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 size-dependent credit programs targeted toward small-scale entrepreneurs. In our quantitative analysis, we find that making the typical microfinance program more widely available has a negligible impact on per-capita income. While microfinance has a positive impact on total factor productivity (TFP), it has a large negative effect on capital accumulation by redistributing income from individuals with high saving rates to those with low saving rates. Programs that offer larger-scale credit can avoid this effect and lead to growth in the stock of capital, TFP, and output per capita.

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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 percent 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 US. Despite the growth and magnitude of such interventions, and their importance in academic and policy circles, quantitative evaluation 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 hole by providing a quantitative assessment of the potential impacts of economy-wide microfinance availability. Our main finding is that the typical microfinance intervention, even when expanded to the entire economy, has a negligible impact on per-capita income because of off-setting effects. While microfinance has a positive impact on total factor productivity (TFP) by capitalizing poor entrepreneurs, it has a large negative effect on capital accumulation by redistributing income from individuals with high saving rates to those with low saving rates. We do find, however, that microfinance interventions that also affect entrepreneurs in industries with large-scale technologies will have a large positive impact on per-capita income, TFP, and capital accumulation.

To develop the analysis, we introduce microfinance into a model of entrepreneurship and heterogeneous producers in which financial frictions have already been shown to have sizable impacts on TFP, capital accumulation, and wages (Buera et al., 2010). The model has two sectors, which differ in their per-period fixed cost of operating an establishment. This difference in fixed costs leads to a difference in the scale of establishment, with establishments in the sector with large fixed costs being larger on average. Individuals choose in each period whether to operate an establishment in either sector (entrepreneurship) or to 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) a specified minimum amount of

[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 oppose to expanding the size of loans provided.

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

[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 (2010) use reduced-form methods to estimate the general equilibrium effects of village banks on wages and interest rates within the village.

capital 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 this minimum, 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 minimum capital rental—and key macroeconomic measures of development in steady states: output, TFP, capital, wages, and interest rates. We perform two sets of analyses: We first analyze a one-sector economy as a special case of the two-sector model. The one-sector model is designed to illustrate some of the key mechanisms of the model more clearly. The analysis of the two-sector model in turn highlights the additional implications coming from large-scale technologies.

The one-sector model clearly demonstrates the off-setting forces muting the aggregate impact of microfinance. For a wide range of microfinance levels, guaranteed credit up to 10 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.

TFP increases monotonically with the size of the intervention, increasing by over 10 percent for the guaranteed capital that is 10 times the annual wage. This increase in TFP comes almost exclusively from better allocation of capital across entrepreneurs. Wages also rise monotonically, by up to 18 percent. 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 28 percent. With a capital share of 0.3, this offsets the increase in TFP almost entirely.

We compare these results with an alternative technology innovation, which increases the overall enforcement of financial contracts regardless of the credit size. We compare equivalent innovations by requiring that the improvement in the enforcement of contract yields the same increase in the amount of external finance as the microfinance exercise.

The improvement in overall enforcement has a broader impact on capital rental options than does microfinance, which only increases access for small-scale entrepreneurs. Under this alternative innovation, both TFP and capital increase. The increase in TFP comes again primarily from the better allocation of capital, but the average ability of entrepreneurs also increases. This innovation has a more uniform effect on relative incomes, leaving the average savings rate roughly constant. Since TFP increases output, capital also rises.

Introducing the large-scale sector gives additional insights, because microfinance plays an important role in how resources—capital, labor, and entrepreneurial talent–are allocated between the two sectors. At low levels of guaranteed capital, the aggregate impact of microfinance is similar to that in the one-sector model, but there is a striking threshold effect when the level of guaranteed capital through microfinance reaches a level sufficient to directly benefit entrepreneurship in the large-scale sector. Beyond this level, output, TFP and even capital increase dramatically with the size of the guaranteed capital: With microfinance capital that is 10 times wages, output and TFP increase 20 percent relative to the baseline with no microfinance, while capital essentially returns to the baseline. Wages and interest rates exhibit a similar discontinuous pattern.

[**Distributional of Welfare Gains Here**]

The rest of the paper is organizes as follows. Section 1 provides empirical motivation by summarizing important wide-scale microfinance programs, reviewing the literature, and showing microevidence for the savings patterns underlying our capital accumulation effect. Section 2 develops the model, including the microfinance intervention. The calibration and results are described in Section 3. Section 5 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 percent 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 percent of the per-capita income *of borrowers*. The variation across institutions is also large, with a standard deviation of of 110 percent, and the highest ratio of average loan balance to per-capita income is 12. In 2008, only 3 percent 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 percent of the institutions and reach 36 percent 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 iniatives 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 percent 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 addtional \$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 percent 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, however. 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 percent state-owned until 2003, when 30 percent 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 percent was to small-scale business and 78 percent 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 percent 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 \$3500 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 percent 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 percent of per-capita income at the time. Kaboski and Townsend (2010) show that borrowing limits varied by village size, and they estimate that the program allowed households to borrow up to 91 percent of annual household income in the smallest village. The experience of funds also varied, but typically showed high repayment (97 percent) 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 United States 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, however. 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 less than 150 employees) for loans up to $400,000. In turn, through deposits from the State Treasury, they receive a three percent 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.

Table 1: Summary of Public Small Business Credit 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

1.2 Existing Literature

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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 percent, respectively. In comparison, the median saving rate for non-entrepreneurs was just 4 percent, while that for exiting entrepreneurs was *minus* 48 percent. 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 percent more than non-business owners, but also shows that, just prior to starting a business, future business owners save on average 7 percent 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 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 1-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 that we use to evaluate the aggregate and distributional impact of microfinance policies and innovations.

We follow Buera et al. (2010) in modeling an economy with two sectors, S (small scale, services) and M (large scale, manufacturing, investment). The output of the service sector is used for consumption only. The manufactured goods are used for consumption and investment, and are the numeraire.

There are measure N of infinitely-lived individuals, who are heterogeneous in their wealth and the quality of their entrepreneurial ideas or talent, $z = (z_S, z_M)$. Individuals' wealth is determined endogenously by forward-looking savings behavior. The vector of entrepreneurial ideas is drawn from a distribution $\mu(z)$. Entrepreneurial ideas "die" with a constant hazard rate of $1 - \gamma$, in which case a new vector of ideas is independently drawn from $\mu(z)$; 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 in sector S or M (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 capital rental contracts are not always perfectly enforceable in our model.

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) and per-period fixed costs as in Rossi-Hansberg and Wright (2007).

We model microfinance policies as an innovation that guarantee individuals a minimum size of capital input, independently of individual's wealth and talent. While we introduce it as a technology, it could be interpreted as a mean-tested credit intervention that provides loans of a given size to individuals with low wealth levels.

2.1 Preferences

Individual preferences are described by the following expected utility function over sequences of consumption $c_t = (c_{S,t}, c_{M,t})$:

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

where β is the discount factor, σ is the coefficient of relative risk aversion (and the reciprocal of the in*ter*temporal elasticity of substitution), ε is the in*tra*temporal elasticity of substitution between services and manufactured goods, and ψ controls the share of services in overall consumption expenditure. 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 vector of entrepreneurial ideas z and wealth a chooses whether to work for a wage w or operate a business in either sector $j = S, M$. To operate a business, individuals must pay a sector-specific per-period fixed cost of κ_j, in units of the sector's output. The crucial assumption is that the fixed cost to run an establishment in the manufacturing sector is higher than that in the service sector, $\kappa_M > \kappa_S$. This will generate the scale difference between the two sectors that we observe in the data (Table 1). Note that κ_j is fixed costs that need to be paid in every period of operation. We discuss in Section 3.2.2 how the results would change if one were to introduce a one-time fixed setup costs of starting a business.

After paying the fixed cost, an entrepreneur with talent z_j produces using capital (k) and labor (l) according to:

$$z_j f(k, l) = z_j k^{\alpha} l^{\theta},$$

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. Note that the factor elasticities are assumed to be the same in both sectors, consistent with the empirical findings in the literature (Chari et al., 1997; Valentinyi and Herrendorf, 2008).

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

$$\pi_j(k, l; R, w, p) = p_j z_j k^{\alpha} l^{\theta} - Rk - wl - (1+r) p_j \kappa_j,$$

where r is the interest rate and p_j is the price of sector j output. We normalize p_M to one. For later use, we define the optimal level of capital and labor inputs when production is not subject to financial constraints:

$$\left(k_j^u(z_j), l_j^u(z_j)\right) = \arg\max_{k,l} \left\{ p_j z_j k^{\alpha} l^{\theta} - Rk - wl \right\}.$$

The key feature of this technology is that the fixed costs introduce non-convexity. For any strictly positive fixed cost κ_j, the technology is feasible only if operated above the minimum scale; that is, $z_j k^{\alpha} l^{\theta} \geq (1+r)\kappa_j$.[4]

2.3 Credit and Rental Markets

We first describe credit and rental markets in the absent of microfinance policies.

Individuals have access to competitive financial intermediaries, who receive deposits, rent capital k at rate R to entrepreneurs, and lend entrepreneurs the fixed cost $p_j \kappa_j$. We restrict the analysis to the case where both borrowing and capital rental are within a period—that is, individuals' financial wealth is non-negative ($a \geq 0$). The zero-profit condition of the

[4]The model can be extended to allow for a choice of technologies within each sector: a technology with a small fixed cost and low productivity, $A_{1,j} z_j k^{\alpha} l^{\theta} - \kappa_1$, and a technology with a large fixed cost and high productivity, $A_{2,j} z_j k^{\alpha} l^{\theta} - \kappa_2$, with $A_{2,j} > A_{1,j}$ for $j = S, M$ and $\kappa_2 > \kappa_1$. In this extension, fixed costs are technology-specific but not sector-specific. One can think of our current setup as a case where the productivity gains from the κ_2-technology are significantly larger for manufacturing; that is, $A_{2,M} \gg A_{2,S}$.

intermediaries implies $R = r + \delta$, where r is the deposit and lending rate and δ is the depreciation rate.

Borrowing and 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: $(1 - \phi)\left[p_j z_j f(k, l) - wl + (1 - \delta) k\right]$, $0 \leq \phi \leq 1$. 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 and rental 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 $\bar{k}^j(a, z_j; \phi)$, which is a sector-specific function of the individual state (a, z). We choose the rental limits $\bar{k}^j(a, z_j; \phi)$ to be the largest limits that are consistent with entrepreneurs choosing to abide by their credit contracts. Without loss of generality, we assume $\bar{k}^j(a, z_j; \phi) \leq k_j^u(z)$, where k_j^u is the profit-maximizing capital inputs in the unconstrained static problem in sector j.

The following proposition provides a simple characterization of the set of enforceable contracts and the rental limits $\bar{k}^j(a, z_j; \phi)$ for $j = S, M$.

Proposition 1 *Capital rental k in sector j by an entrepreneur with wealth a and talent z_j is enforceable if and only if*

$$\begin{aligned}
&\max_l \{p_j z_j f(k, l) - wl\} - Rk - (1 + r) p_j \kappa_j + (1 + r) a \\
&\qquad \geq (1 - \phi) \left[\max_l \{p_j z_j f(k, l) - wl\} + (1 - \delta) k\right].
\end{aligned} \tag{2}$$

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

Condition (2) states that an entrepreneur must end up with (weakly) more economic resources when he fulfills his credit and rental 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 $\bar{k}^j(a, z_j; \phi)$.[5] As long as the unconstrained level of capital

[5] The set of enforceable capital rental dictated by (2) may not coincide with $k \leq \bar{k}^j(a, z_j; \phi)$, if, for example, $p_j \kappa_j > a$. Nevertheless, the solution to the individual problem subject to (2) coincides with the solution to the individual problem subject to the simpler limit $k \leq \bar{k}^j(a, z_j; \phi)$. See the proof in the appendix.

rental is not enforceable, the rental limit $\bar{k}^j(a, z_j; \phi)$ is implicitly defined as the larger root of the equation given by the equality in condition (2). 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. In the rest of the paper, we restrict individuals' capital inputs to be less than or equal to the rental limit $\bar{k}^j(a, z_j; \phi)$.

While the enforceability of contracts as measured by ϕ is not sector-specific, the equilibrium enforceable rental contracts, as captured by the rental limits $\bar{k}^j(a, z_j; \phi)$, do vary across sectors because of the differences in technology and output prices.

2.4 Microfinance Policies

We model microfinance as an innovation that guarantees individuals a minimum size of capital input, independently of individual's wealth and talent. This innovation could also be interpreted as a mean-tested credit program, that guarantees loans of a maximum size to poor individuals to cover capital investments and fixed operating costs.

In particular, we incorporate microfinance by modifying individual's rental limit to the following relaxed constraint:

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

where k^{MF} denotes the size of the microfinance innovation or intervention and, to be consistent with the assumption that individuals must finance the fixed cost at the beginning of a period, we net out the value of the fixed cost from the resources granted by microfinance.

In our model, microfinance can be interpreted as a technological innovation that allows financial intermediaries to receive high repayment on small uncollateralized loans at relatively low interest rates.[6] Alternatively, micro-finance can be thought as a government policy that guarantees loans toward small firms, such as those used by the U.S. Small Business Administration. In any of these interpretations, we are abstracting from the cost associated with operating microfinance institutions, or the default cost to guarantee the repayment of loans towards lenders. Our results must 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 in sector S or M for the period. The value for him at this stage, $v(a, z)$, is the maximum over

[6] The exact source of this innovation is debated and includes many possible policies: dynamic incentives, joint liability, or community sanctions.

the value of being a worker, $v^W(a,z)$, and the value of being an entrepreneur in sector j, $v^j(a,z)$, for $j = S, M$:

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

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. Similarly, the value of being an entrepreneur in sector j, $v^j(a,z)$, depends on the entire vector of entrepreneurial ideas, as he may switch sectors at a later date. We denote the optimal occupation choice by $o(a,z) \in \{W, S, M\}$.

As a worker, an individual chooses a consumption bundle $c = (c_S, c_M)$ and the next period's assets a' to maximize his continuation value subject to the period budget constraint:

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

where w is his labor income, and p denotes the vector of goods prices. 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 in sector j. The value function of being an entrepreneur in sector j is as follows.

$$\begin{aligned} v^j(a,z) &= \max_{c,a',k,l\geq 0} u(c) + \beta\left\{\gamma v(a',z) + (1-\gamma)\mathbb{E}_{z'}\left[v(a',z')\right]\right\} \\ \text{s.t. } & p\cdot c + a' \leq p_j z_j f(k,l) - Rk - wl - (1+r)p_j\kappa_j + (1+r)a \\ & k \leq \max\left\{\bar{k}^j(a, z_j; \phi), k^{MF} - p_j\kappa_j\right\} \end{aligned} \tag{5}$$

Note that an entrepreneur's income is given by period profit $p_j z_j f(k,l) - Rk - wl$ net of fixed costs $(1+r)p_j\kappa_j$ plus the return to his initial wealth, and that his choices of capital inputs are constrained by the microfinance-adjusted rental limit $\max\left\{\bar{k}^j(a, z_j; \phi), k^{MF} - p_j\kappa_j\right\}$.

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 $c_S(a,z)$, $c_M(a,z)$, $a'(a,z)$, $o(a,z)$, $l(a,z)$, $k(a,z)$; rental limits $\bar{k}^j(a, z_j; \phi)$, $j = S, M$; and prices w, R, r, p such that:

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

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

3. Unadjusted rental limits $\bar{k}^j(a, z_j; \phi)$ are the most generous limits satisfying condition (2), with $\bar{k}^j(a, z_j; \phi) \leq k^u_j(z_j)$;

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

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

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

$$\int c_S(a,z)\, G(da,dz) = \int_{\{o(a,z)=S\}} \left[z_S k(a,z)^{\alpha} l(a,z)^{\theta} - \kappa_S \right] G(da,dz) \qquad \text{(Services)}$$

$$\int c_M(a,z)\, G(da,dz) + \delta \frac{K}{N} = \int_{\{o(a,z)=M\}} \left[z_M k(a,z)^{\alpha} l(a,z)^{\theta} - \kappa_M \right] G(da,dz)$$

(Manufactured 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 US data on the distribution and dynamics of establishments, and data on standard macroeconomic aggregates, we calibrate a set of technological and preferences parameters that are fixed across countries. In a second stage we choose ϕ, the parameter governing the enforcement of contracts, to match the external finance to GDP ratio of the typical developing country. We then conduct experiments to assess the effect of microfinance innovation or policies by varying k^{MF}, the parameter governing the size of microfinance. In addition, we consider extensions where we incorporate idiosyncratic distortions to capture variation in the size distribution and dynamic of establishments across countries that are not accounted for by cross-country differences in the working of credit markets.

Our calibration strategy assumes that countries are endowed with the same entrepreneurial talent distribution. We maintain this assumption in our benchmark analysis to obtain a simpler and clearer characterization of the impact of micro-finance. Nevertheless, while starting with the same potential pool of entrepreneurs, financial frictions distort the selection into entrepreneurship. The productivity distribution of entrepreneurs in operation therefore differs across countries, with financial frictions lowering the mean and raising the dispersion of this distribution. The effect on the mean conforms to the conventional wisdom of aggregate TFP differences across countries. The increase in dispersion is consistent with the empirical findings of Hsieh and Klenow (2009), who show that less developed countries' establishment-level productivity (TFPQ in their terminology) dispersion is larger than that of the US.

It is straightforward to incorporate cross-country differences in the average productivity of potential entrepreneurs and workers by considering human capital and exogenous TFP differences. Furthermore, in our robustness analysis, we consider exogenous cross-country differences in higher moments of the talent distribution, and idiosyncratic distortions leading to additional sources of misallocation of resources across entrepreneurs, following the work by citetRest07.

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, the establishment size distribution within and across sectors, and establishment dynamics, among others.

We need to specify values for eleven parameters: four technological parameters, α, θ, κ_S, κ_M, and the depreciation rate δ; two parameters describing the process for entrepreneurial talent, γ and η; the subjective discount factor β, the coefficient of relative risk aversion σ, the intratemporal elasticity of substitution ε, and the service share in consumption ψ.

Two preference parameters, σ and ε, and two technological parameters, $\alpha/(1/\eta+\alpha+\theta)$ and δ, can be set to standard values in the literature. We let $\sigma = 1.5$ and $\varepsilon = 1.0$.[7] The one-year depreciation 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.[8]

Table 2: Calibration

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	$\alpha + \theta = 0.79$
Average scale in services	14	14	$\kappa_S = 0.00$
Average scale in manufacturing	47	47	$\kappa_M = 4.68$
Establishment exit rate	0.10	0.10	$\gamma = 0.89$
Manufacturing share of GDP	0.25	0.25	$\psi = 0.91$
Interest rate	0.04	0.04	$\beta = 0.92$

We are thus left with the seven parameters that are more specific to our study. We calibrate them to match seven relevant moments in the US data as shown in Table 2: the average size of establishments in services and in manufacturing; 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; the share of manufacturing value-added in the absorbed GDP; and the annual real interest rate.

The identification of these seven parameters follows the basic logic given in our discussion of the perfect-credit benchmark. We calibrate the sector-specific fixed costs, $\kappa_S = 0.0$ and $\kappa_M = 4.68$, to match the average establishment size in services and manufacturing (14 and 47, respectively). The per-period fixed cost in manufacturing sector, $\kappa_M = 4.68$, is tantamount to about three times the equilibrium wage in the perfect-credit benchmark. Given the returns

[7] See Section III.C in Buera et al. (2010) for more discussions on the choice of ε.

[8] 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.

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.[9] We set $\psi = 0.91$ to match the share of manufacturing value-added in absorbed GDP. Note that all investment goods are manufactured goods in our model. Finally, the model requires a discount factor of $\beta = 0.92$ to match the annual interest rate of four per cent.

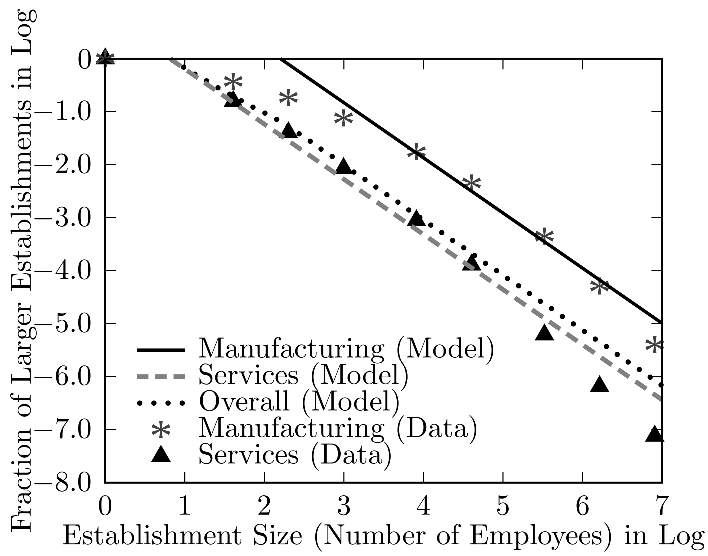

Fig. 1: Establishment Size Distribution in the Model and Data

Figure 1 shows the establishment size distribution from the calibrated perfect-credit benchmark, and compares it with the US data. The horizontal axis is the establishment size (number of employees, l) in log. For each l, we compute the fraction of establishments whose size is larger than or equal to l. With our independent Pareto distribution for talent in each sector, the perfect-credit benchmark gives straight lines for services (dashed line) and manufacturing (solid line). We construct a line using all establishments in our perfect-credit benchmark (dotted line). We do the same calculation using the 2002 US Economic Census: asterisks for manufacturing and triangles for services. The model is able to fit the tails of the empirical distribution, the distance between the two within-sector distributions, and the initial concavity in the overall (inclusive of both sectors) distribution of establishment size. The assumption that the entrepreneurial talents for the two sectors are drawn from the same Pareto distribution generates the identical slope for the right tails. The model

[9]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.

cannot capture the initial concavity in the distribution of establishment size within a sector, presumably because we abstract from within-sector heterogeneity in fixed costs.

Finally, we calibrate ϕ so that the ratio of external finance to GDP equals 0.34, which is roughly that of Kenya, Zimbabwe, Bulgaria or Jamaica and equals the average ratio across non-OECD countries (plus Hong Kong) over the ten years 1990-1999 from Beck et al (2000). The 1990s are chosen as a period that is relatively recent, yet still precedes the most recent boom in wide-scale microfinance programs.

3.2 Results

We quantify the effects of varying the scale of the microfinance intervention k^{MF} from zero to ten (times the benchmark annual wage). We begin by presenting results for a one-sector model. Its simplicity allows for greater clarity, and it captures the opposing effects of microfinance on higher TFP and lower capital accumulation. We compare the results to an increase in contract enforcement that expands borrowing limits more uniformly across the population but produces an equivalent level of external finance. Finally, we show the additional impacts that come from introducing the large-scale sector.

3.2.1 One Sector Model

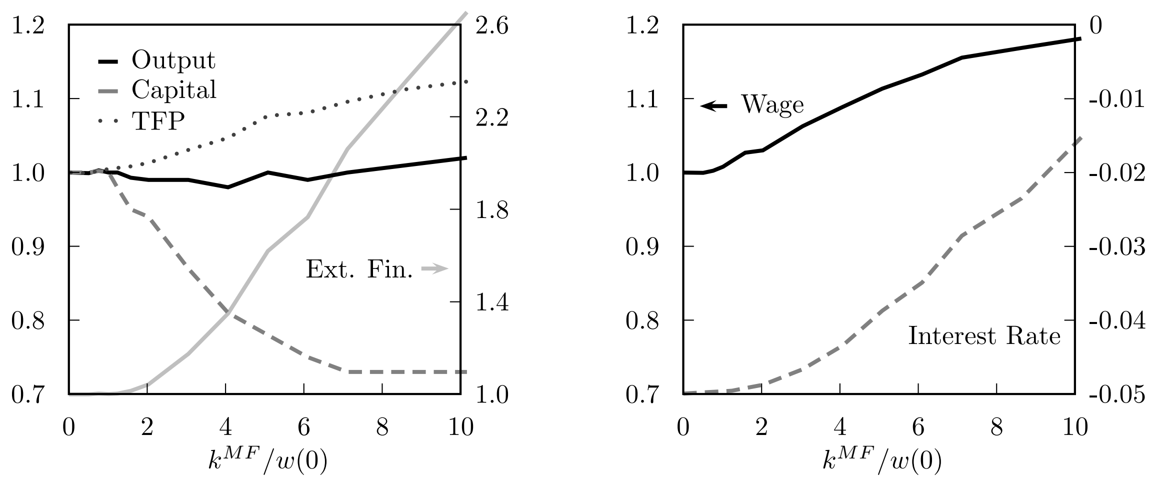

Fig. 2: Aggregate Implications of Microfinance: One Sector Model

In this section, we discuss the impact of microfinance using a model where the share of the large-scale sector (sector M) output in consumption has been set to zero and capital can be produced by small-scale methods, effectively a one-sector model. This one-sector model is obviously simpler than our two-sector model, and hence helps us clarify many of the underlying features in our framework.

In Figure 2, we show aggregate output, capital, TFP, and external finance in the steady states corresponding to various levels of k^{MF}. On the horizontal axis, k^{MF} relative to the equilibrium wage with $k^{MF} = 0$ is shown, which ranges from 0 to 10. All four aggregate quantities are normalized by their respective levels in the $k^{MF} = 0$ economy.

We observe four 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 the quantity limits on microfinance, i.e., k^{MF} (dashed line). Third, aggregate capital declines with the microfinance limits (dotted line). The second and third patterns happen to cancel each other out, resulting in the first pattern. Finally, microfinance has unambiguously positive effects on the quantity of externally-financed capital (dash-dot line, righthand-side vertical scale).

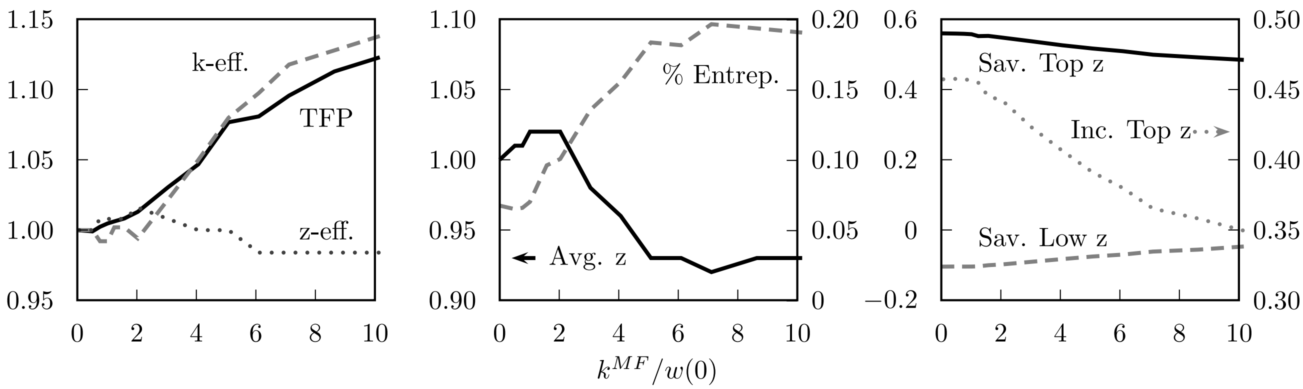

Fig. 3: Determinants of TFP and Capital Accumulation

Effect on TFP In the left panel of Figure 3, we trace with a solid line the aggregate TFP in the steady states corresponding to alternative values of k^{MF}. We observe an increase in the TFP of 12 percent as k^{MF} goes from 0 to 10 times the wage in the $k^{MF} = 0$ economy. This increase reflects changes in 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 formulas for the TFP decomposition are derived and explained in the appendix.

The dashed line in the left panel of Figure 3 shows the increase in TFP that results from 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 to $\underline{k}^{MF}$ units of capital for production purposes and alleviates the financial constraints up to a point. The higher k^{MF} is, the more equal the marginal product of capital across entrepreneurs, raising the measured aggregate TFP. Notice that the solid line is close to the dashed line. This implies that the intensive margin explains most of the positive TFP effect of microfinance. In fact, 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 only partially offset by the extensive margin as explained below.

The changes in TFP driven by the extensive margin are also shown with the dotted line in the left panel of Figure 3. Microfinance has a non-uniform effect on the selection into entrepreneurship. With small enough k^{MF}, microfinance positively affects the extensive margin (dotted line above 1), as it helps highly-talented but poor individuals to enter into entrepreneurship. However, with larger k^{MF}, the extensive margin negatively affects the extensive margin (dotted line below 1), as it induces even those individuals with mediocre talent to start business, which more than negates whatever positive selection it causes.

The middle panel of Figure 3 clearly shows these effects of microfinance on the extensive margin. A small enough k^{MF} (i.e., less than twice the normalized wage) facilitates the entry of highly-talented but poor entrepreneurs, and the average talent level of active entrepreneurs (solid line, left scale) increases with k^{MF}. More generous microfinance limits encourage entry of even the entrepreneurs who are not highly talented, and these are much more numerous than those with the highest levels of talent. As a result, there is 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 entrepreneurial talent (solid line).

In summary, in the one-sector model, 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 into entrepreneurship, a positive effect on the allocation of entrepreneurial talent, this positive effect can be wiped out with generous enough microfinance programs that promote the entry of many relatively-unproductive entrepreneurs.

Effect on Capital Accumulation In Figure 2, 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 wealth 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 rightmost panel of Figure 3, the average saving rate of those belonging to the top 5 percentiles 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), which is in fact negative (dashed line, right scale).

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 entrepreneurial activities and some pre-cautionary 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 3, generous microfinance promotes the entry of such marginal entrepreneurs. As shown in the rightmost panel of Figure 3, 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 now earn more than what they would have earned as a worker, and the labor income share is fixed at θ in the model.[10]

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.[11]

Microfinance vs. Overall Improvement in Enforcement We conclude our analysis of the one-sector model by comparing the impact of micro-finance interventions with that of a change in ϕ that spans the same range of external finance. To be more specific, the micro-finance interventions in this section (k^{MF} from 0 to 10 times the normalizing wage) increases the quantity of externally financed capital by 165 percent (dash-dot line, Figure 2). Empirically, this roughly corresponds to a change in external finance to GDP ratio from that of Kenya to that of Chile. To generate the same increase in external finance, we raise the enforcement parameter ϕ from 0.12 to 0.29. (Note that $\phi = 1$ is the perfect-credit case.)

The change in the enforcement parameter ϕ can be thought of as a broad improvement in policies and institutions enforcing contracts that result in more relaxed financial constraints overall. This contrasts with microfinance which by definition focuses on providing size-dependent (i.e., small) access to externally-financed capital.

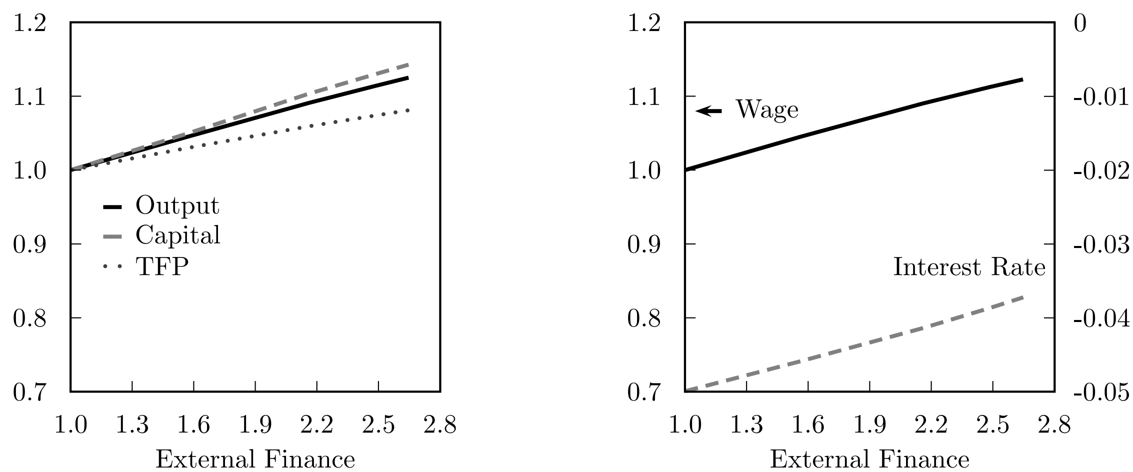

Fig. 4: Aggregate Implications of Contract Enforcement, ϕ

The aggregate impact of better contract enforcement (higher ϕ) is shown in Figure 4.

[10]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 the workers, and there are now more entrepreneurs and fewer workers in this group.

[11]Also note that the saving rate of the top talent group is also decreasing in $\underline{k}^{MF}$. There are two reasons for this. First, more entry drives up market wage, and a higher wage lowers 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 $\underline{k}^{MF}$, 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 $\underline{k}^{MF}$.

Aggregate output, capital, and TFP are normalized by their respective levels in the $\phi = 0.12$ economy. They are plotted against the amount of externally-financed capital, which is also normalized by its value in the $\phi = 0.12$ economy.

We observe that, as in Figure 2, TFP increases with external finance. However, unlike in Figure 2, output and capital also increase with external finance.

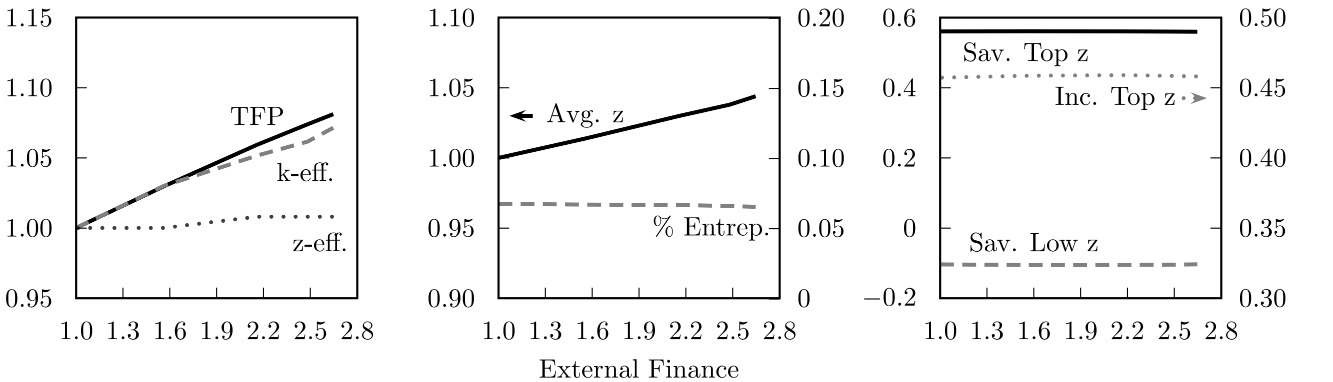

Fig. 5: Micro Implications of Contract Enforcement, ϕ

The increase in TFP can be decomposed into better resource allocation along the intensive margin and the extensive margin. In the left panel of Figure 5, we show that almost all of the increase in TFP (caused by higher ϕ) is again accounted for by the intensive margin – i.e., more efficient capital allocation among existing entrepreneurs. The extensive margin is responsible for only a small fraction of the positive effect. However, the contrast here to the microfinance result is that the extensive margin effect is still positive, not negative.

Indeed, the center panel of Figure 5 shows that the average quality of active entrepreneurs increases in response to higher ϕ. There are two reasons. First, the entry of highly-talented but poor individuals is facilitated by better financial access. Recall that this effect existed in the microfinance case, except that there this effect was overwhelmed by the entry of marginal entrepreneurs. Second, our collateral constraint specification is such that entrepreneurs still have to self-finance a large portion of their capital, and marginal entrepreneurs do not find it profitable enough to save up collateral and produce. With microfinance, entrepreneurs could have access to k^{MF} without putting down any collateral. Thus, for those with small efficient scale (i.e., mediocre entrepreneurs), the collateral accumulation phase does not factor into their entry decision.[12] The same panel shows that the fraction of the population choosing to be entrepreneurs remain almost flat across the steady states spanned by our ϕ range. This clearly contrasts with the microfinance result where the number of entrepreneurs doubled over the same range of external finance (middle panel, Figure 3).

The near invariance of the number of entrepreneurs across steady states accounts for the stability in the income share of the top-talent group (i.e., those in the top 5 percentiles of

[12]Another reason for the positive selection from higher ϕ is the property of our collateral constraint that implies a larger increase in externally-financed capital for individuals with a higher z (controlling for wealth) for the given increase in ϕ. However, this is not essential, as an alternative form of collateral constraints that are independent of z also gives positive selection caused by an improvement in contract enforceability.

the talent distribution), as shown in the right panel of Figure 5 with a dotted line. The average saving rates of the two groups (solid and dashed lines) also remain roughly constant across steady states with differing ϕ, implying that the aggregate saving rate is also nearly constant. This, coupled with the increase in TFP and hence output, explains the increase in steady-state capital stock in response to better contract enforcement.

3.2.2 Two Sectors Model

In this section we explore the impact of microfinance in a two-sector model with sector-specific fixed costs. We use this model because the role of credit markets is particularly important for sectors with a large efficient scale (Buera et al., 2010). The impact of microfinance will depend on whether it extends to large-scale sectors.

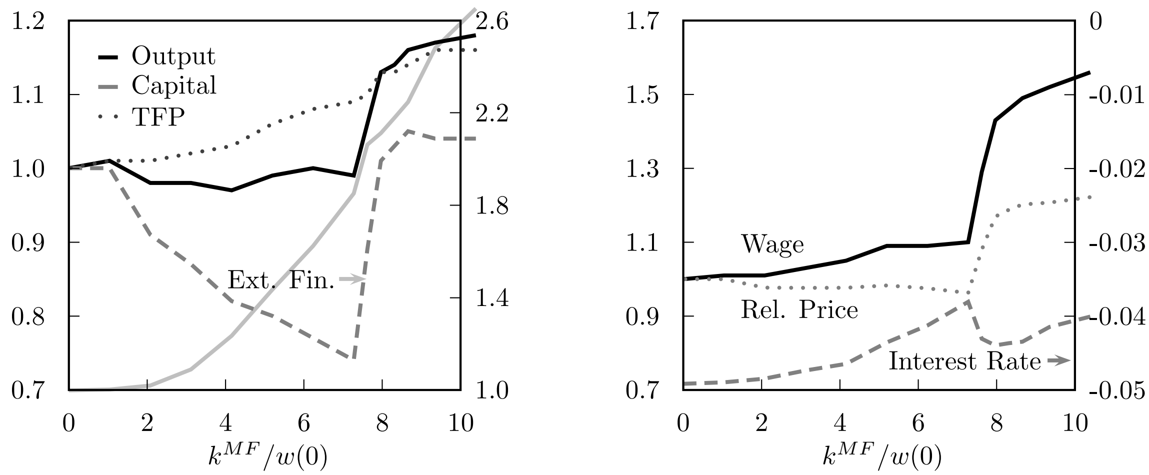

Fig. 6: Aggregate Implications of Microfinance: Two Sectors Model

Aggregate Effect of Microfinance The aggregate effects of microfinance in the two-sector model are summarized in Figure 6. Three clear patterns emerge. First, aggregate TFP increases with the size of microfinance programs (k^{MF}). Second, microfinance has a nonlinear impact on aggregate output, which does not change in spite of increases in k^{MF} initially, but then increase dramatically once k^{MF} reaches a certain threshold (7 times the normalizing wage). Third, microfinance has a nonmonotonic effect on aggregate capital: Capital initially decreases with k^{MF}, just as in the one-sector case, but then reverses its course once k^{MF} reaches the threshold.

In summary, the aggregate impact of microfinance in the two-sector model is qualitatively similar to that in the one-sector model if k^{MF} is small enough: TFP increases, capital decreases, but output is nearly unaffected. However, when k^{MF} is large enough that microfinance begins to directly influence the large-scale sector (e.g., manufacturing and investment goods sector)—which occurs when k^{MF} is more than 7 times the normalizing wage—we observe an aggregate effect that is qualitatively different from that in the one-sector model: Output and capital increase sharply, along with aggregate TFP.

The behavior of equilibrium prices share the discontinuous impact of microfinance, as illustrated in the right panel of Figure 6. For small interventions (i.e., k^{MF} less than 7 times the normalizing wage), microfinance favors the small-scale sector almost exclusively, and leads to an increase in the relative price of investment/manufactured goods. For k^{MF} larger than 7 times the normalizing wage, entrepreneurs in the large-scale sector also directly benefit from microfinance, resulting in a substantial decline in the relative price of investment/manufactured goods, and a sharp increase in wages. Note that the overall effect on wages of microfinance interventions is substantially larger than in the one-sector model, with wages increasing by up to 55 percent as k^{MF} goes from 0 to 10 times the normalizing wage. Recall that its one-sector counterpart is only 18 percent.

Sector-Level Effect of Microfinance Our two-sector model also allows us to analyze how resources are allocated between sectors in response to microfinance arrangements. The relative price of investment/manufactured goods (produced by large-scale sector) to consumption/services (produced by small-scale sector) reflects such inter-sectoral allocation of resources. We now characterize this in more detail.

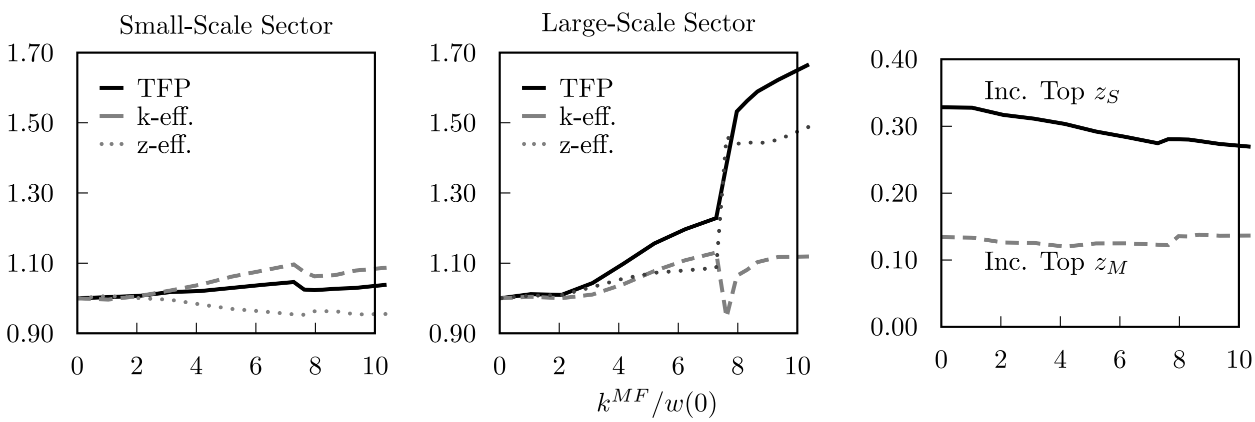

Fig. 7: Micro Implications of Microfinance: Two Sectors Model

In the left and the center panels of Figure 7, we show the impact of microfinance on the sector-level TFP of the small-scale and the large-scale sectors. We again decompose the changes in sector-level TFP into improvements in the allocation of capital across active entrepreneurs (intensive margin or k-efficiency) and changes in the allocation of entrepreneurial talents into sectors (extensive margin or z-efficiency).

For small interventions (i.e., k^{MF} less than 7 times the normalizing wage), the sector-level TFP of the small-scale sector behaves in a way similar to the aggregate TFP in the one-sector model: The increase in TFP reflects better allocation of capital among entrepreneurs (intensive margin), which is then partially offset by the entry of marginal entrepreneurs into the small-scale sector. Note that k^{MF} is too small to make a marginal entrepreneur profitable in the large-scale sector. This entry of marginal entrepreneurs also implies that more capital and labor are channeled into the small-scale sector, driving up the relative price of goods produced in the large-scale sector.

Even for such small interventions, TFP of the large-scale sector is more affect by microfinance, although k^{MF} is too small to directly benefit entrepreneurs in this sector. The TFP increase over this region is almost equally decomposed into the improvements in the intensive and the extensive margins. In the intensive margin, the higher relative price of their output enables talented-but-poor entrepreneurs to accumulate collateral faster, thereby reducing the dispersion of the marginal product of capital. In the extensive margin, now some of the marginal entrepreneurs in the large-scale sector find it more profitable to take advantage of microfinance and start business in the small-scale sector instead. The exit of the marginal entrepreneurs drives up the z-efficiency, or the allocation of talent for the large-scale sector.[13]

When k^{MF} is large enough, microfinance can also directly benefit talented-but-poor entrepreneurs in the large-scale sector, for whom it takes a particularly long time to self-finance the capital needed for profitable production otherwise. They can now enter right away. The faster entry and growth of entrepreneurs who are highly talented but poor in the large-scale sector now lowers the relative price of the sector output, leading to the exit of marginal entrepreneurs from the large-scale sector. Overall, large interventions (i.e., k^{MF} more than 7 times the normalizing wage) sharply increase the sector-level TFP of the large-scale sector, and more than 100 percent of this increase is accounted for by better allocation in the extensive margin (z-efficiency).

Effect on Capital Accumulation The right panel of Figure 7 shows the impact of microfinance on the income share of those in the right tail of the entrepreneurial talent distribution in each sector. For the small-scale sector, we look at the top 5 percentiles. For the large-scale sector, we consider the top half percentile. As we have discussed in the analysis of the one-sector model, the behavior of the income share of top entrepreneurial talents is central to understanding the impact of microfinance on aggregate investment, because they have substantially larger saving rates than the rest. As in the one-sector model, the income share of top talents in the small-scale sector declines by 10 percentage points. In contrast, the income share of the top talents in the large-scale sector remains roughly constant. This is because their income is positively affected by the increase in the relative price of their output for small interventions, and then directly by micro-finance for large interventions. Overall, the lower income share of these individuals with high saving rates leads to a moderate decline in aggregate investment rates.

In the two-sector model, there is an additional channel through which microfinance affects capital accumulation: the relative price of investment goods (a large-scale sector output). We have observed that initially more resources are channeled into the small-scale sector by microfinance, driving up the investment goods price. This reinforces the negative impact on capital accumulation. Eventually, with large interventions through microfinance, the TFP of the large-scale sector jumps up, pushing down the price of investment goods, encouraging capital accumulation. Overall, there is small difference in the capital stock in the $k^{MF} = 0$ economy and the large intervention case.

Microfinance vs. Overall Improvement in Enforcement We conclude our analysis of the two-sector model by comparing the impact of micro-finance interventions with that of a change in ϕ that spans the same range of external finance.

[13] Although not shown, the number of entrepreneurs in the small-scale sector increases with k^{MF}, while it decrease in the large-scale sector.

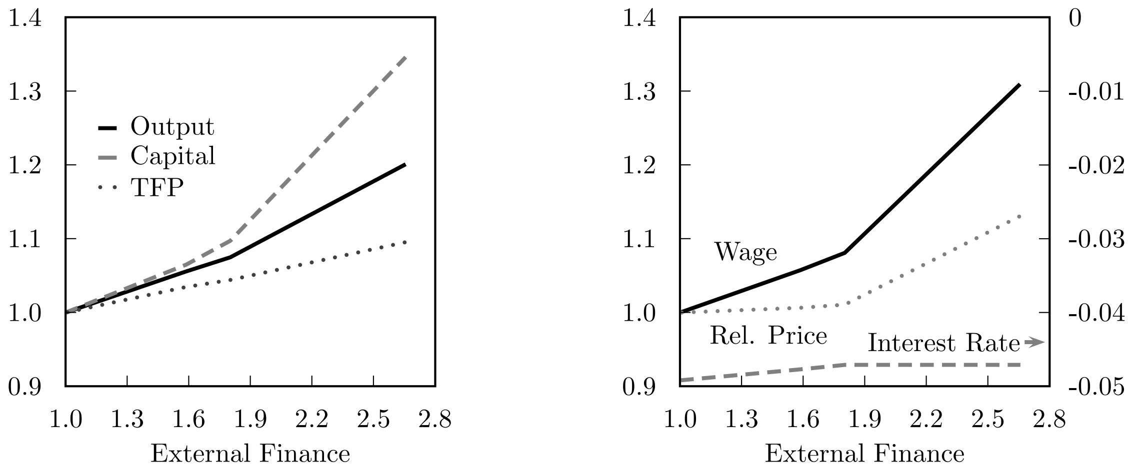

Fig. 8: Aggregate Implications of Contract Enforcement, ϕ, Two Sectors

We observe that, unlike Figure 6, all quantities and prices are monotonically increasing with the amount of externally-financed capital in the economy (caused by better contract enforcement). The main difference here is that any improvement in contract enforcement directly affect entrepreneurs in both the small-scale and the large-scale sectors. There is no threshold level of ϕ at which the large-scale sector begins to be directly affected. Therefore, the impact of improved access to external finance is continuous and monotonic. Nevertheless, the impact is not symmetric between the two sectors, because the large-scale sector is more sensitive to the availability of external finance. Note in particular the decrease in the relative price of the output of the large-scale sector (dotted line, right panel), which reflects the increase in the relative productivity of that sector.

3.2.3 Distribution of Welfare Gains

TO BE WRITTEN.

4 Extensions

TO BE WRITTEN.

5 Concluding Remarks

TO BE WRITTEN.

A TFP Decomposition

In this Appendix we derive the decomposition of TFP used in figures 3 and 7. To simplify the analysis, we consider the case with $\kappa_i = 0$.

Using the optimal choice of labor input, $l(a,z) = (z_i \theta p_i k(a,z)^\alpha / w)^{1/(1-\theta)}$, 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):

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

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