4. The labour market

I. Exercise Questions

Readings:
Lecture slide sets: #5, 6
The Economy: Employment rent (9.3), wage-setting curve (9.3), Nash Equilibrium (4.7), coordination game (13.7), Elasticity of demand (Section: 7.8.1), Labour Discipline Model (9.4 ff.)

Problem 1 *(Unemployment and the unemployment rate)*

You are provided with the following statistics:

- The number of people living in a country P.
- The number of people of working age N.
- The number of people employed E and unemployed U.
- The number of registered unemployed R.
- The number of people not working NW.

(a) How do you calculate the labour participation rate, the employment rate and the unemployment rate?

Labour force: Employed + Unemployed = E + U

Labour participation rate: $\dfrac{\text{Labour force}}{\text{Population of working age}} = \dfrac{E+U}{N}$

Employment rate: $\dfrac{\text{Employed}}{\text{Population of working age}} = \dfrac{E}{N}$

Unemployment rate: $\dfrac{\text{Unemployed}}{\text{Labour force}} = \dfrac{U}{E+U}$

(b) Most countries publish several unemployment statistics. Are officially published unemployment rates across countries comparable?

Unemployment rates can be statistically influenced by defining who is employed and unemployed, i.e. how is the labour force composed? E.g. officially not labelled as unemployed is the "inactive labour force" (pupils, students, housemen and housewives, disabled).

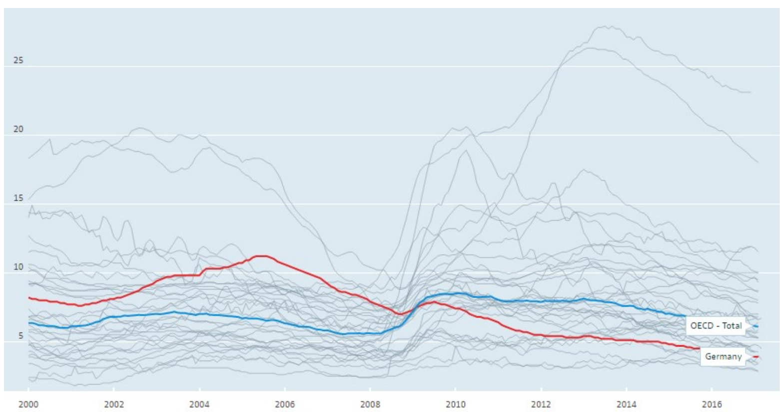
(c) How is the unemployment rate defined according to the International Labour Organization (ILO)?

The ILO unemployment rate refers to the percentage of economically active people who are unemployed by ILO standards. The unemployed comprise all persons of working age who were:

- without work during the reference period, i.e. were not in paid employment or self-employment
- currently available for work, i.e. were available for paid employment or self-employment during the reference period
- seeking work, i.e. had taken specific steps in a specified recent period to seek paid employment or self-employment.

The uniform application of this definition results in estimates of unemployment rates that are more internationally comparable than estimates based on national definitions of unemployment.

(d) Similarly to the ILO, the Organisation for Economic Cooperation and Development (OECD) provides a harmonised unemployment rate. Please describe and interpret the development of the unemployment rates in Germany and the OECD in the graph below.
`https://data.oecd.org/unemp/harmonised-unemployment-rate-hur.htm`



Source: OECD

Figure 1: Harmonised Unemployment Rate (HUR) of the OECD: Total compared to Germany, % of labour force, Jan 2000 - Mar 2017.

After the millennium turn, Germany faced major challenges in terms of its labour market compared to other OECD countries. Subsequently, the situation on the labour market improved a lot. The figure indicates that the German policy measure "Agenda 2010" could have changed something. The reforms featured a comprehensive liberalisation of the labour market and welfare cuts on the one hand, and more sanctions for the unemployed on the other. However, the question is how much of this effect is driven by the policy measure itself or by a change in definition of who was labelled unemployed. For instance, individuals in "job market trainings" do not count as unemployed anymore.

Problem 2 *(Employment rents)*

Assume Homer S. works for a company that offers him an hourly wage of $W = \$16$ for a 38-hour week. Homer's effort (e) depends on the wage offered and his disutility from working (a) with $a = \$8$. His effort level determines the time that he actually works in a hour (for the remaining time, he eats donuts and sleeps). For instance, at an effort level of $e = 0.5$, he works half of the time. Homer expects 40 weeks of unemployment when he does not keep this job.

(a) Calculate Homer's employment rent at the wage offered. First, assume no unemployment benefits exist. Then, calculate his rent assuming that the government pays benefits of \$152 per week.

1. scenario: Without unemployment benefits:

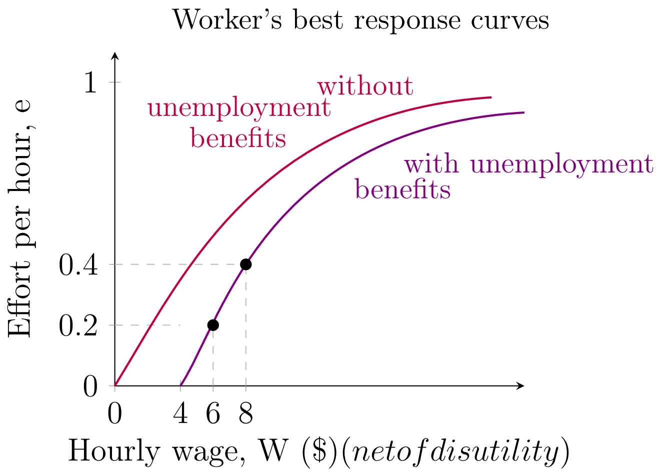
$$\begin{aligned}\text{Net utility per hour} &= \text{wage} - \text{disutility}\\ &= 16 - 8 = 8\\ &\Rightarrow \text{employment rent per hour.}\end{aligned}$$

In case of no unemployment benefits the reservation wage is 0.

2. scenario: With unemployment benefits:
Calculate the unemployment benefits per hour: 152/38=4

$$\begin{aligned}\text{net utility per hour} &= \text{wage} - \text{benefits} - \text{disutility}\\ &= 16 - 4 - 8 = 4.\end{aligned}$$

In the presence of unemployment benefits, the employment rent reduces from 8 to 4.



(b) Calculate the total employment rent for an expectation of 40 weeks of unemployment with the assumption that the government pays benefits.

$$\begin{aligned}\text{Total empl. rent} &= \text{empl. rent/hour} \times \text{expected hours}\\ &= 4 \times 38 \times 40 = 6.080.\end{aligned}$$

(c) What happens to his total employment rent if Homer experiences a psychological cost of unemployment of \$1 per hour, assuming that the government pays benefits?

$$\begin{aligned} \text{net utility per hour} &= \text{wage} - \text{disutility} - \text{benefits} + \text{psych. cost} \\ &= 16 - 8 - 4 + 1 = 5. \\ \text{Total empl. rent} &= 5 \times 38 \times 40 = 7.600. \end{aligned}$$

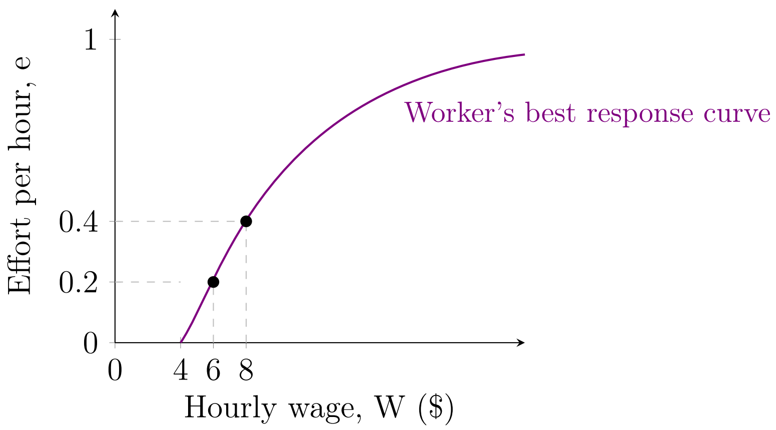
(d) The employer gets some occasional report on Homer's work performance. Homer knows that the probability of getting a bad report decreases the higher his effort (probability p of getting caught not working). Write down Homer's effort function and discuss how it depends on the wage W, on his disutility of effort a, on the level of unemployment benefits b, on the expected duration of unemployment d and on the probability of being detected p .

$$e = E(W, a, b, d, p)$$

$$\begin{aligned} \text{Wage: } &\frac{\partial E}{\partial W} > 0 \text{ and } \frac{\partial^2 E}{\partial^2 W} < 0 \\ \text{Disutility: } &\frac{\partial E}{\partial a} < 0 \\ \text{Benefits: } &\frac{\partial E}{\partial b} < 0 \\ \text{Duration of unemployment: } &\frac{\partial E}{\partial d} > 0 \\ \text{Prob. of being detected: } &\frac{\partial E}{\partial p} > 0 \end{aligned}$$

(e) Show why paying the reservation wage cannot be a Nash equilibrium.

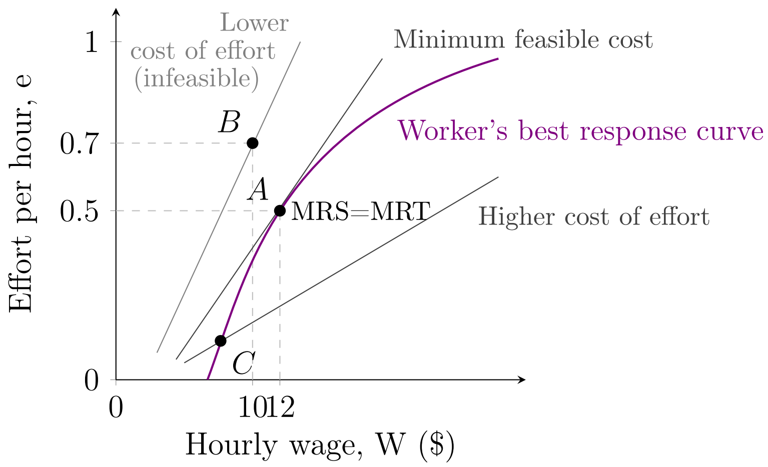
The employment game
The employer chooses the wage based on expectations regarding Homer's best response in terms of effort when wage increases. The firm minimizes its cost $c = \frac{W}{e}$. Go up the curve until $\frac{W}{e}$ is minimal, but still feasible.



Example:

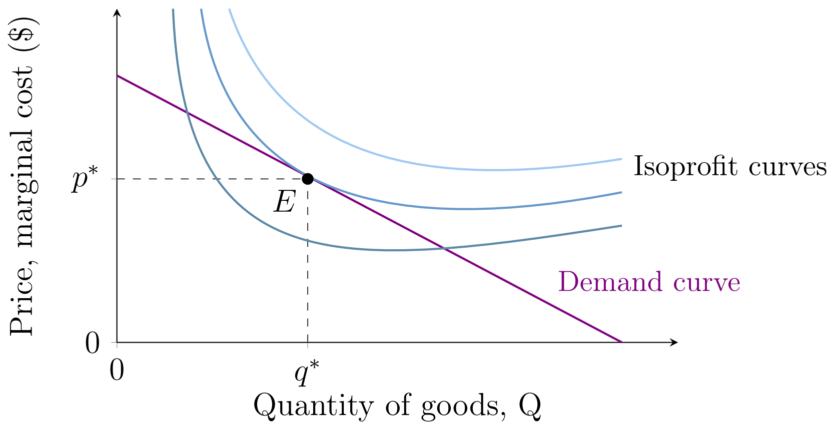
$$\text{Output } Q = f(e) = f(Q, p).$$
$$\text{when } e = 0 \Rightarrow Q = 0 \Rightarrow \pi = 0.$$

At the reservation wage, the effort $e = 0 \Rightarrow$ both the employer and Homer are better off when increasing wage and effort, respectively. The slope of the isocost line for effort (slope $\frac{e}{W}$ = MRS) equals Homers' MRT in the optimal wage-effort-combination.



Problem 3

The Human Resource (HR) department of a company determines the lowest wage W^* it can pay given the effort response of the employees. It communicates this wage to the marketing department (MD) which needs the information for determining a price greater than cost. (Assume for simplicity that there are no further costs.) The MD sets the price according to the demand curve it faces in the market:



The firm's profit costs are defined such that

$$\text{Profit} = \text{total revenue} - \text{total costs}.$$

The isoprofit curves show combinations of price and quantity that achieve the same profit level. A firm's mark-up is the fraction of the price of a good that goes to the profit of the firm. To maximize profits the firm will set a price p^* such that it reaches the highest of the profit curves given the demand function. This determines the optimal quantity and q^* is then communicated to the production department (PD).The PD then calculates according to the firm's production function how many employees (n^*) are needed.

(a) Assume that a worker produces $\lambda = 10$ units of output per hour and that λ is independent of how many people work at the company. The firm pays the worker a wage $W = 30$ per hour. What is the unit labour cost?

$$\begin{aligned}\text{Unit labour cost} &= \frac{\text{Nominal wage}}{\text{Productivity}}\\ &= \frac{W}{\lambda}\\ &= \frac{30}{10} = \$3 \text{ per unit.}\end{aligned}$$

(b) Assume now that the firm chooses its price such that the mark-up μ is inversely proportional to the elasticity of the demand curve, i.e. the mark-up will be greater if demand is less elastic. How do real wage and mark-up depend on each other?

$$\mu = \frac{1}{\text{elasticity}} = \frac{p-c}{p} = \frac{\text{Profit per unit}}{\text{Price per unit}}$$

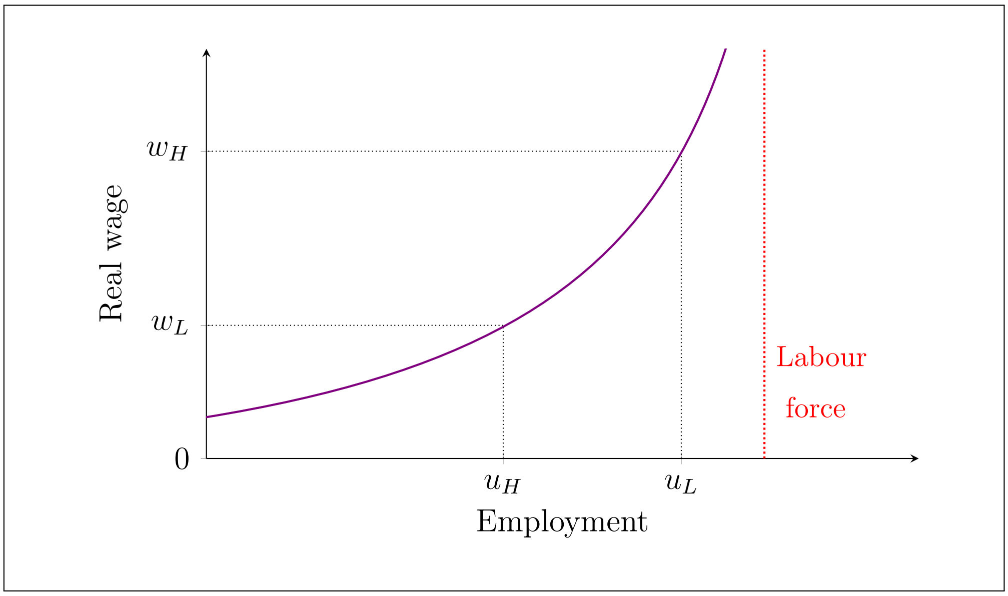
Assuming that there are only labour costs relevant here, we can write:

$$\begin{aligned}
\mu &= \frac{p - \frac{W}{\lambda}}{p} \\
\mu p &= p - \frac{W}{\lambda} \\
\mu &= 1 - \frac{\frac{W}{p}}{\lambda} \\
\frac{\frac{W}{p}}{\lambda} &= 1 - \mu \\
\frac{W}{p} &= \lambda(1-\mu) && \text{Price setting equation} \\
\frac{W}{p} &= \lambda - \lambda\mu,
\end{aligned}$$

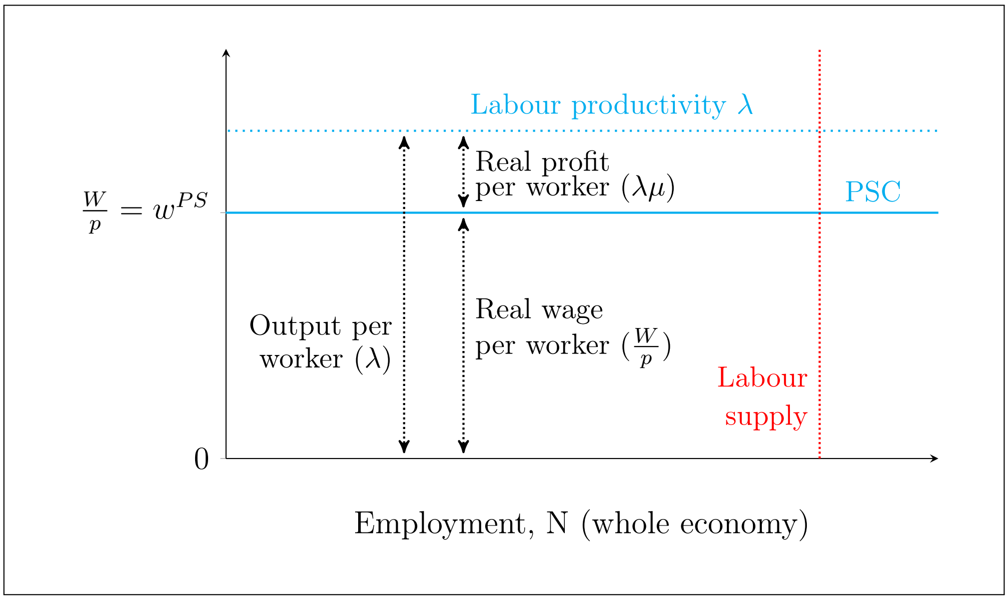
which means

Real wage per worker = Output per worker (λ) − Real profit per worker ($\lambda\mu$).

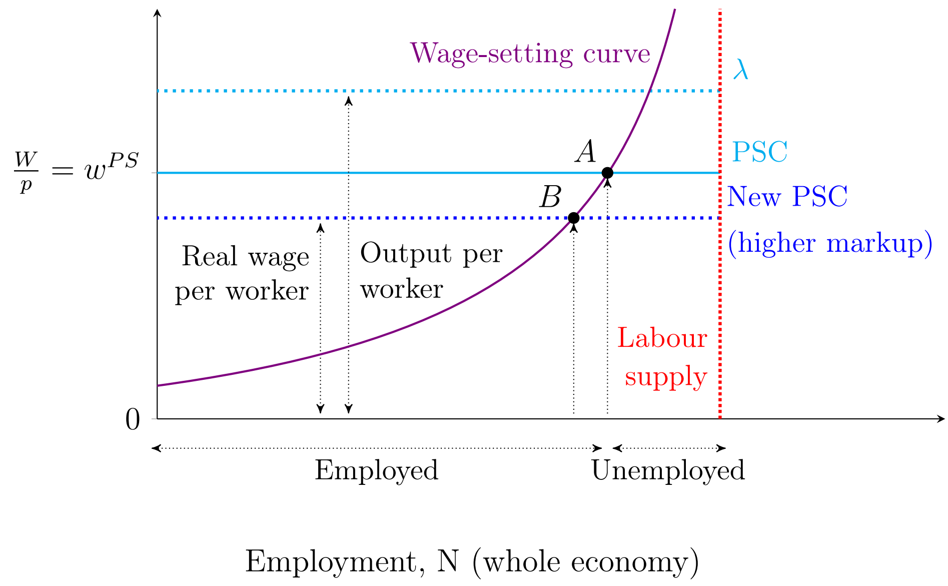
(c) Draw the wage-setting curve for the entire economy. Assume that wage-setting works the same in all firms.



(d) Draw the price-setting curve for the whole economy in an appropriate diagramme.



(e) Depict the wage-setting curve and the price-setting curve in a single diagramme and indicate the labour market equilibrium.

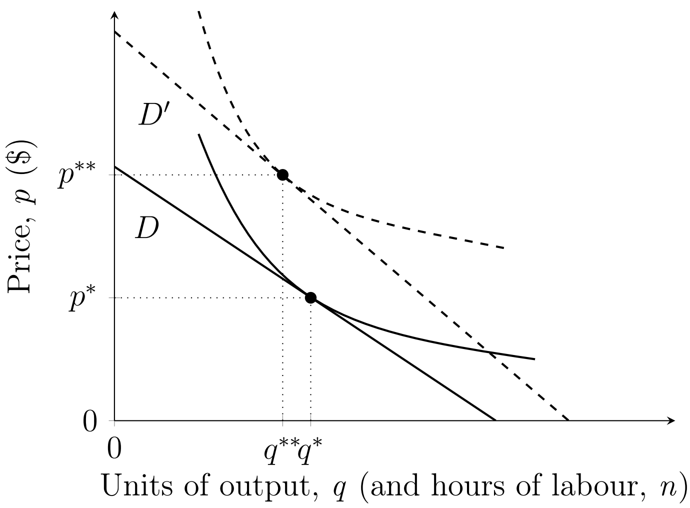


The equilibrium of the labour market is where the wage- and price-setting curves intersect. This is a Nash equilibrium because all parties are doing the best they can, given what everyone else is doing. Each firm is setting the nominal wage where the isocost curve is tangent to the best response function (wage-setting curve), and is setting the profit-maximizing price (price-setting curve).

(f) Show explicitly what happens to the model when there is a reduction in competition (for instance through the implementation of import restrictions)?

After import restrictions, competition and supply fall.
In reaction to that, demand gets less elastic: The demand cuve gets steeper D $\rightarrow$ D'
Since the mark-up is $\mu = \frac{1}{\text{elasticity}}$, elasticity $\downarrow \rightarrow \mu \uparrow$.
μ and hence the price p* increase.
Less output q* is produced at price p**.

For the labour market model, the price-setting-curve shifts down because the ratio $\frac{W}{p}$ decreases: p* $\uparrow \rightarrow \frac{W}{p} \downarrow$
This implies higher unemployment: N $\downarrow$
In the new labour market equilibrium, a lower real wage and less employment prevail.



Problem 4

Consider an economy with a completely inelastic labour supply of $L^S = 20$ and a price level of $P = 1$. In the economy there is exactly one company which is assumed to be price taking and efficiency wage setting. The only input factor for production is labour. Depending on labour L and wage w, the profit function of the company is

$$\pi(w, L) = 32 \cdot [e(w) \cdot L]^{\frac{1}{2}} - w \cdot L,$$

where the efficiency of labour $e(w)$ depends on the wage w according to

$$e(w) = w^{\frac{1}{2}} - 1.$$

(a) What is the efficiency wage of the economy?

The firm chooses how many workers to hire (i) and the wage w (ii) to maximize profits.

$$\max_{L,w} \quad \pi(w,L) = 32 \cdot [e(w) \cdot L]^{\frac{1}{2}} - w \cdot L$$

$$\text{(i)} \quad \frac{\partial \pi}{\partial L} = 32 \cdot \frac{1}{2 \cdot [e(w) \cdot L]^{\frac{1}{2}}} \cdot e(w) - w \stackrel{!}{=} 0$$

$$\Leftrightarrow \quad \frac{16}{[e(w) \cdot L]^{\frac{1}{2}}} = \frac{w}{e(w)}$$

$$\text{(ii)} \quad \frac{\partial \pi}{\partial w} = 32 \cdot \frac{1}{2 \cdot [e(w) \cdot L]^{\frac{1}{2}}} \frac{\partial e(w)}{\partial w} \cdot L - L \stackrel{!}{=} 0$$

$$\Leftrightarrow \quad \frac{16}{[e(w) \cdot L]^{\frac{1}{2}}} \frac{\partial e(w)}{\partial w} = 1$$

Substituting (i) into (ii) yields the optimal profit maximixing condition (Solow condition):

$$\underbrace{\frac{\partial e}{\partial w} \cdot \frac{w}{e}}_{\epsilon_w^e} \stackrel{!}{=} 1 \quad \Leftrightarrow \quad \underbrace{\frac{\partial e}{\partial w}}_{MRT} = \underbrace{\frac{e}{w}}_{MRS} \text{ (analogues to 2e)}$$

Interpretation: In the optimum, the elasticity of effort with respect to wage is 1. The efficiency wage minimizes cost per unit of effort, $\frac{w}{e(w)}$.

Deriving the efficiency wage w^{eff} from the Solow condition:

$$\frac{1}{2 \cdot w^{\frac{1}{2}}} \cdot \frac{w}{w^{\frac{1}{2}} - 1} \stackrel{!}{=} 1$$

$$\Leftrightarrow \quad \frac{w^{\frac{1}{2}}}{2 \cdot w^{\frac{1}{2}} - 2} \stackrel{!}{=} 1$$

$$\Leftrightarrow \quad w^{\frac{1}{2}} = 2 \cdot w^{\frac{1}{2}} - 2$$

$$\Rightarrow \quad w^{eff} = 4$$

(b) What is the unemployment level of the economy caused by the efficiency wage?

The profit maximizing employment level L^* can be derived from the first derivative of the profit function with respect to L.

$$\begin{aligned} \frac{\partial \pi}{\partial L} &= 32 \cdot \frac{1}{2 \cdot [e(w) \cdot L]^{\frac{1}{2}}} \cdot e(w) - w \stackrel{!}{=} 0 \\ \Leftrightarrow \quad w &= \frac{16}{L^{\frac{1}{2}}} \cdot [e(w)]^{\frac{1}{2}} \\ \Rightarrow \quad L^* &= (\frac{16}{w})^2 \cdot e(w) \end{aligned}$$

Using the given formula and inserting the efficiency wage gives the profit maximizing employment level with efficiency wages.

$$\begin{aligned} L^{eff*} &= (\frac{16}{w^{eff}})^2 \cdot e(w^{eff}) \\ \Rightarrow \quad L^{eff*} &= (\frac{16}{4})^2 \cdot ((4)^{\frac{1}{2}} - 1) = 16 \end{aligned}$$

As the demand for labour is binding in this case ($L^{eff*} < L^S$), the unemployment rate with efficiency wages is

$$u(w^{eff}) = \frac{L^S - L^{eff*}}{L^S} = \frac{20 - 16}{20} = 20\%.$$