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On the Welfare Costs of Business Fluctuations in Sweden 1970 - 2007

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1. Introduction

The phenomenon of business fluctuations seems to be an inherent property of all market economies. The incomes, the consumption, the number of employed people and the number of hours worked, are relatively volatile in the short run. The business cycle attracts a lot of attention in the public debate, and statistics on unemployment, production, inflation etc. are continuously published, providing a measure of current state of the business cycle.

Dampening of the business fluctuations is usually considered as one of the most important areas of economic policy.

The well-being of people, and their utility in the economics sense, is quite likely higher during economic booms, when unemployment is low and incomes are high, and lower during recessions. Stabilisation policy aims to bring the economy to a state in between boom and recession – a state in between high and low utility. What is the argument for such a policy?

If the welfare losses of recessions are higher than the welfare gains of booms, business fluctuations imply a welfare loss on average. This would constitute an argument in favour of stabilisation policy. In the case of a utility function depending only on consumption, such an asymmetric phenomenon occurs if the individual is risk averse, which most basic books in microeconomics explain. But as we will see, a stabilised business cycle implies a welfare gain also in a more general model, including both consumption and working hours.

From a welfare-theoretical perspective, the perhaps most reasonable business cycle measure is given by the willingness to pay for a complete business cycle elimination. This is the starting point of this paper.

The primary aim of the paper is to study welfare effects in Sweden. The 1990's is of particular interest, since Sweden experienced huge economic problems during this period.

I analyse models for calculating the welfare costs of business cycles proposed by Lucas (1987) and Galí et al. (2007). I apply these models on Swedish quarterly data for the period 1970 - 2007. I calculate not only average welfare effects, but also welfare effects of individual booms and recessions.

I find small welfare effects on average. The simple calculation based on Lucas' (1987) model yields 0.01 percent of consumption, whereas the calculations based on Galís' et al. (2007) model yield between 0.02 and 0.20 percent of consumption, depending on the choice of parameter values and detrendings. However, the effect of individual booms and recessions might be large. In some of my model variations, I find a welfare cost of about 10 percent of yearly consumption for the recession of the 1990s. On the other hand, two of my model variations only give a cost of 2 percent of yearly consumption for the same recession.

I only study utility functions of private consumption and working hours, although other presumably important factors vary over the business cycle as well, for instance inflation and public consumption. Furthermore, throughout this paper I assume that society consists of one representative individual. Under some assumptions, however, the results also apply to a world with many individuals. Finally, the models I study do not take into account the fact that the trend of, for example, GDP might be affected by the choice of stabilisation policy.

A short plan of the paper is as follows. Section 2 describes a couple of models for calculating the welfare cost of business fluctuations. First, I describe Lucas' (1987) model, which only considers fluctuations in consumption. Then, I make a few comments on the interpretation of the welfare loss. Thereafter, working hours are introduced in the utility function. After an introducing example, Galís et al. (2007) model is presented. I suggest some alternative choices of parameter values and detrendings. A welfare measure based on the gap between marginal product and marginal rate of substitution is derived. I also discuss the recession of the 1990s and propose another version of the model, which assumes that the economy underwent a permanent shift during the 1990s. A short discussion of some other models that have been proposed for calculating the cost of business cycles concludes section 2.

Section 3 presents the data material which I use in my calculations. The result is presented, illustrated and commented in section 4. In section 5, I make some concluding comments on the result and policy implications.

2. Models

2.1 Lucas' model

Lucas' (1987) is one of the simplest possible models for calculating the welfare cost of business fluctuations. Lucas (1987) applies his model on US data for the post-war period and finds that the welfare gain from eliminating consumption variability is negligible. In this model, society is assumed to consist of one representative individual, whose utility only depends on consumption.¹ The individual maximises expected utility. I follow Romer (2001) and present a slightly simplified version of the model, which mainly differs from Lucas' (1987) in assuming that the (expected) utility function only depends on *current* consumption. In Lucas (1987) utility is a discounted sum of (an infinitely long) lifetime consumption. The simplified utility function is given by

$$EU = E\left[\frac{C^{1-\sigma} - 1}{1-\sigma}\right], \sigma > 0, \quad (2.1)$$

where C denotes consumption. The utility function implies that the individual has a constant relative risk aversion equal to σ . For $\sigma = 1$, it can be shown that

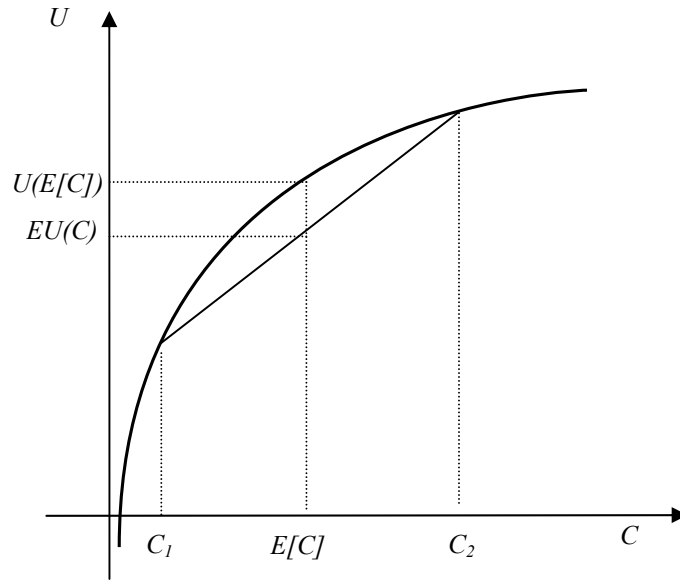
$$EU = E[\ln(C)]. \quad (2.2)$$

Figure 2.1 shows the utility function. Since the curve is concave, the utility of expected consumption is higher than the expected utility of consumption. This implies an asymmetrical phenomenon: eliminating consumption fluctuations, in letting consumption equal $E[C]$ for all outcomes instead of fluctuate between C_1 and C_2 , increases expected utility.

A second-order Taylor approximation of the expected utility function gives

¹ Or of several individuals with identical utility functions and a perfect insurance market against individual risk.

Figure 2.1: A concave utility function



$$EU = E\left[\frac{C^{1-\sigma} - 1}{1-\sigma}\right] \approx \frac{\bar{C}^{1-\sigma} - 1}{1-\sigma} - \frac{\sigma}{2} \bar{C}^{-\sigma-1} Var[C], \quad (2.3)$$

where $Var[C]$ denotes the variance of consumption and \bar{C} denotes the expected value of C. Elimination of consumption fluctuations implies letting the variance of consumption equal zero. As can be seen from the above expression, this increases expected utility by

$$\frac{\sigma}{2} \bar{C}^{-\sigma-1} Var[C] \quad (2.4)$$

Marginal utility with respect to consumption equals $\bar{C}^{-\sigma}$ for consumption equal to \bar{C} . An approximate measure of the gain from elimination of consumption fluctuations, expressed in terms of consumption units, is obtained by dividing the utility in 2.4 by the marginal utility with respect to consumption. This gives

$$\frac{\sigma}{2} \bar{C}^{-\sigma-1} Var[C] / \bar{C}^{-\sigma} = \frac{\sigma}{2} \bar{C}^{-1} Var[C], \quad (2.5)$$

which, as a share of average consumption, equals

$$\frac{\sigma}{2} \bar{C}^{-1} Var(C) / \bar{C} = \frac{\sigma}{2} Var\left[\frac{C}{\bar{C}}\right]. \quad (2.6)$$

This is a measure of the average welfare loss caused by business fluctuations. Since it is expressed in consumption units, it can be interpreted as willingness to pay for elimination of the fluctuations. Lucas (1987) argues that a reasonable choice of σ is 1. Note that for this choice of σ , expression 2.4 and 2.6 are identical because marginal utility with respect to consumption and consumption cancel out each other.

In order to estimate the variance in expression 2.6, we can, as suggested by Lucas (1987) apply an H-P filter on (the logarithm of) aggregate consumption to determine the trend value of consumption at every time point. We then set this trend value equal to the expected value, \bar{C}_t , at every time point. Furthermore, we assume that the variance in expression 2.6 is constant over time. The variance is estimated by the OLS method.

2.2 The interpretation of the welfare loss

Let me, before continuing, point out the interpretation of the welfare loss. The welfare loss should *not* be seen as the amount of money worth spending on stabilisation policy measures, but as an indicator of how large a *net cost* is worth to be spent in order to eliminate business fluctuations entirely. Elimination of the variability in consumption is of course always motivated, if it can be done without a net cost, given that the individual is risk averse. This can be seen in figure 2.1. If it is possible to decrease consumption during good years, and increase consumption during bad years by the very same amount, so that we constantly consume $E[C]$, a utility gain is achieved. To achieve this, however, large-scale stabilisation policy measures might be necessary. These measures can lead to net losses such as decision costs, distortions, and waste of resources, so that \bar{C} is affected.

Also note that the welfare loss indicates the difference in utility between status quo and a perfectly eliminated business cycle. Thus, it does not, for instance, say anything about the difference in utility between status quo and a world in where *less* stabilisation policy measures are taken.

2.3 A model with consumption and leisure/working hours, introduction

The perhaps most natural generalisation of Lucas' (1987) model is to include leisure (or working hours) in the utility function. This generalisation constitutes the core of this paper, and this section gives a first introduction.

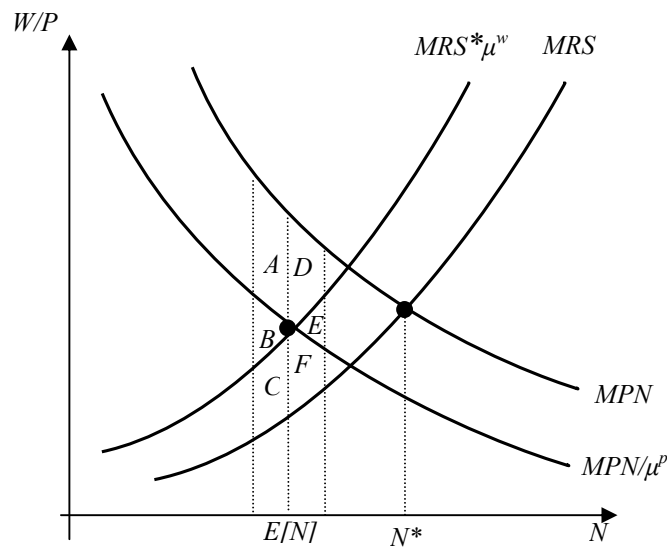
In this model, the individual chooses an optimal bundle of consumption and leisure, which is reasonably an interior bundle (that is, the individual chooses to work, but does not work the whole day). First, assume that in the long run there are no market failures, so that production and consumption during the “normal” state of the business cycle assumes their optimal values. This implies, per definition, a utility loss from business cycles, since business cycles imply a departure from optimum. However, this does not seem to be very realistic, since it suggests that economic booms are associated with a utility loss.

There are good reasons to believe that, as a result of rigidities in the goods- and labour markets, production (and employment) is always on an inefficiently low level so that welfare is increasing in production (and thus in consumption and working hours).² From this follows, as I will now illustrate, yet again an asymmetrical effect – but of a quite different sort than that of Lucas' model – which generates a utility loss on average. I assume that society consists of a representative individual who consumes the entire output. Utility does only depend on consumption and working hours. Figure 2.2 illustrates the marginal rate of substitution between working hours and real wage, MRS, and the marginal product of labour, MPN. The intersection of these curves constitutes a social optimum. In the figure, N denotes working hours, whereas W/P denotes real wage. In social optimum, $N = N^*$.

As a result of rigidities in the goods market, e.g. imperfect competition and taxes, we assume that labour demand is not given by MPN, but by MPN/μ^P , $\mu^P > 1$, where μ^P denotes the price markup. In a similar manner we assume that labour supply as a result of rigidities in the labour market, e.g. monopolistic labour unions and taxes, but also search frictions, is not

2 Although such rigidities exist and are of great importance, which is today quite generally accepted, it is not clear whether production is inefficiently low. One could think of several types of external effects, which may actually lead to an inefficiently high level of production.

Figure 2.2: The welfare effects of fluctuations in the quasilinear case



given by MRS, but by $MRS * \mu^W$, $\mu^W > 1$, where μ^W denotes the wage markup. The economy ends up in the intersection between MPN/μ^P and $MRS * \mu^W$.

First, assume that the individual exhibits quasilinear preferences, i.e.

$$U(Y, N) = Y - f(N) = \Pi + \frac{W}{P} N - f(N), \quad (2.7)$$

where Π denotes economic profit. This implies that her utility can be exactly expressed as the total surplus, i.e. the area between the MRS- and the MPN-curves (see, for instance, Varian, 2006, p. 391 for the interpretation of producer's surplus, and p. 248-253 for the interpretation of consumer's surplus). I suppose that the markups fluctuate around some steady-state level, and that this causes the number of working hours to fluctuate symmetrically around the inefficiently low level $E[N]$ in figure 2.³ Now follows an important observation. The utility gain, $D + E + F$ in figure 2.2, during a boom (i.e. when the number of worked hours is high), is smaller than the utility loss, $A + B + C$, during a recession (i.e. when the number of worked hours is low). Hence, fluctuations imply a welfare loss on average.

³ The fluctuations may, for instance, arise if wage setters over- or underestimate inflation. If inflation is overestimated, real wage rises and the number of working hours decreases since $MRS * \mu^W$ moves upwards. If inflation on the other hand is underestimated, the opposite takes place.

2.4 Galí's et al. model

Quasilinear preferences are only reasonable when income effects are negligible. In this section, therefore, a more general utility function is considered. A measure of the welfare effect of the business cycle, with the gap between MRS and MPN as the only independent variable, will be derived. The underlying assumption is that fluctuation of this gap is the driving force behind the business cycle. The model was proposed by Galí, Gertler and López-Salido (2007).

It is assumed that society consists of a representative individual with the following utility function,⁴

$$U_t(C_t, N_t) = \frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\varphi} N_t^{1+\varphi} \bar{\Xi}_t \quad (2.8)$$

where C denotes consumption, N the number of working hours, and a varying $\bar{\Xi}_t$ allows the preferences to vary over time. This preference shifter, however, should not be strictly interpreted, but can also reflect institutional changes.

Society's production function is assumed to take the form

$$Y_t = F(K_t) N_t^\alpha, \quad (2.9)$$

where K denotes capital. From the utility function follows the marginal rate of substitution (in logarithm form),

$$mrs \equiv \ln(MRS) = \ln\left(-\frac{\delta U_t(C_t, N_t) / \delta N_t}{\delta U_t(C_t, N_t) / \delta C_t}\right) = \ln\left(-\frac{N_t^\varphi \bar{\Xi}_t}{C_t^\alpha}\right) = \varphi n_t + \sigma c_t - \bar{\xi}_t, \quad (2.10)$$

4 As appendix 1 shows, this utility function can under certain assumptions arise also in a model with many individuals, where every individual either works a fixed number of hours, or does not work at all.

where I define $-\ln(\bar{\Xi}_t) \equiv \bar{\xi}_t$; n_t and c_t denote the logarithm values of N_t and C_t . Throughout this paper lower-case letters denote logarithms of the corresponding upper-case letter variable.

The production function gives the marginal product of labour (in logarithm form) as follows.

$$mpn \equiv \ln(MRS) = \ln\left(\frac{\delta Y_t}{\delta N_t}\right) = \ln\left(\alpha \frac{Y_t}{N_t}\right) = \ln\alpha + y_t - n_t = \text{constant} + y_t - n_t \quad (2.11)$$

Furthermore, the inefficiency gap, the price markup, and the wage markup are defined as follows.

$$gap_t \equiv mrs_t - mpn_t, \quad (2.12)$$

$$\mu_t^p \equiv p_t - (w_t - mpn_t), \quad (2.13)$$

$$\mu_t^w \equiv (w_t - p_t) - mrs_t. \quad (2.14)$$

Note the order in which the difference between mrs_t and mpn_t is written. The gap is negative when production is below optimum. The price markup indicates the difference between price and marginal cost, or equivalently, as can easily be shown, the difference between marginal product and real wage. Correspondingly, the wage markup is defined as the difference between marginal product and wage. When I estimate the preference shifter, $\bar{\xi}_t$, I will use the fact that the wage markup can be expressed as

$$\mu_t^w = (w_t - p_t) - mrs_t = (w_t - p_t) - (\varphi n_t + \sigma c_t - \bar{\xi}_t) = (w_t - p_t) - (\varphi n_t + \sigma c_t) + \bar{\xi}_t. \quad (2.15)$$

I now discuss the choice of the parameter values φ and σ . The parameter φ is given by the inverse of the Frisch wage elasticity of labour supply, which in the micro literature has been estimated to fall in the interval between 0.05 and 0.5, but is probably not higher than 0.2 according to Card (1994). In the macro literature, on the other hand, values of unity and higher are used, in order to achieve balanced growth paths.⁵ I follow Galí et al. (2007) and use 1, i.e. $\varphi = 1$, as my baseline case, but I also study 0.2, i.e. $\varphi = 5$, to get an idea of to what

⁵ According to Guirio and Noual (2006), adjustments along the extensive margin, i.e. changes in the employment rate rather than changes in hours per worker, can probably explain the discrepancy between microeconomic estimates and macroeconomic parameters.

extent changes in parameter values change the result.

In a similar way, there is a controversy between the macro and micro literature over the value of σ . I choose to use $\sigma = 1$, which has been suggested by Lucas (1987), as mentioned earlier, among other. See, for instance, Galí et al. (2007) for a further discussion on the choice of these parameters.

I now discuss the estimation of the preference shifter, $\bar{\xi}_t$. Define

$$\tilde{\mu}_t^w \equiv (w_t - p_t) - (\varphi n_t + \sigma c_t). \quad (2.16)$$

This implies that the wage markup can be written as

$$\mu_t^w = \tilde{\mu}_t^w + \bar{\xi}_t. \quad (2.17)$$

Suppose, as in Galí et al. (2007), that the left hand side of 2.17, i.e. the wage markup, in the long run, i.e. in steady state, equals a constant, k . Then we can estimate $\bar{\xi}_t$ as (minus) some smoothed, or trend, version of $\tilde{\mu}_t^w$. This estimation, of course, only holds up to the additive constant, k . When calculating the wage markup minus its steady state, this does not matter, however, since the same additive constant is included in the wage markup as in the steady-state wage markup, and they therefore cancel out. The difference between the wage markup and its steady state is given by

$$\mu_t^w - \mu_{ss}^w = (w_t - p_t) - (\varphi n_t + \sigma c_t) + \hat{\xi}_t + k - k = (w_t - p_t) - (\varphi n_t + \sigma c_t) + \hat{\xi}_t, \quad (2.18)$$

where $\hat{\xi}_t$ denotes (minus) the estimated trend of $\tilde{\mu}_t^w \equiv (w_t - p_t) - (\varphi n_t + \sigma c_t)$ and "ss" denotes "steady state".

However, the gap needs not be constant in the long run. Increased (decreased) competition, lower (higher) taxes or more (less) centralised wage negotiations are some of the factors that can lead to a smaller (larger) gap. The estimation of the preference shifter also reflects possible changes in the steady-state wage markup. Of course, the deviation of the wage

markup from its steady state is given by

$$\mu_t^w - \mu_{ss}^w = (w_t - p_t) - (\varphi n_t + \sigma c_t) + \bar{\xi}_t - \mu_{ss}^w, \quad (2.19)$$

which in the long run cycles around zero, i.e. in the long run, $(w_t - p_t) - (\varphi n_t + \sigma c_t)$ equals minus $\bar{\xi}_t - \mu_{ss}^w$. Therefore, an estimation of the preference shifter will, by definition, reflect $\bar{\xi}_t - \mu_{ss}^w$. That is, an estimation of the deviation of the wage markup from its steady state is given by

$$\mu_t^w - \mu_{ss}^w = (w_t - p_t) - (\varphi n_t + \sigma c_t) + \hat{\xi}_t. \quad (2.20)$$

But since this is the same formula as in expression 2.18, we do not end up in any trouble when calculating the difference between the wage markup and its steady state.

I use two different techniques for estimating the “preference shifter”. First, following Galí et al. (2007), I use a third degree polynomial. Secondly, I use an H-P filter with $\lambda = 1600$ to obtain a smoothed version of $\tilde{\mu}_t$.⁶

The gap can be expressed as the (negative) sum of the markups,

$$gap_t = mrs_t - mpn_t = -([mpn_t - (w_t - p_t)] - [mrs_t - (w_t - p_t)]) = -(\mu_t^p + \mu_t^w). \quad (2.21)$$

This is the expression I will use when calculating the gap.

I investigate three alternatives for the price markup. First, in line with Galí et al. (2007), I assume that the price markup fluctuates around some constant value. Secondly, I assume that it fluctuates around a third degree trend; thirdly, that it fluctuates around an H-P trend with $\lambda = 1600$. (My detrendings will also reflect possible trend variations in workers' share of the production, α .)

6 It is customary to choose $\lambda = 1600$ when estimating a trend of, for instance, GDP (given that we are dealing with quarterly data). Preferences shifting in such a high-frequency way is perhaps a more bold assumption.

I also consider a model variation in which I assume that the economy underwent some permanent and sudden shift during the 1990s. This model variation will be discussed in section 2.7.

2.4.1 A welfare measure based on the inefficiency gap

I now make a second order Taylor approximation of the deviation of the utility function from its steady state,⁷

$$\begin{aligned}
\Delta_t &\equiv U_t(C_t, N_t) - U_t(\bar{C}_t, \bar{N}_t) \approx \\
&\approx \bar{U}'_{C_t} * (C_t - \bar{C}_t) + \bar{U}'_{N_t} * (N_t - \bar{N}_t) + \\
&+ \frac{1}{2} \left(\bar{U}''_{C_t C_t} * (C_t - \bar{C}_t)^2 + \bar{U}''_{N_t N_t} * (N_t - \bar{N}_t)^2 + 2 * \bar{U}''_{C_t N_t} * (C_t - \bar{C}_t) * (N_t - \bar{N}_t) \right) \approx \\
&\bar{U}'_{C_t} \bar{C}_t \left(\tilde{c}_t - \frac{1}{2} \sigma \tilde{c}_t^2 \right) + \bar{U}'_{N_t} \bar{N}_t \left(\tilde{n}_t + \frac{1}{2} \phi \tilde{n}_t^2 \right),
\end{aligned} \tag{2.22}$$

where I use the definition of the utility function, \bar{X}_t denotes the steady-state value of X_t , and

$$\tilde{x} \equiv \ln\left(\frac{X_t}{\bar{X}_t}\right) \approx \frac{X_t - \bar{X}_t}{\bar{X}_t}.$$

Expressed as a share of steady-state consumption, this utility difference becomes

$$\frac{\Delta_t}{\bar{U}'_{C_t} \bar{C}_t} = \left(\tilde{c}_t - \frac{1}{2} \sigma \tilde{c}_t^2 \right) + \frac{\bar{U}'_{N_t} \bar{N}_t}{\bar{U}'_{C_t} \bar{C}_t} \left(\tilde{n}_t + \frac{1}{2} \phi \tilde{n}_t^2 \right), \tag{2.23}$$

where I divided by *marginal* utility to get a measure of the willingness to pay.

In order to obtain a welfare loss that is a function of only the gap, I assume, in line with Galí

⁷ My result differs somewhat from Galí et al. (2007), whom seem to have made some mistake.

Their Taylor approximation reads $\bar{U}'_{C_t} \bar{C}_t \left(\tilde{c}_t + \frac{1-\sigma}{2} \tilde{c}_t^2 \right) + \bar{U}'_{N_t} \bar{N}_t \left(\tilde{n}_t + \frac{1+\phi}{2} \tilde{n}_t^2 \right)$.

et al. (2007) that the entire output is consumed. From this follows that $\tilde{c}_t = \tilde{y}_t$. Furthermore, the capital stock is assumed to be constant and the utilisation of the capital stock is proportional to the number of working hours, which is not an unreasonable assumption in the short run. From this, and the production function 2.8, follows $\tilde{y}_t = \tilde{n}_t$.⁸ From the definitions of MRS and MPN now follows

$$-\frac{\bar{U}_{N_t} \bar{N}_t}{\bar{U}'_{C_t} \bar{C}_t} = \frac{\bar{MRS}_t}{\bar{MPN}_t} = e^{-\mu} \equiv 1 - \Phi, \quad (2.24)$$

where Φ is defined by the expression. In Galí et al. (2007), the inefficiency gap is assumed to fluctuate around some constant value, $-\mu$, which Galí et al. (2007) set equal to -0.5 . For the sake of simplicity, I also choose this constant value – even in the model variations where I assume that the steady-state gap is not constant. Since the uncertainty in my results is large anyway, this should not be of critical importance. The value, 0.5 , that was assigned to μ , implies that $\Phi \approx 0.4$.

Thanks to the assumptions of proportionality between production, consumption and working hours, and equation 2.24, equation 2.23 can now be expressed as

$$\frac{A_t}{\bar{U}'_{C_t} \bar{C}_t} = \Phi \tilde{y}_t - \frac{\tilde{y}_t^2}{2} (\sigma + (1 - \Phi)\varphi). \quad (2.25)$$

Furthermore, since the gap can be expressed as the negative sum of the markups and therefore as $(\varphi n_t + \sigma c_t - \bar{\xi}_t) - (\alpha + y_t - n_t)$, the same assumptions give

$$g\hat{a}p_t = (\sigma + \varphi)\tilde{y}_t \quad (2.26)$$

where $g\hat{a}p_t$ denotes the difference between the gap and the steady-state gap. Let ω denote the utility deviation expressed in consumption units. Inserting 2.26 in 2.25 gives

⁸ Assuming a Cobb-Douglas production function, we get $Y = (kN)^{1-\alpha} N^\alpha = k^{1-\alpha} N$, i.e GDP is proportional to working hours.

$$\frac{\Delta_t}{\bar{U}'_{C_t} \bar{C}_t} = \frac{1}{\sigma + \varphi} \left(\Phi g\hat{p}_t - \frac{1}{2} \left(1 - \frac{\Phi\varphi}{\sigma + \varphi} \right) g\hat{p}_t^2 \right) \equiv \omega(g\hat{p}_t). \quad (2.27)$$

Note that the welfare measure that has hereby been derived includes welfare effects of first and second order. Given that production is lower than optimal, the parameter Φ is positive, and hence the first order welfare effect is positive with respect to the gap. The second order welfare effect, on the other hand, is negative for all reasonable parameter values.

Assume that the individual maximises expected utility. The expected utility is given by

$$E[U_t(C_t, N_t)] = E[\bar{U}_t + \Delta_t] \approx \bar{U}_t + E \left[\bar{U}'_{C_t} \bar{C}_t \frac{1}{\sigma + \varphi} \left(\Phi g\hat{p}_t - \frac{1}{2} \left(1 - \frac{\Phi\varphi}{\sigma + \varphi} \right) g\hat{p}_t^2 \right) \right], \quad (2.28)$$

where I use the definition of Δ_t and expression 2.27. $g\hat{p}_t$ is, by assumption, on average zero and therefore the expected value of $g\hat{p}_t^2$ becomes a variance. Elimination of the business cycle is the same as elimination of this variance. Expressed as a share of steady-state consumption, such an elimination implies that expected utility increases by

$$\frac{1}{2(\sigma + \varphi)} \left(1 - \frac{\Phi\varphi}{\sigma + \varphi} \right) Var(g\hat{p}), \quad (2.29)$$

where $Var(g\hat{p})$ denotes the variance of the gap. This expression can be thought of as the long-run willingness to pay for a complete elimination of the business cycle, and can thus be compared to expression 2.6 in Lucas' model.

2.5 A comparison between Lucas' and Galí's et al. models

Lucas' (1987) model can in principle be seen as a special case of the above model, with $N = 0$. Since the number of working hours and consumption tend to move in the same direction over the business cycle, and the utility function is decreasing with respect to working hours and increasing with respect to consumption, these two effects should counteract each other, and the welfare effects are hence smaller, i.e. closer to zero, in Galí's et al. (2007) model than in Lucas' (1987). However, if the variability in working hours is much larger than the variability

in consumption, we reach the opposite conclusion.

When deriving the welfare loss as a function of the inefficiency gap, we assumed that GDP, the number of working hours, and private consumption move in the same pace over the business cycle. If these assumptions are too unrealistic, the result gets distorted. It should also be of great importance which types of (possible) detrendings one chooses to use. Low frequency steady-state shifts imply large business cycle effects, whereas high frequency steady-state shifts imply small business cycle effects.

Also note that the model of Galí et al. (2007) only considers welfare deviations from steady state. This implies that the welfare losses may be underestimated. For suppose, for instance, that the gap were constantly equal to zero and business fluctuations were generated by a fluctuating marginal productivity of labour. Since the gap never deviates from its steady state, the welfare loss is zero according to the model. But an expected utility loss would nevertheless occur since marginal utility is declining with respect to consumption and leisure (see Galí et al., 2007, p. 54).

Smoothing of the fluctuations of the gap implies (if no efficient fluctuations, such as fluctuations in the marginal productivity of labour, take place) smoothing of consumption as well as working hours. Consider now the utility function given by Galí et al. (2007), i.e. expression 2.7. In the same manner as in Lucas (1987), smoothing of the consumption fluctuations implies a utility gain since utility is a concave function of consumption. But we now also have to consider working hours. Smoothing of the number of working hours implies that $N^{1+\varphi}/(1+\varphi)$ decreases since this expression is a convex function of N. But since $N^{1+\varphi}/(1+\varphi)$ is a *negative* term in the utility function 2.8, utility increases. Hence, smoothing the business fluctuations should imply a larger *average* welfare gain in Galí's et al. (2007) than in Lucas' (2007). Formally, taking expected value of expression 2.23 gives

$$E\left[\frac{\Delta_t}{\bar{U}'_{C_t} \bar{C}_t}\right] = -\frac{\sigma}{2} Var\left[\frac{C}{\bar{C}}\right] + \frac{\varphi}{2} \frac{\bar{U}'_{N_t} \bar{N}_t}{\bar{U}'_{C_t} \bar{C}_t} Var\left[\frac{N}{\bar{N}}\right]. \quad (2.30)$$

The first term is negative and is the same as in expression 2.6, i.e. in Lucas' (1987) model.

The second term is also negative since $(\bar{U}'_{N_t} \bar{N}_t)/(\bar{U}'_{C_t} \bar{C}_t)$ is negative. Hence, average costs are larger in Galí's et al. (2007) model than in Lucas' (1987).

2.6 The recession of the 1990s

Since the recession of the 1990s was an extraordinary severe crisis for the Swedish economy and labour market, it deserves a separate discussion. There has been a lot of discussion regarding the sources of the crisis, and on the seemingly permanently increased unemployment rate (see figure 3.1g). Before the crisis, unemployment fluctuated around 2 percent whereas after the crisis the unemployment level has been about 5 percent on average. It is not obvious whether this (what seems to be a) shift in the equilibrium unemployment rate, would have occurred without the crisis.

Another question is whether the rise in equilibrium unemployment is a result of increased frictional unemployment or structural unemployment. According to Fregert and Jonung (2005, p. 192 - 193) frictional unemployment seems to have increased by about 2 to 3 percentage points, whereas there is no evidence that structural unemployment has increased. The increase in frictional unemployment suffices to explain the increase in equilibrium unemployment. The most important possible explanations for the increased frictional unemployment given by Fregert and Jonung (2005, p. 193) are that the vacancies are geographically distributed in a different way than the unemployed, and that the share of time-limited jobs has increased (increasing the flows out of the labour market and hence, increasing unemployment). Another explanation that is sometimes suggested is that unemployment for a long time was kept down by the expansion of the public sector. The size of the Swedish public sector, measured in terms of employment figures, increased rapidly during the 1970s and the 1980s and reached its maximum in the year 1990 (Statistiska Centralbyrån, 1982; Statistiska Centralbyrån, 1993; Statistiska Centralbyrån 1998; Statistiska Centralbyrån, 2003). Thus, according to this viewpoint, many of those who are unemployed today would have been employed if the expansion of the public sector had continued.

A permanent shift in unemployment rates caused by business cycle phenomena is called hysteresis. A business cycle related high unemployment rate may generate a permanent higher

unemployment if, for instance, the unemployed loose (parts of) their skills during their unemployment period, or if the wages of those who still work (as a result of their stronger bargaining position) raise rapidly when the business cycle strengthens, so that structural unemployment increases.⁹

Another possibility is that the employers, after experiencing macroeconomic turbulence, feel unsure about the macroeconomic future, and whether new crises may emerge, and therefore become more inclined to short time, rather than long time, engagement. As noted, short time jobs have become more common in Sweden since the early 1990s. Hence, it is quite possible that the increased equilibrium unemployment is, in whole or in part, a result of the 1990s crisis (Holmlund and Storrie, 2002).

Avoidance of permanent negative shifts might be an important argument in favour of stabilisation policy, but these effects will not be taken into account in my calculations. In connection with expression 2.23 it was assumed that $\tilde{y} = \tilde{n}$, which is only reasonable in the short run, i.e. during business cycles. For this reason, the model can only be used to calculate welfare effects in relation to a smoothed business cycle, not in relation to some hypothetical steady state.

2.7 A model variation with a sudden shift

I also study a variation of Galís' et al. (2007) model, in which I, instead of using detrendings or preference shifters to mirror changes in the structure of the economy, assume that some sudden steady-state shift occurred during the 1990s. Since the equilibrium unemployment rate appears to have increased during the 1990s, I assume a shift in the wage markup.

The steady-state gap is, as usual, given by the negative sum of the steady-state wage markup and price markup, i.e. $-(\mu_{ss}^w + \mu_{ss}^p)$, where I let the steady-state wage markup, μ_{ss}^w for the period 1970-1994 be given by the average of the wage markup for the period 1970-1989. For

⁹ Blanchard and Summers (1987) find that the increased unemployment rate in Europe during the 1970s and the 1980s can be explained by hysteresis effects caused by the weakened bargaining position of the unemployed.

the period 1995-2007, I let the steady-state wage markup be given by the average of the wage markup for the period 2000-2007. (Because of the turbulence during the 1990s, I do not base my steady-state wage markup calculations on the period 1990-1999.) I assume that the steady-state price markup is constantly equal to the average of the price markup (up to a constant) for the whole period 1970 - 2007. As in my earlier model variations, I investigate the two cases $(\sigma, \varphi) = (1, 1)$ and $(\sigma, \varphi) = (1, 5)$.

2.8. Other models

There exist a number of attempts to calculate the welfare effects of the business cycle under various assumptions regarding preferences and choices of parameter values. Most of the models are variations of Lucas' (1987). Most of them find, like Lucas (1987), small effects on average, although there are exceptions. For example, Otrok (2001) argues that quite reasonable preferences can generate welfare losses up to 40 percent of yearly consumption on average.

One possible weakness of Lucas' model is the assumption that society consists of only one individual (but recall footnote 1). Atkeson and Phelan (1994) find that the welfare cost decreases rather than increases when accounting for the dispersion in consumption, whereas the findings of Imrohoroglu (1989) point in the opposite direction.

Instead of just assuming other preferences or parameter values than Lucas (1987), some authors assume shocks that are persistent or even permanent. In the latter case, the cost of business cycles becomes substantially higher than in Lucas' (1987) calculations; 1.8 percent according to one model, and more than 20 percent according to another (see Barlevy, 2004). According to Barlevy, however, these shocks should be seen as changes in the economy's potential rather than deviations that policy makers can try to offset.

Some authors investigate how the growth rate is affected by short term volatility, e.g. a high macroeconomic volatility may reduce investments. Different studies find different effects, ranging between zero and eight percent of consumption (Barlevy, 2004).

A somewhat less theoretical approach is given by the field of happiness research. In this field, people are asked in surveys about their happiness or life-satisfaction, and then regression analysis is used to estimate the impact of different factors on well-being. Wolfers (2003) uses as explanatory variables unemployment, inflation and a variable that is constant over the business cycle, and finds that a complete elimination of the business cycle would increase average well-being by the same amount as a reduction in the unemployment rate by a quarter of a percentage point.

3. Data

I use quarterly data from the OECD Economic Outlook¹⁰ on real GDP at market prices, nominal GDP at market prices, nominal compensation to employees, real private consumption, total employment, hours worked per employee, unemployment, equilibrium unemployment and the working age population for Sweden for the period 1970 - 2007. These data are seasonally adjusted¹¹ and expressed on yearly basis. To obtain seasonally adjusted data on quarterly basis, I divide by four. I calculate a deflator by dividing nominal GDP by real GDP. Using this deflator and nominal compensation to employees, I calculate real compensation to employees. For simplicity, I let consumption equal private consumption. Another possibility would be to use a weighted sum of private and public consumption, but it is far from obvious how one should choose the weights. Data is shown in figure 3.1a – 3.1h. All pecuniary values are given in millions of kronor.

Figure 3.1a: Gross domestic product, volume

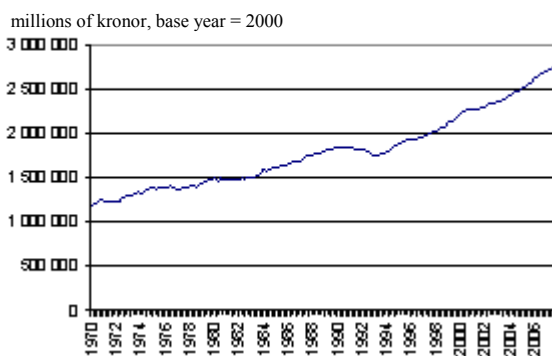


Figure 3.1b: Gross domestic product, value

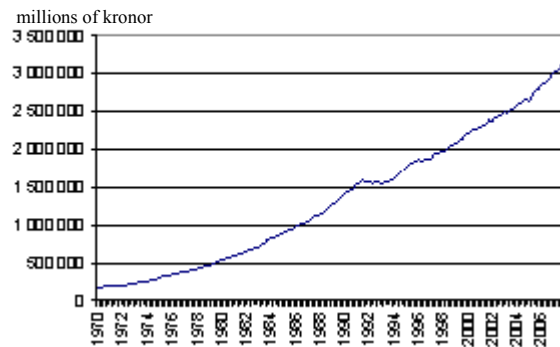


Figure 3.1c: Compensation of employees, value

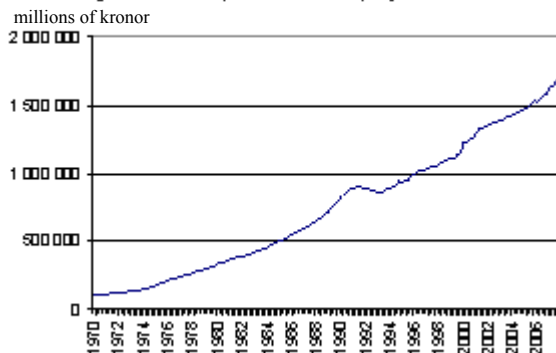
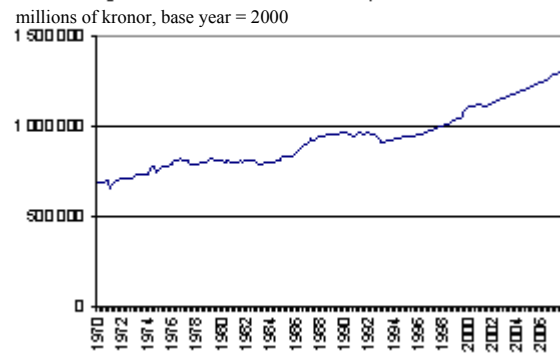


Figure 3.1d: Private final consumption, volume



¹⁰ www.sourceoecd.org, OECD Economic Outlook.

¹¹ Hence, we don't have to worry about preferences changing over the year with respect to, for instance, holidays. On the other hand, we might miss welfare effects if the inefficiency gap varies over the year.

Figure 3.1e: Total employment

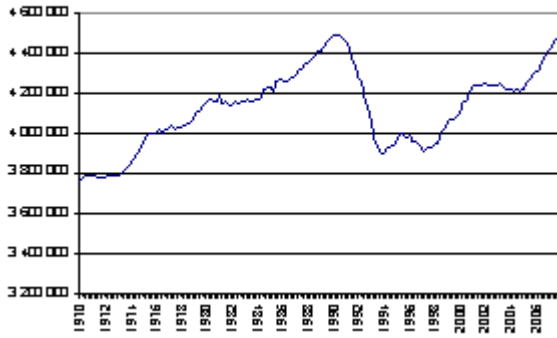


Figure 3.1f: Hours worked per employee

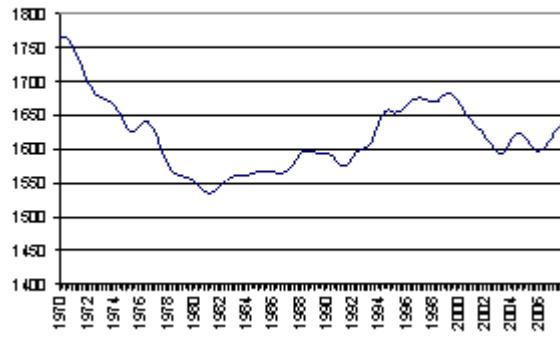


Figure 3.1g: Unemployment rate and NAIRU

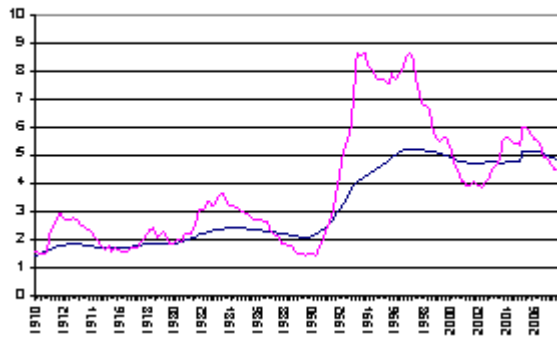
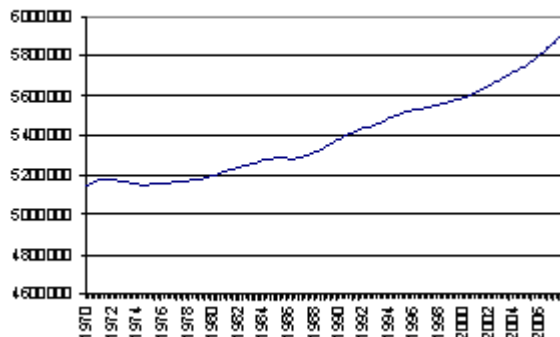
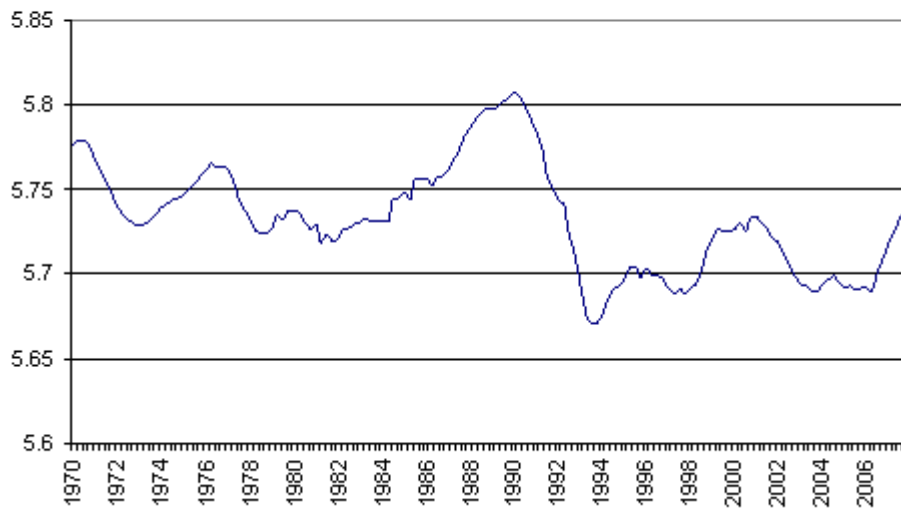


Figure 3.1h: Working-age population



From these data, all the variables which are used in the models follow. The variable n , which is given by the logarithm value of hours worked per person, is shown in figure 3.2.

Figure 3.2: Hours worked per person (quarterly; seasonally adjusted; logarithm values)



The number of working hours was relatively constant during the 1970s and the first half of the 1980s; the increase in women's labour force participation is almost perfectly balanced by a decrease in the number of working hours per employee. After a peak about 1990, the number of working hours per person suddenly - as a result of increased unemployment - drops down to a lower level, from where they seem to have not yet returned.

4. Result

4.1 Lucas' model

I now carry out a calculation corresponding to Lucas (1987). I only consider *private* consumption and find, for Sweden, a standard deviation of C/\bar{C} equal to 0.015.¹² Using expression 2.6 (with $\sigma = 1$), it follows a (average) welfare loss of 0,011 percent of (steady state) consumption. This expected utility loss can be considered negligible.¹³

To obtain a measure of the welfare effect at different time points, I remove the expectation operator from expression 2.2. The utility deviation from the trend at any time point, t , becomes $\Delta_t = \ln(C_t) - \ln(\bar{C}_t)$, which is also the utility deviation as a share of (steady-state) consumption since marginal utility and consumption cancel out each other in the same manner as in expression 2.6. Of course, $\ln(\bar{C}_t)$ is given by the H-P trend of $\ln(C_t)$.

I now define business cycle phases for Sweden for the period 1970–2007. The start of a boom is defined as (at least) two consecutive quarters with an unemployment rate below equilibrium unemployment (see figure 3.1g), whereas the start of a recession is defined as (at least) two consecutive quarters with an unemployment rate above equilibrium unemployment. I use the OECD data on unemployment and equilibrium unemployment. The welfare effects, summarised over booms and recessions, expressed as a percentage of yearly (trend) consumption, are shown in table 4.1.

As can be seen in table 4.1, the effect of individual booms and recessions is large. It may seem strange that the recession of the 1990s is not the most costly, but as we see in figure 4.1, this recession was not extremely costly in terms of private consumption, given my choice of H-P filter.

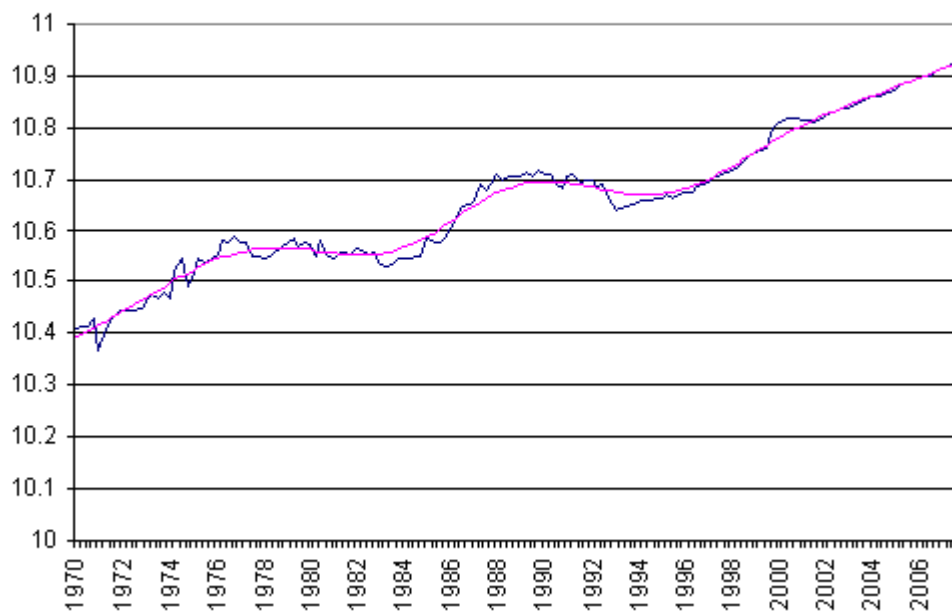
12 I use an H-P filter with $\lambda = 1600$.

13 Lucas (1987), considers aggregate consumption, and finds for post-war USA, a standard deviation equal to 0.013. This implies a welfare cost of about 0.008 percent of consumption.

Table 4.1: Welfare effects in Lucas' model

Boom		Recession	
1970:2 – 1970:4	+3.80 %	1971:1 – 1974:4	-11.99 %
1975:1 – 1977:2	+15.02 %	1977:3 – 1979:3	-2.96 %
1979:4 – 1980:3	+3.70 %	1980:4 – 1986:4	-25.19 %
1987:1 – 1991:1	+24.81 %	1991:2 – 2000:1	-12.37 %
2000:2 – 2003:2	+6.24 %	2003:3 – 2006:3	-3.21 %

Figure 4.1: $\ln(C)$ and its H-P trend



4.2 Galí's et al. model

In this section, my variations of Galí's et al. (2007) model are applied on Swedish quarterly data for the period 1970 – 2007. I calculate not only the welfare effect for every quarter, but also average effects by applying formula 2.29. My model variations are defined in table 4.2.

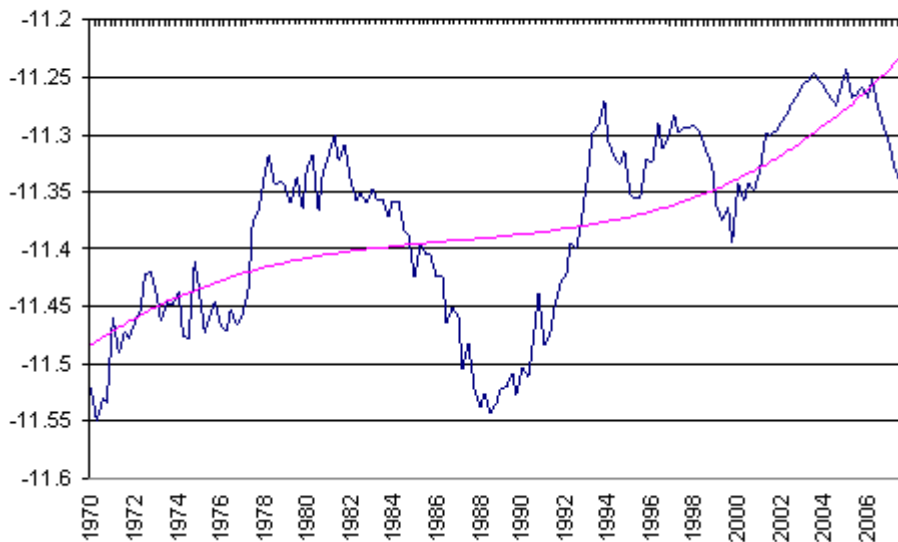
”TB” stands for “trend break”.

Table 4.2: Definitions of model variations

preference shifter	steady-state price markup	$(\sigma, \varphi) = (1, 1)$	$(\sigma, \varphi) = (1, 5)$
third degree polynomial	constant	Case 1	Case 5
H-P trend with $\lambda = 1600$	constant	Case 2	Case 6
third degree polynomial	third degree polynomial	Case 3	Case 7
H-P trend with $\lambda = 1600$	H-P trend with $\lambda = 1600$	Case 4	Case 8
constant, with a shift in the mid-1990s	constant	Case TB1	Case TB2

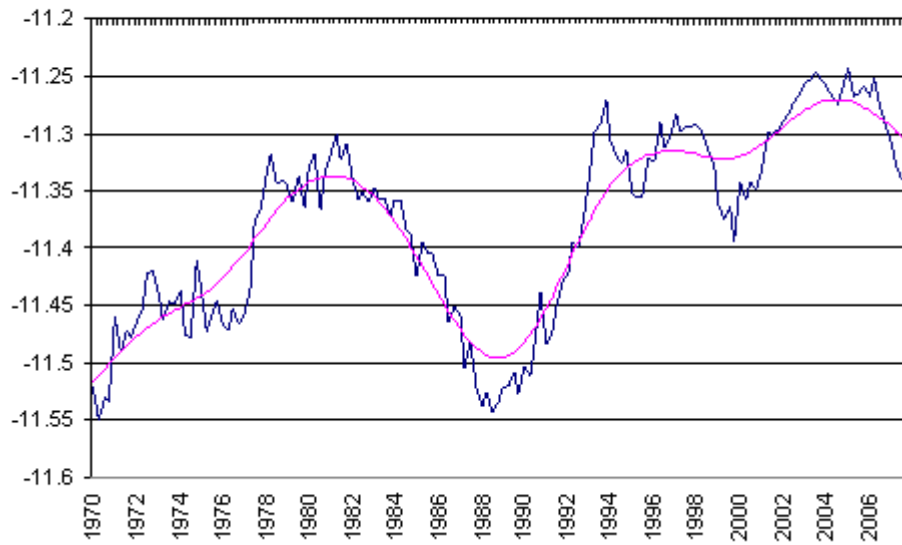
First, the preference shifter, $\bar{\zeta}_t$, is identified. In case 1, 3, 5 and 7 the preference shifter is assumed to take the form of a third-degree polynomial. A third degree estimation, by the OLS method, of the preference shifter when $\sigma = 1$, is illustrated in figure 4.2. As earlier established, this also reflects possible changes in the steady-state wage markup.

Figure 4.2: $\bar{\mu}^w$ and its third degree trend; $\sigma = 1$



When instead applying the H-P filter, the following trend is obtained.

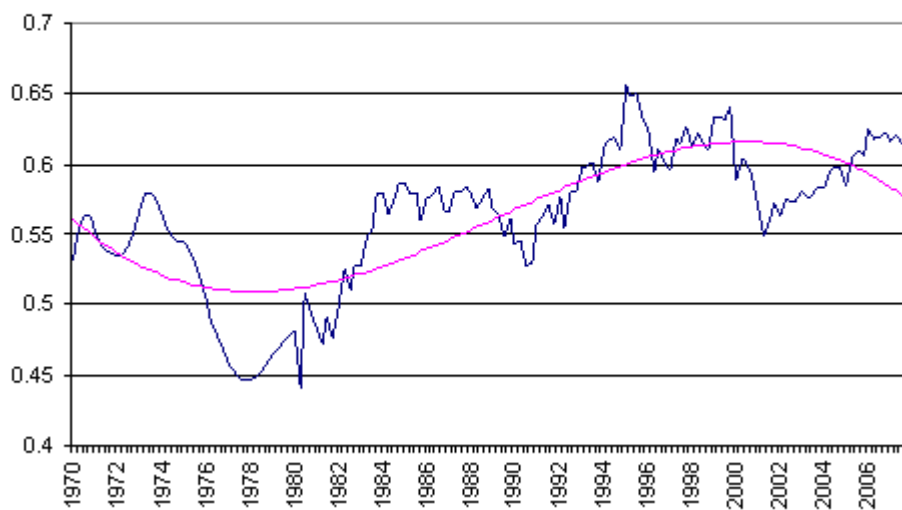
Figure 4.3: $\hat{\mu}^w$ and its H-P trend; $\sigma = 1$



When estimating a trend, the uncertainty in the estimation is particularly high at the beginning and at the end of the time period. For this reason, we should not pay too much attention to the result for the first and last few years.

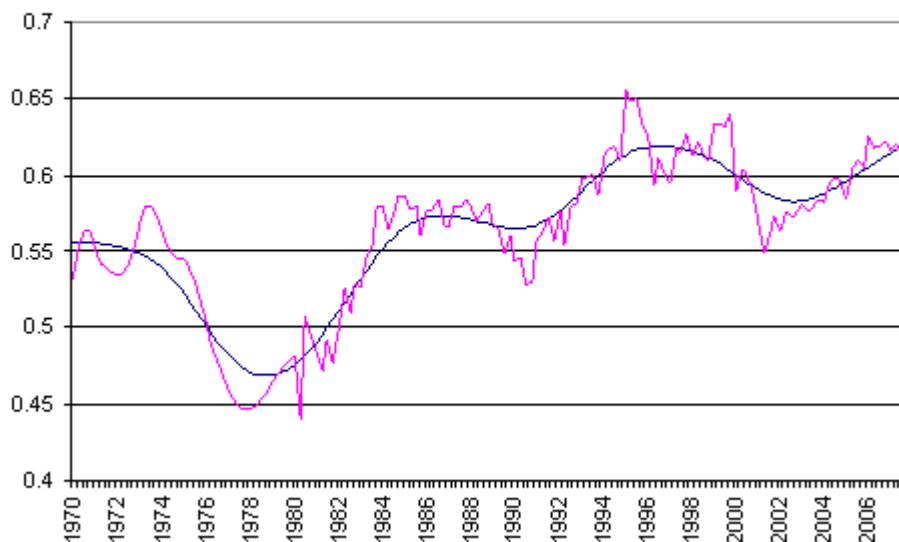
Then, I investigate the steady-state price markup. A third-degree detrending of the price markup (up to an additive constant) is illustrated in figure 4.4.

Figure 4.4: The price markup and its third degree trend



Furthermore, the H-P detrending of the price markup is shown in figure 4.5.

Figure 4.5: The price markup and its H-P trend



As noted in section 2.5, low frequency steady-state shifts imply large business cycle effects, whereas high frequency steady-state shifts imply small business cycle effects. This is clear from the figures above. For instance, the difference between the price markup and its (estimated) steady state is in most points much smaller in figure 4.5 than in figure 4.4.

4.2.1 Welfare effects

Now, the gap and the welfare effects are computed. The welfare effects for case 1 – 4 are shown in figure 4.5 – 4.8 below. The welfare effect for every quarter is expressed as a share of yearly consumption.

Figure 4.6: Welfare effect (yearly) in case 1

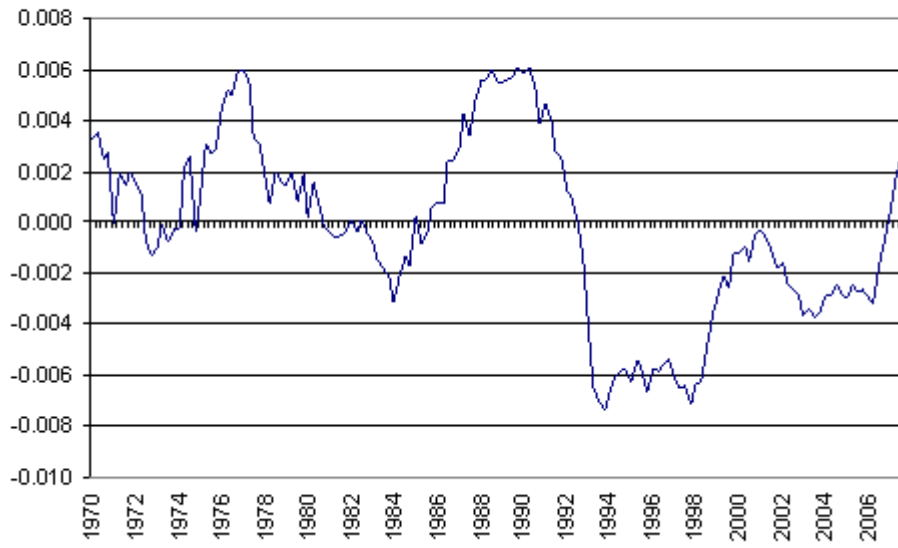


Figure 4.7: Welfare effect (yearly) in case 2

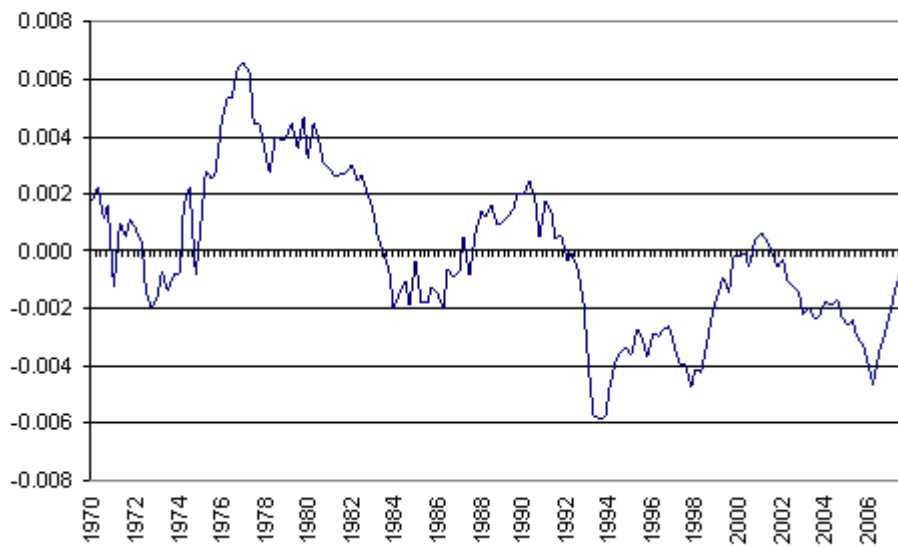


Figure 4.8: Welfare effect (yearly) in case 3

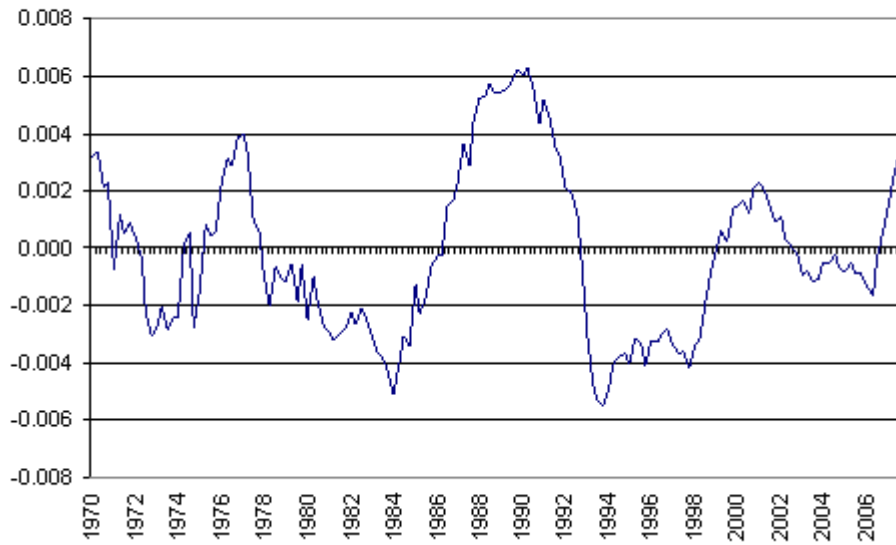
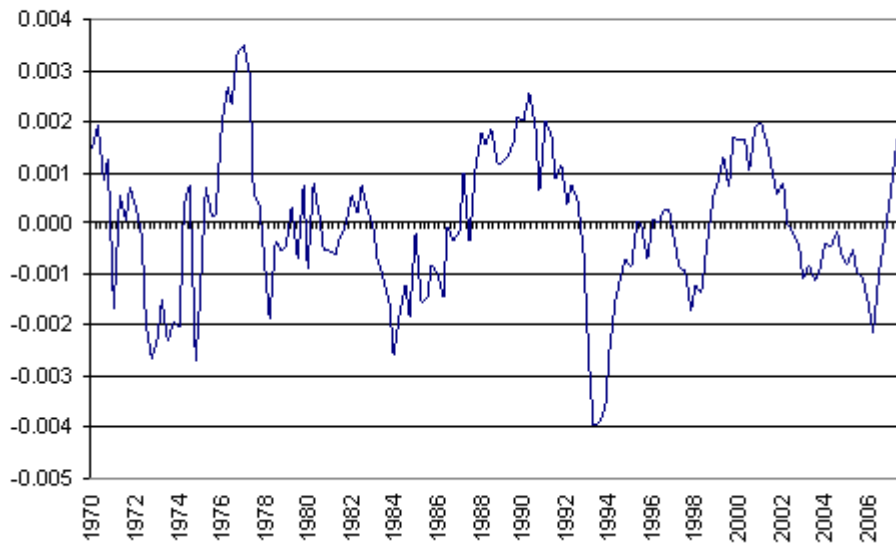


Figure 4.9: Welfare effect (yearly) in case 4



About 1992, the welfare effect abruptly drops down. This is quite closely connected to the drop in the number of working hours and in the unemployment rate, as can be seen from figure 3.2 and 3.1g.

The welfare effects in case 1 and 2, expressed as a percentage of yearly consumption, summarised over periods of boom or recession (as defined in section 4.1), are presented in

table 4.3.

Table 4.3: Welfare effects of booms and recessions in case 1 and 2

Boom	Case 1	Case 2	Recession	Case 1	Case 2
1970:2 – 1970:4	+0.88	+0.50 %	1971:1 – 1974:4	+0.79	-0.33 %
1975:1 – 1977:2	+4.13	+4.28 %	1977:3 – 1979:3	+1.65	+3.45 %
1979:4 – 1980:3	+0.43	+1.61 %	1980:4 – 1986:4	-1.11	+0.84 %
1987:1 – 1991:1	+8.64	+1.85 %	1991:2 – 2000:1	-14.33	-9.54 %
2000:2 – 2003:2	-2.32	-0.80 %	2003:3 – 2006:3	-3.69	-3.58 %

As can be seen from table 4.3, case 1 generates positive welfare effects of the recessions in the 1970s, whereas it generates a negative welfare effect of the boom in the 2000s. One possible explanation of this, seemingly, strange behaviour, is the disparity in the movements of unemployment (which was used to define booms and recessions) and working hours. This can be seen from figure 3.1g and 3.2. Another explanation is that possible changes in steady state in this case are assumed to be very slow and smooth (since only a third degree polynomial is used), which implies that possible changes in equilibrium unemployment are also slow and smooth, as opposed to the equilibrium unemployment rates given by the OECD. Thus, from the viewpoint of this model variation, most of the period before the recession of the 1990s should be described as an economic boom. Of course, such a conclusion must be questioned.

Case 2 delivers a similar result. The most apparent difference is that the effect of the boom in the 1980s has become much smaller. In this case I allow high frequency shifts in preferences and in the steady-state wage markup, but the steady-state price markup is still assumed to equal a constant. In case 3 and 4, I allow the steady-state price markup to vary over time. The welfare effects are given in table 4.4

As opposed to case 1 – 3, case 4 generates the “right” sign for all booms and recessions. However, model variation 4, as well as 3, gives that the utility gain from the boom in the end of the 1980s was larger than the utility loss from the recession of the 1990s. Once again, one

Tabell 4.4: Welfare effects of booms and recessions in case 3 and 4

Boom	Case 3	Case 4	Recession	Case 3	Case 4
1970:2 – 1970:4	+0.77 %	+0.40 %	1971:1 – 1974:4	-1.82 %	-1.64 %
1975:1 – 1977:2	+1.96 %	+1.62 %	1977:3 – 1979:3	-0.68 %	-0.36 %
1979:4 – 1980:3	-0.59 %	+0.08 %	1980:4 – 1986:4	-5.78 %	-1.78 %
1987:1 – 1991:1	+8.50 %	+2.32 %	1991:2 – 2000:1	-6.60 %	-1.63 %
2000:2 – 2003:2	+1.10 %	+0.82 %	2003:3 – 2006:3	-1.06 %	-1.18 %

explanation of this is the large discrepancy between working hours and employment (the latter defines the booms and recessions given in the tables). For, consider the area between the number of working hours in figure 3.2 and some reasonable trend. The area for the 1990s seems to be of about the same size as the area for the end of the 1980s. On the other hand, if considering figure 3.1g, which shows the unemployment rate and the equilibrium unemployment rate, we reach the conclusion that the cost of the recession of the 1990s was much larger than the gain from the boom of the 1980s.

The disparity between employment and working hours points to a possible weakness of the representative-agent model. The model does not take into account the way in which the hours worked are allocated over the population. Since the effect, *cet. par.*, on well-being is probably much higher – and probably goes in the opposite direction – for changes in the unemployment rate than for pure changes in the number of hours worked per employee, there is reason for some scepticism about the models.¹⁴

I now carry out the calculations with $\varphi = 5$, that is, case 5 – 8. The results are given in table 4.5 – 4.6.

The only difference between case 1 and 5, and between case 2 and 6, is the choice of the parameter value φ . Especially case 1 and 5 yield similar results. In both cases, the negative effect of the recession of the 1990s is about twice as large as the positive effect of the boom of the 1980s.

¹⁴ However, recall the findings of Atkeson and Phelan (1994). When only considering consumption, the representative-agent model might not be a problematic simplification.

Table 4.5: Welfare effects of booms and recessions in case 5 and 6

Boom	Case 5	Case 6	Recession	Case 5	Case 6
1970:2 – 1970:4	+0.81 %	+0.41 %	1971:1 – 1974:4	-0.50 %	-0.94 %
1975:1 – 1977:2	+1.81 %	+2.11 %	1977:3 – 1979:3	-0.60 %	+0.86 %
1979:4 – 1980:3	-0.24 %	+0.66 %	1980:4 – 1986:4	-2.15 %	-0.45 %
1987:1 – 1991:1	+6.56 %	+1.86 %	1991:2 – 2000:1	-10.66 %	-4.66 %
2000:2 – 2003:2	-0.24 %	+0.18 %	2003:3 – 2006:3	-2.11 %	-2.06 %

Table 4.6: Welfare effects of booms and recessions in case 7 and 8

Boom	Case 7	Case 8	Recession	Case 7	Case 8
1970:2 – 1970:4	+0.78 %	+0.38 %	1971:1 – 1974:4	-1.42 %	-1.39 %
1975:1 – 1977:2	+1.11 %	+1.29 %	1977:3 – 1979:3	-1.48 %	-0.48 %
1979:4 – 1980:3	-0.61 %	+0.16 %	1980:4 – 1986:4	-3.82 %	-1.35 %
1987:1 – 1991:1	+6.51 %	+2.01 %	1991:2 – 2000:1	-7.84 %	-1.99 %
2000:2 – 2003:2	+0.84 %	+0.70 %	2003:3 – 2006:3	-1.19 %	-1.23 %

The result in case 7 is similar to case 3, but the negative effect of the recession of the 1990s has now become larger than the positive effect of the boom of the 1980s. Furthermore, case 8 yields similar results as case 4.

Finally, I study the model variations with a permanent and sudden shift in the mid-1990s. The welfare effects for individual time points, as shares of yearly consumption, are shown in figure 4.9 – 4.10 and in table 4.7

Figure 4.10: Welfare effect (yearly) in case TB1

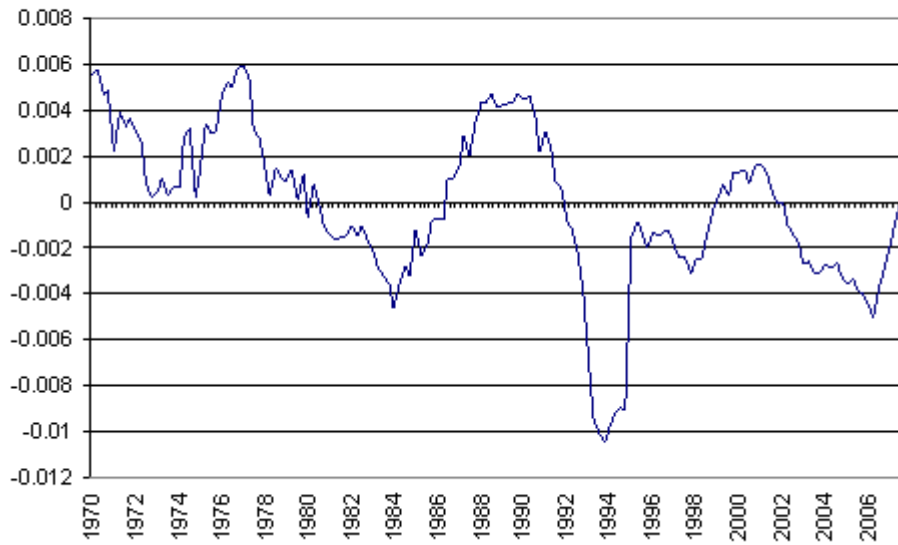
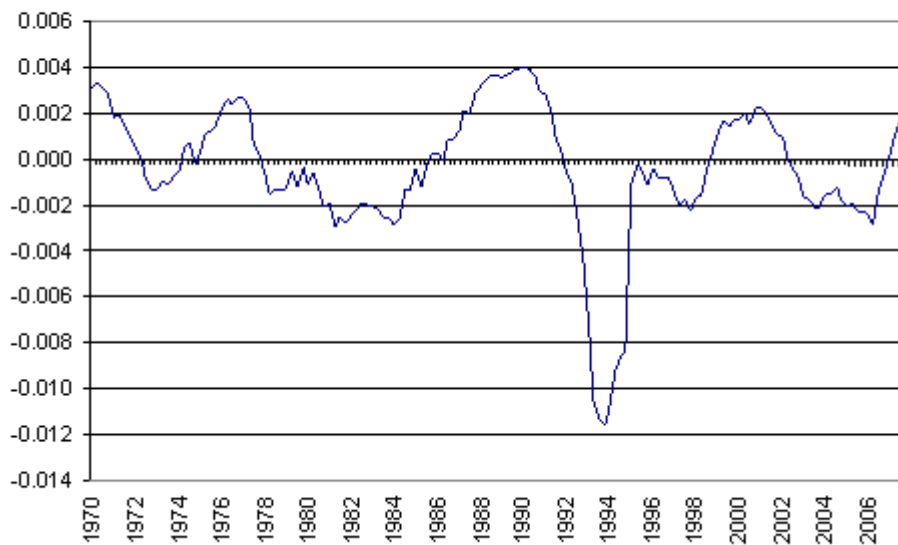


Figure 4.11: Welfare effect (yearly) in case TB2



According to these model variations, the cost of the recession of the 1990s amounted to about ten percent, whereas the gain from the boom of 1980s amounted to about six percent.

Table 4.7: Welfare effects of booms and recessions in case TB1 and TB2

Boom	Case TB1	Case TB2	Recession	Case TB1	Case TB2
1970:2 – 1970:4	+1.53 %	+0.92 %	1971:1 – 1974:4	+2.90 %	+0.05 %
1975:1 – 1977:2	+4.25 %	+1.87 %	1977:3 – 1979:3	+1.23 %	-0.71 %
1979:4 – 1980:3	+0.11 %	-0.35 %	1980:4 – 1986:4	-4.40 %	-3.83 %
1987:1 – 1991:1	+6.26 %	+5.43 %	1991:2 – 2000:1	-10.25 %	-9.20 %
2000:2 – 2003:2	-0.24 %	+0.89 %	2003:3 – 2006:3	-4.57 %	-2.56 %

4.2.2 Some comments

Since public consumption is not included in my calculations and the crisis of the 1990s was largely characterised by cutbacks in the public sector, the cost of the crisis of the 1990s might be underestimated.

Appendix 2 gives tables of average welfare losses, largest individual losses (i.e. for individual quarters) and largest individual gains for the different cases. The average losses fall in the interval between 0.02 percent and 0.20 percent. Letting φ equal 5 instead of 1 changes the average effects in different directions from case to case.

The largest individual gains range between one and three percent. Increasing the value of φ from one to five lowers the effects. In a majority of the cases, the largest welfare gain occurred during the first half of the year 1990, whereas in three cases it took place at the first quarter of the year 1977.

The largest individual losses amount to about two to three percent, except in the TB cases, where they become about five percent. In all cases, the largest loss occurs during the year 1993. Changing the value of φ changes the results in different directions in different cases.

Galí's et al. (2007) model, under its baseline assumptions, corresponds to my case 1. Galí et

al. (2007) study post-war USA and find an average welfare loss of about 0.01 percent of steady-state consumption. There are several possible explanations why this value differs by a factor of 10 from my result in case 1. One explanation is that Galí's et al. (2007) expression for calculating the welfare effect seems to be wrong, unless it is just a misprinting.¹⁵ Another explanation is that the fluctuations in US *total* consumption, which Galí et al. (2007) study, have been larger than the fluctuations in Swedish *private* consumption, as noted in section 4.1. On the whole, the results are very sensitive to variations in assumptions and data material. For instance, as noted in appendix 2, one and the same model variation can give a more than five times larger average effect for the period 1970 – 1994 than for the period 1995 – 2007, as a result of, among other things, the higher variability in working hours during the first-named period.

Galí et al. (2007) find, under their baseline assumptions that the cost of the recession of the 1990s for the US amounted to 2.26 percent (however, their definitions of booms and recessions differ from mine). The most severe recession in post-war USA according to Galí's et al. (2007) findings, under the baseline assumptions, was the recession of the 1980s, which amounted to 4.69 percent of yearly consumption.

In most of my model variations, the boom of the 1980s and the recession of the 1990s give the largest effects. In the cases where $\varphi = 1$, the cost of the crisis of the 1990s falls in the interval between 7 and 14 percent, whereas in the cases where $\varphi = 5$, it falls in the interval between 2 and 10 percent. The gain from the boom of the 1980s falls between 5 and 9 percent when $\varphi = 1$, and between 1 and 2 percent when $\varphi = 5$.

15 Under the baseline assumptions, my expression for the average welfare effect gives a twice as large welfare loss as the expression given in Galí et al. (2007).

5. Conclusion

I find average welfare costs ranging between 0.01 and 0.20 percent of consumption. This indicates that the gain from further stabilisation of the business cycle is small.

However, individual booms and recessions may have large effects. For instance, a majority of my model variations yield a welfare cost of the recession of the 1990s amounting between 8 and 14 percent of yearly steady-state consumption. To the extent crises of this sort can be predicted, the potential gain from stabilisation policy is therefore large. On the other hand, according to two of my model variations, the cost of the 1990s recession only amounts to about two percent.

In this paper, only welfare effects compared to some fixed trend are considered. To the extent that stabilisation policy can affect this trend, the gain from such a policy might be large. For instance, a stable macroeconomic environment may lead to an increased production by increasing investments, or keep unemployment low by avoidance of hysteresis effects. The welfare loss of, for instance, a permanently higher unemployment rate may very well be infinite, given that the discount factor for future utility is not too large. On the other hand, macroeconomic volatility may have some positive effects, such as elimination of bottlenecks.

It should also be pointed out that stabilisation policy may be very difficult to carry out. In particular, fiscal policy in a country like Sweden, with a small open economy and a flexible exchange rate has little, or in theory no, effect (see, for instance, Burda and Wyplosz, 2005, chapter 10). Furthermore, there is always a risk that measures are taken too late, so that these do more harm than good. It is quite probable that stabilisation policy generates net losses, but the sizes of these are beyond the scope of this paper to estimate.

Some model variations give that the gain from the boom of the 1980s was larger than the loss from the recession of the 1990s, which seems unrealistic. This result points to a (possible) weakness of the representative-agent models considered in this paper. These models do not take into account the way in which the number of working hours (and consumption) is allocated over the population. That is, they do not take into account whether a shift in the number of working hours per person originates from a shift in the unemployment rate or from

a shift in the number of working hours per employee. Typically, unemployment does not only lead to a utility gain from additional leisure, but also to a psychological cost, which the models considered in this paper ignore. A more realistic model should include this effect.

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Appendix 1. An alternative specification with adjustments along the extensive margin

The utility function 2.7 can under certain assumptions arise also in a model with many individuals, where every individual either works a fixed number of hours, or does not work at all. I assume, in line with Galí et al. (2007) that individuals differ according to their disutility of work and that this disutility is $j^\varphi \bar{\Xi}_t$ for individual j . Furthermore, individuals are assumed to be uniformly distributed over the unit interval.

Assume that all individuals, thanks to a perfect unemployment insurance, receive the same income, and that the utility of consumption, as in section 2.4, is

$$\frac{1}{1-\sigma} C_t^{1-\sigma}. \quad (\text{B1.1})$$

Individuals with the smallest disutility of work are employed, whereas those with higher disutility of work are unemployed. The utility for a randomly chosen individual, i.e. the expected utility, is given by

$$E[U_t] = E\left[\frac{1}{1-\sigma} C_t^{1-\sigma} - j^\varphi \bar{\Xi}_t\right] = \frac{1}{1-\sigma} C_t^{1-\sigma} - E[j^\varphi] \bar{\Xi}_t = \frac{1}{1-\sigma} C_t^{1-\sigma} \int_0^{N_t} j^\varphi * 1 dj \bar{\Xi}_t = \frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\varphi} N_t^{1+\varphi} \bar{\Xi}_t, \quad (\text{B1.2})$$

where N_t denotes the employed share of the individuals. But this is the same utility function as in expression 2.7.

Appendix 2. Average and extreme values

Table B2.1: Average welfare losses expressed as percentages of consumption

$\varphi = 1$		$\varphi = 5$	
Case 1	-0.10 %	Case 5	-0.16 %
Case 2	-0.06 %	Case 6	-0.05 %
Case 3	-0.07 %	Case 7	-0.15 %
Case 4	-0.02 %	Case 8	-0.03 %
Case TB1 1970-1994	-0.11 %	Case TB2 1970-1994	-0.20 %
Case TB1 1995-2007	-0.02 %	Case TB2 1995-2007	-0.05 %

Expression 2.29 is used for the calculations. The estimated variance in expression 2.28 is assumed to be constant over time.

The considerably larger average effect in the TB models over the period 1970 – 1994 than over the period 1995 – 2007 is largely due to a higher volatility in the number of working hours during the earlier period. The variance of (the logarithm of) the number of working hours per person was almost four times larger during the period 1970 – 1994 than during the period 1995 – 2007.

Table B1.2: Largest welfare gains expressed as percentages of consumption

$\phi = 1$			$\phi = 5$		
Case 1	1990:2	+2.41 %	Case 5	1990:1	+1.81 %
Case 2	1977:1	+2.63 %	Case 6	1976:4	+1.23 %
Case 3	1990:2	+2.52 %	Case 7	1990:1	+1.82 %
Case 4	1977:1	+1.40 %	Case 8	1990:2	+0.96 %
Case TB1	1977:1	+2.35 %	Case TB2	1990:1	+1.59 %

Of course, welfare gains expressed as percentages of yearly consumption are obtained by dividing the above numbers by four.

Table B1.3: Largest welfare losses expressed as percentages of consumption

$\phi = 1$			$\phi = 5$		
Case 1	1993:4	-2.94 %	Case 5	1993:4	-3.17 %
Case 2	1993:3	-2.35 %	Case 6	1993:3	-2.20 %
Case 3	1993:4	-2.18 %	Case 7	1993:4	-2.85 %
Case 4	1993:2	-1.58 %	Case 8	1993:2	-1.89 %
Case TB1	1993:4	-5.58 %	Case TB2	1993:4	-4.64 %