Self-Employment and Development*

Juan Herreño
Columbia Business School
& UC San Diego

Sergio Ocampo
Western University

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Abstract

Selection into self-employment among the poor is dominated by subsistence concerns, which leads to high levels of unproductive self-employment in developing countries. We incorporate this view into an otherwise benchmark macro-development model by allowing for labor frictions. Standard models that rely only on financial frictions are at odds with crucial features of the data, including large self-employment rates among the poor and the response of labor markets after well-identified labor demand shocks. We study the efficacy of a wide range of development policies on occupational choices, prices, and productivity. We find that providing unemployment benefits improves selection into self-employment, increasing total-factor productivity (TFP). Self-employment grants and unconditional transfers lower TFP by making self-employment more attractive to low-productivity individuals. Finally, financial reforms that improve access to credit succeed in raising productivity, but they do not address the subsistence concerns of poor individuals. Self-employment is still concentrated among the poor after the reforms take place.

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*Herreño: juan.herreno@columbia.edu; Web: https://sites.google.com/view/juanherreno.
Ocampo: socampod@uwo.ca; Web: https://sites.google.com/site/sergiocampod/.
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1 Introduction

The behavior of self-employment across and within countries is well documented in development economics, with two consistent messages (Schoar, 2010; Poschke, 2013a,b, 2019; Breza, Kaur, and Shamdasani, 2020). First, self-employment rates decrease as countries develop. For example, self-employment constitutes 65 percent of the workforce in Bangladesh, but only 12 percent in the United States. Second, self-employment rates are high among the rich and poor, exhibiting a U-shaped pattern along the earnings distribution. These facts are summarized in Figure 1.

High self-employment rates among the poor are consistent with the *self-insurance* role of self-employment for individuals facing unemployment risk in developing countries.[1] In the absence of other income sources, unemployed individuals may engage in self-employment for *subsistence* reasons, rather than because of comparative advantage in entrepreneurial activities. We show that the self-insurance and subsistence motives behind self-employment shape the macroeconomic effects of development policies.

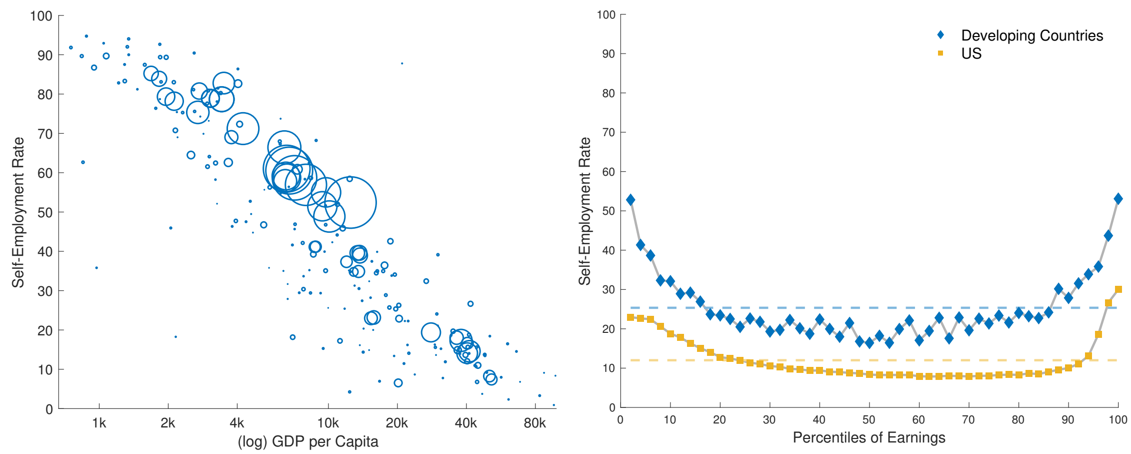
However, benchmark models in the macro-development literature ignore the self-insurance role of self-employment. We allow for subsistence concerns to dominate selection into self-employment among the poor by introducing unemployment risk into an otherwise standard macro-development model. We use existing cross-sectional evidence to distinguish between models with and without subsistence concerns. Notably, the observed response of wages and employment to a well-identified labor demand shock rejects the benchmark macro-development model. Furthermore, our model captures many non-targeted moments, including the pattern of self-employment rates across the earnings distribution (Figure 1b).

We use our model to study typical development policies, differentiating between their general and partial equilibrium outcomes. Specifically, we analyze two types of policies: targeted cash transfers and credit-deepening reforms. Cash transfers are ubiquitous across the developing world, and their design has direct consequences for selection into self-employment and aggregate productivity. Financial reforms that improve credit access also affect aggregate productivity, with important implications for wages and workforce composition, as they change incentives to engage in self-employment.

[1] Labor market frictions have been shown to play a crucial role in explaining cross-country differences along the development path. See the recent work of Poschke (2019) and Feng, Lagakos, and Rauch (2020).

Figure 1: Self-Employment Around the World

(a) Self-Employment Rate Across Countries (b) Self-Employment and Earnings



Note: *The left panel shows self-employment rates for countries around the world, as a function of their GDP per capita. The size of each bubble illustrates the population size of each country. Data source: World Development Indicators of the World Bank. The right panel shows the joint distribution of income and self-employment for the U.S. and nine developing economies for which we had access to household surveys (Azerbaijan, Albania, Bulgaria, Brazil, Colombia, Mexico, Peru, Serbia, and South Africa). We compute self-employment rates in 50 equal-sized quantiles of the income distribution. The underlying data comes from the CPS for the U.S. and from household surveys for the developing countries. We report the profile for each individual country in Figure E.2.*

Understanding the macroeconomic effects of development policies is a first-order concern. The developing world spends significant resources on policies to alleviate poverty and boost productivity, with uncertain macroeconomic effects.[2] The economy's response to these policies depends on the direct impact on beneficiaries and the general equilibrium feedback between individual choices and prices, affecting those not directly targeted.

Our model is a tractable extension of the occupational choice model by Buera, Kaboski, and Shin (2015) that incorporates unemployment risk. There are employed, self-employed, and unemployed agents. While agents can become self-employed or unemployed at will (by starting their own business or quitting their job), they can only become employed after receiving a job offer. When unemployment becomes intolerable for poor individuals, they turn to self-employment as a source of income, regardless of their entrepreneurial productivity. Self-employment acts as self-insurance. Without unemployment risk, self-employment is taken up by agents who are productive enough to have higher earnings as self-employed entrepreneurs than as salaried workers.

[2] Banerjee, Niehaus, and Suri (2019) reviewed the evidence of cash transfers in the developing world. Sukhtankar (2016) reviewed the NREGS, the largest employment guarantee program in the world.

Introducing unemployment risk allows the model to match the responses of wages and employment to well-identified labor demand shocks estimated in cross-sectional studies (Breza, Kaur, and Shamdasani, 2020; Muralidharan, Niehaus, and Sukhtankar, 2017), even when this moment is not targeted in the calibration. In the data, the increase in wages is smaller than the rise in employment after the same labor demand shock. In standard macro-development models that stress the role of collateral constraints (Moll, 2014; Midrigan and Xu, 2014; Buera, Kaboski, and Shin, 2015), aggregate wages rise considerably to accommodate additional labor demand. In a model with unemployment risk, however, low-income self-employed individuals meet the additional labor demand with little upward pressure on wages.

Our model also captures many non-targeted patterns of self-employment selection and behavior. The model predicts a U-shaped profile of self-employment rates across the earnings distribution, present in a variety of countries. Removing unemployment risk makes the pattern disappear, predicting a concentration of self-employed agents only among the rich. Moreover, the subsistence concerns that generate the U-shaped profile are also present in a version of our model without collateral constraints, the main ingredient stressed in benchmark macro-development models.

Cash transfers targeted to various population groups are a staple of government action in developing (and developed) countries. Banerjee, Niehaus, and Suri (2019) reported that government-provided cash transfers reach on average 11 percent of the population of low- and middle-income countries. These transfers are substantial, amounting on average to 18 percent of the beneficiaries' expenditures. Moreover, the targeting of the transfers influences the recipients' occupational choices, leading to large changes in the makeup of the workforce, as well as in productivity and wages.

We find that cash transfers to the unemployed increase productivity by improving selection into self-employment. The gains are substantial, around a 3 percentage-point increase in TFP in our simulated exercise, and they hold when the program is financed with distortionary income taxes. General equilibrium forces are important to reach this answer. The transfers prevent unproductive individuals from engaging in self-employment, increasing the labor supply and imposing downward pressure on equilibrium wages. Lower wages increase the optimal scale of the firms owned by the more productive self-employed.

We then study the effects of cash transfers to poor individuals, regardless of their occupation.[3] At fixed prices, cash transfers are successful at reducing self-employment

[3]Unconditional transfers resemble universal basic income or guaranteed income schemes, but they

rates, by increasing the threshold of productivity at which poor agents become self-employed. However, the transfers entail general equilibrium effects that reverse most of the positive effects in partial equilibrium. Once we account for how wages clear the labor market, self-employment increases and total factor productivity falls.

When the transfers target self-employed individuals, selection into self-employment worsens, subsistence self-employment increases, and TFP falls. The reform is successful at lowering the unemployment rate, but for the wrong reasons. In this dimension, our results align with the theory of Feng, Lagakos, and Rauch (2020), showing that decreases in unemployment are not necessarily evidence of improving economic conditions.

Finally, we evaluate the effects of financial reforms that loosen the collateral constraints faced by the self-employed. The financial and informational frictions that prevent entrepreneurs' access to credit have long been viewed as an important driver of misallocation and low productivity in developing economies. In fact, these frictions are at the heart of most macro-development models, e.g. Buera, Kaboski, and Shin (2015). We revisit the role of these frictions in the presence of subsistence concerns by first relaxing and then eliminating the collateral constraints in the model.

In line with the previous literature, credit-deepening reforms that loosen the agents' collateral constraints reduce misallocation and increase productivity. The reforms also increase unemployment, as individuals move from low-productivity self-employment activities into frictional labor markets. However, financial reform, even when taken to the limit of eliminating collateral constraints, does not solve the subsistence concerns that lead poor individuals to choose self-employment, preserving the U-shaped pattern of self-employment across the earnings distribution.

Related Literature

Our work is related to a longstanding strand of literature linking productivity and misallocation to entrepreneurship and self-employment (e.g., Hsieh and Klenow, 2009, 2014; Banerjee and Moll, 2010; Restuccia and Rogerson, 2013; Midrigan and Xu, 2014; Buera, Kaboski, and Shin, 2020). We contribute by showing the conceptual and quantitative importance of *subsistence* concerns behind self-employment in driving macroeconomic aggregates and responses to economic policy.[4]

Selection into self-employment is at the core of our mechanism. Heathcote,

also capture the difficulty of distinguishing between unemployed and self-employed individuals in the presence of informality.

[4] In related studies, Quadrini (2000) and Cagetti and De Nardi (2006, 2009) quantify the extent to which financial frictions distort the scale of firms.

Storesletten, and Violante (2008) studied the welfare effects of insurance and risk, while Hombert, Schoar, Sraer, and Thesmar (2020, 2016); Garcia-Cabo and Madera (2019); Levine and Rubinstein (2020) discussed the role of risk and ability on selection into entrepreneurship and self-employment. We contribute by evaluating the relevance of these margins in influencing the aggregate economy and the response to economic policy when agents face subsistence concerns.

The introduction of unemployment risk is key to generating the subsistence concerns that lead unproductive agents to engage in self-employment. More broadly, Poschke (2019) showed how labor market frictions are vital to explain cross-country differences in the composition of the workforce. We show that these frictions not only lead to higher self-employment rates in developing countries, but also explain the joint distribution of income and occupations that in turn shape the aggregate response to policy.

Our work complements recent papers on the role of structural transformation in wage and unemployment dynamics. As countries develop, people are pulled from low-productivity activities into more "modern" sectors. During early stages of development, activities like self-employment can absorb or supply labor in response to shocks, muting the response of wages. Storesletten, Zhao, and Zilibotti (2019) linked this pattern to the unresponsiveness of wages to business cycles in China. Feng, Lagakos, and Rauch (2020) documented a positive relation between unemployment and GDP per capita around the world, driven by the reallocation of individuals into modern sectors.

Finally, our paper speaks to a large literature that studies the efficiency of social programs in developing countries, where informality is high (Meghir, Narita, and Robin, 2015). Our results indicating that unemployment benefits increase aggregate productivity align with the positive effects of unemployment benefits extensions found by Gerard and Gonzaga (2020) and Britto (2020).

The rest of the paper is organized as follows. First we describe the main mechanism behind self-employment under unemployment risk in section 2. Then, we describe the model and its calibration in sections 3 and 4. In section 5, we show that the model is consistent with the observed features of self-employment. Finally, in section 6, we use the model to study the effects of cash transfers and credit-deepening reforms.

2 Self-employment as self-insurance

What drives individuals to become self-employed? We sketch the problem faced by an agent considering self-employment to illustrate the core of our argument. We show that the combination of unemployment risk and limited credit access induces poor agents to become self-employed, even if they have low entrepreneurial productivity, generating a mass of low-earning self-employed agents. This mechanism disappears in the presence of strong safety nets.[5] Policies that mitigate the downside of labor income risk reduce the likelihood that low-productivity agents will choose self-employment.

Consider an agent choosing between unemployment (U) or self-employment (S). The agent has a units of assets and a productivity of z. Utility depends only on consumption and satisfies $\lim_{c \to 0^+} u'(c) = \infty$. There is no borrowing or lending.

If the agent chooses unemployment, she can become employed (E) with probability $p \in (0, 1]$, receiving a wage $w > 0$ and consuming $c^E = a + w$. If she does not get a job, the agent receives unemployment income $b \in [0, w)$ and consumes $c^U = a + b$.

Alternatively, the agent can become self-employed. Self-employment income (or production) depends on her assets and her productivity according to $f(a, z)$. Consumption for the self-employed is: $c^S = a + f(a, z)$.

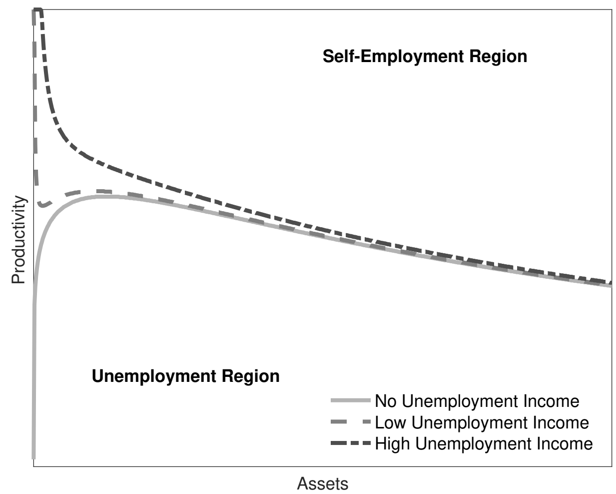
The agent becomes self-employed when the utility of doing so exceeds the expected utility of looking for a job: $u(a + f(a, z)) > p \cdot u(a + w) + (1 - p) \cdot u(a + b)$. For each level of wealth a, this inequality defines a threshold value for productivity (z), above which agents opt into self-employment, as shown in Figure 2.

The occupational choice of poor agents is heavily influenced by the level of unemployment income (b), which determines their consumption. When b is low, unemployment becomes intolerable. Self-employment acts as self-insurance against unemployment risk, bounding consumption away from zero for poor agents. Via this mechanism, the productivity threshold decreases as agents become poorer, even though self-employment income decreases as well. Agents will become self-employed even when they lack the productivity or the assets needed to run a profitable business.[6]

[5] The mechanism is also absent when there is no labor income risk, a common feature in the macro-development literature; see, for instance, Buera, Kaboski, and Shin (2015).

[6] Paulson and Townsend (2005) elaborated similar ideas in a short policy note. They showed evidence from Thailand during the Asian crisis of 1997, after which "*entrepreneurial activity in Thailand increased ... [and] the number of business households more than doubled*." The authors further noted that "*rising unemployment and falling real wages during the crisis led to changes in the types of people who started businesses—and in the types of businesses they started*" (pp. 34-35).

Figure 2: Occupational Choice: Unemployment vs. Self-Employment



Note: *The figure characterizes the occupational choice of the agent for different levels of unemployment income. Lines depict the threshold value of productivity* (z) *for each level of assets* (a) *and a given value of unemployment income. The agent chooses self-employment if productivity is above the threshold.*

Unlike poor agents, wealthy agents are not sensitive to unemployment income. They choose self-employment whenever their entrepreneurial income would be sufficiently high relative to their potential labor income, using their wealth for self-insurance. Thus, only sufficiently productive or sufficiently wealthy agents become self-employed.[7]

The mechanisms we highlight have important implications for the effects of development policies targeting the poor, such as unemployment benefits, cash transfers, or micro-finance. Whenever agents turn to self-employment to escape unemployment, they become "*disguised unemployed, or forced entrepreneurs*" (Breza, Kaur, and Shamdasani, 2020). The quantitative relevance of this type of selection depends on the density of agents at the bottom of the wealth distribution, and, crucially, on their access to both credit markets and insurance against income risk. As Figure 2 shows, unemployment benefits can affect selection by reducing the incentives of unproductive agents to become self-employed. In section 6, we study the quantitative ability of this policy to improve productivity and increase the supply of labor in the economy.[8]

Other policies, like micro-finance, affect selection by making self-employment more attractive, potentially reducing allocative efficiency. This mechanism is well-known in

[7] Selection into self-employment for the wealthy works in the same way as in Buera, Kaboski, and Shin (2011), where there is no unemployment $(p = 1)$, and no uncertainty over wages.

[8] The potential productivity gains from unemployment insurance through better selection have been explored before; see, for instance, Acemoglu and Shimer (1999, 2000).

the literature (e.g., Buera, Kaboski, and Shin, 2020), but there has been little emphasis on the role of unemployment risk in determining the magnitude of the effect on productivity. Absent insurance against unemployment, benefits tied to self-employment lead a larger share of agents to become self-employed, despite having low productivity. We explore this mechanism in Section 6.

3 Model

In this section we describe a quantitative macro-development model with occupational choice, in which agents face unemployment risk and financial frictions. We extend the baseline macro-development model in Buera, Kaboski, and Shin (2015) of employed (E) and self-employed (S) agents by introducing unemployment (U) and limiting the transitions between occupations.

Occupations differ with respect to their income source and whether or not agents can freely opt into them. Agents can become self-employed or unemployed at will. In contrast, transitions to employment are governed by exogenous processes that capture (in a reduced form) the arrival of job offers to unemployed and self-employed agents. Agents are free to reject job offers and keep their current occupations.

There is a continuum of agents in a small open economy. Time is continuous and goes on forever. Agents are heterogeneous with respect to their occupations $\{E, U, S\}$, their productivity (z), and their asset holdings (a). Employed agents receive labor income, which depends on the aggregate wage rate w and a function of their productivity z. Unemployed agents receive a constant income b.[9] Self-employed agents produce final goods using capital and labor, with a technology indexed by the agent's productivity.

Productivity (z) follows a Poisson process with arrival rate γ^z. Upon arrival, the agent draws a new value for z from a conditional probability distribution $\Pr^z(z'|z)$. Job offers also follow Poisson processes with arrival rates γ^U for the unemployed and γ^S for the self-employed.

As is standard in the literature, agents have limited access to credit markets. Employed and unemployed agents face a borrowing limit $\underline{a} \leq 0$. Self-employed agents can borrow to obtain productive capital, but they face a collateral constraint that depends on their assets: $k \leq \lambda a$. This reduced-form collateral constraint captures

[9] Unemployment income b can be interpreted as home production, or as transfers from family members or government agencies. In section 6 we take the latter view and examine what happens if b increases.

information frictions and commitment problems, which we do not model explicitly. See Cagetti and De Nardi (2006) and Buera, Kaboski, and Shin (2011), among others, for the micro-foundations of the borrowing constraint.

We depart from previous models in two important and intertwined ways. First, we include labor income risk by letting the labor income of employed agents fluctuate. Second, we prevent agents from becoming employed at will by including labor market frictions.[10] Without these features, employment serves as an outside option from self-employment (where income is volatile, following changes in productivity). Consequently, the standard family of models in macro-development is unable to produce self-employed agents with low assets and productivity. In our model, self-employment serves primarily as an outside option for unemployed agents.

In Appendix B we present a version of the model without unemployment risk. This alternative model is a useful point of reference for judging the performance of the model, as we show in section 4.

3.1 The Agent's Problem

The problem of an agent depends on her occupation. We discuss each occupation in turn. In what follows we denote as V^o the value of an agent in occupation $o \in \{E, U, S\}$, taking into account the occupational choice of the agent, and we denote as $\tilde{V}^o$ the value that the agent would receive if she were to remain in occupation o.

Employment Agents receive a labor income of $w\epsilon(z)$, where $\epsilon(z) = \exp(\eta \log(z))$, and η captures the relevance of productivity for the earnings of employed workers. Employed agents are subject to job destruction shocks with arrival rate γ^E that force them into unemployment. Agents can also voluntarily become unemployed or self-employed at any time. The value for an employed agent who remains employed is given by $\tilde{V}^E$:

$$\begin{aligned} \rho\tilde{V}^E(a,z) &= \max_c u(c) + V_a^E(a,z)\,\dot{a} + \gamma^E\left(V^U(a,z) - \tilde{V}^E(a,z)\right) \\ &\qquad + \gamma^z \int \left(V^E(a,z') - \tilde{V}^E(a,z)\right) d\mathrm{Pr}^z(z'|z) \\ \text{s.t.} &\qquad \dot{a} = w\epsilon(z) + ra - c \qquad a \geq \underline{a} \end{aligned} \tag{1}$$

[10] Most of the literature assumes labor income to be common to all agents (given by the market wage) and allows agents to opt freely into employment, instead, imposing costs to engage in entrepreneurship.

Unemployment Agents receive an income of b and are subject to job offers with arrival rate γ^U. They are free to reject an offer depending on their current assets and productivity. They can also choose to become self-employed at any time. The value for an agent who remains unemployed is given by $\tilde{V}^U$:

$$\begin{aligned} \rho\tilde{V}^U(a,z) &= \max_c u(c) + V_a^U(a,z)\,\dot{a} + \gamma^U \max\left\{V^E(a,z) - \tilde{V}^U(a,z), 0\right\} \\ &\quad + \gamma^z \int \left(V^U(a,z') - \tilde{V}^U(a,z)\right) d\mathrm{Pr}^z(z'|z) \\ \text{s.t.} &\quad \dot{a} = b + ra - c \qquad a \geq \underline{a} \end{aligned} \tag{2}$$

Self-employment Agents receive income from profits, $\pi(a,z)$, generated by their productive activities. Self-employed agents receive job offers at a rate γ^S, which they are free to reject. The agent can also choose to become unemployed at any time. The value for an agent who continues being self-employed is $\tilde{V}^S$:

$$\begin{aligned} \rho\tilde{V}^S(a,z) &= \max_c u(c) + V_a^S(a,z)\,\dot{a} + \gamma^S \max\left\{V^E(a,z,\epsilon) - \tilde{V}^S(a,z), 0\right\} \\ &\quad + \gamma^z \int \left(V^S(a,z') - \tilde{V}^S(a,z)\right) d\mathrm{Pr}^z(z'|z) \\ \text{s.t.} &\quad \dot{a} = \pi(a,z) + ra - c \qquad a \geq \underline{a} \\ &\quad \pi(a,z) = \max_{k \leq \lambda a,\, n \geq 0} \left\{z\left(k^\alpha n^{1-\alpha}\right)^\nu - wn - (r+\delta)k\right\}, \end{aligned} \tag{3}$$

where $\alpha \in (0,1)$ and $\nu \leq 1$.

The optimal consumption/savings decision can be found in all cases from the first-order condition of the agent's problem (see Achdou, Han, Lasry, Lions, and Moll, 2020). Letting $o \in \{E,U,S\}$ denote the occupational state of the agent, we have:

$$c^o(a,z) = u^{'-1}\left(V_a^o(a,z)\right). \tag{4}$$

To account for occupational choices, the value function of an agent reflects the upper envelope of the choices available to her at every instant. This is akin to a value-matching condition in optimal stopping-time problems (Stokey, 2009). The following conditions must hold:

$$V^E(a,z) = \max\left\{\tilde{V}^E(a,z), \tilde{V}^U(a,z), \tilde{V}^S(a,z)\right\}, \tag{5}$$
$$V^U(a,z) = \max\left\{\tilde{V}^U(a,z), \tilde{V}^S(a,z)\right\}, \tag{6}$$
$$V^S(a,z) = \max\left\{\tilde{V}^U(a,z), \tilde{V}^S(a,z)\right\}. \tag{7}$$

The last two conditions imply that unemployment and self-employment must give the same value to the agent; this is because the agent can instantaneously move between the two occupations, so any difference in value is arbitraged away.

3.2 Labor market

There is a common labor market. Total labor supply in efficiency units is given by the integral over the efficiency units of employed agents:

$$N^S = \int \epsilon(z) dG^E, \tag{8}$$

where G^E is the distribution of employed agents in the economy.

The only source of labor demand is the businesses of the self-employed. Total labor demand is thus given by:

$$N^D = \int n(a,z)\, dG^S, \tag{9}$$

where G^S is the distribution of self-employed agents in the economy and $n(a,z)$ is the optimal labor demand from a self-employed agent with asset a and productivity z.

3.3 Aggregate output and productivity

Aggregate output in the economy is given by

$$Y \equiv \int z\left(k(a,z)^\alpha n(a,z)^{1-\alpha}\right)^\nu dG^S = Z\left(M^S\right)^{1-\nu}\left(K^\alpha N^{(1-\alpha)}\right)^\nu, \tag{10}$$

with aggregate inputs $K \equiv \int k(a,z)\, dG^S$ and N as in (9). $M^S \equiv \int dG^S$ is the mass of self-employed agents, which plays a role due to the decreasing returns to scale of the production technology. Finally, Z measures the aggregate (average) productivity or

TFP:

$$Z \equiv \left[\frac{1}{M^S} \int \left(z \cdot \frac{1}{\tilde{\tau}(a,z)} \right)^{\frac{1}{1-\nu}} dG^S \right]^{1-\nu}, \tag{11}$$

where $\tilde{\tau}$ is defined as in Hsieh and Klenow (2009) to be a firm-specific wedge that captures the extent of the distortions generated by the collateral constraint.[11] The aggregation procedure is standard and follows Hopenhayn (2014).

Without the collateral constraint there would be no wedges and $\tilde{\tau}(a,z) = 0$ for all firms. However, eliminating $\tilde{\tau}$ from (11) is not enough to compute aggregate productivity in the absence of the constraint; instead, it is necessary to recompute the full equilibrium of the economy. Aggregate productivity depends on the distribution of the self-employed, which reacts endogenously to changes in the constraints, in turn changing prices and factor demands. Setting $\tilde{\tau}(a,z) = 0$ in (11) only captures the effect of constraints on self-employed agents with firms operating at current prices.

3.4 Equilibrium

We evaluate the effects of several policies in our model. We focus on the stationary equilibrium of the economy. The definitions of the equilibrium value and policy functions, prices, and stationary distributions are standard and we present them in Appendix A. Appendix D describes the computational implementation of the solution.

3.5 Discussion of modeling assumptions

There are three assumptions that deserve discussion. First, labor demand comes exclusively from the self-employed. Second, job-arrival rates are fixed parameters instead of functions of the labor market tightness. Third, income shocks across occupations are driven by the same shifter z.

The first assumption imposes a tight link between labor demand by the self-employed and the overall labor supply. In the model, shifts in labor supply require reassigning self-employed agents to employment, reducing labor demand. Consequently, equilibrium wages in the model are very responsive to changes in the occupational choices of agents (as we see in sections 6.1 and 6.4). This link can be

[11] Formally, $\tilde{\tau}$ is such that $k(a,z) = \left[\left(\frac{\nu\alpha}{\tilde{\tau}(a,z)(R+\delta)} \right)^{1-\nu(1-\alpha)} \left(\frac{\nu(1-\alpha)}{w} \right)^{\nu(1-\alpha)} z \right]^{\frac{1}{1-\nu}}$ for each (a,z).

weakened by introducing a corporate sector that demands labor (as in Kitao, 2008), or by introducing a new sector that mixes entrepreneurial output with labor to produce final goods (as in Guvenen, Kambourov, Kuruscu, Ocampo, and Chen, 2019). We choose not to pursue these extensions because our objective with the model is to highlight the mechanisms arising from unemployment risk, nesting macro-development models without it.

Second, we chose to impose fixed job-arrival rates because we are aiming for parsimony and comparability with models used in the macro-development literature. The main consequence of fixing these arrival rates is muting a set of general equilibrium effects that may affect the response to policy.[12] Nevertheless, these general equilibrium effects are likely to strengthen the results we provide in section 6.

Finally, we assume that shocks to self-employment productivity and employed earnings at the individual level are perfectly correlated. We consider that this is a conservative assumption, as it prevents gains from misallocation of individual agents (there are no individuals who are unproductive as self-employed but highly productive as employed). Additionally, this assumption allows us to match the joint income dynamics of employed and self-employed agents in a parsimonious way. We explored the results of the model under the alternative assumption that the productivity levels of different occupations are determined by independent shocks. Our main results are robust to this alternative, and the alternate analyses are available upon request.

Two assumptions on the problem of the self-employed deserve a note as well. The first one is that the self-employed have access to capital at the global (risk-free) interest rate. The second is that self-employed agents operate a common technology.

The global risk-free interest rate is lower than the rate that entrepreneurs in developing countries actually face. As a consequence, self-employment in the model becomes more attractive and the optimal scale of businesses increases. However, the quantitative effect of a low interest rate is small for the least productive self-employed, who are the focus of this paper, given that their optimal scale is close to zero.

Finally, introducing a menu of technologies and installation costs, as in Midrigan and Xu (2014) or Buera, Kaboski, and Shin (2011), would only strengthen our results by making low-productivity self-employment more attractive for low-wealth agents, who

[12] For instance, if there is an increase in unemployment benefits, the number of unemployed workers increases, reducing labor demand (section 6.1). This would increase market tightness, in turn inducing vacancy creation among firms still in operation. Absent these effects, all the adjustment in the labor market has to come through the wage rate.

would choose inferior technologies associated with low installation costs. A similar logic follows from expanding the model to allow for formal and informal technologies, akin to Meghir, Narita, and Robin (2015). In section 6 we consider an important dimension of informality: the distortions arising from income taxes levied on salaried workers but not on self-employed individuals.

4 Model calibration

We calibrate the model in two steps. First, we calibrate a group of parameters externally, with values taken from the literature or chosen independently of the model's equilibrium outcomes. We then choose a second group of parameters to match targeted moments of the earnings distribution, workforce composition, and transition rates across occupations. We use aggregate and micro data from Mexico to calibrate the second group of parameters.[13] Before discussing the parameter values, we define the parameterization of the productivity process and the discretization of assets.

Productivity process We discretize the process for productivity (z) so that the conditional probability distribution $\mathrm{Pr}^z\left(z'|z\right)$ is characterized by a stochastic matrix of dimensions $n_z \times n_z$. We use the method proposed in Rouwenhorst (1995) to discretize an AR(1) processes for $\log(z)$. This reduces the number of parameters to choose from $n_z(n_z-1)$ to just the standard deviation and persistence of the process, σ_z, and ρ_z. We also set $n_z = 11$. We experimented with finer grids and verified that our results do not depend on the particular size we chose.

Asset grid We use a curved grid with $n_a = 120$ nodes. Curvature ensures a higher density for low levels of assets. The limits of the grid are given by the borrowing constraint $(\underline{a})$ and an asset barrier $(\overline{a})$. The asset grid is given by:

$$a_i = \underline{a} + \left(\frac{i-1}{n_a-1}\right)^{\eta_a} (\overline{a}-\underline{a}) \quad \text{for } i \in \{1,\ldots,n_a\}. \tag{12}$$

The values of all computational parameters are presented in Table 1b.

Externally calibrated parameters We set a number of parameters to values common in the literature or to match features of the Mexican economy; we summarize them in Table 1a. The discount factor is taken from Moll (2014) to match a 5 percent annual

[13] This choice is motivated by the availability of high-quality data that allow us to explore the composition of the workforce, as well as individual transitions in and out of self-employment.

Externally Calibrated Parameters		
	Parameter	Value
$r^\star$	International Interest Rate	0.0075
ρ	Discount Factor	0.0125
σ	CRRA Parameter	2
α	Technology - Capital Share	0.3
δ	Capital Depreciation	0.0125
ν	Technology - Decreasing Returns	0.85
λ	Equity Constraint	1.42
γ^ϵ	Labor Efficiency - Arrival Rate	1
γ^z	Productivity - Arrival Rate	1

Internally Calibrated Parameters		
	Parameter	Value
b	Unemployment Income	$w \cdot 10^{-5}$
γ^E	Job Destruction Arrival Rate	0.20
γ^U	Job Offer Arrival Rate - U	0.80
γ^S	Job Offer Arrival Rate - S	0.50
$\bar{\epsilon}$	Labor Efficiency- Base Value	0.10
η	Labor Efficiency - Shifter	3.10
$\bar{z}$	Productivity - Base Value	1.00
σ_z	Productivity - Variance	0.12
ρ_z	Productivity - Persistence	0.17

(a) Model Parameters

	Parameter	Value
$\underline{a}$	Borrowing Constraint	10^{-5}
$\bar{a}$	Asset Barrier	200
η_a	Asset Grid Curvature	2
n_a	Asset Grid Size	120
n_ϵ	Productivity Grid Size	11

(b) Computational Parameters

Table 1: Parameters

discount rate. We set the annual interest rate at 3 percent, to target an annual gap between the interest rate, and set the discount factor to 0.02 as in Itskhoki and Moll (2019). The degree of decreasing returns (ν) is taken from Midrigan and Xu (2014). The curvature of the utility function (σ) is set to 2, and the power of capital in the self-employed production technology (α) is set to 0.3, consistent with standard values used in the literature. We set the collateral constraint parameter (λ) to match a debt-to-asset ratio of 42 percent, consistent with observed debt-to-asset ratios for large firms in Mexico, gathered from Compustat. We set the depreciation rate of capital to an annual rate of 5 percent. Finally, we set unemployment income to $w \cdot 10^{-5}$, a positive but small value, to avoid unemployed agents having zero consumption.

Internally calibrated parameters We jointly choose the values for 6 parameters, σ_z, ρ_z, γ^U, γ^E, γ^S, and η, to target 6 moments. These are the unemployment rate, the self-employment rate, the volatility of log-income for employed and self-employed agents, and the correlation of individual-level income for agents who stay employed and who stay self-employed in consecutive quarters ($corr(y_t^o, y_{t+1}^o)$ for $o \in S, E$).

Although these six parameters affect all six moments, loosely speaking the γ^o parameters are more important for mean occupational rates as they affect transitions between occupations. The remaining parameters, η, σ_z, and ρ_z, are more important for income moments as they affect the productivity process. We report the values of the

Occupational Rates	Data	Model
Unemployment	4.4	4.1
Self-employment	26.7	26.2
Employment	69.1	69.7

Income Moments	Data	Model
std(y_t^S)	0.86	0.86
std(y_t^E)	0.54	0.58
corr(y_t^S, y_{t+1}^S)	0.59	0.59
corr(y_t^E, y_{t+1}^E)	0.60	0.58

Table 2: Targeted Moments

Note: *The table specifies targeted moments for internally calibrated parameters. We only target two out of the three occupational rates, as together they imply the third. We report all three occupational rates for completeness.*

parameters in Table 1a, while the value of the targeted moments in the data and the model is shown in Table 2. We match all moments closely, including income moments for the employed and self-employed, despite having a single productivity shifter.

The data we use to construct the targeted moments comes from the *Encuesta Nacional de Ocupación y Empleo* (ENOE), a household survey administered by the National Institute of Statistics and Geography (INEGI) in Mexico.[14] The ENOE includes a rotating panel of responding households who participate in the survey for up to five quarters. We restrict our attention to men aged 23 to 65 who are heads of households and who live in one of Mexico's ten largest municipalities.[15] We analyze data from 2005.Q1 to 2019.Q4. We define as self-employed an individual who reports working in their own business. In Appendix E.1 we document the comparison of average occupational rates for our samples versus the overall Mexican population, and versus the U.S. population as a benchmark.

One key result is that the calibration implies a lower job-offer arrival rate for the self-employed (γ^S), compared to the arrival rate for the unemployed (γ^U). Lower job-arrival rates from self-employment are consistent with cross-sectional findings by Jackson (2020), who indicated that engaging in gig-economy jobs in the U.S. reduces the rate at which individuals find salaried employment. In Appendices E.2 and E.3, we provide a battery of reduced-form correlations documenting that individuals in Mexico who have second earners in their household or receive remittances from abroad (variables that indicate fewer financial constraints) transition into self-employment less often, even when their self-reported job finding activities are similar to individuals who have neither remittances nor second earners. We also document that individuals who engage in self-employment transition less into salaried work than their unemployed counterparts. We take this evidence as suggestive of potential negative

[14]See http://en.www.inegi.org.mx/proyectos/enchogares/historicas/enoe/.
[15]Our results are robust to including both men and women instead.

effects of self-employment for some agents who engage in it out of necessity.

5 Model performance and validation

We now turn to the model's ability to match salient features of self-employment in developing economies. As mentioned above, the model is able to match the targeted moments (Table 2). More importantly, it performs well on a wide range of non-targeted dimensions, like the prevalence of self-employment across the income distribution, the relative response of wages to employment after a well-identified shock to labor demand, transition rates across occupations, and individual-level income changes after an occupation change. Further, the data strongly reject an alternative version of the model without unemployment risk.

Self-employment across the income distribution An important success of the model is matching self-employment rates across the income distribution, as in Figure 1b. The model produces low-earning self-employed agents in equilibrium, capturing the joint distribution of occupational rates and earnings.

Figure 3a plots the self-employment rate for individuals in each decile of the earnings distribution, both in the data and the model.[16] The model captures the observed u-shape of self-employment rates thanks to the selection into self-employment from unemployment (Figure 3b). As explained in section 2, poor unemployed agents become self-employed even when their productivity is low, thus generating a mass of low-earning self-employed agents.

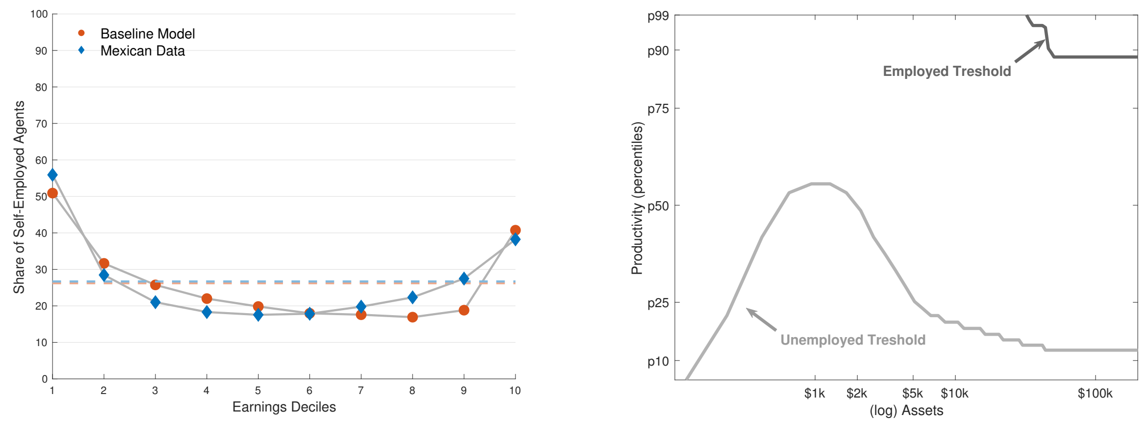
In contrast, the standard macro-development model that abstracts from unemployment risk cannot generate the u-shaped pattern between income and self-employment. Figure 4a shows the pattern of self-employment across the earnings distribution for the model without unemployment risk, presented in Appendix B. In models without unemployment risk, labor income constitutes a lower bound for earnings and self-employment concentrates among high-earning agents exclusively.

Moreover, the ability of the model to generate the U-shaped pattern between income and self-employment does not depend on the presence of collateral constraints,

[16]To compute the data series in Figure 3a, we first run a regression of the form $\log(earn_{i,t}) = \alpha + \gamma_t + \beta X_{i,t} + \eta_{i,t}$, where $earn_{i,t}$ corresponds to the earnings of individual i at time t, and X is a vector of individual-level controls. We rank $\hat{\eta}_{i,t}$ and classify them in bins of 2 percent of the sample, then compute the self-employment rate in each bin. The pattern we report is robust when we use raw earnings instead of controlling for observables.

Figure 3: Model Performance

(a) Self-Employment Rate by Decile of Earnings (b) Occupational Choice



Note: *The left panel reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model with unemployment risk. Blue diamonds show the data equivalent for Mexico. The right panel reports productivity thresholds characterizing the occupational choice of unemployed (light gray line) and employed (dark gray line) agents. Lines depict the threshold value of productivity* (z) *for each level of assets* (a)*. The agent chooses self-employment if her productivity is above the threshold.*

the main friction in the standard macro-development model. Figure 4b shows that the model exhibits the same U-shaped pattern when we eliminate the collateral constraint by letting λ go to infinity. We revisit this case in section 6.4.

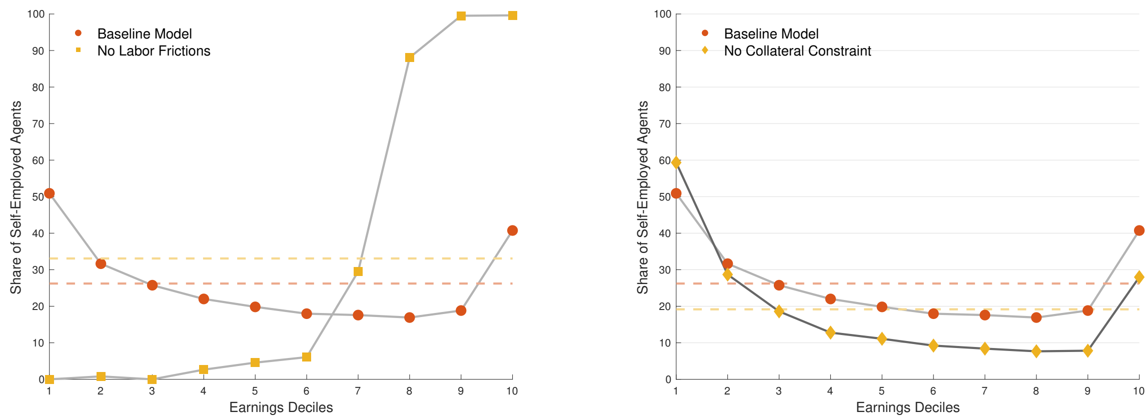
Response to labor demand shocks We further distinguish models with and without unemployment risk, by comparing their response to an exogenous increase in labor demand. We contrast the implications of these models against cross-sectional evidence from development economics that identifies the response of employment and wages to this type of shock. The shocks to labor demand are identified in the data from interventions administered at the local labor market level, and are therefore informative about the general equilibrium effects at the core of our mechanism, making them good evidence to validate model specifications.[17]

The empirical evidence comes from a randomized controlled intervention carried out by Breza, Kaur, and Shamdasani (2020) and from the implementation of the NREGS, a National Job Guarantee Scheme in India (Muralidharan, Niehaus, and Sukhtankar, 2017). Both studies deal with the effects of additional labor demand coming from either the researchers' intervention or the government, both offering employment at market wages. Both studies show that the reaction of wages to the shock is significantly smaller than the reaction of employed work. We refer to this fact as an "elasticity of wage to

[17]The small open economy assumption we make implies that local interventions do not change the real interest rate in untreated regions.

Figure 4: Self-Employment Rate by Decile of the Earnings Distribution

(a) Labor Frictions: Unemployment Risk (b) Financial Frictions: Collateral Constraint



Note: *The figure reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model with unemployment risk. The yellow squares in the left panel correspond to the alternative model without unemployment risk. The yellow squares in the right panel correspond to the baseline model without collateral constraints* ($\lambda \to \infty$).

labor demand" $(\Delta\%w/\Delta\%N^d)$ less than 1.[18]

To reproduce the response in workforce composition and wages to an increase in labor demand, we modify the models by introducing government demand for labor n^{gov}, then solve for the new market-clearing wage.[19] The total labor demand is

$$N^d = \int n^\star(a,z)dG^S + n^{gov}. \tag{13}$$

Government labor demand amounts to 11.5 percent of the baseline demand for efficiency units of labor.[20]

In response to an increase in labor demand by the government, the model implies a reallocation of the workforce from self-employment into both higher employment and unemployment. This response is in line with the results of Imbert and Papp (2015), Breza, Kaur, and Shamdasani (2020) and Muralidharan, Niehaus, and Sukhtankar (2017). As Imbert and Papp (2015) found, there is a strong crowding-out effect on private employment (in this case on self-employment). Private demand for labor decreases by 9.35 percent (self-employment decreases by 1.25 percentage points). However, the overall demand for labor increases (by about 2.15 percent), as does the

[18] This is the ratio of the elasticity of wages to the shock, over the elasticity of employment to the shock.

[19] In the spirit of the experimental intervention cited above and the implementation of the NREGS program, we do not introduce taxes to finance the government's labor demand.

[20] The size of the shock emulates the experiment by Breza, Kaur, and Shamdasani (2020).

Occupational Transition Rates								
	Data	Model		Data	Model		Data	Model
$U \to U$	27.4	29.3	$S \to U$	1.9	4.6	$E \to U$	3.1	2.5
$U \to S$	14.6	23.6	$S \to S$	76.8	62.2	$E \to S$	8.1	12.8
$U \to E$	58.0	47.1	$S \to E$	21.3	33.1	$E \to E$	88.8	84.7

Income Moments					
	Data	Model		Data	Model
$\text{corr}(y_t^E, y_{t+1}^S)$	0.43	0.39	$\text{corr}(y_t^S, y_{t+1}^E)$	0.43	0.34

Table 3: Untargeted Moments

Note: *The table specifies untargeted moments. All transition rates are quarterly and reported in percentage points. The income moments are auto-correlations of income conditional on occupational switching in consecutive quarters.*

unemployment share of the workforce (by 0.3 percentage points). These movements are qualitatively in line with the findings of Breza, Kaur, and Shamdasani (2020). The decrease in self-employment comes mostly from the low-productivity self-employed agents (see figure C.1 in Appendix C).

Crucially, the increase in labor demand is not accompanied by a sizeable increase in wages. The market wage (per efficiency-unit of labor) increases by 0.35 percent, implying an relative elasticity of wage to labor after a labor demand shock ($^{\Delta\% w}/_{\Delta\% N^d}$) of 0.16. This is consistent with the experimental evidence referenced above, which establishes a low response of wages relative to increases in labor demand. The presence of unemployment risk and low-earning self-employed agents plays a crucial role in generating this result. In contrast, the increase in wages required to meet the additional demand in the model without unemployment risk is an order of magnitude larger than what is implied by the experimental evidence and our baseline model, producing an "elasticity of wage to labor demand" of 1.6. As with the joint distribution of self-employment and earnings, the data reject the model without unemployment risk in policy-relevant dimensions.

Transition rates between occupations The model also does a good job capturing the transition rates between occupations observed in the data, as shown in Table 3. We compute transition rates in the same way in the data and in the model, based on the occupation of agents at the end of each quarter.

All transitions have the right order of magnitude even though none of them was targeted directly in our calibration. However, the model does not capture all transition patterns. In particular, the model overstates the transition rate from unemployment to self-employment (23 percent in the model versus 15 percent in the data). In both the data and the model, the low unemployment rate is explained by high transition rates out of unemployment, particularly into self-employment.

Income of occupational switchers The model captures the correlation of income for switchers observed in the data. This moment is particularly relevant for the gains or losses following a reallocation of agents across occupations. Again, these are untargeted moments. The model implies slightly lower correlations than those from the data despite the common productivity shifter for both occupations, which is explained by the role of assets in determining self-employment income. The correlation between current and future income of individuals who switch from employment to self-employment is 0.39 versus 0.43 in the data. The correlation of switchers from self-employment to employment is 0.34 versus 0.43 in the data (Table 3).

6 Policy analysis

In this section, we analyze the response of the economy to a set of development policies with macroeconomic implications. We study two broad sets of policies: targeted cash transfers, and credit-deepening reforms which loosen collateral constraints. Within cash transfers, we analyze the case of cash transfers to unemployed individuals, to self-employed individuals, and to low-income individuals regardless of their occupation. In each case, we report the partial equilibrium (PE) response of the economy, the general equilibrium response with an unbalanced budget (GE), and a balanced-budget general equilibrium response, where each policy we consider is funded via linear labor income taxes.

We choose to focus on cash transfer policies for two reasons. They are ubiquitous in policy implementation and discussions in the developing world, and they all influence selection into self-employment and therefore have important consequences for productivity. Each of these policies changes selection in a different way. We highlight their effects on the two drivers behind selection into self-employment, subsistence concerns and comparative advantage. Then, we discuss the effects of financial reform in the context of the agents' occupational choices. Reforms that loosen the constraints faced by the self-employed improve allocative efficiency, but they also change the incentives of agents to become self-employed.

In our analysis, we highlight different channels by which development policies affect the economy. PE analysis focuses on the direct effects of policies on recipients, keeping prices constant. GE analysis highlights that, by affecting input prices like the wage rate, policies also have an indirect effect on non-recipients and on the optimal scale of firms in the economy. Balanced-Budget GE analysis goes yet one step further, to inquire whether the distortionary taxation required to fund transfers undoes the effects of the policies.

The implementation of the policies takes two steps. First, the government targets the policy using information on the economy *before* enactment. For example, if the government gives a transfer to the bottom ten percent of the earnings distribution, the income threshold to receive the transfer is calculated in an economy where the transfer does not yet exist. In our judgement, that setting closely replicates the targeting problems faced by authorities. Second, we assume governments can observe the occupation and income of any individual. This is of course a simplification. In all cases, we make the size of the transfer consistent to the average cash transfer in developing countries, as reported by Banerjee, Niehaus, and Suri (2019).

6.1 Cash transfers to the unemployed: Unemployment benefits

Unemployment benefits affect the occupational choices of self-employed individuals. Section 2 highlights how access to higher unemployment income can deter unproductive agents from engaging in self-employment. Unemployment benefits can therefore improve efficiency by changing the selection into entrepreneurship and by increasing the overall labor supply.[21]

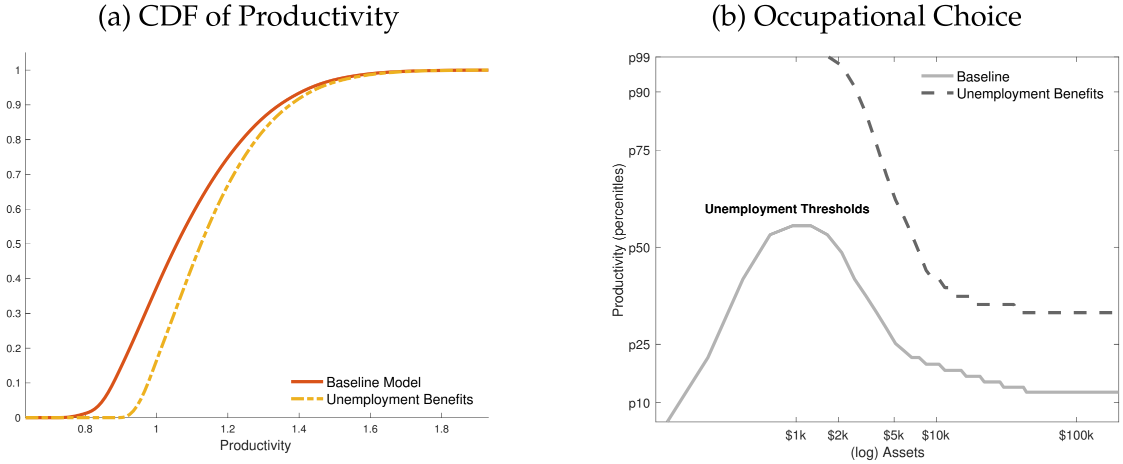
We model unemployment insurance as an increase in the income of unemployed agents, which is now $b + b_{UB}$.[22] Our policy grants a transfer of 17% of the average labor income to anyone who is unemployed. The benefits do not expire.

Unemployment benefits in partial equilibrium Unemployment benefits improve the productivity distribution of those who would choose to be self-employed at fixed prices. Figure 5a compares the baseline CDF of productivity among self-employed agents to the CDF under unemployment benefits. The figure makes clear that the

[21]More generous safety nets that provide insurance against productivity risk may also improve productivity by spurring entrepreneurship. See the recent work by Robinson (2020) and evidence from France in Hombert, Schoar, Sraer, and Thesmar (2020, 2016). Unlike the case in this paper, the French insurance program does not change the selection into self-employment because the unemployed already had access to insurance.

[22]Our exercise is meant to capture a cash transfer to unemployed individuals, not to capture the many specificities of established unemployment insurance (UI) schemes.

Figure 5: Model Response to Unemployment Benefits in Partial Equilibrium



Note: *The left panel reports the CDF of productivity among self-employed agents. The continuous red line corresponds to the baseline model. The dashed yellow line corresponds to the model with unemployment benefits in partial equilibrium. The right panel reports productivity thresholds characterizing the occupational choice of unemployed agents for the baseline model (continuous light gray line) and the model with unemployment benefits (dashed dark gray line). Lines depict the threshold value of productivity* (z) *for each level of assets* (a)*. The agent chooses self-employment if productivity is above the threshold.*

productivity distribution in partial equilibrium first-order stochastically dominates the baseline distribution.

The shift in productivity is explained by a plummeting of self-employment rates among unproductive agents, especially the poor, who, at constant wages, would prefer to become unemployed and look for salaried work. Figure 5b shows the thresholds of productivity at which unemployed individuals become self-employed as a function of their wealth. Compared to the baseline, poor unemployed agents only become self-employed if they have extremely high productivity (larger than the 99th percentile). In the benchmark, sufficiently poor individuals become self-employed, even when they have below-median productivity (gray line in the figure).

The change in selection triggers large occupational changes, as described in Column 3 of Table 4. At fixed prices, the self-employment rate decreases by 11.2 percentage points. This decrease is matched by (roughly) even increases in unemployment and employment. The decrease in self-employment happens across the income distribution, but particularly in the tails, as both unproductive and highly productive agents prefer to be unemployed and await a job offer. As a consequence, the pattern of self-employment becomes flat throughout the income distribution (Figure 6a).

Moment	GE - τ	GE	PE	Moment	GE - τ	GE	PE
% Δ W	-1.6	-2.0	—	Δ E	0.5	0.7	5.2
% Δ Y	-2.5	-2.3	—	Δ S	-5.8	-5.8	-11.7
%Δ TFP	3.2	2.9	—	Δ U	5.4	5.1	6.5

Table 4: Model Response to Unemployment Benefits

Note: *The table presents changes in variables with respect to the baseline model. All numbers are in percentage points. By design, the wage does not change in partial equilibrium. We refrain from reporting macroeconomic aggregates that are constructed in partial equilibrium.*

Unemployment benefits in general equilibrium In order to clear the labor market, the wage rate decreases. Lower wages increase entrepreneurial income, but do so disproportionately for the most productive agents. In this way, general equilibrium forces undo the decrease of self-employment in the right-tail of the earnings distribution, but maintain it among the poor. The result is a relatively flat self-employment rate across the bottom 90 percent of the income distribution (at around 20 percent) and a high rate among top earners (50 percent, see Figure 6b). Even a mild unemployment benefit scheme can vastly change selection into self-employment at the bottom of the income distribution.

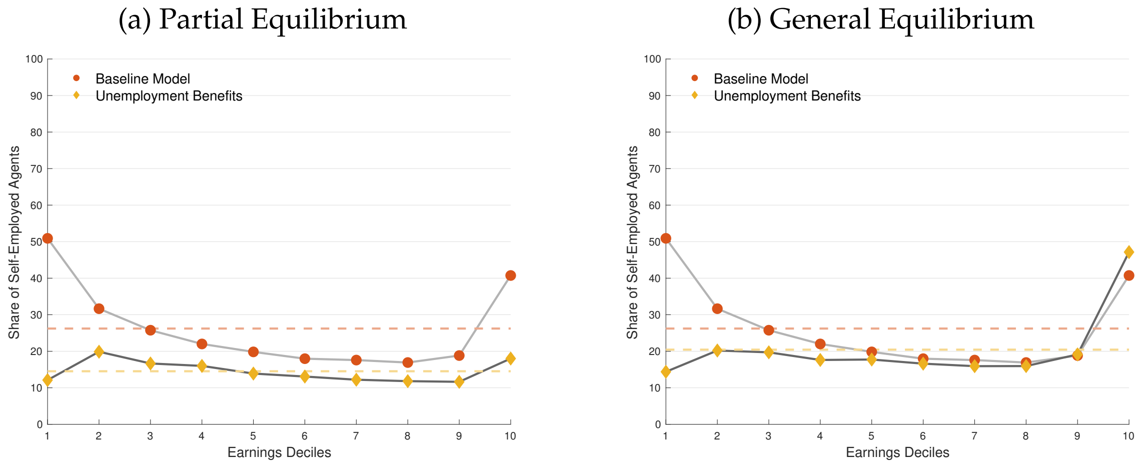
Relative to the baseline, the decrease in wages is accompanied by a 5.8 percentage point decrease in the self-employment rate (half as much as in PE), compensated almost completely by an increase in the unemployment rate. The distribution of productivity among the self-employed first order stochastically dominates the baseline distribution (as in PE), which is reflected in a higher TFP. Despite this, output falls because of the reduction in self-employment (see equation 10).[23]

Unemployment benefits in general equilibrium and balanced budget Financing unemployment benefits with linear labor taxes τ does not meaningfully change the results (see the GE-τ columns of Table 4). A tax of $\tau = 2.39\%$ is required to balance the budget in equilibrium:

$$\tau \int w \cdot \epsilon(z) dG^E = b_{UI} \cdot U. \tag{14}$$

[23] The reduction in output is not implied by the introduction of unemployment benefits. For instance, unemployment benefits increase output in an alternative version of the model where labor and entrepreneurial productivity are not perfectly correlated.

Figure 6: The Self-Employment Rate and Unemployment Benefits



Note: *The figure reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model. The yellow squares in the left panel correspond to the model with unemployment benefits in partial equilibrium. The yellow squares in the right panel correspond to the model with unemployment benefits in general equilibrium.*

These taxes reduce labor income with respect to the baseline by 3.95 percent.[24] The reduction in prospective labor income deters some agents from taking a job (with respect to unfunded GE), but, interestingly, does not prevent employment from increasing while self-employment decreases substantially. The reason behind this is the effect of unemployment benefits on poor unemployed agents. Transfers improve the allocation of agents by making it possible for poor agents to remain unemployed.

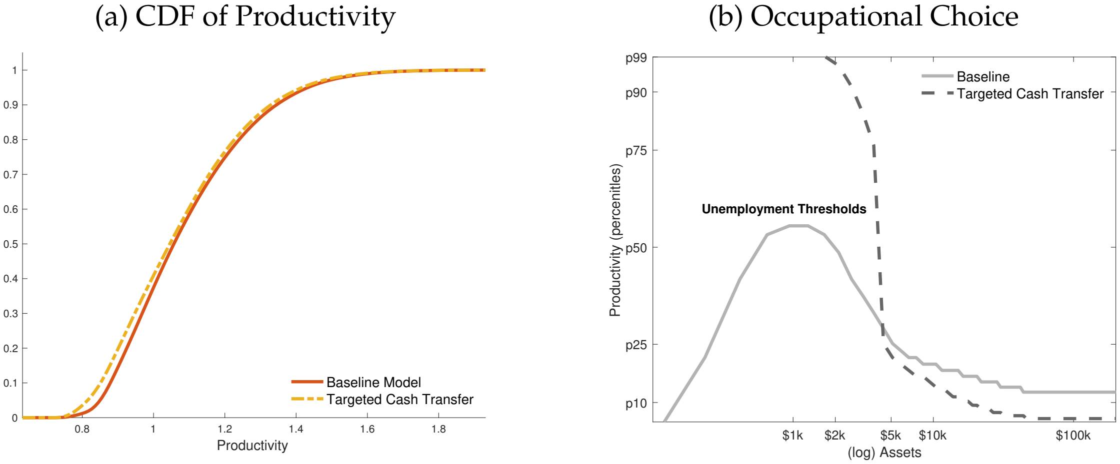
Our results highlight how safety net programs can play a role in increasing productivity in developing countries by affecting the occupation choices of individuals. These programs not only allow individuals to search for jobs longer (Acemoglu and Shimer, 1999, 2000; Chetty, 2008); they also prevent unproductive agents from engaging in entrepreneurial activities for which they are ill-suited. This in an additional rationale for these programs, beyond their insurance role against labor income fluctuations.

6.2 Income-Targeted Cash Transfers

Providing a monetary transfer to low-income individuals is one of the most ubiquitous policies in the developing world. Transfers in low- and middle-income countries reach 11 percent of their population and amount to roughly 18 percent of the expenditures in

[24] Recall that the agents have no intensive margin decision over labor supply. Because of this, the introduction of taxes only affects the agents' occupational choice through changes in after-tax wages.

Figure 7: Model Response to Targeted Cash Transfers in Partial Equilibrium



Note: *The left panel reports the CDF of productivity among self-employed agents. The continuous red line corresponds to the baseline model. The dashed yellow line corresponds to the model with targeted cash transfers in partial equilibrium. The right panel reports productivity thresholds characterizing the occupational choice of unemployed agents for the baseline model (continuous light gray line) and the model with targeted cash transfers (dashed dark gray line). Lines depict the threshold value of productivity* (z) *for each level of assets* (a)*. The agent chooses self-employment if productivity is above the threshold.*

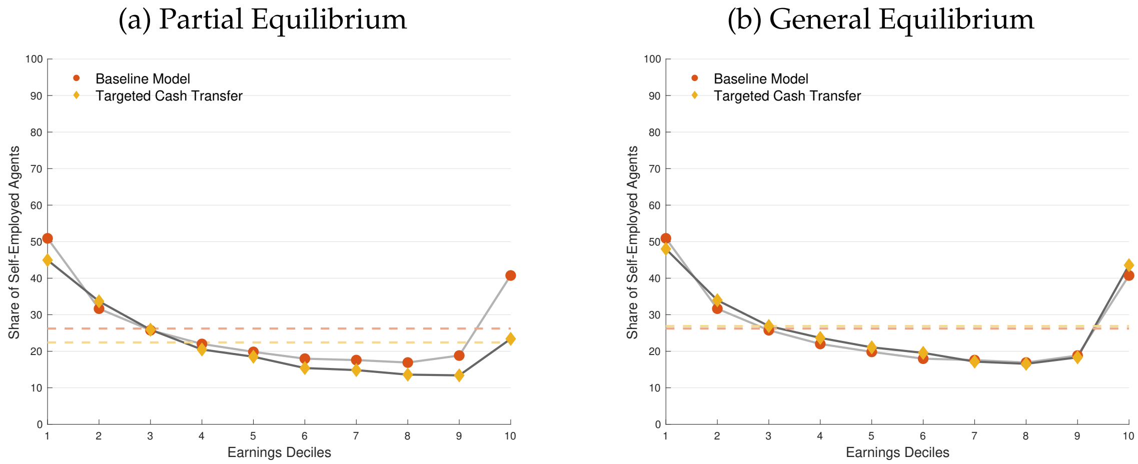
recipient households. See Banerjee, Niehaus, and Suri (2019) for further references.

To be consistent with these figures, we provide a transfer targeting the poorest 10% in terms of income in the baseline model. The transfer amounts to 15% of this group's consumption expenditures, or roughly 17% of the mean average labor income in the economy. Importantly, the targeting is independent of the individual's occupation or other variables such as wealth.

Targeted cash transfers in partial equilibrium Unlike transfers targeted to the unemployed, transfers given to the poor, irrespective of their occupation, lead to less productive self-employed agents. Figure 7a shows that the distribution of productivity worsens (in the FOSD sense) after the introduction of the transfers. This can seem surprising, given the change in the productivity threshold that characterizes the occupational choice of the unemployed (Figure 7b). Self-employment becomes less attractive for the poorest among the unemployed, but it also becomes more attractive for relatively wealthier agents with low productivity. At the same time, the transfers induce agents to save less. In fact, asset holdings go down 35 percent in the economy—39 percent among the self-employed.[25] The combination of these two effects

[25] Daruich and Fernandez (2020) found similar results when analyzing the effects of Universal Basic Income. One of the main determinants of welfare and output losses is the decrease in savings and hence capital after the policy is enacted.

Figure 8: The Self-Employment Rate and Targeted Cash Transfers



Note: *The figure reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model. The yellow squares in the left panel correspond to the model with targeted cash transfers in partial equilibrium. The yellow squares in the right panel correspond to the model with targeted cash transfers in general equilibrium.*

leads to a pool of self-employed agents that are less productive and less wealthy.

The consequences of the change in selection and wealth accumulation are made apparent by the distribution of self-employment across the earnings distribution. Figure 8a shows that the reduction in self-employment (3.8pp, Table 5) is concentrated among high earners, with a smaller decline among the bottom 10 percent of earners.

Targeted cash transfers in general equilibrium The fall in self-employment, particularly among top earners, is undone in general equilibrium. Figure 8b makes this clear. As with unemployment benefits, these effects are driven by lower wages (see Table 5), which simultaneously make unemployment/employment less attractive and make self-employment more profitable for highly productive agents.

In equilibrium, the introduction of targeted cash transfers incentivizes self-employment (which goes up 0.66 percentage points), at the expense of salaried employment (which goes down 0.77 percentage points). See the GE columns in Table 5. These changes are consistent with cross-sectional results by Bianchi and Bobba (2013), who compared treated and control regions after the enactment of *Progresa*, a large conditional cash transfer program in Mexico.[26]

Despite reversing some of the changes to self-employment, the worsening of the productivity distribution among the self-employed is not undone in general

[26] The general equilibrium effects of the model correspond to what we should observe by comparing different local labor markets with differential exposure to cash transfers.

Moment	GE - τ	GE	PE	Moment	GE - τ	GE	PE
% Δ W	-0.58	-1.15	—	Δ E	-1.04	-0.77	2.47
% Δ Y	-2.25	-2.24	—	Δ S	1.15	0.66	-3.80
%Δ TFP	-1.15	-1.17	—	Δ U	-0.11	0.11	1.34

Table 5: Model Response to Targeted Cash Transfers

Note: *The table presents changes in variables with respect to the baseline model. All numbers are in percentage points. By design, the wage does not change in partial equilibrium. We refrain from reporting macroeconomic aggregates that are constructed in partial equilibrium.*

equilibrium. On top of this, the decrease in asset holdings among the self-employed makes them more constrained, further reducing productivity (see equation 11). This is reflected in a fall of aggregate TFP by 1.17 percent.

Targeted cash transfers in general equilibrium and balanced budget We introduce a linear labor income tax to finance the expenditures of the targeted cash transfer. We set a tax rate τ_{tct} of 3.2% in order to finance a transfer of b_{TCT} units to a mass of TCT agents.

$$\tau_{tct} \int w \cdot \epsilon(z) dG^E = b_{TCT} \cdot TCT. \tag{15}$$

Once we account for the effects of financing the expenditures, the distortions created by the policy are still present. Despite the fall in wages being half of what it was without taxes, the introduction of an income tax on employed individuals further incentivizes self-employment over employment (after tax wages decrease 3.76 percent). The result is an increase in self-employment of 1.15 percentage points, almost double that in the GE case. The inflow of self-employed agents slightly changes TFP, but the productivity loss remains, driven as before by a worsening of the selection of self-employment towards less productive and less wealthy agents.

Thus, in the presence of subsistence self-employment, across-the-board income transfers entail general equilibrium effects that reverse most of the positive effects in partial equilibrium. Once we account for the behavior of wages to clear the labor market, self-employment increases and total factor productivity falls.

6.3 Self-Employment Grants

In this section, we implement a cash transfer to low-earning self-employed agents. To keep the policies comparable, we maintain the threshold and transfer size that we used for the targeted cash transfers (17 percent of labor income to agents below the 10th percentile of the baseline earnings distribution). The size of the transfer is substantial once we take into account the prevalence of low-earning self-employed agents in the economy: this grant amounts to 60 percent of the average assets of the targeted group in the baseline economy.[27] Moreover, the transfer is handed out every quarter as long as the agent meets the policy's earnings requirements.

This policy generates drastic changes in the composition of the workforce, which we summarize in Table 6. Unemployment vanishes regardless of whether prices or taxes adjust.There is also a marked reduction in employment (over 5 percentage points in partial equilibrium). This is partly because grants make self-employment more alluring for unproductive employed agents, but it is also a consequence of agents avoiding unemployment, as self-employed agents have a lower job-offer arrival rate than unemployed agents. The decrease in employment is cut in half in general equilibrium after an increase in the wage rate.

In line with the literature, we find that this policy leads to a decrease in TFP (Buera, Kaboski, and Shin, 2020), regardless of whether the policy is paid for using labor income taxes. The decrease is large, with aggregate TFP falling around 2.5 percentage points. The reason behind the decrease in productivity is the deterioration of the productivity distribution of those in self-employment. Figure 9a shows how the policy works as an incentive for agents with low productivity to become self-employed, in effect worsening the distribution of productivity (in the FOSD sense) with respect to the baseline. Self-employed increases across the earnings distribution, except at the very top, as Figure 9b shows.[28]

[27] The situation would be quite different without unemployment risk, when the self-employed are high-earning and typically wealthy agents. In that case, a transfer of a comparable size would not lead to the drastic changes in workforce compositions we find.

[28] In partial equilibrium, the increase in the self-employment rate is stronger and occurs throughout the distribution. The increase in wages reduces the share of high-earning self-employed agents.

Moment	GE - τ	GE	PE	Moment	GE - τ	GE	PE
% Δ W	1.4	1.0	—	Δ E	-2.7	-2.5	-5.2
% Δ Y	-2.6	-2.4	—	Δ S	6.8	6.6	9.3
% Δ TFP	-2.4	-2.5	—	Δ U	-4.1	-4.1	-4.1

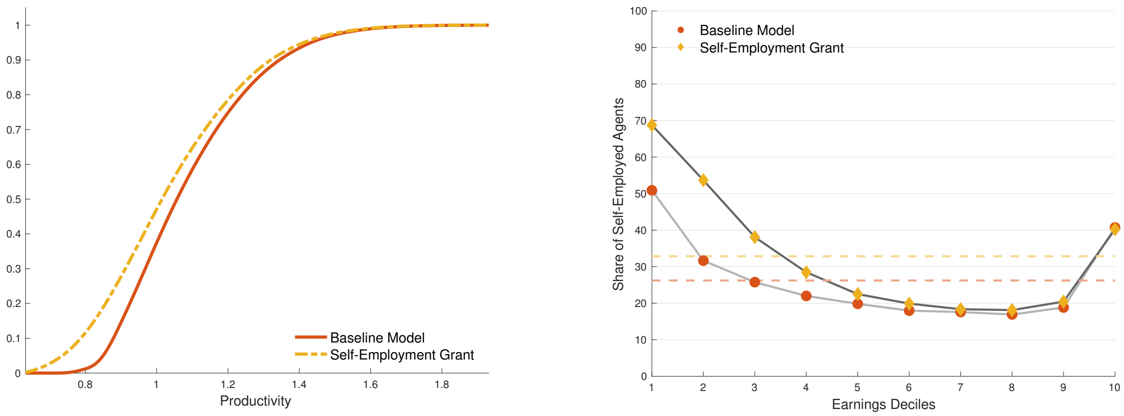
Table 6: Model Response to Self-Employment Grants

Note: *The table presents changes in variables with respect to the baseline model. All numbers are in percentage points. By design, the wage does not change in partial equilibrium. We refrain from reporting macroeconomic aggregates that are constructed in partial equilibrium.*

Figure 9: Model Response to Self-Employment Grants in General Equilibrium

(a) CDF of Productivity

(b) Self-Employment Rate



Note: *The left panel reports the CDF of productivity among self-employed agents. The continuous red line corresponds to the baseline model. The dashed yellow line corresponds to the model with grants in general equilibrium. The right panel reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model. The yellow squares correspond to the model with grants in general equilibrium.*

6.4 Financial Sector Reform

Finally, we use the model to study the effects of policies that loosen the collateral constraints of self-employed agents. Micro-finance programs are common in developing economies, generally motivated by dysfunctional credit markets that prevent entrepreneurs' access to credit. These financial constraints curtail the growth of productive entrepreneurs. However, the experimental literature has found only small average effects following the provision of micro-credit in developing countries. See, among others, Banerjee, Duflo, Glennerster, and Kinnan (2015) and Banerjee, Breza, Duflo, and Kinnan (2019).

The spirit of these policies is to alleviate financial frictions by improving agents' access to credit. However, the general equilibrium effects of such reforms are not trivial to determine, because agents will react by changing their occupational choices as credit becomes more widely available. At the same time, credit-deepening reforms will improve allocative efficiency, in turn increasing productivity and wages. We proceed in two steps. First, we study the effects of a moderate reform that loosens the collateral constraint of the self-employed. Second, we compare these results with those following a complete elimination of credit frictions.

Credit Deepening We start by introducing a partial loosening of self-employed agents' collateral constraints. In particular, we increase the credit line that self-employed individuals can get from λa to $(\lambda + \lambda_{cd})a$. We understand this reform broadly as an improvement of financial markets in developing economies. The new collateral constraint takes the form of

$$k \leq (\lambda + \lambda_{cd}) \cdot a, \tag{16}$$

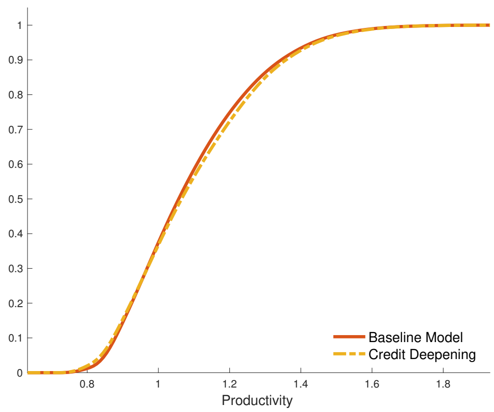
and we assume that λ_{cd} is such that the collateral constraint is 20% less stringent than in the baseline model.

In partial equilibrium, the loosening of the collateral constraint induces individuals to enter into self-employment, especially among individuals with higher earnings, a group which includes individuals with high productivity (and consequently higher optimal scale) and those with large asset holdings (who can rent more capital as a result of the reform). See Figure 10b. However, as shown in Figures 10a and 11a, there is entry to self-employment among low earners as well. With fixed prices, the reform causes large occupational changes. Self-employment would increase by 3.72%.

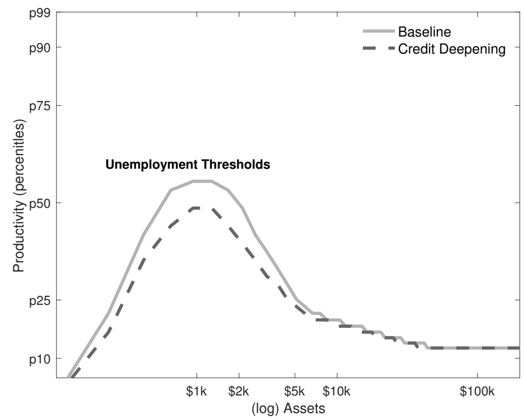
In general equilibrium most of these occupational changes dissipate, a comparison shown in Figures 11a and 11b. The reason is that the wage rate increases in order to clear the labor market. The increase in the wage rate produces a decrease in the self-employment rate of around 0.98%, and an increase of the unemployment rate of 0.54%. These results are reminiscent of the channels highlighted by Feng, Lagakos, and Rauch (2020). As economies develop, unemployment is created as a byproduct. Because capital can be assigned more efficiently to high-productivity entrepreneurs, the reform increases TFP in 0.9% and is the main driver behind an increase in aggregate output of 1.1%.

Figure 10: Model Response to Credit Deepening in Partial Equilibrium

(a) CDF of Productivity



(b) Occupational Choice



Note: *The left panel reports the CDF of productivity among self-employed agents. The continuous red line corresponds to the baseline model. The dashed yellow line corresponds to the model with credit deepening in partial equilibrium. The right panel reports productivity thresholds characterizing the occupational choice of unemployed agents for the baseline model (continuous light gray line) and the model with credit deepening (dashed dark gray line). Lines depict the threshold value of productivity (z) for each level of assets (a). The agent chooses self-employment if productivity is above the threshold.*

Moment	GE	PE	Moment	GE	PE
% Δ W	0.07	—	Δ E	0.02	-0.11
% Δ Y	0.04	—	Δ S	-0.17	0.02
% Δ TFP	0.12	—	Δ U	0.16	0.09

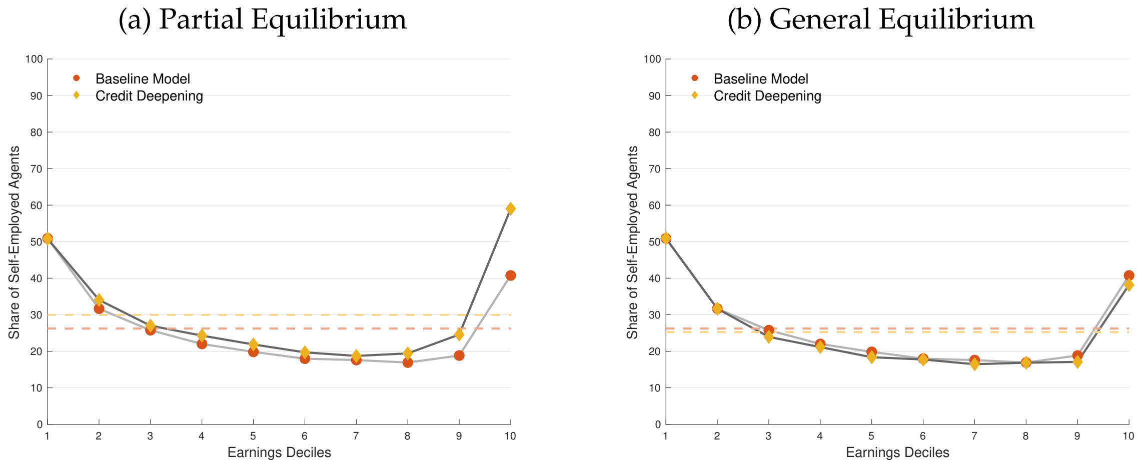
Table 7: Model Response to Credit Deepening

Note: *The table presents changes in variables with respect to the baseline model. All numbers are in percentage points. By design, the wage does not change in partial equilibrium. We refrain from reporting macroeconomic aggregates that are constructed in partial equilibrium.*

Elimination of Collateral Constraints ($\lambda_{cd} \to \infty$) At fixed prices, the elimination of collateral constraints creates two effects, illustrated in Figures 12a and 12b. Figure 12a shows that the elimination of collateral constraints shifts the distribution of productivity of the entrepreneurs to the right, as more productive firms are able to produce more. Figure 12b shows that for sufficiently rich agents, the reform makes selection into self-employment flat with respect to wealth. The model still predicts an increasing profile of selection for sufficiently poor agents who still have subsistence concerns that are not directly solved via the elimination of collateral constraints.

Figure 12c, which reproduces Figure 4b, shows the joint distribution of self-employment and earnings. In an economy without collateral constraints, the self-employment rate goes down by 7 percentage points and is accompanied by an

Figure 11: Self-Employment Rate and Credit Deepening



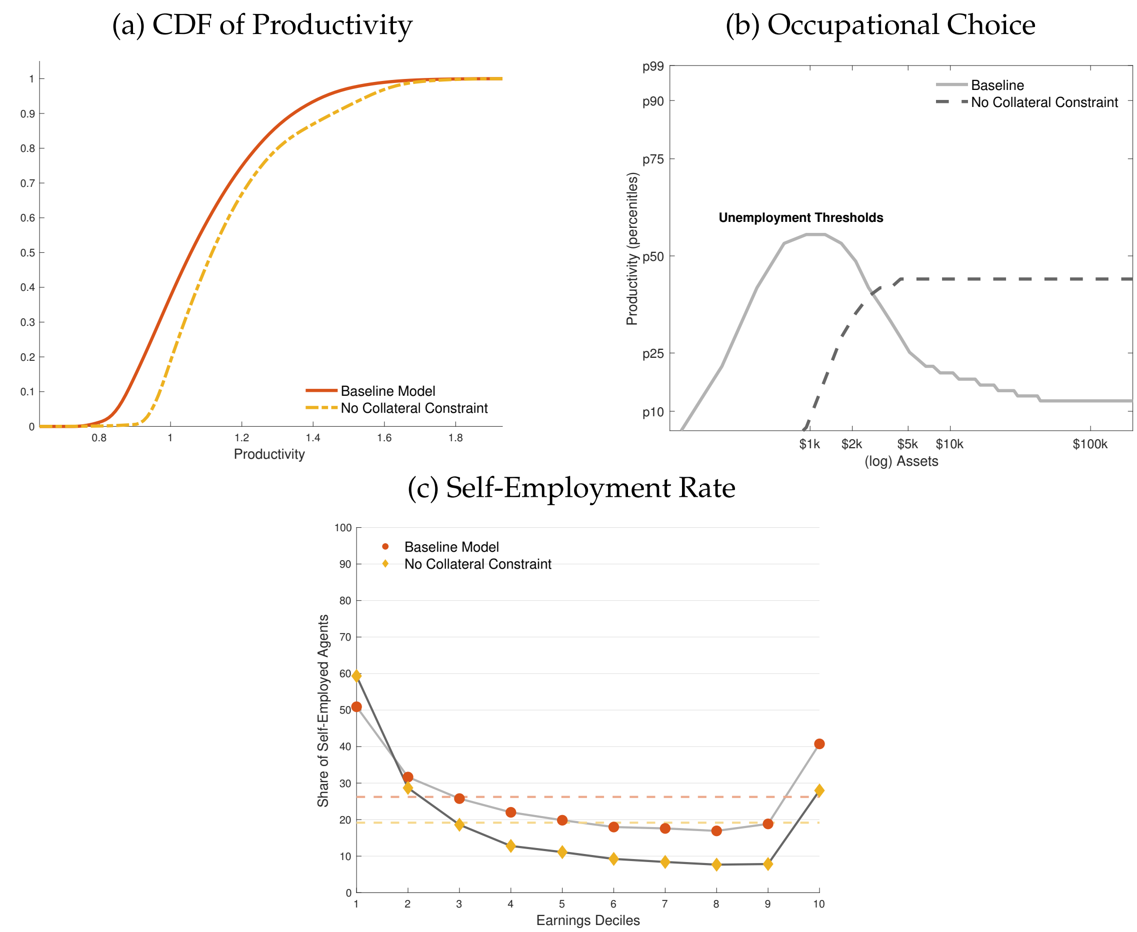
Note: *The figure reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model. The yellow squares in the left panel correspond to the model with a credit-deepening reform in partial equilibrium. The yellow squares in the right panel correspond to the model with unemployment benefits in general equilibrium.*

increase in unemployment of 4.5 percentage points. Aggregate output increases by 32%, with TFP rising 11%. In order to clear the labor market, the wage rate goes up by 19%, while aggregate salaried employment increases by 2.5%.

Financial sector reforms are beneficial to productivity and generate unemployment as a byproduct, as more individuals move from low-productivity self-employment activities into frictional labor markets. However, financial reform, even when taken to the limit of eliminating collateral constraints, does not solve the subsistence concerns that lead individuals to choose self-employment. Other policies, like unemployment benefits, have a more direct effect on agents facing subsistence concerns.

The effects of financial reforms also illustrate the importance of general equilibrium analysis. While the partial equilibrium effects of the reform point to a large increase in self-employment, the general equilibrium analysis shows those conclusions would be premature. As firms have better access to credit, productive firms grow and increase the overall productivity of the economy. This invariably leads to higher wages, which in turn affect agents' occupational choices. The net effect of these reforms is likely to be a better selection into self-employment, with fewer but more successful self-employed agents.

Figure 12: Model without Collateral Constraints



Note: *Panel (a) reports the CDF of productivity among self-employed agents. The continuous red line corresponds to the baseline model. The dashed yellow line corresponds to the model with credit deepening in partial equilibrium. Panel (b) reports productivity thresholds characterizing the occupational choice of unemployed agents for the baseline model (continuous light gray line) and the model with credit deepening (dashed dark gray line). Lines depict the threshold value of productivity* (z) *for each level of assets* (a)*. The agent chooses self-employment if productivity is above the threshold. Panel (c) reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model. The yellow squares correspond to the model without collateral constraints in general equilibrium.*

7 Concluding Remarks

Self-employment can reflect the entrepreneurial drive of a society, signaling innovation and growth. But it can also reflect subsistence concerns of individuals looking for an income source when no alternatives are available. This is painfully evident across developing economies characterized by high self-employment rates, concentrated among the poor. Clarifying the features of an economy that lead to large numbers of low-earning, self-employed agents is crucial to understanding the effects of policies that are often used to alleviate poverty or foster growth.

We show that the features of self-employment in developing economies are consistent with its role as self-insurance for poor individuals. Consequently, policies that supplement this insurance role, like providing unemployment income, are effective at preventing low-productivity individuals from becoming self-employed. This in turn has important general equilibrium implications, tied to increases in productivity and employment. On the contrary, policies aiming to promote entrepreneurship can have unintended consequences by making self-employment more attractive for low-productivity individuals, resulting in lower aggregate productivity. The precariousness of the material conditions of the poor mean that even small incentives have a large impact on their occupational choices.

We argue that incorporating labor market frictions alongside financial frictions is critical to correctly capture the aggregate dynamics of developing economies and their response to policy. Doing so not only improves the fit of models to salient features of developing economies, but it also brings macro-development models in line with micro-estimates of the identified response of the economy to shocks (e.g., the response of wages to labor demand shocks). The key mechanism lies in incorporating the view that subsistence concerns dominate selection into self-employment among the poor.

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Appendices

A Equilibrium of the model

A stationary equilibrium for this economy is a set of value functions $\left\{V^o, \tilde{V}^o\right\}_{o\in\{E,U,S\}}$, along with optimal consumption functions $\{c^o\}_{o\in\{E,U,S\}}$, labor and capital demand from self-employed $\{n,k\}$, prices $\{r,w\}$, a distribution of agents for each occupation $\{G^o\}_{o\in\{E,U,S\}}$, given exogenous shifters $\{z\}$ such that:

1. Value functions are consistent with individual optimization. That is, they satisfy equations (1)-(3) and equations (5)-(7).
2. Consumption (and thus asset accumulation) is consistent with the agent's optimization. That is, it is given by equation (4).
3. Capital and labor demand solve the profit-maximization problem of the self-employed. That is, they are given by (A.5) and (A.6) if $\nu < 1$, or by (A.7) if $\nu = 1$.
4. Labor market clears: $N^S = N^D$, where total labor supply is given by (8), and total labor demand by (9).
5. The interest rate is given by the international interest rate $r^\star$.
6. The distribution of agents is stationary. For this, the densities g^E, g^U, and g^S of employed, unemployed, and self-employed agents must satisfy the system of Kolmogorov-Forward Equations (KFE) defined by[29]

$$
\begin{aligned}
0 = & -\frac{\partial}{\partial a}\left[\dot{a}g^U(a,z)\right] + \chi^{EU}(a,z,)\,g^E(a,z,) + \chi^{SU}(a,z)\,g^S(a,z) \\
& -\chi^{US}(a,z)\,g^U(a,z) - \gamma^U \mathrm{Pr}^U(\epsilon)\,g^U(a,z)\,\mathbb{1}_{\{V^E(a,z)>V^U(a,z)\}} \\
& -\gamma^z \int \mathrm{Pr}^z(z'|z)\,g^U(a,z)\,dz' + \gamma^z \int \mathrm{Pr}^z\left(z|z'\right) g^U(a,z')\,dz',
\end{aligned} \tag{A.1}
$$

$$
\begin{aligned}
0 = & -\frac{\partial}{\partial a}\left[\dot{a}g^S(a,z)\right] + \chi^{ES}(a,z,\epsilon)\,g^E(a,z) + \chi^{US}(a,z)\,g^U(a,z) \\
& -\chi^{SU}(a,z)\,g^S(a,z) - \gamma^S g^S(a,z)\,\mathbb{1}_{\{V^E(a,z)>V^S(a,z)\}} \\
& -\gamma^z \int \mathrm{Pr}^z(z'|z)\,g^S(a,z)\,dz' + \gamma^z \int \mathrm{Pr}^z\left(z|z'\right) g^S(a,z')\,dz'
\end{aligned} \tag{A.2}
$$

[29]The density functions are also such that: $1 = \int\int\left(\int g^E(a,z,\epsilon)\,d\epsilon + g^U(a,z) + g^S(a,z)\right) da\,dz$. So $\int g^E(a,z,\epsilon)\,da\,dz\,d\epsilon$ gives the mass of employed agents, and $\int g^o(a,z)\,da\,dz$ for $o\in\{U,S\}$ gives the mass of unemployed and self-employed agents.

$$
\begin{aligned}
0 =& -\frac{\partial}{\partial a}\left[\dot{a}g^{E}\left(a,z\right)\right]-\gamma^{E}-\chi^{EU}\left(a,z\right)g^{E}\left(a,z\right)-\chi^{ES}\left(a,z\right)g^{E}\left(a,z,\epsilon\right) \\
&+\gamma^{U}\mathrm{Pr}^{U}\left(\epsilon\right)g^{U}\left(a,z\right)\mathbb{1}_{\{V^{E}(a,z)>V^{U}(a,z)\}} \\
&+\gamma^{S}g^{S}\left(a,z\right)\mathbb{1}_{\{V^{E}(a,z)>V^{S}(a,z)\}} \\
&-\gamma^{z}\int\mathrm{Pr}^{z}\left(z'|z\right)g^{E}\left(a,z\right)dz'+\gamma^{z}\int\mathrm{Pr}^{z}\left(z|z'\right)g^{E}\left(a,z'\right)dz'
\end{aligned}
\tag{A.3}
$$

In the definition of the stationary distribution we let $\chi^{oo'}$ be an indicator function for the occupational choice of the agents. Then for the employed we have:

$$
\chi^{Eo'}\left(a,z,\right)=\begin{cases}1 & \text{if } V^{E}\left(a,z\right)=\tilde{V}^{o'}\left(a,z\right)\\ 0 & \text{otherwise}\end{cases},
$$

where $o'\in\{U,S\}$. For the unemployed and the self-employed we have:

$$
\chi^{US}\left(a,z\right)=\begin{cases}1 & \text{if } V^{U}\left(a,z\right)=\tilde{V}^{S}\left(a,z\right)\\ 0 & \text{otherwise}\end{cases} \quad \text{and} \quad \chi^{SU}\left(a,z\right)=\begin{cases}1 & \text{if } V^{S}\left(a,z\right)=\tilde{V}^{U}\left(a,z\right)\\ 0 & \text{otherwise}\end{cases}.
$$

Of course $\chi^{oo}=1$ indicates no change in the agent's occupation.

The profit maximization problem of the self-employed is given by:

$$
\pi\left(a,z\right)=\max_{k\leq\lambda a\,,\,n\geq0}\left\{z\left(k^{\alpha}n^{1-\alpha}\right)^{\nu}-wn-\left(r+\delta\right)k\right\}\ . \tag{A.4}
$$

The solution to the problem when $\nu<1$ is characterized by the following demand for labor:

$$
n\left(a,z\right)=\left(\frac{\nu\left(1-\alpha\right)z}{w}\right)^{\frac{1}{1-(1-\alpha)\nu}}\left(k\left(a,z\right)\right)^{\frac{\alpha\nu}{1-(1-\alpha)\nu}}\ , \tag{A.5}
$$

and capital:

$$
k\left(a,z\right)=\min\left\{\nu^{\frac{1}{1-\nu}}z^{\frac{1}{1-\nu}}\left(\frac{\alpha}{r+\delta}\right)^{\frac{1-(1-\alpha)\nu}{1-\nu}}\left(\frac{1-\alpha}{w}\right)^{\frac{(1-\alpha)\nu}{1-\nu}},\lambda a\right\}\ . \tag{A.6}
$$

In the case of $\nu=1$ production is only profitable if $z\geq\underline{z}=\left(\frac{r+\delta}{\alpha}\right)^{\alpha}\left(\frac{w}{1-\alpha}\right)^{1-\alpha}$, then:

$$
n\left(a,z\right)=\left(\frac{\left(1-\alpha\right)z}{w}\right)^{\frac{1}{\alpha}}k\left(a,z\right)\ ,\ \text{with } k\left(a,z\right)=\lambda a\mathbf{1}_{\{z\geq\underline{z}\}}\,. \tag{A.7}
$$

B Model without unemployment risk

In this section we describe a simplified model without unemployment risk. We lay out the model in general terms allowing for a labor efficiency component independent (ϵ) of the agent's productivity (z). In the calibration we set the variance of ϵ to zero for comparability with our baseline model, results with both sources of variation are available upon request. As before, an agent is free to become self-employed at any point, but now the agent is also free to become employed in response to changes in her labor efficiency, productivity or assets. There is no change in the profit maximization problem of the self-employed, or in the definition of total supply and demand for labor.

B.1 Agent's Problem

Because agents can change instantly across occupations, the occupational choice problem reduces to maximizing instantaneous income. The value of an agent is then:

$$\rho V(a,z,\epsilon) = \max_c u(c) + V_a(a,z,\epsilon)\dot{a} + \gamma^\epsilon \int V(a,z,\epsilon')\, d\mathrm{Pr}^\epsilon(\epsilon'|\epsilon) + \gamma^z \int V(a,z',\epsilon)\, d\mathrm{Pr}^z(z'|z)$$
$$\text{s.t. } \dot{a} = \max\{w\varepsilon(\epsilon,z), \pi(a,z)\} + ra - c \qquad a \geq \underline{a} \tag{B.1}$$

with $\pi(a,z)$ given as in equation (A.4), and $\varepsilon(\epsilon,z) = \epsilon + \eta z$.

The optimal consumption decision is found as in Section 3, following equation (4). Finally agents are employed if $w\varepsilon(\epsilon,z) \geq \pi(a,z)$ and as self-employed otherwise.

B.2 Equilibrium

An stationary equilibrium for this economy is a value function $\{V\}$, along with an optimal consumption function $\{c\}$, labor and capital demand from self-employed $\{n,k\}$, prices $\{r,w\}$ and a distribution of agents $\{G\}$ such that:

1. The value function satisfies (B.1).
2. Consumption (and thus asset accumulation) are consistent with the agent's optimization. That is, it is given by equation (4).
3. Capital and labor demand solve the self-employed's profit maximization problem. That is, they are given by (A.5) and (A.6) if $\nu < 1$, or by (A.7) if $\nu = 1$.
4. Labor market clears: $N^S = N^D$, satisfying equations (8) and (9).
5. The interest rate is given by the international interest rate $r^\star$.
6. The distribution of agents is stationary and solves:

$$0 = -\frac{\partial}{\partial a}\left[\dot{a} g(a,z,\epsilon)\right] - \gamma^z \int \mathrm{Pr}^z(z'|z)\, g(a,z,\epsilon)\, dz' + \gamma^z \int \mathrm{Pr}^z\left(z|z'\right) g(a,z',\epsilon)\, dz'$$
$$- \gamma^\epsilon \int \mathrm{Pr}^\epsilon(\epsilon'|\epsilon)\, g(a,z,\epsilon)\, d\epsilon' + \gamma^\epsilon \int \mathrm{Pr}^\epsilon\left(\epsilon|\epsilon'\right) g(a,z,\epsilon')\, d\epsilon' \tag{B.2}$$

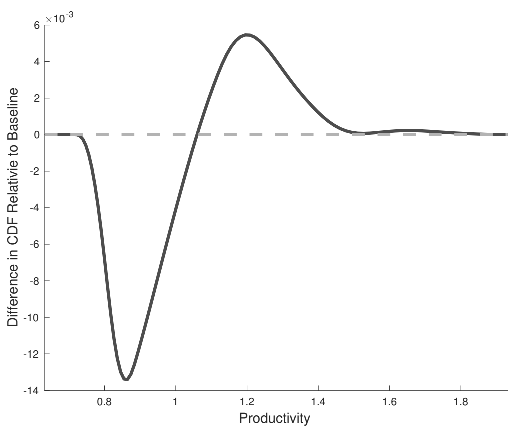
C Model: additional graphs and tables

	Shocks		Preferences
$\overline{\epsilon}$	Labor Efficiency - Base Value	ρ	Discount Factor
σ_ϵ	Labor Efficiency - Variance	σ	CRRA Parameter
ρ^ϵ	Labor Efficiency - Persistence		Technology
γ^ϵ	Labor Efficiency - Arrival Rate	α	Capital Share
$\overline{z}$	Productivity - Base Value	δ	Capital Depreciation
σ_z	Productivity - Variance	ν	Decreasing Returns
ρ^z	Productivity - Persistence		Assets
γ^z	Productivity - Arrival Rate	λ	Equity Constraint
γ^U	Job Offer Arrival Rate - Unemployed	$\underline{a}$	Borrowing Constraint
γ^S	Job Offer Arrival Rate - Self-employed	$\overline{a}$	Asset Barrier
γ^E	Job Destruction Arrival Rate		Income
η	Productivity - Labor Efficiency	b	Unemployed Income

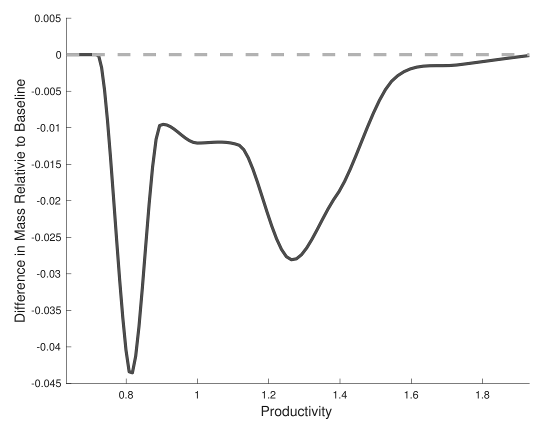
Table C.1: Model Parameters

Figure C.1: Productivity Changes after Labor Demand Shock

(a) Difference of Cumulative Distributions



(b) Difference of Mass per $z-$type



Note: *The figures show changes in the distribution of productivity (z) between the equilibrium of the baseline model and the model with government labor demand. The left panel presents the difference in the CDF of productivity among the self-employed relative to the baseline model. Negative values indicate that the new distribution first order stochastically dominates the baseline distribution. The right panel presents the difference in the mass of self-employed agents for each $z-$type. Differences are due to changes in the distribution and overall mass of self-employed agents.*

D Computational appendix

D.1 Solution to HJB equations

The model is solved using an implicit finite difference method as the one shown in Achdou, Han, Lasry, Lions, and Moll (2020). The occupational choice is solved through a splitting method, solving first for an auxiliary value $\tilde{V}$, the value that applies if the agent continues in the same occupation, and then solving for the occupational choice. We present a more general model that allows for separate labor efficiency and productivity processes.

Consider grids over assets, entrepreneurial ability and labor efficiency:

$$\vec{a} = [a_1, \ldots, a_{n_a}] \qquad \vec{z} = [z_1, \ldots, z_{n_z}] \qquad \vec{\epsilon} = [\epsilon_1, \ldots, \epsilon_{n_\epsilon}]$$

with n_a, n_z and n_ϵ elements respectively, and constant distance between grid points of Δa, Δz and $\Delta \epsilon$. Let i denote the index of the asset dimension, j of the entrepreneurial ability, and k of the labor efficiency.

For notational convenience we will treat all value functions as depending on all three states, it is understood that V^U and V^S do not vary across ϵ. Denote $V^o_{ijk} = V^o(a_i, z_j, \epsilon_k)$ and let the backward and forward difference of the value function approximate the derivative:

$$V^o_a(a_i, z_j, \epsilon_k) \approx \frac{V^o_{i+1,jk} - V^o_{ijk}}{\Delta a} = \partial_a V^o_{ijk,F} \qquad V^o_a(a_i, z_j, \epsilon_k) \approx \frac{V^o_{ijk} - V^o_{i-1,jk}}{\Delta a} = \partial_a V^o_{ijk,B}\,.$$

The problem to solve is:

$$\begin{aligned}\rho \tilde{V}^E_{ijk} = {} & u\left(c^E_{ijk}\right) + \partial_a V^E_{ijk} \cdot \left(y^E_{ijk} + r a_i - c^E_{ijk}\right) + \gamma^E \left(V^U_{ij} - \tilde{V}^E_{ijk}\right) \\ & + \gamma^z \sum_{j'=1}^{n_z} \left(V^E_{ij'k} - \tilde{V}^E_{ijk}\right) \Pr^z(z_{j'}|z_j) + \gamma^\epsilon \sum_{k'=1}^{n_\epsilon} \left(V^E_{ijk'} - \tilde{V}^E_{ijk}\right) \Pr^\epsilon(\epsilon_{k'}|\epsilon_k)\end{aligned} \tag{D.1}$$

$$\begin{aligned}\rho \tilde{V}^U_{ij} = {} & u\left(c^U_{ij}\right) + \partial_a V^U_{ij} \cdot \left(y^U_{ij} + r a_i - c^U_{ij}\right) + \gamma^U \sum_{k'=1}^{n_\epsilon} \left(V^E_{ijk'} - \tilde{V}^U_{ij}\right) \Pr^U(\epsilon_{k'}) \mathbb{1}_{\left\{V^E_{ijk'} > V^U_{ij}\right\}} \\ & + \gamma^z \sum_{j'=1}^{n_z} \left(V^U_{ij'} - \tilde{V}^U_{ij}\right) \Pr^z(z_{j'}|z_j)\end{aligned} \tag{D.2}$$

$$\begin{aligned}\rho \tilde{V}^S_{ij} = {} & u\left(c^S_{ij}\right) + \partial_a V^S_{ij} \cdot \left(y^S_{ij} + r a_i - c^S_{ij}\right) \\ & + \gamma^S \sum_{k'=1}^{n_\epsilon} \left(V^E_{ijk'} - \tilde{V}^S_{ij}\right) \Pr^S(\epsilon_{k'}) \mathbb{1}_{\left\{V^E_{ijk'} > V^S_{ij}\right\}} + \gamma^z \sum_{j'=1}^{n_z} \left(V^S_{ij'} - \tilde{V}^S_{ij}\right) \Pr^z(z_{j'}|z_j)\end{aligned} \tag{D.3}$$

together with:

$$V_{ijk}^{E} = \max\left\{\tilde{V}_{ij,k}^{E}, \tilde{V}_{ij}^{U}, \tilde{V}_{ij}^{S}\right\} \tag{D.4}$$

$$V_{ij}^{U} = \max\left\{\tilde{V}_{ij}^{U}, \tilde{V}_{ij}^{S}\right\} \tag{D.5}$$

$$V_{ij}^{S} = \max\left\{\tilde{V}_{ij}^{U}, \tilde{V}_{ij}^{S}\right\} \tag{D.6}$$

The implicit method solves the following equation on $\tilde{V}_{ijk}^{o,n+1}$ given a value for $V_{ijk}^{o,n}$. For employment the equation is:

$$\begin{aligned} \frac{\tilde{V}_{ijk}^{E,n+1} - \tilde{V}_{ijk}^{E,n}}{\Delta} + \rho\tilde{V}_{ijk}^{E,n+1} = u\left(c_{ijk}^{E,n}\right) + \partial_a\tilde{V}_{ijk}^{E,n+1} \cdot s_{ijk}^{E,n} + \gamma^{E}\left(\tilde{V}_{ij}^{U,n+1} - \tilde{V}_{ijk}^{E,n+1}\right) \\ + \gamma^{z}\sum_{j'=1}^{n_z}\left(\tilde{V}_{ij'k}^{E,n+1} - \tilde{V}_{ijk}^{E,n+1}\right)\Pr^{z}\left(z_{j'}|z_j\right) \\ + \gamma^{\epsilon}\sum_{k'=1}^{n_\epsilon}\left(\tilde{V}_{ijk'}^{E,n+1} - \tilde{V}_{ijk}^{E,n+1}\right)\Pr^{\epsilon}\left(\epsilon_{k'}|\epsilon_k\right) \end{aligned} \tag{D.7}$$

For $o \in \{U, S\}$ the equation is:

$$\begin{aligned} \frac{\tilde{V}_{ij}^{o,n+1} - \tilde{V}_{ij}^{o,n}}{\Delta} + \rho\tilde{V}_{ij}^{o,n+1} = u\left(c_{ij}^{o,n}\right) + \partial_a\tilde{V}_{ij}^{o,n+1} \cdot s_{ij}^{o,n} + \sum_{k'=1}^{n_\epsilon}\tilde{\gamma}_{ijk'}^{o,n}\left(\tilde{V}_{ijk'}^{E,n+1} - \tilde{V}_{ij}^{o,n+1}\right)\Pr^{o}\left(\epsilon_{k'}\right) \\ + \gamma^{z}\sum_{j'=1}^{n_z}\left(\tilde{V}_{ij'}^{o,n+1} - \tilde{V}_{ij}^{o,n+1}\right)\Pr^{z}\left(z_{j'}|z_j\right) \end{aligned} \tag{D.8}$$

Note that the (known) value at iteration n is used to compute consumption, and the drift of the assets, which we will call savings for convenience:

$$s_{ijk}^{o,n} = y_{ijk}^{o} + ra_i - c_{ijk}^{o,n} \qquad \text{where} \qquad c_{ijk}^{o,n} = u^{'-1}\left(\partial_a V_{ijk}^{o,n}\right)$$

It is also used to define if the agent is willing to change after a job offer. We have:

$$\tilde{\gamma}_{ijk}^{U,n} = \gamma^{U}\mathbb{1}_{\left\{V_{ijk'}^{E,n} > V_{ij}^{U,n}\right\}} \qquad \tilde{\gamma}_{ijk}^{S,n} = \gamma^{S}\mathbb{1}_{\left\{V_{ijk'}^{E,n} > V_{ij}^{S,n}\right\}}$$

Next it is necessary to determine whether to use the forward or backward approximation to the first derivatives of the value function. We follow the "upwind scheme" presented in Achdou et al. (2020).

Since consumption can be defined with the backward or forward difference approximation we get:

$$s_{ijk,B}^{o,n} = y_{ijk}^{o} + ra_i - u^{'-1}\left(\partial_a V_{ijk,B}^{o,n}\right) \qquad s_{ijk,F}^{o,n} = y_{ijk}^{o} + ra_i - u^{'-1}\left(\partial_a V_{ijk,F}^{o,n}\right)$$

The idea is to use the backward difference when the implied drift is negative, and the forward difference when the drift is positive. Yet there are cases for which $s_{ijk,F}^{o,n} < 0 < s_{ijk,B}^{o,n}$, in these cases we set savings equal to zero, so the derivative is not used, in any case the FOC of the problem gives the exact derivate of the value function as: $\partial_a \overline{V}_{ijk}^{o,n} = u'\left(y_{jk} + ra_i\right)$.[30]

Consumption is then:

$$c_{ijk}^{o,n} = u'^{-1}\left(\partial_a V_{ijk,B}^{o,n}\right) \mathbb{1}_{\left\{s_{ijk,B}^{o,n}<0\right\}} + u'^{-1}\left(\partial_a V_{ijk,F}^{o,n}\right) \mathbb{1}_{\left\{s_{ijk,F}^{o,n}>0\right\}} + \left(y_{ijk}^{o} + ra_i\right) \mathbb{1}_{\left\{s_{ijk,F}^{o,n}<0<s_{ijk,B}^{o,n}\right\}},$$

and the drift term for assets is replaced by:

$$\begin{aligned}
\partial_a \tilde{V}_{ijk}^{o,n+1} \cdot s_{ijk}^{o,n} &= \partial_a \tilde{V}_{ijk,B}^{o,n+1} \left[s_{ijk,B}^{o,n}\right]^{-} + \partial_a \tilde{V}_{ijk,F}^{o,n+1} \left[s_{ijk,F}^{o,n}\right]^{+} \\
&= \frac{\tilde{V}_{ijk}^{o,n+1} - \tilde{V}_{i-1,jk}^{o,n+1}}{\Delta a} \left[s_{ijk,B}^{o,n}\right]^{-} + \frac{\tilde{V}_{i+1,jk}^{o,n+1} - \tilde{V}_{ijk}^{o,n+1}}{\Delta a} \left[s_{ijk,F}^{o,n}\right]^{+}
\end{aligned}$$

Grouping terms we get the following expression for employment:

$$\begin{aligned}
\frac{\tilde{V}_{ijk}^{E,n+1} - \tilde{V}_{ijk}^{E,n}}{\Delta} + \rho \tilde{V}_{ijk}^{E,n+1} = u\left(c_{ijk}^{E,n}\right) &+ \gamma^E \tilde{V}_{ij}^{U,n+1} \\
&+ x_{ijk}^{E} \tilde{V}_{ijk}^{E,n+1} + x_{ijk}^{E-} \tilde{V}_{i-1,jk}^{E,n+1} + x_{ijk}^{E+} \tilde{V}_{i+1,jk}^{E,n+1} \\
&+ \gamma^z \sum_{j'=1}^{n_z} \mathbf{Pr}^z\left(z_{j'}|z_j\right) \tilde{V}_{ij'k}^{E,n+1} + \gamma^\epsilon \sum_{k'=1}^{n_\epsilon} \mathbf{Pr}^\epsilon\left(\epsilon_{k'}|\epsilon_k\right) \tilde{V}_{ijk'}^{E,n+1}
\end{aligned}$$

where

$$\begin{aligned}
x_{ijk}^{E} &= \frac{\left[s_{ijk,B}^{E,n}\right]^{-}}{\Delta a} - \frac{\left[s_{ijk,F}^{E,n}\right]^{+}}{\Delta a} - \gamma^E - \gamma^z - \gamma^\epsilon \\
x_{ijk}^{E-} &= -\frac{\left[s_{ijk,B}^{E,n}\right]^{-}}{\Delta a} \\
x_{ijk}^{E+} &= \frac{\left[s_{ijk,F}^{E,n}\right]^{+}}{\Delta a}
\end{aligned}$$

[30] Additional care is needed because of the non-convexities introduced by the occupational choice of agents. It is possible that both $s_{ijk,B}^{o,n} < 0$ and that $s_{ijk,F}^{o,n} > 0$ for the same state. In this case we take the drift that provides the highest change in value by comparing $u\left(c_{ijk,B}^{o,n}\right) + \partial_a V_{ijk,B}^{o,n} \cdot s_{ijk,B}^{o,n}$ with $u\left(c_{ijk,F}^{o,n}\right) + \partial_a V_{ijk,F}^{o,n} \cdot s_{ijk,F}^{o,n}$. We omit this from the notation for readability.

For unemployment and self-employment:

$$\frac{\tilde{V}_{ij}^{o,n+1}-\tilde{V}_{ij}^{o,n}}{\Delta}+\rho\tilde{V}_{ij}^{o,n+1}=u\left(c_{ij}^{o,n}\right)+\sum_{k'=1}^{n_\epsilon}\tilde{\gamma}_{ijk'}^{o,n}\mathrm{Pr}^{o}\left(\epsilon_{k'}\right)\tilde{V}_{ijk'}^{E,n+1}$$
$$+x_{ij}^{o}\tilde{V}_{ij}^{o,n+1}+x_{ij}^{o-}\tilde{V}_{i-1,j}^{o,n+1}+x_{ij}^{o+}\tilde{V}_{i+1,j}^{o,n+1}$$
$$+\gamma^{z}\sum_{j'=1}^{n_z}\mathrm{Pr}^{z}\left(z_{j'}|z_j\right)\tilde{V}_{ij'}^{o,n+1}$$

where

$$\begin{aligned}
x_{ij}^{o}&=\frac{\left[s_{ij,B}^{o,n}\right]^{-}}{\Delta a}-\frac{\left[s_{ij,F}^{o,n}\right]^{+}}{\Delta a}-\sum_{k'=1}^{n_\epsilon}\tilde{\gamma}_{ijk'}^{o,n}\mathrm{Pr}^{o}\left(\epsilon_{k'}\right)-\gamma^{z}\\
x_{ij}^{o-}&=-\frac{\left[s_{ij,B}^{o,n}\right]^{-}}{\Delta a}\\
x_{ij}^{o+}&=\frac{\left[s_{ij,F}^{o,n}\right]^{+}}{\Delta a}
\end{aligned}$$

D.1.1 Boundary Conditions

A final loose end before writing up the linear system in matrix form is what to do with the boundaries of the different grids. At the lower boundary of the asset grid the agent is subject to a no-borrowing constraint. Hence it has to be the case that the agent does not try to borrow. The drift has to be non-negative at that point, which implies that $\tilde{x}_{1jk}^{o-}=0$ for all (j,k). At the upper boundary a similar constraint can be imposed, so that $\tilde{x}_{n_a jk}^{o+}=0$. This should arise naturally if the upper boundary is high enough. Notice that imposing these restrictions implies that V_{0j}^{n+1} and $V_{n_a+1,j}^{n+1}$ are not part of the system.

D.1.2 System Solution

The equations above describe a system of $n_a\times n_z\left(2+n_\epsilon\right)$ equations, its best to define the value function a stack of three value functions, one for each occupation:

$$\begin{aligned}
V&=\left[V^{U};V^{S};V^{E}\right]^{T}\\
V^{o}&=\mathrm{vec}\left[V_{ijk}^{o}\right]
\end{aligned}$$

The system is:

$$\frac{1}{\Delta}\left(V^{n+1}-V^{n}\right)+\rho V^{n+1}=u^{n}+A^{n}V^{n+1}$$

where $u^{n}=\left[u^{U,n};u^{S,n};u^{E,n}\right]$ and $u^{o,n}=\mathrm{vec}\left[u\left(c_{ijk}^{o,n}\right)\right]$ with consumption computed as explained above.

Matrix A^n is given by:

$$A^n = B^n + C + D$$

$$B^n = \begin{bmatrix} B^n_{UU} & \mathbf{0} & B^n_{UE} \\ \mathbf{0} & B^n_{SS} & B^n_{SE} \\ B_{EU} & \mathbf{0} & B^n_{EE} \end{bmatrix} \qquad C = \begin{bmatrix} \tilde{C} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \tilde{C} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \tilde{C}_E \end{bmatrix} \qquad D = \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \tilde{D} \end{bmatrix}$$

The matrices B^n_{oo} are sparse and they only contain elements in the diagonal, upper diagonal and lower diagonal. Consider $X_o = \left[\tilde{x}^o_{ijk}\right]$, $X^-_o = \left[\tilde{x}^{o,-}_{ijk}\right]$ and $X^+_o = \left[\tilde{x}^{o,+}_{ijk}\right]$, all three dimensional matrix that contain the coefficients $\tilde{x}$ (note that $\tilde{x}$ is already adjusted for the boundaries). Then we have: $\text{diag}\left(B^n_{oo}\right) = \text{vec}\left(X_o\right)$, $\text{diag}^+\left(B^n_{oo}\right) = \text{vec}\left(X^+_o\right)$ and $\text{diag}^-\left(B^n_{oo}\right) = \text{vec}\left(X^-_o\right)$, where the upper diagonal and lower diagonal are adjusted not to include the zero terms of the boundaries.

The matrices $B^n_{oo'}$ depend on the type of transition. For the transition from employment to unemployment we have:

$$B_{EU} = \gamma^E \begin{bmatrix} I_{n_a \cdot n_z} \\ \vdots \\ I_{n_a \cdot n_z} \end{bmatrix}$$

so that B_{EU} is of size $n_a \cdot n_z \cdot n_\epsilon \times n_a \cdot n_z$. For the transition from unemployment and self-employment to employment:

$$B^n_{oE} = \gamma^o \left[\begin{array}{ccc} \text{Pr}^o\left(\epsilon_1\right) \text{diag}\left(\text{vec}\left(\mathbb{1}_{\left\{V^E_{ij1} > V^o_{ij}\right\}}\right)\right) & \cdots & \text{Pr}^o\left(\epsilon_{n_\epsilon}\right) \text{diag}\left(\text{vec}\left(\mathbb{1}_{\left\{V^E_{ijn_\epsilon} > V^o_{ij}\right\}}\right)\right) \end{array} \right]$$

where we abuse notation by letting $\text{diag}\left(\cdot\right)$ give a diagonal matrix when it is evaluated in a vector.

Matrices $\tilde{C}$ and $\tilde{D}$ are also sparse and they are independent of the iteration. Their construction takes advantage of the fact that the elements of $\tilde{C}$ only vary with j and the elements of $\tilde{D}$ only vary with k. We first construct $\tilde{C} = \gamma^z \text{Pr}^z \otimes I_{n_a}$ and $\tilde{C}_E = \gamma_z I_{n_\epsilon} \otimes \tilde{C}$. Finally, $\tilde{D} = \gamma^\epsilon \text{Pr}^\epsilon \otimes I_{n_a \cdot n_z}$.

This problem can now be expressed as:

$$T^n V^{n+1} = t^n$$

where:

$$T^n = \left(\frac{1}{\Delta} + \rho\right) I_{n_a n_z (2+n_\epsilon)} - A^n \qquad t^n = u^n + \frac{1}{\Delta} V^n$$

D.1.3 Algorithm

1. Compute matrices C and D. These matrices do not change with equilibrium prices or iterations.
2. Take as given w.
3. Solve for earnings in each state: y^o_{ijk} for each combination of (a, z, ϵ) and

occupation. These values don't change with iterations.

4. Guess a value for V^n, a $n_a n_z (2 + n_\epsilon)$ vector. It is easier to store it as three separate matrices of dimensions $n_a \times n_z$, $n_a \times n_z$ and $n_a \times n_\epsilon \times n_z$.

   (a) We find it better to find the initial condition by solving for a fixed point of the problem without occupational choice (this same algorithm without the last step).

5. Compute the backward and forward drift: $s^{o,n}_{ijk,B}$ and $s^{o,n}_{ijk,F}$ for $i = \{2, \ldots, n_a\}$ and $i = \{1, \ldots, n_a - 1\}$ respectively, and all (j, k, o).

$$s^{o,n}_{ijk,B} = y^o_{jk} + ra_i - u^{'-1}\left(\partial_a V^{o,n}_{ijk,B}\right) \qquad s^{o,n}_{ijk,F} = y^o_{jk} + ra_i - u^{'-1}\left(\partial_a V^{o,n}_{ijk,F}\right)$$

   These values are stored in six matrices (two per occupation, one with backward drift and the other one with forward drift).

6. For all (i, j, k, o) compute consumption as:

$$c^{o,n}_{ijk} = u^{'-1}\left(\partial_a V^{o,n}_{ijk,B}\right) 1_{s^{o,n}_{ijk,B}<0} + u^{'-1}\left(\partial_a V^{o,n}_{ijk,F}\right) 1_{s^{o,n}_{ijk,F}>0} + \left(y^o_{jk} + ra_i\right) 1_{s^{o,n}_{ijk,F}<0<s^{o,n}_{ijk,B}}$$

   These values are stored in three matrices of dimensions $n_a \times n_z$, $n_a \times n_z$ and $n_a \times n_\epsilon \times n_z$.

7. Compute the utility vector as: $u^n = \left[u^{U,n}; u^{S,n}; u^{E,n}\right]$ and $u^{o,n} = \text{vec}\left[u\left(c^{o,n}_{ijk}\right)\right]$.

8. Compute the adjusted shock arrival rates:

$$\tilde{\gamma}^{U,n}_{ijk} = \gamma^U 1_{V^{E,n}_{ijk} > V^{U,n}_{ijk}} \qquad \tilde{\gamma}^{S,n}_{ijk} = \gamma^S 1_{V^{E,n}_{ijk} > V^{U,n}_{ijk}} \qquad \tilde{\gamma}^{E,n}_{ijk} = \gamma^E$$

9. Compute the matrices $X_o = \left[\tilde{x}^o_{ijk}\right]$, $X^-_o = \left[\tilde{x}^{o,-}_{ijk}\right]$ and $X^+_o = \left[\tilde{x}^{o,+}_{ijk}\right]$.

10. Compute matrix $B^n = \begin{bmatrix} B^n_{UU} & \mathbf{0} & B^n_{UE} \\ \mathbf{0} & B^n_{SS} & B^n_{SE} \\ B^n_{EU} & \mathbf{0} & B^n_{EE} \end{bmatrix}$, where $\text{diag}\left(B^n_{oo}\right) = \text{vec}\left(X_o\right)$, $\text{diag}^+\left(B^n_{oo}\right) = \text{vec}\left(X^+_o\right)$ and $\text{diag}^-\left(B^n_{oo}\right) = \text{vec}\left(X^-_o\right)$, where the upper diagonal and lower diagonal are adjusted not to include the zero terms of the boundaries. The matrices $B^n_{oo'}$ are defined above.

11. Compute the matrix $A^n = B^n + C + D$.

12. Compute the matrix T and vector t:

$$T^n = \left(\frac{1}{\Delta} + \rho\right) I_{3n_a n_\epsilon n_z} - A^n \qquad t^n = u^n + \frac{1}{\Delta} V^n$$

13. Compute $V^{n+1/2}$ as:

$$V^{n+1/2} = \left(T^n\right)^{-1} t^n$$

   (a) We use the Biconjugate gradients stabilized (l) method, preconditioned with LU Factorization. See Matlab functions "ilu" and "bicgstabl."

14. Divide the vector $V^{n+1/2}$ into three matrices of $n_a \times n_z$, $n_a \times n_z$ and $n_a \times n_\epsilon \times n_z$: $V^{U,n+1/2}$, $V^{S,n+1/2}$, and $V^{E,n+1/2}$.

15. Compute $V^{U,n+1}$, $V^{S,n+1}$, and $V^{E,n+1}$ as follows:

$$\begin{aligned}
V_{ijk}^{U,n+1} &= \max\left\{V_{ijk}^{U,n+1/2}, \tilde{V}_{ijk}^{S}\right\} \\
V_{ijk}^{S,n+1} &= \max\left\{V_{ijk}^{U,n+1/2}, V_{ijk}^{S,n+1/2}\right\} \\
V_{ijk}^{E,n+1} &= \max\left\{V_{ijk}^{U,n+1/2}, \tilde{V}_{ijk}^{S}, V_{ijk}^{E,n+1/2}\right\}
\end{aligned}$$

(a) Define the following matrices as indicators of the occupation choice: $\left[\tilde{\chi}_{ijk}^{oo'}\right]$

$$\tilde{\chi}_{ij}^{US} = \begin{cases} 1 & \text{if } V_{ij}^{U,n+1} = \tilde{V}_{ij}^{S} \\ 0 & \text{otw} \end{cases} \qquad \tilde{\chi}_{ij}^{SU} = \begin{cases} 1 & \text{if } V_{ij}^{S,n+1} = V_{ij}^{U,n+1/2} \\ 0 & \text{otw} \end{cases}$$

$$\tilde{\chi}_{ijk}^{EU} = \begin{cases} 1 & \text{if } V_{ijk}^{E,n+1} = V_{ij}^{U,n+1/2} \\ 0 & \text{otw} \end{cases} \qquad \tilde{\chi}_{ijk}^{ES} = \begin{cases} 1 & \text{if } V_{ijk}^{E,n+1} = \tilde{V}_{ij}^{S} \\ 0 & \text{otw} \end{cases}$$

These functions are 1 if the agent changes occupations at (i, j, k).

(b) Define now the vectors $\chi^{oo'} = \text{vec}\left(\tilde{\chi}^{oo'}\right)$ to be used later. χ is a vector of length $n_a n_z (2 + n_\epsilon)$.

D.2 Solution to KFE equations

Before solving the KFE the transition matrix A has to be modified to include the endogenous transitions between unemployment and self-employment. For this we use the indicators χ constructed as part of the value function iteration.

Now, consider a transition matrix P:

$$P = \begin{bmatrix} P^{UU} & P^{US} & A^{UE} \\ P^{SU} & P^{SS} & A^{SE} \\ P^{EU} & P^{ES} & A^{EE} \end{bmatrix}$$

note that since there are not endogenous transitions to employment the last column of matrices are just as in matrix A. The other columns are modified only if there are endogenous transitions. Note that each matrix $P^{oo'}$ is of size $n_a n_\epsilon n_z \times n_a n_\epsilon n_z$.

1. Make all matrices $P^{oo'} = A^{oo'}$ and $P^{oo} = A^{oo}$.
2. For matrix P make zero any (column) entry related to an endogenous transition, since these states are not reached. For all m and q in $\{1, \ldots, n_a n_\epsilon n_z\}$:

$$P_{mq}^{*U} = 0 \qquad \text{if } \chi^{US}(q) = 1$$

$$P_{mq}^{*S} = 0 \qquad \text{if } \chi^{SU}(q) = 1$$

$$P_{mq}^{*E} = 0 \qquad \text{if } \chi^{EU}(q) = 1 \quad \text{or} \quad \chi^{ES}(q) = 1$$

where $* \in \{U, S, E\}$.

3. For matrix P adjust entries to take into account endogenous transitions coming from other occupation o into occupation o'. This implies moving the columns of P^{o*} that were set to 0 because of transitions into $P^{*o'}$. For all m and q in $\{1, \ldots, n_a n_\epsilon n_z\}$:
$$P_{m,q-l_q}^{*S} = P_{m,q-l_q}^{*S} + A_{mq}^{*U} \qquad \text{if } \chi^{US}(q) = 1$$
$$P_{mq}^{*U} = P_{mq}^{*U} + A_{mq}^{*S} \qquad \text{if } \chi^{SU}(q) = 1$$
$$P_{mq}^{*U} = P_{mq}^{*U} + A_{mq}^{*E} \qquad \text{if } \chi^{EU}(q) = 1$$
$$P_{m,q-l_q}^{*S} = P_{m,q-l_q}^{*S} + A_{mq}^{*E} \qquad \text{if } \chi^{ES}(q) = 1$$
where l_q maps the index of the agent after paying the l_k units of adjustment cost.
4. Finally as explained in Moll's example for stopping time (multiple assets with adjustment costs) the diagonal elements with transitions have to be adjusted:
$$P_{mm}^{UU} = \frac{-1}{\Delta} \qquad \text{if } \chi^{US}(m) = 1$$
$$P_{mm}^{SS} = \frac{-1}{\Delta} \qquad \text{if } \chi^{SU}(m) = 1$$
$$P_{mm}^{EE} = \frac{-1}{\Delta} \qquad \text{if } \chi^{EU}(m) = 1 \quad \text{or} \quad \chi^{ES}(m) = 1$$
Moll says: "To see why the ${}^{-1}/_{\Delta}$ term shows up, consider the time-discretized process for g:
$$\dot{g}_t = P^T g_t \longrightarrow g_{t+\Delta t} = (\Delta P + I)^T g_t$$
where I is the identity matrix. The transition matrix $\tilde{P} = \Delta P + I$ needs to have all entries in the adjustment region $\tilde{C}_{mm} = 0$ and hence $\Delta P + I = 0$. Without the adjustment, the matrix P is singular.

The system to solve is:
$$P^T g = 0$$

A simple way to solve the system is to make one of the elements of g to be equal to an arbitrary number, and replace such row of P^T by a row of zeros with a one in the diagonal. Call this matrix $\tilde{P}^T$ and let $\tilde{\imath} = [0, \ldots, 0, 0.1, 0, \ldots, 0]^T$ then solve for:

$$\tilde{g} = \left[\tilde{P}^T\right]^{-1} \tilde{\imath}$$

Normalize $\tilde{g}$ so that it sums to 1: $\tilde{g} = {}^{\tilde{g}}/_{\text{sum}(\tilde{g})}$. Finally define g as:

$$g_i = \frac{\tilde{g}_i}{\Delta a_i}$$

E Additional Reduced Form Analysis

E.1 Workforce composition

Table E.1 shows the composition of the labor force in our sample and contrasts it with the composition of the whole Mexican economy and the U.S. over the period 2005-2019. Our sample behaves in a similar way to the overall Mexican labor force, while the differences between Mexico and the U.S. are apparent, particularly in the share of self-employed individuals.

Labor Status	Our Sample	General Population	U.S.
Worker	69.1%	57.9%	80.7%
Unemployed	4.4%	3.9%	6.3%
Self Employed	26.7%	38.1%	12.9%

Table E.1: Workforce Composition

Note: *The data for the Mexican general population are taken from the world development indicators (WDI). The data for the U.S. are taken from the current population survey (CPS).*

E.2 Mobility across occupations

In what follows we dig deeper into how the labor market status of an individual affects transitions. To do so, we follow the same strategy as Katz and Krueger (2017) in their study of alternative work arrangements in the U.S.. The first question we ask is whether individuals who are unemployed are more likely to transition into self-employed. To answer this we focus on the universe of individuals who are either employed or self-employed in period t, and check whether the transitions to self-employment are larger for those agents who were unemployed in the previous period.

This exercise differs from the conditional transition rates reported in Table 3. The regression in this section allows us to control for the observable characteristics of individuals, comparing transition rates across similar individuals in terms of age, education and location, instead of computing transitions among individuals with the same labor market status (e.g. unemployed). We take this evidence as only suggestive of the mechanisms we study.

Table E.2 reports the regression results. The transition rates of unemployed agents to self-employment are 20.9 percentage points higher than those exhibited by observationally comparable agents who had a salaried job. This result holds after controlling for age, education, and after adding time and city fixed-effects. While we are not able to control for all the relevant factors affecting transitions into self-employment, we interpret the higher transition rate from unemployment as suggestive of the role of self-employment as an outside option for individuals who need an income source, as opposed to self-employment representing entrepreneurial

	(1) SE	(2) SE	(3) SE	(4) SE
U_{t-1}	0.209***	0.209***	0.208***	0.208***
	[0.003]	[0.003]	[0.003]	[0.003]
S_{t-1}	0.717***	0.717***	0.706***	0.706***
	[0.012]	[0.012]	[0.012]	[0.012]
Age			0.002***	0.002***
			[0.000]	[0.000]
Constant	0.080***	0.109***	-0.027	-0.038
	[0.005]	[0.005]	[395.990]	[167.520]
Observations	1033397	1033397	1033397	1033397
Mean Ent	0.285	0.285	0.285	0.285
Schooling Controls	No	No	Yes	Yes
City Fixed Effect	No	No	No	Yes
Time Fixed Effect	No	Yes	Yes	Yes
Weighted	Yes	Yes	Yes	Yes

Table E.2: Transitions to Self-Employment

Note: *The LHS variable is an indicator variable that takes the value of one if the individual is self-employed and zero if the individual is employed. U_{t-1} and S_{t-1} are indicator variables that take the value of 1 if the individual was unemployed or self employed in the previous quarter respectively. Age is the age in years. Standard errors are clustered at the city level. Schooling controls are a set of dummies by education level to control non-parametrically for education. Time fixed effects are at the year-quarter level. The sample consists of individuals who are either employed or self-employed in period t. We run the regressions by weighted OLS. *, **, and ***, denote significance at the 10%, 5%, and 1% level.*

activities for which the individual is better suited (relative to working in a salaried job). Our results align with those of Katz and Krueger (2017) for the U.S.. They find that unemployed individuals are more likely to transition to an alternative work arrangement job than agents who are employed.

The second question we ask is whether individuals who become self-employed transition less to salaried jobs. The effect of self-employment on the transitions into employment matters to determine how persistent the effects of individual occupational choices are, and how policies that affect those choices affect in turn the labor market. To answer this question we focus on the universe of agents who are either unemployed or self-employed in period $t-1$, and follow them to determine whether or not they become employed. As before this allows us to compare the transition rates of self-employed individuals with comparable unemployed individuals.

Table E.3 presents the regression results. We do in fact find that self-employed individuals are 34 percentage points less likely to transition to employment than comparable unemployed individuals. Even if the actual effect of self-employment is not as large, this estimate indicates that opting into self-employment can have long-lasting implications for an individual, particularly for low-productivity self-employed who are now less likely to abandon this state and move to employment. Jackson (2020) finds similar results studying self-employed workers in the United States.

An important caveat for the results in Table E.3 is that we are not controlling for

	(1)	(2)	(3)	(4)	(5)
	E	E	E	E	E
S_{t-1}	-0.268***	-0.268***	-0.255***	-0.254***	-0.340***
	[0.021]	[0.021]	[0.020]	[0.020]	[0.014]
Age			-0.006***	-0.006***	-0.004***
			[0.000]	[0.000]	[0.000]
Second Earner					0.022
					[0.018]
$S_{t-1}\times$ Second Earner					0.024**
					[0.011]
Constant	0.463***	0.417***	0.704***	0.684***	0.589
	[0.015]	[0.014]	[0.103]	[0.111]	[1203.540]
Observations	327250	327250	327250	327250	145945
Mean Emp	0.221	0.221	0.221	0.221	0.221
Schooling Controls	No	No	Yes	Yes	Yes
Time Fixed Effect	No	Yes	Yes	Yes	Yes
Weighted	Yes	Yes	Yes	Yes	Yes

Table E.3: Transitions to Employment

Note: *The LHS variable is an indicator variable that takes the value of one if the individual is employed in period t. S_{t-1} and Second Earner are indicator variables that take the value of 1 if the individual was self-employed and if the individual's couple was an income earner in the previous quarter respectively. Age is the age in years. Standard errors are clustered at the city level. Schooling controls are a set of dummies by education level to control non-parametrically for education. Time fixed effects are at the year-quarter level. The sample consists of individuals who were either unemployed or self-employed in period $t-1$. We run the regressions by weighted OLS. *, **, and ***, denote significance at the 10%, 5%, and 1% level.*

selection into self-employment on the basis of entrepreneurial ability or preference for self-employment. We also lack the full occupational history of individuals, so we cannot condition on the attachment to self-employment of each individual. However, we can partially address some of these shortcomings by focusing on individuals who were unemployed to begin with (in period $t-2$), and who then either remain unemployed or transition to self-employment (in period $t-1$). This lets us compare individuals that start in a common state, and who then differ on whether or not they transition through self-employment. When we perform this analysis the same result emerges, with individuals who become self-employed being 14.4 percentage points less likely to transition to employment in period t. The regression results can be found in Table E.4.

	(1) E	(2) E	(3) E	(4) E	(5) E
S_{t-1}	-0.066***	-0.069***	-0.084***	-0.086***	-0.144***
	[0.014]	[0.014]	[0.017]	[0.017]	[0.050]
Age			-0.009***	-0.009***	-0.007***
			[0.001]	[0.001]	[0.001]
Second Earner					0.035
					[0.057]
$S_{t-1}\times$ Second Earner					-0.024
					[0.058]
Constant	0.383***	0.456***	0.854***	0.863***	1.327***
	[0.017]	[0.064]	[0.226]	[0.228]	[0.075]
Observations	7320	7320	7320	7320	3205
Mean Emp	0.355	0.355	0.355	0.355	0.355
Schooling Controls	No	No	Yes	Yes	Yes
Time Fixed Effect	No	Yes	Yes	Yes	Yes
Weighted	Yes	Yes	Yes	Yes	Yes

Table E.4: Transitions to Employment from Unemployment

Note: *The LHS variable is an indicator variable that takes the value of one if the individual is employed in period t. S_{t-1} and Second Earner are indicator variables that take the value of 1 if the individual was self-employed and if the individual's couple was an income earner in the previous quarter respectively. Age is the age in years. Standard errors are clustered at the city level. Schooling controls are a set of dummies by education level to control non-parametrically for education. Time fixed effects are at the year-quarter level. The sample consists of individuals who were unemployed in period $t-2$, and were not employed in period $t-1$. We run the regressions by weighted OLS. *, **, and ***, denote significance at the 10%, 5%, and 1% level.*

E.3 Constrained agents transition more into self-employment

We now ask whether the transitions to self-employment we observe are consistent with the idea that individuals who are more resource-constrained are more likely to become self-employed. We focus on this mechanism for two main reasons. First, individuals who choose self-employment out of necessity do so based less on their own preferences for self-employment or entrepreneurial ability,[31] and more on the insurance properties of self-employment, producing a larger share of unproductive small enterprises and reducing aggregate productivity (section 2). Second, the decision to become self-employed out of necessity can be influenced by policy more directly than when the decision is dictated by the preferences or ability of the individual.

We use two variables to proxy for access to additional sources of income: the presence of a second earner in the household (as in Chetty (2008)), and the receipt of remittances from relatives living abroad. We compare transitions from unemployment for constrained and unconstrained individuals. Table E.5 show the results. Individuals with additional sources of income transit less into self-employment.[32]

Turning to the results in Table E.5a, we estimate that individuals in a household with a second earner have a 3.2 percentage point higher probability of transitioning to employment and a 3.9 percentage point lower probability of transitioning to self-employment (a 17 percent decrease, from 22.2 to 18.3 percent) than individuals without a second earner. We also test whether the individual's (self-reported) job search activity changes with the presence of a second earner (Table E.6). Most job-search activities (e.g., examining job postings, looking for a temporary job) are not significantly different for individuals with a second earner. Importantly, there is no difference in whether agents report being making plans to start their own business.

The same results are backed by the exercise using remittances as a proxy for the resources of the individual. Individuals who receive remittances in times of unemployment transition at a lower rate to self-employment (10.8 percent vs 18.8 percent, Table E.5b). We also check whether individuals receiving remittances differ on search activities or the intent to start a business. Receiving remittances is associated with a lower likelihood of using the internet to look for a job, and a lower likelihood of of searching for temporary employment; however, it is also associated with a higher likelihood of asking directly for a job (Table E.7). Of course, we cannot rule out other sources of bias as the receipt of remittances is not created by exogenous variation across individuals.

Finally, we repeat the exercise on the transition rates out of self-employment. We find that less-constrained individuals are more likely to transition out of self-employment. Self-employed agents are on average 2.4 percentage points more likely to transition to employment when they are able to rely on a second earner. Unlike less-constrained self-employed, those constrained cannot devote time/effort to search activities that facilitate the transition to a salaried job. We report these results in column 5 of Tables E.3 and E.4.

[31] Hurst and Pugsley (2016) proposed non-pecuniary benefits from self-employment to explain the patterns of self-employment in the U.S. This taste for self-employment complements standard arguments for selection into self-employment based on own-perceptions (correct or not) of entrepreneurial ability, or other idiosyncratic traits like a low job-finding rate.

[32] The results can also be interpreted as indicating that preferences and ability are not the main drivers of the transition to self-employment. If they were, we should observe that people with external income sources transit more to self-employment, as they could enjoy the non-pecuniary benefits of work independence or try their luck at entrepreneurship, while not worrying (as much) about low income levels.

	(1) U→E	(2) U→S	(3) U→U	(4) U→I
Second Earner	0.032***	-0.039**	0.007	-0.000
	[0.010]	[0.018]	[0.015]	[0.000]
Age	-0.008***	0.003***	0.005***	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Constant	0.835***	0.209	-0.044	-0.001
	[0.301]	[0.326]	[0.098]	[0.002]
Observations	8376	8376	8376	8376
Mean Dep. Variable	0.505	0.222	0.272	0.000104
Schooling Controls	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
Weighted	Yes	Yes	Yes	Yes

(a) Second Earner and Transitions from Unemployment

	(1) U→E	(2) U→S	(3) U→U	(4) U→I	(5) U→S
Remittances	0.058	-0.080***	-0.033	0.055	
	[0.053]	[0.021]	[0.040]	[0.037]	
Age	-0.012***	0.002***	0.002**	0.008***	0.001***
	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]
Latent Remittances					-0.045
					[0.036]
Constant	1.237***	0.147	-0.168***	-0.216	0.177
	[0.262]	[0.202]	[0.050]	[0.227]	[0.114]
Observations	8615	8615	8615	8615	25135
Mean Dep. Variable	0.463	0.188	0.256	0.0932	0.188
Schooling Controls	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
Weighted	Yes	Yes	Yes	Yes	Yes

(b) Remittances and Transitions from Unemployment

Table E.5: Transitions from Unemployment

Note: *In both panels, the LHS variable is an indicator variable that takes the value of one if the individual experienced the transition specified in each column. U denotes unemployment, E salaried work, S self-employment, and I inactivity. Second Earner is an indicator variable that takes the value of one if the individual's partner was an income earner in period $t-1$. Remittances is an indicator variable that takes the value of one if the individual reported having received remittances in period $t-1$. Latent Remittances is a dummy equal to one if we observe the individual to ever receive remittances. Standard errors are clustered at the city level. Schooling controls are a set of dummies by education level to control for education in a non parametric manner. Time fixed effects are at the year-quarter level. The sample consists of individuals who were unemployed in period $t-1$. The regressions are run by weighted OLS. *, **, and *** denote significance at the 10%, 5%, and 1% level.*

	(1) Asked	(2) Job Post	(3) Public Ag	(4) Temp	(5) SE Plans	(6) Internet	(7) Newspaper	(8) Need to Work	(9) Age
Second Earner	-0.033	-0.009	-0.006	-0.002	0.002	-0.058***	-0.022	0.000	1.564***
	[0.023]	[0.010]	[0.008]	[0.003]	[0.001]	[0.019]	[0.017]	[0.000]	[0.528]
Constant	0.203***	0.021**	0.020**	0.008***	0.001	0.105***	0.069***	0.000	41.063***
	[0.022]	[0.009]	[0.008]	[0.002]	[0.001]	[0.018]	[0.016]	[.]	[0.497]
Observations	11214	11214	11214	11214	11214	11214	11214	11214	11214

Table E.6: Second Earner and Job-Search Activities

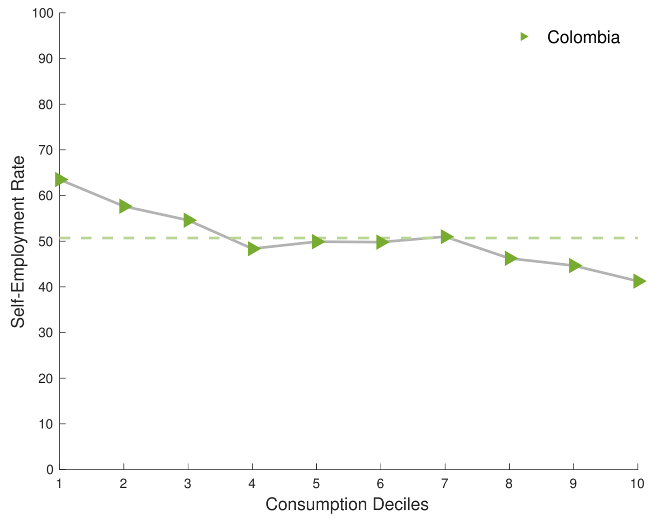
Note: *The LHS variable is an indicator variable that takes the value of one if individual i performed the given activity to search for a job in the previous quarter. The last two columns correspond to weather or not the individual declares to have a need to work, and differences in age. Second Earner is an indicator variable that takes the value of one if the individual's couple was an income earner in period $t-1$. Standard errors are clustered at the city level. All regressions include schooling controls (a set of dummies by education level to control non-parametrically for education), and time fixed effects at the year-quarter level. The sample consists of individuals who were unemployed in period $t-1$. The regressions are run by weighted OLS. *, **, and ***, denote significance at the 10%, 5%, and 1% level.*

	(1) Asked	(2) Job Posting	(3) Public Ag.	(4) Temp	(5) SE Plans	(6) Internet	(7) Newspaper	(8) Need to Work	(9) Age
Remittances	0.183*	0.023	0.004	-0.007***	-0.004**	-0.035***	0.092	0.045	-0.250
	[0.103]	[0.023]	[0.012]	[0.002]	[0.002]	[0.004]	[0.089]	[0.051]	[2.385]
Constant	0.157***	0.007***	0.008***	0.007***	0.004**	0.035***	0.040***	0.043***	43.766***
	[0.007]	[0.002]	[0.002]	[0.002]	[0.002]	[0.004]	[0.004]	[0.004]	[0.212]
Observations	8200	8200	8200	8200	8200	8200	8200	8200	8200

Table E.7: Remittances and Job Search Activities

Note: *The LHS variable is an indicator variable that takes the value of one if individual i performed the given activity to search for a job in the previous quarter. The last two columns correspond to weather or not the individual declares to have a need to work, and differences in age. Remittances is an indicator variable that takes the value of one if the individual reported having received remittances in period $t-1$. Standard errors are clustered at the city level. All regressions include schooling controls (a set of dummies by education level to control non-parametrically for education), and time fixed effects at the year-quarter level. The sample consists of individuals who were unemployed in period $t-1$. The regressions are run by weighted OLS. *, **, and ***, denote significance at the 10%, 5%, and 1% level.*

Figure E.1: SE by Consumption Distribution



Note: *The figure reports the share of the population classified as self-employed for bins of the consumption distribution for Colombia. Each bin corresponds to ten percent of the population. The horizontal dashed lines correspond to the average self-employment rate.*

E.4 Self-employment around the world

In this appendix we reproduce the exercise behind Figure 1b with data from 10 countries around the world We first run a regression of the form $\log(earn_{i,t}) = \alpha + \gamma_t + \beta X_{i,t} + \eta_{i,t}$, where $earn_{i,t}$ corresponds to the earnings of individual i at time t, and X is a vector of individual-level controls. We rank $\hat{\eta}_{i,t}$ and classify them in bins of 2 percent of the sample, then compute the self-employment rate in each bins. In all cases we use harmonized household surveys.

Figure E.2 presents the results. The u-shape relationship between self-employment and earnings with a skewed presence in the bottom of the earnings distribution is common across countries, with the exception of Azerbaijan.

Finally, there is the concern that misreporting of income correlated with occupation is behind this pattern. To address this, we show in Figure E.1 that the same pattern of concentration at the bottom is present when comparing self-employment across the consumption distribution. Self-employment is concentrated among those who consume less.

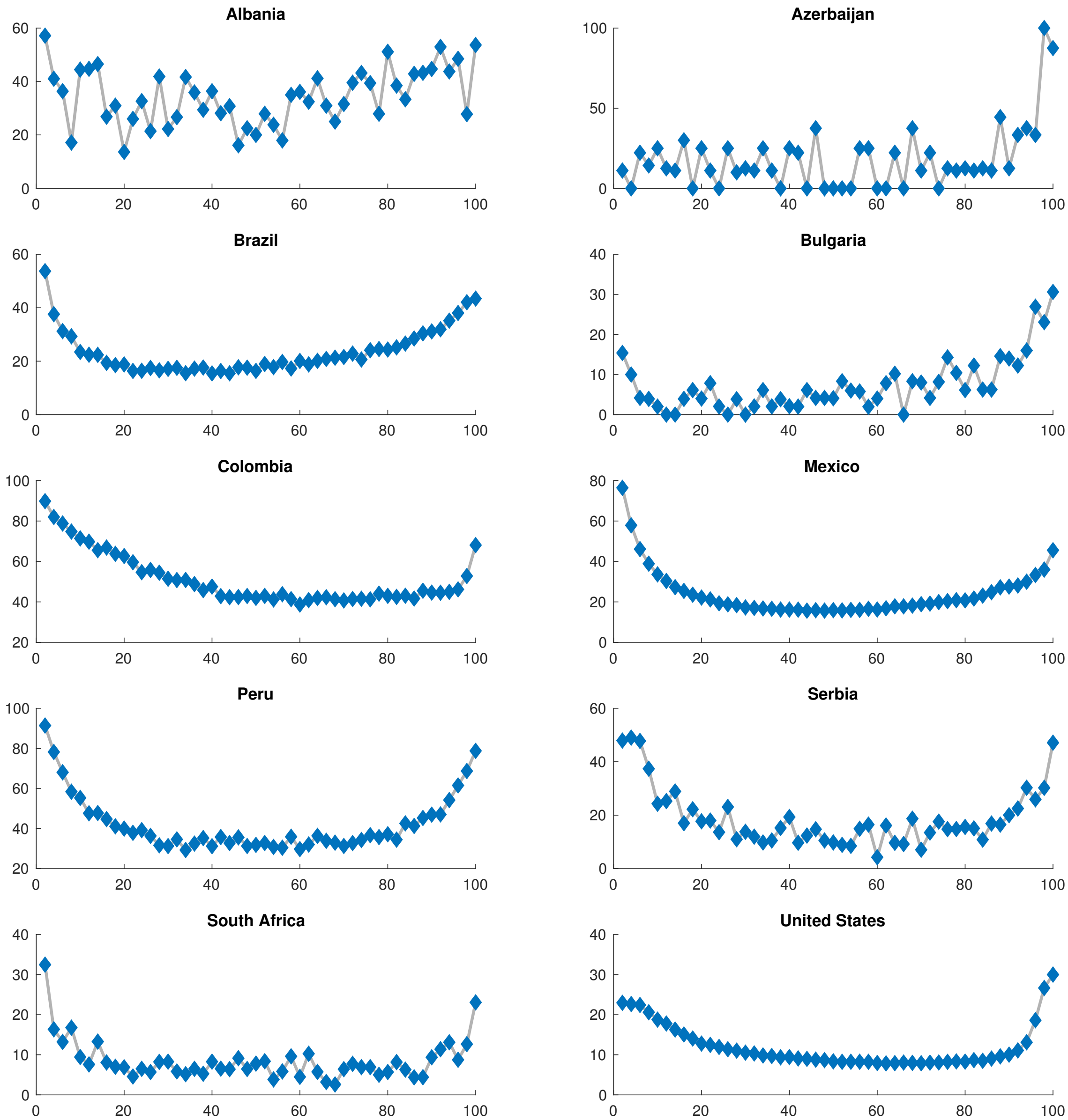


Figure E.2: Self-Employment and Earnings Across Countries

Note: *The figure reports the share of the population classified as self-employed for bins of the earnings distribution for ten countries around the world. Each bin corresponds to two percent of the population. The horizontal dashed lines correspond to the average self-employment rate in each country.*