The Macroeconomics of Microfinance

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Abstract

This paper provides a quantitative evaluation of the aggregate and distributional impacts of economy-wide microfinance or other credit programs targeted toward small-scale entrepreneurs. In our analysis, we find that the redistributive impacts of microfinance are stronger in general-equilibrium, but the aggregate impacts are smaller. Making the typical microfinance program more widely available has a negligible impact on per-capita income, since an increase in aggregate total factor productivity (TFP) is offset by lower capital accumulation that stems from redistributing income from individuals with high saving rates to those with low saving rates. However, the welfare impact is uniformly positive except for those few that are extremely talented and/or wealthy.

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Over the past several decades microfinance—credit targeted toward small-scale entrepreneurial activities of the poor who may otherwise lack access to financing—has become a pillar of economic development policies. In recent years, there has been a concerted effort to expand such programs with the goal of alleviating poverty and promoting development.[1] Between 1997 and 2006, access grew by up to 29 per cent a year. The Microcredit Summit Campaign as of 2007 reports 3,552 initiatives serving roughly 107 million borrowers, which including borrowers and their households affect 533 million people, roughly the size of Latin America. Moreover, other programs that direct credit toward small businesses are common even in advanced economies like the United States. Despite the growth and magnitude of such interventions and their importance in academic and policy circles, quantitative analyses of these programs are almost exclusively limited to microevaluations.[2] The macroeconomic effects of economy-wide microfinance have been largely unexplored.[3]

This paper is an attempt to fill that void by providing a quantitative assessment of the potential impacts of economy-wide microfinance availability. We find that typical microfinance, when widely available in an economy, can have significant aggregate and distributional impacts, and that general equilibrium (GE) increases in interest rates and wages are quantitatively important. Microfinance is a pro-poor redistributive policy, benefitting the poor and especially marginal entrepreneurs and hurting the wealthy and most able entrepreneurs. An increase in wages greatly amplifies this aspect of microfinance. Higher wages also redistributes income away from individuals with high saving rates (high-ability entrepreneurs) to those with low saving rates (workers and marginal entrepreneurs), lowering aggregate savings. Higher interest rates partially mitigate this, but in GE lower savings lead to lower capital accumulation. Although microfinance has a positive impact on total factor productivity (TFP) and wages, given lower capital accumulation, it has only small long-run impacts on aggregate output and consumption. This contrasts with the partial-equilibrium impacts, which are more strongly positive on TFP, output, and consumption, especially in the short-run.

To develop the analysis, we start from a model of entrepreneurship and heterogeneous producers in which financial frictions have already been shown to have sizable impacts on

[1]The United Nations, in declaring 2005 as the "International Year of Microcredit," called on a commitment to scaling up microfinance at regional and national levels in order to help achieve their Millenium Development Goals. The scaling up of microfinance is often understood as the expansion of programs providing small loans to reach all the poor population, as opposed to expanding the size of loans provided.

[2]The microevaluations of the economic impacts of microcredit on households include Pitt and Khandker (1998), Banerjee et al. (2009), Kaboski and Townsend (2010a), and Karlan and Zinman (2010a,b).

[3]We note two important exceptions. Ahlin and Jiang (2008), using the stylized model of Banerjee and Newman (1993), derive the theoretical conditions under which microfinance can lead to aggregate development. Kaboski and Townsend (2010a) use reduced-form methods to estimate the general equilibrium effects of village banks on wages and interest rates within the village.

TFP, capital accumulation, and wages (Buera et al., 2010). Individuals choose in each period whether to become an entrepreneur or supply labor for a wage. They have different levels of entrepreneurial productivity and wealth. The former evolves stochastically, generating the need to reallocate capital and labor from previously-productive entrepreneurs to currently-productive ones. Financial frictions—which we model in the form of endogenous collateral constraints founded on imperfect enforceability of contracts—hinder this reallocation process. Into this environment, we introduce microfinance. While being agnostic about the underlying innovation behind microfinance, we view it as a financial intermediation technology that guarantees people access to (and full repayment of) productive capital up to a limit regardless of their collateral or entrepreneurial talent. Since we model economy-wide microfinance, everyone has access to it in principle. However, since the wealthy already have access to financing beyond the microfinance limit, only the poor—who tend to have low entrepreneurial productivity—have their choice set expanded by microfinance.

We discipline the quantitative analysis by requiring that our model matches data from developed and developing countries on the distribution and dynamics of establishments, and the size of external finance to GDP. We then quantify the relationship between the size of microfinance—that is, the guaranteed capital rental limit—and key macroeconomic measures of development in steady states: output, TFP, capital, wages, and interest rates. We show the long-run impact of the program on key outcomes, and then contrast these impacts with both short- and long-run partial equilibrium outcomes, which are often measured in microevaluations. In general equilibrium, the off-setting forces muting the aggregate impact of microfinance on output are clear. For a wide range of microfinance levels, guaranteed credit up to 5 times the annual wage, the effects on steady state output are negligible. While TFP increases with the size of capital guaranteed by microfinance, the decline in capital accumulation almost exactly counterbalances the positive effect on TFP. Accordingly, when credit is guaranteed up to 5 times the annual wage—a fairly large level of microfinance credit—steady state consumption is five per cent higher.

The channels leading to these effects are equally clear. TFP increases monotonically with the size of the intervention, increasing by seven per cent for the guaranteed capital that is 5 times the annual wage. This increase in TFP comes almost exclusively from better allocation of capital across entrepreneurs. Wages also rise monotonically, by ten per cent. This is a result of both the higher TFP and a reduction in the supply of labor, as marginal-ability individuals choose entrepreneurship and double the number of active entrepreneurs in the economy. The rise of the marginal-ability entrepreneurs redistribute wealth from higher-ability entrepreneurs with higher saving rates to lower-productivity individuals with lower saving rates. Thus, aggregate saving rates fall, and likewise capital falls monotonically, by up to 20 per cent. With a capital share of 0.3, this offsets the increase in TFP almost entirely. The higher consumption is attainable at the same level of output because savings rates are lower.

Nonetheless, the aggregate impacts of microfinance on TFP, output, and consumption are much smaller in general equilibrium than they would be in partial equilibrium. If prices and wages remained constant, guaranteed credit up to five times the annual wage would increase output and consumption by almost 50 per cent, TFP by nearly 40 per cent, and capital by 30 per cent in the long run.[4] The general equilibrium effects are smaller because of the redistribution of income away from high-ability entrepreneurs and toward low-ability entrepreneurs. At lower levels of microfinance, credit equal to annual wages, the short-run partial-equilibrium impacts on output, consumption and TFP are substantially larger than the long-run impacts. Thus, extrapolating results of microevaluations may exaggerate the large-scale gains of microfinance, since these typically evaluate short-run impacts of interventions that are small-scale with presumably negligible general equilibrium effects.

On the other hand, for the same reason, microfinance is even more strongly pro-poor in general equilibrium. The welfare gains for those with essentially zero wealth (the vast majority of the population) are about twice as large under general equilibrium, equivalent to almost five per cent of their consumption for guaranteed credit of twice annual wages. Similarly, the welfare gains of low ability agents—those with no intention of becoming entrepreneurs—are equivalent to about 12 percent of consumption, or roughly twice the gains in partial equilibrium. However, the GE effects cause the highest ability entrepreneurs and wealthiest tail of the economy to actually lose from economy-wide microfinance.

We analyze two variations of the model that add additional insights. The first introduces an idiosyncratic shock to labor supply that effectively forces individuals, even those with little capital and/or ability, into entrepreneurship. This captures the idea of potentially undercapitalized but also low-ability entrepreneurs with few labor market alternatives. In this model, for levels of microfinance up to three times annual wages, the TFP effects are smaller as capital is redistributed to low ability entrepreneurs. Given their low savings rates, capital accumulation is lower, and steady state wages can actually fall. The second extension follows Buera et al. (2010) by introducing a large-scale sector that requires a large fixed cost. This adds a third general equilibrium effect (the relative price between the large- and small-scale sectors) and microfinance plays an important role in how resources (capital, labor, and entrepreneurial talent) are allocated between the two sectors. When guaranteed credit is sufficient to directly finance entrepreneurship in the large-scale sector, the available credit

[4] Although the model is partial equilibrium, the dynamics in capital are a result of agents building up collateral through dynamic savings decisions.

can dramatically increase output, TFP, and even capital.

The rest of the paper is organizes as follows. Section 1 provides empirical motivation by summarizing important microfinance programs, reviewing the literature, and showing microevidence for the saving patterns underlying our capital accumulation effect. Section 2 develops the model, including the microfinance intervention. Calibration and benchmark results are described in Section 3, with Section 4 providing extensions. A detailed comparison of our results with empirical microevaluations is provided in Section 5, while Section 6 concludes.

1 Empirical Motivation

This section shows the importance of government-sponsored credit programs targeted toward small-scale entrepreneurs, reviews existing studies on microfinance, and summarizes the empirical literature on differences in savings rates among entrepreneurs and non-entrepreneurs.

1.1 Credit Programs

Microfinance programs and other credit programs targeted toward small-scale entrepreneurs are both prevalent and growing. The Microcredit Summit Campaign Report (2009) documents 3,552 institutions with reported loans to over 154 million clients throughout the world as of 2007. For comparison, the numbers in 1997 were 618 institutions and 13 million clients. The six-fold increase in the number of institutions and 12-fold increase in the number of borrowers over 10 years certainly overstates average growth—because of an increase in survey participation—but the actual growth is still dramatic. For example, a single program, the National Bank for Agriculture and Rural Development (NABARD) in India grew from 146,000 to 49 million clients over this period. By the same token of incomplete survey participation and coverage, these numbers certainly understate the actual number of institutions and borrowers.

Microloans are, almost by definition, small, and typically relatively short-term (e.g. one year or less), and have high repayment rates. A broad vision of the structure of microlending can be gleaned from the Microfinance Information Exchange (MIX) MicroBank Bulletin 2006–2008 benchmark, a survey of 611 microfinance institutions, totalling $40 billion in assets and serving over 56 million borrowers in 2008. The average loan balance per borrower is $1,351 (in PPP) in 2008, but because these are in poor countries, they are equivalent on average to 62 per cent of per-capita gross national income. Moreover, since per-capita income overstates median personal income, and microfinance is often targeted toward the poorer segments of the economy, the average loan is likely substantially more than 62 per cent of the per-capita income *of borrowers*. The variation across institutions is also large, with a standard deviation of 110 per cent, and the highest ratio of average loan balance to per-capita income is 12. In 2008, only 3 per cent of loans on average are more than 90 days delinquent.

NGOs and private for-profit institutions certainly play a large role in global microfinance. In the MIX data, NGOs constitute 40 per cent of the institutions and reach 36 per cent of the borrowers. Private banks constitute 9 percent of the institutions, but, because they are larger, they reach another 36 percent of the borrowers in the data. Nonetheless, government initiatives in microfinance, and other credit programs targeted toward small-scale entrepreneurs are still important. We review programs in five countries of varying levels of development: India, Indonesia, the Philippines, Thailand, and the U.S.

In India, the banking and credit sector is dominated by state-owned banks. NABARD is the government rural development bank which operates through state co-operative banks, state agricultural and rural development banks, regional rural banks, and even commercial banks. A major program of NABARD is the promotion of small-scale Self Help Groups (SHG) for savings and internal lendings. In 2009, 4.2 million credit-linked SHGs had roughly $5.1 billion in outstanding loans, of which almost $2.7 billion was new loans. We calculate an average loan size of $1,200, or roughly 140 per cent of per-capita income. In addition, another roughly $80 million went to microfinance institutions. These loans were then distributed to members of the SHGs. Another important program, the District Rural Industries Project, lent out an additional $151 million to over 47,000 borrowers, so average loans were roughly $3,000, or about 3.7 times per-capita income.

In addition, Banerjee and Duflo (2008) describe regulations governing all (private and public) banks that stipulate that 40 per cent of credit must go toward priority sectors—agriculture, agricultural processing, transportation, and small-scale industry. Large firms (plants and machinery in excess of Rs. 10 million in 2000) were excluded from the priority sector. They show that these regulations are indeed binding.

Indonesia is another country with a long history of government-sponsored banking and regulations for all banks to target credit toward small businesses. The Bank Rakayat Indonesia (BRI, People's Bank of Indonesia) is the government-run bank, 100 per cent state-owned until 2003, when 30 per cent of its ownership was sold publicly. BRI has a long history and was the primary Indonesian bank before financial liberalizations in the mid-1980s. In 1984, BRI introduced it KUPEDES program into its network of village banks (unit desas). The program grew rapidly and was expanded in 1987 with a $102 million loan from the World Bank. BRI's model is to charge market interest rates, but it targets microloans and loans to small- and medium-scale enterprises. Loan size varies up to $2,800. At the end of 2009, BRI's total loans were roughly $21 billion. Of this, 27 per cent was to small-scale businesses and 78 per cent was to small- or medium-scale businesses.

Two other important banking regulations favor small-scale borrowers in Indonesia. First, the liberalization in 1987 allowed for local banks (people's credit banks) to operate with lower capital requirements of just $25,000, while restricting them to a a small geographic level (the subdistrict, or roughly 15 villages). Second, in 1993, the government stipulated that 20 percent of all national banks' (whether public or private) credit be targeted toward small businesses, defined as loans under $5,000, roughly 2.5 times per-capita income in 2009. In 2009, BRI reported 37 per cent of their loans under this category.

The Philippines has both government-financed and government-regulated microfinance. As of 2000, the Central Bank of the Philippines (CBP) began regulating both microfinance-oriented banks and regular banks with microfinance activities. An example is the People's Credit and Finance Corporation (PCFC), a public finance company, founded in 1994. The PCFC is mandated by law to provide financial services to the poor through wholesale funds to retail MFIs. The maximum MFI loan size was 150,000 Philippine Pesos, roughly $3,500 or twice per-capita income in the Philippines, though the average loan was just $165. In total, the CBP reported $150 million in regulated microfinance loans in 2009.

Thailand is another country that has had a large, government-sponsored expansion of credit to village banks for microlending. In 2001, the Thai Million Baht Village Fund program (MBVF) was inaugurated, which offered one million baht (roughly $25,000 at the time) to each of the nearly 80,000 villages in Thailand, as a seed grant for starting a village lending and saving fund. The $1.5 billion was tantamount to about 1.5 per cent of Thai GDP at the time. Loans were typically made without collateral, up to roughly $1,250, but most loans were annual loans of about $500, about 40 per cent of per-capita income at the time. Kaboski and Townsend (2010a) show that borrowing limits varied by village size, and they estimate that the program allowed households to borrow up to 91 per cent of annual household income in the smallest villages. The experience of funds also varied, but typically showed high repayment rates (97 per cent) in the initial years. These funds were evaluated, and successful funds were offered to leverage their capital through loans of up to an additional one million baht from the Government Savings Bank and the Bank of Agriculture and Agricultural Cooperatives, becoming true village banks.

In addition, Thailand has two public banks, the Bank of Agriculture and Agricultural Cooperatives, and the Government Savings Bank, a more urban bank. In practice, these institutions target credit toward lower income borrowers, and all financial institutions are required to hold a minimum amount of assets in these public banks, providing an implicit subsidy.

Although the US is a more developed country in terms of both income and financial system, it too has important government programs extending small business credit. The definitions of small business and the average loan size are substantially larger than in other countries. As of 2009, the total portfolio was $91 billion with over 50,612 new loans in 2009 alone. The average loan is $1.8 million, or 38 times the US per-capita income. These loans are effected through three key programs. The Basic 7(a) loan guarantee constitutes about two-thirds of new loans. It is a guarantee program working through private credit agencies, which guarantees loans for fixed assets or working capital. The bulk of the remaining credit is through the SBA 504 loan, which has a standard loan limit of $1 million. The Microloan 7(m) program, a much smaller program, provides loans of up to $35,000 for working capital to small businesses. The federal definition criteria for small businesses are in terms of either total receipts or number of employees, and vary by primary industry. Common standards are $7 million in revenue or 500 employees. For the 7(a) business loan, the requirements are more stringent: a limit of $8.5 million in tangible net worth and $3.0 million in average net income over the previous two years.

In addition to these federal programs, many states have credit assistance programs for small businesses. For example, the Ohio State Treasurer's GrowNow program invests up to ten percent of the state Treasury (roughly $1 billion) in below-market-interest commercial bank deposits that are linked to loans to small-businesses. That is, banks lend to small businesses (employing fewer than 150 employees) for loans up to $400,000. In turn, through deposits from the State Treasury, they receive a three per cent interest rate subsidy on their cost of funds, which is in principle passed on to borrowers. Similar programs exist in other states (e.g, Iowa, Oregon, Idaho, and Illinois).

Table 1 summarizes these programs.

	India	Indonesia	Philippines	Thailand	US
Program	NADARD	BRI-KUPEDES	PCFC	MBVF	SBA
Program Size	$2.7 Bn	$21 Bn	$150 M	$1.5 Bn	$91 Bn
Typical/Avg. Loan	$1,200	up to $2,800	up to $3,500	$500	up to $1 M
Loan/Income per-Capita	1.4	up to 1.3	up to 2	0.4	38

Table 1: Summary of Public Small Business Credit Programs

1.2 Existing Literature

A theoretical literature has emphasized the aggregate and distributional impacts of financial intermediation in models of occupational choice and financial frictions (Banerjee and Newman, 1993; Aghion and Bolton, 1997; Lloyd-Ellis and Bernhardt, 2000; Erosa and Hidalgo Cabrillana, 2008). In these studies, improved financial intermediation induces entry into entrepreneurship, increased productivity and investment, and a general equilibrium effect that increases the wage. In these studies, the distribution of wealth (Banerjee and Newman, 1993) and often the joint distribution of wealth and productivity (Lloyd-Ellis and Bernhardt, 2000; Erosa and Hidalgo Cabrillana, 2008) are critical. A related quantitative literature has found impacts of increases in financial intermediation in these models on productivity and income to be sizable (Giné and Townsend, 2004; Amaral and Quintin, 2009), but Buera et al. (2010) and Buera and Shin (2010) show that modeling endogenous saving responses and general equilibrium effects on interest rates are important to quantitative assessment. This paper is the first to evaluate the quantitative impact of microfinance as a targeted form of financial intermediation. We follow this literature by evaluating microfinance within a model that incorporates occupational choice, endogenous wages and interest rates, and rich savings decisions.[5]

Microfinance or microcredit has been viewed as a technological or policy innovation enabling high repayment of uncollateralized loans. Alternative theories of the precise nature of this technology have been proposed, including joint liability lending (e.g., Besley and Coate (1995)), high frequency repayment (e.g., Jain and Mansuri (2003)), and dynamic incentives (e.g., Armendariz and Morduch (2005)). Unfortunately, empirical tests of the importance of these alternative mechanisms have not produced a smoking gun in terms of the nature of technology leading to high repayment (e.g., Ahlin and Townsend (2007); Field and Pande (2008); Gine and Karlan (2010)). We therefore take an agnostic approach to the nature of this technology and simply assume it as an available free lunch.

There is a recent empirical literature that has focused on estimating partial equilibrium impacts of relatively-small interventions.[6] While each study is in some sense unique, they generally find positive impacts on consumption and business activity. Kaboski and Townsend (2010a) find increases in investment, but the largest impacts are on consumption, and their model stresses that microfinance availability induces investment only for those along the margin, and therefore large samples are required to pick up impacts on investment. In a randomized intervention, Banerjee et al. (2009) confirm these results in the context of business starts rather than just investment. However, even in an areas where 30 per cent of the sample are entrepreneurs, they measure 1.5 percentage points higher business starts

[5]Ahlin and Jiang (2008) study the aggregate impact of microfinance within the context of a Banerjee and Newman (1993) model. The analysis is theoretical rather than quantitative. They show that in a model with exogenous saving decisions and interest rates, general equilibrium effects on wages can impact the ability of people to finance large-scale projects and can determine whether microfinance increases or decreases aggregate output in the steady state.

[6]Kaboski and Townsend (2010b) do find some evidence of a positive effect on within-village wages, this is interpreted as a general equilibrium effect within less-than-perfectly integrated local villages, and the influx of funds constituted up to 40 per cent of village income.

in areas where a microfinancier is introduced, and the effect is concentrated among those ex ante most likely to start businesses. Thus, the impacts on business propensity are small and require large samples. Neither Karlan and Zinman (2010b) nor Kaboski and Townsend (2010b) does find direct effects on business starts, but they do find impacts on business income or profits, and neither has the large sample of Banerjee et al.. While Karlan and Zinman do not find overall impacts on consumption, Kaboski and Townsend (2010a) and Banerjee et al. find heterogeneous impacts on consumption, even among those who do not own businesses, with the latter driven presumably by changing in savings behavior rather than general equilibrium effects. [7] In summary, the impacts are *prima facie* qualitatively in line with the aforementioned theories. We perform a more critical comparison of these results with our theory in Section 5.

1.3 Savings Heterogeneity

A central feature of our mechanism is the differential endogenous saving rates between entrepreneurs and workers, and between high- and low-ability people. There is empirical support for these patterns.

Quadrini (1999), Gentry and Hubbard (2000), and Buera (2009) provide evidence of savings behavior among entrepreneurs and non-entrepreneurs in the US that is qualitatively consistent with the mechanism that we emphasize. Specifically, using data from two rounds of the Survey of Consumer Finance, and defining savings as the change in net worth, Gentry and Hubbard find that the median saving rates for entrants and continuing entrepreneurs were 36 percent and 17 per cent, respectively. In comparison, the median saving rate for non-entrepreneurs was just 4 per cent, while that for exiting entrepreneurs was *minus* 48 per cent. The pattern is robust to regression analyses that include demographic controls. Quadrini analyzes data from the Panel Study of Income Dynamics and finds that the propensity for entrepreneurship is significantly related to higher rates of wealth accumulation, even after controlling for income. Buera confirms that business owners save on average 26 per cent more than non-business owners, but also shows that, just prior to starting a business, future business owners save on average 7 per cent more than non-business owners. Finally, Buera shows that after entry young entrepreneurs have higher saving rates than mature entrepreneurs.

In the context of a developing country, Pawasutipaisit and Townsend (2010) use monthly longitudinal survey data to construct corporate accounts for households in rural and semi-urban Thailand. They have several findings of relevance to our study. First, returns on assets

[7] Kaboski and Townsend (2005) find evidence of increased occupational mobility, but the exogenous source of variation in microfinance availability is driven by training and savings related policies.

are highly persistent, and they are therefore interpreted as a measure of productivity. Second, increases in net savings are positively associated with the return on assets (correlation of 0.53) and also the saving rate (correlation of 0.21), both of which are significant at the one-percent level. These significant positive relationships are robust to the addition of control variables, fixed effects, instrumenting for productivity, and using TFP estimates as an alternative measure of productivity.

Although the Thai study is a very different environment from the US research, all of the studies provide evidence that entrepreneurial ability matters for savings behavior. In the United States, entrepreneurial decisions are a reasonable proxy for entrepreneurial ability because financial markets are relatively developed, so entry depends less on wealth and more on ability (Hurst and Lusardi, 2004). However, in Thailand, where financial frictions are stronger, entrepreneurial decision are more constrained by wealth and thus less related to productivity (Paulson and Townsend, 2004).

2 Model

In this section, we introduce the basic model with which we evaluate the aggregate and distributional impact of microfinance.

There are measure N of infinitely-lived individuals, who are heterogeneous in their wealth and the quality of their entrepreneurial idea or talent, z. Individuals' wealth is determined endogenously by forward-looking saving behavior. The entrepreneurial idea is drawn from an invariant distribution $\mu(z)$. Entrepreneurial ideas "die" with a constant hazard rate of $1-\gamma$, in which case a new idea is drawn from $\mu(z)$ independently of the quality of the previous idea; that is, γ controls the persistence of the entrepreneurial idea or talent process. The γ shock can be interpreted as changes in market conditions that affect the profitability of individual skills.

In each period, individuals choose their occupation: whether to work for a wage or to operate a business (entrepreneurship). Their occupation choices are based on their comparative advantage as an entrepreneur (z) and their access to capital. Access to capital is limited by their wealth through an endogenous collateral constraint, because of imperfect enforceability of capital rental contracts.

One entrepreneur can operate only one production unit (establishment) in a given period. Entrepreneurial ideas are inalienable, and there is no market for managers or entrepreneurial talent. The way we model an establishment draws upon the span of control of Lucas (1978).

We model microfinance as an innovation that guarantees the use and the repayment of productive capital up to a limit regardless of their wealth and talent. Although we introduce it as a financial technology, it could also be thought of as a means-tested credit intervention that provides loans not exceeding a given size to individuals little wealth.

2.1 Preferences

Individual preferences are described by the following expected utility function over sequences of consumption $c_t =$:

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

where β is the discount factor, and σ is the coefficient of relative risk aversion. The expectation is over the realizations of entrepreneurial ideas (z), which depend on the stochastic death of ideas ($1-\gamma$) and on draws from $\mu(z)$.

2.2 Technology

At the beginning of each period, an individual with entrepreneurial idea z and wealth a chooses whether to work for a wage w or operate a business. An entrepreneur with talent z produces using capital (k) and labor (l) according to:

$$zf(k,l) = zk^{\alpha}l^{\theta},$$

where α and θ are the elasticities of output with respect to capital and labor, and $\alpha+\theta<1$, implying diminishing returns to scale in variable factors at the establishment level.

Given factor prices w and R (rental rate of capital), the profit of an entrepreneur is:

$$\pi(k,l;R,w) = zk^{\alpha}l^{\theta} - Rk - wl.$$

For later use, we define the optimal level of capital and labor inputs when production is not subject to financial constraints:

$$(k^u(z), l^u(z)) = \arg\max_{k,l}\left\{zk^{\alpha}l^{\theta} - Rk - wl\right\}.$$

2.3 Credit (Capital Rental) Markets

We first describe credit markets in the absence of microfinance. Individuals have access to competitive financial intermediaries, who receive deposits and rent out capital k at rate R to entrepreneurs. We restrict the analysis to the case where credit transactions are within a period—that is, individuals' financial wealth is restricted to be non-negative ($a \geq 0$). The zero-profit condition of the intermediaries implies $R = r + \delta$, where r is the deposit and lending rate and δ is the depreciation rate.

Capital rental by entrepreneurs are limited by imperfect enforceability of contracts. In particular, we assume that, after production has taken place, entrepreneurs may renege on the contracts. In such cases, the entrepreneurs can keep fraction $1-\phi$ of the undepreciated capital and the revenue net of labor payments: $(1-\phi)\left[zf\left(k,l\right)-wl+\left(1-\delta\right)k\right]$, $0\leq\phi\leq 1$. The only punishment is the garnishment of their financial assets deposited with the financial intermediary, a. In the following period, the entrepreneurs in default regain access to financial markets and are not treated any differently, despite their history of default.

Note that ϕ indexes the strength of an economy's legal institutions enforcing contractual obligations. This one-dimensional parameter captures the extent of frictions in the financial market owing to imperfect enforcement of credit contracts. This parsimonious specification allows for a flexible modeling of limited commitment that spans economies with no credit ($\phi=0$) and those with perfect credit markets ($\phi=1$).

We consider equilibria where the borrowing and capital rental contracts are incentive-compatible and are hence fulfilled. In particular, we study equilibria where the rental of capital is quantity-restricted by an upper bound $\bar{k}\left(a,z;\phi\right)$, which is a function of the individual state (a,z). We choose the rental limits $\bar{k}\left(a,z;\phi\right)$ to be the largest limits that are consistent with entrepreneurs choosing to abide by their credit contracts. Without loss of generality, we assume $\bar{k}\left(a,z;\phi\right)\leq k^{u}\left(z\right)$, where k^{u} is the profit-maximizing capital inputs in the unconstrained static problem.

The following proposition provides a simple characterization of the set of enforceable contracts and the rental limit $\bar{k}\left(a,z;\phi\right)$.

Proposition 1 *Capital rental k by an entrepreneur with wealth a and talent z is enforceable if and only if*

$$\max_{l}\left\{zf\left(k,l\right)-wl\right\}-Rk+\left(1+r\right)a\geq\left(1-\phi\right)\left[\max_{l}\left\{zf\left(k,l\right)-wl\right\}+\left(1-\delta\right)k\right]. \tag{2}$$

The upper bound on capital rental that is consistent with entrepreneurs choosing to abide by their contracts can be represented by a function $\bar{k}\left(a,z;\phi\right)$, which is increasing in a, z, ϕ.

Condition (2) states that an entrepreneur must end up with (weakly) more economic resources when he fulfills his credit obligations (left-hand side) than when he defaults (right-hand side). This static condition is sufficient to characterize enforceable allocations because we assume that defaulting entrepreneurs regain full access to financial markets in the following period.

This proposition also provides a convenient way to operationalize the enforceability constraint into a simple rental limit $\bar{k}\left(a,z;\phi\right)$. Rental limits increase with the wealth of entrepreneurs, because the punishment for defaulting (loss of collateral) is larger. Similarly, rental limits increase with the talent of an entrepreneur because defaulting entrepreneurs keep only a fraction $1 - \phi$ of the output.

2.4 Microfinance

We model microfinance as an innovation in financial technology that guarantees individuals' access and repayment of capital input up to a limit, independently of individual's wealth and talent. To be more specific, we incorporate microfinance by relaxing individuals' capital rental limit into the following constraint:

$$k \leq \max\{\bar{k}(a, z; \phi), k^{MF}\}$$

where k^{MF} denotes the rental limit of the microfinance innovation.

Our modeling of microfinance can be interpreted as a technological innovation that enables financial intermediaries to receive full repayment on small uncollateralized loans.[8] Alternatively, microfinance can be thought as a government policy that guarantees loans for small firms, such as that of the US Small Business Administration. Either way, we are abstracting from the cost associated with operating microfinance institutions or the cost incurred by defaulters. In this context, our results should therefore be interpreted as an upper bound on the gains from microfinance.

2.5 Recursive Representation of Individuals' Problem

Individuals maximize (1) by choosing sequences of consumption, financial wealth, occupations, and capital/labor inputs if they choose to be entrepreneurs, subject to a sequence of period budget constraints and rental limits.

At the beginning of a period, an individual's state is summarized by his wealth a and vector of talent z. He then chooses whether to be a worker or to be an entrepreneur for the period. The value for him at this stage, $v(a, z)$, is the maximum over the value of being a worker, $v^W(a, z)$, and the value of being an entrepreneur, $v^E(a, z)$:

$$v(a, z) = \max\left\{v^W(a, z), v^E(a, z)\right\}. \tag{3}$$

Note that the value of being a worker, $v^W(a, z)$, depends on his assets a and on his entrepreneurial ideas z, which may be implemented at a later date. We denote the optimal occupation choice by $o(a, z) \in \{W, E\}$.

[8] The exact nature of this innovation is being debated, and is thought to take the form of dynamic incentives, joint liability, and/or community sanctions.

As a worker, an individual chooses consumption c and the next period's assets a' to maximize his continuation value subject to the period budget constraint:

$$v^W(a,z) = \max_{c,a'\geq 0} u(c) + \beta\{\gamma v(a',z) + (1-\gamma)\mathbb{E}_{z'}[v(a',z')]\} \tag{4}$$
$$\text{s.t. } c + a' \leq w + (1+r)a,$$

where w is his labor income. The continuation value is a function of the end-of-period state (a',z'), where $z' = z$ with probability γ and $z' \sim \mu(z')$ with probability $1-\gamma$. In the next period, he will face an occupational choice again, and the function $v(a,z)$ appears in the continuation value.

Alternatively, individuals can choose to become an entrepreneur. The value function of being an entrepreneur is as follows.

$$v^E(a,z) = \max_{c,a',k,l\geq 0} u(c) + \beta\{\gamma v(a',z) + (1-\gamma)\mathbb{E}_{z'}[v(a',z')]\} \tag{5}$$
$$\text{s.t. } c + a' \leq zf(k,l) - Rk - wl + (1+r)a$$
$$k \leq \max\left\{\bar{k}(a,z;\phi), k^{MF}\right\}$$

Note that an entrepreneur's income is given by period profit $zf(k,l) - Rk - wl$ plus the return to his initial wealth, and that his choices of capital inputs are constrained by the larger of $\bar{k}(a,z;\phi)$ and k^{MF}.

2.6 Stationary Competitive Equilibrium

A stationary competitive equilibrium is composed of: an invariant distribution of wealth and entrepreneurial ideas $G(a,z)$, with the marginal distribution of z denoted with $\mu(z)$; policy functions $c(a,z)$, $a'(a,z)$, $o(a,z)$, $l(a,z)$, $k(a,z)$; rental limits $\bar{k}(a,z;\phi)$; and prices w, R, r such that:

1. Given $\bar{k}(a,z;\phi)$, w, R, and r, the individual policy functions $c(a,z)$, $a'(a,z)$, $o(a,z)$, $l(a,z)$, $k(a,z)$ solve (3), (4) and (5);

2. Financial intermediaries make zero profit: $R = r + \delta$;

3. Rental limits $\bar{k}(a,z;\phi)$ are the most generous limits satisfying condition (2), with $\bar{k}(a,z;\phi) \leq k^u(z)$;

4. Capital rental, labor, and goods markets clear:

$$\frac{K}{N} \equiv \int k(a,z)\,G(da,dz) = \int aG(da,dz) \tag{Capital rental}$$

$$\int l(a,z)\, G(da,dz) = \int_{\{o(a,z)=W\}} G(da,dz) \qquad \text{(Labor)}$$

$$\int c(a,z)\, G(da,dz) + \delta \frac{K}{N} = \int_{\{o(a,z)=E\}} \left[zk(a,z)^{\alpha}\, l(a,z)^{\theta} \right] G(da,dz) \qquad \text{(Goods)}$$

5. The joint distribution of wealth and entrepreneurial ideas is a fixed point of the equilibrium mapping:

$$G(a,z) = \gamma \int_{\{(\tilde{a},\tilde{z}) | \tilde{z} \leq z, a'(\tilde{a},\tilde{z}) \leq a\}} G(d\tilde{a}, d\tilde{z}) + (1-\gamma)\, \mu(z) \int_{\{(\tilde{a},\tilde{z}) | a'(\tilde{a},\tilde{z}) \leq a\}} G(d\tilde{a}, d\tilde{z})\,.$$

3 Quantitative Analysis

To quantify the aggregate and distributional impact of microfinance, we calibrate our quantitative framework in two stages. First, using the US data on the distribution and dynamics of establishments, and standard macroeconomic aggregates, we calibrate a set of technological and preferences parameters that are assumed to be the same across countries.[9] In a second stage we choose ϕ, the parameter governing the enforcement of contracts, to match the external finance to GDP ratio of a typical less developed country. We then conduct experiments to assess the effect of microfinance by varying k^{MF}, the maximum loans guaranteed under microfinance. In addition, we consider extensions where we incorporate non-financial frictions and distortions in order to capture cross-country variations in establishment size distribution and dynamics that are not entirely explained by cross-country differences in financial development.

3.1 Calibration

We calibrate preference and technology parameters so that the perfect-credit economy matches key aspects of the US, a relatively undistorted economy. Our target moments pertain to standard macroeconomic aggregates, and establishment size distribution and dynamics, among others.

We need to specify values for seven parameters: two technological parameters, α, θ, and the depreciation rate δ; two parameters describing the process for entrepreneurial talent, γ and η; the subjective discount factor β, and the coefficient of relative risk aversion σ.

One preference parameter, σ, and two technological parameters, $\alpha/(1/\eta + \alpha + \theta)$ and δ, can be set to standard values in the literature. We let $\sigma = 1.5$. The one-year depreciation

[9] In our benchmark analysis we assume that countries are endowed with the same entrepreneurial talent distribution. However, in our robustness analysis, we consider exogenous cross-country differences in the talent distribution.

rate is set at $\delta = 0.06$, and we choose $\alpha/(1/\eta + \alpha + \theta)$ to match the aggregate capital income share of 0.30.[10]

Target Moments	US Data	Model	Parameter
Top 10-percentile employment share	0.69	0.69	$\eta = 4.84$
Top 5-percentile earnings share	0.30	0.30	$\alpha + \theta = 0.79$
Establishment exit rate	0.10	0.10	$\gamma = 0.89$
Interest rate	0.04	0.04	$\beta = 0.92$

Table 2: Calibration

We are thus left with the four parameters that are more specific to our study. We calibrate them to match as many relevant moments in the US data as shown in Table 2: the employment share of the top decile of establishments; the share of earnings generated by the top five per cent of earners; the annual exit rate of establishments; and the annual real interest rate. Given the returns to scale, $\alpha + \theta$, we choose the tail parameter of the entrepreneurial talent distribution, $\eta = 4.84$, to match the employment share of the largest ten percent of establishments, 0.69. We can then infer $\alpha + \theta = 0.79$ from the earnings share of the top five percent of earners. Top earners are mostly entrepreneurs (both in the US data and in the model), and $\alpha + \theta$ controls the fraction of output going to the entrepreneurial input. The parameter $\gamma = 0.89$ leads to an annual establishment exit rate of ten per cent in the model. This is consistent with the exit rate of establishments reported in the US Census Business Dynamics Statistics.[11] Finally, the model requires a discount factor of $\beta = 0.92$ to match the annual interest rate of four per cent

Finally, we calibrate ϕ so that the ratio of external finance to GDP equals 0.34, which is equal to the average ratio across non-OECD countries over the 1990s as reported by Beck et al. (2000).[12] This period is chose because it immediately precedes the explosive proliferation of large-scale microfinance programs.

3.2 Results

We quantify the effects of microfinance for a wide range of k^{MF}. We begin by presenting the results of the general-equilibrium analysis, which we then compare with the results of the partial-equilibrium analysis.

[10] We are being conservative in choosing a relatively low capital share: The larger the share of capital, the bigger the role of capital misallocation. We are also accommodating the fact that some of the payments to capital in the data are actually payments to entrepreneurial input.

[11] Note that $1 - \gamma$ is larger than 0.1, because a fraction of those hit by the idea shock chooses to remain in business. Entrepreneurs exit only if their new idea is below the equilibrium cutoff level in either sector.

[12] The ratio of 0.34 is roughly that of Bulgaria, Jamaica, Kenya, and Zimbabwe.

3.2.1 Microfinance in the General Equilibrium

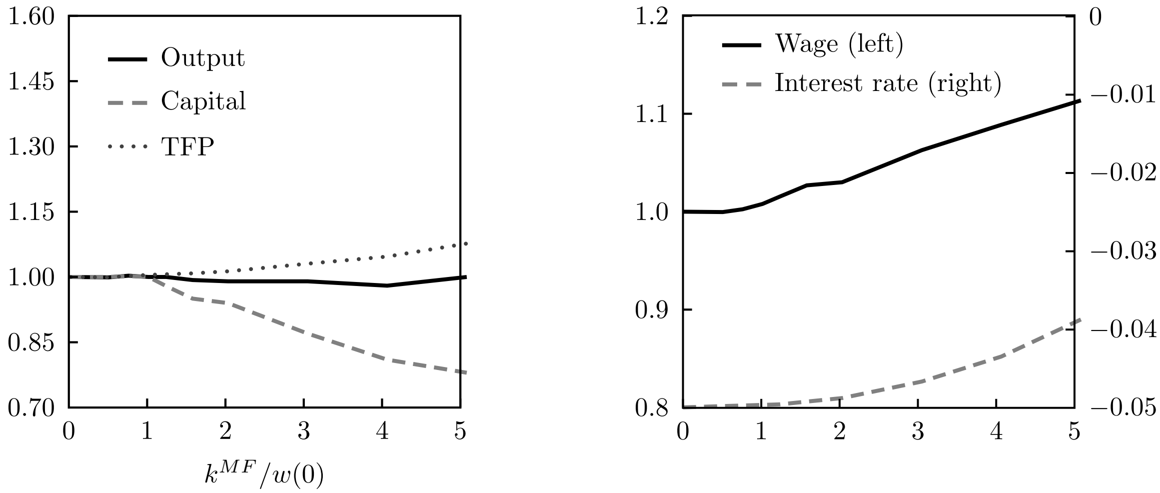

Fig. 1: Aggregate Implications of Microfinance

In the left panel of Figure 1, we show aggregate output, capital, and TFP in the steady states corresponding to various levels of k^{MF}. On the horizontal axis, k^{MF} relative to the equilibrium wage in the $k^{MF} = 0$ economy (i.e., k^{MF} over $w(k^{MF} = 0)$) is shown, which ranges from 0 to 5. All three aggregate quantities are normalized by their respective levels in the $k^{MF} = 0$ economy.

We observe three clear patterns. First, aggregate output (and output per capita, as the population size is fixed) is nearly constant across all steady states with different k^{MF} (solid line). Second, TFP of the economy increases with k^{MF} (dotted line). Third, aggregate capital declines with k^{MF} (dashed line). The second and the third patterns happen to cancel each other out, resulting in the first pattern.

In the right panel of Figure 1, we see that equilibrium wages and interest rates rise with k^{MF}. We now provide explanations of these outcomes.

Effect on TFP In the left panel of Figure 2, we trace with a solid line the aggregate TFP in each steady state corresponding to a given k^{MF}. We observe an increase in the TFP of 7.7 per cent as k^{MF} goes from 0 to 5 times the wage in the $k^{MF} = 0$ economy. This increase reflects changes in the allocation of production resources (capital and entrepreneurial talent). We decompose the TFP increase into the effect of better capital allocation among existing entrepreneurs (intensive margin) and into the effect through selection into entrepreneurship (extensive margin). The formulae for the TFP decomposition are derived and explained in the appendix.

The dashed line in the left panel of Figure 2 shows the increase in TFP that results from

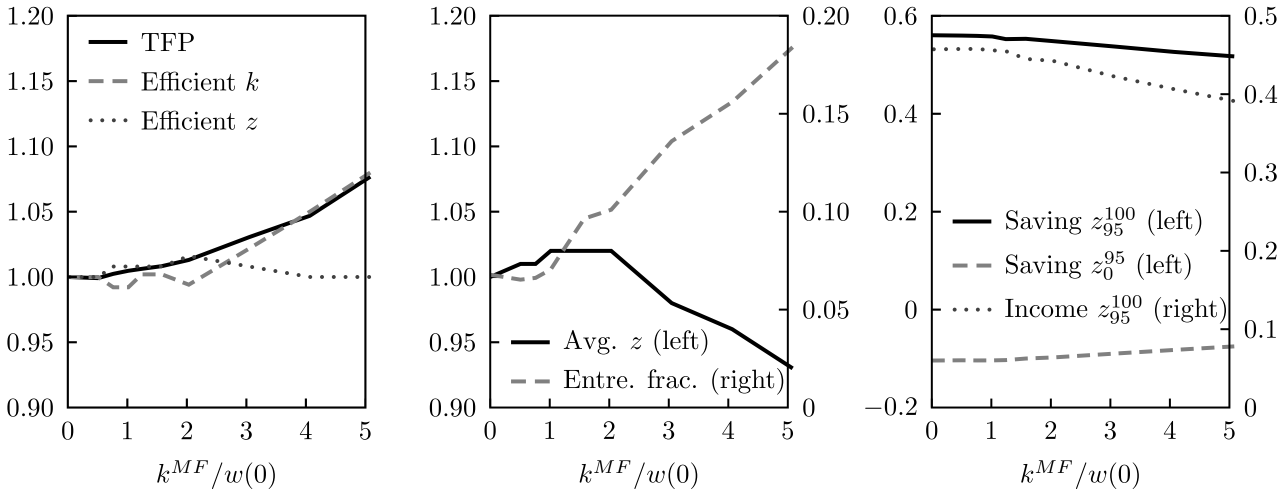

Fig. 2: Determinants of TFP and Capital Accumulation

better allocation of capital (intensive margin). With financial frictions, the marginal products of capital among active entrepreneurs are not equalized, with constrained entrepreneurs having a marginal products higher than the rental rate. The microfinance program guarantees access up to k^{MF} units of capital for production purposes and thusly alleviates the financial constraints. The higher k^{MF} is, the less disperse the marginal products of capital across entrepreneurs are, raising the measured aggregate TFP. Note that the dashed line is very close to the solid line. This implies that the intensive margin explains almost all of the positive TFP effect of microfinance. In particular, with a k^{MF} that is more than 4 times the normalizing wage, the intensive margin contributes more than 100 percent of the increase in TFP, which is partially offset by the extensive margin as explained below.

The changes in TFP driven by the extensive margin are shown with the dotted line in the left panel of Figure 2. Microfinance has a non-monotone effect on the selection into entrepreneurship. With small enough k^{MF}, microfinance positively affects the extensive margin (dotted line above one), as it helps talented-but-poor individuals to enter into entrepreneurship. However, with larger k^{MF}, the extensive margin negatively affects the aggregate TFP (dotted line below one), as it induces even those individuals with mediocre talents to start business, which more than negates whatever positive selection it promotes.

The center panel of Figure 2 clearly shows the effect of microfinance on the extensive margin. A small enough k^{MF} (i.e., less than twice the normalizing wage) facilitates the entry of talented-but-poor entrepreneurs, and the average talent level of active entrepreneurs (solid line) increases with k^{MF}. More generous k^{MF} encourages the entry of even those who are not really talented, and they outnumber by a big margin those with the highest levels of talent. As a result, there are a steep increase in the fraction of the population choosing to be entrepreneurs (from less than one-in-ten to almost one-in-five, dashed line, right scale) and a steep decline in the average talent level among active entrepreneurs.[13]

In summary, microfinance has a significant positive impact on aggregate TFP. Most of the effect comes through the intensive margin, by allocating capital more efficiently among entrepreneurs. While microfinance also facilitates the entry of top talents who are poor into entrepreneurship, this positive effect can be wiped out with generous enough microfinance programs that promote the entry of many mediocre entrepreneurs.

Effect on Capital Accumulation In the left panel of Figure 1, we observe a substantial negative impact of microfinance on aggregate capital accumulation (dashed line). Here we explain that this results from the redistributive effect of microfinance, redistributing income from those with high saving rates to those with low saving rates.

In the model, individuals with high levels of entrepreneurial talent have high saving rates. There are two reasons. First, given the financial constraints, they derive collateral services from their wealth (i.e., more wealth allows them to produce closer to the efficient scale). Second, given the stochastic nature of the entrepreneurial talent, they save for the periods/states in which they will not be as talented and will not generate as much income. In the right panel of Figure 2, the average saving rate of those belonging to the top 5 percentiles (denoted with z_{95}^{100}) of the talent distribution is shown with a solid line (left scale). This is much higher than the average saving rate of the rest (i.e., those in the bottom 95 percentiles, denoted with z_{0}^{95}), which is in fact negative (dashed line).

Those in the latter group mostly choose to be workers, and do not have a self-financing motive. In addition, our model specification is such that one's earnings are bounded from below by the market wage. Therefore, workers do not have any reason to save from the permanent-income perspective: Their earnings will either remain the same or go up in the future. This latter group also includes not-so-talented entrepreneurs. These "marginal" entrepreneurs clearly have higher saving rates than the workers, because they at least have some self-financing motive for their businesses as well as some precautionary motive since their income may fall in the future. However, compared to those in the top 5 percentiles, their efficient scale is much smaller, and their future earnings are not expected to fall by as much. Therefore, their motive for saving is not as strong, and their saving rate is far lower than that of the top talent group.

As seen in the middle panel of Figure 2, generous microfinance promotes the entry of such marginal entrepreneurs. As shown in the rightmost panel of Figure 2, the income share of the bottom 95-percentile talent group increases with k^{MF} (and the income share of the top-talent group declines as shown by the dotted line), because the marginal entrepreneurs

[13] The average entrepreneurial talent is normalized by its value in the stationary equilibrium with $k^{MF} = 0$.

now earn more than what they would have earned as a worker, and the aggregate labor income share is fixed at θ in the model.[14]

Overall, the fact is that the income share of those with the lower saving rate increases with k^{MF}. The aggregate saving rate is the income-weighted average of individual saving rates, and hence microfinance reduces aggregate saving and the steady-state capital stock.[15]

3.2.2 Microfinance in the Partial Equilibrium

In this section, we explore the impact of microfinance in a partial equilibrium setting. Notwithstanding their growing popularity, microfinance interventions are conducted in scales that will not have aggregate impact. Studies evaluating microfinance programs are hence focused exclusively on local (and partial-equilibrium) evidence. With our partial equilibrium analysis in this section, we will be better able to relate our analysis to the existing empirical work in the literature. Furthermore, by collating the general-equilibrium results with partial-equilibrium ones, we can clarify some of the conduits through which microfinance affects the economy.

In the left panel of Figure 3, we show how aggregate output, capital, and TFP respond to changes in k^{MF}, holding fixed market wages and interest rates at their levels in the $k^{MF} = 0$ equilibrium (i.e., not clearing markets). The results are for the stationary equilibrium corresponding to each k^{MF}. TFP increases by as much as 35 per cent, which is almost five times as large as the magnitude of the TFP increase in the general equilibrium (left panel, Figure 1). More strikingly, in contrast to the general equilibrium case where aggregate capital decreased with k^{MF}, aggregate capital increases with k^{MF}. Accordingly, aggregate output increases by 50 per cent as k^{MF} goes from zero to five times the normalizing wage.

We first explain why aggregate capital increases with k^{MF}. In the general equilibrium setting, microfinance redistributed income from those with high saving rates to those with low saving rates, resulting in lower aggregate saving and hence investment. In a partial equilibrium, aggregate saving and investment do not have to coincide. (Neither do aggregate wealth and capital.) As k^{MF} increases, more and more people enter into entrepreneurship,

[14] The entry of marginal entrepreneurs, as a compositional effect, also explains why the saving rate of the bottom 95-percentile talent group increases (dashed line): The marginal entrepreneurs have higher saving rates than workers, and there are now more entrepreneurs and fewer workers in this group (denoted with z_0^{95}).

[15] Also note that the saving rate of the top talent group is also decreasing in k^{MF}. There are two reasons for this. First, more entry drives up market wage and capital rental rate, and lowering the efficient scale of production. Therefore, less collateral is needed. Second, with the marginal entrepreneurs operating, the future earnings of the top-talent group is now expected to fall by less. That is, without microfinance, you either maintain your talent or become a worker in the next period. With generous k^{MF}, you could in the next period maintain your talent, become a worker, or a marginal entrepreneur who will earn more than a worker. Therefore, the permanent-income saving motive is weaker with high k^{MF}.

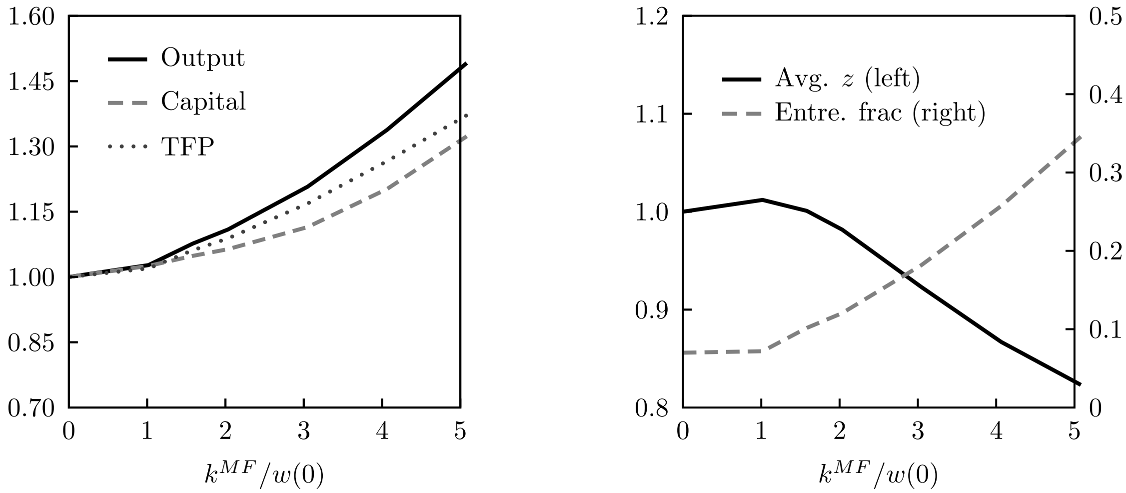

Fig. 3: Impact of Microfinance in Partial Equilibrium

as shown in the right panel of Figure 3 (dashed line). Without microfinance, less than seven per cent of the population operate individual-specific technologies. With k^{MF} five time the normalizing wage, more than a third of the population are entrepreneurs. More entrepreneurs mean more demand for capital for production use. This is the simple explanation for the rise in aggregate capital stock.[16]

The substantial increase in TFP requires more discussion. As is shown in the right panel of Figure 3, the average talent of active entrepreneurs falls precipitously, which would drive down aggregate productivity. However, these "marginal" entrepreneurs operate at small scales, and have only a small direct impact on aggregate productivity. The reason for the larger TFP increase in the partial equilibrium relative to the general equilibrium lies with the wealth distribution. Holding other things equal, entrepreneurial profits are higher in partial equilibrium because of the lower factor prices. Although a higher interest rate implies a higher return on assets they hold, entrepreneurs tend to earn more and be wealthier in the partial equilibrium exercises. In addition, there are more entrepreneurs in the partial equilibrium. As a consequence, entering talented entrepreneurs are likely to be better capitalized and then are able to self-finance their growth faster. Accordingly, resources (capital and entrepreneurial talent) are more efficiently allocated in the partial equilibrium, as is reflected on the larger impact of microfinance on TFP.

The short run dynamics

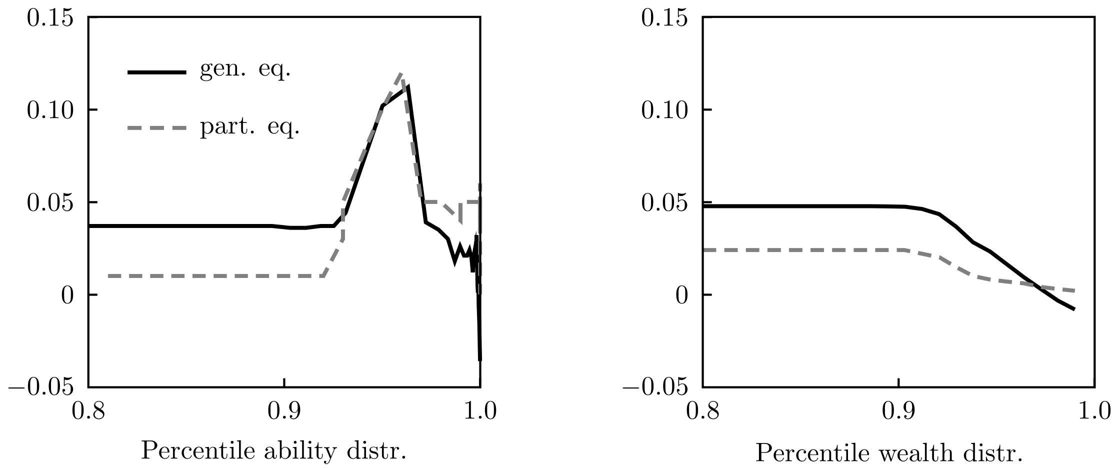

Fig. 4: Welfare Gains of Microfinance (Fraction of Consumption)

3.2.3 Distribution of Welfare Gains

The analysis so far suggests that microfinance could have heterogeneous impact, and that the full extent of its effects need to be traced through rich general equilibrium interactions through wages and interest rates. This point is most clearly seen when studying the distribution of the welfare consequences of microfinance innovations.

In Figure 4 we present the welfare impact of microfinance across individuals of different entrepreneurial ability (left panel) and wealth (right panel). We report the direct welfare impact (partial equilibrium, dashed line) as well as the impact once general equilibrium interactions are accounted for (solid line). In particular, we show the fraction of consumption that individuals of different ability and wealth are willing to pay in order to have access to microfinance programs that guarantee an investment of twice the initial yearly wage. These calculations take into account the transitional dynamics following the introduction of microfinance.

Two important messages arise from this figure. First, microfinance has a disproportionally large impact on relatively talented individuals. Second, consistent with the conventional narratives, microfinance have a larger positive impact on the poor, i.e., individuals with low wealth.

Another important lesson that follows from the left panel of Figure 4 is that general equilibrium considerations are key to fully understand the distributional effect of microfinance. For instance, a partial equilibrium analysis would lead to the conclusion that the least talented individuals will be barely affected, and that the most talented are going to be among the most benefited by this technology. Instead, when accounting for the increase

[16]For this economy, there are excess demands in capital and labor markets, which can be inferred from the fact that their general-equilibrium levels are higher than the level they are fixed to in the partial-equilibrium exercise.

in the equilibrium wage, this picture is reversed. Individuals with low entrepreneurial talent, who choose to be workers, experience a significant welfare gain, in the order of 5% of consumption, while the most talented could be hurt by microfinance.

4 Extensions

TO BE WRITTEN.

5 Comparison with Microevaluations

TO BE WRITTEN.

6 Concluding Remarks

TO BE WRITTEN.

A TFP Decomposition

In this Appendix we derive the decomposition of TFP used in Figure 2. Using the optimal choice of labor input, $l(a,z) = \left(z_i \theta p_i k(a,z)^{\alpha}/w\right)^{1/(1-\theta)}$, we can write aggregate output in sector i as:

$$Y_i = (\theta p_i / w)^{\frac{\theta}{1-\theta}} \int_{(a,z):o(a,z)=i} z_i^{\frac{1}{1-\theta}} k(a,z)^{\frac{\alpha}{1-\theta}} \, dG(a,z)$$

Denoting the total labor input in section i by $L_i (= \int_{(a,z):o(a,z)=i} l(a,z)\, dG(a,z))$, the broad labor input in sector i by N_i, i.e., labor plus the un-weighted entrepreneurial input, $N_i = L_i + E_i$, $E_i = \int_{(a,z):o(a,z)=i} dG(a,z)$, the total capita input in sector i by K_i, and the share of capital employed by an individual entrepreneurs by $\varkappa_i(a,z) = k(a,z)/K_i$, we can rewrite aggregate output as,

$$Y_i = \frac{\left[\int_{(a,z):o(a,z)=i} z_i^{\frac{1}{1-\theta}} \varkappa_i(a,z)^{\frac{\alpha}{1-\theta}} \, dG(a,z)\right]^{1-\theta}}{N_i^{1-\alpha-\theta}} \left(\frac{L_i}{N_i}\right)^{\theta} K_i^{\alpha} N_i^{1-\alpha}.$$

We define TFP as output net of the capital and the braod labor inputs, raise to their respected income elasticities, α and $1-\alpha$,

$$TFP_i = \frac{\left[\int_{(a,z):o(a,z)=i} z_i^{\frac{1}{1-\theta}} \varkappa_i(a,z)^{\frac{\alpha}{1-\theta}} \, dG(a,z)\right]^{1-\theta}}{N_i^{1-\alpha-\theta}} \left(\frac{L_i}{N_i}\right)^{\theta}.$$

We view this to be the measurement of sectoral TFP that is closest to that used in development accounting exercises, under the presumption that the entrepreneurial input is not weighted by individual's productivities, z_i.

In addition, we define the k-efficient TFP, TFP_i^{k-eff}, as the value of the TFP in the case that capital is efficiently allocated among existing entrepreneur,

$$TFP_i^{k-eff} = \left[\frac{\int_{(a,z):o(a,z)=i} z_i^{\frac{1}{1-\alpha-\theta}} dG(a,z)}{E_i}\right]^{1-\alpha-\theta} \left(\frac{E_i}{N_i}\right)^{1-\alpha-\theta} \left(\frac{L_i}{N_i}\right)^{\theta}.$$

Notice that this measure is only a function of a geometric weighted average of entrepreneurial talent in sector i, and the fraction of entrepreneurs and workers.

Using the measure of k-efficient TFP we can decompose the change in TFP into that associated with changes in the allocation of capital across entrepreneurs (k-efficiency) and changes in the allocation of entrepreneurs (z-efficiency):

$$\frac{TFP_i\left(k^{MF}\right)}{TFP_i\left(0\right)} = \underbrace{\frac{\frac{TFP_i\left(k^{MF}\right)}{TFP_i^{k-eff}\left(k^{MF}\right)}}{\frac{TFP_i(0)}{TFP_i^{k-eff}(0)}}}_{\text{k-efficiency}} \underbrace{\frac{TFP_i^{k-eff}\left(k^{MF}\right)}{TFP_i^{k-eff}\left(0\right)}}_{\text{z-efficiency}}.$$

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