Working paper

International Growth Centre

The implications of worker and firm heterogeneity for unemployment and self-employment in Ethiopia

Markus Poschke

January 2020

When citing this paper, please use the title and the following reference number:
C-32416-ETH-1

DIRECTED BY

FUNDED BY

The implications of worker and firm heterogeneity for unemployment and self-employment in Ethiopia*

Markus Poschke†

January 31, 2020

Abstract

Ethiopia, like many other African countries, faces high urban unemployment and self-employment rates. This paper analyzes labor market states and flows by skill level, and develops a general equilibrium model with heterogeneous individuals and heterogeneous firms, where individuals choose their type of occupation (wage employment, own-account work, being an employer), and employers choose employment levels. The model is calibrated to Ethiopian data and used for quantitative analysis. Unemployment and self-employment rates are particularly high for low-skill workers. Available duration data suggest that separation rates are very high and job finding rates very low for both skill levels. Quantitative analysis of the model shows that reductions in both frictions could contribute to significantly lower unemployment and increase wage employment. For the low-skilled, it would also strongly reduce self-employment – by more than unemployment – and thus increase wage employment even more. For the low-skilled, self-employment thus is a valve that reduces unemployment. Its prevalence reacts to the attractiveness of job and search opportunities. Changes in occupational choices are key to capturing the welfare gains from reductions in frictions. Finally, in this setting, the standard positive effect of income support to the unemployed on the unemployment rate is amplified, as higher attractiveness of job search reduces own-account work.

Keywords: unemployment, labor market frictions, self-employment, occupational choice, entrepreneurship, firm size, productivity.

JEL Codes: .

*

† markus.poschke@mcgill.ca , McGill University and CIREQ, Leacock Building, 855 Sherbrooke St. West, Montreal QC H3A 2T7, Canada.

1 Introduction

Ethiopia, like many other African countries, faces high urban unemployment and self-employment rates. In Addis Ababa, the unemployment rate for low-skill workers exceeded 25% in 2016. The unemployment rate for high-skill workers was much lower but still elevated, at 12.9% (source: 2016 Urban Employment and Unemployment Survey UEUS). Rates of own-account work almost reached 20% for the low-skilled. For the high skilled, they were much lower, at around 5%. Private sector wage employment, in contrast, is rare (compared to richer countries), accounting for only about a third of employment.

The paper first shows that unemployment is not only high, but also very persistent. First, this is implied by high observed unemployment durations. Second, it follows from an analysis of the duration of lifetime employment patterns gathered in the 2013 National Labor Force Survey (NFLS). Both approaches reveal unemployment outflow rates that are low by international standards, comparable to those in continental European countries. The second analysis also shows very high separation rates from jobs. The combination of these two rates results in high unemployment rates.

Both of these approaches neglect labor market states other than unemployment and wage employment, despite their prominence in the data. Particularly important is the omission of self-employment. To be able to jointly analyze the determinants of a broader set of labor market states, the paper then builds a general equilibrium model with heterogeneous individuals and heterogeneous firms, where individuals choose their type of occupation, and employer firms choose their employment level. Besides the states of unemployment, wage employment, own-account work and being an employer, the model also includes public sector employment and casual work, two other important features of the data, in simple ways.

In this model, the prevalence of the different labor market states is an endogenous outcome that depend on fundamental characteristics of the economy, like the productivity of firms and workers, the cost of creating firms, the efficiency of the hiring process, and the durability of employment relationships. The model can thus be used to assess which of these characteristics are important as determinants of the incidence of unemployment, self-employment and wage employment, and how these outcomes would change in response to changes in fundamentals.

The starting point for the model is Poschke (2018*b*), which introduced endogenous self-employment, with a choice between own-account work and being an employer, into a Diamond-Mortensen-Pissarides (DMP) type model of frictional labor markets. The model used here extends that work by including two types of workers (high and low skill) and taste heterogeneity with respect to self-employment. Taste heterogeneity is important for matching the lower tail of the firm size distribution, which is very important in poor countries. Firms employing low- and high-skill workers, respectively, employ different technologies. While low-skill employers can only operate the low-skill technology, high-skill employers can choose between the two technologies. As a result, the two segmented labor markets for low- and high-skill workers are connected, since the composition of employer firms adjusts to the economic environment.

The calibrated model captures key features of the Ethiopian economy. In particular, it reproduces its high rate of self-employment, in particular low-income own-account work, as well as a preponderance of small firms, combined with a very small number of large employers. It also captures differences in wages and occupational choices across skill groups.

The calibration is informative about the labor market situation faced by different types of workers. In a nutshell, high-skill agents face highly frictional labor markets with low finding rates and moderate destruction rates, not entirely dissimilar from those in mediterranean countries with highly regulated labor markets. Low-skill workers face extremely high separation rates, making job search quite unattractive, so that own-account work becomes an important alternative to search for them.

Quantitative analysis of the model shows that labor market frictions, captured in the model as the separation rate of existing matches and the cost of creating new matches, strongly affect both unemployment and self-employment. A large reduction in frictions would have the potential to reduce unemployment and self-employment rates to the range of 5 to 10%. This would require reductions of the separation rate to levels seen in continental Europe, and increases in the job finding rate to values comparable to those in the UK or Japan. Some poor countries in South-East Asia, which tend to have low unemployment rates, have flow rates in this range.

There are several important lessons from this analysis. First, agents' choices in the model amplify the effect of changes in frictions. In particular, firms respond to lower separation rates by hiring more, so that the unemployment rate declines both due to the direct effect of fewer separations, and because of the induced effect of faster job finding. Second, changes in labor market frictions lead to very large changes in low-skill own-account work. In fact, for the low skilled, the rate of own-account work reacts more strongly to changes in frictions than the unemployment rate. This illustrates that labor market frictions are an important determinant of low-skill self-employment rates, echoing the findings in Poschke (2018*b*). (For the low-skilled, the elasticity of the rate of own-account work with respect to hiring frictions even exceeds that with respect to the entry cost.) Own-account work for some agents is an attractive alternative to search when the return to search is low. Existing frictions thus not only cause unemployment, but also contribute to high self-employment rates among the low skilled. Both factors depress wage employment.

Changes in labor market frictions for one skill level do not affect workers of the other type much. This is different for changes in entry costs. Reductions in entry costs for one type of worker spur entry of own-account workers of that type. This reduces unemployment and thus the pool of searchers. Because this drives up wages, firms shift towards the other type of workers, driving up their wages, too. As a result, reductions in entry costs for one type of workers have similar effects on wages of both types of workers. Generally, shifts in the composition of firms – in particular in the choice by high-skill employers what kind of technology to employ – occur in reaction to changes in the effective bargaining power or supply of workers of one type.

High levels of unemployment may motivate policies of income support for the unemployed. Typically in search and matching models, such policies raise wages, thus reduce hiring, and increase unemployment. This is no different here. In addition, in this setting, such benefits reduce self-employment entry, amplifying the increase in unemployment. Even if benefits improve the efficiency of search by reducing the incidence of casual work, they still raise unemployment, again with a contribution from reduced own-account work. Tax financing of benefits, by raising the cost of labor, reduces vacancy posting further and thus raises unemployment even further. Yet, aggregate welfare may still increase, as the increase in welfare of the low-skilled, in particular the low-skilled unemployed, can outweigh welfare losses of the high-skilled.

The paper is structured as follows. Section 2 sets out some key features of the Ethiopian labor market that are important for the analysis. Section 3 describes the model. Section 4 shows the calibration of the model. Section 5 analyzes the determinants of unemployment and self-employment, and the effects of reductions in frictions. Section 6 contains all the results of policy analysis. An Appendix contains technical details.

2 The setting

This paper analyzes the determinants of high levels of unemployment and self-employment in Ethiopia. Since these outcomes vary significantly by worker skill, the analysis allows for two skill levels. Before delving into the analysis, this section gives a brief overview of some relevant features of the Ethiopian economy.

In doing so, it draws on data from the 2016 Urban Employment and Unemployment Survey (UEUS), as well as the 2013 National Labor Force Survey. The tools used in the paper are most appropriate for the use of urban labor markets, where large firms, small firms, and own-account workers in various sectors all coexist. Therefore, I use data for survey respondents in Addis Ababa aged 16 and over only to inform the analysis.

2.1 Labor force states

Table 1 shows the composition of the labor force, overall and by skill level. For this, the labor force is split into two skill levels, high and low, where high is defined as having completed a diploma or a degree. By this definition, 17% of those surveyed in Addis Ababa are high-skilled. (This proportion is very similar, at 21%, when one considers only those in the labor force.)

Almost a quarter of the labor force is unemployed. The unemployment rate is significantly lower for the high-skilled, at only 13%. Both rates are high by international standards, in particular the low-skill one.

Information on unemployment duration included in the UEUS allows inferring unemployment outflow rates, as in Shimer (2012) and Elsby, Hobijn & Şahin (2013). This reveals that unemployment is persistent, with outflow rates around 5% per month for both groups. This level is comparable to that observed in continental European economies with some of the lower unemployment outflow rates in the world (Elsby et al. 2013, Donovan, Lu & Schoellman 2019). These low outflow rates clearly are one factor contributing to high levels of unemployment.

For those who are employed, there are five quantitatively important labor market states. About one third of those who are employed are in wage employment. More than one quarter is self-employed. Out of these, about six out of ten are own-account workers, and four in ten employs others. These values are fairly typical for developing economies. Finally, about one in five works for the government or a government development organization, and a similar fraction is engaged in casual work at the time of the survey. (These are private sector workers who declare being a "casual worker" or who are on a temporary contract.)

This split of employment contrasts with the situation in rich countries, where levels of casual work are lower, and self-employment rates typically are around 10%, split roughly evenly between employers and own-account workers. (See Poschke (2018*b*) for more information.)

There are significant differences by skill not only in the incidence of unemployment, but also in the split of employment. The self-employment rate is particularly high for low-skill workers. While low-skill workers are almost three times as likely as high-skill workers to be employers, they are almost four times as likely to be own-account workers. In contrast, levels of government employment are particularly high for high skill workers. What is common across skill levels is that private sector employment is low, at only about a third of employment.

Table 1: Composition of the labor force (%)

	all	high skill	low skill
labor force share		16.8	83.2
u rate	23.5	12.9	25.7
u outflow rate	4.7	5.3	4.6
among those employed:			
private sector employees	33.8	34.3	33.7
government employment	21.4	48.6	14.9
casual work	18.9	8.2	21.4
self-employment rate	25.9	8.9	30.0
own-account workers	15.9	4.9	18.5
fraction employers	10.0	4.0	11.5
relative earnings		2.22	1

Source, UEUS, 2016, data for Addis Ababa. High skill: diploma or degree. u outflow rate is monthly, to any other state.

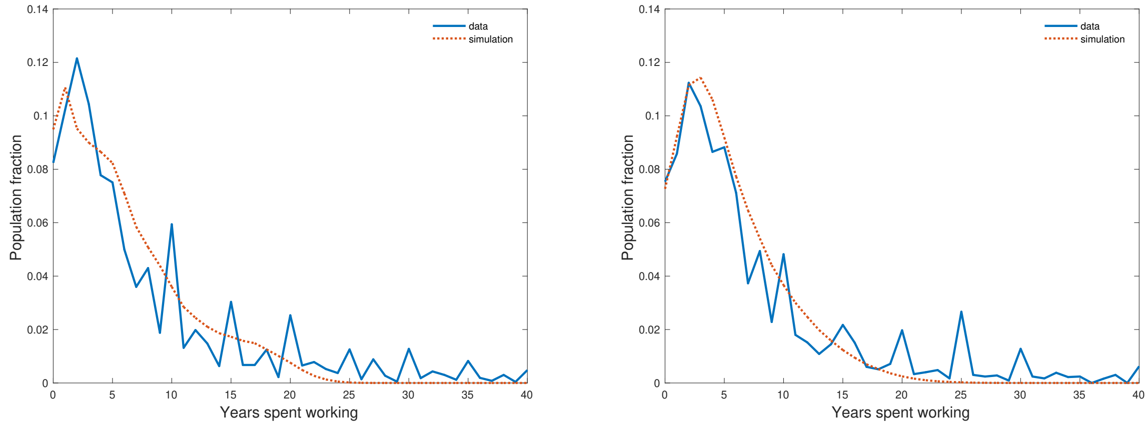
Finally, the table reveals that the skill premium is large, with high-skill workers earning more than twice as much as low-skill workers on average.

2.2 Employment durations and separations

The UEUS does not contain information on job tenure. The NLFS, however, contains a variable that measures for how many years a respondent "has been in employment". The density of this variable for private sector employees is given by the solid line in Figure 1 (low skill workers in the left panel, high skill workers in the right panel). In the entire working age population, almost half the respondents have spent less than five years in employment. A small fraction has spent a significantly larger time in employment. The mean time spent in employment is 8 years, and the median a mere 5 years. For low-skill workers, the mean is 7.4 and the median 4. For high-skill workers, time spent in employment is only slightly higher, with a mean of 9.3 years and a median of 6 years.

Because this variable does not refer to a single job spell but aggregates information across job spells, one cannot directly estimate a job loss hazard using this data. Instead, additional assumptions on job finding need to be made. I therefore estimate the job loss hazard and job finding rate jointly using this series, as follows.

Assume a constant job loss hazard rate ξ and a constant job finding rate f. Simulate individual



(a) Low skills

(b) High skills

Figure 1: Years spent working – data and simulation

work histories for a population with the same age structure as that in the survey, assuming that all individuals start their working life unemployed, find jobs with a monthly probability f, and lose them with a monthly probability ξ. Then compute the population density of years spent working from the simulation. Minimize the squared distance between this and the empirical density.

Doing so leads to estimates of the job loss hazard ξ of 6.6% per month and the job finding rate of 5.1% per month for the entire population. For low (high) skill workers, estimates are 6.3% (6.6%) for ξ and 6.0% (3.1%) for the job finding rate. The simulated density of years worked is shown as the dotted line in Figure 1 (low skills on the left, high skills on the right). Obviously, the simple model abstracts from many features of reality, in particular the dependence of hazard rates on observable and unobservable characteristics of individuals. Yet, despite its simplicity, it provides an excellent fit to the data.[1]

The estimated job loss rate is very high. The fact that it exceeds the estimated job finding rate is very unusual – job finding rates exceed separation rates in almost all countries (see e.g. Elsby et al. (2013) and Donovan et al. (2019)). Yet, these estimates are required to match the very low numbers of years respondents have spent in employment.

Clearly, such a high job loss rate and low finding rate would generate very high levels of unemployment. In reality, their effect is mitigated by the presence of other employment states, in particular self-employment and public sector employment. The full model developed and calibrated in the rest of the paper explicitly takes these states into account.

[1]The main shortcoming of the fit is in the right tail; the model understates the population fraction with high employment durations. A model with an age- or duration-dependent job destruction rate could improve on this. Alternatively, use of a different objective function could force the model to obtain a better fit in the right tail.

2.3 Firm characteristics

The UEUS also contains information on firms, via their owners. Owners report whether they have employees, how many, and in which industry they are active. The latter can be taken as an indication of the skill level of workers in the firm.

Table 2 gives information on employer firms, by skill of the owner and the worker. Since there are hardly any firms with low-skill owners in the high-skill sector, I omit that group, and focus on low-skill owners employing low-skill workers, as well as high-skill owners employing low-skill or high-skill workers. For the purposes of this table and the quantitative analysis below, firms are classified as high-skilled if more than 31.5% of the workers in a firm's industry are high-skilled in LFS data. With this classification, the share of workers in high skill industries equals exactly the share of high-skill workers in private sector employment.

The table shows that most employer firms are run by low-skill owners, and employ low-skill workers. These firms account for nine out of ten firms, and only a slightly smaller proportion of low skill employment. Eighty percent of firms from this group have fewer than five employees (conditional on having employees), and almost all have fewer than twenty employees. The median number of employees is only two. Firms employing high skill workers or run by high skill entrepreneurs are also small by global standards, with median employment of three, but somewhat larger. High-skill owners mostly run firms employing low-skill workers. Only about one percent of firms employ high-skill workers. Given their low number, it is clear that these firms are larger than firms with low-skill workers.

At this point, a caveat is in order. While sample sizes in the UEUS are reasonable for computing shares of firms by size, they are small for computing accurate measures of the size distribution. In particular, the survey almost completely misses large firms. Some information on such firm could be obtained from the Manufacturing Census. Yet, the usefulness of this information would be very limited, given the small role of manufacturing. While the model does generate larger firms, it is thus at this point not possible to verify its accuracy in this dimension.

3 Model

This section sets out a model of entrepreneurship and employment in frictional labor markets. In this setting, policies can affect not only labor demand, but also occupational choices. Effects may also differ by worker skill. Therefore, a key part of the model consists in the choices of het-

Table 2: The firm size distribution (%)

	worker skill/owner skill		
	L/L	L/H	H/H
fraction of firms	90.5	8.3	1.2
fraction of low-skill employment	85	15	
	owner skill		
	L	H	
fraction of firms with...			
$n < 5$	81.1	55.7	
$n < 20$	96.1	83.5	
median employment	2	3	

erogeneous individuals between job search and entrepreneurship (with a further choice between own-account work or being an employer). The results of these choices, as well as rates of unemployment, employment, and wages by skill level, are all endogenous outcomes of the model. They are in turn functions of fundamentals of the economy and of economic policies. The model can thus be used to simulate the responses of the endogenous outcomes to changes in the environment, like variation in labor market frictions or entry regulation.

The model economy consists of a measure one of individuals, and an endogenous measure of firms, which are created and operated by individuals who choose to do so. Individuals who choose self-employment may be employers, and employ other individuals as workers, or they may be own-account workers.

There are two types of individuals, H and L, with high and low skills respectively, present in the population in proportions p_H and p_L, $p_H + p_L = 1$. When working as employees in a firm, they have productivity a_H and a_L, respectively. That is, high-skill workers supply a_H efficiency units of labor per period, and low-skill workers a_L efficiency units. In addition, individuals differ in their taste for entrepreneurship, τ.[2]

Individuals who enter self-employment differ in the productivity z of their enterprise. Based on its

[2] It is well documented that tastes with respect to entrepreneurship differ widely in the population and have a strong effect on the choice to pursue entrepreneurship (see e.g. Hamilton (2000), Hurst & Pugsley (2011)). While taste heterogeneity in itself does not play an important role in the model, it helps generate realistic rates of entrepreneurship across the firm size distribution, as also discussed in Poschke (2018*a*). Without it, only entrants above a specific, endogenous threshold of productivity would run firms, resulting in an unrealistically stark firm size distribution. With taste heterogeneity, this threshold is smoothed out as it depends on both productivity and taste. Then some firms will operate despite low productivity because their owners like the activity.

value, they decide whether to be own-account workers or to employ others. Productivity in own-account work is in line with an individual's productivity as a worker. In equilibrium, those with highly productive enterprises decide to be employers. There are two types of employer firms. Firms can operate either a high-skill technology, using only high-skill workers, or a low-skill technology, using only low-skill workers. Low-skill employers can only operate the low-skill technology, and thus hire only L-type workers. High-skill employers can choose whether to operate the high- or the low-skill technology. That is, they may run a firm employing only high-skill workers, or only low-skill workers.[3]

Finding a job as an employee requires job search in a frictional labor market, analogous to other large-firm versions of the canonical Diamond-Mortensen-Pissarides (DMP) model like Cahuc, Marque & Wasmer (2008) or Elsby & Michaels (2013). That is, the unemployed who do not become self-employed have to search for a job, and may or may not find one in a given period. As a result, some of them remain unemployed. Once an unemployed worker finds a job, wages are bargained between the worker and the employer.

In addition, the model also captures the important realities of casual work and public sector employment in simple ways. Those in casual work earn income, but cannot find a longer-lasting job. Those in government work remain in the sector until retirement.

The model builds closely on Poschke (2018*b*), who adds self-employment, a choice between own-account work and being an employer, and firm size heterogeneity to the DMP model.[4] The setting here goes beyond this by featuring two types of workers and firms, as well as taste heterogeneity. This setting allows analyzing how the regulation of employment affects not only employment and wages, but also unemployment, self-employment, and differences between high- and low-skill individuals. To capture these margins, it is obviously essential to allow for two skill types, and it is also necessary to allow for endogenous entry into self-employment, a choice between own-account work and being an employer, and endogenous firm size and labor market outcomes. Labor market frictions may play an important role in how regulation affects wages, unemployment, and self-employment.

3.1 States, flows and the labor market

Time in the model economy is discrete. The economy consists of a measure one of individuals of the two skill types. Each individual also has a permanent taste parameter τ, which governs her taste

[3] In practice, of course, firms combine both types of workers. Still, this setting is a good approximation of different types of technologies.

[4] See Pissarides (2000) for an overview of the canonical DMP model.

for self-employment compared to wage work. This parameter is drawn from a distribution $\mathcal{T}_j$ at labor market entry, where j indexes worker skill type ($j \in \{H, L\}$). In each period, any individual leaves the labor market through death or retirement with a fixed probability ϕ. At the same time, a measure ϕ of new-born individuals (with the same skill composition as the general population) newly enter the labor market via unemployment. As a result, the population and its skill and taste composition are constant.

At any point in time, an individual can be in exactly one of five states: unemployment, (private sector) wage employment, government employment, own-account work, or being an employer. Let their measures be u_j, n_j, g_j, e_{sj}, and e_{fj}. A fraction of the unemployed engages in casual work in any period.

Flows. Individuals flow between the five states. Some of the flows occur exogenously (like retirement and job destruction), while other flows are endogenously determined in the model (like job finding and self-employment entry). All flow rates can vary between firms using the high-skill and the low-skill technology.

The exogenous flows occur with fixed rates, and are as follows. Existing matches dissolve with a probability ξ_j. Own-account workers and employers need to close their business with probabilities λ_{sj} and λ_{fj}, respectively. All of these flows move the affected individuals into the unemployment pool. For firm closures, employees also lose their jobs and move to unemployment. To simplify notation, denote the total job separation rate for workers by $s_j \equiv 1 - (1-\phi)^2(1-\xi_j)(1-\lambda_{fj})$, and the exit rates for firms by $\tilde{\lambda}_{sj} \equiv \lambda_{sj} + (1-\lambda_{sj})\phi$ and $\tilde{\lambda}_{fj} \equiv \lambda_{fj} + (1-\lambda_{fj})\phi$, respectively. Separations can be caused by death of either the worker or the employer, by firm shutdown, or by an exogenous match separation.

Any period, a fraction δ_j of individuals in the unemployment pool need to engage in casual work. I model this state as a result of a shock instead of a choice to keep the model simple. Modeling it as a choice would require introducing saving, which would substantially complicate the model. While engaged in casual work, individuals cannot search for jobs. In the following period, they return to the unemployment pool and again face the probability δ of casual work. Given its exogenous nature, income from casual work does not affect equilibrium outcomes unless it is so high that individuals would voluntarily choose it over job search. Hence, to save on notation, I assume that both the unemployed and individuals in casual work enjoy an income flow of b.

Similarly, I assume that in any period, a fraction χ_j of individuals in the unemployment pool finds a government job. These jobs last until retirement. I assume that wages paid in these jobs are high enough that individuals would not voluntarily leave them.[5] This model feature mostly serves to get the accounting of different job types right. Given the small entry probability into the sector, it does not affect choices much.

The flows from unemployment into jobs and into self-employment are endogenous. The job finding rate for job searchers f is an equilibrium object, and I discuss its determination below. The entry rate into self-employment, h, depends on choices of the unemployed. Its determination is described when their occupational choice problem is discussed below.

The labor market. The labor market is as in a standard random search and matching model: The creation of new job matches is governed by a matching function, which transforms its inputs – job searchers and job vacancies – into successful matches. This process is segmented along skill lines. Unemployed workers decide whether to search or become self-employed. With a self-employment entry rate h_j, this implies a measure of job searchers $\bar{u}_j = (1-\delta_j)(1-\chi_j)(1-h_j)(1-\phi)u_j$. (Those who retire or take a casual or a government job cannot search.) Note that measured unemployment in a period does not include casual workers.

Firms aiming to hire an employee post vacancies, at a cost of k_{vj} per vacancy and period. Define labor market tightness for skill level j as $\theta_j \equiv v_j/\bar{u}_j$. Then, assuming a standard Cobb-Douglas matching function, the probability that a vacancy is filled in any given period is $q_j = q(\theta_j) \equiv A\theta_j^{-\mu}$, and the probability that a job seeker finds a job is $\theta_j q_j$, where μ is the exponent on vacancies in the matching function, and A parameterizes the efficiency of the matching process. Both probabilities depend only on labor market tightness in the relevant market segment. Since both the number of vacancies and that of searchers arise from choices, labor market tightness in each segment is an equilibrium outcome of the model, and so are the job finding and vacancy filling probabilities.

The distribution of employment states. These flows generate a partition of individuals in the economy into the five states. I will focus on stationary equilibria of this economy. In a stationary equilibrium, the measure of agents in each state is constant. Each measure can be derived by equating flows into and out of a state. In this way, the equilibrium measures of own-account workers and employers can be obtained as

$$e_s = \frac{(1-\delta)h(1-\phi)p_s}{\tilde{\lambda}_s}u \tag{1}$$

[5] This pattern is consistent with longer durations of these jobs, and entry into them later in the life cycle.

and

$$e_f = \frac{(1-\delta)h(1-\phi)p_f}{\tilde{\lambda}_f}u, \tag{2}$$

where p_s and p_f denote the probability that an entrant chooses to become an own-account worker or an employer, respectively, and skill subscripts have been omitted for conciseness. These two endogenous objects are described below.

The unemployment rate in a stationary equilibrium is given by the *modified Beveridge curve* (MBC). For $\lambda_f = \lambda_s$, this simplifies to

$$u = \frac{s}{s(1+\chi(1-\phi)/\phi) + (1-\phi)(1-\delta)(1-\chi)(1-h)\theta q + (1-\phi)(1-\chi)(1-\delta)h(p_f+p_s)s/\tilde{\lambda}_f}. \tag{3}$$

This expression is analogous to the usual Beveridge curve, with three differences. First, finding a government job causes flows out of employment at a rate χ. Since government jobs only end with retirement, this reduces the unemployment rate. Second, individuals on casual jobs cannot search. Therefore, a higher rate of casual jobs, δ, raises the unemployment rate. Third, unemployment outflows occur not only to employment (at a rate θq for searchers), but also to self-employment. As a result, the job finding rate and the unemployment outflow rate are different in this economy. Fourth, employees and entrepreneurs have different flow rates into unemployment. This is captured in the different terms in the numerator of equation (**??**), and results in the final fraction in the denominator in equation (3). Intuitively, if the flow rate into unemployment is lower for entrepreneurs than for employees, then a larger entrepreneurship rate tends to reduce unemployment.

Finally, the measure of employees follows as

$$n = 1 - u - e_s - e_f - g, \tag{4}$$

Next, I describe the values and optimal behavior for firms, employees, and the unemployed.

3.2 Agents' problems, value functions, and occupational choice

Firms. Firms produce a homogeneous good and sell it in a perfectly competitive market. The price of output is normalized to 1. Recall that there are two types of firms, employing a high-skill technology with high-skill workers, or a low-skill technology with low-skill workers. Firms differ in their productivity z. Starting a firm requires paying a fixed cost k_{fj}. After this, entrants learn about the productivity of their venture. (They draw it from a known distribution with mean and variance that can differ by the owner's skill.) For simplicity, productivity is constant throughout a firm's life. Depending on their realized productivity, entrants choose whether to hire employees and which technology to operate, whether to become an own-account worker, or whether to return to unemployment.

Taste τ affects how much an individual enjoys net income from self-employment relative to that from other sources. A taste value larger than 1 implies that the individual enjoys self-employment. This modeling features captures the well-known fact that the taste for self-employment varies broadly in the population, and is an important determinant of being self-employed. The parameter can capture a variety of motives, like e.g. desire to be your own boss, or stand in in a simple way for variation in risk aversion.

Own-account workers produce with the production function $y = \zeta_j a_j z$. The skill-specific parameter ζ controls the relative productivity of firms run by own-account workers. It can also reflect that own-account workers need to cover both management and production tasks, but also that they may be treated more leniently in terms of regulation and taxes, de jure or de facto, which is a typical presumption in the literature (see e.g. Albrecht, Navarro & Vroman 2009).

Employer firms use a production function $y = z(a_j n_j)^{\gamma_j}$, where j indicates the skill type used in the firm, and n_j is employment of workers of type j. (Recall that only a single skill type can be used in a firm.) The parameter $\gamma_j \in (0, 1)$ captures the degree of decreasing returns to scale in production. They could potentially face a tax at rate t_j on their wage bill.

In this setting, a firm's employment is an endogenous object that depends on a firm's productivity, technology, and the cost of labor and hiring. As a result, the model generates firms of different sizes (in addition to own-account workers), and has a well-defined firm size distribution for any distribution of productivity. Firms of the two types differ in the productivity of their employees, in their returns to scale, and in their distribution of productivity. All of these lead to differences in size between the two types of firm. Taste does not affect firm size because it applies to net income, i.e. both revenue and cost. It only affects which firms are active.

Entrants can choose between own-account work and becoming an employer, and high-skill entrants can choose between operating a high- or low-skill firm. The relative attractiveness of these options depends on the wages for the two types of workers (w_j), the cost k_{vj} and difficulty q_j of hiring them, and the relative productivity of own-account workers, ζ_j.

Let a firm's optimal employment choice given prices be $n_j(z)$. Then the value of own-account work for an individual of type j and with taste τ is given by

$$F_{sj}(\tau,z)=\tau\zeta_j a_j z+\frac{(1-\phi)(1-\lambda_{sj})}{1+r}F_{sj}(\tau,z)+\frac{(1-\phi)\lambda_{sj}}{1+r}U_j. \tag{5}$$

The value of being an employer with technology j for an individual of type i is

$$\begin{aligned} F_{fij}(\tau,z)=&\tau\left[z(a_j n_j(z))^{\gamma_j}-(1+t_j)w_j n_j(z)-\frac{k_{vj}}{q_j(\theta_j)}\hat{\xi}_j n_j(z)\right] \\ &+\frac{(1-\phi)(1-\lambda_{fj})}{1+r}F_{fij}(\tau,z)+\frac{(1-\phi)\lambda_{fj}}{1+r}U_i, \end{aligned} \tag{6}$$

where $\hat{\xi}_j=\xi_j+(1-\xi_j)\phi$ is the rate of attrition of workers that a firm faces due to exogenous separations, death/retirement, and accidents.

The value of each activity consists in the utility value of flow profits plus the expected, discounted continuation value. For own-account workers, flow profits are simply equal to output. For employers, they equal output minus the wage bill, minus the cost of rehiring workers who depart, either due to match destruction or due to death. The effective cost of a worker in this setting, due to match separations, is not just w but $w+\hat{\xi}k_v/q$.

Firm entry and type decision. The unemployed can decide to start a firm instead of searching for a job. Doing so involves first paying an entry cost k_{fj}. They then draw their productivity z from a known distribution $G_j(z)$.[6] Based on the realization of z, they decide whether become an employer and of which type, whether to continue as own-account workers, or whether to return to unemployment. The following description is for high-skilled individuals, who can choose to operate either the high- or the low-skill technology. The problem for low-skill individuals is analogous but simpler, since the low-skill technology is not available to them.

For a high-skill entrant with taste τ and productivity z, four choices are available: return to unemployment (yielding U_H), own-account work (yielding $F_{sH}(\tau,z)$), being an employer with the low-skill technology (yielding $F_{fHL}(\tau,z)-\frac{k_{vL}}{q_L(\theta_L)}n_L(z)$), or being an employer with the high-skill technology (yielding $F_{fHH}(\tau,z)-\frac{k_{vH}}{q_H(\theta_H)}n_H(z)$). In the latter two options, the term that is subtracted accounts for the cost of hiring that is incurred to bring the firm to its optimal scale.

The optimal choice is characterized by three thresholds, $z_{sH}(\tau)$, $z_{fH}(\tau)$ and $z_{fHH}(\tau)$. (See Figure 2.) It is clear that the value of unemployment, U_H, is independent of z. It is also clear from equation (5) that the value of own-account work increases linearly in productivity z. Finally,

[6] The assumption of uncertainty about post-entry productivity is in line with the literature on firm dynamics, and is motivated by the large rates of turnover of young firms.

given optimal employment choices discussed below, the net value of operating an employer firm at optimal employment, net of the cost $n_j(z)k_{vj}/q_j$ of reaching that level, is increasing and convex in z.[7] As a result, continuation values as a function of z are as depicted in Figure 2. Entrants with productivity above $z_{fH}(\tau)$ become employers. Those with productivity below $z_{sH}(\tau)$ exit to unemployment, and those with z between $z_{sH}(\tau)$ and $z_{fH}(\tau)$ become own-account workers. The third threshold $z_{fHH}(\tau)$ separates the levels of productivity where it is optimal to be a low-tech employer from those where the optimal choice is to be a high-tech employer. (This structure is analogous to that in Gollin (2007), except for the third threshold.) In general, it is not clear whether the most productive employers choose the high- or the low-skill technology. But one can show that they will choose the one that is closer to constant returns to scale (i.e. the one with the higher level of γ_j).

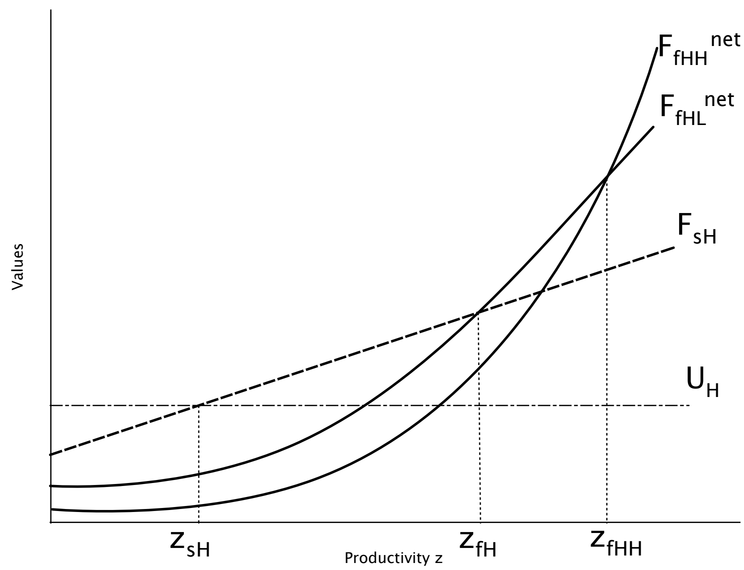


Figure 2: The values of unemployment (U_H), self-employment (F_{sH}), and the value of being an employer net of hiring costs at entry for firms employing low-skill ($F^{\text{net}}_{fHL}(z) = F_{fHL}(z) - n_{HL}(z)k_{vL}/q_L$) and high-skill workers, respectively, with associated productivity cutoffs

Combining these possibilities, the value of entry for high-skill individuals with taste parameter τ

[7] Convexity reflects the ability of employers to leverage their own productivity z by hiring workers accordingly. Given constant firm-level productivity and constant, linear hiring costs due to labor market frictions, it is optimal for firms to move to optimal employment directly upon entry.

is given by

$$
\begin{aligned}
Q_H(\tau) =& \frac{1-\phi}{1+r}\Bigg[-k_{fH} + \int \max\Bigg(F_{fHH}(\tau,z) - \frac{k_{vH}}{q_H(\theta_H)}n_H(z), \\
& F_{fHL}(\tau,z) - \frac{k_{vL}}{q_L(\theta_L)}n_L(z),\ F_{sH}(\tau,z),\ U_H\Bigg)\mathrm{d}G_H(z)\Bigg],
\end{aligned}
\tag{7}
$$

and analogously for low-skill individuals, with the difference that they can only run firms with the low-skill technology.

I now turn to workers and the unemployed.

Workers. Employed workers receive a wage w_j per period. They lose their job with the combined separation probability s_j, and keep it otherwise. Wage determination is discussed below. Since wages are common across jobs in a sector, workers have no incentive to leave a job voluntarily. As a result, the value of employment is given by

$$
W_j = w_j + \frac{1-s_j}{1+r}W_j + \frac{s_j-\phi}{1+r}U_j, \tag{8}
$$

where U_j is the value of the unemployment state, and D_j the value of the post-accident disability state for an individual of skill j.

Government jobs. With probability χ_j, workers permanently enter government employment, earning an exogenous wage w_{gj} per period. Let the value of this state be G_j. Then

$$
G_j = \frac{w_{gj}(1+r)}{r+\phi}. \tag{9}
$$

Unemployment and occupational choice. In any period, the unemployed need to engage in casual work with probability δ_j, and find a government job with probability χ_j. Otherwise, they choose between job search and self-employment entry. These choices determine the self-employment entry rate h_j.

Job search yields a per period flow value of b_j, and results in success with probability $\theta_j q_j$. As a result, the values of search, S_j, and that of casual employment, $\underline{U}_j$, are given by

$$S_j = b_j + \frac{1-\phi}{1+r}\left[\theta_j q_j W_j + (1-\theta_j q_j) U_j\right] \tag{10}$$

$$\underline{U}_j = b_j + \frac{1-\phi}{1+r} U_j. \tag{11}$$

With occupational choice, the value of unemployment for an individual of skill j is given by[8]

$$U_j = \delta_j \underline{U}_j + (1-\delta_j)\chi_j G_j + (1-\delta_j)(1-\chi_j)\max\left\{S_j, Q_j(\tau)\right\}. \tag{12}$$

With probability δ_j, the unemployed need to engage in casual work and cannot search. With probability χ_j, they find a government job. With the complementary probability, they can either search, or choose to start a firm. Since individuals differ in taste, only those with $Q_j(\tau) > S_j$ enter self-employment. Those with τ such that $Q_j(\tau) = S_j$ are indifferent between the two choices. Let the value of τ that satisfies this condition be $\bar{\tau}$. Then, those individuals with $\tau > \bar{\tau}$ enter self-employment. Since $\bar{\tau}$ is endogenous and depends on equilibrium objects, this implies that an endogenous fraction h_j of the unemployed with skill j start a firm, where $h_j \equiv \int_{\bar{\tau}_j}^{\infty} u_j(\tau) \mathrm{d}\tau / u_j$, where $u_j(\tau)$ is the taste distribution of the unemployed with skill j.

3.3 Wage determination and vacancy posting

When a firm and a worker meet and a match is created, the two parties bargain over the wage. Because of frictions in match creation, each match involves some surplus. The wage determines how this surplus is split between the firm and the worker.

Like Cahuc et al. (2008) and Elsby & Michaels (2013), I assume that sector j workers and firms split the surplus from a match, with workers receiving a fixed share proportional to their bargaining weight η_j.[9] Wages are bargained upon hiring, and remain constant thereafter. That is, wages solve the surplus sharing equation

$$(1-\eta_j)(W_j - U_j) = \eta_j \frac{\partial F_f^{ij}(\tau, z, n_j)}{\partial n_j}, \tag{13}$$

where the last term on the right hand side denotes the marginal value of an additional worker to a j-tech firm with productivity z and employment n_j operated by an owner with skill i and taste τ.

[8] Note that via $Q_j(\tau)$, the other worker values also depend on τ. This is suppressed in the equation for conciseness.

[9] See Stole & Zwiebel (1996) and Bruegemann, Gautier & Menzio (forthcoming) for the game-theoretic foundations of this assumption.

For simplicity, I assume that when a worker and a firm bargain over the wage, neither of them can observe the other's taste τ, and that they instead assume that the other has the population average taste.[10]

In this setting, it can be shown (see Appendix A.3 for a detailed derivation) that

$$w = \frac{1-\tilde{\eta}t(\gamma-1)}{1-\tilde{\eta}(1+t\gamma)}\frac{r+\phi}{1+r}\frac{1-\eta}{1+\eta t}U+ \\ + \frac{\tilde{\eta}}{1-\tilde{\eta}(1+t\gamma)}\left[1-\frac{(1-\phi)(1-\lambda_f)}{1+r}+\hat{\xi}\right]\frac{k_v}{q(\theta)}, \tag{14}$$

where $\tilde{\eta} = \eta\dfrac{1+t}{(1+\eta t)}$, and j subscripts are omitted for conciseness.

Four remarks are in order. First, the wage curve given by equation (14) is analogous to the wage curve in a standard DMP model, with the exception of the values of the constants. In particular, wages increase in labor market tightness θ, reflecting the fact that match surplus is larger when the expected hiring cost k_v/q is larger. Wages also increase in the value of the worker's outside option U. Second, although firms vary in productivity, all workers in a market segment are paid the same wage. This is because upon hiring, any worker is marginal, and the relevant surplus to consider in bargaining is that of a marginal job. When firms are at their optimal employment, the marginal surplus is equalized across firms. As a consequence, wages are also equalized across firms of heterogeneous productivity. More productive firms then do not pay higher wages, but instead have more employees. (See Appendix A.3 for more detail on this point.) Third, self-employment opportunities enter bargaining workers' outside option U, and can affect wages in this way.

A firm's optimal employment is given by

$$n(z) = (z\gamma a^{\gamma})^{\frac{1}{1-\gamma}}\left\{\frac{1+\tilde{\eta}(\gamma-1)}{1-\tilde{\eta}t(\gamma-1)}\left[(1+t)w+\left(1-\frac{(1-\phi)(1-\lambda_f)}{1+r}+\hat{\xi}\right)\frac{k_v}{q}\right]\right\}^{-\frac{1}{1-\gamma}}. \tag{15}$$

(Again, see Appendix A.3 for a detailed derivation.) Optimal firm size increases in productivity, and decreases in the cost of employing a worker, which comprises both the wage and the expected cost of replacing departing workers. The taste for entrepreneurship does not affect optimal employment, because it applies to profits.

Continuing employer firms face departures of workers at a rate of $\hat{\xi}$ per period, and thus need to post $\hat{\xi}n(z)/q$ vacancies per period to replace them. New entrants find it optimal to hire $n(z)$

[10] This implies that workers ignore some information at their disposal, like the effect of taste on entry, and that both parties ignore selection patterns. Taking these issues into account would complicate the analysis without obvious added benefit or realism.

workers all at once, and therefore post $n(z)/q$ vacancies. From equation (2), new entrants account for a fraction $\tilde{\lambda}_f$ of employers. As a result, total vacancies in a sector are given by

$$v = \frac{\tilde{\lambda}_f + (1 - \tilde{\lambda}_{fj})\hat{\xi}}{q}\, e_{fj} \int n(z)\tilde{g}(z)\mathrm{d}z. \tag{16}$$

Individuals make choices taking labor market tightness θ in both market segments as given. In equilibrium, tightness generated by individuals' actions in terms of occupational choice and hiring needs to be consistent with this, that is

$$\theta = \frac{v}{(1-\delta)(1-\chi)(1-h)(1-\phi)u}, \tag{17}$$

where the denominator on the right hand side results from entry choices, and the numerator results from entry, firm type and hiring choices.

3.4 Equilibrium

The quantitative analysis considers a stationary equilibrium of this model. In words, this is an equilibrium in which individuals flow across states, but aggregate quantities and flow rates remain constant. More formally:

Stationary equilibrium. A stationary equilibrium consists in values $W_j, G_j, U_j, S_j, \underline{U}_j, F_f^{ij}(\tau, z)$, $F_s^{ij}(\tau, z), Q_j(\tau)$, a distribution described by $u_j, n_j, g_j, e_s^j, e_f^j$, and d_j, probabilities h_j, functions $n_j(z)$, and numbers $\bar{\tau}_j, v_j,\ \theta_j,\ w_j$, for $i, j \in \{H, L\}$ such that

1. the values $W_j, G_j, U_j, S_j, \underline{U}_j, F_f^{ij}(\tau, z), F_s^{ij}(\tau, z), Q_j(\tau)$ are given by equations (5) to (6) and (7) to (12),
2. the unemployed choose optimally whether to enter self-employment ($\tau > \bar{\tau}_j$) or to search,
3. wages fulfill equation (14),
4. the equilibrium distributions are generated by household choices and are stationary, according to equations (1) to (4),
5. firms post vacancies optimally (equations (15) and (16)), and
6. labor market tightness in each segment j (given by equation (17)) is generated by unemployment in- and outflows and by firms' vacancy posting decisions.

The key equilibrium objects are θ_H and θ_L. Given the assumptions on bargaining, θ_j is sufficient for computing value functions and thus optimal choices (entry, firm type, hiring) for individuals and firms of different taste in a market segment. These choices imply flow rates, which in turn determine rates of unemployment, self-employment etc. states in a stationary state of the economy. The combination of these states and choices imply segment-level vacancies and the number of searchers, and thus tightness.

The two sectors of the economy are linked because high-skill employers can run firms employing low-skill workers. This implies that opportunities for high-skill workers, which affect how many of them choose to become employers, can affect demand for hiring low-skill workers. At the same time, opportunities for low-skill workers, which affect how many of them search for wage employment, affect how many high-skill workers choose to run firms with the low-skill technologies.

4 Calibration

To be able to conduct a quantitative evaluation of various policy proposals, I calibrate the model to the economy of Ethiopia. This requires choosing an empirical definition of high versus low skills, choosing distributions for productivity z and taste τ, and setting parameter values. A model period corresponds to one month.

High skill is defined as having completed a diplome or a degree. This implies that the fraction of the labor force with high skills, p_H, is 17.3% (2016 UEUS). The 2013 LFS implies similar figures.

The taste distribution is assumed to be log-normal. Log tastes have standard deviation σ_τ and mean $-\sigma_\tau^2/2$, implying that tastes have mean 1. This distribution is assumed to be identical for both skill groups.[11]

The productivity distribution is assumed to be log-normal, augmented by an atom at a high level of productivity. This is important for capturing the fact that some large employers account for a substantial fraction of employment. This would not be possible with a log-normal distribution alone. Thus, I assume that with probability $1 - \iota_j$ an entrant draws her productivity from a log-normal distribution, where log z has mean μ_j and standard deviation σ_z^j. With probability ι_j, her log productivity is $\mu_j + \kappa_j \sigma_z^j$.

With these choices made, it remains to choose parameter values. Four of these can be normalized: I set the productivity of low-skill workers, a_L, mean productivity of entrants, $\exp(\mu_j + {\sigma_z^j}^2/2)$,

[11] Ideally, all parameters would vary by skill. However, the challenge is to find identifying information in the data. Therefore, I let as many parameters as possible vary by skill, but am restricted to assume that some are common.

$j = H, L$, and the productivity parameter in the matching function, A, to 1. Furthermore, I set the exponent on vacancies in the matching function to the commonly used value of 0.5. The annual discount rate is set to 4%, and the death/retirement probability ϕ is set such that the expected duration of a working life is 40 years. Absent direct information from Ethiopia, the firm exit rates λ_f^j and λ_s^j are set to be equal, and to generate flows out of entrepreneurship of 1% a month as those implied by the data in Bigsten, Mengistae & Shimeles (2007, Figure 3).

This leaves 28 parameters to calibrate: $a^H, k_f^j, k_v^j, \zeta_j, \xi_j, \eta_j, b_j, \gamma_j, \sigma_z^j, \iota_j, \kappa_j, \sigma_\tau, \chi_j, w_{gj}$, and δ_j. These are set to match 28 targets describing the Ethiopian economy. Because of the non-linearity of the model, it is not possible to match these targets exactly. Therefore, I set parameter values to minimize the sum of squared distances between target moments and model equivalents.

Next, I discuss what information is used to calibrate the model. In general, because of the complexity of the model, all parameters affect all calibration targets to some extent. However, each parameter has a particularly strong effect on one or a few target moments. I therefore next discuss which information is useful for identifying which parameter.

I begin with firms and the distribution of productivity. The parameters describing the distribution of productivity are calibrated to match information on the distribution on firm sizes, by skill, computed from the Economic Census for Ethiopia. Concretely, I calibrate γ_j, σ_z^j, ι_j and σ_τ to match the fraction of firms with high-skill or low-skill owners and under 5 and under 20 employees, respectively, as well as the share of low-skill workers in firms run by low-skill owners, the share of high-skill entrepreneurs running low-skill firms, as well as median size of firms run by low-skill owners.[12]

The costs of entry, k_f^j, are set to match self-employment rates by skill. The relative productivity of own-account workers, ζ_j, is set to match the fraction of employers by skill type.

The cost of hiring is one of the main determinants of firms' employment choices, as shown in equation (15). As a result, it directly feeds into vacancy creation by firms (equation 16). Given an unemployment rate and occupational choices, vacancy creation directly determines labor market tightness and thereby a searcher's probability of finding a job (equation 17). Thus, the vacancy posting cost k_v^j is set to match unemployment outflow rates by skill group.[13]

The unemployment rate at a point in time depends on unemployment outflows and inflows. Outflows are essentially governed by the match destruction rate ξ_j. I thus set it to match the unem-

[12] These targets identify a set of combinations of ι_j and κ_j, for each j. In practice, it does not matter much which of these combination is chosen. In principle, additional information on employment at the top of the firm size distribution could be used to choose one of these combinations.

[13] This is computed from unemployment durations reported in the UEUS using the method from Shimer (2012).

ployment rate by skill. Given this, the probability of casual employment by sector, δ_j, can be set to match the unemployment rate, and the probability of finding a governed job, χ_j, can be set to match the fraction of such jobs. The wages in government jobs, w_{gj}, are set to match their data counterparts relative to private sector wages.

Finally, the relative productivity of high-skill workers, a_H, is set to match their relative wage. The bargaining power of workers, η_j, is set to match a labor share in national income of approximately two thirds (Gollin 2002). The utility flow in unemployment, b_j, is set at 40% of the wage.

Table 3: Calibration: model fit

	model skill group		data skill group	
moment	L	H	L	H
unemployment outflow rate (%)	4.9	5.4	4.6	5.3
unemployment rate (%)	23.7	12.8	25.7	12.9
rate of own-account work (%)	19.6	6.7	18.5	4.9
fraction employers (%)	15.0	6.1	11.5	4.0
fraction casual employment (%)	19.5	8.4	21.4	8.2
fraction government employees (%)	14.6	47.3	14.9	48.6
% share of firms with H owners in L industries	76.7		87.4	
% share of L workers employed in firms with L owners	92.9		85.0	
median firm employment	2.4	3.3	2.0	3.0
% share of firms with...				
$n < 5$	96.6	65.1	81.1	55.7
$n < 20$	96.6	70.2	96.1	83.5
skill premium (w_H/w_L)	1.96		2.22	
rel. wage in government (w_{gj}/w_j)	1.22	0.74	1.14	0.83
labor income share	71.1	66.1	67.0	67.0
b/w	0.50	0.56	0.40	0.40

Table 3 shows the fit of the model. Key statistics are matched fairly closely.[14] In particular, the distribution of the population over unemployment and the different employment states is close to the data. Matching the firm size distribution well turns out to be quite difficult. Still, the model obtains a reasonable match, with a very realistic median of employment, and both very small and

[14] At this point, there is still scope to improve the calibration. Because of the large number of parameters and the non-convexity of the objective function, doing so is time-intensive.

somewhat larger firms. As in the Ethiopian economy, there are very few large firms.[15]

Ideally, it would be desirable to evaluate the fit of the model along further dimensions. However, this would require access to additional sources of micro data, to compute moments that could be compared to the model.

Table 4: Calibration: parameter values

		skill group	
parameter	interpretation	L	H
σ_z^2	variance log productivity	0.090	0.299
σ_τ^2	variance log taste	1.195	1.195
ι	probability top productivity	0.020	0.065
κ	level top productivity	11.4	6.0
γ	returns to scale	0.674	0.677
k_f	entry cost	4.0	313.4
ζ	rel. productivity own-account	0.202	0.129
k_v	vacancy posting cost	41.0	122.0
ξ	match destruction rate	0.050	0.017
δ	probability casual work	0.386	0.365
χ	probability government job	0.0006	0.004
a	worker productivity	1	1.782
η	worker bargaining power	0.507	0.499
b	utility flow in unemployment	0.351	0.756
w_g	government wage	0.846	1.011

Table 4 reports model parameters. A few stand out. The productivity of high-skill entrepreneurs is much more dispersed than that of low-skilled ones. In addition, high-skill (low-skill) entrants benefit from a 6.5% (2%) probability of drawing a very high level of productivity. These two parameter settings reflects the fact that larger firms are run by high-skill entrepreneurs, whereas low-skill employers mostly run small firms. While mean productivity of the distribution that entrants draw from does not vary by entrepreneur skill, productivity conditional on choices is higher for high-skill entrepreneurs.

High-skill individuals are also significantly more productive as workers. This gives them a wage premium of around 100%, in line with the data.

Finally, the calibration assigns much higher entry costs to high-skill owners. At the same time, their relative productivity as employers (compared to own-account workers) is higher. If it were

[15] As stated above, the model probably understates the true importance of large firms due to measurement issues.

not for the high entry costs, the attractive productivity distribution faced by high-skill entrants would motivate too many high-skill individuals to start firms. The higher entry cost is, of course, in line with the larger size and (not measured here) capital intensity of businesses run by high-skill employers. The higher relative productivity as an employer leads a larger fraction of high-skill entrants to become employers, in line with the data. This could be interpreted to reflect choices of industry and production technology of high-skill entrepreneurs, which more naturally imply employing others.

The calibration also assigns higher vacancy posting costs to high-skill owners. Otherwise, their higher productivity would translate into excessive (compared to the data) unemployment outflow rates. The match destruction rate for low-skill workers is extremely high, at 5%. This lets the model match the low-skill unemployment rate. Finally, the small probabilities of entering government jobs let the model match the observed share of employment in that sector.

For a model of labor market flows, it is important to match empirical flows well. Apart from information on unemployment outflows obtained from duration data, there is no recent flow data with broad coverage. For an earlier period, 2000-04, labor market transitions are reported by Bigsten et al. (2007).[16] This was a period with lower rates of private sector employment and higher rates of government employment. Still, it featured similar entrepreneurship exit rates and similar rates of finding government jobs as those obtained in the calibration. Transitions between unemployment and private sector jobs, however, were much less dynamic at that time. The higher rates found in recent data are in line with the increasing importance of private sector wage employment.

Overall, the model captures key features of the Ethiopian economy: high rates of self-employment and in particular own-account work, and a preponderance of small firms, combined with a very small number of very large employers. In the following section, I use the calibrated model for policy analysis.

5 The determinants of unemployment and self-employment

The model matches the composition of employment in Ethiopia, with its high rates of unemployment and self-employment, in particular for the low-skilled. What accounts for their prevalence, according to the model? To answer this question, I will first inspect model parameters and compare them to estimates for other countries, where possible. I will then explore the effect of varying key parameters on the composition of employment.

[16] These rates need to be converted to a monthly basis.

5.1 Model parameters governing unemployment

The unemployment rate is given by the modified Beveridge curve (MBC). It depends on the balance of unemployment in- and outflows. Inflows occur from wage employment at the exogenous rate ξ_j. (Other components of the separation rate s_j are quantitatively less important.) The core outflow rates are that to wage employment, f_j, and that to entrepreneurship, h_j. Outflows to casual work, δ_j, are temporarily and therefore effectively just reduce the outflow rate. Outflows to government jobs are permanent, but occur at a very low rate. The job finding rate f_j depends on firms' incentives to post vacancies, which depend on the vacancy posting cost k_v^j as well as unemployment flow utility b_j, which has an effect on wages.

The self-employment rate similarly depends on the balance of in- and outflows. Outflows are given by the exit rate. Inflows occur from unemployment, and depend on the relative attractiveness of self-employment as well as the distribution of tastes. The attractiveness of self-employment depends on the entry cost, k_f^j, but also on the attractiveness of the alternative, job search, and thus on the job finding rate.

What are the calibrated values of these parameters, and how do they compare? First, firms in the calibrated benchmark economy face an expected cost of hiring, k_v^j/q_j, of about four times the monthly wage for low skill workers, and about six times the monthly wage for high-skill workers. These hiring costs are comparable to those reported for developed economies. This is surprising, given that jobs in richer economies often require more specific skills, explaining the cost of hiring. In particular for low-skill jobs, this cost of hiring appears very high.[17]

As a consequence, job finding rates are low, at 6.6% per month for low-skill workers and 6.9% for high-skill workers. These rates are at the low end internationally (Donovan et al. 2019). The unemployment outflow rate is about 5% for both skill levels. (The job finding rate is conditional on search and can therefore exceed the unemployment outflow rate.) This is a similar level to that observed in continental European economies (Elsby et al. 2013).

Second, the separation rate ξ_j is very high for low-skilled workers, at 5% per month. For high-skilled workers, it is lower, at 1.7% per month. But even this rate is high: it exceeds continental European separation rates, which cluster around 0.5-0.7% per month, and is comparable to separation rates in Australia or New Zealand (Elsby et al. 2013). Yet, these countries have significantly

[17] Note that this high cost of hiring may appear to contrast with reports that firms can fill vacant positions very quickly. Time aggregation matters here: the model features a cost of hiring for a job that remains filled after a month. In reality, it is not uncommon for matches to dissolve more quickly than this (see e.g. Blattman & Dercon 2018). The cost here should thus be interpreted as the cost of filling a position and keeping it filled after a month, which may in practice require a sequence of hires.

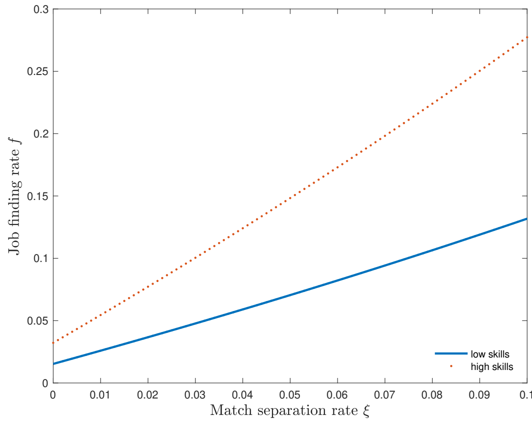
higher unemployment outflow rates than Ethiopia. Moreover, it is a general phenomenon across countries that separation rates are lower for high-skilled workers. Therefore, countries with an average separation rate around 1.7% will have lower separation rates for high-skilled workers, making the high-skill separation rate inferred for Ethiopia high in international comparison. Since the unemployment rate increases close to linearly in the separation rate for low values of the separation rate, these differences are very significant.

Overall, the two skill types face very different labor market situations. High-skill workers face very low job finding rates and moderate separation rates, resulting in slightly elevated unemployment. Since entry into self-employment activities appropriate for their skill level is costly, they mostly focus on job search. Low-skill workers also face very low job finding rates but, on top of that, very high separation rates. Because this makes search unattractive, and because self-employment entry in low-skill activities is less costly, self-employment constitutes an important alternative to job search for these workers.

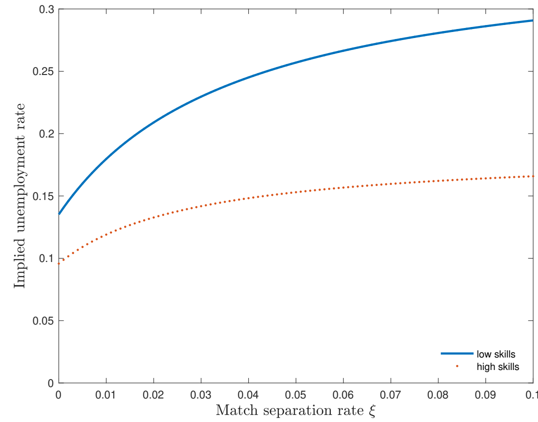
5.2 Unemployment – an accounting analysis

The model calibration uses the unemployment rate by skill as a target, and thus matches its level by construction. It also uses the unemployment outflow rate as a target. This is observed to be rather low, and thereby contributes to high unemployment. The match separation rate is not observed directly. The calibration assigns rather high values to this rate in order to match the high unemployment rate. From the MBC (equation 3), for given values of $\delta_j, h_j, \phi_j, \chi_j, p_f^j$ and p_s^j, and unemployment rate of 25.7% can be attained in various ways. One of them is a job finding rate of 6.7% coupled with a separation rate of 5%, as in the benchmark calibration. The solid line in Figure 3a illustrates other combinations consistent with a 25.7% unemployment rate. The dotted line shows the combinations consistent with the 12.9% high-skill unemployment rate. This shows that both components contribute to the high unemployment rate, for both skill levels.

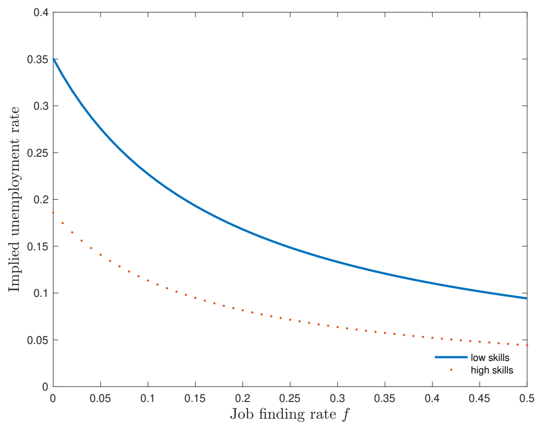
The remaining panels of Figure 3 show how unemployment depends on other model parameters and equilibrium outcomes: the separation rate ξ, the job finding rate f, and the rate of casual work δ. It is clear that lower separations, faster job finding, or a lower need for casual work could all reduce unemployment. (The need for searchers to take on casual work – and the time spent away from search as a result – reduces the efficiency of search.) However, while unemployment varies significantly with each of these rates, low-skill unemployment tends to remain above 10% even if there were no separations, job finding was very fast, or there was no need for searchers to take casual jobs. This illustrates the interaction of these features: for example, eliminating separations



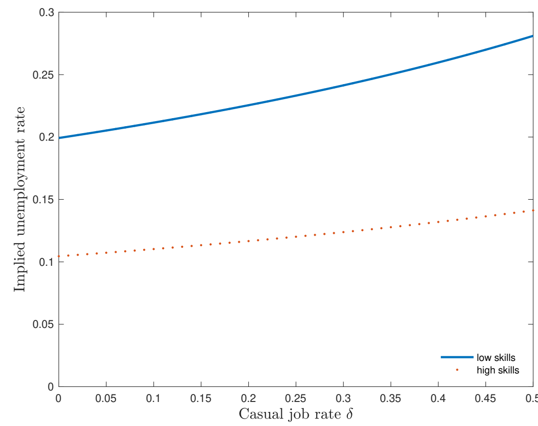
(a) Combinations of ξ and f generating observed unemployment



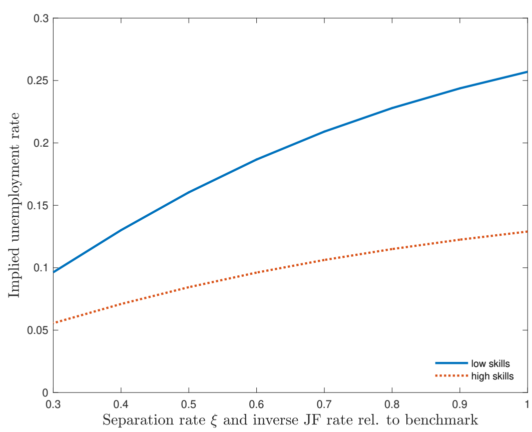
(b) Separations and unemployment



(c) Job finding and unemployment



(d) Casual work and unemployment



(e) Lower separation rates and higher JF rates and unemployment

Figure 3: Labor market frictions and unemployment – an accounting analysis using the modified Beveridge curve

Note: These simulations use the modified Beveridge curve (equation 3), keeping all other parameters and the self-employment entry rate at their values in the benchmark economy.

has a limited impact on unemployment if the job finding rate remains low. Reducing both the separation rate and raising the job finding rate can reduce unemployment more significantly (Figure 3e). This joint reduction in frictions can bring low-skill unemployment below 10% and high-skill unemployment towards 5%. Note however that the scenario with the lowest frictions shown in this panel reduces the separation rate by 70% and increases the job finding rate by a factor 1/0.3, or more than 3. These are very large changes that would naturally completely transform the labor market.

How do reductions in different frictions compare? Cutting the separation rate in half would reduce low-skill unemployment by 3.7 percentage points and high-skill unemployment by a bit more than one percentage point. As shown in Figure 3b, the marginal effect of reducing separation rates is low at high rates, and grows as rates decline. Doubling the job finding rate would reduce low-skill unemployment by 4.4 percentage points and high-skill unemployment by 3 percentage points. Here, the marginal effect of raising this rate decreases in its level. Completely eliminating separations (surely unrealistic and in fact not desirable, but a useful benchmark) would reduce low-skill unemployment to 14% and high-skill unemployment to just under 10%. Raising the job finding rate to the very high levels seen in the US would reduce unemployment even more. Overall, it appears that reductions in both frictions have the potential to strongly reduce unemployment, with a slightly larger effect of increases in the job finding rate.

It is important to note that this is a pure accounting analysis. In particular, it does not take into account how behavior of searchers and firms reacts to parameter changes. For example, changes in the separation rate would also make hiring more attractive to firms, and should therefore also lead to a higher job finding rate. These changes would also affect the self-employment entry rate: more attractive job search, due to fewer separations or quicker job finding, should reduce self-employment entry. This tends to raise unemployment somewhat, but may be good for efficiency of the economy. I thus next turn to a fuller analysis using the model.

5.3 Frictions and equilibrium unemployment

To assess the effect of frictions on the full model, I solve the model several additional times, varying parameters. In the following, I discuss the effects of reducing labor market frictions, as parameterized by k_v and ξ. I first illustrate the mechanism in detail, and then assess the potential for reductions in frictions to reduce unemployment and increase wage employment.

Table 5 shows the effects lower hiring frictions on occupational choices and aggregate model outcomes. The table shows the effect of a reduction in k_v by 30%. While in the model, k_v stands for

Table 5: The effect of lower hiring frictions

reduce by 30%:	k_v^L		k_v^H		k_v^L and k_v^H	
	outcomes for skill group					
	L	H	L	H	L	H
% change in:						
θ_j	64.5	-7.5	0.0	65.5	67.9	60.8
w_j	-0.6	-1.9	0.0	0.8	0.0	-0.5
effective cost of labor	-2.2	-2.1	0.0	-0.2	-1.5	-1.6
aggregate welfare	2.0		1.2		3.2	
..., fixed occupational choices	-0.2		0.8		1.5	
..., fixed occupational choices and unemployment	-0.6		0.7		1.0	
% pt change in:						
u outflow rate	1.2	-0.1	0.0	1.3	1.2	1.2
job finding rate	1.9	-0.3	0.0	2.0	2.0	1.8
unemployment rate	-2.1	0.1	0.0	-1.0	-2.1	-1.0
fraction employees	3.8	-1.0	0.0	5.0	4.2	4.5
rate of...						
own-account work	-3.8	-0.2	0.0	-0.3	-3.1	-0.5
employers	3.7	1.0	0.0	0.2	2.5	0.8
% share of firms with H owners in L industries	-2.7		-2.4		-2.2	
% share of L workers employed in firms with L owners	0.7		0.1		0.4	
elasticity of ... with respect to the parameter change:						
u_j	0.26	-0.01	0.0	0.24		
rate of own-account work	0.61	0.09	0.0	0.16		

hiring costs borne by employers, one should not take such a narrow interpretation. The reason is that reductions in k_v in the model affect outcomes of interest in the same way as increases in the efficiency of the matching process. Hence, one can think of lower k_v as stemming not only from improvements in firms' hiring efficiency, but also as capturing anything else that makes it easier to create a productive match between a worker and a firm.

The table shows results for reductions in k_v for low-skill workers only, high-skill workers only, and both groups. For each skill group, lower hiring frictions motivate firms to hire more workers and post more vacancies, driving up tightness θ in the respective labor market segment. This leads to a higher job finding rate, faster unemployment outflows, and a lower unemployment rate. The reaction of the unemployment rate to the higher job finding rate is of a similar size as that found in the accounting analysis above (see Figure 3c). Yet, the model also predicts that unemployment outflows decline by less than the job finding rate because better chances of finding jobs attract individuals from self-employment into job search. As a result, the fraction of own-account workers declines steeply – by more than the unemployment rate for low-skill workers. The elasticity of the low-skill rate of own-account work with respect to k_v^L is 0.61, much larger than the elasticity of low-skill unemployment of 0.26.

High-skill workers experience wage gains as a result of increased hiring by firms when k_v^H declines. This is not the case for low-skill workers after a reduction in k_v^L, because of the larger inflow of searchers out of own-account work. Welfare increases in all cases, since fewer resources are devoted to hiring, and more individuals end up in productive employment. Welfare changes are a combination of changes in net income for the different employment groups, and shifts across the groups. The table shows that, if occupational choices were kept fixed, welfare would actually decline as k_v^L declines. Hence, changing occupational choices are key for the economy to reap gains from advantageous changes in the environment. Across scenarios, about half the welfare gains come from changes in occupational choices.

There are also some changes in the population of firms. The decline in k_v^L affects firm creation and labor demand by low-skill employers particularly strongly. As a result, more workers work in their firms. Lower k_v^H makes creating high-skill firms more attractive for high-skill entrepreneurs. While lower k_v^H hardly affects low-skill workers, reduced frictions in hiring low-skill workers do affect high-skill workers. Because of increased demand for low-skill workers, their labor market tightness and wages decline slightly.

The second key reason for high levels of unemployment are high separation rates. Table 6 shows the effect of reducing model separation rates by 30%. As firms anticipate that matches will last longer, they post more vacancies, so that tightness increases. Higher demand for workers raises their wages. The effective cost of employing workers still declines, as they stay with the firm for longer.

Higher tightness translates into a higher job finding rate and faster unemployment outflows. The latter compound the effect of lower separations on unemployment: where the accounting analysis would have predicted a decline in the low-skill unemployment rate by only 1.8 percentage points (see Figure 3b), the unemployment rate here declines by almost 3 percentage points. This captures the additional, endogenous response of the job finding rate, which was kept constant in the accounting analysis. In addition, the model predicts a sharp decline in the fraction of own-account workers, and thus a very large increase in wage employment.

Table 6: The effect of a lower separation rate ξ

reduce by 30%:	ξ^L		ξ^H		ξ^L and ξ^H	
	outcomes for skill group					
	L	H	L	H	L	H
% change in:						
θ_j	34.4	-2.6	-4.4	16.3	27.7	10.6
w_j	2.8	-0.7	-1.3	0.7	0.8	-0.6
effective cost of labor	-0.4	-0.7	-1.4	-1.5	-2.7	-2.9
% pt change in:						
u outflow rate	0.7	0.0	-0.1	0.4	0.6	0.3
job finding rate	1.1	-0.1	-0.1	0.5	0.9	0.4
unemployment rate	-2.9	0.0	-0.1	-1.1	-3.2	-1.0
fraction employees	7.0	-0.3	-0.6	4.6	6.3	4.0
rate of...						
own-account work	-2.9	-0.1	-1.7	-0.5	-5.5	-0.7
employers	0.5	0.3	2.7	1.0	4.5	1.5
% share of firms with H owners in L industries	-0.1		-16.7		-1.8	
% share of L workers employed in firms with L owners	0.2		1.4		0.4	
elasticity of ... with respect to the parameter change:						
u_j	0.39	-0.01	0.01	0.25		
rate of own-account work	0.48	0.03	0.25	0.23		

Again, there are some interactions across skill groups: lower separation rates for one group make it more attractive to hire that group, and therefore slightly reduce tightness and wages in the other market segment.

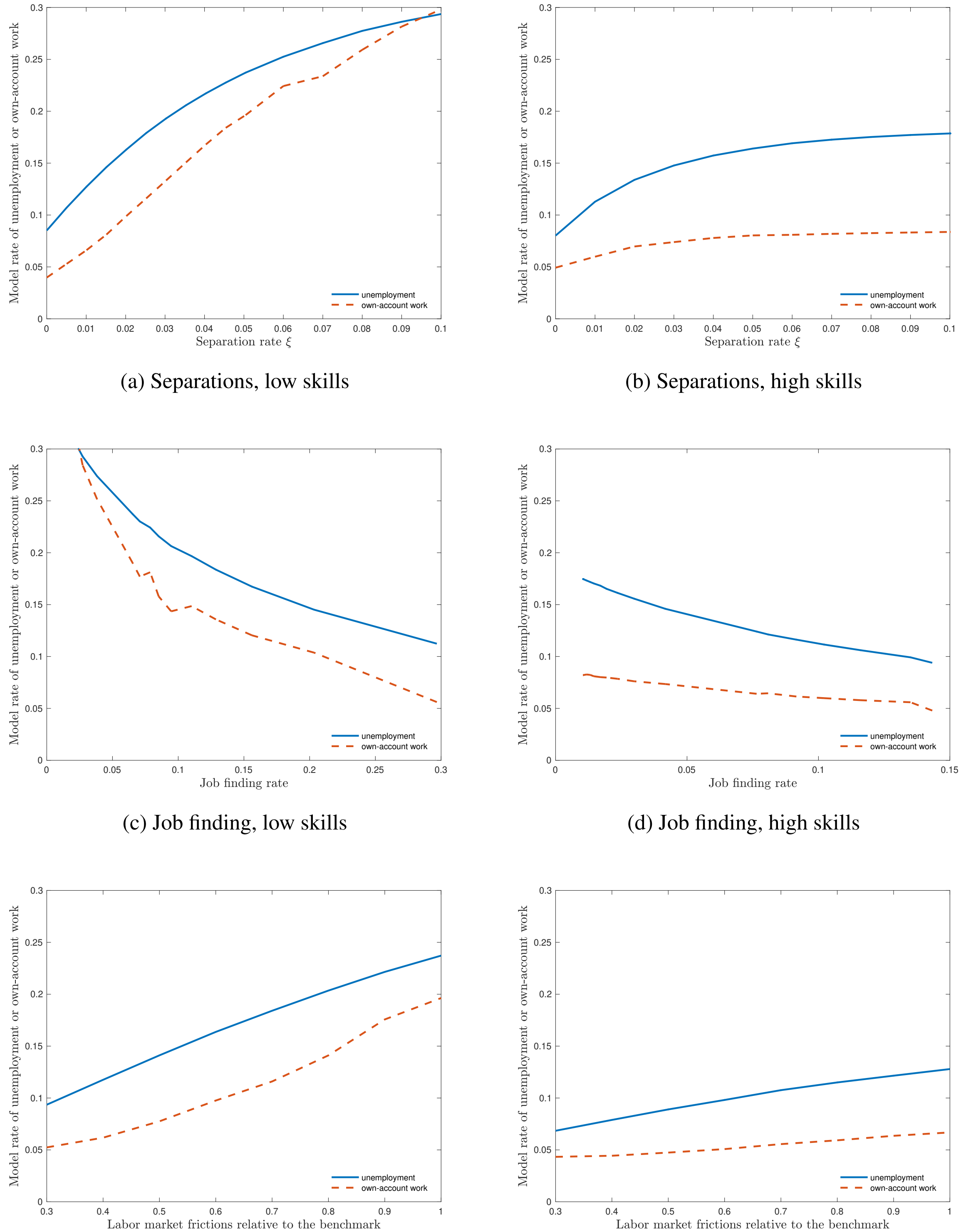
Figure 4 shows the reactions of unemployment and self-employment to changes in the separation rate and to changes in the job finding rate induced by changes in k_v for a whole range of changes. These results highlight what we learn from the model beyond the lessons from an accounting analysis. First, changes in the separation rate lead to larger changes in unemployment than found in the accounting analysis, because of the endogenous response of vacancy posting: firms react to lower separations by hiring more, which in turn reduces unemployment (Figure 4a). This effect is strong. The same is true, to a lesser extent, for changes in the job finding rate brought about by changes in hiring frictions. As a result, the finding shown in Figure 3 is overturned. Endogenous responses of other margins, which were ignored in Section 5.2, imply that reductions in both frictions have a similarly strong potential to reduce unemployment rates.

Second, for the low-skilled, changes in the separation rate or in hiring frictions lead to large changes in the rate of own-account work. In fact, in line with the elasticities reported in Table 5, the changes in the fraction of own-account workers are larger than those in the unemployment rate. The effect is also present for high-skill workers, but quantitatively smaller. In general, reductions of frictions from the benchmark first reduce own-account work most. Further reductions then reduce unemployment more. (See the bottom panels.) This implies that reductions in frictions not only increase wage employment by reducing unemployment, as already seen in Figure 3, but increase wage employment even further due to the reduction in own-account work.

Third, there are differences across skill groups. Because low-skill matches last less long, low-skill unemployment would be higher even if job finding rates were identical. Even if both separation and job finding rates were identical (not shown), low-skill unemployment would still be higher due to the lower propensity of the public sector to hire low-skill workers. The reaction to changes in frictions also differs across skill groups. While reductions in unemployment do not differ that much across skill groups, reductions in own-account work are particularly stark for the low-skilled.

Sufficiently large changes in frictions can reduce unemployment and self-employment rates to the range of 5 to 10%. These reductions do not appear entirely unrealistic or fundamentally infeasible: Reducing separations rates by 70% would take them to 1.5% and 0.5% monthly for low- and high-skilled workers, respectively. These values are in the range of continental European countries (Elsby et al. 2013). Reducing k_v by 70% would raise job finding rates to 16 to 18% monthly. These values are comparable to those in the UK or Japan (ibid.). Poor countries in South-East Asia, which tend to have low unemployment rates, tend to have flow rates in this range (see e.g. Poschke 2019). Hence, a transition from continental European job finding rates, combined with Anglosaxon job destruction rates to the inverse could reduce unemployment and self-employment rates by up to two thirds for the low-skilled, and more than third for the high-skilled. A more limited reduction that left these rates close to international averages could reduce unemployment and self-employment by a third or more.

Summarizing, both hiring frictions and high rates of separations contribute significantly to the high unemployment rates and the high self-employment rates in urban Ethiopia. The effect of high separation rates is amplified as firms respond to them by hiring less. Reactions in frictions also lead to large reactions in own-account work, implying that wage employment increases by significantly more than just the reduction in unemployment. This effect, like the effect of lower separations on hiring, cannot be captured by accounting models. Finally, changes in occupational choices are necessary to capture the full welfare gains from reductions in labor market frictions.



(a) Separations, low skills

(b) Separations, high skills

(c) Job finding, low skills

(d) Job finding, high skills

(e) Lower frictions, low skills

(f) Lower frictions, high skills

Figure 4: Labor market frictions and unemployment – model predictions

Note: These simulations use the full model. In the top panels, the separation rate ξ is varied. In the middle panels, the vacancy posting cost k_v is varied. For comparability to Figure 3, the graphs show the implied job finding rate instead of k_v on the horizontal axis. In the bottom panels, ξ_L, ξ_H, k_v^L and k_v^H are all varied at the same time by the same proportion, and their values relative to the benchmark are shown on the horizontal axis. In all panels, other outcomes adjust endogenously in the model.

6 The effects of policies towards entry and unemployment

This section explores the effect of policies and other components of the economic environment on self-employment and unemployment. First, I analyze the effect of entry barriers, since high self-employment rates in poor countries are often thought to reflect low barriers to entry. Then I quantify the potential effect of income support policies for the unemployed on self-employment and unemployed.

Table 7 shows the effect of reducing entry costs in the model by 30%. Lower entry costs attract the unemployed into self-employment. As a result, unemployment declines, the pool of searchers shrinks, and wages increase. For a reduction in low-skill entry costs, all additional low-skill entrepreneurs become own-account workers. The fraction of low-skill employers declines due to the higher cost of labor.

Table 7: The effect of a lower entry cost k_f

reduce by 30%:	k_f^L		k_f^H		k_f^L and k_f^H	
	outcomes for skill group					
	L	H	L	H	L	H
% change in:						
θ_j	6.7	8.6	12.5	13.7	19.9	22.1
w_j	1.9	2.2	3.5	3.4	5.6	5.5
effective cost of labor	2.1	2.4	4.0	3.8	6.2	6.0
% pt change in:						
u outflow rate	0.1	0.2	0.2	0.5	0.3	0.6
job finding rate	0.2	0.3	0.4	0.5	0.6	0.7
unemployment rate	-0.8	-0.1	0.2	-0.7	-0.5	-0.7
fraction employees	-0.6	1.0	1.8	-0.2	1.2	0.8
rate of...						
own-account work	2.7	0.2	4.0	1.0	6.0	1.1
employers	-0.2	-0.9	-6.7	2.9	-6.4	1.8
elasticity of ... with respect to the parameter change:						
u_j	0.09	0.02	-0.02	0.15		
rate of own-account work	-0.36	-0.08	-0.52	-0.38		

For the same reason, the fraction of high-skill employers falls. At the same time, the higher cost of low-skill labor leads more high-skill employers to open up shop in high-skill industries. This increases demand for high-skill workers, and thus their wages and employment rates. The reduction in low-skill searchers brought about by the increase in self-employment entry thus spills over to high-skill workers, as firms shift employment towards them.

The effects are similar for lower entry costs for high-skill firms. In this case, the effect of the lower entry cost dominates that of the higher cost of labor, and more high-skill employers are created. Again, the effect spills over: the higher cost of employing scarcer high-skill workers also leads to increasing demand for low-skill workers, pushing up their wages.

Overall, it is obvious that entry costs are an important determinant of self-employment entry, just like the labor market frictions seen above. Lower entry costs have the potential to reduce unemployment – but they do not necessary raise wage employment, since they mostly affect self-employment entry, and only a small fraction of the self-employed become employers. Moreover, for the low-skilled, the elasticity of the rate of own-account work with respect to the entry cost is significantly smaller in absolute value than that with respect to k_v^L. This implies that low entry costs are not the main determinant of high rates of own-account work here – high labor market frictions are at least as important.

Given the high observed levels of unemployment, income support for the unemployed has been proposed. Often, the concern is that such a policy would make the unemployed better off, but would also lead to increased levels and durations of unemployment. To assess this, I simulate the effect of raising the flow value of unemployment, b_L, by 30%. This corresponds to a payment of 15% of the low-skill wage in the benchmark economy each month. In the scenario considered here, this might plausibly allow individuals to search more and engage in less casual work. Therefore, I also assess the effect of a transfer that results in a reduction in the rate at which searchers undertake casual work by 30%.[18]

Effects of these changes are shown in Table 8. Consider first the scenario where only b_L increases. The first direct effect of this is to increase wages, and thus to reduce vacancy posting by firms, and thus labor market tightness. As a result, job finding slows down, the unemployment rate increases, and the wage employment rate declines. The increase in unemployment is exacerbated by the fact that more attractive search induces the unemployed to search and not to take up self-employment. Summarizing, the effect of transfers on unemployment benefits and levels is standard, and is amplified by the reduction in self-employment entry. These effects are similar for both skill groups.

When higher benefits lead to more efficient search (lower δ), these effects are qualitatively similar. Because more effective search on its own also makes search more attractive compared to self-employment, the increase in the unemployment rate is amplified. The larger pool of searchers does

[18]Alternatively, one might think that income support could allow constrained workers to invest more in search, as the findings of Abebe, Caria & Ortiz-Ospina (2017) would imply, and would thereby increase the efficiency of search.

not translate into higher wage employment because of the reduced job finding rate.

This analysis abstracted from the need to finance benefits by taxes. In the last counterfactual, I assume that the increase in benefits is financed by payroll taxes. Table 8 shows results for an increase in b_L, and for an increase in b_L combined with a reduction in δ_L. In the first case, a payroll tax of 5% on all employees is required to finance the change in b. In the second scenario, a tax rate of 5.5% is required. These tax rates are high given the high incidence of unemployment. In practice, collecting them may be a challenge, since most firms are small and many may be informal and evade taxes. As is well known (see e.g. Restuccia & Rogerson 2008), collecting them only from larger firms induces misallocation of resources, which can have a substantial welfare cost. Here, I abstract from this problem. (A different, related problem consists in the screening of the eligibility of beneficiaries.) Then, the burden of the taxes is shared by employers and workers. Overall, wages now fall slightly, since taxes more than compensate for the effect of the higher outside option. Tightness contracts sharply due to taxes. The reduction in vacancy posting and tightness compensates for the effect of taxes on the effective cost of hiring workers.

Lower tightness implies a substantially larger increase in unemployment than in the case without taxes. The change in the rate of low-skill own-account work is not much affected by taxes. This arises from the balance of two effects. While higher unemployment makes self-employment more attractive, taxes that employers would have to pay make it less attractive. For the high-skill, the latter dominates, and self-employment falls despite lower wages and higher unemployment.

In all scenarios, welfare increases strongly. This is despite a decrease in aggregate consumption due to the distortionary effect of payroll taxes. There are two types of major welfare changes: First, income support redistributes from employees, who pay payroll taxes, to low-skill job searchers. In the present setting with linear utility, this redistribution does not increase aggregate welfare. Second, marginal own-account workers are attracted into job search, where they are better off. This second effect is quantitatively important, and depends on the distribution of taste for self-employment.

Given the fact that welfare gains from benefits depend on the distribution of taste for self-employment, it may be more productive to dedicate resources to promoting search and improving search outcomes, aiming for outcomes as in Table 5 and Figure 4c. Findings such as those by Abebe et al. (2017) suggest that there is large scope for this.[19]

[19] Note that while employment protection legislation is known to reduce separation rates, it does not appear to be a promising policy in this context since it can also suppress hiring and cause resource misallocation across firms (see e.g. Hopenhayn & Rogerson 1993).

7 Conclusion and Discussion: Sources of frictions

The analysis in this paper has shown that labor market frictions are very strong in urban Ethiopia. Job finding rates are very low, and the low-skilled also face very high job separation rates. These frictions contribute not only to high unemployment, but also to high rates of own-account work for the low skilled.

A natural next question to ask is why labor market frictions are so high in Ethiopia. There are many potential candidates, among which search costs for workers or for firms, and information frictions in matching. Without longitudinal data on individuals, firms, or employees in firms, ideally at a high frequency, it is hard to assess their importance directly.

Existing experimental evidence suggests a combination of high search costs for workers and information frictions. Abebe et al. (2017) estimate that search costs for job seekers are very high, and that job seekers are financially constrained, implying sub-optimal levels of search on their part. This is reflected in low job finding rates and high rates of casual work in the model here. Franklin (2018) also finds that reducing search costs at the individual level improves job search outcomes in Addis Ababa. In line with this, Blattman & Dercon (2018) show that individuals use temporary, unpleasant jobs to cope with adverse shocks or finance search for better jobs or future self-employment.

Experiments conducted in other African countries have found that certifying worker skills affects labor market outcomes and that job fairs can improve employment outcomes by conveying information (Beam 2016, Bassi & Nansamba 2018, Carranza, Garlick, Orkin & Rankin 2019). In another experiment, Banerjee & Chiplunkar (2018) find that the quality of job matches can be greatly improved, even when it is already done by professionals.

Ethiopia is not alone among poor countries in having high job separation rates and low job finding rates. Donovan et al. (2019) analyze flows across labor market states in the urban areas of 36 countries, the poorest of which are Nicaragua and the Philippines. Figure B1 in their paper shows that poorer countries generally have slightly higher flows from wage work to unemployment, slightly lower flows from unemployment into wage employment, and much higher flows from unemployment to self-employment. These authors also interpret high levels of separations as stemming from information frictions.

Table 8: The effect of income support (higher b) and less casual work (lower δ)

raise by 30%:	b^L		b^L and b^H		b^L		b^L and b^H		b^L		b^L	
									— financed by payroll taxes —			
reduce by 30%:					δ^L		δ^L and δ^H				δ^L	
	outcomes for skill group											
	L	H	L	H	L	H	L	H	L	H	L	H
% change in:												
θ_j	-32.8	0.6	-28.1	-22.6	-36.5	0.1	-34.4	-30.3	-45.7	-16.4	-51.0	-17.7
w_j	3.8	0.2	5.2	3.4	3.5	0.0	5.1	3.0	-0.4	-4.2	-0.8	-4.6
effective cost of labor	0.1	0.2	1.8	1.8	-0.6	0.0	1.0	1.0	-0.7	-0.4	-1.3	-0.4
% pt change in:												
u outflow rate	-0.8	0.0	-0.8	-0.6	-0.3	0.0	-0.2	-0.1	-1.2	-0.4	-0.8	-0.5
job finding rate	-1.2	0.0	-1.0	-0.8	-1.3	0.0	-1.3	-1.1	-1.7	-0.6	-2.0	-0.6
unemployment rate	2.1	0.0	2.2	0.6	5.4	0.0	5.7	2.4	3.2	0.4	7.1	0.5
fraction employees	-2.6	0.1	-1.8	-2.2	-0.5	-0.1	0.2	-0.3	-3.9	-1.5	-2.1	-1.5
rate of...												
own-account work	-1.6	0.1	0.0	-0.2	-1.5	0.0	0.1	-0.2	-1.8	-0.1	-1.5	-0.2
employers	0.2	-0.1	-2.8	-0.5	2.4	0.2	-0.6	0.1	-0.5	-0.6	1.3	-0.7
% share of firms with H owners in L industries	-18.5		-4.8		5.7		-5.1		-19.2		7.3	
% share of L workers employed in firms with L owners	1.9		-0.1		-0.5		0.2		2.1		-0.1	

Notes: Required payroll tax rates: 5% when δ at benchmark value, 5.5% when δ is reduced 30%.

References

Abebe, G., Caria, S. and Ortiz-Ospina, E. (2017), 'The Selection of Talent: Experimental and Structural Evidence from Ethiopia', *Working Paper, University of Oxford* .

Albrecht, J., Navarro, L. and Vroman, S. (2009), 'The effects of labour market policies in an economy with an informal sector', *The Economic Journal* **119**(539), 1105–1129.

Banerjee, A. and Chiplunkar, G. (2018), 'How important are matching frictions in the labour market? experimental & non-experimental evidence from a large indian firm', *Working Paper, Yale University* .

Bassi, V. and Nansamba, A. (2018), 'Information on skills in the labor market: Experimental evidence from uganda', *Working Paper, University of Southern California* .

Beam, E. A. (2016), 'Do job fairs matter? experimental evidence on the impact of job-fair attendance', *Journal of Development Economics* **120**, 32–40.

Bigsten, A., Mengistae, T. and Shimeles, A. (2007), 'Mobility and earnings in ethiopia's urban labor markets: 1994-2004', *World Bank Policy Research Working Paper* **4168**.

Blattman, C. and Dercon, S. (2018), 'The impacts of industrial and entrepreneurial work on income and health: Experimental evidence from ethiopia', *American Economic Journal: Applied Economics* **10**, 1–38.

Bruegemann, B., Gautier, P. and Menzio, G. (forthcoming), 'Intra Firm Bargaining and Shapley Values', *Review of Economic Studies* .

Cahuc, P., Marque, F. and Wasmer, E. (2008), 'A Theory of Wages and Labor Demand with Intrafirm Bargaining and Matching Frictions', *International Economic Review* **48**(3), 943–972.

Carranza, E., Garlick, R., Orkin, K. and Rankin, N. (2019), 'Job search and hiring with two-sided limited information about workseekers' skills'.

Donovan, K., Lu, J. and Schoellman, T. (2019), 'Labor Market Flows and Development', *mimeo, Federal Reserve Bank of Minneapolis* .

Elsby, M. W. L., Hobijn, B. and Şahin, A. (2013), 'Unemployment Dynamics in the OECD', *Review of Economics and Statistics* **95**, 530–548.

Elsby, M. W. and Michaels, R. (2013), 'Marginal jobs, heterogeneous firms, and unemployment flows', *American Economic Journal: Macroeconomics* **5**(1), 1–48.

Franklin, S. (2018), 'Location, search costs and youth unemployment: Experimental evidence from transport subsidies', *The Economic Journal* **614**, 2353–2379.

Gollin, D. (2002), 'Getting income shares right', *Journal of Political Economy* **110**(2), 458–474.

Gollin, D. (2007), 'Nobody's business but my own: Self-employment and small enterprise in economic development', *Journal of Monetary Economics* **55**(2), 219–233.

Hamilton, B. (2000), 'Does Entrepreneurship Pay? An Empirical Analysis of the Returns to Self-Employment', *Journal of Political Economy* **108**(3), 604–631.

Hopenhayn, H. and Rogerson, R. (1993), 'Job Turnover and Policy Evaluation: A General Equilibrium Analysis', *Journal of Political Economy* **101**(5), 915–938.

Hurst, E. and Pugsley, B. (2011), 'What Do Small Businesses Do?', *Brookings Papers on Eco-*

nomic Activity .

Pissarides, C. A. (2000), *Equilibrium Unemployment Theory*, 2nd edn, MIT Press, Cambridge, MA.

Poschke, M. (2018*a*), 'The firm size distribution across countries and skill-biased change in entrepreneurial technology', *American Economic Journal: Macroeconomics* **10**, 1–41.

Poschke, M. (2018*b*), 'Wage employment, unemployment and self-employment across countries', *IGC Working Paper* **F-32205-ETH-1**.

Poschke, M. (2019), 'A model of entrepreneurship and employment in bangladesh: Simulating the impact of employment regulations', *mimeo, McGill University* .

Restuccia, D. and Rogerson, R. (2008), 'Policy Distortions and Aggregate Productivity with Heterogeneous Establishments', *Review of Economic Dynamics* **11**(4), 707–720.

Shimer, R. (2012), 'Reassessing the ins and outs of unemployment', *Review of Economic Dynamics* **15**(2), 127–148.

Stole, L. A. and Zwiebel, J. (1996), 'Intra-firm bargaining under non-binding contracts', *The Review of Economic Studies* **63**(3), 375–410.

Appendix

A Proofs and derivations

A.1 Summary of model timing

The following summarizes the timing of events in this economy.

1. If individuals chose to enter, they pay the entry cost k_f and their productivity $z \sim f(z)$ is realized.
2. Depending on z, entrants decide whether
   (a) to keep the business and post vacancies to reach the optimal employment level,
   (b) to be self-employed, or
   (c) to exit and go to the unemployment pool.
3. Shocks $(\phi,\ \lambda_f,\ \lambda_s,\ \ \xi,\ \delta,\ \theta \cdot q\,(\theta))$ are realized.
4. Value functions are measured and occupational choices take place.
5. Production takes place and payoffs $(w,\ b)$ are realized.

A.2 Derivation of steady state stocks in the different states

In a stationary equilibrium, inflows and outflows from each state are equal. Moreover, the measure of agents in all states adds up to the total population. This implies

$$e_k = \frac{(1-\delta)(1-\chi)(1-\phi)hp_k}{\tilde{\lambda}_k}u \tag{18}$$

for $k = s, f$, as well as

$$n = \frac{(1-\delta)(1-\phi)(1-h)\theta q}{1-(1-\lambda_f)(1-\xi)(1-\phi)^2}u. \tag{19}$$

In addition,

$$1 = e_f + e_s + n + g + u = e_f + e_s + n + u(1 + \frac{\chi(1-\phi)}{\phi}), \tag{20}$$

When setting $\lambda_f = \lambda_s$, we obtain the MBC (equation 3) in the text.

A.3 Detailed Derivation of Wage

As stated in the main part of the paper, workers and firms split the surplus according to workers' bargaining weight η. The total surplus is the sum of workers' and firms' surplus, explicit expressions of which are given below. Let j index agent/employee type. Let i index employer type, if needed separately. Let parameters differ, except for ϕ and r.

Worker's Surplus The value of employment is given by

$$W_j = \left(1 + \chi_j \frac{\rho_j}{r+\phi}\right) w_j + \frac{1 - s_j - \chi_j}{1+r} W_j + \frac{s_j - \phi}{1+r} U_j.$$

Rewrite this to obtain $W_j - U_j$:

$$W_j - U_j = \frac{1+r}{r + s_j + \chi_j} \left(1 + \chi_j \frac{\rho_j}{r+\phi}\right) w_j - \frac{r + \phi + \chi_j}{r + s_j + \chi_j} U_j.$$

Firm's Surplus The value of a firm is given in (6). The marginal value of hiring an additional worker the firm has just met, and keeping that worker until either the firm shuts down or some type of separation occurs, is given by

$$c_0 \left(\varepsilon y_j' \left(n_j\right) - w_j - n_j \cdot w_j' \left(n_j\right)\right), \tag{21}$$

where $\hat{c}_0 = (1+r)/(r+\hat{s}_j)$, and $\hat{s} = 1 - (1-\phi)^2 (1-\lambda_{fj})(1-\xi_j)(1-\chi_j)$.

Nash Bargaining The following is identical for H and L worker firms, so drop j subscripts.

The bargaining rule implies that the wage solves

$$(1-\eta)(W-U) = \eta \hat{c}_0 \cdot \left(y'(n) - (1+t)w - n \cdot (1+t) w'(n)\right)$$

Using the expressions above, this becomes

$$(1-\eta)\left(\frac{1+r}{r+s+\chi}\left(1+\chi\frac{\rho}{r+\phi}\right)w - \frac{r+\phi+\chi}{r+s+\chi}U\right) = \eta\hat{c_0} \cdot \left(y'(n) - (1+t)w - n \cdot (1+t)w'(n)\right)$$

$$\left[\frac{(1-\eta)(1+r)}{r+s+\chi}\left(1+\frac{\chi\rho}{r+\phi}\right) + \eta\hat{c_0}(1+t)\right] w = \frac{(1-\eta)(r+\phi+\chi)}{r+s+\chi} U + \eta\hat{c_0} \cdot \left(y'(n) - n \cdot (1+t)w'(n)\right)$$

$$\frac{(1-\eta)(1+r)\left(1+\frac{\chi\rho}{r+\phi}\right) + \eta\hat{c_0}(1+t)(r+s+\chi)}{r+s+\chi} w = \frac{(1-\eta)(r+\phi+\chi)}{r+s+\chi} U + \eta\hat{c_0}(y'(n) - n(1+t)w'(n)).$$

Then, approximating $\hat{c}_0$ as $(1+r)/(r+s+\chi)$,

$$\left(1+\eta t+\frac{(1-\eta)\chi\rho}{r+\phi}\right)w=(1-\eta)\frac{r+\phi+\chi}{1+r}U+\eta\cdot\left(y'\left(n\right)-n\cdot(1+t)w'\left(n\right)\right),$$

so that

$$w=\frac{(1-\eta)(r+\phi)}{(1+\eta t)(r+\phi)+(1-\eta)\chi\rho}\frac{r+\phi+\chi}{1+r}U+\frac{\eta(r+\phi)}{(1+\eta t)(r+\phi)+(1-\eta)\chi\rho}\left(y'\left(n\right)-n(1+t)w'\left(n\right)\right).$$

Let

$$\hat{\eta}\equiv\eta\frac{r+\phi}{(1+\eta t)(r+\phi)+(1-\eta)\chi\rho};\quad c_U\equiv(1-\eta)\frac{r+\phi}{(1+\eta t)(r+\phi)+(1-\eta)\chi\rho}\frac{r+\phi+\chi}{1+r}. \tag{22}$$

Note that $c_U=\frac{r+\phi+\chi}{1+r}\frac{1-\eta}{\eta}\hat{\eta}$. Then the differential equation is

$$w=c_UU+\hat{\eta}\left(y'\left(n\right)-n(1+t)w'\left(n\right)\right). \tag{23}$$

The solution to the differential equation then is

$$w(n)=n^{-1/\tilde{\eta}}\int_0^n y'(z)z^{1/\tilde{\eta}-1}dz+c_UU, \tag{24}$$

where $\tilde{\eta}\equiv(1-t)\hat{\eta}$. Integrating yields

$$w(n)=c_UU+\frac{y'(n)}{\gamma-1+1/\tilde{\eta}}. \tag{25}$$

The firm's optimality condition for employment here is

$$y'(n)=(1+t)w+n\cdot(1+t)w'(n)+\left[\frac{1+r-(1-\phi)(1-\lambda_f)}{1+r}+\hat{\xi}\right]\frac{k_v}{q} \tag{26}$$

or, using the solution to the wage equation,

$$y'(n)=\frac{1+\tilde{\eta}(\gamma-1)}{1-\tilde{\eta}t(\gamma-1)}\left\{(1+t)w+\left[\frac{1+r-(1-\phi)(1-\lambda_f)}{1+r}+\hat{\xi}\right]\frac{k_v}{q}\right\}. \tag{27}$$

Solving this for n yields labor demand

$$n(z) = (z\gamma a^{\gamma})^{\frac{1}{1-\gamma}} \left\{ \frac{1+\tilde{\eta}(\gamma-1)}{1-\tilde{\eta}t(\gamma-1)} \left[(1+t)w + \left(1 - \frac{(1-\phi)(1-\lambda_f)}{1+r} + \hat{\xi} \right) \frac{k_v}{q} \right] \right\}^{-\frac{1}{1-\gamma}}. \quad (28)$$

Substituting it into the wage equation yields

$$w = c_U U + \frac{\tilde{\eta}}{1-\tilde{\eta}t(\gamma-1)} \left\{ (1+t)w + \left[\frac{1+r-(1-\phi)(1-\lambda_f)}{1+r} + \hat{\xi} \right] \frac{k_v}{q} \right\}. \quad (29)$$

That is, the wage at optimal labor demand is

$$w = \frac{1-\tilde{\eta}t(\gamma-1)}{1-\tilde{\eta}(1+t\gamma)} \frac{r+\phi+\chi}{1+r} \frac{1-\eta}{\eta} \frac{\tilde{\eta}}{1+t} U + \frac{\tilde{\eta}}{1-\tilde{\eta}(1+t\gamma)} \left[1 - \frac{(1-\phi)(1-\lambda_f)}{1+r} + \hat{\xi} \right] \frac{k_v}{q}, \quad (30)$$

where $\tilde{\eta} = (1+t)\eta \dfrac{r+\phi}{(1+\eta t)(r+\phi)+(1-\eta)\chi\rho}$.

Solution of the differential equation for w. Without the constant, the equation is

$$w'(n) + \frac{w}{\hat{\eta}(1+t)n} - \frac{y'(n)}{(1+t)n} = 0. \quad (31)$$

Let $\tilde{\eta} \equiv \hat{\eta}(1+t)$. The solution of the homogeneous equation

$$w'(n) + \frac{w}{\tilde{\eta} n} = 0$$

then is

$$w(n) = C n^{-1/\tilde{\eta}}. \quad (32)$$

C is a function of integration that can be a function of n. So take the derivative of equation (32) with respect to n:

$$\frac{\partial w}{\partial n} = C'(n)\, n^{-1/\tilde{\eta}} - \frac{C}{\tilde{\eta}} n^{-1/\tilde{\eta}-1}$$

Substituting this into (31) yields

$$C'(n) = y'(n)\, n^{1/\tilde{\eta}-1}$$

Integrating this gives $C(n)$ as

$$C(n) = \int_0^n y'(z)\, z^{1/\tilde{\eta}-1} dz + D$$

so the wage w is

$$w(n) = n^{-1/\tilde{\eta}} \int_0^n y'(z)\, z^{1/\tilde{\eta}-1} dz + Dn^{-1/\tilde{\eta}}$$

The constant D can be dealt with assuming that the wage bill goes to zero as employment goes to zeros. This implies $D = 0$. The solution to equation (23) then is

$$w(n) = n^{-1/\tilde{\eta}} \int_0^n y'(z)\, z^{1/\tilde{\eta}-1} dz + c_U U.$$

Integrating yields

$$w(n) = c_U U + \frac{y'(n)}{\gamma - 1 + 1/\tilde{\eta}}. \tag{33}$$

The division in the last term here comes from the overhiring effect. Note that y' of course is $j-$specific. But conditional on the type of worker hired, this equation applies to both types of firm, indexing all terms by j as required.

To obtain the wage at the firm's optimal constant level of employment (replacing any workers who leave), use the labor demand condition. To obtain this, equate the marginal value of having an additional employee for the firm's entire life, from (21), to the expected hiring cost. This results in

$$y'(n) = (1+t)w + n \cdot (1+t)w'(n) + \left[\frac{1 + r - (1-\phi)(1-\lambda_f)}{1+r} + \xi + (1-\xi)\phi\right] \frac{k_v}{q}.$$

To simplify, take the derivative of (33) with respect to n, multiply by n, and replace the $n \cdot w'(n)$ term in the labor demand condition. This yields

$$y'(n) = (1+t)w + (1+t)\frac{(\gamma-1)y'(n)}{\gamma - 1 + 1/\tilde{\eta}} + \left[\frac{1 + r - (1-\phi)(1-\lambda_f)}{1+r} + \xi + (1-\xi)\phi\right] \frac{k_v}{q}$$

or

$$y'(n) = \frac{1 + \hat{\eta}(1+t)(\gamma-1)}{1 - \hat{\eta}t(1+t)(\gamma-1)} \left\{(1+t)w + \left[\frac{1 + r - (1-\phi)(1-\lambda_f)}{1+r} + \xi + (1-\xi)\phi\right] \frac{k_v}{q}\right\}.$$

Again, this holds for each worker type j. Solve this for n to obtain the labor demand condition in (28). Substituting this expression into (33) yields the wage at the optimal employment level given in equation (30).

B Computation

The algorithm for solving the model is as follows.

1. Guess candidate values of $\theta_j, j = L, H$.
2. Compute the implied sectoral job finding rates and vacancy filling rates using the matching function.
3. For each segment, solve the linear system of equations (**??**), (10), (12) and (14) for the wage w and the values of employment (W), search (S) and unemployment (U).
4. Compute optimal employment for each type of firm, using equation (15), for a grid of values of productivity. (These depend on θ and w.)
5. For each type of worker, use equations (5) and (6) to compute the values of own-account work and being an employer, for a grid of values of productivity and taste. (These depend on θ and w.)
6. For each value of productivity and taste, obtain the optimal post-entry action (return to unemployment, own-account work, employ low-skill workers, or, for H individuals only, employ high-skill workers). This yields the thresholds z_{sj}, z_{fj} and z_{fHH}.
7. Using the distribution of productivity for each type of worker, compute the probability of each of these outcomes (this yields p_f and p_s) as well as the expected value of entry $Q_j(\tau)$ for each taste value using these optimal choices (equation 7).
8. Compare $Q(\tau)$ to S to determine at which taste levels entry is optimal. This implies the probability for entering from unemployment, h_j.
9. Using these probabilities, compute the stationary distribution of productivity and the steady state stocks of individuals in the different labor market states using the expressions in equations (1) to (**??**).
10. Using these stocks, optimal labor demands and the guess of tightness, compute total vacancies by segment (equation (16)) and implied labor market tightness (equation (17)).
11. If implied labor market tightness equals the initial guess in each segment, the equilibrium has been obtained. Otherwise, update the guesses for θ_j in step 1, and begin again from that step.

The International Growth Centre (IGC) aims to promote sustainable growth in developing countries by providing demand-led policy advice based on frontier research.

Find out more about our work on our website
www.theigc.org

For media or communications enquiries, please contact
mail@theigc.org

Subscribe to our newsletter and topic updates
www.theigc.org/newsletter -signup

Follow us on Twitter
@the_igc

Contact us
International Growth Centre, London School of Economic and Political Science, Houghton Street, London WC2A 2AE

International Growth Centre

DIRECTED BY
LSE
UNIVERSITY OF OXFORD

FUNDED BY
UKaid
from the British people

Designed by soapbox.co.uk