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 credit programs targeted toward small-scale businesses. In our analysis, we find that the redistributive impacts of microfinance are stronger in general equilibrium than in partial equilibrium, but the aggregate impacts are smaller. Making the typical microfinance program more widely available has only a small impact on per-capita income, since an increase in aggregate total factor productivity (TFP) is offset by lower capital accumulation that stems from the redistribution of income from high-saving individuals to low-saving ones. However, the welfare impact is uniformly positive except for those few that are extremely talented.

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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 focus on a single important aspect of scaling up microfinance: general equilibrium (GE) effects. We find that typical microfinance, when made widely available in an economy, can have significant aggregate and distributional impacts, and that the GE effects on interest rates and wages are quantitatively important. Microfinance is a pro-poor redistributive policy, benefitting the poor and especially marginal entrepreneurs and potentially hurting the most able entrepreneurs. A resulting increase in wages greatly amplifies this aspect of microfinance. Microfinance redistributes income away from individuals with high saving rates (high-ability entrepreneurs) to those with low saving rates (marginal entrepreneurs), lowering aggregate savings. Higher interest rates partially mitigate this, but in the general equilibrium lower savings lead to lower capital accumulation. Although microfinance has a positive impact on total factor productivity (TFP), wages, and consumption, given lower capital accumulation, it has substantially smaller long-run impacts on aggregate output. This contrasts with the partial-equilibrium impacts, which are more strongly positive on TFP, output, capital and consumption.

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 effectively expanded by microfinance.

We discipline our analysis on two fronts. We first require that our model matches data from developed and developing countries on the distribution and dynamics of establishments, and the ratio of external finance to GDP. We then compare the short-run partial equilibrium implications of our calibrated model with measured impacts of in recent microevaluations of interventions in urban India (Banerjee et al., 2009) and rural Thailand (Kaboski and Townsend, 2010a,b). Namely, the model captures the overall level of credit, and the increase in investment and entrepreneurship, including the entry of marginal entrepreneurs. Although the model does not address consumption loans, and so underpredicts the increase in consumption, it nevertheless captures the heterogeneous impact on consumption reported in both studies. Thus, the mechanisms we model seem important in empirical studies, and their orders of magnitude are also reasonable.

We then use the model to quantify the relationship between the size of microfinance—that is, the guaranteed borrowing limit—and key macroeconomic measures of development in steady states: output, TFP, capital, wages, and interest rates. We begin with the impacts on long-run outcomes in partial equilibrium, and then we contrast these with the corresponding impacts in general equilibrium.

In the short-run PE case, which corresponds most closely to the microevaluations, wages and interest rates are held fixed. TFP increases monotonically with the size of the intervention, increasing by over 60 percent for guaranteed capital that is five times the annual wage but roughly 2-13 percent for the more typical one to two times the annual wage. In this case, the increase in TFP comes from almost exclusively from the increased entry of entrepreneurs rather than a better allocation of capital across entrepreneurs. Even in the short-run capital, output, and consumption increase by as much as 40 percent, 80 percent, and 10 percent, respectively, but again the impacts are much lower for more typical levels of guaranteed credit.

Both capital/asset dynamics and GE have crucial effects on the impacts of microfinance, however. In PE, in the long run steady state, the higher TFP leads to increased asset accumulation. This has large effects on the impacts on capital, output, TFP and consumption. For example, for a PE innovation of two times the annual wage, the impacts on capital and consumption are ten and twenty times higher, and those on TFP and ouptut are two and half times higher.

In GE, wages rise monotonically with the level of microfinance, by 7 percent for guaranteed borrowing that is twice the annual wage. The higher steady state wages are 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. These higher wages and interest rates lead to aggregate impacts that are much smaller than those in PE. TFP still rises but by 5 percent, less than one-fifth of the PE effect, and with the higher wages, more than half of the TFP gain comes from a more efficient distribution of capital. Moreover in GE, the higher wage redistributes 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 10 percent. With a capital share of 0.3, this offsets a large part of the increase in TFP, so output increases by less than two percent. Lower savings rates leads to larger positive impacts on consumption, however: 5 percent higher for guaranteed borrowing twice the annual wage.

While the aggregate impacts of microfinance on TFP, output, and consumption are much smaller in general equilibrium than they would be in partial equilibrium, for the same reasons 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 11 percent of their permanent 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 eight percent of permanent consumption, or more than double the gains in partial equilibrium. However, the GE effects make the highest ability entrepreneurs of the economy actually worse off from economy-wide microfinance.

We analyze three variations of the model that add additional insights. The first extension models a small open economy in which microfinance borrowers does not compete with other borrowers for aggregate capital. Wage gains are smaller under this model, though output gains are marginally higher. Aggregate capital is barely affected by microfinance. The second 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 undercapitalized, low-ability entrepreneurs with few labor market alternatives. In this model, for levels of microfinance up to three times annual wages, the resulting rise in interest rates induces marginal entrepreneurs to become workers, and wages and output actually fall. The third extension follows Buera et al. (2010) by introducing a large-scale sector that requires a large fixed cost for production. 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 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. In Section 2, we develop the model, including the microfinance intervention. Section 3 describes the calibration, benchmark partial equilibrium results, and a detailed comparison of our results with empirical microevaluations. We contrast these with general equilibrium results in Section 4, and then provide extensions. 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 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.[4]

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.

[4]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.

There is a recent empirical literature that has focused on estimating partial equilibrium impacts of relatively-small interventions.[5] 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 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. [6] 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 3.3.

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.

[5]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.

[6]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.

The pattern is robust to regression analyzes 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 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 repayment of capital up to a limit regardless of entrepreneurs' wealth or talent.

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: $(1 - \phi)\left[zf(k, l) - wl + (1 - \delta)k\right]$, $0 \leq \phi \leq 1$. 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 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 $\bar{k}(a, z; \phi)$, which is a function of the individual state (a, z). We choose the rental limits $\bar{k}(a, z; \phi)$ to be the largest limits that are consistent with entrepreneurs choosing to abide by their credit contracts. Without loss of generality, we assume $\bar{k}(a, z; \phi) \leq k^u(z)$, 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 $\bar{k}(a, z; \phi)$.

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

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

The upper bound on capital rental that is consistent with entrepreneurs choosing to abide by their contracts can be represented by a function $\bar{k}(a, z; \phi)$, 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 $\bar{k}\,(a, z; \phi)$. 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 additional capital input. While the *total* capital limit will depend on the individuals' assets, this additional capital is independent of wealth and talent. To be more specific, we incorporate microfinance by relaxing individuals' capital rental limit into the following constraint:

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

where b^{MF} denotes the intra-period borrowing limit of (i.e., the additional capital provided by) the microfinance innovation. Note that an entrepreneur chooses either to rent from the financial intermediary subject to the endogenous rental limit $\bar{k}(a, z; \phi)$ or to use microfinancing to top up his self-financed capital $a + b^{MF}$.

Our modeling of microfinance can be interpreted as a technological innovation that enables financial intermediaries to receive full repayment on small uncollateralized loans.[7] Alternatively, microfinance can be thought of 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 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

[7]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.

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 $o(a,z) \in \{W, E\}$.

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:

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

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.

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

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 b^{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 $\bar{k}(a,z;\phi) \le k^u(z)$;

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

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

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

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

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

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

3 Quantitative Analysis

To quantify the aggregate and distributional impact of microfinance, we calibrate our model in two stages. First, using the US data on standard macroeconomic aggregates, we calibrate a set of technological and preference parameters that are assumed to be the same across countries. In the second stage, using data from India, we choose ϕ, the parameter governing the enforcement of contracts, to match the external finance to GDP ratio, and jointly calibrate the parameter governing the establishment distribution. We then conduct experiments to assess the effect of microfinance by varying b^{MF}, the maximum loans guaranteed under microfinance.

3.1 Calibration

We first 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. Of these seven parameters, η will be re-calibrated below to match the Indian data.

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 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]

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	$\beta = 0.92$
Target Moments	Indian Data	Model	Parameter
Top 10-percentile employment share	0.58	0.58	$\eta = 5.56$
External finance to GDP ratio	0.34	0.34	$\phi = 0.08$

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.[9] Finally, the model requires a discount factor of $\beta = 0.92$ to match the annual interest rate of four per cent

We use the above parameter values calibrated to the US data for our analysis of microfinance, with two important exceptions. First, microfinance is implemented in countries with underdeveloped financial markets. Second, the establishment size distribution in less

[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.

[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.

developed countries are vastly different from that of the US. Using detailed data available for India, we re-calibrate ϕ and η. The ratio of external finance to GDP in India is 0.34, which happens to be equal to the average ratio across non-OECD countries over the 1990s as reported by Beck et al. (2000). This period is chosen because it immediately precedes the explosive proliferation of large-scale microfinance programs. From Indian census data, we compute the employment share of the largest 10-percent of establishments to be 0.58. A joint calibration leads to $\phi = 0.08$ and $\eta = 5.56$.

3.2 Short-run PE Results

We quantify the effects of microfinance for a wide range of b^{MF}. We begin by discussing the results of the short-run partial equilibrium analysis. This builds understanding of the model, and it also facilitates our next step, a comparison of the model's implications with microevaluations. Although the comparison is not precise, the model matches key qualitative features and the quantitative magnitudes are also of reasonable order of magnitude.

We begin in the steady state, with the GE prices that result from the calibration. The short-run PE impact we now discuss refer to impacts one period after the introduction of the microfinance technology, when labor and capital market clearing conditions are relaxed and the wage and interest rate are kept constant at their levels in the $b^{MF} = 0$ equilibrium

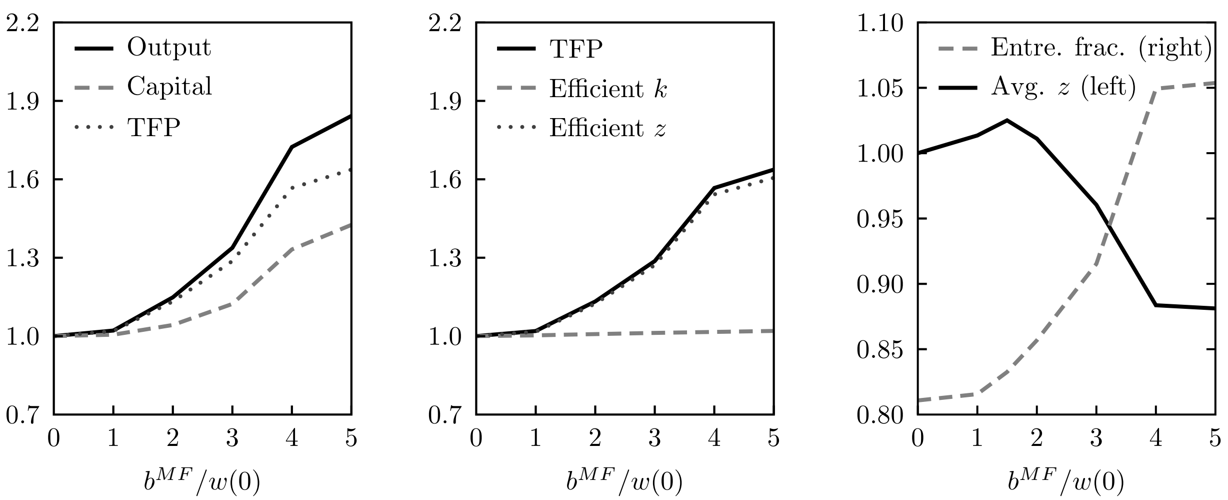

Fig. 1: Short-Run Aggregate Implications in Partial Equilibrium

In the left panel of Figure 1, we show aggregate output, capital, and TFP in for several such experiments corresponding to various levels of b^{MF}. On the horizontal axis, b^{MF} relative to the equilibrium wage in the $b^{MF} = 0$ economy (i.e., b^{MF} over $w(b^{MF} = 0)$) is shown, which ranges from 0 to 5. All three aggregate quantities are normalized by their respective levels in the $b^{MF} = 0$ economy. The pattern is clear, all three increase monotonically, with output increasing up to almost 85 percent, TFP increasing up to over 40 percent, and capital increasing up to almost 65 percent.

In the center panel of Figure 1, we reproduce the aggregate TFP measure with a solid line and then decompose this productivity gain, which reflects changes in the allocation of production resources (capital and entrepreneurial talent). The dashed line represents the effect of better capital allocation among existing entrepreneurs (intensive margin), while the dotted line shows the effect through selection into entrepreneurship (extensive margin). The formulas for this TFP decomposition are derived and explained in the appendix. In this short-run PE exercise, the TFP gain is almost exclusively accounted for by the extensive margins.

The right-hand side panel sheds further light on the extensive margin gains by plotting the rate of entrepreneurship and the average ability of entrepreneurs.[10] The availability of microfinance increases the number of entrepreneurs, marginally for low levels of guaranteed borrowing but dramatically for higher levels. The available capital allows some talented-but-poor agents to enter, but also induces marginal ability people to become entrepreneurs. At low levels of guaranteed capital (i.e., $b^{MF} < 1.5w$), the former plays a significant role, but at higher levels, the latter dominates and average ability falls as more and more entrepreneurs enter. At these levels, the extensive margin productivity gains come purely from increased entry.

In summary, microfinance has a significant positive impact on capital accumulation and aggregate TFP. While both entry and better allocation of capital play a role in explaining the TFP gains, increased entry — even of marginal entrepreneurs — is most important.

3.3 Comparison with Microevaluations

We now compare the above short-run partial equilibrium predictions of our model two recent microevaluations, the urban Indian Spandana study by Banerjee et al. (2009) and the rural Thai Million Baht village fund program evaluation by Kaboski and Townsend (2010a,b).one urban and one rural. These two microevalations are chosen since they closely examine the patterns most relevant to our model, entrepreneurship, investment, and consumption.

While the model and empirical studies do not map together perfectly, the purpose is to gauge whether our model captures key aspects and mechanisms in the empirical work, in order to assess the potential validity of the model for making GE predictions.

We compare along three dimensions: the amount of microfinance borrowing, the impact on investment activities (entrepreneurship and investment), and the impact on consumption,

[10] normalized by its value in the stationary equilibrium with $b^{MF} = 0$.

and find that the model performs reasonably well along each front, although the model overpredicts impacts on investment and underpredicts impacts on consumption. It is important to keep in mind that we do not model consumption loans which are an important use of microcredit in both empirical studies. Hence, our intervention is somewhat larger in terms of credit for entrepreneurial activities but clearly smaller in terms of credit for consumption.

The Indian study involved a randomized expansion of branches across different slum neighborhoods in Hyderabad, India. The follow up survey was roughly 18 months after loans were disbursed. Loan amounts ranged from 10 to 20,000 Rupees, or roughly up to 1 to 2 times annual per capita expenditures in the baseline survey (12,000 R).[11] The randomization led to an increase of roughly 1300 R of microfinance per capita, or just over 0.1, when normalized by annual expenditures. This increase was a 50 percent increase over the baseline level of microfinance, of about 2400 R, and the after intervention level of microfinance constituted about 42 percent of total credit. The loans increased new business starts by 1.6 percentage points on a baseline of 5.4 percent. The impacts on the revenues, assets, and profits of existing business owners are positive but all statistically insignificant. However, the loans did produce a significant increase in durable consumption of 16 percent, and a significant increase in durables used for businesses of 128 percent.

Table 3: Comparison Summary

	Model	India	Thailand
Max Loan/Exp per Cap	1.1	1-2	1
Credit/Exp per Cap	0.1	0.1	0.1
Microfinance/Total Credit	22%	44%	33%
Entrepreneurship	+4 pp	+2 pp	+1 pp
Investment	+40%	+16/128%	+30% (prob).
Consumption	+0%	+16%	+15%

The Thai study involved the study of a government transfer of one million baht of seed money to rural villages for founding village funds. Since villages differed in their size, this constituted more than 25 percent of total annual income in the smallest village but less than 0.2 percent in the largest village, which caused variation in lending.[12] Loan sizes were about 20,000 baht, roughly equal to annual expenditures per capita (22,000 Baht) in the survey area. Since impacts are measured as coefficients on continuous variables, we put impacts in terms of the median village. The credit injection constituted 2300 baht per capita, or again roughly 0.1 as a fraction of annual per capita expenditure, and the intervention constituted

[11] The empirical per capita numbers in this section are actually "per adult equivalent".

[12] The impact results here are taken from Kaboski and Townsend (2010a), with the exception of new business starts and business profits, which are from Kaboski and Townsend (2010a). For the purpose of better comparison, we have specifically calculated the other numbers for this paper using the same data.

about 33 percent of total credit in the median village. The point estimates of a 15 percent increase in new businesses is statistically insignificant, but credit did lead to a significant increase in business profits as a fraction of income of 2.6 percentage points, which amounts to an increase of 56 percent. The credit had no measurable impact on the aggregate level of investment, but did significantly increase the probability of investment by about 33 percent[13] Credit led to a significant increase in per capita consumption of about 15 percent, with essentially no impact on durable consumption, and led to an 11 percentage point increase in income at the end of the second year.

For the model, we choose $b^{MF} = 1.5w$, which yields a maximum loan size relative to consumption of 1.1, comparable to the two empirical interventions. Our short run, one period (i.e., one year) results match up well with the the horizon of the empirical studies. For easier comparison, Table 3 summarizes the aggregate impact across the two studies and the model. The resulting microfinance credit relative to consumption is 0.10, quite comparable to the studies. This constitutes a smaller fraction of total credit (i.e., external finance), 22 percent, but in the model this is total external finance, including very large firms. Additional large formal external finance clearly exist in India and Thailand, but are not part of the survey of local neighborhoods and villages, respectively. The impact on entrepreneurship is larger in the model, increasing entrants by 4.4 percentage points, than in the studies. In percentage terms, this increase is even larger, since entrepreneurship rates are substantially larger in the empirical studies. We also find large increases in investment of 40 percent. On the other hand, we find a negligible increase in consumption, consistent with the statistical insignificance in the India, but substantially less than the point estimate increase of 16 percent, and the statistically significant increase of 15 percent in Thailand. Again, a likely reason is that our model lacks pure consumption loans.

Both the Kaboski-Townsend and Banerjee et al studies emphasize that impacts are heterogeneous, namely that marginal investors are more likely to increase investment and decrease consumption, while others are more likely to increase consumption. Our model is consistent with the increase in investment among marginal entrepreneurs. For example, Banerjee et al find that entrants under microfinance are smaller, employing 0.2 less workers on average. Our model predicts that marginal entrepreneurs have 0.1 less workers.[14]

The model's heterogeneous impacts on borrowing and consumption are shown in Figure 6, where we use $b^{MF} = 2w$ for clearer illustration. The left panel plots the take up rate of microfinance loans and microfinance as a fraction of total external finance. We emphasize

[13] The point estimate is actually a negative 4 percent, but this is in no way significant (the standard error is four times the coefficient).

[14] Banerjee et al also find that with microfinance new entrepreneurs are concentrated in small-scale, lowest fixed cost industries like food industries, which is consistent with the prediction of our two-sector model.

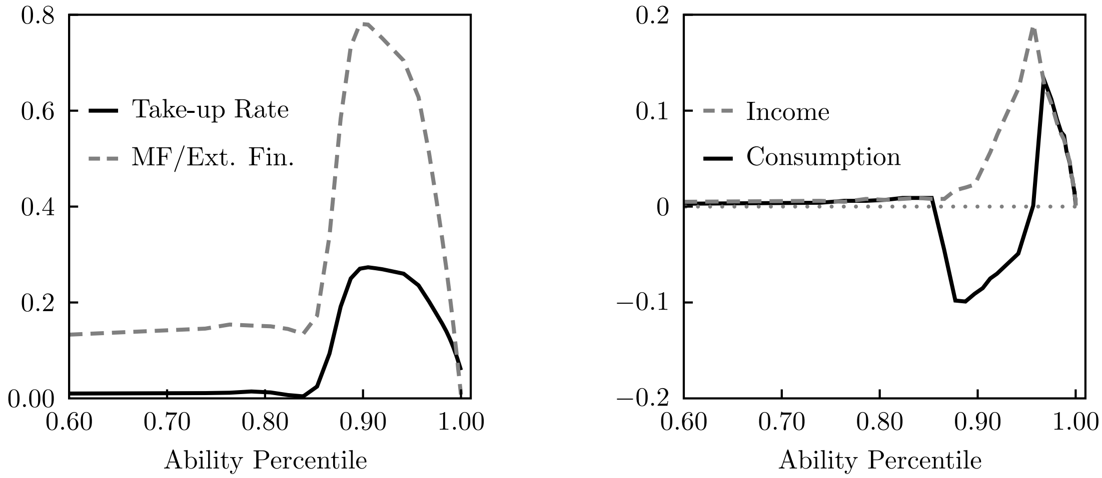

Fig. 2: Additional Micro-Implications, $b^{MF} = 2w$

that take-up rates are low overall, and though highest for those with marginal entrepreneurial ability, they are still less than one-third. Low take-up rates are consistent with the findings of Banerjee et al, who find that treatment increased the fraction of households borrowing by just 13 percentage points. The right-hand side shows the heterogeneous impact on consumption, which actually decreasing for the marginal ability entrepreneurs. The decrease in consumption corresponds with an increase in savings, consistent with both the Indian and Thai studies findings that investors (or those likely to invest on average) decrease current consumption.

In summary, while the model lacks consumption loans, an important element of microfinance credit, it does capture important aggregate and heterogeneous aspects of entrepreneurship, investment/savings, and consumption decisions that are prevalent in the data. We turn now to evaluate the impact of these decisions on long run and then general equilibrium outcomes.

4 Microfinance in General Equilibrium

This section evaluates the impacts of microfinance in general equilibrium. We first evaluate the long run implications of microfinance, contrasting the impacts in general equilibrium with those in partial equilibrium. We then discuss the effect of general equilibrium on the welfare implications of introducing a microfinance technology. Finally, we present extensions.

4.1 Partial vs. General Equilibrium

Figure 3 shows the long run, steady state implications of microfinance in partial equilibrium. Relative to the short run results in Figure 3, the impacts here are strikingly larger. The

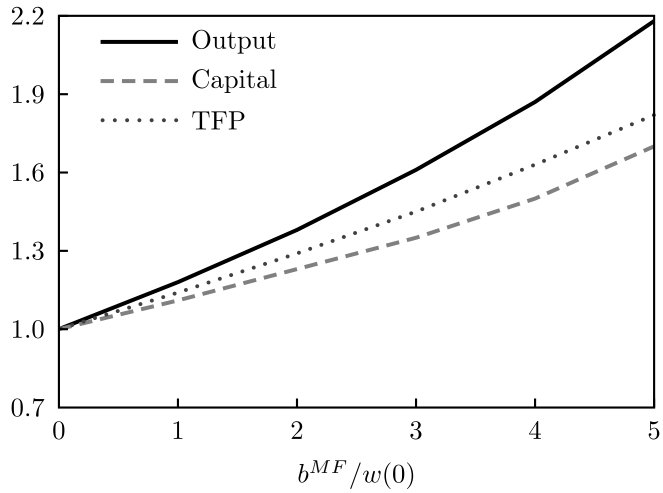

Fig. 3: Steady State Aggregate Implications in Partial Equilibrium

steady state effects on output, capital, and TFP are two to three times as large than the effects after one period. These differences reflect the importance of asset accumulation dynamics. Increased income and increased entrepreneurship leads to higher levels of savings among entrepreneurs and those saving to become entrepreneurs. This increased savings acts as collateral, and therefore enables still higher use of capital. Thus, capital increases. Savings accumulation also induces even greater entry of entrepreneurs over time. These are typically the more marginal entrepreneurs, however, and so this has little effect on TFP. The additional gains in TFP are driven by high ability entrepreneurs re-investing profits and leading to a better allocation of capital. Thus, savings accumulation is important along both dimensions, reinforcing the short-run impacts in partial equilibrium.

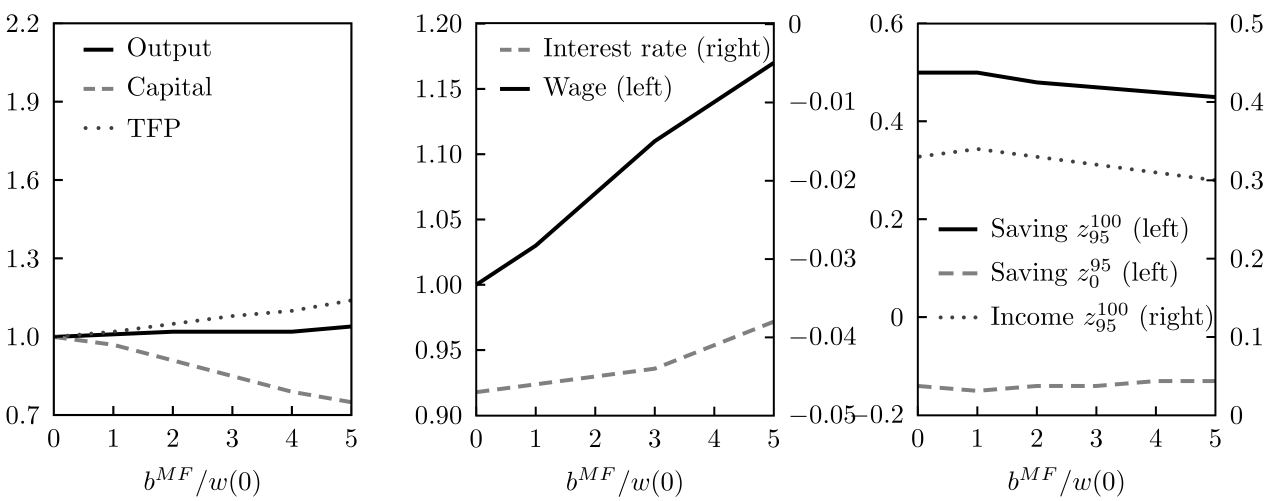

Fig. 4: Impact of Microfinance in General Equilibrium

We contrast these results with the results in general equilibrium. In the partial equilibrium simulations, microfinance leads to excess demands in capital and labor markets, which can be inferred from the fact that the general-equilibrium interest rate and wage are higher than the level they are fixed to in the partial-equilibrium exercise. In general equilibrium, aggregate savings and investment decisions now must coincide. More importantly, labor markets must clear.

Figure 4 shows the importance of GE for the aggregate impacts of microfinance in our benchmark economy. In the left panel, we observe the impacts on capital, TFP, and output. There are three clear differences from the PE analysis. First, capital falls precipitously with microfinance in GE, by almost 10 percent for $b^{MF} = 2w$. Second, TFP gains are still positive, 5 percent for $b^{MF} = 2w$, but substantially smaller than in PE. Finally, given TFP gains but lower levels of capital, the net effects on output are relatively small, less than 2 percent for $b^{MF} = 2w$.

In the center panel of Figure 4, we see that equilibrium wages (solid line) and interest rates (dashed line) rise with bMF. The higher interest rate is due in part from the direct effect of microfinance increasing demand for capital, but mainly it is due to the reduction in the overall capital stock. The increase in the wage is due to both a reduction in available workers as more agents become entrepreneurs, but it is also due to the increased demand for workers because of the increased TFP.

We now provide explanations for the effect of GE on TFP and then its effect on capital accumulation.

Effect on TFP In GE, the cost of capital rises as does the opportunity cost of becoming an entrepreneur. Hence, although the rate of entrepreneurship increases in GE, the increase is substantially smaller than in PE. In GE, the fraction of entrepreneurs increases 4 percentage points for $b^{MF} = 2w$ relative to 13 percentage points in PE. However, the higher wage also causes greater selection of talented-but-poor entrepreneurs, so that although microfinance still induces some not-so-talented entrepreneurs to enter in GE, the average ability of entrepreneurs actually increases (5 percent for $b^{MF} = 2w$). Still, in GE, the majority of TFP gains actually come the intensive margin, the more efficient allocation of capital among existing entrepreneurs, especially for larger levels of b^{MF}. This is in contrast to the PE result, where the extensive margin dominated.

Effect on Capital Accumulation The substantial negative impact of microfinance on aggregate capital accumulation in Figure 4(dashed line) is due to redistributive effects of microfinance in general equilibrium.

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 4, 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 permanent-income saving 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.

Recall that generous microfinance promotes the entry of such marginal entrepreneurs. As shown in the rightmost panel of Figure 4, the income share of the bottom 95-percentile talent group increases with b^{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 aggregate labor income share is constant at θ in the model.[15]

Overall, the fact is that the income share of those with lower saving rates increases with b^{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.[16]

[15] 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}).

[16] Also note that the saving rate of the top talent group is also decreasing in b^{MF}. There are two reasons for this. First, more entry drives up market wage and capital rental rate, and 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 b^{MF}, you could in the next period maintain your talent, become a worker, or become a marginal entrepreneur who earns more than a worker. Therefore, the permanent-income saving motive is weaker with high b^{MF}.

4.2 Distribution of Welfare Gains

The analysis so far emphasizes that microfinance has heterogeneous impacts, and that the full extent of its effects need to be traced through rich general-equilibrium interactions. This point is most clearly seen when studying the distribution of the welfare consequences of microfinance.

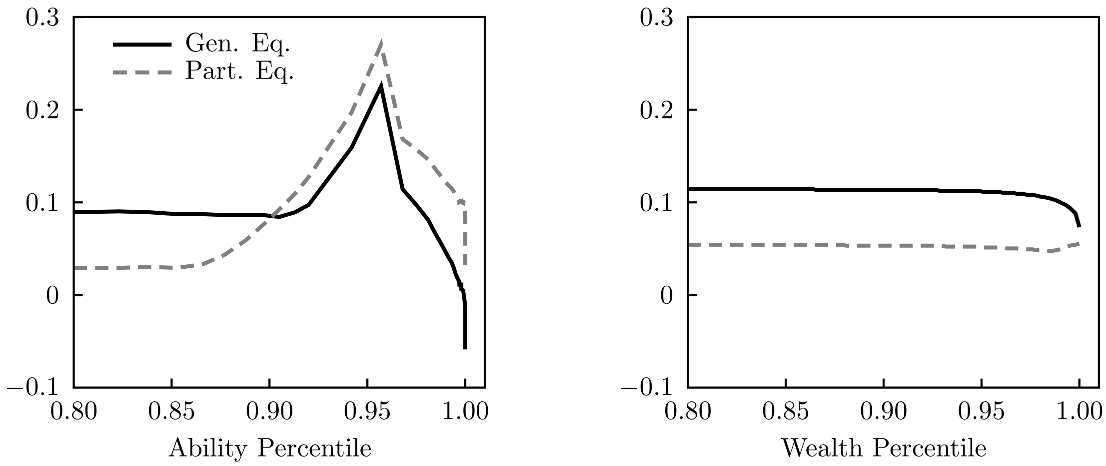

Fig. 5: Welfare Gains of Microfinance

In Figure 5 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, i.e., $b^{MF} = 2w$ ($b^{MF} = 0$). These calculations take into account the transitional dynamics following the introduction of microfinance.

Two important messages arise from this figure. First, in the left panel, the large spike among relatively highly talented individuals shows who gains the most from microfinance: marginal entrepreneurs. Microfinance does not directly affect those who choose to be workers, and at the same time it is too small to directly affect the business of the most talented entrepreneurs. For marginal entrepreneurs, however, their scale of operation is small enough that the microfinance has a meaningful direct impact. Second, in the right panel, consistent with the conventional narratives, microfinance have a larger positive impact on the poor, i.e., individuals with low wealth. Likewise, for the wealthiest individuals, microfinance is unimportant in comparison with their wealth, and they gain relatively less than do those less wealthy.

Another important lesson from the left panel of Figure 5 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 would be only slightly affected, and that the most talented would be among those most benefiting from this technology. Instead, when the increase in the equilibrium wage is accounted for, the inference is different. Individuals with low entrepreneurial talent, who choose to be workers, experience a significant welfare gain in the order of nearly ten percent of permanent consumption. On the other hand, the most talented could be made worse-off by microfinance, because their profits are reduced by the higher wage.

4.3 Extensions

We evaluate three extensions to the baseline general equilibrium model. The first is a small open economy, where wage effects operate, but the interest rate is held constant at the world interest rate. The second extension 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 undercapitalized low-ability entrepreneurs with few labor market alternatives, who make up a large fraction of the self-employed in less developed economies. The third extension follows Buera et al. (2010) by introducing a large-scale sector that requires a large fixed cost of production. This ushers in 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.

4.3.1 Small Open Economy

The small open economy (SOE) we consider differs from the benchmark equilibrium in that we fixed the interest rate at an international market interest rate of four percent. This interest rate is substantially higher than the negative interest rate in the benchmark model. Relative to our partial equilibrium analysis, the SOE differs in that the wage is a market-clearing wage, and, again, the fixed interest rate is higher than in the benchmark model. Given the higher interest rate, individuals save more, but entrepreneurs demand less capital. Thus, the amount of capital in this economy without microfinance is about half the level of capital in the benchmark model without microfinance, and the external finance to GDP ratio is lower than its level in the benchmark (0.14 vs. 0.34).

Perhaps surprising, the impact of microfinance on TFP in this model is not only smaller than in the partial-equilibrium analysis but also smaller than in the benchmark general-equilibrium model. At $b^{MF} = 5w$ ($b^{MF} = 0$), the wage and TFP gains of microfinance are 11 and 6 percent, respectively, relative to 17 and 14 percent in the benchmark model.

The direct effect of the innovation is to increase capital demand, but the resulting higher wage suppresses capital demand. Aggregate capital decreases overall, but the impact is negligible: At levels of microfinance of two or three times the normalizing wage, this decline constitutes a percent or two of the capital stock, but at $b^{MF} = 5w$ ($b^{MF} = 0$), it is essentially zero. Hence, even with smaller TFP gains, output increases slightly more in the SOE than in the general-equilibrium benchmark (six percent vs. four percent), but domestic income is essentially unchanged by microfinance, increasing by just 002 percent even at $b^{MF} = 5w$. Hence, the income gains are smaller in the SOE.

4.3.2 Market Labor Shock

Self-employment rates are typically high in developing countries, and these self-employments partly reflect a lack of access to market labor. To capture this, we add a stochastic labor endowment to the model. Specifically, individuals now receive a vector $\mathbf{z} \equiv \{z, \ell\}$, where z remains the productivity as an entrepreneurs, and ℓ is now the productivity in market labor. With probability χ, $\ell = 1$, and the individual choice set parallels the baseline model, but with probability $1 - \chi$, $\ell = 0$, and the individual is effectively forced into entrepreneurship. We assume that the ℓ-shock is independent of the z-shock, and that the two are equally persistent. We calibrate $\chi = 0.22$ so that the self-employment rate in the model matches the 35 percent non-rural self-employment rate in the 2004–05 National Sample Survey of India. Effectively, this leads to a large mass of poor, low ability entrepreneurs.

The results differ from the baseline along a few dimensions. First, the microfinance innovation leads to substantially higher levels of external finance to GDP, given the demand from the numerous poor entrepreneurs who are forced into self-employment.[17] In other words, the take-up rate of microfinance is higher than in the benchmark case without market labor shock.

Second, more important, for low levels of b^{MF}, output and wage actually fall with microfinance. For example, at $b^{MF} = w(b^{MF} = 0)$, TFP effects are negligible but the steady state capital stock declines by 7.5 percent, so that wage declines by 3 percent and output by 2 percent. With microfinance, interest rate goes up because of the increased demand for capital especially by those in forced entrepreneurship. This induces the marginal entrepreneurs to become workers, thereby increasing the supply in the labor market and driving down the wage. At the same time, income is redistributed from the marginal entrepreneurs to the poor, less able entrepreneurs who are forced into self-employment, and the aggregate capital stock goes down. With large enough microfinance (e.g., b^{MF} three times the normal-

[17] As b^{MF} goes from zero to five times the normalizing wage, the external finance to GDP ratio increases from 0.56 to 1.08. In the benchmark, the ratio increases from 0.34 to 0.72.

izing wage), marginal entrepreneurs and most talented entrepreneurs also directly benefit from microfinance, and output and wage are higher than in the no-microfinance case. The magnitude of the increase is still smaller than in our benchmark case without market labor shock.

In terms of welfare, the lowest ability "forced" entrepreneurs now gain the most from microfinance. Those who choose to be workers gain less or even lose out in terms of wages, but are still better off in utility terms, since they will also benefit from microfinance when hit with the market labor shock in the future.

4.3.3 Large-Scale Sector

Large-scale establishments dominate certain sectors such as manufacturing, investment goods in particular, and less developed countries tend to have lower relative productivity and higher relative prices in these sectors (Buera et al., 2010). In a multi-sector model, microfinance, although it is not explicitly sector-specific, may thus affect a third pricing margin, the relative price between large- and small-scale sectors. Following Buera et al., we capture this by introducing a second sector with a technology that requires a fixed cost κ to run each period. Individuals now receive a stochastic vector $\mathbf{z} \equiv \{z, z_L\}$, where z_L, the productivity in the large-scale sector, is distributed identically but independently of z. Individuals now choose between being a worker and operating a technology in either sector. Quantitatively, we follow Buera et al. in calibrating $\kappa = 5.5$ to match the observed difference in average scale between manufacturing and services, and assuming that all capital is produced in the large-scale sector.

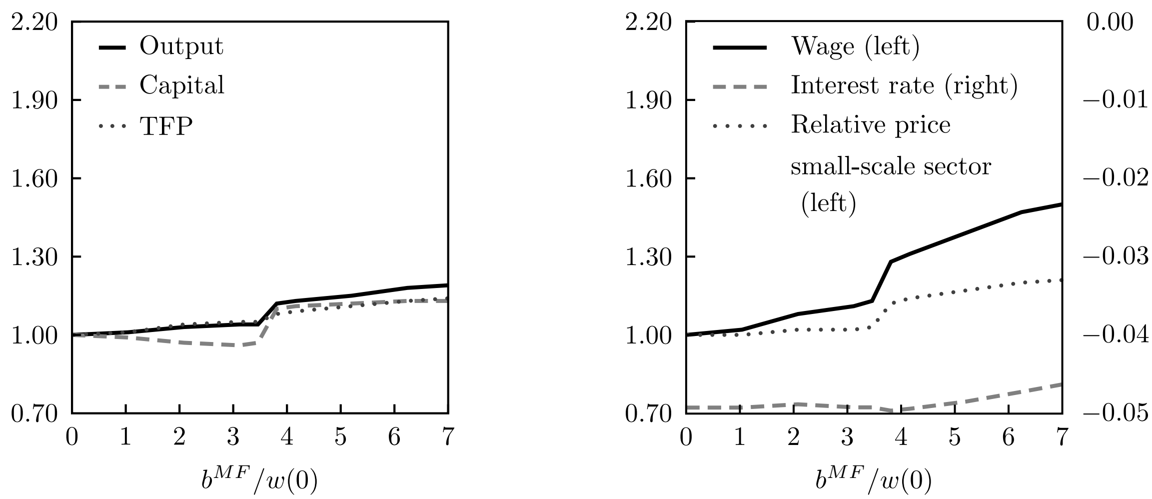

Fig. 6: Aggregate Impacts in Two-Sector Model

Figure 6 shows the aggregate implications of microfinance in this two-sector model. For moderate levels of microfinance, the model behaves very similarly to the one sector model, although the relative price of the small-scale sector falls somewhat, as financial frictions in this sector are more easily alleviated by microfinance. It is at higher levels of guaranteed credit, those above four times wages — higher than typical microfinance but within the range of loans available from the U.S. small business administration — where the two sector model shows striking differences. Here, guaranteed credit dramatically increase wages and output because it *increases* capital accumulation. The threshold for this change occurs, when the amount of guaranteed credit is sufficient to induce agents with the highest ability in the large-scale sector to become entrepreneurs even if they have no wealth. Here, the general equilibrium effect on the relative price drives the results. Although interest rates decline, capital increases because the increase in the relative price of small-scale output is equivalent to a decrease in the relative price of capital. Thus, each units of savings/investment yields substantially more physical capital.

5 Concluding Remarks

Microfinance lending is growing all the time, and indeed in some countries, the levels of microfinance are already at or approaching levels where general equilibrium effects may be important. We have shown than such general equilibrium considerations are quantitatively important for the evaluation of the impacts of wide-scale microfinance. The increase in wages in GE has a strong redistributive component. This leads to smaller levels of capital stocks than PE analysis would predict. However, it also reinforces the redistributive aspect of microfinance to low ability, low wealth individuals.

We believe our results may be more widely applicable to large microfinance interventions, even if local. In many developing countries, local markets are effectively segmented (see, for example, Townsend (1995)), due to high transportation/trade costs or poor information. In such markets, which are small and segmented, even relatively moderately sized interventions may exhibit the important GE effects that we have emphasized.

A TFP Decomposition

In this Appendix we derive the decomposition of TFP used in Figure 1. 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):

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

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