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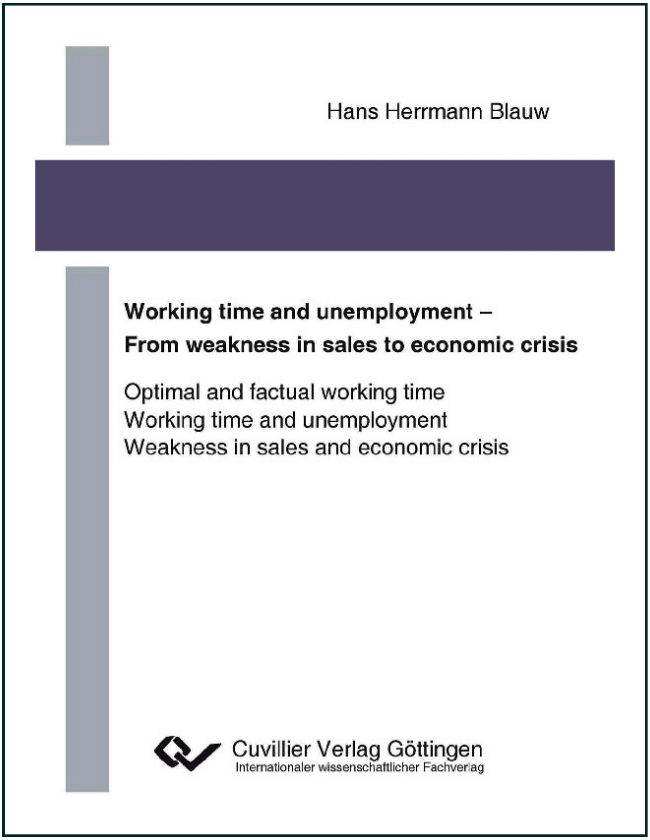
Working time and unemployment - From weakness in sales to economics crisis

Optimal and factual working time Working time and unemployment Weakness in sales and economic crisis



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Preface

In view of the huge rise of production with a thirty-fold increase of labour productivity and a decrease to half the working time per employee since the beginning of industrialisation, this book investigates why the working time per employee just decreased to the degree it did, and which working time is optimal for the household and for the company.

It is obvious that unemployment has something to do with working time. But all the explanatory approaches to explain unemployment have in common that they do not take into account the quantity of work per employee as desired by suppliers and demanders, and therefore say little that is convincing about the reduction of working time. This book derives how the unemployment rate is connected with the working time per employee.

Independent of cyclical fluctuations, the key problem of industry has almost always been the sale of its output. This results in overproduction over and over again. If, in addition, big income differences per person exist, savings can become so high that not enough profitable or at least amortisable investments in newly produced goods are possible, and the economic circuit can then slacken off even to the extent of an economic crisis. Possible measures for remedy are discussed. The economic crisis from 2007 is compared with that from 1929 and with later recessions. Because of the higher debt, today's crisis has a larger potential than that from 1929.

I obtained the following new results: The optimal working time of the employee decreases with increasing wage rate and with worsening of working conditions. If the factual working time is longer than optimal, consumption does not keep pace with production and unemployment results. If working time is not reduced in line with increasing productivity, the national income eventually stagnates. If savings are much larger than investment in real goods an economic crisis can develop. It can be resolved without inflation and government debt by taxing away the surplus savings and investing or consuming them via the state, and by reducing working time per employee.

In Western industrialised countries the economic crisis is combated predominantly by government loans to the financial industry. But it is first and foremost a sales crisis and cannot be remedied like that. States which invest additionally in public goods, where need exists, for example of infrastructure or conservation, are on a better track.

The book consists of three largely independent chapters dealing with working time, unemployment and economic crises. The problems are investigated theoretically and the results tested empirically for the USA, Japan and Germany.

I stumbled upon the problem of productivity, working time and employment years ago as a business planner with an industrial group. Since then I have dealt with the topic in detail, in contact with experts, also of universities and institutes at home and abroad, alongside my job as a managing director in industrial companies. My repeated confrontation with the problem of sale of goods motivated me to investigate its causes and effects. As eventually the crisis from 2007 came and stayed, it was not difficult to explain it with the approach described here. This meant I could deal with the topic of working time, unemployment and economic circuit in context.

H. H. B.

Chapter 1
Optimal and factual working time

The chief business of the Stywards - in fact, practically their only business - is to see that nobody sits around doing nothing, but that everyone gets on with his job. They don't wear people out, though, by keeping them hard at work from early morning till late at night, like cart-horses. That's just slavery - and yet that's what life is like for the working classes nearly everywhere else in the world. In Utopia they have a six-hour working day...

With everybody doing useful work, and with such work reduced to a minimum, they build up such large reserves of everything that from time to time they can release a huge labour force to mend any roads which are in bad condition. And quite often, if there's nothing of that sort to be done, the authorities announce a shorter working day. They never force people to work unnecessarily...

Thomas More, Utopia, 1516 (1965 p. 75-76, 79)

Abstract

The optimal working time of the household decreases with increasing wage rate or non-work income. With longer working time a higher proportion of the income is saved. From the point of view of the company the optimal working time is longer than that of the employee household. The factual working time is longer than desired by the employees. For the time from 1850 on, the working time in the USA, Japan and Germany are in line with the optimal working time for the employee as a function of the wage rate.

JEL code and keywords

J22, J23

company, employee household, historical, labour supply curve, saving, utility, wage rate, working time

The course of argumentation can also be pursued without the parts written in italics.

1. Initial position

In today‘s industrialised countries, labour productivity per working person and hour rose to about 27 fold between the years 1800 and 2000 (Maddison 1995 p. 46). In Germany, labour productivity in mining rose to about 10 fold, in agriculture 15 fold, in production up to 100 fold and more, and in services 3 fold (Katalyse 1981 p. 10). Between 1820 and 2000 the gross domestic product per person in real terms rose to about 20 fold, in the preceding 200 years only to about 1.5 fold (Maddison 2003 p. 262). In Germany since 1800 the conversion of non-renewable raw materials rose to more than 10-fold (Katalyse 1981 p. 13). On average, the population of Western Europe and Japan rose on average to 3.2 fold (Maddison 2003 p. 256). In the USA, the gross wages and salaries in real terms increased to 12-fold and in Germany to 30-fold per working hour (section 8 figure 7). The annual earning working time per employee was reduced to half or even less (Maddison 2001 p. 347), slavery was banned in 1865 or earlier (Brockhaus 1993 vol.20 p. 359) and child labour in 1973 or earlier (Brockhaus 1990 vol.11 p. 683).

These dimensions of the changes will make it revealing to investigate, why the working time per employee just decreased to the degree as it did, or how the working time depends on the wage rate, and which working time is optimal for the household and for the company. To clarify this, in the first place the utility of the household depending on the consumption is described. Then it is considered, that the means for the consumption are acquired with work or non-work income, and then the optimal working time for the household is determined. Next the optimal working time of the employee from the point of view of the company is discussed. Finally the desired and the factual working time are compared, and the historical development of working time and wage rate shown.

2. Utility and consumption

A key question in this study is the optimal amount of work or its corresponding optimal working time from the view of the working person. It can be seen as working time, with which the utility of a person or its household has its maximum. Utility can be understood as the standard of living or well-being. In order to achieve this, goods are consumed or used. To buy them money has to be spent. Hence the optimum working time can be determined if the dependence of utility on consumption and working time is known. For this there are several approaches.

In 1738, Daniel Bernoulli postulates for the calculation of the values of strokes of luck, that an increase in the quantity of goods creates an increase in utility, which is inversely proportional to the already available quantity of goods. For instance, if the quantity of goods is three times as large, utility grows only by a third with the same increase of the quantity of goods.So utility changes with the logarithm of the quantity of goods (Bernoulli 1954 p. 25, 27). In 1728, for this case Gabriel Cramer uses the hypothesis that utility grows with the square root of the quantity of goods, thus utility is a power function of the quantity of goods (Bernoulli 1954 p. 34).

The psycho-physical relation by Weber and Fechner from the year 1860 shows that the strength of perception of a sensory stimulus grows with the logarithm of the strength of the sensory stimulus (Schmidt... 2000 p. 210-211). It can be written as $y = a\ln x + b$*, with the strength of perception* y*, the strength of stimulus* x *and constants* a *and* b*. This relation is valid for an average segment of the strength of sensory stimuli. According to Plateau and Stevens in 1959, in many cases the strength of perception grows with a power of with the strength of the sensory stimuli (Schmidt... 2000 p. 211-212),. The exponent* n *is for example 0.21 for intensity of white light, 0.35 for loudness and 0,79 for force (Klinke... 1996 p. 628). Over a large range, the logarithmical function is a good approximation for the power function. The sound pressure is* *defined as* $L = 20\lg(p_1 / p_0)$ *with* p_1 *= effective sound pressure and* p_0 *= 2 x* 10^{-5} *N/m*^{2} *scale basis (Hütte vol.1 1955 p. 624).*

From economics comes Turgot's law of diminishing returns as well as Gossen's first law, that the increase of utility diminishes with growing input of goods. In the report on human development by the United Nations Development Programme (UNDP) a human development index (HDI) is used, in which parameters for life expectancy, education, and standard of living that can assume the same values, are added (United... 2003 p. 341). In the definition of 2003 is:

Human Development Index = 1/3 of the index of life expectancy + 1/3 of the index of education + 1/3 of the index for standard of living.

Index for the standard of living = ((lg (real gross domestic product per inhabitant) - lg (fictitious minimum value of GDP per inhabitant)) / ((lg (fictitious maximum value of GDP per inhabitant) - lg (fictitious minimum value of GDP per inhabitant).

The fictitious minimum and maximum values are values that are reached by different groups of persons all over the world, or they are plausible limits.

Since the fictitious minimum value, the fictitious maximum value, and the conversion factor of $\lg$ *to* $\ln$ *are constants, the index of the standard of living can again be expressed by the formula* $y = a \ln x + b$ *, with the standard of living* y *, the real gross domestic product per person* x *and constants* a *and* b *.*

However, in social psychology this degressive relation is only confirmed for needs with a strong physiological link. At “goods” such as wealth, performance and power utility is said to increase progressively with increasing “consumption” (Fischer/Wiswede 2002 p. 109). But this is only relevant at a higher income.

For the facts discussed here, only the difference between various utilities is important. Then the constant b is not needed. The constant a can be combined with the numerus of the logarithm. Then utility is

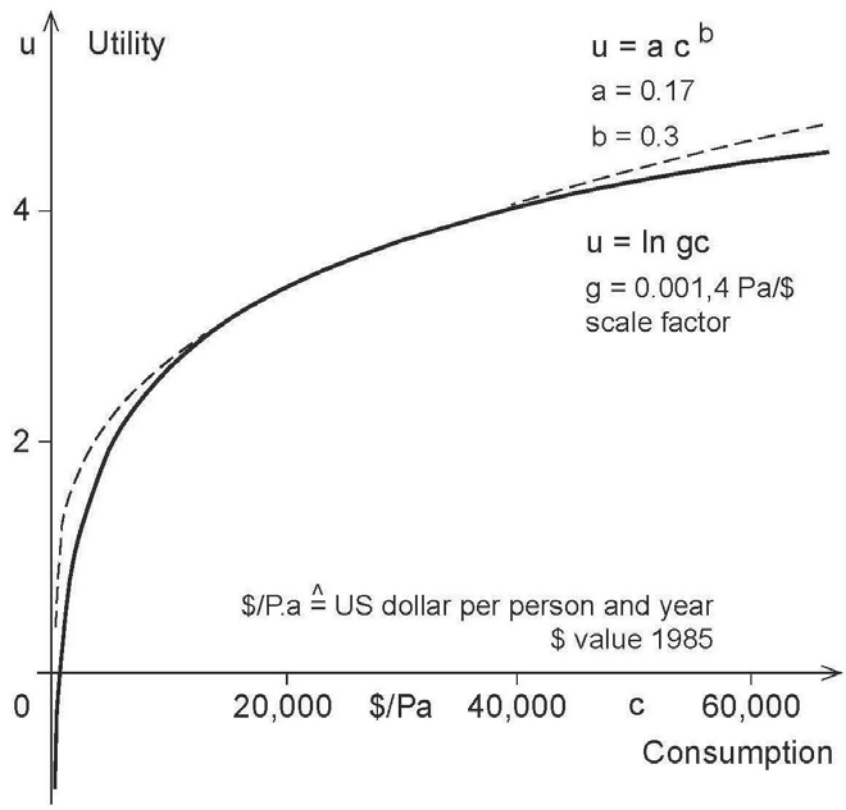
$$u = \ln gc \qquad (1)$$

where u is the average utility of a person at each moment of their active life time of a time period, c the consumption of the person in this period, expressed in money value, and g is a scale factor.

The scale factor can be chosen in any way. In this study, its size is determined in such a way that utility has its maximum with the desired working time of the earning working person and the selected currency. See below. Its dimension Pa/$ (person multiplied with year, divided by US-$) is the inverse value of the dimension of consumption $/Pa. The utility function is shown in figure 1, and also a power function, whose values are approximately the same in the range examined here.

Figure 1

Consumption and utility



3. Work and utility

In order to develop a utility function, if the means for the consumption are obtained through work, reference is made to the explanations of Seitz (1965) and Becker (1965), in which it is shown that the consumption of goods requires time, which is then not available for work. Other authors describe this using *a* Cobb-Douglas function, for example $u = \alpha \ln c + (1-a) \ln q$, where u is the utility, c the consumption, q the leisure time and α a parameter (for example Leuthold 1968 p. 314, Romer 2001 p. 177). But this term does not, among other things, express that the consumption mainly occurs during leisure time. In this article a function which considers this is derived from elemental relations. The leisure time which is used for the consumption of goods is not linked with these goods to new commodities, and leisure time is also not subdivided according to the nature of goods consumed. A differentiation is only made between working time and leisure time.

If one works in order to acquire means for consumption, this requires effort to an extent that reduces the utility. To consider this, the current utility during working time and leisure time are determined separately and then added to an entire utility. As postulated in 1916 by Gilbreth/Gilbreth (1919 p. 158) fatigue caused by work should be eliminated. According to the present general opinion in ergonomics, work should be organised in such a way that the degree of fatigue during working time after an initial rise remains constant (Rohmert/Rutenfranz (1983). Praktische Arbeitsphysiologie 1983 p. 87, 356) and that the fatigue totally disappeared after the next sleep (Rohmert/Rutenfranz 1983 p. 102). Here it is assumed that this is true in reality, and the additional fatigue caused by work is disregarded.

To be able to calculate the average utility from the utility during working time and leisure time, active life time is set as half of the calendar time, and it is assumed that the active life time of earning working persons consists exclusively of earning working time and leisure time, and that the average utility is the timely weighted arithmetical average of the utility in different time periods. That means that in life processes such as saturation by intake of food, satisfaction through having pleasant experience or fatigue caused by activity, in a wide field, ‘intensive and short lasting’ has the same effect as ‘weak and long lasting’. Contrary to utility as a function of consumption there is no degression in average utility as a function of the varyingly utility at different time periods.

Similarly, with intertemporal utility the future utilities in successsive time periods are discounted and added up to a total utility (for example Mas-Colell/Whinston/Green 1995 p. 733-734). Here the discount can be disregarded since the periods of working time and leisure time are short. An average utility can be determined by adding the current utility multiplied by the associated time periods together and dividing it by the total number of time periods. In health economics health conditions are similarly assessed in this way. The measure QALY (quality-adjusted life years) used by the World Health Organisation (WHO) and World Bank likewise does not include a discount. It is the product of the time period multiplied by an index for health quality or, if this index shows different values at different times, the sum of these products (Dolan 2000 p. 1731).

The average utility thus calculated increases with the utility during working time, with the wage rate, and up to a certain value with the working time. It does not reach its maximum value at the maximum working time but at a shorter time, the optimal working time. See figure 2. If the increased fatigue after longer working time were taken into account, the optimal working time would be even shorter. The decreasing utility at longer working times is the result of two contrary effects. With longer working times, income and consumption increase, but related to a shorter leisure time they increase even more than when related to the total active life time. However, utility increases underproportionally with consumption, and average utility increases less with increasing working time. With long working times the decrease of utility by taking the average dominates the increase of utility in leisure time by higher wage rate and shorter leisure time.

The optimal working time as a function of the wage rate is deduced as follows. As argued above the utility of a person during working time u_l *first of all depends on the working conditions in a certain occupation, not on the working time,*

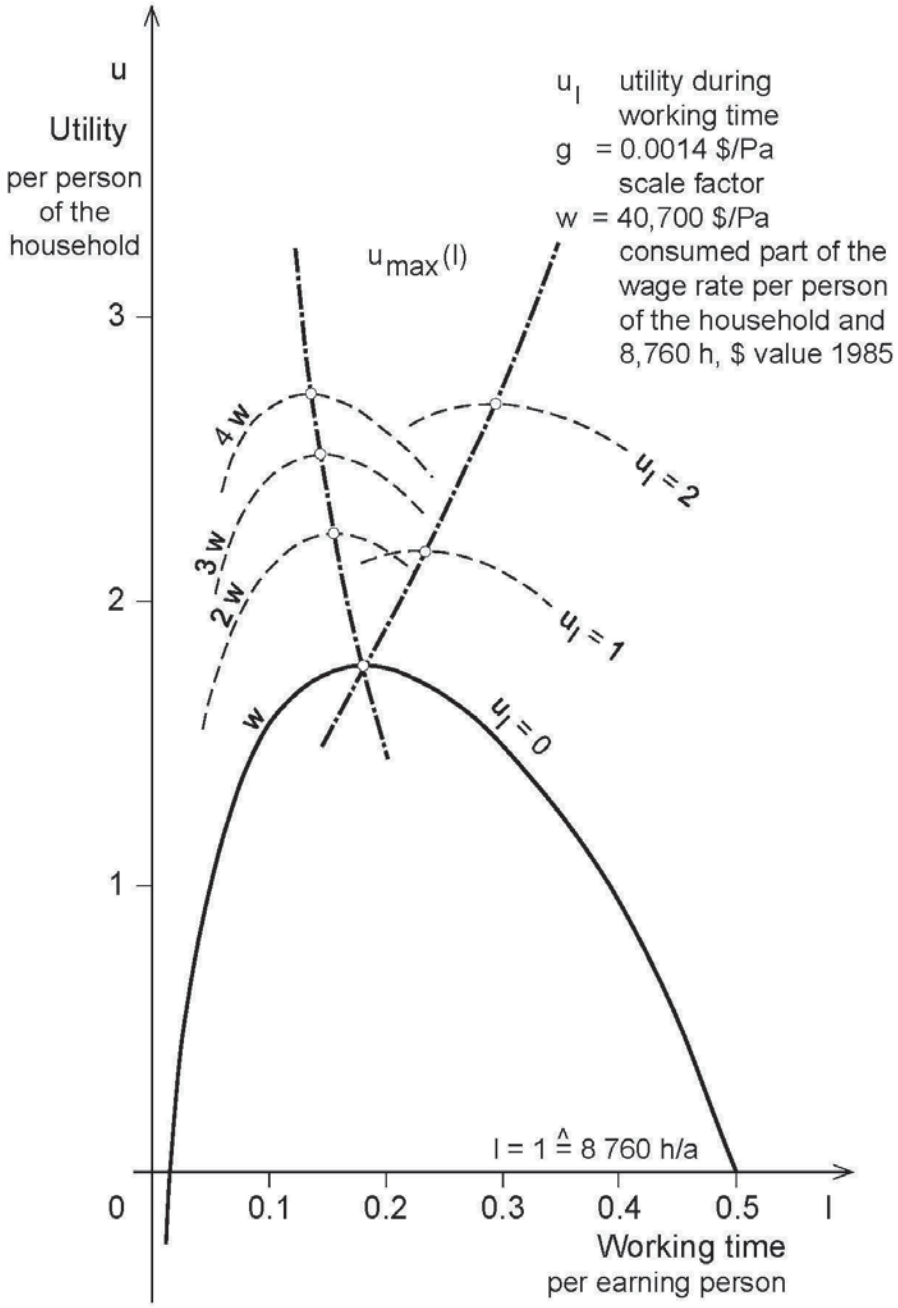


Figure 2
Utility in relation to working time

u_l *= f (occupation, working conditions, ...).* *(2)*

Utility during leisure time u_q *depends on the goods consumed (inclusive worn out) during this time, and hence also on the means expended for it, as shown in equation (1). The case that only work income is achieved is* *treated first. The disposable work income per person of the household and time period* y_w *is*

$$y_w = w_d l \quad (3)$$

with the disposable part of the wage or pay rate (less direct taxes and social contributions), per person of the household w_d *and the earning working time per earning person* l *. Here the working time is set as a proportion of the active life time, which is set as half of the calendar time, so the maximal working time is then 1/2. The time period is set as one year. So the wage (or pay) rate is the income from 8,760 working hours. The wage rate is used as an average per person of the household,*

$$w_d = w_{ge} t_w p_e \quad (4)$$

with the gross wage rate per employee in the household w_{ge}*, the reduction factor for direct taxes, social contributions, balance of transfers) for the wage rate* t_w *and the activity rate* p_e *(the share of earning working persons out of all persons). So the non-earning persons in the household are taken into account in the work income, but not in the paid working time. Consumption per person of the household and time period* c *is disposable work income* y_w *minus saving* s_w*, therefore*

$$c = y_w - s_w = w_d l - s_w = wl \,. \quad (5)$$

w *is the consumed part of the wage rate per person of the household. The active life time is half the calendar time, with earning persons it consists solely of working time* l *and leisure time* $q = 1/2 - l$ *, and they only consume during their leisure time. Therefore consumption related to leisure time is higher with the factor*

$$\frac{q+l}{q} = \frac{\frac{1}{2}}{\frac{1}{2}-l} = \frac{1}{1-2l}$$

than when related to working time plus leisure time. Utility of the earning persons during leisure time u_q *is with equation (1) and this factor*

$$u_q = \ln \frac{gc}{1-2l}. \quad (6)$$

After inserting the term for c from equation (5) results

$$u_q = \ln \frac{gw}{\frac{1}{l}-2}. \quad (7)$$

Utility for the earning person is determined as the timely weighted arithmetical average of utility during working and leisure time

$$u = \frac{u_l l + u_q\left(\frac{1}{2}-l\right)}{\frac{1}{2}}$$

or

$$u = 2lu_l + (1-2l)u_q. \quad (8)$$

After inserting the term for u_q *from equation (7) results*

$$u = 2lu_l + (1-2l)\ln \frac{gw}{\frac{1}{l}-2}. \quad (9)$$

The average utility u *increases thus with the utility during working time and with the wage rate. With constant wage rate and variable working time utility does not have its maximum at the maximal working time, but at a shorter time. See figure 2. Therefore this optimal working time is shorter than the maximal one. It results from the rules of extremes with*

$$\frac{\partial u}{\partial l} = \frac{1}{2l} + \ln\left(\frac{1}{l}-2\right) + u_l - \ln gw = 0 \quad (10)$$

set, and with

$$\frac{\partial^2 u}{\partial l^2} = -\frac{1}{2l^2(1-2l)} < 0 \qquad \text{for } 0 < l < \frac{1}{2} \quad (11)$$

from equation (10) to

$$\left(\frac{1}{l_*}-2\right)e^{\frac{1}{2l_*}} = \frac{gw}{e^{u_l}}.$$

Using l_* *instead of* l *is to express that this relation is valid only for the maximum of* u. $l_* = f(w)$ *can only be determined numerically with this* *relation. However, an explicit solution is obtained for the inverse function* $w = f_1(l_*)$

$$w = \frac{1}{g}\left(\frac{1}{l_*} - 2\right)e^{\frac{1}{2l_*}+u_l} . \qquad (12)$$

w *is the consumed part of the wage (or pay) rate per person of the household and time period,* g *a scale factor,* l_* *the optimal working time per earning person and* u_l *the utility during working time. Thus, the optimal working time is determined by the wage rate and utility during working time. The term* e^{u_l}/g *can be combined and then there is only one parameter in the equation.*

For utility during working time u_l*, which is not ascertained here, one can distinguish two extremes,* u_l *= 0 und* $u_l \geq u_q$*. In the first case, termed here functional work, no utility (in the sense of current well-being) during working time is achieved. Then the utility from equation (9) results in*

$$u_f = (1-2l)\ln\frac{gw}{\frac{1}{l}-2}$$

and the wage rate from equation (12) in

$$w_f = \frac{1}{g}\left(\frac{1}{l_0} - 2\right)e^{\frac{1}{2l_0}} .$$

With $u_l = 0$*, the wage rate with the factor* e^{-u_l} *is smaller than for* $u_l > 0$*, if the same working time should be optimal. Conversely, with the same wage rate, the optimal working time with* $u_l > 0$ *is longer than for* $u_l = 0$*, also see figure 2, and smaller for* $u_l < 0$*. In the second case, with* $u_l \geq u_q$*, referred to here ideal work, working time is at least as pleasant as the leisure time. Then the optimal working time is equal to the maximum,* l_{0i} *= 1/2.*

To calculate the optimal working time, the scale factor for utility g *is necessary. It is determined with equation (19) for West Germany in 1985 with following data. For the conversion of DM into US-$ for 1985 with an* *exchange rate of 2.94 DM / US-\$ and a purchasing power parity of 1.97 DM / US-\$ (Statistisches... 1988 p. 722) following the German scheme 1 DM = 0.5 US-\$ is used. The components of the income of the employee household are taken from the national accounts. See table 1.*

From this the factors for the indirect taxes and the social contributions related to the income are calculated. With that the disposable amounts of the components of the income result. The disposable current transfers received are determined from the disposable income minus the disposable amounts of the components of income. The number of persons in the employee household is 2.69 (Statistisches... 1994 Sep b p. 14). The number of employees per household is 1.62, calculated from the gross wage and salary per employee household and year of 28,600 \$/Ha (Statistisches... 1994 Sep a p. 5) divided by 17,700 $\$/P_ea$ *per employee and year (Statistisches... 1999), so the activity rate is 1.62 / 2.69 =0.60. The factual working time per employee is 1,580 h/a (Statistisches... 2003, Tafel 1.1.12) or* l *= 0.180. The average gross wage and salary rate is thus 11.20* $\$/P_ea$*, the average net wage and salary rate is about 7.73* $\$/P_ea$*. After removing the unemployed from the employee households (chapter 2 table 3) the number of persons per household is lower, their incomes are higher, and the current transfers received are lower. The saving ratio of the employee household is calculated to 12.1 % as the weighted average of all civil servant, white collar and blue collar employee households related to the income which can be spent, found out in the income and consumption random sample survey in 1983. The saving ratio of all two-person households with the average income which can be spent of 8,750 \$/Pa, adjusted for inflation to 8,370 \$/Pa in 1983, is 6.6 %. See section 5, figure 6. (The income which can be spent is approximately equal to the disposable income.) The saving ratio of the private households in 1983 was 10.8 % of the disposable income, in 1985 it was 11.4 %. From this the saving ratio of 10 % of the employee households with a disposable income of 8,750 \$/Pa in 1985 is estimated. Wages and salaries count as work income while industrialist income, property income and current transfers received count as non-work income. With saving it is assumed that it*

Table 1
Disposable income, consumption and scale factor for the utility
(Employees, West Germany 1985, 1 DM = 0.5 US-$)

*Persons per household (P) 2.69 2.54**

Item	*Amount ($/Pa)***	*Reduction factor (1)*	*Share disposable work income ($/Pa)***		*Share disp. non-work income ($/Pa)***	
Gross wage and salary income	*13,080*					
Gross wage and salary	*(10,630)*	*0.69*	*7,340*	*7,776**		
Employer's contribution	*(2,450)*					
Gross income from entrepreneurial activity without unwithdrawn profits	*470*	*0.85*			*390*	*413**
Gross property income less interests for capital credits	*430*	*0.85*			*370*	*394**
Current transfers received	*1,060*				*440*	*173**
Current transfers made	*-6,500*					
Social contributions	*(4,070)*					
Employee social contributions	*(1,620)*					
Disposable income without unwithdrawn profits	*8,540*	*8,756**		*7,776**		*980**
Saving	*(10 %)*	*-876**	*(5 %)*	*-438**	*(5 %)*	*-438**
Consumption				*7,338**		*542**
Working time l *(1)*	*0.18*					
Consumed part of the wage rate w *($/Pa)*	*40,700**					
Ratio of consumed non-work income to consumed part of the wage rate v/w *(1)*	*0.013**					
Optimal working time l_* *(1)*	*0.18*					
Scale factor for utility g *(Pa/$)*	*0.0014**					

**) Figures for the employee households after subtraction of the unemployed and their relatives*
***) $/Pa ≙ US-$ per person and year*

Sources: Statistisches... (1994 Sep a), Statistisches... (1994 Sep b), Statistisches... (1997) Tafel 2.4.2, Statistisches... (1984).

depends half on the work income, and half on the non-work income. With the working time it is assumed that in West Germany in 1985 the factual working time was 5 % longer than the optimal working time for the employee household. This is about half so much as results from the average for the desired working time from random surveys. See section 7, tables 2 and 3. With that the optimal working time is l_* = 0.172 or 1,505 h/a. Utility during working time is set to = 0. The other parameters according to equation (19) are w = 40,700 \$/Pa, v/w = 0.013, and thus , according to equation (19) g = 0.0014. If the scale factor is determined for the gross wage rate per employee and working hour w_{ge} = 11.20 $\$/P_e a$, the working time l_* = 1,505 h/a and the ratio of consumed non-work income to consumed part of the wage rate v/w = 0, so g_{ge} = 6.26 results. With this value the left curve of the gross wage and salary rate depending of the optimal working time for the employee $w_{ge}(l_*)$ is obtained. See section 8, figure 7.

The elasticity of the optimal working time related to the consumed part of the wage rate

$$\eta_{l_*w} = \frac{\partial l_*}{\partial w}\frac{w}{l_*}$$

can be determined by deriving the equation (12) and inserting the term for w

$$\frac{\partial l_*}{\partial w}\frac{w}{l_*} = \frac{1}{\frac{\partial w}{\partial l_*}}\frac{w}{l_*}, \qquad \frac{\partial w}{\partial l_*} = -\frac{w}{l_*}\left(\frac{1}{1-2l_*}+\frac{1}{2l_*}\right),$$

$$\eta_{l_*w} = -2l_*\left(1-2l_*\right). \qquad (13)$$

This function is drawn as a thick curve in figure 3. The elasticity does not depend on utility during working time and on wage rate, but only on the optimal working time. It is smaller than 0 and has a minimum of $\eta_{l_*w} = -1/4$ at $l_* = 1/4$ (= 2,180 hours per year).

In figure 2 further utility curves are drawn for different utilities during working time and for different wage rates, and their maxima are connected. The curve of maxima for different utilities during working time with a constant wage rate shows the optimal working time as a function of this utility. The curve of maxima for different wage rates with a constant utility during working time shows the optimal working time as a function of the wage rate. The optimal working time gets shorter with increasing wage rate. If in the diagram on the vertical axis instead of utility u the wage rate w is given, the curve of $w(l_*)$ instead of maximal $u(l_*)$ is slightly extended upwards. It is usually called the labour supply curve. This curve is drawn in section 8, figure 7, on the left. If the utility during working time u_l is constant (or rises only little or falls with rising wage rate), the curve inclines downwards to the right, bent concavely to the origin. It therefore confirms the negative sloping or 'backward-bending' labour supply curve.

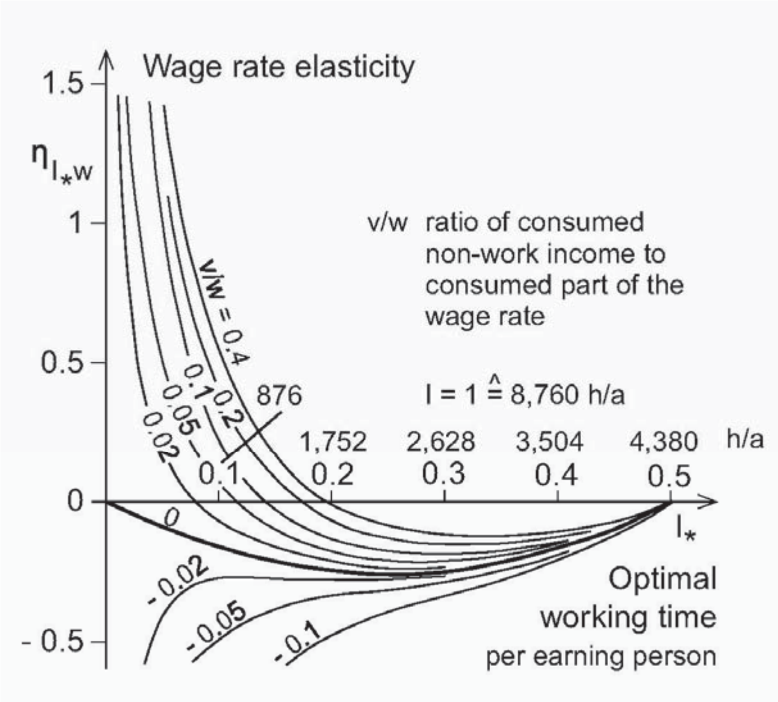


Figure 3
Wage rate elasticity of optimal working time

This has already been a well-known theory in mercantilism and a common argument for a low-wage policy (Ekelund/Hebert 1975 p. 38-39). With general considerations Pigou (1920 p. 593) and Knight (1921 p. 117) came to the conclusion that with an increasing wage rate the offered working time becomes shorter, because the utility increases degressively with a rising income. Pigou (1920 p. 593) thought about how an income tax influences the working time: „Since a part of his income is taken away, the last unit of income that is left to him will be more urgently than the last unit of income that would have been left to him if there had been no taxation. But the last unit of energy that he devotes to work will not affect him differently from what it did. Consequently, there will be a tendency for him to work a little harder ... than he would have done otherwise.” Knight (1921 p. 117) states: ”... they will at a higher rate divide their time between wage-earning and non-industrial uses in such a way as to earn more money, indeed, but to work fewer hours.” This opinion is also confirmed by the following consideration. If the shopping basket and leisure time are normal goods (demand increases with income), the demand for both of them increases with rising income, thus the supply of paid work decreases (Wagner... 1997 p. 15). Because if the wage rate increases, and leisure time increases however so little that the wage rate increases much more, there is a stronger demand for normal goods, including leisure time.

In animal experiments from different authors “labour supply curves” with a positive gradient with low “wage rates” and with a negative gradient with high wage rates or with negative gradient over the whole range were found (Battalio... 1981 p. 622, 623, 628 table 3). For example in the case of pigeons, which had to peck corn, it was also possible to separate the income and substitution effect. In the range with negative gradient of the labour supply curve with increasing wage rate the income effect and the substitution effect in absolute values decreased, and the substitution effect declined stronger in relation to the income effect. (Battalio... 1981 p. 629).

With the relations of the elasticity of the optimal working time related to the consumed part of the wage rate values of -0.21 to -0.25 result, if the utility during working time is zero and working times per employee are 0.15 to 0.24 (1,300 to 2,100 h/a). The wage rate increases 4 to 5 times as much as the working time falls. The wage rate elasticity of the optimal working time is comparable to the uncompensated wage rate elasticity of the supply of working time. Many very different values were found in the numerous available empirical studies. Most values for men lie in the range between -0.27 and 0.14 with an accumulation around -0.08, for women from -0.17 to 2.4 with an average approximately of 0.2 (Killingsworth 1983). Pindyck/Rubinfeld state the elasticities from studies for several types of households as being from -0.11 to 0.03 for men and from -0.09 to 0.11 for women (2009 p. 533-534). The higher values, which are in contrast to the results deducted here, may result from the fact that the surveys mostly refer to households with a low income. Then, as shown in the following section 4, the wage rate elasticity of the optimal working time increases with shorter working time and additional non-work income. However, the deducted values above can be confirmed well from the secular development of economy; since 1850 the wage rate has increased 4 to 5 times as much as the working time has fallen. See section 8, figure 7.

4. Non-work income

If besides work income another income is obtained or the income is not consumed completely, consumption and utility change. As non-work income the disposable income from entrepreneurship and capital, transfers, dissaving and borrowing is calculated, if it is obtained independently from working time. Consumption is calculated as work income plus non-work income minus saving. A direct utility of saving is not mentioned here. The course of utility over working time is shown in figure 4 for different (consumed parts of the) wage rates and non-work incomes. If, for example, the consumed non-work income is 5 % of the consumed wage income with maximum working time, this is 25 % of the consumed work income with a working time per employee of 0.2 (1,750 h/a). If the consumed non-work income is zero, the utility and the optimal working time are the same as in section 3, figure 2. If it is higher, the optimal working time is shorter, and from a certain amount upwards it is zero. In this case a higher utility is obtained, if the whole active life time is used for consumption instead of additionally working for money.

The wage rate as a function of the optimal working time is deduced as follows. If non-work income is obtained, consumption per person and time period is