Entrepreneurship & Interest Rate Shocks in a Small Open Economy

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- Study a model of entrepreneurship in a small open economy subject to interest rate shocks.
- Present empirical evidence about entrepreneurship and shocks to real interest rates in a representative emerging economy (Colombia).

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- Entrepreneurship is an important economic activity.
- Emerging markets are subject to large swings in the availability and price of external financing.
- Questions:
- What are the effects of interest rate shocks in occupational decisions?
- How do fluctuations in interest rates affect the distribution of income and capital accumulation through their impact on entrepreneurial decisions?

Related Literature

- Evans and Jovanovic, 1989. Static model of entrepreneurship choice under borrowing constraints. Strong prediction that wealthier individuals select themselves into entrepreneurship.

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- Buera, 2006. Dynamic continuous-time version of occupational choice. Large welfare costs of borrowing constraints mainly due to undercapitalized enterprises, rather than to barriers to entry into entrepreneurship.
- Quadrini, 2000. General equilibrium model of entrepreneurial choice that successfully replicates the wealth concentration observed in the US economy.

Related Literature (cont.)

- Cagetti and De Nardi, 2006. Model of occupational choice in a life cycle model with intergenerational altruism with endogenous borrowing constraints. As in Quadrini, 2000, the model generates a wealth distribution that matches the one observed in the US.

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- Hurst and Lusardi, 2004. Empirical evidence on the importance of borrowing constraints for entrepreneurship. At least for the US, low assets do not seem to prevent entrepreneurs to engage in profitable ventures.
- Mondragón and Peña, 2009. Business owners are more closely linked to what the literature traditionally defines as entrepreneurs.

Empirical evidence

- Importance of entrepreneurship in Colombia.

Table 1

Percentage share of total workforce and total income, and mean and median monthly income in thousand of 2004 pesos by occupations

	% Share in Workforce	% Share of Income	Income	
			Mean	Median
Business owners	4.1	13.7	2,142	1,320
White-collar workers	29.5	38.6	921	817
Self-employed	39.0	32.0	580	451
Blue-collar workers	21.0	13.1	436	363

Source: Own calculations based on the ENH.

Empirical evidence (cont.)

- Income inequality in Colombia.

Table 2

Percentage share in various percentiles of income

	Income Percentile, Top			
	1%	5%	10%	20%
Business owners	43	41	38	37
White-collar workers	21	23	24	19

Source: Own calculations based on the ENH.

Empirical evidence (cont.)

- Behavior of real interest rates in Colombia.

Table 3

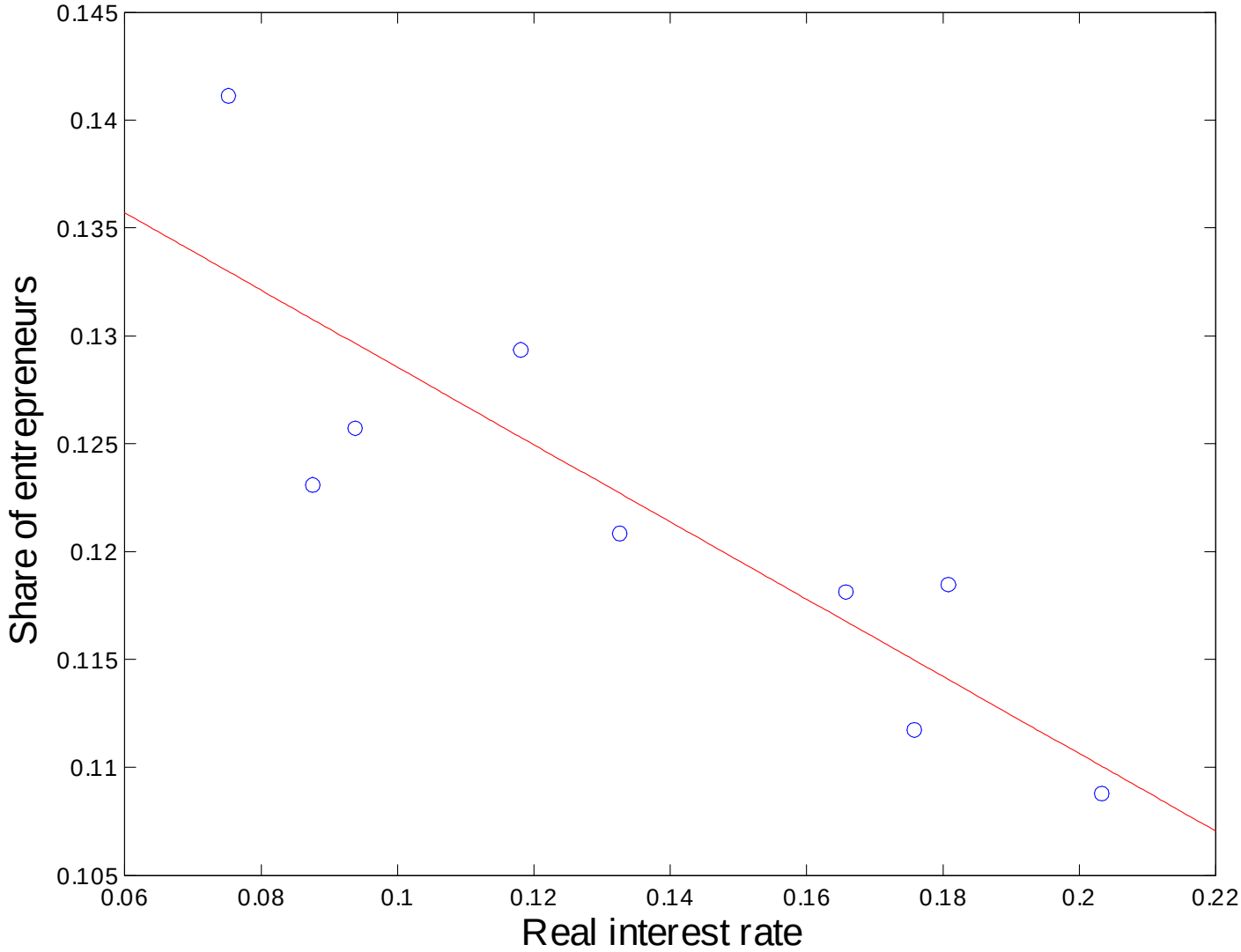
Real interest rate, %

	Mean	Standard Deviation
1996:1-1999:12	16.94	4.03
2000:1-2004:12	9.23	1.78
Whole sample	12.65	4.87

Source: Own calculations based on information from the Central Bank of Colombia.

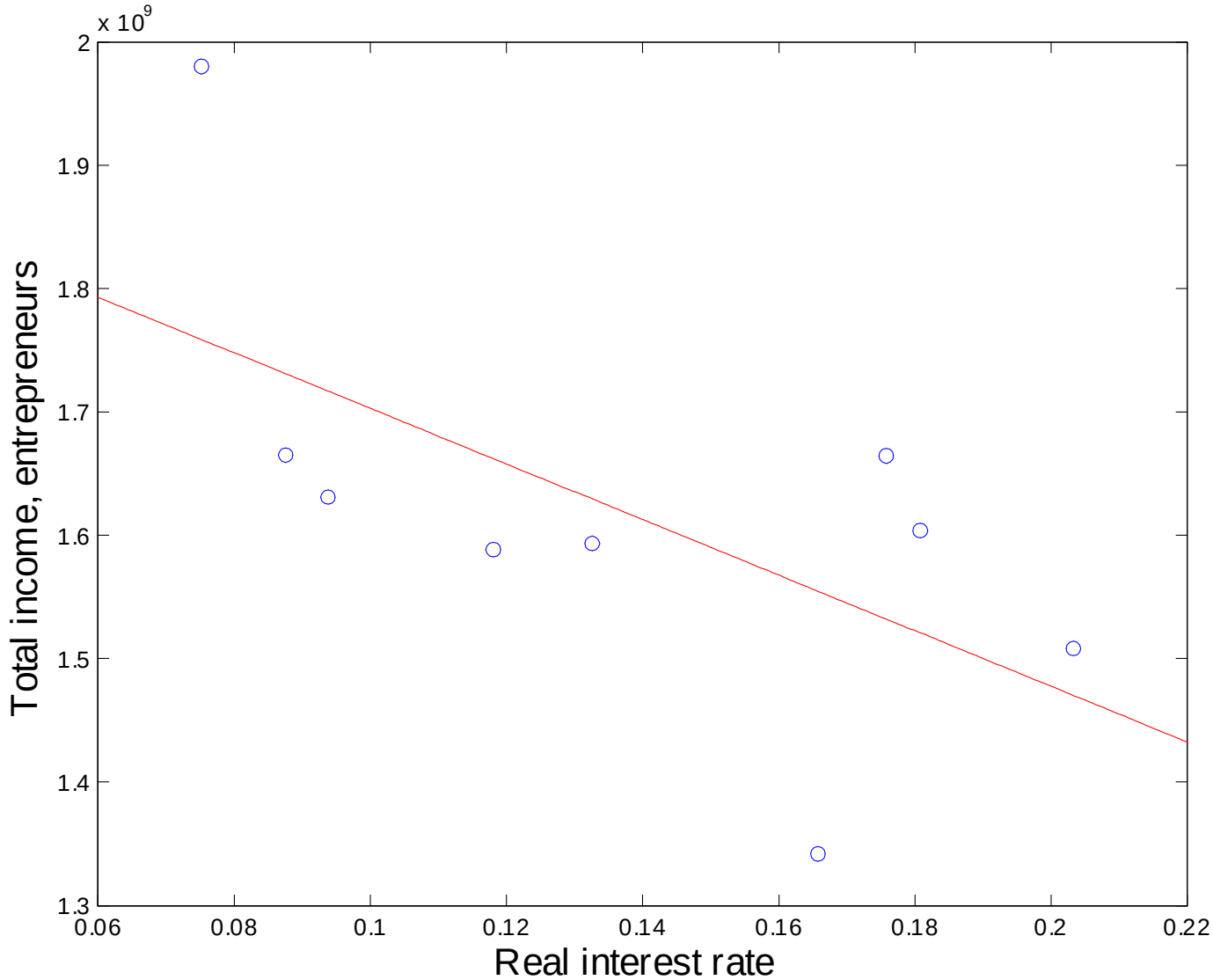
Empirical evidence (cont.)

- Suggestive evidence: impact of interest rates on the extensive margin.



Empirical evidence (cont.)

- Suggestive evidence: impact of interest rates on total profits.



Environment

Preferences and Occupational Choice

- Continuum of unit mass of individuals with preferences:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t\right),$$

where $\beta \in (0,1)$ and

$$u\left(c_t\right) = \frac{c_t^{1-\sigma}}{1-\sigma}, \qquad \sigma > 0.$$

Environment (cont.)

Technology in the Entrepreneurial Sector

- Each person is endowed with a stochastic entrepreneurial ability $\theta_t \in \left[0, \bar{\theta}\right]$.

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Environment (cont.)

Technology in the Entrepreneurial Sector

- Each person is endowed with a stochastic entrepreneurial ability $\theta_t \in \left[0, \bar{\theta}\right]$.
- θ_t follows a first-order Markov process with transition probability $\pi_{\theta\theta'}$.
- Output y_t of an entrepreneur with ability θ_t that invests capital k_t:

$$y_t = \theta_t k_t^v, \qquad v \in [0, 1].$$

Environment (cont.)

Technology in the Corporate Sector

- Standard Cobb-Douglas production function:

$$Y_t^c = K_{c,t}^{\alpha} L_{c,t}^{1-\alpha}, \qquad \alpha \in [0,1].$$

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$$Y_t^c = K_{c,t}^{\alpha} L_{c,t}^{1-\alpha}, \qquad \alpha \in [0,1].$$

- Capital in both sectors depreciates at the rate $\delta \in [0,1]$.

Environment (cont.)

Market Structure

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- The economy is small and open.
- There is an external sector that is willing to lend to entrepreneurs at the rate r_t, the economy-wide equilibrium interest rate.
- r_t follows a first-order Markov process with transition matrix $\pi_{rr'}$.

Agent's Decisions

- At the beginning of each period an agent observes θ_t, r_t and his assets a_t.

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  - Whether to become an entrepreneur, or work at wage w_t in the corporate sector (occupational choice).
  - How much to consume and save (consumption-savings choice).
- Borrowing constraints: an entrepreneur can invest at most a proportion $(\lambda - 1)$ of his assets a_t. That is,

$$k_t \leq \lambda a_t.$$

Entrepreneur's Investment Problem

- Given $(a_t, \theta_t; r_t)$, the optimal investment is the solution to:

$$\pi_t = \max_{k_t \leq \lambda a_t} \theta_t k_t^v + (1-\delta) k_t - (1+r_t) k_t.$$

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- Optimal scale:

$$k_t(a_t; \theta_t, r_t) = \min \left\{ \left(\frac{\theta_t v}{r_t + \delta} \right)^{\frac{1}{1-v}}, \lambda a_t \right\}.$$

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- Define the indirect profit function

$$\pi_t(a_t; \theta_t, r_t) \equiv \theta_t k_t(a_t; \theta_t, r_t)^v - (r_t + \delta) k_t(a_t; \theta_t, r_t).$$

Individual's Problem

- Thus,

$$V(a;\theta,r) = \max_{c,a'} u(c) + \beta \mathbb{E} V\left(a';\theta',r'\right), \tag{1}$$

subject to

$$\begin{aligned} a' &= (1+r)\,a + \max\left\{w(r), \pi(a;\theta,r)\right\} - c. \\ a &\geq 0. \end{aligned}$$

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- The expectation in the RHS of V is taken with respect to $\left(\theta',r'\right)$ conditional on (θ,r).

Equilibrium

Definition

Given factor prices r and w, a recursive competitive equilibrium consists of a value function $V(\cdot)$ and decision rules $c(\cdot)$, $k(\cdot)$, $a'(\cdot)$ such that, given r and w:

1. The decision rules $c(\cdot)$, $k(\cdot)$, $a'(\cdot)$ are optimal, i.e., they solve the problem described in 1 and $V(\cdot)$ is the associated value function;
2. Factors are paid their marginal product in the corporate sector, i.e., $r + \delta = \alpha k_c^{\alpha - 1}$ and $w = (1 - \alpha) k_c^{a}$, where $k_c \equiv K_c / L_c$ is the capital-labor ratio in the corporate sector; and
3. Capital and labor markets clear.

Equilibrium (cont.)

Theorem

For any interest rate r there exists a unique entrepreneurial threshold $\underline{\theta}(a)$ such that any agent with ability $\theta \geq \underline{\theta}(a)$ and wealth a will decide to become an entrepreneur. Moreover, $\underline{\theta}'(a) < 0$, i.e., wealthier individuals enter entrepreneurship at lower ability levels.

Equilibrium (cont.)

Proof.

The entrepreneurial threshold $\underline{\theta}$ that identifies the marginal entrepreneur satisfies

$$\Delta \equiv \pi\left(a, \underline{\theta}; r\right) - w = 0. \tag{2}$$

By the envelope theorem,

$$\frac{d\pi\left(a, \theta; r\right)}{d\theta} = k\left(a, \theta; r\right)^{v} > 0,$$

so the first term in the RHS of equation (2) is strictly increasing in θ. The result follows since $w > 0$. Moroever,

$$\underline{\theta}'\left(a\right) = -\frac{\mu\lambda}{k\left(a, \underline{\theta}; r\right)^{v}} \leq 0.$$

Equilibrium (cont.)

- Static effect on the intensive margin:

Lemma

The optimal scale of the enterprise falls with r, i.e., $dk(a;\theta,r)/dr \leq 0$, with strict inequality if and only if the borrowing constraint is not binding.

Equilibrium

- Static effect on the extensive margin:

Theorem

Consider the marginal entrepreneur with wealth a, i.e., the individual with ability level $\underline{\theta}(a)$, where $\underline{\theta}(a)$ satisfies $\Delta \equiv \pi(a;\underline{\theta}(a),r) - w = 0$. Then, $d\Delta/dr < 0$ if and only if $k(a;\underline{\theta}(a),r) > k_c$.

Corollary

If the marginal entrepreneur is not borrowing constrained, then $d\Delta/dr < 0$ if $\underline{\theta}v > \alpha$.

Some Evidence on the Curvature Parameter

Table 4

Evidence on the curvature parameter v

Author(s)	Value	Source
Evans and Jovanovic, 1989	0.39	National Longitudinal Survey
Cooper and Haltiwanger, 2006	0.60	Longitudinal Research Dataset
Quadrini, 2000	0.78	Calibration
Cagetti and De Nardi, 2006	0.88	Calibration

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- Calibrated parameters:
  - Look for a stochastic process for the interest rate with a long-run average of $r_\mu = 12.6\%$ and a standard deviation of $r_\sigma = 4.9\%$. Using a standard Tauchen-Hussey quadrature-based procedure, this gives a ten-state Markov process with $r \in [0.056, 0.195]$.

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  - I assume that the discount rate is 0.20 so that $\beta = 0.80$

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  - θ has support with just two realizations: zero (no entrepreneurial ability) and some positive number, θ_1. Thus, the transition matrix for the ability process, Π_θ, is a 2×2 matrix. Since its rows must add up to one, this gives two additional parameters to be calibrated.

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    - the long-run average of the income Gini coefficient, 0.49; Birchenall, 2001.

Quantitative Analysis (cont.)

TABLE 5

A. Fixed Parameters	Value
Discount factor, β	0.80
Elasticity of substitution, σ	2.00
Capital's share of income, α	0.33
Depreciation rate, δ	0.06
B. Calibrated Parameters	**Value**
Long-run average interest rate, r_μ	0.126
Std. dev. for the interest rate, r_σ	0.049
Entrepreneurial ability, θ	$\{0, 0.83\}$
Curvature of entrepreneurial sector, ν	0.79
Tightness of borrowing constraint, λ	3.23

Quantitative Analysis (cont.)

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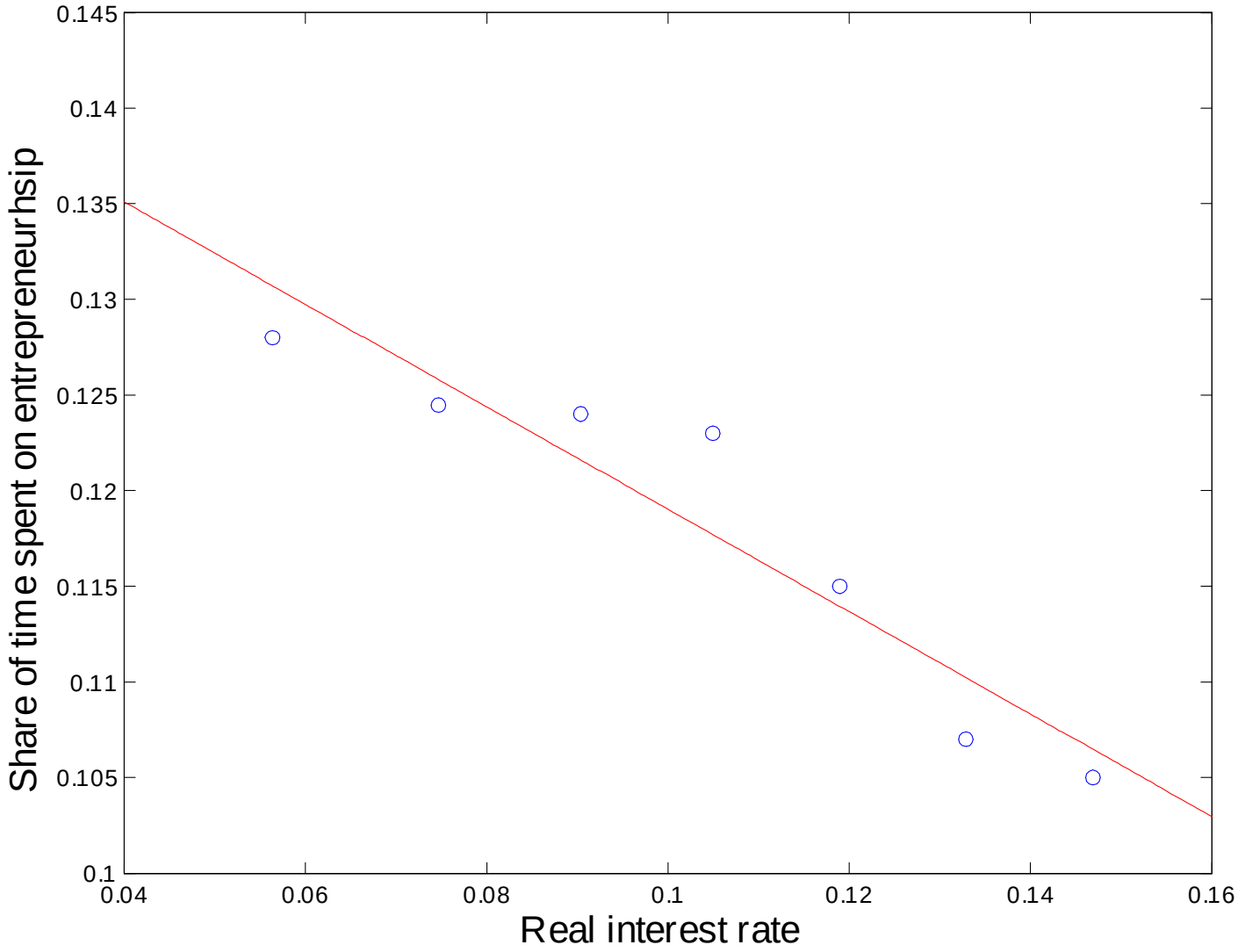
- Repeat this procedure 10,000 times.

Calibration Results

TABLE 6

Variable, correlation with r	$\lambda = 2.5$	$\lambda = 3.23$	$\lambda = 4.5$
Assets, a	0.169	0.193	0.211
	(0.031)	(0.042)	(0.021)
Entrepreneurial scale, k	−0.311	−0.394	−0.417
	(0.037)	(0.064)	(0.051)
Entrepreneurial dummy	−0.073	−0.089	−0.091
	(0.011)	(0.007)	(0.009)
Income, $(1+r)\,a + \max\{w, \pi\}$	0.121	0.137	0.194
	(0.032)	(0.041)	(0.029)
Capital-output ratio	2.58	2.71	2.87
Gini coefficient	0.45	0.49	0.50

Calibration Results (cont.)



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1. The effects of interest rate shocks are mild on the extensive margin (the correlation between an entrepreneurial dummy and the interest rate is negative but small), but
2. Significantly affect the size of the entrepreneurial sector (the correlation between the business scale and the interest rate is large and negative).
3. Moreover, a tightening of borrowing constraints leads to a reduction in income inequality at the cost of lower capital accumulation.

Counterfactual Experiment

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  - Evaluate the impact of partially insuring the economy against interest rate shocks over work choices and entrepreneurial scale.
- Re-calibrate the model under the assumption that volatility of the autoregressive process for the interest rate is cut in half, $r_\sigma = 2.4\%$.

Counterfactual Experiment (cont.)

TABLE 7

Variable, correlation with r	$r_\sigma = 4.87$	$r_\sigma = 2.43$
Assets, a	0.193	0.135
	(0.042)	(0.031)
Entrepreneurial scale, k	−0.394	−0.212
	(0.064)	(0.073)
Entrepreneurial dummy	−0.089	−0.062
	(0.007)	(0.021)
Income, $(1+r)\,a + \max\{w, \pi\}$	0.137	0.149
	(0.041)	(0.027)
Capital-output ratio	2.71	2.89
Gini coefficient	0.49	0.41

Counterfactual Experiment (cont.)

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  - The homogenization of entrepreneurial returns among agents, which leads to lower inequality and lower capital accumulation
  - A higher willingness of risk-averse agents for entering entrepreneurial activities due to a lower inherent risk, which implies lower income inequality and higher capital accumulation.

Final Remarks

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- The model examined the effects of stochastic shocks in interest rates in the context of a model of entrepreneurship in an emerging market.
- Movements in the interest rate affect the optimal scale of enterprises (the intensive margin), and the decision of whether to become an entrepreneur or not (the extensive margin).
- The model predicts an unambiguously negative effect of a higher interest rate on the intensive margin, and an ambiguous effect on the extensive margin, the latter depending whether the curvature of the entrepreneurial technology is smaller than that of the technology in the corporate sector

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Final Remarks (cont.)

- The paper then resorts to a numerical calibration of the model to fully examine the dynamic implications of stochastic shocks to the interest rate.
- The results suggest that uninsurable shocks to the interest rate have a moderate negative effect over the extensive margin of entrepreneurship and a large and negative effect on the intensive margin.
- A counterfactual exercise implies that a reduction in the volatility of the interest rate significantly dampens the negative effects of interest rates on entrepreneurial decisions, lowers overall income inequality and positively impacts capital accumulation (and hence output).