

# Firm-specific information and the efficiency of investment<sup>☆</sup>

Anusha Chari<sup>a</sup>, Peter Blair Henry<sup>b,\*</sup>

<sup>a</sup>University of Michigan, Department of Economics, 611 Tappan Street, Ann Arbor, MI 48109, USA

<sup>b</sup>Stanford University, Graduate School of Business, Stanford, CA, 94305, USA

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## Abstract

In the three-year period following stock market liberalizations, the growth rate of the typical firm's capital stock exceeds its pre-liberalization mean by an average of 4.1 percentage points. Cross-sectional changes in investment are significantly correlated with the signals about fundamentals embedded in the stock price changes that occur upon liberalization. Panel-data estimations show that a 10-percentage point increase in a firm's expected future sales growth predicts a 2.9- to 3.5-percentage point increase in the growth rate of its capital stock. Country-specific changes in the cost of capital drive changes in investment but firm-specific changes in the cost of capital do not.

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## 1. Introduction

Do the investment decisions of firms in emerging economies reflect information about the fundamentals of those firms? On the one hand, there is little reason to expect an affirmative answer to this question, as stock price movements in emerging economies generally do not convey much firm-specific information (Morck, Yeung, and Yu, 2000). If managers in emerging economies make investment decisions in accordance with changes in stock prices, but the prices contain little information about the underlying firms, then investment will also be divorced from firm-specific fundamentals.

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\*Corresponding author.

*E-mail address:* [pbhenry@stanford.edu](mailto:pbhenry@stanford.edu) (P. Blair Henry).

On the other hand, firm-specific information in emerging economies sometimes exerts greater influence on stock prices than macroeconomic factors (Johnson, Boone, Breach, and Friedman, 2000). Furthermore, the firm-specific information contained in stock prices tends to rise as countries adopt greater capital market openness (Li, Morck, Yang, and Yeung, 2004), and with few exceptions, emerging economies continue to move rapidly in that direction (Stulz, 1999a,b, 2005). For example, in the late 1980s and early 1990s, several developing countries liberalized their stock markets, allowing foreign investors to purchase shares for the first time. Moreover, when these liberalizations occur, publicly traded firms in the liberalizing countries experience large stock price changes, and firm-specific fundamentals help to explain much of the variation in price changes across firms (Chari and Henry, 2004).

Since liberalization-induced stock price movements do contain information about firm-specific fundamentals, it is natural to ask whether those fundamentals also have predictive power for investment.<sup>1</sup> In this paper, we examine whether the real investment decisions of firms in emerging economies respond to the changes in fundamentals implicitly signaled by the liberalization-induced stock price changes of those firms.

In a rational asset pricing world, a change in a firm's stock price reflects a change in either or both of the following: (a) the firm's expected future profitability; (b) the firm's cost of capital. In theory, stock market liberalization affects only the cost of capital, and it does so through two channels. The first cost-of-capital channel is a common shock to all firms in the economy—a fall in the risk-free rate as the country moves from financial autarky to integration with the rest of the world. All else equal, the common shock to the cost of capital will increase the average investment rate of all firms. The second cost-of-capital channel is a firm-specific “beta” effect. With liberalization, the relevant benchmark for pricing the risk of individual stocks switches from the local stock market index to a world market index (Stulz, 1999b). Consequently, the equity-risk premium falls for firms whose returns are less correlated with the world market than they are with the local market and *vice versa*. Given the common shock, the firm-specific shock implies that firms whose equity premia fall should increase their investment by even more than those whose premia rise.

While the theory of stock market liberalizations focuses primarily on the cost of capital, in practice liberalizations often coincide with other economic reforms that may increase total factor productivity, economic growth, and the profitability of investment (Henry, 2000a, 2003; Kose, Prasad, Rogoff, and Wei, 2006). Therefore, it is important to control for the possibility that reform-induced changes in expected future profitability may drive any post-liberalization changes in investment. We use a simple open economy model of the stock market and investment to demonstrate how changes in investment by firms in the post-liberalization period will reflect changes in (1) firm-specific expected future profitability, (2) the economy-wide risk-free rate, and (3) firm-specific equity premia. We then use the cross-sectional variation in our five-country, 369-firm data set to identify the economic and statistical significance of each of the three effects.

Panel data estimations show that a ten-percentage point rise in our measure of a firm's expected future profitability results in a 2.9- to 3.5-percentage point increase in the growth rate of the firm's capital stock, depending on the specification. The common shock to firms' cost of capital is also important, as it generates an economically and statistically significant increase in capital stock growth in almost every specification. In contrast, firm-specific changes in equity premia have an economically trivial effect on changes in investment and are statistically insignificant in every specification.

While our empirical design enables us to test for effects of liberalization on investment that have previously gone unexamined, the use of firm-level panel data requires special care. Peterson (2006) finds that almost half of all panel data studies published in the top three finance journals between 2001 and 2004 do not appropriately adjust their standard errors to account for the simultaneous occurrence of correlation of the residuals both within a given firm over time and across firms within a given time period. Peterson's critique applies with special force in the context of the liberalization experiment examined in this paper.

Liberalizing the stock market increases investment demand. Because it takes time to install new capital, investment for a given firm may remain elevated above its normal rate for a number of years in the post-liberalization period, thereby inducing correlation in the firm's investment residuals over time. Similarly,

<sup>1</sup>The idea of trying to relate changes in investment to the liberalization-induced changes in stock prices follows in the spirit of earlier work that tries to relate changes in investment to changes in stock prices more generally (Blanchard, Rhee, and Summers, 1993; Fischer and Merton, 1984; Tobin and Brainard, 1977).

liberalization in a given country simultaneously raises investment demand for all firms, thereby inducing correlation in the investment residuals across all firms in the country at a given point in time. Our empirical analysis uses the clustering technique developed by Peterson (2006) to adjust the standard errors for the simultaneous occurrence of both forms of dependence in the residuals.

In addition to providing the first firm-level study of the link between liberalization, stock prices, and the efficiency of investment, our paper makes a substantive methodological contribution.<sup>2</sup> The issue of whether finance causes growth remains an open question, and aggregate data are simply too coarse to determine whether the transmission mechanisms suggested by theory are actually at work (Levine, 2005). Our analysis shows how to use firm-level data to design a test that confronts theory head-on. By doing so, we provide a template upon which future work may build as more and better firm-level data in emerging economies become available.

The remainder of the paper proceeds as follows. Section 2 provides a more detailed explanation of the contribution of our paper relative to previous work. Section 3 presents a simple model that generates testable empirical predictions. Section 4 describes the data and presents descriptive findings. Section 5 outlines the empirical methodology and presents the main results. Section 6 conducts robustness checks. Section 7 concludes.

## 2. Related literature

Broadly speaking, previous work expresses two views about the wisdom of opening capital markets in emerging economies to foreign investors. The first view argues that liberalization promotes efficient resource allocation. Removing restrictions on international capital movements permits resources to flow from capital-abundant developed countries, where expected returns are low, to capital-scarce emerging economies, where expected returns are high. In theory, the flow of resources into the capital-scarce countries should reduce their cost of capital, increase investment, and raise output (Fischer, 2003; Obstfeld, 1998; Rogoff, 1999; Summers, 2000).

The second view sees the first as unsubstantiated. This view asserts that instead of promoting a more efficient international allocation of capital, liberalizations generate speculative capital flows that are divorced from the fundamentals and have no discernible effect on investment, output, or any other real variable with nontrivial welfare implications (Bhagwati, 1998; Rodrik, 1998; Stiglitz, 1999, 2002).

Recent research tries to resolve the difference of opinions by examining the economic impact of stock market liberalizations using aggregate, country-level data. For example, previous work uses aggregate data to document three central facts: when countries liberalize their stock markets (1) the cost of capital falls (Bekaert and Harvey, 2000; Henry 2000a; Martell and Stulz, 2003), (2) aggregate investment booms (Henry, 2000b), and (3) the growth rate of GDP per capita increases (Bekaert, Harvey, and Lundblad, 2005; Levine, 2001). While studies based on aggregate data support the view that liberalization leads to a more efficient allocation of capital, they have at least two shortcomings that cry out for further investigation.

First, it is not clear how much confidence to place in an empirical result that attributes an economy-wide investment boom to stock market liberalization, a policy change that directly affects only those firms listed on the stock market. Because the link from liberalization to growth works through investment, it too must be treated with skepticism. For instance, Bekaert, Harvey, and Lundblad (2005) find that stock market liberalization raises the growth rate of GDP per capita by more than a percentage point per annum after controlling for other factors. This result is inconsistent with standard production theory. Because theory predicts that stock market liberalization affects growth exclusively through its impact on capital accumulation, the Bekaert et al. result requires an implausibly large elasticity of output with respect to capital (Henry, 2003; Kose, Prasad, Rogoff, and Wei, 2006).

Our paper addresses the first shortcoming in the previous literature by using firm-level data. Instead of using aggregate investment as a proxy for the investment of the firms affected by liberalization, we use the investment of only those firms that are listed on the stock market. Since liberalization has a direct impact on

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<sup>2</sup>Mitton (2007) examines the impact of liberalization on firm-level operating performance, but does not examine the link between stock prices, investment, and efficiency.

publicly traded firms, our data provide a tighter link to the theory than aggregate investment data. Further, instead of using GDP growth as a proxy for the effects of contemporaneous economic reforms on the expected future profitability of investment, we control for changes in profitability with data taken directly from firms' income statements. With more reliable data we provide a small step towards more reliable inferences about the impact of liberalization on the allocation of real resources.

A second shortcoming of aggregate data is that increased investment in the liberalizing countries may suggest an efficient reallocation of capital *between* countries, but it says nothing about whether the capital gets allocated efficiently *within* the countries to which it flows. Furthermore, questions about within-country allocative efficiency cannot be answered with aggregate data that, by definition, provide no within-country variation in investment.

Our paper addresses the second shortcoming by using the cross-sectional variation in firm-level data to construct an identification strategy that speaks to the within-country efficiency of the allocation of investment. The key idea is that the stock price changes that occur upon liberalization embody signals about firm-specific fundamentals such as the cost of capital and profitability. While recent evidence confirms that the stock price changes that occur during liberalizations do contain such firm-specific information (Chari and Henry, 2004), the more pressing economic question is whether investment responds accordingly. The next section of the paper develops a simple model that allows us to address the question in a systematic fashion.

### 3. A simple model of firm-level investment, stock prices, and liberalization

This section generates empirically testable, cross-sectional predictions about liberalization, firm-level investment, and firm-specific information. It does so by analyzing what happens to the investment of all-equity-financed firms when the country in which they reside switches from a regime in which foreigners are not permitted to own domestic shares and domestic residents cannot invest abroad, to one in which all stocks are fully tradable.<sup>3</sup> The frictionless capital markets framework highlights the key margins at which liberalization affects firms' investment decisions (Section 5.3.1 considers the possibility of capital market imperfections). The central idea is that the changes that occur in firms' stock prices at the time of liberalization convey information about the impact of liberalization on the firms' fundamentals. If capital allocation is efficient, then the firms' investment should respond to these signals.

In the standard neoclassical production framework, an efficient allocation of capital is one that satisfies the first-order condition for investment. Before liberalization occurs, the first-order condition for each firm's investment is

$$f'_i(k_i)^e = r + \gamma COV(\tilde{r}_i, \tilde{r}_M). \quad (1)$$

The expression on the left-hand side of Eq. (1) is firm  $i$ 's expected marginal product of capital. For expositional convenience, we ignore depreciation and express the firm's (Cobb-Douglas) production function in terms of capital per unit of effective labor, that is,  $k_i = K_i/A_iL_i$ , where  $K_i$  is the firm's capital stock,  $A_i$  is its technology parameter, and  $L_i$  is its labor force. The right-hand side of (1) denotes the firm's cost of capital and has two components. The first component, the domestic interest rate,  $r$ , is the same for all firms in a given country. The second component, the equity premium, is unique to each firm and is given by the price of covariance risk,  $\gamma$ , times the covariance of firm  $i$ 's return with that of the entire domestic market,  $COV(\tilde{r}_i, \tilde{r}_M)$ .

Eq. (1) implies that before liberalization each firm installs capital at a rate that keeps its expected marginal product of capital constant and equal to its pre-liberalization cost of capital. In order for the expected marginal product of capital,  $f'_i(k_i)^e$ , to be constant, each firm's ratio of capital to effective labor,  $k_i = K_i/A_iL_i$ , must also be constant. In other words, before liberalization the equilibrium growth rate of a given firm's capital stock,  $(I/K)_i$ , is the same as the growth rate of its effective labor force,  $A_iL_i$ . Consider now what happens to the growth rate of the firm's capital stock when the country opens its stock market to the rest of the world and also allows its residents to invest abroad.

Liberalization throws the country's firms into a temporary state of disequilibrium. Interest rates and risk premia change instantaneously in response to the news; capital stocks adjust more slowly because it takes time

<sup>3</sup>The central intuition of the analysis extends to asymmetric liberalizations (see Chari and Henry, 2004).

to buy and install new machines. For instance, if liberalization reduces a firm's cost of capital, then, at the pre-liberalization ratio of capital to effective labor, each firm's expected marginal product of capital will exceed its post-liberalization cost of capital. The firm's optimal response to this disequilibrium is to increase investment, driving down the expected marginal product of capital to the firm's new, lower cost of capital.

The following first-order condition defines the post-liberalization equilibrium:

$$f'_i(k_i^*)^e = r^* + \gamma COV(\tilde{r}_i, \tilde{r}_W), \quad (2)$$

where  $r^*$  is the world interest rate,  $k_i^*$  is the steady state post-liberalization ratio of capital to effective labor, and  $COV(\tilde{r}_i, \tilde{r}_W)$  is the covariance of firm  $i$ 's return with the world market. Subtracting Eq. (2) from (1) gives an expression for the change in the first-order condition from before to after liberalization:

$$\Delta f'_i(k_i^*)^e = (r - r^*) + \gamma DIFCOV_i, \quad (3)$$

where  $DIFCOV_i = COV(\tilde{r}_i, \tilde{r}_M) - COV(\tilde{r}_i, \tilde{r}_W)$ . The goal of this paper is to assess whether the cross-sectional variation in the liberalization-induced changes in the firms' fundamentals drives the cross-sectional variation in the temporary increases in the growth rate of firms' capital stocks. Eq. (3) implicitly defines the magnitude of the change in the growth rate of the capital stock,  $\Delta(I/K)_i$ , that is needed to restore equilibrium following liberalization. To see why, note that the larger the difference between the pre- and post-liberalization cost of capital on the right-hand-side of (3), the larger the increase in the ratio of capital to effective labor that is needed to move the firm from  $k_i$  to  $k_i^*$  and bring about the required decline in the expected marginal product of capital on the left-hand side.

The terms on the right-hand side of Eq. (3) also clarify the forces that will drive the magnitudes of  $\Delta(I/K)_i$  if capital is allocated efficiently. The first term is the common shock to the cost of capital,  $(r - r^*)$ . It shows that the post-liberalization change in investment depends on the change in the risk-free rate. All else equal, investment will rise if  $r^*$ , the world risk-free rate, is lower than  $r$ , the autarky rate, and *vice versa*. Importantly, the common shock term has no subscript, because it has the same effect on all firms in the economy.

The second term on the right-hand side,  $DIFCOV_i$ , is a firm-specific shock to the cost of capital and illustrates why  $\Delta(I/K)_i$  will vary across firms. Liberalization reduces the equity premium for firms whose returns are more correlated with the local market than they are with the world market, and *vice versa*. Given the common shock, the second term implies that firms with large, positive values of  $DIFCOV$  will experience a greater decline in their cost of capital than firms with low or negative values of  $DIFCOV$ . All else equal, firms that experience a larger fall in their cost of capital will also experience a larger increase in investment.

Changes in expected future profitability are another important source of cross-sectional variation that may help to explain cross-sectional differences in  $\Delta(I/K)_i$ . Liberalizations coincide with important economic reforms such as trade liberalizations and inflation stabilization programs that may increase firms' profitability (Frankel and Romer, 1999; Henry, 2002).<sup>4</sup> The left-hand side of Eq. (3) shows that for any given ratio of capital to effective labor,  $k_i^*$ , higher profitability raises the expected marginal product of capital,  $\Delta f'_i(k_i^*)^e$ , and will drive up investment demand.

In the end, we seek to estimate an equation of the general form

$$\begin{aligned} \Delta(I/K)_{ijt} &= (r - r^*) + a * DIFCOV_{ijt} \\ &+ b * \Delta(EXPECTED FUTURE PROFITS)_{ijt} \\ &+ \varepsilon_{ijt}, t \in \{[0], [+1], [+2], [+3]\}, \end{aligned} \quad (4)$$

where the variable  $t$  in Eq. (4) denotes time in years relative to the liberalization:  $t = [0]$  is the year in which liberalization occurs,  $t = [+1]$  is the year immediately following the liberalization, and so on. The next section discusses the data we use in our formal estimations and presents some germane descriptive findings along the way.

<sup>4</sup>Liberalization itself might also change a firm's profitability. For example, incumbent firms may lose monopoly rents if liberalization increases access to capital and facilitates entry into sectors that were previously dominated by a few firms (Chari and Gupta, 2007).

#### 4. Data and descriptive findings

This section introduces the data. Subsection 4.1 explains how we use the data to construct the variables needed to test the predictions of the model in Section 3. Subsection 4.2 presents descriptive findings: basic facts in 4.2.1, time-series facts in 4.2.2, and cross-sectional facts in 4.2.3.

Estimating regressions akin to Eq. (4) requires measures of capital stock growth rates, expected future profitability, and covariances of stock returns. We obtain firm-level data on capital stocks, profitability, and stock returns from the International Finance Corporation's Corporate Finance Database. Singh, Hamid, Salimi, and Nakano (1992) and Booth, Aivazian, Demirguc-Kunt, and Maximovic (2001) provide extensive descriptions of this database. Our discussion focuses on the details relevant to this paper.

Between 1980 and 1994, the International Finance Corporation (IFC) collected annual balance sheet and income statement data for a maximum of the 100 largest publicly traded, non-financial firms in 11 developing countries: Argentina, Brazil, India, Jordan, Korea, Malaysia, Mexico, Pakistan, Thailand, Turkey, and Zimbabwe. In choosing the sample of countries for its database the IFC employed two screening criteria: (1) quality data had to be available for a reasonably large sample of firms; and (2) developing countries from each continent had to be represented. For several countries the sample begins after 1984, because the early years did not contain data of sufficiently high quality.

In order for a country in the IFC database to be included in our sample, it must satisfy one additional criterion: the IFC data for that country must exist before and after the year in which the country liberalized its stock market. To identify the date of each country's first stock market liberalization we employ the same procedure as Henry (2000a). Official policy decree dates are used when available. When no policy decree date is available, we employ two indirect methods. The first is the establishment of the first country fund permitting foreign ownership. The second is a 10% increase in the IFC's investibility index; the index captures the ratio of the market capitalization of stocks that foreigners can legally hold to total market capitalization. Table 1 lists the liberalization dates for the five countries in the sample.

The before-and-after criterion, in combination with the short length of some countries' time series, reduces our sample to 369 firms spread across five countries: India, Jordan, Korea, Malaysia, and Thailand. Despite its modest size, this sample of firms is better suited to addressing the question of whether liberalization affects

Table 1  
Descriptive statistics

(1) Country	(2) Year of Liberalization	(3) Number of Firms	(4) Market Capitalization of Firms as a Fraction of Total Market Capitalization	(5) Percentage Change in Stock Price in Liberalization Year	(6) Average Pre-Liberalization Growth Rate of Capital Stock	(7) Average Deviation of Capital Stock Growth from Pre-liberalization Mean
India	1992	99	0.25	64.9	0.125	0.057
Jordan	1987	35	0.14	18.8	0.076	-0.093
Korea	1987	89	0.38	76.7	0.129	0.013
Malaysia	1987	85	0.45	30.0	0.077	0.031
Thailand	1988	61	0.66	42.7	0.091	0.163
Full Sample	1988*	369	0.40	51.4	0.105	0.041

Notes: Column 2 contains the liberalization date for each country in our sample; the liberalization dates are taken from Henry (2000a,b, 2003). "\*" represents the median liberalization year in our sample. Column 3 gives the number of firms in each country. Column 4 presents the fraction of total market capitalization that the firms in our sample represent as a fraction of total market capitalization in the respective countries. The total market capitalization represents the value of all publicly traded companies on the domestic exchange in the liberalization year. Column 5 reports the average percentage change in all firms' stock prices during the liberalization year. Column 6 reports the average annual growth rate of the capital stock for all the firms in a given country over the three-year period immediately preceding the liberalization (years [-3, -1]). Column 7 reports the average deviation of the growth rate of each firm's capital stock from its pre-liberalization mean during the four-year post-liberalization window (years [0, +3]).

firms' investment decisions than competing databases such as Worldscope and Global Vantage. The reason is that data from Worldscope and Global Vantage do not satisfy the before-and-after criterion. The median stock market liberalization date in the sample is 1988 (see Table 1), and Worldscope and Global Vantage contain little firm-level data before that time.

#### 4.1. Constructing measures of capital stock, profitability, and covariances

The IFC database provides balance sheet information that we use to construct a time series on the growth rate of each firm's capital stock. For each firm, the database reports the nominal value of net fixed assets (the stock of property, plant, and equipment less depreciation) on an annual basis. In order to obtain the real growth rate of each firm's capital stock, the ideal adjustment procedure would deflate the percentage change in net fixed assets (NFA) by the rate of inflation of each firm's capital goods. Since no such capital goods data exist, we deflate using the Consumer Price Index (CPI) in three steps. First, we take the natural log of nominal NFA at time  $t+1$  and subtract the natural log of NFA at time  $t$ . Second, we take the natural log of the CPI at time  $t+1$  and subtract the natural log of the CPI at time  $t$ . Third, we subtract the second quantity from the first to produce the real growth rate of each firm's capital stock between year  $t$  and  $t+1$ .

The database also contains income statement information that we can use to construct proxy measures for the growth rate of expected future profitability. In looking at the income statement data to construct our measures of profitability we have to choose whether to use earnings or sales. In thinking through the choice it is important to recognize that earnings and sales are not perfect substitutes. For instance, high levels of sales do not necessarily produce high levels of profitability. All else equal, earnings would clearly be the more direct (and therefore preferable) measure of profitability. However, because of the data constraints we face, all else is not equal and we are forced to think harder about the relative merits of each variable.

Sales are a relatively straightforward number while earnings may reflect firms' recognition of extraordinary items at different points in time. The problem is that with the exception of depreciation, the IFC database provides no information on the extraordinary items and myriad other line items that enter the earnings numbers within any given country. To complicate matters further, the definitions of such items vary across countries, along with the rules and regulations governing their usage. In the end, we choose to use sales as our measure of profitability, because we do not have sufficient confidence about what comprises the firm-level earnings numbers and whether the temporal variation in firm-level earnings is driven by changes in the economic fundamentals of the firms or accounting idiosyncrasies about which we have no information.

An important concern about our measure is that firms that maximize sales instead of profits may come to grief. If sales are a reasonable proxy, then they should be positively correlated with more direct measures of profitability. While our direct measure of profitability at the firm level (earnings) contains substantial idiosyncratic noise about which we have little information, these idiosyncrasies should average out as we aggregate across a large number of firms. The correlation of the growth rate of aggregate sales and the growth rate of aggregate earnings in our sample is 0.66. Thus, firm-level sales provide a relatively transparent income statement variable that tracks overall profitability reasonably well. We divide the nominal value of each firm's sales by the CPI to create a real index.

The IFC database also contains annual stock return data, which we use to compute the variable *DIFCOV*. Recall that *DIFCOV* is the historical covariance of a firm's stock return with the local market index, minus the historical covariance of the firm's stock return with the world market index. Since the goal is to relate changes in investment—an annual variable—to changes in risk, we compute annual covariances. For each firm we compute the covariance of its annual, real dollar-denominated, dividend-inclusive return with that of the local market. For each firm we also compute its annual, real dollar-denominated, dividend-inclusive return with that of the MSCI World Total Return Index. Monthly covariances are notoriously fraught with measurement error (Fama and French, 2004). The signal-to-noise ratio in our annual covariance data is even lower. Section 5.2.1. attempts to address the measurement error problem, and the conclusion explains why, in spite of measurement error, it is important to test whether changes in the cross-section of risk explain changes in the cross-section of investment.

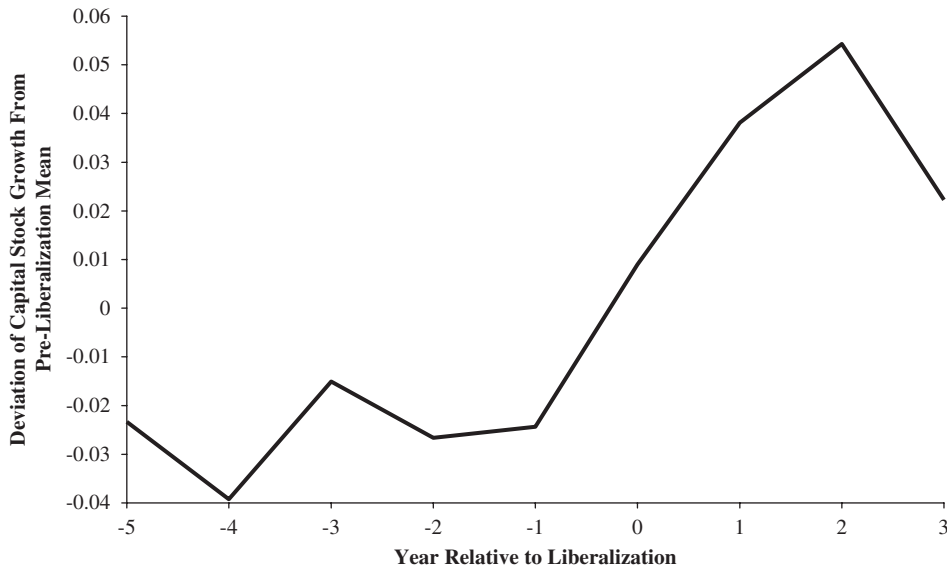


Fig. 1. Liberalization and the Growth Rate of Firms' Capital Stock. Capital stock growth is the growth rate of firm  $i$ 's capital stock in year  $t$  minus the average growth rate of firm  $i$ 's capital in the entire period preceding the liberalization ( $t = [-1, -5]$ ). The y-axis measures the average growth rate of the capital stock across the firms in our sample. The x-axis measures time in terms of years relative to liberalization:  $t = 0$  is the liberalization year;  $t = [-1, -3]$  is the pre-liberalization period, and  $t = [+1, +3]$  is the post-liberalization period.

#### 4.2. Descriptive findings

Table 1 summarizes the essential characteristics of the data. Column (1) provides country names. Column (2) lists the year of each country's stock market liberalization. Column (3) gives the number of firms in each country. Column (4) shows that the stock market capitalization of the 369 firms in our sample constitutes about 40% of the total stock market capitalization of all publicly traded firms in these countries. This number suggests that the firms account for a non-trivial fraction of total economic activity, but the point should not be overstated because publicly traded firms account for a smaller fraction of the economy in these countries than they do in the US.

##### 4.2.1. Preliminary facts about liberalization: changes in stock prices and investment

The fifth column of Table 1 shows that the average firm experiences a 51% jump in its stock price during the liberalization year. Since stock prices and the cost of capital move inversely, the jump in prices is consistent with the fall in the cost of capital emphasized during the discussion of the model in Section 3. The logical next issue is whether investment responds accordingly. This raises two questions. The first is time series in nature: do we see an increase in the average investment rate of the firms in our sample? The second is cross-sectional: is the size of the increase in investment positively correlated with the size of the stock price jump, that is to say, do the firms that experience the largest increases in stock prices also experience the largest increases in investment? The next two subsections address each of these questions in turn.

##### 4.2.2. Time-series findings

Fig. 1 provides a preliminary answer to the time-series question. It plots the average growth rate of the 369 firms' capital stocks in liberalization time. The figure shows that the average firm's rate of investment rises sharply in the three years immediately following a liberalization.<sup>5</sup> Fig. 1 is not entirely surprising since previous work documents that aggregate investment increases in the aftermath of liberalizations (Henry,

<sup>5</sup>Consistent with this finding, Morck, Strangeland, and Yeung (2000) document a rise in capital intensity of production for widely held firms after liberalization in Canada.

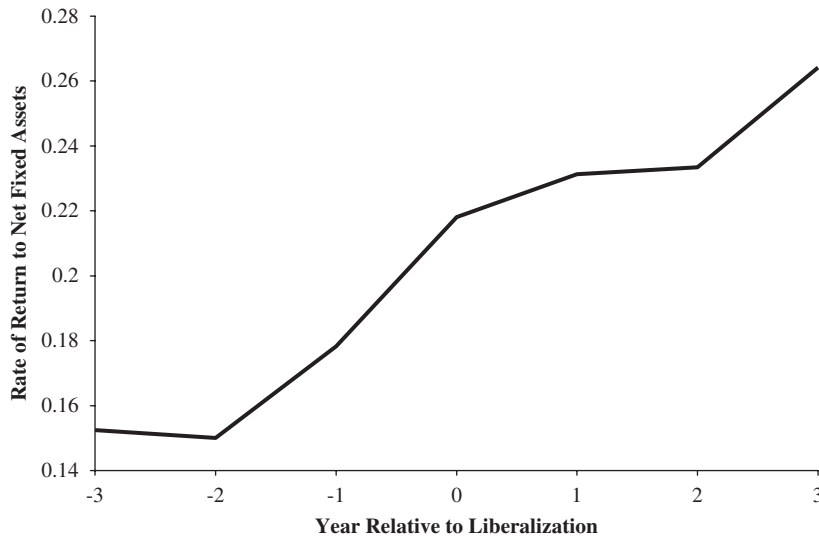


Fig. 2. Liberalization and the Rate of Return to Firms' Capital. The y-axis represents  $E/K$ , which is the average rate of return to net fixed assets or the aggregate rate of return to capital. For each firm, we compute the flow return to the stock of capital as the ratio of earnings before interest and taxes to the value of net fixed assets.  $E/K$  represents the average of this ratio across the 369 firms in our sample. The x-axis measures time in terms of years relative to liberalization:  $t = 0$  is the liberalization year;  $t = [-1, -3]$  is the pre-liberalization period, and  $t = [+1, +3]$  is the post-liberalization period.

2000b). But previously published work uses aggregate (country-level) data, which consists of investment by both publicly and non-publicly traded firms. Since liberalizations most directly affect the investment incentives of publicly traded firms, the firm-level effects documented in this paper are more tenable.

Moreover, as one would expect, the firm-level effects are also larger. For instance, the growth rate of the average country's capital stock exceeds its pre-liberalization mean by an average of 1.1 percentage points per year in the three years after liberalization (Henry, 2003). In contrast, Fig. 1 shows that the growth rate of the average firm's capital stock exceeds its pre-liberalization mean by an average of 4.1 percentage points per year over the same time period. A simple back-of-the-envelope calculation demonstrates the economic significance of the firm-level numbers. Multiplying the firm-level capital-stock-growth deviation number, 4.1, by the elasticity of output with respect to capital (about one-third), gives a rough sense of its implication for the growth rate of firm output: about 1.4 percentage points per year.

It is important to remember, however, that stock prices may deviate from their fundamental values (Shiller, 1981, 2000). Ramping up investment in response to such deviations may not be efficient.<sup>6</sup> In order to assess whether liberalization fosters inefficient investment, we examine the ex-post rate of return to capital. For each firm, we compute the flow return to the stock of capital as the ratio of earnings before interest and taxes to the value of net fixed assets. After computing this ratio for each of the 369 firms, we take a simple average and call it the rate of return to capital.

Fig. 2 shows that the rate of return to capital actually increases from an average of 16.0% per year in the pre-liberalization period (years  $[-3]$  to  $[-1]$ ) to 24.3% per year in the post-liberalization period (years  $[+1]$  to  $[+3]$ ). While Fig. 2 appears inconsistent with the notion of indiscriminate, bubble-driven investment, we would expect to see some decline in the rate of return to capital as firms increase the rate at which they buy and install new machinery. Why does this not happen? Again, liberalizations may coincide with reforms that increase the profitability of investment. Fig. 3 demonstrates the point. The growth rate of real sales and real earnings both increase sharply during liberalization episodes.

<sup>6</sup>See Baker, Stein, and Wurgler (2003), Blanchard, Rhee, and Summers (1993), Fischer and Merton (1984), and Stein (2003) for an extensive discussion of efficient investment when stock prices deviate from fundamentals.

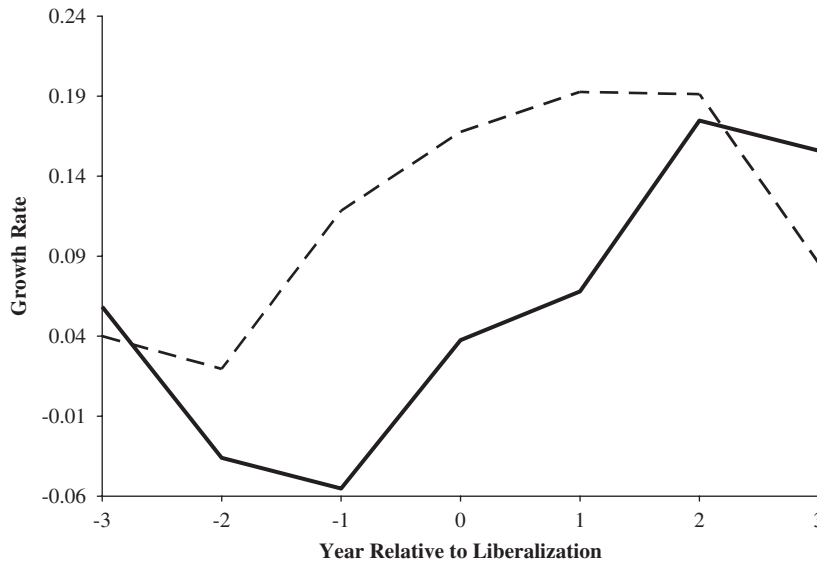


Fig. 3. Liberalization and the Growth Rate of Firms' Sales and Earnings. Sales and earnings growth are the first difference of the log of sales and earnings for any given firm. The y-axis measures the average growth rate of sales and earnings across the firms in our sample. The x-axis measures time in terms of years relative to liberalization:  $t = 0$  is the liberalization year;  $t = [-1, -3]$  is the pre-liberalization period and  $t = [+1, +3]$  is the post-liberalization period.

#### 4.2.3. Cross-sectional findings

There is no glaring evidence of inefficiency in the time-series profiles of investment and the fundamentals. Yet for firms to invest efficiently, they must be discerning not only in the time series but also in the cross-section. In turn, cross-sectional efficiency requires that firms' post-liberalization investment decisions systematically reflect the signals about fundamentals that are embedded in the stock price changes that occur at liberalization.

Before providing a preliminary answer to the cross-sectional question—are changes in investment correlated with the changes in stock prices?—it is useful to review the rationale for raising the question in the first place. The paper began with the observation that liberalization-induced stock price changes contain firm-specific information and proposed to investigate whether that information affects firms' investment decisions. Specifically, the goal is to decompose the correlation between changes in investment and the liberalization-induced stock price changes into something more fundamental: the correlation between changes in investment and the changes in discount rates and profitability that drive the stock price changes.

As a first step in this direction, we examine the simple correlation between the changes in firms' investment and their stock price change at liberalization (standard errors in parentheses; adjusted  $R^2 = 0.01$ ;  $N = 1185$ ):

$$\Delta(I/K)_{it} = 0.001 + 0.056 \text{ STOCKPRICECHANGE}_{it},$$

$$t \in \{[0], [+1], [+2], [+3]\} (0.012)(0.014) \quad (5)$$

The variable *STOCKPRICECHANGE* is the percentage change in firm  $i$ 's stock price during the liberalization year (year [0]). As before, the variable  $t$  indexes liberalization time. The variable  $\Delta(I/K)_{it}$  is defined as the growth rate of firm  $i$ 's capital stock in year  $t$  minus the average pre-liberalization growth rate of firm  $i$ 's capital stock. The pre-liberalization average is calculated over the three-year period immediately preceding the liberalization ( $t = [-3]$  to  $t = [-1]$ ). The rationale for this construction is straightforward. Just as the stock price response to liberalization is a measure of news, analyzing firms' investment responses to that news requires a measure of the abnormal growth rate of their capital stock relative to some pre-liberalization benchmark. All else equal, in the instant before news of liberalization arrives, the pre-liberalization mean of the growth rate of a firm's capital stock is a reasonable forecast of its expected future growth rate.

Eq. (5) provides reasonable support for the theory. On average, the larger the impact of liberalization on a firm's stock price, the larger is the firm's post-liberalization increase in investment. A simple calculation illustrates the economic significance of the correlation. As mentioned earlier, the average value of the liberalization-year stock price changes in our sample is 51%, so Eq. (5) predicts that the growth rate of the average firm's capital stock will exceed its pre-liberalization mean by an average of 2.9 percentage points (51% times 0.056) in the post-liberalization period. Again, the implication of this estimate for firm-level output growth is not small—about one percentage point per year.

While both the time-series and the cross-sectional data suggest the empirical relevance of the question with which the paper began, neither Fig. 1 nor Eq. (5) constitute conclusive evidence. The next section conducts formal empirical estimations.

## 5. Empirical methodology and results

This section explains the empirical methodology and presents results. Subsection 5.1. presents the benchmark results. Subsection 5.2. takes a closer look at the role of the cost of capital in the results, and 5.2.1 re-estimates the results using alternative measures of firm-specific changes in risk. Subsection 5.3 examines why changes in risk do not affect investment, and 5.3.1 examines the potential impact of imperfect capital markets on the results.

We begin by estimating the following panel regression:

$$\begin{aligned} \Delta(I/K)_{ijt} = & \text{CONSTANT} + \text{COUNTRY}_j \\ & + a_0 \Delta \text{SALESGROWTH}_{ijt} \\ & + a_1 \sum_{\tau=1}^3 \Delta \text{SALESGROWTH}_{ijt+\tau} + b_0 \text{DIFCOV}_{ij} \\ & + \varepsilon_{ijt}, \quad t \in \{[0], [+1], [+2], [+3]\}. \end{aligned} \quad (6)$$

As before, the variable  $\Delta(I/K)_{ijt}$  is the deviation of the growth rate of the capital stock of firm  $i$  in country  $j$  (in years  $t = [0]$  to  $t = [+3]$ ) from the average growth rate of the firm's capital stock in the three-year period immediately preceding the liberalization (year  $[-3]$  to year  $[-1]$ ). The intercept term, *CONSTANT*, measures the average value of the common shock to the cost of capital after controlling for the country-specific effects captured by the dummy variable, *COUNTRY<sub>j</sub>*.

The variable  $\Delta \text{SALESGROWTH}_{ijt}$  is the deviation of the growth rate of firm  $i$ 's sales (in years  $t = [0]$  to  $t = [+3]$ ) from the average growth rate of its sales in the three-year period immediately preceding the liberalization (year  $[-3]$  to year  $[-1]$ ). The sales growth deviation variable is our best proxy for changes in the growth rate of expected future profits. Just as the left-hand-side variable captures the abnormal change in capital stock growth, the sales variable captures the abnormal growth in sales. In theory, only changes in expected future growth should affect investment, but including changes in current sales growth proves useful when we examine the validity of the perfect capital markets assumption in Section 5.3.1. To control for the impact of future abnormal growth on investment we use the sum of three leads of abnormal growth. For instance, when  $t = [0]$ , the summation variable takes on the value of cumulative abnormal growth in years  $[+1]$ ,  $[+2]$ , and  $[+3]$ . It bears repeating that the sales growth variables control for shocks to current and expected future growth, whether they originate from economic reforms coincident with stock market liberalization or elsewhere.

The next term on the right-hand side of (6) is the previously defined risk-sharing variable *DIFCOV*. Even though *DIFCOV* does not vary over time for any given firm, it does vary across firms. Eq. (6) uses this cross-firm variation in *DIFCOV* for any given time period to estimate the effect of changes in risk.

Turning at last to the error term,  $\varepsilon_{ijt}$ , it is important to note that the standard distributional assumptions needed for valid statistical inference will not hold if there is (a) correlation of the residuals across firms within a given time period, or (b) correlation of the residuals within a given firm over time (Peterson, 2006). Point (a) matters because liberalization in a given country simultaneously raises investment demand for all firms, thereby inducing correlation in the investment residuals across all firms in the country at a given point in time.

Table 2  
Panel estimations: the impact of changes in firm-fundamentals on post-liberalization changes in investment

Right-Hand-Side Variables	(1)	(2)	(3)	(4)	(5)	(6)
CONSTANT	0.057*** (0.009)	0.061*** (0.01)	0.055*** (0.011)	0.059*** (0.011)	0.035* (0.020)	0.022 (0.029)
$\Delta SALES GROWTH_{ijt0}$		0.257*** (0.066)		0.282*** (0.061)	0.271*** (0.061)	
$\sum_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau}$		0.324** (0.139)		0.295** (0.128)	0.342*** (0.09)	
$DIFCOV_{ij}$			0.029 (0.322)	-0.028 (0.27)	-0.086 (0.265)	
$STOCKPRICECHANGE_i$					0.044* (0.023)	0.057*** (0.016)
Adjusted- $R^2$	0.038	0.14	0.013	0.11	0.142	0.032
Number of Observations	1,285	1,270	1,076	1,069	1,044	1,181

Notes: Table 2 presents results for alternative specifications of the benchmark panel regression, which is given by the following equation:  $\Delta(I/K)_{ijt} = CONSTANT + COUNTRY + a_0 \Delta SALES GROWTH_{ijt0} + a_1 \sum_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau} + b_0 DIFCOV_{+ejt}$ ,  $t \in \{[0],[+1],[+2],[+3]\}$ . The left-hand-side variable  $\Delta(I/K)_{ijt}$  is the defined as the growth rate of the capital stock of firm  $i$  (in country  $j$ ) in year  $t$ , minus the average pre-liberalization growth rate of firm  $i$ 's capital stock. The pre-liberalization average is calculated using capital stock growth data from the three-year period immediately preceding the liberalization ( $t = [-3]$  to  $t = [-1]$ ). The variable  $\Delta SALES GROWTH_{ijt0}$  is the deviation of the growth rate of firm  $i$ 's sales from its pre-liberalization mean.  $\sum_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau}$  is the cumulative deviation of the growth rate of firm  $i$ 's sales (in years  $[+1]$ ,  $[+2]$ , and  $[+3]$ ) from its pre-liberalization mean. For a given firm,  $DIFCOV_i$  is equal to the historical covariance of firm  $i$ 's annual stock return with the local market minus the historical covariance of firm  $i$ 's annual stock return with the Morgan Stanley Capital International (MSCI) Total World Return Index. The variable  $STOCKPRICECHANGE_i$  is the percentage change in firm  $i$ 's real stock price during the liberalization year. Standard errors, clustered by both firm and country, are in parentheses.  $COUNTRY_j$  represents a set of country-specific dummies that control for country fixed effects. The symbols (\*\*\*), (\*\*), and (\*) represent significance at the 1%, 5%, and 10% levels, respectively.

Point (b) matters because it takes time to install new capital; investment for a given firm may remain elevated above its normal rate for a number of years in the post-liberalization period, thereby inducing correlation in that firm's investment residuals over time.

Our empirical analysis adjusts the standard errors to account for the possible presence of both forms of dependence in the residuals. Specifically, to correct for both (a) and (b) we adjust the standard errors by simultaneously clustering by firm and by country.<sup>7</sup>

### 5.1. Benchmark empirical results

Table 2 reports the results we obtain after estimating several variants of Eq. (6). In order to gain a sense of the importance of the country-specific common shock to investment, Column (1) reports the results of a regression of changes in capital stock growth on a constant and country fixed effects for Jordan, Korea, Malaysia, and Thailand. The constant term therefore measures the common shock for India. The constant is equal to 0.057 and is significant at the 1% level. This means that in the post-liberalization period, the growth rate of the capital stock of the typical Indian firm exceeds its pre-liberalization mean by an average of 5.7 percentage points per year. The common shock for every country other than India is equal to the sum of the constant and the country's estimated fixed effect: this sum is -0.091 for Jordan, 0.013 for Korea, 0.031 for Malaysia, and 0.163 for Thailand. The country-specific common shock is statistically significant for Thailand and Jordan, but not for Malaysia and Korea.

Column (2) reports the results of a regression on a constant, country fixed effects, and changes in current and future sales growth. In this specification, the common shock is significant for every country except

<sup>7</sup>Specifically, we use the STATA code discussed in footnote 2 of Peterson (2006) and available at <http://www.kellogg.northwestern.edu/faculty/petersen/htm/papers/se/cluster.ado>

Malaysia. The coefficient on changes in current sales growth is 0.257, significant at the 1% level. The coefficient on changes in future sales growth is 0.324, significant at the 5% level. Both coefficients are economically significant. For instance, the estimate on changes in future sales growth indicates that a ten-percentage point deviation in the future sales growth measure from its pre-liberalization mean predicts that the typical firm's capital stock growth in the post-liberalization period will exceed its pre-liberalization mean by 3.24 percentage points (0.1 times 0.324).

Column (3) reports the results of a regression on a constant, country fixed effects, and *DIFCOV*. The impact of risk sharing on investment is positive, as predicted by the theory, but statistically insignificant and economically trivial. To see what trivial means, multiply the coefficient on *DIFCOV* (0.029) by the average value of *DIFCOV* for all the firms in the sample (0.015). This calculation shows that the average annual effect of risk sharing on the typical firm's capital stock growth is 0.00044, or 0.044 percentage points, which means that the effect on firm output growth is roughly 0.014 percentage points per annum.

Column (4) reports the results of the full-blown decomposition: regression on a constant, country fixed effects, changes in sales growth, and *DIFCOV*. The common shock remains significant. The estimate of the coefficient on the change in current sales is 0.282, the coefficient on the change in future sales is 0.295, and both are significant at the 1% level. The estimate of the coefficient on *DIFCOV* continues to be economically and statistically insignificant.

## 5.2. Does the cost of capital matter for changes in investment?

While the estimated effect of changes in risk on changes in capital stock growth is economically trivial and statistically insignificant in Columns (1) through (4) of Table 2, the estimate of the constant is always significant. The economic significance of the constant (and the country fixed effects) suggests that common shocks to the cost of capital exert a meaningful impact on post-liberalization changes in investment. Having said that, interpreting significant intercept terms as evidence of the common shock to the cost of capital requires caution. In theory, the intercepts measure the impact of the change in the risk-free rate on investment as countries move from closed to open capital markets. In practice, country-specific intercept terms may also reflect unobserved regime shifts that have nothing to do with a change in the cost of capital.

To determine whether changes in the cost of capital really matter, Column (5) of Table 2 reports the results of a regression that adds one more variable to the right-hand side of the regression reported in Column (4): the firm's stock price change during the liberalization year. The logic of this regression is as follows. Theory says that changes in stock prices are driven by changes in expected future profitability and changes in the cost of capital. Since we are controlling for changes in profitability with changes in current and future sales growth, a significant coefficient on the change-in-stock-prices variable would suggest a significant effect of the cost of capital on investment. Column (5) shows that the coefficient on the change in stock prices is 0.044, significant at the 5% level. This is a slightly smaller number than the coefficient on stock price changes from the univariate regression reported in Section 4.2.3. (Eq. (5)), but it is economically significant and thus suggests that firms' post-liberalization changes in investment are meaningfully related to changes in their overall cost of capital.

To underscore the point, Column (6) reports the results from a regression of changes in capital stock growth on a constant, country fixed effects, and the change in stock price with no other controls. Again, the coefficient on the stock price change is significant while the coefficient on the constant is statistically insignificant and reduced to a third of its previous magnitude. If the significant constant in Columns (1) through (5) reflects some spurious regime shift in investment that is unrelated to a change in the cost of capital, then the constant should not be affected by the inclusion of the change in stock prices as a right-hand-side variable, but this is not the case.

### 5.2.1. Alternative measures of changes in risk

After controlling for current and expected future sales growth, stock prices matter for investment, possibly suggesting a role for the cost of capital. Yet the evidence so far suggests that changes in risk sharing have a negligible impact. The unavoidable conclusion would seem to be that if liberalization-induced changes in the cost of capital do influence investment, then the common shock to the cost of capital matters far more than

firm-specific changes in risk premia. But it is possible that measurement error masks the significance of risk sharing.

One source of measurement error arises for the following reason. When countries liberalize, some publicly listed firms become eligible for foreign ownership (investible), while others remain off limits (non-investible). Data from the IFC's Emerging Markets Database show that *DIFCOV* robustly explains the change in the cost of capital for investible firms, but is never significant for the non-investible ones (Chari and Henry, 2004). Therefore, it is possible that the changes in investment are significantly correlated with *DIFCOV* for the investible firms, but the relation is masked because the investible and non-investible firms are grouped together in our sample.

The investible and non-investible firms are grouped together in our sample because the IFC Corporate Finance Database—the source of all the capital stock data—does not identify investible and non-investible firms. The Emerging Markets Database (EMDB) distinguishes between investible and non-investible firms, but it contains no capital stock data. By using the information in the EMDB, we are able to identify 61 investible and 28 non-investible firms in the IFC Corporate Finance database. We then re-conduct the entire battery of tests for risk sharing on this sample of 89 firms. The coefficient on *DIFCOV* is not significant in any specification.

Returning to the full sample, we conduct two additional tests for evidence that changes in risk affect changes in capital allocation. First, we sort the firms by the sign of *DIFCOV*. Firms for which *DIFCOV* is greater than zero we label *DIFCOVPOSITIVE*; firms for which *DIFCOV* is less than zero we label *DIFCOVNEGATIVE*. Second, we rank the firms in descending order of the magnitude of *DIFCOV*. Firms in the top 20% of the distribution we label *DIFCOVHIGH*; those in the bottom 20% we label *DIFCOVLOW*. After constructing our new risk-sharing variables, we replicate the regressions in Table 2 using the new measures in place of *DIFCOV*. None of the two new variables are significant.

### 5.3. Why do changes in risk have no impact on the allocation of capital?

The failure of changes in risk to matter for the allocation of physical capital might suggest a “numb” (Morck, Yeung, and Yu, 2000, p. 259) invisible hand incapable of responding to the signals about risk embedded in the liberalization-induced stock price changes. But an alternative explanation is that firms face financial constraints that hinder their ability to allocate capital in accordance with the neoclassical model of investment. This is not a paper about financing constraints *per se*, and we do not claim to make any contribution to that literature. Financing constraints are germane only to the extent that their existence would impinge on the ability of firms to implement their desired investment decisions, requiring that we adjust the interpretation of our results accordingly. To get a sense of whether financing constraints affect the firms in our sample, we take a closer look at the sensitivity of their investment to measures of current cash flow.

#### 5.3.1. Imperfect capital markets

In a frictionless capital market world, only expected future cash flow should matter for investment. There is ample evidence, however, that current cash flow also exerts significant influence (Fazzari, Hubbard, and Petersen, 1988; Hubbard, 1998). Furthermore, the results in Table 2 show that the post-liberalization decisions of the firms in our sample are strongly influenced by our proxy for current profitability. One possible explanation for this fact is as follows: the growth rate of sales that occurs at liberalization is unusually large (Fig. 2), and this positive shock to profitability provides firms a cash windfall with which to finance projects that they could not implement in the pre-liberalization period.

In order to further scrutinize the relation between investment and current sales evident in Table 2, we examine whether the correlation between investment and current sales growth during liberalization episodes is stronger than the correlation at any generic point in time. Specifically, we estimate the following regression:

$$\left(\frac{I}{K}\right)_{ijt} = \text{CONSTANT} + \text{COUNTRY}_j + \beta_1 \text{SALESGROWTH}_{ijt} + \beta_2 \text{SALESGROWTH}_{ijt} * \text{LIBERALIZATION}_{ijt} + \varepsilon_{ijt}. \quad (7)$$

Importantly, in Eq. (7) the variable  $t$  now denotes calendar time, not liberalization time as in all of the other regression specifications. Accordingly, the left-hand-side variable is the growth rate of the real capital stock, not deviations of the growth rate from the mean as in Eq. (6). Similarly, the right-hand-side variable is the growth rate of current sales, not deviations of the growth rate from its mean. The reason for not using deviations is that Eq. (7) attempts to estimate the behavior of investment over the entire sample (not just the post-liberalization period) and deviations from the mean over the entire sample will, by definition, be equal to zero. If the responsiveness of investment to sales growth at a generic time,  $t$ , is the same as when  $t$  is a liberalization year, then the coefficient on the interaction term should not be significant.

Table 3 presents the results. The regression in Column (1) shows that both the coefficient on current sales growth and the interaction of current sales growth with the liberalization dummy are significant. The regressions in Columns (2) through (6) show that the only significant interaction terms are those with current sales growth. The question is how to interpret the finding that investment is more sensitive to current sales growth during liberalization periods.

If a firm faces financing frictions, then investment will be sensitive to current cash flow. Importantly, the converse of the preceding statement need not be true. A firm's investment may be sensitive to cash flow, even in the absence of financial constraints that impede its ability to implement optimal investment decisions (Kaplan and Zingales, 1997, 2000; Stein, 2003). A number of models can account for the significant relation we find between investment and current profitability, and an attempt to distinguish between all of the competing explanations lies beyond the scope of this paper.<sup>8</sup> Instead we ask the question most germane to the task at hand: is there any evidence that a lack of access to external finance impedes the investment decisions of the firms in our sample? While access to external finance would not seem to be an issue for the 100 largest manufacturing firms in a country—large established firms with lots of tangible assets tend to have access to credit—we examine several variables that speak directly to the issue.<sup>9</sup>

Let us begin with dividends. A firm that pays dividends could invest more by cutting dividends, so it seems unlikely that a dividend-paying firm suffers from capital rationing (Lang and Stulz, 1994). All of the firms in our sample pay dividends. Furthermore, Table 4 (Row 1) shows that a significant increase in dividend issuance takes place following liberalization, and it seems unlikely that capital-constrained firms would increase dividends at the very moment investment opportunities are improving (as Figs. 2 and 3 suggest they are). Next, let's turn to debt. All of the firms in our sample have long-term debt, which again does not suggest a lack of access to external finance.

To provide a more general picture of the extent to which the firms in our sample use external sources to finance investment, Table 4 lists several indicative variables: dividends, long-term debt, total external finance, retained earnings, and equity. We construct the ratio of the change in each variable to the change in the stock of net fixed assets (investment). We then calculate the average value of the ratio before liberalization and the average value after liberalization, and test whether the difference between the two averages is statistically significant. Table 4 shows that reliance on external finance rises in the aftermath of liberalizations, but not significantly so. Furthermore, there is a significant increase in reliance on internal funds.

Taken together with the evidence on the impact of current and future sales growth, the evidence in Table 4 suggests that the firms in our sample increase investment when future growth prospects improve, but they also increase investment when they have a lot of cash. These findings are roughly consistent with what we know about the investment behavior of firms in developed countries.<sup>10</sup> Again, sorting through all of the alternative explanations of these facts lies beyond our ambit. The central point is that while financial constraints are surely an issue for some firms in the countries we study, there is no glaring evidence that a lack of access to external finance severely impedes the investment decisions of the 369 firms in our sample.

Having shown that lack of access to external finance cannot explain why firms' investment decisions are insensitive to changes in risk, we turn to other issues of robustness.

<sup>8</sup>See Stein (2003) for a review of the literature on capital market imperfections and corporate investment.

<sup>9</sup>Our analysis of access to external finance is similar in spirit to that of Johnson, McMillan, and Woodruff (2002) and Rajan and Zingales (1998).

<sup>10</sup>See, for instance, the evidence surveyed in Stein (2003).

Table 3  
Panel regression estimations of sales growth-investment elasticities during liberalization years

Right-Hand-Side Variables	(1)	(2)	(3)	(4)	(5)	(6)
<i>CONSTANT</i>	0.0648*** (0.006)	0.1064*** (0.005)	0.0919*** (0.005)	0.1117*** (0.006)	0.1035*** (0.005)	0.0862*** (0.005)
<i>SALESGROWTH<sub>ijt</sub></i>	0.3072*** (0.0186)		0.1593*** (0.015)		0.1084*** (0.016)	0.1239*** (0.015)
<i>SALESGROWTH<sub>ijt</sub> * LIBERALIZATION<sub>ijt</sub></i>	0.0555* (0.0302)		0.1788*** (0.027)		0.2085*** (0.028)	0.1899*** (0.0288)
<i>SALESGROWTH<sub>ij(t+1)</sub></i>		0.1004*** (0.0177)	0.1158*** (0.0154)			0.1499*** (0.016)
<i>SALESGROWTH<sub>ij(t+1)</sub> * LIBERALIZATION<sub>ij(t+1)</sub></i>		0.0316 (0.0301)	−0.021 (0.028)			−0.0559 (0.0303)
<i>SALESGROWTH<sub>ij(t+2)</sub></i>				0.0491** (0.021)	0.0579*** (0.0164)	0.070*** (0.016)
<i>SALESGROWTH<sub>ij(t+2)</sub> * LIBERALIZATION<sub>ij(t+2)</sub></i>				0.0141 (0.034)	−0.0386 (0.035)	−0.0547 (0.0311)
<i>R</i> <sup>2</sup>	0.13	0.03	0.08	0.02	0.05	0.08

Notes: Table 3 presents estimates of the specification:  $(I/K)_{ijt} = \text{CONSTANT} + \text{COUNTRY}_j + \beta_1 \text{SALESGROWTH}_{ijt} + \beta_2 \text{SALESGROWTH}_{ijt} * \text{LIBERALIZATION}_{ijt} + \varepsilon_{ijt}$ . The variable  $(I/K)_{ijt}$  is the growth rate of the real capital stock, not deviations of the growth rate from the mean as in Table 2. The variable  $\text{SALESGROWTH}_{ijt}$  is the first difference of the natural log of the real value of contemporaneous sales for any given firm over the entire sample period. The variables  $\text{SALESGROWTH}_{ij(t+1)}$  and  $\text{SALESGROWTH}_{ij(t+2)}$  measure the first and second leads of the growth rate of sales.  $\text{LIBERALIZATION}_{ijt}$  is a dummy variable that takes on the value of one in the liberalization year [0] and each of the three subsequent years.  $\text{COUNTRY}_j$  represents a set of country-specific dummies that control for country fixed effects. All interactions terms between the  $\text{SALESGROWTH}$  variables and the liberalization dummy measure the change in the elasticity of the investment response to sales growth during the liberalization window. Standard errors, clustered by firm and country, are in parentheses. The symbols (\*\*\*), (\*\*), and (\*) represent significance levels of 1%, 5%, and 10%, respectively.

Table 4  
Pre- and post-liberalization measures of firms' access to external finance

Variable	Pre-Liberalization Average	Post-Liberalization Average	Post-Liberalization Average Differs From Pre?
Change in Dividends/NFA	0.0336	0.0525	Yes***
Change in Long-term Liabilities/ Change in NFA	0.521	2.222	No
Change in External Finance1/ Change in NFA	0.237	1.357	No
Change in External Finance2/ Change in NFA	1.192	1.285	No
Change in Retained Earnings/ Change in NFA	0.516	1.534	No
Change in Internal Sources/NFA	0.015	0.080	Yes*
Change in Equity/Change in NFA	0.363	1.026	No

*Notes:* Change in dividends/NFA is the first difference of the log of the ratio of dividends divided by net fixed assets for each firm. External Finance1 for each firm is the sum of long-term liabilities and net worth less retained earnings. Change in External Finance1 is the first difference of the log of External Finance1 for each firm. Change in NFA is the first difference of the log of net fixed assets for each firm. External Finance2 for each firm is the sum of total liabilities and net worth less retained earnings. Change in External Finance2 is the first difference of the log of External Finance2 for each firm. Change in retained earnings is the first difference of the log of retained earnings or total reserves for each firm. Internal Sources is earnings after taxes less dividends paid for each firm. Change in Internal Sources/NFA is the first difference of the log of Internal Sources to net fixed assets for each firm. Equity is paid in capital or net worth less retained earnings. All changes are calculated on an annual basis for each firm. Pre-liberalization average is the average for any given variable across firms and countries for the period  $t = -3$  to  $t = -1$ . Post-liberalization average is the average for any given variable across firms and countries for the period  $t = 0$  to  $t = +3$ .

## 6. Robustness checks

This section performs two robustness checks. The first concern is that the left-hand-side variable in the regressions in Table 2 (capital stock growth deviations) displays both cross-sectional and time-series variation while two of the right-hand-side variables (*DIFCOV* and *STOCKPRICECHANGE*) are purely cross-sectional. Consequently, for any given firm, the panel regression repeatedly uses a single observation of *DIFCOV* and *STOCKPRICECHANGE* to match each time-series observation of that firm's capital stock growth deviation in the post-liberalization period. Clustering the residuals by both firm and country, as we do in Table 2, adjusts the standard errors so that each use of *DIFCOV* and *STOCKPRICECHANGE* is not treated as an independent observation. Nevertheless, for the sake of completeness we now present purely cross-sectional estimations.

Table 5 collapses the panel regression of Table 2 into a purely cross-sectional regression with the sum of the deviations of capital stock growth from years [0] to [+3] on the left-hand side. Since the left-hand-side variable is now the sum of deviations over a four-year period, we must divide the estimated coefficients by four in order to compare them with those in Table 2. The results in Table 5 closely mirror those in Table 2. Post-liberalization changes in investment continue to be explained by changes in current and future sales growth and the common shock to the cost of capital. The coefficient on *DIFCOV* remains insignificant. Of particular interest are the results reported in column (5), which show that the coefficient on the stock price change variable remains significant in the full-blown decomposition. Column (6) confirms that liberalization-induced stock price changes have a significant effect on investment.

The second robustness concern is that it is important to examine whether our measure of capital stock growth deviations is sensitive to the choice of the pre-liberalization window. If countries liberalize in response to crises or recessions, then using the three years immediately preceding the liberalization as a benchmark may overstate the abnormal growth rate of the capital stock in the post-liberalization period. Table 6 replicates all

Table 5  
Cross-sectional regression estimations: the impact of changes in firm-fundamentals on post-liberalization changes in investment

Right-Hand-Side Variables	(1)	(2)	(3)	(4)	(5)	(6)
CONSTANT	0.14*** (0.047)	0.065 (0.048)	0.097* (0.048)	0.018 (0.049)	-0.049 (0.058)	0.003 (0.062)
$\Delta SALES GROWTH_{ijt[0]}$		0.152 (0.132)		0.317*** (0.127)	0.221* (0.130)	
$\Sigma_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau}$		0.369*** (0.064)		0.386*** (0.069)	0.456*** (0.075)	
<i>DIFCOV</i>			0.176 (0.898)	-0.303 (0.887)	-0.551 (0.881)	
<i>STOCKPRICECHANGE<sub>i</sub></i>					0.121* (0.067)	0.188*** 0.074
Adjusted- <i>R</i> <sup>2</sup>	0.01	0.085	0.001	0.12	0.15	0.02
Number of Observations	377	360	322	306	298	346

Notes: Table 5 presents results for alternative specifications of the benchmark cross-sectional regression, which is given by the following equation:  $\Sigma \Delta(I/K)_{ij} = CONSTANT + COUNTRY_j + a_0 \Delta SALES GROWTH_{ijt[0]} + a_1 \Sigma_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau} + b_0 DIFCOV_{+eijt}$ . The left-hand-side variable  $\Sigma \Delta(I/K)_{ij}$  denotes the sum of the deviations of the capital stock growth of firm *i* (in country *j*) in the liberalization year and the three years following it from its pre-liberalization firm-specific mean.  $\Delta SALES GROWTH_{ijt[0]}$  is the sum of the deviation of the growth rate of firm *i*'s sales from its pre-liberalization firm-specific mean in the liberalization year.  $\Sigma_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau}$  is cumulative abnormal growth rate in firms *i*'s sales in the three years following liberalization. *DIFCOV<sub>i</sub>* is the difference between the historical covariances of firm *i*'s returns with the local and world markets. *STOCKPRICECHANGE<sub>i</sub>* is the percentage change in firm *i*'s real stock price during the liberalization year. *COUNTRY<sub>j</sub>* represents a set of country-specific dummies that control for country fixed effects. All specifications control for clustering in the error structure. The symbols (\*\*\*), (\*\*), and (\*) represent significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 6  
Panel regression estimates: the impact of changes in firm-fundamentals on post-liberalization changes in investment (alternative definition of post-liberalization changes in investment)

Right-Hand-Side Variables	(1)	(2)	(3)	(4)	(5)	(6)
CONSTANT	0.038*** (0.009)	0.0138 (0.008)	0.021** (0.010)	-0.0003 (0.009)	-0.014 (0.012)	0.004 (0.012)
$\Delta SALES GROWTH_{ijt[0]}$		0.281*** (0.046)		0.316*** (0.047)	0.312*** (0.047)	
$\Sigma_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau}$		0.329*** (0.027)		0.289*** (0.032)	0.329*** (0.034)	
<i>DIFCOV</i>			-0.016 (0.186)	-0.0273 (0.177)	-0.044 (0.177)	
<i>STOCKPRICECHANGE<sub>i</sub></i>					0.028** (0.013)	0.046*** (0.015)
Adjusted- <i>R</i> <sup>2</sup>	0.00	0.099	0.002	0.095	0.11	0.01
Number of Observations	1,293	1,292	1,080	1,079	1,054	1,185

Notes: Table 6 presents results for alternative specifications of the benchmark regression using an alternative measure of the post-liberalization change in investment:  $\Delta(I/K)_{ijt} = CONSTANT + COUNTRY_j + a_0 \Delta SALES GROWTH_{ijt[0]} + a_1 \Sigma_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau} + b_0 DIFCOV_{+eijt}$ ,  $t \in \{[0],[+1],[+2],[+3]\}$ . The left-hand-side variable  $\Delta(I/K)_{ijt}$  is defined as the growth rate of firm *i*'s capital stock in year *t* minus its average growth rate in the entire pre-liberalization period.  $\Delta SALES GROWTH_{ijt[0]}$  is the deviation of the growth rate of firm *i*'s sales from its firm-specific mean in year [0].  $\Sigma_{\tau=1}^3 \Delta SALES GROWTH_{ijt+\tau}$  is cumulative abnormal growth rate in firms *i*'s sales in years [+1], [+2], and [+3]. *DIFCOV<sub>i</sub>* is the difference between the historical covariances of firm *i*'s returns with the local and world markets. *STOCKPRICECHANGE<sub>i</sub>* is the percentage change in firm *i*'s real stock price during the liberalization year. *COUNTRY<sub>j</sub>* represents a set of country-specific dummies that control for country-fixed effects. All specifications control for clustering in the error structure. The symbols (\*\*\*), (\*\*), and (\*) represent significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

of the results in Table 2 using a new left-hand-side variable, which is defined as the growth rate of firm  $i$ 's capital stock in year  $t$  minus its average growth rate in the entire pre-liberalization period. The results in Table 6 are very similar to those in Table 2. The coefficients on current and future sales growth deviations are always significant, the coefficient on the stock price change is always significant, and changes in risk never matter.

## 7. Conclusion

Since there is little evidence to suggest that levels of expected stock returns in developed markets vary cross-sectionally according to the degree of firms' exposure to aggregate covariance risk, testing the hypothesis that firms in developing countries allocate investment in accordance with the CAPM may seem to fly in the face of all common sense. However, new evidence suggests that changes in firm-level stock returns during stock market liberalization episodes do reflect changes in covariance risk (Chari and Henry, 2004). And while the stock price changes that occur during liberalizations may convey information about changes in risk sharing, the more pressing economic question is whether investment responds accordingly.

Because stock market liberalizations reduce firms' risk premia, theory predicts that in the aftermath of liberalizations firms will implement some projects that were too risky to undertake in autarky, à la Obstfeld (1994). We provide the first firm-level test of this prediction. The expression for the liberalization-induced change in a firm's cost of capital demonstrates why the data do not speak in favor of the risk-sharing-investment hypothesis:

$$\Delta\rho_i = (r - r^*) + \gamma DIFCOV_i. \quad (8)$$

Suppose that liberalization reduces the risk-free rate by ten percentage points and that  $\gamma$ , the coefficient of relative risk aversion, is two. Since the average value of the change in a firm's covariance (*DIFCOV*) in our sample is 0.015, the average firm-specific change in the cost of capital will be about three percentage points (two times 0.015). These numbers imply that the total fall in the cost of capital is 13 percentage points, with the common shock accounting for roughly 80% of the change.

This simple numerical example illustrates a fundamental point. If the common shock dominates firm-specific shocks, then detecting an impact of risk sharing on investment will require precisely measured changes in covariance. Since our data are noisy, measurement error alone may account for the results. On the other hand, if the problem is not measurement error but that firms' capital allocation decisions are truly insensitive to risk, then Morck, Yeung, and Yu's (2000) result on the synchronicity of stock price movements in emerging markets may extend to synchronicity of real investment.

Yet it seems hard to argue that firm-specific information is entirely irrelevant when the market allocates capital in accordance with various firm-specific proxies for changes in profitability. Furthermore, the common shock helps explain post-liberalization increases in investment, and there is some evidence that it signifies a change in the cost of capital. Regardless of how one chooses to interpret the evidence, it moves us a step closer to understanding whether resources are efficiently re-allocated when countries remove barriers to international capital flows. Applied to better data in the future, the firm-level identification strategy developed in this paper may bring us nearer still.

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