Marcin Bielecki, Advanced Macroeconomics IE, Spring 2019

1 Shapiro-Stiglitz model of efficiency wages

Shapiro and Stliglitz (1984) propose a model where workers can either work "honestly" and exert effort at work, or "shirk" and do not exert effort at all, while still receiving wages. Whether a worker shirks or not is a hidden action, and thus creates a moral hazard problem. Firms would like for all workers not to shirk, and will fire any worker caught shirking. However, monitoring is imperfect and will only detect a shirking worker with probability f. To overcome this principal-agent problem, firms will have to motivate workers with higher wages, so that becoming unemployed will entail a higher cost and will incentivize workers to exert effort. Thus wages will have two functions: allocating labor and motivating employees. However, each time we use a single instrument to solve two problems, inefficiencies will emerge. In this model an inefficient outcome is the emergence of unemployment. The model will also help us in gaining intuition on why does the unemployment rate increase faster in a recession than it decreases once the recession is over.

I will use the notation analogous to the notation used in the search and matching lecture.

1.1 Values of labor market states

First, let us derive the value of being employed and not shirking $\mathcal{E}$. Working honestly requires a worker to exert effort, which costs e. With probability s the worker and a firm become separated, in which case the worker becomes unemployed. We will consider first the discrete time expression in a stationary equilibrium, and then switch to continuous time case:

$$\begin{aligned}
\mathcal{E} &= w - e + \beta\left[(1-s)\,\mathcal{E} + s\mathcal{U}\right] \\
\frac{1}{\beta}\mathcal{E} &= \frac{w-e}{\beta} + (1-s)\,\mathcal{E} + s\mathcal{U} \\
\left(\frac{1}{\beta} - 1\right)\mathcal{E} &= \frac{w-e}{\beta} - s\,(\mathcal{E} - \mathcal{U}) \\
\rho\mathcal{E} &= \frac{w-e}{\beta} - s\,(\mathcal{E} - \mathcal{U})
\end{aligned}$$

In continuous time, the discount factor between moments goes to 1, and the expression becomes:[1]

$$\rho\mathcal{E} = w - e - s\,(\mathcal{E} - \mathcal{U})$$

The above expression can be also justified by the following asset-pricing logic. Imagine that I can sell the "rights" to state $\mathcal{E}$ and then put the money in a bank, generating me interest income. On the other hand, if I don't sell the rights to $\mathcal{E}$, I earn $w - e$, and with probability s I lose rights to $\mathcal{E}$, but gain rights to $\mathcal{U}$. In equilibrium, I am indifferent between selling the rights and keeping them.

The value of being employed and shirking is given by:

$$\rho\mathcal{S} = w - (s+f)\,(\mathcal{S} - \mathcal{U})$$

A shirking worker does not exert effort, but loses their job with a higher probability.

The value of being unemployed is given by:

$$\rho\mathcal{U} = b + p\,(\max\{\mathcal{E}, \mathcal{S}\} - \mathcal{U})$$

An unemployed person gets unemployment benfits b and with probability p finds a job, where she has a choice on whether to shirk or not.

[1]Note that here I am using a bit of hand-waving. Deriving the expression accurately is quite a bit more complicated, so treat this procedure as a short-cut which allows us to arrive at the result faster.

1.2 Non-shirking condition (NSC)

The firms want to incentivize workers to self-select into state $\mathcal{E}$, rather than $\mathcal{S}$. Therefore:

$$\begin{aligned}
\mathcal{E} &\geq \mathcal{S} \\
\rho\mathcal{E} &\geq \rho\mathcal{S} \\
w - e - s\left(\mathcal{E} - \mathcal{U}\right) &\geq w - (s+f)\left(\mathcal{S} - \mathcal{U}\right) \geq w - (s+f)\left(\mathcal{E} - \mathcal{U}\right) \\
-e &\geq -f\left(\mathcal{E} - \mathcal{U}\right) \\
\mathcal{E} - \mathcal{U} &\geq \frac{e}{f}
\end{aligned}$$

The non-shirking condition implies that the difference between the employed and non-shirking state and the unemployed state has to be large enough. The higher the cost of effort e and the lower the shirker detection probability f, the higher this difference needs to be.

Assuming that the NSC holds, the values of relevant states can be rewritten as:

$$\begin{aligned}
\rho\mathcal{E} &= w - e - s\left(\mathcal{E} - \mathcal{U}\right) \\
\rho\mathcal{U} &= b + p\left(\mathcal{E} - \mathcal{U}\right)
\end{aligned}$$

If we subtract the equations from each other, we get:

$$\begin{aligned}
\rho\left(\mathcal{E} - \mathcal{U}\right) &= w - e - s\left(\mathcal{E} - \mathcal{U}\right) - \left[b + p\left(\mathcal{E} - \mathcal{U}\right)\right] \\
\rho\left(\mathcal{E} - \mathcal{U}\right) &= w - e - b - (s+p)\left(\mathcal{E} - \mathcal{U}\right) \\
(\rho + s + p)\left(\mathcal{E} - \mathcal{U}\right) &= w - e - b \\
\mathcal{E} - \mathcal{U} &= \frac{w-e-b}{\rho+s+p} \geq \frac{e}{f} \\
w - e - b &\geq (\rho+s+p)\frac{e}{f}
\end{aligned}$$

$$w \geq e + b + (\rho+s+p)\frac{e}{f}$$

The above expression states that the wage needs to be at least as high as the RHS of the inequality to motivate workers to self-select into the non-shirking state.

Recall that the job-finding probability p is a negative function of the unemployment rate. More formally:

$$\begin{aligned}
u &= \frac{s}{s+p} \\
su + pu &= s \\
p &= s\frac{(1-u)}{u} = s\left(\frac{1}{u} - 1\right)
\end{aligned}$$

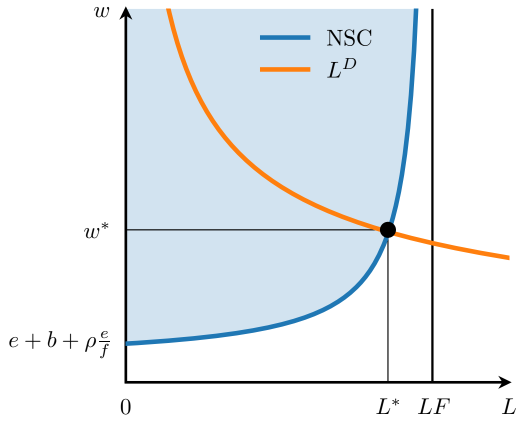
Rewrite the expression for the NSC:

$$\begin{aligned}
w &\geq e + b + (\rho+s+p)\frac{e}{f} \\
w &\geq e + b + \left(\rho + s + s\left(\frac{1}{u} - 1\right)\right)\frac{e}{f} \\
w &\geq e + b + \left(\rho + \frac{s}{u}\right)\frac{e}{f}
\end{aligned}$$

The lower the unemployment rate is, the higher the wages need to be to motivate workers to exert effort. With $u = 1$ the condition becomes $w \geq e + b + \rho e/f$, but with $u \to 0$, $w \to \infty$. Therefore, a positive level of unemployment rate is necessary for workers to exert effort.

1.3 Equilibrium and comparative statics

The equilibrium wage and level of employment are determined by the intersection of the labor demand curve L^D and the non-shirking condition (NSC):

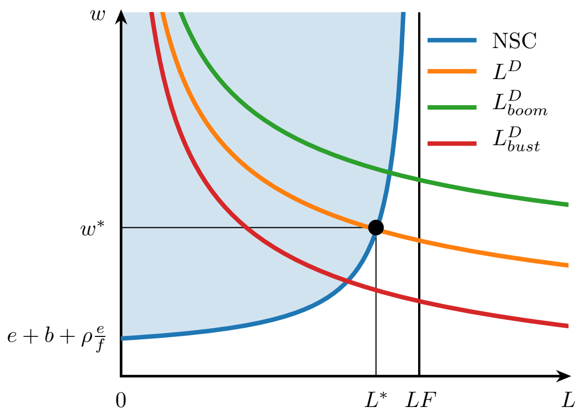


The equilibrium unemployment rate is given by the following relationship between the level of employment L^* and total labor force LF:

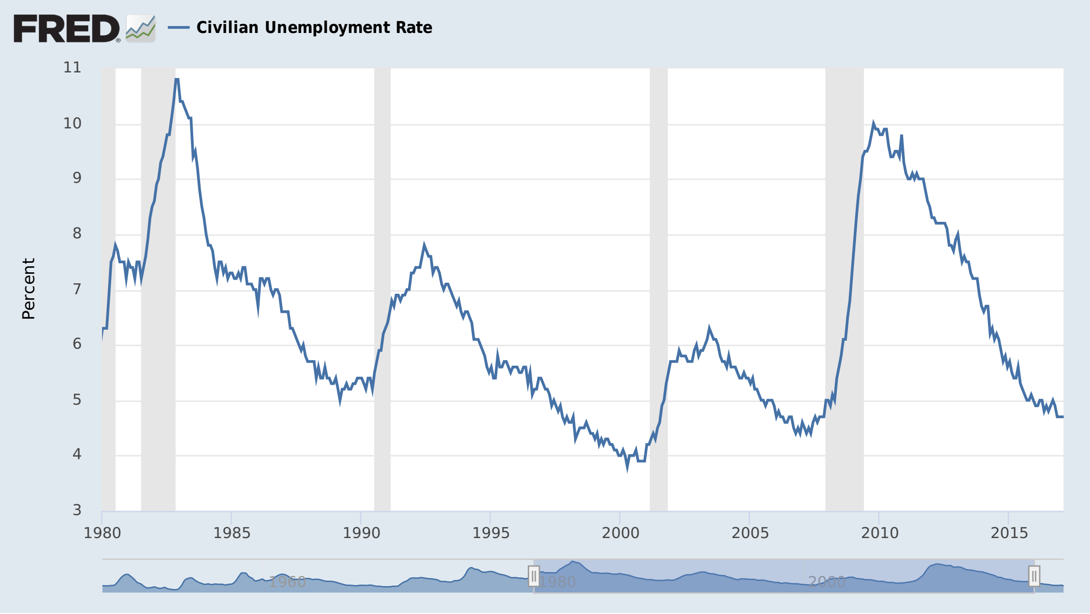
$$u^* = 1 - \frac{L^*}{LF}$$

Increases in the unemployment benefit b, separation rate s and workers' impatience ρ result in higher wages, but lower levels of employment and higher unemployment rate. An increase in shirker detection probability f decreases wage but increases level of employment and the unemployment rate goes down.

We can now analyze how the labor markets react in a boom or recession (bust). An increase in the demand for labor in a boom induces both an increase in wages and employment, and the firms can do both at the same time. However, a decrease in the demand for labor in a bust has different effects. In the new equilibrium, both wages and employment are lower, but firms cannot cut wages first, as the workers would start shirking. Therefore, firms first reduce employment, without changing wages. As a consequence, the unemployment rate react asymmetrically to the shocks, increasing sharply during a recession, but decreasing only slowly after the recession is over.



Bewley (1999) has conducted a series of interviews with business executives during the recession in the early 1990s. He found that the executives were averse to cutting wages of either current employees or new hires, even during the economic downturn when demand for their products fell sharply. They believed that cutting wages would hurt morale, which they felt was critical in gaining the cooperation of their employees and in convincing them to internalize the managers' objectives for the company.



Shaded areas indicate U.S. recessions Source: U.S. Bureau of Labor Statistics myf.red/g/o1Pq