Duchin (2012), and Gao, Harford, and Li (2013)). Our article shows that precautionary demand for cash differs across countries due to the varying degrees of market imperfections. Pinkowitz, Stulz, and Williamson (2016) examine whether U.S. firms hold more cash than foreign firms. They match U.S. and foreign firms by propensity scores based on various firm characteristics (e.g., cash-flow volatility, research and development (R&D) expenditure, acquisition, leverage, dividend, size, market-to-book, and cash flow). After the matching, they find that cash holding of U.S. firms is not higher than the holding of their foreign counterparts, suggesting that cash holding differs because the types of firms in the United States are different. Our article adds to their study by explaining how and why, in term of operating risk, firms differ across countries in the first place.[1]

Our article is also related to the literature on financial development. This strand of research argues that well-functioning financial markets can alleviate conflicts of interest and informational asymmetries between

[1]We further discuss the consistency and complementarity between the two sets of results in Section VII.

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corporate insiders and investors, loosen firm financial constraint, and promote economic growth (e.g., Demirguc-Kunt and Maksimovic (1998), Rajan and Zingales (1998), Beck, Demirguc-Kunt, and Maksimovic (2005), Beck, Demirguc-Kunt, and Maksimovic (2008), and Ayyagari, Demirguc-Kunt, and Maksimovic (2010)). Our article shows that, despite its positive effects on growth and aggregate stability, financial development increases competition and poses risk to individual firms.

The rest of this article is organized as follows: Section II outlines the theoretical framework. Section III discusses data sources and sample statistics. Section IV studies the cross-country determinants of firm-level and aggregate risk. Section V analyzes firm-level risk in industries dependent on external finance. Section VI examines the cross-country determinants of competition. Section VII describes the implication of our findings on international cash studies. Section VIII presents additional results and robustness checks. Section IX concludes.

II. Theoretical Framework

Here, we present a stylized model of operating volatilities that illustrates how capital-market imperfections in developing countries can lead to lower risk at the firm level but higher risk at the aggregate level.[2] The intuition of our model is as follows: In our setup, firms compete for a limited supply of production resources. Initial endowment of resources can be reallocated across firms in response to autoregressive productivity shocks.

Our central assumption is that capital markets are imperfect. Specifically, we assume that reallocating resources across firms is costly. Examples of such costs include external financing cost of the expanding firms or the cost associated with asymmetric information in the market for corporate assets. We expect that these costs are lower in financially developed countries.

Given that market imperfections prevent the winning firm from expanding and the losing firm from contracting, we show that firm-level volatility is decreasing in the degree of market imperfections. In other words, firms in underdeveloped countries where market imperfections slow the reallocation of resources are less sensitive to productivity shocks and are subject to smaller volatility.

Our model also predicts the inversion of firm-level and aggregate volatilities. We prove that aggregate volatility is increasing in the degree of market imperfections. Intuitively, the ability to reallocate resources to the most productive firm in financially developed countries helps increase and stabilize aggregate output. By contrast, in developing countries where firms are "stuck" with past endowment, aggregate output fluctuates greatly when firm-level productivity changes. Thus, aggregate output growth is less volatile in developed countries.

III. Data and Sample Statistics

Here, we describe the data and present sample statistics, which show that firms in financially developed countries are more volatile and competitive than are firms in developing countries.

[2]Details are presented in the Supplementary Material.

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A. Data Sources and Variable Construction

Our main source for firm-level data is WorldScope, which covers over 95% of the world market capitalization and provides financial statement information on firms around the world. WorldScope is the standard data source for many recent cross-country studies (see, e.g., Fan, Titman, and Twite (2012), Mclean, Zhang, and Zhao (2012)). We construct a 1980–2016 annual data set of all the public firms available in WorldScope. Since many of our tests focus on cross-country variations, we exclude countries with fewer than 100 firm-year observations in the sample to reduce noise generated by countries with minimal coverage (e.g., Malawi and Myanmar).[3]

A potential concern with a study of publicly listed firms is that listed firms in developed and developing countries might be inherently different. For example, listed firms in developing countries might be larger and more mature than listed firms in developed countries, where firms early in their life cycle can raise funds in equity markets. We perform a number of robustness checks to address this selection issue. Besides the size quintile, we control for the exact firm size (both total assets and market capitalization), the size relative to other firms in its country, the size relative to other firms in its sector, the size relative to GDP of its country, and firm age. In Section IV, we also control for a full set of 2-digit Standard Industrial Classification (SIC) industry fixed effects and other firm characteristics such as cash and leverage. We confirm that our cross-country difference in volatilities goes beyond the selection of firms along these observable dimensions.[4]

We measure all variables in U.S. dollars. Following other studies, we exclude all financial firms and regulated utilities (primary SIC codes 4900–4999, 6000–6999, and above 9000). We also exclude all observations with 0 or negative total assets. To ensure that our results are not driven by the differences in size distribution across countries, we create a control for size by constructing the size quintile variable based on the global distribution of the total assets of all firms in WorldScope.[5]

Given our focus on the operational side of the companies, we compute the growth rate of each firm's total assets, sales, and profit.[6] We use earnings before

[3]Our final sample covers Argentina, Australia, Austria, Bahrain, Bangladesh, Belgium, Bermuda, Botswana, Brazil, Bulgaria, Canada, Cayman Islands, Chile, China, Colombia, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Egypt, England, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Luxembourg, Malaysia, Malta, Mauritius, Mexico, Montenegro, Morocco, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Palestine, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States, Venezuela, Vietnam, Zambia, and Zimbabwe.

[4]In Supplementary Material II, we provide additional evidence from Orbis that includes unlisted companies.

[5]For some countries, WorldScope does not provide exhaustive coverage of listed companies and bases its sample selection on criteria related to firm size. Controlling for size should alleviate this selection concern. We further examine the subsample of countries with more complete coverage in the Section VIII robustness check.

[6]We use growth rate formulation to circumvent the scaling issue. The growth rate formulation also addresses the concern that the quality of financial statement information may vary across countries: Any persistent discrepancies in accounting standards and practices are differenced away in the

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interest, taxes, depreciation, and amortization (EBITDA) as the measure for profit to ensure that our proxy does not simply reflect cross-country differences in corporate tax systems. Growth rate is defined as the difference in natural logs. Then we compute volatilities (time-series standard deviations) of firm growth rates and use them as a measure of firm-level risk. We also compute cross-sectional dispersions (cross-sectional standard deviations of firm growth rates in each country) and aggregate volatilities (time-series standard deviations of country or 2-digit SIC industry growth rates). To measure competition and firm policies related to competition, we compute the level of profit (EBITDA scaled by total assets), HHI (Herfindahl–Hirschman Index computed from sales), incumbent age based on the year the company was founded, issuance rate (number of equity offerings from Dealogic scaled by number of firms in each industry), investment (additions to fixed assets scaled by lagged fixed assets), and cash scaled by total assets. We winsorize all firm-level variables, including firm-level volatilities, at the 1% level across the sample.

To control for industry characteristics, we include various industry indicators or 2-digit SIC dummies in our regressions. The manufacturing dummy (MANUFACTURING_DUMMY) is equal to 1 if the firm has an SIC code of 2000–3999 according to Aguiar and Gopinath (2005), and 0 otherwise. The high-tech dummy (HIGH_TECH_DUMMY) is equal to 1 if the firm is in what the American Electronics Association identifies as a high-tech industry (comprising 47 4-digit SIC codes in the 2-digit industries 28, 35, 36, 38, 48, and 73), and 0 otherwise. The external-finance-dependence score is from Rajan and Zingales (1998). To measure each industry's technological dependence on external finance, Rajan and Zingales (1998) compute the median fraction of capital expenditures that is not financed with cash flow from operations among American firms. The scale-economies score (our alternative measure of dependence on external finance) is based on Beck et al. (2008). To capture each industry's natural firm-size distribution, Beck et al. (2008) compute an industry's share of employment in firms with fewer than 20 employees in the United States based on U.S. Census data. Both Rajan and Zingales (1998) and Beck et al. (2008) assume that U.S. financial markets are relatively frictionless and, therefore, that external financing and firm size distribution in the United States tend to reflect technological factors such as productive technologies, capital intensities, and scale economies. They further assume that these technological differences persist across countries, so that the measures computed from the U.S. data can also be used as proxies for the natural levels of external financing and firm size for other countries.

Given our focus on capital-market imperfections, the main country-level institutional measure in this article is financial development. We define FINANCIAL_DEVELOPMENT as the ratio of stock-market capitalization of domestic companies to GDP, following Rajan and Zingales (1998), who examine the effects of financial development on industry growth. In the Section VIII

calculation of growth rates. From a theoretical perspective, our model maps the underlying shocks to fundamentals into firm growth. Approximately 21% of our sample involves negative profits and hence cannot be included in the computation of profit growth. In robustness Table 8, we use an alternative profit definition (the level of return on assets), which preserves all observations with negative profits. Our key coefficients remain positive and significant.

robustness tests, we examine a broad measure of institutional development, per capita GDP, as an alternative to the financial development score. Both financial development and per capita GDP measures are from the World Bank's World Development Indicators (WDI) database. All variables are defined in the Appendix. Panel A of Table 1 reports the descriptive statistics of each variable.

TABLE 1
Sample Description

Panel A of Table 1 reports summary statistics of the main variables. The sample period is 1980–2016. Firm-level data are from WorldScope. Equity issuance is from Dealogic. The external-finance-dependence score is from Rajan and Zingales (1998), and economies-of-scale-dependence score is from Beck et al. (2008). Columns 1–6 report total number of observations, mean, standard deviation, and 25th, 50th, and 75th percentiles of the distribution, respectively. All firm-level variables, except categorical variables, are winsorized at the 1% and 99% levels. Panel B compares the main variables across the levels of financial development, with numbers in columns 5–6 being the *t*-statistics from the 2-sample *t*-test for equal means and the *z*-statistics from the nonparametric Wilcoxon–Mann–Whitney test. All financial development scores are from the World Bank's Word Development Indicators Database. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. The Appendix provides detailed definitions of the variables.

Panel A. Summary Statistics

Variable	No. of Obs. 1	Mean 2	25th Percentile 3	Median 4	75th Percentile 5	Std. Dev. 6
Firm-Level Volatility						
SALES	105,534	0.369	0.100	0.189	0.388	0.507
ASSETS	112,275	0.364	0.097	0.183	0.384	0.524
PROFIT	82,752	0.572	0.220	0.401	0.735	0.526
Cross-Sectional Dispersion						
SALES	2,220	0.466	0.242	0.389	0.578	0.444
ASSETS	2,229	0.367	0.193	0.280	0.438	0.404
PROFIT	2,172	0.640	0.448	0.625	0.774	0.390
Country-Level Volatility (Equal-Weighted)						
SALES	295	0.178	0.063	0.097	0.150	0.319
ASSETS	296	0.146	0.053	0.079	0.126	0.274
PROFIT	293	0.238	0.100	0.150	0.249	0.304
Country-Level Volatility (Value-Weighted)						
SALES	295	0.477	0.096	0.157	0.436	0.783
ASSETS	296	0.462	0.075	0.130	0.495	0.764
PROFIT	293	0.582	0.175	0.304	0.639	0.709
Industry-Level Volatility (Equal-Weighted)						
SALES	8,548	0.262	0.091	0.156	0.279	0.417
ASSETS	8,608	0.210	0.080	0.131	0.222	0.345
PROFIT	7,994	0.427	0.188	0.302	0.512	0.421
Industry-Level Volatility (Value-Weighted)						
SALES	8,551	0.372	0.113	0.203	0.399	0.565
ASSETS	8,610	0.336	0.100	0.184	0.362	0.525
PROFIT	7,912	0.595	0.233	0.414	0.749	0.595
Competition Measures or Firm Policies						
PROFIT	717,976	−0.04	0.02	0.09	0.15	0.65
AGE	290,574	42.80	17.00	35.00	59.00	33.52
INVESTMENT	685,703	0.28	−0.06	0.03	0.21	1.25
CASH	557,474	0.12	0.02	0.06	0.15	0.17
HHI	66,347	0.607	0.30	0.56	1.00	0.34
ISSUANCE	66,345	0.07	0.00	0.00	0.00	0.18
Explanatory Variables						
FINANCIAL_DEVELOPMENT	689,671	1.09	0.55	0.88	1.25	1.39
MANUFACTURING_DUMMY	773,384	0.49	0.00	0.00	1.00	0.50
HIGH_TECH_DUMMY	773,384	0.20	0.00	0.00	0.00	0.40
SIZE	773,143	1,110	28	119	494	3,570
EXTERNAL_FINANCE_DEPENDENCE	405,597	0.47	0.23	0.42	0.80	0.29
ECONOMIES_OF_SCALE_DEPENDENCE	405,597	−6.32	−8.39	−5.45	−3.82	3.62

(continued on next page)

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TABLE 1 (continued)
Sample Description

Panel B. Main Variables by Financial Development

		FINANCIAL_DEVELOPMENT				
Variable	No. of Obs. 1	Above (or =) Median 2	Below Median 3	Above Below Minus Median 4	*t*-Statistic 5	*z*-Statistic Wilcoxon–Mann–Whitney Test 6
Firm-Level Volatility						
SALES	105,534	0.468	0.290	0.178	55.88***	50.68***
ASSETS	112,275	0.511	0.241	0.370	86.23***	86.81***
PROFIT	82,752	0.601	0.547	0.053	14.04***	12.07***
Cross-Sectional Dispersion						
SALES	2,220	0.549	0.434	0.116	7.18***	6.7***
ASSETS	2,229	0.435	0.338	0.097	7.18***	5.14***
PROFIT	2,172	0.659	0.635	0.024	1.82*	2.17**
Country-Level Volatility (Equal-Weighted)						
SALES	295	0.141	0.216	−0.075	1.84*	3.97***
ASSETS	296	0.107	0.176	−0.069	2.03**	1.70*
PROFIT	293	0.176	0.282	−0.106	2.81***	4.23***
Country-Level Volatility (Value-Weighted)						
SALES	295	0.391	0.590	−0.199	2.00**	3.53***
ASSETS	296	0.375	0.570	−0.195	2.01**	2.81***
PROFIT	293	0.511	0.648	−0.136	1.51***	2.91***
Industry-Level Volatility (Equal-Weighted)						
SALES	8,548	0.225	0.298	−0.073	7.83***	9.61***
ASSETS	8,608	0.182	0.236	−0.054	7.15***	5.62***
PROFIT	7,994	0.371	0.479	−0.108	11.41***	13.89***
Industry-Level Volatility (Value-Weighted)						
SALES	8,551	0.340	0.406	−0.066	5.22***	5.03***
ASSETS	8,610	0.319	0.355	−0.037	3.15***	2.25**
PROFIT	7,912	0.547	0.646	−0.098	7.18***	7.22***
Competition Measures or Firm Policies						
PROFIT	717,976	−0.16	0.06	−0.22	130.15***	106.89***
AGE	290,574	39.84	47.78	−7.93	58.34***	72.2***
INVESTMENT	685,703	0.34	0.23	0.11	35.49***	14.38***
CASH	557,474	0.15	0.10	0.06	110***	83.83***
HHI	66,347	0.53	0.64	−0.11	38.23***	39.18***
ISSUANCE	66,345	0.09	0.05	0.04	28***	53.83***
Explanatory Variables						
FINANCIAL_DEVELOPMENT	689,671	1.65	0.53	1.13	370***	719.21***
MANUFACTURING_DUMMY	773,384	0.42	0.54	−0.12	100.9***	100.16***
HIGH_TECH_DUMMY	773,384	0.23	0.16	0.07	68.2***	67.97***
SIZE	773,143	1,070	1,210	−144	16.51***	123.14***
EXTERNAL_FINANCE_DEPENDENCE	405,597	0.52	0.42	0.10	100***	104.06***
ECONOMIES_OF_SCALE_DEPENDENCE	405,597	−6.31	−6.45	0.14	11.69***	9.71***

B. Univariate Analysis

Here, we examine how our key variables vary across levels of financial development. Panel B of Table 1 presents this univariate comparison. We classify countries in our sample by their financial development scores and compare below-the-median countries with countries that financial development scores above or equal to the median.[7] The 2-sample *t*-test confirms that firms in financially developed countries have higher firm-level risk. For instance, the average firm-level volatility of sales growth is 0.468 in financially developed countries and 0.290

[7] A partition of countries into developed and developing countries based on the World Bank's Atlas method classification yields similar results.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

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in underdeveloped countries. The differences are statistically significant at the 1% level for volatilities of all three variables: sales, assets, and profit. However, the sector- and country-level growth rates are less volatile in financially developed countries. For instance, the (equal-weighted) country-level volatility of sales growth is 0.141 in financially developed countries and 0.216 in underdeveloped countries. The 2-sample t-test also confirms that competition is more intense in financially developed countries. Firms in financially developed countries have less market power (lower HHI) and lower profit. They also hold more cash, invest more, and issue more equities. For the explanatory variables, financially developed countries have higher fractions of high-tech firms and firms in industries that depend more on external financing and economies of scale but lower fractions of firms in manufacturing industries.

To ensure that our univariate comparison does not depend on any distributional assumption, we perform the nonparametric Wilcoxon–Mann–Whitney test and report the corresponding z-statistics in column 6 of Panel B in Table 1. The nonparametric test confirms that firms are more volatile and competitive in financially developed countries. The z-statistics are statistically significant at the 1% level for almost all of the variables.

Our descriptive statistics and univariate analyses indicate that firms in developed and developing countries have different levels of real risks, consistent with the notion that firm volatilities of sales, assets, and profit growth rates are higher in financially developed countries due to more intense competition.

IV. Firm-Level and Aggregate Risk

Here, we study how firm-level risk, both in time series and in cross section, varies with a country's level of financial development. We then examine whether a similar relation exists for aggregate risk at the sector and country levels.

A. Firm-Level Risk

To examine whether performance and size of individual firms are more volatile in financially developed countries, we first estimate the following regressions:

$$
\begin{aligned}
(1) \qquad V_{i,\tau} \;=\; & \beta_0 + \beta_1 \text{FINANCIAL_DEVELOPMENT}_{i,\tau} \\
& + \beta_2 \text{MANUFACTURING_DUMMY}_i \\
& + \beta_3 \text{HIGH_TECH_DUMMY}_i \\
& + \beta_4 \text{SIZE_QUINTILE}_{i,\tau} + T_\tau + \varepsilon_{i,\tau}.
\end{aligned}
$$

We define annual growth rate, $G_{i,t}$, as $\ln(X_{i,t}) - \ln(X_{i,t-1})$, where $X_{i,t}$ represents sales, assets, and profit of firm i in year t. Firm-level volatility, $V_{i,\tau}$, is the time-series standard deviation of $G_{i,t}$ during decade τ, where $\tau \varepsilon \{1980s, 1990s, 2000s, 2010s\}$. In other words, we define $V_{i,\tau}$ as $\sqrt{\frac{\sum t(Gi,t-\overline{Gi})^2}{n-1}}$, where n is the number of years for which data on $G_{i,t}$ are available. $\overline{G_i}$ is the average growth rate over the decade. Computing volatilities decade by decade allows us to control for decade fixed effects (T_τ). The fixed effects ensure that our cross-country difference in volatilities is not driven by for instance,

the comparison of 1990s volatilities in one country with 2000s volatilities in another. In each year, we divide firms into size quintiles (SIZE_QUINTILE) based on their total assets that year. Since the dependent variable is defined at the decade level, the explanatory variables, FINANCIAL_DEVELOPMENT and SIZE_QUINTILE, are the time-series averages across the years. We also cluster standard errors at the country level as shocks to firm-level risk can be correlated within a country.[8] We report the results in columns 1–3 of Panel A of Table 2.

We find that firms in financially developed countries are more volatile. The coefficients on FINANCIAL_DEVELOPMENT are positive and significant in all columns of Table 2. We estimate the coefficients at 0.025 for sales, 0.025 for total assets, and 0.020 for profit.[9] These numbers are large relative to the median volatilities. For example, the difference in sales growth volatilities between financially developed countries (financial development score $\geq$ the median) and underdeveloped countries (financial development score $<$ the median) implied by the estimated coefficient is around 15% of the median reported in Panel A of Table 1.

We also find that firms in manufacturing industries are less volatile and that firms in high-tech industries are more volatile. The coefficients MANUFACTURING_DUMMY are negative and significant, whereas the coefficients on HIGH_TECH_DUMMY are positive and significant in most columns of Table 2. High-tech industries (e.g., software, computer, and biotech) are likely to experience higher degrees of innovation, uncertainty, and dynamism than are manufacturing industries, which include primitive industries such as food, textile, and other basic goods.[10] The coefficients on SIZE_QUINTILE are negative and significant in all columns, showing that large firms are less volatile than small firms. This result is consistent with the conjecture that smaller, and perhaps younger, firms are riskier.[11]

[8]For alternative standard errors, we compute heteroscedasticity-robust standard errors using the Huber–White sandwich estimators. Inferences based on alternative standard errors also yield statistically significant results. Given our emphasis on cross-country comparison, unless otherwise noted, we follow recent international literature (e.g., Doidge, Karolyi, and Stulz (2017)) and use country-level clustering throughout the paper.

[9]Similar to total asset growth, investment (additions to fixed assets scaled by lagged fixed assets) is more volatile in financially developed countries.

[10]As alternative controls for industry effects, we replace manufacturing and high-tech dummies with 2-digit SIC industry fixed effects. The coefficients on FINANCIAL_DEVELOPMENT and SIZE_QUINTILE are still highly significant. We report the specifications with manufacturing and high-tech dummies in Panel A of Table 2 because their coefficients are informative. In Panel B, we report the specifications with 2-digit SIC industry fixed effects.

[11]We also use market capitalization as an alternative proxy for firm size. Market capitalization is computed from number of shares outstanding multiplied by year-end equity price in U.S. dollars. The size quintile constructed from market capitalization is highly correlated with our original measure constructed from total assets. Existing results remain unchanged. One might be concerned that size quintile constructed from a global distribution might not be an adequate control for firm size and that total assets might not be comparable across countries. For example, a certain level of total assets considered to be small in large countries should be considered large in small countries because it is larger than other firms in its own country. To address these issues, we replace the size quintile with the exact firm size (natural log of total assets), the size relative to other firms in its country (the firm's total assets scaled by its country's average total assets), the size relative to other firms in its local sector (the firm's total assets scaled by its local sector's average total assets), and the size relative to GDP of its country (the firm's total assets scaled by its country's GDP from the World Bank's WDI database). Our main results hold for all alternative measures: Firms in financially developed countries

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

TABLE 2
Firm-Level Risk

Panel A of Table 2 reports the coefficient estimates from the firm-level volatility and cross-sectional dispersion regressions. In columns 1–3, the dependent variables are the volatilities of sales, total assets, and profit. The explanatory variables are FINANCIAL_DEVELOPMENT, MANUFACTURING_DUMMY, HIGH_TECH_DUMMY, and SIZE_QUINTILE. FINANCIAL_DEVELOPMENT is stock market capitalization per gross domestic product (GDP). MANUFACTURING_DUMMY is equal to 1 if the firm is in the manufacturing industries (Standard Industrial Classification (SIC) codes 2000–3999), and 0 otherwise. HIGH_TECH_DUMMY is equal to 1 if the firm is in the high-tech industry according to the American Electronics Association, and 0 otherwise. SIZE_QUINTILE is constructed from the cross-country distribution of total assets. In columns 4–6, the dependent variables are the cross-sectional dispersion of sales, total assets, and profit. Cross-sectional dispersion is defined as the cross-sectional standard deviation of the firm growth rate calculated across all firms within a country. Also estimated but not reported are the time fixed effects and, in Panel B, 2-digit SIC fixed effects. Panel B reports the coefficient estimates from the firm-level volatility regressions with additional controls. The dependent variables and main explanatory variables are similar to those in Panel A (columns 1–3 use the full sample; columns 4–6 use the subsample of firms in nontradable industries). CASH is cash scaled by total assets. ASSET_TANGIBILITY is tangible assets scaled by total assets. LEVERAGE is total liabilities scaled by total assets. SHORT_TERM_DEBTS is current liabilities scaled by total liabilities. CLOSELY_HELD_SHARES is the average fraction of shares that are closely held in each country. All additional characteristics are from WorldScope. Volatility is defined as the time-series standard deviation of the firm's annual growth rate. *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Firm-Level Volatilities and Cross-Sectional Dispersion

	Firm-Level Volatility			Cross-Sectional Dispersion		
	SALES	ASSETS	PROFIT	SALES	ASSETS	PROFIT
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT	0.025 (3.09)***	0.025 (2.67)***	0.020 (3.55)***	0.041 (3.60)***	0.046 (3.16)***	0.019 (3.56)***
MANUFACTURING_DUMMY	−0.084 (4.75)***	−0.096 (9.90)***	−0.008 (0.81)			
HIGH_TECH_DUMMY	0.000 (0.00)	0.061 (4.46)***	0.035 (2.53)**			
SIZE_QUINTILE	−0.113 (6.77)***	−0.140 (6.32)***	−0.058 (6.78)***			
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.12	0.18	0.04	0.14	0.18	0.18
No. of obs.	101,248	107,927	79,031	1,522	1,522	1,517

Panel B. Firm-Level Volatilities with Additional Controls

	Full Sample			Nontradable Subsample		
	SALES	ASSETS	PROFIT	SALES	ASSETS	PROFIT
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT	0.020 (2.67)***	0.013 (2.52)**	0.019 (3.08)***	0.030 (3.68)***	0.019 (3.71)***	0.029 (5.97)***
CLOSELY_HELD_SHARES	0.074 (0.99)	−0.157 (2.82)***	−0.097 (1.32)	0.169 (1.82)*	−0.157 (2.40)**	−0.009 (0.14)
SIZE_QUINTILE	−0.091 (8.26)***	−0.077 (8.01)***	−0.062 (7.75)***	−0.115 (8.10)***	−0.095 (8.46)***	−0.072 (9.30)***
CASH	0.453 (5.10)***	0.729 (10.25)***	0.073 (1.02)	0.402 (4.65)***	0.692 (9.51)***	0.078 (1.51)
LEVERAGE	0.001 (6.29)***	0.002 (17.75)***	0.001 (3.29)***	0.001 (4.90)***	0.002 (16.52)***	0.000 (1.34)
SHORT_TERM_DEBTS	0.262 (6.46)***	0.058 (1.84)*	0.352 (4.93)***	0.287 (6.33)***	0.077 (2.06)**	0.422 (6.45)***
ASSET_TANGIBILITY	−0.129 (4.71)***	−0.117 (5.69)***	−0.088 (4.27)***	−0.131 (3.35)***	−0.123 (5.02)***	−0.152 (6.63)***
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.23	0.40	0.07	0.25	0.40	0.09
No. of obs.	85,992	91,450	68,169	43,551	47,878	32,842

and smaller firms have higher volatilities. To address the concern that observations are not comparable because firms in different countries decide to go public at different stages in their life cycles, we control for firm age. Our existing results still hold. Younger firms also have higher volatilities.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

B. Cross-Sectional Dispersion

Firm-level volatilities can be driven by both aggregate and firm-specific components. Thus, firms may have high volatilities simply because country-level fundamentals such as inflation are volatile. To test whether this is the case, we complement our volatilities results with cross-sectional dispersions results. Hence, we estimate the following regressions:

$$(2) \qquad C_{c,t} = \beta_0 + \beta_1 \text{FINANCIAL_DEVELOPMENT}_{c,t} + T_t + \varepsilon_{c,t}.$$

Again, we define annual growth rate, $G_{i,t}$, as $\ln(X_{i,t}) - \ln(X_{i,t-1})$, where X_i is firm i's sales, assets, and profit. We define the country c's cross-sectional dispersion, $C_{c,t}$, as the cross-sectional standard deviation of $G_{i,t}$, $\sqrt{\frac{\sum i(Gi,t-\overline{G}c,t)^2}{n-1}}$; n is the number of firms in country c in year t for which the data on $G_{i,t}$ are available. $\overline{G}_{c,t}$ is the average growth rate across all firms in country c in year t. T_t represents the year fixed effects. Columns 4–6 of Panel A in Table 2 report the results.

We find that dispersions of sales, assets, and profit growth are higher in financially developed countries. The coefficients on FINANCIAL_DEVELOPMENT are positive and significant in all columns of Table 2. We estimate the coefficients at 0.041 for sales, 0.046 for total assets, and 0.019 for profit. These results are similar to the volatility results in columns 1–3 of Panel A in Table 2. In addition, these coefficients suggest that the difference in dispersion across countries is large relative to the dispersion within a country. For example, the dispersion difference between financially developed countries and underdeveloped countries implied by the estimated coefficient is around 12% of the median within-country dispersion.[12]

C. Additional Controls and Nontradable Subsamples

Firms in financially developed countries and firms in underdeveloped countries differ along many dimensions besides volatilities. Prior literature has shown that financial and institutional development affects cash holding (e.g., Pinkowitz et al. (2003), Dittmar, Mahrt-Smith, and Servaes (2003), Kalcheva and Lins (2007), and Caprio et al. (2013)), leverage (e.g., Rajan and Zingales (1995), Demirguc-Kunt and Maksimovic (1996), Demirguc-Kunt and Maksimovic (1998), Booth, Aivazian, Demirguc-Kunt, and Maksimovic (2001), and Giannetti (2003)), and debt maturity (e.g., Demirguc-Kunt and Maksimovic (1999), Fan et al. (2012)). Cross-ownership and family business groups are also prevalent in emerging markets (e.g., Claessens, Djankov, and Lang (2000), Faccio and Lang (2002)). In this section, we show that the effects of financial development on volatilities are robust even after controlling for these potentially endogenous characteristics. In columns 1–3 of Panel B in Table 2, we re-estimate equation (1) with 2-digit SIC industry fixed effects and additional

[12] In a study of stock return volatilities, Harvey (1995) proposes that lower aggregate volatilities in developing countries are driven by sector concentration. Consistent with his argument, we verify that financially developed countries in our sample are more diversified across sectors. However, the difference in intersector diversification is not the sole factor driving our cross-sectional dispersion results. In our robustness check, we find that dispersion of firms within the same sector is also higher in financially developed countries.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

controls for firm characteristics: CASH (cash scaled by total assets), LEVERAGE (total liabilities scaled by total assets), SHORT_TERM_DEBTS (current liabilities scaled by total liabilities), and ASSET_TANGIBILITY (property, plant, and equipment scaled by total assets). We also include a country-level indicator of business group presence, proxied by the average fraction of closely held shares across all firms in a country (CLOSELY_HELD_SHARES). All characteristics are from WorldScope and measured contemporaneously with volatilities. (We use the time-series average of the control variables to capture the characteristics of the firms during each decade.) We find that firms with more cash, higher leverage, more short-term debts, and fewer tangible assets are more volatile. Assets of firms in countries with more closely held shares are less volatile. The coefficients on FINANCIAL_DEVELOPMENT and SIZE_QUINTILE are still highly significant.

One factor that affects the extent to which existing businesses are insulated from competitive threats is import competition. To isolate the effects of financial development from import competition, we examine the volatilities of firms in nontradable sectors. In columns 4–6 of Panel B in Table 2, we exclude the sample of manufacturing firms with SIC codes 2000–3999, which are identified as tradable industries by Aguiar and Gopinath (2005). We find that the coefficient on FINANCIAL_DEVELOPMENT is in fact larger in the nontradable subsample compared to the full sample. In other words, underdevelopment has greater anticompetitive effects among firms without external competition. Since nontradable firms are not in direct competition with foreign imports, this subsample test also suggests that the effect of financial development does not come from the cross-country variation in trade openness.

D. Sector- and Country-Level Volatilities

To examine aggregate risk across countries, we estimate the following sector- and country-level regressions:

$$
\begin{aligned}
(3) \qquad V_{s,\tau} &= \beta_0 + \beta_1 \text{FINANCIAL_DEVELOPMENT}_{s,\tau} \\
&\quad + \beta_2 \text{MANUFACTURING_FRACTION}_{s,\tau} \\
&\quad + \beta_3 \text{HIGH_TECH_FRACTION}_{s,\tau} + T_\tau + \varepsilon_{s,\tau}, \\
(4) \qquad V_{c,\tau} &= \beta_0 + \beta_1 \text{FINANCIAL_DEVELOPMENT}_{c,\tau} + T_\tau + \varepsilon_{c,\tau}.
\end{aligned}
$$

Table 3 reports the results. In Panel A (equal-weighted volatilities), for each year t, we average firm-level growth rates ($G_{i,t}$) across all firms in each sector s (based on 2-digit SIC industries) in each country or average firm-level growth rates across all firms within each country c. We then use the equal-weighted averages to compute the sector-level volatilities, V_s, or the country-level volatilities, V_c. In Panel B (value-weighted volatilities), for each year t, we first sum sales, assets, or profit ($X_{i,t}$) across all firms in each sector in each country or across all firms within each country and then compute the growth rate of the aggregate. We then use the aggregate growth rate to compute the value-weighted sector- and country-level volatilities. Similar to firm-level volatilities, we compute aggregate volatilities for each decade τ, where $\tau \varepsilon$ {1980s, 1990s, 2000s, 2010s}. T_τ represents decade fixed effects. MANUFACTURING_FRACTION is the fraction of firms in sector s that

TABLE 3
Aggregate Risk

Table 3 reports the coefficient estimates from the country- and sector-level volatility regressions. The dependent variables are the volatilities of sales, total assets, and profit. In columns 1–3, volatility is defined as the time-series standard deviation of the country-level annual growth rate. In columns 4–6, volatility is defined as the time-series standard deviation of the sector-level annual growth rate. In Panel A, the aggregate growth rate is the equal-weighted average of firm growth rates. In Panel B, the aggregate growth rate is the value-weighted average of firm growth rates. Sector classification is based on 2-digit Standard Industrial Classification (SIC) industries. The explanatory variables are FINANCIAL_DEVELOPMENT, MANUFACTURING_FRACTION, and HIGH_TECH_FRACTION. FINANCIAL_DEVELOPMENT is stock market capitalization per gross domestic product (GDP). MANUFACTURING_FRACTION is the fraction of manufacturing firms in that sector. HIGH_TECH_FRACTION is the fraction of high-tech firms in that sector according to the American Electronics Association. Also estimated but not reported are the time fixed effects. *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Equal-Weighted Aggregate Volatility

	Country-Level Volatility			Sector-Level Volatility		
	SALES	ASSETS	PROFIT	SALES	ASSETS	PROFIT
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT	−0.059 (2.76)***	−0.049 (2.65)***	−0.075 (3.06)***	−0.015 (2.82)***	−0.007 (1.57)	−0.037 (2.80)***
MANUFACTURING_FRACTION				−0.064 (7.33)***	−0.058 (8.07)***	−0.033 (3.29)***
HIGH_TECH_FRACTION				−0.065 (3.86)***	−0.020 (1.38)	−0.128 (5.91)***
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.04	0.04	0.06	0.01	0.02	0.02
No. of obs.	265	266	264	8,121	8,170	7,635

Panel B. Value-Weighted Aggregate Volatility

	Country-Level Volatility			Sector-Level Volatility		
	SALES	ASSETS	PROFIT	SALES	ASSETS	PROFIT
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT	−0.135 (2.40)**	−0.127 (2.32)**	−0.079 (1.60)	−0.017 (2.49)**	−0.004 (0.64)	−0.015 (1.72)*
MANUFACTURING_FRACTION				−0.052 (4.24)***	−0.036 (3.06)***	0.000 (0.02)
HIGH_TECH_FRACTION				−0.048 (1.70)*	0.000 (0.01)	−0.097 (3.16)***
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.01	0.01	0.02	0.01	0.01	0.02
No. of obs.	265	266	264	8,124	8,172	7,559

are manufacturing firms. HIGH_TECH_FRACTION is the fraction of firms in sector *s* that are high-tech firms. The fractions are averaged across all years in each decade to match the timing of the dependent variables.

The results show that sector- and country-level volatilities are lower in financially developed countries. The coefficients on FINANCIAL_DEVELOPMENT are negative in all columns and statistically significant in most columns. These results are opposite to the firm-level results in Table 2. We find that most coefficients on MANUFACTURING_FRACTION are negative, suggesting that manufacturing sectors are less volatile than nonmanufacturing sectors. The coefficients on HIGH_TECH_FRACTION are also negative but less significant.

In sum, while firm-level volatilities are higher in financially developed countries, we find that the sector- and country-level volatilities are lower in those countries. Our findings are consistent with the widely accepted view that developing economies are less stable (see Lucas (1988), Acemoglu et al. (2003), Prasad et al. (2006), Aguiar and Gopinath (2007), and Koren and Tenreyro (2007)).

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

V. Market Imperfection and Firm-Level Risk

The previous section shows that firm-level volatilities increase with financial development. We propose that underdeveloped markets have lower firm-level risk because capital-market imperfections insulate incumbent firms from competition. This section examines whether cross-country differences in firm-level risk are more pronounced in industries that are more sensitive to capital-market imperfections.

A. External Finance Dependence

We propose that firms in industries dependent on external finance are more sensitive to capital-market imperfections. In underdeveloped markets, firms in industries dependent on external finance may not be able to raise the optimal amount of external capital to compete with rival firms. The effect of such capital-market imperfections may be to lower cash-flow risk of incumbents in those industries. Rajan and Zingales (1998) construct a score from external financing usage (median fraction of capital expenditures that is not financed with cash flow from operations) of listed firms in the United States during the 1980s. Given that capital markets in the United States are highly developed, the authors argue that their score can be considered the unconstrained demand for external funds.[13]

Following the difference-in-difference method in Rajan and Zingales (1998), we adopt their external-finance-dependence score (EXTERNAL_FINANCE_DEPENDENCE) and estimate the following regression:

$$(5) \quad V_{i,\tau} = \beta_0 + \beta_1 \text{FINANCIAL_DEVELOPMENT_INDICATOR}_i \times \text{EXTERNAL_FINANCE_DEPENDENCE}_i + C_i + I_i + T_\tau + \varepsilon_{i,\tau}.$$

The key explanatory variable here is the interaction term between the financial development indicator (FINANCIAL_DEVELOPMENT_INDICATOR) and EXTERNAL_FINANCE_DEPENDENCE. FINANCIAL_DEVELOPMENT_INDICATOR takes a value of 1 if the country's financial development score is above or equal to the median, and 0 otherwise. In this specification, we use the financial development indicator as a proxy of institutional development because the coefficient on the indicator variable and its interaction lend themselves to easy interpretation. In addition to the time fixed effects (T_τ), we include the full set of country fixed effects (C_i) and 2-digit SIC industry fixed effects (I_i) to absorb the first-order differences across countries and industries.[14] We report the results in columns 1–3 of Table 4.

The coefficients on the interactions are positive and highly significant in all columns. We estimate the interaction coefficients at 0.231 for sales, 0.192 for

[13] For example, the least external finance dependent industry is tobacco (score = −0.45) and the most external dependent industry is drugs (score = 1.49). We note that Rajan and Zingales (1998) score is only available for each of the 36 International Standard Industrial Classification (ISIC) manufacturing industries. Therefore, number of observations in external finance dependent regressions is about 50% of what we report in Table 2 Panel A.

[14] In a robustness test, we replace country fixed effects with FINANCIAL_DEVELOPMENT and replace industry fixed effects with EXTERNAL_FINANCE_DEPENDENCE. Similar to the fixed effect specification, the coefficients on the interaction term are positive and significant.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

TABLE 4
Market Imperfection and Firm-Level Volatilities

Table 4 reports the coefficient estimates from the firm-level volatility regressions. The dependent variables are the volatilities of sales, total assets, and profit. Volatility is defined as the time-series standard deviation of the firm annual growth rate. In columns 1–3, the main explanatory variable is the interaction term between FINANCIAL_DEVELOPMENT_INDICATOR and EXTERNAL_FINANCE_DEPENDENCE. FINANCIAL_DEVELOPMENT_INDICATOR takes the value of 1 if the country's financial development score is above or equal to the median, and 0 otherwise. EXTERNAL_FINANCE_DEPENDENCE is the median fraction of capital expenditures that is not financed with cash flow from operations of U.S. firms from Rajan and Zingales (1998). In columns 4–6, we replace EXTERNAL_FINANCE_DEPENDENCE with an alternative measure (ECONOMIES_OF_SCALE_DEPENDENCE). ECONOMIES_OF_SCALE_DEPENDENCE is the negative of industry's share of employment in firms with fewer than 20 employees in the United States from Beck et al. (2008). Also estimated but not reported are country, industry, and time fixed effects. *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Rajan–Zingales Measure			Alternative Industry Measure		
	SALES	ASSETS	PROFIT	SALES	ASSETS	PROFIT
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT_INDICATOR × EXTERNAL_FINANCE_DEPENDENCE	0.231 (9.69)***	0.192 (6.44)***	0.100 (3.76)***	0.007 (4.71)***	0.006 (4.23)***	0.002 (0.77)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.10	0.15	0.05	0.09	0.15	0.05
No. of obs.	52,890	54,628	42,404	52,890	54,628	42,404

assets, and 0.100 for profit. This finding means that volatility differences across countries are consistently greater in industries that depend on external financing.

These interaction terms can be interpreted as second derivatives.[15] To illustrate the magnitude of the interaction coefficients, we follow the example in Rajan and Zingales (1998). Electric machinery is the industry at the 75th percentile of financial dependency (score = 0.80). Rubber products is the industry at the 25th percentile of financial dependency (score 0.23). Assume that for rubber products, sales volatilities in financially developed countries are higher than sales volatilities in underdeveloped countries by δ. The interaction coefficient of 0.231 implies that for electric machinery, sales volatilities in developed countries are $\delta + 0.231(0.80 - 0.23) = \delta + 0.132$ higher than underdeveloped countries. In our sample, the median sales volatility is 0.189. Thus, the interaction effect is economically significant.

The positive interaction coefficients are consistent with the notion that underdeveloped markets can reduce risk for incumbent firms. In developing countries, where small firms and potential entrants face severe financial constraints, existing firms in industries that require a large amount of external financing may face lower competition and have lower risk.

B. Alternative Measure: Dependence on Economies of Scale

Industries that require economies of scale and that have large optimal firm size are more likely to be affected by poor institutions. In large-firm industries,

[15] As in Rajan and Zingales (1998), the key coefficient in our difference-in-difference test is the coefficient on the interaction term between the country and industry indicators. The logic of the inference is as follows: The external finance dependence measure may capture both external financing needs and other industry characteristics correlated with volatilities but unrelated to financing needs or financial market imperfection. The test relies on the notion that only the components related to financing would produce effects that vary with country-level financial development.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

where economies of scale are crucial, small firms and potential entrants may have to raise large amounts of capital in order to be competitive. Large, established incumbents also tend to suffer less from information problems than do smaller entrants, so they are less affected by capital-market imperfections in emerging markets. Cash flow risk of incumbents in those industries should be lower in developing countries due to lack of competition from new players.

Beck et al. (2008) suggest that, for technological reasons, certain industries do not require economies of scale and therefore have a larger share of small firms. Their small-firm share is defined as the share of industry's employment by firms with fewer than 20 employees (based on the 1992 U.S. Census data). Given that institutions in the United States are highly developed and that there are few policy distortions, Beck et al. (2008) argue that their scores are based on the natural size distribution of firms.[16] We use the negative of Beck et al.'s (2008) small-firm share as an alternative measure of external finance dependence. (Firms in industries with small optimal firm size are less likely to require external financing.) We then re-estimate equation (5) using the alternative industry measure. We report the results in columns 4–6 of Table 4.

The coefficients on the interactions between the financial development indicator and the alternative industry measure are positive in all columns. We estimate the interaction coefficients at 0.007 for sales, 0.006 for total assets, and 0.002 for profit. This finding means that the cross-country volatility difference is generally greater in industries that depend more on economies of scale. In underdeveloped markets, where new entrants suffer more from poor institutions, existing firms in scale-dependent industries face lower risk.[17,18]

To demonstrate the magnitude of the interaction coefficients, we examine the apparel industry, which is the industry at the 25th percentile of large-firm share (score $=-8.39$), and the food industry, which is the industry at the 75th percentile of large-firm share (score $=-3.82$). Assume that for apparel, sales volatilities in financially developed countries are higher than sales volatilities in underdeveloped countries by δ. The interaction coefficient implies that for food, sales volatilities in developed countries are $\delta+0.007(8.39-3.82)=\delta+0.032$ higher than underdeveloped countries. In our sample, the median sales volatility is 0.189. Therefore, the interaction effect is economically significant.

In sum, cross-country differences in firm-level volatilities are more pronounced in industries that suffer more from capital-market imperfections. Under the Rajan and Zingales (1998) framework, differences in firm-level volatilities are

[16]For example, the industry with the least share of small firms is paper manufacturing (score = -0.14). The industry with the highest share of small firms is wood (score $=-21.37$).

[17]We also estimate an alternative specification where SIZE_QUINTILE and its interaction with FINANCIAL_DEVELOPMENT_INDICATOR are included as explanatory variables. The coefficient on this interaction term is negative and significant, suggesting that small firms in financially developed countries are particularly risky because they have to compete with both new entrants and larger incumbents.

[18]In untabulated results, the robustness tests in Panels B and D of Table 8 also hold for the economies of scale measure. Our result is robust across alternative country and volatility measures and for all our subsamples, confirming that the cross-country volatility difference is larger in industries relying more on scale economies.

more pronounced in industries dependent on external finance and economies of scale.

VI. Competition

Previously, we show that firms in financially developed countries are more volatile and argue that capital-market imperfections insulate incumbent firms in underdeveloped markets from competitive risk. Here, we provide direct evidence that financial development is associated with competition. We then confirm that, similar to firm-level risk, cross-country differences in competition are more pronounced in industries dependent on external finance.

A. Determinants of Competition

To test how competition varies across countries and industries, we examine two conventional measures of competition (profit and market concentration), incumbent age, and corporate policies related to competition (investment, capital raising, and cash holding). Based on the specification in Section IV, we estimate the following panel regression:

$$\begin{aligned} Y_{i,t} &= \beta_0 + \beta_1 \text{FINANCIAL_DEVELOPMENT}_{i,t} \\ &\quad + \beta_2 \text{MANUFACTURING_DUMMY}_i \\ &\quad + \beta_3 \text{HIGH_TECH_DUMMY}_i \\ &\quad + \beta_4 \text{SIZE_QUINTILE}_{i,t} + T_t + \varepsilon_{i,t}. \end{aligned} \tag{6}$$

The dependent variables, $Y_{i,t}$, are measures of competition and relevant firm policies in year t: PROFIT is defined as EBITDA scaled by total assets. HHI is the Herfindahl–Hirschman Index computed from sales in each country, 2-digit SIC industry,[19,20] and year (i.e., $\text{HHI} = \sum_j (\text{SHARE}_j^2)$, where SHARE_j is the market share of firm j and HHI ranges from 0 to 1). AGE is the firm's age based on the year the company was founded. Capital raising is proxied by ISSUANCE, the number of equity offerings scaled by the number of firms in each country, industry, and year. INVESTMENT is defined as additions to fixed assets scaled by lagged fixed assets. CASH is cash scaled by total assets. The number of equity offerings is from Dealogic, and all other characteristics are from WorldScope. T_t represents the year fixed effects. We report the results in Panel A of Table 5.

We find more competition in financially developed countries. Financial development lowers profit margin and market concentration (HHI). Financially developed countries are also populated by younger incumbents, indicating higher turnover rates and more competitive environments. An average firm in financially

[19] Since HHI and ISSUANCE are defined at the industry level, each observation in the HHI and ISSUANCE regressions represents one industry. Therefore, the firm-level explanatory variable $\text{SIZE_QUINTILE}_{i,t}$ is not applicable to these regressions.

[20] In Table 5 Panel A, we use the 2-digit SIC code to define an industry sector since we use this definition throughout the paper. However, we switch to the 4-digit SIC code in Panel B, where we examine the effects of external finance dependence. Given that the Rajan–Zingales (1998) score for external finance dependence is defined at the 4-digit SIC level and only available for manufacturing industries, there is not enough variation in this variable at the 2-digit SIC level to estimate the difference-in-difference specification.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

TABLE 5
Competition

Table 5 reports the coefficient estimates from the competition regressions. The dependent variables are measures of competition and relevant firm policies. PROFIT is earnings before interest, taxes, depreciation, and amortization (EBITDA) scaled by total assets. AGE is the firm's age based on the year the company was founded. INVESTMENT is defined as additions to fixed assets scaled by lagged fixed assets. CASH is cash scaled by total assets. HHI is the Herfindahl–Hirschman Index computed from sales in each country, 2-digit Standard Industrial Classification (SIC) industry, and year. ISSUANCE is number of equity issuances scaled by number of firms in each country, 2-digit SIC industry, and year. Issuance data are from Dealogic and all other characteristics are from WorldScope. The explanatory variables in Panel A are FINANCIAL_DEVELOPMENT, MANUFACTURING_DUMMY, HIGH_TECH_DUMMY, and SIZE_QUINTILE. FINANCIAL_DEVELOPMENT is stock market capitalization per gross domestic product (GDP). MANUFACTURING_DUMMY is equal to 1 if the firm is in the manufacturing industries (SIC codes 2000–3999), and 0 otherwise. HIGH_TECH_DUMMY is equal to 1 if the firm is in the high-tech industry according to the American Electronics Association, and 0 otherwise. SIZE_QUINTILE is constructed from the cross-country distribution of total assets. The main explanatory variable in Panel B is the interaction term between FINANCIAL_DEVELOPMENT_INDICATOR and EXTERNAL_FINANCE_DEPENDENCE. FINANCIAL_DEVELOPMENT_INDICATOR takes the value of 1 if the country's financial development score is above or equal to the median, and 0 otherwise. EXTERNAL_FINANCE_DEPENDENCE is the median fraction of capital expenditures that is not financed with cash flow from operations of U.S. firms from Rajan and Zingales (1998). Also estimated but not reported are the time fixed effects and, in Panel B, the country and industry fixed effects. *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Determinants of Competition

Variable	PROFIT 1	AGE 2	INVESTMENT 3	CASH 4	HHI 5	ISSUANCE 6
FINANCIAL_DEVELOPMENT	−0.010 (3.14)***	−2.067 (3.13)***	0.016 (5.07)***	0.008 (3.56)***	−0.033 (3.77)***	0.015 (4.99)***
MANUFACTURING_DUMMY	0.052 (11.32)***	12.386 (10.40)***	−0.150 (9.14)***	−0.024 (4.73)***	−0.113 (12.98)***	−0.020 (7.28)***
HIGH_TECH_DUMMY	−0.083 (8.43)***	−15.506 (11.42)***	0.043 (1.95)*	0.069 (10.80)***	−0.187 (9.03)***	0.054 (6.61)***
SIZE_QUINTILE	0.134 (9.99)***	4.341 (4.33)***	−0.063 (5.82)***	−0.025 (2.68)***		
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2 / log likelihood	0.09	0.15	0.02	0.08	0.06	0.04
No. of obs.	639,677	252,859	612,785	496,815	53,244	53,244

Panel B. Market Imperfection and Competition

Variable	PROFIT 1	AGE 2	INVESTMENT 3	CASH 4	HHI 5	ISSUANCE 6
FINANCIAL_DEVELOPMENT_INDICATOR × EXTERNAL_FINANCE_DEPENDENCE	−0.179 (4.92)***	−10.844 (3.61)***	0.095 (4.50)***	0.064 (4.21)***	−0.077 (5.13)***	0.036 (3.46)***
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.11	0.24	0.02	0.20	0.17	0.06
No. of obs.	330,645	139,312	318,657	257,046	112,271	112,271

developed countries also holds more cash, accumulates more fixed assets, and raises more equities. Higher cash holding is consistent with the precautionary motive to accommodate higher competitive risk. Higher accumulation of fixed assets is consistent with the notion that competition creates more dynamism, which leads to higher average firm growth.[21] More equity raising allows firms without internal financial resources to compete more aggressively. The coefficients on FINANCIAL_DEVELOPMENT are highly significant in all columns. The estimated coefficients imply that, ceteris paribus, moving from a financially undeveloped country to a financially developed country will decrease profit by 19%,

[21] This result is also consistent with Bartram et al.'s (2012) suggestion that the higher return volatilities of U.S. stocks are associated with more shareholder wealth and economic growth.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

incumbent age by 5%, and HHI by 6%. Such a move will also increase investment by 8%, cash by 9%, and equity issuance rate by 34%. Therefore, the results are economically significant.

We also find less competition in manufacturing industries and more competition in high-tech industries. Profit and market concentration are higher (lower) in manufacturing (high-tech) industries, whereas incumbent age is lower (higher) in high-tech (manufacturing) industries. Firms in manufacturing (high-tech) industries make fewer (more) investments, hold less (more) cash, and issue fewer (more) equities. Small firms face higher competitive risk than large firms. Small firms have lower profits and hold more cash. Almost all of the coefficients on MANUFACTURING_DUMMY, HIGH_TECH_DUMMY, and SIZE_QUINTILE are statistically significant at the 1% level.

B. Market Imperfection and Competition

Section V shows that the cross-country differences in firm-level volatilities are more pronounced in industries dependent on external finance. Here, we examine whether the measures of competition and relevant firm policies exhibit a similar pattern. If, in developing countries, potential entrants to industries dependent on external finance cannot raise enough capital to compete with incumbents, there should be less competition and capital raising in those countries and industries. Based on the difference-in-difference specification in Section V, we estimate the following regression:

$$(7) \quad Y_{i,t} = \beta_0 + \beta_1 \text{FINANCIAL_DEVELOPMENT_INDICATOR}_i \times \text{EXTERNAL_FINANCE_DEPENDENCE}_i + C_i + I_i + T_t + \varepsilon_{i,t}.$$

The dependent variables are measures of competition and relevant firm policies from Section VI.A (PROFIT, HHI, AGE, ISSUANCE, INVESTMENT, and CASH). The explanatory variables include the interaction between FINANCIAL_DEVELOPMENT_INDICATOR and EXTERNAL_FINANCE_DEPENDENCE, defined in Section V.A, as well as country, industry, and year fixed effects. We report the results in Panel B of Table 5.

We find more competition (lower profit and market concentration) as well as higher growth (more investment and equity issues) in financially developed countries, particularly in industries dependent on external finance. The cross-country differences in firm age and cash holding are also more pronounced in industries dependent on external finance. The coefficients on the interactions are significant in all columns. Following the example in Section V.A, we illustrate the economic significance of the interaction term by comparing electric machinery (the industry at the 75th percentile of financial dependency scores) with rubber products (the industry at the 25th percentile). The implied developed–undeveloped country differences in electric machinery are higher than the implied difference in rubber products by −0.10 for PROFIT, −6.18 for AGE, 0.05 for INVESTMENT, 0.04 for CASH, −0.04 for HHI, and 0.02 for ISSUANCE. These implied differences-in-differences are between 40% and 80% of the developed–undeveloped country differences in Panel B of Table 1. Therefore, the estimated coefficients are economically large.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

Overall, our results support the notion that capital-market imperfections shield incumbent firms from competition. In underdeveloped markets, where small firms and potential entrants face severe financial constraints, incumbents in industries that require a large amount of external financing face less competition.

VII. Implication on Cash Holding

This section provides an example of a context in which our findings on firm-level and aggregate volatilities have a crucial implication: the cross-country analysis of cash holding. We show that industry cash-flow volatility, which is a common proxy for firm risk in domestic studies, should not be used as a proxy for firm risk in the cross-country framework.

We note that one of the reasons that firms hold cash is to respond to unforeseen shortfalls in operating cash flow. For the United States, existing literature provides evidence for this precautionary demand for cash by showing a positive relation between firms' cash holdings and the cash-flow volatility of the industry in which the firm operates. Given that emerging markets are more volatile at the industry and country levels, a generalization suggests that firms in developing countries should hold more cash. However, as shown in prior literature (see, e.g., Pinkowitz et al. (2003), Caprio et al. (2013)), this is not the case. Lower cash holdings in developing countries might suggest that either the precautionary demand theory of cash is not robust or that other factors (e.g., differences in agency costs or threat of political extraction) are great enough to overcome the effect of higher operating risk. We consider the possibility that the precautionary demand theory of cash holdings is correct but that the natural estimates of the risk confronting the firm are confounded by the inverse relation between firm and industry cash-flow risk across the world.

In Table 6, we augment our cash-holding regressions in Section VI.A by including country-level aggregate volatility, sector-level aggregate volatility, and firm-level volatility. As in Section IV, we define country-level volatility as the standard deviation of average sales growth in one country, sector-level volatility as the standard deviation of average sales growth in one 2-digit SIC industry in one country. We define firm-level volatility as the standard deviation of firm-level sales growth.

In columns 1–2 of Table 6, for the sake of comparison, we restrict the sample to firms in the United States In columns 3–6, we use the full sample of international firms. In column 1, we estimate the coefficient on sector-level volatility at 0.048 with a t-statistic of 4.31. In column 2, we estimate the coefficient on firm-level volatility at 0.042 with a t-statistic of 23.70. These results show that sector- and firm-level volatilities lead to more cash holding in the United States (In columns 1 and 2, we use robust standard errors since a single-country sample does not allow us to cluster standard errors by country).

In columns 3–4 of Table 6, we use country- and sector-level aggregate volatilities as proxies for risk in cross-country regressions. In column 3, we estimate the coefficient on country-level aggregate volatility at −0.028. In column 4, we estimate the coefficient on sector-level volatility at −0.039. These negative coefficients imply that firms in countries and sectors with higher aggregate

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

TABLE 6
Application to International Study of Cash Policy

Table 6 reports the coefficient estimates from the cash-holding regressions. The dependent variable is cash scaled by total assets. Country-level volatility is defined as the standard deviation of average sales growth in one country. Sector-level volatility is defined as the standard deviation of average sales growth in one 2-digit Standard Industrial Classification (SIC) industry in one country. Firm-level volatility is defined as the standard deviation of firm-level sales growth. In columns 1–2, the sample of only U.S. companies is used in the analysis. In columns 3–6, the full sample is used. FINANCIAL_DEVELOPMENT is stock market capitalization per gross domestic product (GDP). MANUFACTURING_DUMMY is equal to 1 if the firm is in the manufacturing industries (SIC codes 2000–3999), and 0 otherwise. HIGH_TECH_DUMMY is equal to 1 if the firm is in the high-tech industry according to the American Electronics Association, and 0 otherwise. SIZE_QUINTILE is constructed from the cross-country distribution of total assets. Other firm characteristics are leverage (total liabilities scaled by total assets), dividend dummy (a dummy equal to 1 if the firm pays dividends and 0 otherwise), capital expenditures scaled by total assets, acquisitions scaled by total assets, R&D scaled by total assets, and Tobin's *Q* (market capitalization scaled by total assets). These firm characteristics are from WorldScope and lagged by 1 year. Also estimated but not reported are the time fixed effects. *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	U.S. Sample			International Sample		
Variable	Industry-Level Volatility	Firm-Level Volatility	Country-Level Volatility	Industry-Level Volatility	Firm-Level Volatility	Firm-Level Volatility
	1	2	3	4	5	6
Volatility	0.048 (4.31)***	0.042 (23.70)***	−0.028 (2.05)**	−0.039 (2.36)**	0.034 (5.57)***	0.016 (3.60)***
FINANCIAL_DEVELOPMENT			0.005 (2.48)**	0.006 (3.48)***	0.006 (3.38)***	0.004 (3.54)***
MANUFACTURING_DUMMY	−0.009 (6.30)***	0.002 (1.97)**	−0.022 (4.82)***	−0.023 (5.10)***	−0.014 (2.78)***	−0.012 (2.63)***
HIGH_TECH_DUMMY	0.072 (43.93)***	0.076 (52.84)***	0.066 (11.68)***	0.064 (12.93)***	0.068 (12.17)***	0.057 (9.71)***
SIZE_QUINTILE	−0.059 (98.09)***	−0.032 (57.40)***	−0.028 (4.68)***	−0.027 (4.31)***	−0.014 (2.78)***	−0.011 (2.68)***
Other firm characteristics						Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.15	0.15	0.11	0.11	0.11	0.15
No. of obs.	93,389	80,455	496,815	496,082	460,073	294,991

volatilities appear to hold less cash. We argue that these counterintuitive results arise because countries with low aggregate volatilities generally have higher firm-level risk. In column 5, we use firm-level volatility as a proxy for risk. The coefficient on firm-level volatility is estimated at 0.034 with a *t*-statistic of 5.57.[22] A 1-standard-deviation increase in firm-level volatility is associated with a 2% increase in cash holding. This estimate is large relative to the median cash holding of 6% in our sample. This finding confirms that the cross-country (inverse) relation between aggregate and firm-level risk drives the results in columns 3 and 4.

Our findings highlight that the distinction between aggregate and firm-level risks has a crucial implication for the study of international cash holding. Sector- and country-level volatilities should not be used as a proxy for firm-level risk in a cross-country context. The misspecification not only underestimates the effect of risk on cash holding but the negative correlations between aggregate and firm-level volatilities also lead to a coefficient estimate with the incorrect sign.

[22]Pinkowitz et al. (2016) use the propensity score matching method to show that cash holding of U.S. firms does not differ from cash holdings of foreign firms after matching U.S. firms with foreign firms by firm-level volatility and a number of other firm characteristics. Consistent with their results, we show that firm-level risk alone already explains a quarter of the international differences in cash holding. Comparing our cash-holding regressions in column 4 of Panel A in Table 5 and column 5 of Table 6, the coefficient on FINANCIAL_DEVELOPMENT drops from 0.008 to 0.006 after controlling for firm-level volatility.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

In column 6 of Table 6, we add the firm characteristics to the cash-holding regressions with firm-level volatilities.[23] The coefficient on firm-level volatility remains large. Column 6 confirms that cash holding increases with firm-level volatility. Even after we control for the arguably endogenous firm-level variables, firm-level volatility is still statistically significant.

VIII. Additional Results

In this section, we present additional tests on sensitivity to investment opportunities and alternative measures of financial development and firm-level risk. We also perform robustness checks on alternative sample period and country coverage.

A. Sensitivity to Investment Opportunities

Here, we examine how firm investment responds to growth opportunities, proxied by industry Tobin's Q. Well-developed financial markets should allow firms with good opportunities to finance their growth, even when they are financially constrained. However, firms in undeveloped countries have limited access to external capital markets and may not be able to take advantage of investment opportunities.

Based on the approach in Bekaert, Harvey, Lundblad, and Siegel (2007), we construct local growth opportunities and global growth opportunities from industry aggregate market valuation. In each year, we define GLOBAL_INVESTMENT_OPPORTUNITIES as the average Tobin's Q across all firms in one 2-digit SIC industry in all countries and define LOCAL_INVESTMENT_OPPORTUNITIES as the average Tobin's Q across all firms in one 2-digit SIC industry in one country. Then, we interact these growth opportunities with FINANCIAL_DEVELOPMENT_INDICATOR, controlling for country, industry, and time fixed effects. The results are reported in Table 7.

We find that investment is more responsive to growth opportunities in developed countries. The coefficients on the average Tobin's Q and its interaction with FINANCIAL_DEVELOPMENT are positive and significant. A comparison of the average Tobin's Q coefficient and the interaction coefficient implies that the firms in developed countries are 25% (41%) more responsive to global (local) investment opportunities relative to firms in underdeveloped countries. This result confirms the importance of financial development on firms' ability to benefit from arising opportunities.

[23] Following other studies on the determinants of cash holding, we include 1-year lagged leverage (total liabilities scaled by total assets), dividend dummy (a dummy equal to 1 if the firm pays dividends and 0 otherwise), capital expenditures scaled by total assets, acquisitions scaled by total assets, R&D scaled by total assets, and Tobin's Q (market capitalization scaled by total assets) as explanatory variables. These additional data are from WorldScope. We find that firms with lower leverage, dividend, capital expenditure, and acquisitions hold more cash, as do firms with more R&D and higher Tobin's Q. The signs and magnitudes of the coefficients on firm characteristics are consistent with prior research. For brevity, the coefficients on these additional characteristics are not tabulated.

TABLE 7
Sensitivity to Investment Opportunities

Table 7 reports the coefficient estimates from the firm investment regressions. The dependent variable is INVESTMENT, defined as additions to fixed assets scaled by lagged fixed assets. The key explanatory variables are INVESTMENT_OPPORTUNITIES and its interaction with FINANCIAL_DEVELOPMENT_INDICATOR. FINANCIAL_DEVELOPMENT_INDICATOR takes the value of 1 if the country's financial development score is above or equal to the median, and 0 otherwise. GLOBAL_INVESTMENT_OPPORTUNITIES is defined as the average Tobin's *Q* across all firms in one 2-digit Standard Industrial Classification (SIC) industry in all countries. LOCAL_INVESTMENT_OPPORTUNITIES is defined as the average Tobin's *Q* across all firms in one 2-digit SIC industry in one country. INVESTMENT_OPPORTUNITIES refers to GLOBAL_INVESTMENT_OPPORTUNITIES in columns 1–2 and LOCAL_INVESTMENT_OPPORTUNITIES in columns 3–4. Also estimated but not reported are the country, industry, and time fixed effects. *t*-statistics are given in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	GLOBAL INVESTMENT OPPORTUNITIES		LOCAL INVESTMENT OPPORTUNITIES	
Variable	1	2	3	4
INVESTMENT_OPPORTUNITIES	0.187 (10.89)***	0.152 (9.27)***	0.054 (9.61)***	0.039 (6.25)***
FINANCIAL_DEVELOPMENT_INDICATOR × INVESTMENT_OPPORTUNITIES		0.038 (4.23)***		0.016 (2.01)**
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
R^2	0.03	0.03	0.03	0.03
No. of obs.	685,689	611,576	679,804	607,976

B. Alternative Measures

1. Alternative Country Measure

Given our focus on capital-market imperfections, the main country measure in this article is the financial development score (market capitalization per GDP), based on Rajan and Zingales (1998). To ensure that our results are not tied to this specific institutional measure, we examine an alternative measure that has been found to be associated with a well-functioning financial market. Here, we adopt a broad measure of institutional development: per capita GDP from the World Bank's WDI database.[24] In columns 1–3 of Panel A in Table 8, we replace Rajan and Zingales's (1998) financial development score with PER_CAPITA_GDP and re-estimate equation (1). Given that the cross-country distribution of GDP is highly skewed, we transform the raw GDP numbers into five quintile indicators before including them in the regressions. We find that firm-level volatilities increase with the level of income. The coefficients on PER_CAPITA_GDP are positive in all three columns. In columns 1–3 of Panel B in Table 8, we re-estimate equation (5) with GDP indicator as an alternative measure for financial development indicator. All the interaction coefficients are positive and significant, suggesting that the volatility difference between countries with high and low per capita GDP is more pronounced in industries dependent on external finance, similar to prior results on financial development.

[24] In addition to per capita GDP, we examine McLean et al.'s (2012) resource allocation efficiency measures, the Ease of Doing Business rank from the World Bank Doing Business indicator, and additional institutional variables from La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998). We confirm that better institutions in general lead to higher firm-level volatilities.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

TABLE 8
Robustness Tests

Table 8 reports the coefficient estimates from the firm-level volatility regressions. In columns 1–3 of Panels A and B, we use the quintile of per capita GDP (PER_CAPITA_GDP) as an alternative measure of financial development. In columns 4–6, the dependent variables are volatilities (the time-series standard deviation) of employment growth, Tobin's *Q* growth, and profit level (earnings before interest, taxes, depreciation, and amortization (EBITDA) scaled by total assets). EMPLOYMENT is the number of employees. In Panels B and D, the main explanatory variable is the interaction term between FINANCIAL_DEVELOPMENT_INDICATOR and EXTERNAL_FINANCE_DEPENDENCE. FINANCIAL_DEVELOPMENT_INDICATOR takes the value of 1 if the country's financial development score is above or equal to the median, and 0 otherwise. EXTERNAL_FINANCE_DEPENDENCE is the median fraction of capital expenditures that is not financed with cash flow from operations of U.S. firms from Rajan and Zingales (1998). In Panels C and D, FINANCIAL_DEVELOPMENT is stock market capitalization per gross domestic product (GDP), and in Panel C the explanatory variables are FINANCIAL_DEVELOPMENT, MANUFACTURING_DUMMY, HIGH_TECH_DUMMY, and SIZE_QUINTILE. MANUFACTURING_DUMMY is equal to 1 if the firm is in the manufacturing industries (Standard Industrial Classification (SIC) codes 2000–3999), and 0 otherwise. HIGH_TECH_DUMMY is equal to 1 if the firm is in the high-tech industry according to the American Electronics Association, and 0 otherwise. SIZE_QUINTILE is constructed from the cross-country distribution of total assets. In Panels C and D, the dependent variables are the volatilities of sales, total assets, and profit. Volatility is defined as the time-series standard deviation of the firm's annual growth rate. In columns 1–3, volatilities are computed from the subsample of countries with complete coverage. In columns 4–6, volatilities are computed without the global crisis years (2008–2010). Per capita GDP and stock market capitalization per GDP are from the World Development Indicators database; all other firm characteristics are from WorldScope. Also estimated but not reported are the time fixed effects and, in Panels B and D, the country and industry fixed effects. *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Alternative Measures of Financial Development and Volatilities

	Alternative Country Measure (GDP)			Alternative Volatility Measures		
	SALES	ASSETS	PROFIT	EMPLOYMENT	TOBINS_Q	PROFIT (level)
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT	0.022	0.039	0.015	0.030	0.033	0.020
	(1.46)	(5.38)***	(2.15)**	(4.94)***	(2.72)***	(1.84)*
MANUFACTURING_DUMMY	−0.080	−0.087	−0.006	−0.051	−0.106	−0.044
	(6.01)***	(9.74)***	(0.65)	(8.57)***	(6.39)***	(6.37)***
HIGH_TECH_DUMMY	−0.005	0.052	0.031	0.010	0.060	0.059
	(0.23)	(3.96)***	(2.26)**	(1.54)	(2.77)***	(4.40)***
SIZE_QUINTILE	−0.108	−0.129	−0.056	−0.049	−0.148	−0.110
	(7.42)***	(6.34)***	(6.95)***	(7.20)***	(5.17)***	(5.05)***
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.13	0.19	0.04	0.08	0.14	0.17
No. of obs.	101,520	108,207	79,227	79,963	93,382	110,995

Panel B. Market Imperfection and Alternative Measures of Financial Development and Volatilities

	Alternative Country Measure (GDP)			Alternative Volatility Measures		
	SALES	ASSETS	PROFIT	EMPLOYMENT	TOBINS_Q	PROFIT (level)
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT_ INDICATOR × EXTERNAL_ FINANCE_DEPENDENCE	0.201	0.162	0.114	0.032	0.206	0.186
	(6.43)***	(5.68)***	(4.38)***	(3.08)***	(6.23)***	(10.40)***
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.10	0.15	0.05	0.08	0.16	0.16
No. of obs.	53,025	54,763	42,489	42,708	47,653	56,299

Panel C. Alternative Country Coverage and Sample Period

	Countries with Complete Coverage			Without Crisis Period		
	SALES	ASSETS	PROFIT	SALES	ASSETS	PROFIT
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT	0.024	0.020	0.019	0.023	0.019	0.020
	(2.57)**	(2.21)**	(2.99)***	(3.26)***	(2.12)**	(3.81)***
MANUFACTURING_DUMMY	−0.081	−0.096	−0.003	−0.079	−0.090	−0.009
	(4.37)***	(9.25)***	(0.30)	(4.82)***	(10.32)***	(1.02)
HIGH_TECH_DUMMY	0.003	0.061	0.040	0.013	0.074	0.041
	(0.16)	(4.26)***	(2.85)***	(0.61)	(5.31)***	(2.75)***
SIZE_QUINTILE	−0.115	−0.142	−0.056	−0.108	−0.129	−0.056
	(6.50)***	(6.26)***	(6.35)***	(6.79)***	(6.61)***	(6.55)***
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.13	0.18	0.04	0.12	0.17	0.03
No. of obs.	90,686	97,083	70,107	95,228	101,020	73,748

(continued on next page)

TABLE 8 (continued)
Robustness Tests

Panel D. Market Imperfection and Alternative Country Coverage and Sample Period

	Countries with Complete Coverage			Without Crisis Period		
	SALES	ASSETS	PROFIT	SALES	ASSETS	PROFIT
Variable	1	2	3	4	5	6
FINANCIAL_DEVELOPMENT_INDICATOR × EXTERNAL_FINANCE_DEPENDENCE	0.226 (9.76)***	0.184 (5.99)***	0.103 (3.74)***	0.245 (8.43)***	0.213 (8.79)***	0.117 (3.43)***
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.10	0.15	0.06	0.09	0.15	0.04
No. of obs.	46,286	47,873	36,710	49,801	51,283	39,472

2. Alternative Volatility Measures

Given our focus on the operational side of the firm, the main dependent variables in this article are the volatilities of sales, assets, and profit growth. Here, we examine alternative definitions of volatilities.

In columns 4–6 of Panels A and B in Table 8, we re-estimate equations (1) and (5) using volatilities of employment growth, Tobin's Q growth, and level of profit (EBITDA scaled by total assets) as dependent variables. Studying employment growth alleviates the concern that our results are driven by international differences in accounting-data quality because the employment numbers are arguably more difficult to manipulate. Studying Tobin's Q growth (i.e., change in firm valuation) links our results back to the literature on stock return volatilities. Studying the level of profit ensures that our results are not specific to the growth-rate formulation. In addition, percentage growth (log difference) in profit is not defined when earnings are less than 0. So observations with negative earnings are automatically omitted from the calculation of profit growth volatilities. Using the level of profit instead of profit growth solves this problem. Across these three new measures, we still find that the financial development coefficients in Panel A and the interaction coefficients in Panel B are all positive and statistically significant.[25,26]

[25] Additionally, we perform a number of other untabulated robustness checks: i) One might be concerned that firms with high average growth rates will automatically have high volatilities, so we scale volatilities by means before running the regressions. ii) We use firm characteristics denominated in U.S. dollars. To address the concern that our results are driven by exchange rate movements, we examine firm-level risk in local currencies. iii) Another concern is that fundamentals of firms in emerging markets are in fact volatile, but their financial statements do not reflect the true fundamentals. To alleviate this concern, we subtract increase in accounts receivable from sales growth to eliminate the possibility of credit sales manipulation. Our results are robust across all alternative measures of volatility.

[26] While both sales and profit volatilities are higher in financially developed countries, we find no evidence that operating leverage increases with financial development. These results indicate that profit is more volatile in financially developed countries because sales are more volatile, not because high operating leverage magnifies the fluctuation in sales.

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

C. Alternative Samples

1. Alternative Country Coverage

To address the concern that our sample might be biased (since WorldScope coverage is uneven across countries), we examine the subsample of countries for which coverage is more complete. Here, we only include countries in which WorldScope targets all domestic listed companies according to its current data guide (issue 14.2).[27] The results are reported in columns 1–3 of Panels C and D in Table 8. Both the financial development coefficients and the interaction coefficients are still positive and statistically significant.[28]

2. Alternative Sample Period

Given that we find greater firm-level risk in financially developed countries, a concern is whether we underestimate the downside risk (distributional asymmetry arising from financial crises) in developing countries. An advantage of our main sample period (1980–2016) is that it covers multiple crisis episodes in the emerging world, including the 1994 Tequila Crisis, 1997 Asian Crisis, 1998 Russian Crisis, 1999 Argentine Crisis, and 2000 Turkish Crisis. It is unlikely that we underestimate the downside risk of developing countries relative to developed countries.

To address the concern that our sample period covers the subprime crisis in the United States and the debt crisis in Europe, which may increase firm-level risk in developed world, columns 4–6 of Panels C and D in Table 8 report the results when we exclude 2008–2010 from the calculation of volatilities.[29] The results are close to the main results in Panel A of Table 2 and in Table 4. Additionally, we also examine cross-sectional dispersions year by year. We still find that cross-sectional dispersions are generally higher in financially developed countries.

IX. Conclusion

While developing economies are more volatile, this article shows that firms in developed countries have higher operating risk. Firm-level growth rates in assets, sales, and profit are more volatile in developed countries. The cross-sectional dispersions of these variables also increase with financial development.

Firm-level risk is influenced by imperfections in capital markets, as these imperfections can insulate incumbent firms from risk because they reduce the ability

[27] This subsample covers Argentina, Australia, Austria, Bahrain, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Indonesia, Ireland, Italy, Japan, Jordan, Kuwait, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Norway, Oman, Philippines, Poland, Portugal, Qatar, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, United Arab Emirates, United Kingdom, United States, and Vietnam. While the current coverage of these countries should be exhaustive, we acknowledge that their historical coverage might not be complete.

[28] We also examine the subsample without the United States. We still find that firms in developed countries are more volatile than firms in undeveloped countries, and the cross-country difference is more pronounced in industries dependent on external finance.

[29] We also examine an alternative crisis period. Given that the European debt crisis lasted longer than the U.S. subprime crisis, we exclude all observations from 2008 to 2013 and re-estimate columns 4–6 of Panels C and D in Table 8. The coefficient on FINANCIAL_DEVELOPMENT and the coefficient on the interaction term are still positive and significant.

of competitors to contest product markets by aggressive investment. Consistent with this notion, we find that the intensity of product-market competition is higher in developed economies. The cross-country differences in firm-level volatilities and competition are also more pronounced in industries dependent on external finance. These are the industries in which we expect capital-market imperfections to have larger impacts.

The results in this article advance our understanding of comparative volatilities and international cash policies. Prior studies almost unanimously show that aggregate volatility is greater in the developing world. Paradoxically, we find that firm-level risk in developing countries is lower, even though the industry and macrorisks in those countries are higher. Thus, differences in firms' cash policies across countries are not only a direct effect of differences in access to financial markets but also occur because firms in those countries, especially firms in financially dependent industries, face lower competitive risk as an indirect result of capital-market imperfections.

More broadly, we show that cross-country differences in operating risk are an important factor that must be considered if we are to understand the effects of institutional factors such as agency costs, taxes, and capital-market development. Our results suggest that as economic institutions in developing countries strengthen, there will be increases in firm-level operating volatility. This increase will put additional pressure on corporate governance in these countries and will require adjustments to financial policies and governance structures.

Appendix. Variable Definitions

The names and definitions of the main variables used in the article are listed below. We winsorize all firm-level variables, including firm-level volatilities, at the 1% level. Unless noted otherwise, all characteristics are from WorldScope.

Risk Measures

Firm-level volatility: Time-series standard deviation of firm annual growth rates. The firm growth rate, $G_{i,t}$, is $\ln(X_{i,t}) - \ln(X_{i,t-1})$, where X_i represents net sales, total assets, and profit of firm i.

Cross-sectional dispersion: Cross-sectional standard deviation of firm annual growth rates in each country. The firm growth rate, $G_{i,t}$, is $\ln(X_{i,t}) - \ln(X_{i,t-1})$, where X_i represents net sales, total assets, and profit of firm i.

Country-level volatility: Time-series standard deviation of country annual growth rates. For equal-weighted volatilities, country growth rate is the average firm growth rate ($G_{i,t}$) across all firms in each country. The firm growth rate, $G_{i,t}$, is $\ln(X_{i,t}) - \ln(X_{i,t-1})$, where X_i represents net sales, total assets, and profit of firm i. For value-weighted volatilities, we first sum sales, assets, or profit ($X_{i,t}$) across all firms in each country and then define country growth rate as the growth rate of the aggregate.

Industry-level volatility: Time-series standard deviation of industry annual growth rates. For equal-weighted volatilities, industry growth rate is the average firm growth rates ($G_{i,t}$) across all firms in each 2-digit Standard Industrial Classification (SIC) industry in each country. The firm growth rate, $G_{i,t}$, is $\ln(X_{i,t}) - \ln(X_{i,t-1})$, where X_i represents net sales, total assets, and profit of firm i. For value-weighted volatilities, we first sum sales, assets, or profit ($X_{i,t}$) across all firms in each 2-digit

https://doi.org/10.1017/S002210901800159X Published online by Cambridge University Press

SIC industry in each country and then define industry growth rate as the growth rate of the aggregate.

SALES: Net sales.

ASSETS: Total assets.

PROFIT: earnings before interest, taxes, depreciation, and amortization (EBITDA).

EMPLOYMENT: Number of a firm's employees.

Competition Measures or Firm Policies

PROFIT (level): EBITDA scaled by total assets.

AGE: Year t minus the year company was founded.

INVESTMENT: Additions to fixed assets scaled by lagged fixed assets.

CASH: Cash scaled by total assets.

HHI: Herfindahl–Hirschman index computed from sales in each country, 2-digit SIC industry, and year. That is, $\text{HHI} = \sum_j (\text{SHARE}_j^2)$, where SHARE_j is the market share of firm j and HHI ranges from 0 to 1.

ISSUANCE: The number of equity offerings from Dealogic scaled by the number of firms in each country, 2-digit SIC industry, and year.

Explanatory Variables

FINANCIAL_DEVELOPMENT: Market capitalization of listed domestic companies scaled by gross domestic product from the World Development Indicator Database.

PER_CAPITA_GDP: the quintile of per capita GDP from the World Development Indicator Database.

MANUFACTURING_DUMMY: A dummy equal to 1 if the firm has an SIC code of 2000–3999 according to Aguiar and Gopinath (2005), and 0 otherwise.

MANUFACTURING_FRACTION: Fraction of manufacturing firms in a sector.

HIGH_TECH_DUMMY: A dummy equal to 1 if the firm is in what the American Electronics Association identifies as a high-tech industry (comprising 47 4-digit SIC codes in the 2-digit industries 28, 35, 36, 38, 48, and 73), and 0 otherwise.

HIGH_TECH_FRACTION: Fraction of high-tech firms in a sector.

SIZE: Total assets in millions of U.S. dollars.

SIZE_QUINTILE: The quintile of firm size constructed from the cross-country distribution of total assets.

EXTERNAL_FINANCE_DEPENDENCE: A proxy of each industry's optimal level of external financing from Rajan and Zingales (1998): Median fraction of capital expenditures that is not financed with cash flow from operations of U.S. firms over the 1980s.

ECONOMIES_OF_SCALE_DEPENDENCE: A proxy of each industry's "natural" or "technological" size distribution of firms based on Beck et al. (2008): An industry's share of employment in firms with greater than 20 employees in the United States and is obtained from the 1992 Census.

ASSET_TANGIBILITY: Tangible assets scaled by total assets.

LEVERAGE: Total liabilities scaled by total assets.

SHORT_TERM_DEBTS: Current liabilities scaled by total liabilities.

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CLOSELY_HELD_SHARES: Average fraction of shares that are closely held in each country.

GLOBAL_INVESTMENT_OPPORTUNITIES: Average Tobin's Q across all firms in one 2-digit Standard Industrial Classification (SIC) industry in all countries.

LOCAL_INVESTMENT_OPPORTUNITIES: Average Tobin's Q across all firms in one 2-digit SIC industry in one country.

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