Central Bank of Iceland, April 2002.

Labour Economics for Central Bankers: Practical Lessons about the Inflation-Unemployment Trade-off

Gylfi Zoega

Preliminary report

Outline

1. Introduction
2. A representative agent model of wage inflation.
3. Extension to cover heterogeneous firms and workers.
4. Data for Iceland.

1. Introduction

Channels of the **monetary policy transmission mechanisms**:

- The direct effect of interest rates on investment and saving.
- The indirect effect of changes in interest rates on exports and imports through exchange-rate determination.
- The indirect effect of changes in interest rates on private consumption through asset prices (wealth effect).
- The effect on the supply of credit and financial stability.

It matters where the effects of monetary policy are found because:

- There are differences in labour intensity across sectors.
- Labour differs across sectors: skilled versus unskilled, general skills versus specific.
- Foreign versus domestic labour.
- Distribution of income matters.

This opens the possibility that the relationship between inflation and unemployment depends on the nature of the monetary-transmission channel.

When using interest rates to achieve an inflation target, the magnitude of the desired interest rate change is likely to depend on the exact channel of the monetary transmission mechanism.

The wage-price spiral in labour economics

Dunlop (1938) argued that unemployment affected not just the level of nominal wages but also its rate of change.

Phillips (1958) was later to confirm this prediction in his much-cited study of inflation and unemployment in the United Kingdom.

Three distinct types of inflation.

Dunlop (1950): High employment makes union raise wages which makes firms raise prices which makes unions raise wages further and so on. → real wages matter

Phelps (1968): High employment makes firms offer higher wages in order to retain and recruit workers. → relative wages matter

Lerner (1949): Expectations of inflation cause inflation without unemployment playing any role.

The contribution of Friedman and Phelps (1968) was to introduce the idea of anticipated inflation into the theory of the Phillips curve. When combined with the notion of adapted expectations, an unemployment rate persistently below the natural rate causes rising inflation without limit; and similarly, a very high and constant rate of inflation only buys low unemployment for a short period of time.

There is no long-run trade-off between unemployment and inflation.

Later contributions have managed to endogenize the path taken by the natural rate of unemployment. This becomes a function of macroeconomic shocks as well as social policy.

Some later contributions: Layard and Nickell (1986), Layard, Nickell and Jackman (1991), Calvo (1979), Salop (1979), Shapiro and Stiglitz (1984), Hoon and Phelps (1992).

II. A representative-agent model of wage inflation – Phelps (1968)

The desired wage differential of firm i – that is the difference between wages paid at firm i and average wages in the economy:

$$\Delta_i^* = \frac{w_i^* - w}{w} \tag{1}$$

w denotes average wages in the economy

w_i is the wage paid by firm i.

This desired wage differential is a function of several variables,

$$\Delta_i^* = j^i(u, v, V_i, L) \tag{2}$$

u is the unemployment rate

v is the vacancy rate

V_i denotes the number of vacancies in firm i

L is the size of the labour force.

Ruling out scale effects we get:

$$\Delta_i^* = k^i(u, v, v_i) \tag{3}$$

Assume that all firms are alike and we get:

$$\Delta^* = m(u,v) \tag{4}$$

m_u<0 and m_v >0.

Inflation is a positive function of desired wage differential:

$$\frac{\dot{w}}{w} = l\Delta^* \tag{5}$$

The dynamics of employment.

$$\dot{N} = R - D - Q \tag{6}$$

R denotes hires, D the number of retirements and Q the number of workers quitting *Q*. Hiring and quitting depend on vacancies and unemployment.

$$\dot{N} = R(U,V,L) - dN - Q(U,V,L) \tag{7}$$

Assuming the two functions are homogeneous of degree one, we can rewrite equation (7) as follows:

$$z = \frac{\dot{N}}{L} = R(u,v) - d(1-u) - Q(u,v,1) = z(u,v) \tag{7'}$$

where z_1>0 and z_2>0.

Define: $v = \Psi(z,u)$, where Y_z>0 and Y_u<0.

$$\frac{\dot{w}}{w} = lm[u, \Psi(u,z)] = f(u,z) \tag{8}$$

Anticipated inflation introduced.

$$\frac{\dot{w}}{w} = f(u,z) + \frac{\dot{w}^e}{w} \tag{9}$$

By definition: $z = (1-u)g - \dot{u}$.

Macroeconomic equilibrium path:

$$\frac{\dot{w}}{w} = \frac{\dot{w}^e}{w} \tag{10}$$

$$f[u^*, (1-u^*)g - \dot{u}^*] = 0 \tag{11}$$

The equilibrium path can be defined in terms of correct expectations or perfect foresight.

The natural rate of unemployment u_n is defined as the steady-state unemployment rate:

$$f[u_n, (1-u_n)g] = 0 \tag{12}$$

Key lesson for central bankers:

If monetary policy is used to maintain unemployment at a rate lower than the equilibrium rate u^* – or the natural rate u_n in steady state – inflation will be rising. There is some rate of unemployment, which is compatible with stable inflation. If the economy is pushed – by intent or due to a business cycle – below this level, inflation will become a problem.

III. An extension with heterogeneous agents

Assume that there are *N* firms and also *N* types of labour and that each firm only employs one type of labour.

Each firm has a desired wage differential when it comes to its own wage and the average wage elsewhere.

Equilibrium differentials reflect differences in the quality of labour – workers' education and training. But they also reflect the attributes of firms and jobs. As Adam Smith pointed out, jobs carrying non-pecuniary disadvantages should have positive wage differentials. Wages also depend on the nature and extent of incentive problems that firms face.

Desired wage differential for firm i:

$$\Delta_i^* = \frac{w_i^* - w^e}{w^e} \tag{13}$$

Expected wage differential:

$$\Delta_i^e = \frac{w_i - w^e}{w^e} \tag{14}$$

Decision rule:

$$\dot{\Delta}_i^e = l\left[\Delta_i^* - \Delta_i\right] \tag{15}$$

Speed of adjustment depends on such factors as the staggering of wage-setting decisions; whether all wages are revised at the same time.

This gives:

$$\dot{\Delta}_i^e = \frac{\dot{w}_i}{w^e} - \frac{\dot{w}^e}{w^e} - \frac{\dot{w}^e}{w^e w^e}\left(w_i - w^e\right) \tag{16}$$

which gives:

$$\dot{\Delta}_i^e = \frac{\dot{w}_i}{w^e} - \frac{\dot{w}^e}{w^e}\frac{w_i}{w^e} \tag{17}$$

Combine equations (15) and (17) to get:

$$\frac{\dot{w}_i}{w_i} = l_i\left(\Delta_i^* - \Delta_i\right)\frac{w}{w_i} + \frac{\dot{w}^e}{w} \tag{18}$$

Definition: In a macroeconomic equilibrium actual wage differentials equal actual wage differentials: $\Delta_i = \Delta_i^e = \Delta_i^*, \quad i = 1, 2, 3, \ldots\ldots N$ It follows that in such actual inflation equals expected inflation in equilibrium:

$$\frac{\dot{w}_i}{w_i} = \frac{\dot{w}}{w} = \frac{\dot{w}^e}{w}, \qquad \text{i} = 1, 2, 3 \ldots\ldots N$$

Disequilibrium with heterogeneous agents

In disequilibrium the actual and desired wage differentials are not equalised at the firm level.

Two sets of firms:

Firms wanting to increase their wage differentials: $\Delta_i^* > \Delta_i \quad \rightarrow \quad \dot{\Delta}_i^* > 0$

Firms wanting to decrease their wage differentials: $\Delta_i^* < \Delta_i \quad \rightarrow \quad \dot{\Delta}_i^* < 0$

Average wage inflation is then equal to the weighted average of wage inflation in each of the N firms:

$$\frac{\dot{w}}{w} = \sum_{i=1}^{N} v_i \frac{\dot{w}_i}{w_i} \tag{19}$$

where $v_i = N_i / N$ and $\sum v_i = 1$.

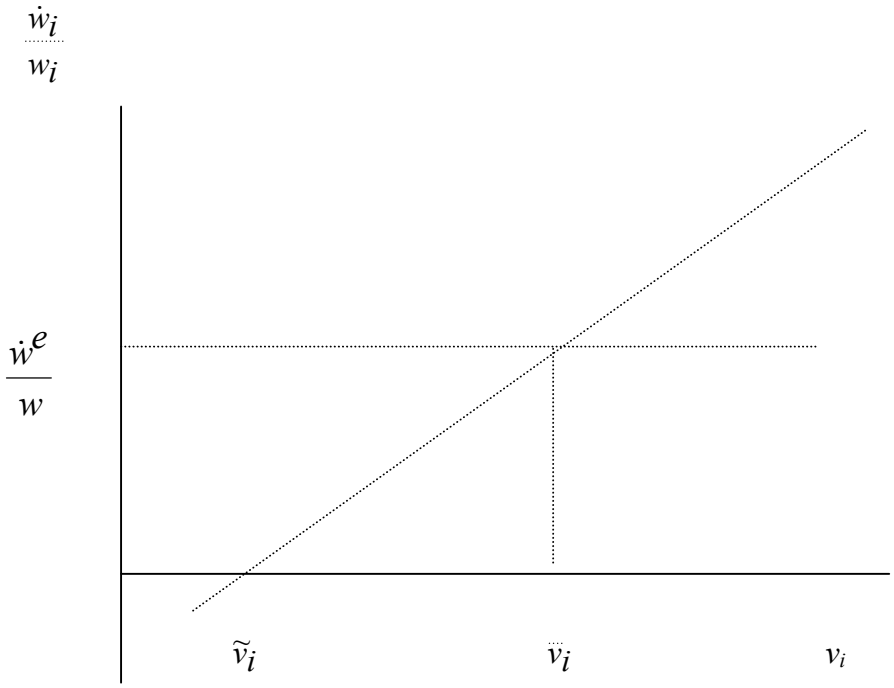
Combining equations (18) and (19) gives:

$$\frac{\dot{w}}{w} = \sum_{i=1}^{N} v_i \, l_i \left(\Delta_i^* - \Delta_i \right) \frac{w}{w_i} + \frac{\dot{w}^e}{w} \tag{20}$$

Using equation (3) we get:

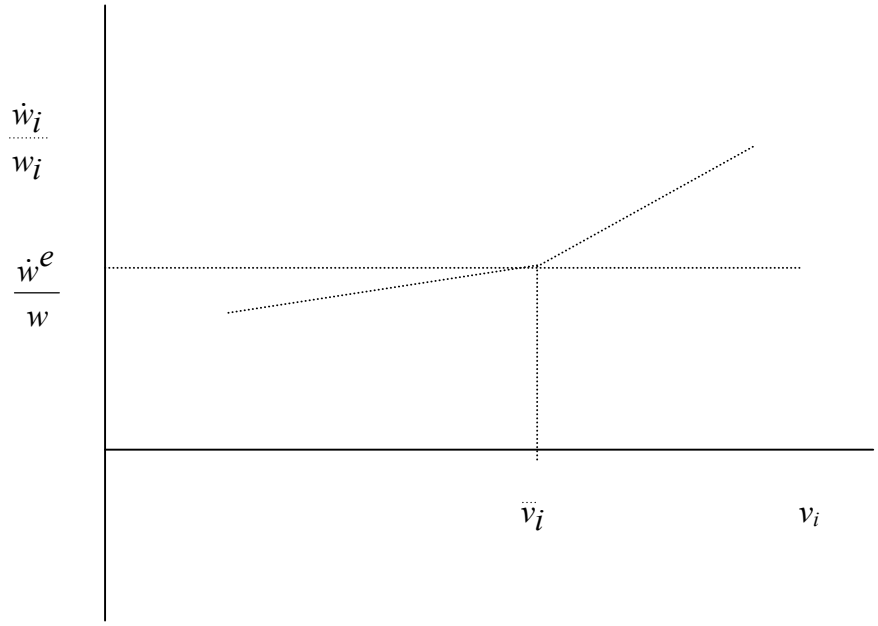
$$\frac{\dot{w}}{w} = \sum_{i=1}^{N} v_i \, l_i \left(k^i (u, v, v_i) - \Delta_i \right) \frac{w}{w_i} + \frac{\dot{w}^e}{w} \tag{21}$$

The distribution of vacancies may matters!



Assume that the speed of adjustment is higher for firms wanting to raise their wage differential than for those who would like to reduce it.

(Personnel and incentive problems.)

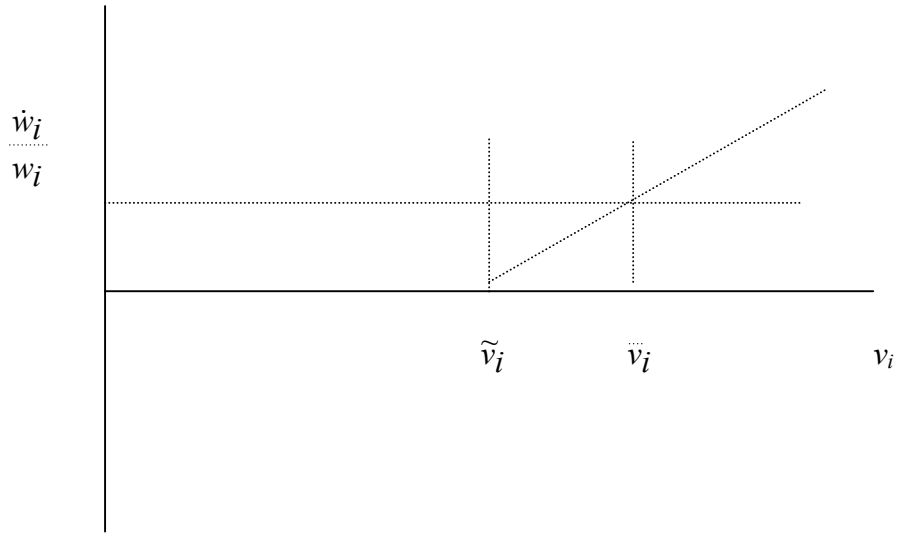


The higher moments of the distribution of vacancies matter.

A mean-preserving spread of the distribution of vacancies will hence act to raise inflation. Note that the total number of vacancies stays the same but the variance goes up.

There is the possibility that an increase in the dispersion of vacancies at an unchanged unemployment rate will cause rising inflation. Increased dispersion raises average inflation, which then feeds into anticipated inflation that affects subsequent wage setting. To prevent this rise in inflation the rate of unemployment will have to be higher.

Assumption: Rule out absolute money wage reductions.



First implication:

Again the higher moments of the distribution matter.

Second implication:

The long-run Phillips curve that now acquires a non-vertical segment.