How Much Do Firms Save? Financial Frictions and the Microeconomic Implications of the Euler Equation*

Ananya Kotia†

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Abstract

Neoclassical models with standard parameter values provide powerful self-financing incentives to financially constrained entrepreneurs. This fundamental prediction has important implications for capital misallocation. If entrepreneurs can indeed save themselves out of financial constraints, capital misallocation should disappear on its own and impose a small, transient cost to aggregate productivity. This is contrary to a large body of empirical work that has documented high dispersion in marginal products of resources, particularly capital. Using micro firm-level data and the staggered implementation of a financial liberalization policy in India, I provide causal evidence on the relationship between financial constraints and self-financing by individual firms. I find that the behavior of treated firms that see an easing in their financial constraints does not conform with standard predictions of the neoclassical growth model.

Keywords: Financial constraints, capital misallocation, self-financing, entrepreneurship
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†Department of Economics, London School of Economics. a.kotia1@lse.ac.uk. Personal website.

1 Introduction

In an economy where firms are heterogeneous in their wealth and productivity, allocative efficiency requires that their productivity should determine their size. In such an economy, the largest producers would be those with the best ideas, whereas unproductive firms would be small or exit the market altogether. Financial frictions may distort such an allocation and lead to the misallocation of resources. For example, the ability of an entrepreneur to raise external finance typically depends both on her productivity and her wealth (e.g., due to frictions such as collateral constraints). In a static model, if wealth and productivity are imperfectly correlated, firm productivity ceases to be the sole determinant of firm size. This may restrict the scale of less wealthy but high productivity entrepreneurs who are unable to raise sufficient external finance to achieve their optimal size. Such an equilibrium will be characterized by wedges in marginal products: firms that are constrained to be small due to lack of external financing will have higher marginal products than wealthier but less productive large firms. Aggregate TFP would be higher if resources were reallocated to firms with higher marginal products.[1]

In a dynamic model, however, where entrepreneurs additionally face an intertemporal consumption-saving decision, things are more complicated. A high productivity, credit-constrained entrepreneur may be willing to forgo present consumption in order to save and accumulate wealth for investment. This self-financing mechanism has important implications for misallocation. If firms can quickly save sufficient internal funds, then financial frictions may not be a persistent drag on the growth of productive firms. On the other hand, if firms are unable to save themselves out of financial constraints, we should see large and persistent misallocation, particularly in developing countries where financial markets are less mature.

There is a growing consensus from recent quantitative work that while financial constraints may cause significant misallocation on the extensive margin (entry/exit decisions), they cause little misallocation on the intensive margin, i.e., among existing firms.[2] Self-financing by forward-looking firms is key to understanding this prediction. Banerjee and Moll (2010) calibrate a simple model of heterogeneous entrepreneurs and find that, even if credit markets are completely shut off, self-financing can undo capital misallocation after just seven years. Buera et al. (2011) find that self-financing can help

[1] There may also be misallocation on the extensive margin: potentially productive but financially constrained entrepreneurs may not enter into production because they lack the funds required to start a business. In this paper, unless otherwise stated, by misallocation, I mean intensive margin misallocation only, i.e., the dispersion of marginal products among existing firms.

[2] Note that this statement only pertains to one source of intensive margin misallocation: financial frictions. It says nothing about the presence or persistence of misallocation on the intensive margins due to other reasons.

firms overcome financial frictions, particularly in sectors that use small-scale technologies, reducing the aggregate productivity cost of financial frictions by as much as 50%. Similarly, studying plant-level data from Colombia and South Korea, Midrigan and Xu (2014) find small losses from misallocation among existing firms, as efficient establishments quickly accumulate internal funds and grow out of their borrowing constraints. Finally, Moll (2014) shows that as long as firm productivity is sufficiently persistent, entrepreneurs have enough time to accumulate internal funds, making self-financing an effective substitute for external financing.

While these quantitative models with reasonable parametric assumptions imply that self-financing is an effective means to overcome financial constraints, there is no systematic empirical documentation of this forward-looking behavior among firms, particularly in developing countries. How sensitive are a firm's savings (e.g., retained earnings) to a shock to its financial constraints? Do we see more financially constrained firms saving more? Do relatively unconstrained firms save less? These are first-order questions for thinking about firm growth and capital misallocation. To answer them, I use firm panel data and exploit a natural experiment from India, where firms belonging to certain industries were allowed easier access to foreign capital, thereby reducing financial frictions. The main contribution of this paper is to provide the first causal evidence on the relationship between financial frictions and forward-looking self-financing behavior.

To interpret my reduced form results, I outline a standard model of entrepreneurship with financial frictions. The goal at present is to derive clear, *qualitative* theoretical predictions about the various margins on which a firm adjusts its behavior after experiencing a shock that reduces its financial constraints and compare the reduced form evidence to these theoretical predictions. When a financially constrained entrepreneur faces an easing in these constraints, she reduces her savings because the availability of new external finance reduces some of the motive behind self-financing. Raising new finance from outside alleviates the need to fund firm expansion from self-financing alone.

India has strictly regulated the inflow of foreign capital since its independence in 1947. This meant that domestic firms were either prohibited or had to take explicit government permission to raise funds from abroad. Even during the broad-based economic reforms in India in 1991, foreign capital, and in particular, foreign direct investment (FDI) was allowed in very few sectors and was capped at 51% foreign equity in most cases. In the 2000s, the government liberalized its FDI regime in two phases, with different industries being liberalized in each phase. The policy made three changes to the status quo. First, it expanded the list of industries that could raise funds from abroad. Second, it increased the cap on FDI in many industries from 51% to over 74%. Third, firms in the liberalized industries no longer needed explicit government permission to raise

FDI, thereby greatly simplifying the process. Therefore, the policy eased the financial constraints of firms in liberalized industries by allowing easier access to foreign capital.

This staggered and narrow change in policy is ideal for causally estimating the impact of financial frictions on self-financing by firms for two reasons. First, there is a clear mechanism by which this reform affects a firm that operates in a liberalized sector: easier access to foreign capital. Thus, it relaxes a firm's financial constraints. Usually, foreign capital reforms are part of a wider structural reform agenda that often includes trade liberalization and domestic product or factor market deregulation. Each of these reforms impacts firms in its own way, making it difficult to empirically sift between different theoretical mechanisms that may drive a firm's growth dynamics and self-financing after such wide reforms.[3] Second, the policy is implemented in two phases, with a different set of narrowly defined 5-digit industries liberalized in each phase. This staggered nature of the liberalization naturally lends itself to a difference-in-differences approach to estimate the causal impact of easing a firm's financial constraints on its internal savings.

For this exercise, I need firm panel data on both production and detailed balance sheet variables that are not commonly available for developing countries. Manufacturing censuses are the dominant source of unit-level production data from developing countries. But these data have scant balance sheet information because they are typically *establishment-level* production surveys used by statistical agencies for national income accounting. Balance sheets, on the other hand, are prepared only at the *enterprise-level*. India's manufacturing survey, the Annual Survey of Industries, has been widely used by economists but suffers from the same limitation. I therefore use the Prowess database of the Center for Monitoring the Indian Economy, which is a panel of large and medium Indian firms. On the balance sheet side, I use information on a firm's retained profits and cash flow statements to derive measures of self-financing.

One limitation of the current paper is that while I know which industries were liberalized, I do not observe firm-level FDI inflows. Therefore, I am only able to present naive intent-to-treat estimates, where I consider all firms in a liberalized industry as treated by the policy. I hope to soon obtain new, confidential administrative data on firm-level FDI inflows from the Ministry of Commerce, Government of India. These data need to be digitized and then matched with firm data in Prowess based on firm names. The procurement of these data was severely delayed due to the pandemic. I hope to obtain and digitize the administrative data over the summer of 2021. In the final section of this

[3]For example, in many countries, capital market deregulation happens simultaneously with trade reform such as tariff reductions. In such a setting, a firm's growth dynamics may simultaneously be impacted by higher competition from imports, cheaper imported inputs, and cheaper access to capital, making it difficult to establish a causal link between self-financing and financial constraints.

paper, I outline how I plan to use these data for additional empirical and quantitative work.

With my current data, I find that the policy has a significant and sustained role in reducing financial constraints faced by firms in treated industries. Over a 10-year post-policy period, the average capital stock of firms in the treated industries is 12 percent higher as compared to the average capital stock in firms in the control group. This result, which indicates the "first-stage" of the policy, is in line with the findings of Bau and Matray (2020), who study the same policy in another context.

While the standard neoclassical model predicts that treated firms (who have access to new, foreign capital) would save less, I find the opposite. Firms in my sample report higher levels of savings, as measured by retained earnings and internal reserves. Moreover, firm sales revenues and profits are unaffected by the policy. This implies that the savings to profit ratio has *risen* in firms that saw an easing in their financing constraints. Finally, even though firms in treated industries accumulate substantially more capital after the reform, there is no decline in their average product of capital, as should be the case with a neoclassical, concave production function.

Why does individual firm behavior not comply with standard predictions of the neoclassical growth model? There are two types of candidate explanations. One deals with its assumptions on preferences. Behavioral extensions such as present bias or loss aversion could potentially explain firm behavior that deviates from standard predictions. The second explanation deals with neoclassical assumptions on technology, in particular the concavity of the production function. Assessing these competing explanations in any detail would require more data, particularly on firm-level FDI. This is my main agenda for future work on this project.

For now, I discuss how tweaking a standard assumption on the production function can rationalize these non-standard empirical findings. In particular, I relax the assumption of strict concavity of the production function. As noted by Banerjee and Moll (2010)[4], the concavity of the production function has implications for misallocation. If the production function has strong diminishing returns (e.g., in Midrigan and Xu (2014)), then there are high returns to self-financing, and agents will quickly save themselves out of financial constraints, restoring allocative efficiency in the economy. On the other hand, a production function that is non-concave, like the one I discuss in section 7, self-financing may be less remunerative for the entrepreneur.

Related literature. This paper contributes to two literatures. First, by studying the empirical validity of a key mechanism– self-financing by financially constrained firms– the paper contributes to the understanding of the link between financial frictions

[4]See footnote 14 in their paper.

and misallocation of resources. In this sense, the paper speaks directly to a rich and growing body of work that has documented large aggregate productivity losses due to misallocation (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Hopenhayn, 2014; Restuccia and Rogerson, 2017). In particular, as mentioned above, the paper is related to the quantitative literature on financial constraints, firm behavior, and capital misallocation (Banerjee and Moll, 2010; Buera et al., 2011; Midrigan and Xu, 2014; Moll, 2014). The theoretical frameworks of these papers emphasize the salience of self-financing by firms to overcome financial constraints. The key contribution of this paper is to provide the first causal empirical link between financial constraints and firm savings. The results suggest that this key prediction of the neoclassical framework may be less generally applicable than is presently appreciated. By documenting that firms may be less forward-looking than these models predict, this paper presents a candidate explanation for why capital misallocation may be pervasive and persistent, even though theory suggests that financially constrained firms should quickly save themselves out of these constraints.

Second, the paper makes some progress towards understanding what Kremer et al. (2019) call the "Euler equation puzzle". A vast body of work has found that many potential investments in developing countries yield very high returns (Fafchamps, 2000; Banerjee and Duflo, 2005; De Mel et al., 2008; Kremer et al., 2013; Banerjee and Duflo, 2014). In neoclassical models of intertemporal consumption and saving, the Euler equation links the returns on investment to consumption growth. Producers who face high returns (e.g., due to financial constraints that are the focus of this paper) would forgo current consumption and save in order to reap these high returns, leading to high consumption growth. The puzzle is that, based on estimates of returns in the papers mentioned above, a neoclassical model with standard parameter values would predict consumption growth of over 44%, an order of magnitude higher than what is observed in the data.

This paper contributes to the understanding of this puzzle by studying the key mechanism that translates high returns to consumption growth: the ability of firms to self-finance and accumulate capital.

The paper is organized as follows. In section 2, I sketch a standard dynamic model of entrepreneurship and conduct some policy experiments to pin down intuition. Sections 3 and 4 detail the policy context and data. I then outline the empirical strategy in section 5 and discuss the results in the following section. Section 7 discusses candidate explanations that could rationalize firm behavior that deviates from neoclassical predictions, and section 8 concludes and sketches a work plan to carry forward this project when I have access to firm-level FDI data.

2 Theoretical framework

To fix intuition, I present a standard partial equilibrium model of entrepreneurship with financial constraints. Entrepreneurs are heterogeneous in their productivity, z, and wealth, a.

A. Preferences and technology

The entrepreneur's preferences are given by a time separable utility function. Time is continuous.

$$u(c) = \int_0^\infty e^{-\rho t} u\left(c(t)\right) dt \tag{1}$$

where ρ is the rate of time preference and $u(\cdot)$ is a strictly increasing and strictly concave function. For all the analysis below, I use CRRA utility $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$ with intertemporal elasticity of substitution σ.

B. Technology and resource constraint

The state of the economy is characterized by the joint distributions of productivity and assets $g_t(z, a)$ at any given point in time. Each entrepreneur owns a technology $f(z, k, \ell)$ that she can use to convert capital goods and labor into consumer goods. I assume that productivity, z, follows a diffusion process with drift $\mu(z)$ and diffusion term $\sigma(z)$.

$$dz_t = \mu\left(z_t\right) dt + \sigma\left(z_t\right) dW_t \tag{2}$$

The capital stock depreciates at rate δ. For the analysis in this section, I will assume a standard neoclassical production function that is strictly concave: $f(z, k, \ell) = zk^\alpha \ell^\beta$ with $\alpha + \beta < 1$. Later, in section 7, I will discuss an extension to a non-concave production function and discuss consequent implications for the entrepreneur's consumption and saving behavior.

Labor is inelastically supplied by workers who do not face any uncertainty and have the same preferences as the entrepreneurs. I assume that workers are hand-to-mouth, i.e., they consume all their income instantly, and therefore omit them from the analysis. Entrepreneurs can rent capital in the rental market at rate $R = r + \delta$ and hire workers at wages, w, in a competitive labor market.

Thus, the entrepreneur's resource constraint is as follows:

$$\dot{a} = f(z, k, \ell) - (r + \delta)k - w\ell + ra - c \tag{3}$$

That is, the entrepreneur's savings, $\dot{a}$, are what is left over from her output and interest income after paying for consumption and expenditure on capital and labor inputs.

I model financial frictions as collateral constraint, such that the entrepreneur's capital stock at any given time is limited by her wealth.[5] This simple formulation of financial frictions nests the extreme case of $\lambda = 1$, i.e., the entrepreneur is completely cut off from financial markets and has no source of external finance. As λ increases, she can fund an increasing amount of her investment by raising money externally.

$$k \leq \lambda a \tag{4}$$

The entrepreneur's intertemporal consumption-saving problem and static production problem can be separated and solved independently. The profit maximization problem is static, with the entrepreneur's per-period profit function being increasing in both z and a.

$$\Pi_t(a,z) = \max_{k,l} \left\{ z k^{\alpha} \ell^{\beta} - (r+\delta)\, k - w\ell \quad \text{s.t.} \quad k \leq \lambda a \right\} \tag{5}$$

Optimal capital and labor choices are given by

$$k(a,z;w,r) = \min\left\{\lambda a, k^{u}(a,z;w,r)\right\} \tag{6}$$

$$\ell(a,z;w,r) = \left(\frac{\beta z}{w}\right)^{\frac{1}{1-\beta}} k(a,z;w,r)^{\frac{\alpha}{1-\beta}} \tag{7}$$

where

$$k^{u}\left(z,r;w,r\right) \equiv z^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r+\delta}\right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}} \tag{8}$$

is unconstrained capital demand.

I assume that the interest rate and wages are exogenously set at r and w respectively, i.e., I only consider this model in partial equilibrium.

C. Stationary equilibrium

To summarize, the entrepreneur solves the following utility maximization problem.

[5]Please see section 8 for a discussion of this modeling choice and its suitability in the context of available data and the policy studied here.

$$
\begin{aligned}
&\max_{\{c_t\}} \mathbb{E}_0 \int_0^\infty e^{-\rho t} \frac{c_t^{1-\sigma}-1}{1-\sigma} dt \\
&\text{st.} \\
&\dot{a}_t + c_t = \Pi\left(a_t, z_t\right) + r_t a_t \\
&dz_t = \mu\left(z_t\right) dt + \sigma\left(z_t\right) dW_t \\
&a_t \geq 0
\end{aligned}
$$

The partial equilibrium (for a fixed interest rate r and wage w) stationary equilibrium of this optimal control problem is characterized by the following four equations.

$$
\begin{aligned}
\rho v(a,z) = \max_c u(c) + \partial_a v(a,z)[\Pi(a,z) + ra - c] \\
+ \partial_z v(a,z)\mu(z) + \frac{1}{2}\partial_{zz} v(a,z)\sigma^2(z)
\end{aligned} \tag{9}
$$

$$
0 = \partial_a \left[s(a,z)g(a,z)\right] - \partial_z \left[\mu(z)g(a,z)\right] + \frac{1}{2}\partial_{zz}\left[\sigma^2(z)g(a,z)\right] \tag{10}
$$

$$
s(a,z) = \Pi(a,z) + ra - c(a,z) \tag{11}
$$

$$
c(a,z) = \partial_a u^{-1}\left[\partial_a v(a,z)\right] \tag{12}
$$

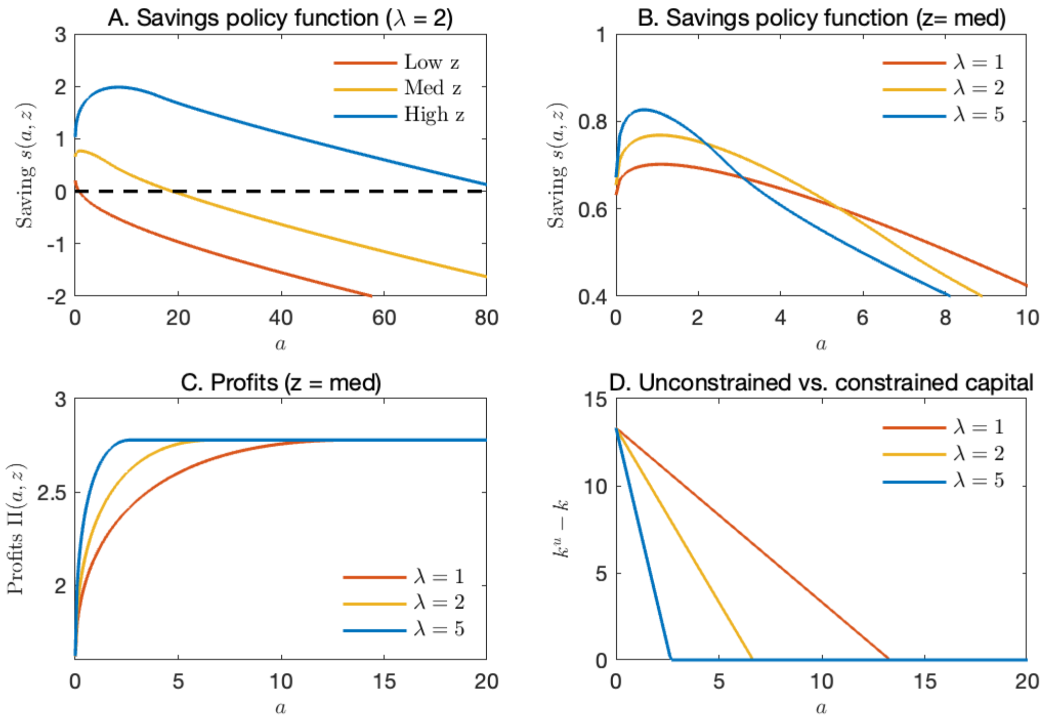
Equation 9 is the Hamilton-Jacobi-Bellman equation and governs the optimal consumption-saving decision. It yields the consumption (equation 12) and saving (equation 11) policy functions of an entrepreneur with assets a and productivity z, where $c(a,z)$ is given by the undistorted first-order condition $\partial_a u(c(a,z)) = \partial_a v(a,z)$.[6] The stationary joint distribution of wealth and productivity is summarized by equation 10, the stationary Kolmogorov-Forward equation.

2.1 Numerical solution and comparative statics

I consider a numerical example of the model outlined above to show how an entrepreneur adjusts her consumption and saving decisions to changes in the degree of financial frictions, λ. I use benchmark parameter values of $\gamma = 2$, $\rho = .08$, $\alpha = .33$, $\beta = .35$ $r = \delta = .05$, and $w = 1.1$. As in Moll (2014), I assume that the log of productivity, z, follows an Ornstein-Uhlenbeck process, where both the drift and the diffusion in equation 2 are scaled by θ, a positive parameter.

[6]As shown in Achdou et al. (2021), the borrowing constraint never binds in the interior of the state space and only shows up in a state constraint boundary condition, given by $v'(z, a_{min}) \geq u'(\Pi(a,z) + ra)$.

Figure 1: Entrepreneur behavior and as financial constraint are eased



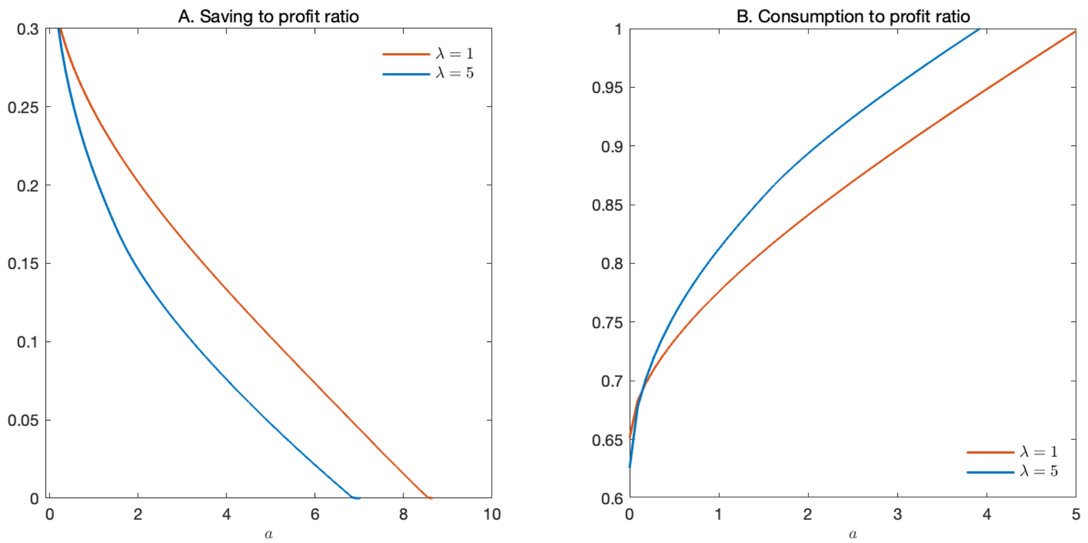
$$d \log z = \frac{-1}{\theta} \log z dt + \sigma \sqrt{\frac{1}{\theta}} dW$$

This process is just the continuous time analog of an AR(1) process. The autocorrelation of this process, $\text{corr}[\log z(t), \log z(t+1)] = e^{-1/\theta}$, and I set it to be equal to 0.95.

The goal here is to derive qualitative predictions regarding the consumption and saving behavior of the entrepreneur as her financial constraints are relaxed. In Figures 1 and 2, I solve the model for different values of λ: $\lambda = 1$, 2, and 5. $\lambda = 1$ corresponds to the case where the entrepreneur is completely shut off from raising external finance. I consider cases for entrepreneurs with low, medium, and high levels of productivity.
Figure 1, Panel A shows typical saving policy functions for entrepreneurs of different productivity levels for the case where $\lambda = 2$. For a given level of productivity, sufficiently rich entrepreneurs dissave. For a given level of wealth, a, more productive entrepreneurs save more because the returns to investing in their firm are higher. For panels B to D of Figure 1, I fix the entrepreneur's productivity to the median productivity level in the economy to see how various model features behave as I change the degree of financial frictions, λ. Panel B shows the saving policy function. Entrepreneurs who are most financially constrained ($\lambda = 1$) save more than entrepreneurs with $\lambda = 5$ except at very low levels of wealth. This is intuitive: a higher λ allows an entrepreneur to raise money externally. She therefore chooses to raise her current consumption and

reduce savings, which are now substituted with external finance. This forward-looking behavior is the focus of this paper.[7] Another way to see this is in Figure 2, where I plot savings and consumption as a ratio of profits. Panel A of Figure 2 shows that the savings-profit ratio is lower for entrepreneurs who are less financially constrained. Easier availability of external finance means that entrepreneurs prefer to save a lesser fraction of their profits and consume more (panel B). Internal savings that require sacrificing present consumption are a substitute for external funds. With less stringent financial constraints, this loss to present consumption is avoided.

Figure 2: Saving and consumption rates



It is this intertemporal adjustment of the entrepreneurs that undoes intensive margin misallocation. Productive, financially constrained producers save aggressively in order to overcome their constraints and grow in size. Over time, without any intervention by the social planner, this economy will endogenously move towards allocative efficiency.

The model presented above has several neoclassical features. In particular, it features a strictly concave production function, which is key to the prediction that financially constrained entrepreneurs will save more than their less financially constrained peers. This is not only a qualitative prediction. Quantitatively, this positive relationship between high capital returns (e.g., due to financial constraints, as studied here) and firm savings is large in magnitude. As discussed in section 1, this relationship plays a central role in most papers that model financially constrained entrepreneurs and has strong

[7] The lower nominal savings of the constrained entrepreneur ($\lambda = 1$) at low levels of wealth is entirely due to lower nominal profits (panel C). Financial constraints create a gap between the entrepreneur's feasible capital choice,k, and unconstrained, first best level of capital stock k^u (panel D), resulting in lower nominal profits. The profits in all three scenarios eventually converge, but only when wealth is sufficiently high for financial constraints to become irrelevant. Therefore, the lower nominal savings of the most constrained entrepreneur for low wealth levels in panel B is because she is saving out of lower income (profits).

consequences for the persistence and magnitude of capital misallocation.

Despite its canonical role in theory, this prediction of the neoclassical growth model has so far not been tested using firm-level balance sheet and production data. Do firms save as much as the model predicts? How forward-looking are firms, particularly in developing countries, where lack of competition may allow "behavioral firms" to survive on a sustained basis (Kremer et al., 2019)? To answer this question, I exploit a financial liberalization policy in India that is outlined in the next section.

3 Institutional background and policy change

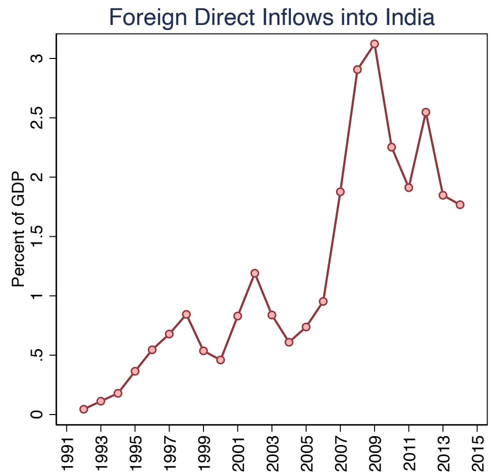
During much of its independent history, India strictly regulated the inflow of foreign capital, both direct investments (where the investor has some control over management), as well as portfolio investments in security markets. International flows have been gradually liberalized since the early 1990s when India undertook broad-based trade and industrial reforms as part of an IMF structural package (Ahluwalia, 2002).

Typically, foreign investment in India has been restricted in three ways. First, the government restricts the amount of stake that a foreign investor can purchase in an Indian firm. These vary from zero to 100% for different industries. Second, before these reforms, and in some industries even today, foreign investors have to seek explicit government permission through the Foreign Investment Promotion Board of India. After 1991, the government introduced an 'automatic approval route' to FDI where no government approval was needed. This greatly simplified procedures, only requiring foreign investors to register with the Reserve Bank of India before investing. Finally, the government controls the parts of the economy to which the above regulations apply. Foreign capital is heavily regulated in some industries (such as agriculture) but allowed liberally in others (e.g., medical devices and infrastructure).While the reforms of the early 1990s marked a start towards opening up to foreign capital, substantial parts of the economy remained closed to FDI until the 2000s.

I study two phases of foreign investment liberalization in India in 2001 and 2006, when the government expanded the list of industries that are eligible for automatic approvals of FDI up to 74%. The policy applied to 24 5-digit manufacturing industries listed in Table A1, which is taken from Bau and Matray (2020). The policy improved access to foreign capital for firms in treated industries by (1) allowing firms in previously prohibited industries to access FDI and (2) by raising the amount of FDI that firms could raise to 74%. Figure 3 shows the dramatic expansion of foreign investment into India since the early 2000s.

I exploit the staggered and narrow implementation of the policy to estimate the causal impact of easier access to external finance on firm growth dynamics and savings behavior.

Figure 3: Annual FDI inflows into India



Source: Reserve Bank of India.

4 Data

The industry-level FDI data is obtained from Bau and Matray (2020), who have sourced it from different editions of the Handbook of Industrial Policy and Statistics, Ministry of Commerce, Government of India. This data (see appendix Table A1) contains 5-digit industry names and years in which these industries were liberalized. I follow the same definition of a treated industry as Bau and Matray (2020), i.e., an industry is considered treated if the maximum threshold for FDI that is allowed under the automatic approval route is at least 51% of capital.

The main firm-level data I use is called the CMIE Prowess, a well-known data for large and medium firms in India. It includes the universe of all listed Indian firms plus a large number of privately held firms. The data span 1988-present and the latest vintage of the data has over 50,000 firms. The companies in the database together comprise 60 to 70 percent of the economic activity in the organized industrial sector and account for 75 percent of corporate taxes and 95 percent of excise duty collected by the Government of India (Goldberg et al., 2010).

I use data from 1995-2015 to avoid using data that may be contaminated by variation caused by the structural reforms adopted by India in 1991. I restrict my sample to only manufacturing firms. Since the sample is very unbalanced, I select a firm into the estimation sample only if its data are available for at least five years consecutively around the implementation of the policy. This gives me 21,041 total firms and 166,390 firm-year observations.

As with most firm-level data, the value of assets is on historical cost basis. I assume that assets which appear in the accounts of a firm were purchased three years before the first year for which data for that particular firm is available. Then, the replacement value of the capital stock is constructed using an iterative perpetual inventory method, detailed in appendix A.1.

The capital stock is deflated using the implicit deflator for gross fixed capital formation. Profits, sales, and savings variables are deflated using the implicit deflator for gross domestic product[8].

There are three measures of self-financing that I use in the empirical analysis below. I use Prowess variable names, which follow the Indian accounting standards and the Companies Act 2013, which lays down rules according to which firms should prepare their balance sheets and profit and loss statements. The exact names may differ from variable names in European or US firm-level data such as Compustat. Therefore, I provide detailed definitions of these variables from the Prowess data dictionary.

The first measure of firm savings I use is retained profits or losses during the year. In Prowess, this variable measures the net profit of a firm, which is retained by the company in the business after paying dividends to its shareholders. It is computed by subtracting equity and preference dividends and dividend tax from the current year's net profit. When a company incurs a net loss during the year, this data field will show the amount of net loss, which will be a negative number.

A narrower notion of a firm's savings is the change in "reserves and surpluses." Reserves are that portion of accumulated profits that are retained in the business and not distributed to shareholders. They are monies set aside from the accumulated profits of the company for specific purposes, usually to act as a buffer against future losses.

The final variable I use is a firm's financial investments. Firms often make investments in shares, debentures, bonds, mutual funds, immovable properties etc. The sum of all such investments outstanding at the end of the balance sheet date is captured in this variable. This variable only includes financial investments: those that a firm uses to earn some returns on its accumulated cash. It does not include investments in plant and machinery, land, buildings or in any other asset that the company uses for its core production activity.

[8] The data on price deflators are sourced from the Central Statistical Organization (CSO), Ministry of Statistics and Programme Implementation (MOSPI), Government of India.

5 Empirical strategy

The structural equation I would ideally like to estimate is:

$$Y_{it} = \beta \mathsf{FDI}_{it} + \Lambda \mathbf{X}_{it} + \sum \gamma_t W_i + \eta_i + \varepsilon_{it} \tag{13}$$

where Y_{it} is some firm outcome, like capital stock, output, or self-financing, FDI_{it} is a dummy variable indicating if firm i receives FDI in year t, $\mathbf{X}_{it}$ are firm-level controls that vary both across firms and time. W_i is a vector of time-invariant firm characteristics and γ_t vary over time. η_i are firm fixed effects.

As discussed, at present, I do not have data on firm-level FDI inflows, and therefore, I do not observe FDI_{it}, making the above specification infeasible. I therefore estimate a generalized difference-in-differences regression which estimates changes in outcomes of firms in liberalized vs. non-liberalized industries before and after the episode of foreign capital liberalization. These regressions summarize the average treatment effect on the treated (ATT) averaged across all post-intervention years. I also present event study graphs that show the dynamic effects of the policy and also validate the lack of pre-trends.

The main specification I estimate is

$$Y_{ijt} = \beta \mathsf{Liberalized}_{jt} + \Lambda \mathbf{X}_{it} + \sum \gamma_t W_i + \eta_i + \varepsilon_{it} \tag{14}$$

where $\mathsf{Liberalized}_{jt}$ is an indicator that switches on if industry j is treated in year t. All other terms are the same as defined above. Apart from firm fixed effects, η_i, I also include 3-digit industry $\times$ year (47 industries), pre-treatment size quartile $\times$ year, and age quartile $\times$ year fixed effects.

The key parameter of interest is β, which measures the differential impact of financial liberalization on the outcome variable (e.g., capital stock or internal savings) of a firm belonging to a liberalized industry as compared to a firm that operates in an industry that did not experience this policy shock.

5.1 Identification

For β to identify the causal impact of financial liberalization on firm outcomes, firms in the treated and untreated industries should have similar paths of outcome variables in the absence of the policy. I address this by showing that there are parallel trends in pre-treatment outcome variables of treated and untreated firms. Even if the data rule out pre-trends, the identification assumption can still fail if there was a shock to the economy at the same time as the financial liberalization, and if this shock differentially impacted industries that were also financially liberalized. This is unlikely in my setting because the financial liberalization is not done in one year but in two phases: 2001 and 2006. Moreover, all my estimates are robust to including 3-digit industry $\times$ year fixed effects that to control for industry-specific time trends at the 3-digit industry level. This still allows me to identify β, as Liberalized_{jt} varies at the 5-digit industry level.

Another threat to identification could arise if firms in treated industries are somehow different from firms in control industries. This may be so for various reasons. For e.g., in interviews I conducted at a New Delhi-based accounting firm, I learned that there might be industry rules of thumb that firms follow in their financing practices. I control for these and any other time-invariant firm-specific attributes by including firm fixed effects in all regression specifications.

Finally, in treated industries, firms that actually acquire FDI may be different from firms that do not. Given that I do not yet have data on firm-specific FDI, this is not a relevant concern for the moment. For now, I am using a coarse measure of shifts in industry-level access to foreign capital. As long as the difference-in-differences assumption of parallel trends discussed above is valid, β identifies the causal impact of access to foreign capital on firm outcomes.

6 Results

Table 1 presents results from estimating equation 14 for various firm outcomes. Column 1 shows that firms in industries that were opened up to foreign capital saw a large and statistically significant rise in their real capital stock relative to firms in control group industries. I take this as evidence of the fact that firms were rationed in their supply of external finance and thus financially constrained prior to the policy. The ability to raise external funds eases their financial constraints, allowing them to expanded their scale of operation and increased their real capital stock by 12 percent.

As mentioned above, these results are robust to arbitrary time trends that vary by firm size quartile, 3 digit industry classification, and firm age. Figure 4 shows an event study graph for the log of real capital stock. Two points are worth noting. First, it is clear that there are no pre-trends. The path of capital stock for firms in treated and control industries before the policy shock is very similar. This is in line with Bau and Matray (2020), who study the same policy in a different context. Second, the policy shock is large and persistent. The capital stock of firms in treated industries remains 10-20 percent higher than firms in control industries, even eight years after the policy shock. The rest of the variables also do not show any pre-trends and the corresponding event study graphs are in Figure A1.

Table 1: Impact of foreign capital liberalization: difference-in-differences estimates

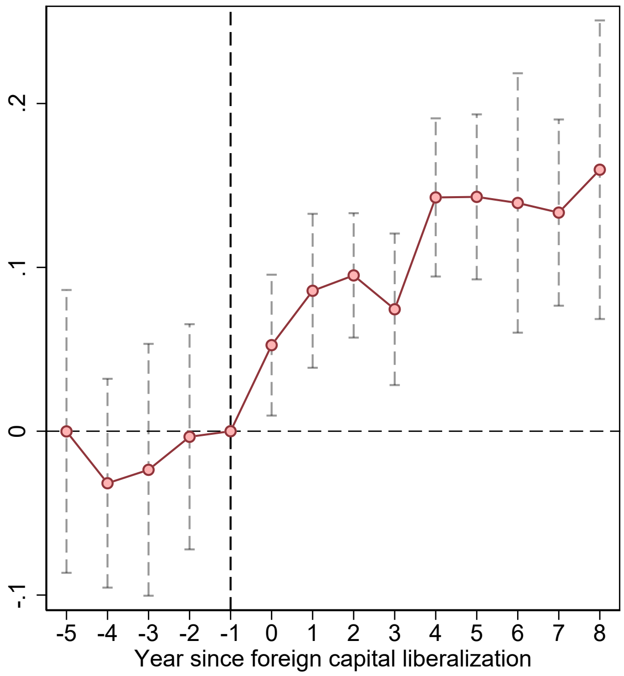
	(1) Capital stock	(2) Profits	(3) Sales Revenue	(4) Retained Profits	(5) Internal Reserves	(6) Financial Investment
Liberalized_{jt}	0.12***	2.10	-276.4	41.7**	86.7**	26.9
	(0.019)	(33.3)	(184.9)	(18.9)	(42.9)	(29.6)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Size × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Age quartile FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	76757	78218	78218	78218	42978	70587

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parenthesis are two-way clustered at the 3-digit industry × year level. Liberalized_{jt} is an indicator that switches on if a firm belongs to a treated industry in year t. Size × year are quartile fixed effects for firms' average pre-treatment gross fixed assets interacted with year fixed effects. Industry-year fixed effects are at the 3-digit NIC classification. All dependent variables are deflated using industry-specific indices). Capital stock is in logs.

Interestingly, while there is no increase in average profits or sales revenues of firms in the treated industry (columns 2, 3), these firms report higher *levels* of savings as measured by retained earnings and internal reserves. The point estimate of financial savings is also positive but not precisely estimated. From a neoclassical standpoint, this is a surprising result. If the policy indeed eases the financial constraints of firms, they should save less than before. To the extent that their past saving behavior was driven by a self-financing motive to overcome these constraints, the availability of fresh foreign funds should dampen this motive. Therefore these results are not in sync with the simple neoclassical model outlined in section 2.1. In particular, Figure 1, panel B shows that less constrained firms should save less than their ore constrained peers.

To provide further evidence in support of this anomalous savings behavior, I present savings to profit ratios in Table **??**. Firms in liberalized industries see a *rise* in their retained earnings to profit after tax, however this coefficient is not significant at the five percent level. The ratios of the other two savings measures are not statistically different from zero. Again, this contradicts the theoretical predictions from section 2.1, where Figure 2 shows that less financially constrained firms should have significantly lower savings to profit ratios. Moreover, recall that forward looking savings behavior is not just a qualitative prediction of the neoclassical model. The model predicts that high returns to capital (say, because of financial frictions, as studied here) provide a very strong incentive for forgoing present consumption in order to self-finance. Therefore, it is surprising to see that a policy that reduces financial frictions and induces a large capital expansion does not reduce firm savings.

Figure 4: Event study graph for the log of real capital stock



	(1) Retained earnings / Profits	(2) Financial Investment / Profits	(3) Internal Reserves / Profits
Liberalized$_{jt}$	0.059*	0.63	-0.31
	(0.034)	(0.62)	(0.64)
Firm FE	Yes	Yes	Yes
Size $\times$ year FE	Yes	Yes	Yes
Industry $\times$ year FE	Yes	Yes	Yes
Age quartile FE	Yes	Yes	Yes
Observations	75267	42454	68939

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parenthesis are two-way clustered at the 3-digit industry $\times$ year level. Liberalized$_{jt}$ is an indicator that switches on if a firm belongs to a treated industry in year t. Size $\times$ year are quartile fixed effects for firms' average pre-treatment gross fixed assets interacted with year fixed effects. Industry-year fixed effects are at the 3-digit NIC classification.

Finally, in Table 2, I test for the impact of the policy on the average product of capital. Given that we see a large, statistically significant, and persistent expansion in the capital stock of firms in the treated industries, a neoclassical production function should imply a fall in the marginal product of capital. Estimating production functions and marginal products is tricky. Standard methods such as the one proposed by Levinsohn and Petrin (2003) rely on strong functional form assumptions. However, in this paper, these are precisely the kinds of functional form assumptions (e.g., concavity of the production function) I want to avoid. Therefore, instead of getting into a detailed production function estimation exercise, I simply assess the impact of the policy on the average revenue product of capital (ARPK) in Table 2. The results show that, despite a rise in the

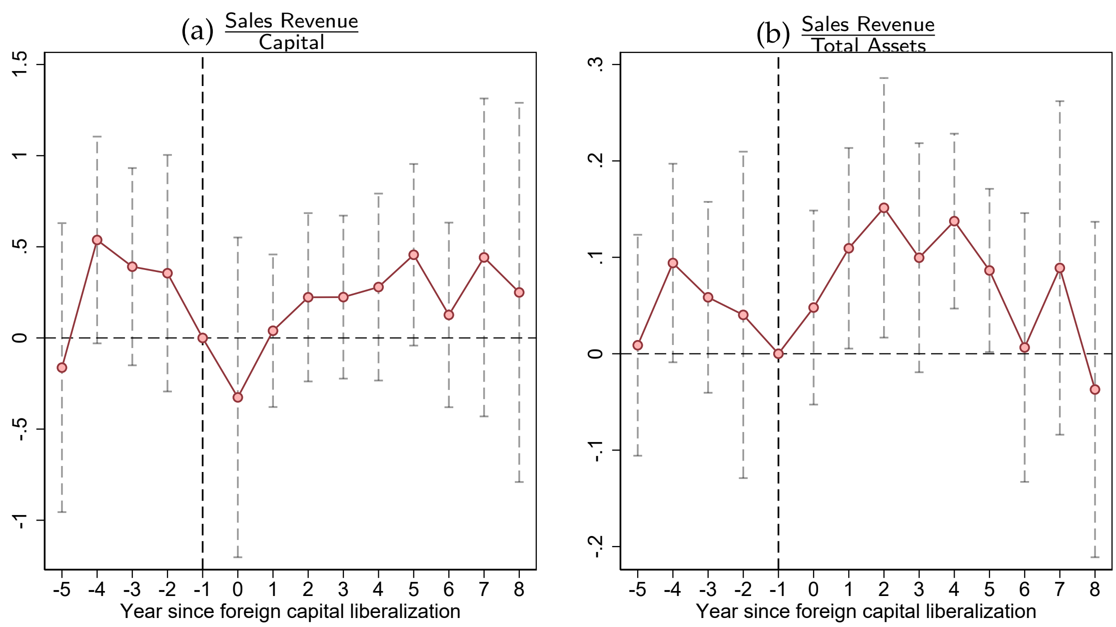
Table 2: Impact of foreign capital liberalization: difference-in-differences estimates

	(1) $\frac{\text{Sales Revenue}}{\text{Capital}}$	(2) $\frac{\text{Sales Revenue}}{\text{Total Assets}}$
Liberalized_{jt}	-0.13	0.015
	(0.12)	(0.028)
Firm FE	Yes	Yes
Size × year FE	Yes	Yes
Industry × year FE	Yes	Yes
Age quartile FE	Yes	Yes
Observations	76838	78026

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parenthesis are two-way clustered at the 4-digit industry × year level. Liberalized_{jt} is an indicator that switches on if a firm belongs to a treated industry in year t. Size × year are quartile fixed effects for firms' average pre-treatment gross fixed assets interacted with year fixed effects. All dependent variables are deflated using industry-specific indices). Capital measures real capital stock computed using the perpetual inventory method. Industry-year fixed effects are at the 3-digit NIC classification.

capital stock (Figure 4), there is no statistically discernible change in the average revenue product of capital. I measure ARPK in two alternative ways. Columns 1 of Table 2 uses the replacement value of capital stock computed using the perpetual inventory method. Column 2 uses a simpler, readily available variable for total assets as the denominator.

Figure 5: Event study graphs for the average product of capital



While none of the average effects reported in Table 2 are statistically significant, Figure 5 shows intriguing dynamic effects. First, there is no pre-trend in the average revenue products. If anything, the point estimates before the policy seem to be declining, while they are rising after the policy, but these are not precisely estimated for any pre-policy year. After the policy, however, panel B of the Figure shows that the sales revenue to total assets ratio is actually *greater* in the treated industries (where capital stock rose dramatically) after the policy than in control industries. This result is at odds with a neoclassical production function, where the concavity would imply that an expansion in capital stock should decrease average returns.

7 Candidate explanations for this anomaly in firm behavior

The empirical results suggest that, after an easing in their financial constraints, firms increase their savings or keep them unchanged. Moreover, as these firms expand their capital stock, there is no concomitant decline in average products. Both these findings are in stark contrast to standard predictions of a neoclassical model of entrepreneurship with financial frictions.

Neoclassical models assume strictly concave production functions with diminishing marginal returns. I discuss how this assumption is crucial for a positive relationship between high marginal returns and self-financing. To better understand the empirical results of the previous section, I drop the concavity assumption of the production function to shed light on how this might rationalize observed firm behavior.

While relaxing neoclassical assumptions on technology is one way to proceed, there may also be explanations on the preference-side. These include present bias that can induce impatient short-run behavior, misprediction of future preferences, leading to sub-optimal choices, and loss aversion (see Kremer et al. (2019) for a detailed introduction to these concepts in the context of the Euler equation puzzle). While it may be useful to explore these behavioral concepts in the present context, I do not have data on the entrepreneur's consumption-side to assess any of these issues in detail.

7.1 Technology: convex-concave production function

Consider a modification to the model presented in section 2, in which I replace the Cobb–Douglas production function with a non-concave production function based on Skiba (1978) and Moll (2018). There are two technologies, an unproductive production function, f_u, for which there is no fixed cost, and a productive technology, f_p. To access the productive technology, the entrepreneur has to pay some fixed cost in capital and labor.

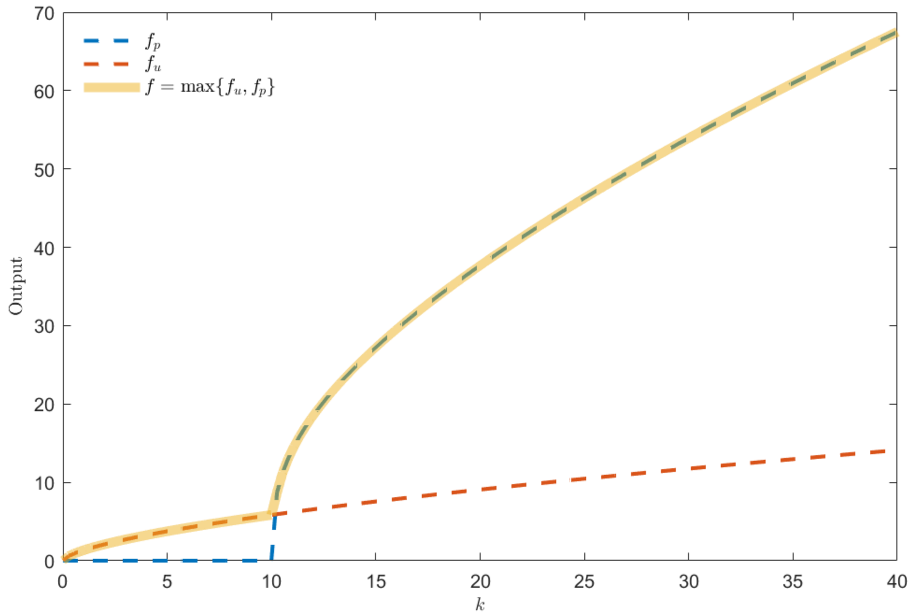
$$f_u = zA_u(k)^\alpha l^\beta \tag{15}$$
$$f_p = zA_p[(k-\kappa)^+]^\alpha[(l-\phi)^+]^\beta \tag{16}$$

where $A_p > A_u$. κ and ϕ are capital and labor fixed costs, respectively, and $x^+ = \max\{x, 0\}$. In this setup, the production function is given by $f = \max\{f_u, f_p\}$ and is shown in Figure 6[9].

At low levels of wealth, the entrepreneur cannot afford the fixed cost needed to use the high productivity technology. She therefore operates technology f_u, as shown in the red dashed line. If the entrepreneur is sufficiently rich however, she will be able to pay for the fixed cost and graduate to using technology f_p shown in blue. Her production function is piece-wise concave but has a kink at the point where she jumps from using the low to high productivity technology.

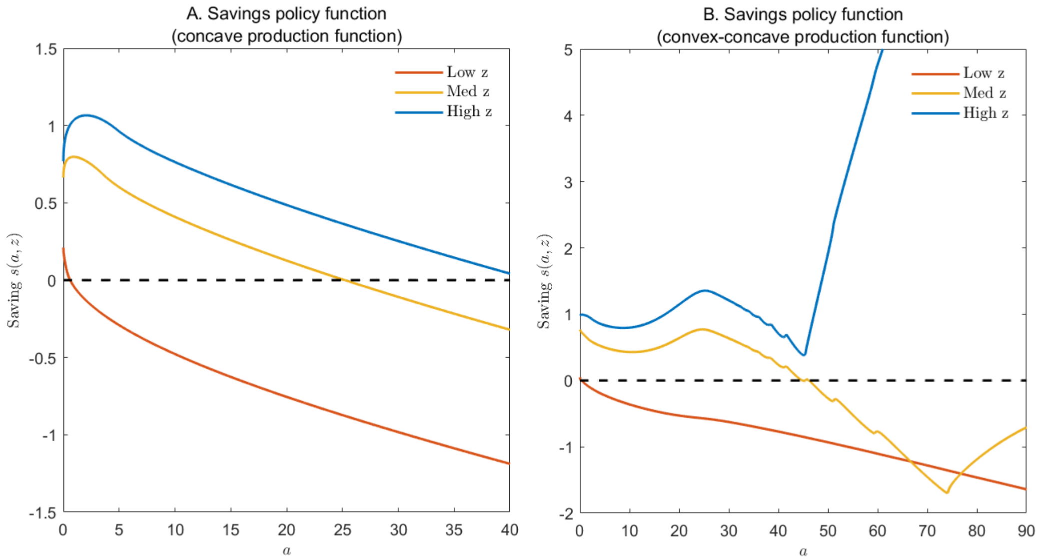
In this economy, we may observe that the marginal products of capital and labor of a firm increase as the firm switches its technology from low to high productivity and grows in size. While each of the individual production functions f_u and f_k have diminishing returns to factors, the kink in the overall production function implies that marginal products are not monotonically declining with firm size, as they are with a strictly concave production function.

Figure 6: Convex-concave production function



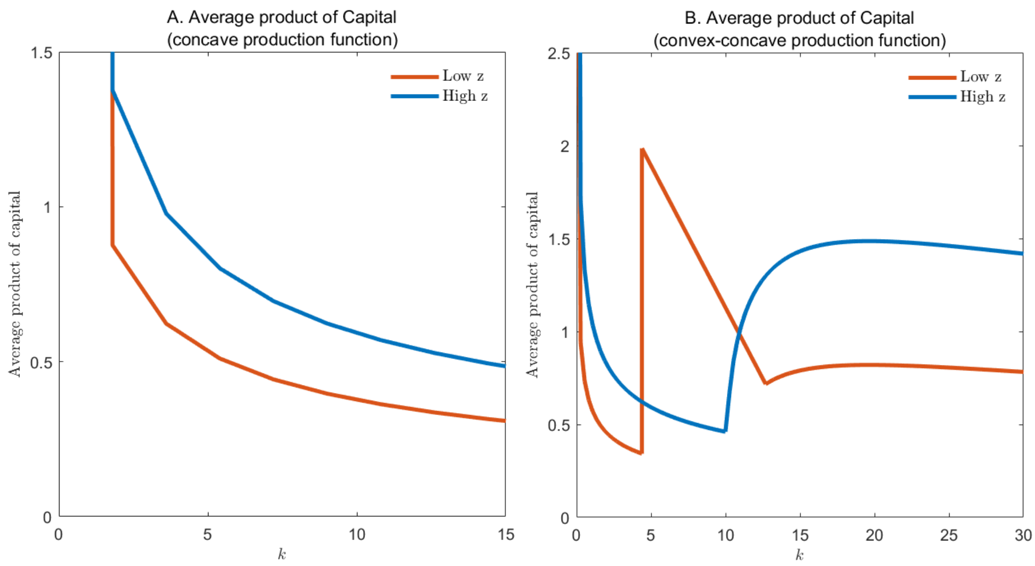
[9] I assume κ = 10, $\phi = 5$, α = .35, β=.45, $A_u = 1$, and $A + p$=2.5.

Figure 7: Savings policy functions



I show that departing from the neoclassical model by using a non-concave production function such as this can rationalize the empirical finding of higher firm savings in the presence of easing financing constraints. This is because there are jumps in the savings policy function due to the kink in the production function. Figure 7 shows savings policy functions for two models in which everything except the production function is the same. Panel A plots the savings policy function for a model with a strictly concave production function, like in section 2. Panel B uses the convex-concave production function specified above. An entrepreneur's savings monotonically decline if her production function is strictly concave, as long as she is sufficiently wealthy. However, in the case of a convex-concave production function, this is not guaranteed. The savings policy function in panel B shows a jump in savings when the entrepreneur switches from the low productivity to the high productivity technology.

Figure 8: Average product of capital



As mentioned in the previous section, estimating production functions and marginal products is tricky, and neither is it the main purpose of this paper. Therefore, like in the empirical section, in Figure 8, I compare the *average* product of capital for low and high productivity entrepreneurs in an economy with a strictly concave production function (panel A) and a convex-concave production function (panel B). While the APK is monotonically declining in the left panel, it is characterized by discrete jumps in the case of a convex-concave production function. As entrepreneurs switch from low to high productivity technology, their average product of capital jumps sharply before declining as they expand and exploit the diminishing returns of the high productivity technology, f_p.

This setup, with a convex-concave technology, provides one framework to interpret the empirical findings in section 6, where firms in liberalized industries are seen to increase their savings to profit ratios and where marginal products of capital are not falling despite a large and statistically significant expansion in the capital stock of treated firms. As mentioned in section 1, the concavity of the production has important implications for the amount and persistence of misallocation. Therefore, the finding that micro firm behavior is not consistent with a strictly concave production function is important.

8 Taking stock and future plans

8.1 New data on firm-level FDI

One of the main directions of future work that I plan to take on this project is to obtain data on firm-level FDI in India. Presently, this data is confidential and has not been shared with any researcher in the past. The data is maintained jointly by the Reserve Bank of India, Mumbai and the Ministry of Commerce and Trade, Government of India, New Delhi. After long discussions with officials, I have obtained an extract of this data and hope to get access to comprehensive administrative data on the universe of firm-level FDI inflows into India from the mid-1990s to the present.

Figure 9 shows a screenshot of an extract of this data. The data contains information on the name of the firm receiving FDI, the name and country of the foreign collaborator, the month of FDI inflow, the amount in US dollars, as well as the equity stake bought by the foreign collaborator.

I hope to obtain this data by the end of June 2021 and plan to digitize it over the summer. Since the data contains names of firms that received FDI, I will, in principle, be able to merge it to the firm-level data in Prowess using some fuzzy merging algorithm. Once this merging is complete, I will know for each firm in my database if and when it raised funds from abroad and how much.

Figure 9: Extract of firm-level FDI data

FOREIGN INVESTMENT & TECHNICAL COLLOBORATION PROPOSALS APPROVED BY RBI
DURING THE MONTH OF MAY, 2000

Sl	NAME OF FOREIGN COLLABORATOR	COUNTRY	NAME OF INDIAN COMPANY	ITEM OF MANUFACTURE	AMT OF FDI APPROVED (% EQUITY)	ROYALTY DOMESTIC (PERIOD)	ROYALTY EXTERNAL (PERIOD)
157	CUPH HOLDING BV NETHERLANDS	NETHERLANDS	H.I. INSPECTIONS INDIA PVT. LTD. MULLA HOUSE 51,MAHATMA GANDHI ROAD MUMBAI Location : GREATER MUMBAI(MUMBAI)(MAHARASHTRA)	TECHNICAL TESTING/ANALYSIS SERVICES	0.00 (51.00)	0.00 (0)	0.00 (0)
158	DRAGOCO ASIA PACIFIC PVT. LTD. 226 PANDAN LOOP SINGAPORE - 128412	SINGAPORE	DRAGOCO INDIA LTD. 144, SEEVARAM FIRST STRET PERUNGUDI CHENNAI-600096 Location : CHENNAI(TAMIL NADU)	MANUF. OF FLAVOURS FOR FOOD AND BEVERAGE INDUSTRY WITH THE PROPOSED TRANSFER OF TECHNOLOGY.	-	3.00 (7)	3.00 (7)
159	STANDARD AG. SWITZERLAND	SWITZERLAND	GLENCARE INDIA LIMITED 806, MEGHDOOT 94,NEHRU PLACE NEW DELHI Location : DELHI(DELHI)	MISCELLANEOUS	10.49 (51.00)	0.00 (0)	0.00 (0)
160	CHINA MOTOR CORPORATION, 11TH FLOOR,2, TUNG HWA SOUTH ROAD, SEC.2, TAIPEI,THE REPUBLIC OF CHINA(TAIWAN).	TAIWAN	PREMIER AUTOMOBILES LTD., LAL BAHADUR SHASTRI MARG. KURLA, MUMBAI, MAHARASHTRA-400070 Location : GREATER MUMBAI(MUMBAI)(MAHARASHTRA)	MANUFACTURE OF MULTI UTILITY VEHICLES FOR PERSONAL TRANSPORT & GOODS	-	2.00 (7)	2.00 (7)
161	SMT MADHU BALA UAE	U.A.E.	POINEER INDUSTRIES LTD. PATHANKOT	FLOUR MILLING	4.70 (11.74)	0.00 (0)	0.00 (0)

This data will be useful for both empirical and theoretical exercises. On the empirical side, I will use this data to go beyond the naïve, intent-to-treat analysis that I have presently conducted in Section 6. As a start, I plan to explore whether fuzzy difference-in-differences designs like the one proposed by De Chaisemartin and d'Haultfoeuille (2018) would be appropriate in my context.

On the theoretical side, data on firm-level FDI will allow me to do a more quantitative exercise. In section 6, I show that after the liberalization of foreign capital markets, firms in treated industries behaved in ways which deviate from the standard neoclassical framework. Even though these firms experience an easing in their financial constraints and expand their capital stock significantly after the policy, they either continue to save at the same rate as before or actually save an even larger proportion of their profits, depending on the definition of savings used. This behavior is opposite to what the standard neoclassical model would predict. With additional data on firm-level FDI flows, I hope to quantify the magnitude of this discrepancy.

This is important because the neoclassical model's prediction of a positive relationship between financial constraints and firm savings is not just qualitative. It predicts that this relationship is quantitatively large, i.e., that financially constrained firms would save aggressively to overcome their constraints and vice versa. The underlying mechanism. i.e., self-financing due to high returns to capital at low wealth levels, is a fundamental characteristic of neoclassical models that feature concave production functions. It is the same reason why these models predict that the speed of convergence in the neoclassical growth model is fairly quick (King and Rebelo, 1993). As noted earlier, Banerjee and Moll (2010) also find very quick convergence of marginal products in an economy which starts off with intensive margin misallocation due to credit constraints.

Since I do not observe how much FDI each firm gets, I am unable to conduct a thorough quantitative exercise to compare my empirical results with the quantitative predictions of a rigorously calibrated model. Once I procure this data however, I plan to do precisely this. While it is challenging to compare reduced form results from regressions that include various fixed effects, I can at least start with a dynamic calibration exercise where I match salient moments from my model to those in the data. For doing this, the ability to measure firm-level FDI is crucial because it will give me a quantitative handle on the extent to which foreign inflow of capital reduces the financial constraints of firms.

8.2 Modeling financial frictions

In my theoretical framework in section 2, I model financial frictions as a collateral constraint on debt. This may seem odd because my policy shock is a shock to a firm's ability to issue fresh equity to investors from abroad. I do this because unlike debt, there is no standard way of issuing equity– it depends on the context and the kind of equity being studied. For this paper, I am concerned with a very specific type of equity:

foreign direct investment. For instance, I do not at the moment know how frequent foreign equity issuance actually is in the firms in my sample. Is it the case that most firms receive FDI only once in their lifespan, or is FDI a more regular source of external finance like debt? This empirical *fact* will determine whether I should model FDI as one-time equity issuance as in Midrigan and Xu (2014) or add it as an annual feature to my model as Covas and Den Haan (2012) do. Therefore for the moment, instead of taking an ex-ante call on the best way to model FDI inflows, I have decided to keep my model simple. The model outlined above, of collateral constraints, is the most standard model in the literature of heterogeneous firms with financial fictions (Buera et al., 2011; Moll, 2014).

Moreover, the model in this paper is meant to derive qualitative results only, to aid intuition and interpretation of the empirical results. Adding equity issuance to this model will not change the qualitative prediction of the model regarding financial frictions and self-financing. For a more quantitative exercise, however, which I plan to do subsequently, I would like to model a firm's financial decisions more realistically.

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A Appendix

A.1 Perpetual inventory method to compute the replacement cost of capital stock

This section provides details of the Perpetual Inventory Method (PIM) used to compute the replacement cost value of capital stock from the historical cost measure of gross fixed assets. Prowess provides Figures for four components of gross fixed assets: land & buildings, plant & machinery, transport & communication equipment, and furniture & social amenities. Investment in time t (I_t) is obtained as the first difference between gross fixed assets (GFA_t^i) of each of these components:

$$I_t^i = GFA_t^i - GFA_{t-1}^i$$

The replacement cost value of each type of capital is then calculated from the PIM formula:

$$P_{t+1}K_{t+1}^i = \frac{P_{t+1}}{P_t}(1 - \delta^i)P_t K_t^i + P_{t+1}I_{t+1}^i$$

where δ^i is the component–specific depreciation rate, and i denotes the components of capital stock mentioned above. The depreciation rates, which have been taken from Das and Erumban (2010) are as follows:

Plant & Machinery	4%
Land & Buildings	1.25%
Transport & Communication	5%
Furniture & Social amenities	10%

Once the replacement cost value is estimated for each component of Gross Fixed Assets, the replacement cost value of total fixed capital assets is then estimated as $P_t K_t = \sum_i P_t^i K_t^i$.

B Tables

Table A1: List of Industries Affected by the 2001 and 2006 Reforms (source: Bau and Matray (2020))

NIC 5-Digit Industry Classification Reform	Year
Manufacture of 'ayurvedic' or 'unani' pharmaceutical preparation	2001
Manufacture of allopathic pharmaceutical preparations	2001
Manufacture of medical impregnated wadding, gauze, bandages, dressings, surgical gut string etc.	2001
Manufacture of homeopathic or biochemic pharmaceutical preparations	2001
Manufacture of other pharmaceutical and botanical products n.e.c. like hina powder etc.	2001
Manufacture of rubber tyres and tubes n.e.c.	2006
Manufacture of essential oils; modification by chemical processes of oils and fats (e.g., by oxidation, polymerization etc.)	2006
Manufacture of various other chemical products	2006
Manufacture of rubber tyres and tubes for cycles and cycle-rickshaws	2006
Manufacture of distilled, potable, alcoholic beverages such as whisky, brandy, gin, 'mixed drinks' etc.	2006
Coffee curing, roasting, grinding blending etc. and manufacturing of coffee products	2006
Retreading of tyres; replacing or rebuilding of tread on used pneumatic tyres	2006
Manufacture of chemical elements and compounds doped for use in electronics	2006
Manufacture of country liquor	2006
Manufacture of matches	2006
Manufacture of rubber plates, sheets, strips, rods, tubes, pipes, hoses and profile -shapes etc.	2006
Distilling, rectifying and blending of spirits	2006
Manufacture of bidi	2006
Manufacture of catechu (katha) and chewing lime	2006
Stemming and redrying of tobacco	2006
Manufacture of other rubber products n.e.c.	2006
Manufacture of rubber contraceptives	2006
Manufacture of other tobacco products including chewing tobacco n.e.c.	2006
Manufacture of pan masala and related products.	2006

C Figures

Figure A1: Event study graphs for the dependent variables in Table 1

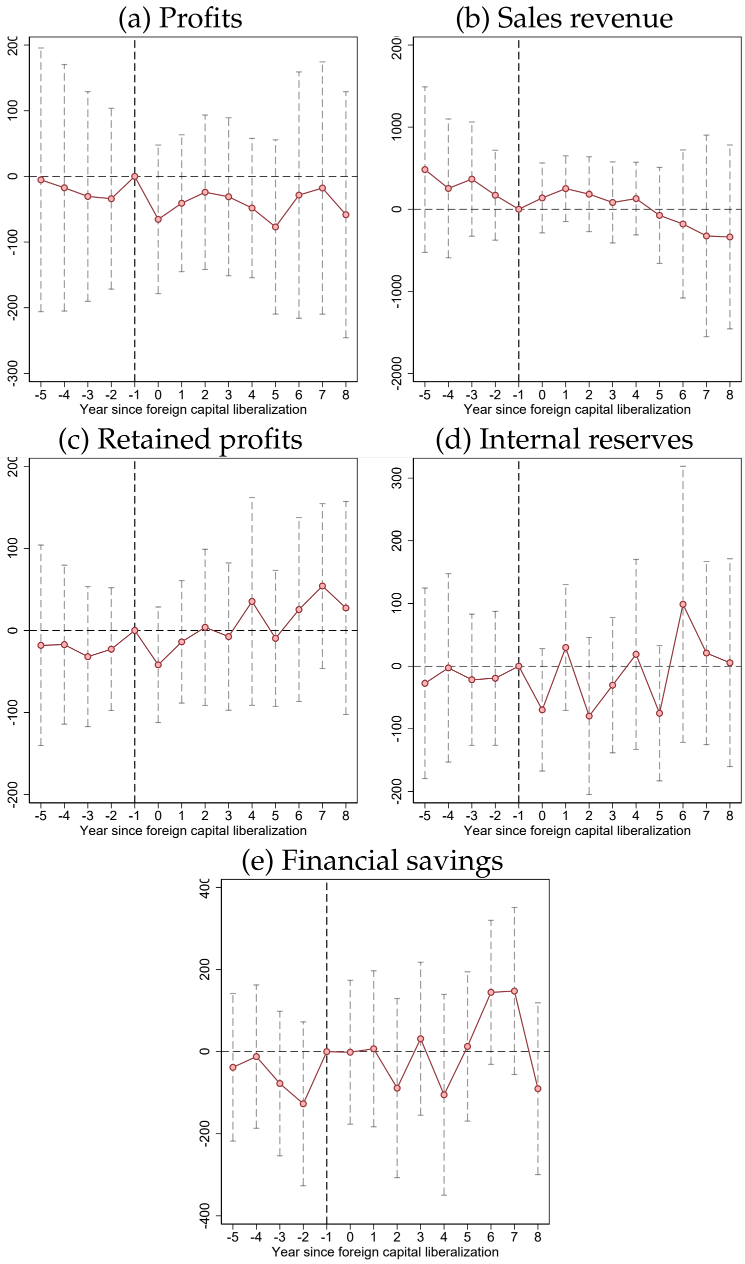

Figure A2: Event study graphs for the dependent variables in Table **??**