# Notes on "Labor Markets and Monetary Policy"*

These notes assume that the reader is familiar with the canonical Diamond-Mortensen-Pissarides (DMP) model with Nash bargaining. The details of the model – and derivations of the steady-state equilibrium conditions – are available in a number of articles and textbooks. Personally, I've benefited from reading Shimer (2005) and Mortensen and Nagypal (2007).

Throughout my talk, and in these notes, I abstract from the potentially important issue of firm search intensity. Davis, Faberman, and Haltiwanger (2010) argue that firms are expending less effort in 2010 than they did in 2007 to fill a given job vacancy. If their argument is correct, then the labor market is actually slacker than is indicated by the December 2010 observation on $(v/u)$. This extra slack would generate higher estimates for the benefits of job creation and lower estimates for $u^*$, for any value of $(p - z)$.

**Slide on Benefits of Job Creation:** The approximation on this slide can be derived as follows. The steady-state version of the firm's job-creation first-order condition is

$$\begin{aligned} k &= q(\theta)(1-\beta)V \\ V &= \frac{p-z}{r+s+\beta f(\theta)}, \end{aligned}$$

where $r$ represents the discount rate, $s$ is the separation rate, $\theta = v/u$, $f(\theta)$ is the job-finding rate, and $q(\theta) = f(\theta)/\theta$. We can substitute for $V$ to get

$$k = \frac{q(\theta)(1-\beta)(p-z)}{r+s+\beta f(\theta)}.$$

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For standard parameterizations of the model, the parameters $r, s$ are small compared with $\beta f(\theta)$. Then, this is well approximated by

$$\begin{aligned} k &= \frac{q(\theta)(1-\beta)(p-z)}{\beta f(\theta)} \\ &= \frac{(1-\beta)(p-z)}{\beta\theta}, \end{aligned}$$

which is the version of the first-order condition that I use.

**First Slide on Labor Market Matching Efficiency:** Since the end of the recession in June 2009, the job openings rate has gone up noticeably, while the unemployment rate has fallen little. This change suggests that there has been a decline in labor market matching efficiency since December 2007. Technically, a decline in labor market matching efficiency means for any given job opening, firms are finding fewer qualified applicants *than they should, given the huge increase in* $(u/v)$. This italicized phrase is a critical one. Both models and evidence suggest that, given the high unemployment rate, firms are more likely to find qualified applicants than they did in December 2007 for any job opening. A decline in labor market matching efficiency means that the increase in the size of the pool of qualified applicants is smaller than we would have expected, given the change in $(u/v)$.

There has been a host of empirical research that attempts to assess the sources and consequences of this apparent change in labor market matching efficiency. I will not attempt to summarize this burgeoning literature here (except to note the useful analysis of Schulhofer-Wohl (2010) on "housing lock," done here at the Minneapolis Fed).

In the DMP model, changes in labor market matching efficiency are typically captured through shifts in the matching function. However, as shown above, the matching function has no impact on the firm's benefits of job creation. Intuitively, a decline in matching efficiency affects the benefits of job creation in two ways. First, a given job opening is less likely to find a qualified worker. That lowers the benefits of job creation. Second, unemployed workers are less likely to find a match, and so are willing to accept lower wages. That raises the benefits of job creation. As it turns out, with a constant returns-to-scale matching function (and small values for $r$ and $s$), the two effects exactly offset.

Hence, changes in the matching function do not affect the equilibrium level of job market tightness $(v/u)$. Instead, changes in the matching function show up in the determination of the unemployment rate. Given $(v/u)$, in the DMP model, there is another steady-state relationship that determines the equilibrium level of unemployment itself:

$$u = \frac{s}{s + f(\theta)} \tag{1}$$

A decline in matching efficiency affects this relationship by shifting the job-finding rate $f$ (so that a given level of $\theta$ translates into a lower job-finding rate).

Has such a shift happened? In December 2007, $f(\theta)$ was $s(1-u)/u = 0.036(0.95)/0.05 = 0.684$. The observed level of market tightness $\theta$ has fallen by approximately 60%. Mortensen and Nagypal (2007) calibrate the elasticity of $f$ to be 0.54. Hence, the fall in $\theta$ alone should have resulted in $f(\theta)$ falling to 0.414. Instead, in December 2010, $f(\theta)$ is $0.032(0.906)/0.094 = 0.308$. So, $f(\theta)$ has shifted down markedly, by 25.6%.

Now, suppose this shift in $f$ had not taken place. What would the unemployment rate have been in December 2010? The answer is readily calculated:

$$u = \frac{0.032}{0.032 + 0.414} = 7.2\%.$$

It follows that the unemployment rate is about 1/3 higher (2.2 percentage points) than it would be if matching efficiency had not declined since December 2007. I view this calculation as only suggestive: it is one calculation from one model, using aggregate data.[1]

**Second Slide on Labor Market Matching Efficiency:** In the second slide on mismatch, I describe a range of possible values of $u^*$ that emerge from applying the DMP model to the aggregate data on unemployment and vacancies. I obtain this range of values in the following way. As in the slides, I interpret the wedge in the firm's job-creation first-order condition as being wholly attributable to nominal rigidities. Hence, to find $u^*$, I ask: what would the unemployment rate be if $u/v$ fell so as to eliminate the wedge – that is, so as to satisfy the firm's job creation condition with equality? (In

[1] I have done a similar calculation by applying the entirely different Shimer (2007) model to aggregate unemployment-vacancies data. In that model, the unemployment rate is 28% (2 percentage points) higher than it would be in absence of the decline in matching efficiency.

answering this question, I assume that labor market matching efficiency has declined as discussed above.)

To figure out the answer to this question, I proceed in two steps. First, I calculate a natural level of job market tightness:

$$\begin{aligned}\theta^* &= \left(\frac{p-z}{p_{2007}-z_{2007}}\right)\theta_{2007} \\ &= \frac{(p-z)}{1-0.73}(0.031/0.05).\end{aligned}$$

This calculation tells us what job market tightness would be without nominal rigidities (assuming that nominal rigidities were not having a significant impact on job market tightness in December 2007).

Second, suppose that – in the absence of nominal rigidities – the level of job market tightness were $\theta^*$, rather than $\theta_{2010}$. As discussed above, that will raise the job-finding rate by a multiple equal to $(\theta^*/\theta_{2010})^{0.54}$. We can then plug this hypothetical job-finding rate into the steady-state relationship (1):

$$\begin{aligned}u^* &= \frac{s_{2010}}{s_{2010}+f_{2010}(\frac{\theta^*}{\theta_{2010}})^{0.54}} \\ &= \frac{0.032}{0.032+0.308(\frac{\theta^*}{\frac{0.023}{0.094}})^{0.54}}.\end{aligned}$$

Finally, we can substitute out for $\theta^*$. We obtain

$$u^* = \frac{0.032}{0.032+0.308(2.53)^{0.54}(\frac{p-z}{0.27})^{0.54}}.$$

This formula provides a way to map changes in $(p-z)$ into $u^*$. The results of this computation are described in the table below.[2]

[2] As Mortensen and Nagypal (2007) discuss, their calibration for the elasticity of the matching function is high relative to others in the literature. Lower values for this elasticity would translate into higher values for $u^*$, for any value of $(p-z)$. For example, if I were to use a (more standard) elasticity of 0.4, then $u^*$ would range between 6.7% and 9.0%.

I have also calculated the same table in the Shimer (2007) model. I parameterize the model, as Shimer does, by setting $p = 1$ and $z = 0.4$. I abstract from any changes in the risk-adjusted discount rate $r$ or the layoff rate $l$. In that model, $u^*$ ranges from 6.4% (if $(p-z)$ has not changed since December 2007) to 9.4% (if $(p-z)$ has fallen by 0.12).

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|---|---|---|---|---|---|---|---|
| Fall in $(p-z)$ | 0.00 | 0.025 | 0.05 | 0.075 | 0.1 | 0.125 | 0.15 |
| $u^*$ | 5.9% | 6.2% | 6.6% | 7.0% | 7.5% | 8.1% | 8.9% |

Note that even if $(p-z)$ does not change, $u^*$ is higher than its December 2007 level (5.9% instead of 5%). This increase of 90 basis points is a combination of two effects. First, as discussed above, the decline in labor market matching efficiency in the past three years pushes up $u^*$ by roughly 1/3. Second, the fall in the separation rate since December 2007 *lowers* $u^*$ by about 1/9.

The previous table describes the relationship between absolute changes in $(p-z)$ and $u^*$. This relationship is nonlinear. However, the relationship between $\ln(p-z)$ and $\ln(u^*)$ is essentially linear.

## References


[1] Davis, S., J. Faberman, and J. Haltiwanger, 2010, "Labor Market Flows in the Cross Section and Over Time," unpublished manuscript.

[2] Mortensen, D., and E. Nagypal, 2007, "More on Unemployment and Vacancy Fluctuations," *Review of Economic Dynamics* 10(3): 327–47.

[3] Schulhofer-Wohl, S., 2010, "Negative Equity Does Not Reduce Homeowners' Mobility," Working Paper 682, Federal Reserve Bank of Minneapolis.

[4] Shimer, R., 2005, "The Cyclical Behavior of Equilibrium Unemployment and Vacancies," *American Economic Review* 95(1): 25–49.

[5] Shimer, R., 2007, "Mismatch," *American Economic Review* 97(4): 1074–101.