# Self-Employment, Efficiency Wage, and Public Policies

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**Abstract**

Empirical evidence suggests that unemployed workers are much more likely to become self-employed than wage employed workers. Also higher unemployment benefits significantly reduce the rate of self-employment. This paper develops a model of self-employment which incorporates transitions between unemployment and self-employment. It integrates two strands of theoretical literature – models of occupational choice and the efficiency wage models. In this model, a higher unemployment benefit reduces the self-employment rate and the transition rate of unemployed workers to self-employment, which is consistent with empirical evidence.

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# 1 Introduction

Self-employed workers constitute an important segment of the labor force. In OECD countries, the proportion of self-employed workers varies between 8-30 percent (Blanchflower 2004). In many developing countries they constitute the majority of workers (Gollin 2008).

In this paper, I develop a model of self-employment which allows for transitions between unemployment and self-employment. I analyze the effects of tax and labor market policies on the self-employment rate and the transition between unemployment and self-employment. This study is motivated by the substantial empirical evidence of transitions between unemployment and self-employment and the empirical literature linking higher unemployment benefits to lower rates of self-employment.

Empirical evidence from several countries shows that unemployed workers are two to three times more likely to become self-employed than wage employed workers (e.g. Evans and Leighton 1989 for the U.S., Kuhn and Schuetze 2001 for Canada, Carrasco 1999 for Spain). There is a view that many individuals choose self-employment due to limited job opportunities (Storey 1991, Alba-Ramirez 1994, Blanchflower 2004).

At the same time, there is substantial empirical evidence that a higher unemployment benefit is associated with a lower rate of self-employment. Carrasco (1999) finds that a higher unemployment benefit reduced the transition rate of unemployed workers to self-employment in Spain. Parker and Robson (2000) find a significant negative association between unemployment benefits and self-employment in OECD countries.

The transitions between unemployment and self-employment and factors affecting them are also very important policy issues. Governments in many countries consider self-employment to be a possible solution to their unemployment problem. Many countries have introduced (e.g. in Australia, Germany, U.K, U.S.A.) government programs to encourage unemployed workers to become self-employed.

Existing models of entrepreneurship (self-employment) typically assume a perfectly competitive environment in the labor market in which there is no unemployment (e.g. Lucas 1978, Kanbur 1979, 1981, Kihlstrom and Laffont 1979). In these models, workers choose between wage employment and entrepreneurship. The absence of unemployment in these models and their static nature preclude the analysis of transitions between between self-employment and unemployment and factors affecting them.

In this paper, I integrate two strands of theoretical literature – models of occupational choice and models of efficiency wage to explain the above mentioned empirical findings. In particular, I embed the shirking model of

Shapiro and Stiglitz (1984) in the occupational choice framework. Shapiro and Stiglitz's model is one of most influential models of unemployment. Dickens, Katz, Lang, and Summers (1989) provide evidence with regard to the importance of worker theft and shirking and argue that these phenomena are essential to understanding the labor market. In addition, this model is highly tractable analytically.

The model developed in this paper distinguishes among three labor market states: self-employment, wage employment, and unemployment. Agents in the model can choose to be either self-employed or wage workers in any time period. Wage workers can be unemployed or wage (or salary) employed. Self-employed workers create firms and hire workers to produce.

This paper focuses on the flows between unemployment and self-employment. In this model, only unemployed workers choose to become self-employed in *equilibrium.* I do this because existing models allow workers to choose only between employer status (entrepreneurship) and wage employment and ignore the flows between unemployment and self-employment. I view my model as shedding light on a very important, largely neglected, and interesting component of self-employment. In addition, as mentioned earlier empirical evidence suggests that unemployed workers are much more likely to become self-employed than wage employed workers. Finally, focussing on these flows allows me to clearly differentiate my approach and the mechanism from the existing models.

In the model developed in this paper, I examine the effects of three important policies – unemployment benefits, start-up cost subsidy, and wage tax. My primary findings regarding the effects of these policies are as follows. First, I find that higher unemployment benefits reduce the self-employment rate and the rate of transition of unemployed workers to both self-employment and wage employment, which are consistent with existing empirical evidence.

Second, I find that changes in unemployment benefits do not affect wages. This prediction is consistent with a large body of empirical literature which suggests that changes in unemployment benefits have a negligible effect on post-unemployment wages (e.g. Classen 1977, Blau and Robins 1986, Meyer 1995, Addison and Blackburn 2000).

Third, a lower start-up cost subsidy reduces the self-employment rate and the rate of transition of unemployed workers to both self-employment and wage employment. These results are consistent with substantial empirical evidence which suggest that a higher start-up cost reduces new business formation and entrepreneurial activity (e.g. Desai et. al. 2003, Klapper et. al. 2006, Nystrom 2008, Djankov et. al. 2009).

Finally, a higher wage tax may reduce the self-employment rate and the rate of transition of unemployed workers to self-employment. The negative effect of a higher wage tax on the self-employment rate is in contrast to the prediction of models based on competitive labor markets. In these models, a higher wage tax increases the self-employment rate.

The remainder of the paper is organized as follows. In Section 2, I describe the environment. In Section 3, I analyze the optimal decisions of self-employed and wage workers. In Section 4, I prove the existence and uniqueness of a stationary equilibrium. In Section 5, I analyze the effects of taxes and subsidies. This is followed by a conclusion. All proofs are in the Appendix.

# 2 Environment

Time is continuous. Consider a labor market consisting of a unit measure of risk-averse infinitely-lived agents. These agents discount the future at the common rate $r$. These agents can either be self-employed or unemployed or wage employed (employees). Unemployed and wage employed workers together constitute wage workers. No agent in the model can be in more than one state. Assuming occupational choice as a discrete rather than a continuous variable is standard in the literature ( e.g. Lucas 1978, Kihlstrom and Laffont 1979, Kanbur 1979, 1981).

Let $E$, $N$, and $U$ be the measures of employers, wage employed workers, and unemployed workers respectively in the economy. Thus at any time,

$$E + N + U = 1. \tag{2.1}$$

Note that total employment at any time is given by the sum of self-employed and wage employed workers, $E + N$.

An unemployed worker can choose to be self-employed at any point in time. However, the opportunities to become an employee arise randomly for an individual unemployed worker. Let $f$ be the job-finding rate (or the transition rate of unemployed workers to wage employment) and $\phi$ be the transition rate of unemployed workers to self-employment. Individual agents take $\phi$ and $f$ as given. However, in the model both $\phi$ and $f$ are endogenous and are determined in equilibrium. The transition rate of unemployed workers to self-employment is determined by the fraction of unemployed workers who choose to join self-employment at each point in time. The job-finding rate is determined by the number of unemployed workers who choose to search for wage jobs and the number of workers hired by employers.

In the model, wage employed workers can also choose to become self-employed at any point in time. However, as we will see below no wage employed worker chooses to become self-employed in equilibrium. Only unemployed workers choose to become self-employed. As mentioned earlier, the focus on the transitions between unemployment and self-employment allows me to clearly differentiate my approach and mechanism from existing models.

Self-employed workers create and manage firms (or businesses) and organize production. Production at a firm depends on the number of employees, $n$, and the average effort level of employees, $e$. When firms want to hire workers, they choose workers at random from the pool of unemployed workers searching for wage jobs. For future reference, I call unemployed workers who do not choose to become self-employed but search for wage jobs as *unemployed wage workers*.

The production function is assumed to be an increasing and concave function of the number of employees and the average effort level. The production function is given by[1]

$$F(ne) \text{ with } F(0) = 0, \ \lim_{n\to 0} F_n(ne) = \infty \ \& \ \lim_{n\to 0} nF_n(ne) = 0. \tag{2.2}$$

Since self-employed workers are also employers, I use these two terms interchangeably throughout the paper. Assume that an employer can create and manage just one firm at a time. Thus, at any time the number of employers and firms are equal. Starting a business/firm requires a one time start-up cost, $K$. This cost is incurred by new employers (business entrants).

Employers face the possibility of business failure. Assume that at any point in time, an employer receives an exogenous business failure shock at the rate of $\mu$. In the case an employer receives a business failure shock, both the employer as well as employees become unemployed. A business failure shock is entirely temporary and a failed employer can start a business after a spell of unemployment. This assumption ensures that agents are inherently identical. The idea is that if an employer fails in one business, it does not preclude her from successfully starting another business.

Let the period utility function of employers and unemployed workers be

$$u(c) \tag{2.3}$$

where $c$ is the net income and $u_c(c) > 0$ & $u_{cc}(c) < 0$.

Suppose that the utility of an employed wage worker depends on both her net income and the effort level exerted by her. More specifically, let the period utility function of an employed wage worker be

[1] For any function $g(x)$, $g_x$ and $g_{xx}$ denote first and second derivatives respectively.

$$u(c) - \hat{e}. \tag{2.4}$$

Suppose that there are only two possible effort levels, $\hat{e} = 1$ and $\hat{e} = 0$.[2] Thus employed wage workers can be in two states: either exerting effort ($\hat{e} = 1$) or shirking ($\hat{e} = 0$). Suppose that employers can observe effort levels of employees only imperfectively. An employer can detect a shirking worker at the exogenous rate $\rho$ per unit of time. In the case a shirking worker is detected, she is fired and becomes unemployed. Note that an employee can also become unemployed due to business failure.

There is a government which imposes wage tax and pays unemployment benefits to unemployed workers and start-up cost subsidy to new business entrants. Suppose that the government imposes a constant proportional wage tax, $\tau_w$ $(0 < \tau_w < 1)$, on the incomes of wage workers (both unemployed and employed). Also suppose that the government pays each new employer a proportional subsidy equal to $\tau_s$ $(0 < \tau_s < 1)$. Finally, assume that an unemployed worker receives unemployment benefits, $b$, per unit of time from the government as long as she is unemployed.

Let $\lambda^n$, $\lambda^s$, $\hat{\lambda}^u$, and $\pi$ be the value functions (expected life-time utility under optimal strategies) of a non-shirking wage employed worker, a shirking wage employed worker, an unemployed wage worker, and a new employer respectively. Then, anticipating an equilibrium in which the value function of a non-shirking wage employed worker is greater than or equal to the value functions of a shirking wage employed worker, an unemployed wage worker, and a new employer, (*i.e.* $\lambda^n \geq \lambda^s,\ \hat{\lambda}^u,\ \pi$) the evolution of the number of unemployed workers, wage employed workers, and employers are given by

$$\dot{U} = \mu N + \mu E - (f + \phi)U; \tag{2.5}$$

$$\dot{N} = fU - \mu N; \tag{2.6}$$

and

$$\dot{E} = \phi U - \mu E. \tag{2.7}$$

The left hand side of (2.5) is the change in the number of unemployed workers. The first term on the right hand side is the number of wage employed workers who become unemployed. The second term is the number of employers who become unemployed due to business failures. The last term

[2]The results of this paper do not depend on whether the utility function is quasi-linear in effort level or not.

is the number of unemployed workers who either become wage employed or employers.

The left hand side of (2.6) is the change in the number of wage employed workers. The first term on the right hand side is the inflow to the wage employment pool. The second term is the outflow from the wage employment pool.

The left hand side of (2.7) is the change in the total number of employers. The first term on the right hand side is the number of unemployed workers who become employers. The second term is the total number of employers who receive business failure shocks.

# 3 Optimal Decisions

I first describe the optimal choices of wage workers and then of employers.

## 3.1 Wage Workers

A wage worker chooses whether to open a business or not, a job acceptance strategy and the optimal effort level in order to maximize her expected life-time utility; taking as given the job-finding rate, the transition rate of unemployed workers to self-employment, and the strategies of employers and other wage workers. Let $w$ be the wage paid to employees.

Recall that an unemployed worker can choose to become a business owner or an unemployed wage worker (*i.e.* search for a wage job) at any point in time. Let $\lambda^u$ be the value function of an unemployed worker. Then, $\lambda^u$ satisfies

$$\lambda^u = \max < \pi,\ \hat{\lambda}^u > . \tag{3.1}$$

An unemployed worker will choose to become a business owner iff $\pi > \hat{\lambda}^u$. On the other hand, she will choose to become an unemployed wage worker iff $\hat{\lambda}^u > \pi$.

The value functions of non-shirking employed wage workers, shirking employed wage workers, and unemployed wage workers are given by

$$r\hat{\lambda}^u = u(b(1-\tau_w)) + f(\lambda^n - \hat{\lambda}^u); \tag{3.2}$$

$$r\lambda^n = u(w(1-\tau_w)) - 1 - \mu(\lambda^n - \lambda^u); \tag{3.3}$$

and

$$r\lambda^s = u(w(1-\tau_w)) - (\rho+\mu)(\lambda^s - \lambda^u). \tag{3.4}$$

Equation (3.2) reflects the fact that the net flow of utility to an unemployed wage worker is, $u(b(1-\tau_w))$, and she finds a wage job at the rate of $f$, in which case she becomes wage employed. The value function of unemployed wage workers is increasing in $b$ and decreasing in $\tau_w$.

Equation (3.3) can be interpreted in a similar fashion. The net flow of utility to a non-shirking wage employed worker is $u(w(1-\tau_w))$-1. She can become unemployed at the rate of $\mu$. Note that in the case of losing a wage job, she can choose to become either a business owner or an unemployed wage worker. Thus, the net utility loss in the case of losing a wage job is $\lambda^n - \lambda^u$. Finally, net utility flow of a shirking wage employed worker is $u(w(1-\tau_w))$. However, she can become unemployed at the rate of $\rho+\mu$. The value functions of both shirking and non-shirking employed wage workers are increasing in net income, $w(1-\tau_w)$.

The optimal job-acceptance strategy for an unemployed wage worker is to accept a job iff $\lambda^n > \hat{\lambda}^u$. An employed wage worker will not shirk iff $\lambda^n \geq \lambda^s$. In addition, an employed wage worker will not choose to become an employer iff $\lambda^n \geq \pi$.

## 3.2 Employers

A new employer incurs a start-up cost of $K$ and receives a subsidy proportional to the start-up cost. Thus, the value function of a new employer is

$$\pi = \pi(n) - (1-\tau_s)K \tag{3.5}$$

where $n$ is the number of workers hired. (3.5) shows that $\pi$ is increasing in the start-up cost subsidy.

An employer chooses the number of workers to hire and the wages to be paid in order to maximize her expected life-time utility; taking as given the job-finding rate, the transition rate of unemployed workers to self-employment, and the strategies of wage workers and other employers. While setting wages, an employer takes into account the incentives of employees. She sets wages such that employees are indifferent between shirking and not shirking:

$$\lambda^s = \lambda^n. \tag{3.6}$$

Combining (3.3), (3.4) and (3.6), I have

$$\lambda^n - \lambda^u = \frac{1}{\rho}. \tag{3.7}$$

(3.7) implicitly solves for wages.

Since, employers pay efficiency wages, no employee shirks and thus, $\hat{e} = 1$. From now on, I set the average effort level $e = \hat{e} = 1$. Turning to the optimal decision with regard to hiring, an employer chooses $n$ in order to maximize her expected inter-temporal utility, $\pi(n)$, given by

$$r\pi(n) = \max_{n} u(F(n) - wn) + \mu(\lambda^u - \pi(n)) \tag{3.8}$$

where $w$ solves (3.7). Equation (3.8) can be interpreted as follows. The first term is the net flow of utility from profit to an employer. The second term is the expected continuation value, which takes into account that she can fail at the rate of $\mu$.

The optimal number of employees, $n$, is given by

$$F_n(n) = w \tag{3.9}$$

which equates the marginal product of labor to (efficiency) wages.

# 4 Equilibrium

In the economy, all employers are identical. They choose identical wages and numbers of employees. Thus, the average wage and the average employer size in the economy will be equal to $w$ and $n$ respectively. Similarly, wage workers are identical and thus they choose the same optimal strategies. In equilibrium, the choices and strategies of employers and wage workers will be consistent with the job-finding rate and the rate of transition of unemployed workers to self-employment. Also the job-finding rate and the rate of transition of unemployed workers to self-employment will be consistent with the choices and the strategies of employers and wage workers.

Note that in the model one cannot have $\lambda^n < \pi$ in equilibrium. If $\lambda^n < \pi$, then all agents would become employers and wages, $w = F_n(n)$, will go to infinity as $n \to 0$. This will lead to $\lambda^n \to \infty$. Also when $\hat{\lambda}^u > \pi$, no agent would choose to be an employer. So the only interesting case left is that $\hat{\lambda}^u \leq \pi < \lambda^n$.[3] In this equilibrium, no wage employed worker would have an incentive to become self-employed. Finally, $\pi > \hat{\lambda}^u$ cannot be an equilibrium. In this case, every agent would like to become self-employed and thus $\pi = -(1 - \tau_s)K < 0$. But $\hat{\lambda}^u > 0$, and so there is a contradiction.

[3]The value function of an existing employer, $\pi(n)$, can be higher or lower than the value function of a wage employed worker, $\lambda^n$, depending on the start-up cost, $K$.

Thus in equilibrium, an unemployed worker would be indifferent between the two states of self-employment and being an unemployed wage worker at any point in time. Therefore, we have

$$\pi = \hat{\lambda}^u = \lambda^u. \tag{4.1}$$

In the steady state, the inflows to and outflows from any state are equal. Also the total number of wage employed workers is equal to the total number of employees, $N = nE$. Then utilizing (2.1) and (2.5)-(2.7), one can derive expressions for the equilibrium number of employers, wage employed workers, unemployed workers, and the transition rate of unemployed workers to self-employment (see Appendix ).

The equilibrium number of employers is given by

$$E = \frac{f}{\mu n + (1+n)f}; \;\; E_f > 0, E_n < 0. \tag{4.2}$$

Equation (4.2) is the key equation of the model. It shows that the equilibrium number of employers is increasing in $f$ and decreasing in $n$. Intuitively, for a given $n$ a higher $f$ requires that in equilibrium the number of employers be larger. On the other hand, for a given $f$, a higher $n$ leads to a smaller number of employers.

Similarly, one can derive expressions for the equilibrium number of wage employed workers and unemployed workers, which are given by

$$N = \frac{fn}{\mu n + (1+n)f}; \;\; N_f > 0, N_n > 0; \tag{4.3}$$

and

$$U = \frac{\mu n}{\mu n + (1+n)f}; \;\; U_f < 0, U_n > 0. \tag{4.4}$$

Equation (4.3) shows that the equilibrium $N$ is increasing in both $f$ and $n$. Equation (4.4) shows that the equilibrium number of unemployed workers is decreasing in $f$ and increasing in $n$. Since total employment, $N + E = 1 - U$, total employment is increasing in $f$ and decreasing in $n$.

Finally, the expression for the transition rate of unemployed workers to self-employment is given by

$$\phi = \frac{f}{n} \text{ with } \phi_f > 0, \quad \phi_n < 0. \tag{4.5}$$

The transition rate of unemployed workers to self-employment is increasing in $f$ and decreasing in $n$. Intuitively, a higher $f$ implies that the outflow from unemployment to wage employment is higher. Then for a given $n$, number of employers must be higher in order to maintain equilibrium leading to a higher $\phi$. Similarly, for a given $f$, a higher $n$ implies a smaller number of employers and thus a lower $\phi$.

Note that (4.5) shows that the average employer size, $n = \frac{f}{\phi}$, is given by the ratio of the job-finding rate and the transition rate of unemployed workers to self-employment. Thus, $n$ can be interpreted as *the relative rate of transitions into wage employment and self-employment* by unemployed workers.

## 4.1 Wages

Equations (3.2), (3.3), (3.7), and (4.1) imply that wage implicitly solves

$$u(w(1-\tau_w)) = u(b(1-\tau_w)) + 1 + \frac{r+\mu+f}{\rho}. \tag{4.6}$$

The third term in the RHS of (4.6) is the wage premium employers must pay in order to prevent employees from shirking. It is this wage premium which generates unemployment in equilibrium. At wage $w$ every wage worker would like to work, but employers do not hire all of them in order to prevent employees from shirking.

Equation (4.6) shows that $w$ is increasing in both $b$ and $f$. The reason is that a rise in $b$ and $f$ increases the relative attraction of outside option (unemployment) to employees. Thus, employers must pay more in order to prevent employees from shirking.

The effect of changes in the wage tax is more complicated. The implicit differentiation of (4.6) with respect to $\tau_w$ for a given $f$ shows that

$$\frac{dw}{d\tau_w} = \frac{1}{1-\tau_w}\left[w - \frac{u_c(b(1-\tau_w))b}{u_c(w(1-\tau_w))}\right]. \tag{4.7}$$

The sign of $\frac{dw}{d\tau_w}$ depends on the sign of the term $w - \frac{u_c(b(1-\tau_w))b}{u_c(w(1-\tau_w))}$. To show the effects of changes in $\tau_w$, assume that workers have the CRRA utility function $u(c) = \frac{c^{1-\alpha}}{1-\alpha}$. Then, (4.7) shows that for any $w > b$

$$\frac{dw}{d\tau_w} > 0 \text{ if } \alpha < 1 \ \& \ \frac{dw}{d\tau_w} < 0 \text{ if } \alpha > 1 \tag{4.8}$$

for a given $f$. In the case of a logarithmic utility function ($\alpha = 1$), changes in $\tau_w$ have no effect on wages.

An increase in $\tau_w$ reduces the net income and thus the utility of both employees and unemployed wage workers. The effect of an increase in $\tau_w$ on

$w$ depends on whether the fall in the utility of employees, $u_c(w(1-\tau_w))w$, is more or less than the fall in the utility of unemployed wage workers, $u_c(b(1-\tau_w))b$. If the fall in the utility of employees is relatively more, then wages must rise in order to induce employees not to shirk. When $\alpha < 1$, $u_c(w(1-\tau_w))w > u_c(b(1-\tau_w))b$ and thus $w$ rises. On the other hand, when $\alpha > 1$, $u_c(w(1-\tau_w))w < u_c(b(1-\tau_w))b$ and thus $w$ falls. In the case of $\alpha = 1$, the utilities of both employees and unemployed wage workers fall by the same amount, leaving wages unchanged.

## 4.2 Employer-Size (ES) Curve

Equation (4.1) pins down the distribution of workers between employers and wage workers. Using (3.2), (3.5), (3.7), (3.8), (3.9), and (4.1) (see Appendix), one can derive a relationship between $f$ and $n$ given by

$$u(F(n) - nF_n(n)) = u(b(1-\tau_w)) + \frac{f}{\rho} + (\mu + r)(1-\tau_s)K. \tag{4.9}$$

Since (4.9) determines the ratio of wage workers to employers, I call this curve the **Employer-Size (ES) curve**. It traces an upward relationship between $f$ and $n$ in the $(n, f)$ space.

The intuition for the positive relationship between $f$ and $n$ is quite simple. Other things remaining the same, an increase in $f$ raises the relative return of unemployed wage workers. Thus for equilibrium to be maintained, the return from self-employment must rise. Since the profit of employers, $F(n)-F_n(n)n$, is increasing in $n$, the average employer size rises. Alternatively, wages must fall, which increases the profit of employers and reduces the return from being an unemployed wage worker. A fall in wages requires $n$ to rise.

Equation (4.9) shows that a lower start-up cost subsidy shifts the ES curve downward to the right in the $(n, f)$ space, *i.e.* for a given $n$ the associated value of $f$ falls. The intuition is that a lower start-up cost subsidy reduces the relative return from self-employment. Thus, more unemployed workers choose to search for wage jobs and the number of new business entrants falls. An increase in the number of unemployed wage workers and a fall in the number of employers reduce $f$. A higher unemployment benefit and a lower wage tax have similar effects as they increase the relative return from being an unemployed wage worker compared to being a self-employed worker.

## 4.3 Job-Creation (JC) Curve

By combining (3.9) and (4.6), I get another equation in $n$ and $f$ given by

$$u(F_n(n)(1-\tau_w)) = u(b(1-\tau_w)) + 1 + \frac{r+\mu+f}{\rho}. \tag{4.10}$$

Equation (4.10) gives a negative relationship between $f$ and $n$ and traces a downward sloping curve in the $(n, f)$ space. I call this curve the **Job-Creation (JC) curve**. The reason for the negative relationship between the two is efficiency wage considerations. A higher $n$ reduces the marginal product of labor and thus wages must fall. But then in order to prevent employees from shirking it must be the case that $f$ falls.

Equation (4.10) shows that a higher unemployment benefit shifts the JC curve down to the left in the $(n, f)$ space *i.e.*, for a given $n$ associated $f$ falls. For the CRRA utility function, a higher wage tax has a similar effect for $\alpha < 1$. This happens because in both cases unemployment becomes more attractive relative to wage employment and thus the associated job-finding rate must fall in order to prevent employees from shirking.

When $\alpha = 1$, a change in wage tax has no effect on the JC curve as it does not affect the relative attractiveness of unemployment vis-a-vis wage employment leaving the associated job-finding rate unaffected. On the other hand, for $\alpha > 1$, a higher wage tax shifts the JC curve up in the $(n, f)$ space. In this case, a higher wage tax makes unemployment less attractive relative to wage employment and thus the associated job-finding rate rises.

## 4.4 Existence of Equilibrium

The intersection of the JC and ES curves determines the equilibrium job-finding rate, $f^*$, and the average employer size, $n^*$.

**Lemma 1** Under the assumptions that $F(0) = 0$, $\lim_{n\to 0} F_n(n) = \infty$, $\lim_{n\to 0} nF_n(n) = 0$, and $u(\infty) - A > u(0)$, where $A$ is a constant given by

$$A = 1 + \frac{r+\mu}{\rho} - (\mu + r)(1-\tau_s)K$$

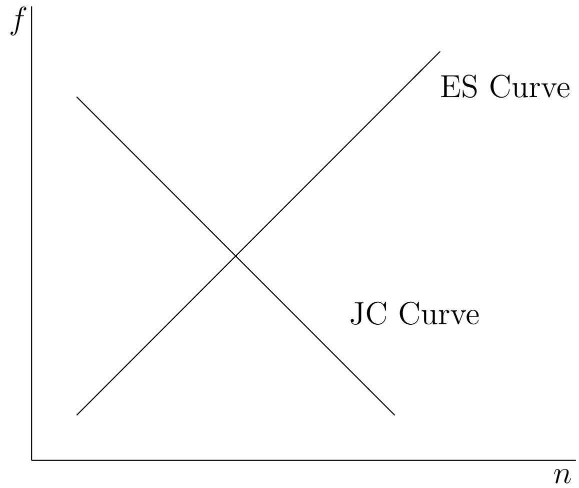
there exists a unique and strictly positive and finite pair of $(n^*,\ f^*)$, which solve equations (4.9) and (4.10).

The proof of Lemma 1 is in the Appendix. Once $f^*$ and $n^*$ are determined, one can back out equilibrium values of other endogenous variables. Hence, I have following proposition:

**Proposition 1** There exists a steady state equilibrium characterized by equations 4.1-4.6, 4.9, and 4.10.

The existence of equilibrium is illustrated below in Figure 1.

**Figure 1**
**Graphic Portrait of Equilibrium**




# 5 Effects of Public Policies

## 5.1 Start-up Cost Subsidy

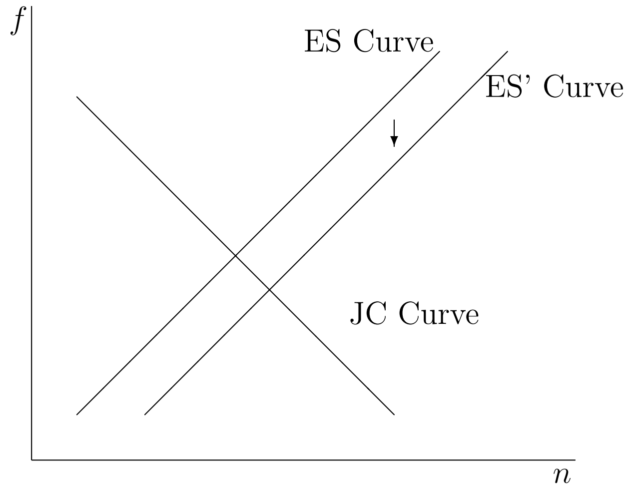
The start-up cost subsidy affects only the ES curve (see equation 4.9). A lower start-up cost subsidy shifts the ES curve downward to the right in the $(n, f)$ space. Thus, the equilibrium job-finding rate falls and the average employer size rises.

The mechanism of these results is as follows. A lower start-up cost subsidy reduces the relative return from self-employment, which results in a fall in the number of new business entrants. This negatively affects the job-finding rate in two ways. Firstly, more unemployed wage workers search for wage jobs. Secondly, a lower number of employers reduces the demand for workers. A fall in the job-finding rate reduces the efficiency wage, which induces employers to hire more workers.

**Proposition 2** A lower start-up cost subsidy, $\tau_s$, reduces the number of employers, $E$, the transition rate of unemployed workers to self-employment, $\phi$, and the job-finding rate, $f$. Further, it increases the average employer size, $n$, unemployment, $U$, and reduces total employment, $E + N$, and wage, $w$.

Note that since both $f$ and $\phi$ fall and $n$ rises, it implies that $\phi$ falls relatively more than $f$. A lower $\tau_s$ reduces the transition rate of unemployed workers to self-employment relatively more than the job-finding rate. In addition, a lower start-up cost subsidy may increase or lower wage employment, since $E$ falls and $n$ rises.

**Figure 2**
**Effects of Lower Start-up Cost Subsidy**




## 5.2 Unemployment Benefits

To analyze the effects of unemployment benefits, it is convenient to combine (4.9) and (4.10). Combining these two equations, I get one equation in one unknown, $n$:

$$u(F(n) - F_n(n)n) = u(F_n(n)(1 - \tau_w)) - 1 - \frac{r + \mu}{\rho} + (\mu + r)(1 - \tau_s)K. \quad (5.1)$$

In the proof of Lemma 1, I show that there exists a unique $n^*$ which solves (5.1).

Equation (5.1) shows that the average employer size is independent of the unemployment benefit. Then from (4.10) it follows that a higher unemployment benefit reduces the equilibrium job-finding rate.

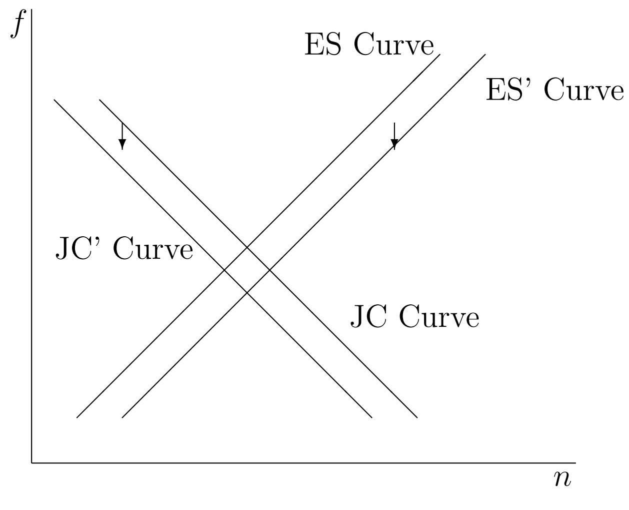
As discussed earlier, a higher unemployment benefit shifts the JC curve downward to the left in the $(n, f)$ space as a higher $b$ makes unemployment more attractive relative to wage employment. Thus, both $n$ and $f$ fall. On the other hand, a higher unemployment benefit shifts the ES curve downward to the right in the $(n, f)$ space as it increases the return from being an unemployed wage worker relative to being a self-employed worker. This leads to a fall in $f$, but a rise in $n$. The result is that $f$ unambiguously falls. However, a reduction in $n$ resulting from the shift in the JC curve is completely offset by the shift in the ES curve.

Intuitively, an increase in $b$ has two effects. Firstly, a higher $b$ increases wages, which reduces $n$. A decline in $n$ reduces the job-finding rate. Secondly, a higher $b$ reduces the number of new business entrants and increases the pool of unemployed wage workers. This further reduces the job-finding rate. This additional reduction in the job-finding rate induces employers to reduce wages and increase number of workers hired. The resulting increase in $n$ completely offsets the initial decline in $n$.

Since $n = \frac{f}{\phi}$, this implies that both $f$ and $\phi$ fall by the same proportion. Also as $w = F_n(n)$, changes in unemployment benefits do not affect wages. In the model, the positive effect of a higher unemployment benefit on wages is completely offset by the negative effect of a decline in the job-finding rate.

**Proposition 3**: A higher unemployment benefit, $b$, reduces the number of employers, $E$, the transition rate of unemployed workers to self-employment, $\phi$, and the job-finding rate, $f$. It increases unemployment, $U$, and reduces wage employment, $N$, and total employment, $E + N$. However, it does not affect the average employer size, $n$, and wage, $w$.

**Figure 3**
**Effects of a Higher Unemployment Benefit**




## 5.3 Wage Tax

The wage tax affects both the ES and the JC curves. As discussed earlier, a higher wage tax shifts the ES curve up to the left in the $(n, f)$ space as it reduces the return from unemployment relative to self-employment. On the other hand, a higher wage tax has an ambiguous effect on the JC curve.

**Proposition 4:** Assume that agents have the CRRA utility function, $u(c) = \frac{c^{1-\alpha}}{1-\alpha}$.

(i) Suppose $\alpha < 1$. Then a higher wage tax, $\tau_w$, reduces the average employer size, $n$, and increases wage, $w$.

(ii) Suppose $\alpha = 1$. Then a higher wage tax, $\tau_w$, increases the number of employers, $E$, the transition rate of unemployed workers to self-employment, $\phi$, and the job-finding rate, $f$. Further, it reduces the average employer size, $n$, and unemployment, $U$, and increases total employment, $E+N$, and wage, $w$.

(ii) Suppose $\alpha > 1$. Then a higher wage tax, $\tau_w$, increases the job-finding rate, $f$.

Proposition 4 shows that the effect of changes in the wage tax on the self-employment rate and the transition rate of unemployed workers to self-employment is ambiguous in general. An increase in $\tau_w$ shifts the ES curve up to the left in the $(n, f)$ space. In the case of $\alpha < 1$, an increase in $\tau_w$ shifts the JC curve down to the left in the $(n, f)$ space. Thus, $n$ necessarily falls but $f$ may rise or fall.

When $\alpha = 1$, an increase in $\tau_w$ does not affect the JC curve and thus $f$ rises and $n$ falls. In the case of $\alpha > 1$, an increase in $\tau_w$ shifts the JC curve up to the right in the $(n, f)$ space. Thus, $f$ necessarily rises but $n$ may rise or fall.

The ambiguous effect of changes in the wage tax on $E$ and $n$ in this model is in contrast to a model based on a perfectly competitive labor market. A model with a perfectly competitive labor market predicts that a higher wage tax should unambiguously lead to an increase in $E$ and a reduction in $n$. This can be shown as follows. In the model with a perfectly competitive labor market, since $E + N = 1$ and $N = nE$, the equilibrium $E$ and $N$ are given by

$$E = \frac{1}{1+n} \; \& \tag{5.2}$$

$$N = \frac{n}{1+n}. \tag{5.3}$$

It is straight-forward to show that $E_n < 0$ and $N_n > 0$. Since, a self-employed worker and an employee should be indifferent between these two states in equilibrium, we have

$$u(F_n(n)(1-\tau_w)) = u(F(n) - F_n(n)n) - K(1-\tau_s). \tag{5.4}$$

Implicit differentiation of (5.4) shows that $n_{\tau_w} < 0$. Thus, a higher wage tax leads to a fall in $n$ and an increase in $E$.

# 6 Conclusion

In this paper, I developed a theory of self-employment in the efficiency wage framework. The major contribution of this paper is to incorporate transitions between self-employment and unemployment in a model of occupational choice. The model is able to explain many empirical regularities, particularly with regard to the effects of unemployment benefits, which are not explained by the existing theoretical models of self-employment. In this model, a higher unemployment benefit reduces the self-employment rate and the rate of transition from unemployment to self-employment, which are consistent with empirical evidence (Carrasco 1999, Parker and Robson 2000). This model also predicts that a higher unemployment benefit does not affect wages. This prediction is consistent with a large body of empirical literature which suggests that changes in unemployment benefits have a negligible effect on post-unemployment wages (e.g. Classen 1977, Blau and Robins 1986, Meyer 1995, Addison and Blackburn 2000).

In addition, in this model a higher start-up cost reduces the self-employment rate and the rate of transition from unemployment to self-employment. These results are consistent with substantial empirical evidence which suggests that a higher start-up cost reduces new business formation and entrepreneurial activities (e.g. Desai et. al. 2003, Klapper et. al. 2006, Nystrom 2008, Djankov et. al. 2009).

In this paper, I used an efficiency wage model to generate unemployment in part due to its analytical tractability. An alternative way to generate unemployment is to use the search and matching (MP) model of Mortensen and Pissarides. The MP model is more complex due to two-sided search and Nash bargaining. In analytical work, it is generally assumed that there are firms with large numbers of jobs. Some of these jobs are filled and some are vacant. This assumption of large firms removes the uncertainties with regard to labor market flows at the firm level. Equivalently, one can assume that there is a large number of firms with one job each. More precisely, with these assumptions one does not have to worry about the size distribution of firms. However, in the occupational choice framework, one cannot assume that new firms are large. Given the uncertainty about the hiring process, business failure, and job-destruction, this will lead to a non-degenerate distribution of firm-size.

My conjecture is that the effects of changes in unemployment benefits and start-up cost subsidy on self-employment would go through in the MP framework. An increase in unemployment benefits is likely to reduce self-employment for two reasons. Firstly, it will raise the reservation wage of unemployed wage workers, which will reduce the profit of employers. Secondly, it will increase the attractiveness of unemployment vis-a-vis self-employment. Similarly, a reduction in the start-up cost subsidy would reduce self-employment by increasing the attractiveness of unemployment vis-a-vis self-employment. However, due to the non-degenerate distribution of firm-size, showing the effects of public policies analytically in the MP framework is a very difficult problem. Thus, the analysis of the effects of public policies on self-employment in the MP framework is left for future research.

## Appendix

### Derivation of Equations (4.2-4.5)

In the steady state, (2.5), (2.6), and the condition that $N = nE$ imply that

$$\mu(1+n)E = (f+\phi)U \ \& \tag{A1}$$

$$U = \frac{\mu}{f}nE. \tag{A2}$$

(2.1), $(A2)$, and $N = nE$ imply that

$$E = \frac{f}{\mu n + (1+n)f}; \tag{A3}$$

$$N = \frac{fn}{\mu n + (1+n)f}; \tag{A4}$$

and

$$U = \frac{\mu n}{\mu n + (1+n)f}. \tag{A5}$$

$(A1)$ and $(A2)$ imply that

$$\phi = \frac{f}{n}. \tag{A6}$$

### Derivation of the ES Curve (Equation (4.9))

(3.2), (3.7), and (4.1) imply that

$$r\lambda^u = u(b(1-\tau_w)) + \frac{f}{\rho}. \tag{A7}$$

(3.5), (3.8), (3.9), and (4.1) imply that

$$r\pi(n) = u(F(n) - nF_n(n)) - \mu(1-\tau_s)K. \tag{A8}$$

Then (3.5), (4.1), $(A7)$, and $(A8)$ imply that

$$u(F(n) - nF_n(n)) = u(b(1-\tau_w)) + \frac{f}{\rho} + (\mu + r)(1-\tau_s)K \tag{A9}$$

which traces the ES curve. Since $\frac{d[F(n)-F_n(n)n]}{dn} > 0$, the ES curve traces an upward relationship between $n$ and $f$ in the $(n, f)$ space.

**Proof of Lemma 1**

Recall that $F(0) = 0$, $\lim_{n\to 0} F_n(n) = \infty$, $\lim_{n\to 0} nF_n(n) = 0$, & $u_c(c) > 0$. From (4.9) and (4.10), we have

$$u(F(n) - nF_n(n)) = u(F_n(n)(1-\tau_w)) - \frac{r+\mu}{\rho} - 1 + (\mu+r)(1-\tau_s)K. \quad (A10)$$

$(A10)$ is one equation with one unknown, $n$. Given that $\frac{d[F(n)-F_n(n)n]}{dn} > 0$ and $u_c(c) > 0$, the LHS of $(A10)$ is increasing in $n$. On the other hand, the RHS is decreasing in $n$. To show the existence of equilibrium, it is sufficient to show that $\lim_{n\to 0} RHS > \lim_{n\to 0} LHS$.

Given that $\lim_{n\to 0} F(n) - nF_n(n) = 0$, and $\lim_{n\to 0} F_n(n) = \infty$, under the condition that $u(\infty) - A > u(0)$, where $A = 1 + \frac{r+\mu}{\rho} - (\mu + r)(1 - \tau_s)K$, we have $\lim_{n\to 0} RHS > \lim_{n\to 0} LHS$. Thus, there exists a unique $0 < n < \infty$ which solves $(A10)$. Then one can back out the associated $f$ from equation 4.10.

**Proof of Propositions 1, 2, 3, and 4** Follows from the discussion in the text.

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