Journal of Monetary Economics 136 (2023) 91–106

Contents lists available at ScienceDirect

Journal of Monetary Economics

journal homepage: www.elsevier.com/locate/jmoneco

The macroeconomic consequences of subsistence self-employment☆

Juan Herreño[a,1,*], Sergio Ocampo[b,2]

[a] UC San Diego
[b] University of Western Ontario

ARTICLE INFO

Article history:
Received 22 June 2022
Revised 16 February 2023
Accepted 16 February 2023
Available online 20 February 2023

JEL classification:
E44
J25
O11
O16
O17

Keywords:
Self-employment
Unemployment
Development
Micro-finance

ABSTRACT

We evaluate the aggregate effects of expansions of credit supply in environments where subsistence self-employment is prevalent. We extend a standard macro development model to include unemployment risk, which becomes a key driver of selection into self-employment. The model is consistent with the joint distribution of earnings and occupations, the reaction of wages to labor demand shocks, and the small effects of expansions in the supply of microloans on the earnings of the self-employed. We find that the elasticity of aggregate output to expansions in credit supply is proportional to the elasticity of individual earnings. This proportionality arises due to the muted effects of wages in general equilibrium in the presence of subsistence self-employment, and is not present in models without subsistence self-employment due to a larger wage response, and a larger crowding-out of private savings in response to a higher availability of credit.

1. Introduction

Self-employment rates are high in developing countries, particularly among the poor (Gollin, 2008; Poschke, 2013a; 2013b; 2019). The subsistence concerns faced by poor individuals often push them to become self-employed, starting businesses that do not grow and generate little value added (Banerjee and Duflo, 2011). These individuals are referred to as *"subsistence entrepreneurs"* (Schoar, 2010). In this context, policymakers create programs aimed at fostering growth and reducing poverty, for example, introducing credit expansions and conditional and unconditional transfers. Many of these programs target self-employed individuals, changing the incentives to become self-employed, in turn altering their composition.

☆ We thank the editor Yuriy Gorodnichenko and our anonymous referee for their constructive comments and feedback. We also thank Luigi Bocola, Sylvain Catherine, Julieta Caunedo, Kevin Donovan, Andres Drenik, Charles Gottlieb, Fatih Guvenen, Nir Jaimovich, Gueorgui Kambourov, Loukas Karabarbounis, Supreet Kaur, Burhan Kuruscu, David Lagakos, Jennifer La'O, Lance Lochner, Rory McGee, Benjamin Moll, Monica Morlacco, Emily Moschini, Chris Moser, Emi Nakamura, Paolo Piacquadio, Tommaso Porzio, Kjetil Storesletten, Jón Steinsson, Dominic Smith, Thomas Winberry, as well as seminar participants at various institutions for valuable comments and discussions. This work was supported by the Institute for New Economic Thinking. A previous version of this paper circulated under the title "Self-Employment and Development."

* Corresponding author.
E-mail addresses: juanherreno@ucsd.edu (J. Herreño), socampod@uwo.ca (S. Ocampo).
[1] Web: https://sites.google.com/view/juanherreno.
[2] Web: https://sites.google.com/site/sergiocampod.

https://doi.org/10.1016/j.jmoneco.2023.02.002
0304-3932/

Fig. 1. Self-Employment and Earnings. *Note:* The figure shows the joint distribution of income and self-employment for 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 come from household surveys for the developing countries. We report the profile for each individual country in Fig. 3. We accessed the underlying data from every country except Colombia, and Mexico via the Living Standards Measurement Study (LSMS). Data for Colombia is from the national statistical agency (DANE).

We study the aggregate effects of micro credit expansions in contexts where subsistence self-employment is prevalent. Specifically, we compute the elasticity of aggregate output to a shift in the supply of credit to the self-employed. We do so using an occupational choice model with idiosyncratic income risk, financial frictions, and labor frictions that introduce unemployment risk for individuals. In equilibrium, self-employment is chosen by high-productivity individuals but also by poor unemployed individuals who use it as a source of self-insurance. In this way, introducing unemployment risk together with financial frictions allows *subsistence* concerns to dominate the selection into self-employment among the poor. These occupational sorting incentives imply that self-employment rates in the model are highest among the rich and the poor, exhibiting a U-shaped pattern along the earnings distribution as is the case in the data, see Fig. 1 which averages data from nine developing countries and Fig. 3 that shows how the pattern looks for each country.

Our main contribution is showing that the elasticity of aggregate output to increasing credit availability is *proportional* to the elasticity of individual self-employment earnings, linking the aggregate (macro) and micro response of the economy to an increase in lending. To reach this conclusion, we first simulate an expansion of credit availability of the same magnitude as in loans provided by Compartamos Banco in Mexico, studied by Angelucci et al. (2015), and find that our model replicates the micro effects on earnings in the data. Second, we compare the average micro effects with the macro effects of the same reform, concluding that they are proportional.

The reason why the macro and micro elasticities are similar in size is the muted response of wages to the reform we consider. An increase in credit supply allows productive self-employed individuals to expand production, increasing labor demand in the salaried-work sector of the economy. However, individuals in subsistence self-employment are willing to meet this additional labor demand at current wages. Without an increase in wages, self-employed individuals can increase their scale of operation without decreasing their profit share. The consequence is that both individual self-employment earnings and total output increase proportionately. Without subsistence self-employment, wages would increase in order to clear the labor market (as we explain below) and the elasticity of individual self-employment earnings would be lower than the elasticity of aggregate output to the increase in lending.

The small wage response to labor demand shifts in our model is consistent with experimental and quasi-experimental evidence on the presence of slack in labor markets where self-employment is prevalent, as in Breza et al. (2021) and Muralidharan et al. (2022). Our results show that the response of wages to labor demand shocks is an informative cross-sectional moment when determining the strength of the general equilibrium effects of policies.

We also measure the effects of an increase in credit supply on TFP and welfare. TFP increases due to productive individuals disproportionately benefiting from additional credit, reallocating capital and labor into more productive hands. The self-employment rate decreases, as more labor is concentrated in more productive firms. The policy creates small (0.1pp) welfare improvements, measured in consumption equivalent units.

By contrast, in economies without subsistence self-employment, an expansion of credit of similar magnitude would induce larger changes in wages and productivity, and a larger crowding out of private savings, implying a larger elasticity of output to the expansion of credit that is no longer proportional to the micro elasticity of income. On top of these conditional moments, models without subsistence self-employment imply that self-employment is concentrated exclusively among high earners, contrary to the data, see Fig. 1.

These differences reflect the role of subsistence concerns in two key dimensions that shape our results. First, without subsistence concerns, only individuals with a high span of control, those with high productivity, choose to run businesses and demand credit. This implies a counterfactually high elasticity of wages to increases in labor demand because there is no slack in the labor market in the form of subsistence self-employment. It also implies a larger increase of productivity to the expansion of credit as only the highest-productivity individuals become self-employed. Second, without subsistence concerns, individuals hold assets primarily to operate close to their optimal scale as precautionary savings play a smaller role. This explains the stronger crowding out of private savings that ends up reducing the effective expansion of credit.

The model we use to reach these findings incorporates unemployment risk into an occupational choice model in the spirit of Buera et al. (2015). Agents can be employed, self-employed, or unemployed. Employed and self-employed agents are subject to income fluctuations generated by idiosyncratic productivity shocks. Labor income depends on individual labor productivity. Self-employment income depends on productivity and wealth because of financial frictions. 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, which arrives stochastically. We calibrate the model to match workforce composition and income fluctuations from Mexican longitudinal household data.

The model highlights how the interplay between labor and financial frictions impacts the decision of individuals to become self-employed. For a risk-averse individual, unemployment becomes intolerable whenever they have low assets and no effective access to credit. To avoid the risk of failing to find a job, poor individuals choose to self-insure by becoming self-employed even when they lack the productivity or the assets needed to run a profitable business. By contrast, wealthier individuals do not face the same trade-offs because they self-insure by running down their assets while searching for a job. Consequently, wealthy individuals only become self-employed if doing so implies high earnings. The same pattern arises for employed individuals, who trade off current wages against the potential income from operating their own business.

Our model captures non-targeted patterns of self-employment selection and behavior. It matches the U-shaped profile of self-employment rates across the earnings distribution (see Fig. 1), as well as transition rates across occupations and the income auto-correlation of occupation switchers in Mexico. Further, the model matches the micro level response of individual earnings to micro-credit supply expansions (Angelucci et al., 2015) and the response of wages and employment to well-identified labor demand shocks estimated in cross-sectional studies (Breza et al., 2021; Muralidharan et al., 2022), which we reproduce. As Breza et al. (2021) show, the response of wages to labor demand shocks is informative about the underlying slack in the market. As we discussed above, the low response of wages to labor demand shocks implies that there is not much dampening or amplification coming from general equilibrium effects in the labor market. In our setting, this implies that the cross-sectional effects of credit supply expansions closely aggregate-up.

Related literature

Our work is related to a long-standing strand of literature linking productivity and misallocation to entrepreneurship and self-employment (e.g., Banerjee and Moll, 2010; Buera et al., 2015; Hsieh and Klenow, 2009; 2014; Midrigan and Xu, 2014; Restuccia and Rogerson, 2013). We contribute by showing the conceptual and quantitative importance of *subsistence* concerns behind self-employment in driving macroeconomic aggregates and responses to economic policy.[3]

We focus on the aggregate impact of development policies in environments where subsistence entrepreneurship is prevalent. In this sense, our work complements that of Buera et al. (2020), who highlight the importance of general equilibrium channels and longer time horizons when evaluating the effects of credit expansions. Similar to Buera et al. (2020), we use evidence from the evaluation of policy interventions through RCTs to validate our model. We also show how cross-sectional moments, like the prevalence of self-employment along the earnings distribution and the response of wages to labor demand shocks, can be used to validate the model's mechanisms.

Selection into self-employment is at the core of our mechanism. Feng and Jie (2023) study the effects of skill-biased technical change on cross-country differences in the composition of self-employment, under the assumption that different types of self-employed are differentially affected by technical progress, a mechanism that is complementary to the subsistence concerns we highlight. While we abstract from potential differences in technology across self-employed individuals, poorer and less able individuals are more likely to engage in forms of self-employment with lower productivity as own-account employment, emphasizing the effects that subsistence concerns have on productivity and occupational choices.[4]

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) and Feng et al. (2020) show how labor market frictions are central to explain cross-country differences in the workforce's composition. 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. Unemployed individuals are more likely to become self-employed and start smaller and potentially less productive firms as in Galindo da Fonseca (2022).

Finally, our paper adds to a large literature that studies the efficiency of social programs in developing countries where informality is high (Meghir et al., 2015). Our results indicating that unemployment benefits increase productivity align with the positive effects of unemployment benefits extensions found by Gerard and Gonzaga (2021) and Britto (2020) and the work of Acemoglu and Shimer (1999, 2000).

[3] In related studies, Quadrini (2000) and Cagetti and De Nardi (2006, 2009) quantify the extent to which financial frictions distort the scale of firms, while Heathcote et al. (2008) study the welfare effects of insurance and risk.

[4] We also abstract from other margins in which risk shapes selection into self-employment, as those studied in Hombert et al. (2016, 2020), Garcia-Cabo and Madera (2019), and Levine and Rubinstein (2018) while focusing on evaluating the role of labor market risk.

2. Model

In this section we describe a quantitative model with occupational choices in which agents face unemployment risk and financial frictions. Consider a small open economy with a continuum of agents facing an international interest rate $r^{\star}$. Time is continuous and goes on forever. Agents are heterogeneous with respect to their productivity (z), their asset holdings (a), and their occupations. Idiosyncratic productivity is the only exogenous state, and it follows a Poisson process with arrival rate γ^z. Upon arrival, the agent draws a new value for z from a conditional probability distribution $\Pr^z\left(z'|z\right)$.

There are three occupations: employment (E), unemployment (U), and self-employment (S). The occupations differ on whether agents can freely opt into them. Agents can become unemployed or self-employed 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. Formally, job offers follow Poisson processes with arrival rates γ^U for the unemployed and γ^S for the self-employed. Finally, employed agents are subject to job destruction shocks that force them into unemployment. These shocks follow a Poisson process with arrival rate γ^E.

Agents have limited access to credit markets. Employed and unemployed agents face a borrowing limit $\underline{a} \leq 0$. Self-employed agents can borrow capital for production, but they face a collateral constraint so that: $k \leq \lambda a$. This constraint captures information frictions and commitment problems. See Cagetti and De Nardi (2006) and Buera et al. (2011), among others, for microfoundations.

2.1. The agents' problem by occupation

Employment Agents receive an income of $w\epsilon(z)$ while employed, where w is the aggregate wage rate and $\epsilon(z)$ are the agent's effective units of labor, which are a function of their productivity. In practice, we assume that $\epsilon(z) = z^{\eta}$, where η captures the relevance of productivity for the earnings of employed workers.[5] Workers are subject to job destruction shocks with arrival rate γ^E that force them into unemployment and productivity shocks that arrive at a rate γ^z. The value of an employed agent is the solution to the following Hamilton-Jacobi-Bellman (HJB) equation:

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

Additionally, the value of an employed agent must satisfy

$$V^E(a,z) \geq \max\left\{V^U(a,z), V^S(a,z)\right\}, \quad (2)$$

where V^U and V^S are the values of unemployed and self-employed agents, respectively, which we define below in Eqs. (3) and (6). The inequality in (2) captures the occupational choice of an employed agent. Because agents are free to become unemployed or self-employed at any time, the value of agents choosing to remain employed must be at least that of the alternative occupations.

Unemployment Agents receive an income of b and get job offers at rate γ^U while unemployed.[6] We assume that $b < \min_z w^{*}\epsilon(z)$ so that employment is always preferable to unemployment. Unemployed agents also receive productivity shocks that arrive at rate γ^z. The value of an unemployed agent is the solution to the following HJB equation:

$$\rho V^U(a,z) = \max_c u(c) + V_a^U(a,z)\dot{a} + \gamma^U \max\left\{V^E(a,z) - V^U(a,z), 0\right\} + \gamma^z \int \left(V^U\left(a,z'\right) - V^U(a,z)\right) d\Pr^z\left(z'|z\right) \quad (3)$$
$$\text{s.t.} \qquad \dot{a} = b + ra - c, \qquad a \geq \underline{a}.$$

Additionally, the value of an unemployed agent must satisfy

$$V^U(a,z) \geq V^S(a,z). \quad (4)$$

The inequality in (4) captures the occupational choice of an unemployed agent. Because agents are free to become self-employed at any time, the value of agents choosing to remain unemployed must be at least that of being self-employed.

Self-employment Agents engage in the production of final goods that they sell in a competitive market while self-employed. Production combines capital and (efficiency units of) labor through a technology that depends on the agent's productivity:

$$f(z,k,n) = z\left(k^{\alpha} n^{1-\alpha}\right)^{\nu}, \quad (5)$$

[5] Despite there being a single productivity shifter (z), $\text{var}(\log w\epsilon(z)) \neq \eta^2 \text{var}(\log z)$ due to endogenous selection in and out of employment. Using a single shifter is a conservative assumption because it reduces the gains from reallocation across occupations (i.e., no individual is unproductive as self-employed but productive as employed). We explored results with independent labor and entrepreneurial productivity processes, accessible at https://ocamp020.github.io/HO_Self_Employment.pdf.

[6] Unemployment income b can be interpreted as home production or as transfers from family members (intra-household insurance) or government agencies (means-tested programs or unemployment benefits). In Section D of the Supplemental Material we take the latter view and examine what happens if b increases.

where $\alpha \in (0,1)$ and $\nu \leq 1$. In general, agents are prevented from operating at their optimal scale because of the collateral constraint they face. Agents' earnings come from profits $\pi(a,z)$ that depend on their assets and productivity.

Self-employed agents receive job offers at a rate γ^S and productivity shocks at a rate γ^z. They are free to reject job offers and so will only accept them if the value of employment is higher than the value of self-employment given their current state (a,z). The value of a self-employed agent is the solution to the following HJB equation:

$$\rho V^S(a,z) = \max_c u(c) + V_a^S(a,z)\dot{a} + \gamma^S \max\left\{V^E(a,z) - V^S(a,z), 0\right\} + \gamma^z \int \left(V^S\left(a,z'\right) - V^S(a,z)\right) d\Pr^z\left(z'|z\right) \tag{6}$$

$$\text{s.t.} \quad \dot{a} = \pi(a,z) + ra - c, \qquad a \geq \underline{a},$$

$$\pi(a,z) = \max_{k \leq \lambda a,\, n \geq 0} f(z,k,n) - wn - (r+\delta)k.$$

Finally, the value of a self-employed agent must satisfy

$$V^S(a,z) \geq V^U(a,z), \tag{7}$$

which captures the occupational choice of self-employed agents in much the same way as (4) captures the choice of the unemployed.

Self-employed agents operate a common technology. Introducing a menu of technologies and installation costs, as in Midrigan and Xu (2014) or Buera et al. (2011), would only strengthen our results by making low-productivity self-employment more attractive for low-wealth agents, who 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 et al. (2015).

Savings choice. The optimal consumption/savings decision can be found in all occupations from the first-order condition of the agent's problem (see Achdou et al., 2021). Letting $o \in \{E, U, S\}$ denote the agent's occupation,

$$c^o(a,z) = u'^{-1}\left(V_a^o(a,z)\right). \tag{8}$$

Occupational choice. The agents' occupational choices define regions Ω^o in the space of assets and productivity $\mathcal{S} \equiv [\underline{a}, \infty) \times \mathbb{R}_+$ in which each occupation $o \in \{E, U, S\}$ prevails over its alternatives. These regions are characterized by Eqs. (2), (4), or (7), respectively, holding with strict inequalities. For employed agents,

$$\Omega^E = \left\{(a,z) \in \mathcal{S} \,|\, V^E(a,z) > V^S(a,z)\right\}, \tag{9}$$

for unemployed agents,

$$\Omega^U = \left\{(a,z) \in \mathcal{S} \,|\, V^U(a,z) > V^S(a,z)\right\}, \tag{10}$$

and for self-employed agents, $\Omega^S = \mathcal{S} \setminus \Omega^U$.

The shape of the occupational regions Ω^o plays a central role in determining the composition of self-employment, aggregate productivity, output, and wages. We show numerically in Section 4 that Ω^E and Ω^U are characterized by minimum (threshold) values of productivity required for an agent to become self-employed coming from either employment or unemployment. For employed agents, the productivity threshold decreases monotonically with assets, reflecting the fact that self-employment income increases with assets as the collateral constraint loosens. By contrast, for unemployed agents, the productivity threshold is non-monotone in assets. In fact, the minimum productivity required for self-employment tends to zero as the agent's asset holdings decrease toward $\underline{a}$. This is because unemployment becomes intolerable for poor agents who cannot self-insure using their savings. This behavior gives rise to low-productivity self-employed agents who populate the low end of the earnings distribution.

Reforms that affect the availability of credit to the self-employed or insure unemployed agents from having low consumption levels have a direct effect on the minimum productivity required for self-employment. We show in Section 5 that the occupational choices of agents with low assets are highly sensitive to the environment they face. By preventing low-productivity agents from becoming self-employed, it is possible to increase aggregate productivity and output, potentially increasing welfare.

2.2. Labor market

There is a competitive market for the efficiency units of labor. Only employed agents can supply labor. The supply of efficiency units of labor is

$$N^S = \int \epsilon(z) dG^E, \tag{11}$$

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

The demand for labor comes from the production activities of the self-employed. Total labor demand is thus

$$N^D = \int n^\star(a,z) dG^S, \tag{12}$$

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

2.3. Aggregate output and productivity

All output is produced by the self-employed. Thus, aggregate output in the economy is

$$Y \equiv \int z\left(k^{\star}(a,z)^{\alpha} n^{\star}(a,z)^{1-\alpha}\right)^{\nu} dG^S = Z\left(M^S\right)^{1-\nu}\left(K^{\alpha} N^{(1-\alpha)}\right)^{\nu}, \tag{13}$$

with aggregate inputs $K \equiv \int k^{\star}(a,z)dG^S$ and N as in (12). $M^S \equiv \int dG^S$ is the mass of self-employed agents, which plays a role when the production technology in (5) exhibits decreasing returns to scale ($\nu < 1$).

Aggregate (average) productivity or TFP is

$$Z \equiv \left[\frac{1}{M^S}\int \left(z \cdot \frac{1}{\tilde{\tau}(a,z)}\right)^{\frac{1}{1-\nu}} dG^S\right]^{1-\nu}, \tag{14}$$

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.[7] The aggregation procedure is standard and follows Hopenhayn (2014). TFP is affected by changes in the selection into self-employment via changes in the distribution G^S and by changes in financial frictions faced by self-employed agents via the wedges $\tilde{\tau}$. Policies that lead more productive agents to become self-employed, increase the asset holdings of self-employed agents, or loosen collateral constraints increase productivity through their effects on G^S and $\tilde{\tau}$.

2.4. Equilibrium

We focus on the stationary equilibrium of the economy. We describe the computational implementation in Section B of the Supplemental Material. A stationary equilibrium is a set of value functions $\{V^o\}_{o\in\{E,U,S\}}$ along with optimal consumption functions $\{c^o\}_{o\in\{E,U,S\}}$, capital and labor demand from self-employed $\{k^{\star}, n^{\star}\}$, wages $\{w\}$, and a distribution of agents for each occupation $\{G^o\}_{o\in\{E,U,S\}}$ such that, given an international interest rate $r^{\star}$ and exogenous processes for job offers, job destruction, and productivity shocks, the following holds:

1. Value functions $\{V^o\}_{o\in\{E,U,S\}}$ solve the system of HJB variational inequalities:

$$0 = \max\left\{\rho V^E - \max_c u(c) - V^E_a \cdot (w\epsilon(z) + ra - c) - \frac{\mathbb{E}\left[dV^E\right]}{dt}, V^E - V^S\right\}, \tag{15}$$

$$0 = \max\left\{\rho V^U - \max_c u(c) - V^U_a \cdot (b + ra - c) - \frac{\mathbb{E}\left[dV^U\right]}{dt}, V^U - V^S\right\}, \tag{16}$$

$$0 = \max\left\{\rho V^S - \max_c u(c) - V^S_a \cdot (\pi + ra - c) - \frac{\mathbb{E}\left[dV^S\right]}{dt}, V^S - V^U\right\}. \tag{17}$$

   These variational inequalities capture jointly the agent's dynamic problem (Eqs. (1), (3), and (6)) and their occupational choice (Eqs. (2), (4), and (7)).
2. Consumption functions $\{c^o\}_{o\in\{E,U,S\}}$ (and thus asset accumulation) are consistent with the agent's optimization as in Eq. (8).
3. Capital and labor demand $\{k^{\star}, n^{\star}\}$ solve the profit-maximization problem:

$$\{k^{\star}, n^{\star}\} = \underset{k\leq\lambda a,\, n\geq 0}{\operatorname{argmax}}\left\{z\left(k^{\alpha} n^{1-\alpha}\right)^{\nu} - wn - (r+\delta)k\right\}. \tag{18}$$

4. The wage w is such that the labor market clears: $N^S = N^D$, with labor supply as in (11) and labor demand as in (12).
5. The distribution of agents for each occupation $\{G^o\}_{o\in\{E,U,S\}}$, and their densities $\{g^o\}_{o\in\{E,U,S\}}$, solve the following system of Kolmogorov-forward equations:

$$0 = -\frac{\partial}{\partial a}\left[\dot{a}g^E(a,z)\right] - \left(\gamma^E + \gamma^z\right)g^E(a,z) + \gamma^z \int \Pr^z\left(z|z'\right)g^E\left(a,z'\right)dz' + \gamma^U g^U(a,z) + \gamma^S g^S(a,z)\mathbb{1}_{\{(a,z)\in\Omega^E\}} \tag{19}$$

$$0 = -\frac{\partial}{\partial a}\left[\dot{a}g^U(a,z)\right] - \left(\gamma^U + \gamma^z\right)g^U(a,z) + \gamma^z \int \Pr^z\left(z|z'\right)g^U\left(a,z'\right)dz' + \gamma^E g^E(a,z), \tag{20}$$

$$0 = -\frac{\partial}{\partial a}\left[\dot{a}g^S(a,z)\right] - \left(\gamma^S \mathbb{1}_{\{(a,z)\in\Omega^E\}} + \gamma^z\right)g^S(a,z) + \gamma^z \int \Pr^z\left(z|z'\right)g^S\left(a,z'\right)dz' + \gamma^E g^E(a,z)\mathbb{1}_{\{(a,z)\notin\Omega^U\}}, \tag{21}$$

[7] 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).

Table 1
Parameters.

Externally Calibrated Parameters			Internally Calibrated Parameters		
Parameter		Value	Parameter		Value
$r^\star$	International Interest Rate	0.0075	b	Unemployment Income	$w \cdot 10^{-5}$
ρ	Discount Factor	0.0125	γ^E	Job Destruction Arrival Rate	0.20
σ	CRRA Parameter	2	γ^U	Job Offer Arrival Rate – U	0.80
α	Technology – Capital Share	0.3	γ^S	Job Offer Arrival Rate – S	0.50
δ	Capital Depreciation	0.0125	$\overline{\epsilon}$	Labor Efficiency – Base Value	0.10
ν	Technology – Decreasing Returns	0.85	η	Labor Efficiency – Shifter	3.10
λ	Equity Constraint	1.42	$\overline{z}$	Productivity – Base Value	1.00
γ^ϵ	Labor Efficiency – Arrival Rate	1	σ_z	Productivity – Variance	0.12
γ^z	Productivity – Arrival Rate	1	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

where (19) holds for $(a, z) \in \Omega^E$, (20) holds for $(a, z) \in \Omega^U$, and (21) holds for $(a, z) \notin \Omega^U$. Moreover, the distributions $\{G^o\}_{o \in \{E,U,S\}}$ are such that $1 = \int dG^E + \int dG^U + \int dG^S$. Thus, $\int dG^o$ gives the mass of agents in occupation $o \in \{E, U, S\}$. We provide details on the transitions across occupations in the Supplemental Material.

3. Model calibration

We now turn to the calibration of the model. We choose to target data from Mexico, a prominent developing country where self-employment is prevalent and with access to high-quality data on the income and occupational dynamics of individuals. Our main objective is to make the model quantitatively consistent with individuals' occupational choices and the unemployment and labor income risk they face. To that end, we target the occupational mix and volatility of income in the data, providing us with a sensible benchmark from where to test the response of the economy to policy interventions as the ones we describe in Section 5. Further, we show in Section 4 that the mechanisms embedded in the model are successful at capturing the relevant features of the economy as the distribution of self-employment across the income distribution, the response of the economy to labor demand shocks, and the transition across occupations.

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. These high-quality data allow us to explore the workforce composition as well as individual transitions in and out of self-employment.

The data we use to construct the targeted moments come from the *Encuesta Nacional de Ocupación y Empleo* (ENOE), a household survey administered by the National Institute of Statistics and Geography (INEGI) in Mexico.[8] The ENOE includes a rotating panel of responding households who participate in the survey for up to five quarters. We use answers to questions about individual behaviour in our main analysis. We analyze data from 2005.Q1 to 2019.Q4, and we restrict our attention to men aged 23 to 65 who are heads of households and live in one of Mexico's ten largest municipalities.[9] We define as self-employed an individual who reports working in their own business.

We start by defining the parameterization of the productivity process and the discretization of assets. Table 1b presents the values of these parameters.

Productivity process We discretize the process for productivity (z) so that the conditional probability distribution $\Pr^z\left(z'|z\right)$ 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 $\log(z)$, which 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.

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

Table 2
Targeted Moments.

Occupational Rates	Data	Model	Income Moments	Data	Model
Unemployment	4.4	4.1	$\text{std}(y_t^S)$	0.86	0.86
Self-employment	26.7	26.2	$\text{std}(y_t^E)$	0.54	0.58
Employment	69.1	69.7	$\text{corr}(y_t^S, y_{t+1}^S)$	0.59	0.59
			$\text{corr}(y_t^E, y_{t+1}^E)$	0.60	0.58

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.

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

$$a_i = \underline{a} + \left(\frac{i-1}{n_a - 1}\right)^{\eta_a} (\overline{a} - \underline{a}) \quad \text{for } i \in \{1, \ldots, n_a\}. \tag{22}$$

Externally calibrated parameters The discount factor is taken from Moll (2014) to match a 5 percent annual discount rate. We set the interest rate at 3 percent to target a gap to the discount factor of 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 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 and reflect the absence of a safety net in developing countries like Mexico. This assumption is not critical for our results. We provide sensitivity to the value of b in Section C.1 of the Supplemental Material. Table 1a summarizes these choices.

Internally calibrated parameters We jointly choose the values for six parameters, σ_z, ρ_z, γ^U, γ^E, γ^S, and η, to target six 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 those 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, 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. Table 1a reports the values of the parameters, while Table 2 shows the value of the targeted moments in the data and the model. We match all moments closely, including income moments for the employed and self-employed, despite having a single productivity shifter.

One key result of the calibration is that the self-employed have a lower job offer arrival rate (γ^S) compared to that of the unemployed (γ^U). This is consistent with cross-sectional findings by Jackson (2022), who indicate that engaging in gig-economy jobs in the U.S. reduces the rate at which individuals find salaried employment.

Selection and preferences for self-employment We focus on the pecuniary motives behind selection into self-employment in part motivated by the evidence referenced above and evidence for Mexico of potential negative effects of self-employment for individuals who engage in it out of necessity. In Sections E.2 and E.3 of the Supplemental Material, 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 higher intra-household insurance) transition into self-employment less often, even when their self-reported job finding activities are similar to individuals who do not receive remittances and do not have a second earner in their household. We also document that individuals who engage in self-employment transition less into salaried work than unemployed individuals. We take this evidence as suggestive of a limited role of preferences for self-employment for those engaging in subsistence self-employment, who are at the center of our analysis.

4. 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 can match targeted moments (Table 2). Moreover, 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 after well-identified labor demand shocks, transition rates across occupations, and individual-level income changes after an occupation change.

Self-employment across the income distribution The model matches self-employment rates across the income distribution, as in Fig. 1. It produces low-earning self-employed agents in equilibrium, capturing the joint distribution of occupational rates and earnings. Figure 2a plots the self-employment rate for individuals in each decile of the earnings distribution, both in the data and the model.[10]

[10] To compute the data series in Fig. 2a, 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 and 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.

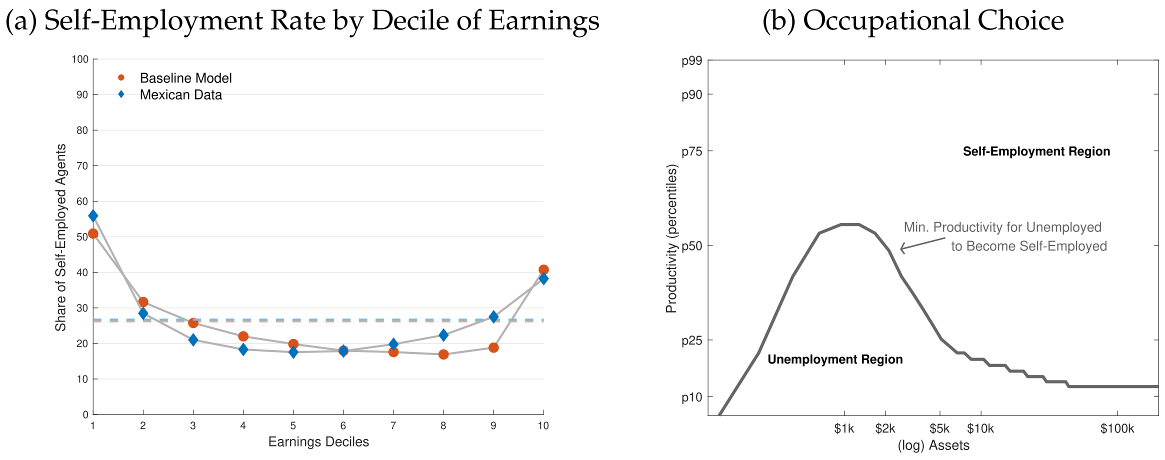

Fig. 2. Model Performance. *Note:* The left panel reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model with unemployment risk, and the blue diamonds show the data equivalent for Mexico. The right panel reports productivity thresholds characterizing the occupational choice of unemployed agents. The line depicts the threshold value of productivity (z) for each level of assets (a). The agent chooses self-employment if their productivity is above the threshold. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The model captures the U-shape of self-employment rates thanks to the selection into self-employment from unemployment. This mechanism is reflected in the non-monotonicity of the minimum (threshold) productivity required to become self-employed (Fig. 2b). The threshold decreases for poor unemployed individuals as they become poorer, so more low-productivity individuals become self-employed.

The U-shape pattern of the self-employment rate across the income distribution is not particular to Mexican data and instead holds across countries, as we show in Fig. 3. Even though the level of self-employment decreases consistently as countries' income rises, see Figure E.1 in the Supplemental Material, self-employment tends to be concentrated in the bottom and top of the earnings distribution within each country.

In Fig. 3, we use data from 9 developing countries and the USA to illustrate the patterns of self-employment rates and income. Our data comes from local statistical agencies, the Living Standards Measurement Study (LSMS) and IPUMS USA (Ruggles et al., 2022). In all cases we use harmonized household surveys.[11] The pattern is clearest among Latin American countries, but it is also visible in European countries and South Africa. The patterns we document are not the result of our focus on working-age men who are heads of households in an average city. We document similar patterns for Mexico and the United states for women, for younger men, across municipalities of different size for Mexico, and for individual states in the United States, see Figures E.3 and E.4 of the Supplemental Material showing robustness to sample restrictions for Mexico and the USA, respectively.

Response to labor demand shocks We next compare the responses of employment and wages to an exogenous increase in labor demand in the model and in cross-sectional data. 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.[12]

The empirical evidence comes from a randomized controlled intervention carried out by Breza et al. (2021) and the implementation of the NREGS, a national job guarantee scheme in India (Muralidharan et al., 2022). Both studies estimate the effects of additional labor demand, offering employment at market wages. Both show that the reaction of wages is small relative to the reaction of employed work. We refer to this as an *"elasticity of wage to labor demand"* caused by a labor demand shock $\left(\Delta\%w/\Delta\%N^d\right)$ lower than one.[13]

To reproduce the response of employment and wages to an increase in labor demand, we modify the model by introducing government demand for labor n^{gov} and then solve for the new market-clearing wage. The total labor demand is

$$N^d = \int n^\star(a,z)dG^S + n^{gov}. \tag{23}$$

Government labor demand amounts to 11.5 percent of the baseline demand for efficiency units of labor, as in the intervention by Breza et al. (2021).

[11] One potential concern is that the extent of misreporting of income is correlated with occupational choices, artificially driving the patterns we document. To address this concern, we show in Figure E.2 of the Supplemental Material 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.

[12] We implicitly assume that local interventions do not change the real interest rate in untreated regions.

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

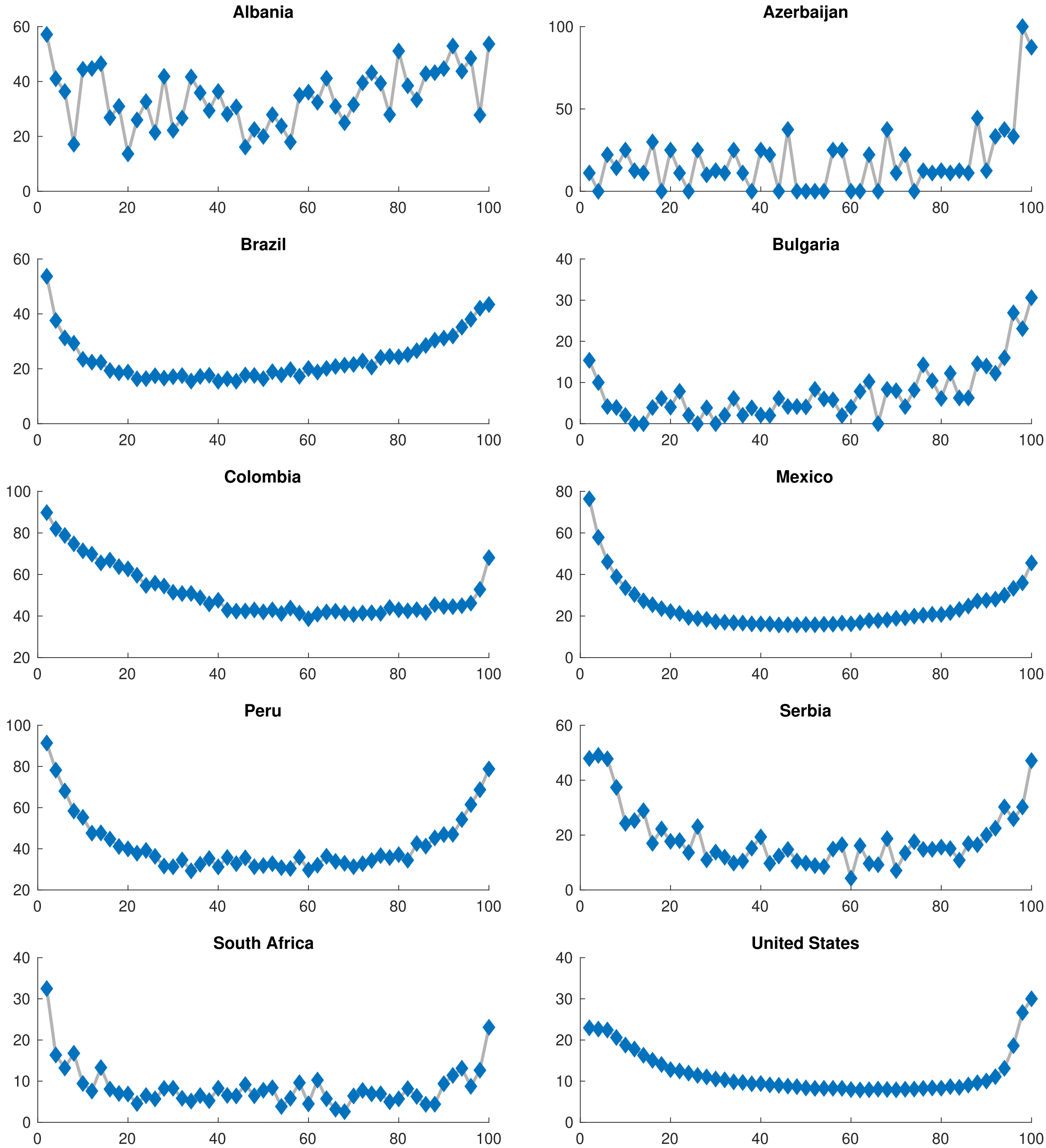

Fig. 3. Self-Employment and Earnings Across Countries. *Note:* The figure reports the share of the population classified as self-employed for bins of the earnings distribution for ten countries around the world. Each bin corresponds to two percent of the population. The horizontal dashed lines correspond to the average self-employment rate in each country. We accessed the underlying data from every country except Colombia, Mexico, and USA via the Living Standards Measurement Study (LSMS). Data for Colombia is from the national statistical agency (DANE) and we accessed data from the USA via IPUMS.

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 et al. (2021) and Muralidharan et al. (2022). As Imbert and Papp (2015) find for the NREGS, 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 unemployment share of the workforce (by 0.3 percentage points). These movements are qualitatively in line with the findings of Breza et al. (2021). The decrease in self-employment comes mostly from the low-productivity self-employed agents (see Figure C.3 in Section C of the Supplemental Material).

Table 3
Untargeted Moments.

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
$\mathrm{corr}(y_t^E, y_{t+1}^S)$	0.43	0.39	$\mathrm{corr}(y_t^S, y_{t+1}^E)$	0.43	0.34

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.

Crucially, the increase in labor demand is not accompanied by a sizable increase in wages. The market wage (per efficiency unit of labor) increases by 0.35 percent, implying an "*elasticity of wage to labor demand*" $\left(\Delta\%w/\Delta\%N^d\right)$ of 0.16. This result is consistent with the experimental evidence referenced above, which establishes a low response of wages relative to increases in labor demand.

These results imply a larger role for labor market slack and a more limited role for preferences driving occupational sorting in the segments of the population we consider. Consistent with Breza et al. (2021), if self-employment was driven by preferences, then attracting self-employed individuals would require a wage premia.[14]

Transition rates between occupations The model does a good job capturing the transition rates between occupations observed in the data, as shown in Table 3. The model predicts that transition rates from unemployment to self-employment are roughly twice as common than transitions from employment to self-employment, in line with causal evidence for Canada in Galindo da Fonseca (2022). 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. We use the method described in Ocampo and Robinson (2022) to avoid imprecise simulations of the model.

All transitions have the right order of magnitude even though none of them were targeted directly in our calibration. However, the model does not capture all transition patterns; it 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 (untargeted) correlation of income for switchers observed in the data. This moment is particularly relevant for the gains following a reallocation of agents across occupations. The model implies slightly lower correlations than the data despite the common productivity shifter for both occupations, which is explained by the role of assets in determining self-employment income. The income auto-correlation of individuals who switch from employment to self-employment is 0.39 versus 0.43 in the data, and the correlation of switchers from self-employment to employment is 0.34 versus 0.43 in the data (Table 3).

5. Credit expansions under subsistence self-employment

We now turn to our main exercise. We show that our model can replicate the elasticity of individual earnings to credit supply coming from an RCT that increased the availability of credit to self-employed individuals in Mexico (Angelucci et al., 2015), even when we do not target these statistics. Then, we use the model to study the effects of the increase in credit on macroeconomic aggregates and welfare. Our exercise provides self-employed agents access to a loan of the same size as the loans in the experimental intervention. We modify the collateral constraint of the self-employed to be

$$k \leq \lambda \cdot a + \phi, \tag{24}$$

and we set the value of ϕ to be consistent with the average size of loans provided by Compartamos Bank, studied in Angelucci et al. (2015), about 540 dollars per quarter.[15]

[14] The results in Breza et al. (2021) imply that the wage premia should be required irrespective of other market conditions if preferences for self-employment played an important role. However, they show that reallocation from self-employment to employment can be done with no pressure on wages during lean seasons, and with high premiums during the months in which labor markets are tight.

[15] This policy is qualitatively different form a reduction in financial frictions as captured by an increase in λ, that would have a limited effect on poor agents because the loosening of the constraint is proportional to asset holdings. We explore the consequences of financial reforms that increase λ in Section C.4 of the Supplemental Material.

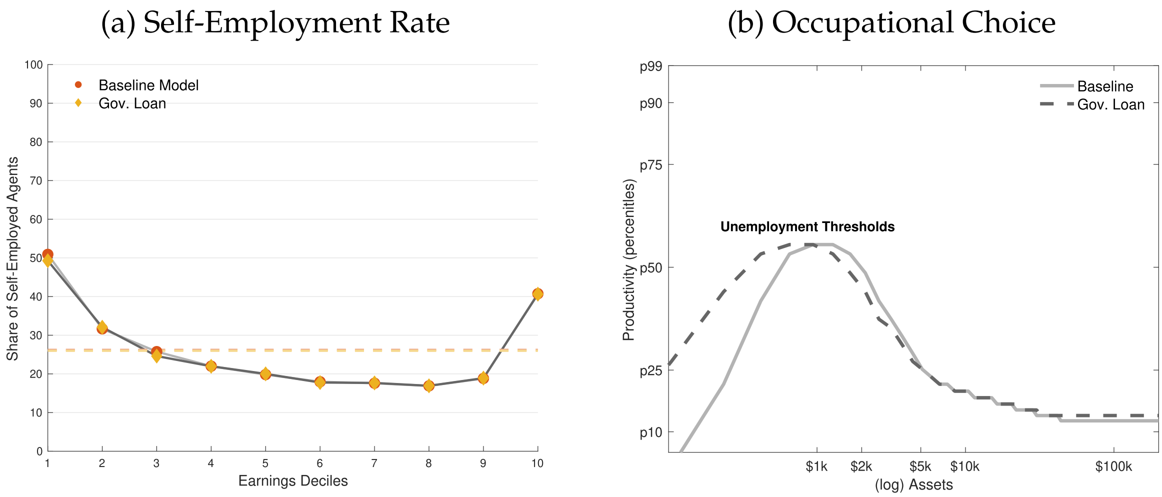

Fig. 4. Model Response to Increase in Credit. *Note:* Panel (a) reports the share of self-employed agents for each decile of the earnings distribution. The red circles correspond to the baseline model, and the yellow squares correspond to the model with expanded credit access in general equilibrium. 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. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 4
Model Response to Increase in Credit.

Variable	Δ	Variable	% Δ	Variable	% Δ
Employment	0.08	TFP	0.15	Output	0.20
Unemployment	0.16	Income(E)	0.04	Consumption	0.02
Self-Employment	-0.24	Income(SE)	0.95	Assets	-0.40

Note: The table presents changes in variables with respect to the baseline model after access to credit was expanded. All numbers are in percentage points.

5.1. Micro effects of increases in credit availability

The policy induces an increase in credit of 20 percent (including funds from the program and private sources). This results in small changes in the distribution of individual-level earnings of the self-employed in the model, with average earnings increasing 0.95 percent. This implies an elasticity of self-employment income to lending of 0.0475.

The average change in self-employment profits is roughly 8 dollars and the change in business revenue is 41 dollars per quarter in general equilibrium, where we allow for adjustment in wages in local economies. In the data, the increase in self-employment profits on the local areas where credit supply was expanded was zero and the increase in business revenue is equal to 55 dollars per quarter.[16] The small magnitude of the effects holds throughout the earnings distribution in both the data and the model. We discuss this further in Section C of the Supplemental Material.

Furthermore, the model predicts small changes in the self-employment rate across the income distribution (Fig. 4a) and small changes in selection into self-employment (Fig. 4b). As a consequence, the response of consumption is small, increasing just 0.02 percent on average. See Table 4. Our results are also consistent with Meager (2019), who finds that after an extension of microcredit, "the impact on household business and consumption variables is unlikely to be transformative and may be negligible" in a meta study of RCTs from seven different countries, and with outcomes reported by Angelucci et al. (2015) on employment income, and several categories of non-durable consumption.

Partial vs General Equilibrium These results also hold in partial equilibrium, where wages do not adjust. The reason is that the wage adjustment in response to the increase in credit supply is small (0.06 percent), in line with evidence from Breza et al. (2021) and the results in Section 4. The small response of wages also implies that the increase in self-employment earnings reported above captures most of the increase in output. The changes in selection are concentrated among poor individuals, raising the productivity threshold at which they engage in self-employment. We will return to these results shortly when we discuss the aggregate effects of the increase in credit availability. We provide more details in Section D.1 of the Supplemental Material.

[16] To reach this number we multiply the effect of 121 pesos every two weeks reported in Angelucci et al. (2015), times 6 to get quarterly numbers, bring 2009 pesos to 2019 using the Mexican CPI, and use the average nominal exchange rate between the Mexican Peso and the US Dollar 19.24 for 2019.

5.2. Macro effects of increases in credit availability

We now turn to the aggregate effects of the increase in credit availability. Table 4 summarizes the results. Output increases by 0.2 percent, driven by changes in composition among the self-employed and increases in their production scale. This implies an elasticity of aggregate output to lending of 0.011. Importantly, the low elasticity of wages (that increase only 0.06 percent) implies that self-employed individuals can increase their scale of operation without decreasing their profit share, so that individual self-employment earnings and total output increase proportionately. Therefore, the individual effects on the self-employed aggregate. Specifically, the elasticity of output with respect to lending is proportional to the elasticity of self-employment earnings (0.0475) times their share in the population (26 percent).

The differential effect of the policy on the occupational choice of low- and high-productivity agents generates a change in the selection into self-employment, which plays a key role in shaping the aggregate effects of the policy. In the aggregate, there is a reallocation away from self-employment, although this effect is small.[17] More credit supply could in principle lead to higher self-employment rates as more individuals may decide to start businesses. However, only the more productive agents can successfully take advantage of the new funds. In fact, there is a reallocation of capital and labor into the hands of more productive agents. The increase in labor demand from more productive self-employed individuals generates a small increase in wages, which reduces the profitability of low-productivity self-employment, in turn triggering the reallocation away from self-employment.

The effects of the policy in favor of high productivity self-employed individuals results in an increase of TFP that drives three fourths of the increase in output. This force is helped by the loosening of their collateral constraints. TFP increases by 0.15 percent, which amounts to an elasticity of TFP to lending of 0.008. These results highlight the importance of the aggregation exercise, showing that the micro effects of the policy aggregate up, leading to positive macro effects in output and productivity. It also showcases the advantages of credit programs in occupational sorting.

Finally, we find that the expansion of credit increases welfare. We measure welfare in consumption equivalent units, defined as the percentage increase in consumption that would make an agent indifferent between our baseline economy (B) and the economy where the policy has been implemented (P). The consumption equivalent welfare measure for an agent in occupation o with a assets and a productivity of z is

$$1 + \mathrm{CE}^{o}(a,z) = \left(\frac{V_P^o(a,z)}{V_B^o(a,z)} \right)^{\frac{1}{1-\sigma}}. \quad (25)$$

The average welfare change in the economy is 0.07 percent. Gains are broad based and are only slightly higher among the unemployed, who gain the equivalent of 0.13 percent of lifetime consumption, on average.

6. Credit expansions without subsistence self-employment

We now unpack the mechanisms behind the response of aggregate output and productivity to an exogenous increase in the supply of micro credit in economies with subsistence self-employment. We do so by contrasting these responses with those of economies without subsistence self-employment.

We consider two economies for this exercise.[18] First, we take an economy without unemployment risk, where workers can instantly switch between wage employment and self-employment with no frictions. However, we maintain the assumption that workers face labor income risk as in Section 2. This assumption is important. Even without unemployment risk, labor income risk gives workers incentives to accumulate precautionary savings, which in turn allow potential self-employed to access more capital by loosening their collateral constraint. To show the role of this assumption, we remove it in the second economy we consider, having all workers earn the same income.

These two economies illustrate the role of two departures of our model with respect to the literature, the presence of unemployment risk, which generate subsistence self-employment, and the presence of labor income risk, that shapes agents' saving incentives. Without them, only individuals with a high span of control (a high z) choose to run businesses as in Buera et al. (2020).

In each of the two economies, we recalibrate the parameters governing the exogenous processes for individual productivity (z) and the arrival of shocks. We target the same measures of labor and entrepreneurial income volatility as in Section 3 whenever possible. We choose to fix the interest rate, preference parameters, the discount factor, the degree of decreasing returns to scale, and the tightness of the collateral constraint with the aim of maintaining comparability between models. However, without unemployment risk, the models predict a concentration of self-employment among high earners, failing to generate a u-shape of self-employment rates across the income distribution, and quantitatively fail at getting the right occupational mix, as shown in Fig. 5.

Table 5 shows the response to the expansion of micro credit across models. The aggregate elasticity of output to the credit expansion is 0.09 in the model without unemployment, over 8 times higher than in our baseline, and 0.06 in the

[17] This effect is consistent with the findings of Angelucci et al. (2015) who report a negative but insignificant point estimate for the share of individuals who have a business.

[18] See Section A of the Supplemental Material for details.

Fig. 5. Self-Employment Rate by Decile of Earnings Across Models. *Note:* The figure reports the share of self-employed agents for each decile of the earnings distribution. The blue diamonds show the data from Mexico. The red circles correspond to the baseline model with unemployment risk. The yellow squares correspond to the model without unemployment risk. The green triangles correspond to the model without labor income risk. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 5
Response to Increase in Credit with and without Subsistence Self-Employment.

	Baseline	No Unemp. Risk	No Labor Inc. Risk
Elasticities			
Output to credit supply	0.011	0.091	0.065
Wage to labor demand	0.16	0.36	2.32
Change in Variables (pp)			
Output	0.20	0.37	0.47
TFP	0.15	0.42	0.10
Wage	0.06	0.54	0.53
Self-employment	-0.24	0.07	0.05
Income (SE)	0.95	-0.38	-0.10
Assets	-0.40	-2.45	-2.14
Lending	20.00	4.03	7.27

Note: The top panel of the table presents the elasticity of output to an increase in the supply of credit of the same magnitude as the one in Section 5 and the elasticity of wages to an increase in labor demand of the same magnitude as the one in Section 4. The bottom panel of the table presents the changes in each variable listed after an increase in the supply of credit. All numbers are in percentage points.

model without labor income risk.[19] The higher elasticities reflect a larger increase in output and a smaller increase in total lending in response to the policy. Both margins illustrate the role of subsistence self-employment in the economy.

The increase in aggregate output is driven by a loosening of borrowing constraints. Without unemployment risk, only the most productive individuals become self-employed and there is no subsistence self-employment. Therefore, there is a larger effect of the expansion of credit on TFP, that goes up 0.42 percent, compared with 0.15 percent in our baseline.

The smaller increase in lending is explained by the crowding out of private assets, which is at least 6 times larger than in our baseline model, as individuals do not have strong precautionary saving motives.[20] In both models total assets fall over 2 percent after the introduction of the policy, while they only fall 0.4 percent in our baseline. The result is an increase in total lending of between 4 and 7 percent, lower than the 20 percent increase reported in the previous section.

The changes in selection into self-employment also affect the response of wages in the economy, making them more elastic to changes in labor demand. The elasticity of wages without unemployment risk is 0.36, more than twice as large as in the baseline, and without labor income risk it is 2.32, a value incompatible with the micro-evidence reported above.[21] The higher responsiveness of wages without subsistence self-employment, together with the crowding out of private assets,

[19] We calculate this elasticity as in Section 5, by computing the ratio of the response of aggregate output to the response of total credit (private and that coming from the credit expansion program).

[20] When workers do not face any income risk, the only reason to accumulate savings is to "grow off the borrowing constraint" and operate at optimal scale, because salary employment provides insurance.

[21] To compute the elasticity of wages we introduce an exogenous public labor demand shock, like the one we introduced in the validation of the model, and compare the change in total labor demand and wages.

breaks the proportionality of the elasticity of output (macro-response) to the elasticity of self-employed earnings (micro-response). In fact, the income of the self-employed decreases on average in response to an increase in credit in economies without subsistence self-employment. This follows from the increase in wages, which is at least 9 times higher than in the baseline, and the decrease in assets.

7. Concluding remarks and discussion of policy design

Self-employment can reflect entrepreneurial drive, leading to innovation and growth. But it can also reflect subsistence concerns. We have shown that the features of self-employment in developing economies are consistent with its role as self-insurance for the poor and that those features are relevant for the evaluation of policy, as they shape the responses of individual and aggregate outcomes. In particular, accounting for the prevalence of subsistence self-employment leads the micro and the macro elasticities of income to credit expansions to be proportional, due to the dampened responses of aggregate savings and wages.

Incorporating labor market frictions alongside financial frictions is critical to correctly capture individual's occupational choices and their incentives to save, as we showed in Sections 4 to 6. Selection into self-employment plays a central role for the response to policy as it determines the productivity of the self-employed, while the risks individuals face induce precautionary savings that are partially supplemented by policies like the expansion of credit. Without labor market frictions an increase in credit availability generates a larger reaction of output as well as a stronger crowing-out of private assets. Together, these effects would have implied an elasticity of output several times larger in the absence of subsistence self-employment than with it.

We conclude by briefly discussing a set of exercises in which we alter the targeting, implementation, and generosity of the policy we studied. First, we consider an alternative policy that takes the interest rate of the credit-expansion to zero, capturing the heterogeneity in interest rates of micro credit expansions around the world (Meager, 2019). Second, we consider the limit where loans become grants targeted at different segments of the population. We focus here on broad messages of these exercises, and provide a more detailed discussion in Section D of the Supplemental Material.

Subsidized loans to the self-employed Reducing the interest rate on loans flips the effects of the credit expansion, reducing TFP (-0.45 percent) and increasing the self-employment rate (0.96 percentage points). It also increases the prevalence of self-employment among the lowest-earners.

Unlike interest-bearing loans, subsidized loans are particularly advantageous to low-productivity individuals who have low rates of return, leading them to leave unemployment and become self-employed. The difference in outcomes coming from a change in the loans' generosity highlights the importance of understanding individuals' occupational choices to correctly evaluate the effects of policy.

Grants Not only the generosity of the policy matters, but also who it targets. To make this point, we make the loans into a grant that unemployed agents can access in each period, similar to targeted transfer policies often used in developing economies (Banerjee et al., 2019). The transfer amounts to 10 percent of the lowest wage among the employed.

The transfers increase TFP by 0.42 percent and decrease the self-employment rate by -0.9 percentage points, reflecting changes in the selection into self-employment. In effect, the transfer provides (partial) insurance, preventing low-productivity individuals from becoming self-employed.[22] These results suggest that safety net programs can play a role in increasing productivity by affecting individuals' occupation choices.[23]

To further illustrate the importance of targeting, we compute responses when the policymaker cannot distinguish unemployed from self-employed individuals, effectively assuming that the institution in charge of implementing the transfers cannot screen these occupations. This assumption flips the results. TFP goes down by -0.32 percent and the self-employment rate goes up by 0.36 percentage points, undoing the positive effects of targeting unemployed individuals exclusively. The reasons once again lie in individuals' occupational choices and saving incentives. Low-productivity individuals take the transfer and engage in self-employment at the same time, lowering productivity. Simultaneously, the transfers crowd out savings, much as in the discussion of Section 6. In this way, changes in policy implementation can do away with the productivity gains, just as in the expansions of credit discussed above.

Data availability

The authors do not have permission to share data.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmoneco.2023.02.002.

[22] We show in the Supplemental Material that the non-monotonicity of the minimum productivity required to become self-employed (Fig. 2b) disappears as transfers to the unemployed are introduced.

[23] Similar mechanisms apply in the context of search frictions, see, i.a. Acemoglu and Shimer (1999, 2000), and Chetty (2008). Providing insurance against production risk may also improve productivity by spurring entrepreneurship. See Robinson (2020) and Hombert et al. (2016, 2020).

References

Acemoglu, D., Shimer, R., 1999. Efficient unemployment insurance. J. Polit. Economy 107 (5), 893–928. doi:10.1086/250084.

Acemoglu, D., Shimer, R., 2000. Productivity gains from unemployment insurance. Eur. Econ. Rev. 44 (7), 1195–1224. doi:10.1016/S0014-2921(00)00035-0.

Achdou, Y., Han, J., Lasry, J.-M., Lions, P.-L., Moll, B., 2021. Income and wealth distribution in macroeconomics: acontinuous-time approach. Rev. Econ. Stud. 0 (0), 1–42. doi:10.1093/restud/rdab002.

Angelucci, M., Karlan, D., Zinman, J., 2015. Microcredit impacts: evidence from a randomized microcredit program placement experiment by compartamos banco. Am. Econ. J. Appl. Econ. 7 (1), 151–182. doi:10.1257/app.20130537.

Banerjee, A., Duflo, E., 2011. Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty. Public Affairs.

Banerjee, A., Niehaus, P., Suri, T., 2019. Universal basic income in the developing world. Annu. Rev. Econom. 11 (1), 959–983. doi:10.1146/annurev-economics-080218-030229.

Banerjee, A.V., Moll, B., 2010. Why does misallocation persist? Am. Econ. J. Macroecon. 2 (1), 189–206. doi:10.1257/mac.2.1.189.

Breza, E., Kaur, S., Shamdasani, Y., 2021. Labor rationing. Am. Econ. Rev. 111 (10), 3184–3224. doi:10.1257/aer.20201385.

Britto, D.G.C., 2020. The employment effects of lump-sum and contingent job insurance policies: evidence from Brazil. Rev. Econ. Stat. 0 (0), 1–45. doi:10.1162/rest_a_00948.

Buera, F.J., Kaboski, J.P., Shin, Y., 2011. Finance and development: a tale of two sectors. Am. Econ. Rev. 101 (5), 1964–2002. doi:10.1257/aer.101.5.1964.

Buera, F.J., Kaboski, J.P., Shin, Y., 2015. Entrepreneurship and financial frictions: amacrodevelopment perspective. Annu. Rev. Econom. 7 (1), 409–436. doi:10.1146/annurev-economics-080614-115348.

Buera, F.J., Kaboski, J.P., Shin, Y., 2020. The macroeconomics of microfinance. Rev. Econ. Stud. 88 (1), 126–161. doi:10.1093/restud/rdaa047.

Cagetti, M., De Nardi, M., 2006. Entrepreneurship, frictions, and wealth. J. Polit. Economy 114 (5), 835–870. doi:10.1086/508032.

Cagetti, M., De Nardi, M., 2009. Estate taxation, entrepreneurship, and wealth. Am. Econ. Rev. 99 (1), 85–111. doi:10.1257/aer.99.1.85.

Chetty, R., 2008. Moral hazard versus liquidity and optimal unemployment insurance. J. Polit. Economy 116 (2), 173–234. doi:10.1086/588585.

Feng, Y., Lagakos, D., Rauch, J.E., 2020. Unemployment and Development. Working Paper 25171. National Bureau of Economic Research doi:10.3386/w25171.

Feng, Y., Jie, R., 2023. Skill bias, financial frictions, and selection into entrepreneurship. Journal of Development Economics 103046.

Galindo da Fonseca, J., 2022. Unemployment, entrepreneurship and firm outcomes. Rev. Econ. Dyn. 45, 322–338. doi:10.1016/j.red.2021.07.003.

Garcia-Cabo, J., Madera, R., 2019. The Self-Employment Option in Rigid Labor Markets: An Empirical Investigation. International Finance Discussion Papers 164. Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/econres/ifdp/files/ifdp1264.pdf

Gerard, F., Gonzaga, G., 2021. Informal labor and the efficiency cost of social programs: evidence from unemployment insurance in Brazil. Am. Econ. J. Econ. Policy 13 (3), 167–206. doi:10.1257/pol.20180072.

Gollin, D., 2008. Nobody's business but my own: self-employment and small enterprise in economic development. J. Monet. Econ. 55 (2), 219–233. doi:10.1016/j.jmoneco.2007.11.003.

Heathcote, J., Storesletten, K., Violante, G.L., 2008. Insurance and opportunities: a welfare analysis of labor market risk. J. Monet. Econ. 55 (3), 501–525. doi:10.1016/j.jmoneco.2008.02.001.

Hombert, J., Schoar, A., Sraer, D., Thesmar, D., 2016. Does unemployment insurance change the selection into entrepreneurship? In: Haltiwanger, J., Hurst, E., Miranda, J., Schoar, A. (Eds.) Measuring Entrepreneurial Businesses: Current Knowledge and Challenges. In: NBER Book Series: Studies in Income and Wealth. University of Chicago Press, pp. 351–369. doi:10.7208/chicago/9780226454108.001.0001. chapter 8

Hombert, J., Schoar, A., Sraer, D., Thesmar, D., 2020. Can unemployment insurance spur entrepreneurial activity? Evidence from France. J. Finance 75 (3), 1247–1285. doi:10.1111/jofi.12880.

Hopenhayn, H.A., 2014. Firms, misallocation, and aggregate productivity: areview. Annu. Rev. Econom. 6 (1), 735–770. doi:10.1146/annurev-economics-082912-110223.

Hsieh, C.-T., Klenow, P.J., 2009. Misallocation and manufacturing TFP in China and India. Q. J. Econ. 124 (4), 1403. doi:10.1162/qjec.2009.124.4.1403.

Hsieh, C.-T., Klenow, P.J., 2014. The life cycle of plants in India and Mexico. Q. J. Econ. 129 (3), 1035. doi:10.1093/qje/qju014.

Imbert, C., Papp, J., 2015. Labor market effects of social programs: evidence from India's employment guarantee. Am. Econ. J. Appl. Econ. 7 (2), 233–263. doi:10.1257/app.20130401.

Itskhoki, O., Moll, B., 2019. Optimal development policies with financial frictions. Econometrica 87 (1), 139–173. doi:10.3982/ECTA13761.

Jackson, E., 2022. Availability of the Gig Economy and Long Run Labor Supply Effects for the Unemployed. SOI Tax Stats Working Paper. Internal Revenue service. https://www.irs.gov/pub/irs-soi/22rpgigeconomylongrunlaborsupply.pdf

Levine, R., Rubinstein, Y., 2018. Selection into Entrepreneurship and Self-Employment. Working Paper 25350. National Bureau of Economic Research doi:10.3386/w25350.

Meager, R., 2019. Understanding the average impact of microcredit expansions: a bayesian hierarchical analysis of seven randomized experiments. Am. Econ. J. Appl. Econ. 11 (1), 57–91. doi:10.1257/app.20170299.

Meghir, C., Narita, R., Robin, J.-M., 2015. Wages and informality in developing countries. Am. Econ. Rev. 105 (4), 1509–1546. doi:10.1257/aer.20121110.

Midrigan, V., Xu, D.Y., 2014. Finance and misallocation: evidence from plant-level data. Am. Econ. Rev. 104 (2), 422–458. doi:10.1257/aer.104.2.422.

Moll, B., 2014. Productivity losses from financial frictions: can self-financing undo capital misallocation? Am. Econ. Rev. 104 (10), 3186–3221. doi:10.1257/aer.104.10.3186.

Muralidharan, K., Niehaus, P., Sukhtankar, S., 2022. General Equilibrium Effects of (Improving) Public Employment Programs: Experimental Evidence from India. forthcoming, Econometrica. National Bureau of Economic Research doi:10.3386/w23838.

Ocampo, S., Robinson, B., 2022. Computing Longitudinal Moments for Heterogeneous Agent Models. Research Report Series 2022-10. University of Western Ontario, Department of Economics. https://ir.lib.uwo.ca/economicsresrpt/852/

Poschke, M., 2013. Entrepreneurs out of necessity: a snapshot. Appl. Econ. Lett. 20 (7), 658–663. https://doi.org/10.1080/13504851.2012.727968

Poschke, M., 2013. Who becomes an entrepreneur? Labor market prospects and occupational choice. J. Econ. Dyn. Control 37 (3), 693–710. doi:10.1016/j.jedc.2012.11.003.

Poschke, M., 2019. Wage Employment, Unemployment and Self-Employment Across Countries. Discussion Paper Series 12367. IZA - Institute of Labor Economics. https://www.iza.org/publications/dp/12367/wage-employment-unemployment-and-self-employment-across-countries

Quadrini, V., 2000. Entrepreneurship, saving, and social mobility. Rev. Econ. Dyn. 3 (1), 1–40. doi:10.1006/redy.1999.0077.

Restuccia, D., Rogerson, R., 2013. Misallocation and productivity. Rev. Econ. Dyn. 16 (1), 1–10. doi:10.1016/j.red.2012.11.003.

Robinson, B., 2020. Risky business: the choice of entrepreneurial risk under incomplete markets. Unpublished Manuscript. https://baxter-robinson.github.io/Robinson_JMP.pdf.

Rouwenhorst, K.G., 1995. Asset pricing implications of equilibrium business cycle models. In: Cooley, T. (Ed.), Frontiers of Business Cycle Research. Princeton University Press. chapter 10, pp. 394–330

Ruggles, S., Flood, S., Goeken, R., Schouweiler, M., Sobek, M., 2022. IPUMS USA: Version 12.0 [dataset]. IPUMS.

Schoar, A., 2010. The divide between subsistence and transformational entrepreneurship. Innov. Policy Economy 10, 57–81. doi:10.1086/605853.