Welfare Losses from Financial Frictions: The Role of Fixed Costs

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Abstract

Are fixed costs to using financial intermediation quantitatively important in explaining income differences across-countries? I introduce fixed costs into an entrepreneurship model with financial frictions where agents are heterogeneous in their financial assets, entrepreneurial ability and labor productivity. I find that the fraction of agents using financial intermediation substantially decreases as fixed costs increase. Fixed costs as low as 11 per cent of typical year's income lower the intermediated population from almost one to one fifth. Fixed costs also reduce accumulation of capital by 20 per cent as they restrict the intermediated population. Lastly, barriers to financial intermediation play an important role in increasing wealth inequality within an economy and across economies. Aforementioned fixed costs raise the wealth Gini index from 0.78 to 0.92 and reduce income by 10 per cent. That is, the fixed costs alone can explain 10% of income difference between Belgium and Guyana.

JEL Classification: D52; D58; E44; L26; O16

Keywords: Financial frictions; Fixed costs; Financial intermediation; Incomplete market

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1 Introduction

Are fixed costs to using financial intermediation quantitatively important in explaining income differences across and within countries? This paper tries to answer the question by introducing fixed costs to using financial services in an entrepreneurship model where agents are heterogeneous in their financial assets, entrepreneurial ability and labor productivity. I find that fixed costs as low as 11 per cent of typical year's income lower the fraction of population that is intermediated from almost one to one fifth. Fixed costs also reduce accumulation of capital by 20 per cent as they restrict the intermediated population. Lastly, fixed costs play an important role in increasing wealth inequality within an economy and between economies.

Several facts support the existence of barriers to financial services. It is observed that only limited fraction of people has access to formal financial services in many developing countries. Although more than 90 per cent of households have a bank account in several European and North American countries, the fraction is less than a half in many countries in Asia, Latin America and Middle East. In many African countries, fewer than one out of five households has an account. Annual fees for checking accounts are negligible in developed countries, but they are as high as 13 per cent of per capita GDP in Kenya according to Beck et al (2009). There is also evidence of the households' willingness to *pay* for saving. Dupas and Robinson (2009) show that daily income earners face important savings constraints and have a demand for formal saving devices in their experiment in Kenya. The barriers to financial service can be captured by the fixed costs to use financial services in the model.

In addition to the fixed costs that limit the population using financial services, I also consider the cross country difference in financial depth by using collateral constraints that limit the volume of external financing. While both accessibility to and depth of financial services have positive relationships with per capita income, they show a different picture

among low-income and middle-income economies. Figure 1 suggests that fixed costs to financial services could be more important in distinguishing low-income and middle-income countries. Therefore, the paper considers the effects of financial frictions of two types: collateral constraints that limit the volume of external financing and fixed costs that limit the population using financial services.

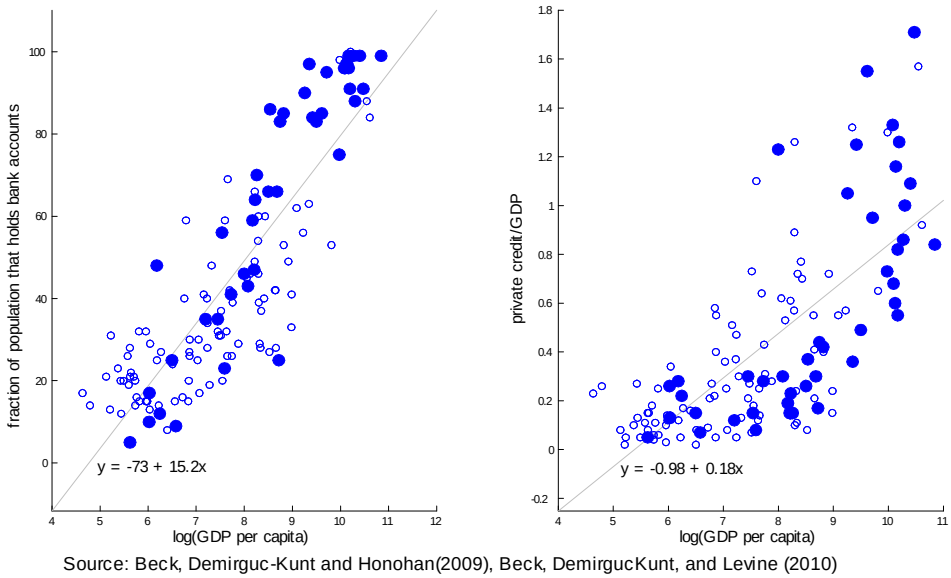


Figure 1: Accessibility to and Depth of Financial Intermediation. The composite indicator measures the percentage of the adult population with access to an account with a financial intermediary. For any country with data on access from a household survey, the survey percentage is given.These are 46 countries out of 135 countries in the sample and are expressed in filled dots. For the other two thirds countries, the fraction is constructed as a function of the estimated number and average size of bank accounts. The full data set is provided in the appendix.

Related Literature Intermediation costs are posited in modeling growth and endogenous financial deepening in Greenwood and Jovanovic (1990). Townsend and Ueda (2006) quantitatively investigate the linkages among economic growth, financial structure, and inequality where financial intermediaries offer savers higher and safer return for one-time and per-period costs. Most recently, Greenwood et al. (2010) estimate the impact of financial development on economic development in an economy where financial intermediaries cannot observe firms' productivity costlessly.

Among early studies of models featuring heterogeneity and incomplete capital markets, Huggett (1993) and Aiyagari (1994) show that the precautionary saving motive from uninsurable idiosyncratic shocks lowers the capital rental rate by accumulating more capital stock. A recent related literature shows that both self-financing and financial frictions are important. With persistent shocks, self-financing can substitute for well-functioning capital rental market (Buera and Shin, 2010). Furthermore, Moll (2010) argues that self-financing can undo capital misallocation from financial frictions.

2 Model

The model of this paper follows the setup of Buera and Shin (2011) in being a one-sector model with an incomplete financial market with collateral constraints. Additional features of the model are fixed costs to using financial services and shocks to labor endowments. For simplicity, the per period fixed costs are symmetric to whether an individual saves or borrows. Each period, an agent makes an occupational choice and a decision whether to use financial services or not. Lastly, agents are heterogeneous in wealth, entrepreneurial talent, and labor endowment. Since the model is mainly interested in cross sectional differences resulted from degree of financial frictions, aggregate shocks are not considered.

2.1 Heterogeneity

Individuals live indefinitely, and are heterogeneous with respect to their wealth a and their entrepreneurial talent and labor productivity. At the beginning of each period, an individual is endowed with a vector of idiosyncratic shocks $z = (z_e, z_w)$ where z_e is an entrepreneurial idea and z_w is a labor productivity as a worker. Each individual chooses whether to work for wages or run a business and makes a forward-looking saving decisions. At the same time, she makes a decision whether to use costly financial services or not. ((Workers can save at banks for interest return, while entrepreneurs can either save or borrow from banks subject to a collateral constraint. Among financially unintermediated people, only entrepreneurs

are able to store their wealth in the form of physical capital. Unintermediated workers are considered to live from hand to mouth.)) Therefore, there are four types of individuals-entrepreneur using financial services, entrepreneur not using financial services, workers using financial services and workers not using financial services.

Entrepreneurial talent z_e is assumed to follow an autoregressive process with i.i.d. normal innovations, $\log z_e' = \rho \log z_e + \varepsilon, \varepsilon \sim N(0, \sigma_\varepsilon^2)$. The process is discretized as a nine-state Markov chain using Tauchen's (1986) algorithm.

Labor productivity z_w has two states and its transition matrix is given as a two-state Markov chain:

$$\Pi = \begin{bmatrix} \pi_{ll} & \pi_{lh} \\ \pi_{hl} & \pi_{hh} \end{bmatrix}$$

where π_{jk} is the conditional probability that a worker with the productivity $j \in \{l, h\}$ will be endowed with $k \in \{l, h\}$ in the next period. A worker may want to save despite the costs of saving because she has the risk of a falling labor productivity in the future. z_e and z_w are assumed to be independent each other.

2.2 Preferences and Technology

Individual preferences are described by the following standard expected utility function:

$$U(c) = \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t u(c_t)\right], u(c_t) = \frac{c^{1-\sigma}}{1-\sigma}$$

where β is the discount factor and σ is the coefficient of relative risk aversion. There's no utility from leisure, so workers provide labor inelastically.

An entrepreneur with talent z_e produces using capital k and effective labor l according to:

$$z_e f(k, l) = z_e k^\alpha l^\nu$$

where $\alpha + \nu < 1$ implies diminishing returns to scale.

Given unit labor income w and interest rate r, the profit of an entrepreneur makes is:

$$\begin{aligned}\pi(k,l;r,w) &= \max\{z_e f(k,l) - (r+\delta)k - wl - \mathcal{I}(k)(1+r)\kappa\} \\ &\text{subject to } k \leq \lambda a \\ &\text{where } \mathcal{I}(k) = \begin{cases} 0, k = a \\ 1, k \neq a \end{cases}\end{aligned}$$

where δ is the depreciation rate of capital, $\mathcal{I}(k)$ is an indicator function, and κ units of output are the per period fixed costs to use financial services. Capital rental rate is $r + \delta$. For convenience, it is assumed that individuals pay fixed costs κ at the end of each period when they repay the borrowed capital. This is why the fixed costs incur interest. An entrepreneur's capital rental k is limited by a collateral constraint $k \leq \lambda a$ where a denotes financial assets at the beginning of the period and λ measures the degree of credit frictions, with $\lambda = \infty$ corresponding to perfect capital rental markets. Everyone in a given economy is subject to the same level of λ. In this setup, both borrowing and capital rental are within a period, that is, individuals' wealth is non-negative, $a \geq 0$. Therefore, while an entrepreneur can either borrow or save, a worker uses financial intermediation only when she wants to save. Intertemporal borrowing for consumption is not allowed.

Two types of financial frictions play role when entrepreneurs determine the factor inputs. In terms of λ,the unrestricted optimal level capital k^u is chosen if the collateral constraint is not binding, that is, $a \geq \frac{k^u}{\lambda}$. However, entrepreneurs set $k = \lambda a$ when the collateral contraint binds, or $a < \frac{k^u}{\lambda}$. In this case, the marginal product of capital is $r + \delta + \mu(a)$, when $\mu(a)$ is the multiplier of the collateral constraint. The deviation of shadow price of capital for constrained entrepreneurs is a source of aggregate productivity losses. In addition to the collateral constraint, fixed costs affect the decision rule for capital. when entrepreneurs are willing to pay fixed costs to use financial intermediation, the unrestricted optimal level capital k^u is chosen. But they decide not to use finanical services and run the business in the scale of their own assets when the fixed costs exceed additional profits from external financing or when their financial assets are close enough to the optimal level of capital. Putting two

types of financial frictions together, the solution for profit maximizing capital stock is:

$$k = \begin{cases} a, & a < \tilde{k} \\ \lambda a, & \tilde{k} < a < \frac{k^u}{\lambda} \\ k^u, & \frac{k^u}{\lambda} < a < \underline{k} \\ a, & \underline{k} < a < \bar{k} \\ k^u, & a > \bar{k} \end{cases} \tag{1}$$

where $\tilde{k}$ is the smaller root of the equation, $\pi(\tilde{k}) = \pi(\lambda\tilde{k}) - (1+r)\kappa$ and $(\underline{k}, \bar{k})$ satisfy $\pi(\underline{k}) = \pi(\bar{k}) = \pi(k^u) - (1+r)\kappa$. The unrestricted optimal level of capital and labor inputs, that is, k and l under neither fixed costs nor collateral constraints, are defined as:

$$(k^u, l^u) = \arg\max\{zf(k,l) - (r+\delta)k - wl\}$$

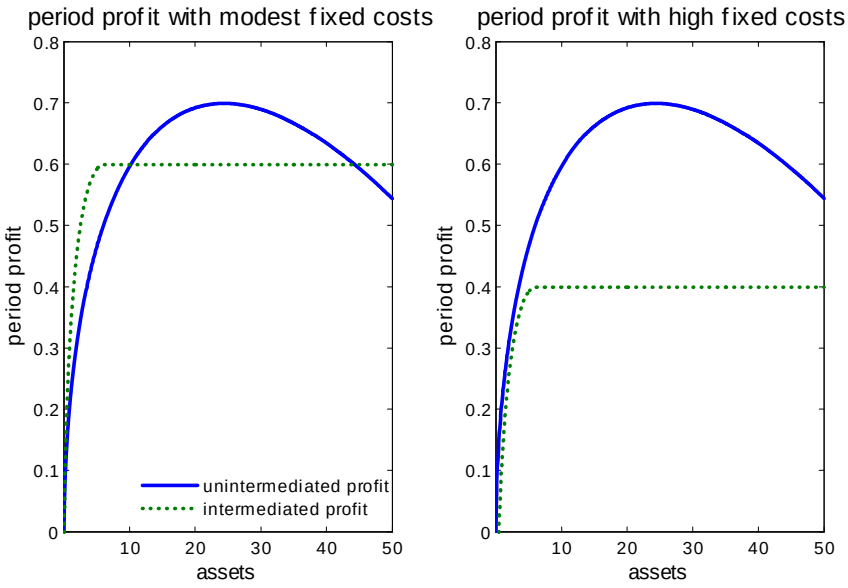
The solution for the unconstrained problem is $k^u = \left[z(\frac{\alpha}{r+\delta})^{1-\nu}(\frac{\nu}{w})^{\nu}\right]^{1/(1-\alpha-\nu)}$. Relative size of cutoff asset levels strictly depends on the degree of financial frictions. For example, there is no roots for the equation for $\tilde{k}$ because profit with financial intermediation is lower than unintermediated profit for all asset levels, hence $k = a$ for all a. The period profits under intermediation and non-intermediation are shown in the Figure 2.

2.3 Value Function Representation

At the beginning of each period, an individual solves:

$$\begin{aligned} V(a,z) &= \max\{V^e(a,z), V^w(a,z)\} \\ &\qquad \text{s.t. budget constraint and collateral constraint} \end{aligned}$$

where $V^e(a,z)$ is the value of being an entrepreneur, and $V^w(a,z)$ is the value of being a worker.



As an entrepreneur, an individual makes her financial service decision, and chooses consumption c, factor inputs (k, l), and the next period's assets a' to maximize her continuation value subject to the period budget constraint and collateral constraint:

$$
\begin{aligned}
V^e(a,z) &= \max\left\{V^{ei}(a,z), V^{eu}(a,z)\right\} \qquad (2)\\
V^{ei}(a,z) &= \max_{c,a',k,l\geq 0}\left(u(c)+\beta\mathop{\mathbb{E}}_{z'}V(a',z')\right)\\
\text{s.t. } c+a' &\leq z_e f(k,l)-(r+\delta)k-wl+(1+r)(a-\kappa)\\
k &\leq \lambda a\\
V^{eu}(a,z) &= \max_{c,a',l\geq 0}\left(u(c)+\beta\mathop{\mathbb{E}}_{z'}V(a',z')\right)\\
\text{s.t. } c+a' &\leq z_e f(a,l)-wl+(1-\delta)a
\end{aligned}
$$

where $V^{ei}(a,z)$ is the value of being an entrepreneur who uses financial intermediaries by paying fixed costs κ and $V^{eu}(a,z)$ is the value of being an financially unintermediated entrepreneur whose capital equals her financial assets $(k=a)$.

A worker also makes a financial service decision and chooses consumption c and next

period's asset a' subject to budget constraint:

$$\begin{aligned} V^w(a,z) &= \max\left\{V^{wi}(a,z), V^{wu}(a,z)\right\} \\ V^{wi}(a,z) &= \max_{c\geq 0, a'\geq 0}\left(u(c)+\beta\mathop{\mathbb{E}}_{z'}V(a',z')\right) \\ \text{s.t. } c+a' &= wz_w+(1+r)(a-\kappa) \\ V^{wu}(a,z) &= u\left(wz_w+(1+r)a\right)+\beta\mathop{\mathbb{E}}_{z'}V(0,z') \end{aligned} \tag{3}$$

where $V^{wi}(a,z)$ is the value of being an financially intermediated worker by paying fixed costs κ and $V^{wu}(a,z)$ is the value of being an unintermediated worker. A worker who is not intermediated has to consume all of her wage income and the gross return on her assets this period, hence next period's asset will be zero. $o(a,z)\in\{ei,eu,wi,wu\}$ denotes the optimal occupational and financial service decision.

2.4 Stationary Competitive Equilibrium

A stationary competitive equilibrium is composed of: an invariant distribution of assets, entrepreneurial ideas, and labor endowment $G(a,z)$; occupational and financial service choice function $o(a,z)$, and policy functions $c(a,z), a'(a,z), l(a,z)$, and $k(a,z)$; and prices w and r so that:

1. Given w and r, the individual policy functions solve (1) - (3).

2. Capital rental, labor and goods markets clear.

   (Capital rental market)

$$K\equiv\int_{o(a,z)\in\{ei,eu\}}k\left(a,z\right)dG(a,z)=\int_{o(a,z)\in\{ei,eu,wi\}}adG(a,z)$$

   (Labor market)

$$\int_{o(a,z)\in\{ei,eu\}}l(a,z)dG(a,z)=\int_{o(a,z)\in\{wi,wu\}}z_w dG(a,z)$$

(Goods market)

$$\int c(a,z)dG(a,z) + \kappa \int_{o(a,z)\in\{ei,wi\}} dG(a,z) + \delta K = \int zk(a,z)^{\alpha} l(a,z)^{v} dG(a,z)$$

3. The distribution is stationary with the equilibrium mapping:

$$G(a,z) = G(a'(a,z),z)$$

3 Quantitative Results

In this section, I choose the model parameters from the related literature so that the baseline model resembles the post war U.S. economy. I then assess the effect of financial frictions by varying the parameters governing the degree of credit constraints and of barriers to using financial services. In particular, by varying the degree of fixed costs, we could isolate the effects of the fixed costs on accessibility to financial services, depth of financial market, and wealth distribution within an economy and across economies.

One of the main results is that fixed costs reduce accumulation of capital by restricting the financially intermediated population. In particular, the capital stock falls by a fifth when the fixed costs to using financial services increase from 0.2 per cent to 11 per cent of average income. In addition, fixed costs increase wealth inequality within an economy.

3.1 Parameters

Parameters are chosen to mimic the postwar U.S. data and they are comparable to the relevant litarature as in Table 1.

Parameters are chosen from the relevant literature as in Table 1. For the decreasing returns to scale production, $\alpha+\nu$ controls the fraction of output going to the entrepreneurial input. α is set at 0.3 to match the aggregate share of capital in output. ν is chosen at 0.5 from Buera and Shin (2011) where they match the fraction of total income accounted for by the top

five per cent of earners in the population. The depreciation rate and preference parameter are set to standard values at $\delta = 0.06$ and at $\sigma = 1.5$. The process of entrepreneurial idea is set at $\sigma_\varepsilon^2/(1-\rho^2) = 0.39$−the unconditional variance of the log entrepreneurial productivity− to match the fraction of labor employed by the largest ten per cent of establishments, 0.63. [1] The subjective discount factor is set at $\beta = 0.92$ to match an annual interest rate of four per cent. The transition matrix of labor endowment is chosen in the way that nine per cent of agents are endowed with low labor productivity in the stationary distribution.

Fixed parameters		Basis
Technology	$\alpha = 0.3, \nu = 0.5$	BS(2011)
Depreciation rate	$\delta = 0.06$	"
CRRA	$\sigma = 1.5$	"
Subjective discount factor	$\beta = 0.92$	
Process for entrepreneurial idea	$\rho = 0.98, \sigma_\varepsilon = 0.124$	BS(2011)
Transition matrix of labor endowment	$\begin{bmatrix} 0.425 & 0.575 \\ 0.05 & 0.95 \end{bmatrix}$	Hugget(1993)
Parameters to be varied		
Collateral constraint	$\lambda = 5$ for baseline	
Fixed costs to using financial services	$\kappa = 0.01$ for baseline	

TABLE 1: PARAMETER VALUES

The two parameters associated with financial frictions do not have exact counterparts in data. Nevertheless, λ is conventionally inferred from ratio of external finance to GDP in many studies. BS(2011) sets $\lambda = 5$ for the U.S. and $\lambda = 1.5$ for emerging countries. Similarly, Moll(2010) uses 4.15 for the U.S. and 1˜2 for developing countires such as Columbis, Chile, India and China. Midrigan and Xu(2010) sets $\lambda = 2.58$ for Korea. On the other hand, Khan

[1] Buera and Shin (2011) pick $\sigma_\varepsilon^2/(1-\rho^2) = 0.39$, then choose $\rho = 0.98$ for their benchmark model in accordance with the consensus within the standard Bewley literature that idiosyncratic income shocks are quite persistent, although there is no reliable estimate for the persistence. In their experiments, the level of ρ is varied.

and Thomas(2011) uses relatively tight collateral contraint for the U.S. by seting $\lambda = 1.28$ for the U.S. I set $\lambda = 5$ for the baseline model. Fixed costs to using financial services is more difficult to be inferred because there are no data that we can match for the fixed costs. the model abstracts from the banking sector, there is no interest rate margin between borrowing rate and lending rate. Fixed costs are assumed to be symmetric both to savers and borrowers. In addition, fixed costs include measurable and non-measurable barriers to financial services such as actual fees, accessibility to bank branches or ATMs, required minimum amount of savings or loans, documentation for loan application, and forgone time spent on application, etc. Given the limited ability to guess fixed costs, I set $\kappa = 0.05$(?) units of output for the baseline model. According to the xxx, the annual fees of checking account is about 0.2 per cent of per capita GDP both in United Kingdom and the United States and average costs for making a loan.....[2]

3.2 Baseline model

The baseline model is designed to mimic post-war U.S. economy. In Table 2, the model generates high concentration of wealth and income that is observed in the U.S. data. Invariant stationary density of financial assets is shown in Figure 2. Agents are endowed with enough assets initially. Then, the stationary distribution is generated by updating the initial distribution using each agent's policy for next period's assets until the distribution converges. Figures for policy function(?)

Income share of the top five percentile earners is reported as 0.3 in Cagetti and De Nardi (2006). Using the span-of-control parameters determined so to hit the target 0.3, our benchmark economy shows a very close income share, 0.29. Wealth share of top five percentile and wealth Gini index of the benchmark is lower than that of the U.S. economy from Diaz-Gimenez, Quadrini and Rios-Rull (1997), implying that the income distribution of the benchmark is less dispersed than the U.S. The ratio of external finance to GDP and

[2]The data for annual fees come from World Bank(2007) for United Kingdom and from GAO(2008) for the United States.

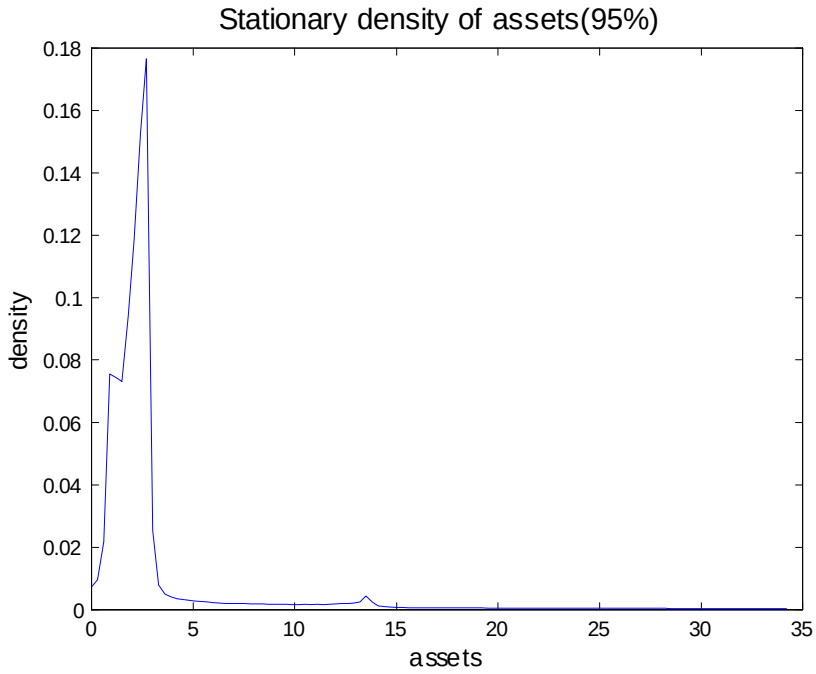


Figure 2: Invariant Density of Financial Assets. Since the density has very long tail, the figure shows only 95% of the distribution for presentation purpose.

participation ratio to financial services can be considered as immediate results of the two types of financial frictions in the model economy. Benchmark economy($\lambda = \infty$) generates a higher ratio of external finance to GDP than that of the U.S. It implies that the U.S. economy is away from perfect capital rental markets.[3] It also has greater accessibility to financial intermediation than the U.S. In the benchmark of our model economy, 99 per cent of agents pay the fixed costs and use financial services. According to the composite measure of access to financial services by the World Bank, the ratio is 91 per cent for the U.S. Fixed costs are equivalent to 0.2 per cent of per capita income in our benchmark. In terms of the fraction of entrepreneurs in the population and the exit rate, which measures how many entrepreneurs switch their job to worker in stationary equilibrium, our benchmark economy is close to the U.S. economy. For the next step, model predictions will be explored by varying λ and κ. Add Lorenz curve.

[3] $\lambda = 4$ generates the external finance ratio of 1.75 that is close to that of the U.S.

	Model	U.S. Data
Income share of top 5%	0.29	0.30
Wealth share of top 5%	0.56	0.54
Wealth Gini index	0.69	0.78
Participation to financial services	0.99	0.91
Ratio of external finance to GDP	2.00	1.71
Fraction of entrepreneurs	0.10	0.08
Exit rate	0.09	0.10
Capital to output	2.8	3.0
Interest rate	0.04	0.04
Fixed costs to average income	0.002	0.002

TABLE 2: MOMENTS OF BENCHMARK AND U.S. ECONOMY[4]

3.3 Welfare Effects of Fixed Costs

Collateral constraint is more restrictive in developing countries. In this section,

We now explore the role of fixed costs in an economy with restrictive collateral constraints ($\lambda = 1.5$).[5] The impact of fixed costs is summarized in Table 3. Those who do not use financial services substantially increase as fixed costs increase. In particular, the participation ratio falls from 99 per cent to 20 per cent when the capital market is incomplete. The ratio of external finance to GDP falls from 0.79 to 0.59. Degree of fixed costs κ is disciplined by the range of accessibility data that are associated with the actual range of private credit. In particular, the participation ratio of developing countries of which private credit ratio are in the range of $0.5 - 0.9$ is bounded by 20 per cent. Therefore, the largest fixed cost in the experiment is pinned down so that the model economy yields approximately 20 per cent of

[4]US data for external finance is the average of private credit by deposit money banks and other financial institutions to GDP according to Beck et al. (2010) in years 1999-2003

[5]I pick $\lambda = 1.5$ as it yields an equilibrium external finance to GDP ratio of a typical developing economy, 0.6-0.8 according to Beck et al (2010). Our model economy with $\lambda = 1.5$ and low κ results in the above-mentioned ratio of 0.8. Effects of fixed costs under different degrees of collateral constraints are qualitatively the same as the results analyzed in this section.

participation ratio at that level of fixed costs. Among the countries with private credit ratio of $0.5 - 0.9$, European countries such as Sweden, Finland and Belgium have participation ratio near one while Bolivia (30 per cent) and Guyana (20 per cent) are at the bottom.

Interest rate rises from 0.3 per cent to 2 per cent with high fixed costs. Given a collateral constraint, more barriers raise the rental rate of capital because lower participation to financial services reduces the available loanable funds, i.e., savings, in the economy. When we recall that interest rates fall as collateral constraints become tighter (lower λ) due to stronger precautionary saving or self-financing motive, the aforementioned fact implies that the two types of financial frictions might counteract each other in determining equilibrium interest rates. Fixed costs tend to suppress savings by more than they do demand for capital. It is likely that fixed costs are more important for workers (savers) than entrepreneurs (borrowers) because only small scale entrepreneurs would respond to higher fixed costs.

The wealth distribution becomes more concentrated as fixed costs increase. In particular, the wealth Gini index increases from 0.78 to 0.92 as fixed costs increase from 0.2 per cent to 11 per cent of per capita income. According to Davies et al (2009), the wealth Gini index of Brazil, Chile, Guatemala and Swaziland is about 0.78 which is already higher than the most of countries. At the extreme, there are Namibia and Zimbabwe with the wealth Gini index of 0.85.[6] Considering that tighter collateral constraints raise the wealth Gini index from 0.69 to 0.78 given small degree of fixed costs, the fixed costs tend to play an important role in wealth inequality within an economy.

Fraction of entrepreneurs is stable across degrees of fixed costs and its change is not monotonic. It increases only modestly as fixed costs increase, but a bunch of people chooses to be an unintermediated worker rather than to be a self-financed entrepreneur when fixed costs increase exceeding a threshold level. In this case, even decently paid workers tend to be unintermediated.[7] Exit ratio exhibits similar movements with the fraction of entrepreneurs.

[6] Davies et al (2009) estimates the distribution of global household wealth of the year 2000 using households' balance sheet and survey data. The top 10 per cent owns 71 per cent of world wealth, and the world Gini index is estimated to be 0.802 which coincides with that of the US, 0.801.

[7] When fixed costs are high, average income of unintermediated workers, who constitute 77 per cent of the population, is 96 per cent of the average income of intermediated workers.

Aggregate measures of capital, output and consumption are decreasing in fixed costs. Capital falls by 20 per cent in our experiment. The degree of reduction is greater in capital than output and consumption which fall by 10 per cent.[8] The 10 per cent reduction in output explains about 10 per cent of the income difference between Belgium on the one hand and Guyana on the other. Welfare is built as a perfectly-egalitarian measure of economy-wide wellbeing, which is used in Buera and Shin (2011). Hence, the welfare costs are in units of permanent consumption compensation that is necessary to make an individual indifferent between the two economies. The measure of welfare is reduced by 15 per cent when the fixed costs are high.

	Baseline	Constrained Economy		
	$\lambda = 5$	$\lambda = 1.5$		
degree of fixed costs κ[9]	low κ	low κ	mid κ	high κ
Participation to financial services	0.99	0.99	0.94	0.20
Ratio of external finance to output	2.0	0.79	0.74	0.59
Interest rate	0.04	0.003	0.003	0.02
Wealth share of top 5%	0.56	0.63	0.64	0.74
Wealth Gini index	0.69	0.78	0.80	0.92
Percent of entrepreneurs	0.10	0.10	0.11	0.09
(entrepreneurs not using financial services)	0.004	0.003	0.03	0.02
Exit rate	0.09	0.10	0.15	0.09
Capital		100	100	80
Output		100	100	90
Consumption		100	96	90
Egalitarian Welfare		100	95	85

TABLE 3: IMPACT OF FIXED COSTS

[8] Consumption falls by slightly more than output because fixed costs eat up part of output.
[9] low, mid and high κ are equivalent to 0.2%, 7% and 11% of average period income

3.4 Welfare Effects of Collateral Constraints

When we vary the degree of collateral constraints with keeping fixed costs minimal, the model yields stationary equilibria that are compatible with results from earlier work such as Buera and Shin (2011). When the collateral contraints become tigher from $\lambda = \infty$ to $\lambda = 1.5$, interest rate falls from 4 per cent to 0.3 per cent. Economies with worse credit markets have a lower interest rate because of entrepreneurs' lower demand for capital and higher savings due to self-financing motive. The ratio of external finance falls from 2, which is higher than that of U.S., to 0.8 which is consistent with the ratio of middle-income countries. Capital and output fall by 14 per cent and 7 per cent respectively as shown in Figure 3. ((CORRECT THE GRAPH))

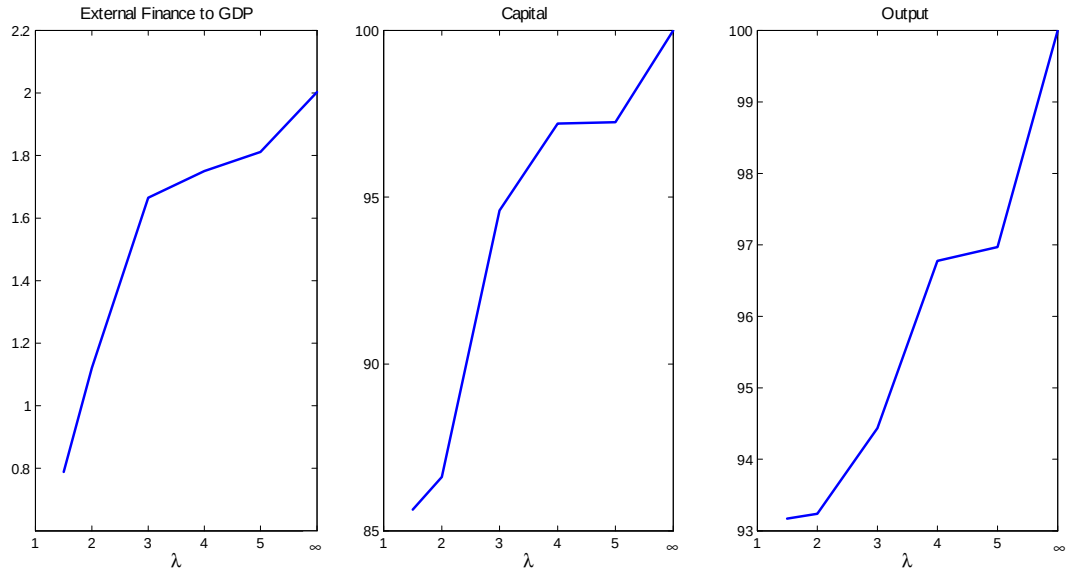


Figure 3: Effect of Collateral Constraints. Stationary equilibria are computed for various values of λ, while fixed costs are held low. Note that a lower λ implies tighter constraints.

4 Conclusion

The paper introduces per period fixed costs to using financial intermediation into an one-sector incomplete capital market model. The quantitative experiment shows that barriers

to access to financial services lower the fraction of agents using financial intermediation substantially by suppressing precautionary savings. When fixed costs are about 11 per cent of typical year's income, capital stock and output fall by 20 per cent and 10 per cent respectively. In addition, fixed costs have considerable impact on the wealth distribution, increasing inequality.

The model predicts that the two types of financial frictions might counteract each other in determining general equilibrium interest rates. While tighter collateral constraints lower interest rates by suppressing demand for capital as well as provoking savings, higher barriers raise interest rates by suppressing supply of loanable funds dominantly. Relative importance of fixed costs and collateral constraints could be pursued based on micro evidence in future research.

The existence of alternative informal financial intermediations might challenge the assumption of this paper that one has to consume everything she has if she chooses not to use formal financial intermediation. To relax the assumption, we could incorporate cheaper unofficial intermediation into the model as rural population in developing countries does.

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