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DYNAMIC EFFECTS OF FOREIGN DIRECT INVESTMENT WHEN CREDIT MARKETS ARE IMPERFECT

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This paper argues that foreign direct investment (FDI) may increase the vulnerability to capital flow shocks of economies with credit market imperfections. Because of worse access to financial markets, wages in domestic firms carry higher default risk than wages in foreign ones. This alters the domestic wage composition and the subsequent wealth distribution. When credit markets are imperfect, the wealth distribution typically determines an economy's growth potential in autarky; hence, high exposure to FDI may significantly impede the capability to recover from sudden withdrawals of foreign capital. This appears consistent with a first glance at empirical evidence on durations of output recovery after systemic sudden stops.

Keywords: Credit Market Imperfections, Foreign Direct Investment, Inequality, Growth, Occupational Choice, Sudden Stops

1. INTRODUCTION

In economies where capital is scarce and credit market imperfections are severe, foreign direct investment (FDI) can provide an adequate means of channeling capital to its most productive use. Independent of further effects such as technology spillovers or disciplinary effects of fiercer competition, foreign capital inflows may enable the undertaking of profitable projects that otherwise would not have been implemented, and thus boost domestic growth. This may, however, come at the cost of increased vulnerability to sudden capital outflows.

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TABLE 1. Impact of the financial crisis

	Emerging economies	Advanced economies
Output collapse		
Median	−4.9	−4.5
25th percentile	−8.4	−6.6
75th percentile	−2.0	−2.9
Rise in sovereign spreads		
Median	462	465
25th percentile	287	
75th percentile	772	

Notes: Output collapse measured as percent change from peak to trough. Rise in sovereign spreads measured as increase in basis point from trough to peak. For advanced economies table reports rises in spreads on U.S. corporates rated BBB. *Source*: International Monetary Fund (2010).

This appears relevant, not least in light of the recent global financial crisis: In its course, breakdowns of financial markets were followed by severe output contractions and sudden withdrawals of foreign capital from emerging economies. Table 1 depicts the impact of the financial crisis on emerging and advanced economies, showing a stronger effect on emerging economies even though the crisis originated in the advanced economies. This is often accompanied by a drop in the stock of FDI (see Figure 1).

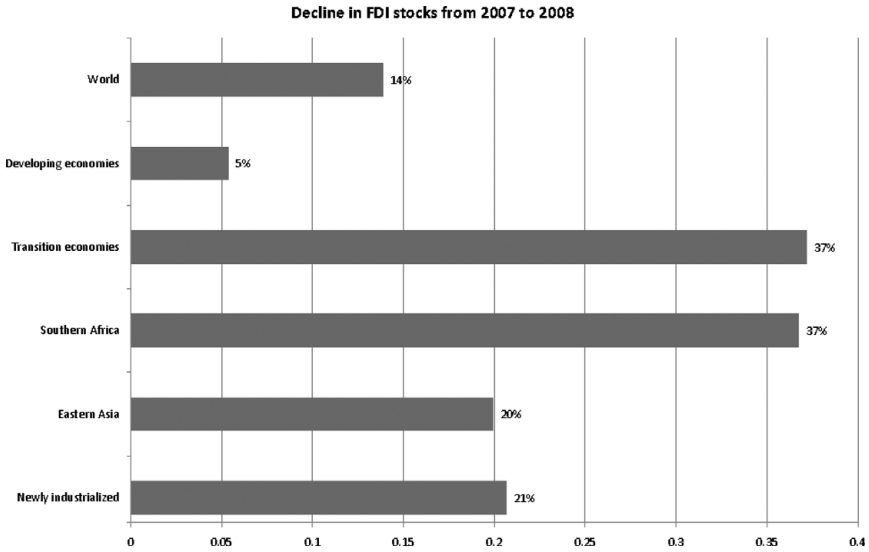

FIGURE 1. The impact of the financial crisis on FDI stocks. *Source:* UNCTAD online statistical database, http://www.unctadstat.unctad.org.

This paper argues that higher past exposure to FDI may impede an economy's ability to respond to sudden withdrawals, or sudden stops, and to adequately reorganize production when domestic credit market frictions are severe. This tends to prolong the duration of economic recoveries after sudden stops in financially less developed economies. Systemic sudden stops, defined by substantial increases of a country's borrowing cost in the wake of an international financial crisis, provide a suitable test case for the study of possible determinants of macroeconomic recovery from financial shocks. This paper predicts long-lasting effects of financial crises in an emerging country that has depended heavily on foreign capital inflows before and is financially less developed. Indicative empirical evidence from various systemic sudden stops since the 1980s is consistent with such a mechanism.

The argument builds on heterogeneity in firms' borrowing costs, in that domestic firms have less access to loans than foreign subsidiaries. This seems plausible; for instance, Manova et al. (2012) find that among exporters in China, foreign-owned firms and joint ventures outperform private domestic firms, and more so in sectors that have higher capital requirements. They conclude that domestic private firms are more credit-constrained than foreign ones, because foreign-owned firms can be refinanced by their parent companies. Guiso et al. (2013) report that firms facing worse credit market conditions tend to rely on internal financing by postponing wage expenditure, i.e., by back-loading employees' wage profiles. When a firm that has a median score on credit market conditions is compared with one that has a 50% worse score, initial wages for workers in the latter firm are about 18% lower and wages increase about 4% faster per year. Wages are about equal after 4.5 years of tenure. This turns employees into de facto creditors and, if the firm's success is uncertain, induces considerable risk in workers' income profiles, which take the form of low initial and higher future wages, paid in case of the firm's success. Regarding risk-taking, Acharya et al. (2009) report that firms that access credit markets with lower creditor rights protection choose riskier investments projects than firms accessing markets where creditors are well protected, which strengthens the effect. Taken together, these observations suggest that domestic firms offer riskier wage profiles than foreign ones, paying lower initial but higher final wages, but only if the firm succeeds.

Sufficiently high final wages enable successful workers' offspring to overcome borrowing constraints and become entrepreneurs, thus building a stock of potential domestic entrepreneurs, facilitating reorganization of the production in case of a sudden stop. This appears relevant, as recent evidence [e.g., Abiad et al. (2011); Coricelli and Roland (2011); Cowan and Raddatz (2011)] points to a connection of sudden stops and credit market imperfections, finding a stronger adverse effect for industries that rely more on external financing, and more so in countries with less developed financial markets.

To formalize the argument, we use a dynamic occupational choice model à la Banerjee and Newman (1993) and focus on distributional effects of FDI when credit markets are imperfect. Setting up a firm requires a fixed investment.

Domestic and foreign owners access different credit markets: domestic entrepreneurial firms face borrowing constraints, whereas foreign ones with access to international and corporate credit markets do not. Borrowing-constrained domestic firms have to back-load wages, offering low initial and higher final wages. Sufficiently high final wages enable successful workers' offspring to overcome collateral constraints and become entrepreneurs. In contrast, foreign firms without collateral constraints need not turn their employees into creditors, and offer flatter income profiles. That is, in economies with severe credit market frictions, steep wage profiles can provide a positive intertemporal externality, and domestic entrepreneurial firms are more likely to generate future potential domestic entrepreneurs than foreign firms.

Entry of foreign firms, which have higher productivity than domestic ones, increases output and the demand for human capital, raising the wage for skilled labor in the domestic economy.[1] This reduces the demand for skilled labor by domestic firms, as the wage increase exacerbates collateral constraints for domestic entrepreneurs. That is, some domestic firms employing skilled labor may be crowded out, and use unskilled instead of skilled labor, which is less efficient. Hence, foreign entry may lower the productivity of domestic firms through a price effect, raising collateral requirements for some domestic firms.[2] More intensive use of unskilled labor also means that the average wage is lower in domestic than in foreign firms. Yet the higher final wage for skilled workers in successful domestic firms implies that skilled workers have a higher probability of leaving sufficient bequests for their offspring to become entrepreneurs when employed at a domestic entrepreneurial firm than at a foreign firm. That is, FDI affects social mobility, reducing the transition rate from skilled worker to entrepreneur.

This effect becomes relevant, for instance, in the case of a sudden stop, that is, a sudden surge in the domestic borrowing cost. It induces a credit squeeze in our model, tightening collateral constraints of domestic firms and reducing investment and economic activity, so that human capital remains idle. Economic recovery may take place even if access to international capital markets remains weak, if domestic entrepreneurial firms have generated sufficiently many potential entrepreneurs [Calvo et al. (2006) describe several such recoveries]. The speed of the recovery is determined by the stock of potential domestic entrepreneurs, which is negatively affected by past exposure to FDI, even if all foreign firms remain in the domestic market during the crisis. That is, the diversification of idiosyncratic risk in foreign firms, offering employees less risky income profiles, may increase the vulnerability of the host economy to systemic shocks.

Following this line of reasoning, higher past exposure to FDI reduces an economy's ability to mitigate sudden withdrawals when credit market frictions are severe. This is consistent with a first glance at the empirical evidence. We use a sample of 33 systemic sudden stops [as classified by Calvo et al. (2006)] in 23 countries between 1980 and 2000, typically triggered by currency crises and contagion. They are thus unlikely to depend on past exposure to FDI. We find suggestive evidence that past FDI inflow is associated to an increase in the

duration of a full output recovery from a sudden stop in economies with weak creditor protection [from Djankov et al. (2007)].

Although the theoretical literature has focused on potential effects of FDI such as technological or human capital spillovers, or fiercer competition in domestic markets [see. e.g., Markusen and Venables (1999); Fosfuri et al. (2001)], distributional effects have received scant attention. This paper relates to the literature on inequality and growth, particularly to studies interested in dynamic effects of changes in credit market frictions on output and the wealth distribution [see Banerjee and Newman (1993) and Galor and Zeira (1993) and the subsequent literature].

Ghatak et al. (2001) and Ahlin and Jiang (2008) use versions of the Banerjee and Newman (1993) model and find that better credit markets (through introduction of micro credit institutions or better law enforcement) may be accompanied by slower long-run growth. This is due either to a distortion in occupational choice, because micro credit is available for certain occupations only, or to lower incentives to save when rents diminish. Matsuyama (2004) applies a related argument to the world economy and shows that if international capital markets are liberalized, but remain imperfect, some economies may be stuck in a poverty trap; FDI is absent from the model, however. Gall (2008) shows that when credit market imperfections are severe enough, minor improvements in credit markets may crowd out alternative ways of capital allocation generating a poverty trap. Other related theoretical literature includes Grossman (1984), where FDI serves as an insurance device and efficiently crowds out domestic entrepreneurs in a static setting with risk-averse agents. Balcão Reis (2001) puts forward the argument that FDI may erode domestic rents thereby reducing research and development.

The paper proceeds by introducing the theoretical framework in Section 2 and deriving the labor market equilibrium with FDI in Section 3. We then present the dynamics in Section 4. Section 5 analyzes the effects of a sudden stop and provides some supporting evidence, and Section 6 concludes. The more cumbersome proofs are in the Appendix.

2. A MODEL OF FDI

We present a model of FDI and growth in which credit markets are imperfect. Domestic and foreign firms will pay the same expected wage conditional on employees' human capital, but the wage variance will be higher across domestic firms.[3]

2.1. Agents

In each period t the domestic economy is populated by a continuum of agents endowed with unit measure. An agent i is born with initial wealth ω_i. Denote the domestic wealth distribution in period t by $G_t(\omega)$. At the beginning of their economic lives agents can invest in human capital h_t: either they become skilled,

$h_t = s$, at a cost of k, or they remain unskilled, $h_t = 0$, at no cost. Skills are observable. Agents' utilities are determined by consumption c_t of the single good at the end of their lives and by bequests to their offspring b_t according to the utility function

$$u = c_t^{1-\beta} b_t^{\beta},$$

where $\beta \in (0, 1)$ is a preference parameter determining the bequest share. That is, agents are risk-neutral in income y_t as $u = \gamma y_t$ with $\gamma = \beta^{\beta}(1-\beta)^{1-\beta}$.[4] Bequests and thus endowments of an agent's offspring are given by $\omega_{t+1} = b_t = \beta y_t$.

2.2. Production

The single good is produced in firms or in subsistence. A firm consists of two members and requires a fixed investment of $I > k$ units of the good.[5] Production is stochastic; with probability q the firm succeeds, otherwise it fails. In the case of failure the output is 0 and in the case of success the firm's output is the sum of its members' human capital:

$$\pi = h + h'.$$

This assumes locally increasing returns to skill, because the setup cost does not depend on h and h'.[6]

If not investing I, agents can produce in subsistence, which yields an income of 0 units of the good. Subsistence can also be interpreted as self-employment, or working in firms using labor input only. As two unskilled agents generate revenue $\pi = 0$ at setup cost I, production in firms with two unskilled members is inefficient. These assumptions limit the potential role of unskilled agents, as our focus lies on the effects of foreign entry on the skill premium.

2.3. Timing

The timing of events in the economy is as follows. At the beginning of a period t, labor and capital markets open and agents choose capital investments and occupations. The labor market is competitive and cleared by expected wages $\bar{v}_t^s$ and $\bar{v}_t^u$ that equate demand and supply for skilled and unskilled labor. Then production takes place and projects' successes or failures are realized. At the end of a period agents are paid out, decide on bequests, and consume.

2.4. Credit Market

There are two types of investment that may require financing: education acquisition and setting up a firm. Suppose for simplicity that borrowing against human capital is impossible in this economy, so that only individuals with endowments $\omega_t \geq k$ may become skilled.[7] There is a credit market for firms, however, that allows firms to borrow or lend at the world market interest rate r.[8] That is, the domestic economy has access to foreign credit markets, subject to domestic imperfections.

These imperfections take the form of moral hazard on the side of the borrowers. A borrower may strategically default, that is, wrongfully announce that the firm cannot meet its financial obligations and attempt to abscond with the firm's liquid assets. With probability δ she is caught by her creditors and loses the assets. That is, δ reflects the quality of creditor rights protection.

2.5. Domestic Firms

A domestic firm is set up by a domestic entrepreneur with skill h. The investment I needed to set up a firm can be financed out of wealth or by borrowing on the credit market. A loan contract specifies a loan D and a repayment R to be paid to the creditor unless the entrepreneur defaults. A default occurs when an entrepreneur reneges on outstanding payments, loan repayments, or wages. A labor contract specifies a wage v to be paid to the worker in the case of no default. This means that workers are effectively creditors of the entrepreneur, consistent with Guiso et al. (2013).

Consider a skilled entrepreneur with wealth $\omega_t < k + I$ who needs to borrow in order to set up a firm. If the project fails, output is 0 and the firm defaults, as $0 > -R - v$, assuming limited liability of the firm's owner. Hence, in the case of a failure, no wages are paid out. Loan contracts must thus ensure that a successful entrepreneur does not find it profitable to abscond. Because labor and loan markets are competitive, the wage v paid in the case of success satisfies $qv = \bar{v}$, where $\bar{v}$ denotes the worker's expected wage, and $qR = (1 + r)D$, with $D \geq I + k - \omega_t$. Hiring a skilled worker at a success wage v^s and average wage $\bar{v}^s$ is incentive-compatible for a skilled entrepreneur if

$$(1 - \delta)2s \leq 2s - R - v^s = 2s - \frac{(1 + r)D}{q} - \frac{\bar{v}^s}{q}.$$

That is, $I + k - \omega_t \leq D \leq (\delta 2qs - \bar{v}^s)/(1 + r)$, which is a condition on the entrepreneur's endowment:

$$\omega_t \geq I + k + \bar{v}^s/(1 + r) - q\delta 2s/(1 + r) := \hat{\omega}^s(\bar{v}^s). \qquad \textbf{(CRS)}$$

That is, the entrepreneur invests k in human capital and funds setup cost I by a loan of $D \in [I - (\omega_t - k), I - (\hat{\omega}^s - k)]$. Suppose that $D = I + k - \hat{\omega}^s(\bar{v}^s)$ as a convention.[9] Wages are 0 in case of failure and v^s in case of success; i.e., a steep wage schedule offers low initial and high future wages, paid if the firm succeeds. If $\hat{\omega}^s(\bar{v}^s) > I + k$, only agents with $\omega_t > I + k$ can potentially become entrepreneurs, and they may have to put up collateral to ensure that they will not strategically default on the wages (see the Appendix for details). For a skilled entrepreneur hiring an unskilled worker the condition becomes

$$\omega_t \geq I + k + \bar{v}^u/(1 + r) - q\delta s/(1 + r) := \hat{\omega}^u(\bar{v}^u). \qquad \textbf{(CRU)}$$

Note that $\bar{v}^s \geq \bar{v}^u + (1+r)k$ is needed for some agents to become skilled workers. Hence, (CRS) implies (CRU) if $\delta qs \leq (1+r)k$. $\bar{v}^s \geq \bar{v}^u + (1+r)k$ also implies that an agent with sufficient wealth to become an unskilled entrepreneur hiring a skilled worker can also become a skilled entrepreneur hiring an unskilled worker. The latter is always weakly preferable to the former, and strictly so if $\bar{v}^s > \bar{v}^u + (1+r)k$. As a convention we focus on the case where entrepreneurs become skilled when indifferent (as payoffs of the entrepreneur and the associated worker are the same in both cases, this is without loss of generality for our results). We will refer to a firm that hires unskilled labor as an *unskilled firm* and to one that hires skilled labor as a *skilled firm*. Assume that production in firms is efficient,

$$qs > (1+r)(I+k).$$

If the domestic credit market has sufficiently severe frictions, i.e.,

$$(1+r)k > \delta qs, \tag{SF}$$

both conditions (CRS) and (CRU) have a bite and require a positive minimum wealth,

$$0 < k < \hat{\omega}^u(\bar{v}^u) < \hat{\omega}^s(\bar{v}^s). \tag{1}$$

For the last inequality note that $k < I$. Economies that have sufficiently severe credit market frictions to satisfy (SF) have the following class structure.

LEMMA 1. *Suppose that condition (SF) holds. Then individuals' feasible occupational choices depend monotonically on their wealth ω:*

- *the rich ($\omega \geq \hat{\omega}^s(\bar{v}^s)$) have access to all occupations;*
- *the upper middle class ($k \leq \hat{\omega}^u(\bar{v}^u) \leq \omega < \hat{\omega}^s(\bar{v}^s)$) have access to careers as skilled or unskilled workers, or may start unskilled firms;*
- *the lower middle class ($k \leq \omega < \hat{\omega}^u(\bar{v}^u)$) can become skilled or unskilled workers;*
- *the poor ($\omega < k$) necessarily become unskilled workers.*

2.6. Foreign Firms

A foreign-owned firm uses the same technology as a domestic firm: two agents of skill h and h' jointly produce stochastic output. Foreign firms differ from domestic firms in some important respects, however. Foreign owners have access to frictionless foreign capital markets (or a multinational's internal capital market), which is embodied in a foreign owner's probability of successfully absconding, $1 - \delta_F = 0$. That is, there is no credit rationing for foreign firms and they can commit to servicing outstanding payments even in the case of a project's failure. This is best motivated by assuming that a foreign firm is able to diversify the risk of its projects, more so than a domestic one.[10] Indeed, empirical findings suggest that default occurs more often in domestic firms than in foreign-owned firms; see,

e.g., Li and Guisinger (1991) for the United States and Mata and Portugal (2004) for Portugal. Acharya et al. (2009) report that firms that access credit markets with better creditor rights protection invest in safer projects.

That is, a foreign firm that offers a wage $\bar{v}^s$ will pay out this wage with certainty.[11] We allow for a productivity advantage for foreign firms: output in case of success in a foreign firm employing workers with human capital h and h' is

$$\pi^f = a(h + h'),$$

where $a \geq 1$. There is a measure μ^f of homogeneous foreign firms that can potentially enter the domestic economy. To simplify exposition, let μ^f be exogenously given, for instance, as a result of domestic policy.[12]

A foreign firm finds it profitable to enter the market if, and only if,

$$qa(h + h') - \bar{v}(h) - \bar{v}(h') - (1 + r)I \geq 0,$$

where $\bar{v}(h) \in \{\bar{v}^u; \bar{v}^s\}$ denotes the market wage for skill h. Because $qas > \bar{v}^s$ implies that also $2qas - 2\bar{v}^s > qas - \bar{v}^s - \bar{v}^u$, whenever a foreign firm finds entry profitable at all it strictly prefers to hire only skilled labor, even if $\bar{v}^u = 0$. Hence, foreign firms specialize in hiring skilled workers, or do not enter. Because $a \geq 1$, a foreign firm finds entering strictly profitable at all market wages $\bar{v}^s$ that allow a domestic firm to make a profit.

3. LABOR MARKET

Key to the dynamics is the labor market equilibrium. An equilibrium is characterized by market wages for unskilled and skilled workers, $\bar{v}^u$ and $\bar{v}^s$, such that demand equals supply for skilled and unskilled labor. Labor demand and supply are determined by individual occupational choices.

3.1. Occupational Choice

Start with individuals who have $\omega \geq \hat{\omega}(\bar{v}^s)$, i.e., whose wealth is sufficient for them to choose any occupational role possible in this economy: unskilled worker, skilled worker, and skilled entrepreneur hiring an unskilled, respectively a skilled, worker. The different occupational choices yield the following expected incomes:

$y = (1 + r)\omega + \bar{v}^u$ for an unskilled worker,

$y = (1 + r)(\omega - k) + \bar{v}^s$ for a skilled worker,

$y = (1 + r)(\omega - k - I) + qs - \bar{v}^u$ for an entrepreneur hiring unskilled,

$y = (1 + r)(\omega - k - I) + q2s - \bar{v}^s$ for an entrepreneur hiring skilled.

Suppose that $\bar{v}^s \geq \bar{v}^u + (1 + r)k$; otherwise no agent finds it profitable to become skilled. Becoming an entrepreneur and hiring skilled labor is preferable to

becoming a skilled worker whenever $qs-(1+r)I/2 \geq \bar{v}^s$, which implies that $qs > \bar{v}^s - \bar{v}^u$, so that hiring a skilled worker is always preferable to hiring an unskilled worker. Hence, individuals with $\omega \geq \hat{\omega}^s(\bar{v}^s)$ prefer to become entrepreneurs and hire skilled labor if

$$\bar{v}^s \leq qs - (1+r)I/2 := \bar{v}^s_{\max},$$

and to become skilled workers when $\bar{v}^s \geq \bar{v}^s_{\max}$. This pins down the domestic demand for skilled labor.

Individuals with wealth $\hat{\omega}^u(\bar{v}^u) \leq \omega < \hat{\omega}^s(\bar{v}^s)$ can only afford to become entrepreneurs hiring unskilled labor, which is preferable to being skilled workers if $qs-(1+r)I-\bar{v}^u \geq \bar{v}^s$. Agents with $k \leq \omega < \hat{\omega}^u(\bar{v}^u)$ can only become workers and prefer to become skilled. Those with $\omega < k$ become unskilled workers.

Hence, as a corollary to Lemma 1, there is credit rationing. That is, depending on the market wage $\bar{v}^s$, some agents would strictly prefer to become skilled workers or entrepreneurs in skilled firms, but do not have access to loans to finance the necessary investment.

COROLLARY 1. *Suppose that condition (SF) holds. If $\bar{v}^s > (1+r)k$, all agents with $\omega < k$ strictly prefer to acquire education, but are credit-rationed. If $\bar{v}^s < \bar{v}^s_{\max}$, all agents with $\omega < \hat{\omega}^s(\bar{v}^s_{\max})$ strictly prefer to become skilled entrepreneurs, but are credit-rationed.*

3.2. Demand and Supply

The last missing piece for constructing labor market supply and demand schedules is the behavior of foreign firms. As argued earlier, foreign firms always prefer to hire skilled workers if they enter the domestic market at all. Demand for skilled workers is thus

$$D_s = \begin{cases} 2\mu^f + 1 - G(\hat{\omega}^s(\bar{v}^s)) & \text{if } 0 \leq \bar{v}^s < \bar{v}^s_{\max}, \\ \left[2\mu^f, 2\mu^f + 1 - G\left(\hat{\omega}^s\left(\bar{v}^s_{\max}\right)\right)\right] & \text{if } \bar{v}^s = \bar{v}^s_{\max}, \\ 2\mu^f & \text{if } \bar{v}^s_{\max} < \bar{v}^s < qas - (1+r)I/2, \\ \left[0; 2\mu^f\right] & \text{if } \bar{v}^s = qas - (1+r)I/2, \\ 0 & \text{if } \bar{v}^s > qas - (1+r)I/2. \end{cases} \quad (2)$$

The demand for unskilled workers is

$$D_u = \begin{cases} G(\hat{\omega}^s(\bar{v}^s)) - G(\hat{\omega}^u(\bar{v})^u) & \text{if } 0 \leq \bar{v}^u < \bar{v}^u_{\max}, \\ \left[0, G(\hat{\omega}^s(\bar{v}^s)) - G\left(\hat{\omega}^u\left(\bar{v}^u_{\max}\right)\right)\right] & \text{if } \bar{v} = \bar{v}^u_{\max}, \\ 0 & \text{if } \bar{v} > \bar{v}^u_{\max}, \end{cases} \quad (3)$$

where $\bar{v}^u_{\max} = [qs - (1+r)(I+k)]/2$. The supply of skilled and unskilled workers depending on $\bar{v}^u$ and $\bar{v}^s$ is derived in the Appendix. Note that $\bar{v}^u$ is

positive if unskilled workers are scarce, as they are needed to form an unskilled firm.

Our analysis focuses on economies that are characterized by an abundance of labor and capital market imperfections. We assume therefore that in a given period t the wealth distribution is sufficiently skewed so that the measure of individuals sufficiently rich to become entrepreneurs is less than that of individuals too poor to invest in education:

$$G_t(k) > 1/2 > 1 - G_t(I + k - \delta qs/(1 + r)) > 0. \qquad \textbf{(SK)}$$

This allows illustrating the mechanics of the model in a plausible yet tractable setting. We shall maintain this assumption for the remainder of the paper; applying the model to economies where the unskilled are scarce is straightforward, however. Under assumption (SK), demand for unskilled labor in (3) is less than $G_t(k)$. Because at wages $\bar{v}^u > 0$ all individuals with $\omega < k$ strictly prefer unskilled work to subsistence, the supply exceeds demand. Hence, in a labor market equilibrium, the wage for unskilled workers is

$$\bar{v}^u = 0.$$

Abbreviating $\hat{\omega}^u = \hat{\omega}^u(0)$, the supply of skilled labor depends only on $\bar{v}^s$, as follows:

$$S_s = \begin{cases} [0, G(\hat{\omega}^u(0)) - G(k)] & \text{if } \bar{v}^s = (1+r)k, \\ G(\hat{\omega}^u(0)) - G(k) & \text{if } (1+r)k < \bar{v}^s < qs - (1+r)I, \\ [G(\hat{\omega}^u(0)) - G(k), G(\hat{\omega}(\bar{v}^s)) - G(k)] & \text{if } \bar{v}^s = qs - (1+r)I, \\ G(\hat{\omega}^s(\bar{v}^s)) - G(k) & \text{if } qs - (1+r)I < \bar{v}^s < \bar{v}^s_{\max}, \\ \left[G\left(\hat{\omega}^s\left(\bar{v}^s_{\max}\right)\right) - G(k), 1 - G(k)\right] & \text{if } \bar{v}^s = \bar{v}^s_{\max}, \\ 1 - G(k) & \text{if } \bar{v}^s > \bar{v}^s_{\max}. \end{cases}$$

The equilibrium wage for skilled workers is thus determined by the relative scarcity of those who can invest in education compared to those who can become entrepreneurs and hire skilled workers.

3.3. Labor Market Equilibrium

We are interested in the properties of the labor market equilibrium depending on the amount of FDI, parameterized by the measure of foreign firms μ^f. As argued above, foreign firms specialize in hiring skilled workers.

Denote the measures of skilled and unskilled domestic firms' labor by $\mu^s(\bar{v}^s)$ and $\mu^u(\bar{v}^s)$, respectively. Both will depend on the market wage for skilled work.

Aggregate end-of-period wealth of domestic agents, ω^E, is

$$\omega^E = \mu^s(\bar{v}^s)[q2s - (1+r)(I+2k)] + \mu^u(\bar{v}^s)[qs - (1+r)(I+k)] + \min\{2\mu^f; 1 - G(k)\}[\bar{v}^s - (1+r)k] + (1+r)E[\omega],$$

where $E[\omega]$ denotes aggregate endowments. Aggregate income of domestic agents is therefore $\omega^E - E[\omega]$. Aggregate output is

$$y = \min\{2\mu^f; 1 - G(k)\}qas + \mu^s(\bar{v}^s)2qs + \mu^u(\bar{v}^s)qs,$$

where the minimum operator accounts for the possibility that all firms are foreign-owned.

If there are domestic firms, $\mu_t^f < [1 - G_t(k)]/2$, the effect of a change in FDI is not straightforward: on one hand, increasing the measure of foreign firms μ^f has a direct effect, increasing the number of firms using skilled labor, which may raise $\bar{v}^s$. This, in turn, has a more subtle, indirect effect: entrepreneurial rents diminish and the credit constraint for domestic entrepreneurs hiring skilled labor tightens, i.e., $\hat{\omega}^s(\bar{v}^s)$ increases, reducing the equilibrium measure of domestic skilled firms. Hence, more openness to FDI may crowd out domestic entrepreneurs through increased collateral requirements [De Backer and Sleuwaegen (2003) offer some evidence for such contemporaneous crowding-out in Belgium]. Crowded-out entrepreneurs either hire unskilled labor instead of skilled labor, increasing employment but decreasing domestic rents, or become skilled workers, if $\bar{v}^s$ is high enough. The following proposition states this; its proof is in the Appendix.

PROPOSITION 1 (Labor Market and FDI). *Suppose that condition (SF) and Assumption (SK) hold. Then an increase of the measure of foreign firms μ^f affects the labor market equilibrium as follows:*

(i) *the wage for skilled workers $\bar{v}^s$ increases and the wage for unskilled work remains constant;*
(ii) *the measure of domestic skilled firms decreases, and the measure of domestic unskilled firms increases if $\bar{v}^s < qs - (1+r)I$ and otherwise decreases;*
(iii) *aggregate human capital investment of domestic agents increases;*
(iv) *aggregate income of domestic agents increases if $\mu^f \geq 1 - G(k)$, but otherwise the effect is ambiguous;*
(v) *income decreases at the top of the wealth distribution $[\omega \geq \hat{\omega}^s(\bar{v}^s)]$ and increases for intermediate wealth levels $[k \leq \omega < \hat{\omega}^s(\bar{v}^s)]$.*

Interestingly, more FDI may decrease capital productivity in the domestic economy, if higher productivity in foreign firms is swamped by the increased use of inferior technology by credit-constrained domestic entrepreneurs.

COROLLARY 2. *A marginal increase in μ^f*

— *strictly increases human capital productivity;*

— *decreases capital productivity* $y/[I(\mu^f + \mu^s + \mu^u)]$ *if* $\bar{v}^s \in ((1+r)k, qs - (1+r)I]$, *and* a *is sufficiently close to* 1*;*
— *increases capital productivity if* $\bar{v}^s = (1+r)k$ *or* $\bar{v}^s > qs - (1+r)I$.

The statements on capital productivity follow because, in an equilibrium where skilled labor is scarce and unskilled firms are present, every additional foreign firm requires two skilled workers. This corresponds to two domestic skilled firms becoming unskilled firms and a marginal output increase of $2q(a-1)s$.

4. DYNAMICS

The labor market equilibrium in a period t determines individual income and end-of-period wealth. This in turn pins down the next generation's endowment, ω_{t+1}, given the constant saving rate β.

4.1. Wealth Transition

Individual income depends on occupational status and for skilled workers on the identities of their employers, because wages in foreign firms do not carry default risk. Start with unskilled workers whose offspring have endowment

$$\omega_{t+1} = \beta(1+r)\omega_t.$$

This implies that $\omega_{t+1} \leq \omega_t$ for all $\omega_t < k$ if $\beta(1+r) \leq 1$, and whenever Assumption (SK) holds in a period t it does so as well in all following periods. For a skilled worker in a foreign firm,

$$\omega_{t+1} = \beta(1+r)(\omega_t - k) + \beta\bar{v}_t^s.$$

For a skilled worker in a domestic firm,

$$\omega_{t+1} = \beta(1+r)(\omega_t - k) + \begin{cases} \beta\bar{v}_t^s/q & \text{with probability } q, \\ 0 & \text{otherwise.} \end{cases}$$

An entrepreneur who hires unskilled labor has to invest at least $\hat{\omega}^u$ and leaves bequest

$$\omega_{t+1} = \beta(1+r)(\omega_t - \hat{\omega}^u) + \begin{cases} \beta(1-\delta)s & \text{with probability } q, \\ 0 & \text{otherwise.} \end{cases}$$

Similarly, an entrepreneur who hires skilled labor has to invest at least $\hat{\omega}^s(\bar{v}_t^s)$ and leaves bequest

$$\omega_{t+1} = \beta(1+r)[\omega_t - \hat{\omega}^s(\bar{v}_t^s)] + \begin{cases} \beta 2(1-\delta)s & \text{with probability } q, \\ 0 & \text{otherwise.} \end{cases}$$

Figure 2 illustrates the wealth transition described earlier.

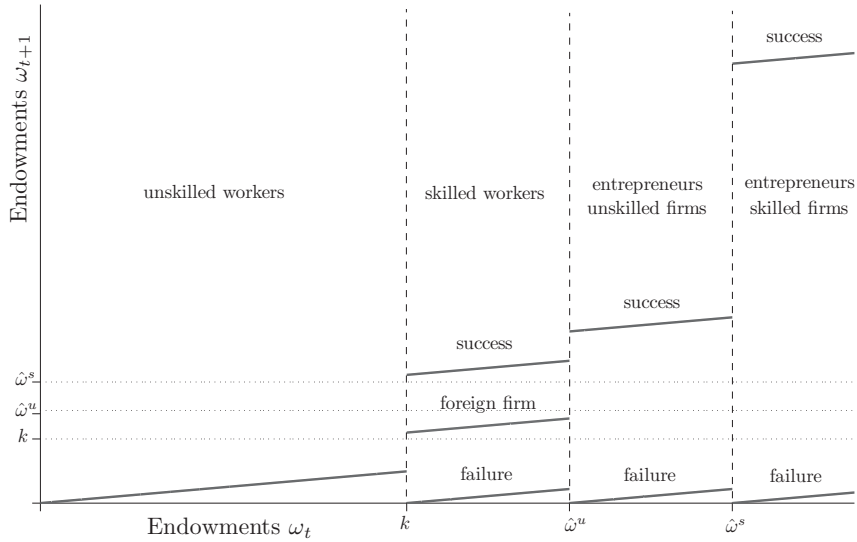

FIGURE 2. Intergenerational wealth transition.

The wealth transition is important, as it determines the occupational paths open to an individual's offspring. For instance, the offspring of an entrepreneur in a successful unskilled firm has sufficient wealth to become an entrepreneur hiring skilled work, and therefore can choose any possible occupational path, if and only if

$$\beta(1+r)(\omega_t - \hat{\omega}^u) + \beta(1-\delta)s \geq \hat{\omega}(\bar{v}^s_{t+1}).$$

Using the definitions of the cutoff wealth levels, this becomes

$$\beta(1+r)\omega_t + \beta[1-(1-q)\delta]s \geq [1+\beta(1+r)](I+k) + \frac{\bar{v}^s_{t+1} - q\delta 2s}{1+r}.$$

Because $\omega_t \geq \hat{\omega}^u$, a sufficient condition for the offspring of a successful entrepreneur in an unskilled firm to become an entrepreneur starting a skilled firm is

$$[\beta(1+r)(1-\delta) + 2q\delta]s \geq (1+r)(I+k) + \bar{v}^s_{t+1}. \tag{4}$$

Note that this condition also ensures that individuals with $\omega_t \geq \hat{\omega}^u$ who are employed as skilled workers in domestic firms will leave their offspring sufficient funds to enable them to become entrepreneurs hiring skilled labor. This is because to find working profitable $\bar{v}^s_t \geq qs - (1+r)I$, and a domestic firm defaults on wages with probability $1-q$.

4.2. FDI and Dynamics

Distributional effects of FDI in a dynamic setting are likely to be important when they affect individual occupational choice sets of the next generation, in particular as far as access to roles such as skilled worker or entrepreneur is concerned. Because domestic firms generate more extreme payoffs than foreign firms, they will also tend to produce both more rich individuals (i.e., potential entrepreneurs) and more poor individuals (i.e., unskilled workers) in the next generation. This intuition gives rise to the next statement; its proof is in the Appendix.

PROPOSITION 2. *Suppose that* $(1-q)\beta(1+r) < 1$ *and* $q > 1/2$*, and the endowment distribution* $G_t(\omega)$ *has decreasing density* $g_t(\omega)$ *for* $\omega > k$*. Then there is* $\delta^0 \in (0,1)$ *such that if* $\delta < \delta^0$ *(*$\delta > \delta^0$*), the probability that the offspring of an agent who is chosen randomly from all agents with endowment* $k \leq \omega_t < \hat{\omega}^u$ *and becomes a skilled worker is able to become entrepreneur is higher (lower) if the agent works in domestic firm.*

That is, when capital market frictions are severe enough, a randomly chosen skilled worker is less likely to leave a sufficient bequest for his offspring to become an entrepreneur if employed at a foreign firm rather than at a domestic firm. Domestic firms generate fewer agents with substantial income than foreign firms ($2q$ on average compared to 2), but their income is higher. Hence, domestic firms may generate fewer future entrepreneurs per firm, but they generate entrepreneurs for lower wealth levels of the parent than foreign firms. At the threshold δ^0 the wealth cutoff $\hat{\omega}^u$ exactly balances these effects. As δ decreases, the required wealth $\hat{\omega}^u$ increases, and the fraction of potential entrepreneurs among offspring of domestic firm members exceeds that of workers in foreign firms. A similar statement holds for the probability that a randomly chosen skilled worker's offspring will be able to start a skilled firm.

This affects the intergenerational transition of the wealth distribution and social mobility when skilled labor is scarce, which is likely, as the skill premium typically increases with foreign entry. Because the supply of skilled labor is limited by the borrowing constraint, Proposition 2 implies that the measure of potential entrepreneurs in the next period will be higher, the greater the share of skilled workers employed at domestic firms.

Figure 2 shows an extreme version of Proposition 2. Both skilled and unskilled domestic firms are active and the wage is $\bar{v}_t^s = qs - (1+r)I$. Skilled workers in foreign firms earn sufficiently well to enable their offspring to become skilled, but not to become entrepreneurs. Skilled workers and entrepreneurs in successful domestic firms earn enough to enable their offspring to start skilled firms, however. That is, the probability for the offspring of a skilled worker to become entrepreneurs is q if the worker is employed at a domestic firm and 0 if the worker is employed at a foreign firm.

There are a number of extensions that offer some scope for an interesting role of FDI in the dynamics of the economy. For instance, when unskilled labor is not

abundant and $\bar{v}_u > 0$, poor, unskilled agents can potentially accumulate sufficient wealth to eventually surpass the borrowing constraint, similarly to Maoz and Moav (2004). FDI has an ambiguous effect on the price for unskilled labor, and thus on intergenerational educational mobility, depending on whether domestic demand for unskilled labor increase or decreases as FDI changes; see Proposition 1. Yet foreign firms could also provide on-the-job training if skilled workers were scarce, thereby eliminating the borrowing constraint for human capital investments, and slowing the increase of the skill premium. Both possibilities seem interesting and are compatible with the results to follow, but probably best left to future research.

5. APPLICATION: SUDDEN STOPS

The wealth distribution affects the real allocation via the supply of potential entrepreneurs in the case of a negative shock, e.g., a sudden withdrawal of foreign capital or a substantial tightening of access to foreign credit markets. In particular, the latter has been observed in the form of sudden stops: sudden increases of the domestic country's bond spreads in conjunction with capital outflow. Here we focus on an increase of the interest rate for domestic agents. As a consequence, borrowing constraints $\hat{\omega}^s(\bar{v}^s)$ and $\hat{\omega}^u$ tighten and some domestic firms exit [see, e.g., Zeng (2012)]. Gallego and Tessada (2012) provide evidence suggesting that in sudden stops credit squeezes decrease employment. That is, some agents who may have become skilled workers move into subsistence. This decreases TFP and the domestic economy contracts. Reorganizing production by reallocating skilled labor starts a recovery, even if access to the outside capital market remains difficult [termed a "Phoenix Miracle" in Calvo et al. (2006)]. When skilled labor is abundant, labor demand by domestic entrepreneurs and the foreign firms that remain in the domestic economy determines the speed of recovery. Proposition 2 indicates that the presence of foreign firms before the sudden stop may have two opposing effects: increasing the number of remaining foreign firms during the sudden stop, but depleting the pool of domestic entrepreneurs. In the following we provide an example where the latter effect dominates even when all foreign firms remain active.

Although the effects of a sudden stop are immediate, the recovery speed depends on the wealth composition, which is determined by the previous growth path. To account for the different time scales, we shorten the period length to $1/2$ and allow for overlapping generations of agents living for one period. Production takes one period to generate revenue. That is, in a period t, agents are born and invest, the labor market clears, and production starts. Output accrues to this cohort of agents in period $t + 1/2$, generating bequests to offspring born in period $t + 1$, illustrated in Figure 3.

Period $t - 1/2$. We shall be concerned with the effects of a sudden stop occurring in period t. We begin by examining period $t - 1/2$. Output in $t - 1/2$ is produced by the generation who entered the labor market in $t-1$ with endowments ω_{t-1}. In $t - 1$, given interest rate r and the measure of foreign firms μ^f_{t-1}, the

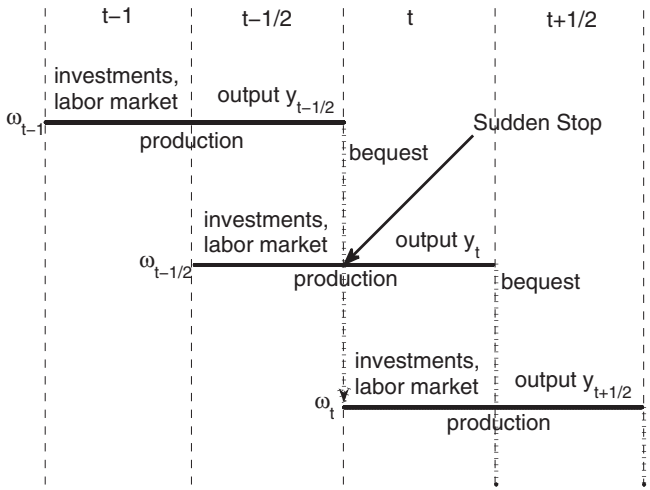

FIGURE 3. Overlapping generations structure.

labor market equilibrium is characterized by the wage $\bar{v}^s_{t-1}$ and measures of firms $\mu^s_{t-1}(\bar{v}^s_{t-1})$ and $\mu^u_{t-1}(\bar{v}^s_{t-1})$. Output in $t-1/2$ is

$$y_{t-1/2} = \mu^f_{t-1} 2qas + \mu^s_{t-1}(\bar{v}^s_{t-1}) 2qs + \mu^u_{t-1}(\bar{v}^s_{t-1}) qs.$$

Period t. In period t a sudden stop occurs. That is, the interest rate increases from r to $i > r$. Let threshold wealth levels depend explicitly on the wage and interest rate ρ_t, $\hat{\omega}^s(\bar{v}^s_t, \rho_t)$ and $\hat{\omega}^u(\rho_t)$. We model the effects of the sudden stop as a credit squeeze that decreases employment. Active entrepreneurs in t were born in $t-1/2$ with endowments $\omega_{t-1/2} \geq \hat{\omega}^s(\bar{v}_{t-1/2}, r)$ and $\omega_{t-1/2} \geq \hat{\omega}^u(r)$, respectively. That is, producers in t faced borrowing constraints based on the interest rate r. After an increase to i, some entrepreneurs, with $\hat{\omega}^s(\bar{v}^s_{t-1/2}, r) \leq \omega_{t-1/2} < \hat{\omega}^s(\bar{v}^s_{t-1/2}, i)$ and $\hat{\omega}^u(r) \leq \omega_{t-1/2} < \hat{\omega}^u(i)$, do not qualify for a loan anymore. Suppose that these entrepreneurs default, for instance because banks do not extend credit lines for working capital.[13]

Let the measure of foreign firms remain constant for periods $\tau \geq t-1$ at μ^f.[14] Explicitly accounting for the dependency of firm measures on endowment thresholds by writing $\mu^s(\bar{v}^s_{t-1/2}, \rho_t)$, output in t is given by

$$y_t = \mu^f 2qas + \mu^s_{t-1/2}(\bar{v}^s_{t-1/2}, i) 2qs + \mu^u_{t-1/2}(i) qs.$$

The growth rate in period t, $y_t/y_{t-1/2} - 1$, thus increases in μ^f if $y_t < y_{t-1/2}$, and is negative if the wealth distributions in $t-1$ and $t-1/2$ are similar. Denote the output effect of the sudden stop in t by κ, defined by

$$y_t = (1-\kappa) y_{t-1/2}.$$

Period $t + 1/2$. The labor market equilibrium in period $t + 1/2$ is determined by endowments ω_t, which result from bequests of agents who finished production in period $t - 1/2$, and the interest rate i. The equilibrium outcome consists of the wage $\bar{v}_t^s$ and measures $\mu_t^s(\bar{v}_t^s, i)$ and $\mu_t^u(i)$. Output in period $t + 1/2$ is given by

$$y_{t+1/2} = \mu^f 2qas + \mu_t^s(\bar{v}_t^s, i)2qs + \mu_t^u(i)qs.$$

Labor market outcomes in periods $t - 1/2$ and $t + 1/2$ are determined by endowments of the same cohort of agents, but those in period t by a different cohort. Therefore it is convenient to state the recovery in period $t + 1/2$ relative to the output change κ. Hence, a steady state assumption for the endowment distribution is not required. The growth rate in period $t + 1/2$ is

$$\frac{y_{t+1/2}}{y_t} - 1 = \frac{y_{t+1/2}}{(1-\kappa)y_{t-1/2}} - 1.$$

5.1. Foreign Firms and the Recovery

We examine now the dynamic effect of an increase of μ^f by some small amount $\epsilon > 0$ and focus on the case where in the periods $\tau = t - 1, t - 1/2$ both cohorts' wealth distributions are *sufficiently skewed*: $G_\tau(k) > 1/2$ is sufficiently great and $G_\tau(k + \frac{qs}{1+r}) < 1$ sufficiently close to 1.

This implies Assumption (SK) and ensures that before the sudden stop, in equilibrium skilled workers are scarce, and both skilled and unskilled domestic firms form (see the Appendix for details). We note that the latter can be dispensed with. If the wealth distributions before the sudden stop are sufficiently skewed in the sense just stated, an increase of ϵ in μ^f increases output $y_{t-1/2}$ in period $t-1/2$ by $2q(a-1)s\epsilon$: for every additional foreign firm, two skilled domestic firms become unskilled domestic firms. Similarly, output y_t increases by $2q(a-1)s\epsilon$. A change in μ^f does not affect endowments $\omega_{t-1/2}$.

Suppose that the sudden stop leads to an abundance of skilled labor, in line with the employment effects described in Gallego and Tessada (2012),

$$2G_t(\omega_t^s((1+i)k), i) - G_t(k) \geq 1 + 2\mu^f, \tag{5}$$

which means that at a wage $\bar{v}_t = (1 + i)k$ in period t the measure of potential skilled workers is greater than the possible demand.[15]

An increase of μ^f has a twofold effect: first, output $y_{t+1/2}$ increases by $2qas\epsilon$, as foreign firms take up idle skilled labor. Second, there is an indirect dynamic effect: an additional foreign firm in $t - 1$ crowds out two skilled domestic firms, possibly decreasing the supply of entrepreneurs in t. Denote by P_f^s (P_f^u) the probability that a randomly selected skilled worker in $t - 1$ in a foreign firm leaves enough for his offspring to become a skilled (unskilled) entrepreneur, and P_d^s and P_d^u the respective probabilities for workers in domestic firms. Similarly, let P_s^s (P_s^u) be the probability that a successful skilled entrepreneur in $t - 1$ leaves enough for his

offspring to become a skilled (unskilled) entrepreneur in t, and by P_u^s and P_u^u the respective probabilities for unskilled entrepreneurs. The total effect of an increase of μ^f by ϵ is thus

$$\Delta y_{t+1/2} = \left[a - 2\left(P_d^s - P_f^s\right) + \left(P_f^u - P_d^u\right) - 2\left(P_s^s - P_u^s\right) + \left(P_u^u - P_s^u\right)\right]\epsilon 2qs. \tag{6}$$

This illustrates well the opposing effects: an additional foreign firm increases output $y_{t+1/2}$ by $2qas$, but decreases it by $2qs$ (qs) for *each* domestic skilled (unskilled) entrepreneur in t who would have been among the offspring of the members of *both* domestic firms crowded out in $t-1$, had the foreign firm not entered. Note that larger firm sizes amplify the indirect effect.

To illustrate (6), we focus now on a particular parametric case. Suppose that the interest rate shock is severe, so that

$$qs < (1+i)(I+k) < 2qs - (1+i)k. \tag{7}$$

This means the interest rate i is sufficiently high so that only skilled domestic firms are profitable. The effect of an inflow of foreign firms (6) reduces to

$$\Delta y_{t+1/2} = \left[a - 2\left(P_d^s - P_f^s\right) - 2\left(P_s^s - P_u^s\right)\right]\epsilon 2qs.$$

The probabilities P_j^s for $j = d, f, s, u$ depend on the intergenerational transition of wealth. If

$$\beta(1-\delta)2s \geq I + 2k - \frac{2\delta qs}{1+i}, \tag{8}$$

all skilled entrepreneurs in $t-1$ bequeath enough for their offspring to become skilled entrepreneurs in t and $P_s^s = q$. On the other hand, if

$$\beta(1+r)\left[\hat{\omega}^s\left(\bar{v}_{t-1}^s, r\right) - \hat{\omega}_u(r)\right] + \beta(1-\delta)s < I + 2k - \frac{2\delta qs}{1+i}, \tag{9}$$

all unskilled entrepreneurs in $t-1$ with wealth $\hat{\omega}^u(r) \leq \omega_{t-1} < \hat{\omega}^s(\bar{v}_{t-1}^s, r)$ bequeath too little for their offspring to become skilled entrepreneurs in t, analogously to (4). Then $P_u^s = 0$, which implies that $P_d^s = P_f^s = 0$. Indeed, if

$$\frac{q}{1+r} < \beta < \frac{I+2k}{(1+q)s - (1+r)I}, \tag{10}$$

there is a $\delta > 0$ sufficiently small so that both (8) and (9) hold; see the Appendix for details. Note that the upper bound increases in I, and may exceed 1 if the sudden stop is severe enough, i.e., $1+i$ approaches $2qs/(I+2k)$. Hence, if skilled work is abundant in t and condition (10) applies, an inflow of foreign firms affects the recovery of output in $t+1/2$ as follows:

$$\Delta y_{t+1/2} = [a - 2q]\epsilon 2qs.$$

Hence, $a < 2q$ is sufficient for $\Delta y_{t+1/2} < 0$. This qualifier need not apply when entry is endogenous. That is, if the sudden stop is severe, β is intermediate, and

the productivity advantage of foreign firms not too great, there is δ low enough so that an inflow of foreign firms in $t-1$ decreases the growth rate $y_{t+1/2}/y_t$ (recall that y_t increases in μ^f). The next statement summarizes these findings.

PROPOSITION 3. *Suppose that in period t a severe sudden stop occurs, satisfying (7), the measure of foreign firms remains unchanged, $\mu^f_\tau = \mu^f$ for $\tau \geq t-1$, G_{t-1} is sufficiently skewed, β is intermediate satisfying (10), and $a < 2q$. Then a small increase of μ^f increases output in $t-1/2$ and t, and*

(i) *for $\delta > (1+r)k/(qs)$ sufficiently close to 1, an increase of μ^f increases output growth $y_{t+1/2}/y_t$;*
(ii) *if skilled labor is abundant in t, then for $\delta < (1+r)k/(qs)$ sufficiently close to 0, an increase of μ^f decreases output $y_{t+1/2}$ and output growth in $t+1/2$, also conditional on the output drop $y_t/y_{t-1/2}$.*

That is, there are situations such that the period-$(t+1/2)$ growth rate, which determines the speed of recovery, increases as the measure of foreign firms in period $t-1$ decreases.[16] Intuitively, if the sudden stop induces a shortage of entrepreneurial capital and makes skilled labor abundant, the binding constraint on domestic economic activity is local entrepreneurs, who are generated in domestic firms at a higher rate than in foreign firms. This is despite the fact that all foreign firms stay in the domestic market.

More generally, there will be attrition of foreign firms; see for instance Figure 1, showing declines in FDI stocks accompanying the financial crisis of 2008. Suppose that foreign firms leave the domestic economy with exogenous probability λ in period t. If domestic firms generate future skilled entrepreneurs at a higher rate than foreign firms (Proposition 2), this can offset the direct effect of the foreign firms that remain active in (6) as stated in the following corollary; seethe Appendix for details.

COROLLARY 3. *Suppose that $\delta < (1+r)k/(qs)$, and that $q > 1/2$ and $\beta(1+r) < 2$. Assume $G_{t-1}(k)$ is sufficiently high, i.e., (SK) holds, and $G_{t-1}(\omega)$ has decreasing density for $\omega > k$. If skilled labor is abundant in t, then there is $\lambda^0 < 1$, such that for all exit rates $\lambda \in [\lambda^0, 1]$ an increase of μ^f decreases output growth in $t+1/2$ conditional on the output drop $y_t/y_{t-1/2}$.*

Moreover, the adverse effect is amplified in the long run. During the sudden stop, each domestic skilled firm that forms in $t-1$ generates up to $2q$ skilled entrepreneurs in period t on the average, up to $(2q)^2$ in $t+1$, and so forth. The mechanism is driven by the fact that the size of a firm (i.e., the number of skilled workers) increases in its owner's wealth if credit markets are imperfect.

This mechanism seems particularly relevant for domestic financial crises in the form of a credit squeeze: capital becomes scarce and labor abundant. Hence, absent an unlikely increase of FDI during a sudden stop, enlarging the stock of potential domestic entrepreneurs quickens the recovery from crisis. This comes at

the cost of losing the capital and higher productivity of foreign firms in the sudden stop. Moreover, when not in crisis, productivity benefits of foreign firms increase domestic output, turning a policy of decreasing FDI into very costly insurance against sudden stops.

5.2. Systemic Sudden Stops and the Duration of Recovery

Our theoretical results link the duration of recovery after a sudden withdrawal of foreign capital to previous foreign capital inflow and credit market frictions. In particular, Proposition 3 and Corollary 3 state that past foreign capital inflows have an adverse effect on the duration of recovery, if domestic credit market frictions are sufficiently severe.

A straightforward way to compare to this to the evidence is using data from systemic sudden stop episodes and subsequent recoveries. Calvo et al. (2006) identify 33 episodes of systemic sudden stops that are followed by an output recovery, not triggered by regaining access to foreign capital markets, termed "Phoenix Miracles." Systemic sudden stops are defined as periods of capital inflow collapse and surging emerging markets aggregate bond spreads that affected a range of countries at approximately the same time and, thus, had a systemic component. Postwar history and data requirements limit our sample to 33 episodes. Therefore, we emphasize that our estimation results should be regarded as indicative rather than conclusive. However, the recent substantial outflows of foreign capital in a number of emerging markets due to the financial crisis may allow a more conclusive analysis in the future.

For each of the 33 episodes, we compute the duration (in years) until output returned to its precrisis level, based on the Penn World Table data on real GDP per capita.[17] Our computations are based on PPP-adjusted real GDP data, because nominal exchange and inflation rates can fluctuate dramatically during systemic sudden stop episodes. Moreover, we use per capita data, because fast population growth in some countries would otherwise bias the duration to full output recovery downward.[18]

The time scale of the empirical study is consistent with our theory. The model predicts that past exposure to FDI over a long period (decades) before a systemic sudden stop affects the duration of a recovery in the years thereafter; i.e., it reduces the growth rate in the years after the sudden stop if creditor rights are weakly protected.

We measure the degree of a country's credit market imperfections using data on creditor rights protection from Djankov et al. (2007) (redefining the variable so that higher values correspond to less creditor rights protection). Degrees of creditor rights protection are fairly stable over time and there is little time variation within a country. FDI inflows are taken from UNCTAD (2007). We consider FDI inflows in the five (ten) years before a systemic sudden stop to capture a country's past exposure to FDI. Hence, both variables of interest, creditor rights protection and past FDI, are plausibly exogenous to the event of a sudden stop. In addition, we

consider the following control variables: the drop in real GDP from the precrisis level to the trough, the level of real GDP, private investment as a share of GDP, trade as a share of GDP, terms of trade, an indicator for the quality of the rule of law, and the number of coups d'etat during the decade of the recovery. The first two variables are from the Penn World Table [Heston et al. (2006)], the following three from the World Development Indicators. Real GDP per capita accounts for possible convergence and wealth effects, which could mitigate the impact of a sudden stop for more developed countries. Similarly, a higher level of private investments, trade openness, and more beneficial terms of trade are associated with a quicker period of recovery. The last two variables control for political stability and the quality of legal institutions. Rule of law is the average index of the variable law and order (from the International Country Risk Guide) and the number of revolutions [from Dollar and Kraay (2003)] during the decade of the recovery.[19] We also include regional dummy variables, as well as a time dummy for the 1980s.

Our main finding is that higher exposure to past FDI is associated with slower output recovery in countries with worse creditor rights. As for a causal interpretation, we cannot strictly exclude reverse causation; yet this would require that factors leading to a faster output recovery also have led to higher past FDI—the most likely candidate is trade openness, which we control for. At a first glance the evidence appears consistent with the theoretical argument. This does not rule out other explanations such as a general absence of entrepreneurs in economies with low creditor rights protection that could take up the slack after an outflow of FDI. This would, however, primarily affect the size of the drop in output and be reflected in a direct effect of creditor rights protection on the duration of recovery, both of which we control for.

Table 2 lists the systemic sudden stops following the definition of Calvo et al. (2006). The duration to a full output recovery was longest in El Salvador, Nigeria, and Uruguay in the 1980s, whereas for a number of systemic sudden stop episodes it was relatively short (two to three years). The largest output drops from peak to trough amount to approximately 20% of GDP per capita (Uruguay and Chile in the early 1980s, and Argentina in the late 1990s). Table 2 shows substantial variation in creditor rights protection and the preceding ratios of FDI over GDP. The highest rates of past FDI in countries with weak creditor rights are observed in Argentina (1998), Colombia (1998), Ecuador (1998), Mexico (1994), Peru (1997), and Tunisia (1981).

We estimate a generalized negative binomial regression model with the duration until output has returned to its precrisis level as the dependent variable. The choice of model rests on the assumption that the distribution of durations is represented well by a Poisson-like process, because the probability of an output recovery increases over time. This interdependence can lead to extra variation, which is referred to as overdispersion. The distributional assumption is quite general and seems appropriate for the setting. Moreover, we always include hereroskedasticity-robust standard errors clustered by years to allow a correlation

TABLE 2. Episodes of systemic sudden stops

Country	Year	Duration	Output drop	Creditor rights	Past FDI/GDP
Argentina	1980	4	−12.91	3	0.36
Argentina	1994	2	−3.69	3	1.15
Argentina	1998	6	−19.89	3	2.00
Brazil	1980	5	−11.92	3	1.07
Chile	1981	5	−20.59	2	0.91
Chile	1998	2	−1.01	2	4.87
Colombia	1998	5	−2.04	4	1.92
Cote d'Ivoire	1982	4	−7.20	4	0.41
Ecuador	1981	3	−7.40	4	0.69
Ecuador	1998	6	−4.04	4	2.78
El Salvador	1980	12	−9.65	1	0.21
Indonesia	1997	5	−9.34	1	3.29
Lebanon	1999	5	−9.65	0	2.48
Malaysia	1997	2	−2.74	1	5.35
Mexico	1981	4	−10.42	4	0.66
Mexico	1994	3	−7.91	4	1.39
Morocco	1980	2	−1.17	3	0.13
Morocco	1982	2	−2.79	3	0.18
Morocco	1994	2	−8.86	3	0.72
Morocco	1996	2	−4.87	3	0.70
Nigeria	1980	11	−10.58	0	0.06
Peru	1981	5	−15.55	4	0.26
Peru	1997	5	−2.59	4	4.28
Philippines	1997	2	−5.70	3	1.25
Russia	1997	2	−2.65	2	0.36
South Africa	1981	3	1.06	1	−0.10
South Korea	1997	2	−9.02	1	0.33
Thailand	1996	6	−11.57	1	1.41
Tunisia	1981	2	−2.11	4	1.82
Turkey	1993	3	−7.20	2	0.35
Turkey	1998	2	−4.71	2	0.32
Uruguay	1981	10	−21.96	2	2.16
Venezuela	1980	7	−13.40	1	0.07

Notes: All 33 episodes refer to systemic sudden stops that are followed by an output recovery that does not rely on regaining access to foreign capital markets, termed "Phoenix Miracles." The identification of these periods follows the definition of Calvo et al. (2006).

of macroeconomic shocks across countries in a given year. In particular, we correct standard errors for contagion effects during the Asian crisis episode, which led to systemic sudden stops in Indonesia, Malaysia, Peru, the Philippines, and Russia in 1997.[20]

TABLE 3. General negative binomial model: Dependent variable is duration

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)[a]
Past FDI/GDP	−0.0211	−0.2557*	−0.1939*	−0.1456**	−0.2237**	−0.1408		−0.2341
	(−0.42)	(−1.87)	(−1.82)	(−2.01)	(−2.31)	(−1.51)		(−1.57)
Creditor rights	−0.1526	−0.3205**	−0.3391***	−0.3339***	−0.3455***	−0.3072***	−0.3141**	−0.3693***
	(−1.33)	(−2.41)	(−4.56)	(−7.37)	(−3.52)	(−4.04)	(−2.47)	(−4.02)
Past FDI×CR		0.1186**	0.1166***	0.0831***	0.1198***	0.0752**		0.1595**
		(2.26)	(3.18)	(3.46)	(3.10)	(2.43)		(2.15)
Drop real GDP			−0.0357***	−0.0398***		−0.0444***	−0.0258***	−0.0359***
			(−6.66)	(−4.18)		(−4.82)	(−3.75)	(−6.72)
Real GDP				−0.0001***		−0.0001**		
				(−4.30)		(−2.56)		
Investment/GDP				−0.0032		−0.0028		
				(−0.25)		(−0.18)		
Trade/GDP				0.001		0.0012		
				(0.43)		(0.47)		
Terms of trade				−0.0008		−0.0018		
				(−0.71)		(−1.41)		
Rule of law					−0.1915***	−0.1218		
					(−2.73)	(−1.60)		
Coup d'etat					−0.1173	0.0030		
					(−1.51)	(0.04)		
Past trade/GDP							−0.0026	
							(−0.86)	
Past trade×CR							0.0016	
							(1.07)	
Reg./time dummies	no	no	yes	yes	no	yes	yes	yes
Observations	33	33	33	33	33	33	33	31

[a] Past FDI captures the averages over the last ten years instead of five.

Notes: Always include a constant and hereroskedasticity-robust s.e., which is clustered each year to allow yearly correlation of macro shocks across countries. *t*-statistics in parenthesis. ***, **, * Significant at 1%, 5%, 10%. We include a time dummy for the 1980s and three regional dummies for Latin America, Asia, and Africa.

5.3. Empirical Results

Table 3 lists the results for the generalized negative binomial regression model. The first two columns show that past foreign investments, on the average, do not affect the length of the recovery period. The positive, significant interaction term with creditor rights in column (2) reveals substantial heterogeneity: past FDI reduces the length of a recovery period if creditor rights are relatively well protected (CR $\in \{0; 1; 2\}$) and prolongs this period if they are not (CR $\in \{3, 4\}$), consistent with the predictions of our theory.[21] Columns (3)–(6) of Table 3 include time and region dummies as well as the additional control variables. Better institutions, measured by the quality of the rule of law, tend to shorten the period until full output recovery after a systemic sudden stop [columns (5) and (6)]. Our main empirical result, that past exposure to FDI prolongs the recovery period if credit market imperfections are severe, is robust to the inclusion of these institutional control variables. Moreover, we note that the qualitative results in column (3), which refers to our baseline specification, are robust to the successive exclusion of one country at a time from the sample.[22]

TABLE 4. General negative binomial model: Dependent variable is duration

CR ∈ {0; 1; 2} vs. CR ∈ {3; 4}		Effects by each CR	
Drop real GDP	−0.0441***	Drop real GDP	−0.0582***
	(−4.79)		(−4.39)
Creditor rights	−0.3125***	CR1	−0.3890**
	(−4.27)		(−2.26)
Past FDI × CRgood	−0.0017	CR2	−1.10***
	(−0.08)		(−3.97)
Past FDI × CRbad	0.3778***	CR3	−1.24***
	(7.37)		(−15.21)
		CR4	−1.12***
			(−7.85)
		Past FDI	−0.1766*
			(−1.92)
		Past FDI × CR1	0.1202*
			(1.73)
		Past FDI × CR2	0.2595*
			(1.82)
		Past FDI × CR3	0.3784***
			(3.27)
		Past FDI × CR4	0.4798***
			(4.71)
Time dummies	yes		yes
Observations	33		33

Notes: Good creditor rights protection CRgood: CR ∈ {0; 1; 2}; bad creditor rights protection CRbad: CR ∈ {3; 4}. Observations: 2 for CR = 0, 7 for CR = 1, 6 for CR = 2, and 9 for CR = 3, 4. Always include hereroskedasticity-robust s.e., which are clustered each year. t-statistics in parentheses. ***, **, * Significant at 1%, 5%, 10%.

Column (7) of Table 3 repeats the exercise using the interaction of past trade with creditor rights instead of FDI. Now the interaction term between past trade and creditor rights is not significant at conventional levels, which supports the specific FDI mechanism. The last column of Table 3 uses average foreign investments over the past decade rather than over five years. The interaction term remains significant at the 5% level.[23]

Table 4 provides a robustness check allowing for a nonlinear relationship between past FDI and creditor rights protection. For the left half of the table we separate countries into two groups based on the degree of creditor rights protection using dummy variables CRgood, which is 1 if CR ∈ {0; 1; 2} and 0 otherwise, and CRbad, which is 1 if CR ∈ {3; 4} and 0 otherwise. This confirms our findings, and the corresponding coefficient is significant at the 1% level. The right half of Table 4 uses a dummy variable for each of the five realizations of CR and the corresponding interaction term of that dummy with past FDI. Interestingly, the

average effect in Table 3 seems to conceal a significant degree of nonlinearity: the effect of past exposure to FDI on the duration to a full recovery is more pronounced the worse the protection of creditor rights. The corresponding coefficients are all statistically significant, though the interaction terms with the lowest three realizations ($CR \in \{0; 1; 2\}$) are significant only at the 10% level. Overall, past FDI seems to prolong the duration of output recoveries in countries where creditor rights are worse than their best two realizations.

6. CONCLUSION

This paper has examined possible effects of FDI on the wealth dynamics of an economy with credit market frictions. Although exposure to FDI has a strictly beneficial first-order effect on output in our model; this is accompanied by a distributional effect on income and wealth. Borrowing constraints induce domestic firms to postpone wage expenditure and offer steep wage profiles, characterized by a low initial and a high future wage in case of the firm's success, whereas foreign firms with access to credit offer flatter wage profiles. This becomes relevant in the case of sudden withdrawal of foreign capital and a surge in bond spreads, a sudden stop. The presence of enough individuals with sufficient funds to overcome borrowing constraints makes it possible to maintain investment without broad access to international financial markets. The stock of potential entrepreneurs depends on past income distributions, and in particular on past employment in domestic firms, when workers' wage profiles are steep enough to endow successful workers' offspring with enough funds to become entrepreneurs. Hence, past exposure to FDI may deplete the pool of potential domestic entrepreneurs and increase vulnerability to sudden stops. This means that, in the case of a sudden stop, adverse effects of credit market imperfections can be amplified by previous exposure to FDI, which emphasizes the importance of financial market development for emerging economies that rely heavily on foreign investment to grow.

Two more observations are worth mentioning. First, FDI tends to increase workers' payoffs while decreasing entrepreneurs' payoffs. Hence, political acceptance of FDI increases as the pivotal agent's wealth decreases, i.e., when the franchise is extended to the poor. Second, in the equilibrium with FDI, positive net portfolio investment from the domestic into the foreign economy may outweigh net FDI, which is consistent with the observation by Lucas (1990). Intuitively, multinationals incorporate and collect capital in the more developed foreign capital market.

Finally, not only does the ongoing global financial crisis demonstrate the desirability of an economy's ability to recover from a sudden stop, but also it generates additional empirical observations of collapses in foreign capital flows to emerging markets. This will contribute to overcoming the caveat of a small sample size in our present empirical exercise, and eventually make possible policy-related statements based on substantiated empirical evidence.

NOTES

1. There is evidence for a positive relationship between FDI and income inequality [Tsai (1995); Choi (2006)]; effects vary in less developed countries, however. Other studies focus on the effects on wage inequality in developed and developing countries and tend to conclude that FDI correlates with an increase in the premium for higher education [see Aitken et al. (1996); Feenstra and Hanson (1997)]. Lipsey and Sjöholm (2004) find a foreign ownership wage premium in Malaysia, and that it increases in workers' education.

2. Empirical findings on effects of FDI on growth are mixed; effects seem to depend on host country characteristics, such as human capital and capital market imperfections. See the survey by De Mello (1997) and, more recently, Borensztein et al. (1998); Aitken and Harrison (1999); Alfaro et al. (2004), and Javorcik (2004), among others.

3. The results are consistent with a foreign ownership premium in expectations; equal expected wages facilitate the exposition.

4. Risk neutrality is not crucial for our results. In fact, if agents are risk-averse, e.g., with a utility function as in Galor and Zeira (1993) or Jaimovich (2010) explicitly considering risk of occupational returns, domestic firms will pay a risk premium, which increases the income difference between workers in successful domestic and foreign firms, exacerbating the effect emphasized in this paper.

5. Our qualitative results extend to firm sizes greater than two. Letting factor inputs vary in firms, e.g., by endogenizing firm size, considerably increases the complexity of equilibrating the labor market and adds distortions in production technology choices [see, e.g., Gall (2010)], blurring the focus of this paper.

6. Assuming decreasing returns to skill would not alter our results on the sudden stop substantially. It would imply that firms with one skilled and one unskilled worker are efficient, so that borrowing constraints for entrepreneurs no longer affect technology choice.

7. Extending the model to allow for, e.g., student loans is relatively straightforward, yielding an endogenous credit constraint similar to the one for firms. The observations emphasized in this paper continue to be true, however.

8. Exogeneity of the interest rate is not driving our results on the dynamics; cf. Section 5, where the loan interest rate is allowed to vary.

9. This convention is adopted for simplicity. Absent a transaction cost of banking, incentive problems within firms, or risk aversion, entrepreneurs are indifferent with regard to the loan size. Taking out the maximum loan possible guarantees almost all entrepreneurs strictly positive income. Assuming that entrepreneurs take the smallest loan possible instead would not change our analysis in Sections 4 and 5.

10. For instance, a foreign owner may fund a large number of projects in the domestic and in the foreign economy. If these projects' successes are independent events, invoking the law of large numbers, aggregate revenue can be substituted for by its expected value. Hence, funding a measure m of projects with skilled workers, a foreign owner's revenue is $mq2s$. The foreign owner finds it profitable not to abscond because $\delta_F = 1$. If domestic agents' wealth is bounded by $\omega \leq 2\hat{\omega}^s(\bar{v}^s, r)$ they cannot commit to repay the necessary loan in the case of success, preventing diversification by domestic owners.

11. Possibly a foreign firm could choose to offer the same wage contract as a domestic firm. Paying a fixed wage is privately strictly optimal if there is costly state verification or employees are risk-averse. Also, an incentive problem within the firm may yield inefficiently steep wages in domestic firms and efficient wages in foreign firms. All these cases generate an endogenous productivity advantage for foreign firms.

12. A case where foreign firms differ in their productivities and face entry costs, and μ^f is endogenous, yields similar results; see an earlier version available from the authors.

13. This assumes that agents assign probability 0 to the event of a sudden stop. If agents assign a positive probability, loan contracts will take the interest rate risk into account, leading to loan interest rates exceeding r for the poorest borrowers, decreasing in borrower wealth. Our results on the effects of FDI carry over, however.

14. This is the simplest case to analyze and covers the medium ground between two opposite extremes: (i) foreign firms' borrowing interest rates remain at r, because they borrow abroad, implying that FDI would increase in a sudden stop, and (ii) foreign firms' borrowing interest rates increase to i, in which case FDI would contract. Alfaro and Chen (2011) report that foreign-owned firms tend to be more profitable than domestic ones, and Levchenko and Mauro (2007) show evidence that FDI flows remain relatively stable during sudden stops, but FDI stocks decrease in sudden stops; see also Figure 1.

15. This is ensured if, e.g., the saving rate β is sufficiently close to $1/(1+r)$, or if foreign firms do not dominate the domestic economy before the sudden stop, in the sense that there are more successful unskilled firms than foreign workers; see the Appendix.

16. Another example is the case depicted in Figure 2. In this situation $P_f^s = P_f^u = 0$ but $P_d^s = q$, so that an inflow of foreign firms in $t-1$ decreases output $y_{t+1/2}$ if $a < 2q$.

17. After the sudden stop in Argentina in 1982, output did not recover fully before the country was hit by another sudden stop. In this case, we use the observation with the highest value of output prior to the next sudden stop as the full recovery point.

18. We obtain the same qualitative result as in Table 3 if we base the durations on absolute real GDP levels (instead of per capita levels) or if we alternatively use PPP-adjusted real GDP data from the World Development Indicators.

19. Alternative measures of institutional factors (such as the number of victims related to revolutions and war during the decade of the recovery, as well as two alternative indicators for the quality of the rule of law from the Freedom House indicators and the Economic Freedom Dataset) yield qualitatively similar results. All of these variables have regularly been used to account for institutional quality in empirical research; see for example La Porta et al. (1998).

20. The clustering tends to reduce the standard errors, which highlights the importance of contagion effects across countries in a given year. The interaction term between past FDI and creditor rights is also positive and significant in our basic specifications if we do not cluster the standard errors, or if we impose alternative clustering schemes.

21. The direct effect of better protection of creditor rights tends to prolong the duration to recovery once we control for the interaction effect between creditor rights and past exposure to FDI. This may be explained by a costly-state-verification argument: better creditor rights generate more costly monitoring and inspection, for instance, in form of time-consuming bankruptcy procedures that tie up capital needed elsewhere. Substantiating the evidence on such a trade-off between static (quick reallocation of capital) and dynamic (incentives for borrowers not to strategically default) is left to future research.

22. This robustness check refers to 23 additional estimates. The results are available from the authors upon request.

23. The results presented in the last two columns of Table 3 are robust to the inclusion of the additional control variables, which we omit for the sake of exposition.

24. The collateral could also be used as equity in the firm, making it possible to commit the firm to pay a positive wage in case of failure also. The minimum wealth required for such a contract is greater than $\hat{\omega}^s(\bar{v}^s)$, however, and skilled workers in successful domestic firms using equity collateral still earn substantially more than their peers in foreign firms.

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MATHEMATICAL APPENDIX

A.1. OMITTED DETAILS FOR LOAN CONTRACTS IN DOMESTIC FIRMS

In the case $\omega_i > I + k$ the investment can be financed out of wealth, so that $D = R = 0$, and the incentive compatibility condition becomes

$$\bar{v}^s \leq 2\delta q s.$$

This means that if $\bar{v}^s \leq 2\delta q s$, which implies $\hat{\omega}^s(\bar{v}^s) \leq I + k$, all agents with $\omega_t \geq \hat{\omega}^s(\bar{v}^s)$ can become entrepreneurs taking out a loan of size $D \in [I + k - \omega_t, I + k - \hat{\omega_s}]$. If $\bar{v}^s \leq 2\delta q s$, only agents with $\omega_t > I + k$ can potentially become entrepreneurs, and they have to put up collateral to ensure that they will honor their obligations.

To see this, suppose that an agent with $\omega_i > I + k$ borrows an amount D and puts up collateral $C \leq \omega_i - I - k + D$. That is, the entrepreneur has to have a deposit while taking out a loan, which is quite common in micro lending and cooperative banking. The collateral is lost in case of default, but has to return the market interest rate r in expectation. If the firm fails, the revenue is 0 and the firm defaults. In case of success and if payment obligations are honored, $(1 + r)C/q$ is returned. The incentive compatibility condition in

case of success is now

$$(1-\delta)2s \leq 2s - \bar{v}^s/q - (1+r)(D-C)/q,$$

which becomes

$$\bar{v}^s \leq 2\delta qs - (1+r)(D-C).$$

Because $\omega_i \geq I + k + C - D$, to be able to pay the wage the entrepreneur needs at least endowment $\omega_t \geq I + k + \bar{v}^s/(1+r) - 2\delta qs/(1+r)$. This yields the cutoff endowment in (CRS). That is, an agent with $\omega_i \geq \hat{\omega}^s(\bar{v}) > I + k$ satisfies incentive compatibility by taking out a loan D and setting up collateral C such that $C - D \in [\hat{\omega}^s - I - k, \omega_i - I - k]$, and is indifferent between all these combinations.[24]

A.2. DERIVING THE SUPPLY OF SKILLED AND UNSKILLED WORKERS

Given $\bar{v}^s$ and $\bar{v}^u$, the supply of skilled workers is given by

$$L_s^S = \begin{cases} [0, G(\hat{\omega}^u(\bar{v}^u)) - G(k)] & \text{if } \bar{v}^u + (1+r)k = \bar{v}^s < \bar{v}^u_{\max} + (1+r)k, \\ [0, G(\hat{\omega}^s(\bar{v}^s)) - G(k)] & \text{if } \bar{v}^s = \bar{v}^u_{\max} + (1+r)k, \\ G(\hat{\omega}^u(\bar{v}^u)) - G(k) & \text{if } \bar{v}^u + (1+r)k < \bar{v}^s < qs - (1+r)I - \bar{v}^u, \\ [G(\hat{\omega}^u(\bar{v}^u)) - G(k), G(\hat{\omega}^s(\bar{v}^s)) - G(k)] & \text{if } \bar{v}^u_{\max} + (1+r)k < \bar{v}^s = qs - (1+r)I - \bar{v}^u, \\ G(\hat{\omega}^s(\bar{v}^s)) - G(k) & \text{if } qs - (1+r)I - \bar{v}^u < \bar{v}^s < \bar{v}^s_{\max}, \\ \left[G(\hat{\omega}(\bar{v}^s_{\max})) - G(k), 1 - G(k)\right] & \text{if } \bar{v}^s = \bar{v}^s_{\max}, \\ 1 - G(k) & \text{if } \bar{v}^s > \bar{v}^s_{\max}. \end{cases}$$

The supply of unskilled workers is

$$L_u^S = \begin{cases} [0, G(k)] & \text{if } \bar{v}^u = 0 < \bar{v}^s - (1+r)k, \\ [0, G(\hat{\omega}^u(\bar{v}^u))] & \text{if } \bar{v}^u = 0 = \bar{v}^s - (1+r)k, \\ G(k) & \text{if } 0 < \bar{v}^u < \bar{v}^s - (1+r)k, \\ [G(k), G(\hat{\omega}^u(\bar{v}^u))] & \text{if } 0 < \bar{v}^u = \bar{v}^s - (1+r)k < \bar{v}^u_{\max}, \\ [G(k), G(\hat{\omega}(\bar{v}^s))] & \text{if } \bar{v}^u_{\max} \leq \bar{v}^u = \bar{v}^s - (1+r)k < \bar{v}^s_{\max} - (1+r)k, \\ [G(k), 1] & \text{if } \bar{v}^u = \bar{v}^s - (1+r)k \geq \bar{v}^s_{\max}. \end{cases}$$

A.3. PROOF OF PROPOSITION 1

Regarding (i), an increase of μ^f increases demand for skilled labor (2) at a given wage $\bar{v}^s$. Therefore $\bar{v}^s$ has to increase in response, and strictly so if $\mu^f < [1 - G(k)]/2$, which implies that $\bar{v}^s < qas - (1+r)C/2$.

To establish the remaining statements in the proposition, a number of different cases arise:

1. $G(\hat{\omega}^u) - G(k) \geq 1 - G(\hat{\omega}^s((1+r)k)) + \mu^f$:
   $\bar{v}^s = (1+r)k$, and the measures of domestic firms are $\mu^s((1+r)k) = 1 - G(\hat{\omega}^s((1+$

$r)k))$ and $\mu^u((1+r)k) = G(\hat{\omega}^s((1+r)k)) - G(\hat{\omega}^u))$. Educational investment is $(\mu^u((1+r)k) + 2\mu^s((1+r)k) + \mu^f((1+r)k, C))s$.

2. $1 - G(\hat{\omega}^s(qs - (1+r)I)) + \mu^f < G(\hat{\omega}^u) - G(k) < 1 - G(\hat{\omega}^s((1+r)k)) + \mu^f$: $(1+r)k < \bar{v}^s < qs - (1+r)I$, and the measures of domestic firms are $\mu^s(\bar{v}^s) = G(\hat{\omega}^u) - G(k) - \mu^f$ and $\mu^u(\bar{v}^s) = G(\hat{\omega}^s(\bar{v}^s)) - G(\hat{\omega}^u)$. Educational investment is $(1 - G(k))s$.
3. $G(\hat{\omega}^s(qs - (1+r)I)) - G(k) \geq 1 - G(\hat{\omega}^s(qs - (1+r)I)) + \mu^f \geq G(\hat{\omega}^u) - G(k)$: $\bar{v}^s = qs - (1+r)I$, and the measures of domestic firms are $\mu^s(qs - (1+r)I) = 1 - G(\hat{\omega}^s(qs - (1+r)I))$ and $\mu^u(qs - (1+r)I) = 2G(\hat{\omega}^s(qs - (1+r)I)) - 1 - G(k) - \mu^f$. Educational investment is $[1 - G(k)]s$.
4. $2G(\hat{\omega}^s(qs - (1+r)I)) - \mu^f < 1 + G(k) < 2G(\hat{\omega}^s(\bar{v}^s_{\max})) - \mu^f$: $qs - (1+r)I < \bar{v}^s < \bar{v}^s_{\max}$, and the measures of domestic firms are $\mu^s(\bar{v}^s) = 1 - G(\hat{\omega}^s(\bar{v}^s)) = [1 - G(k)]/2 - \mu^f$ and $\mu^u(\bar{v}^s) = 0$. Educational investment is $[1 - G(k)]s$.
5. $2G(\hat{\omega}^s(\bar{v}^s_{\max})) \leq 1 + G(k) + \mu^f \leq 1 + (1 + G(k))/2$: $\bar{v}^s = \bar{v}^s_{\max}$, and the measures of domestic firms are $\mu^s(\bar{v}^s_{\max}) = [1 - G(k)]/2 - \mu^f$ and $\mu^u(\bar{v}^s) = 0$. Educational investment is $[1 - G(k)]s$.
6. $\mu^f > [1 - G(k)]/2$: $\bar{v}^s > \bar{v}^s_{\max}$ and the measures of domestic firms are $\mu^s(\bar{v}^s) = \mu^u(\bar{v}^s) = 0$. Educational investment is $[1 - G(k)]s$.

If $G(\hat{\omega}^s((1+r)k)) \leq G(\hat{\omega}^u))$, at least the weak forms of the statements in (ii) are still true. Note also the possibility that, as $\bar{v}^s$ increases from $(1+r)k$ to $qs - (1+r)I$, the measure of unskilled firms increases from 0 to a strictly positive amount and then decreases to 0 again.

A.4. PROOF OF PROPOSITION 2

To compute the probability, we need the wealth necessary to generate a sufficient bequest given a wage $\bar{v}^s_t$ in both a domestic and a foreign firm. A skilled worker's offspring has sufficient endowment to qualify for a loan to become an entrepreneur if

$$\beta(1+r)(\omega_t - k) + \beta\bar{v}^s_t \geq \hat{\omega}^u.$$

Using the definition of $\hat{\omega}^u$, this becomes

$$\omega_t \geq k + \frac{I + k - \beta\bar{v}^s_t - \dfrac{\delta qs}{1+r}}{\beta(1+r)} := \omega^f.$$

Repeating the same exercise for a skilled worker in a successful domestic firm,

$$\omega_t \geq k + \frac{I + k - \beta\bar{v}^s_t/q - \dfrac{\delta qs}{1+r}}{\beta(1+r)} := \omega^d.$$

Hence, the probability that a randomly chosen skilled worker in a foreign firm leaves enough bequest is given by $P_f = \frac{G_t(\hat{\omega}^u) - G_t(\omega^f)}{G_t(\hat{\omega}^u) - G_t(k)}$. The probability that a randomly chosen skilled worker in a domestic firm leaves enough bequest is given by $P_d = q\frac{G_t(\hat{\omega}^u) - G_t(\omega^d)}{G_t(\hat{\omega}^u) - G_t(k)}$.

Hence, $P_d > P_f$ if and only if $G_t(\omega^f) > qG_t(\omega^d) + (1-q)G_t(\hat{\omega}^u)$. This can be rewritten

$$G_t\left(\frac{\hat{\omega}^u}{\beta(1+r)} + k - \frac{\bar{v}_t^s}{1+r}\right) > qG_t\left(\frac{\hat{\omega}^u}{\beta(1+r)} + k - \frac{1}{q}\frac{\bar{v}_t^s}{1+r}\right) + (1-q)G_t(\hat{\omega}^u). \quad \textbf{(A.1)}$$

It is easy to verify that this condition holds for $\bar{v}_t^s = (1+r)k$. Differentiating with respect to $\bar{v}_t^s$ implies that the LHS increases in $\bar{v}_t^s$ at least as fast as the RHS whenever

$$g_t\left(\frac{\hat{\omega}^u}{\beta(1+r)} + k - \frac{\bar{v}_t^s}{1+r}\right) \leq g_t\left(\frac{\hat{\omega}^u}{\beta(1+r)} + k - \frac{1}{q}\frac{\bar{v}_t^s}{1+r}\right).$$

Because skilled workers are drawn from $\omega_t \in [k, \hat{\omega}^u)$, the assumption in the proposition in fact implies (A.1) for all $\bar{v}_t^s \in [(1+r)k, q\hat{\omega}^u/\beta]$. If $\beta\bar{v}_t^s/q > \hat{\omega}^u$, on the other hand, $\omega^d < k$ and $P_d = q$. For $P_f = q$, $(1-q)G_t(\hat{\omega}^u) + qG_t(k) = G_t(\omega^f)$, i.e., defining a δ^0 such that $P_f = P_d = q$,

$$(1-q)G_t\left(I + k - \frac{\delta^0 qs}{1+r}\right) + qG_t(k) = G_t\left(k + \frac{I + k - \beta\bar{v}_t^s - \dfrac{\delta^0 qs}{1+r}}{\beta(1+r)}\right).$$

δ^0 exists and is unique if $(1-q)\beta(1+r) < 1$, given the assumption on the density in the proposition. Note that $P_f = 1$ for $\delta qs \geq (1+r)(I+k) - \beta(1+r)\bar{v}_t^s$, and $P_d = 1$ for $\delta qs \geq (1+r)(I+k)$.

An analogous argument applies to the cutoff $\hat{\omega}^h(\bar{v}_t^s)$. In this case the qualifier follows from $\beta\hat{v}_t^s > \hat{\omega}_t^s(\bar{v}_t^s) = I + k + (\bar{v}_t^s - \delta q 2s)/(1+r)$.

A.5. OMITTED DETAILS FOR PROPOSITION 3

Note for the first statement that there is δ sufficiently close to 1 so that $\hat{\omega}^s(\bar{v}_{\max}^s, i) \leq k$. This guarantees that skilled labor is scarce in the labor market in period t and an increase of μ^f yields an increase of output $y_{t+1/2}$ by $2q(a-1)s$.

Suppose now that instead $\delta qs < (1+r)k$, that is, condition (SF) holds, and that in periods $\tau = t-1, t-\frac{1}{2}$,

$$1 - G_\tau(k) < G_\tau\left(I + k - \frac{\delta qs}{1+r}\right) < G_\tau(k) + 1 - G_\tau\left(I + 2k - \frac{2\delta qs}{1+r}\right) \quad \textbf{(A.2)}$$

and

$$2\mu^f + G_\tau(k) + 1 - G_\tau\left(k + \frac{1-2\delta}{1+r}qs\right) < G_\tau\left(k + \frac{1-2\delta}{1+r}qs\right) < 1. \quad \textbf{(A.3)}$$

The first condition is Assumption (SK). The second ensures that skilled workers will be scarce in equilibrium (i.e., all agents with $\omega_{t-1/2} \geq k$ and $\omega_{t-1/2}$ acquire education). The second line implies that both skilled and unskilled domestic firms are active in equilibrium; that is, $\mu_\tau^s > 0$ and $\mu_\tau^u > 0$. The conditions require skewed endowment distributions (because $k < I + k - \frac{\delta qs}{1+r} < I + 2k - \frac{2\delta qs}{1+r} < k + \frac{1-2\delta}{1+r}qs$ in an economy with $\delta < (1+r)k/qs$). The sufficient conditions in the text are sufficient for (A.2) and (A.3) to hold, at least for δ close to 0.

The change of the growth rate in period $t + 1/2$ due to an increase of μ^f is positive if, and only if,

$$\frac{y_{t+1/2} + \Delta}{(1-\kappa)[y_{t-1/2} + 2q(a-1)s\epsilon]} > \frac{y_{t+1/2}}{(1-\kappa)y_{t-1/2}}.$$

That is, using (6), if

$$\left[a - 2\left(P_d^s - P_f^s\right) - \left(P_d^u - P_f^u\right) - 2\left(P_s^s - P_s^u\right) - \left(P_s^u - P_u^u\right)\right] < \frac{y_{t+1/2}}{y_{t-1/2}}(a-1), \quad \textbf{(A.4)}$$

an inflow of foreign firms in period $t-1$ decreases the growth rate in $t + 1/2$, conditional on the output drop in period t.

Rewriting condition (9) yields

$$\beta \bar{v}_{t-1}^s - \beta\delta qs + \beta(1-\delta)s < I + 2k - \frac{2\delta qs}{1+i}. \quad \textbf{(A.5)}$$

Setting $\delta = 0$ and using the fact that $\bar{v}_{t-1}^s \leq qs - (1+r)I$ in (8) and (9) yields the bounds

$$\frac{I+2k}{2s} < \beta < \frac{I+2k}{(1+q)s - (1+r)I}.$$

Noting that $2qs > (1+r)(I+2k)$ to make production profitable yields the lower bound in condition (10).

Finally, if (10) holds, a sufficient condition for abundant skilled labor in t is that foreign firms do not dominate the domestic economy:

$$\frac{1}{q}\frac{G_{t-1}\left(\frac{k}{q}\right) - G_{t-1}(k)}{G_{t-1}\left(I + 2k - \frac{2\delta qs}{1+r}\right) - G_{t-1}\left(I + k - \frac{\delta qs}{1+r}\right)} \leq 1 + \frac{1 - G_{t-1}\left(k + \frac{1-2\delta}{1+r}qs\right)}{2\mu^f}. \quad \textbf{(A.6)}$$

To see this, note that with condition (10) the demand for skilled labor in t is $q\mu_{t-1}^s + 2\mu^f$. As $(1+r)\beta \geq q$, the offspring of all workers in domestic successful firms can become skilled in t, satisfying the labor demand by skilled entrepreneurs in t. Under (10), the offspring of any skilled worker in a foreign firm with $\omega_{t-1} \geq k/q$ in $t-1$ can become skilled in t. If foreign and domestic employers are assigned uniformly to skilled workers, the condition

$$q\mu_{t-1}^u > 2\mu^f \left[1 - \frac{G_{t-1}(\hat{\omega}^u(r)) - G_{t-1}(k/q)}{G_{t-1}(\hat{\omega}^u(r)) - G_{t-1}(k)}\right]$$

implies that the supply of skilled work in t in the form of offspring of unskilled entrepreneurs and wealthy enough workers in foreign firms can satisfy the demand by foreign firms. Rearranging the condition, using the bounds of $\hat{\omega}^u$ and $\hat{\omega}^s$, and noting that $G_{t-1}(\hat{\omega}^u(r)) - G_{t-1}(k) = \mu_{t-1}^s + 2\mu^f$ yields (A.6). Note that (A.6) relaxes in δ.

A.6. OMITTED DETAILS FOR COROLLARY 3

Using (A.4), an inflow of foreign firms in period $t-1$ decreases the growth rate in $t + 1/2$, conditional on the output drop in period t, if

$$\left[\lambda a - 2\left(P_d^s - P_f^s\right) - \left(P_d^u - P_f^u\right) - 2\left(P_s^s - P_u^s\right) - \left(P_s^u - P_u^u\right)\right] < \frac{y_{t+1/2}}{y_{t-1/2}}(a-1).$$

If $q > 1/2$, domestic firms generate potential skilled entrepreneurs at a (weakly) higher rate than foreign firms, because workers in successful domestic firm earn more than their counterparts in foreign firms. Hence, the LHS of the condition is at most λa. This implies the statement. Note that this argument extends to the case of abundant skilled labor in period $t-1$, because then the RHS becomes $\frac{y_{t+1/2}}{y_{t-1/2}}a$.