Foundations of Modern Macroeconomics
Second Edition

Chapter 6: A closer look at the labour market

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Outline

Aims of this lecture

- To discuss some of the most important stylized facts about the labour market.
- To demonstrate what the "standard models" are able to explain.
- To look for the direction(s) in which we should look for plausible explanations.
- Note: Every serious student of the labour market(s) should consult the book by Layard, Nickell, and Jackman (1991), *Unemployment: Macroeconomic Performance and the Labour Market*.

Some stylized facts

- SF1 Unemployment fluctuates over time. See **Figures 6.1(a)-6.1(c)**.
- SF2 Unemployment fluctuates more *between* business cycles than *within* business cycles. See **Figures 6.2(a)-6.2(b)** for long date series for the UK and the US. There is a lot of *persistence* in the data:

$$\hat{U}_t = \underset{(2.83)}{0.7139} + \underset{(20.2)}{0.8561}\, U_{t-1}, \quad \text{(UK, 1856-2005)}$$

$$\hat{U}_t = \underset{(2.47)}{0.9919} + \underset{(17.7)}{0.8567}\, U_{t-1}, \quad \text{(US, 1891-2005)}$$

- SF3 The rise in European unemployment coincides with an enormous increase of *long-term* unemployment. See **Tables 6.1-6.2**. In Europe the high unemployment level is not due to an increased probability of losing one's job but rather to a decreased probability of finding a job when unemployed!

Figure 6.1(a): Postwar unemployment in the European Union and the United States

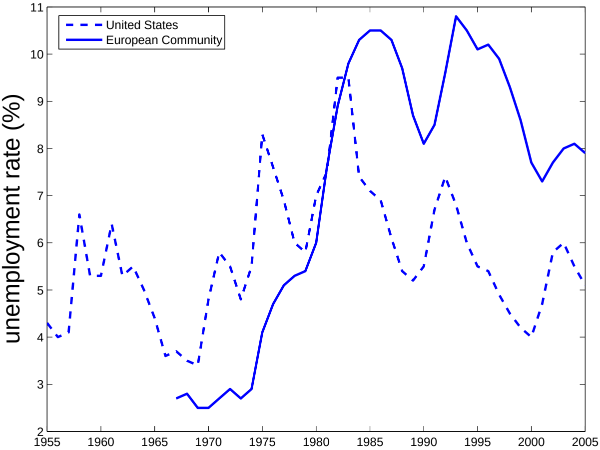


Figure 6.1(b): Postwar unemployment in Japan and Sweden

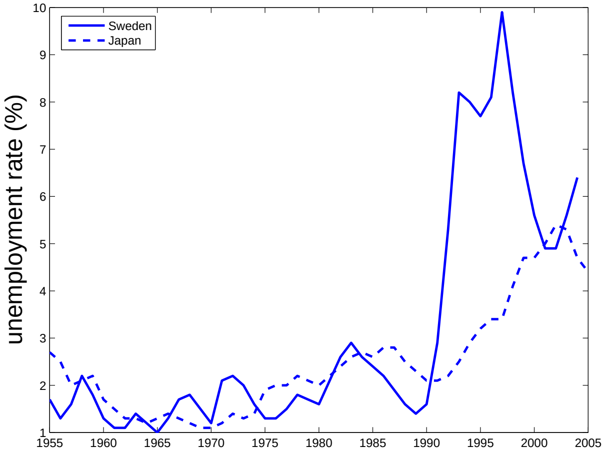


Figure 6.1(c): Postwar unemployment in the United Kingdom and the Netherlands

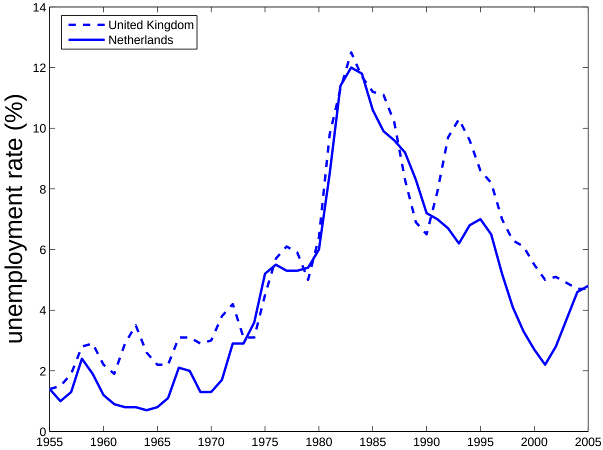


Figure 6.2(a): Unemployment in the United Kingdom, 1855-2005

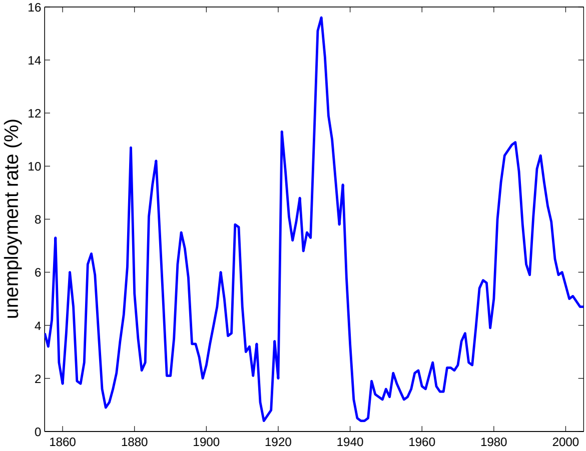


Figure 6.2(b): Unemployment in the United States, 1890-2005

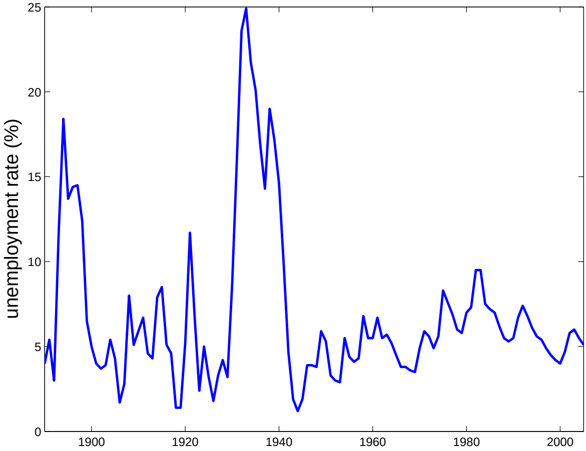


Table 6.1: The nature of unemployment

	France			Germany			United Kingdom		
	In[a]	*Out*[b]	*LTU*[c]	*In*[a]	*Out*[b]	*LTU*[c]	*In*[a]	*Out*[b]	*LTU*[c]
1979	0.27	6.6	33.1	0.18	19.6	18.8	0.41	14.3	26.0
1988	0.33	5.7	44.6	0.26	6.3	46.2	0.68	9.5	43.0
1996	0.36	3.3	39.6	0.49	6.4	47.8	0.72	11.6	39.8
2005	0.33	4.5	42.5	0.46	4.1	54.0	0.61	17.2	22.4
	Sweden			*Japan*			*United States*		
	In[a]	*Out*[b]	*LTU*[c]	*In*[a]	*Out*[b]	*LTU*[c]	*In*[a]	*Out*[b]	*LTU*[c]
1979	0.58	34.5	6.8	0.31	19.1	16.5	2.07	43.5	4.2
1988	0.40	30.4	14.9	0.37	17.2	20.6	1.98	45.7	7.4
1996	1.34	15.1	30.1	0.41	15.7	19.3	1.56	37.1	9.5
2005	1.33	17.4	18.9	0.51	15.1	33.3	1.39	35.9	11.8

Notes:
a: Monthly flow employment into unemployment (percentage of source population)
b: Monthly flow out of unemployment (percentage of source population)
c: Long-term (≥ 1 year) unemployment (percentage of total unemployment)

Table 6.2: Unemployment duration by country (1)

	2005			1990			1979		
	All	Under 1 year	Over 1 year	All	Under 1 year	Over 1 year	All	Under 1 year	Over 1 year
Belgium	8.1	3.9	4.2	8.7	1.9	6.8	8.2	3.4	4.8
Denmark	4.9	3.6	1.3	9.6	6.8	2.8	6.2	–	–
France	9.9	5.7	4.2	8.9	5.4	3.5	5.9	4.1	1.8
Germany	11.3	5.2	6.1	5.0	2.6	2.4	3.2	2.6	0.6
Ireland	4.3	2.8	1.5	14.0	4.8	9.2	7.1	4.8	2.3
Italy	7.8	3.7	4.1	7.9	2.4	5.5	5.2	3.3	1.9
Netherlands	5.0	3.4	1.6	7.6	3.8	3.8	5.4	3.9	1.5
Portugal	8.1	4.2	3.9	5.1	2.5	2.6	4.8	–	–
Spain	9.2	6.2	3.0	16.2	6.7	9.5	8.5	6.1	2.4
United Kingdom	4.6	3.6	1.0	6.5	3.6	2.9	5.0	3.8	1.3
Australia	5.2	4.3	0.9	6.8	5.2	1.6	6.2	5.1	1.1
New Zealand	3.8	3.4	0.4	7.6	–	–	1.9	–	–
Canada	6.8	6.1	0.7	8.1	7.6	0.5	7.4	7.1	0.3
United States	5.1	4.5	0.6	5.5	5.2	0.3	5.8	5.6	0.2
Japan	4.6	3.1	1.5	2.1	1.7	0.4	2.1	1.7	0.4
Austria	5.2	3.9	1.3	3.3	2.9	0.4	1.7	1.5	0.2
Finland	8.5	6.4	2.1	3.4	2.8	0.6	5.9	4.8	1.1
Norway	4.7	4.2	0.5	5.3	4.7	0.6	2.0	1.9	0.1
Sweden	6.6	5.3	1.3	1.6	1.5	0.1	1.7	1.6	0.1
Switzerland	4.5	2.7	1.8	1.8	–	–	0.9	–	–

Table 6.2: Unemployment duration by country (2)

	2005			1990			1979		
	All	Under 1 year	Over 1 year	All	Under 1 year	Over 1 year	All	Under 1 year	Over 1 year
Belgium	8.1	3.9	4.2	8.7	1.9	6.8	8.2	3.4	4.8
Denmark	4.9	3.6	1.3	9.6	6.8	2.8	6.2	–	–
France	9.9	5.7	4.2	8.9	5.4	3.5	5.9	4.1	1.8
Germany	11.3	5.2	6.1	5.0	2.6	2.4	3.2	2.6	0.6
Ireland	4.3	2.8	1.5	14.0	4.8	9.2	7.1	4.8	2.3
Italy	7.8	3.7	4.1	7.9	2.4	5.5	5.2	3.3	1.9
Netherlands	5.0	3.4	1.6	7.6	3.8	3.8	5.4	3.9	1.5
Portugal	8.1	4.2	3.9	5.1	2.5	2.6	4.8	–	–
Spain	9.2	6.2	3.0	16.2	6.7	9.5	8.5	6.1	2.4
United Kingdom	4.6	3.6	1.0	6.5	3.6	2.9	5.0	3.8	1.3
Australia	5.2	4.3	0.9	6.8	5.2	1.6	6.2	5.1	1.1
New Zealand	3.8	3.4	0.4	7.6	–	–	1.9	–	–
Canada	6.8	6.1	0.7	8.1	7.6	0.5	7.4	7.1	0.3
United States	5.1	4.5	0.6	5.5	5.2	0.3	5.8	5.6	0.2
Japan	4.6	3.1	1.5	2.1	1.7	0.4	2.1	1.7	0.4
Austria	5.2	3.9	1.3	3.3	2.9	0.4	1.7	1.5	0.2
Finland	8.5	6.4	2.1	3.4	2.8	0.6	5.9	4.8	1.1
Norway	4.7	4.2	0.5	5.3	4.7	0.6	2.0	1.9	0.1
Sweden	6.6	5.3	1.3	1.6	1.5	0.1	1.7	1.6	0.1
Switzerland	4.5	2.7	1.8	1.8	–	–	0.9	–	–

Table 6.2: Unemployment duration by country (3)

	2005			1990			1979		
	All	Under 1 year	Over 1 year	All	Under 1 year	Over 1 year	All	Under 1 year	Over 1 year
Belgium	8.1	3.9	4.2	8.7	1.9	6.8	8.2	3.4	4.8
Denmark	4.9	3.6	1.3	9.6	6.8	2.8	6.2	–	–
France	9.9	5.7	4.2	8.9	5.4	3.5	5.9	4.1	1.8
Germany	11.3	5.2	6.1	5.0	2.6	2.4	3.2	2.6	0.6
Ireland	4.3	2.8	1.5	14.0	4.8	9.2	7.1	4.8	2.3
Italy	7.8	3.7	4.1	7.9	2.4	5.5	5.2	3.3	1.9
Netherlands	5.0	3.4	1.6	7.6	3.8	3.8	5.4	3.9	1.5
Portugal	8.1	4.2	3.9	5.1	2.5	2.6	4.8	–	–
Spain	9.2	6.2	3.0	16.2	6.7	9.5	8.5	6.1	2.4
United Kingdom	4.6	3.6	1.0	6.5	3.6	2.9	5.0	3.8	1.3
Australia	5.2	4.3	0.9	6.8	5.2	1.6	6.2	5.1	1.1
New Zealand	3.8	3.4	0.4	7.6	–	–	1.9	–	–
Canada	6.8	6.1	0.7	8.1	7.6	0.5	7.4	7.1	0.3
United States	5.1	4.5	0.6	5.5	5.2	0.3	5.8	5.6	0.2
Japan	4.6	3.1	1.5	2.1	1.7	0.4	2.1	1.7	0.4
Austria	5.2	3.9	1.3	3.3	2.9	0.4	1.7	1.5	0.2
Finland	8.5	6.4	2.1	3.4	2.8	0.6	5.9	4.8	1.1
Norway	4.7	4.2	0.5	5.3	4.7	0.6	2.0	1.9	0.1
Sweden	6.6	5.3	1.3	1.6	1.5	0.1	1.7	1.6	0.1
Switzerland	4.5	2.7	1.8	1.8	–	–	0.9	–	–

Some stylized facts

SF4 In the **very** long run unemployment shows no trend. Take the time series representation for unemployment:

$$U_t = \alpha_0 + \alpha_1 U_{t-1} \quad \Rightarrow \quad \bar{U} = \frac{\alpha_0}{1-\alpha_1}$$

where $\bar{U}$ is the long-run unemployment rate [4.96% for the UK]. We can derive the transition speed as follows:

$$\begin{aligned} U_1 &= \alpha_0 + \alpha_1 U_0, \\ U_2 &= \alpha_0 + \alpha_1 U_1 = \alpha_0 + \alpha_1 \left[\alpha_0 + \alpha_1 U_0\right] \\ \vdots & \quad \vdots \\ U_t &= \alpha_0 \left[1 + \alpha_1 + \alpha_1^2 + \ldots + \alpha_1^{t-1}\right] + \alpha_1^t U_0 \end{aligned}$$

Some stylized facts

- We thus find:
$$U_t - \bar{U} = \left[U_0 - \bar{U}\right] \alpha_1^t$$
where U_0 is the unemployment rate in some base year.
- *Experiment*: Suppose that the unemployment rate is currently U_0 and the long-run unemployment rate is $\bar{U}$. How many periods (t_H) does it take, for example, before **half** of the difference $(U_0 - \bar{U})$ is eliminated? We can use t_H (the "half life") as the indicator for the adjustment speed in the system:
$$\left[U_{t_H} - \bar{U}\right] \equiv \left[U_0 - \bar{U}\right] \alpha_1^{t_H} = \tfrac{1}{2} \left[U_0 - \bar{U}\right] \;\Rightarrow$$
$$\alpha_1^{t_H} = \tfrac{1}{2} \;\Rightarrow$$
$$t_H \ln \alpha_1 = -\ln 2 \;\Rightarrow\; t_H = -\frac{\ln 2}{\ln \alpha_1}$$
- For the UK the half life of the adjustment is 4.46 years.

Some stylized facts

- SF5 Unemployment differs a lot between countries. See **Table 6.2**
- SF6 Few unemployed have chosen themselves to become unemployed
- SF7 Unemployment differs a lot between age groups, occupations, regions, races and sexes. See **Tables 6.3-6.5**

→ So we have quite a lot to explain!

Table 6.3: Sex and age composition of unemployed in 2005

		15-24		25-54		55-64	
	All	Men	Women	Men	Women	Men	Women
Belgium	8.1	20.6	19.1	6.3	8.3	4.4	4.2
Denmark	4.9	6.1	9.8	3.7	4.9	4.8	5.1
France	9.9	21.4	24.6	7.7	9.9	7.1	6.4
Germany	11.3	16.1	14.0	10.6	10.2	12.6	13.0
Ireland	4.3	9.1	7.3	4.0	3.1	3.1	2.6
Italy	7.8	21.5	27.4	5.1	9.0	3.6	3.2
Netherlands	5.0	9.4	8.6	4.2	4.5	4.3	3.4
Portugal	8.1	13.7	19.1	6.2	8.5	6.9	5.3
Spain	9.2	16.7	23.5	5.9	10.9	5.4	7.5
United Kingdom	4.6	13.4	10.0	3.6	3.3	3.4	1.8
Australia	5.2	11.1	10.5	3.7	4.2	3.6	2.6
New Zealand	3.8	9.1	9.8	2.4	3.0	1.8	1.9
Canada	6.8	14.2	10.6	5.8	5.7	5.4	5.3
United States	5.1	12.4	10.1	3.9	4.4	3.3	3.3
Japan	4.6	9.9	7.4	4.0	4.4	5.0	2.7
Austria	5.2	10.7	9.9	4.0	4.9	4.1	2.7
Finland	8.5	20.6	19.3	6.5	7.3	7.1	6.5
Norway	4.7	12.5	11.5	4.2	3.8	2.1	1.3
Sweden	6.6	17.8	16.1	5.7	5.2	5.8	4.0
Switzerland	4.5	8.5	9.2	3.1	4.7	3.9	3.6

Table 6.4: Sex and age composition of the participation rate in 2005

		15-24		25-54		55-64	
	All	Men	Women	Men	Women	Men	Women
Belgium	66.4	34.8	31.5	91.8	76.8	43.2	24.0
Denmark	79.4	70.6	63.9	91.1	84.1	70.2	55.7
France	69.1	37.3	29.9	93.8	80.7	47.1	40.2
Germany	73.8	53.5	46.7	93.6	79.1	61.3	43.2
Ireland	70.2	53.3	47.6	92.2	69.6	67.8	38.4
Italy	62.4	38.1	28.7	91.2	63.6	44.3	21.5
Netherlands$^{(a)}$	75.8	70.6	69.3	92.8	77.4	58.8	34.4
Portugal	73.4	46.9	38.8	92.4	81.8	62.4	46.1
Spain	70.8	57.2	46.8	92.4	69.0	63.2	29.6
United Kingdom	76.1	69.0	62.7	91.0	77.4	68.1	49.1
Australia	75.5	72.5	70.0	90.3	73.8	66.3	44.6
New Zealand	77.5	65.6	60.0	92.4	76.4	79.7	62.5
Canada	77.8	66.1	65.8	91.5	81.1	66.7	49.4
United States	75.4	62.9	58.6	90.5	75.3	69.3	57.0
Japan	72.6	44.2	45.0	96.0	68.8	83.1	50.8
Austria	72.4	63.6	54.8	92.8	79.9	43.0	23.5
Finland	74.3	47.9	50.5	90.3	85.1	56.8	56.4
Norway	78.9	61.0	59.4	90.1	83.0	74.6	62.9
Sweden$^{(a)}$	78.7	51.4	51.6	90.1	85.3	76.0	70.2
Switzerland	80.9	66.6	64.9	95.6	81.3	77.8	57.5

Table 6.5: Unemployment and educational attainment in 2004

		Educational status:		
	All	Low	Medium	High
Belgium	7.4	11.7	6.9	3.9
Denmark	5.3	7.8	4.8	3.9
France	10.0	12.1	7.6	6.2
Germany	10.4	20.5	11.2	5.5
Ireland	4.4	6.4	3.2	2.1
Italy	8.1	7.8	5.3	4.8
Netherlands	5.0	5.7	3.9	2.8
Portugal	7.0	6.4	5.6	4.4
Spain	11.0	11.0	9.5	7.3
United Kingdom	4.7	6.6	3.7	2.2
Australia	5.6	6.2	3.9	2.8
New Zealand	4.0	4.2	2.4	2.4
Canada	7.3	9.9	6.1	4.7
United States	5.6	10.5	5.6	3.3
Japan	4.9	6.7	5.4	3.7
Austria	5.0	7.8	3.8	2.9
Finland	8.9	12.0	8.2	4.7
Norway	4.5	3.6	3.8	2.4
Sweden	6.6	6.5	5.8	4.3
Switzerland	4.4	7.2	3.7	2.8

Difference in unemployment of skill groups (1)

- Skilled and unskilled labour in the production function:

$$Y = G(N_U, N_S, \bar{K}) = G(N_U, N_S, 1) \equiv F(\underset{+}{N_U}, \underset{+}{N_S})$$

  with $F_U \equiv \partial F / \partial N_U > 0$, $F_S \equiv \partial F / \partial N_S > 0$, $F_{UU} \equiv \partial^2 F / \partial N_U^2 < 0$, and $F_{SS} \equiv \partial^2 F / \partial N_S^2 < 0$

- Representative firm chooses two types of labour:

$$\max_{\{N_U, N_S\}} \Pi \equiv PF(N_U, N_S) - W_U N_U - W_S N_S$$

  where the respective wage rates are W_U and W_S.

Difference in unemployment of skill groups (2)

- The usual marginal productivity conditions are obtained:

$$\begin{aligned} F_U(N_U, N_S) &= \frac{W_U}{P} \equiv w_U \\ F_S(N_U, N_S) &= \frac{W_S}{P} \equiv w_S \end{aligned}$$

- With our usual trick we find the demands for the two types of labour:

$$\begin{bmatrix} dN_S \\ dN_U \end{bmatrix} = \frac{1}{F_{SS}F_{UU} - F_{SU}^2} \begin{bmatrix} F_{UU} & -F_{SU} \\ -F_{SU} & F_{SS} \end{bmatrix} \begin{bmatrix} dw_S \\ dw_U \end{bmatrix}$$

Difference in unemployment of skill groups (3)

- We find:

$$\begin{aligned} N_S^D &= N_S^D(\underset{-}{w_S}, \underset{?}{w_U}) \\ N_U^D &= N_U^D(\underset{?}{w_S}, \underset{-}{w_U}) \end{aligned}$$

  If $F_{SU} < 0$ then the cross effects are positive [skilled and unskilled labour *gross substitutes*].

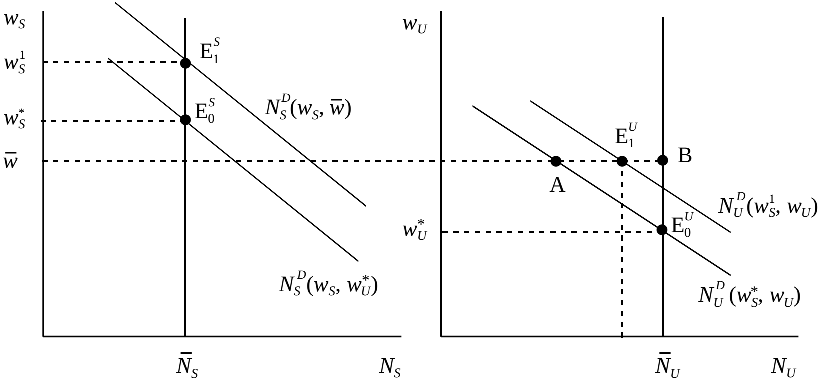
- Supply curves of the two types of labour are both assumed to be inelastic:

$$\begin{aligned} N_S^S &= \bar{N}_S \\ N_U^S &= \bar{N}_U \end{aligned}$$

Difference in unemployment of skill groups (4)

- See **Figure 6.3** for a graphical representation. Punchlines:
  - With flexible wages, both types are fully employed [equilibrium skill premium, $(w_S/w_U)^*$].
  - With a binding, skill-independent, minimum wage $\bar{w}$ the unskilled will experience unemployment. How to cure it?
    - Abolish minimum wage [incomes distribution problems].
    - Subsidize unskilled work ["Melkert jobs"].
    - Let government hire unskilled workers ["dead end jobs"].
    - Train unskilled workers to become skilled [investment in human capital may pay for itself].
- So this standard model has sensible predictions.

Figure 6.3: The markets for skilled and unskilled labour



Taxes and the labour market (1)

- Single type of labour (as in Chapter 1).
- Short-run (capital constant).
- Representative firm chooses employment (and thus output):

$$\Pi \equiv PF(N, \bar{K}) - W(1 + t_E)N$$

where t_E is the *payroll tax* [a tax on the use of labour levied on employers, e.g. employer's contribution to social security].

Taxes and the labour market (2)

- The first-order condition, $F_N(N^D, \bar{K}) = w(1 + t_E)$ can be loglinearized:

$$\tilde{N}^D = -\varepsilon_D \left[\tilde{w} + \tilde{t}_E\right]$$

  $w \equiv W/P$ is the gross real wage, $\varepsilon_D \equiv -F_N/(NF_{NN})$ is the absolute value of the labour demand elasticity, $\tilde{N}^D \equiv dN^D/N^D$, $\tilde{t}_E \equiv dt_E/(1+t_E)$, and $\tilde{w} \equiv dw/w$.
- The representative household chooses consumption and leisure just as in Chapter 1 but faces some extra taxes. The utility function and budget equation are:

$$U = U(C, 1 - N^S)$$

$$P(1 + t_C)C = WN^S - T(WN^S) \equiv (1 - t_A)WN^S$$

  where $T(WN^S)$ is the *tax function* and $t_A \equiv T(WN^S)/(WN^S)$ is the average tax rate.

Taxes and the labour market (3)

- The tax system is *progressive*, i.e. the average tax rises with income and the marginal tax rate is denoted by:

$$t_M \equiv \frac{dT(WN^S)}{d\left(WN^S\right)} = T'$$

Note: t_M is either constant (if $T'' = 0$) or increasing (if $T'' > 0$).

- The household takes the tax progressivity into account when deciding on consumption and labour supply. The Lagrangian is:

$$\mathcal{L} \equiv U(C, 1 - N^S) + \lambda\left[(1 - t_A)WN^S - P(1 + t_C)C\right]$$

Taxes and the labour market (4)

- The first-order conditions:

$$\frac{\partial \mathcal{L}}{\partial C} = U_C - \lambda P(1+t_C) = 0$$

$$\frac{\partial \mathcal{L}}{\partial N^S} = -U_{1-N} + \lambda W \left[(1-t_A) - N^S \frac{dt_A}{dN^S} \right] = 0$$

  - Simplifying the first-order conditions we obtain:

$$\lambda = \frac{U_C}{P(1+t_C)} = \frac{U_{1-N}}{W(1-t_M)} \Rightarrow$$

$$\frac{U_{1-N}}{U_C} = w \frac{1-t_M}{1+t_C} \quad \text{(S1)}$$

  - The marginal rate of substitution between consumption and leisure is affected the marginal tax rate t_M on labour income [not the average tax rate].
  - The tax on consumption affects the MRS just as if it was a tax on labour income.

Taxes and the labour market (5)

- Equation (S1) and the household budget constraint, $P(1+t_C)C = (1-t_A)WN^S$, together determine C and N^S. In loglinearized form we get for labour supply:

$$\begin{aligned}\tilde{N}^S &= (1-N^S)\left[(\sigma_{CM}-1)\tilde{w} - \sigma_{CM}(\tilde{t}_M+\tilde{t}_C) + \tilde{t}_A + \tilde{t}_C\right] \\ &= \bar{\varepsilon}_{SW}\left[\tilde{w} - \tilde{t}_M - \tilde{t}_C\right] + \varepsilon_{SI}\left[\tilde{t}_A + \tilde{t}_C - \tilde{w}\right] \\ &= \varepsilon_{SW}\left[\tilde{w} - \tilde{t}_C\right] - \bar{\varepsilon}_{SW}\tilde{t}_M + \varepsilon_{SI}\tilde{t}_A\end{aligned}$$

  where $\tilde{N}^S \equiv dN^S/N^S$, $\tilde{t}_C \equiv dt_C/(1+t_C)$, $\tilde{t}_M \equiv dt_M/(1-t_M)$, and $\tilde{t}_A \equiv dt_A/(1-t_A)$. We now have quantitative handles:

  (a) $\bar{\varepsilon}_{SW} \equiv \sigma_{CM}(1-N^S) \geq 0$ is the *compensated* wage elasticity [corresponds to the substitution effect and is always non-negative].

  (b) $-\varepsilon_{SI} \equiv -(1-N^S) < 0$ is the *income* elasticity [corresponds to the income effect and is always negative].

Taxes and the labour market (6)

- Continued.
  (c) $\varepsilon_{SW} \equiv \bar{\varepsilon}_{SW} - \varepsilon_{SI} = (\sigma_{CM} - 1)(1 - N^S)$ is the *uncompensated* wage elasticity [the total effect of a change in the gross wage]. Total effect of a wage change is positive (zero, negative) if $\sigma_{CM} > 1$ $(= 1, < 1)$.
- Summary of our labour market model with tax effects:

$$\tilde{N}^D = -\varepsilon_D \left[\tilde{w} + \tilde{t}_E\right] \quad \text{(S2)}$$

$$\tilde{N}^S = \varepsilon_{SW} \left[\tilde{w} - \tilde{t}_C\right] - \bar{\varepsilon}_{SW}\tilde{t}_M + \varepsilon_{SI}\tilde{t}_A \quad \text{(S3)}$$

we can complete [or "close"] the model in two ways:

(a) Equilibrium interpretation, $N = N^D = N^S$, or:

$$\tilde{N} = \tilde{N}^D = \tilde{N}^S \quad \text{(S4)}$$

(b) Disequilibrium interpretation, $N = \min[N^D, N^S] = N^D$, say because the consumer wage $[w_C \equiv w(1 - t_A)/(1 + t_C)]$ is inflexible.

(a) Taxes and the labour market: flexible wages

- See **Figure 6.4** for the graphical illustration [**Table 6.6** contains the analytical results].
- More progressive tax system [$\tilde{t}_M > 0$ only]: shifts labour supply to the left [pure substitution effect], so that $w \uparrow$ and $N \downarrow$.
- Higher average tax rate [$\tilde{t}_A > 0$ only]: shifts labour supply to the right [income effect], so that $w \downarrow$ and $N \uparrow$.
- Higher payroll tax [$\tilde{t}_E > 0$ only]: shifts labour demand to the left, so that $w \downarrow$ and (provided $\varepsilon_{SW} > 0$) $N \downarrow$ [Try to draw opposite case also!].
- Higher consumption tax: [$\tilde{t}_C > 0$ only]: shifts labour supply to the left if $\varepsilon_{SW} > 0$, so that $w \downarrow$ and $N \downarrow$ [Try to draw opposite case also!].

Figure 6.4: The effects of taxation when wages are flexible

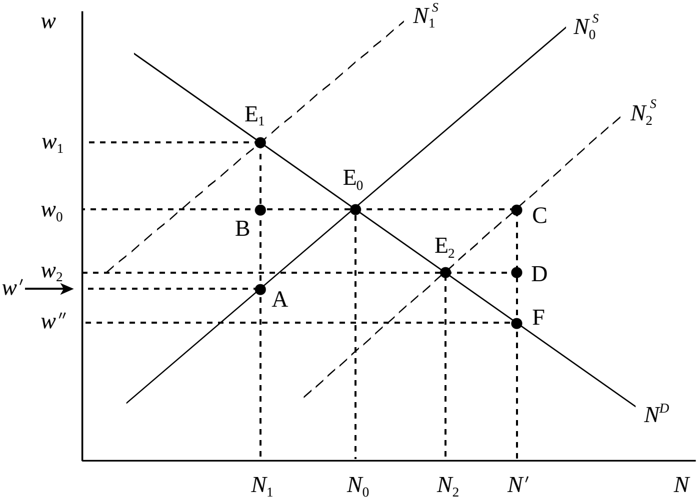


Table 6.6: Taxes and the competitive labour market

Table 6.6. Taxes and the competitive labour market

	(a) Flexible wage			(b) Fixed consumer wage		
	$\tilde{w}$	$\tilde{N}$	dU	$\tilde{w}$	$\tilde{N}$	dU
$\tilde{t}_M$	$\frac{\bar{\varepsilon}_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\bar{\varepsilon}_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	0	0	0	$-\bar{\varepsilon}_{SW}$
$\tilde{t}_A$	$-\frac{\varepsilon_{SI}}{\varepsilon_{SW}+\varepsilon_D}$	$\frac{\varepsilon_D\varepsilon_{SI}}{\varepsilon_{SW}+\varepsilon_D}$	0	1	$-\varepsilon_D$	$\bar{\varepsilon}_{SW}+\varepsilon_D$
$\tilde{t}_M=\tilde{t}_A$	$\frac{\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	0	1	$-\varepsilon_D$	ε_D
$\tilde{t}_E$	$-\frac{\varepsilon_D}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	0	0	$-\varepsilon_D$	ε_D
$\tilde{t}_C$	$\frac{\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	0	1	$-\varepsilon_D$	ε_D
$\tilde{w}_C$	–	–	–	1	$-\varepsilon_D$	$\varepsilon_{SW}+\varepsilon_D$

Notes: (a) coefficients satisfy $\varepsilon_D>0$, $\bar{\varepsilon}_{SW}>0$, $\varepsilon_{SI}>0$;
(b) for dominant substitution effect, $\varepsilon_{SW}\equiv\bar{\varepsilon}_{SW}-\varepsilon_{SI}>0$;
(c) stability condition is $\varepsilon_{SW}+\varepsilon_D>0$.

(b) Taxes and the labour market: rigid consumer wage

- Suppose that workers have an aversion against reductions in their real consumer wage, i.e. $w_C \equiv w(1-t_A)/(1+t_C)$, is inflexible downward.
- In loglinearized form we have:

$$\tilde{w}_C \equiv \tilde{w} - \tilde{t}_A - \tilde{t}_C \tag{S5}$$

- Substituting (S5) into the demand and supply functions yields:

$$\tilde{N}^D = -\varepsilon_D \left[\tilde{w}_C + \tilde{t}_A + \tilde{t}_E + \tilde{t}_C \right]$$
$$\tilde{N}^S = \varepsilon_{SW} \tilde{w}_C + \bar{\varepsilon}_{SW} \left[\tilde{t}_A - \tilde{t}_M \right]$$

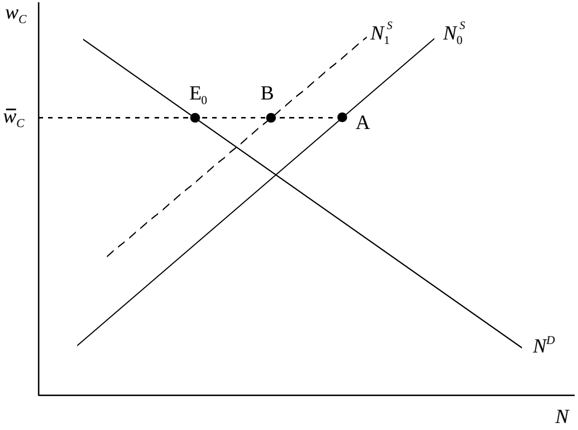
We have approximately that the change in the unemployment rate is:

$$dU = \tilde{N}^S - \tilde{N}^D$$

Taxes and the labour market: rigid consumer wage

- Note: $U \equiv \frac{N^S - N^D}{N^S} = 1 - \frac{N^D}{N^S} \approx \log\left(\frac{N^S}{N^D}\right)$ so that $dU = \tilde{N}^S - \tilde{N}^D$.
- Workings of the disequilibrium model are illustrated in **Figure 6.5**. [**Table 6.6** contains the analytical results]. We see that taxes work differently now.
- More progressive tax system [$\tilde{t}_M > 0$ only]: shifts labour supply to the left [pure substitution effect], so that w_C and N constant but unemployment down.
- Higher average tax rate [$\tilde{t}_A > 0$ only]: shifts labour supply to the right [income effect] and shifts labour demand to the left. Hence, w_C constant but $N \downarrow$.
- Higher payroll tax [$\tilde{t}_E > 0$ only]: shifts labour demand to the left; w_C constant but $N \downarrow$ (regardless of sign of ε_{SW}).
- Higher consumption tax: [$\tilde{t}_C > 0$ only]: shifts labour demand to the left; w_C constant but $N \downarrow$ (regardless of sign of ε_{SW}).

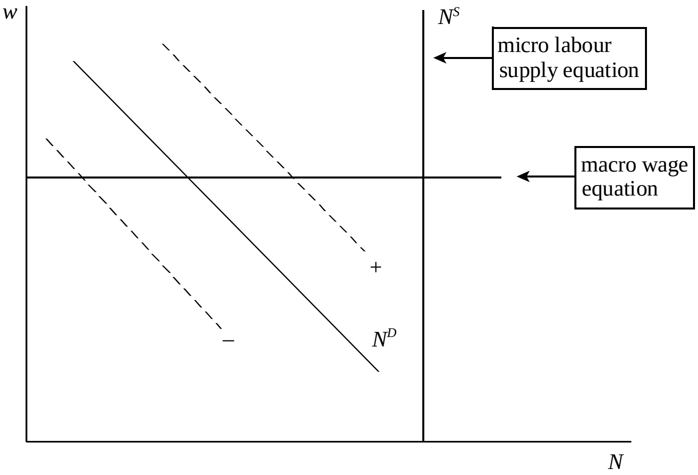
Figure 6.5: The effects of taxation with a fixed consumer wage



Conclusion based on ‘standard models’

- Models with flexible wage(s) hard to bring in line with the real world (e.g. empirical studies suggest that $\sigma_{CM} \approx 1$ to that $\varepsilon_{SW} \approx 0$: almost vertical uncompensated labour supply curve).
- The facts suggest that the **macroeconomic wage** equation is almost horizontal (even though the **microeconomic labour supply** is almost vertical). See **Figure 6.6**.
- Hence, we desperately need a theory of real wage rigidity [one of the Holy Grails of modern macroeconomics].

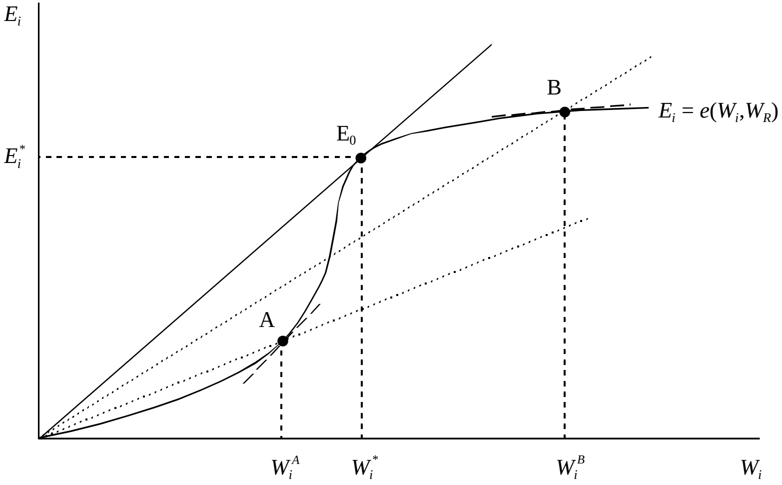
Figure 6.6: Labour demand and supply and the macroeconomic wage equation



The theory of efficiency wages

- Basic idea: worker productivity depends positively on the wage that he/she receives.
- Possible reasons for this effect are:
  - Link between productivity and nutrition.
  - Labour turnover and training costs.
  - High wage to attract the best workers.
  - High wage to limit shirking.
  - Fair wage hypothesis.
- The effort exerted by a worker may be S-shaped as in **Figure 6.7**.

Figure 6.7: Efficiency wages



A simple model of efficiency wages (1)

- Effort function:

$$E_i \equiv e(\underset{+}{W_i}, \underset{-}{W_R}), \;\; e_W > 0, \; e_{W_R} < 0$$

where E_i is the effort of a worker in firm i, W_i is the wage paid by firm i to its workers, and W_R is the *reservation wage* [the wage that can be obtained elsewhere in the economy].

- Profit of firm i is defined as:

$$\Pi_i \equiv P_i A F(\underbrace{E_i N_i}_{L_i}) - W_i N_i \tag{S6}$$

where P_i is the price of firm i, A is a general productivity index, and L_i represents the effective labour units employed in firm i [dimension: bodies $\times$ effort per body].

A simple model of efficiency wages (2)

- Firm chooses N_i and W_i [the latter to control effort]. First-order conditions:

$$\frac{\partial \Pi_i}{\partial N_i} = P_i A E_i F_L(E_i N_i) - W_i = 0 \tag{S7}$$

$$\frac{\partial \Pi_i}{\partial W_i} = P_i A N_i F_L(E_i N_i) e_W(W_i, W_R) - N_i = 0$$

  By combining these conditions we get the Solow condition:

$$\frac{W_i e_W(W_i, W_R)}{e(W_i, W_R)} = 1 \tag{S8}$$

  Hence, the firm picks the wage W_i for which the elasticity of the effort function equals unity. In terms of Figure 6.7, points A and B are no good but point E_0 is just right.
- Once W_i and thus–via the effort function–E_i are known, equation (S7) determines the number of workers, N_i.

A simple model of efficiency wages (3)

- Major result already: The firm chooses (W_i, E_i, N_i) but there is no reason to believe that all firms taken together will demand enough labour to employ all workers. The wage does not clear the market but instead is a motivating device. Unemployment will probably exist!
- We close the model with an expression for the *reservation wage*:

$$W_R = (1-U)\bar{W} + UB = \bar{W}\left[1 - U + \beta U\right] \qquad \text{(S9)}$$

where U is the unemployment rate, $\bar{W}$ is the average wage paid in the economy, and $\beta \equiv B/\bar{W}$ is the unemployment benefit expressed as a proportion of the average wage paid in the economy (the so-called replacement rate).

A simple model of efficiency wages (4)

- Finally, we adopt a specific effort function to keep things simple:

$$E_i = (W_i - W_R)^{\varepsilon}, \quad 0 < \varepsilon < 1 \tag{S10}$$

where ε measures the strength of the productivity-enhancing effects of high wages, which we call the *leap-frogging effect*. For this effort function we can apply the Solow condition:

$$\begin{aligned} \frac{W_i}{E_i}\frac{\partial E_i}{\partial W_i} &= 1 \quad \Rightarrow \\ \left(\frac{W_i - W_R}{W_i}\right) &= \varepsilon \quad \Leftrightarrow \\ W_i &= \frac{W_R}{1-\varepsilon} \end{aligned}$$

Hence, the firm pays a markup $\frac{1}{1-\varepsilon}$ times the reservation wage!

A simple model of efficiency wages (5)

- But all firms are assumed to be the same so that they all set the same wage so that $W_i = \bar{W}$. This implies:

$$\begin{aligned} W_i &= \bar{W} = \frac{W_R}{1-\varepsilon} = \frac{\bar{W}(1-U+\beta U)}{1-\varepsilon} \quad \Rightarrow \\ U^* &= \frac{\varepsilon}{1-\beta} \end{aligned}$$

- Hence, there is indeed a positive *equilibrium unemployment* as we thought there would be. U^* is higher the higher is ε and the higher is β.

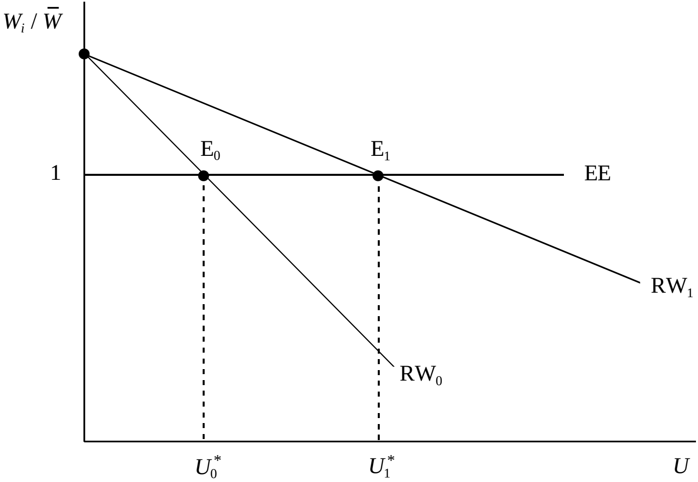
A simple model of efficiency wages (6)

- The intuition can be understood with **Figure 6.8** .

$$\frac{W_i}{\bar{W}} = \frac{1-(1-\beta)U}{1-\varepsilon} \quad \text{(RW curve)}$$
$$\frac{W_i}{\bar{W}} = 1 \quad \text{(EE curve)}$$

- The RW curve slopes down because, as U is high there is a strong threat of unemployment. This means there is less reason to pay high wages.
- An increase in β or ε rotates the RW curve counter-clockwise and raises equilibrium unemployment.

Figure 6.8: The relative wage and unemployment



Test your understanding

****** Self Test ******

Study the effects of taxation on unemployment and wages for the efficiency wage model. One interesting result is that increasing the progressivity of the tax system leads to a reduction of the equilibrium unemployment rate! There is less scope for leap frogging by firms. Wages fall and employment rises.

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Punchlines

- We have stated some stylized facts about the labour market.
- Standard models can explain a lot.
- There is a tension between micro- and macroeconomic evidence regarding the labour supply elasticity.
- The efficiency wage theory has some very attractive features in removing this tension.
- Taxes affect the labour market no matter what theory you use [the direction of the effects depends on the details].