Active Labor Market Policies in General Equilibrium: Crowd-In or Crowd-Out?*

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Abstract

Recent empirical work has shown that high search costs may contribute to the low levels of wage work in many developing countries, but the aggregate effects of job search assistance are unclear. Greatly increasing the number of searchers without an equivalent increase in the number of jobs could lead to substantial crowd-out effects and limit the effectiveness of such policies in promoting employment. Conversely, making it easier for firms to find qualified workers could reduce the cost of hiring and grow the wage sector, crowding in additional workers and accelerating the process of structural transformation. Which effect dominates is crucial in understanding the effectiveness of job search assistance at an aggregate level. I examine this question using a two-sector general equilibrium search model with a frictional wage sector and frictionless traditional sector. The model allows for both crowd-in and crowd-out effects, but neither effect dominates in general. I estimate the key model parameters using the simulated method of moments to match the results of an experiment that provided job search subsidies to job seekers in Ethiopia. Using the estimated model, I evaluate the impact of implementing a job search subsidy for the all households. I find that the crowd-out effect dominates. Ignoring equilibrium adjustment, the percent of households engaging in wage employment increases from 31 to 51 percent; however, after accounting for the adjustment in labor market tightness, wage employment only increases to 38 percent. The welfare gains follow a similar pattern. In partial equilibrium, the policy results in a gain of welfare equivalent to 1.2 percent of consumption which falls to only 0.6 in general equilibrium. These results suggest that job search assistance alone is limited in its ability to move workers into the wage sector and may benefit from being accompanied by policies aimed at increasing the number of jobs posted by firms.

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1. Introduction

It is well established in the development economics literature that the reallocation of labor from self-employment to wage work is a crucial aspect of structural change and economic development. For example, Gollin (2008) documents a substantial cross-country relationship between income and self-employment rates where low-income countries have substantially higher rates of self-employment. Poschke (2019) shows that this relationship continues to hold even when looking at only urban workers, suggesting that it is not merely the result of cross-country differences in agricultural share. Furthermore, while some self-employed individuals may be successful entrepreneurs, there is widespread belief that many of the self-employed in poor countries are unproductive entrepreneurs choosing self-employment out of necessity, sometimes referred to as "subsistence self-employment" (Schoar, 2010; Herreño and Ocampo, 2021). This notion is further reinforced by the fact that a large fraction of self-employed individuals in poor countries report turning to self-employment due to a lack of other employment opportunities (Poschke, 2013).

This observation that there are high levels of self-employment and little wage work has inspired policymakers in developing countries to implement Active Labor Market Policies (ALMPs) aimed at encouraging and assisting workers' participation in the labor market for wage jobs. These policies cover a wide variety of interventions including explicit subsidies for job seekers, free or subsidized vocational training or apprenticeship, job fairs, or algorithm-made matches between workers and jobs. As the popularity of such policies has grown, economists have begun to evaluate their effects experimentally. For example, Abebe, Caria, Fafchamps, Falco, Franklin and Quinn (2021); Caria, Kasy, Quinn, Shami, Teytelboym et al. (2020); and Franklin (2018) evaluate the effects of providing explicit subsidies to job searchers through conditional cash transfers, unconditional cash transfers, and transportation subsidies respectively. These policies are primarily motivated by the observation that many individuals searching for jobs have little to no savings and face fairly high costs of searching for jobs (which is performed in-person in many developing countries). A search subsidy can help overcome this barrier and allow workers to find jobs in the wage sector. Other policies include various vocational training and apprenticeship programs (evaluated in Alfonsi, Bandiera, Bassi, Burgess, Rasul, Sulaiman and Vitali, 2020; Bratti, Ghirelli, Havari and Santangelo, 2018; Bandiera, Bassi, Burgess, Rasul, Sulaiman and Vitali, 2021; Crépon and Premand, 2018) and explicit hiring subsidies (as in Algan, Crépon and Glover, 2020) motivated by the fact that many firms self-report difficulties in finding reliable workers.

In this paper, I evaluate the effects of a particular ALMP, a subsidy for job searchers, in general equilibrium. I build a macroeconomic model of entrepreneurs, workers, and labor search in developing countries. Workers face a choice between engaging in self-employment or participating in the labor market for wage work (as in Herreño and Ocampo, 2021; Poschke, 2019). Workers experience idiosyncratic productivity shocks in self-employment and face incomplete markets in the spirit of Aiyagari (1994), creating an incentive for self-insurance. To participate in the wage sector, workers must first pay a search cost to find a job. Workers face idiosyncratic job-finding risk; paying the search cost may or may not lead to a job at the end of the period. Combined with incomplete markets, this job-finding risk induces workers to ensure that they are sufficiently self-insured before they attempt to search for a job and, if they are unlucky and fail to find one for a few periods, they will return to self-employment. Firms are run by heterogeneously productive entrepreneurs who face a financial friction in the form of a collateral constraint that restricts their choice of capital (as in Itskhoki and Moll, 2019; Buera, Kaboski and Shin, 2021). To overcome this friction, entrepreneurs accumulate collateral by reinvesting a portion of their profits each period, allowing them to continue to grow. Entrepreneurs hire workers in the frictional labor market by posting costly vacancies. Paying vacancy costs reduces entrepreneur profits and thus reduces their ability to grow through reinvestment each period.

The justification for job search subsidies is immediately apparent. Although wage work is, on average, more productive than self-employment, workers are unable to insure against job-finding risk and, as a result, poor workers will opt for the safety of self-employment, despite the fact that it is less productive. A job search subsidy can encourage participation in the labor market and provide insurance against the risk that an individual may not find a job. However, I identify two key general equilibrium channels that served to dampen and enhance the impact of the subsidy respectively. The first channel, which I refer to as the crowd-out effect, is that as workers move out of self-employment and into wage work, the labor market slackens, reducing the probability that any individual searcher will find a job at the end of the period, heightening the risk of participating in the market for wage labor. This mechanism is ubiquitous in labor search models and, in the context of my model, drives some individuals who would have searched for wage work absent this heightened risk to self-employment, shrinking the wage sector.

The second channel, which I refer to as the crowd-in effect, reflects the fact that the difficulty of matching with qualified workers may act as a substantial constraint to growth for entrepreneurs. As the subsidy moves workers into the wage sector, entrepreneurs spend less on hiring costs and grow faster. This reduction in hiring costs is more substantial for highly productive entrepreneurs who want to rapidly expand their firms and thus induces more productive entrepreneurs to grow faster than less productive entrepreneurs, increasing TFP and wages. As average earnings in the wage sector increase, additional workers are induced to move from self-employment to wage work.

I estimate the model using the simulated method of moments to match the results of an experiment in Addis Ababa, Ethiopia performed by Abebe et al. (2021). The experiment offered cash subsidies to job seekers in the city center and was designed to operate as a conditional cash transfer; that is, treated individuals only received the subsidy if they spent the day looking for work. I estimate the model to match the observed increase in search behavior and wage employment as a result of the subsidy as well as some data moments from the control arm of the experiment, such as the average savings held by job searchers and the average job-finding rate. In addition to data from this experiment, I also estimate the model to match typical macro aggregates for Ethiopia as well as firm-level moments calculated using the World Bank Enterprise Survey for Addis Ababa.

Using the estimated model, I evaluate the effects of implementing an economy-wide labor search subsidy funded by a tax on wage workers. Overall, I find that the policy is successful in moving workers out of the traditional sector; however, the crowd-out effect dominates and substantially limits the policy's effectiveness. Participation in the wage sector increases modestly from 34 percent to 39 percent as a result of the subsidy; however, the policy exhibits substantial crowding out. Fixing labor market tightness, and thus shutting down the crowd-in and crowd-out channels, suggests that the policy should increase wage sector participation to 50 percent in the absence of both effects. The large difference between these two results is evidence that the crowd-out effect dominates quantitatively, mostly arising from the fact that households' job search behavior changes strongly in response to changes in their probability of finding a job.

Despite substantial crowding out, the policy still increases average welfare by about 0.6 percent of consumption. When labor market tightness is fixed, welfare increases by 1.2 percent of consumption, suggesting that the net impact of the crowd-out and crowd-in effects is to reduce the welfare gains of the policy by about half. Rather than a large expansion of the wage sector, the welfare gains arise largely from the fact that the subsidy improves insurance by taking resources from the state of the world in which workers are employed and transferring them to the state in which workers are unemployed, which is highly valued by workers. The gains accrue entirely to the unemployed while the employed, who pay the tax required to fund the subsidy, suffer welfare losses of about 1 percent of consumption. Surprisingly, the gains and losses exhibit no substantial pattern with respect to household wealth; poor and rich households both gain (or lose) equally from the policy. Separating the welfare gains into the direct effects of the subsidy and the indirect effects due to higher taxes, crowd-in, and crowd-out does, however, reveal patterns in wealth. In particular, wealthier households benefit more from the direct effects of the subsidy as they are the most likely to be able to fund long periods of job search and collect the subsidy. But wealthier households also experience the largest welfare losses due to the dominance of the crowd-out effects and higher taxes, as they are the most likely to be engaged in wage work where they suffer from both effects. The net result is that changes in welfare are roughly equal for households of all levels of wealth.

1.1. Related Literature

Methodologically, this paper is closely related to the macroeconomic development literature studying the interactions of workers and entrepreneurs in developing countries. The model builds on Itskhoki and Moll (2019) who study optimal Ramsey policies in a model with credit-constrained entrepreneurs and households and find that optimal policy begins by subsidizing entrepreneurship at the expense of workers to encourage growth. Buera, Kaboski and Shin (2011) show that the allocation of capital across entrepreneurs is a key determinant of productivity, a channel also present in this paper and responsible for driving the crowd-in effect through higher wages. Buera, Kaboski and Shin (2021) study the macroeconomic effects of microloans in a model of heterogeneous agents and endogenous selection into entrepreneurship.

This paper also builds on work that distinguishes between subsistence self-employment and entrepreneurship in the developing world. Feng and Ren (2021) document stark differences between the self-employed with and without employees (referred to as own-account workers and employers respectively) and show that employers' labor share is increasing in GDP while own-account work declines as GDP rises, consistent with the ALMP's goal of moving own-account workers into the wage sector. The model is closely related to the model of Herreño and Ocampo (2021) who study the macroeconomics effects of microloans and cash transfers in a heterogeneous agent model in which poor agents use less productive self-employment to cope with the risks of wage employment (as in this paper). Donovan, Lu and Schoellman (2020) construct detailed measures of worker flows between employment, unemployment, and self-employment for countries of various incomes and show that, in developing countries, self-employment and unemployment exhibit similar flows to employment and that self-employment does not help workers climb the job ladder. These results are consistent with the idea that self-employment in developing countries largely exists as a subsistence activity.

This paper contributes to a recent literature documenting and examining the macroeconomic effects of labor search frictions across the cross-country income distribution. Feng, Lagakos and Rauch (2018) document that overall unemployment rates are increasing in GDP per capita and show that skill-biased productivity differences can explain a large fraction of the observed variation in a model with frictional labor markets and frictionless self-employment. I expand on their model by adding risk-averse households and financially-constrained entrepreneurs. Poschke (2019) shows that urban unemployment is substantially higher in developing countries and builds a model in which cross-country variation in search frictions can jointly explain cross-country variation in self-employment and urban unemployment rates, consistent with this paper's finding that individuals self-employment decisions respond strongly to changes in job-finding probabilities. In a similar vein, Banerjee, Basu and Keller (2021) find that skilled workers in developing countries exhibit higher unemployment rates, relative to unskilled workers, than in developed countries and show that this difference leads to differences in occupational choice. Finally, Porzio, Rossi and Santangelo (2021) use a model with frictional reallocation of labor from (self-employment dominated) agriculture to (wage work dominated) non-agriculture to quantify the importance of human capital in explaining the process of structural change.

This paper studies the effects of Active Labor Market Policies in general equilibrium and is thus closely related the empirical literature evaluating the effects of these policies. Abebe et al. (2021) and Franklin (2018) both study the effects of cash transfers to job searchers in extremely similar experiments and find that these subsidies increase search behavior and an individual's probability of being employed in a permanent, formal job after 16 weeks. Interesting, while they find substantial effects on job amenities and self-report job satisfaction, they find no significant effect on earnings. The results and data from these experiments play an important role in the quantitative discipline of this paper's model.

Algan et al. (2020) randomize a government program in France aimed at reducing recruitment and vacancy posting costs for firms and find that the program successfully increased vacancy posted and hirings. Similarly, De Mel, McKenzie and Woodruff (2019) find that wage subsidies effectively increase employment among microenterprises in Sri Lanka but that the impacts of the subsidy are fleeting and employment quickly returns to normal when the subsidy is removed. Alfonsi et al. (2020) evaluate the impact of free training programs, provided either directly to workers for free or provided through firms and subsidized by the experiment. Although this is less directly related to my results as there is no concept of training in the model, it is still an important experimental evaluation of ALMPs and sheds light on a main constraint preventing workers from finding wage sector employment, namely that they lack a credible mechanism through which to signal their abilities.

2. Model

The model features many properties that are characteristic of labor markets in the developing world while remaining computationally tractable. Time is discrete. Because my primary source of data is collected at a weekly frequency, I conceptualize one model period as one week. There is measure one of households and an endogenous measure of entrepreneurs. Households consume, save, and choose between working in self-employment or participating in the labor market while entrepreneurs operate firms, consume profits, and accumulate capital and labor for future periods.

Households are ex-ante homogeneous but face idiosyncratic shocks and incomplete markets. As a result, they accumulate assets for self-insurance (as in Aiyagari, 1994). In any period, an unemployed household must pick between self-employment, which they can participate in costlessly, or paying a cost to search for a permanent wage job. Job search is risky, and only households with sufficient self-insurance will opt to search. Employed households can choose between working at their job in the wage sector or self-employment (in equilibrium they will always choose to work at their wage job).

Entrepreneurs are ex-ante heterogeneous in ability but are financially constrained and must accumulate assets to use as collateral in renting capital. Each period, entrepreneurs earn profits and split these profits between consumption, hiring workers, and financing capital for the next period. Entrepreneurs face no idiosyncratic risk other than an exogenous death rate which ensures that the model has a steady-state in which collateral constraints are binding.

2.1. Labor Markets

The labor market for wage work exhibits typical search-and-matching frictions. Households must search for jobs and entrepreneurs must hire by posting vacancies. The cost of searching for a job and the cost of posting a vacancy are denoted by b and c respectively. Each period, the number of worker-firm matches is given by a homogeneous of degree 1 matching function $m(u,v)$ where u is the number of households searching for a job and v is the number of vacancies posted by firms. As is standard in search-and-matching models, I define $\theta = \frac{v}{u}$ to be labor market tightness. Then $p(\theta) \equiv m(\frac{1}{\theta}, 1) = \frac{m(u,v)}{v}$ is the probability that any vacancy is filled and $\theta p(\theta) = \frac{m(u,v)}{u}$ is the probability that any searcher finds a job. Matches between workers and firms are separated with exogenous probability λ at the end of every period.

2.2. Households

There exists a unit measure of infinitely-lived households. Households are ex-post heterogeneous due to their realizations of idiosyncratic shocks and are indexed by their wealth a, their employment status e, and their self-employment productivity z. Households are endowed with one unit of time each period which they supply inelastically and indivisibly to their activity of choice each period. Households gain utility from consumption according to a CRRA utility function and discount the future at rate β so that household lifetime utility is given by

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma}}{1-\sigma}$$

where σ is a parameter governing the risk aversion and intertemporal elasticity of substitution of households.

Households can spend their time either working for a wage, searching for work, or engaging in self-employment. Importantly, each unit of time is indivisible; a household must commit its entire time endowment to a single activity each period.[1] Any household can engage in self-employment, but to work in the wage sector, a household must first search for and match with a job. A household's self-employment productivity y follows an exogenous Markov process described by transition matrix M. For expositional clarity, I assume that self-employment productivity takes a binary form with only a low and high value , y_l and y_h respectively, but more states can be easily accommodated. A household engaging in self-employment earns w_S per unit of productivity; I normalize w_S to one so that a household's earnings from self-employment are given by y.

Instead of engaging in self-employment, a household can choose to pay a search cost b and search for a wage job. A searching household earns nothing in the current period and finds a permanent job with probability $\theta p(\theta)$. Labor market tightness θ is an equilibrium object and depends on the aggregate state X. Wages in the wage sector are determined through bargaining and depend on the state variables of the entrepreneur employing the household as well as the household's earnings in the traditional sector which serves as the household's outside option. For notational simplicity, I suppress much of this dependence and write the permanent sector wage function as $w_t(z)$, depending only on the matched entrepreneurs productivity z, which the household takes as given each period. I will show in a later section that, although all entrepreneurs state variables appear in the bargaining problem, all entrepreneur-household pairs end up bargaining an identical wage conditional on entrepreneur productivity z, justifying this suppression of notation.

Insurance markets are incomplete, and households cannot insure themselves against idiosyncratic shocks; however, households can accumulate assets a as self-insurance. Each period, assets pay an exogenous rate of return $R \geq 1$ which does not vary over time. Households cannot borrow and must satisfy the restriction $a_t \geq 0 \forall t$. The budget constraint for the household can be written

$$a_{t+1} + c_t = Ra_t + (1-s_t)y_t + s_t(e_t w_t(z_t) - (1-e_t)b) \tag{1}$$

where $s_t \in \{0,1\}$ is a choice variable for the household with $s_t = 1$ representing the decision to search in period t and $e_t \in \{0,1\}$ is an indicator variable with $e_t = 1$ indicating that the household has a permanent job in period t.

A household employed in the wage sector can lose it's job for three reasons. First, the match between the household and firm separates with exogenous probability λ at the end of every period. Second, the entrepreneur employing

[1] This assumption can be justified by the fact that this model is designed to be calibrated to a weekly frequency. Within a week, the returns to job search can exhibit increasing returns to scale. For example, the time and effort it takes to prepare a CV is a fixed cost regardless of how many jobs one applies for.

the household can die at the end of the period with probability $(1-\xi)$. Finally, the entrepreneur can endogenously choose to downsize its labor force. The probability of a household being downsized μ is a function of the state variables of the entrepreneur employing the household as well as aggregate state variables. I will show later that entrepreneurs will never choose to downsize households in steady-state so that $\mu = 0$ in the steady-state equilibrium of the model (although entrepreneurs may choose to downsize along the transition path between two steady-states under certain conditions, to be described later). I define the total probability of a household keeping its job each period as $\lambda^* = (1-\lambda)\xi(1-\mu)$, suppress the dependence of μ on various state variables.

Taking all of the above, the household's problem can be written recursively as

$$
\begin{aligned}
V(a,y,e,Z;X) = & \max_{c,a',s\in\{0,1\}} \frac{c^{1-\sigma}}{1-\sigma} + \beta E_{z',e'}[V(a',y',e',Z';X')|y,e,s] \\
s.t.\ a'+c = & Ra + (1-s)y + s(ew(z)-(1-e)b) \\
X' = & G(X) \\
y' \sim & M(y) \\
e',Z' \sim & \text{As described above}
\end{aligned}
\tag{2}
$$

where X is a vector of aggregate state variables (to be described later) and G is the household's perception function for the evolution of the aggregate state. Z is a vector containing the state variables of the entrepreneur that the household is matched with or a vector of zeros if the household has no match and is included for technical reasons. As mentioned above, I will show that although the full vector of state variables may be important in some contexts, for the purposes of this paper, the household problem will only depend on the matches entrepreneurs productivity z.

2.3. Entrepreneurs

There is an exogenous measure M of entrepreneurs born each period and, at the end of a period, entrepreneurs die with probability Δ. Entrepreneurs are born with idiosyncratic ability z drawn from a distribution described by pdf $h(z)$ and some starting level of financial wealth $\underline{f}$. They discount the future at rate β (the same rate as households), face an exogenous death probability Δ each period, and wish to maximize the following preferences over their consumption (labeled d_t for "dividends")

$$\sum_{t=0}^{\infty} (\beta\Delta)^t \log(d_t)$$

An entrepreneur with idiosyncratic ability z operates a production technology that takes capital k and labor n and produces output y according a Cobb-Douglas production function:

$$y_t = z k_t^{\alpha} n_t^{1-\alpha} \tag{3}$$

The entrepreneur rents capital from an international capital market at an exogenous rental cost $(r+\delta)$ that does not vary over time and pays workers at a wage w_t determined by bargaining. Similar to the previous section, I suppress the dependence of the wage on household and entrepreneur state variables, justified by the fact that the entrepreneur will end up bargaining the same wage with all paired households.

The entrepreneur is constrained in her choice of both k_t and n_t. In particular, the entrepreneur must provide her own assets f as collateral in order to rent capital. Thus k must satisfy the inequality

$$k_t \leq \gamma f_t \tag{4}$$

where $\gamma \geq 1$ is a parameter summarizing the degree of financial market frictions. The case where γ is equal to one corresponds to an economy where there are no financial markets and entrepreneurs must entirely self-finance. As γ goes to infinity, we approach the case with no financial frictions. I take this collateral constraint as exogenous, but it can be thought of as arising from unenforceability of contracts or other institutional features that make uncollateralized lending risky.

To hire labor and adjust n_t, the entrepreneur must post vacancies v_t. Each vacancy costs c units of output to post and is filled at the end of the period with probability $p(\theta)$. In addition, the exogenous separation rate means that the entrepreneur is separated from a proportion λ of her workforce each period. Thus the evolution of n_t is dictated by the equation

$$n_{t+1} = (1-\lambda)n_t + p(\theta)v_t \tag{5}$$

An entrepreneur's period profits are given by

$$\pi_t(z,k_t,n_t) = zk_t^{\alpha}n_t^{1-\alpha} - (r+\delta)k_t - w_t n_t \tag{6}$$

Due to the constraints on the choices of k_t and n_t, an entrepreneur will earn positive profits each period and splits her profits between consumption, posting vacancies, and accumulating additional collateral f_{t+1}. The entrepreneur's period budget constraint is

$$d_t + f_{t+1} = \pi_t(z,k_t,n_t) + f_t - cv_t \tag{7}$$

Taking the preferences and combining equations (3)-(7), the problem of the entrepreneur can be written recursively as

$$\begin{aligned}
V(z,f,n;X) = &\max_{f',n',k,v,d} \log(d) + \beta\Delta V(z,f',n';X)\\
s.t.\ d+f' =& zk^{\alpha}n^{1-\alpha} - (r+\delta)k - wn + f - cv\\
n' =& (1-\lambda)n + p(\theta)v\\
k \leq& \gamma f\\
v \geq& 0\\
X' =& H(X)
\end{aligned}$$

where f is a vector of probability density functions summarizing the aggregate distributions of entrepreneurs and households in the economy and H is the perception function of entrepreneurs.

2.4. Wage Bargaining

Each period, entrepreneurs and workers bargain over wages. Because capital acts as a fixed factor of production (it is easy to show that an entrepreneur's collateral constraint will always be binding in equilibrium), an entrepreneur's output exhibit decreasing returns to scale in labor. I follow Smith (1999) and, more recently, Acemoglu and Hawkins (2014) and model production as a cooperative game between workers and entrepreneurs in which each agent is paid their Shapley value.

The entrepreneur enters the game with capital k and workforce n. Any worker that chooses not to cooperate will instead engage in self-employment for the period and then return to the bargaining table the next period. That is, the outside option for the worker takes the form of a temporary strike in which the match between worker and firm is preserved rather than the termination of the match. To simplify the problem, I assume that the period self-employment productivity of an uncooperative worker is drawn from an independent distribution and does not depend on the worker's productivity state. In particular, the worker has probability p of having high productivity and $(1-p)$ of having low productivity so that expected self-employment earnings are given by $py_l + (1-p)y_h$ denoted $\underline{w}$ for simplicity. This simplifies computation of the problem as it allows the productivity of every uncooperative worker to be known a priori, eliminating any potential dependence of the game on aggregate state variables such as the cross-sectional distribution of workers over productivity states and employment.

If the entrepreneur and x of the n workers form a coalition, they operate the entrepreneur's production technology and produce $zk^{\alpha}x^{1-\alpha}$. The remaining $(n-x)$ workers form their own coalition and produce $(n-x)\underline{w}$. Each agent is paid their Shapley value arising from this game, so that the wage per worker is given by

$$w = \chi z k^{\alpha} n^{-\alpha} + (1-\chi)\underline{w} \tag{8}$$

where χ is a parameter governing the bargaining power of the entrepreneur relative to workers. This wage determination equation is intuitive. The workers are simply paid some linear combination of their marginal labor product and their outside option, where the weight on each is determined by bargaining power.

2.5. Characterizing Equilibrium

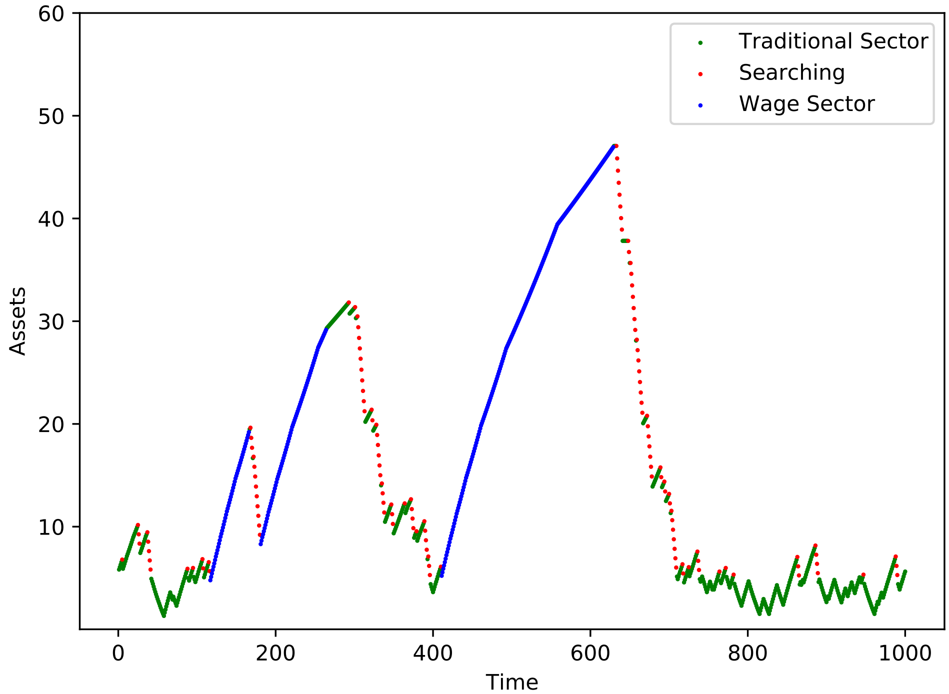
The model has many moving parts and is somewhat complicated to write down, but households and entrepreneur behavior exhibits some intuitive properties given the environment they are facing. Here I give a brief characterization of the equilibrium behavior of both agents. Because very little analytical progress can be made on the household problem, I provide an intuitive description of household behavior and some quantitative simulations demonstrating the household dynamics. I also provide some analytic results from the entrepreneur problem that make clear the role of entrepreneurs in contributing to crowd-in and crowd-out effects.

2.5.1. Household Equilibrium Behavior

Because of credit constraints, households in the model face a stark trade-off between the lower risk of self-employment and the higher earnings of participating in the wage sector. As a result, only households who are sufficiently self-insured will opt to search for wage work while households without much self-insurance will enjoy the safety of self-employment. But households looking for wage work must pay a search cost which quickly diminishes their savings and reduces their self-insurance, driving them to self-employment to recoup the lost search costs. The result is that households near the threshold of self-insurance spend a few periods working in self-employment and accumulating assets, then switch to searching for a wage job for a few periods, and return to self-employment once their savings have been depleted.

Figure 1 displays an example of this behavior for a single household simulated for 1000 periods (about 20 years). Time, denoted in model periods which correspond to one week, is on the x-axis while the household's stock of assets in any period is displayed on the y-axis. The color of each period shows the household's behavior in that period; green points represent periods where the household is engaging in self-employment, red points represent periods where the

Figure 1: Household Self-Employment and Wage Sector Behavior over Time



This figure plots a simulated household's search, wage work, and self-employment behavior as well as assets over 1000 periods of the household's life. This simulation is performed using the full quantitative calibration of the model described in Section 3.

household is searching for wage work, and blue points represent periods where the household is matched with an entrepreneur and working a wage job.

The figure demonstrates the household behavior described above. At period 0, the household is near the threshold of self-insurance and alternates between working in self-employment and searching for wage work depending on their particular level of assets and self-employment productivity. Around period 150 the household's search is successful, and they acquire a high-earning wage job and quickly accumulate assets. They eventually separate from their employer but use their stock of assets to fund extensive search and remain in the wage sector. This behavior continues until around period 600 where the household has exhausted its savings without finding a wage job and returns to self-employment with occasional wage search. There is even a long period around period 800 where the household's assets fall so low that they stop searching altogether and only engage in self-employment.

With this behavior in mind, it is clear how implementing a subsidy for labor search will lead to crowd-out and crowd-in effects. When the subsidy is implemented, this directly encourages household participation in the wage sector and leads to a slackening of the labor market. This slackening has two primary effects. First, it decreases the probability that a searching household will be matched with a wage job. This decreases the expected earnings of participating in the wage sector, as a larger fraction of a household's time is spent searching rather than earning a wage, and also increases the level of self-insurance that households require before they will choose to search. These channels serve to reduce the number of households searching for wage jobs, shrinking the size of the wage sector and leading to crowd-out. Second, as I will explain below, a decrease in labor market tightness increases average wages in the wage sector. Higher average wages increase participation in the wage sector both by directly increasing the return to searching for a wage job and by increasing the amount that wage workers are able to save each period. With higher wealth, workers are able to sustain a longer period of job search after being separated from their job, increasing the likelihood that they remain in the wage sector rather than falling out. These effects serve to crowd-in additional workers.

2.5.2. Entrepreneur Equilibrium Behavior

While the entrepreneur's problem is complex, substantial progress can be made by reworking the problem analytically. In particular, it can be shown from the first-order conditions that an entrepreneur choosing to post positive vacancies will choose their collateral tomorrow f' and labor force tomorrow n' such that their ratio depends only on the entrepreneur's productivity and aggregate state variables (see the Appendix for the derivation of this result). In particular, this ratio does not depend on an entrepreneur's size as measured by either their current collateral f or current labor force n. Thus I define

$$\eta(z;X) = \frac{\gamma f'^{*}}{n'^{*}} \tag{9}$$

so that η denotes an entrepreneur's optimally-chosen capital-labor ratio which depends only on productivity z and the aggregate state X and thus, in steady-state, is constant over the lifecycle of the entrepreneur (as z is fixed for the entrepreneur's lifetime) and for all entrepreneurs born with the same productivity. The intuition for this result is fairly straightforward. Because entrepreneurs face a constant marginal cost of both financing capital and hiring workers and production is Cobb-Douglas with constant returns to scale in capital and labor, entrepreneurs will pursue a fixed capital-labor ratio.

Because bargained wages are a linear combination of an entrepreneur's marginal product of labor (which depends only on their productive and capital-labor ratio) and a worker's outside option (which is the same for all workers), this result ensures that the wage bargained with employed households depends only on the entrepreneur's productivity and not on any other entrepreneur or household state variables. This result, mentioned above in the discussion of the household problem, is extremely useful and makes the model substantially more tractable; it collapses the entrepreneur-level state variables that are relevant for the decision problem of a matched household from three (z, f, and n) to one (just z), reducing the size of the state-space for households. Additionally, it means that the steady-state equilibrium wage function w is one-dimensional (in z) rather than depending on all entrepreneur and household state variables.

A second useful result of the entrepreneur problem, stemming from the constant capital-labor ratio, is that entrepreneurs will pursue a growth rate that depends only on their productivity and aggregate state variables or, mathematically, f'^* will satisfy

$$\begin{aligned} f'^* &= g(z;X)f \\ \frac{\partial g}{\partial z} &> 0 \end{aligned} \tag{10}$$

for some function g (derivation of this result can be found in the Appendix). As with the capital-labor ratio η, this result also ensures that, in steady-state, an entrepreneur's growth rate g will be fixed for their entire lifetime. Importantly, g is increasing in z so that more productive entrepreneurs will choose to grow more quickly. Together, these two functions η and g are sufficient to fully characterize entrepreneur behavior as a function of their productivity z and the aggregate state X.

To shed light on crowd-out and crowd-in effects, which operate through labor market tightness θ, define functions $\hat{\eta}(z,\theta)$ and $\hat{g}(z,\theta)$ to be equal to the capital-labor ratio and growth rate chosen by an optimizing entrepreneur who faces constant exogenous labor market tightness θ. Because these alternative policy functions take labor market tightness as exogenous, they make it possible to perform comparative statics and examine how outcomes of the entrepreneur's problem depend on θ. In particular, aggregate vacancies V and the expected earnings in the wage sector $\bar{w}$ for a newly employed household can be written in the following forms using these functions

$$\begin{aligned} V &= \int \frac{1}{p(\theta)} \Big(\frac{1-\Delta(1-\lambda)}{1-\Delta\hat{g}}\Big) \frac{\gamma}{\hat{\eta}} \underline{f} h(z) dz \\ \bar{w} &= \frac{1}{p(\theta)V} \int \big(\chi z \hat{\eta}^{\alpha} + (1-\chi)\underline{w}\big) \Big(\frac{1-\Delta(1-\lambda)}{1-\Delta\hat{g}}\Big) \frac{\gamma}{\hat{\eta}} \underline{f} h(z) dz \end{aligned} \tag{11}$$

where I've suppressed the dependence on z and θ. Intuitively, the equation for V arise simply by counting vacancy posting across all entrepreneurs and the equation for $\bar{w}$ is the vacancy-weighted average wage.

Proposition 1. *Let $\hat{g}$ and $\hat{\eta}$ be defined as above. Then*

$$\frac{d\hat{\eta}}{d\theta} > 0$$
$$\frac{d\hat{g}}{d\theta} < 0 \text{ and } \frac{\partial^2 \hat{g}}{\partial z \partial \theta} < 0$$

where partial derivatives denoted by ∂ are taken while holding other endogenous outcomes (i.e. $\hat{\eta}$) constant.

Proposition 1 provides a basic characterization of how entrepreneur growth rates and capital-labor ratios respond to changes in labor market tightness. In words, the proposition makes three claims. The first, expressed mathematically as $\frac{d\hat{\eta}}{d\theta} > 0$, says that an entrepreneur's capital-labor ratio is increasing in labor market tightness. This result is intuitive; a tighter labor market leads to higher hiring costs and thus increases the cost of labor relative to capital. Subsequently, the entrepreneur's optimal capital-labor ratio increases. The second claim, $\frac{d\hat{g}}{d\theta} < 0$, is similarly intuitive. It says that an entrepreneur's optimal growth rate is decreasing in labor market tightness. As labor market tightness increases and hiring costs rise, the entrepreneur must spend more on hiring, reducing the profit per unit of consumption good invested. In response, the entrepreneur chooses to consume a higher proportion of their wealth today and invest less for tomorrow, reducing their growth rate. The final statement $\frac{\partial^2 \hat{g}}{\partial z \partial \theta} < 0$ is somewhat more complex. This statement is best interpreted as a statement about how $\frac{\partial \hat{g}}{\partial \theta}$ changes with productivity z. In essence, it says that the reduction in the growth rate due to an increase in labor market tightness is larger (i.e. more negative) for more productive entrepreneurs. In other words, more productive entrepreneurs are more responsive to changes in θ. This result arises from the fact that faster-growing entrepreneurs must hire more workers and thus post more vacancies. When the labor market tightens, hiring costs for these entrepreneurs increase by more than less productive entrepreneurs, resulting in a large decrease in growth.

Combining these results with the formula for average expected wage sector earnings 11 yields two channels through which entrepreneurs' reactions to the decline in labor market tightness induced by a search subsidy lead to crowd-out and crowd-in. First, Proposition 1 notes that the capital-labor ratio $\hat{\eta}$ will decline as the labor market slackens. As capital per worker declines, so do average wage sector earnings $\bar{w}$ which are a function of the marginal product of labor, as exhibited by term $\chi z \hat{\eta}^{\alpha}$ in equation 11. Second, Proposition 1 states that declining labor market tightness will lead to higher growth rates for entrepreneurs and that this increase in the growth rate will be larger for more productive entrepreneurs (as $\frac{\partial^2 \hat{g}}{\partial z \partial \theta} < 0$). As a result, the relative share of the labor force employed by more productive entrepreneurs increases which, because more productive entrepreneurs pay their workers more, increase average earnings, crowding in additional workers. Which effect dominates is a quantitative question and a key outcome in determining the overall impact of labor search subsidies.

3. Model Estimation and Quantification

In this section, I discus the estimation and quantification of the model as well as perform some model validation exercises. Broadly speaking, the parameters of the model fall into two categories. The first are parameters that can be estimated directly from data or are well-known macroeconomic parameters with standard values. These parameters I simply set equal to their estimated or standard value. The second set of parameters I estimate using the simulated method of moments to match key moments measured using weekly data on job searchers. In the subsection below, I describe these data as well as the experimental context in which they were collected.

3.1. Experimental Evaluation of Search Subsidies

I use data from an experiment evaluating the effect of providing search subsidies to potential wage workers in Addis Ababa, Ethiopia. The experiment was performed by Abebe et al. (2021) and began in 2014. In the context of Addis Ababa, the majority of openings for permanent wage jobs are posted on job boards located in the city center. To apply for a job, an individual must first travel to the city center, typically by bus, to view the job posting. In this context, the cost of buying a bus ticket serves as a cost to job search that is both large and salient.

The experiment sampled young individuals who were likely to desire a permanent wage job. In particular, individuals included in the sample "(i) were between 18 and 29 years of age; (ii) had completed high school; (iii) were available to start working in the next three months; and (iv) were not currently working in a permanent job or enrolled in full time education." (Abebe et al., 2021). Individuals in the sample were randomly offered cash that could be collected in person at the job boards in the city center up to three times per week. To minimize the incentive to travel to the job boards and collect the subsidy with no intention to actually search for work, the subsidy was designed to offset the cost of a bus ticket from each individual's home to the city center. As a result, each individual was offered a different subsidy amount. I abstract from this heterogeneity when estimating the model and simply use the average amount of the subsidy collected per person per week. Treated individuals were offered the subsidy for 16 weeks. Weekly data on the search behavior and labor market outcomes of both the treated and control groups were collected through phone surveys.[2]

After 16 weeks, the authors calculate the effect of being offered the search subsidy on a variety of labor market outcomes. Their results are replicated in Table A.1. The search subsidy has a significant effect on the type of jobs that searchers have at the end of the 16 weeks. Individuals offered the subsidy are 3.4 percentage points and 5.4 percentage points more like to be in permanent and formal jobs respectively. For the purpose of my model, I interpret this as evidence of an increase in wage employment and choose to treat temporary, informal employment as part of the model's self-employment sector. There is also some suggestive evidence that the subsidy increases wages and employment, but these estimates are very imprecisely estimated.

These data are useful in quantifying the model for two primary reasons. First, the data collected on the control group provides a high-frequency look at the search behavior of workers. This allows direct observation of many important model moments, such as the probability of finding a job conditional on searching ($\theta p(\theta)$ in the model) or the average level of savings among searchers. Direct observation of these micro moments allows for more direct estimation of model parameters instead of relying on aggregate moments. Second, the experimentally evaluated impact of job search subsidies on wage sector employment provides a valuable moment that directly speaks to the effectiveness of subsidies in encouraging workers to search. Because I have enough parameters to estimate the model, I reserve this moment for model validation, allowing me to check whether the model's predicted increase in wage employment aligns with reality.

3.2. Directly Estimated and Calibrated Parameters

Table 1 displays the model parameters that are either calibrated directly from external sources or are estimated directly using data along with their source. The discount rate β is calibrated to match an annual discount rate of 0.95. I choose to conceptualize a model period as one week resulting in a very small value for β. The rate of return on worker's savings R is calibrated to be less than one, meaning that workers are unable to save in productive assets. Instead, workers save in the form of cash which is subject to devaluation due to inflation. I choose R to match an annual inflation rate of 10 percent, consistent with World Bank estimates of the rate of inflation in Ethiopia over the last few years. Capital's share of income in production is set to 0.33 as is standard.

I calibrate the search costs b to match the average cost of a bus ticket to the city center calculated in Abebe et al. (2021). As mentioned in the previous section, this cost exhibits substantial heterogeneity across individuals; however, for simplicity I choose to use the average and treat individuals as homogeneous in their search costs. The cost that entrepreneurs face of financing capital, given by $(r+\delta)$, is calibrated to match that reported in Banerjee et al. (2015). It's important to note that the rental rate of capital faced by entrepreneurs r and the rate of return on worker assets $R-1$ are not equal, implying the existence of some sort of wedge between these two rates. This is possible, even in general equilibrium, due to the assumption of a small open market economy. Because of this, r and δ are not separately identified and I choose to calibrate them together as a single parameter.

The probability of entrepreneur death is taken from Abebe et al. (2017) which reports detailed data on firms in Addis Ababa. I also use their data on firm vacancies to calculate a vacancy filling rate of 3.76 percent, to which I calibrate the efficiency parameter of the matching function a. I estimate the collateral constraint for entrepreneurs using the

[2] At the current moment, these data are not publicly available. Instead, I use data collected from an almost identical pilot experiment. These data are published in Franklin (2018). In the future, I plan to use data from the full experiment.

World Bank Enterprise Survey, limited to enterprises based in Addis Ababa, and find that the average loan requires approximately 75 percent collateral, implying a γ of 1.33. Finally, the exogenous separation rate of workers from jobs λ is calibrated to match an unemployment rate of 18.5 percent, consistent with World Bank estimates for Addis Ababa.

The remaining two parameters, the distribution from which newborn entrepreneurs draw their productivity $F(z)$ and the initial level of assets for newborn entrepreneurs $\underline{f}$ are set somewhat arbitrarily. The distribution is chosen to be Pareto with tail parameter 2.1, which, consistent with evidence, results in a Pareto distribution in establishment size. The tail parameter is chosen to be 2.1 so that the distribution of establishments exhibits finite mean and variance. The initial level of assets for newborn entrepreneurs $\underline{f}$ is chosen entirely arbitrarily.

Table 1: Directly Estimated Parameters

Parameter	Value	Description	Source
β	.997	Discount rate	.95 annual discount rate
R	.998	Return to savings	10% annual inflation (World Bank)
α	.33	Capital share	Standard value
b	.137	Search cost	Abebe et al. (2021)
$r+\delta$	.0041	Capital cost for entrepreneurs	Banerjee et al. (2015)
Δ	.998	Entrepreneur death prob.	Abebe et al. (2017)
$p(\theta) = 1 - e^{-a/\theta}$	.0376	Job filling rate	Abebe et al. (2017)
γ	1.33	Collateral constraint	World Bank ES
λ	.0071	Unemployment rate of 18.5%	Poschke (2019)
M	$(1-\Delta).25$	Entre. population share of 25%	Itskhoki and Moll (2019)
$h(z)$	$\frac{1}{z^{2.1}}$	CDF of entpreneur z	
$\underline{f}$	0.1	Initial firm assets	

This table displays the model parameters that are estimated directly as well as their values and sources and/or aggregate target. See the discussion for details on each parameter.

3.3. Parameters Estimated using the Simulate Method of Moments

Table 2: Moments Targeted using the Simulated Method of Moments

Moment	Data	Model	Parameter
Wage Work as % of Total Work	30.0%	34.4%	$u(c) = \frac{c^{1-5.6}-1}{1-5.6}$
Median Savings while Self-Employed	25.1% of earnings	25.6% of earnings	$\frac{y_h}{y_l} = 2.088$
Control Wage Employment after 16 Weeks	17.1%	16.8%	$c = 18.0$
Productivity Transition Prob.	21%	21%	$p = .21$

This table displays the moments targeted in the simulated method of moments estimation and their values in both the data and model. The final column lists the model parameters estimated using SMM and provides a rough, intuitive correspondence indicating which moment is most responsible for disciplining each parameter. See the discussion for details.

Table 2 displays the model moments that are targeted in the simulated method of moments estimation as well as their values measured in the data and in the model. The final column of Table 2 reports the four estimated parameters corresponding to the four moments. Although all four moments are determined jointly by all four parameters, the correspondence between moments and parameters displayed in the table gives intuition for which moment is most important in estimating which parameter.

The first moment is the percentage of the population engaged in wage work which I calculate to be 30 percent for Addis Ababa based on the data of Abebe et al. (2021). It's worth noting that this is substantially lower than the rates of wage work calculated by the World Bank for Ethiopia which are 10 to 15 percent. Although this is not particularly surprising as it would be expected that urban Addis Ababa would have higher rates of wage employment. In the model, this moment is closely pinned down by the CRRA parameter of the utility function. This correspondence is intuitive as participating in the wage sector carries a higher expected return that participating in self-employment but is subject to idiosyncratic job-finding risk. As a result, conditional on other variables (savings, relative earnings, and job-finding probability), the decision to participate in the wage sector is determined fully by an individual's risk tolerance. I estimate the CRRA parameter to be 5.6, reflecting the fact that workers seem to be very risk-averse in choosing whether or not to engage in wage work.

For those engaged in self-employment, the relative productivity of the high productivity state versus the low productivity state is pinned down by observing savings held by the self-employed or casually employed measured in Abebe et al. (2021). If the gap between productivity states is larger, individuals will hold higher savings to be more self-insured. I estimate that the high productivity state is roughly twice as productive as the low productivity state. Having fixed most of the search parameters in the previous sector, the remaining search parameter, the cost of vacancy posting c, is estimated using the rate of wage work in the control group of Abebe et al. (2021) after the 16 week observation period. Because all other search parameters have been fixed, c directly determines the job finding probability $\theta p(\theta)$ and thus corresponds closely to this moment. The final moment, the probability of transitioning between productivity states when self-employed, is estimated to match the average transition probability between a week spent without work and a week spent casually working for individuals observed in Abebe et al. (2021)

3.4. Model Validation

As my primary model validation exercise, I replicate the experiment performed by Abebe et al. (2021) in the model and compare the model outcomes to the experimentally estimated outcomes. To emphasize the appropriateness of this exercise to validate the model, it is important to make one note. When using data from the experiment to estimate the model in the section above, I make sure to only use data from the control group of individuals in the experiment. In other words, data from the treatment group is used nowhere in the estimation process. Thus comparing the treatment effect estimated in the experiment, which boils down to a difference in means between the treatment and the control group, provides validation of the model that is independent of the data used to estimate it.

To replicate the experiment in the model, I begin by selecting a representative but small portion of workers. This "representative but small" assumption is important because it captures the idea that an experiment providing a treatment to a few thousand individuals in a city of millions will have essentially zero impact on equilibrium outcomes. When replicating the experiment in the model, I want to capture this notion and ensure that the model predicted experimental effect arises purely due to the treatment and not due to equilibrium adjustment. In a technical sense, I select a representative measure zero set of workers. Because the set is measure zero, outcomes for this group will have no impact on equilibrium objects.

I split the sample into treatment and control groups. The control group receives no changes while the cost of searching for wage work b is changed to be equal to zero for the treatment group. Setting this cost to zero reflects the fact that, in reality, the treatment was designed to exactly offset the cost of a bus ticket to the city center. I then simulate the economy forward for sixteen weeks (sixteen periods), as in the experiment, while tracking the behavior and outcomes of the control and treatment groups. After these sixteen periods are up, the model equivalents of the experimentally estimated treatment effects can be constructed by comparing the mean outcome between the control and treatment groups.

Overall, I find that the model does a very good job of predicting the experimentally estimated outcomes. The model predicts that wage sector employment will be 3.5 percentage points higher (from a baseline of 16.8 percent) in the treatment group after 16 weeks. In reality, the experiment finds that wage sector employment is 3.3 percentage points higher (from a baseline of 17.1 percent) in the treatment group. The fact that the model prediction is remarkably close to the experimentally estimated treatment effect, despite no data from the treatment group being used in estimation, is an encouraging signal of the model's ability to accurately capture the sectoral decision of workers.

4. Quantitative Exercise and Results

As the main quantitative experiment, I implement a cash transfer each period targeted at all individuals who are searching for wage work. I choose the size of the subsidy to be equal size used to validate the model in the previous section. In particular, this subsidy is equal to 13.7 percent of average weekly earnings (across both sectors). Recall that this subsidy size was designed to exactly offset the costs of search. As a result, the subsidy essentially sets the search cost b to zero. For the main exercise, I assume that the subsidy is funded by a flat tax levied on wage workers, rather than a tax on all workers. This is an important distinction as it means that the tax itself serves to distort workers' choice of sector towards self-employment and, as a result, the tax contributes to the crowd-out effect. In the future, I plan to evaluate an alternative scenario where the subsidy is funded by a flat tax on all workers, eliminating this distortion, and compare how the results differ between these two cases.

Table 3 displays the results of this policy. Column (1) displays the value of moments key aggregate moments in the benchmark steady-state of the estimated model while column (2) displays the values of these moments in the post-subsidy steady-state. The policy results in a substantial increase in both GDP and welfare. Welfare increases by 0.6 percent of consumption on average while GDP increases by a little over 2 percent. This increase in GDP is the result of a 5.4 percentage point increase in the size of the wage sector, which is more productive than the self-employment sector, and an increase in wage sector earnings of 1.88 percent. This increase in earnings is the direct result of higher average wage sector TFP in the post-subsidy steady-state of the model. As the subsidy encourages wage work and the labor market slackens, entrepreneurs now dedicate fewer resources towards hiring and more resources to growth. This increase in growth is disproportionately beneficial to higher productivity entrepreneurs, allowing them to increase their market share and increasing TFP. A portion of this higher TFP is shared with workers through higher wages due to bargaining. However, it is important to note that the increase in wages due to higher TFP is not enough to overcome the increase in taxes necessary to fund the policy; post-tax earnings in the wage sector decrease by 0.5 percent

The search subsidy has only a modest impact on the size of the wage sector which increases from 34.4 percent to 39.8 percent. Labor market tightness decreases resulting in a small decrease in the job-finding probability from 3.1 percent to 2.95 percent and, consequently, an increase in the unemployment rate by 1.2 percentage points. The decrease in job-finding probability together with the decrease in post-tax earnings in the wage sector strongly suggests that the crowd-out effect dominates the crowd-in effect. To investigate this quantitatively, I perform an additional numerical

Table 3: Results of Implementing Search Subsidies

Variable	(1) Benchmark	(2) After Subsidy	(3) Equil. Values Fixed
GDP (relative to benchmark)		+2.06%	+4.10%
CE Welfare (relative to benchmark)		+0.60%	+1.25%
Size of Wage Sector	34.4%	39.8%	50.5%
Wage Sector Earnings (relative to benchmark)		+1.88%	+0.00%
Wage Sector Earnings (includ. tax)		-0.50%	+0.00%
Labor Market Tightness	0.094	0.074	0.094
Job-Finding Prob.	3.10%	2.95%	3.10%
Unemployment Rate	18.6%	19.4%	18.6%

This table displays the results of the primary quantitative exercise of subsidizing search for wage jobs. Column (1) reports key aggregate parameters in the steady-state of the model before implementation while Column (2) reports these same parameters in the new steady-state of the model once the policy has been implemented. Column (3) displays the results in a hypothetical steady-state where labor market tightness θ is fixed. See the discussion for details on how to interpret these results.

experiment. Because the crowd-out and crowd-in effects operate through labor market tightness and earnings, both of which are equilibrium objects, I also compute the results of the subsidy if these equilibrium objects were fixed to their pre-subsidy values.

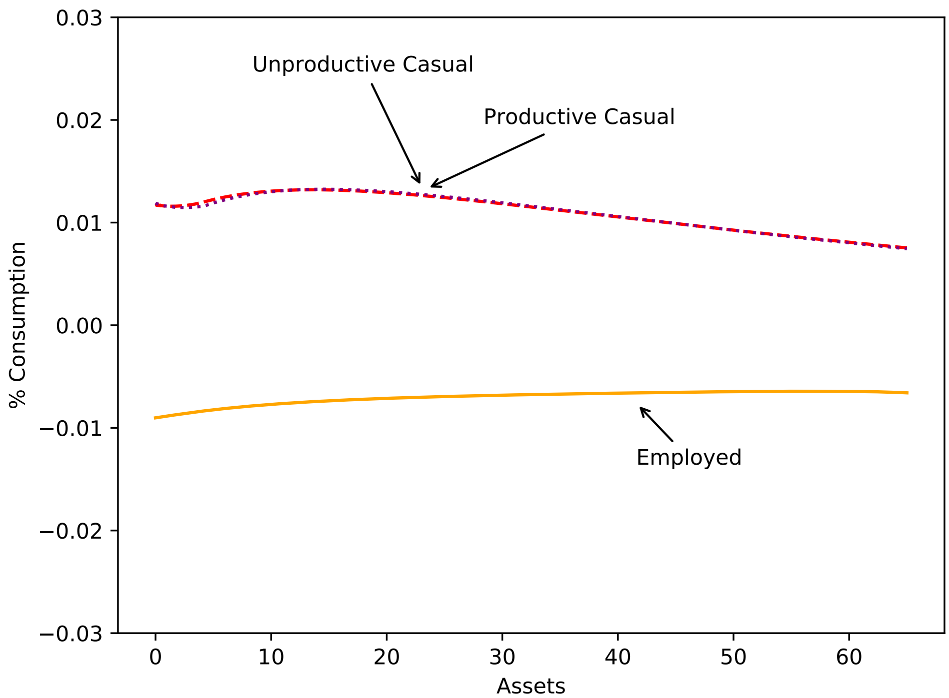
The results of this numerical experiment are displayed in column (3) of Table 3. I interpret these results (when compared to the pre-subsidy model) as revealing the direct impact of the subsidy on workers' decisions and outcomes while the difference between these results with fixed labor market tightness and wages then reveals the impact of the general equilibrium effects of the subsidy. The most striking difference between this numerical experiment and the post-subsidy steady state is the size of the wage sector. When equilibrium parameters are fixed, the subsidy increases wage sector participation by a remarkable 16.1 percent points to 50.5 percent. Nearly three times as much as the 5.4 percentage point increase induced by the policy in full equilibrium. This stark difference suggests that the direct impact of the search subsidy is large; search costs serve as a substantial constraint in preventing workers from participating in the wage sector.

The large difference in wage sector participation between the full equilibrium results and the results with equilibrium values fixed also suggests that the crowd-out effects play a substantially larger quantitative role than the crowd-in effects. As can be seen from column (3), when equilibrium adjustment is shut down, the crowd-in and crowd-out channels are shut down. Labor market tightness is fixed, there is no change in the job-finding probability or in taxes that may crowd out wage workers. Similarly, because wages are fixed, there is no increase in the wage due to higher TFP that could crowd-in additional workers. Once both these channels are introduced, the size of the wage sector falls substantially, consistent with the notion that the crowd-out channels dominate.

Interestingly, the crowd-out effect seems to be large despite a fairly small decrease in the job-finding probability in the new equilibrium. The probability falls by 0.15 percentage points from 3.10 percent to 2.95 percent, a small decline. This large change in the size of the wage sector despite a small decline in job-finding probability indicates that the semi-elasticity between an individual's search choice and their probability of finding a job must be fairly large, likely a direct result of high estimated risk aversion. This behavior seems consistent with experimental interventions such as Alfonsi et al. (2020) and Abebe et al. (2017) that find large impacts on search behavior of treatments that lead individuals to substantially revise their expectations of their job-finding likelihood.

4.1. Welfare

Figure 2: Welfare Effects of Search Subsidy as a Function of Household Assets



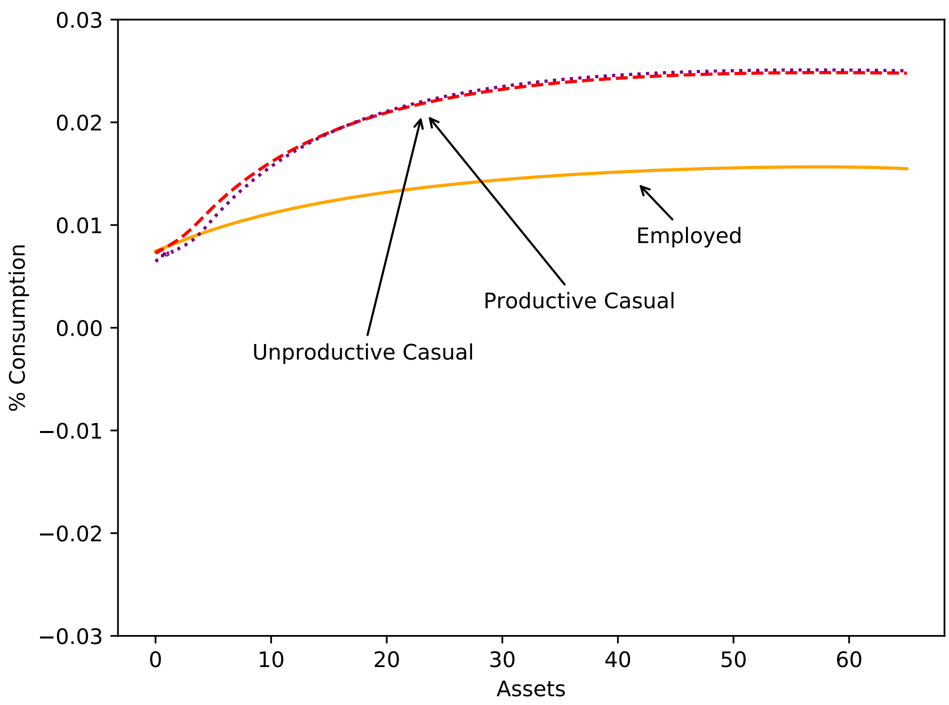
This figure displays the change in welfare, measured in consumption equivalent welfare, of the search subsidy policy as a function of a household's assets as well as their employment status and self-employment productivity.

Figure 2 displays the welfare impact of the search subsidy as a function of individual assets and employment status. For now, these numbers are calculated by comparing steady-states, although I plan to compute welfare along the transition path in the future. The red and purple lines display the welfare impact for workers without a wage sector job in the high productivity and lower productivity states respectively while the orange line displays the impact for workers matched with a wage job. Two aspects of the figure are striking. The first is that the welfare effects are highly dependent on an individual's employment state. The workers without a wage job, who switch between engaging in self-employment and searching for work, experience large welfare gains equal to around 1 percent of consumption while workers matched with an employer experience welfare loss of a little less than 1 percent. This gap is intuitive; workers without a wage job are either searching or anticipate to be searching in a few periods and thus are direct beneficiaries of the subsidy while workers already matched with a job pay a tax in order to fund the subsidy.

The second striking aspect of Figure 2 is that the welfare impacts exhibit very little heterogeneity with respect to an individual's level of wealth; individuals with zero assets experience welfare changes similar to the highest asset individuals. At first glance this result seems puzzling; however, splitting the welfare impact into the direct impact of the subsidy and the indirect impact through equilibrium objects reveals the intuition. Figure 3 displays the effect of the subsidy on welfare as a function of assets while fixing the equilibrium values of labor market tightness, wages and taxes (i.e. corresponding to column (3) of Table 3) while Figure 4 displays the difference between this counterfactual and the full results. In essence, Figure 3 displays the direct impact of the subsidy while Figure 4 displays the indirect impact.

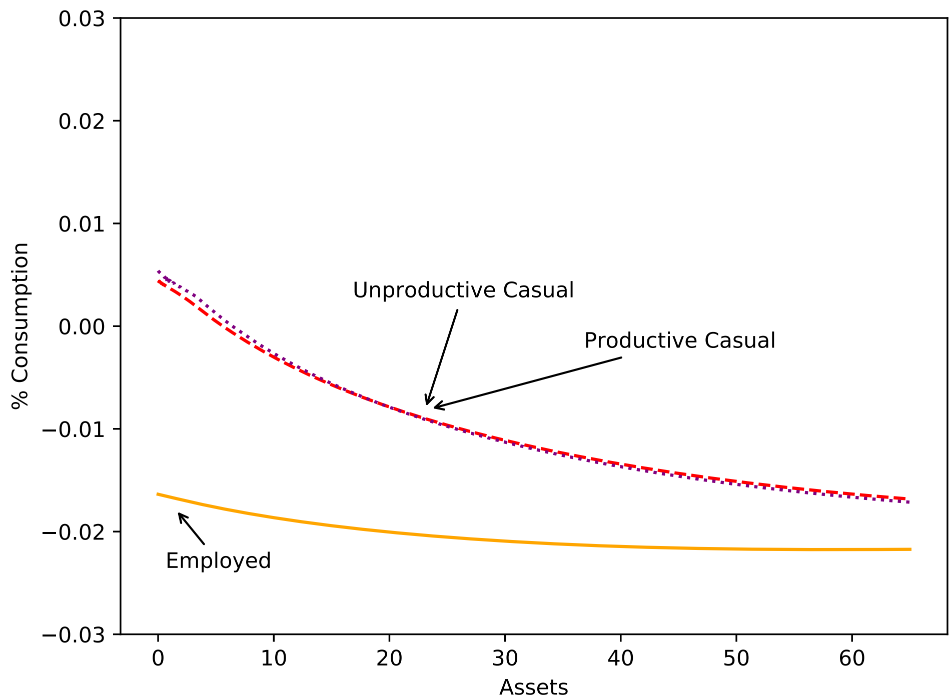
In these figures, the impact of the policy is clearly heterogeneous with respect to individual wealth. The direct effect of the subsidy exhibits the largest welfare gains for the wealthiest individuals. Recall that households will participate in the wage sector until their self-insurance falls below a certain level, after which they will turn to self-employment until they have accumulated a buffer stock of savings. Because wealthy individuals can run down their assets for longer than poor individuals while searching for a job, they expect to collect the subsidy for more periods than poor households, who may only be able to search for a handful of periods before turning to self-employment. The welfare losses from the indirect effects of the policy are largest for wealthy households for a similar reason. Because wealthy households expect to participate in the wage sector the longest, they face the largest losses from a decline in the job-finding probability and an increase in taxes. Although the indirect effect and the direct effect individually exhibit substantial heterogeneity with respect to wealth, when they are combined the larger gains and larger losses for wealthy households serve to counteract each other and the overall welfare change doesn't vary much with wealth.

Figure 3: Welfare Effects of Search Subsidy as a Function of Household Assets (Fixed θ)



This figure displays the change in welfare, measured in consumption equivalent welfare, of the search subsidy policy as a function of a household's assets as well as their employment status and self-employment productivity in an alternative model where labor market tightness θ is fixed and does not change as a result of the policy. See the discussion for intuition on how to interpret these results.

Figure 4: Difference Between Welfare Effects of Subsidy with and without Fixed θ



This figure the difference in the change in welfare as a function of household assets, employment status, and self-employed productivity between the full model and the alternative model with fixed θ. See the discussion for intuition on how to interpret this figure.

5. Conclusion

Overall, my results suggest that the impact of subsidies for labor search is complex but, generally speaking, substantially smaller in general equilibrium than experimental results would suggest. As an Active Labor Market Policy designed to encourage participation in the market for wage labor and reduce self-employment, the effects are substantially muted, largely due to households' high elasticity of labor search with respect to job-finding probability. Even the substantial subsidy evaluated in this paper only increases wage sector participation by 5.4 percentage points in general equilibrium. The subsidy results in a small increase in TFP in the wage sector as a large wage sector allows more productive entrepreneurs to increase their relative size. Although capital per worker declines in response, this increase in TFP is still enough to boost wage sector earnings by 1.88 percent.

Despite its muted effects in expanding the wage sector, the subsidy does substantially increase welfare by about 0.6 percent of consumption. This gain occurs almost entirely due to the increase in insurance that the subsidy provides. The subsidy transfers resources from a good state of the world (wage employment) to a bad state of the world (search) which is very valuable to households as they lack the means to do so effectively. These gains accrue entirely to unemployed households of all asset levels while employed households suffer welfare losses. The intuition is straightforward as unemployed households are the direct beneficiaries of the policies while employed households pay the taxes required to fund it.

One potentially important channel missing from this analysis is that of entry into entrepreneurship. It seems intuitive that subsidies expanding the market for wage labor would have an impact on business formation and entry into entrepreneurship; however, it is unclear, even in theory, which direction this effect will push. On one hand, it might be the case that the reduction in hiring costs lowers the cost of operating a business and encourages entrepreneurship. On the other hand, while I model entrepreneurs and workers as two completely different types of agents, it's possible that a subsidy for search would induce some entrepreneurs to close their businesses and pursue wage work, reducing the number of entrepreneurs. Additionally, in both these cases, the marginal entrepreneur choosing to close or open a business likely possess lower than average productivity, leading their entry decision to affect TFP and average earnings as well. Because of a lack of solid empirical evidence to discipline any of these channels and because of their theoretical ambiguity, I choose to abstract from them. However, future work could examine these channels more closely.

Future work could also examine the impact of Active Labor Market Policies aimed at firms such as hiring subsidies or subsidized apprenticeships. My results suggest that search subsidies alone are not sufficient to expand the wage sector, largely because the labor market slackens and the probability of finding a job decreases. These effects could be mitigated by policies aimed at increasing hiring by firms which would tighten the labor market. A combination of subsidies for job seekers and subsidies for firms may be the most effective tool for policymakers looking to expand wage sector employment.

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Appendix

A. Additional Tables and Figure

Table A.1: Effect of Search Subsidy on Labor Market Outcomes (Abebe et al., 2021)

Outcome	Control Mean	Effect of Subsidy
Any Work	0.526	0.037
		(0.029)
Hours Worked	26.18	0.183
		(1.543)
Monthly Wages	857.9	65.88
		(63.86)
Permanent Job	0.171	0.033*
		(0.018)
Formal Job	0.224	0.054**
		(0.019)
Job Satisfaction	0.237	-0.001
		(0.027)

This table reproduces the primary results of Abebe et al. (2021) and displays the control mean for a variety of labor market outcomes as well as the experimentally estimated treatment effect of a conditional cash transfer to job seekers.

B. Derivations and Proofs from Section 2.5.2

The first result to show is that the entrepreneur's optimal choice of f' and n' satisfy $\eta(z;X) = \frac{\gamma f'^*}{n'^*}$ for some function η depending only on z and X. Substituting in the wage determination equation (which the entrepreneur takes as given) and the vacancy posting constraint, the first-order condition for f' and n' can be combined with the envelope condition for f and n to generate

$$\mu\left((1-\alpha)(1-\chi)z(\frac{\gamma f'}{n'})^{\alpha} - \left((1-\chi)\underline{w} - \frac{c}{p(\theta(X'))}(1-\lambda)\right)\right) = \frac{c}{p(\theta(X'))}\beta\Delta\mu'$$
$$\mu\left(\gamma\alpha(1-\chi)z(\frac{\gamma f'}{n'})^{\alpha-1} + 1 - \gamma(r+\delta)\right) = \mu'\beta\Delta$$

where μ is the Lagrange multiplier on the budget constraint, μ' is the Lagrange multiplier on the budget constraint in the following period, and $\theta(X')$ is a price function mapping aggregate states X to equilibrium values of θ. Combining these two equations, substituting in η, and defining A, $B(X')$, and $C(X')$ for clarity yields

$$Az\eta^{\alpha} + B(X')z\eta^{\alpha-1} + C(X') = 0$$

which, for $0 < \alpha < 1$, can be shown to have a unique and positive solution for η for any value of z and X'. Call this solution $\tilde{\eta}(z;X')$. Finally, substituting $X' = H(X)$ and defining $\eta(z;X) = \tilde{\eta}(z;G(X))$ completes the derivation.

The next result to show is that entrepreneurs choose a growth rate that depends only on their z and aggregate state variables. This follows almost directly from the previous result. Substituting $n = \frac{\gamma}{\tilde{\eta}(z;X)} f$ in to the budget constraint of the entrepreneur problem reveals that the RHS of the budget constraint is now linear in f and can be written

$$\begin{aligned} d + \big(1 + \frac{c}{p(\theta(X))}\frac{\gamma}{\eta(z;X)}\big) f' &= \Big((1-\chi)\gamma z \tilde{\eta}(z;X)^{\alpha-1} - \big((1-\chi)\underline{w} - \frac{c}{p(\theta(X))}(1-\lambda)\big)\frac{\gamma}{\tilde{\eta}(z;X)} + \big(1-\gamma(r+\delta)\big)\Big) f \\ \Rightarrow \; d + E(z,X) f' &= D(z,X) f \end{aligned}$$

where $D(z,X)$ and $E(z,X)$ are defined such that the second line is equivalent to the first line. E functions as the price of collateral f relative to the price of consumption d while D functions as the return to collateral. Because entrepreneurs possess log utility, the entrepreneur problem has the well-known solution of a constant growth rate in f depending on the values of D and E which are given by z and X so that $f' = g(z;X) f$.

The final result to show is the proof of Proposition 1. By assumption, θ is assumed to be constant. Let $\hat{E}(z,\theta)$ and $\hat{D}(z,\theta)$ denote E and D respectively, but with $\theta(X)$ simply replaced by θ, the argument to the function. Note that this is possible because E and D only depend on X through θ. Then we have the explicit solution

$$\hat{g}(z,\theta) = \beta\Delta \frac{\hat{E}(z,\theta)}{\hat{D}(z,\theta)} = \beta\Delta \frac{\Big((1-\chi)\gamma z \hat{\eta}(z;\theta)^{\alpha-1} - \big((1-\chi)\underline{w} - \frac{c}{p(\theta)}(1-\lambda)\big)\frac{\gamma}{\hat{\eta}(z;\theta)} + \big(1-\gamma(r+\delta)\big)\Big)}{\big(1 + \frac{c}{p(\theta)}\frac{\gamma}{\hat{\eta}(z;\theta)}\big)}$$

The chain rule yields $\frac{d\hat{g}}{d\theta} = \frac{\partial \hat{g}}{\partial c/p(\theta)}\frac{dc/p(\theta)}{d\theta} + \frac{\partial \hat{g}}{\partial \hat{\eta}}\frac{d\hat{\eta}}{dc/p(\theta)}\frac{dc/p(\theta)}{d\theta}$. Using either direct calculation of partial derivatives or implicit differentiation (in the case of $\frac{d\hat{\eta}}{dc/p(\theta)}$), we can express each individual piece as

$$\begin{aligned} \frac{\partial \hat{g}}{\partial c/p(\theta)} &= -\frac{(\frac{\hat{g}}{\beta\Delta} - 1) + \lambda}{\frac{\eta}{\gamma} + \frac{c}{p(\theta)}} \leq 0 \\ \frac{\partial \hat{g}}{\partial \hat{\eta}} &= \frac{\frac{\beta\Delta}{\hat{g}} - \frac{\hat{g}}{\beta\Delta}}{\frac{\eta}{\gamma} + \frac{c}{p(\theta)}} \leq 0 \\ \frac{d\hat{\eta}}{dc/p(\theta)} &= \frac{\gamma\big(\alpha(1-\chi)z\hat{\eta}^{\alpha-1} - (r+\delta)\big) + \lambda}{J(\theta)} > 0 \end{aligned}$$

where $J(\theta)$ is a placeholder for a complex but unambiguously positive expression and I have made use of the first-order condition for f' in the second expression. It is worth commenting briefly on why the claimed inequalities hold. Both the first and second expressions follow directly from the fact that an optimally acting entrepreneur will ensure that $g \geq \beta\Delta$. This is clearly true as an entrepreneur can always choose to select $k = 0, n = 0$ and simply eat their cake, yielding $g = \beta\Delta$. An entrepreneur will only choose to operate if they can be weakly better off by doing so. The third and final expression follows from the first-order condition for capital which ensures that the marginal product of capital $\alpha(1-\chi)z\hat{\eta}^{\alpha-1}$ is greater than the marginal cost of capital $r+\delta$ (the MPK is greater, rather than equal to, the marginal cost due to the presence of the financing constraint). Because $\frac{dc/p(\theta)}{d\theta} > 0$ by construction, combining these inequalities with the chain rule provides the result $\frac{d\hat{g}}{d\theta} < 0$ and along the way we have shown $\frac{d\hat{\eta}}{d\theta} > 0$.

The result for $\frac{\partial \hat{g}}{\partial\theta\partial z}$ is straightforward. We have $\frac{\partial \hat{g}}{\partial z} = \frac{(1-\chi)\hat{\eta}^{\alpha}}{\frac{\hat{\eta}}{\gamma} + \frac{c}{p(\theta)}}$ which is also clearly greater than zero and decreasing in θ. Although this result holds only for partial derivatives (i.e. with $\hat{\eta}$ being held constant), it can also be shown to hold for total derivatives in the case where $\hat{\eta} \geq \alpha(1 + \frac{c}{p(\theta)}\gamma)$ by applying the chain rule as above and computing $\frac{d\hat{\eta}}{dz}$ using implicit differentiation.