Credit Rationing, Risk Aversion, and Industrial Evolution in Developing Countries*

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Abstract

Relative to their counterparts in high-income regions, entrepreneurs in developing countries face less efficient financial markets, more volatile macroeconomic conditions, and higher entry costs. This paper develops a dynamic empirical model that links these features of the business environment to cross-firm productivity distributions, entrepreneurs' welfare, and patterns of industrial evolution. Fit to panel data on Colombian apparel producers, the model yields estimates of a credit market imperfection index, the sunk costs of creating a new business, and various technology parameters. Model-based counterfactual experiments suggest that improved intermediation could dramatically increase the return on assets for entrepreneurial households with modest wealth.

Short title: Credit Rationing, Industrial Evolution

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1. Introduction

An extensive literature finds that entrepreneurs in developing countries face less efficient financial markets, more volatile macroeconomic conditions, and higher entry costs than their counterparts in high income economies.[2,3,4] This paper develops a dynamic empirical model that links these features of the business environment to firm ownership patterns, firm size distributions, productivity distributions, and borrowing patterns.

The model emphasizes several basic effects. First, borrowing constraints force households with modest collateral to either forego profitable entrepreneurial activities or pursue them on an inefficiently small scale. Second, since credit constraints limit households' ability to smooth their consumption streams, those with relatively less tolerance for risk shy away from

[2] Private credit is scarce (as a share of GDP), spreads between borrowing and lending rates are large, non-bank intermediation is relatively unimportant, and equity markets are often almost non-existent. The literature documenting these patterns of financial development is vast; Beck, et al. (2000) provide a cross-country data set that reflects the characteristics mentioned here. Banerjee (2003) surveys the evidence on spreads. Levine (2005) surveys the evidence linking these features of financial sectors (among others) to countries' aggregate growth rates. Djankov, et al. (2007) empirically link the poor performance of credit markets in developing countries to their lack of legal creditor protections and information-sharing institutions.

[3] Loayza, et al. (2007) survey the literature on macroeconomic volatility in developing countries and discuss its causes and costs. Kaminsky and Reinhardt (1999) document patterns of banking and financial crises in developing countries. Tybout (2000) provides additional references and notes that Latin America and Sub-Saharan Africa stand out among the developing countries as the most volatile, but all developing regions do worse than the industrialized countries.

[4] Surveying entry regulations in 85 countries, Djankov, et al. (2002) conclude that "business entry is extremely expensive, especially in the countries outside the top quartile of the income distribution." (p. 25)

business ventures during periods of macro volatility.[5] Finally, in combination with substantial entry costs and a significant spread between borrowing and lending rates, uncertainty about future business conditions creates an incentive for entrepreneurs to continue operating firms that generate sub-market returns. Combined, these effects make firms' survival and growth less dependent upon their owners' entrepreneurial ability, and more dependent upon their owners' wealth and market-wide volatility.

We fit our model to plant-level panel data and macro data from Colombia, obtaining econometric estimates of plant-level profit functions, the sunk cost of creating a new business, and an index of credit market imperfections (inter alia). Then, using our estimated parameters, we simulate industrial evolution patterns under alternative assumptions about credit market imperfections. In particular, we explore the effects of credit market imperfections and volatile macro environments on entry and exit patterns, cross-firm investment patterns, industry-wide productivity distributions, and savings.

The simulations yield a number of findings. First, the credit markets in which small-scale Colombian entrepreneurs operate are subject to severe contract enforcement problems. These problems interact with macro volatility, substantial entry costs, and risk aversion to discourage households with modest wealth from investing in proprietorships—even those with high earnings potential. Second, if enforcement problems were eliminated, many households with limited wealth but high earnings potential would create businesses or expand the ones they own. Also, the option value of remaining in business would fall for firms with low earnings rates, and some of these firms would exit. These effects would increase the welfare level of entrepreneurs with

[5] Volatility can also change the types of capital goods that entrepreneurs invest in, as in Lambson (1991) and Aghion, et al. (2005). Our analysis does not deal with this phenomenon.

low levels of wealth and high productivity firms, who stand to gain the most from more efficient credit markets, by as much as 45 percent. Wealthier households, on the other hand, are not credit constrained and would be relatively unaffected by improvements in credit market conditions. The differential impact across wealth levels of improved enforcement reduces the correlation between entrepreneurs' personal wealth and the size of their firms from 0.85 to 0.38. Finally, since debt allows entrepreneurs to smooth consumption and quickly react to business conditions, credit market imperfections are more costly in more volatile macro environments.

Our study is distinctive in that we econometrically estimate a dynamic structural model of entrepreneurship with uncertainty and endogenous borrowing constraints. However, it shares a focus on entrepreneurship, borrowing constraints and wealth heterogeneity with a number of dynamic general equilibrium models, including Banerjee and Newman (1993, 2001), Aghion and Bolton (1997), Lloyd-Ellis and Bernhardt (2000), Giné and Townsend (2004), Felkner and Townsend (2011), Cagetti and De Nardi (2006), and Buera, et al. (2011). And it resembles Townsend and Ueda (2006) and Greenwood and Jovanovic (1990) in that it characterizes the choices of risk-averse households between a risky business venture that is subject to idiosyncratic shocks and a financial asset that is subject only to market-wide shocks.

The model we develop is also consonant with many of the main messages that emerge from the micro empirical literature on entrepreneurship and credit market imperfections. These include findings that small scale entrepreneurs in developing countries are credit-constrained (Del Mel, et al. 2008; Banerjee and Duflo, 2005; Paulson and Townsend, 2004; Midrigan and Xu, 2014), that wealthy households are more likely to own businesses (Evans and Jovanovic, 1989; Evans and Leighton, 1989; Fairlie, 1999; Quadrini, 1999; Gentry and Hubbard, 2004; Hurst and Lusardi, 2004; Cagetti and de Nardi, 2006), and that the correlation between wealth

and entrepreneurship partly reflects lower absolute risk aversion among the wealthy (Hurst and Lusardi, 2004).

Finally, our paper is related to several empirical models of industry dynamics. These include Cooley and Quadrini's (2001) model of risk-neutral firms' investment behavior with credit constraints (based on costly state verification), Bloom's (2009) model of firms' input choices in the face of convex adjustment costs and uncertainty, Midrigan and Xu's (~~forthcoming~~ 2014) model of establishment dynamics with financing constraints, Buera, et al.'s (2011) model of financial frictions with sector-specific non-convexities, and Buera's (2009) deterministic model of entrepreneurial behavior subject to a leverage constraint.[6]

2. The Model

Several basic assumptions underpin our model. First, securities markets are negligible and households must hold their wealth as bank deposits and/or investments in proprietorships. Second, households can borrow to finance some of their business investments, but their loans must be sufficiently small that they consider default less profitable than repayment. Third, households are forward-looking, infinitely-lived, and risk-averse. Fourth, households are heterogeneous in terms of their ability to generate business income, which is subject to serially correlated, idiosyncratic shocks. Fifth, all firms produce traded goods, so changes in the real exchange rate result in changes in demand for their output. Finally, exchange rates and interest rates evolve jointly according to an exogenous Markov process. We now turn to specifics.

2.1. The Macro Environment

Three macro variables appear in our model: the real exchange rate, *e*, the real lending

[6] Methodologically our paper is also related to Utar's (2008) model of employment dynamics under import competition with firing costs and uncertainty.

rate, r, and the real deposit rate, $r - \mu$. The interest spread $\mu > 0$ is parametrically fixed, so we can summarize the state of the macro economy at any point in time by the vector $s_t = \begin{pmatrix} e_t \\ r_t \end{pmatrix}$, which we assume evolves according to an exogenous Markov process: $\psi(s_{t+1} \mid s_t)$.

2.2. The Household Optimization Problem

Households fall into one of three categories: incumbent owner-households (*I*), potential owner-households (*P*), and non-entrepreneurial households (*N*). Incumbent owner-households currently own firms, and must decide each period whether to continue operating them or exit. Those that exit become non-entrepreneurial households; those that remain in the industry must further choose their output levels, capital stocks, and debt/equity ratios, subject to borrowing constraints. Potential owner households are not currently in the industry, but do have "ideas" of various qualities on which they could base new firms. After assessing the potential earnings streams associated with their ideas, these households decide whether to create a firm in the current period by paying a sunk entry cost and initiating production. Non-entrepreneurial households do not currently operate a firm or have a business idea, so they need only make a consumption/saving decision in the current period. Next period, however, they may be struck with a new idea and become a potential entrant—this happens with exogenously given probability.[7] The possible transitions between the household types are summarized by figure 1.

[Figure 1 about here]

All households are characterized by a constant relative risk aversion (CRRA) utility

[7] An earlier version of this paper ruled out re-entry. This distorted our parameter estimates because some entrepreneurs whose businesses fail eventually get an opportunity to try again, and all entrepreneurs recognize this fact when deciding whether to create a firm or shut one down.

function, $U(c_{it}) = \frac{(c_{it})^{1-\sigma}}{1-\sigma}$, where c_{it} is consumption by household *i* at time *t*. Each period, households choose their savings rates, next-period types (if they are incumbent- or potential-owners), and business investments (if they are incumbent-owners). They make these decisions with the objective of maximizing their discounted expected utility streams, $E_t \sum_{\tau=t}^{\infty} U(c_{i\tau})\beta^{\tau-t}$, subject to borrowing constraints. (Here E_t is an expectations operator conditioned on information available in period *t*, and β is a discount factor that reflects the rate of time preference.) Outcomes are uncertain because the macro economy evolves stochastically, and because owner-households experience idiosyncratic shocks to the return on their business investments.

Non-entrepreneurial households

The optimization problem faced by non-entrepreneurial households is the simplest, since these households only decide how to allocate their current income between consumption and savings. Let a_{it} denote the wealth held by household *i* at the beginning of period *t*, and let its exogenous non-asset income be *y*. Consumption by non-entrepreneurial household *i* in period *t* is $c_{it} = y + (r_t - \mu)\cdot a_{it} - (a_{it+1} - a_{it})$. In the following period, the household becomes a potential entrant household with probability *p*.

In period *t*, non-entrepreneurial household *i* maximizes the expected present value of its utility stream by choosing its savings rate $a' - a_{it}$. The resulting expected present value of its utility stream is

$$V^N(a_{it}, s_t) = \max_{a' \geq 0}\Big[U\big(y + (r_t - \mu)a_{it} - (a' - a_{it})\big) + \beta \sum_{s'} \psi(s' \mid s_t)\Big(pV^P(a', s') + (1-p)V^N(a', s')\Big)\Big] \quad (1)$$

Here V^P (a, s) is the value function for a potential owner household (discussed below), and the constraint $a' \geq 0$ reflects our assumption that households are unable to borrow against their non-asset income.

Incumbent owner households

Owner-households face a more involved optimization problem because they must choose whether to continue operating their proprietorships and—given that they continue—how much of their wealth to hold as investments in their firms. The business income (before fixed costs and interest payments) generated by household *i*'s proprietorship is:

$$\pi(k_{it}, e_t, \nu_{it}),\ \pi_k > 0, \pi_{kk} < 0,\ \ \pi_e < 0,\ \ \pi_\nu > 0, \tag{2}$$

where k_{it} is the firm's stock of productive assets and ν_{it} is an idiosyncratic shock that captures managerial skills and investment opportunities. We assume that ν_{it} evolves exogenously according to the ~~discrete~~ Markov process $\phi(\nu_{it+1} \mid \nu_{it})$ and that it is independent of the macroeconomic state vector s_t.

Several features of the function (2) merit comment. First, business income is decreasing in e because we treat an increase in the exchange rate as an appreciation, which intensifies import competition and reduces the return to exporting. Second, firms' incomes are not affected by the behavior of their domestic competitors because we assume that each firm's product has many substitutes in foreign markets, making the effects of entry, exit or price adjustments by domestic producers insignificant. Finally, diminishing returns to productive assets, $\pi_{kk} < 0$, reflect finite demand elasticities for each product, and may capture span-of-control effects as well.

Owner-households allocate their assets between bank deposits and investments in their businesses. If $a_{it} < k_{it}$ for household *i*, it finances the excess $k_{it} - a_{it}$ with a loan at rate r_t, subject to the no-default constraint (to be discussed below). If $a_{it} > k_{it}$, it holds the balance $a_{it} - k_{it}$ as bank deposits, which yield $r_t - \mu$.[8] Combining these possibilities, the i^{th} household earns or pays out $(a_{it} - k_{it}) \cdot (r_t - \mu D_{it})$ in interest during period *t*, where $D_{it} = 1(a_{it} - k_{it} > 0)$ is a dummy variable indicating whether households hold bank deposits. Accordingly, the incumbent's period *t* consumption is

$$c_{it}^{I} = y + \pi(k_{it}, e_t, \nu_{it}) - f + (r_t - \mu D_{it}) \cdot (a_{it} - k_{it}) - (a_{it+1} - a_{it}) \tag{3}$$

where *f* is the per-period fixed cost of operating a business.

If household *i* continues to operate its business in period *t*, it reaps current utility $U(c_{it}^{I})$ and it retains the option to continue producing next period without incurring entry costs. Alternatively, if the household sells off its productive assets, pays off its debts, and shuts down its firm, it reaps the expected utility stream of a non-entrepreneur, $V^{N}(a_{it}, s_{it})$. Accordingly, the unconditional expected utility stream for an owner-household in state (a_{it}, s_t, ν_{it}) when it is able to borrow as much as it wants at rate r_t to finance its capital investment is:

$$V^{I}(a_{it}, s_t, \nu_{it}) = \max\left[\tilde{V}^{I}(a_{it}, s_t, \nu_{it}), V^{N}(a_{it}, s_t)\right], \tag{4}$$

where

$$\tilde{V}^{I}(a_{it}, s_t, \nu_{it}) =$$

$$\max_{a' \geq 0, k_{it} > 0} \left[U\left(c_{it}^{I}(k_{it}, a_{it}, a', s_t, \nu_{it})\right) + \beta \sum_{\nu'} \sum_{s'} V^{I}(a', s', \nu') \cdot \psi(s' | s_t) \cdot \phi(\nu' | \nu_{it}) \right]$$

[8] Households never borrow to acquire bank deposits because, with $\mu > 0$, this amounts to giving money away to the bank.

Owner-households face a borrowing constraint, however, so they may not be able to attain the expected utility levels described by (1) - (4). Specifically, their choices of *a'* and *k* must satisfy:

$$\tilde{V}^{I}(a_{it}, s_t, \nu_{it}) \geq V^{N}(\theta k_{it}, s_t) \ , \tag{5}$$

where $\theta \in [0,1]$ is the fraction of their assets that owner-households are able to keep in the event that they default. This constraint—which appears in Banerjee and Newman (1993, 2001) and Cagetti and De Nardi (2006), among others—follows from the assumption that lenders are perfectly informed about the current profitability of household *i*'s firm, ν_{it}, but they are unable to observe the uses to which household *i* puts its loans. It states that defaulting owner-households, whose welfare matches that of a non-entrepreneurial household with assets θk_{it}, do worse than owner households in the same (a_{it}, s_t, ν_{it}) state who continue to operate their businesses and pay their debts. [9] The limiting cases of $\theta = 0$ and $\theta = 1$ correspond to perfectly enforceable debt contracts and costless default, respectively. We interpret θ to capture all of the monetary costs of defaulting, including possible punishments.

This formulation captures two senses in which household wealth accumulation leads to business financing. First, wealthy households satisfy (5) at higher borrowing ($k_{it} - a_{it}$) levels because they stand to lose more in the event of default. That is, household wealth acts as collateral. Second, when $a_{it} < k_{it}$, the wedge μ between the borrowing and lending rate makes

[9] Borrowing constraints of this type allow one to characterize contract enforceability problems without introducing costly state verification. They thus make numerical solution of the model relatively quick, and thereby facilitate econometric estimation.

business assets more attractive than bank deposits as a use for new savings.[10]

Potential owner-households

We conclude our description of our model by characterizing industry entry. Each period, an exogenous number of households develop new business ideas and become potential owner-households. Households' ideas determine their initial profit shocks, which are independent and identically distributed across potential-owners according to the density $q_0(\nu)$.

Taking stock of its particular ν draw, each household decides whether to create a new firm by paying start-up costs, F, and purchasing an initial capital stock k_{it}.[11] At the same time, households that create new firms choose their savings levels, $a' - a_{it}$, subject to the relevant no-default constraint. The return to entry when savings and capital stocks are chosen optimally, given the household's productivity draw, is equal to

$$(6)\quad \tilde{V}^P(a_{it}, s_t, \nu_{it}) = \max_{a' \geq 0, k_{it} > 0} \left[U\left(c^I_{it}(k_{it}, a_{it}, a', s_t, \nu_{it}) - F\right) + \beta \sum_{\nu'} \sum_{s'} V^I(a', s', \nu') \cdot \psi(s' | s_t) \cdot \phi(\nu' | \nu_{it}) \right]$$

subject to

[10] Midrigan and Xu (2014) consider a capital market constraint in which firms must borrow to cover both labor and capital costs, and they assume that borrowing cannot exceed a fixed ratio to the entrepreneur's assets. As a result, more productive entrepreneurs are more likely to be credit constrained. In our formulation, the amount that an entrepreneur can borrow against assets depends on the expected value of the project. This allows us to capture the effect of varying macroeconomic conditions on firms' ability to borrow. More able entrepreneurs will want to borrow more, but will also have a lower incentive to default because of their higher future returns.

[11] In the previous version of this paper we assumed that entrepreneurs did not learn their productivity until they had paid the cost of creating a new firm. We switched to the current specification because it generates selection on profitability at the entry margin, which seems more realistic. Also, since it increases the set of firms with high productivity and low assets, it creates a larger role for credit constraints.

$$\tilde{V}^P(a_{it}, s_t, \nu_{it}) \geq V^N(\theta k_{it}, s_t).$$

Potential entrant households that choose *not* to enter return to being non-entrepreneurial households and allocate their current income of $y + (r_t - \mu)a_{it}$ between consumption and asset accumulation in the form of bank deposits. The window for exploiting their particular idea closes, and the quality of their future business ideas is independent of their current ν. Accordingly, potential entrant households create new proprietorships when

$$\tilde{V}^P(a_{it}, s_t, \nu_{it}) \geq V^N(a_{it}, s_t). \tag{7}$$

Note that they might choose not to enter for two reasons. One is that the current (s, ν) realization makes entry unattractive. The other is low initial wealth holdings.

The expected value of being a potential entrant, prior to drawing one's initial profit shock, is

$$V^P(a_{it}, s_t) = \sum_{\nu} \max[\tilde{V}^P(a_{it}, s_t, \nu), V^N(a_{it}, s_t)]\varphi^P(\nu) \tag{8}$$

where $\varphi^P(\nu)$ is the density function for ν among potential owner households.. Since a non-entrepreneurial household has a probability p of having an idea and becoming a potential entrant, the expected return in (8) enters the return to a non-entrepreneurial household in (1).

In the absence of borrowing constraints, the functional equations (1), (4), (6), and (7) are a contraction mapping that yield unique solutions V^{N*}, V^{P*} and V^{I*} for the value functions of the respective household types with perfect capital markets. When the borrowing constraint (5) is imposed, however, the functional equations are no longer a contraction because the value functions appear in the constraint. Multiple equilibria can arise because beliefs may be self-fulfilling: the expectation of a low value for the firm will make the no default constraint more binding, and will reduce the amount the firm can borrow. To deal with this potential

multiplicity, we first solve this problem for the case of perfect capital markets. We then use the first best value functions (V^{N*}, V^{P*}, V^{I*}), as starting points for value function iteration of the system where the borrowing constraint is imposed. The limit of this sequence is a solution to this optimization problem. We verified that this solution yields the highest payoff to entrepreneurs, given the equilibrium payoff to non-entrepreneurial households.[12]

3. Industry Evolution

The solution to the owner-household optimization problem (3)-(5) yields a policy function $\tilde{a}^I(a_{it}, s_t, \nu_{it})$ for incumbent households' asset accumulation, and an indicator function

[12] Rustichini (1998) examines a class of incentive constrained dynamic programming problems where the sequence of value functions generated by this procedure is non-increasing, and shows that the limit of this sequence is the solution to the dynamic programming problem with the highest payoff. In our problem, it is not guaranteed that the sequence of value functions will be non-increasing because the value functions appear on both sides of the incentive constraint in (5). To address this concern, we took a two stage approach. In the first stage, we did a value function iteration for the household payoff functions starting from the first best value functions. This process converged to value functions that we denote (V_1^N, V_1^P, V_1^I). In the second stage, we repeated the process from the first stage, but using the fixed payoff function V_1^N to calculate the payoff to a deviating entrepreneur who does not repay the loan (on the right hand of (5)). Since this payoff function is constant throughout the iterative process, the sequence of value functions in the second stage will be non-increasing. The limit of the sequence of value functions in the second stage, which we denote (V_2^N, V_2^P, V_2^I), represents the highest payoff attainable to households when V_1^N is the deviation payoff. If $V_1^j = V_2^j$ for j = (N, P, I), then our first stage value functions represent payoff that are not Pareto dominated by any other equilibrium payoff. The difference between the first and second stage value functions satisfied the convergence criterion for the potential entrant households and non-entrepreneurial households. For the incumbent household value functions, the difference exceeded the convergence criterion due to differences on two grid points.

$\chi^I(a_{it}, s_t, \nu_{it})$ that is equal to one for those households that do not sell their businesses. Similarly, the solution to the potential entrepreneur's optimization problem (6)-(7) yields a policy function $\tilde{a}^P(a_{it}, s_t)$ for potential owner-households' asset accumulation and an indicator function $\chi^P(a_{it}, s_t)$ that is equal to one for those potential-owner households that create new firms. Once the model's parameters have been estimated, these policy functions provide the basis for simulations discussed in section 4 below.

3. Fitting the model to data

Our estimation strategy is dictated partly by data availability. Matched employer-employee data are generally not available in developing countries, and the household surveys that do exist are not very informative about the businesses that entrepreneurial households operate. We therefore estimate our model using macro time series and plant-level panel data.

More precisely, we fit our model to data on Colombian apparel producers and the exchange rates and interest rates they have faced. The Colombian macro environment suits our purposes because it exhibited major changes in real exchange rates and real interest rates during the past 25 years, and thus should have induced the type of variation in behavior that is needed to identify parameters. The Colombian regulatory environment suits our purposes because creditors have limited rights to seize collateral in this country, and bureaucratic barriers to entry are substantial.[13] Finally, the apparel industry suits our purposes because apparel is highly tradable

[13] The World Bank (2008) gives Colombia a score of 2 on a 10-point scale for the strength of the legal rights enjoyed by its creditors. Out of 178 economies, including 24 OECD "benchmark countries," this study ranks Colombia 84th in terms of credit access. In terms of "ease of starting a business" it ranks Colombia 88th in the world. More specifically, the Bank reports that "it requires 11 procedures, takes 42 days, and costs 19.32 percent of GNI per capita to start a business in Colombia." (p. 10).

and because its minimum efficient scale is relatively low. Tradability is necessary if prices are to be determined in global markets, as the model presumes, and modest scale economies are necessary to ensure monopolistic competition and large numbers of closely-held firms.

3.1. Estimating the Markov process for macro variables

To estimate the joint transition density for interest rates and exchange rates, $\varphi(s_{t+1} \mid s_t)$, we use the longest quarterly s_t series available, which spans the period 1982I through 2007II. As figure 2 demonstrates, this period began with several years of high interest rates and a strong peso; thereafter, the exchange rate regime collapsed, triggering a major devaluation and a modest reduction in ~~in~~ the real lending rate.[14] After 1990 the exchange rate gradually regained strength while lending rates rose. But going into the new century, both variables headed downward once again.

[Figure 2 about here]

These trajectories suggest that a regime-switching model might do a good job of approximating the transition density, $\varphi(s_{t+1} \mid s_t)$. Such models presume that the time series of interest obeys different vector autoregressions (VARs) at different points in time, with switches

[14]Kaminsky and Reinhart (1999) document similar patterns in their study of 20 crisis-prone countries: periods of appreciation and low interest rates are followed by periods of depreciation with higher interest rates. In the Colombian context, the major changes in the macro environment reflected associated changes in global coffee prices, global oil prices, international credit conditions, and Colombian policy decisions. For descriptions of these shocks and the associated policy responses, see Edwards (2001), Garcia and Jayasuriya (1997), and Partow (2003).

between the VARs governed by a function to be estimated. [15] Some switching models treat the probabilities of regime changes as exogenous, some treat these probabilities as a function of exogenous variables, and some treat regime changes as triggered by the movement of an element of the VAR across a threshold. We opt for the latter type of model, known as a "self-exciting threshold autoregression" (SETAR), because it allows the probability of a regime change to build when macro conditions are unsustainable, as for example, when exchange rate policy leads to an increasingly strong currency. Also, unlike the second type of switching mentioned above, the SETAR model allows the triggering variable itself to switch processes.

[Table 1 about here]

To implement the SETAR model, we assume the economy is in one of two macro regimes at any point in time. When regime $m \in \{1,2\}$ prevails, s_t evolves according to $s_t = \beta_0^m + \beta_1^m s_{t-1} + \upsilon_t^m$, where $E\left(\upsilon_t^m \upsilon_t^{m\prime}\right) = \Sigma^m$. Regime switches are triggered when one of the elements of the vector *s*—the exchange rate, in our case—crosses an estimated threshold value.

Estimates of this specification are reported in Table 1. They imply that the economy is in regime 1 when the log of the real exchange rate is below 4.65, and in regime 2 otherwise. Also, the point estimates imply stable processes in both regimes, but real interest rates are substantially higher in

[15] Applications of regime-switching models to exchange rates include Engel and Hamilton (1990) and Bollen, et al. (2000). Applications to interest rate processes include Gray (1996). We are unaware of papers that apply switching estimators to the joint evolution of exchange rates and interest rates, although Chen (2006) estimates an exchange rate switching model in which the interest rate affects the probability of a regime switch but does not enter the VAR directly. The methodology for estimating multivariate switching models is nonetheless well developed (e.g., Clarida, *et al*. 2003).

the second regime, and the peso tends to be weaker. [16] Finally, simulations of the estimated SETAR show that the variance of the exchange rate process is similar in both regimes, while the variance of the interest rate process is higher in regime 2. Thus, other things equal, reliance on business income will make households prefer regime 2, while indebtedness and risk aversion will make households prefer regime 1. We examine the question of which effect dominates for different types of households in section 4 below.

It remains to estimate the spread between the lending rate and the deposit rate, μ. We identify this parameter as the mean difference between these two series over the sample period: μ = 0.069. This figure is not unusual for Latin American economies, but it is several percentage points higher than the spreads typically found in high-income countries (Beck et al, 2000).

3.2. Estimating the profit function

To estimate the operating profits function, $\pi(k_{it}, e_t, \nu_{it})$, and the transition density for profit shocks, $f(\nu_{it+1} \mid \nu_{it})$, we use Colombia's Annual Survey of Manufacturers. This longitudinal data set covers all establishments with at least 10 workers (including unpaid and temporary employees) and describes an average of 991 establishments per year during our sample period, 1981-91. Among other things it provides information on each plant's revenues, capital stocks, variable input costs, and debt service payments (from which we impute borrowing levels).

[Table 2 about here]

[16] The p-value for the null that data were generated by a single regime is 0.0009. We have not performed unit root tests. Caner and Hansen (2001) develop unit root tests for univariate threshold autoregressions, but we are unaware of tests for the case of vector autoregressions.

Some key features of the data are summarized in Table 2. First, most plants are quite small. In the lowest quintile, the average value of fixed capital stocks is only $US 5,051, and even in the top quintile the average producer has less than half a million dollars worth of fixed assets (column 1). These figures reflect the very simple technologies involved in small-scale apparel production.[17] Second, the capital intensity of production increases dramatically with establishment size (column 2). Interpreted through the lens of our model, this reflects credit rationing among the smallest producers, which forces them to respond to positive demand shocks mainly by adding labor. Third, and consistent with this interpretation of the capital-labor ratios, small producers have very high levels of income per unit capital (column 6). [18] Fourth, while more than one-third of the smallest quintile producers carry no debt at all (column 5), debt per unit capital is highest among small firms (column 3). [19] This is not because small firms borrow

[17] The small figures may also reflect understatement due to historic cost bookkeeping—more on this later.

[18] While the ratio 22.4 may seem too big to be credible, several considerations should be borne in mind. First, the balance sheets of the 230 apparel producers who reported to Colombia's Superintendency of Businesses in 1995 show that the median ratio of fixed capital to total assets was only 0.145. This reflects the relatively large role of inventories, trade credit and cash reserves among apparel firms. (All firms with total assets valued at greater than 20,000 times the monthly minimum wage must report their financial statements to the Colombian Superintendency of Business; a handful of additional firms also report voluntarily.) Second, assuming a Cobb-Douglas technology, the marginal return to capital is the average return weighted by the elasticity of output with respect to capital. Finally, very high returns on capital at micro enterprises are commonly found in developing countries (Banerjee, 2003; McKenzie and Woodruff, 2006; De Mel, et al., 2008).

[19] This finding stands in contrast to Arrellano, et al.'s (2010), probably because most Colombian apparel producers are below the size range covered by the Amadaeus data set they use. Note that the debt to fixed capital ratio doesn't fall with capital above the second quintile. Among the 230 apparel firms reporting financial statements to the Colombian Superintendency of Business, 190 of which fall in the largest size quintile in Table 2, we do find a

more than their larger counterparts; rather, it reflects their very low physical capital intensity. It may also reflect higher interest rates among small producers, since we must infer their debt levels as their total interest payments divided by the market lending rate. Finally, despite their apparent high average returns, small firms are relatively likely to exit (column 7), and their gross investment rates are relatively low (column 5).

To interpret these patterns in the context of our model, we next use these data to estimate the profit function. First, let the production function for firm *i* be $Q_{it} = \exp(u_{it}) \cdot k_{it}^{\alpha} \ell_{it}^{1-\alpha}$, where Q_{it} is physical output, u_{it} is a productivity index, and ℓ_{it} is an index of variable input usage—labor, energy, and materials. Next, assume that each firm sells a single differentiated product in the global marketplace, where it faces a demand function of the form $Q_{it}^{d} = A_{it} p_{it}^{-\omega}$. Here $\omega > 1$ is the elasticity of demand and A_{it}, which is exogenous from the perspective of individual producers, collects all market-wide and idiosyncratic forces that shift demand for the i^{th} firm's product.[20] Finally, let the i^{th} firm face exogenous price w_{it} for a unit bundle of variable inputs, and assume that it chooses the associated profit-maximizing quantity and output price.

Given these assumptions, operating profits are:

$$\pi_{it} = \max_{\ell_{it}} \left\{ A_{it} \left[\exp(u_{it}) k_{it}^{\alpha} \ell_{it}^{1-\alpha} \right]^{(\omega-1)/\omega} - w_{it} \ell_{it} \right\},$$

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positive correlation (0.16) between log assets and log leverage. (Figures are based on 1995, the earliest year for which data were available.)

[20] This characterization of demand is consistent with CES preferences over product varieties, frictionless trade, and the assumption that each firm supplies an insignificant fraction of the global apparel market.

and at the optimal variable input usage, we can write profits as $\pi_{it} = G_{it} - C_{it}$, where gross revenues ($G$) and variable costs ($C$) are determined by:

$$G_{it} = \tau^{(1-\alpha)(\omega-1)/\kappa} A_{it}^{1/\kappa} \exp\left(\frac{u_{it}(\omega-1)}{\kappa}\right) w_{it}^{(\alpha-1)(\omega-1)/\kappa} k_{it}^{\alpha(\omega-1)/\kappa}, \tag{9a}$$

$$C_{it} = \tau^{\omega/\kappa} A_{it}^{1/\kappa} \exp\left(\frac{u_{it}(\omega-1)}{\kappa}\right) w_{it}^{(\alpha-1)(\omega-1)/\kappa} k_{it}^{\alpha(\omega-1)/\kappa} \tag{9b}$$

Here the parameters $\kappa = \alpha(\omega-1)+1$ and $\tau = \frac{(1-\alpha)(\omega-1)}{\omega}$ are introduced for convenience.

Since the demand shifter (A), the productivity shock (u), and the factor price index (w) are unobservable at the firm level, we treat the profit shifter $A_{it}^{1/\kappa} \exp\left(\frac{u_{it}(\omega-1)}{\kappa}\right) w_{it}^{(1-\alpha)(\omega-1)/\kappa}$ as a Cobb-Douglas function of the real exchange rate and serially correlated firm-specific shocks. Further, to allow for discrepancies between book values and true values, we assume that the log of measured variable production costs ($\ln C^m$) differs from the log of "true" costs ($\ln C$) by the measurement error ε^c.[21] Then, defining $\underline{\nu}(s_t, a_{it})$ to be the minimum profit shock at which a firm continues operating (as implied by the dynamic programming problem in section 2 above), the following system of equations provides a basis for identification of profit function parameters and the transition density $f(\nu_{it+1} \mid \nu_{it})$:

$$\ln G_{it} = \eta_0 + \eta_1 \ln e_t + \eta_2 \ln k_{it} + \nu_{it} \tag{10a}$$

[21] Among other things, this discrepancy reflects the fact that some wages are overhead expenses rather than variable production costs, inventory accounting does not accurately reflect the opportunity cost of inputs, and some costs that are recorded as overhead may vary with production levels. Since sales revenue (G) is straightforward to record and much less subject to measurement error we do not allow for errors in the values of this variable.

(10b) $$\ln C_{it}^{m} = \eta_0 + \ln\tau + \eta_1 \ln e_t + \eta_2 \ln k_{it} + \nu_{it} + \varepsilon_{it}^{C}$$

(10c) $$\nu_{it} = \lambda \nu_{it-1} + \varepsilon_{it}^{\nu}$$

(10d) $$\chi_{it}^{I} = 1[\nu_{it} > \underline{\nu}(s_t, a_{it})]$$

Here $\varepsilon_{it}^{C} \sim N(0, \sigma_{\varepsilon}^{2})$, and $\varepsilon_{it}^{\nu} \sim N(0, \sigma_{\varepsilon^{C}}^{2})$ are assumed to be independent, serially uncorrelated shocks. Note that by equations (10a) and (10b), true operating profits before interest payments may be written as:

$$\pi(k_{it}, e_t, \nu_{it}) = (1-\tau)\exp(\eta_o + \eta_1 \ln e_t + \nu_{it}) \cdot (k_{it})^{\eta_2} - \delta k_{it},$$

where δ is the rate of depreciation.

Selection bias and simultaneity bias complicate estimation of the parameters in (10a)-(10d). The former problem arises because firms that draw very low productivity shocks shut down (by 10d), and the shutdown point is different for entrepreneurs with different asset stocks.[22] The latter problem arises because current period capital stocks are chosen after the current period productivity shock is observed.

The selection problem is readily dealt with using a standard Heckman correction. And in principle, the simultaneity problem could be handled using instrumental variables or a control function approach, as in De Loecker (2011). However, good instruments are not available to us, and our sample period does not include policy changes of the type that allowed De Loecker

[22] Big firms continue operating at relatively low ν_{it} values because the difference between firms' continuation values and their scrap values is increasing in ν_{it} and k_{it} (Olley and Pakes, 1996).

(2011) to implement his estimator.[23] Accordingly, we sidestep the simultaneity problem by taking our estimate of α from Eslava, et al. (2004). This estimate is specific to Colombian apparel producers, but it was constructed using better instruments and more detailed plant-level information than we have access to.[24]

Once α is pinned down, we are able to generate the remaining estimates using our panel of plants. First we construct $\hat{\tau} = \exp\left(\overline{\ln C^m} - \overline{\ln G} - \overline{\ln \varepsilon^c}\right)$, where overbars denote simple averages across all observations in our panel of plants. Next, combining this estimate with Eslava, et al.'s (2004) value for $\hat{\alpha}$, we impute $\hat{\omega} = \frac{1-\hat{\alpha}}{1-\hat{\alpha}-\hat{\tau}}$ and $\hat{\eta}_2 = \frac{\hat{\alpha}(\hat{\omega}-1)}{\hat{\alpha}(\hat{\omega}-1)+1}$. (By the law of large numbers, $\hat{\tau}$ is a consistent estimator for τ, so $\hat{\omega}$ and $\hat{\eta}_2$ are consistent estimators for ω and η_2.) Finally, to estimate η_0, η_1, λ and σ_ϵ, we substitute these values of $\hat{\eta}_2$ and $\hat{\tau}$ into (10a) and (10b), then estimate the system (10a)-(10c) with a selection correction based on (10d). In doing so we sidestep the simultaneity problem that would have arisen if we had treated η_2 as a parameter to be estimated at this stage. Further details appear in the Appendix.

[Table 3 about here]

[23] In a previous draft of the paper (Bond et al, 2010), we used lagged values of endogenous variables as instruments. This GMM estimator proved very sensitive to the exact instrument set and other details, with estimates of η_2 and λ sometimes falling outside the [0,1] interval.

[24] Specifically, Eslava, et al. (2004) were able to include downstream demand measures and regional expenditures in their instrument set. Further, because they had access to plant-level information on intermediate input and output prices, they were able to study production functions directly, rather than base their inferences on revenue functions or cost functions. As an aside, we note that Eslava, et al. (2004) estimate returns to scale of 0.3026 + 0.6634 = 0.964, suggesting our assumption of constant returns is reasonable.

Table 3 reports our estimates of the profit function parameters and the transition density $f(\nu_{it+1} \mid \nu_{it})$. (The depreciation rate is constructed as the simple average across all observations on active firms of current depreciation expenses to capital stocks.) Several comments concerning these estimates are in order. First, our estimate of the elasticity of revenue with respect to capital is consonant with several recent studies. [25] Second, the exchange rate coefficient implies each percentage point of appreciation reduces revenues, variable costs, and profits by about 0.26 percentage points. Third, replacing the exchange rate with annual time dummies (Table 3, column 2) has very little effect on the fit of our revenue and cost equations, nor on the estimated transition density $f(\nu_{it+1} \mid \nu_{it})$. Accordingly, it appears that the exchange rate is a good proxy for the market-wide shocks that apparel producers faced during the sample period. Finally, plant-specific profitability shocks exhibit moderate serial correlation—the root of this process is λ = 0.78, and is highly significant.

3.3. Estimating the remaining parameters

Estimation strategy

A number of parameters remain to be estimated or calibrated. These include the sunk entry cost, *F*, the per-period fixed operating cost, *f*, the credit market imperfection index, θ, the probability that a former entrepreneur encounters a new business opportunity, *p*, the risk aversion parameter, σ, exogenous household income, *y*, the average wealth among new entrepreneurial

[25] For example, Bloom's (2009) analysis is based on an elasticity of revenue with respect to capital in his model is approximately 0.75. Also, calibrating to U.S. data spanning all forms of business, and assuming competitive product markets, Cagetti and Di Nardi (2006) estimate the elasticity of output or revenue with respect to scale at 0.88.

households, $\overline{a_0}$, the variance in wealth among new entrepreneurial households, $\sigma_{a_0}{}^2$, the ratio of total productive assets to fixed capital, ζ and the discount factor, β.[26] The discount factor β is calibrated using the average interest rate implied by the SETAR process: $\beta = 1/(1+0.104) = 0.906$. The risk aversion parameter, σ, is calibrated to 1.5 which is in the range of general consensus among studies that estimate or calibrate this parameter.[27] Finally the exogenous income parameter, *y*, is set equal to the per capital income of Colombia in year 1985. The remaining parameters, hereafter collectively referenced as $\Lambda = (F, f, \theta, p, a_0, \sigma^2_{a_0}, \zeta)$, are estimated using the simulated method of moments.

The logic behind the estimator is as follows. Taking $\pi(k_{it}, e_t, \nu_{it})$, $f(\nu_{it+1} \mid \nu_{it})$ and $\varphi(e_{t+1}, r_{t+1} \mid e_t, r_t)$ as given, one can numerically solve the optimization problem in section 2 at any feasible Λ value. Then, using the resulting policy functions, one can simulate the cross-firm distribution of capital, profits, productivity, and debt for the apparel sector as it evolves through time. Defining $m(\Lambda)$ to be a vector of moments that summarizes these joint distributions and their evolution, the discrepancy between these simulated moments and their sample-based

[26] The parameter ζ is included in Λ for two reasons. First, our survey data only report fixed capital stocks, while conceptually, *k* includes all productive assets. Second, we want to allow for the possibility that fixed capital stocks are themselves systematically mismeasured because of historic cost accounting and/or inaccurate depreciation rates.

[27] We set σ=1.5 on the basis of Kydland and Prescott (1982), Hildreth and Knowles (1982), Attanasio, et al. (1999), and Cagetti and DeNardi (2006), who report similar estimated or calibrated values of the relative risk aversion parameter . These studies all use US data; we are not aware of econometric estimates of this parameter for developing countries. While our model in principle provides sources of identification for σ, we opted to calibrate this parameter, since we do not observe household-level consumption data.

counterparts, $\overline{m}$, can be can measured as $\mathrm{X}(\Lambda) = \left(\overline{m} - m(\Lambda)\right)' W \left(\overline{m} - m(\Lambda)\right)$, where $W = \left[E\left(\overline{m} - m(\Lambda)\right)\left(\overline{m} - m(\Lambda)\right)'\right]^{-1}$ is the efficient weighting matrix. Our estimator is $\hat{\Lambda}$ = arg min $\mathrm{X}(\Lambda)$.

We obtain $\hat{\Lambda}$ by minimizing $\left(\overline{m} - m(\Lambda)\right)' W_0 \left(\overline{m} - m(\Lambda)\right)$, where W_0 is the inverse of the variance-covariance matrix of the data moments, and is calculated by block bootstrapping the actual data with replacement. Then we construct the efficient weighting matrix as $W=[(1+1/S)\Omega]^{-1}$, where Ω is the variance-covariance matrix of the simulated moments and S denotes the number of simulations.[28] Standard errors are then constructed using partial derivatives and the efficient weighting matrix.

Several issues arise in simulating $m(\Lambda)$. First, we must discretize the state space involved in order to use standard solution techniques for solving firms' dynamic optimization problems. For the macro variables and the profit shocks, which are jointly normally distributed, we apply Tauchen and Hussey's (1991) quadrature rules to the estimated transition densities.[29] For capital stocks and asset values, we create a discrete grid based on observed distributions.[30] Second, we

[28] We use S=20 with each of these panels of firms having independent draws of macro shocks. Lee and Ingram (1991) show that variance-covariance matrix of simulated moments is $(1/S)^* \Omega$ under the estimating null hypothesis. To construct Ω using the first stage estimates, we generate new sets of simulations where we draw random macro series for each of the sets. Excluding the burn-in period, the number of years in these simulations is equal to the number of years in the sample data.

[29] In the case of macro variables, we also must convert quarterly transition probabilities to annual transition probabilities by compounding the former.

[30] We used 75 discrete points for capital and 85 discrete points for asset values. To make the model solve quickly

need an algorithm for finding $\arg\min X(\Lambda)$. The function $X(\Lambda)$ is neither smooth nor concave, so gradient-based algorithms fail to identify global minima. We therefore use simulated annealing and pattern search algorithms, repeated using different initial values to ensure robustness. Third, we must construct an initial cross-household distribution for the profitability shocks, ν_{it}. We base this distribution on the steady state distribution for the profitability shocks from our estimated profit function. Fourth, since the data set does not report firms' borrowing levels, we must impute total debt for each observation. We do so using total interest payments (which are reported) divided by the market lending rate. Finally, it is necessary to make some assumptions about the number of households that might potentially start new apparel firms in each period. We assume that in the initial period there are 300 owner-households, and that 200 new households appear in the population of potential entrepreneurs each period. These figures essentially serve to fix the number of active firms.[31]

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enough for econometric estimation, we use 10 discrete points for the exchange rate, 10 for the interest rate, and 6 for the profit shocks. There is a little sensitivity in the solution to the capital and asset discretization, but qualitatively the solution does not change.

[31] Let I_0 be the number of owner-households in period 0, and let N be the number of new households we add to the population each period. Then if the fraction of new households that creates firms is e and the fraction of owner-households that shuts down its firms every period is x, the population of owner-households in period t is $I_t = I_0(1-x)^t + eN\left(\frac{1-(1-x)^t}{x}\right)$. Thus, with stable rates of entry and exit, the current population approaches eN/x as $t \to \infty$, and the size of the initial population becomes irrelevant. Similarly, the asymptotic entry rate and exit rate depend only on e and x. Experiments show that, holding other parameters fixed, changes in the number of new potential entrants per period have very little effect on the simulated moments, and thus on the estimated parameters.

[Table 4 about here]

Moments

The moments we use to estimate Λ are reported in Table 4, juxtaposed with their simulated counterparts, $m(\widehat{\Lambda})$. Overall, the model does a good job of replicating the main features of our panel of apparel firms. In particular, the simulated moments nicely match firm turnover rates, the log capital distribution (mean and variance), the degree of persistence in log capital, and the association between operating profits and capital stock growth. Other simulated moments match their sample-based counterparts less well. These include the log operating profit distribution (mean and variance), the correlation of log capital with lagged log operating profits, and the average growth rate in capital stocks. A likely explanation for this result on growth is that the sample period is not long enough to include a representative sampling of years under the different regimes. (Note that firms shrink on average during the sample period.) Since the model generates cross sectional distributions that are consistent with the long-run ergodic processes of its endogenous variables, it cannot match all features of a time period that over-represents one regime or the other.

While all moments influence our estimates of all parameters, it is worth commenting in general terms about which moments are most useful for identifying particular elements of Λ. First, moments that characterize the joint distribution of debt, capital, and profits are important for the identification of the credit market imperfection parameter, θ. Specifically, our model implies that firms with high marginal products of capital are rationed, so the gap between the amount of observed debt and the amount that would have driven the marginal product of capital down to the lending rate suggests the severity of the credit constraint. Our estimate of θ is also influenced by the degree to which capital stocks and productivity levels co-vary across firms and

through time—the weaker the association, the more important rationing must be.

Second, entry/exit rates are central to the identification of start-up costs (F), and the probability that a new business opportunity will arrive (p). Most obviously, firm turnover is negatively related to start-up costs, and positively related to the probability of new opportunities, other things equal. While reductions in F and increases in p both lead to increased turnover, reductions in F do so by encouraging potential-owner households with marginally profitable ideas to start a business.[32] On the other hand, high p values imply a new business opportunity will probably arrive in the near future, and thereby encourage entrepreneurs with poorly-performing firms to shut them down. Thus the average profitability of incumbents tends to rise with p and the dispersion in profitability tends to fall. Similarly, $corr(\ln k_{it}, \ln k_{it-1})$ and $corr(\ln k_{it}, \ln \pi_{it-1})$ should both fall when p increases but rise when F declines. The reason is that both correlations increase when firms are credit rationed, and unlike high p values, low F values make such firms relatively common. (That is, low F values increase the portion of incumbent producers with modest profits and wealth.) Finally, additional identification for F, p, and f comes from the joint distribution of operating profits and profit shocks (π and υ) among entering versus incumbent firms. This is because, from the perspective of a potential entrepreneur, the present value of a firm's lifetime earnings must cover both annual fixed costs and one-time sunk start-up costs. But once a firm is established, it will continue to operate so long as the expected stream of net operating profits exceeds the value of being a non-entrepreneurial household.

It remains to discuss the nuisance parameters. First, we assume the wealth distribution

[32] This property obtains because we treat Colombian producers as constituting an insignificant fraction of the global apparel market. Thus, unlike in Hopenhayn's (1992) model, reductions in entry costs do not increase competitive pressures on incumbent firms, inducing the weakest to exit.

among potential entrants is lognormal, so that wealth distribution among entrants is determined solely by the entry policy $\chi^P(a_{it}, s_t)$ and the parameters $(\bar{a}_0, \sigma^2_{\bar{a}_0})$. Thus the distribution of wealth among new entrants—implied by their capital stocks and leverage—is key to the identification of $\bar{a}_0$ and $\sigma^2_{\bar{a}_0}$. Second, the factor of proportionality between firms' fixed capital stocks and their total productive asset stock (ζ) is identified by the joint distribution of operating profits and fixed capital stocks. This distribution is informative about ζ because at given fixed capital stocks, larger values of ζ are associated with lower values of the marginal revenue product of capital: $\pi_k(k, e, \nu) = \pi_k(\zeta \cdot k^0, e, \nu)$. Further, the marginal revenue product must be at least as high as the deposit rate, *r*, for all firms and it must match *r* exactly for not rationed firms. Of course, ζ also absorbs any systematic tendency for the data to understate fixed capital stocks. Such understatements may be due to historical cost of bookkeeping in the presence of inflation, or they may reflect official depreciation rates that understate the useful life of capital goods.

[Table 5 about here]

Parameter Estimates

Table 5 reports Λ estimates, their standard errors, and asymptotic *z* ratios. Those that are not unit-free are expressed in thousands of 1977 Colombian pesos. It is convenient to discuss them in blocks corresponding to our discussion of identification above.

First, the estimated credit market imperfection index ($\hat{\theta} = 0.982$) is close to unity, implying that creditors view themselves as unable to seize collateralized assets in the event of default. Put differently, creditors view households as capable of absconding with nearly the entire value of their firms' productive assets if they choose to do so. One should bear in mind that, since θ is identified by the borrowing levels of firms at different (υ, *k*) combinations, it will tend toward unity whenever the data indicate that borrowing levels are low at small, highly

profitable firms. Hence, although information asymmetries and costly state verification are not part of our model, they may well help explain the large θ value that we estimate. In any case, our finding is consistent with the World Bank's (2008) assessment that there are severe enforcement problems in Colombian credit markets (refer to footnote 12). Further, as the simulated moments indicate, the model does a reasonably good job of explaining the borrowing patterns observed in the data. One might question why lenders extend credit to anyone under this parameterization of the model, given their inability to seize the assets of defaulting entrepreneurs. The explanation is that by not defaulting, borrowers keep open the option of operating a business in the future without incurring entry costs.

Next consider the parameters most closely related to entry and exit patterns. Sunk entry costs (F) amount to 605,880 thousand pesos, or $US 41,000—roughly the value of the fixed capital stock for a firm of in the median size quintile (Table 2).[33] Entry costs reflect the bureaucratic costs associated with creating a new firm, capital installation and removal costs, and any customizing of equipment and facilities that does not add to their market value. Their magnitude seems plausible, given the finding that bureaucratic costs alone amounted to 19 percent of Colombian per capita income in 2007 (World Bank, 2008).[34] Fixed costs (f) are estimated to be 60,500 1977 pesos, or $US 4,100. These expenditures are incurred every year, regardless of production levels; they include various overhead expenses like insurance and marketing. Finally the probability that a non-entrepreneurial household receives new business

[33] In 1977, there were 46.11 pesos per dollar. Also the 1977 U.S. GDP deflator was about 32 percent of its 2012 value. We use these two statistics to translate 1977 Colombian pesos into current (2012) U.S. dollars.

[34] By way of crude comparison, Hurst and Lusardi (2004) report that in 1984 the median start-up equity investment among manufacturing business entrepreneurs in the United States was $47,300.

opportunity is p = 0.453. Thus, according to our estimates, about one half of the entrepreneurs who abandon their businesses get an opportunity to try again within the next year.

Third, our mean wealth estimate is $\bar{a}_0$ = 3,179,700 in 1977 pesos, or $215,500 in current dollars. Compared to our entry cost estimate, this figure suggests that the typical new entrepreneur need not borrow in order to create a business. However, start-up costs do not include the cost of productive assets and there is significant variation in new entrepreneurial wealth around this mean (σ_{a_0} = $US 23,000). Thus many households that create businesses must take on significant debt to do so.

Finally, our estimated ratio of total productive assets to fixed capital is ζ=27.66. There are several explanations for the large value of this figure. First, as noted in footnote 15, inventories and working capital are relatively important for apparel producers. In fact, among producers reporting their financial statements to Colombia's Superintendency of Businesses, the median ratio of total to fixed assets is 6.89. Since roughly three-quarters of the firms in our sample are too small to report to the Superintendency, it is likely that they are even less dependent upon fixed capital. Second, annual inflation rates averaged more than 20 percent in Colombia during the 1980s, so historic cost accounting led to considerable understatement of the current market value of those capital goods purchased in the past. Finally, the depreciation rates used for accounting purposes may have understated the useful life of capital goods. The role of ζ in our model is to absorb the net effect of all of these sources of discrepancy between firms' true asset stocks and their reported fixed capital.

4. Industry Structure, Wealth Distributions and Credit Market Imperfections

Given all of the parameter estimates discussed above, we can now use simulations to

answer three basic questions. [35] First, how might industry and household characteristics change if loan contracts were perfectly enforceable? Second, how do credit market imperfections affect industry and household characteristics during regime 1 (strong but volatile exchange rate and low interest rates) versus regime 2 (weak, relatively stable exchange rate and high interest rates)? Third, how do the effects of credit market imperfections depend upon the overall volatility of the macro environment?

4.1. Ability to Enforce Debt Contracts

To summarize industry characteristics under different credit market conditions, we simulate household behavior under three alternative assumptions about contract enforceability: $\theta = 0$, $\theta = 0.5$, and $\theta = 0.98$. At $\theta = 0$, credit markets are perfect in the sense that lenders can seize a defaulting borrower's entire asset stock and sell it at its full market value. At $\theta = 0.5$, creditors can recoup half of the assets held by a defaulting borrower. Finally, at $\theta = 0.98$, our benchmark, lenders are almost completely unable to recoup any collateral from a defaulting borrower. This is the estimated figure reported in Table 5.

The results we report describe the expected behavior of a heterogeneous population of households, with expectations based on averages across 100 sets of results. Each set of results is

[35] To perform these simulations, it is necessary to assume an initial distribution of potential entrant firms over asset levels, $h^N(a_{it})$, and an initial distribution of incumbent owner-households over asset levels and productivity levels, $h^I(a_{it}, \nu_{it})$. We let the former be lognormal with the estimated parameter values reported in Table 5, and we let the initial distribution of incumbents' wealth distributed log-normally with mean 280 and variance 1,500. Since we discard the first 60 years of simulated data, the results proved to be insensitive to the initial wealth distribution of incumbents.

generated by simulating the model for 160 periods and discarding the first 60 periods of each (to eliminate atypical "burn-in" years). The initial distribution of household types is based on the $\overline{a}_0$ and $\sigma^2_{a_0}$ estimates reported in Table 5, as well as the ergodic distribution of profit shocks implied by the λ and σ_ε estimates reported Table 3. The same sets of draws for profit shocks (ν's) and macro shocks (υ's) are used in all sets of simulations, so the only source of difference between our base case and counterfactual results is the associated differences in θ values.

[Table 6 about here]

Table 6 summarizes the results. Note first that as contract enforceability improves (i.e., as θ falls), the average log debt-to-asset (leverage) ratio among borrowers rises. The values associated with $\theta = 0.98$, $\theta = 0.50$, and $\theta = 0$ are -1.22, to -0.74 and -0.71, respectively, or taking antilogs, 0.30, 0.48, and 0.49. The increase in leverage when enforcement kicks in reflects the expansion of firms owned by low-*a*, high-ν households toward the size at which the marginal return on business capital (*k*) matches the lending rate. Interestingly, starting from $\theta = 0.98$, most of the effects of improved contract enforceability appear to have been realized when θ has fallen to 0.50.

One standard indicator of allocative efficiency is the correlation between firm size and profit shocks. Table 6 shows that this statistic rises considerably (from 0.40 to 0.65) as θ falls from 0.98 to 0. This improvement in the allocation of capital is due to a dramatic decline in the importance of household wealth as a constraint on investment: the correlation between firm size and household wealth falls from 0.85 to 0.38.

The effects of contract enforcement on allocative efficiency can also be seen in the more stringent selection criteria according to which firms participate in the apparel market. The mean

profitability index among exiting firms rises from $\bar{\upsilon}$ = -0.55 when θ = 0.98 to $\bar{\upsilon}$ = -0.44 when θ = 0.0, reflecting the reduced option value of staying in the market for low-υ firms. (When it is easy to finance start-up costs, entrepreneurs are more inclined to abandon low-υ firms and try to re-enter with a better business.) This result suggests that better-functioning financial markets can help to purge an economy of low-performing dinosaurs, not by forcing them to declare bankruptcy but by encouraging their owners to try something new.

Finally, the allocative effects of contract enforcement are reflected in the rate of return on households' assets:

$$\Delta_{it} = \frac{\pi(k_{it}, e_t, \nu_{it}) - (r_t - \mu D_{it}) \cdot (k_{it} - a_{it})}{a_{it}}. \tag{11}$$

Table 6 shows that as θ falls, the median value of this statistic rises from 0.33 to 0.47, reflecting the improved ability of credit-constrained households to leverage their wealth by creating high-return businesses. [36]

4.2. Loan enforcement effects under alternative Colombian macro regimes

Next we investigate whether the effects of credit market imperfections are similar during the different macro regimes identified by our switching VAR. To do this, we once again study 100 simulations of our model, each for 160 periods, discarding the initial 60 periods as a burn-in. Now, however, we average values of the various statistics for all periods during which regime 1 prevailed, and for all periods when regime 2 prevailed.

[36] The typical Δ value is above the interest rate, even when θ=0, since operating profits must be large enough in expectation to finance entry costs. Further, since entry costs are the same for all households, Δ is typically larger among low-*a* entrepreneurial households, for whom the denominator of (11) is relatively small.

[Table 7 about here]

The first two columns of Table 7 summarize the regime 1 and regime 2 results for the base case of $\theta = 0.98$ and the last two pairs of columns do the same for the counterfactual cases of $\theta = 0.50$ and $\theta = 0$, respectively. Note that the average realized log exchange rate and interest rate are 4.63 and 0.10, respectively, in regime 1, while they are 4.51 and 0.19, respectively, in regime 2. Thus interest rates and exchange rates move in opposite directions when regimes change, and their effects on businesses' net earnings after interest work in opposite directions. Nonetheless, the median entrepreneur earns higher returns on her wealth under the strong exchange rates and low interest rates of regime 1 (Table 7). Further, since the payoff to low interest rates depends upon firms' ability to borrow, the effects of regime switches are highly dependent upon contract enforceability. The difference between average earnings rates on portfolios under the two regimes is only 0.343 - 0.321 = 0.022 (2.2 percentage points) when credit markets function poorly (θ=0.98), but when they operate moderately well (θ=0.50) it is 0.523 – 0.357 = 0.163, and when contracts are perfectly enforceable (θ=0) it is 0.713 – 0.252 = 0.461.

[Figures 3a and 3b about here]

Figure 3a depicts the percentage changes in welfare for different types of incumbent owner-households as the economy moves from regime 2 to regime 1, presuming that $\theta = 0.98$. Clearly the net gains from switching to regime 1 tend to rise with profitability shocks (ν) and fall with wealth (*a*). Several forces create this pattern. First and most importantly, regime 1's low interest rates help borrowers (low-*a*, high-ν households) and hurt depositors (high-*a*, low-ν households). Second, exchange rate effects moderate the gains to entrepreneurs from being in regime 1, and they are relatively important at large ((high-*a*, high-ν) firms.

Figures 3b shows how the surface in figure 3a would shift if contract enforceability were perfect (θ=0). High-*a*, low-ν households are not affected by θ because these households self-finance their capital investments and are not credit constrained when contract enforcement is weak. However, improvements in enforcement do help low-*a*, high-ν households in periods when they would like to be borrowing more, i.e., when regime 1 prevails.[37] This enforcement-induced shift in the value of low-*a*, high-ν households is associated with more regime-1 business investment by households with modest wealth, and it is the reason that *corr*(*a*,*k*) falls more dramatically with a regime switch from 2 to 1 when $\theta = 0$ (Table 7).

[Figures 4a and 4b about here]

Finally, to give a sense for the magnitude of the welfare gains associated with improvements in enforceability, figures 4a and 4b show how the present value of the expected utility stream for incumbent households, V^I, shifts as θ drops from 0.98 to 0.50. Not surprisingly, the largest gains accrue to low-*a*, high-ν households, which improve their welfare up to 80 percent. Note, however, that even the unrationed (high-*a*, low-ν) gain modestly because there is some possibility that they will become rationed in the future. Note also that it doesn't matter much whether the economy is in regime 1 or regime 2 because households anticipate that they will pass through both regimes repeatedly.

4.3. Contract Enforcement and the Macro Environment: Argentina versus Colombia

Results in the previous section suggest that the effects of improved contract enforceability depend partly upon the degree of macro volatility. To further explore this

[37] This finding is similar to Gine and Townsend's (2004, p. 269), whose simulations imply that the primary beneficiaries of improvements in the Thai financial sector are "talented would-be entrepreneurs who lack credit and cannot otherwise go into business (or invest little capital)."

relationship, we now ask how changes in θ would have affected Colombian households if they had been somehow transplanted to the relatively more volatile Argentine macro environment.

[Figure 5 about here]

Figure 5 shows the evolution of Argentine real exchange rates and real interest rates over the past 30 years. Juxtaposed with figure 1, it demonstrates that this country's recent macro history has been much more turbulent than Colombia's. This impression is confirmed by estimates of our SETAR switching model based on Argentine time series (Table 8). We decisively reject a single regime, and we estimate a covariance matrix for the innovations in the process that is an order of magnitude larger than Colombia's (compare Table 8 to Table 1).

[Table 8 about here]

Table 8 repeats the counterfactual experiment that generated Table 6, replacing the Colombian transition density for s_t from Table 1 with the Argentine transition density from Table 8. All other parameters are left unchanged.

The clear message of this exercise is that credit market imperfections are much more important in a volatile environment. In "Argentina," the same improvement in contract enforcement from $\theta = 0.98$ to $\theta = 0.0$ causes much larger adjustments in the median return on portfolios (0.458 versus 0.141), the mean log leverage of borrowers (0.791 versus 0.514), the mean log firm size (3.30 versus 2.77), and the log of mean wealth among firm owners (5.68 percent versus 3.45). Contrasts for most other variables are less dramatic, but adjustments in virtually all of the dimensions we examine are relatively larger for the Argentine experiment. Overall, the welfare effects of regime switches more than double for credit-constrained producers when we move them from Colombian to Argentine macro conditions.

What explains this pattern? Improvements in contract enforceability make it easier for

entrepreneurs to avail themselves of temporary profit opportunities during boom years through entry and expansion. Similarly, well-functioning credit markets encourage exit during lean years by reducing the costs of re-entry. Both effects matter more when boom-bust cycles are relatively dramatic.

5. Summary

We develop an empirical model that characterizes the effects of macroeconomic volatility, poorly functioning credit markets, and substantial entry costs. Applied to panel data on Colombian apparel producers, the model yields econometric estimates of a loan enforcement index, the sunk costs of creating a new business, and various other parameters. It also provides a basis for counterfactual experiments that explore the effects of improved contract enforcement and reduced spreads between borrowing and lending rates.

In particular, simulations of our model imply that perfect loan contract enforcement substantially increases the ability of entrepreneurial households to pursue profitable business investments. Accordingly, the average return on asset portfolios increases dramatically and the number of active businesses rises. At the same time, firms' sizes become less correlated with the wealth of their owners and more correlated with their capacity to generate operating profits.

The effects of financial reforms on entrepreneurial households depend upon the market potential of their businesses, their wealth, and the macro environment. Not surprisingly, the benefits of good contract enforcement accrue mainly to households with good business ideas but modest wealth. Further, as the macro environment swings from low interest rates and a strong but volatile currency to low interest rates and a weaker, more stable currency, the benefits of improved contract enforcement become larger still for these households.

Finally, the gains from improved enforceability are larger when the macro environment is

volatile because well-functioning credit markets enhance entrepreneurs' ability to quickly adjust their firm size, and the returns to doing so are relatively large when market conditions are unstable. In particular, if the Colombian macro environment were replaced with the Argentine environment of the past 25 years, the effect of moving to perfect enforceability on average leverage rates, average portfolio returns, average firm size, and average wealth of entrepreneurs would be far more dramatic.

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Appendix: The Profit Function Estimator

Using (10c), we obtain quasi-differenced versions of equations (10a) and (10b):

(10a') $\ln G_{it} = (1-\lambda)\eta_0 + \lambda \ln G_{it-1} + \eta_1(\ln e_t - \lambda \ln e_{t-1}) + \eta_2(\ln k_{it} - \lambda \ln k_{it-1}) + \varepsilon^{\nu}_{it}$

(10b') $\ln C_{it} = (1-\lambda)\eta_0 + \lambda \ln C_{it-1} + \eta_1(\ln e_t - \lambda \ln e_{t-1}) + \eta_2(\ln k_{it} - \lambda \ln k_{it-1}) + \varepsilon^{\nu}_{it} + \varepsilon^{C}_{it}$

All variables on the right-hand side of these equations except k_{it} are uncorrelated with the innovation in the profit shock, ε^{ν}_{it}. So, taking the value of η_2 from other sources, nonlinear least squares estimates of the remaining parameters in (10a') and (10b') will not be subject to simultaneity bias. However, they will still be subject to selection bias, since firms exit the sample in response to low ε^{ν}_{it} realizations.

To deal with this selection problem, we use include a standard Heckman correction term in each equation. Specifically, let $\underline{\nu}(s_t, a_{it})$ be the minimum profit shock at which an incumbent entrepreneur with assets a_{it} will continue to operate his firm. (This cut-off is implied by the programming problem described in section IIB.) The conditional continuation probability for this entrepreneur is then:

$$P\left[\chi^{I}_{it} = 1 \mid s_t, a_{it}, \nu_{it-1}\right] = \Pr\left[\underline{\nu}(s_t, a_{it}) - \lambda \nu_{it-1} < \varepsilon^{\nu}_{it}\right]$$
$$= 1 - \Phi\left(\underline{z}_{it}\right),$$

where $\underline{z}_{it} = \dfrac{\underline{\nu}(s_t, a_{it}) - \lambda \nu_{it-1}}{\sigma_{\varepsilon}}$ and $\Phi()$ is the standard normal cumulative distribution function.

Thus, expressing $\underline{\nu}(s_t, a_{it})$ as a polynomial function of a_{it} and time dummies ($d_1, \ldots, d_T$), $\underline{z}_{it}$ can be estimated using a probit function to predict continuation probabilities. To incorporate this probit into our estimator of (10a) – (10c), we approximate $\underline{z}_{it}$ as $\underline{z}_{it} \approx \beta x_{it}$ where x_{it} = [1, a_{it} ,

a_{it}^2, ν_{it-1}, d_1 , … , d_T]. Then, given β, we use the standard formulae for moments of truncated normal distributions to calculate (e.g., Maddala, 1983):

$$E(\varepsilon_{it}^{\nu} \mid s_t, a_{it}, \nu_{it-1}, \chi_{it} = 1) = \sigma_{\varepsilon} M_{it}$$

where $M_{it} = \dfrac{\phi(\underline{z}_{it})}{1-\Phi(\underline{z}_{it})}$ and $\phi()$ is the standard normal density function. Substituting these expressions back into (10a') and (10b') yields the system to be estimated:

(10a'') $\ln G_{it} = (1-\lambda)\eta_0 + \lambda \ln G_{it-1} + \eta_1(\ln e_t - \lambda \ln e_{t-1}) + \eta_2(\ln k_{it} - \lambda \ln k_{it-1}) + \sigma_{\varepsilon} M_{it} + \xi_{it}^G$

(10b'') $\ln C_{it} = (1-\lambda)\eta_0 + \lambda \ln G_{it-1} + \eta_1(\ln e_t - \lambda \ln e_{t-1}) + \eta_2(\ln k_{it} - \lambda \ln k_{it-1}) + \sigma_{\varepsilon} M_{it} + \xi_{it}^C$

where $\xi_{it}^G = \varepsilon_{it}^{\nu} - E(\varepsilon_{it}^{\nu} \mid s_t, a_{it}, \nu_{it-1}, \chi_{it}^I = 1)$ and $\xi_{it}^C = \varepsilon_{it}^{\nu} + \varepsilon_{it}^C - E(\varepsilon_{it}^{\nu} \mid s_t, a_{it}, \nu_{it-1}, \chi_{it}^I = 1)$ are serially uncorrelated, zero mean disturbance terms. Given the presence of the Mills ratios, we bootstrap standard errors.

References

Aghion, Philippe and Patrick Bolton, "A Theory of Trickle-Down Growth and Development", *Review of Economic Studies* 64 (1997), 151-172.

Aghion, Philippe, George-Mario Angeletos, Abhijit Banerjee, and Kalina Manova, "Volatility and Growth: Credit Constraints and Productivity-Enhancing Investment," NBER Working Paper 11349 (2005).

Arellano, Cristina, Yan Bai, and Jing Zhang, "Firm Dynamics and Financial Development" *Journal of Monetary Economics* 59 (2012), 533-549.

Attanasio, Orazio P., James Banks, Costas Meghir, and Guglielmo Weber, "Humps and Bumps in Lifetime Consumption," *Journal of Business and Economic Statistics* 17 (1999), 22–35.

Banerjee, Abhijit, "Contracting constraints, credit markets and economic development," in Hansen, L., Dewatripont, M., Turnovsky, S., eds., *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress, vol. III* (New York: Cambridge University Press, 2003).

Banerjee, Abhijit and Esther Duflo, "Do Firms Want to Borrow More? Testing Credit Constraints Using a Directed Lending Program," Working Paper, MIT (2005).

Banerjee, Abhijit and Andrew Newman "Occupational Choice and the Process of Development," *Journal of Political Economy* 101 (1993), 274-298.

Banerjee, Abhijit and Andrew Newman "Inequality, Growth and Trade Policy," MIT Working Paper, Cambridge, MA (2003).

Beck, Thorsten, Asli Demirguc-Kunt, and Ross Levine, "A New Database on Financial Development and Structure", *World Bank Economic Review* 14 (2000), 597-605.

Bloom, Nicholas "The Impact of Uncertainty Shocks," *Econometrica* 77 (2009), 623-686.

Bollen, Nicolas, Stephen Gray, and Robert Whaley, "Regime Switching in Foreign Exchange Rates: Evidence from Currency Option Prices," *Journal of Econometrics* 94 (2000), 239-76.

Buera, Francisco, "A Dynamic Model of Entrepreneurship with Borrowing Constraints: Theory and Evidence." *Annals of Finance* 5 (2009), 443-464.

Buera, Francisco, Joseph Kaboski, and Yongseok Shin, "Finance and Development: A Tale of Two Sectors," *American Economic Review* 101 (2011), 1964-2002.

Cagetti, Marco and Mariacristina De Nardi, "Entrepreneurship, Frictions and Wealth," *Journal of Political Economy* 114 (2006), 835-870.

Caner, M. and B. Hansen, "Threshold Autoregression with a Unit Root," *Econometrica* 69 (2001), 1555-1596.

Chen, Shiu-Sheng, "Revisiting the Interest Rate-Exchange Rate Nexus: A Markov-Switching Approach," *Journal of Development Economics* 79 (2006), 208-224.

Clarida, Richard, Lucio Sarno, Mark Taylor, and Giorgio Valente (2003), "The Out-of-Sample Success of Term Structure Models as Exchange Rate Predictors," *Journal of International Economics* 60 (1) 61-84.

Cooley, Thomas and Vincenzo Quadrini, "Financial Markets and Firm Dynamics," *American Economic Review* 91 (2001), 1286-1310.

De Loecker, Jan, "Product Differentiation, Multi-product Firms, and Estimating the Impact of Trade Liberalization on Productivity," *Econometrica* 79 (2011), 1407-1451.

De Mel, Suresh, David McKenzie and Christopher Woodruff, "Returns to Capital in Microenterprises: Results from a Randomized Experiment," *Quarterly Journal of Economics* 123 (2008), 1329-72.

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Scheifer, "The Regulation of Entry," *Quarterly Journal of Economics* 118 (2002), 1-39.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer, " Private Credit in 129 Countries," *Journal of Financial Economics* 84 (2007), 299-329.

Edwards, Sebastian, *The Economics and Politics of Transition to an Open Market Economy: Colombia*. (Paris: Organization for Economic Cooperation and Development, 2001).

Engel, Charles and James Hamilton, "Long Swings in the Dollar: Are They in the Data and Do Markets Know It?" *American Economic Review* 80 (1990), 688-713.

Eslava, Marcela, John Haltiwanger, Adriana Kugler and Maurice Kugler, "The Effects of Structural Reforms on Productivity and Profitability Enhancing Reallocation: Evidence from Colombia," *Journal of Development Economics* 75 (2004), 333-371.

Evans, David and Boyan Jovanovic, "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints," *Journal of Political Economy* 97 (1989), 808-27.

Evans, David and Linda Leighton, "Some Empirical Aspects of Entrepreneurship," *American Economic Review* 79 (1989), 519-35.

Fairlie, Robert, "The Absence of the African American-Owned Business: An Analysis of the Dynamics of Self-Employment," *Journal of Labor Economics* 17 (1999), 80-108.

Felkner, John and Robert Townsend, "The Geographic Concentration of Enterprise in Developing Countries," *Quarterly Journal of Economics* 126 (2011), 2005-2061.

Garcia Garcia, Jorge and Sisira Jayasuriya *Courting Turmoil and Deferring Prosperity: Colombia between 1960 and 1990*. Washington, D.C. (Washington, D.C.: The World Bank, 1997).

Gentry, William and R. Glenn Hubbard, "Entrepreneurship and Household Savings," *The B.E. Journal of Economic Analysis and Policy* 4 (2004).

Giné, Xavier and Robert Townsend, "Evaluation of Financial Liberalization: A General Equilibrium Model with Constrained Occupation Choice," *Journal of Development Economics* 74 (2004), 269-307.

Gray, Stephen, "Modeling the Conditional Distribution of Interest Rates as a Regime-Switching Process," *Journal of Financial Economics* 42 (1996), 27-62.

Greenwood, Jeremy and Boyan Jovanovic, "Financial Development, Growth and the Distribution of Income," *Journal of Political Economy* 98 (1990), 1076-1107.

Hildreth, Clifford and Glenn J. Knowles, "Some Estimates of Farmers' Utility Functions", Technical Bulletin 335, Agricultural Experiment Station, University of Minnesota (1982).

Hopenhayn, Hugo, "Entry, Exit, and Firm Dynamics in Long Run Equilibrium," *Econometrica* 60 (1992), 1127-50.

Hurst, Erik and Annamaria Lusardi, "Liquidity Contraints, Household Wealth, and Entrepreneurship," *Journal of Political Economy* 112 (2004), 319-347.

Kaminsky, Graciela and Carmen Reinhart, "The Twin Crises: The Causes of Banking and Balance of Payments Problems," *American Economic Review*, 89 (1999), 473-500.

Kydland, Finn and Edward Prescott, "Time to Build and Aggregate Fluctuations," *Econometrica*, 50 (1982), 1345-1370

Lambson, Val, "Industry Evolution with Sunk Costs and Uncertain Market Conditions,"

International Journal of Industrial Organization 9 (1991), 171-196.

Lee, Bong-Soo and Beth Fisher Ingram, "Simulation Estimation of Time-Series Models," *Journal of Econometrics* 47 (1991), 197-205.

Levine, Ross, "Finance and Growth: Theory, Mechanisms and Evidence", in P. Aghion and S. Durlauf, eds., *Handbook of Economic Growth*, (Amsterdam: Elsevier, 2005).

Lloyd-Ellis Huw, and Dan Bernhardt, "Enterprise, Inequality, and Economic Development," *Review of Economic Studies* 67 (2000), 147–168.

Loayza, Norman, Romain Ranciere, Lusi Serven and Jaume Ventura. "Macroeconomic Volatility and Welfare in Developing Countries: An Introduction," *The World Bank Economic Review* 21 (2007), 343-387.

Maddala, George, *Limited Dependent and Qualitative Variables in Econometrics*. *Econometric Society Monograph No. 3.* (New York: Cambridge University Press, 1983)

McKenzie, David and Christopher Woodruff (2006) "Do Entry Costs Provide and Empirical Basis for Poverty Traps?" *Economic Development and Cultural Change* 55(1): pp. 3-42.

Midrigan, Virgiliu and Daniel Yi Xu, "Finance and Misallocation: Evidence from Plant-Level Data," *American Economic Review* 104 (2014), 422-58.

Olley, G. Stephen and Ariel Pakes, "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica* 64 (1996), 1263-1298.

Partow, Zeinab "Colombia: Macroeconomic and Fiscal Frameworks," in Giugale,-Marcelo-M.; Lafourcade,-Olivier.; Luff,-Connie, eds. *Colombia: The Economic Foundation of Peace*. (Washington, D.C.: World Bank, 2003), 145-72.

Paulson, Anna and Robert Townsend "Entrepreneurship and Financial Constraints in Thailand," *Journal of Corporate Finance* 10 (2004), 229-262.

Quadrini, Vincenzo, “The Importance of Entrepreneurship for Wealth Concentration and Mobility,” *Review of Income and Wealth* 45 (1999), 1-19.

Rustichini, Aldo, “Dynamic Programming Solution of Incentive-Constrained Problems,” *Journal of Economic Theory* 78 (1998), pp. 329-354.

Tauchen, George and Hussey, Robert, "Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models," *Econometrica*, 59 (1991), 371-396.

Townsend, Robert M and Kenichi Ueda, “Financial Deepening, Inequality, and Growth: A Model-Based Quantitative Evaluation” *Review of Economic Studies* 73 (2006), 251-293.

Tybout, James, “Manufacturing Firms in Developing Countries: How Well Do They Do, and Why?” *Journal of Economic Literature* 38 (2000), 11-44.

Utar, Hale, “Import Competition and Employment Dynamics”, Working Paper, University of Colorado (2008).

World Bank *Doing Business 2008: Colombia* (Washington, D.C.: The World Bank, 2008)

Table 1: SETAR Switching Model Parameters[a]

	Regime 1		*Regime 2*	
	e	***r***	***e***	***r***
β_0	0.209	0.040	0.066	0.069
	(0.261)	(0.086)	(0.161)	(0.080)
β_1	0.960	-0.003	0.970	-0.004
	(0.058)	(0.019)	(0.034)	(0.015)
	-0.264	0.737	0.397	0.701
	(0.190)	(0.063)	(0.243)	(0.105)
Σ	1.60e-3	-2.57e-6	1.94e-3	-7.51e-5
	-2.57e-6	1.74e-4	-7.51e-5	3.61e-4
Threshold *e*			4.653	
$\chi^2(8)$ test statistic for single regime:			26.34	

[a]Based on quarterly real lending rate and real effective exchange rate series for Colombia, 1982-I through 2007-IV. Standard errors are in parentheses. The interest rate is measured as the log of one plus the real lending rate. The real effective exchange rate is measured in logs and based to log(100) in 2005. All exchange rate values and post-1985 lending rate values come from the IMF's International Financial Statistics database. Pre-1986 lending rates were not available from the IFS, so they were obtained from Colombia's Planeacion (National Planning Department)'s archive of historical data: https://www.dnp.gov.co/EstudiosEconomicos/Estad%C3%ADsticasHist%C3%B3ricasdeColombia.aspx. Values of the IFS series and the Planeacion series are the same for the period of time during which they overlap.

Table 2: Apparel Producer Characteristics, Averages by Size Quintile*

Plant Size quintile	(1) Fixed capital stock ($US)	(2) Capital per worker (1,000 $US)	(3) Debt per unit capital	(4) Zero debt dummy	(5) Gross investment per unit capital	(6) Operating income per unit capital	(7) Plant turnover rate
<20th percentile	5,051	0.49	2.46	0.38	0.03	23.90	0.20
20th-40th	16,251	1.22	1.03	0.28	0.06	4.15	0.17
40th – 60th	31,602	2.10	0.69	0.22	0.07	2.80	0.16
60th – 80th	63,308	3.27	0.70	0.16	0.09	2.22	0.16
80th -100th	382,787	7.37	0.89	0.09	0.09	2.00	0.12

*Figures are constructed using Colombia's Annual Survey of Manufacturers (DANE) and describe an average of 991 plants per year. All years (1981-1991) are pooled. All nominal values are first converted to 1977 pesos using the Colombian consumer price index. These figures are then re-stated in dollars using the peso-dollar exchange rate and brought forward to 2012 U.S. dollars using the U.S. consumer price deflator. Size quintiles are based on real capital stocks, which are constructed as beginning-of-period capital stocks plus gross investments, less current period depreciation rates.

Table 3: Operating Profit Function Parameters, Colombian Apparel Producers[a]

	Profit function parameters	Profit function with time dummies replacing exchange rate
Intercept, revenue eqn. (η_0)	4.820 (0.241)	--
Exchange rate (η_1)	-0.249 (0.054)	--
Root of ν process (λ)	0.781 (0.014)	0.782 (0.014)
Inverse Mills ratio	-0.008 (0.086)	-0.004 (0.088)
Std. error, ϵ (σ_ε)	0.519 (0.014)	0.519 (0.015)
Depreciation rate (δ)[b]	0.093 (0.004)	0.093 (0.004)
Capital stock (η_2)[c]	0.847	0.847
Mark-up effect (τ)	0.661	0.661
R^2 revenue equation	0.724	0.726
R^2 cost equation	0.674	0.675
Number of observations	6,531	

[a]All standard errors are bootstrapped to deal with the stochastic Mills ratio. All estimates with standard errors are obtained using plant-level panel data on apparel producers from Colombia's Annual Survey of Manufacturing, 1981-1991.

[b]Estimated separately as the average book value of the depreciation rate.

[c]Imputed from estimate reported in Eslava, et al. (2004): $\alpha = 0.303$. This parameter is treated as non-stochastic when calculating standard errors for reported estimates of η_0, η_1, λ, and σ_ε.

Table 4: Moments used to estimate (Λ)

	Data	Model
Mean, log capital	6.198	6.571
Variance, of log capital	2.050	2.068
Mean, log capital, entrants	6.050	5.691
Variance, of log capital, entrants	1.769	0.667
Mean, log operating profits	7.539	8.449
Variance, log operating profits	1.746	2.755
Mean, log leverage (given debt is positive)	-0.997	-1.239
Variance, log leverage (given debt is positive)	2.407	1.875
Mean, growth in net capital stock	-0.026	0.046
Variance, growth in net capital stock	0.713	0.404
Mean, entry rate	0.158	0.130
Mean, exit rate	0.147	0.130
Correlation, log capital, log operating profits	0.568	0.932
Correlation, log capital, lagged log capital	0.828	0.831
Correlation, log leverage, log capital	-0.138	0.245
Correlation, log leverage, log operating profits	0.318	0.460
Correlation, net capital growth, log operating profits	0.118	0.124
Correlation, log capital, net capital growth	0.317	0.336
Correlation, log leverage, lagged log capital	-0.049	0.058
Correlation, log leverage, lagged log operating profits	0.285	0.152
Correlation, log capital, lagged log operating profits	0.529	0.770

Table 5: Parameters Identified by the Dynamic Programming Problem (Λ)[a]

	Parameter
Fixed costs (f)	60.5 (4.12)
Sunk entry costs (F)	605.88 (92.70)
Credit market imperfection index (θ)	0.982 (0.01)
Average assets, new entrepreneurs ($\overline{a_0}$)	3179.7 (99.52)
Variance in assets, new entrepreneurs ($\sigma^2_{a_0}$)	115,740 (2,012.38)
Probability of new business opportunity (p)	0.453 (0.01)
Ratio of total productive assets to fixed assets (ζ)	27.66 (0.10)

[a]Standard errors are in parentheses.

Table 6: Industry Characteristics and Loan Enforcement

	θ = 0.98	**θ = 0.50**	**θ = 0**
Number of firms	553.829	481.546	491.352
Entry rate, exit rate	0.132	0.155	0.155
Mean profitability (ν)	0.705	0.754	0.746
Variance profitability (ν)	0.248	0.223	0.226
Mean log capital (k)	6.557	7.817	9.328
Mean log(k)-weighted profitability	0.778	0.849	0.880
Mean ν of exiting firms	-0.549	-0.433	-0.439
Median portfolio return (Δ)	0.331	0.437	0.473
Correlation, υ and log(k)	0.395	0.489	0.649
Mean log leverage among borrowers	-1.220	-0.740	-0.706
Log of mean wealth of firm owners	10.494	11.729	13.943
Correlation, wealth and capital	0.854	0.714	0.380

Table 7: Loan Enforcement, Macro Conditions and Industry Characteristics

	$\theta = 0.98$		$\theta = 0.5$		$\theta = 0$	
	Regime 1	*Regime 2*	*Regime 1*	*Regime 2*	*Regime 1*	*Regime 2*
Number of Firms	563.760	544.661	487.675	475.888	494.074	488.840
Entry/exit rate	0.133	0.130	0.155	0.155	0.156	0.153
Mean profit shock (ν)	0.693	0.715	0.746	0.760	0.744	0.749
Mean log(*k*)-weighted profit shock	0.767	0.788	0.841	0.857	0.873	0.886
Correlation, exp(υ) and log(*k*)	0.436	0.357	0.544	0.437	0.758	0.548
Median portfolio return (Δ)	0.343	0.321	0.523	0.357	0.713	0.252
Mean log capital	6.630	6.489	8.006	7.643	9.821	8.873
Mean log leverage among borrowers	-1.212	-1.227	-0.691	-0.786	-0.655	-0.753
Log of mean wealth of firm owners	10.476	10.510	11.750	11.708	14.096	13.778
Corr., log wealth and log capital	0.835	0.871	0.692	0.733	0.253	0.497
Mean ν of exiting firms	-0.564	-0.534	-0.440	-0.426	-0.439	-0.439
Mean Exchange Rate	4.634	4.510	4.634	4.510	4.634	4.510
Variance Exchange Rate	0.069	0.087	0.069	0.087	0.069	0.087
Mean Interest Rate	0.097	0.189	0.097	0.189	0.097	0.189
Variance Interest Rate	0.002	0.004	0.002	0.004	0.002	0.004

Table 8: SETAR Switching Model Parameters, Argentina[a]

	Regime 1		*Regime 2*	
	e	***r***	***e***	***r***
β_0	1.492	0.101	1.108	1.877
	(0.332)	(1.158)	(0.516)	(0.491)
β_1	0.681	-0.039	0.798	-0.032
	(0.071)	(0.247)	(0.093)	(0.089)
	0.133	0.023	-0.189	-0.445
	(0.034)	(0.119)	(0.167)	(0.159)
Σ	0.0266	0.0189	0.0032	-0.0005
	0.0189	0.3234	-0.0005	0.0029
Threshold *e*				5.289
$\chi^2(8)$ test statistic for single regime:				216.693

[a]Based on quarterly IFS data for Argentina, 1980-I through 2008-IV. Standard errors are in parentheses. Lending rates are not reported prior to 1986, so the lending rate series is constructed as the deposit rate plus the spread, which is based on the period during which both deposit rates and lending rates are observable.

Table 9: Industry Characteristics and Loan Enforcement in an Argentine Macro Environment

	θ = 0.98	θ = 0.50	θ = 0
Number of firms	567.068	543.561	595.728
Entry/Exit rate	0.130	0.148	0.152
Mean profit shock (ν)	0.694	0.710	0.670
Mean log capital (*k*)	6.387	8.001	9.689
Mean log(*k*)-weighted ν	0.253	0.245	0.273
Mean ν of exiting firms	-0.567	-0.491	-0.496
Median portfolio return (Δ)	0.273	0.177	0.731
Correlation, υ and log(*k*)	0.223	0.254	0.664
Mean log leverage among borrowers	-1.157	-0.448	-0.366
Correlation, wealth and capital	0.777	0.682	0.119
Log of mean wealth, firm owners	12.183	14.093	17.867
Mean exchange rate	4.769	4.769	4.769
Mean interest rate	0.219	0.219	0.219

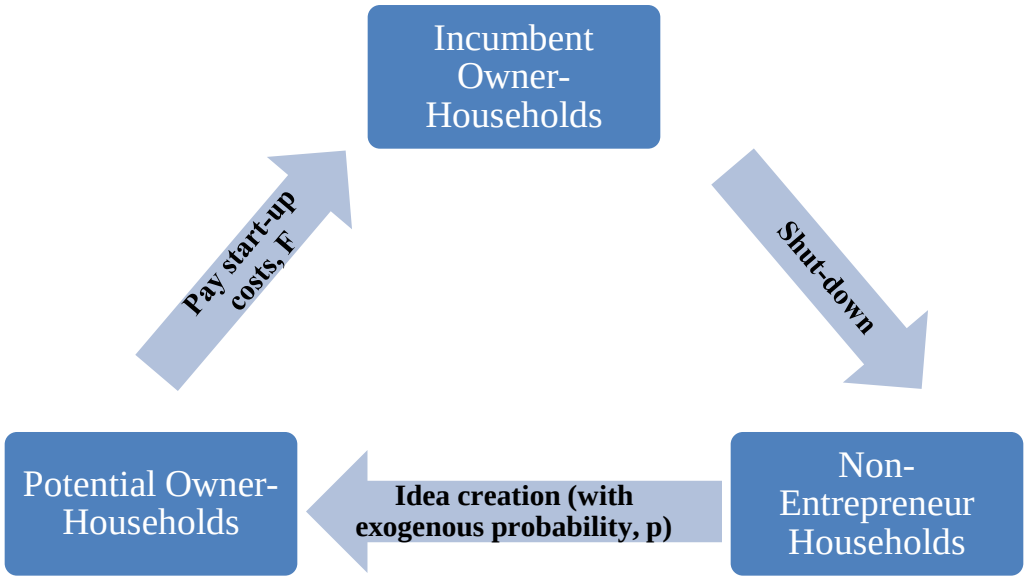
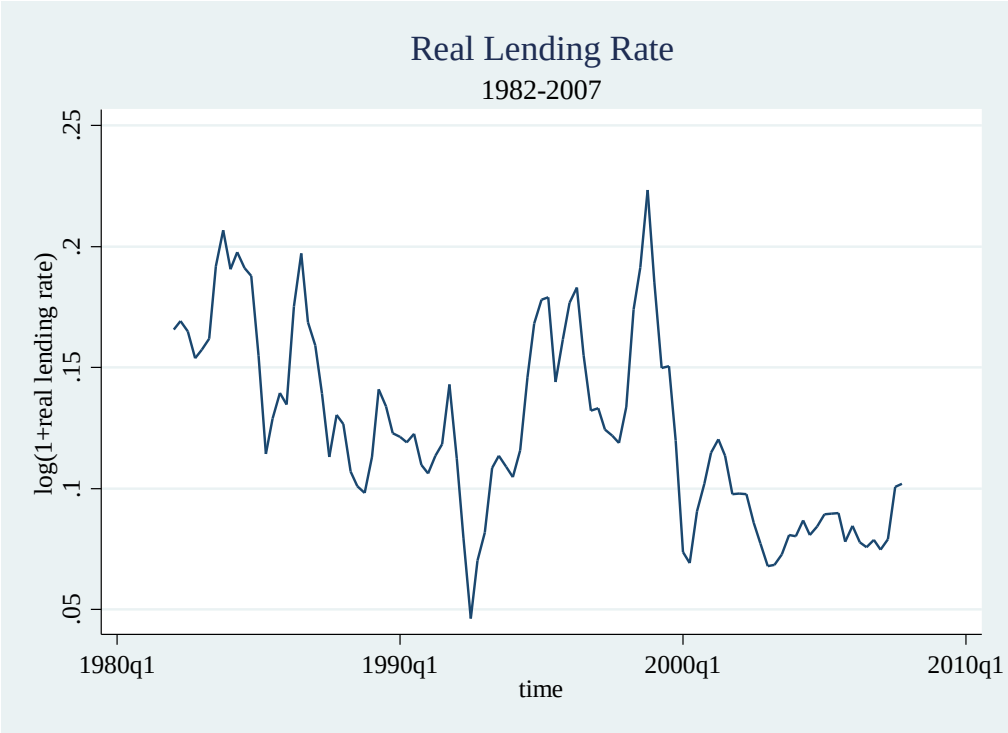


Figure 1: Transitions between household types



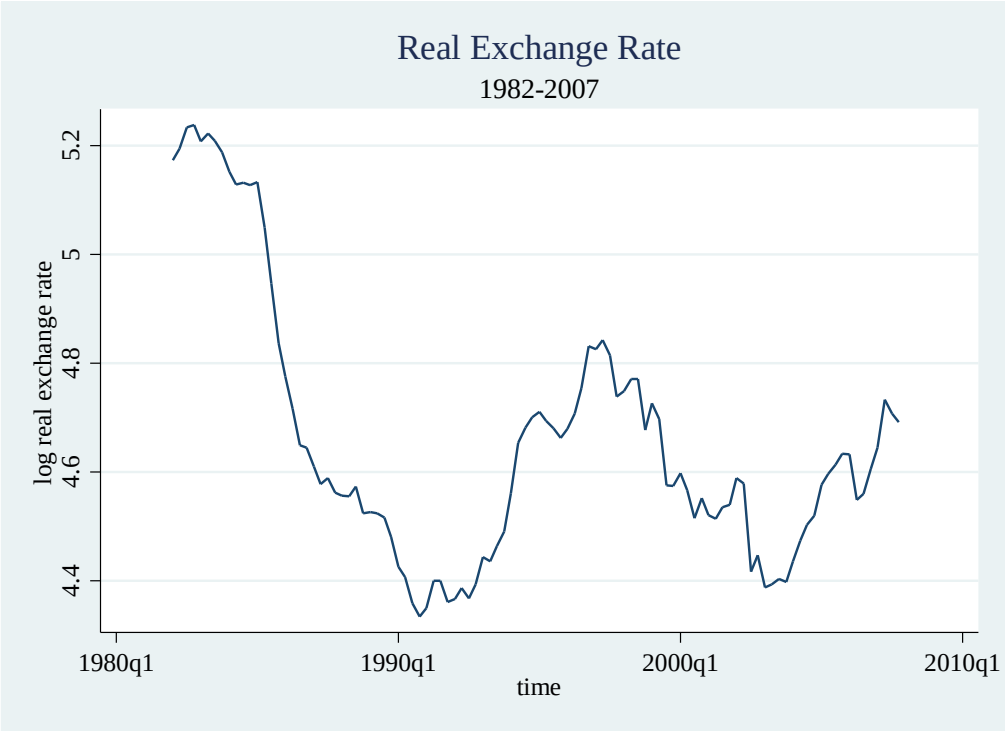


Figure 2: Colombian Exchange Rates and Interest Rates

Source: International Monetary Fund, IFS Statistics, and calculations of the authors. An increase in the exchange rate corresponds to an appreciation.

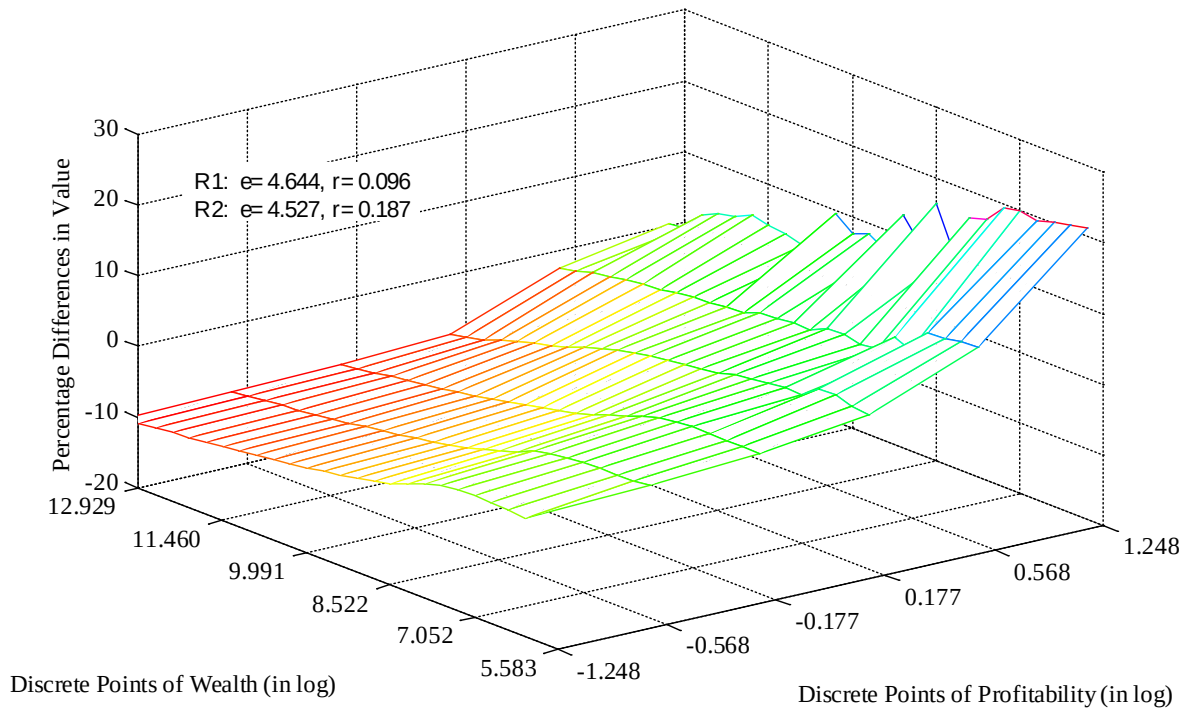


Figure 3a: Percentage Differences in Welfare of an Incumbent Firm Owner, (Colombia, regime 1 – regime 2, θ=0.98)

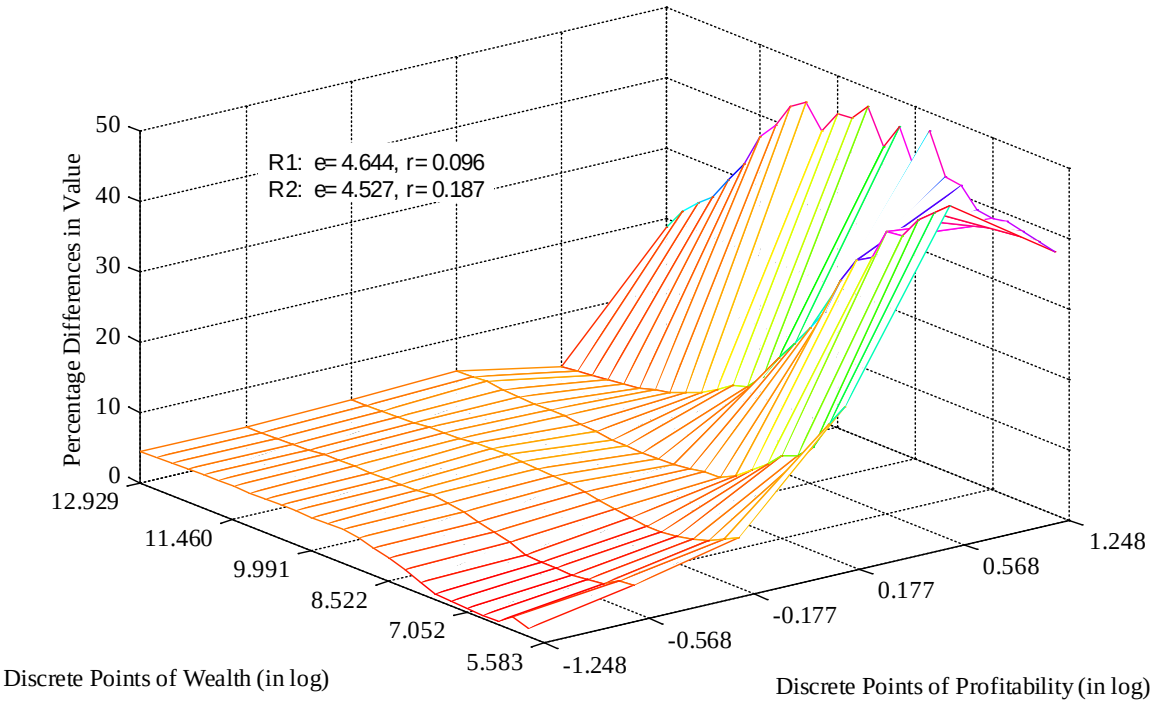


Figure 3b: Percentage Differences in Welfare of an Incumbent Firm Owner, (Colombia, regime 1 – regime 2, θ = 0.00 versus θ = 0.98)

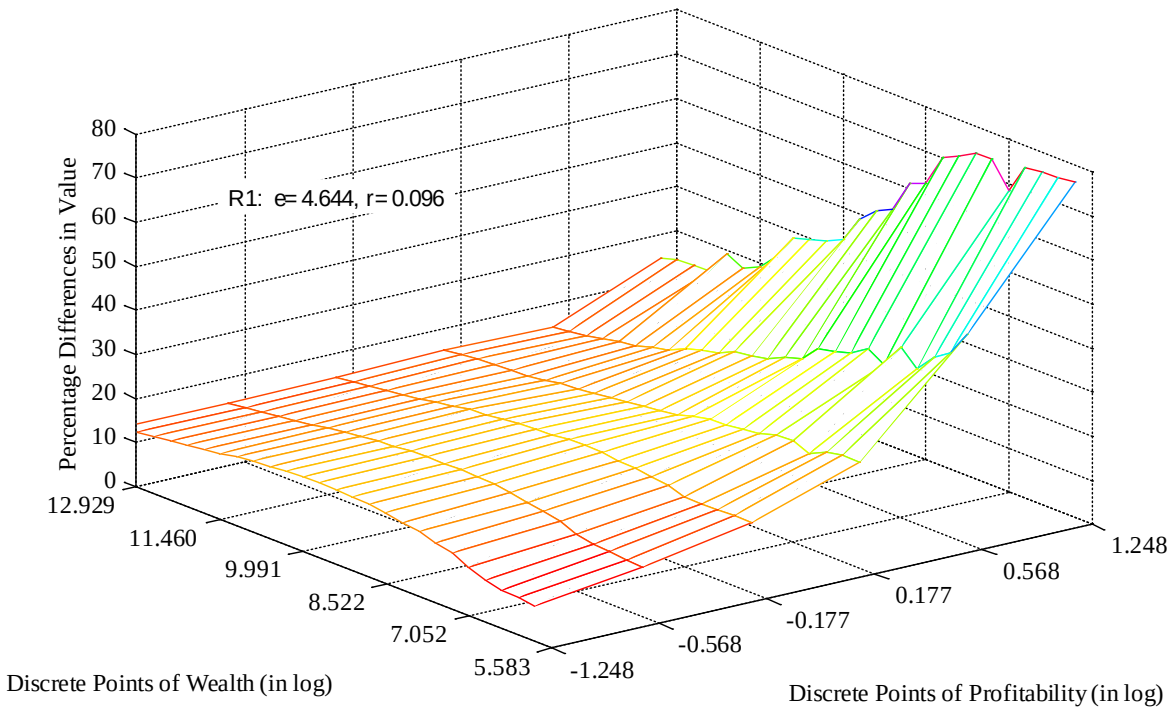


Figure 4a: Percentage Differences in Welfare of an Incumbent Firm Owner, (Colombia, regime 1, θ=0.50 - θ=0.98)

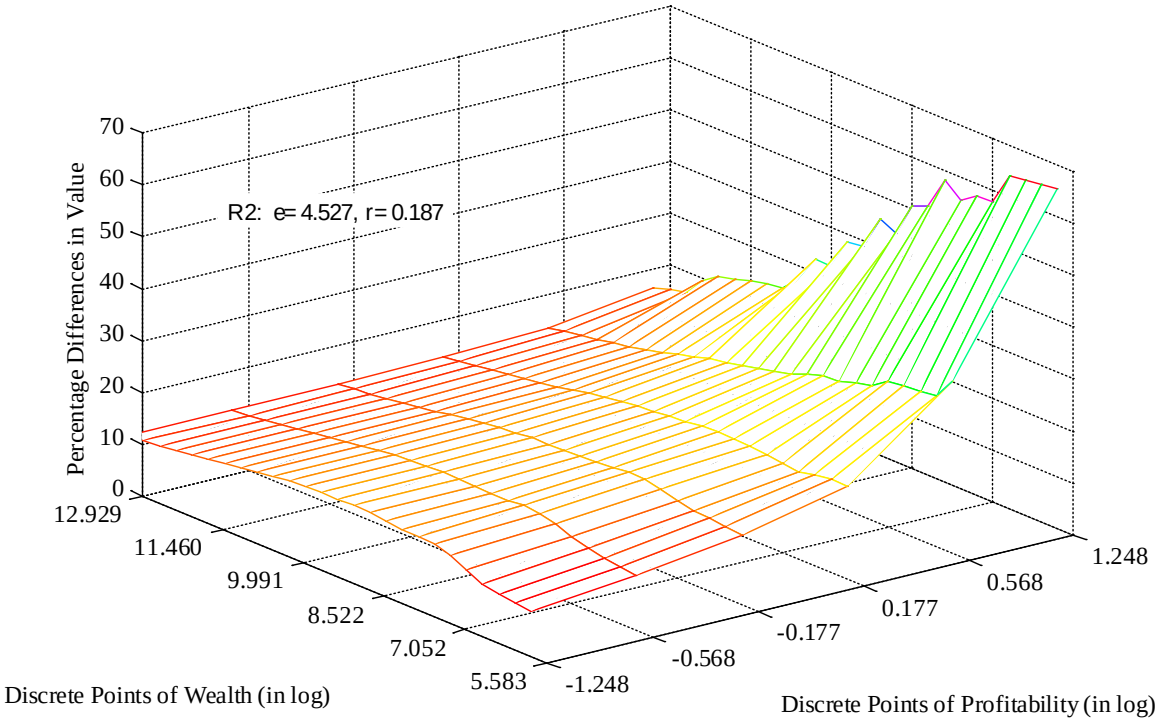
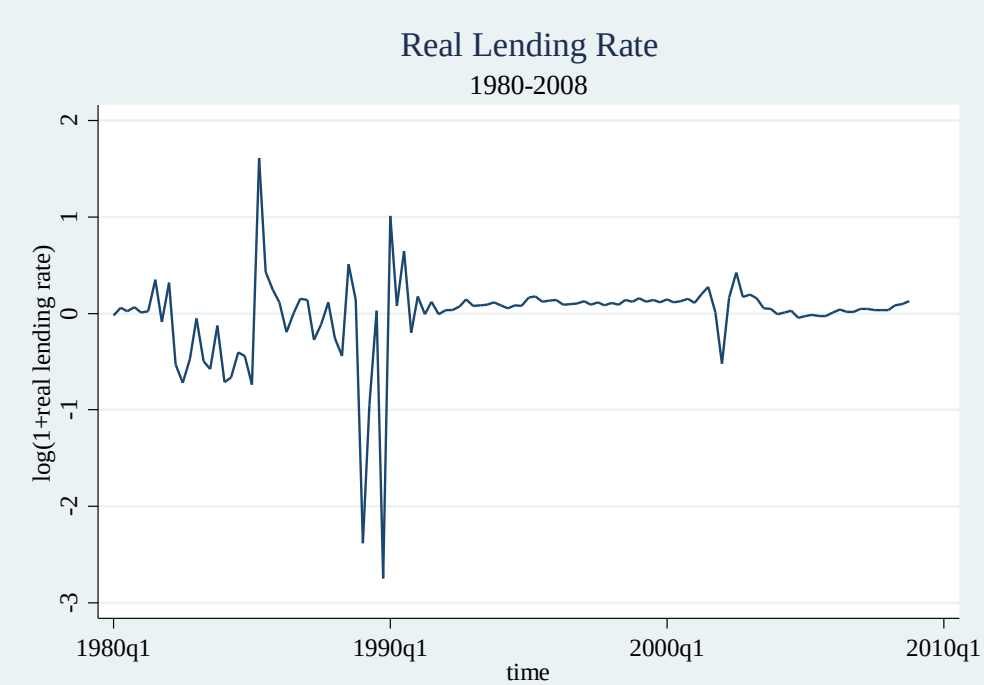


Figure 4b: Percentage Differences in Welfare of an Incumbent Firm Owner, (Colombia, regime 2, θ=0.50 - θ=0.98)



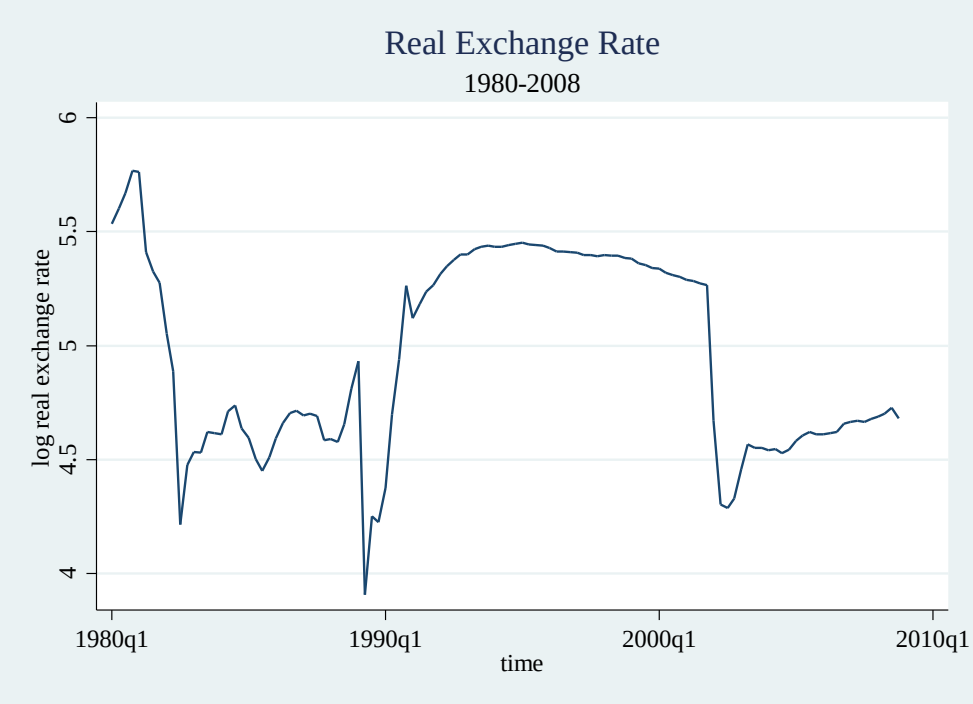


Figure 5: Argentina Exchange Rates and Interest Rates

Source: International Monetary Fund, IFS Statistics, and calculations of the authors. An increase in the exchange rate corresponds to an appreciation.