Industry Shocks, Operating Risk, and Corporate Financial Policies around the World

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Abstract

Although developing economies are more volatile, firms in developed countries hold more cash and less debt. We show that despite greater aggregate and industry stability, the performance and balance sheets of individual firms in developed countries are more volatile. In developing countries, market imperfections insulate incumbent firms from competitive risk. Cross-country differences in firm rivalry and cash flow risk are greater in technology-intensive, external-finance-dependent, and large-firm-dominated industries where we expect greater market imperfections. Firms in developed countries are more sensitive to shocks. Most of the adjustments come from cash balance. We propose product market competition as a new channel in which market imperfections can drive the international difference in financial policies.

JEL Classification: G15, G31, G32

Key Words: International Cash Holding, International Capital Structure, Firm Risk, Volatility, Financial Development

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1. Introduction

The financial policies of firms in developed and developing countries differ greatly. Although some dissimilarities can be explained by cross-country differences in legal and political institutions, trade patterns, and access to financial markets, others remain puzzling. Thus, although in the aggregate and industry levels developing economies are more volatile, firms in developed countries appear to have more conservative liquidity and capital structure policies (more cash, lower leverage, and fewer short-term liabilities). For instance, average cash holding scaled by total assets is 25% in Australia and 21% in the U.S. while an average Indian and Russian firm only holds 6.8% and 8.8% in cash, respectively.[1]

The higher cash holdings in developed countries are, at first sight, perplexing, in view of the widespread perception that that developing economies are risker than are those in developed economies. Starting with the 1988 work of Robert E. Lucas, numerous authors have shown that developed countries tend to exhibit stable output growth over extended periods of time, while developing countries are more prone to sharp fluctuations and frequent financial crises.[2]

At the industry level, prior studies have shown that poor institutions make financially dependent industries in developing countries more volatile and more vulnerable to recessions. As a result, it would be natural to assume that firms in developing countries are riskier and that they adopt more conservative financial policies to address the higher risk. In this paper, we show 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.[3]

We first show that firms in developed countries have higher risk. Firm-level growth rates in assets, cash, debts, short-term liabilities, sales, profit, and employment are more volatile in developed countries. The cross-sectional dispersions of these variables are also higher in developed countries. However, we find completely opposite firm-level results at the aggregate levels. After being averaged across firms, we find that the sector- and country-level growth rates are less volatile in developed countries.

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[1] See Table 1 for details.

[2] See, for example, Lucas (1988), Acemoglu, Johnson, Robinson, and Thaicharoen (2003); Prasad, Rogoff, Wei, and Kose (2006); Aguiar and Gopinath (2007); and Koren and Tenreyro (2007).

[3] We further argue that our finding (that firm-level risk is greater in developed countries) does not contradict the aggregate results in prior literature that industries and economies in the developed world are less volatile (e.g., Raddatz (2006) and Braun and Larrain (2005)). We present a model in which a well-functioning financial system that promptly reallocates capital to the most productive use can pose risk to individual companies but achieve aggregate stability at the same time. We indeed document an inverse relation between aggregate volatilities and firm-level volatilities in our WorldScope sample.

We propose that firm-level volatilities in developing countries are lower due to imperfections in capital and product markets. We show that the cross-country difference in operating risk is more pronounced in those industries where we expect a higher degree of market imperfections. The difference in firm-level volatilities is greater in technology-intensive, external-finance-dependent, and large-firm-dominated industries. We also show that in one important source of risk, intensity of competition, the differences between developing and developed countries are also greater in those industries. These findings are consistent with the notion that market imperfections act to insulate incumbent firms from risk.

We link financial policies to risk by examining how firms react to exogenous shocks. Using productivity data from the United Nations Industrial Development Organization (UNIDO) database, we find that firm-level growth rates in assets, cash, debts, short-term liabilities, sales, and profit are more responsive to shocks in developed countries. Among all types of assets and liabilities, most of the adjustments come from cash balance. Our results suggest that firms devise financial policies to accommodate their firm-level risk.

There are many studies on the cross-country determinants of a firm's capital structure. Rajan and Zingales (1995); Demirguc-Kunt and Maksimovic (1996, 1998); Booth, Aivazian, Demirguc-Kunt, and Maksimovic (2001); and Giannetti (2003) examine the way in which institutional environment affects capital structure in different countries. Although the current literature focuses on the direct effects of market imperfections such as agency costs, taxes, and limited access to financial markets, this paper shows that market imperfections can also affect financial policies indirectly through product market competition. Financial policies may differ across countries because the nature of product markets is different. It might be rational for firms in developing countries to hold less cash and have higher leverage because they have lower competitive risk.

Recent papers on international capital structure focus on specific components of firm liabilities, such as line of credit (Lins, Servaes, and Tufano, 2010), trade credit (Klapper, Laeven, and Rajan, 2012), short- and long-term debts (Demirguc-Kunt and Maksimovic 1999; Fan, Titman, and Twite, 2012), and foreign debt (Allayannis, Brown, and Klapper, 2003). Other related papers study international patterns of security issuances (Miller and Reisel, 2012; Doidge, Karolyi, and Stulz, 2013; Gullapalli, 2013) and equity ownership (Lemmon and Lins, 2003; Lins, 2003; Laeven and Levine, 2007). We contribute to this literature by showing that the cross-country difference in product market risk is an important factor that must be taken into consideration.

Most prior international papers on cash and leverage use panel or cross-sectional regressions. In effect, these papers study the equilibrium financial structures. In this paper, we also examine firm's reaction to productivity shocks. Examining the way in which firms adjust their cash and other financial structures in response to exogenous shocks directly tests our risk-based explanation.[4] Moreover, while existing papers tend to study capital structure or cash in

[4] Existing papers analyze the dynamic patterns of investment in fixed assets across countries. McLean, Zhang, and Zhao (2012) examine the investment's sensitivity to Tobin's Q and cash flows at the firm-level. Love (2003) estimates an investment Euler equation linking capital expenditure to lagged investment, sales, and financial

isolation, we analyze leverage and all other major components of firm assets and liabilities at the same time. Given that operating risk is likely to affect many components of financial structures simultaneously, it is appropriate to investigate several financial policies at the same time.

Studies of cash holdings across countries show that firms in rich countries hold more cash, but firms in poor countries hold more fixed assets. Caprio, Faccio, and McConnell (2012) suggest that cash can easily be expropriated by politicians and bureaucrats. Therefore, firms in poor 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. They explain that cash holding can reduce transaction costs. Hence, firms in countries with higher cost of labor hold more cash.[5] Lins and Kalcheva (2007), and also Pinkowitz, Stulz, and Williamson (2006), study the value implications of cash holdings. These studies both suggest that corporate cash holdings are less valuable in countries with weak shareholders protection. In Section 8, we discuss how our explanation complements these studies and verify that the operating risk mechanism we proposed is not confounded with existing explanations.[6]

Our paper is also related to 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 (2011) suggest that institutional variables such as investor protection and stock market development can explain cross-country differences in return volatilities. McLean, Pontiff, and Zhao (2011) show that equity market liberalization is associated with changes in stock return and fundamental volatilities. Since return volatilities are computed from stock prices, they are driven both by real factors such as cash flow risk, and financial factors such as noise trading. In this paper, we focus on real factors by studying volatilities of the growth in real variables: assets, cash, debts, short-term liabilities, sales, profit, and employment. More importantly, we take a step further to identify the sources of risk. We hypothesize that international differences in firm-level risk come from capital and product market

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constraints. Wurgler (2000) uses the UNIDO Database to study how industry-level capital formation responds to productivity shocks, as measured by value added. In this paper, we study how firm-level asset and liability structures respond to exogenous productivity shocks from UNIDO.

[5] According to Pinkowitz, Stulz, and Williamson (2003), "With the transaction motive, firms hold cash to economize on the costs of transacting. The transaction motive is a 'shoe leather' theory of money demand: it is cheaper to hold cash than to send somebody to the bank. As a result, cash holdings increase with the cost of labor" (p.3).

[6] There is a large literature on the cash holding of firms in the United States. See, for example, Faulkender and Wang (2006); Fresard (2010); Gamba and Triantis (2008); Gao, Harford, and Li (2013); and Harford, Mansi, and Maxwell (2008). Our paper shows that precautionary demand for cash differs across countries due to the varying degrees of market imperfections.

imperfections. We show that the volatilities are more different in industries in which we expect a higher degree of market imperfections (technology-intensive, external-finance-dependent, and large-firm-dominated industries).

The paper is organized as follows. In Section 2 we outline the conceptual framework. In Section 3 we present our data sources and sample construction. In Section 4 we examine the cross-country determinants of asset and liability structures, and in Section 5 the cross-country determinants of firm-level risk. In Section 6 we analyze firm-level risk in different industries, and in Section 7 firms' response to productivity shocks. Section 8 presents additional tests, and Section 9 concludes. We report most robustness checks in Internet Appendix A and propose a stylized model of real volatilities in Internet Appendix B.

2. Framework

Empirical Framework and Key Findings

The paper is structured (1) to document an important puzzle about financial policies of firms in different countries, (2) to propose firm-level risk as a potential explanation, (3) to identify what drive the cross-country difference in firm-level risk, and (4) to examine how financial structures react to exogenous productivity shocks. More precisely, we answer four related questions below:

1. Are asset and liability structures different across countries?

To answer this question we first compare financial structures of firms in developed and developing countries. We study the cross-country difference in cash holdings, intangible assets, total liabilities, and short-term liabilities. We scale these variables by total assets and regress them on country dummies or other institutional factors such as Per Capita GDP and financial development indicators, controlling for size quintile, industry, and year fixed-effects.

We find that firms in developed countries, in high-tech industries and for firms that are smaller, hold more cash while firms in manufacturing industries hold less cash. Firms in rich countries also have lower leverage, use fewer short-term liabilities, and have higher current ratios. We find that firms in rich countries have more conservative financial structures.[7]

2. Is firm-level risk different across countries?

[7] To address the concern that observations in developed and developing countries are not comparable because firms in different countries decide to go public at different stages in their life cycles, we also control for age and relative size. Our results still hold. In Section 6, we also study market shares among industry leaders (the largest two firms in each industry). In this subsample of well-established companies, we still find that market shares are less volatile in developing countries. Restricting our sample to industry leaders provides an alternative method for ensuring that our findings on risk are not driven by the inclusion of small firms in developed countries. In Section 8, we further control for a number of firm characteristics such as leverage, R&D, and Tobin's Q in the cash-holding regressions. We do not include these variables in the main regressions since they are potentially endogenous.

We examine whether performance and characteristics of individual firms are more volatile in certain countries. We compute the volatilities of firm-level growth rates in assets, cash holdings, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. To be consistent with our examination of asset and liability structures, we use reduced-form models, regressing our volatility measures on country dummies, and controlling for firm size and industry effects.

We find that firms in developed countries are more volatile. These volatilities are also higher in high-tech industries and among small firms, and lower in manufacturing industries. We also find that cross-sectional dispersions of performance and characteristics of individual firms are higher in developed countries.

For comparison purposes, we examine aggregate risk in different countries. We average the firm-level growth rates within each sector (based on 17 Fama-French industries) and within each country. We then compute the sector- and country-level volatilities. Opposite to the firm-level results, we find that the sector- and country-level volatilities are higher in developing countries. These findings are consistent with the widely-accepted view that developing economies are less stable.

3. What drives the difference in firm-level risk?

We examine whether the cross-country difference in firm-level risk is more pronounced in certain industries. We hypothesize that idiosyncratic risk is likely to be influenced by imperfections in product and capital markets, because these imperfections can insulate incumbent firms from risk. Detailed arguments are in the discussion below.

Following the difference-in-difference method in Rajan and Zingales (1998), we regress firm-level volatilities on country dummy, industry characteristics, and the interactions between the two, again controlling for firm size. We find that cross-country differences in firm-level volatilities are more pronounced in technology-intensive, financial-dependent, and large-firm-dominated industries. These are the industries where we expect the higher degree of market imperfections.

4. How do a firm's assets and liabilities change in response to exogenous productivity shocks?

We link cross-country differences in financial structure to the underlying firm-level risk by examining how firms react to real shocks. To avoid reverse causality, we measure productivity shocks as the growth rate of domestic value added, which we obtain from the UNIDO Industrial Statistics Database as opposed to Tobin's Q or cash flow shocks at the firm level. (Shocks to cash flows and Q can be driven by change in firm's financial policies.) We regress growth rates in assets, cash holdings, current assets, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment on these productivity shocks.

We find that firms in developed countries are more responsive to exogenous real shocks. Across all types of assets and liabilities, most of the adjustments come from cash balance. Our results suggest that firms devise financial policies to accommodate their firm-level risk.

We use a stylized model of real volatilities to illustrate how market imperfections in developing countries can lead to lower risk at the firm level but higher risk at the aggregate level. The details are presented in Internet Appendix B. In our model, the economy has two firms competing for limited supply of production resources. Firms receive random productivity shocks in each period. Initial endowment of production resources can be reallocated across firms in response to the productivity shocks. With a linear production function, the first best allocation from our model is to transfer all the resources from the losing (low-productivity) firm to the winning (high-productivity) firm.

The central assumption here is that goods and capital markets might be less than fully efficient. Specifically, we assume that it is costly to reallocate resources across firms. 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. These costs prevent the winning firm from expanding and the losing firm from contracting. We expect that these costs are larger in developing countries.[8]

Proposition 1 in Internet Appendix B states that output growth of firms in developed countries is more volatile. Firm-level volatility is decreasing in the degree of market imperfections. Proposition 2 states that output growth of firms in developed countries is more sensitive to productivity shocks. Output-to-shock sensitivity is decreasing in the degree of market imperfections. To prove these propositions, we first show that the amount of resources being reallocated from the losing firm to the winning firm is decreasing with the reallocation costs. Then, we prove that firm-level volatility (time-series standard deviation of output growth over a sample path) is increasing in the amount of resources being reallocated in each period. For Proposition 2, we define output-to-shock sensitivity as the beta coefficient from a regression whose dependent variable is output growth and explanatory variable is productivity shock, estimated over a sample path. We prove that this sensitivity estimate is increasing in the amount of resources being reallocated in each period. Thus, we expect that firms in countries with larger costs of reallocation across firms are subject to lower firm-level risk. Firms in developing countries where financial market imperfections do slow the reallocation of resources are subject to smaller volatility and are less sensitive to productivity shocks.

Our model predicts the inversion of firm-level and aggregate volatilities. Proposition 3 states that aggregate output growth is less volatile in developed countries. Aggregate volatility is increasing in the degree of market imperfections. The intuition of our proof is as follows. We decompose aggregate output into two components: output generated by the initial endowment (as if reallocation is not feasible) and gain from reallocation. The volatility in aggregate output comes from fluctuation in the first component. Without reallocation, aggregate output is high when the initial endowment is "right" (the firm with larger initial endowment receives higher productivity shock) and aggregate output is low when the initial endowment is "wrong" (the firm with the smaller initial endowment receive the higher productivity shock). The gain from reallocation is state invariant and increasing with the amount of resources being reallocated across firms. As the reallocation costs decrease, the amount of resources

[8] In the extreme case where the costs associated with market imperfections are infinitely large, firms always produce with their initial endowment. In a case where these costs are positive but not infinitely large, firms partially respond to productivity shocks.

being reallocated and gain from reallocation increase. As the gain from the reallocation component grows, output generated by initial endowment as a fraction of aggregate output shrinks. Therefore, the aggregate volatility (which is driven by fluctuation in output generated by initial endowment) is increasing with the reallocation costs. In other words, we expect that developing economies where financial market imperfections impede resource reallocation are subject to higher aggregate volatility.

3. Data and Sample Construction

Here, we describe the data and present sample statistics at the country, industry, and individual firm levels. The sample statistics show that asset and financial structures characteristics differ between firms in developed and developing countries.

3.1 Firm-Level Data

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 of many recent studies on financial policies and investment (see Fan, Titman, and Twite (2012) and McLean, Zhang, and Zhao (2012)). We construct a 1988-2008 annual data set of all the public firms available in 46 countries (25 developed and 21 developing countries). Among the 46 countries, WorldScope provides full coverage of the listed firms in 31 countries, ten of which are developing countries. WorldScope also provides targeted coverage (all listed firms with the market capitalization higher than 100 million dollars) for 15 countries. Internet Appendix C lists these countries and their coverage.

A potential concern with WorldScope is that publicly 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, and firm age. We also use a full set of two-digit SIC industry fixed-effects. Internet Appendix A summarizes the robustness results. In Section 8, we further control for other firm characteristics: leverage, dividend, capital expenditure, acquisitions, R&D, and Tobin's Q. We confirm that our cross-country results are not driven by selection of firms along these observable dimensions.

We measure all variables in U.S. dollars. Following other studies, we exclude all financial firms and regulated utilities (primary SIC 4900 - 4999, 6000 - 6999, and above 9000). We also exclude all observations with zero or negative total assets. To ensure that our results are not driven by the difference 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.

We use six measures to study firm assets and liabilities structures: firm size (natural log of total assets), cash/total assets, intangible assets/total assets, total liabilities/total assets, short-term liabilities/total liabilities, and short-term liabilities/short-term assets. To reduce the possibility that our results may be driven by outliers or any mistakes in the original data set, we winsorize all the variables at 1%. In Table 1, Panel A reports the number of firm-year observations and average assets and liabilities structures country by country. Panel B compares asset and liability structures in developed and developing countries.

[INSERT TABLE 1 HERE]

From the size column in Table 1 Panel A, we see that firms in developed countries are slightly larger than are firms in developing countries. From Table 1, Panel B, firm size (the average natural log of total assets in US$) is 4.77 in developed countries and 4.75 in developing countries. Since WorldScope constructs its sample based on market capitalization, the size distribution of firms is not very different across countries. This finding means that the difference between developed and developing countries in our latter analysis is not likely to be driven by firm size.

Cash holdings vary greatly across countries. It is apparent that firms in rich countries hold more cash than do firms in poorer countries. For example, in Table 1, Panel A shows the countries with the lowest cash-to-total-assets ratios are Colombia (6.88%), India (6.8%), and Peru (6.17%). The countries with the highest cash-to-total-assets ratios are Australia (25.07%), Israel (25.51%), and the United States (21.18%). In Table 1, Panel B shows that firms in developed countries have an average cash-to-assets ratio of 18% and that firms in developing countries have the average cash-to-assets ratio of 11.94%. The 6.77% difference yields *t*-statistics of 82.79. These statistics are in line with the descriptive statistics in Caprio, Faccio, and McConnell (2012).

Intangible assets are also very different across countries. We find that firms in developed countries have more intangible assets relative to total assets. For example, in Table 1, Panel A shows that the countries with the lowest intangible-to-total-assets ratios are Brazil (1.83%), Indonesia (1.57%), and Venezuela (1.34%). The countries with the highest intangible-to-total-assets ratios are Ireland (14.19%), Sweden (15.79%), and the United States (15.24%). In Table 1, Panel B shows that firms in developed countries have an average intangible-to-total-assets ratio of 9.73%; firms in developing countries have average ratios of 3.38%. The 6.35% difference yields *t*-statistics of 98.74.

Leverage is relatively similar across countries, but maturity structures are very different. Leverage is slightly lower in developed countries. In Table 1, Panel B shows that the average total-liabilities-to-total-assets ratio is 26.08 in developed countries and 28.44 in developing countries. Firms in developing countries have much higher short-term liabilities relative to their total liabilities. For example, in Table 1, Panel A, we see that the countries with the highest short-term-to-total-liabilities ratios are China (80.13%), Malaysia (65.13%), and Turkey (68.22%). The countries with the lowest short-term-to-total-liabilities ratios are Finland (34.18%), Norway (27.99%), and Sweden (35.3%). The average short-term-liabilities ratio in the United States is 37.51%. In Table 1, Panel B shows that firms in developed countries have an average short-term-to-total-liabilities ratio of 46.42%, but firms in developing

countries have an average ratio of 61.27%. The -14.85% difference yield *t*-statistics of -100.86. These findings are consistent with Demirguc-Kunt and Maksimovic (1999) and Fan, Titman, and Twite (2012).

Our descriptive statistics and univariate analysis in Table 1 show that firms in developed and developing countries have drastically different asset and liability structures. Firms in developed countries seem to have more conservative financial policies (more cash, slightly lower leverage, and fewer short-term liabilities). Firms in developed countries also have more intangible assets relative to their total assets. Thus, the sample characteristics of our firms are in accord with earlier studies.

Next, we compute the growth rate of each firm financial structure (total assets, cash, intangible assets, total debts, and short-term liabilities) and the outcome variable (sales, profit, and employment). Growth rate is defined as the difference in natural log. We winsorize all of the original variables at 1% before computing the growth rates. Then we compute volatilities (time-series standard deviations) of the growth rates and use them as a measure of risk. In Table 2, Panel A reports the number of firms and firm-level risk country by country. Panel B reports the average firm-level risk in developed and developing countries. For comparison purposes, Panel C reports the average growth rates in developed and developing countries.

[INSERT TABLE 2 HERE]

In Table 2, Panel A shows that firms in developed countries are more volatile than are firms in developing countries. The difference in volatilities is present in all of the variables except intangible assets. For example, the countries with the most volatile sales growth are Australia (0.76), Canada (0.6), and Norway (0.55). The least volatile countries are mostly emerging markets. Developing countries with the least volatile sales growth are Colombia (0.23), Egypt (0.21), and Lithuania (0.17). We observe similar patterns for total assets, cash, profit, total liabilities, current liabilities, and employment.

In Table 2, Panel B shows that the univariate comparison confirms that firms in developed countries have higher firm-level risk. The average volatility of sales growth is 0.432 in developed countries and 0.388 in developing countries. The volatility of total assets is 0.436 in developed and 0.347 in developing countries. Cash-holding volatility is 1.113 in developed countries and 1.092 in developing countries. Profit volatility is 0.639 in developed countries and 0.593 in developing countries. Total liabilities volatility is 0.873 in developed countries and 0.718 in developing countries. Short-term liabilities volatility is 1.162 in developed countries and 0.97 in developing countries. Employment volatility is 0.317 in developed countries and 0.257 in developing countries. The differences between developed and developing countries are statistically significant at the 1% level for total assets, intangible assets, total debts, and short-term liabilities, sales, profit, and employment. The difference in volatilities of cash holding is statistically significant at 10%.

It is possible that firms with high average growth rates will automatically have high volatilities and that our volatilities difference is the by-product of growth rates difference. We report the average firm growth rates in developed and developing countries in Panel C of Table 2. It turns out that despite lower volatilities, firms in

developing countries have higher or similar average growth rates. In other words, if we measure firm-level risk as volatilities of firm growth scaled by average firm growth, the difference between developed and developing countries will be even larger than those presented here.

When we compare volatilities of different variables, we find that in the global average column in Table 2, Panel B, cash and short-term liabilities are more volatile compared to other components of firm financial structures. Intangible assets and total liabilities are less volatile. We estimate the average volatilities of cash holding and short-term liabilities growth at 1.107. The average volatility of intangible assets growth is 0.83 and that of total liabilities growth is 0.802. Among the outcome variables, profit growth is the most volatile; sales growth is the second, and employment growth is the least volatile. We estimate their average volatilities at 0.624, 0.419, and 0.304, respectively.

Our descriptive statistics and univariate analyses suggest that firms in developed and developing countries have different levels of real risks. Volatilities of sales, assets, cash holding, profit, total debts, current liabilities, and employment growth rates are higher in developed countries.

4.2 Industry-Level Data

To control for industry characteristics, we include two-digit SIC dummies in our regressions. When we analyze how industry characteristics affect our results, we replace the industry dummies with various industry indicators. The manufacturing dummy is equal to one if the firm is in SIC codes 2000-3999, which Aguiar and Gopinath (2005) define as tradable industries. The high-tech dummy is equal to one if the firm is in the high-tech industry according to the American Electronic Association. The external finance dependent indicator is from Rajan and Zingales (1998). The small-firm-dominated industry indicator is from Beck, Demirguc-Kunt, Laeven, and Levine (2008).

We construct a measure of foreign entry using mergers and acquisitions data from Thomson's Securities Data Corporation (SDC) database. Our sample covers all deals announced and completed between 1989 and 1998. To avoid reverse causality when we study the impacts of foreign entry on firm volatilities, we compute the measure of foreign entry from 1989-1998 data and compute the firm-level volatilities from the non-overlapping period of 1999-2008 (as opposed to the full 1989-2008 sample in other specifications). For each sector (one of the 17 Fama-French industries) in each country, we construct foreign entry by aggregating all inward cross-border M&As and scaling them by all (domestic and inward foreign) M&As during 1989-1998. We also compute the aggregate volume of all outward cross-border M&As scaled by the volume of all (domestic and outward foreign) M&As for a robustness check.

We use the UNIDO General Industrial Statistics database, INDSTAT-4 2011, to construct productivity shocks. This database reports gross fixed capital formation, value added, output, establishments, employment, fixed capital, and sales data for up to four-digit ISIC manufacturing industries. There are 127 ISIC industries in the data set. Following Wurgler (2000), we define productivity shock as the percentage change in value added. We also use percentage growth in domestic output and percentage growth in labor productivity (output per worker) as alternative

measures for productivity shocks. In each country and year, the shocks are constructed at the four-digit ISIC level. We match each firm in WorldScope to the ISIC industry (or industries) based on its primary SIC code.

3.3 Country-Level Data

We base our developed-country indicator on the World Bank's Atlas method classification. The developed-country dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. The list of all developed and developing countries is available in Internet Appendix C.[9]

Our alternative measure of country characteristic is 1980 per capital GDP from the World Bank's World Development Indicator (WDI) database. (All of our main results hold for contemporaneous GDP as well.) We choose the year 1980 to avoid reverse causality because our sample starts in 1988 and financial policies and firm-level risk may have contemporaneous effects on firm output as well as GDP. In Section 8's additional tests, we examine nine other alternatives for institutional variables– Judiciary Efficiency, Rule of Law, Corruption, Accounting Standard from La Porta et al. (1998), 1980 Stock Market Capitalization per GDP from Rajan and Zingales (1998), Ease of Doing Business Rank from the World Bank's doing business indicator[10], investment sensitivity, share issue sensitivity, and debt issue sensitivity to Tobin's Q from McLean, Zhang, and Zhao (2012).

4. Asset and Liability Structures

In this section, we examine whether country-level characteristics or industry characteristics explain the financial structures of firms in different countries. In addition to regressing the firm characteristics on the developed-country dummy variable, we include indicators for firm size and two industry classifications discussed above: whether the firm produces in an industry classified as manufacturing and whether it is in a high-tech industry. The manufacturing industry indicator picks up firms that are likely to have fixed assets that may serve as collateral. Similarly, firms in high-tech industries may be exposed to technological risks. Both may affect cash and the choice of financial structures. Our basic specification is:

$$Y_{i,t} = b_0 + b_1 \text{ Developed-Country Dummy}_i + b_2 \text{ Manufacturing Dummy}_i + b_3 \text{ High-Tech Dummy}_i + b_4 \text{ Size Quintile}_{i,t} + \text{Year Fixed Effects} + e_{i,t}$$

The dependent variable Y_i is a measure of firm i's assets and liabilities structures. Our Ys are firm size (natural log of total assets), cash/total assets, intangible assets/total assets, total liabilities/total assets, short-term liabilities/total

[9] We report the results using the developed-country dummy as the main country characteristic for two reasons. First, the coefficient on the developed-country dummy lends itself to easy interpretation. The interaction terms between the developed-country dummy and other variables can be interpreted directly as a difference of slopes/sensitivities between two groups of population. Second, because using the dummy illustrates clearly that our findings are apparent even when we use a very broad measure of institutional differences.

[10] http://www.doingbusiness.org

liabilities, and short-term liabilities/current assets. We exclude the Size Quintile in the regression where Y is firm size. Table 3 reports the results.

[INSERT TABLE 3 HERE]

We find that firms in developed countries hold more cash than do firms in developing countries. In the Cash/Total Assets column, we estimate the coefficient on developed-country dummy at 6.609. Since Table 1, Panel B, shows that the average cash-to-total-assets ratio is 17.32% globally, the 6.609% difference is economically large.

Leverage is slightly lower in developed countries, but debt maturity is much shorter in developing countries. In the Total Liabilities/Total Assets column, we estimate the coefficient on the developed-country dummy at -1.874%. In the Short-Term Liabilities/Total Liabilities column, we estimate the coefficient on the developed-country dummy at -12.384%. For comparison purposes, in Table 1, Panel B, the average leverage is 26.57% and the average short-term liabilities ratio is 49.66%. Therefore, firms in developing countries have much higher short-term liabilities relative to their total liabilities. In the Current Liabilities/Current Assets column, the coefficient on the developed-country dummy is -12.183%, suggesting that firms in rich countries have more conservative liquidity positions.

Developed-country firms are slightly larger than are the developing-country firms in our sample. In the Size column, the coefficient on the developed-country dummy is 0.047. In the Intangible Assets/Total Assets column, we estimate the coefficient on the developed-country dummy at 6.582%. Thus, firms in developed countries have more intangible assets relative to total assets.

When we focus on the industry effects we find that firms in manufacturing industries hold less cash, have higher leverage, and have more short-term debts. The high-tech dummy is equal to one if the firm is in the high-tech industry according to the American Electronic Association. High-tech firms can be found in various sectors, including high-tech manufacturing, engineering services, and software development. We find that firms in high-tech industries hold more cash and have lower leverage.

We include Size Quintile as a control variable. We construct the Size Quintile based on the global distributions of a firm's total assets in USD in that year. We find that larger firms hold less cash, have lower leverage, and have fewer short-term liabilities, but more intangible assets.

Our regression analysis shows that firms in developed and developing countries have significantly different asset and liability structures. Although developed countries have better financial systems and lower levels of country and industry risk, we find that firms in developed countries have more conservative financial policies, i.e., they have more cash, slightly lower leverage, and fewer short-term liabilities. We also find that small firms, high-tech firms, and non-manufacturing firms also have more cash relative to their total assets.

5. Firm-Level Risk

Here, we examine firm-level risk, both in cross-section and in time-series in developing and developed countries, and the relation between firm-level, sector-level, and country-level risk. Since we are exploring the relation between financial structures and risk, we adopt a similar reduced-form specification for both.

5.1 Volatility

We first estimate the following cross-sectional regressions:

$V_i = b_0 + b_1$ Developed-Country Dummy $_i + b_2$ Manufacturing Dummy $_i + b_3$ High-Tech Dummy $_i + b_4$ Size Quintile $_i + e_i$

We define annual growth rate $G_{i,t}$ as $\ln(X_{i,t}) - \ln(X_{i,t-1})$ where X represents firm characteristics and performance. We define the firm-level volatility, V_i, as the time-series standard deviation of the annual growth rate $G_{i,t}$, $\sqrt{\frac{\sum t(G_{i,t} - \overline{G}_i)^2}{n-1}}$, where n is the number of years for which the data on growth rate $G_{i,t}$ are available. $\overline{G}i$ is the average growth rate over the years. In each year, we divide firms into the size quintiles based on their total assets that year. Since we are estimating a cross-sectional regression, the variable Size Quintile is the time-series average of size quintiles across all years. Instead of studying risk using a single variable, we use the volatilities of eight variables. Our Xs include the firm financial structures of total assets, cash, intangible assets, total liabilities, and short-term liabilities; and also other outcome variables of sales, profit, and employment. Using eight different variables ensures that our results are robust. Each variable has its own strengths and weaknesses. For example, volatility of profits is a more precise measure of firm performance variability but volatility of sales is less likely to be biased by earnings manipulation. We report the results in Table 4.

[INSERT TABLE 4 HERE]

We find that firms in developed countries are more volatile than are firms in developing countries. The coefficients on the developed-country dummy are positive and significant in all columns, except for the intangible assets. We estimate the coefficients at 0.038 for sales, 0.073 for total assets, 0.024 for cash, 0.064 for profit, -0.149 for intangible assets, 0.096 for total liabilities, 0.161 for short-term liabilities, and 0.043 for employment. These numbers are large relative to the average volatilities. Across all the dependent variables, the magnitude of the coefficients on developing countries is around 10% to 20% of average volatilities we show in Table 2, Panel B.

We also find that firms in manufacturing industries are less volatile and that firms in high-tech industries are more volatile. The coefficients on the manufacturing dummy are negative and significant in all columns. We estimate the manufacturing coefficients at -0.098 for sales, -0.12 for total assets, -0.136 for cash, -0.034 for profit, -0.084 for intangible assets, -0.155 for total liabilities, -0.179 for short-term liabilities, and -0.072 for employment. The coefficients on the high-tech dummy are positive and significant in most columns. We estimate the high-tech coefficients at 0.064 for sales, 0.1 for total assets, -0.01 for cash, 0.05 for profit, 0.113 for intangible assets, 0.211 for total liabilities, 0.169 for short-term liabilities, and 0.02 for employment. We are not surprised to find higher volatilities in high-tech and lower volatilities in manufacturing industries. High-tech industries, such as 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. The coefficients on the 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.

In sum, our volatility results in Table 4 combined with our cash holding results in Table 3 support our conjecture that firms hold cash to accommodate real risk. From Table 3, firms in developed countries, firms in high-tech/non-manufacturing industries, and small firms have higher cash-to-total-assets ratios. From Table 4, firms in developed countries, firms in high-tech/non-manufacturing industries, and small firms also have higher volatilities.

5.2 Cross-Sectional Dispersion

Firm-level volatilities can be driven by both systematic and idiosyncratic 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. (We note that another advantage of using cross-sectional dispersion as a dependent variable is that it is only one observation per country-year. So, all countries are given equal weights in the regressions. Doing so ensures that our results in the previous sections are not just driven by observations from some large countries.) Hence, we estimate the following panel regressions.

$C_{c,t} = b_0 + b_1$ Developed-Country Dummy $_c$ + Year-Fixed Effects + $e_{c,t}$

Again, we define annual growth rate $G_{i,t}$ as $\ln(X_{i,t}) - \ln(X_{i,t-1})$ where X is firm i's characteristics and performance. We define the country c's cross-sectional dispersion, $C_{c,t}$, as the cross-sectional standard deviation of the $G_{i,t}$, $\sqrt{\frac{\sum i(G_{i,t} - \bar{G}_{c,t})^2}{n-1}}$ scaled by $\bar{G}c,t$. n is the number of firms in country c at time t for which the data on $G_{i,t}$ are available. $\bar{G}c,t$ is the average growth rate across all firms in country c in year t. Table 5 reports the results.

[INSERT TABLE 5 HERE]

Table 5 shows that dispersions of sales growth, assets growth, total debts growth, short-term liabilities growth, and employment growth are higher in developed countries. The coefficients on the developed-country dummy are positive in all columns. We estimate the coefficients at 0.317 for sales, 0.256 for total assets, 0.244 for cash, 0.233 for profit, 0.04 for intangible assets, 0.368 for total liabilities, 0.46 for short-term liabilities, and 0.04 for employment. These results are similar to the volatilities results in Table 4. In addition, these coefficients suggest that the dispersion across countries is large relative to the dispersion within a country. For example, an average cross-sectional dispersion of sales growth within a country is 1.15. So, the difference between developed and developing countries is 27.6% (=0.317/1.15) of the average within country dispersion.

5.3 Sector- and Country-Level Volatilities

To examine aggregate risk in different countries we estimate the sector- and country-level version of the following regression.

$V_s = b_0 + b_1$ Developed-Country Dummy $_s + b_2$ Manufacturing Fraction $_s + b_3$ High-Tech Fraction $_s + e_s$

$V_c = b_0 + b_1$ Developed-Country Dummy $_c + e_c$

First, we average the firm-level growth rates within each sector s (based on 17 Fama-French industries) or within each country c. We then use the average to compute the sector-level volatilities, V_s, or country- level volatilities, V_c. Manufacturing Fraction is the fraction of firms in sector s that is a manufacturing firm. High-Tech Fraction is the fraction of firms in sector s that is a high-tech firm. Table 6 reports the results.

[INSERT TABLE 6 HERE]

Table 6, Panel A, shows that sector-level volatilities are lower in developed countries. The coefficients on the developed-country dummy are negative in all columns. We estimate the coefficients at -0.056 for sales, -0.051 for total assets, -0.146 for cash, -0.086 or profit, -0.162 for intangible assets, -0.091 for total liabilities, -0.07 for short-term liabilities, and -0.01for employment. These results are opposite to the firm-level results in Table 4. We find that most coefficients on Manufacturing Fraction and High-Tech Fraction are nonsignificant.

Table 6, Panel B, shows that country-level volatilities are lower in developed countries. The coefficients on the developed-country dummy are negative in all columns. We estimate the coefficients at -0.085 for sales, -0.083 for total assets, -0.1 for cash, -0.107 or profit, -0.294 for intangible assets, -0.15 for total liabilities, -0.158 for short-term liabilities, and -0.008 for employment. Again, these results are contrary to the firm-level results in Table 4.

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

5.4 Competition and Firm-Level Risk

In this section, we provide an example of the sources of firm-level risk. We hypothesize that product market competition is a key factor that drives operating risk. To illustrate this point, we use foreign entry as a proxy for competition and examine how foreign entry affects firm-level volatilities. We augment the basic specification in Table 4 with a new variable, foreign entry. We measure foreign entry by sector-level inward cross-border M&As. Sectors are defined as 17 Fama-French industries. For each sector in each country, we construct foreign entry by aggregating all inward cross-border M&As and scaling them by all (domestic and inward foreign) M&As. Our sample covers all deals announced as completed in the SDC. To avoid reverse causality, we compute the measure of foreign entry from 1989-1998 data while the firm-level volatilities are computed from the non-overlapping period of 1999-2008 (as opposed to the full 1989-2008 sample in other specifications). To ensure that foreign entry does not pick up time-invariant industry characteristics, we also control for the initial volatilities. Initial volatilities are the sector averages of firm-level volatilities that we compute from 1989-1998 data. A major advantage of using cross-border M&As as a measure of foreign entry is the availability of detailed data across many industries and countries

during our sample period. In addition, majority of foreign direct investments are mergers. (According to UNCTAD's FDI database, from 1988-2006, 62% of global FDIs are in the form of cross-border M&As.) We report the results in Table 7, Panel A.

[INSERT TABLE 7 HERE]

We find that the coefficients on foreign entry are positive and significant for all variables (except profit). (A possible explanation for a negative coefficient on profit is that a local firm's profitability tends to decline after foreign firms enter.) This finding means that industries with more foreign entries through cross-border M&As later experience higher firm-level risk. We estimate the coefficients on foreign entry at 0.086 for sales, 0.078 for total assets, 0.161 for cash, -0.063 for profit, 0.124 for intangible assets, 0.129 for total liabilities, 0.171 for short-term liabilities, and 0.046 for employment. For comparison purposes, the average foreign entry is 42% in our sample. The sector with the highest average foreign entry is Machinery (61%) and the sector with the lowest foreign entry is Retail (32%).[11] The coefficients on developed-country, tradable, high-tech dummies, and size quintile have similar signs as the baseline estimates in Table 4.

It is possible that our foreign entry measure captures something other than the effect of competition, such as market liberalization in certain countries or globalization of supply chains in certain sectors. To address this concern, as a placebo test we replace foreign entry with foreign outflow. We define foreign outflow as the aggregate the volume of all outward cross-border M&As scaled by the volume of all (domestic and inward foreign) M&As. The sector with the highest average foreign outflow is Machinery (56%) and the sector with the lowest foreign outflow is Chemicals (23%). Although foreign entry and foreign outflow are positively correlated (34% correlation), the two have very different implications for domestic competition and risk of local firms. We report the results in Table 7, Panel B. We find that most coefficients on foreign outflow are not significant. The magnitudes of the outflow coefficients are much smaller than those of the foreign entry.

6. Drivers of Firm-Level Volatilities

To examine whether cross-country difference in firm-level risk is more pronounced in firms and industries that are more subject to imperfections in financial markets, we propose that idiosyncratic risk is likely to be influenced by capital market imperfections as these imperfections can insulate incumbent firms from risk. Some countries have economic institutions to alleviate these imperfections; others do not. Therefore, we hypothesize that the cross-country difference in risk is more pronounced in technology-intensive, external-finance-dependent, and large-firm-dominated industries where we expect higher degrees of market imperfections. Following the difference-in-difference method in Rajan and Zingales (1998), we estimate the following regression.

$V_i = b_0 + b_1$ Developed-Country Dummy $_i + b_2$ Industry Indicator $_i + b_3$ Developed-Country Dummy $_i$ x Industry Indicator $_i + b_4$ Size Quintile $_i + e_i$

[11] Utilities and financial services have lower inflow but they are excluded from our sample.

The industry indicators we use are a high-tech dummy, the external finance score from Rajan and Zingales (1998), and the small-firm industry score from Beck, Demirguc-Kunt, Laeven, and Levine (2008). We report the results in Table 8.

[INSERT TABLE 8 HERE]

6.1 Technology

Technology-intensive industries tend to be heavily affected by market imperfections. For example, stockholders, creditors, and potential buyers who are in the market for corporate assets tend to be much less well-informed about a high-tech firm than are the insiders. Such imperfections can prevent small firms from expanding and prevent new firms from entering. Therefore, we expect to find that firm-level risk is lower for high-tech incumbents in a country without good institutions to overcome the information problems. The cross-country difference in firm-level risk should be more pronounced in industries with higher degrees of product and capital market imperfections.

In Table 8, Panel A confirms that firms in developed countries and small firms are more volatile. The coefficients on the developed-country dummy are positive and significant in all columns, except for that of the intangible assets. The coefficients on the Size Quintile are negative and significant in all columns. Their magnitudes are in line with those of the baseline models in Table 4.

The key parameters here are the coefficients on the interaction terms between the developed country and high-tech dummies. We find that the interaction coefficients are all positive. We estimate the coefficients at 0.056 for sales, 0.085 for total assets, 0.078 for cash, 0.077 for profit, 0.142 for intangible assets, 0.106 for total liabilities, 0.104 for short-term liabilities, and 0.021 for employment. This finding means that the volatility difference between developed and developing countries is consistently larger in high-tech industries.

The positive interaction coefficients suggest that poor institutions in developing countries can shield incumbent firms from risk. These interaction terms can be interpreted as second derivatives. For example, in low-tech industries, sales volatilities in developed countries are 0.041 higher than are sales volatilities in developing countries, while in high-tech industries, sales volatilities in developed countries are 0.097 (=0.041+0.056) higher than are sales volatilities in developing countries. The interaction coefficient of 0.056 is economically large, compared to average sales volatilities of 0.419 shown in Table 2, Panel B.

6.2 External Finance Dependency

A prime example of market imperfections is financial constraints. Firms in financially dependent industries in developing countries may not be able to raise the optimal amount of external capital necessary to compete with rival firms. The effect of this market imperfection may be to lower cash flow risk in those industries

To examine whether financially dependent firms in developing countries are less risky, we adopt the external finance dependency score from Rajan and Zingales (1998). These authors construct the score from external

financing usage of listed firms in the United States during the 1980s, which is non-overlapped with our sample. Given that capital markets in the U.S. are highly developed, Rajan and Zingales suggest that their score can be considered the natural demand for external funds. For example, the least external dependent industry is tobacco (score = -0.45) and the most external dependent industry is drugs (score = 1.49). The major disadvantage of using this score is that the scores are only available for each of the 36 International Standard Industrial Classification (ISIC) manufacturing industries. The number of observations in external dependency regressions is about 50% of what we have in Table 8 Panel A.

Table 8, Panel B reports the results on external finance. As in Table 8, Panel A, the results confirm that firms in developed countries and small firms are more volatile. The coefficients on the Size Quintile are negative and significant in all columns. The coefficients on the developed-country dummy are generally positive. However, the magnitude and significance are smaller than are those of the base-line models in Table 4.

The coefficients on the interactions between the developed-country dummy and external finance dependency are positive and statistically significant in all columns. We estimate the interaction coefficients at 0.159 for sales, 0.155 for total assets, 0.078 for cash, 0.188 for profit, 0.181 for intangible assets, 0.254 for total liabilities, 0.228 for short-term liabilities, and 0.037 for employment. This finding means that the volatility difference between developed and developing countries is consistently greater in industries that depend on external financing.

To illustrate the magnitude of the interaction coefficients, we follow the example in Rajan and Zingales (1998). Machinery is the industry at the 75th percentile financial dependency (score = 0.45). Beverages is the industry at the 25th percentile dependency (score 0.08). In developing countries, sales volatilities in machinery is 0.0244 = 0.066 x (0.45-0.08) higher than sales volatilities in beverages. In developed countries, sales volatilities in machinery is 0.083 = (0.066+0.159) x (0.45-0.08) higher than sales volatilities in beverages. From Table 2 Panel B, the average sales volatility is 0.419. Thus, the interaction effect is economically significant.

The positive interaction coefficients are consistent with the notion that underdeveloped capital 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 face lower competition.

6.3 Small-Firm Dominance

We expect to find that the effect of financial and institutional development on the intensity of competition differs across industries. Industries that require economies of scale and that have large optimal firm size are more likely to be affected by poor institutions. By contrast, even in developing countries industries with small firms are likely to be well served by financial and legal systems.

Beck, Demirguc-Kunt, Laeven, and Levine (2008) suggest that for technological reasons, certain industries may have a larger share of small firms. We adopt their small-firm-share score. Their score is defined as the share of industry's employment by firms with less than 20 employees based on the 1992 U.S. Census data. Given that

institutions in the U.S. are highly developed and that there are few policy distortions, Beck et al. suggest that their scores are based on the natural size distribution of firms. For example, the industries with the least share of small firms are paper manufacturing (score = 0.14) and tobacco (score = 0.3). The industry with the highest share of small firms is wood (score = 21.37).

We report the results on small-firm industries in Table 8, Panel C. Similar to Table 8, Panel B, the number of observations in small-firm dominance regressions is about 50% of what we have in Table 8 Panel A.

The coefficients on the interactions between the developed-country dummy and small-firm industry are negative in all columns. We estimate the interaction coefficients at -0.01 for sales, -0.01 for total assets, -0.006 for cash, -0.003 for profit, -0.008 for intangible assets, -0.014 for total liabilities, -0.012 for short-term liabilities, and -0.003 for employment. (However, we note that the interactions on cash, profit, and employment are not statistically significant.) This finding means that the volatility difference between developed and developing countries is generally greater in industries that are dominated by large firms.

To demonstrate the magnitude of the interaction coefficients, we examine the furniture industry, which is at the 75th percentile small firm share (score = 9.09), and the spinning industry, which is the industry at the 25th percentile small firm share (score 1.91). In developing countries, the sales volatility in furniture is 0.007 = 0.001 x (9.09-1.91) lower than is the sales volatility in spinning. In developed countries, the sales volatility in furniture is 0.079 = (0.001+0.01) x (9.09 -1.91) lower than is the sales volatility in spinning. In Table 2, Panel B, we see that the average sales volatility is 0.419. Therefore, the interaction effect is economically significant.

The negative interaction coefficients imply that in developing countries where new entrants suffer more from poor institutions, existing firms in large-firm industries face lower risk. This finding is consistent with our results on financial dependence, since there is a negative correlation between small-firm share and the dependency on external financing and a negative correlation between small-firm share and the high-tech dummy in our sample. Small-firm industries tend to require less external financing and to have lower technological intensity.

In sum, the cross-country difference in firm-level volatilities is more pronounced in industries with real and financial market imperfections. Under the Rajan-Zingales framework, the difference in firm-level volatilities between developed and developing countries is more pronounced in technology-intensive, financial-dependent, and large-firm-dominated industries.

6.4 Market Imperfections and Product Market Rivalry

In this section we provide more direct evidence of a channel through which ease of access to financial markets and industry characteristics affect firm volatility. We show that high technology industries, industries that are dependent on external financing, and small firm dominated industries exhibit relatively less product market competition in developing countries than in developed countries. This is consistent with the hypothesis that financial market

frictions slow the allocation of resources and thereby our measure of product market competition is market share volatilities of industry leaders.

By construction, market share captures the rivalry effect – one firm's market share always grows at the expense of another's. We focus on the industry leaders because the coverage of WorldScope and other international databases varies over time. Studying the market share of the largest firms helps us mitigate the effects of such changes in data coverage. In each year, we identify the largest two firms in a four-digit SIC industry in each country. Then, we track the size of these largest two firms over the next five years and compute the volatilities of market share based on the total assets of these two firms.

$$V_{i,t} = b_0 + b_1 \text{ Developed-Country Dummy}_i + b_2 \text{ Industry Indicator}_i + b_3 \text{ Developed-Country Dummy}_i \text{ x Industry Indicator}_i + b_4 \text{ Year}_t + e_{i,t}$$

$V_{i,t}$ is the market share volatility of the largest firm in year t. We define market share as Total Assets of the Largest Firm/ (Total Assets of the Largest Firm+ Total Assets of the Second Largest Firm). We compute $V_{i,t}$ from the market share from year t to t+5. We regress market share volatilities, $V_{i,t}$, on the developed-country dummy, industry indicators (high-tech, external finance, and small firm industries), and the interactions between the developed-country dummy and industry indicators. Since our sample consists of only the largest firms, which generally have complete historical data, we are able to use Year as an explanatory variable to examine how these volatilities evolve over time.

To ensure that our results are robust to the way we calculate market share volatilities, we also use market shares among the top five firms (Total Assets of the Largest Firm/ (Sum of Total Assets of the Largest Five Firms)) instead of the top two firms. We report the results in Table 8, Panel D. The first three columns report the results from the top two firms' market shares. The last three columns report the results from the top five firms' market shares.

We find that market shares are less volatile in developing countries. The reduction is the greatest in high-tech, in financially dependent industries, and in industries that are dominated by large firms. We also find that volatilities increase over time.

7. Reaction to Shocks

In this section, we connect cross-country difference in financial structure in Section 4 to the underlying firm-level risk in Section 5 by examining how firms in developed and developing countries react to real shocks to industry productivity. Following Wurgler (2000), we define productivity shocks as the percentage growth in value added.

We construct our measure of productivity from the UNIDO database. Wurgler (2000) studies the relation between growth in capital formation and growth in value added at the three-digit ISIC level (28 manufacturing industries.

However, in 2011, UNIDO published a more detailed data set (INDOSTAT-4 2011) at the four-digit ISIC level (127 manufacturing industries). Hence, we define our productivity shocks at the four-digit ISIC level.[12]

There are several advantages to using productivity shocks from UNIDO. First, the reverse causality problem is less severe. Compared to Tobin's Q or cash flow shocks at the firm level, UNIDO shocks are more exogenous. Clearly, changes in a firm's financial policies can affect both its own cash flow and Tobin's Q. UNIDO data come from surveys and registries that cover both public and private firms both inside and outside of our WorldScope sample. Hence, it is less likely that financial policies of one individual firm will affect our value-added measure. Second, since our paper focuses on firm-level risk, studying the reaction to micro shocks is more relevant than studying the reaction to macro shocks. Unlike shocks to GDP or stock market indexes that are the same for all firms in a country, there are 127 shocks for manufacturing firms in UNIDO.

Our regression is as follows:

$$G_{i,t} = b_0 + b_1 \text{ Productivity Shock}_{i,t} + b_2 \text{ Developed-Country Dummy}_i \text{ x Productivity Shock}_{i,t} + \text{Firm Fixed Effects} + e_{i,t}$$

We define annual growth rate $G_{i,t}$ as $\ln(X_{i,t}) - \ln(X_{i,t-1})$, where X represents the following firm characteristics and performance: assets, cash holdings, current assets, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Since we focus on the coefficient of the interaction term b_2, we include firm-fixed effects to absorb other country and industry characteristics.

[INSERT TABLE 9 HERE]

Table 9 reports the regression results. We find that firms in developed countries are more responsive to exogenous real shocks. All the coefficients on productivity shocks are positive and significant. We interpret the coefficient b_1 as a developing-country firm's sensitivity to productivity shocks. For example, if value added changes by 1%, then firms in developing countries will experience a 0.124% change in sales, 0.09% change in assets, 0.128% change in cash, 0.216% change in profits, 0.094% change in intangible assets, 0.056% change in total debts, 0.081% change in short-term debts, and 0.06% change in employment. All interaction coefficients except the one in the employment regression[13] are positive, which suggests that firms in developed countries are more responsive to shocks.

[12] Our matching procedure is as follows. First, we compute productivity shocks for each four-digit ISIC industry. Then, we match each firm to the appropriate ISIC industry (or industries) based on its four-digit SIC code. Because the four-digit SIC does not correspond to the four-digit ISIC one to one, we use the average productivity shocks across all corresponding ISICs when there is more than one ISIC assigned to one four-digit SIC. We note that the limitation of UNIDO is that it only covers some manufacturing industries. Thus, we can only use about 30% of our firm-year observations in this section.

[13] We note that productivity shocks have ambiguous impacts on employment. If productivity increases come from improvement in production technology, then firms might employ fewer workers to produce the same or higher levels

We interpret the sum of coefficients b_1 and b_2 as a developed-country firm's sensitivity to productivity shocks. If the value added changes by 1%, then firm in developed countries will experience a 0.265 (= 0.124+0.141) % change in sales, 0.24 (= 0.09+0.15) % change in assets, 0.383 (= 0.128+0.255) % change in cash, 0.47 (= 0.216+0.254) % change in profits, 0.244 (= 0.094+0.15) % change in intangible assets, 0.164 (= 0.056+0.108) % change in total debts, 0.158 (= 0.081+0.077) % change in short-term debts, and a 0.053 (= 0.06-0.007) % change in employment.

Across all types of assets and liabilities, most of the adjustments (the largest b_1 and b_2) come from cash balance. This result suggests that firms hold cash to accommodate their firm-level risk. Firms use cash as a buffer asset. During expansion periods, firms accumulate cash. During contraction periods, firms lessen bad shocks by spending cash disproportionately. This result is also consistent with the findings in Sections 4 and 5 that firms in developed countries face higher risk and hence hold more cash. Theoretically, instead of using cash, firms can borrow more (especially short-term) to reduce the effect of bad shocks. We do not find such evidence in our manufacturing firm sample. Both total and short-term debts respond positively to productivity shocks, indicating that debt is mostly used to finance growth rather than to relieve financial distress.

In sum, we show that firms in developed countries are more responsive to shocks. Across all types of assets and liabilities, most of the adjustments come from cash balance. Our results suggest that operating risk is an important determinant of a firm's financial policies.

8. Additional Tests

8.1 Industry Analysis for Cash Holdings

To we examine whether cash holdings are consistent with our findings on firm-level risk, we regress cash ratio (cash holding scaled by total assets) on dependent variables similar to those in Tables 7 Panels A-B and 8 Panels A-C. Since we have a panel data set on cash ratios, we include the year fixed effects in all regressions. The results are reported in Table 10.

We find that the cross-country differences in cash holdings are more pronounced in high-tech, external-finance-dependent, and large-firm-dominated industries. Firms in sectors with more foreign entries during 1989-1998 hold slightly more cash after 1999 while firms in sectors with more foreign outflows during 1989-1998 hold less cash after 1999. These results are consistent with the notion that cash ratios are chosen to accommodate firm-level risk.

[INSERT TABLE 10 HERE]

In the first column, the interaction term between the developed-country dummy and the high-tech dummy is positive and significant. This finding means that the cash ratio differences between developed and developing countries are larger in high-tech industries. Consistent with the results in Section 4, we find that firms in developed countries, high-tech industries, and small firms hold more cash.

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of outputs. But if increases in productivity come from higher demands, then firms may have to employ more workers to meet the firm's needs.

In the second column, the interaction term between the developed-country dummy and the external finance dependency score is positive and significant. In the third column, the interaction term between the developed-country dummy and the small-firm dominance score is negative and significant. These results suggest that the cross-country difference in cash ratio is larger in external-finance-dependent and large-firm-dominated industries.

In the fourth and fifth columns, we restrict our sample to cash ratios after 1999 since we construct our foreign inflow and outflow measurements for the 1989-1998 period. We find that the coefficient on foreign inflow is positive. Foreign inflow raises cash holdings, but foreign outflow lowers cash holdings in the next decade. Consistent with the results in Section 4, we find that firms in developed countries, high-tech industries, and small firms hold more cash. Firms in manufacturing industries hold less cash.

In sum, our difference-in-difference analysis for cash holdings yields results consistent with the difference-in-difference analysis for firm-level risk.

8.2 Alternative Measures for Country Characteristics

Institutions in developing and developed countries differ on many dimensions, only some of which are relevant to financial markets. Hence, we examine whether our results are driven by institutional differences that have been found to be associated with a well-functioning financial market. Wurgler (2000) shows that there are major differences in the response of corporate investment and financing to market signals across countries. We investigate whether there is a relation between the responsiveness to market signals in an economy and the riskiness of the firms' cash flows, and cash holdings. We do this directly, using measures developed by McLean, Zhang, and Zhao (2012), who argue that investment and external finance in countries with better institution increase more strongly with Tobin's Q that captures investment opportunities. These authors provide country-level estimates of the sensitivity of investment, share issuances, and debt issuances to Tobin's Q as a measure of interfirm resource allocation efficiency. However, since these sensitivities may themselves be endogenous and depend on product market characteristics in different economies, we also consider six additional institutional variables that are associated with efficient financial systems: Judiciary Efficiency, Rule of Law, Corruption, Accounting Standard from La Porta et. al (1998), 1980 Log of Per Capita GDP from World Development Indicator Database, 1980 Stock Market Capitalization per GDP from Rajan and Zingales (1998), and a direct measure of the cost of competing in each country, the Ease of Doing Business Rank from the World Bank's Doing Business indicator.

[INSERT TABLE 11 HERE]

First, we estimate the effects of institutional variables on cash holdings by replacing the developed-country dummy in Section 4 with institutional variables. We report the results in Table 11 Panel A.

We confirm that firms in countries with better institutions hold more cash. The coefficients on institutional variables are estimated at -0.068 for Ease of Doing Business Rank, a lower rank means better institutions, 1.697 for Judiciary Efficiency, 1.715 for Rule of Law, 1.624 for Corruption, 0.122 for Accounting Standards, 1.87 for Log of

Per Capita GDP in 1980, 4.466 for Stock Market Capitalization/GDP in 1980, 27.77 for Investment-Q Sensitivity, 10.31 for Share Issue-Q Sensitivity, and 9.32 for Debt Issue-Q Sensitivity. All coefficients are statistically significant at the 1% level. These estimates imply that a one-standard-deviation improvement in institutional variables is associated with an increase in cash-to-total-assets by 3.18% for Ease of Doing Business Rank, 3.68% for Judiciary Efficiency, 4.26% for Rule of Law, 3.63% for Corruption, 2.27% for Accounting Standard, 2.49% for Log of Per Capita GDP in 1980, 1.52% for Stock Market Capitalization/GDP in 1980, 1.36% for Investment-Q Sensitivity, 1.72% for Share Issue-Q Sensitivity, and 1.87% for Debt Issue-Q Sensitivity. The coefficients on other control variables are similar to those in the regressions with the developed-country dummy.

To estimate the effects of institutional variables on firm-level risk we use sales growth volatility as a proxy for firm-level risk, V_i. (In unreported regressions, volatilities of other variables yield qualitatively similar results.) We replace the developed-country dummy in Section 5.1 with institutional variables and report the results in Table 11, Panel B.

We confirm that firms in countries with better institutions have higher volatilities. We estimate the coefficients on institutional variables at -0.001 for Ease of Doing Business Rank, 0.014 for Judiciary Efficiency, 0.03 for Rule of Law, 0.025 for Corruption, 0.004 for Accounting Standard, 0.027 for Log of Per Capita GDP in 1980, 0.115 for Stock Market Capitalization/GDP in 1980, 1.98 for Investment-Q Sensitivity, 0.57 for Share Issue-Q Sensitivity, and 0.43 for Debt Issue-Q Sensitivity. All coefficients are statistically significant at the 1% level. These estimates imply that a one-standard-deviation improvement in institutional variables is associated with an increase in sales growth volatility by 0.047 for Ease of Doing Business Rank, 0.03 for Judiciary Efficiency, 0.075 for Rule of Law, 0.056 for Corruption, 0.074 for Accounting Standard, 0.067 for Log of Per Capita GDP in 1980, 0.039 for Stock Market Capitalization/GDP in 1980, 0.1 for Investment-Q Sensitivity, 0.097 for Share Issue-Q Sensitivity, and 0.088 for Debt Issue-Q Sensitivity. The coefficients on other control variables are similar to the ones we use in the regressions with the developed-country dummy.

When compared across measures, Rule of Law yields the highest R-squared and *t*-statistic in the cash holding regressions. Resource allocation efficiency yields the highest R-squared and *t*-statistic in the volatility regressions. However, the estimates are comparable for all institutional variables. These results suggest that real and financial market imperfections tend to be correlated with allocative inefficiency. It is likely that both types of imperfections lead to less cash and lower firm-level risk.

8.3 Effects of Volatilities on Cash Holding

When we examine the relation between cash holding and firm-level risk directly, we note that one of the reasons that firms hold cash is to respond to unforeseen operating cash flow shortfalls. For the U.S., 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. A generalization suggests that firms in developing countries should hold more cash. However, as we see above, this is not the case. Lower cash holdings in developing countries might suggest that either the precautionary demand theory of demand for cash is not robust, or

that other factors, such as differences in agency costs, are great enough to overcome the effect of higher operating risks. We consider another possibility: that the precautionary demand theory of cash holdings is correct, but that the natural estimates of the risks confronting the firm are confounded by the inverse relation between firm and industry cash flow risk across the world.

[INSERT TABLE 12 HERE]

In Table 12, Panel A, we augment our cash-holding regressions in Section 4 by using country-level aggregate volatility, sector-level aggregate volatility, and firm-level volatility. As in Section 5, 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 sector. Again, we define sectors as the 17 Fama-French industries in one country. We define firm-level volatility as the standard deviation of firm-level sales growth. To alleviate the endogeneity problem, we average firm-level volatilities across all firms in one sector before including them in a regression.

In the first two columns, for the sake of comparison, we restrict the sample to firms in the U.S. In other columns, we use the full sample of international firms. In Column 1, we estimate the coefficient on sector-level volatility at 5.63 with a *t*-statistic of 2.07. In Column 2, we estimate the coefficient on firm-level volatility at 29.17 with a *t*-statistic of 45.28. These results show that sector- and firm-level volatilities lead to more cash holding in the U.S., and that firm-level volatility has a larger impact on cash holding.

In the next two columns, we use country- and sector-level aggregate volatilities as proxies for risk in cross-country regressions. In the third column, we estimate the coefficient on country-level aggregate volatility at -3.99. In the fourth column, we estimate the coefficient on sector-level volatility at -2.18. These negative coefficients imply that firms in countries and sectors with higher aggregate volatilities appear to hold less cash. We argue that these counter-intuitive results arise because countries with low aggregate volatilities generally have higher firm-level risk.

In the fifth column, we use firm-level volatility as a proxy for risk. The coefficient on firm-level volatility is estimated at 10.1 with a *t*-statistic of 56.04. This finding confirms that the cross-country (inverse) relation between aggregate and firm-level risk drives the results in Columns 3 and 4.

We address the concern that we compute volatilities and cash holdings from the same time period. We do so by splitting the sample in half. We then compute the firm-level volatilities from the data from 1989-1998 and use the sample to cash ratios from the non-overlapping period of 1999-2008 for the regressions. We report the result in Column 6. The coefficient on non-overlapping firm-level volatility is still significant at the 1% level.

Table 12 Panel A highlights 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 the cross-country context. The misspecification not only underestimates the effect of risk on cash

holding, but also the negative correlations between aggregate and firm-level volatilities also lead to a coefficient with the wrong sign.

In Table 12, Panel B, we add the firm characteristics to the cash-holding regressions with firm-level volatilities.

Following other studies on the determinants of cash holding, we include lagged Leverage, Dividend Dummy, Capital Expenditure/Total Assets, Acquisitions/Total Assets, R&D/Total Assets, and Tobin's Q as explanatory variables. All additional data are from the WorldScope database. We find that firms with lower leverage, dividend, capital expenditure, and acquisition 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. The coefficients on firm-level volatility, the developed-country high-tech, and manufacturing dummies, and the size quintile remain large and statistically significant at 1% level. The firm characteristic that has the largest impact on cash holding is R&D intensity. Clearly, R&D may capture the effects of firm-level risk itself.

In Table 12, Panel B confirms that cash holding increases with firm-level volatility. Even after we control for the arguably endogenous firm-level variables, firm-level volatility constructed at the sector level is still statistically significant.

8.4 Alternative Explanations

8.4.1 Agency Explanations

Dittmar, Mahrt-Smith, and Servaes (2003) document that firms in countries with poorer shareholder-rights protection tend to hold more cash. To verify that our results are not confounded with shareholder protection, we include the shareholder protection index from La Porta et al. (1998) in all regressions from Tables 3 and 4. We find that all our coefficients remain highly significant. We are interested to note that our results that firms in developed countries hold more cash are not in conflict with Dittmar et al.'s (2003) results that firms in countries with poorer governance hold more cash. In fact, we find that the correlations between shareholder protection and developed-country dummies and the correlations between shareholder protection and other institutional indictors are low or negative. For example, some developed countries such as Denmark, Germany, and Switzerland are classified as low shareholder-rights countries while some developing countries such as Colombia and India are classified as high shareholder-rights countries.

Djankov et al. (2008) and Spamann (2010) reexamine the legal data and revise the shareholder protection index in La Porta et al. (1998). We also control for the updated indices in the cash and volatility regressions. The new indices we adopted are Djankov et al. (2008)'s index as well as the 1997 and 2005 values of Spamann (2010)'s investor protection index. Our results that firms in developed countries hold more cash and have higher volatilities do not change after the inclusion of the new indices.

We also use control-ownership disparity as a proxy for firm-level corporate governance and study its effect on cash holding. Specifically, we use the ratios between control right and cash-flow right of the largest shareholder from

Claessens, Djankov, and Lang (2000) which cover the sample of firms in East Asia. Larger disparity between ownership and control indicates a greater degree of agency problems. Approximately half of our East Asian firms whose data on ownership are available have control-to-cash-flow-right ratios greater than one. We include control-ownership disparity in all regressions from Tables 3 and 4 and find no evidence that firms with high control-ownership disparity hold less cash. So, it is unlikely that our cash-holding results are driven by agency-prone Asian firms with high control-ownership disparity. For risk, we do find that firms with high control-ownership disparity are less volatile.

8.4.2 Other Explanations

While our explanation of international cash holdings is not mutually exclusive with transaction demand explanation (Pinkowitz, Stulz, and Williamson, 2003) and political extraction explanation (Caprio, Faccio, and McConnell, 2012), it is unlikely that our results will be subsumed by alternative stories. First, if facilitating business transaction is the sole reason why a firm holds cash, then we should observe that cash holdings decline over time. Technological improvement in financial service industries should allow business transactions to be completed more efficiently, which would mean that firms would not have to hold a large cash balance. However, we find no evidence that cash holdings decline over time. Second, compared to manufacturing firms whose output can be exported internationally, non-manufacturing firms such as transportation and telecommunications are more likely to be involved with domestic governments. Non-manufacturing firms are also more likely to rely on government services and to be subjected to government regulations. Therefore, these firms should be more likely to be affected by political rent extraction. However, we find that compared to manufacturing firms, non-manufacturing firms hold more cash.

One concern might be that our cross-country variation in cash holdings is driven by the difference in interest rates between developed and developing countries. However, cost of capital alone is not the overriding determinant of cash holding. We find that small firms and firms in external-finance-dependent industries hold more cash, even though these firms are likely to face the highest cost of capital. This result is more consistent with our operating risk explanation. To test this conjecture further, we explicitly include lending rates and interest rate spreads from the World Development Indicator Database in all regressions from Tables 3 and 4. We find that firms in low-interest-rate countries have more cash, more current assets, more current liabilities, and slightly higher firm-level risk. However, the magnitude and significance of other coefficients remains largely unchanged. We also find a negative correlation between per capita GDP and lending rate (-10%). This finding supports the notion that the lending rate itself can be considered a financial development indicator. (For instance, a narrow lending spread means the banking sector is well functioning. Countries that allow free capital flow are likely to have a lower risk-free rate.) Low interest rates may encourage entries and facilitates competitions among established businesses. Thus, firms in low-interest-rate countries have to hold more cash to accommodate product market risks.

Taxes in different countries may affect financial structures and firms' attitude towards risk. For example, Caprio, Faccio, and McConnell (2012) suggest that foreign investors from high-tax countries may want firms in low-tax

countries to hold a large amount of cash to avoid repatriation taxes. Therefore, we control for corporate tax rates explicitly in all regressions from Tables 3 and 4. We obtain the data on tax rates from KPMG Corporate Tax Survey. First, we find that on average, developed countries have higher corporate tax rates than do developing countries. The correlation between the per-capita GDP and tax rate is positive (29%). Second, we find that firms in high-tax countries hold more cash. We also find that firms in high-tax countries have slightly higher leverage. Third, firms in high-tax countries have slightly higher volatilities compared to firms in low-tax countries. Thus, we find no evidence that our findings are confounded with tax considerations.

8.5 Robustness Tests

We perform various robustness tests in the internet appendix. This section highlights some of the important tests. The details are reported in Internet Appendix A.

We examine alternative specifications of the asset and liability structure regressions in Table 3 and the firm-level volatility regressions in Table 4. To fully control for industry effects, we replace industry indicators with two-digit SIC industry fixed effects. To check whether our country dummy captures the degree of economic and institutional development, we use per capita GDP in 1980 instead of a developed country dummy. In Table 8 where we study the interactions between country and industry indicators, we include both country and industry fixed effects to absorb all level effects and focus on the interaction effects. Our results are robust across these alternative specifications.

In addition to size quintile, we also use the exact firm size (natural log of total assets or market capitalization). One might be concerned that size distributions of firms differ across countries and that we only compare the largest firms in developing countries with average firms in developed countries. So, we replace size quintile with (1) the size relative to other firms in its country and (2) the size relative to other firms in its local sector. To address the concern that firms in different countries go public at different stages in their life cycles, we control for firm age. Using alternative measures of firm size and controlling for firm age do not affect our main results. In Table 8, we also interact firm size with country and industry indicators. We find that the interactions between country and industry indicators are still highly significant.

Our main sample covers countries in WorldScope with a large number of observations. To verify that our results are not sample specific, we estimate the regressions in Tables 3 and 4 using alternative country samples: (1) the entire WorldScope and (2) all the countries in WorldScope with greater than 1,000 firm-year observations or 100 firms. (3) We also ensure that our results are not just driven by firms from some large developed countries by excluding countries with the most observations: the U.S., U.K., Japan, and Canada. Notwithstanding the sample changes these additional restrictions imply, our main results still hold.

For standard errors, we compute heteroscedasticity robust standard errors using the Huber-White sandwich estimators. In addition to robust standard errors, we estimate the standard errors with clusters on country and industry where each industry is defined as a two-digit SIC group. In the asset and liability structure regressions, we

also cluster standard errors by firm. Inferences based on alternative standard errors again yield statistically significant results.

We use alternative definitions of volatilities in Table 4. (1) 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. (2) To address the concern that the data we use to compute volatilities are less complete in certain countries, for each firm we count the number of years in which the data are available and explicitly control for them in the regressions. (3) We use firm characteristics denominated in U.S. dollars. To address the concern that our results are driven by exchange rate movements, we compute firm-level risk in local currencies. (4) Percentage growth in profits is not defined when earnings are less than zero. To solve this problem, we use an alternative measure of variation in profitability: we compute the volatilities of ROAs (level) instead of profits growth. (5) Another concern is that fundamentals of firms in emerging markets are in fact very volatile but their financial statements do not reflect the true fundamentals. In Table 4, we already study volatilities of eight different variables including sales and employment which are more difficult to manipulate. To further alleviate this concern, we try subtracting increase in accounts receivable from sales growth to eliminate the possibility of credit sales manipulation. (6) We also examine the survival rates of firms in different countries as an alternative measure of risk. Our results are robust across all alternative measures of volatilities.

In Table 7, we use several proxies for international competition in addition to foreign entry. It is likely that cross-listed and export-oriented firms have more exposure to global competition. So, we examine the volatilities of cross-listed and export-oriented firms. We also use privatization of state-owned enterprises as an alternative proxy of increases in local competitive pressure. All results confirm that firms in competitive environment are more volatile. In Table 12, we control for factors that determine a firm's alternatives to cash: ownership (the fraction of shares that are closely-held and family business group membership), organizational structure (diversified conglomerate status), and bank relationship (whether a firm has bank loans on the balance sheet). Our findings survive the inclusion of these additional controls.

We estimate several variations of the reaction-to-shock regressions in Table 9. (1) We use growth in output and labor productivity (output per worker) as alternative proxies for productivity shock. (2) We divide the sample based on the country dummy and firm size quintile and run the same regressions using different subsamples. (3) One might be concerned that firm reactions in developed and developing countries are not comparable because the productivity shocks are of different sizes. To account for this possibility, we perform the analysis using a matched sample: we directly assign each observation in developing countries a developed country match based on productivity quartile, sector, year, and firm size. Our findings hold across all these robustness checks.

9. Conclusion

While developing economies are more volatile, several authors show that firms in developed countries hold more cash and have fewer short-term liabilities. In this paper, we propose a new explanation for this relation.

We find that despite the fact that sector- and country-level averages are less volatile in developed countries, the performance and characteristics of individual firms in developed countries are more volatile.

Idiosyncratic risk is likely to be influenced by imperfections in product and capital markets, as these imperfections can insulate incumbent firms from risk because they reduce the ability of competitors to contest product markets by aggressive investment. We find that cross-country difference in firm-level volatilities and the intensity of product market competition are more pronounced in technology-intensive, external-finance-dependent, and large-firm-dominated industries. These are the industries in which we expect the higher level of market imperfections in developing countries. Consistent with this finding, entry into markets by foreign competitors is associated with increased volatility.

We link cross-country differences in financial structures to the underlying firm-level risk by examining how firms react to real shocks. We find that firms in developed countries are more responsive to exogenous real shocks. Across all types of assets and liabilities, most of the adjustments come from cash balances.

The results in this paper also advance our understanding of comparative volatilities and international financial 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 macro-risks in those countries are higher. Thus, the differences in the firms' financial 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 operating risk as an indirect result of financial imperfections.

More broadly, we show that the cross-country difference in cash-flow risk is an important factor that must be taken into consideration 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.

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Table 1 Panel A: Asset and Liability Structures by Country

Country	Number of Firm-Year Observations	1980 Per Capita GDP	Size	Cash/Total Assets	Intangible /Total Assets	Total Liabilities /Total Assets	Current/Total Liabilities	Current Liabilities /Current Assets
Developing Countries								
Argentina	844	7551	5.04	7.91	3.08	23.34	56.84	43.66
Brazil	3,347	3557	5.52	10.49	1.83	29.82	55.04	58.74
Chile	1,692	2520	4.84	7.3	2.84	20.33	47.94	36.65
China	15,171	186	5.08	17.73	3.95	27.58	80.13	57.32
Colombia	345	1621	5.47	6.88	2.81	13.03	50.86	20.59
Egypt	290	882	5.8	15.03	4.77	24	47.13	33.97
Hungary	359	3769	4.49	11.36	5.25	15.55	62.17	23.73
India	10,648	229	4.15	6.8	1.87	33.24	42.63	29.87
Indonesia	3,305	397	4.33	11.89	1.57	38.59	59.31	68.88
Korea	10,797	3358	5.25	13.36	2.3	31.21	61.04	44.33
Lithuania	22	n.a.	4.61	7.57	2.45	30.33	39.1	42.1
Malaysia	9,281	1848	4.35	12.13	4.17	26.61	65.13	48.82
Mexico	1,771	5114	6.41	7.78	6.84	24.23	41.31	34.86
Peru	802	2256	4.37	6.17	4.65	24.32	60.18	43.3
Philippines	1,764	989	4.04	11.54	4.12	24.62	61.43	65.69
Poland	1,994	n.a.	3.92	10.97	4.87	19.33	61.58	23.89
Russia	790	n.a.	6.81	8.84	4.6	24.44	50.29	39.17
South Africa	4,617	3463	4.42	13.11	7.05	16.81	49.69	22.27
Thailand	5,195	796	4.24	9.01	2.34	36.47	64.58	72.45
Turkey	2,066	2525	4.75	9.59	2.4	23.95	68.22	31.17
Venezuela	244	5820	5.1	9.42	1.34	14.22	55.53	20.95
Developed Countries								
Australia	13,353	14291	3.22	25.07	12.2	17.51	43.07	25.74
Austria	1,411	15946	5.21	13.04	5.84	24.84	52.41	29.51
Belgium	1,953	15609	5.19	14.09	10.24	25.9	46.96	27.68

Canada	16,376	16751	4.03	18.84	9.72	22.94	38.34	37.18
Czech Republic	292	n.a.	5.13	6.72	1.72	21.57	62.55	41.86
Denmark	2,349	19716	4.82	16.29	5.72	27.04	43.35	25.76
Finland	2,229	15576	5.27	13.45	10.09	28.73	34.18	20.3
France	11,986	15982	4.98	14.15	12.81	22.66	49.29	19.66
Germany	11,572	15656	4.82	14.26	9.58	21.09	50.73	22.69
Greece	3,595	11079	4.46	9.31	3.13	26.49	66.94	34.89
Hong Kong	8,554	11880	4.7	20.92	4.07	21.54	63.47	32.65
Ireland	1,146	9957	4.52	17.1	14.19	22.82	42.7	25.28
Israel	1,545	12603	4.98	25.51	8.37	23.35	49.35	26.82
Italy	3,602	13094	6.01	12.5	10.96	26.35	54.37	29.07
Japan	55,624	23982	5.78	18.28	1.47	25.85	57.89	31.02
Netherlands	3,250	15936	5.5	11.86	8.39	23.57	43.67	20.13
New Zealand	1,231	10265	4.36	9.07	10.33	25.3	35.9	28.88
Norway	2,747	22301	4.91	18.87	9.19	31.31	27.99	24.24
Portugal	1,084	6301	5.24	5.84	9.68	29.69	48.26	44.39
Singapore	5,714	9043	4.41	17.58	2.51	21.18	62.64	31.15
Spain	2,194	8826	6.02	9.41	6.33	23.51	51.89	30.48
Sweden	5,002	19330	4.36	18.01	15.79	20.04	35.3	15.87
Switzerland	3,277	28206	5.79	16.42	7.31	24.82	37.23	17.92
United Kingdom	27,141	15575	4.22	16.18	11.42	20.11	49.87	24.52
United States	108,575	22568	4.55	21.18	15.24	31.11	37.51	41.09

This table reports average asset and liability structures of firms in each country. Cash, Total Assets, Intangible Assets, Total Liabilities, Current Liabilities, and Current Assets are from the WorldScope Database. Size is defined as log of total assets (book value). 1980 Per Capita GDP is from the World Development Indicators Database. Countries are classified by the World Bank's Atlas method. Developed Country is defined as a high-income economy and Developing Country is defined as a middle-income economy or lower.

Table 1 Panel B: Asset and Liability Structures in Developed and Developing Countries

Financial Structure	Global Average	Developed Country Average	Developing Country Average	Developed Minus Developing	*t*-Stat	Observations in Developed Countries	Observations in Developing Countries
Size	4.76	4.77	4.75	0.02**	(2.3935)	288325	74734
Cash/Total Assets	17.32	18.71	11.94	6.77***	(82.79)	286831	74469
Intangible /Total Assets	8.35	9.73	3.38	6.35***	(98.7415)	252878	70206
Total Liabilities /Total Assets	26.57	26.08	28.44	-2.36***	(18.0385)	278730	72813
Current/Total Liabilities	49.66	46.42	61.27	-14.85***	(100.8583)	242336	67607
Current Liabilities /Current Assets	35.7	32.79	46.79	-14***	(38.3312)	275409	72103

This table compares asset and liability structures of firms in developed and developing countries. Cash, Total Assets, Intangible Assets, Total Liabilities, Current Liabilities, and Current Assets are from the WorldScope database. Size is defined as log of total assets (book value). Countries are classified by the World Bank's Atlas method. Developed Country is defined as a high-income economy and Developing Country is defined as a middle-income economy or lower. Numbers in the parentheses are the *t* statistics from univariate comparisons between developed and developing countries. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 2 Panel A: Firm-Level Risk by Country

Country	Number of Firms	1980 Per Capita GDP	Volatility of Sales Growth	Volatility of Assets Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debts Growth	Volatility of Short-Term Liabilities	Volatility of Employment Growth
Developing Countries										
Argentina	80	7551	0.47	0.32	0.98	0.65	1.06	0.93	1.33	0.15
Brazil	373	3557	0.39	0.35	1.18	0.7	1.06	0.74	0.92	0.25
Chile	147	2520	0.36	0.21	1.14	0.54	1.06	0.63	0.91	0.26
China	1,843	186	0.34	0.28	0.84	0.45	0.89	0.6	0.67	0.28
Colombia	31	1621	0.23	0.23	0.76	0.5	1.22	1.04	1.4	0.2
Egypt	46	882	0.21	0.21	0.83	0.35	0.8	0.49	0.62	0.05
Hungary	38	3769	0.39	0.27	0.92	0.65	0.79	0.74	0.96	0.27
India	1,995	229	0.26	0.23	0.97	0.42	0.9	0.53	0.9	0.14
Indonesia	310	397	0.38	0.28	1	0.75	0.76	0.69	1.01	0.26
Korea	1,152	3358	0.38	0.32	0.93	0.73	1.15	0.69	0.94	0.22
Lithuania	5	n.a.	0.17	0.16	0.84	0.52	0.65	0.43	0.89	0.18
Malaysia	969	1848	0.41	0.29	0.93	0.66	0.71	0.71	0.89	0.27
Mexico	154	5114	0.26	0.22	0.86	0.58	0.84	0.63	1.08	0.17
Peru	83	2256	0.31	0.25	1.16	0.61	0.95	0.87	1.12	0.33
Philippines	157	989	0.54	0.37	1.09	0.9	0.66	0.69	0.99	0.41
Poland	317	n.a.	0.38	0.43	1.33	0.67	1.28	0.94	1.14	0.31
Russia	132	n.a.	0.37	0.34	1.1	0.53	1.05	0.64	1.01	0.14
South Africa	591	3463	0.45	0.47	1.35	0.59	0.97	1.02	1.29	0.27
Thailand	487	796	0.34	0.27	1.1	0.63	0.73	0.81	1.06	0.24
Turkey	207	2525	0.43	0.34	1.26	0.72	1.27	0.95	1.1	0.3
Venezuela	23	5820	0.48	0.39	0.94	0.64	0.55	0.66	0.85	0.13
Developed Countries										
Australia	1,950	14291	0.76	0.62	1.36	0.69	0.85	1.05	1.5	0.44
Austria	133	15946	0.41	0.33	1.03	0.58	1.12	0.73	0.97	0.28
Belgium	175	15609	0.39	0.33	0.91	0.62	0.91	0.76	1.04	0.39

Canada	2,024	16751	0.6	0.57	1.57	0.75	0.8	0.9	1.3	0.3
Czech Republic	52	n.a.	0.23	0.22	0.88	0.66	0.62	0.46	0.72	0.11
Denmark	187	19716	0.37	0.35	1.12	0.58	0.91	0.75	1.05	0.3
Finland	166	15576	0.26	0.27	0.72	0.55	0.85	0.62	0.91	0.21
France	1,169	15982	0.31	0.31	0.88	0.58	0.84	0.77	1.02	0.3
Germany	1,001	15656	0.4	0.42	1.22	0.68	1.06	1	1.29	0.32
Greece	342	11079	0.34	0.32	1.07	0.58	1.15	0.86	1.11	0.36
Hong Kong	894	11880	0.47	0.43	0.93	0.68	0.91	1.03	1.24	0.42
Ireland	105	9957	0.44	0.52	1.39	0.59	0.67	1.09	1.24	0.36
Israel	192	12603	0.34	0.34	0.81	0.82	0.85	0.75	1.06	0.23
Italy	327	13094	0.36	0.3	0.93	0.54	0.76	0.7	0.9	0.3
Japan	4,203	23982	0.19	0.19	0.44	0.57	0.64	0.46	0.63	0.16
Netherlands	270	15936	0.29	0.32	1.07	0.52	0.85	0.76	1.1	0.28
New Zealand	151	10265	0.4	0.44	1.4	0.52	0.84	0.74	1.5	0.4
Norway	324	22301	0.55	0.46	1	0.73	0.8	0.77	1.2	0.41
Portugal	103	6301	0.34	0.26	1	0.58	1.13	0.65	1.05	0.23
Singapore	635	9043	0.37	0.3	0.78	0.63	0.89	0.85	1.09	0.26
Spain	174	8826	0.32	0.25	0.94	0.56	0.94	0.81	0.99	0.24
Sweden	533	19330	0.48	0.41	1.04	0.72	0.8	0.85	1.25	0.37
Switzerland	260	28206	0.36	0.28	0.7	0.5	0.95	0.7	1.2	0.22
United Kingdom	2,907	15575	0.46	0.48	1.39	0.62	0.83	0.99	1.28	0.32
United States	11,392	22568	0.53	0.55	1.37	0.7	0.77	0.93	1.35	0.37

This table reports average firm-level volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the annual growth rate. All firm characteristics are from the WorldScope database. 1980 Per Capita GDP is from the World Development Indicators Database. Countries are classified by the World Bank's Atlas method. Developed Country is defined as a high-income economy and Developing Country is defined as a middle-income economy or lower.

Table 2 Panel B: Firm-Level Risk in Developed and Developing countries

Firm-Level Risk	Global Average	Developed Country Average	Developing Country Average	Developed Minus Developing	*t*-Stat	Observations in Developed Countries	Observations in Developing Countries
Volatility of Sales Growth	0.419	0.432	0.388	0.044***	(6.65)	24272	9935
Volatility of Assets Growth	0.41	0.436	0.347	0.089***	(16.58)	25847	10428
Volatility of Cash Holding Growth	1.107	1.113	1.092	0.021*	(1.9)	25564	10187
Volatility of Profit Growth	0.624	0.639	0.593	0.046***	(6.4)	18813	8768
Volatility of Intangible Assets Growth	0.83	0.795	0.93	-0.136***	(12.1)	19574	6770
Volatility of Total Debts Growth	0.802	0.837	0.718	0.119***	(12.14)	22477	9232
Volatility of Short-Term Liabilities	1.107	1.162	0.97	0.192***	(16.34)	21685	8860
Volatility of Employment Growth	0.304	0.317	0.257	0.06***	(11.55)	23440	6870

This table compares firm-level volatilities in developed and developing countries. Volatility is defined as the time-series standard deviation of the annual growth rate. Total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment are from the WorldScope database. Countries are classified by the World Bank's Atlas method. Developed Country is defined as high-income economy and developing country is defined as middle-income economy or lower. Numbers in the parentheses are the *t* statistics from univariate comparisons between developed and developing countries. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 2 Panel C: Firm-Level Growth in Developed and Developing countries

Firm-Level Growth	Global Average	Developed Country Average	Developing Country Average	Developed Minus Developing	*t*-Stat	Observations in Developed Countries	Observations in Developing Countries
Average Sales Growth	0.182	0.183	0.179	0.004	(0.73)	25564	10523
Average Assets Growth	0.176	0.168	0.196	-0.028***	(6.6)	27083	10976
Average Cash Holding Growth	0.143	0.124	0.189	-0.065***	(8.18)	26914	10785
Average Profit Growth	0.14	0.13	0.16	-0.029***	(4.78)	20570	9657
Average Intangible Assets Growth	0.192	0.184	0.213	-0.029***	(3.26)	21470	7668
Average Total Debts Growth	0.113	0.105	0.132	-0.027***	(3.51)	24336	10031
Average Short-Term Liabilities	0.117	0.105	0.145	-0.039***	(4.4)	23672	9736
Average Employment Growth	0.078	0.087	0.049	0.038***	(9.61)	25122	7756

This table compares average firm-level growth rates in developed and developing countries. Total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment are from the WorldScope database. Countries are classified by the World Bank's Atlas method. Developed Country is defined as a high-income economy and Developing Country is defined as a middle-income economy or lower. Numbers in the parentheses are the *t* statistics from univariate comparisons between developed and developing countries. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 3: Assets and Liabilities Structure

	Size	Cash/Total Assets	Intangible /Total Assets	Total Liabilities /Total Assets	Short-Term/Total Liabilities	Short-Term Liabilities /Short-Term Assets
Developed Country Dummy	0.047	6.609	6.582	-1.874	-12.384	-12.183
	(4.92)***	(83.11)***	(102.33)***	(13.93)***	(84.33)***	(32.69)***
Manufacturing Dummy	0.484	-2.124	-2.316	0.308	3.875	-5.799
	(64.16)***	(33.33)***	(44.01)***	(2.85)***	(32.49)***	(19.37)***
High-Tech Dummy	-0.734	10.202	4.93	-4.24	0.116	-9.324
	(79.07)***	(129.49)***	(75.17)***	(31.70)***	(0.76)	(25.22)***
Size Quintile		-2.75	0.518	-0.162	-6.02	-7.01
		(121.18)***	(27.63)***	(4.20)***	(139.24)***	(65.63)***
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.06	0.13	0.08	0.01	0.1	0.02
N	363059	361300	323084	351543	309943	347512

This table reports the coefficient estimates from the assets and liabilities structures regressions. The dependent variables are the following firm characteristics - firm size (natural log of total assets), cash/total assets, intangible assets/total assets, total liabilities/total assets, short-term liabilities/total liabilities, and short-term liabilities/current assets. The explanatory variables are Developed Country Dummy, Manufacturing Dummy, High-Tech Dummy, and Size Quintile. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Also estimated but not reported are a constant term and the year fixed-effects. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 4: Firm-Level Volatilities

Y= Firm-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	0.038	0.073	0.024	0.064	-0.149	0.096	0.161	0.043
	(5.89)***	(14.50)***	(2.21)**	(8.90)***	(13.29)***	(10.04)***	(13.67)***	(8.41)***
Manufacturing Dummy	-0.098	-0.12	-0.136	-0.034	-0.084	-0.155	-0.179	-0.072
	(16.97)***	(26.22)***	(13.93)***	(5.05)***	(8.50)***	(17.80)***	(16.80)***	(16.82)***
High-Tech Dummy	0.064	0.1	-0.01	0.05	0.113	0.211	0.169	0.02
	(9.17)***	(18.23)***	(0.82)	(5.83)***	(9.69)***	(19.71)***	(12.83)***	(3.98)***
Size Quintile	-0.118	-0.115	-0.241	-0.076	-0.06	-0.134	-0.072	-0.055
	(52.41)***	(65.43)***	(64.42)***	(27.84)***	(15.61)***	(39.87)***	(17.46)***	(33.12)***
R-squared	0.09	0.15	0.12	0.03	0.02	0.08	0.04	0.05
N	34207	36275	35751	27581	26344	31709	30545	30310

This table reports the coefficient estimates from the firm-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the firm's annual growth rate. The explanatory variables are Developed Country Dummy, Manufacturing Dummy, High-Tech Dummy, and Size Quintile. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 5: Cross-Sectional Dispersions

Y= Within Country Dispersions across Firms	Dispersion of Sales Growth	Dispersion of Asset Growth	Dispersion of Cash Holding Growth	Dispersion of Profit Growth	Dispersion of Intangible Assets Growth	Dispersion of Total Debt Growth	Dispersion of Short-term Liabilities Growth	Dispersion of Employment Growth
Developed Country Dummy	0.317	0.256	0.244	0.233	0.04	0.368	0.46	0.04
	(4.65)***	(4.09)***	(3.32)***	(3.31)***	(0.50)	(4.75)***	(5.34)***	(0.47)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.24	0.27	0.11	0.23	0.1	0.2	0.18	0.11
N	684	679	602	591	620	605	582	578

This table reports the coefficient estimates from the cross-sectional dispersion regressions. The dependent variables are the cross-sectional dispersion of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Cross-sectional dispersion is defined as the cross-sectional standard deviation of the firm growth rate calculated across all firms within a country. The explanatory variable is Developed Country Dummy. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Also estimated but not reported are a constant term and the year fixed-effects. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 6 Panel A: Sector-Level Volatilities

Y= Sector-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	-0.056	-0.051	-0.146	-0.086	-0.162	-0.091	-0.07	-0.01
	(4.49)***	(5.51)***	(5.29)***	(4.24)***	(4.29)***	(2.36)**	(1.59)	(0.70)
Manufacturing Fraction	-0.057	-0.053	-0.008	-0.007	-0.032	-0.036	0.033	-0.026
	(3.57)***	(4.45)***	(0.22)	(0.25)	(0.67)	(0.72)	(0.58)	(1.49)
High-Tech Fraction	0.027	0.064	-0.036	-0.126	-0.175	-0.003	-0.082	-0.013
	(0.84)	(2.70)***	(0.51)	(2.40)**	(1.84)*	(0.04)	(0.73)	(0.38)
R-squared	0.05	0.07	0.04	0.04	0.04	0.01	0.01	0
N	629	631	631	627	612	629	629	612

This table reports the coefficient estimates from the sector-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the sector-level annual growth rate. Sector classification is based on 17 Fama-French industries. The explanatory variables are Developed Country Dummy, Manufacturing Fraction, and High-Tech Fraction. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is the fraction of manufacturing firms in that sector. High-Tech is the fraction of high-tech firms in that sector according to the American Electronic Association. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 6 Panel B: Country-Level Volatilities

Y= Country-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	-0.085	-0.083	-0.1	-0.107	-0.294	-0.15	-0.158	-0.008
	(3.75)***	(3.29)***	(4.26)***	(4.12)***	(2.49)**	(2.93)***	(2.66)**	(0.96)
R-squared	0.24	0.2	0.29	0.28	0.12	0.16	0.14	0.02
N	46	46	46	46	46	46	46	46

This table reports the coefficient estimates from the country-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the country-level annual growth rate. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 7 Panel A: Foreign Entry and Volatilities

Y= Firm-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	0.07	0.095	0.015	0.078	-0.117	0.069	0.061	0.014
	(9.95)***	(17.53)***	(1.32)	(8.48)***	(8.26)***	(5.83)***	(4.12)***	(2.39)**
Manufacturing Dummy	-0.08	-0.089	-0.067	-0.018	-0.098	-0.14	-0.146	-0.061
	(11.91)***	(17.03)***	(5.99)***	(2.00)**	(7.57)***	(12.16)***	(10.35)***	(11.37)***
High-Tech Dummy	0.015	0.036	0.005	0.02	0.074	0.195	0.158	0.013
	(1.82)*	(5.53)***	(0.33)	(1.74)*	(4.73)***	(13.30)***	(8.79)***	(1.90)*
Size Quintile	-0.078	-0.078	-0.141	-0.058	-0.058	-0.109	-0.057	-0.031
	(29.64)***	(39.05)***	(32.42)***	(16.24)***	(11.26)***	(24.01)***	(10.04)***	(14.62)***
Incoming Mergers/ All Mergers	0.086	0.078	0.161	-0.063	0.124	0.129	0.171	0.046
	(7.93)***	(9.28)***	(8.93)***	(4.46)***	(5.78)***	(6.96)***	(7.54)***	(5.02)***
Initial Volatility	0.556	0.54	0.565	0.349	0.191	0.387	0.423	0.266
	(24.53)***	(20.32)***	(38.74)***	(15.30)***	(10.72)***	(18.04)***	(22.10)***	(12.61)***
R-squared	0.1	0.14	0.16	0.03	0.04	0.09	0.06	0.04
N	20149	21242	20975	17293	15943	18464	17874	16355

This table reports the coefficient estimates from the firm-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the firm annual growth rate. The explanatory variables are Developed Country Dummy, Manufacturing Dummy, High-Tech Dummy, Size Quintile and Incoming Mergers/All Mergers. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Incoming Mergers/All Mergers is the sector-level aggregate inward cross-border M&As scaled by all (domestic and inward foreign) M&As from SDC. Sector classification is based on 17 Fama-French industries. To avoid reverse causality, the measure of foreign entry is computed from 1989-1998 data while the firm-level volatilities are computed from the non-overlapping period of 1999-2008 (as opposed to the full 1989-2008 sample in other specifications). Initial volatilities are the sector average of firm-level volatilities computed from 1989-1998 data. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 7 Panel B: Foreign Outflow and Volatilities

Y= Firm-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	0.057	0.088	-0.03	0.079	-0.139	0.042	0.033	0
	(7.52)***	(15.09)***	(2.43)**	(7.94)***	(9.22)***	(3.30)***	(2.06)**	(0.08)
Manufacturing Dummy	-0.071	-0.079	-0.059	-0.028	-0.086	-0.133	-0.132	-0.06
	(10.38)***	(14.67)***	(5.21)***	(3.08)***	(6.56)***	(11.26)***	(9.17)***	(10.82)***
High-Tech Dummy	0.016	0.039	0.006	0.015	0.08	0.201	0.167	0.014
	(1.88)*	(6.00)***	(0.46)	(1.32)	(5.12)***	(13.65)***	(9.27)***	(2.08)**
Size Quintile	-0.08	-0.079	-0.144	-0.059	-0.06	-0.112	-0.058	-0.032
	(29.87)***	(38.94)***	(32.74)***	(16.31)***	(11.74)***	(24.31)***	(10.19)***	(14.83)***
Outgoing Mergers/ All Mergers	0.002	-0.02	0.096	0.042	0.037	0.043	0.026	0.028
	(0.16)	(1.91)*	(4.35)***	(2.44)**	(1.44)	(1.91)*	(0.93)	(2.69)***
Initial Volatility	0.567	0.544	0.592	0.348	0.206	0.389	0.442	0.294
	(24.80)***	(20.27)***	(39.74)***	(15.07)***	(11.68)***	(18.07)***	(23.03)***	(14.30)***
R-squared	0.1	0.14	0.16	0.03	0.03	0.09	0.06	0.04
N	19971	21063	20796	17138	15854	18297	17711	16247

This table reports the coefficient estimates from the firm-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the firm annual growth rate. The explanatory variables are Developed Country Dummy, Manufacturing Dummy, High-Tech Dummy, Size Quintile, and Outgoing Mergers/All Mergers. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Outgoing Mergers/All Mergers is the sector-level aggregate outward cross-border M&As scaled by all (domestic and outward foreign) M&As from SDC. Sector classification is based on 17 Fama-French industries. To avoid reverse causality, the measure of foreign entry is computed from 1989-1998 data while the firm-level volatilities are computed from the non-overlapping period of 1999-2008 (as opposed to the full 1989-2008 sample in other specifications). Initial volatilities are the sector average of firm-level volatilities computed from 1989-1998 data. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 8 Panel A: Technology and Volatilities

Y= Firm-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	0.041	0.074	0.029	0.056	-0.168	0.101	0.171	0.049
	(5.88)***	(13.36)***	(2.45)**	(7.17)***	(13.38)***	(9.61)***	(13.26)***	(8.83)***
High-Tech Dummy	0.013	0.023	-0.084	-0.009	-0.003	0.116	0.074	-0.004
	(0.92)	(1.94)*	(3.42)***	(0.54)	(0.11)	(5.22)***	(2.70)***	(0.33)
Developed Country Dummy x High Tech	0.056	0.085	0.078	0.077	0.142	0.106	0.104	0.021
	(3.42)***	(6.42)***	(2.81)***	(4.04)***	(5.16)***	(4.18)***	(3.34)***	(1.56)
Size Quintile	-0.121	-0.119	-0.246	-0.076	-0.062	-0.138	-0.077	-0.057
	(53.68)***	(68.00)***	(66.13)***	(28.06)***	(16.36)***	(41.05)***	(18.62)***	(34.70)***
R-squared	0.09	0.14	0.11	0.03	0.02	0.07	0.03	0.04
N	34207	36275	35751	27581	26344	31709	30545	30310

This table reports the coefficient estimates from the firm-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the firm annual growth rate. The explanatory variables are Developed Country Dummy, High-Tech Dummy, the interaction term between Developed Country Dummy and High-Tech Dummy, as well as Size Quintile. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 8 Panel B: External Finance Dependency and Volatilities

Y= Firm-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	-0.01	0.029	0.047	0.011	-0.227	0.027	0.104	0.036
	(0.73)	(2.56)**	(1.89)*	(0.65)	(8.60)***	(1.19)	(3.74)***	(3.14)***
External Dependency	0.066	0.071	-0.134	-0.017	-0.031	0.138	0.082	0.017
	(2.92)***	(3.98)***	(3.40)***	(0.62)	(0.76)	(3.77)***	(1.82)*	(0.87)
Developed Country Dummy x External Dependency	0.159	0.155	0.078	0.188	0.181	0.254	0.228	0.037
	(5.86)***	(7.26)***	(1.65)*	(5.60)***	(3.70)***	(5.76)***	(4.23)***	(1.67)*
Size Quintile	-0.101	-0.096	-0.248	-0.067	-0.048	-0.124	-0.083	-0.048
	(35.01)***	(42.68)***	(49.90)***	(17.85)***	(9.38)***	(26.80)***	(14.61)***	(22.20)***
R-squared	0.1	0.14	0.13	0.03	0.02	0.08	0.04	0.04
N	17628	18133	17953	14509	13783	16412	15985	15407

This table reports the coefficient estimates from the firm-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the firm annual growth rate. The explanatory variables are Developed Country Dummy, External Finance Dependency Indicator, the interaction term between Developed Country Dummy and External Finance Dependency Indicator, as well as Size Quintile. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. External Finance Dependency Indicator is from Rajan and Zingales (1998). Size Quintile is constructed from the cross-country distribution of total assets. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 8 Panel C: Small-Firm Dominance and Volatilities

Y= Firm-Level Volatility	Volatility of Sales Growth	Volatility of Asset Growth	Volatility of Cash Holding Growth	Volatility of Profit Growth	Volatility of Intangible Assets Growth	Volatility of Total Debt Growth	Volatility of Short-term Liabilities Growth	Volatility of Employment Growth
Developed Country Dummy	0.146	0.185	0.108	0.119	-0.086	0.263	0.305	0.073
	(9.48)***	(15.11)***	(4.03)***	(6.33)***	(3.03)***	(10.50)***	(10.03)***	(5.87)***
Small Firm Industry	-0.001	-0.001	-0.001	0.001	0.001	0.004	0.005	-0.001
	(0.85)	(1.00)	(0.18)	(0.48)	(0.39)	(1.30)	(1.62)	(0.93)
Developed Country Dummy x Small Firm Industry	-0.01	-0.01	-0.006	-0.003	-0.008	-0.014	-0.012	-0.003
	(4.83)***	(6.12)***	(1.55)	(1.14)	(1.99)**	(4.10)***	(2.89)***	(1.49)
Size Quintile	-0.11	-0.105	-0.243	-0.072	-0.054	-0.141	-0.096	-0.05
	(39.23)***	(48.00)***	(50.52)***	(19.44)***	(10.84)***	(31.05)***	(17.31)***	(23.97)***
R-squared	0.09	0.13	0.13	0.03	0.02	0.07	0.03	0.04
N	17628	18133	17953	14509	13783	16412	15985	15407

This table reports the coefficient estimates from the firm-level volatility regressions. The dependent variables are the volatilities of total assets, cash, intangible assets, total liabilities, short-term liabilities, sales, profit, and employment. Volatility is defined as the time-series standard deviation of the firm annual growth rate. The explanatory variables are Developed Country Dummy, Small Firm Industry Indicator, the interaction term between Developed Country Dummy and Small Firm Industry Indicator, as well as Size Quintile. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Small Firm Industry Indicator is from Beck, Demirguc-Kunt, Laeven, and Levine (2008). Size Quintile is constructed from the cross-country distribution of total assets. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 8 Panel D: Rivalry among Industry Leaders

Y= Volatilities of Industry Leader's Market Share	Market Share among the Top 2 Firms			Market Share among the Top 5 Firms		
	Technological Intensity	External Dependency	Small Firm Dominance	Technological Intensity	External Dependency	Small Firm Dominance
Developed Country Dummy	0.506	-0.045	0.477	0.496	0.002	0.56
	(11.15)***	(0.50)	(4.48)***	(11.49)***	(0.02)	(5.55)***
High-Tech Dummy	1.18			1.16		
	(8.74)***			(9.03)***		
Developed Country Dummy x High Tech	0.399			0.419		
	(2.58)***			(2.85)***		
External Dependency		0.723			0.704	
		(3.91)***			(4.02)***	
Developed Country Dummy x External Dependency		0.687			0.584	
		(3.20)***			(2.87)***	
Small Firm Industry			0.012			0.026
			(0.98)			(2.29)**
Developed Country Dummy x Small Firm Industry			-0.032			-0.043
			(2.29)**			(3.33)***
Year	0.108	0.09	0.093	0.106	0.088	0.091
	(25.71)***	(17.18)***	(17.79)***	(26.48)***	(17.71)***	(18.28)***
R-squared	0.02	0.01	0.01	0.02	0.01	0.01
N	67615	38638	38638	67615	38638	38638

This table reports the coefficient estimates from the market share volatility regressions. The dependent variables are the volatilities of industry leader's market share. In each year, we identify the largest two (five) firms in each four-digit SIC industry in each country. We track the size of these two (five) firms over the next five years. Then, we compute the volatilities of market share of the largest firms. Volatility is defined as the time-series standard deviation of the market share. The first three columns report the results from the top two firms' market shares. The last three columns report the results from the top five firms' market shares. The explanatory variables are developed country dummy, industry indicators (high-tech, external finance, and small firm industries), the interactions between developed country dummy and industry indicators and Year. High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. External Finance Dependency Indicator is from Rajan and Zingales (1998). Small Firm Industry Indicator is from Beck, Demirguc-Kunt, Laeven, and Levine (2008). Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 9: Reactions to Productivity Shocks

Shock =Growth in Value Added	Sales Growth	Asset Growth	Cash Holding Growth	Profit Growth	Intangible Assets Growth	Total Debt Growth	Short-term Liabilities Growth	Employment Growth
Shock	0.124	0.09	0.128	0.216	0.094	0.056	0.081	0.06
	(8.42)***	(6.77)***	(3.89)***	(8.81)***	(2.40)**	(2.00)**	(2.10)**	(4.33)***
Shock x Developed Country Dummy	0.141	0.15	0.255	0.254	0.15	0.108	0.077	-0.007
	(7.33)***	(8.69)***	(5.92)***	(7.78)***	(3.15)***	(2.90)***	(1.52)	(0.42)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.26	0.25	0.15	0.18	0.19	0.19	0.14	0.22
N	102402	105775	103403	72911	76752	88967	85296	88013

This table reports the coefficient estimates from the reactions-to-productivity-shocks regressions. The dependent variables are the growth rate of sales, total assets, cash, profit, intangible assets, total liabilities, short-term liabilities, and employment. The explanatory variables are Productivity Shocks and the interaction between Productivity Shocks and Developed Country dummy. Productivity Shock is the percentage change in value added from the UNIDO Database. Developed Country Dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Also estimated but not reported are the firm-fixed effects. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 10: Difference-in-Difference Analysis for Cash Holdings

Y= Cash/Total Assets	Technological Intensity	External Dependency	Small Firm Dominance	Foreign Inflows	Foreign Outflows
Developed Country Dummy	6.013	-0.317	13.807	5.88	5.966
	(70.43)***	(1.82)*	(68.45)***	(60.81)***	(57.63)***
High-Tech Dummy	4.564			7.206	7.208
	(23.24)***			(61.60)***	(61.54)***
Developed Country Dummy x High Tech	6.39				
	(29.90)***				
External Dependency		6.245			
		(20.10)***			
Developed Country Dummy x External Dependency		16.66			
		(47.27)***			
Small Firm Industry			-0.053		
			(2.21)**		
Developed Country Dummy x Small Firm Industry			-0.733		
			(26.40)***		
Incoming Mergers/ All Mergers				0.179	
				(1.18)	
Outgoing Mergers/ All Mergers					-0.604
					(3.33)***
Manufacturing Dummy				-3.945	-3.782
				(42.90)***	(40.04)***
Size Quintile	-2.797	-1.784	-2.633	-2.913	-2.926
	(123.70)***	(57.31)***	(83.58)***	(87.13)***	(86.62)***
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.13	0.16	0.09	0.12	0.12
N	361300	188503	188503	151521	150386

This table reports the coefficient estimates from the cash holding regressions. The dependent variable is Cash/Total Assets. Developed Country dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. External Finance Dependency Indicator is from Rajan and Zingales (1998). Small Firm Industry Indicator is from Beck, Demirguc-Kunt, Laeven, and Levine (2008). Incoming Mergers/All Mergers is the sector-level aggregate inward cross-border M&As scaled by all (domestic and inward foreign) M&As. Outgoing Mergers/All Mergers is the sector-level aggregate outward cross-border M&As scaled by all (domestic and outward foreign) M&As. Size Quintile is constructed from the cross-country distribution of total assets. To avoid reverse causality, the measure of foreign entry is computed from 1989-1998 data while Cash/Total Assets in the last two columns are restricted to the non-overlapping period of 1999-2008 (as opposed to the full 1989-2008 sample in other specifications). Also estimated but not reported are a constant term and the year fixed-effects. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table11 Panel A: Institution and Cash Holding

Y=Cash/Total Assets; Institution=	Ease of Doing Business Rank	Judiciary Efficiency	Rule of Law	Corruption	Accounting Standard	Log of Per Capita GDP in 1980	Stock Market Capitalization/ GDP in 1980	Investment-Q Sensitivity	Share Issue-Q Sensitivity	Debt Issue -Q Sensitivity
Institution	-0.068	1.697	1.715	1.624	0.122	1.87	4.466	27.771	10.305	9.32
	(72.05)***	(84.58)***	(91.99)***	(72.06)***	(38.18)***	(76.60)***	(35.07)***	(40.30)***	(50.92)***	(56.08)***
Manufacturing Dummy	-2.324	-2.379	-2.143	-2.217	-2.663	-2.064	-2.609	-2.512	-2.358	-2.366
	(36.43)***	(36.19)***	(32.54)***	(33.43)***	(40.16)***	(31.37)***	(38.01)***	(37.66)***	(35.31)***	(35.56)***
High-Tech Dummy	10.267	10.433	10.258	10.679	10.955	10.445	11.082	10.95	10.772	10.727
	(129.76)***	(127.92)***	(125.78)***	(130.86)***	(133.64)***	(128.35)***	(131.06)***	(133.64)***	(131.34)***	(130.88)***
Size Quintile	-2.69	-2.81	-2.826	-2.777	-2.703	-2.828	-2.788	-2.6	-2.567	-2.6
	(118.16)***	(120.54)***	(121.43)***	(118.82)***	(114.85)***	(121.11)***	(114.80)***	(109.24)***	(108.09)***	(110.19)***
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.12	0.13	0.14	0.13	0.12	0.13	0.12	0.12	0.12	0.12
N	360629	342967	342967	342967	342967	347161	324074	342967	342967	342967

This table reports the coefficient estimates from the cash holding regressions. The dependent variable is Cash/Total Assets. The explanatory variables are Institutional Indicator, Manufacturing Dummy, High-Tech Dummy, and Size Quintile. Institutional Indicators are Ease of Doing Business Rank from the World Bank's doing business indicator, Judiciary Efficiency, Rule of Law, Corruption, Accounting Standard from La Porta et. al (1998), 1980 Log of Per Capita GDP from World Development Indicator Database, 1980 Stock Market Capitalization per GDP from Rajan and Zingales (1998), investment sensitivity, share issue sensitivity, and debt issue sensitivity to Tobin's Q from McLean, Zhang, and Zhao (2012). Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Also estimated but not reported are a constant term and the year fixed-effects. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 11 Panel B: Institution and Firm- Level Risk

Y=Volatility of Sales Growth; Institution=	Ease of Doing Business Rank	Judiciary Efficiency	Rule of Law	Corruption	Accounting Standard	Log of Per Capita GDP in 1980	Stock Market Capitalization / GDP in 1980	Investment-Q Sensitivity	Share Issue-Q Sensitivity	Debt Issue -Q Sensitivity
Institution	-0.001	0.014	0.03	0.025	0.004	0.027	0.115	1.982	0.571	0.427
	(15.53)***	(7.71)***	(19.06)***	(12.96)***	(12.35)***	(13.37)***	(10.42)***	(32.17)***	(31.35)***	(28.84)***
Manufacturing Dummy	-0.09	-0.099	-0.086	-0.091	-0.096	-0.089	-0.097	-0.076	-0.073	-0.078
	(15.41)***	(16.22)***	(14.16)***	(14.79)***	(15.88)***	(14.74)***	(15.40)***	(12.53)***	(12.11)***	(12.90)***
High-Tech Dummy	0.056	0.063	0.052	0.061	0.063	0.058	0.064	0.052	0.047	0.048
	(8.08)***	(8.68)***	(7.12)***	(8.36)***	(8.67)***	(8.03)***	(8.51)***	(7.23)***	(6.58)***	(6.68)***
Size Quintile	-0.118	-0.119	-0.122	-0.12	-0.117	-0.123	-0.12	-0.111	-0.112	-0.115
	(52.55)***	(50.94)***	(52.27)***	(51.42)***	(50.22)***	(52.65)***	(49.74)***	(48.20)***	(48.31)***	(49.62)***
R-squared	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.12	0.12	0.12
N	34120	31984	31984	31984	31984	32594	30221	31984	31984	31984

This table reports the coefficient estimates from the volatility regressions. The dependent variable is the volatilities of sales growth. The explanatory variables are Institutional Indicator, Manufacturing Dummy, High-Tech Dummy, and Size Quintile. Institutional Indicators are Ease of Doing Business Rank from the World Bank's doing business indicator, Judiciary Efficiency, Rule of Law, Corruption, Accounting Standard from La Porta et. al (1998), 1980 Log of Per Capita GDP from World Development Indicator Database, 1980 Stock Market Capitalization per GDP from Rajan and Zingales (1998), investment sensitivity, share issue sensitivity, and debt issue sensitivity to Tobin's Q from McLean, Zhang, and Zhao (2012). Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Also estimated but not reported is a constant term. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 12 Panel A: Cash Holding and Volatilities

Y=Cash/Total Assets	Sample = U.S. Firms Only		Sample = All Countries			Non-Overlapping Sample
Country-Level Aggregate Sales Volatility			-3.989			
			(4.81)***			
Sector-Level Aggregate Sales Volatility	5.633			-2.182		
	(2.07)**			(5.69)***		
Firm-Level Sales Volatility		29.169			10.101	9.83
		(45.28)***			(56.04)***	(30.88)***
Developed Country Dummy			6.236	6.399	5.97	7.45
			(56.19)***	(73.03)***	(74.64)***	(76.27)***
Manufacturing Dummy	-0.744	1.164	-2.124	-2.147	-1.322	-2.198
	(5.02)***	(7.69)***	(33.34)***	(33.63)***	(20.32)***	(26.15)***
High-Tech Dummy	13.271	10.742	10.168	10.159	9.587	10.076
	(83.61)***	(64.51)***	(128.55)***	(128.37)***	(121.03)***	(102.05)***
Size Quintile	-3.924	-3.644	-2.744	-2.755	-2.468	-3.13
	(81.90)***	(76.17)***	(120.81)***	(121.31)***	(106.65)***	(107.25)***
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.16	0.18	0.13	0.13	0.14	0.14
N	103351	103351	361300	361268	361268	244090

This table reports the coefficient estimates from the cash holding regressions. The dependent variable is Cash/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 sector. Firm-level volatility is defined as the standard deviation of firm-level sales growth. To alleviate the endogeneity problem, firm-level volatilities were averaged across all firms in their sector before they are included in the regressions. Developed Country dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. In the last column, the measure of firm-level volatility is computed from 1989-1998 data while Cash/Total Assets are restricted to the non-overlapping period of 1999-2008 (as opposed to the full 1989-2008 sample in other specifications). Also estimated but not reported are a constant term and the year fixed-effects. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 12 Panel B: Cash Holding, Volatilities, and Firm Characteristics

Y=Cash/Total Assets							
Firm-Level Sales Volatility	10.101	8.618	8.567	12.292	13.945	15.188	12.625
	(56.04)***	(46.50)***	(45.28)***	(61.05)***	(55.63)***	(37.81)***	(32.62)***
Developed Country Dummy	5.97	5.16	5.588	4.876	4.94	3.747	2.751
	(74.64)***	(62.86)***	(64.06)***	(54.75)***	(46.18)***	(19.65)***	(14.91)***
Manufacturing Dummy	-1.322	-1.26	-1.174	-1.264	-0.952	-2.443	-1.73
	(20.32)***	(18.98)***	(17.24)***	(17.80)***	(11.39)***	(18.89)***	(13.79)***
High-Tech Dummy	9.587	9.421	9.648	9.601	10.227	7.367	6.921
	(121.03)***	(115.37)***	(115.14)***	(111.59)***	(103.32)***	(53.31)***	(51.38)***
Size Quintile	-2.468	-2.294	-2.268	-2.304	-2.314	-1.709	-0.958
	(106.65)***	(96.02)***	(91.50)***	(90.57)***	(79.02)***	(37.54)***	(21.26)***
Lagged Leverage		-0.1	-0.099	-0.096	-0.089	-0.115	-0.146
		(94.33)***	(91.20)***	(86.60)***	(72.95)***	(65.41)***	(79.47)***
Lagged Dividend Dummy			-0.002	-0.002	-0.002	-0.002	-0.002
			(15.78)***	(14.47)***	(13.94)***	(13.25)***	(13.64)***
Lagged Capital Expenditure/Total Assets				-0.234	-0.253	-0.343	-0.396
				(51.37)***	(47.85)***	(38.77)***	(43.80)***
Lagged Acquisitions/Total Assets					-0.352	-0.392	-0.348
					(45.93)***	(33.15)***	(30.56)***
Lagged R&D/Total Assets						0.387	0.318
						(86.39)***	(66.56)***
Lagged Tobin's Q/Total Assets							0.893
							(57.85)***
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.14	0.16	0.16	0.18	0.19	0.28	0.31
N	361268	312189	298090	279656	216918	104175	94624

This table reports the coefficient estimates from the cash holding regressions. The dependent variable is Cash/Total Assets. Firm-level volatility is defined as the standard deviation of firm-level sales growth. To alleviate the endogeneity problem, firm-level volatilities were averaged across all firms in their sector before they are included in the regressions. Developed Country dummy takes the value of one if the country is classified as a high-income economy and zero if the country is classified as a middle-income economy or lower. Manufacturing Dummy is equal to one if the firm is in the manufacturing industries (SIC codes 2000-3999). High-Tech is equal to one if the firm is in the high-tech industry according to the American Electronic Association. Size Quintile is constructed from the cross-country distribution of total assets. Leverage, Dividend Dummy, Capital Expenditure/Total Assets, Acquisitions/Total Assets, R&D/Total Assets, and Tobin's Q are from the WorldScope. Also estimated but not reported are a constant term and the year fixed-effects. Numbers in the parentheses are the *t* statistics. The *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Internet Appendix

Internet Appendix A: Robustness Tests

In this appendix, we summarize the results from additional robustness checks. The sections in the appendix correspond to the sections in the main article where the robustness checks belong.

4. Asset and Liability Structures

Alternative Specifications

We examine several variations of the asset and liability structure regressions in Table 3. To fully control for industry effects, we replace manufacturing and high tech dummies with two-digit SIC industry fixed effects. To check whether our country dummy captures the degree of economic and institutional development, we use per capita GDP in 1980 instead of a developed country dummy. Our findings hold in all these robustness checks.

Sample Selection

Our main sample covers all countries in WorldScope with a large number of observations. We further add smaller countries such as Egypt and Lithuania to our sample to ensure diverse geographical representation. To verify that our results are not sample specific, we estimate the assets and liabilities structure regressions in Table 3 using alternative country samples: (1) the entire WorldScope and (2) all the countries in WorldScope with greater than 1,000 firm-year observations. We still find that firms in developed countries have more conservative financial policies (more cash, lower leverage, and fewer short-term debts). The coefficients on other explanatory variables barely change. The only major difference between the main and alternative samples is that in the alternative samples, average firms in developed countries are smaller than average firms in developing countries. The size result is the opposite in our main sample where countries with small number of observations are excluded. For the time period, our main samples cover the data from 1989 to 2008 so a concern is whether our results change after the 2008 global financial crisis. We estimate the regressions in Table 3 using the data from 2009 to 2012. The result that firms in developed countries have more conservative financial policies still holds.

Controls for Size and Age

In addition to Total Assets, we also use market capitalization as an alternative proxy for firm size. Market capitalization is computed from the number of shares outstanding x 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. All existing results still hold.

One might be concerned that size quintile is not an adequate control for firm size. To address these issues, we replace 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) and the size relative to other firms in its local sector (the firm's total assets scaled by its local sector's average total assets) where a local sector is defined as one of the 17 Fama-French industries in the firm's country. Our main results hold for alternative measures– developed

country firms hold more cash, have more intangible assets, have lower leverage, and fewer short-term debts. Large firms have less cash, more intangible assets, and less short-term debts. Studying firms in different countries conditioned on relative size also mitigates the concern that WorldScope might not capture the majority of firms in developing countries and that we only compare the largest firms in developing countries with average firms in developed countries.

To address the concern that observations in developed and developing countries are not comparable because firms in different countries decide to go public at different stages in their life cycles, we control for firm age. We define firm age as current year less incorporation year. A caveat is that WorldScope data on firm's age is very limited – fewer than half of our observations have data on firm age. The existing results still hold. Developed country firms hold more cash, have more intangible assets, have lower leverage, and have fewer short-term debts. Firms in developing countries are generally older than firms in developed countries. Age is highly correlated with size, and most effects of age on financial structures are similar to size. Like larger firms, older firms have less cash, lower leverage, and fewer short-term debts. The only difference is intangible assets – larger firms have more intangible assets but older firms have less.

Standard Errors

First, we compute heteroscedasticity robust standard errors using the Huber-White sandwich estimators. In addition to robust standard errors, we estimate the standard errors with clusters on country and industry where each industry is defined as a two-digit SIC group. We also cluster standard errors by firm. All the main results are still statistically significant.

5. Firm-Level Risk

5.1 Volatility

Alternative Specifications

We examine a number of variations of the firm-level volatility regressions in Table 4. As alternative controls for industry effects, we replace manufacturing and high-tech dummies with two-digit SIC industry fixed effects. To check whether our country dummy captures the degree of economic and institutional development, we use per capita GDP in 1980 instead of a developed country dummy. 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. To address the concern that the annual data we use to compute volatilities are less complete in certain countries, for each firm we count the number of years in which the data are available and explicitly control for them in the regressions. Our findings remain strong in all of these robustness checks.

Quality of WorldScope Data

A concern is that the quality of financial statement information may vary across countries. However, we study volatilities of growth rates. So, any fixed discrepancies in accounting standards have already been differenced away.

Yet another concern is that fundamentals of firms in emerging markets are in fact very volatile but their financial statements do not reflect the true fundamentals. For example, the accounting literature suggests that firms may deliberately manipulate their earnings so that the numbers are stable instead of having years with exceptionally good or bad earnings. To alleviate this concern, we study volatilities of eight different variables including sales and employment which are more difficult to manipulate. Furthermore, we try subtracting increase in accounts receivable from sales growth to eliminate the possibility of credit sales manipulation. We still find that firms in developed countries are more volatile.

The survival rates of firms in WorldScope (measured by the likelihood that a firm with financial statement information in year t will exist in WorldScope in year t+i) differ across countries. We find that firms in developed countries have lower survival rates for all i in {1,2,3,4,5}. This is consistent with our main findings that firms in developed countries are riskier.

Sample Selection

To ensure that our risk results are not sample specific, we estimate the regressions in Tables 4-6 using alternative country samples: (1) the entire WorldScope and (2) all the countries in WorldScope with greater than 100 firms. We confirm that firm-level volatilities and cross-sectional dispersions are higher in developed countries. For country-level volatilities, we confirm that aggregate volatilities are higher in developing countries. The major difference between the main and alternative samples is in Table 6 Panel A: Sector-Level Volatilities. In the main sample, sector-level volatilities are higher in developing countries. In alternative samples, sector-level volatilities are higher in developed countries. This difference is likely to be driven by the fact that, in alternative samples which contain many countries with small number of firms, sector-level volatilities are closer proxies of firm-level volatilities, rather than aggregate volatilities. To ensure that our results are not just driven by firms from some large developed countries, we exclude countries with the most observations such as the U.S., U.K., Japan, and Canada. For the time period, our main samples cover the data from 1988 to 2008. We compute alternative measures of volatilities using the data up to 2012 and the main results still hold. We also compute cross-sectional dispersions each year from 2009 to 2012. We still find that cross-sectional dispersions are higher in developed countries.

Given that we find greater firm-level risk in 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 (1988-2008) 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.

Controls for Exchange Rate Volatilities

We use firm characteristics from WorldScope that are denominated in U.S. dollars. Intuitively, it is unlikely that our results are driven by exchange rate volatilities; we find that firms in developed countries are more volatile despite the fact that exchange rate volatilities tend to be higher in developing countries. To formally address this concern,

we compute firm-level risk in local currencies. We define growth rate in local currency as $G_{i,t} + \ln(e_{c,t}) - \ln(e_{c,t-1})$ where $G_{i,t}$ is firm growth rate in USD. $e_{c,t}$ is the exchange rate in local currency/USD and $\ln(e_{c,t}) - \ln(e_{c,t-1})$ is percentage depreciation of local currency. Our exchange rate is the annual average of daily exchange rates from Bloomberg. During the sample period, a number of countries such as Argentina, Mexico, and the Eurozone countries switched their currencies. Since new currencies are sometimes introduced because of high inflation, we use depreciation rate of the old currency for the transition year to capture large revaluation.

Our existing results still hold. Volatilities in local currencies are higher in developed countries. Volatilities in local currencies are not very different from volatilities in USD because exchange rate volatilities are much smaller than the volatilities of firm performance and characteristics. This is even true in developing countries. We also find a positive correlation between firm growth and appreciation of local currency.

Alternative Measure of Profitability

Percentage growth (log difference) in profits is not defined when earnings are less than zero. So, observations with negative earnings are automatically omitted from the calculation of profit growth volatilities. To solve this problem, we use an alternative measure of variation in profitability: we compute the volatilities of ROAs (level) instead of profits growth. The results are qualitatively similar.

Controls for Size and Age

We also use market capitalization as an alternative proxy for firm size. Market capitalization is computed from number of shares outstanding x year-end equity price in USD. The size quintile constructed from market capitalization is highly correlated with our original measure constructed from total assets. All existing results still hold.

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 that are considered 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), and the size relative to other firms in its local sector (the firm's total assets scaled by its local sector's average total assets) where a local sector is defined as one of the 17 Fama-French industries in the firm's country. Our main results hold for all alternative measures – firms in developed countries and smaller firms have higher volatilities.

To address the concern that observations in developed and developing countries are not comparable because firms in different countries decide to go public at different stages in their life cycles, we control for firm age (averaged across all years the firm is present in the sample). Our existing results still hold. Firms in developed countries also have

higher volatilities. Older firms also have lower volatilities. However, the interpretation of this result is not clear as survival of older firms can be considered a measure of market imperfection itself.

Standard Errors

First, we compute heteroscedasticity robust standard errors using the Huber-White sandwich estimators. In addition to robust standard errors, we estimate the standard errors with clusters on country and industry where each industry is defined as a two-digit SIC group. All the main results are still statistically significant.

5.2 Cross-Sectional Dispersion

We estimate several variations of the cross-sectional dispersion regressions in Table 5. First, we replace year-fixed effects with GDP growth rates and find that dispersions tend to be higher during bad times (year with lower GDP growth rate). We also compute cross-sectional dispersion within a sector instead of within a country. Sector is defined as one of the 17 Fama-Frech Industries within a country. We find that sector-level dispersions of sales growth, asset growth, total debt growth, short-term liability growth, and employment growth across firms within an industry are higher in developed countries. The sectors with more high-tech firms have higher cross-sectional dispersions. The sectors with more manufacturing firms have lower cross-sectional dispersions.

5.4 Competition and Firm-Level Risk

Alternative Measures of Competition

In addition to foreign entry, we also use two other proxies for international competition. We examine the volatilities of cross-listed and export-oriented firms. It is likely that cross-listed and export-oriented firms have more exposure to global competition. We collect the data on ADRs from Bank of New York Mellon and foreign sales from WorldScope. Then, we include ADR dummy and percentage of foreign sales in the regressions. First, we find positive correlations with size quintile – larger firms are more likely to have ADRs and a higher fraction of foreign sales. After controlling for size quintile, firms with ADRs and firms with a higher percentage of foreign sales are indeed more volatile.

We also use privatization of state-owned enterprises as an alternative proxy of increases in competitive pressure. An extensive literature finds that state-owned enterprises experience increases in profitability, productivity, and investment after privatization. (See, for example, Gupta (2005).) We thus expect that privatization of state-owned enterprises affects risk of other incumbent firms. The data on privatization are from the World Bank's Privatization Database. We include privatization dummy in the regressions. The dummy takes the value of one if the firm is in an industry where privatization of state-owned enterprises took place during 1989-1998 and zero otherwise. We find that firms in industry with privatization experience higher volatilities in the subsequent period.

6. Drivers of Firm-Level Volatilities

Inclusion of Interaction between Developed Country Dummy and Firm Size

In Table 8 Panels A-C, we also estimate the specification where the interaction between Developed Country Dummy and Size Quintile is included. The coefficient on this interaction term is negative and significant. Besides Size Quintile constructed from global distribution of firms, we also use two alternative proxies: (1) Size Quintile from the distribution within one country and (2) Firm Age. The coefficients on the interaction terms are all negative. These findings are consistent with the notion that small and young firms in developed countries are particularly risky because they have to compete with both new entrants and larger incumbents. The interactions between Developed Country Dummy and industry indicators (High-Tech Dummy, External Finance, and Small Firm Dominated) remain significant across all specifications, implying that the size and the industry effects are distinct and non-nested.

Inclusion of Interactions between Industry Indicators and Firm Size

In Table 8 Panels A-C, we also estimate the specification with the interactions between High-Tech Dummy and Size Quintile, between External Finance and Size Quintile, and between Small Firm Dominated and Size Quintile. We find that the size effects are more pronounced in high-tech, external finance dependent, and large-firm dominated industries. The interactions between Developed Country Dummy and High-Tech Dummy, between Developed Country Dummy and External Finance, and between Developed Country Dummy and Small Firm Dominated remain significant, implying that the size and the country effects are distinct and non-nested.

Alternative Specifications

In Table 8 Panels A-C, we replace developed country dummies with a full set of country fixed-effects, replace industry characteristics with a full set of two-digit SIC industry fixed-effects, and estimate the coefficients on the interaction between 1980 Per Capita GDP and industry characteristics (High-Tech Dummy, External Finance Dependency, and Small Firm Industry Indicators). The results are qualitatively similar. Most coefficients on the interaction terms and size quintile remain statistically significant at 1%.

7. Reaction to Shocks

Alternative Specifications

We estimate several variations of the reaction-to-shock regressions in Table 9. We use growth in output and labor productivity (output per worker) as alternative proxies for productivity shock. We use per capita GDP in 1980 instead of the developed country dummy for the interaction terms. To address the concern that financial statement data are not reliable in some countries, we replace WorldScope financial statement data with establishments, employment, fixed capital, and sales data from UNIDO. We also divide the sample based on the country dummy and firm size quintile. We find the firms in developed countries are more sensitive to shocks in all these robustness tests.

Matching Shock Size

In Table 9, the firm fixed-effects already control for the difference in average growth rates and average productivity shock. However, shock size (absolute value of the shock) can still differ across countries. So, we examine the size

distribution of shocks. We indeed find that the average shock size is larger in developing countries: we classify observations into shock size quartiles and the majority of observations from developing countries fall in the largest quartile. As a consequence, one might be concerned that firm reactions in developed and developing countries are not comparable because the productivity shocks are of different sizes. To address this concern, (1) given that most observations with small productivity shocks are from developed countries, we re-run the response-to-shock regressions using only the subsample with shocks from the largest quartile. (In this quartile, we have roughly equal number of firms in developed and developing countries.) (2) Alternatively, we directly assign each observation in developing countries a developed country match based on productivity quartile, sector, year, and firm size. We still find that firms in developed countries are more responsive to shocks. Across all types of assets and liabilities, cash is the most responsive component.

8. Additional Tests

8.2 Alternative Measures for Country Characteristics

In Table 11 Panel A, we also control for other firm characteristics from the cash holding literature: lagged Leverage, Dividend Dummy, Capital Expenditure/Total Assets, Acquisitions/Total Assets, R&D/Total Assets, and Tobin's Q. All institutional variables remain significant at the 1% level.

As an alternative to McLean, Zhang, and Zhao's (2012) measures, we also use the elasticity of industry investment to industry value added from Wurgler (2000) as a proxy for allocative efficiency. The results are qualitatively similar.

8.3 Effects of Volatilities on Cash Holding

Alternative Specifications

It is possible that the results in Table 12 Panel B are driven by omitted variables. Sector average of firm-level volatilities may pick up industry effects not captured by manufacturing and high-tech dummies or pick up country effects not captured by developed country dummy. To address these concerns, we replace developed-country dummies with 1980 per capita GDP and replace manufacturing/ high-tech dummies with a full set of two-digit SIC fixed effects. The coefficient on firm-level volatility is still large and statistically significant at 1% level.

Dittmar and Duchin (2012)'s Specification

Following Dittmar and Duchin (2012), we also estimate an alternative specification where we do not scale cash with total assets and use either (1) cash in dollar amount or (2) a dummy variable indicating whether firm cash holding is in the top decile as our dependent variable. We still find that firms in developed countries and firms in high-tech industries hold more cash. The coefficients on developed countries and high-tech dummies are large and highly significant. As expected, larger firms hold more cash in dollar amounts and are more likely to be in the top cash decile.

Controls for Alternatives to Cash Holdings

A concern is that cash holding may differ across countries because firms in certain countries have better access to alternative sources of liquidity. For example, closely-held firms such as family businesses might be able to raise capital from their block holders. Conglomerates may be able to transfer funds across their industrial segments. Firms with bank relationships may be able to use lines of credit in lieu of cash. As a robustness check, we control for factors that determine a firm's alternatives to cash: ownership, organizational structure, and bank relationship. All data are from WorldScope.

First, we control for the fraction of shares that are closely-held. We find that shares are more closely-held in developing countries and in small firms. The correlation between the fraction of closely-held shares and developed country dummy is -18% and the correlation between the fraction of closely-held shares and size quintile is -14%. We find that closely-held firms hold less cash but the coefficients become less significant after controlling for the developed country dummy. Closely-held firms are also less volatile.

We also directly address the concern that our results are driven by family business groups in emerging markets. We use the ownership data from Claessens, Djankov, and Lang (2000) which cover the sample of firms in East Asia where family businesses are prevalent. First, we include a family business group dummy in the regressions from Tables 3 and 4 to examine the effects of family business group membership on cash holding and volatilities among firms whose ownership data are available. We confirm that family firms hold less cash and have lower volatilities. To ensure that our results are not solely driven by family firms, we also run the regressions in Tables 3 and 4 with the subsample of non-family firms in East Asia, using firms in the U.S. as a benchmark. We still find that developed-country firms still hold more cash and higher volatilities. We further exclude American firms with dual-class shares (which are more likely to be family firms) from the sample and focus on non-family firms in East Asia and non-dual class firms in the U.S. Again, firms in developed countries (primarily the U.S.) still hold more cash and have higher volatilities.

Second, we construct a dummy variable indicating whether a firm reports more than one product segment. We find that 37% of firms in developed countries and 19% of firms in developing countries are multi-segment. Multi-segment firms are also larger than single-segment firms. Firms in high-tech industries are less likely to have more than one segment while firms in manufacturing industries are more likely to have more than one segment. Multi-segment firms tend to hold less cash and have lower volatilities than average firms.

Third, we control for bank relationships. Since WorldScope does not provide any direct data on bank loans, we use a dummy variable indicating whether a firm has any loans as a proxy for bank relationship. We find that firms with positive total loans tend to hold less cash.

Overall, our evidence supports the notion that firms with better access to alternative sources of liquidity hold less cash. However, our main results are confounded with these factors - the coefficients on volatilities, developed

country dummies, and other variables remain highly significant after controlling for ownership, organizational structure, and bank relationship.

Standard Errors

We estimate the robust standard errors and the standard errors with clusters on country and industry where each industry is defined as a two-digit SIC group. We also perform generalized least square and compute bootstrapping standard errors. All the main results are still statistically significant.

Internet Appendix B: A Stylized Model of Real Volatilities

With a stylized model of real volatilities, we illustrate how market imperfections in developing countries can simultaneously lead to lower risk at the firm level and higher risk at the aggregate level. For simplicity, we assume that there are two firms, A and B. Each firm is endowed with fixed supply of productive resources X_A and X_B. The economy lasts T periods and the resources do not depreciate. Firms have a linear production function: $F(e_{i,t}, K_{i,t}) = e_{i,t} K_{i,t}$ where $K_{i,t}$ is the amount of productive resources allocated to firm i at time t, i={A,B}, and t={0,…,T}. The distribution of productivity e_i is identical and independent across time. We assume that the shocks are binomial: e_A =H and e_B =L with probability ½ and e_A =L and e_B =H with probability ½. Also, H-L = d and d >0. The parameter d represents the true difference in firm-level productivities which does not vary across countries. From this set-up, the first best allocation of resources is $K_{A,t} = X_A + X_B$ and $K_{B,t} = 0$ if $e_{A,t} > e_{B,t}$ and $K_{A,t} = 0$ and $K_{B,t} = X_A + X_B$ if $e_{A,t} < e_{B,t}$.

The key assumption here is that goods and capital markets might be less than fully efficient. Specifically, we assume that it is costly to reallocate resources across firms. For firm B to transfer δ units of resources to firm A for one period, the transaction cost C(δ) must be incurred. Examples of adjustment cost C(.) include external financing cost of the expanding firms or the cost associated with asymmetric information in the market for productive assets. These costs are expected to be high in developing countries.

With costly adjustment, the allocation of resources must solve the Bellman's equation below:

$V(e_{A,t}, e_{B,t}) = \max_{\delta_t} e_{A,t} K_{A,t} + e_{B,t} K_{B,t} - C(\delta_t) + E[V(e_{A,t+1}, e_{B,t+1})]$ where $K_{A,t} = X_A + \delta_t$, $K_{B,t} = X_B - \delta_t$, and $V(e_{A,T}, e_{B,T}) = 0$. Following Hayashi (1982), we use quadratic transaction cost: $C(\delta_t) = c/2\,(\delta_t)^2$. The transaction cost parameter c directly captures the degree of market imperfections. For simplicity, we further assume that transaction cost is large enough, $c > d/\min(X_A, X_B)$, so neither firms will be allocated all the resources in the economy $X_A + X_B$ (i.e., corner solutions).

Lemma 1: The policy function is $\delta_t = (e_{A,t} - e_{B,t})/c$. This policy implies that:

$e_{A,t} = H$ and $e_{B,t} = L$	$e_{A,t} = L$ and $e_{B,t} = H$
Capital of Firm A = $X_A + d/c$	Capital of Firm A = $X_A - d/c$

Output of Firm A = $H(X_A + d/c)$	Output of Firm A = $L(X_A - d/c)$
Capital of Firm B = $X_B - d/c$	Capital of Firm B = $X_B + d/c$
Output of Firm B = $L(X_B - d/c)$	Output of Firm B = $H(X_B + d/c)$
Aggregate Output = $HX_A + LX_B + (H - L)d/c$	Aggregate Output = $LX_A + HX_B + (H - L)d/c$

Proof:

After substituting the resource constraints into the objective function, the maximization problem becomes

$\max_{\delta_t} e_{A,t}(X_A + \delta_t) + e_{B,t}(X_B - \delta_t) - C(\delta_t) + E[V(e_{A,t+1}, e_{B,t+1})]$.

First Order Condition with respect to δ_t is $e_{A,t} - e_{B,t} - C'(\delta_t) + E[V'(.)] = e_{A,t} - e_{B,t} - c\,\delta_t = 0$.

The policy function is $\delta_t = (e_{A,t} - e_{B,t})/c$.

In other words, $\delta_t = \begin{cases} d/c, & e_{A,t} = H \text{ and } e_{B,t} = L \\ -d/c, & e_{A,t} = L \text{ and } e_{B,t} = H \end{cases}$ where $d = H - L$.

Q.E.D.

Proposition 1: Output growth of firms in developed countries is more volatile. Firm-level volatility is decreasing in the market imperfection parameter, c.

Proof:

Without loss of generality, we focus on the output of firm A (denoted by Y_A). Let $\Delta = d/c$.

Y_{AH} is the output of firm A when $e_{A,t} = H$ and $e_{B,t} = L$. So, $Y_{AH} = H(X_A + \Delta)$.

Y_{AL} is the output of firm A when $e_{A,t} = L$ and $e_{B,t} = H$. So, $Y_{AL} = L(X_A - \Delta)$.

Output growth of firm A in percentage term is $g_t = (Y_{A,t} - Y_{A,t-1})/Y_{A,t-1}$. Given the binomial nature of the productivity process, output growth of firm A must take one of these three values: $g_t \in \{g_{up}, g_{down}, 0\}$ where $g_{up} = \frac{Y_{AH} - Y_{AL}}{Y_{AL}} = \frac{Y_{AH}}{Y_{AL}} - 1$ and $g_{down} = \frac{Y_{AL} - Y_{AH}}{Y_{AH}} = \frac{Y_{AL}}{Y_{AH}} - 1$.

Next, we show that positive output growth (g_{up}) is decreasing in c and negative output growth (g_{down}) is increasing in c. In other words, a large value of c will move the growth rate closer to zero.

$\frac{\partial g_{up}}{\partial \Delta} = \frac{\partial}{\partial \Delta}(Y_{AH}/Y_{AL}) = (1/{Y_{AL}}^2)(Y_{AL}\frac{\partial Y_{AH}}{\partial \Delta} - Y_{AH}\frac{\partial Y_{AL}}{\partial \Delta}) = (1/{Y_{AL}}^2)(Y_{AL}H + Y_{AH}L) \geq 0.$

Using the chain rule, $\frac{\partial g_{up}}{\partial c} = \frac{\partial}{\partial c}\left(\frac{d}{c}\right)\frac{\partial g_{up}}{\partial \Delta} = -\left(\frac{d}{c^2}\right)\frac{\partial g_{up}}{\partial \Delta} \leq 0.$

$\frac{\partial g_{down}}{\partial \Delta} = \frac{\partial}{\partial \Delta}(Y_{AL}/Y_{AH}) = (1/{Y_{AH}}^2)(Y_{AH}\frac{\partial Y_{AL}}{\partial \Delta} - Y_{AL}\frac{\partial Y_{AH}}{\partial \Delta}) = -(1/{Y_{AH}}^2)(Y_{AH}L + Y_{AL}H) \leq 0.$

Using the chain rule, $\frac{\partial g_{down}}{\partial c} = \frac{\partial}{\partial c}\left(\frac{d}{c}\right)\frac{\partial g_{down}}{\partial \Delta} = -\left(\frac{d}{c^2}\right)\frac{\partial g_{down}}{\partial \Delta} \geq 0$.

Our economy lasts T periods. Let V be the volatility of a sample path: $\{g_1, g_2, \ldots, g_t, \ldots, g_T\}$. Volatility is defined as the time series standard deviation of the growth rates along the sample path.

$V^2 = \frac{1}{T-1}\sum_{t=1}^{T}(g_t - \bar{g})^2 = \frac{1}{T-1}\sum_{t=1}^{T}(g_t)^2 - 2\, g_t\, \bar{g} + (\bar{g})^2$ where $\bar{g} = \frac{1}{T}\sum_{t=1}^{T} g_t$.

Now, we show that V^2 is decreasing in c by taking the first partial derivative with respect to c.

$\frac{\partial V^2}{\partial c} = \frac{1}{T-1}\sum_{t=1}^{T}(2g_t\, \frac{\partial g_t}{\partial c} - 2\bar{g}\, \frac{\partial g_t}{\partial c} - 2g_t \frac{\partial \bar{g}}{\partial c} + 2\bar{g}\, \frac{\partial \bar{g}}{\partial c}) = \frac{2}{T-1}\sum_{t=1}^{T}(g_t - \bar{g})\frac{\partial g_t}{\partial c} - (g_t - \bar{g})\frac{\partial \bar{g}}{\partial c}$.

According to the definition of $\bar{g}$, the last term in the expression above is equal to zero.

$\sum_{t=1}^{T}(g_t - \bar{g})\frac{\partial \bar{g}}{\partial c} = \frac{\partial \bar{g}}{\partial c}\sum_{t=1}^{T}(g_t - \bar{g}) = 0$.

Therefore, $\frac{\partial V^2}{\partial c} = \frac{2}{T-1}\sum_{t=1}^{T}(g_t - \bar{g})\frac{\partial g_t}{\partial c}$.

Since $g_t \in \{g_{up}, g_{down}, 0\}$, the average growth rate is bounded by g_{up} and g_{down} ($g_{down} \leq \bar{g} \leq g_{up}$).

If $g_t = g_{up}$, then $(g_t - \bar{g})\frac{\partial g_t}{\partial c} \leq 0$ because $(g_{up} - \bar{g}) \geq 0$ and $\frac{\partial g_{up}}{\partial c} \leq 0$.

If $g_t = g_{down}$, then $(g_t - \bar{g})\frac{\partial g_t}{\partial c} \leq 0$ because $(g_{down} - \bar{g}) \leq 0$ and $\frac{\partial g_{down}}{\partial c} \geq 0$.

If $g_t = 0$, then $(g_t - \bar{g})\frac{\partial g_t}{\partial c} = 0$ because $\frac{\partial 0}{\partial c} = 0$.

So, $(g_t - \bar{g})\frac{\partial g_t}{\partial c}$ is always (weakly) negative.

We can conclude that $\frac{\partial V^2}{\partial c} = \frac{2}{T-1}\sum_{t=1}^{T}(g_t - \bar{g})\frac{\partial g_t}{\partial c} \leq 0$: V^2 is decreasing in c. Given that volatility V cannot be negative, $\frac{\partial V}{\partial c} \leq 0$: V is decreasing in c as well.

Q.E.D.

Proposition 2: Output growth of firms in developed countries is more sensitive to productivity shocks. Output-to-shock sensitivity is decreasing in the market imperfection parameter, c.

Proof:

Without loss of generality, we focus on the output of firm A. $Shock_t$ is defined as a percentage change in firm A's productivity: $Shock_t = (e_{A,t} - e_{A,t-1})/e_{A,t-1}$. Given the binomial nature of the productivity process, productivity

shock of firm A must take one of these three values: $\text{Shock}_t \in \{\text{Shock}_{up}, \text{Shock}_{down}, 0\}$ where $\text{Shock}_{up} = \frac{H-L}{L} = \frac{d}{L}$ and $\text{Shock}_{down} = \frac{L-H}{H} = \frac{-d}{H}$.

To measure output-to-shock sensitivity, we estimate the coefficients of the following regression using the data from a sample path: $\{\text{Shock}_1, \text{Shock}_2, \dots, \text{Shock}_t, \dots, \text{Shock}_T\}$ and the corresponding $\{g_1, g_2, \dots, g_t, \dots, g_T\}$.

$$g_t = b_0 + b_1 \text{Shock}_t + \varepsilon_t$$

The estimate of b_1 is given by the following equation:

$b_1 = \frac{\sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})(g_t - \bar{g})}{\sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})^2}$ where $\bar{g} = \frac{1}{T}\sum_{t=1}^{T} g_t$ and $\overline{\text{Shock}} = \frac{1}{T}\sum_{t=1}^{T} \text{Shock}_t$.

Now, we show that b_1 is decreasing in c by taking the first partial derivative with respect to c.

$$\frac{\partial b_1}{\partial c} = \frac{1}{\sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})^2} \sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})\left(\frac{\partial g_t}{\partial c} - \frac{\partial \bar{g}}{\partial c}\right).$$

$$\frac{\partial b_1}{\partial c} = \frac{1}{\sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})^2} \sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})\left(\frac{\partial g_t}{\partial c}\right) - (\text{Shock}_t - \overline{\text{Shock}})\left(\frac{\partial \bar{g}}{\partial c}\right).$$

$$\frac{\partial b_1}{\partial c} = \frac{1}{\sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})^2} \left[\sum_{t=1}^{T}\left(\text{Shock}_t - \overline{\text{Shock}}\right)\left(\frac{\partial g_t}{\partial c}\right) - \sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})\left(\frac{\partial \bar{g}}{\partial c}\right)\right].$$

According to the definition of $\overline{\text{Shock}}$, the last term in the expression above is equal to zero.

$$\sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})\left(\frac{\partial \bar{g}}{\partial c}\right) = \left(\frac{\partial \bar{g}}{\partial c}\right)\sum_{t=1}^{T}\left(\text{Shock}_t - \overline{\text{Shock}}\right) = 0.$$

Therefore, $\frac{\partial b_1}{\partial c} = \frac{1}{\sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})^2} \sum_{t=1}^{T}(\text{Shock}_t - \overline{\text{Shock}})\left(\frac{\partial g_t}{\partial c}\right)$.

There are only three possible realizations of productivity shock and output growth:
$(\text{Shock}_t, g_t) \in \{(\text{Shock}_{up}, g_{up}), (\text{Shock}_{down}, g_{down}), (0,0)\}$. The average productivity shock is bounded by Shock_{up} and Shock_{down} ($\text{Shock}_{down} \leq \overline{\text{Shock}} \leq \text{Shock}_{up}$).

If $\text{Shock}_t = \text{Shock}_{up}$, then $(\text{Shock}_t - \overline{\text{Shock}})\frac{\partial g_t}{\partial c} \leq 0$ because $(\text{Shock}_{up} - \overline{\text{Shock}}) \geq 0$ and $\frac{\partial g_{up}}{\partial c} \leq 0$.

If $\text{Shock}_t = \text{Shock}_{down}$, then $(\text{Shock}_t - \overline{\text{Shock}})\frac{\partial g_t}{\partial c} \leq 0$ because $(\text{Shock}_{down} - \overline{\text{Shock}}) \leq 0$ and $\frac{\partial g_{down}}{\partial c} \geq 0$.

If $\text{Shock}_t = 0$, then $\left(\text{Shock}_t - \overline{\text{Shock}}\right)\frac{\partial g_t}{\partial c} = 0$ because $\frac{\partial 0}{\partial c} = 0$.

So, $\left(\text{Shock}_t - \overline{\text{Shock}}\right)\frac{\partial g_t}{\partial c}$ is always (weakly) negative.

We can conclude that $\frac{\partial b_1}{\partial c} = \frac{1}{\sum_{t=1}^{T}(Shock_t - \overline{Shock})^2}\sum_{t=1}^{T}(Shock_t - \overline{Shock})(\frac{\partial g_t}{\partial c}) \leq 0$: b_1 is decreasing in c.

Q.E.D.

Proposition 3: Aggregate output growth is less volatile in developed countries. Aggregate volatility is increasing in the market imperfection parameter, c.

Let O be aggregate output if there is no reallocation in the economy.

When $e_A = H$ and $e_B = L, O = O_H = HX_A + LX_B$. When $e_A = L$ and $e_B = H, O = O_L = LX_A + HX_B$.

Without loss of generality, assume that initial endowment of firm A is greater than the initial endowment of firm B ($X_A \geq X_B$) so that, without resource reallocation, aggregate output is higher when firm A receives higher productivity than firm B ($O_H \geq O_L$).

Define $\Delta = \frac{d}{c}$ and $d = H - L$.

Let $\widetilde{O}$ be aggregate output if there is reallocation of resources in the economy.

When $e_A = H$ and $e_B = L, \widetilde{O} = \widetilde{O_H} = O_H + d\Delta$. When $e_A = L$ and $e_B = H, \widetilde{O} = \widetilde{O_L} = O_L + d\Delta$.

Aggregate output growth in percentage term is $G_t = (\widetilde{O}_t - \widetilde{O}_{t-1})/\widetilde{O}_{t-1}$. Given the binomial nature of the productivity process, aggregate output growth must take one of these three values: $G_t \in \{G_{up}, G_{down}, 0\}$ where $G_{up} = \frac{\widetilde{O_H} - \widetilde{O_L}}{\widetilde{O_L}} = \frac{O_H - O_L}{O_L + d\Delta}$ and $G_{down} = \frac{\widetilde{O_L} - \widetilde{O_H}}{\widetilde{O_H}} = \frac{O_L - O_H}{O_H + d\Delta}$.

Next, we show that positive output growth (G_{up}) is increasing in c and negative output growth (G_{down}) is decreasing in c. In other words, a small value of c will move the growth rate closer to zero.

$\frac{\partial G_{up}}{\partial \Delta} = \frac{\partial}{\partial \Delta}\left(\frac{O_H - O_L}{O_L + d\Delta}\right) = -\frac{O_H - O_L}{(O_L + d\Delta)^2}(d) \leq 0.$

Using the chain rule, $\frac{\partial G_{up}}{\partial c} = \frac{\partial}{\partial c}\left(\frac{d}{c}\right)\frac{\partial G_{up}}{\partial \Delta} = -\left(\frac{d}{c^2}\right)\frac{\partial G_{up}}{\partial \Delta} \geq 0.$

$\frac{\partial G_{down}}{\partial \Delta} = \frac{\partial}{\partial \Delta}\left(\frac{O_L - O_H}{O_H + d\Delta}\right) = -\frac{O_L - O_H}{(O_H + d\Delta)^2}(d) = \frac{O_H - O_L}{(O_H + d\Delta)^2}(d) \geq 0.$

Using the chain rule, $\frac{\partial G_{down}}{\partial c} = \frac{\partial}{\partial c}\left(\frac{d}{c}\right)\frac{\partial G_{down}}{\partial \Delta} = -\left(\frac{d}{c^2}\right)\frac{\partial G_{down}}{\partial \Delta} \leq 0.$

Let V be the volatility of a sample growth path $\{G_1, G_2, \ldots, G_t, \ldots, G_T\}$. Volatility is defined as the time series standard deviation of the growth rates along the sample path.

$V^2 = \frac{1}{T-1}\sum_{t=1}^{T}(G_t - \overline{G})^2 = \frac{1}{T-1}\sum_{t=1}^{T}(G_t)^2 - 2\,G_t\,\overline{G} + (\overline{G})^2$ where $\overline{G} = \frac{1}{T}\sum_{t=1}^{T} G_t$.

Now, we show that V^2 is increasing in c by taking the first partial derivative with respect to c.

$$\frac{\partial V^2}{\partial c} = \frac{1}{T-1}\sum_{t=1}^{T}\left(2G_t \frac{\partial G_t}{\partial c} - 2\bar{G}\frac{\partial G_t}{\partial c} - 2G_t\frac{\partial \bar{G}}{\partial c} + 2\bar{G}\frac{\partial \bar{G}}{\partial c}\right) = \frac{2}{T-1}\sum_{t=1}^{T}(G_t - \bar{G})\frac{\partial G_t}{\partial c} - (G_t - \bar{G})\frac{\partial \bar{G}}{\partial c}.$$

According to the definition of $\bar{G}$, the last term in the expression above is equal to zero.

$$\sum_{t=1}^{T}(G_t - \bar{G})\frac{\partial \bar{G}}{\partial c} = \frac{\partial \bar{G}}{\partial c}\sum_{t=1}^{T}(G_t - \bar{G}) = 0.$$

Therefore, $\frac{\partial V^2}{\partial c} = \frac{2}{T-1}\sum_{t=1}^{T}(G_t - \bar{G})\frac{\partial G_t}{\partial c}$.

Since $G_t \in \{G_{up}, G_{down}, 0\}$, the average growth rate is bounded by G_{up} and G_{down} ($G_{down} \leq \bar{G} \leq G_{up}$).

If $G_t = G_{up}$, then $(G_t - \bar{G})\frac{\partial G_t}{\partial c} \geq 0$ because $(G_{up} - \bar{G}) \geq 0$ and $\frac{\partial G_{up}}{\partial c} \geq 0$.

If $G_t = G_{down}$, then $(G_t - \bar{G})\frac{\partial G_t}{\partial c} \geq 0$ because $(G_{down} - \bar{G}) \leq 0$ and $\frac{\partial G_{down}}{\partial c} \leq 0$.

If $G_t = 0$, then $(G_t - \bar{G})\frac{\partial G_t}{\partial c} = 0$ because $\frac{\partial 0}{\partial c} = 0$.

So, $(G_t - \bar{G})\frac{\partial G_t}{\partial c}$ is always (weakly) positive.

We can conclude that $\frac{\partial V^2}{\partial c} = \frac{2}{T-1}\sum_{t=1}^{T}(G_t - \bar{G})\frac{\partial G_t}{\partial c} \geq 0$: V^2 is increasing in c. Given that volatility V cannot be negative, $\frac{\partial V}{\partial c} \geq 0$: V is increasing in c as well.

Q.E.D.

Internet Appendix C: The Country Coverage of WorldScope

Full-Coverage

Developed countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

Emerging markets include Brazil, China, Indonesia, Korea, Malaysia, Mexico, Philippines, South Africa, and Thailand.

Targeted Coverage

Countries include Argentina, Chile, Colombia, Czech Republic, Egypt, Hungary, India, Israel, Lithuania, New Zealand, Peru, Poland, Russia, Turkey, and Venezuela.