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Welfare, Employment, and Hours of Work

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Welfare, Employment, and Hours of Work

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ABSTRACT

We use the Pissarides (2000) model to show how social benefits and increased bargaining power of workers can both cause high unemployment and short hours of work. While his matching model has been used to explain higher unemployment in Europe than in the United States, we augment it to account for another observation, which is the fewer hours of work in Europe. We derive an explicit wage curve with variable hours of work that captures wages (per hour) as a function of hours of work. This enables us to show why higher social benefits and greater bargaining power of workers have the dual effect of making workers prefer more leisure time and discouraging firms from offering vacancies.

Keywords: Job search, unemployment, working hours.

JEL Classification: J63, J64, J65

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1 Introduction

In a Keynesian world, the government can expand output and employment by increasing taxes and spending simultaneously, as first shown by Haavelmo (1945). This finding provided a justification for the expansion of the public sector in the decades that followed the Second World War.¹ Nevertheless, problems gradually arose in the labor market during this period, problems that fiscal and monetary policy could not solve. While unemployment in Europe had been lower than in the United States in the 1950s and 1960s, unemployment started to rise in Europe at the end of the 1960s and in the 1970s, eventually becoming much higher than in the U.S. Unemployment has remained high in many European countries ever since while the U.S. economy fully recovered from the recessions of the 1970s and early 1980s. There is also the observation that working hours per employed worker have declined much more in most European countries than in the U.S. In contrast, labor productivity per hour has remained high in Europe compared to the U.S. and other English-speaking countries. See Table 1 below.

The number of hours worked per capita was about the same in the U.S. and in Europe in the early 1970s but has now fallen significantly behind in many, although not all, European countries.² According to Alesina, Glaeser, and Sacerdote (2006) roughly one quarter of the total difference in weekly hours per capita between the United States, on the one hand, and France, Germany, and Italy, on the other hand, is explained by differences in working hours during a normal week, whereas the remaining three quarters is explained by a lower number of weeks worked – that is, vacation time and the employment rate. For France and Germany, the difference in vacation time is the more important of the two factors, while in Italy it is the employment rate.³ As seen in the tables below, in the Continental European countries there are fewer hours of work per employed worker and unemployment is higher while in the English-speaking countries unemployment is lower and more hours of work.

Our contribution in this paper is to use a matching model of the labor market to show why higher spending on social security, as well as higher levels of public consumption, in Europe may both have the effect of making Europeans prefer more leisure time and discourage European firms from offering vacancies.⁴ As shown in Table 2 below social benefits as a proportion of GDP tends to be higher in Europe than in the U.S. and other English-speaking

¹ See Knoester (1991).

² The Nordic countries of Denmark, Finland, Iceland, Norway, and Sweden are an exception. See Hall and Zoega (2014) on the employment-promoting features of their welfare states with roots in the Lutheran-protestant religion.

³ Interestingly, the United States has only 3.9 weeks of holidays and vacations, while Italy and Germany have 7.9 and 7.8 weeks, respectively, and France 7 weeks.

⁴ The insight for our result can be traced to Becker (1965), who made consumption require time off from work.

countries. According to our thesis, any factor – such as unemployment benefits or other welfare payments – which has the effect of increasing wages relative to productivity, will raise the opportunity cost of working by increasing the level of consumption while reducing the profits from posting vacancies due to higher wages and fewer hours of work. This provides a unified explanation for a shorter workweek and higher unemployment. Our model provides support for the thesis of Blanchard (2004) that Europeans prefer leisure more than Americans without having different preferences and, moreover, can explain why this was not the case in the two decades after the Second World War when social spending was lower in Europe than it is now. Our model also encapsulates Prescott (2004) who attributed the differences in labor supply between Europe and the United States to differences in tax rates, which were lower in the 1970s than they are currently since in our model higher taxes increase leisure and lower employment in the presence of public consumption and unemployment benefits. Furthermore, our model is consistent with the findings of Layard, Nickell, and Jackman (1991, 2005) and Nickell et al. (2005) who report a correlation between unemployment, on the one hand, and unemployment benefits, amongst other variables. Both higher taxes and higher social spending may be attributed to increased unionisation and labor market regulations in Europe in the 1970s and 1980s as shown by Alesina, Glaeser, and Sacerdote (2006).

Table 1. Hours of work, unemployment and productivity**Hours of annual work in dependent employment**

Countries	2000	2002	2004	2006	2008	2010	2012	2014	2016
France	1,445	1,401	1,430	1,417	1,447	1,439	1,441	1,425	1,423
Germany	1,360	1,345	1,335	1,344	1,340	1,310	1,301	1,300	1,298
Italy	1,696	1,672	1,657	1,652	1,653	1,616	1,580	1,566	1,577
Spain	1,705	1,723	1,700	1,675	1,668	1,667	1,654	1,643	1,653
Average									
New Zealand	1,777	1,769	1,796	1,767	1,739	1,741	1,723	1,760	1,740
U.K.	1,680	1,668	1,642	1,644	1,642	1,632	1,638	1,667	1,660
U.S.	1,831	1,806	1,799	1,797	1,792	1,781	1,791	1,790	1,787
Average									

Source: OECD.

Unemployment rate (%)

France	8.5	8.4	7.1	8.9	9.4	10.3	10.1
Germany	7.8	8.7	9.8	10.3	7.5	7.0	5.4	5.0	4.1
Italy	10.6	9.0	8.0	6.8	6.7	8.4	10.7	12.7	11.7
Spain	13.9	11.4	11.0	8.5	11.2	19.9	24.8	24.4	19.6
Average									
Australia	6.3	6.4	5.4	4.8	4.2	5.2	5.2	6.1	5.7
New Zealand	6.2	5.3	4.0	3.9	4.0	6.2	6.4	5.4	5.1
U.K.	5.6	5.1	4.7	5.3	5.6	7.8	7.9	6.1	4.8
U.S.	4.0	5.8	5.5	4.6	5.8	9.6	8.1	6.2	4.9
Average									

Source: OECD.

Labor productivity in the total economy in 2012 (dollars, current prices)

France	49.36	52.36	50.52	53.97	56.05	57.55	59.77	63.51	-
Germany	46.81	48.95	52.14	55.42	59.07	58.62	60.94	64.43	-
Italy	44.33	42.63	41.87	43.19	46.83	47.40	50.40	51.65	-
Spain	36.17	36.80	35.93	39.02	42.13	44.22	47.54	51.10	-
Average									
Australia	41.20	41.38	42.54	45.18	47.41	47.94	51.25	54.04	-
New Zealand	30.96	31.92	31.09	30.86	32.68	34.47	35.84	36.75	-
U.K.	43.61	44.71	45.89	47.64	47.65	45.12	46.14	48.07	-
U.S.	50.62	53.00	56.24	57.84	58.90	62.08	62.58	62.94	-
Average									

Source: Penn World Tables. <https://ourworldindata.org/grapher/labor-productivity-per-hour-pennworldtable>.

Table 2. Social benefits to household (% of GDP)

Social benefits to households (% of GDP)									
Countries	2000	2002	2004	2006	2008	2010	2012	2014	2016
France	16.8	17.2	17.4	17.6	17.6	19.2	19.5	20.0	19.9
Germany	17.4	18.0	18.1	17.1	15.8	16.7	15.6	15.4	15.4
Italy	15.8	15.9	16.2	16.3	17.0	18.6	19.3	20.2	19.9
Spain	11.7	11.6	11.6	11.3	12.3	15.1	16.2	16.5	15.6
Average	15.4	15.7	15.8	15.6	15.7	17.4	17.7	18.0	17.7
Australia	8.4	8.0	8.1	7.5	8.9	7.5	7.8	8.0	7.4
New Zealand	11.1	10.0	9.1	9.6	10.4	11.0	10.7	10.0	9.5
U.K.	11.3	11.7	12.1	11.7	12.4	14.3	14.5	13.8	13.4
U.S.	10.3	11.5	11.6	11.6	13.2	15.3	14.5	13.8	13.4
Average	10.3	10.3	10.2	10.1	11.2	12.0	11.9	11.4	10.9

Source: OECD.

Our analysis involves an extension of the model of Pissarides (2000) in that we derive a wage curve with variable hours of work that captures the optimal number of hours given wages.^{5,6} We add to the Pissarides model a derivation of the relationship between working hours and wages, which turns out to be negative. To get this result, we combine the contract curve and the wage curve, on the one hand, and the contract curve and the labor demand curve, on the other hand, while Pissarides (2000) combines labor demand and the wage curve. As a result we end up with a set of two equations, a labor demand curve and a wage curve, while Pissarides solves his model with a contract curve and a wage curve, the latter incorporating the labor demand curve. Moreover, we augment the model of Pissarides to include taxes, public consumption and unemployment benefits and assume a non-linear production function.

A few other contributions can be mentioned at this point that are not related to our model. Rogerson (2006) argues that technology and taxes can explain changes in hours of work between the 1950s and early 2000s. In Pissarides (2007) strong productivity growth in the 1960s caused European unemployment to be low, while the growth slowdown in the

⁵ See also Cahuc and Zylberberg (2004). Our analysis differs from theirs in that we let wages depend on hours of work in the model solution while this relationship is absent in theirs. Cahuc and Zylberberg (2004) simplify the bargaining problem in the maximization of the generalized Nash criterion. When they calculate the partial derivatives with respect to wages and hours worked they use total monthly wages instead of the hourly wage. In so doing they omit the effect of hours worked on the monthly wage in the first-order conditions. This affects the contract curve and is the cause of the difference in this model and theirs in that both *WC* and *LD* shift when the taxes are changed and not only *LD* as in their derivation with fixed real unemployment benefits. Furthermore, there is no taxation of benefits in their model.

⁶ See Section 7.3.

following decades made it rise and exceed the rate of unemployment in the US. He finds that taxes may explain part of the fall in hours of work in Europe because taxes make home production more attractive at the expense of service employment. Ngai and Pissarides (2008), explain changes in market- and home production over long periods by uneven TFP growth.

2 Model setup

The representative worker can either be employed, with hours worked $h > 0$, or unemployed, with $h = 0$. This means that consumption will either be

$$c_t = (1 - \tau)w_t h_t + \bar{c} \quad (1)$$

or

$$c_t = (1 - \tau)z_t + \bar{c} \quad (2)$$

where τ is the tax rate on labor income and benefits, w_t is the real wage, h_t denotes hours worked, z_t stands for unemployment benefits, and \bar{c} is public consumption. In this way, we make private and public consumption be perfect substitutes, as, for example, private and public education and healthcare or private and public parks.⁷ Furthermore, we assume that taxes are collected from employees and benefit recipients and that there are no taxes on employers.

We assume the following functional form for the utility function

$$u(c, h) = c \cdot \phi(1 - h), \quad \phi(1) = 1, \quad \phi' > 0, \quad \phi'' < 0. \quad (3)$$

The utility function is linear and assumes that the utility of consumption depends on the time available from work. The fewer the hours of work, the greater the utility of a given level of consumption indicating complementarity between consumption and leisure.

The matching function is assumed to be increasing in both the number of vacancies (O) and the number of unemployed workers (S), concave, and homogeneous of degree one. We write the matching function M as a function of O and S , $M(O, S)$. The rate at which vacant jobs become filled (exit rate from vacancy) is $M(O, S)/O$ where M denotes the number of matches. This can be written as $m(\theta) = M(1, \theta^{-1})$ where $\theta = O/S$ is a measure of labor

⁷ An effect of public consumption on employment was suggested by Scitovsky (1951) and later Winston (1965). Zoega (1997) derived the effect of higher public consumption, financed by a proportional tax on wage income, on unemployment in an efficiency wage model of the shirking variety. In this model, a higher level of public consumption benefits the unemployed more than the employed due to diminishing marginal utility of consumption, which forces firms to raise wages for incentive reasons, with the effect of lowering employment. The effect of higher taxes on the employed goes in the same direction.

market tightness. From the properties of the matching technology, the derivative with respect to θ is negative. The elasticity of m is $-1 < \eta(\theta) < 0$. The probability that an unemployed worker will get a job is $\theta \cdot m(\theta)$, with a positive derivative. It can be shown that the elasticity of $\theta m(\theta)$ is $1 - \eta(\theta) > 0$. Finally, we denote the job destruction rate by q .

We let U and E represent the discounted value of the expected utility stream of an unemployed and an employed worker, respectively. With a perfect capital market, interest rate r , and infinite horizons, E satisfies the Bellman equation

$$rE = u(c, h) + q \cdot (U - E) \quad (4)$$

where rE is the required return from having a filled job where consumption is given by equation (1). The probability of the change of state from being unemployed to becoming employed can be described by a Poisson process with rate $\theta m(\theta)$. U satisfies the Bellman equation

$$rU = u(c, 0) + \theta \cdot m(\theta) \cdot (E - U) \quad (5)$$

where consumption is given by equation (2) and rU is the required return from being unemployed. Let J be the present discounted value of expected profits from a filled job and V the present discounted value of expected profits from a vacant job. The vacant job costs a per unit of time (a for advertising a job) and is filled according to a Poisson process with rate $m(\theta)$. V thus satisfies:

$$rV = -a + m(\theta) \cdot (J - V) \quad (6)$$

In the same manner, the asset value of an occupied job J satisfies a value equation where the required return is rJ . A filled job yields an instantaneous net return $f(h) - wh$, where $f(h)$ is a strictly concave production function in hours worked. The job changes state with a probability q ; hence J satisfies:

$$rJ = f(h) - wh + q \cdot (V - J) \quad (7)$$

The total surplus S for firms and workers can be written as

$$S = (J - V) + (E - U) \quad (8)$$

where

$$J - V = \frac{f(h) - wh - rV}{r + q} \quad (9)$$

from equations (6) and (7) and

$$E - U = \frac{u(c, h) - rU}{r + q}. \quad (10)$$

from equations (4) and (5). Using equation (5), equation (10) can be written as,

$$E - U = \frac{u(c, h) - u(z(1 - \tau) + \bar{c}, 0)}{r + q + m(\theta)\theta} \quad (11)$$

3 Market equilibrium

Our model solution consists of three equations in three endogenous variables. The first equation shows the supply of vacancies given the assumption of free entry (*LD*). The second equation is the contract curve, which gives all combinations of wages and hours of work in a Nash equilibrium. The third equation is a wage curve (*WC*) that sets wages as a function of productivity, labor market tightness, benefits and public consumption.

3.1 Labor demand

New jobs will be created as long as the profits from a vacant job remain strictly positive; i.e., $V > 0$ due to the free entry condition. This determines the demand for labor using equations (6) and (7),

$$\frac{f(h) - wh}{r + q} = \frac{a}{m(\theta)} \quad (12)$$

where $f(h)$ is the production function with a positive first derivative and a negative second derivative. The left-hand side of the equation measures the present discounted value of profits from an employed worker – this is the marginal benefit from creating a vacancy – and the right-hand side is the expected cost of a vacancy. Firms will create new vacancies until this condition is satisfied.

3.2 The contract curve

Consider the situation of a worker and a firm that have met and have an opportunity to produce a flow of output $f(h)$, which is a function of hours worked and pays wages per hour worked w . The worker and his employer bargain over both the level of wages w and the number of hours h . This translates into finding the maximum of the following expression for

the sharing of the surplus between workers and firms. This represents a generalized Nash bargaining solution, where γ denotes the bargaining power of the worker:

$$\underset{w,h}{\text{Max}}(J(w,h) - V)^{1-\gamma} (E(w,h) - U)^\gamma. \quad (13)$$

The first-order conditions can be made more manageable by taking the logarithm of the objective function, which defines the optimum:

$$\left(\frac{\gamma}{E-U}\right)E_w + \left(\frac{1-\gamma}{J-V}\right)J_w = 0 \quad (14)$$

$$\left(\frac{\gamma}{E-U}\right)E_h + \left(\frac{1-\gamma}{J-V}\right)J_h = 0 \quad (15)$$

When these two equations are solved together to eliminate γ , it yields the contract curve in w and h :

$$\frac{E_w}{E_h} = \frac{J_w}{J_h} \quad (16)$$

Here the marginal rate of substitution between w and h is the same for the worker and the employer. This curve can be expanded by calculating E_h , E_w , J_h and J_w from equations (9) and (10);

$$\frac{u_c \cdot h(1-\tau)}{u_c \cdot w(1-\tau) + u_h} = \frac{-h}{f'(h) - w}. \quad (17)$$

As before, the left-hand side denotes the marginal rate of substitution between w and h for the worker, and the right-hand side denotes the marginal rate of substitution for the employer.

For the specific utility function that we have assumed in equation (3), we can rewrite the contract curve in equation (17) further as:

$$\frac{\phi(1-h) \cdot h(1-\tau)}{\phi(1-h) \cdot w(1-\tau) - [wh(1-\tau) + \bar{c}] \cdot \phi'(1-h)} = \frac{-h}{f'(h) - w} \quad (18)$$

and solve in terms of w . This allows us to express the contract curve for wages as a function of hours worked:

$$w = \frac{f'(h)\phi(1-h)}{h\phi'(1-h)} - \frac{\phi'(1-h)\bar{c}}{h\phi'(1-h)(1-\tau)} \quad (19)$$

This equation yields a relationship between wages and hours worked and gives the main intuition behind the results that follow:

$$(wh(1-\tau)+\bar{c}) \cdot \phi'(1-h) = f'(h)\phi(1-h)(1-\tau) \quad (20)$$

The left-hand side denotes the marginal cost of increased hours of work in utility terms and the right-hand side the marginal benefits in terms of the utility of increased output net of taxes. On a point on the contract curve, higher wages increase the marginal cost of working because they enable consumption to increase, which makes leisure more enjoyable due to the complementarity of consumption and leisure in the utility function, equation (3). Only when hours of work have fallen will the marginal benefit of working increase in the form of higher marginal productivity of hours worked. In equation (20), higher wages raise the left-hand side of the equation requiring a lower h for the right-hand side to increase and the second term on the left-hand side to fall. See Appendix A for a detailed derivation.

3.3 The wage curve

Equations (9), (11), E_w , and J_w and the assumption of $V = 0$ give a wage curve when inserted into equation (14):

$$\gamma \left(\frac{r+q+m(\theta)\theta}{u(c,h)-u(z(1-\tau)+\bar{c},0)} \right) \cdot \left(\frac{u_c \cdot h(1-\tau)}{r+q} \right) + \left(\frac{(1-\gamma) \cdot (r+q)}{f(h)-wh} \right) \left(\frac{-h}{r+q} \right) = 0. \quad (9)$$

This equation defines an implicit function of w given h and θ , which we can think of as a traditional wage curve. Using equation (3) and its derivative generates an explicit equation for the wage curve:

$$w = \frac{z \cdot \phi(1)(1-\tau) + \bar{c}[1-\phi(1-h)]}{(1-\tau)h\phi(1-h)} + \frac{f(h)(1-\tau)\phi(1-h) - (z(1-\tau) + \bar{c}(1-\phi(1-h)))}{(1-\tau)h\phi(1-h)} \cdot \Psi(\theta). \quad (22)$$

The left-hand side of the equation, when multiplied by the denominator on the right-hand side, denotes the utility of after-tax wage income, while the right-hand side has the sum of the utility from receiving unemployment benefits and the extra utility of public consumption for the unemployed, on the one hand, and the share of the employed worker in the surplus generated by the match, on the other hand. The latter has the difference between two terms, where the first $f(h)(1-\tau)\phi(1-h)$ is the value of hours worked after taxes in terms of utility while the second is the sum of the utility of the benefits and the difference between the utility of the unemployment and the employed from public consumption. The difference between

these two terms is the net utility gain from employment to be shared through bargaining between the worker and the employer. The *actual* weight of the employee in the bargaining is given by $0 \leq \Psi(\theta) \leq 1$, where:

$$\Psi(\theta) = \frac{\gamma(r + q + \theta m(\theta))}{(r + q + \gamma \theta m(\theta))} \quad (2310)$$

The exit rate from unemployment $\theta m(\theta)$ is increasing in tightness θ , and consequently $\Psi'(\theta) > 0$. When tightness increases, the unemployed has a higher exit rate from unemployment and the value of U increases, and the worker fearing the prospect of unemployment less can now make more demands, thus driving the negotiated wage up. A similar reasoning gives us that $\Psi(\theta)$ is decreasing with the exit rate q from employment. Finally, when γ increases, the worker's *intrinsic* bargaining strength increases and the *actual* weight goes up.

3.4 A two-equation system

The three-equation system of a wage curve, a labor demand curve, and the contract curve can be reduced further by means of several substitutions. First, by inserting the contract curve of equation (19) into the labor demand equation (12), we find a new relationship between h and θ , which we continue to refer to as labor demand and which is written as:

$$\left(\frac{\phi'(1-h)f(h)(1-\tau) - f'(h)(1-\tau)\phi(1-h) + \bar{c}\phi'(1-h)}{\phi'(1-h)(1-\tau)(r+q)} \right) = \frac{a}{m(\theta)}. \quad (24)$$

Second, we can insert the contract curve into the wage curve (22) and thereby obtain a new wage curve:

$$\begin{aligned} \frac{f'(h)\phi(1-h)(1-\tau) - \phi'(1-h)\bar{c}}{(1-\tau)h\phi'(1-h)} &= \frac{z \cdot (1-\tau) + \bar{c}(1-\phi(1-h))}{(1-\tau)h\phi(1-h)} \\ &+ \frac{f(h)\phi(1-h)(1-\tau) - z(1-\tau)\phi(1-h) - \bar{c}(1-\phi(1-h))}{(1-\tau)h\phi(1-h)} \cdot \Psi(\theta). \end{aligned} \quad (25)$$

The two equations – the labor demand curve (*LD*) and the wage curve (*WC*) – now form a system with two unknowns, h and θ , which can be represented graphically.

The contract curve relation – which has a negative relationship between hours worked and wages – is built into both the labor demand curve and the wage curve and makes the *LD* curve upward-sloping and the *WC* curve downward-sloping in the (θ, h) space. The wage curve is downward-sloping, as shown in Figure 1, because greater labor market tightness θ makes the

wage go up, which raises the opportunity cost of hours worked, creating a negative relationship between tightness θ and hours worked h .⁸ The labor demand curve is upward sloping in the figure because greater labor market tightness increases the cost of posting a vacancy due to the longer expected time to fill a job. For an unchanged wage, hours worked must increase so that the value of posting a vacancy remains equal to the now higher marginal cost of posting a vacancy.⁹ This generates an upward-sloping relationship between hours worked and labor market tightness, as is shown in the figure.¹⁰

We now turn to the effect of raising the level of unemployment benefits z , having greater bargaining power γ , and increasing public consumption \bar{c} .

4 The effect of higher benefits and increased worker bargaining power

A higher level of unemployment benefits z , holding taxes and public consumption unchanged, will shift the WC curve to the left, as can be seen in equation (26):

$$0 = \left(f(h) - \left(\frac{\bar{c}(1-\phi)}{\phi(1-\tau)} + \frac{z}{\phi} \right) \right) \cdot \Psi'(\theta) d\theta + \left[\frac{1}{\phi} (1 - \Psi(\theta)) \right] dz. \quad (26)$$

We note that the sign of the first term on the right-hand side of the equation is positive because the utility of a worker who is able to keep the entirety of his output $f(h)$ net of taxes is greater than the utility of an unemployed individual,

$$f(h)(1-\tau)\phi(1-h) + \bar{c}\phi(1-h) > \bar{c} + z(1-\tau) \quad (27)$$

even though the unemployed enjoys public consumption more because he has more time.

Both terms in the parentheses are positive in sign and so is $\Psi'(\theta)$, which makes $d\theta/dz < 0$.

Therefore, the curve shifts leftward for each level of h . Alternatively, higher benefits increase the utility of the unemployed, which has the effect of raising wages and lowering the number of hours for a given θ . As we move down the labor demand curve, fewer hours of work reduce profits and the value of a new vacancy created, which makes firms offer fewer

⁸ Replacing h with wh on the vertical axis of Figure 1 would make the wage curve upward-sloping and labor demand downward sloping, as both curves incorporate the contract curve that has a negative relation between w and h . See equation (A-14) in Appendix A.

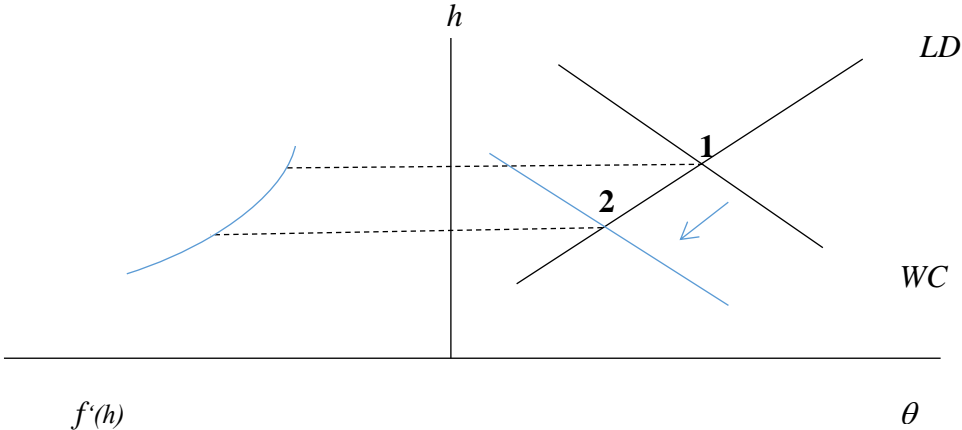
⁹ This follows from $f'(h) > w$ on the contract curve at the point of tangency of the upward-sloping isoprofit curve and the upward-sloping indifference curve, as is shown in Appendix A1.

¹⁰ See Appendix A2 on the slope of the two curves.

vacancies.¹¹ With fewer vacancies, wages will be somewhat lower and hours worked somewhat higher than they would be at unchanged wages. The net effect is to reduce both labor market tightness θ and hours worked h , in addition to raising the marginal productivity of hours worked due to diminishing marginal productivity.

The story here is that when unemployment benefits go up, workers must be paid higher wages because being unemployed now brings more utility. This raises the opportunity cost of working by making leisure more attractive due to a higher level of consumption, and as a result, negotiated hours of work fall. Firms' profits therefore fall (they are on the upward-sloping part of their isoprofit curves as shown in the appendix) and they post fewer vacancies. This shifts down the wage curve, reducing the equilibrium level of h and θ . The relative fall of h and θ depends on the slope of the labor demand curve. This depends on the effect of changes in θ on the number of matches and hence the expected time before a vacancy is filled, as well as on the marginal productivity of hours worked.

Figure 1. Labor demand LD and the wage curve WC in the (θ, h) space



The figure has an upward-sloping labor demand curve (LD) in the θ - h space and a downward-sloping wage curve (WC). Higher benefits shift the WC down and to the left and the economy moves down the LD curve from intersection 1 to intersection 2. The number of hours fall and the ratio of vacancies to unemployment, θ , falls unambiguously. As a result, the marginal product of hours worked per employee, $f'(h)$, rises due to diminishing marginal productivity of hours worked.

An increase in the bargaining strength of workers, γ , would have the same effect of shifting the wage curve. Taking the total differential of equation (25) and now holding z fixed gives

¹¹ Booth and Schiantarelli (1986) explore the employment effects of a cut in hours of work in a monopoly union model with efficient bargaining and find that a reduction in hours, while keeping the number of shifts fixed, has employment effects that are ambiguous and likely to be negative for plausible parameter values.

$$0 = \left(f(h) - \left(\frac{\bar{c}(1-\phi)}{\phi(1-\tau)} + \frac{z}{\phi} \right) \right) \Psi'(\theta) d\theta + \left(f(h) - \left(\frac{\bar{c}(1-\phi)}{\phi(1-\tau)} + \frac{z}{\phi} \right) \right) \frac{\partial \Psi(\theta)}{\partial \gamma} d\gamma \quad (28)$$

where both terms are positive. Hence the effect would be the same as that of raising benefits, in that hours worked would fall, as would the supply of vacancies and consequently labor market tightness. When wages increase workers desire increased leisure and firms reduce the number of vacancies. In the new equilibrium hours worked have fallen as well as labor market tightness.

5 The effect of increased public consumption

Increasing public consumption also has the effect of reducing hours of work, holding taxes and benefits unchanged. Taking the total differential of the labor demand curve (24) gives

$$\frac{1}{(1-\tau)(r+q)} d\bar{c} = -\frac{m'(\theta)a}{(m(\theta))^2} d\theta. \quad (29)$$

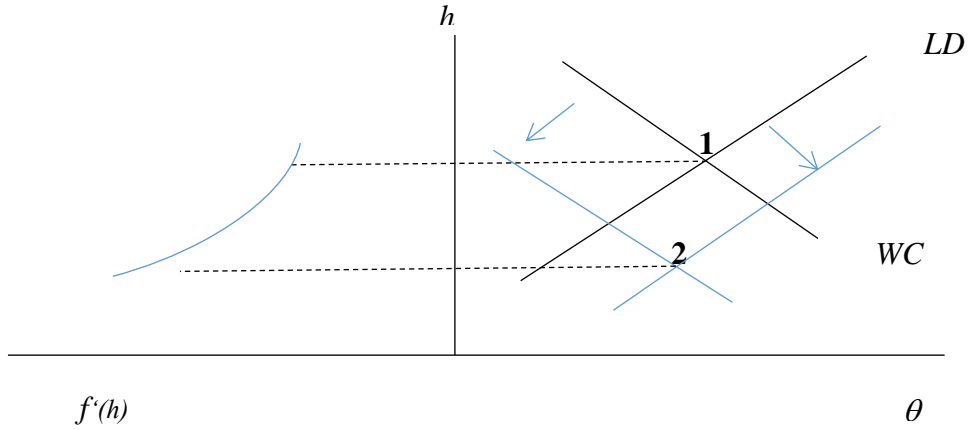
Here both sides of the equation are positive, so that the *LD* curve shifts to the right in the figure below. Intuitively, a higher level of public consumption reduces the negotiated wage on the contract curve, holding hours worked unchanged, as seen in equation (19). Alternatively, hours worked fall for a given wage. Taking the total differential of the wage curve (25) gives

$$\frac{-1}{(1-\tau)} d\bar{c} = \frac{(\phi(1) - \phi(1-h))}{(1-\tau)\phi(1-h)} (1 - \Psi(\theta)) d\bar{c} + \left(f(h) - \left(\frac{\bar{c}(1-\phi)}{\phi(1-\tau)} + \frac{z}{\phi} \right) \right) \Psi'(\theta) d\theta \quad (30)$$

Since both terms on the right-hand side of the equation are positive – see equation (26) above – the *WC* curve shifts to the left in the figure. The higher level of public consumption has the effect of increasing the opportunity cost of working, making hours worked fall and wages increase. There is also the indirect effect that higher levels of public consumption benefit the unemployed more, which then raises the negotiated wage, due to the employed workers' improved fallback position, and hence also the opportunity cost of hours worked.

The two shifts make the curves intersect at a lower level of hours worked h while the effect on labor market tightness θ is ambiguous, as is shown in the figure below. In a later section, we will present numerical simulations that show that θ will fall and unemployment will rise given plausible parameter values.

Figure 2. Labor demand LD and the wage curve WC in the (θ, h) space



The figure has an upward-sloping labor demand curve (LD) in the θ - h space and a downward-sloping wage curve (WC). Higher levels of public consumption shift the WC curve down and to the left and the LD curve down and to the right, moving the economy from intersection 1 to intersection 2. The number of hours fall while the effect on the ratio of vacancies to unemployment, θ , is theoretically ambiguous. As in Figure 1, the marginal product of hours worked per employee, $f'(h)$, rises due to diminishing productivity of hours worked.

6 The effect of higher taxes

We finally come to the effect of higher taxes holding benefits and public consumption unchanged. To start with, taxes are neutral in the absence of public consumption, as is seen from the two equations below. Assuming that $\bar{c} > 0$ and starting with the LD curve, we find the total differential, which describes the effect of higher taxes on labor market tightness:

$$\frac{\bar{c}}{(1-\tau)^2(r+q)}d\tau = -\frac{m'(\theta)a}{(m(\theta))^2}d\theta. \quad (31)$$

Here both sides of the equation are positive as long as $\bar{c} > 0$, which makes the LD curve shift to the right in the figure above. The reason is similar to the one for the shift of the LD curve following an increase of public consumption since higher taxes increase the value of public consumption and the opportunity cost of hours worked, leading to lower wages on the contract curve. See equation (19). The higher taxes have the effect of lowering the wage for a given number of hours worked along the contract curve, which makes firms offer more vacancies.

Turning to the wage curve, we find the following differential:

$$\frac{-\bar{c}}{(1-\tau)^2}d\tau = \frac{\bar{c}(1-\phi)}{(1-\tau)^2\phi}(1-\Psi(\theta))d\tau + \left(f(h) - \left(\frac{\bar{c}(1-\phi)}{\phi(1-\tau)} + \frac{z}{\phi} \right) \right) \Psi'(\theta)d\theta \quad (32)$$

In this case, the left-hand side of the equation is negative while the right-hand side is positive. As a result, the WC curve shifts to the left in the figure. Again, the effect depends on $\bar{c} > 0$. The two shifts are thus of the same sign as those shown for the effect of increased public consumption. Tax increases therefore have the effect of reducing hours of work, as did higher benefits and a higher level of public consumption. The effect on labor market tightness is ambiguous.

The following section has numerical simulations that show that θ will fall and unemployment will rise given plausible parameter values.

7 Simulations

We have found that both higher levels of public consumption and higher taxes have the effect of reducing the number of hours of work while having a theoretically ambiguous effect on labor market tightness, θ , and hence the rate of unemployment in steady state. In order to resolve the ambiguity, we perform numerical simulations for a balanced-budget increase in tax rates and public consumption. We choose the parameter values to resemble a typical Continental European country.

The exercise involves assuming functional forms for the production function, the leisure part of the utility function in equation (3) and the matching function. These functional forms are incorporated into the LD curve of equation (24) and the WC of equation (25). The equation system is nonlinear in two unknowns, hours worked h and tightness, θ . By assuming reasonable parameters for the rate of job destruction q , rate of interest r , the bargaining power of workers γ and hiring costs a , numerical solutions can be attained which involve changes in public consumption and tax rates.

In addition, the Beveridge curve gives the opportunity to calculate the unemployment rate assuming population growth n from the matching function and the equilibrium flows in the labor market. The flow into unemployment results from job-specific shocks that arrive to occupied jobs at the Poisson rate q , the rate of job destruction. We denote the labor force, N as the sum of the employed, L and the unemployed S , the labor force grows at the rate of n . Using the time derivative of employment and unemployment gives a differential equation in the unemployment rate s , which in steady state gives the following expression:

$$\frac{q + n}{(q + n + \theta \cdot m(\theta))} = s. \quad (33)$$

This expression defines a Beveridge curve. If we define the vacancy rate as $o=O/N$ then the labor market tightness is $\theta=o/s$ and the Beveridge curve can be drawn in a plane of (o,s) as decreasing and convex given the properties of the matching function with q and n fixed. We will do an equal-yield exercise (that is one leaving tax revenues unchanged) involving changes in the tax rate and public consumption.

The government’s budget constraint is as follows:

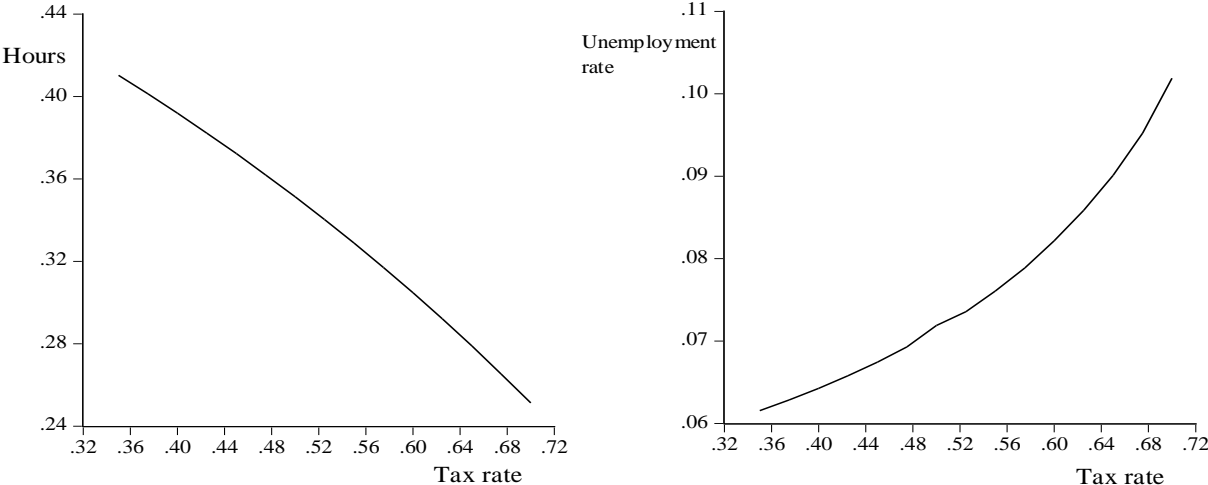
$$s \cdot z + \bar{c} = (wh\tau) \cdot (1-s) + (z\tau) \cdot s \tag{34}$$

The left-hand side of the equation has the expenditures on unemployment benefits and public consumption per capita, while the right-hand side has tax revenues, collected through a proportional tax on wage income. We then let τ and \bar{c} increase so as to maintain a balanced budget.

We calculate the real rate of interest as the average of the difference between the nominal interest rate on 10-year German government bonds and German inflation between 2001 and 2008. The unemployment benefits replacement rate is the German number for year 1999 in Nickel *et al.* (2005) (37% of average wages, wh). The quit rate q is set at 7.5%, as in Germany for 1983-1990. Finally, hiring costs are adjusted to generate an unemployed rate close to the observed one.

The figure below shows the results of the simulation showing the effect a balanced-budget change in taxes and public consumption on hours worked and the unemployment rate, which will clarify the ambiguity in sections 5 (public consumption) and 6 (taxes) above.

Figure 3. The effect of higher taxes and public consumption on hours and unemployment



Parameter values: $z = 0.21$ $a = 0.18$, $q = 0.075$, $n = 0$, $r = 0.024$, $\gamma = 0.50$, $f(h)=h^{0.5}$, $\phi(1-h)=(1-h)^{0.5}$.

The simulations show that raising tax rates from 35% to 70% and spending the increased tax receipts on public consumption would lower the number of hours of work per week from 41.6 to 25.9 and increase the rate of unemployment from 8.8% to 38.2%. Thus the downward shift of the *WC* curve in Figure 2 is much more pronounced than the downward shift of the *LD* curve.

This shows how the inverted Haavelmo effect, discussed in the introduction, arises in our model, i.e. expanding the size of the public sector has the effect of reducing the number of hours worked, raising unemployment and by extension increasing labor productivity in accordance with the stylized facts shown in Table 1.

8 Conclusions

We have shown that a shorter workweek, higher unemployment rates and high hourly labor productivity in continental European economies compared to the U.S. and other English-speaking countries may have a unified cause in a higher level of taxes, benefits and public consumption and a greater bargaining power of workers.¹² This is the inverted Haavelmo effect discussed in the literature, which gives a negative balanced budget multiplier.

In our model, when workers are paid more for being idle, employed workers manage through bargaining to obtain a higher wage, which raises the opportunity cost of working without raising the attractions of work through higher productivity. Firms respond to the higher wages and lower number of hours by reducing the number of vacancies, and we end up with both higher unemployment and a shorter workweek. Greater bargaining power of workers, which could be caused by stronger unions or more extensive labor market regulation, will also raise the wage paid per hour, with the same effect on hours of work and unemployment.

The model encompasses several of the proposed explanations for fewer hours of work in Europe. The model explains why Europeans may have a greater preference for leisure than Americans, as proposed by Blanchard (2004). The model explains why fewer hours of work are correlated with unionization and labor market rigidities such as unemployment benefits, as is shown by Alesina *et al.* (2006). It is also consistent with the finding by Bell and Freeman

¹² The negative effect of government expenditures on labor input and hence output is what Knoester (1991) has called the inverted Haavelmo effect – increased spending by the government makes employment and hours worked fall, contrary to Keynesian predictions.

(1995) that in spite of fewer hours of work, German workers desire to reduce their time at work while Americans want to increase it.

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Appendix A: Derivation of the contract curve

It is possible to draw the tangency between the isoprofit and indifference curves as a solution to the contract curve in (w, h) -space.

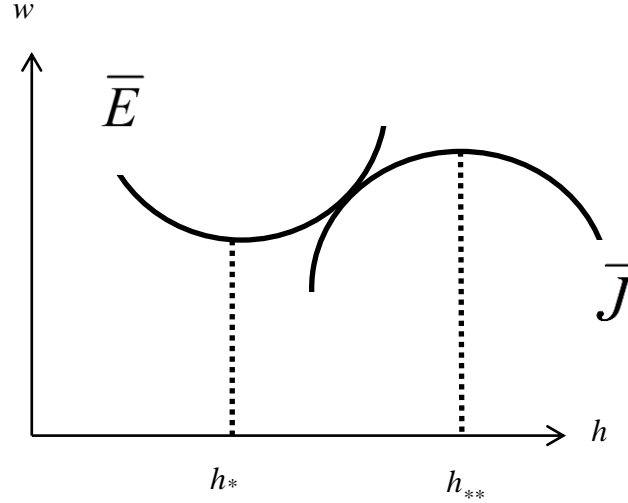


Figure A-1. Contract curve, isoprofit curve and indifference curve

The slope of the indifference curve is given by:

$$\frac{dw}{dh} = -\frac{E_h}{E_w} = -\frac{u_c w(1-\tau) + u_h}{u_c h(1-\tau)} = -\frac{1}{h(1-\tau)} \left(w(1-\tau) + \frac{u_h}{u_c} \right) \quad (\text{A-1})$$

For the neoclassical model of consumption-labor choice the worker takes w as given and maximizes utility so that the slope of the budget constraint is equal to marginal rate of substitution between work and consumption. The slope of the budget constraint in that case is $w(1-\tau)$, and $-u_h/u_c$ is the marginal rate of substitution between work and consumption, the rate at which the consumer demands one more unit of consumption for an hour's increase in work (positive here). In this case, dw/dh is zero in Figure A-1 and we are at h^* .

Here both hours worked and wages are the result of a bargaining process between the firm and the worker. If h^* is the tangency point in the absence of bargaining and if $h < h^*$ the slope of the budget constraint is greater than the marginal rate of substitution and dw/dh will be negative. The opposite applies when $h > h^*$. Thus the \bar{E} curve is downward-sloping to the left of h^* and upward-sloping to the right of h^* . We note that since both h and w are determined in the bargaining process, h does not have to equal h^* in equilibrium.

To see how the indifference curve \bar{E} shifts, we look at:

$$dE = E_w dw + E_h dh \quad (\text{A-2})$$

For an increase in w for a fixed h , E will increase as E_w is positive. Hence an upward shift in the indifference curve represents a higher level of utility for the worker. This can also be seen if we look at an increase in h for a fixed w . This, however, is a bit more complicated. From calculating E_h we get:

$$E_h = \frac{u_c \cdot w(1-\tau) + u_h}{r+q} = \frac{u_c}{r+q} \left(w(1-\tau) + \frac{u_h}{u_c} \right) \quad (\text{A-3})$$

From earlier discussion, we know that if $h < h^*$, then $E_h > 0$, and for an increase in h , E increases. The opposite applies if $h > h^*$.

The slope of the isoprofit curve is given by:

$$\frac{dw}{dh} = -\frac{J_h}{J_w} = \frac{f'(h) - w}{h} \quad (\text{A-4})$$

The isoprofit curve is upward-sloping while marginal product is higher than the wage and is downward-sloping when marginal product is lower than the wage. For higher profits, the isoprofit curve will shift downwards.

The same logic applies here as is discussed earlier in the case of the worker, in that the firm does not set marginal product equal to the wage rate because of the bargain between the firm and the worker. Let h^{**} be a point on the isoprofit curve where the wage is equal to the marginal product. When $h < h^{**}$, the marginal product is greater than the wage. Conversely, when $h > h^{**}$, the opposite applies.

To see how the isoprofit curve \bar{J} shifts, we look at:

$$dJ = J_w dw + J_h dh \quad (\text{A-5})$$

For an increase in w for a fixed h , J will decrease as J_w is negative. Hence a downward shift in the isoprofit curve represents a higher profit for the firm. This can also be seen if we look at an increase in h for a fixed w . This, again, is a bit more complicated. By deriving J_h we get:

$$J_h = \frac{f'(h) - w}{r+q} \quad (\text{A-6})$$

From earlier discussion, we know that if $h < h^{**}$, then $J_h > 0$, and for an increase in h , J increases. The opposite applies if $h > h^{**}$.

The only thing that is left to determine is the location of the point of tangency between the indifference curve and the isoprofit curve. If the point of tangency for a given indifference curve is below h^* , it will be on the downward-sloping part on the indifference curve and the

downward-sloping part of the isoprofit curve, in which case the contract curve will be upward-sloping. If the tangency point is for a given indifference curve above h^* , the opposite will be the case: the point of tangency will be on the upward-sloping part of the indifference curve and the upward-sloping part of the isoprofit curve.

Setting the slope of the indifference curve equal to the slope of the isoprofit curve gives:

$$f'(h) - w = -\frac{1}{(1-\tau)} \left(w(1-\tau) + \frac{u_h}{u_c} \right) \quad (\text{A-7})$$

In equilibrium, the marginal product of labor must be strictly greater than the wage rate because firms must be compensated for their hiring costs. Hence equation (A-7) implies that when hours are set after a Nash bargain, we have

$$\left(w(1-\tau) + \frac{u_h}{u_c} \right) < 0 \quad (\text{A-8})$$

Using the utility function given by equation (3) yields:

$$w(1-\tau) < \frac{c \cdot \phi'(1-h)}{\phi(1-h)} \quad (\text{A-9})$$

which indicates that the marginal rate of substitution between consumption and hours worked is greater than the wage, so hours worked h are now higher than is implied by the worker's choice rule of no bargaining.

The difference between hours worked here and in the no-bargaining solution originates in the hiring costs a , which is the cost of maintaining a vacant position. In the absence of bargaining, workers choose their number of hours worked by comparing the marginal cost of working (loss of leisure) with the marginal benefit of after-tax wage income. In the Nash bargaining, the costs and benefits to the firm must also be taken into account. The joint marginal cost of one more hour to the firm and the worker is still the loss of leisure to the worker, but the joint gain is the after-tax product from one more hour. The bargaining solution gives the same result as in a competitive framework, when wages are given only when the wage rate is equal to the marginal product. This cannot happen in equilibrium due to the hiring costs a faced by firms, which drive a wedge between marginal product and wages.

We have shown that hours worked and wages are negatively related along the contract curve in the bargaining solution. We now turn to showing this negative relation mathematically. Equation (A-7) with the utility function in equation (3) gives:

$$f'(h) - w = -\frac{1}{(1-\tau)} \left(w(1-\tau) - \frac{c \cdot \phi'(1-h)}{\phi(1-h)} \right) \quad (\text{A-10})$$

and because wages cancel out on both sides, we get:

$$f'(h) = \frac{c \cdot \phi'(1-h)}{(1-\tau)\phi(1-h)} \quad (\text{A-11})$$

This equation states that on the contract curve, the after-tax marginal product in utility terms should be equal to marginal disutility of one more hour worked.

Inserting consumption from the budget constraint (1) facing the worker into equation (A-11) gives equation (19), the point of tangency on the contract curve that has been shown to have a negative slope since both the indifference curve and the isoprofit curves are upward-sloping at the point of tangency. Mathematically, however, dw/dh cannot be determined from equation (A-11). In order to derive the slope of the contract curve, we solve for w in (A-11) and multiply by h , which gives:

$$\frac{f'(h)(\phi(1-h))(1-\tau)}{(1-\tau)\phi'(1-h)} - \frac{\bar{c}}{(1-\tau)} = wh \quad (\text{A-12})$$

The equation gives the relationship between hours worked and total wages. Taking the derivative of (A-12) with respect to h gives:

$$\frac{d(wh)}{dh} = \frac{(f''(h)\phi(1-h) - f'(h)\phi'(1-h))\phi'(1-h) + f'(h)\phi(1-h)\phi''(1-h)}{(\phi'(1-h))^2} < 0 \quad (\text{A-13})$$

It follows that on the contract curve we have a negative relationship between total wages wh and hours worked, as well as between w and h in equation (A10). As is shown in equation (A-13), $d(wh)/dh < 0$ and as

$$\frac{d(wh)}{dh} = \frac{dw}{dh}h + w < 0 \quad (\text{A-14})$$

it follows that $dw/dh < 0$ in equation (A-10). The contract curve has a negative slope, as is shown in Figure A-1.

At each point on the contract curve, workers work more hours than they would in the absence of bargaining and firms accept fewer hours of work from each worker than they would have chosen in the absence of bargaining with a given wage.

Appendix B: Slope of labor demand and wage curves

Taking the total differential of the labor demand curve in equation (24) above gives:

$$\left(\frac{f'}{(r+q)} - \frac{(f''\phi - f'\phi')\phi'(r+q) + \phi''f'\phi(r+q)}{(\phi'(r+q))^2} \right) dh = \left(-\frac{m'(\theta)a}{(m(\theta))^2} \right) d\theta \quad (\text{B-1})$$

We see from this that the labor demand curve is upward-sloping since each parenthesis is positive.¹³ Doing the same for the wage curve and using the results of equation (25) gives:

$$\begin{aligned} \frac{d(wh)}{dh} dh = & \left[\left(\frac{\bar{c}\phi'}{\phi^2(1-\tau)} + \frac{z\phi'}{\phi^2} \right) + \left(f'(h) - \left(\frac{\bar{c}\phi'}{\phi^2(1-\tau)} + \frac{z\phi'}{\phi^2} \right) \right) \Psi(\theta) \right] dh \\ & + \left(f(h) - \left(\frac{\bar{c}(1-\phi)}{\phi(1-\tau)} + \frac{z}{\phi} \right) \right) \Psi'(\theta) d\theta \end{aligned} \quad (\text{B-2})$$

From this we see that the wage curve is downward-sloping because the term on the left-hand side is negative from equation (A-13), while the two terms on the right-hand side are positive.

¹³ Assuming that $f'' < 0$.