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Business Cycle Dependent Unemployment Insurance
A Simulation on the Swedish Labour Market

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Abstract

This thesis answers the question whether a business cycle dependent unemployment insurance would improve the welfare compared to the current Swedish system. Using recursive macroeconomics three different unemployment insurance programs are simulated. The simulation uses business cycle data from Sweden as a proxy for the labour market tightness. The program with changing duration of benefits provides the same utility as the current system, but to a lower cost, since it incentives the agents to search persistently for jobs early in their unemployment spell in a boom and at the same time provides them with a high insurance in a recession.

Keywords: business cycle dependent unemployment insurance, incentives, labour economics, recursive methods, search effort

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The best way to appreciate your job is to imagine yourself without one.

Oscar Wilde, 1854–1900

1 Introduction

If it would be the case that everyone wanted to have a job, the design of an optimal unemployment insurance program would be an easy task. All the government would need to do would be to decide how much compensation an unemployed would receive in relation to an employed and then pay out that amount until the unemployed found a new job. In fact, the welfare optimising amount to pay would be the unemployed's previous wage. (Ljungqvist and Sargent, 2004). However, when everyone do not want to work the problem becomes much more complicated and multi-layered.

The Swedish Fiscal Policy Council, who evaluates the Swedish fiscal policy, suggested in their annual report from 2009 that Sweden should implement a business cycle dependent unemployment insurance. (Calmfors et al., 2009) Such a program implies either that the number of weeks when benefits are given are prolonged in a recession and shortened in a boom or that the level of benefits is decreased (increased) in a boom (recession), or a combination of both. The reason for a business cycle dependent program is that it increases the insurance in a recession when people needs to be insured and at the same time it decreases the insurance in a boom where people more easily can find work. The argument for this system, instead of a system with constant length or levels of benefits, is that the optimal trade off between the need for insurance and strong incentives to search for a new job for the unemployed is likely to change over the business cycle. (Kiley, 2003)

In most countries in the world the unemployment insurance is independent

of the state of the economy. Despite this, during the latest recession several countries extended their unemployment benefits through discretionary decisions. Among those are Belgium, Finland, Greece, Japan, Norway and Portugal. (Calmfors et al., 2009) 15 of the OECD member countries took measures to extend the levels and generosity of their unemployment insurance during the financial crisis. (OECD, 2010) This should be seen as extra-ordinary measures and nothing that is connected to the normal policy of each country. In the US and Canada the benefits are dependent on the state of the economy and the benefit policy is both rule based and discretionary. In the case of the US the different states have different rules regarding the duration of benefits but the federal government can also make discretionary changes to the duration. Two examples of this is the Temporary Extended Unemployment Compensation program from 2002 to 2003 (TEUC, 2002) and the Extended Unemployment Compensation in 2008 (EUC, 2008). The Canadian unemployment programme is similar to the one in the US but focus more on the regional unemployment rate rather than on the federal. (Calmfors et al., 2009)

1.1 Statement of Purpose

The purpose of this thesis is to investigate and evaluate the effects on the Swedish labour market if Sweden would to adapt a system with business dependent unemployment insurance. More specifically we want to answer the question

> *Is it possible to provide the same utility for unemployed to a lower cost than the current Swedish system by using a business cycle dependent unemployment insurance?*

Considering that the total amount paid out in unemployment insurance benefits in Sweden 2010 was 18.2 billion SEK even a small fraction of savings is a substantial amount of money. (Swedish Unemployment Insurance Board, 2011b)

The core of the analysis is an economic model that consists of unemployed agents and a government that provides benefits. The model will be simulated under different insurance programs and the programs will be evaluated based on the cost of the programs, the utility of the agents, weeks of unemployment and the search effort of the agents.

Because of the enormous width of the topic certain limitations are necessary. Only cyclical unemployment will be investigated, that is, we will only investigate those who will loose their jobs due to changes in the business cycle. Neither will we incorporate those who are unemployed and for various reasons do not actively search for a job and do not receive any unemployment benefits in our model.

The outline of this thesis is as follows. Section 2 provides a overview of previous research and describes earlier models used to simulate the effects of unemployment insurance programs. Section 3 describes our model. In section 4 three different programs are presented and the model is calibrated. The results of the simulation is presented and evaluated in section 5. In the final section, number 6, we draw conclusions and present suggestions for further research.

2 Previous Research

The International Labour Organization (1982) defines an unemployed individual as being without work, currently available for work and actively seeking for work. To be eligible for unemployment insurance in Sweden the definition needs to be met, together with some additional criteria. (Swedish Public Employment Service, 2011) There are several reasons for unemployment and the reasons lay the foundation for the classifications most commonly used in the economic discourse. The focus of this thesis is the cyclical unemployment or Keynesian unemployment as it is sometimes called after the British economist John Maynard Keynes. Cyclical unemployment is due to a decrease in ag-

gregated demand for goods and services in the economy which leads to less demand for labour. Keynes stated that because of the fact that the wages are sticky they fail to meet the new equilibrium resulting in an increase in unemployment. (Keynes, 1936) In our framework the wages are sticky meaning that the agents will face a changing and exogenously given demand for labour over the business cycle.

2.1 Moral Hazard, Incentives and Insurance

There are several reasons for why the government, either directly or through authorized bodies, provides an unemployment insurance. One of the main reasons is of course that it is a part of a bigger social security system which most modern states have (Estevez-Abe et al., 2001), another is that an insurance decreases the probabilities of mismatching among the job searchers and the vacant positions. That is, people with an insurance will be more "picky" when looking for a job until they find one suitable for there level of education and experience. (Acemoglu, 2002) Whatever the reason is for the insurance we can draw the conclusion that both the government and the citizens will demand it. As with all insurances the problem of moral hazard also exist here. Moral hazard occurs when the unemployed changes her behaviour so that the cost for the financier of the insurance increases. This is because the unemployed does not bear the full cost of its behaviour. In this case the result could be that individuals will take the opportunity to have a paid vacation during their unemployment instead of searching for a new position. The more generous the insurance is when it comes to maturity and benefits, the more people will shirk. In line with economic theory it has been shown that a more generous insurance decreases the propensity to search for a new employment. (Krueger and Mueller, 2010)

2.2 Unemployment Insurance Models

During the last decades a large number of theoretical models have been developed to describe the effect unemployment insurance programs has on the labour market. These models mainly address two questions: how does the unemployment insurance effect the economy and how should an optimal unemployment insurance look like. The questions are of course related since it is necessary to know the effects of a program to be able to design an optimal program. There is no clear definition of what is meant by "optimal" but generally it means that the insurance should be sufficiently high for the unemployed to be satisfied but the incentives to search for a new position shall be effected as little as possible. The programs are sometimes studied in a general equilibrium model but more common is to just study the labour market.

The search for an unemployment insurance with an optimal trade-off between insurance and incentives has been on-going. It started with Baily (1978) who tried to balance the marginal cost of an unemployment insurance to the marginal benefits of it. For this he used a two period model where the unemployed agent has a probability of being employed in the first period and laid off in the second. Each period is approximately one year and the argument for only looking at two periods is that most people finds it hard to plan longer ahead. The agent in the model only cares about consumption. Baily looked at the increase in unemployment caused by the unemployment insurance and tried to decide the optimal program. Not so surprisingly the conclusion was that there exists a trade-off between incentives for searching for a new job and insurance.

The model constructed by Shavell and Weiss (1979) focused on maximizing the utility of the unemployed, given that the unemployed acted in their own self-interest and that the total cost of the unemployment insurance is fixed. They conclude that if the government can not monitor the search effort of the unemployed the benefits should decline over time and eventually reach zero.

Another finding was that when the labour market is "tight" it may be the case that lower benefits do not increase the likeliness of finding a job. The reason for this is that when benefits are low more people perceive it as rational to increase their search effort. Therefore, a high number of people compete for a few vacancies and hence the lion part will not find an employment. If it would be the case that the reason for the unemployment was that people searched too little, the lower benefits would have a larger effect.

Hopenhayn and Nicolini (1997) tried to get rid of, what they called, "the perverse effects on incentives" for re-employment created by the unemployment insurance. They used a multi period setup where the search effort by the agent can not be observed, and therefore not controlled, by the principal that pays out the benefits. The market tightness is constant all the time and after finding a job the agent will be employed for the rest of the future. This model is later described as a standard setting to study unemployment insurance by Ljungqvist and Sargent (2004). Hopenhayn and Nicolini (1997) includes a tax, that the agents has to pay once they have found a job, in their model. The tax is increasing with the unemployment spell and is an incentive for the agents to search for a new job. They concluded that the optimal benefits decreased throughout the unemployment spell.

The initial research in this field concluded that an insurance scheme with a declining benefit over time has less distortionary effects on the incentives to search for a job than a constant benefit level over time.

2.3 Business Cycle Dependent Models

The question if the trade-off between incentives and insurance for the optimal insurance changes over a business cycle is a bit more complicated. The economic intuition behind this idea is that in a recession when the supply of jobs is low the unemployment benefit should not effect the incentives as much as in a boom where the search intensity would have a larger effect, which is in

line with the findings by Shavell and Weiss (1979). The same logic goes for the insurance part where in a recession the demand for a insurance should be larger than in a boom. Andersen and Svarer (2009) conclude that the optimal trade-off changes over the cycle because of the effects of demand for insurance and the incentives to search for a new job also changes over the cycle. In a recession the distortionary effects of the benefits is attenuated according to Moffitt (1985) and Jurajda and Tannery (2003).

Kiley (2003) is one of the first to analyse the effects of a business cycle dependent unemployment insurance. The reason for studying this is that he finds it likely that the balance between sufficient insurance and strong incentives is likely to change over the business cycle, and as a consequence so should the insurance to have an optimal trade-off. The analysis builds on the model presented by Hopenhayn and Nicolini (1997) but he introduces a shifting labour market tightness. After an initial shock to the labour market tightness it evolves back to steady state following an AR-process. Kiley finds that in a recession the benefits should be more generous in two ways. First, the level of benefits should be higher in the initial period in a recession compared to in a boom. Secondly, the decrease in benefits should be slower. In other words Kiley finds it optimal that the agents should receive more for a longer period of time. The findings are supported by Sanchez (2008) who use a similar set-up and reach the same conclusion.

Andersen and Svarer (2009, 2010) use a setup independent from the previous models. Instead of not only looking at the labour market they study an entire economy in a general equilibrium model. In their model the economy shifts between being in "good" and "bad" states. They conclude that, given that benefits appears to be less distortionary in a recession than in a boom, counter-cyclical benefits reduces the unemployment rate. They also note that such program increases the variance in the unemployment rate.

Moyen and Stähler (2009) uses a RBC-model to measure the effects of business cycle dependent unemployment insurance. They draw the conclusion

that prolonging benefits in a recession increases unemployment and decreases production, but it is not clear in which way the welfare of the agents change.

3 The Model

Our model consists of an agent that tries to find a new job when being unemployed. How easy it is to find a job is decided by the labour market tightness and the agent's search effort. The agent optimize its behaviour, i.e. search effort, with regard to the benefits it is receiving. The simulation will consist of 20 agents that behave in the same way but face different labour market tightness.

3.1 The Agent's Preferences

We expect the agent to be rational and to live for infinity. By rational we mean that she can understand the problem she is facing and make an optimal decision in each period. The agent does not have the ability to determine the state of the economy, which means that she can not on her own observe the tightness of the labour market, nor can she predict it. The agent's utility is increasing with consumption and decreasing with the search effort required to find a new job. The utility function for a single period is

$$u(c, a) = \frac{c^{(1-\gamma)}}{(1-\gamma)} - \phi a \tag{1}$$

which is an extension of the model that was used by Hopenhayn and Nicolini (1997), Kiley (2003) and Ljungqvist and Sargent (2004). The utility from consumption is of the power-form where γ is the preference that decides the curvature of the function, i.e. it is a measurement of risk-aversion. The dis-utility related to search effort is linear but to be able to calibrate the magnitude of dis-utility we have added a constant, ϕ, that has to be larger than one. In each period the agent consumes her income, hence there is no saving in the model. When employed she will get a fixed wage, w, that is constant for all

time periods. If the agent is unemployed and entitled for insurance benefits, she will receive a benefit, b, for each time period. The level of the benefits depends on the design of the insurance program and for how long time the agent has currently been unemployed. She will also, on her own, decide a search effort, a, that is non-negative when she is unemployed and zero when employed. It is the search effort that the agent decides when optimizing her utility stream. The utility for a single period for an employed agent is therefore

$$u_e(w) = \frac{w^{(1-\gamma)}}{(1-\gamma)} \tag{2}$$

where the subscript e denotes being employed. Discounting the utility from having a job for each time period until present time results in

$$V_e(w) = \sum_{t=1}^{\infty} \beta^t \frac{w^{(1-\gamma)}}{(1-\gamma)} \tag{3}$$

where V_e is the total value of utility stream of being employed for infinity. β is the discount factor and measures the time preferences between different periods.

3.2 Search Effort and the Probability for Employment

The probability of finding a new job for the next period when unemployed, denoted p, is a function of both the search effort a and the tightness of the labour market r. The probability is given by

$$p(a, r) = 1 - \frac{1}{e^{ar}} \tag{4}$$

which implies that the larger the search effort is, the more probable it is that the agents will find a new job. An increase in r, which means that the state of the economy is improving, results in a higher probability of finding a job for every positive level of search effort. The tightness of the labour market is exogenously given in the model. Kiley (2003) also uses equation (4) as the probability function but uses an AR-process for how r, the labour market

tightness, evolves. Our model is more sophisticated and r will evolve in accordance to the actual business cycle in Sweden. This will be further explained in section 3.4. When r is in steady state it is denoted r^*.

3.3 How the Agent Optimise

When unemployed the agent receives the benefit b each time period. The value of b is decided by how much the simulated program provides for that specific time period. In line with previous findings the amount is decreasing until it reaches b^* which is the benefit that will be received eternally. As mentioned earlier we assume that the agents can not determine which state the economy is in and therefore does not take it into account when choosing their optimal search effort. Hence, we let the agents optimize their search effort as if $r = r^*$ for all time periods. This assumption is in line with empirical findings on the Swedish labour market. (Swedish Public Employment Service, 2010) In steady state the agent faces the Bellman equation

$$V_u = \arg\max_a \left(\frac{b^{*(1-\gamma)}}{(1-\gamma)} - \phi a + \beta \left(p(a, r^*) V_e + (1 - p(a, r^*)) V_u \right) \right) \tag{5}$$

where V_u is the expected total discounted value when being unemployed, V_e is given by equation (3) and $p(a, r^*)$ is the probability of finding a new employment conditional on the search effort a and the labour market tightness r^* as presented in equation (4).

After finding V_u the agent optimise "backwards". In the period prior to steady state the agent wants to maximise

$$u_u(a) = \frac{b'^{(1-\gamma)}}{(1-\gamma)} - \phi a + \beta \left(p(a, r^*) V_e + (1 - p(a, r^*)) V_u \right) \tag{6}$$

where b' is the benefit received in the period before steady state. The optimal a in that period is therefore found by taking the first order conditions of equation (6) with regard to a which results in

$$a = -\left(ln(\phi) - ln(\beta r^* (V_e - V_u) \right) \frac{1}{r^*} \tag{7}$$

After finding the optimal a in that period the agent calculate the corresponding utility for that period. The next step for the agent is to optimise the previous period in the same way, except that V_u is replaced with the following periods utility if unemployed. This backward optimisation continues until the agent has optimised all time periods.

3.4 Labour Market Tightness and the Business Cycle

Considering that business cycles are, to a large extent, a measurement of the number of vacancies and unemployed in the economy, it is natural that the correlation between the labour market tightness and the business cycles is high. Millard et al. (1997) confirms this assumption which supports our decision to use business cycle data as a proxy for market tightness. To measure the business cycle we use the Economic Tendency Indicator by the National Institute of Economic Research. The indicator captures the sentiment among firms and households in Sweden and is commonly used as a measurement of the state of the economy. The design of the indicator is harmonised with European guidelines and it is very similar to the EU Commission's Economic Sentiment Indicator. (National Institute of Economic Research, 2011b)

Hüfner and Schröder (2002) finds that the EU Commission's indicator works well when it is compared to Germany's industrial production and Carroll et al. (1994) provides evidence that consumer sentiments have explanatory power for the changes in households spending. Gelper et al. (2007) compares the EU Commission's indicator with other, more statistically thorough methods used to measure the state of the economy, and finds that the indicator perform as good as those. Since the EU Commission's indicator works so well in predicting the European economy it is safe to assume that the Swedish Economic Tendency Indicator is a good measurement for the state of the Swedish economy and works well as a proxy for labour market tightness in our model.

Both the Swedish and EU:s indicator has a mean value of 100 and a stan-

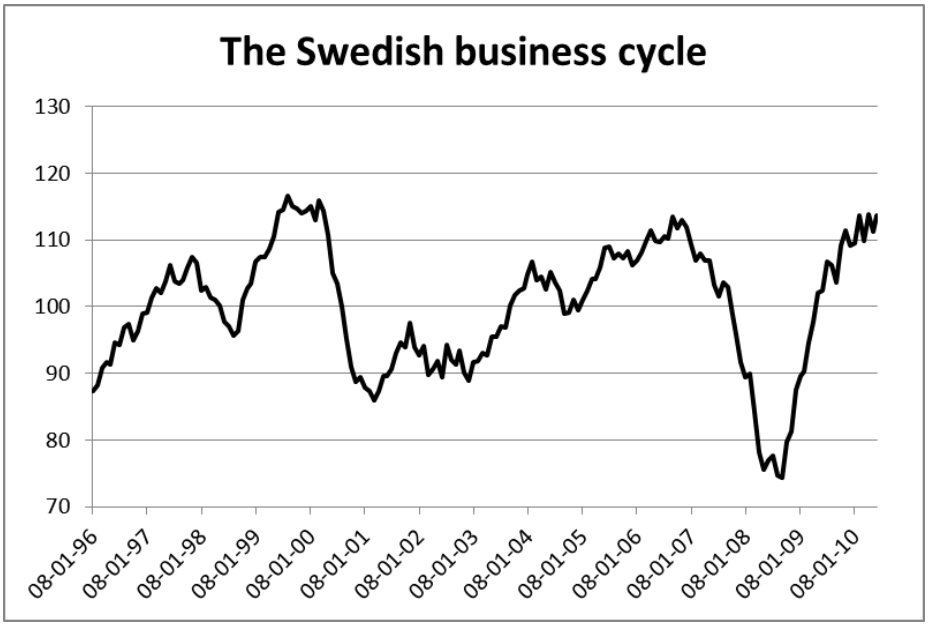

Figure 1: **The Swedish Economic Tendency Indicator from August 1996 to January 2011. (National Institute of Economic Research, 2011a)**

dard deviation of 10. A value above 100 is equivalent to a strong economy and a value above 110 to a very strong economy. Likewise, a value below 100 is indicating a weak economy and below 90 a very weak economy. (National Institute of Economic Research, 2011b) In Figure 1 the Swedish Economic Tendency Indicator is shown from August 1996 to January 2011. The indicator will be used in the simulation but scaled so that the mean equals r^*. When the indicator is below the mean we consider the economy to be in a recession and when above the economy is in a boom. The terms boom and recession are used in a broader meaning than is common. We use them in the simulation to define positive and negative deviations from steady state.

4 The Programs

To be able to decide the if there is any gains by using a business cycle dependent unemployment insurance our model needs to be simulated under different programs, both dependent and non-dependent. Three different programs will be used to do this. One is not dependent on the state of the economy and is constructed to imitate the current Swedish system. This program, which is called *baseline*, will be the reference point for the comparison with the business cycle dependent programs.

The different ways an unemployment insurance can be designed is almost infinite but the key factors will always be the level of the benefits and the duration of the periods for the specific benefit levels. In the first of the two business cycle dependent programs the duration of the period with the highest benefits are changed depending on if the economy is in a boom or in a recession. This unemployment insurance program will be called *changing duration of benefits*. In the other program, called *changing level of benefits*, the level of benefits change in the first period depending on the state of the economy.

In the business cycle dependent programs it will be decided during the first period of the agent's unemployment spell if she will receive the boom-benefits or the recession-benefits. Our proposed method has aspects that might be considered unfair. The winners of the system will be those who become unemployed in a recession, but just before the economy turns into a boom. They will receive generous benefits even though the labour market is in their favour. In a similar way will the losers be those who become unemployed in a boom just before a recession starts.

4.1 Baseline

As earlier mentioned the *baseline* will be based on the current Swedish system. The key factors are that after a compulsory week without benefits the benefits are paid out in three stages. In the first one, that last for 40 weeks, the benefit

is 80 per cent of the previous income but maximum 680 SEK per day. In the next stage 70 per cent, but maximum 680 SEK per day, is paid for another 20 weeks. After 60 weeks the unemployment benefits decreases to 65 per cent of the previous income, but still 680 SEK per day at the most, for as good as infinity. (Swedish Public Employment Service, 2011)

In the model we disregard the first week where the unemployed receives zero in benefit, since previous research conclude that it is never optimal to increase the level of benefits as the unemployment spell continues. Furthermore, we make the assumption that the agent will in fact be effected when entering a new benefit period. Translated to the Swedish setting, this means that the benefits received will be dependent on the percentage allowed, and not the maximum limit. In *baseline* the agents will, if they are unable to find a new employment, receive

- 80 per cent of their previous wage for 40 weeks.
- 70 per cent of their previous wage for the following 20 weeks.
- 65 per cent of their previous wage eternally.

regardless of the state of the economy. This setup is also the foundation for our two business cycle dependent programs.

4.2 Changing Duration of Benefits

In *changing duration of benefits* the length of the first stage with the highest benefit level will be different depending on if the economy is in a boom or recession. A decrease (increase) in the first stage in a boom (recession) will be met with an increase (decrease) of the number of weeks in the stage where 70 per cent of the previous wage is received. The program will be symmetrical regarding the change between boom and recession and the change between the length of the first and second stage. The program is summarised in Table I.

Table I: **Changing duration of benefits**

	Baseline	**Changing duration of benefits**	
Benefit	All States	Boom	Recession
80%	40	$40-\lambda$	$40+\lambda$
70%	20	$20+\lambda$	$20-\lambda$
65%	∞	∞	∞

λ denotes how much the programs will be changed. Which λ that gives the optimal program will be presented in section 5.1 together with the results of the simulation. λ has to be a non-negative integer for the program to be less (more) generous in a boom (recession). Furthermore, λ cannot be more than 20 since that would create "negative" weeks in the 70 per cent level stage in a recession.

4.3 Changing Level of Benefits

The other way to construct a business cycle dependent unemployment insurance is to change the levels of unemployment benefit over the business cycle. That is, the benefits are increased in case of a recessionary shock and decreased in case of a boom. Kiley (2003) concluded that, in an American setting programs similar to *changing level of benefits* result in both higher insurance and incentives with a lower cost than unemployment insurance programs with changing length of benefits. To easier isolate the effect of *changing level of benefits* we only change the levels of benefits in the first 40 weeks of unemployment. This is also in line with the suggestions from Kiley (2003) and Sanchez (2008).

Table II summarise *changing level of benefits*. In a boom the benefit level will decrease with α_1 percentage points for the first 40 weeks. α_1 must be positive and maximum 10 percentage points. In a recession the benefit level will increase with α_2 percentage point for the same time period where α_2 must

Table II: **Changing level of benefits**

	Baseline	**Changing level of benefits**	
Week	All States	Boom	Recession
1-40	80%	$(80-\alpha_1)\%$	$(80+\alpha_2)\%$
41-60	70%	70%	70%
61-∞	65%	65%	65%

be positive and maximum 20 percentage points. The optimal values of α_1 and α_2 will be presented in section 5.2.

4.4 Calibration of Baseline

The calibration of the model consist of two parts. The first part is to find the correct value of the preference-parameters of the agent. The second part is to specify the model-specific parameters so that the model resembles the Swedish economy. The values for the preference-parameters, β and γ, are taken from previous research. In our model each time period is one week. Therefore we use Hopenhayn and Nicolini (1997) weekly discount factor of $\beta = 0.999$ which gives us a yearly discount factor of 0.95. When γ increases, the more risk averse the agents become and they prefer a more stable consumption. When it is zero the agents are risk neutral. We use 0.5 as value for γ which is commonly used in the literature. (McGrattan and Prescott, 2003; Hopenhayn and Nicolini, 1997). The fixed wage, w, will be set to 100.

The quality of the calibration will be measured by comparing the level of unemployment at 5, 20 and 35 weeks after the start of the unemployment spell for *baseline* with actual data from Sweden[3]. The model-specific parameters r^* (market tightness in steady state) and ϕ (the magnitude of the dis-utility

[3]The data shows how long time it took for those who applied for unemployment insurance in January 2008 to find a new position. At that time the Swedish economy was consider to be in steady state. (Swedish Unemployment Insurance Board, 2011a)

connected the search effort) will be decided so the model resembles the real economy. The optimal calibration for the model is when $r^* = 0.0009$ and $\phi = 1.2$. A comparison between the real data and the model is presented in Table III.

Table III: **Comparison between the Swedish economy and baseline**

	Swedish economy	**Baseline**
Week	Percentage unemployed	
5	85.0%	85.9%
20	45.2%	47.0%
35	35.7%	23.6%

The reason for why *baseline* overestimates the amount of re-employed after 35 weeks in Table III is due to the fact that our model only focuses on cyclical unemployment while the data provided is for all kinds of unemployment.

The probability of finding a new employment can be seen in Figure 2. It shows the probability of finding a new position for the next time period, i.e week, given the search effort a for three levels of labour market tightness, r. The different levels of r corresponds to when the Swedish Economic Tendency Indicator is 110 (boom), 100 (steady state) and 90 (recession) but is scaled so that the steady state corresponds to r^*. The figure shows that when the search effort increases the difference in probability between finding a job in a boom or in a recession also increases.

5 Evaluation of the Programs

The goal of the two business cycle dependent programs are to provide the same utility for the agents as *baseline* does, but to a lower cost. For the evaluation we will use 20 agents that loose their jobs evenly distributed over the time period 1996 to 2006. The labour market tightness they face will depend on the

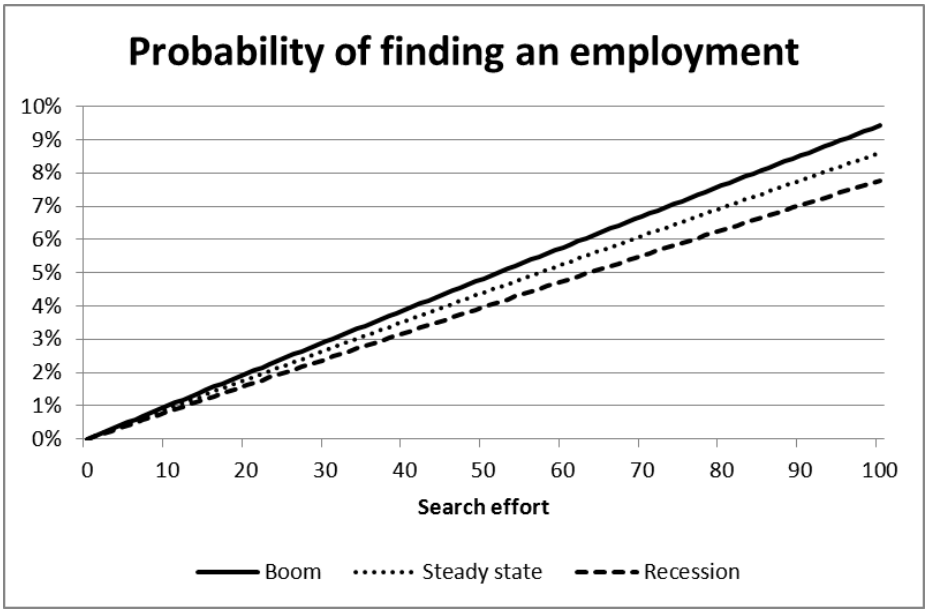

Figure 2: **The probability for a new employment given the search effort** a **and three different levels of labour market tightness**

Swedish Economic Tendency Indicator from the time period they loose their jobs and 180 weeks ahead. After 180 weeks we assume that the labour market tightness is in steady state. 10 of the agents start when the market tightness is above 100, which places them in the boom category. The remaining 10 starts when the market tightness is below 100, which places them in the recession category.

5.1 Evaluation of Changing Duration of Benefits

The simulation shows that the optimal λ is 20 weeks, which gives us Table IV.

We see that *changing duration of benefits - recession* is the most generous program with 60 weeks of 80 per cent of the agent's previous income, followed by *baseline* who has 80 per cent for 40 weeks and 70 per cent for the following 20. *Changing duration of benefits - boom* is the harshest program with 80 per

Table IV: **Optimal changing duration of benefits**

	Baseline	**Changing duration of benefits**	
Benefit	All States	Boom	Recession
80%	40	20	60
70%	20	40	0
65%	∞	∞	∞

cent for only 20 weeks and 70 per cent for 40. Economic theory says that as a consequence the highest search effort will be found in *Changing duration of benefits - boom* and the lowest in *Changing duration of benefits - recession* which is exactly what is observed in Figure 3.

Table V: **Utility, total weeks and total cost**

	Baseline	**Changing duration of benefits**
Utility	100.00	100.00
Total weeks	465.59	460.83
Total cost	36545.84	35953.45

The utility in Table V is the sum of the utility for all agents, normalized to 100 with *baseline* as a benchmark. Total weeks is the sum of the expected number of weeks of unemployment for all agents. Total cost is the sum of benefits paid out for all agents. The simulation calibrated *changing duration of benefits* so that the utility is the same as in *baseline*. The total number of weeks of unemployment for the 20 agents are five weeks less in *changing duration of benefits* which is a decrease of one per cent. The total cost is almost two per cent lower for *changing duration of benefits*. This means that the lower cost is not only due to the fact that less weeks are paid out, but also because the program cost less for each week. In *baseline* the agents starting in a boom receives 48 per cent of the total benefits and the agents starting in a recession receives 52 per cent. In *changing duration of benefits* the agents

starting in a boom receives 46 per cent and the agents starting in a recession receives 54 per cent. This result shows that there is not a large difference in cost distribution between the two programs.

5.1.1 Search Effort

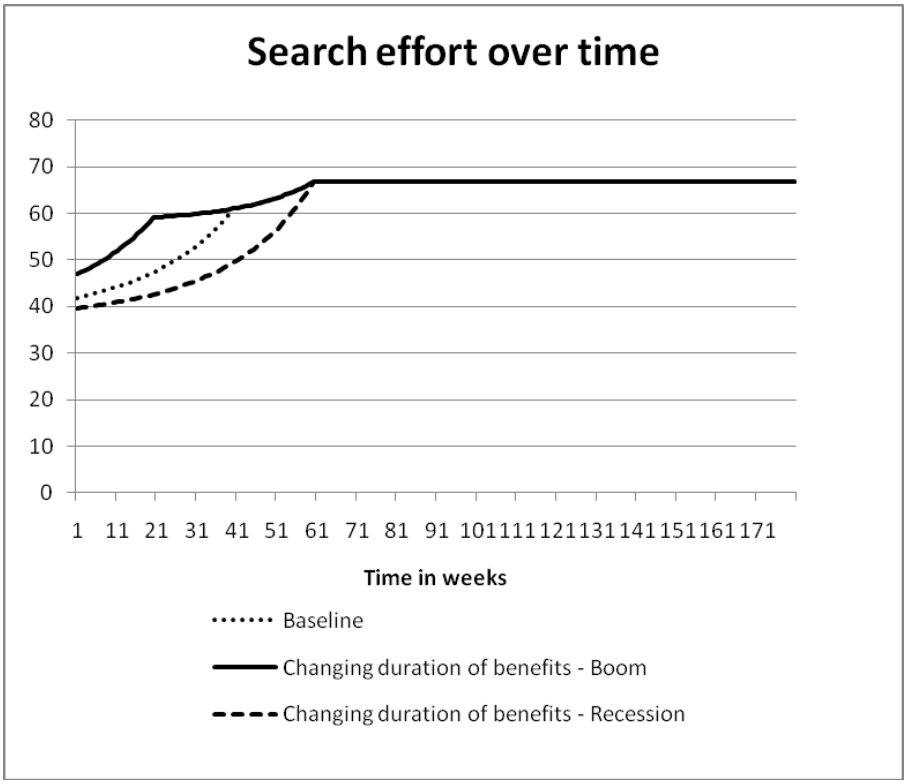

Figure 3: **Search effort over time for baseline and changing duration of benefits.**

The first thing to notice when looking at Figure 3 is that for the *baseline* the search effort is the same regardless of the state of the economy. This is due to the fact that it is the design of the programs that effects the optimisation and not the current or expected state of the economy. The line for *baseline* has a kink every time the benefit changes, one after 40 weeks and one after 60

weeks. The first week the search effort is a bit over 40 and then it increases constantly until week 60 where it is around 68.

Studying the line *changing duration of benefits - boom* we see that it also has two kinks where the level of benefits change. The search effort is higher compared to *baseline* before week 40. At week 41 both the benefits and the effort are the same. The largest difference between the two lines is at week 21, just after *changing duration of benefits - boom* has decreased the levels of benefit.

The line *changing duration of benefits - recession* has the lowest search effort. It only has one kink and not two as the other. The reason for this is that it only has two different levels, first 80 per cent of the agent's previous income and then 65 per cent. The effort is constantly increasing and at week 61 and onwards all three lines are the same.

The conclusion from Figure 3 is that the desired effect of a higher search effort in a boom has been accomplished. The setback is of course that it is lower in a recession when using *changing duration of benefits* instead of *baseline*.

5.1.2 Percentage Employed

Each line in Figure 4 represent the expected level of employment for the different programs and the different states of the economy, as a function of time. When comparing the level of employment for those in *baseline* but starting in either a boom or a recession we see that they are very close to each other. Since all of the agents have the same search effort this indicates that the state of the economy effect the possibility of finding a job, but the impact is small.

For *changing duration of benefits* there is a large difference in the level of employment when comparing between a boom and a recession, around ten percentage point at the most. Comparing the difference between *baseline-boom* and *changing duration of benefits - boom* with *baseline - recession* and *changing duration of benefits - recession* we see that it is larger when the economy is in a boom, i.e the difference between the two programs is larger in a boom than

Figure 4: **Percentage of employment for baseline and changing duration of benefits.**

in a recession. That indicates that in a boom people are forced out to work, but in a recession the more beneficial benefits does not distort the incentives as much.

5.1.3 Weeks of Unemployment

When comparing the boxplots[4] in Figure 5 over the weeks of unemployment for the ten agents in *baseline* and *changing duration of benefits* in a boom they are almost identical. The only significant difference is that the entire distribution of number of weeks is approximately 2.5 weeks less in *changing duration of*

[4]The boxplots are constructed so that the first, second (median) and third quartile is represented with a box and the largest and smallest values are represented by the endpoints.

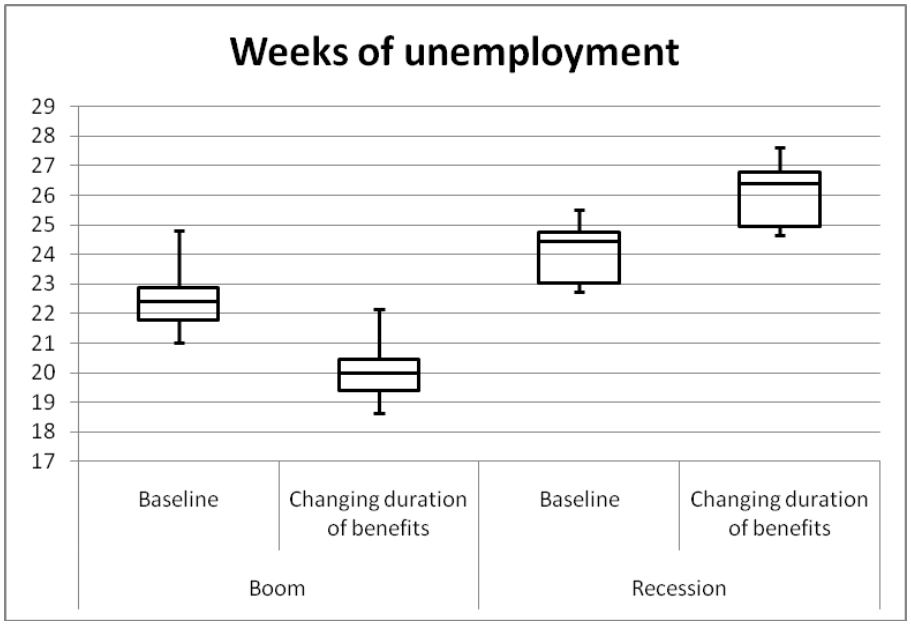

Figure 5: **Weeks of unemployment for baseline and changing duration of benefits.**

benefits. This is due to the increase in search effort.

Comparing the boxplots for when the economy is in a recession a similar pattern reveals. The distribution between the two programs are the same but in this case *baseline* is two weeks lower than *changing duration of benefits*.

5.2 Evaluation of Changing Level of Benefits

The combination of α_1 and α_2 who had the same utility as *baseline* to the lowest cost was $\alpha_1 = 6.97$ percentage points and $\alpha_2 = 5.51$ percentage points. Replacing the α_1 and α_2 with the optimal values gives the program *changing level of benefits*, presented in Table VI.

The gist of the program *changing level of benefits* is that in a boom the benefit will be 73.03 per cent of the previous income for the first 40 weeks and in a recession it will be 85.51 per cent, compared to 80 per cent in *baseline*.

Table VI: **Optimal changing level of benefits**

	Baseline	**Changing level of benefits**	
Week	All States	Boom	Recession
1-40	80%	73.03%	85.51%
41-60	70%	70%	70%
61-∞	65%	65%	65%

For the rest of the time the programs are identical in all states of the economy. The lowered benefits in a boom is expected to increase the incentives to find a job in *changing level of benefits* compared to *baseline*. The reversed effect is expected in a recession. *Changing level of benefits* will be evaluated at the same way as *changing duration of benefits*, starting with Table VII.

Table VII: **Utility, total weeks and total cost**

	Baseline	**Changing level of benefits**
Utility	100.00	100.00
Total weeks	465.59	464.95
Total cost	36545.84	36544.62

The total weeks is slightly lower for *changing level of benefits* than for *baseline* which is also the case for the total cost. However, the differences are small, less than 0.2 per cent for the weeks and 0.001 per cent for the cost, so the gains of the new program seem insignificant. Looking at the distribution of cost, the agents in *changing level of benefits - boom* are responsible for 39 per cent of the total cost. Agents in *changing level of benefits - recession* is responsible for 61 per cent of the total cost.

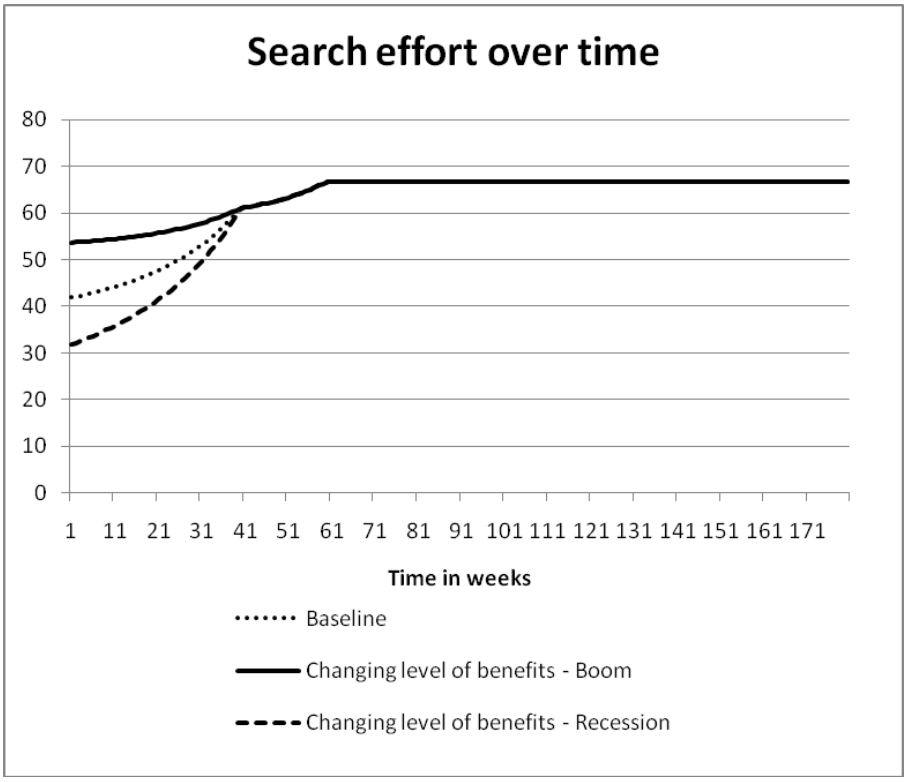

Figure 6: **Search effort over time for baseline and changing level of benefits.**

5.2.1 Search Effort

Figure 6 shows that the search effort converges after week 40. The reason for this is because at week 41 the level of benefits are the same in both programs regardless of the current state of the economy. For the *changing level of benefits - boom* the search effort start quite close to its maximum. The *changing level of benefits - recession* starts lower and increases sharply. The search effort for *changing level of benefits - boom* is significantly higher than for *changing level of benefits - recession* in the first week. There is a kink, for all three lines, at week 41 and week 61. The magnitude of the kink at week 41 is dependent on the level of benefits in the first stage. For *changing level of benefits - boom* the difference in benefit levels is small and so is the kink.

5.2.2 Percentage Employed

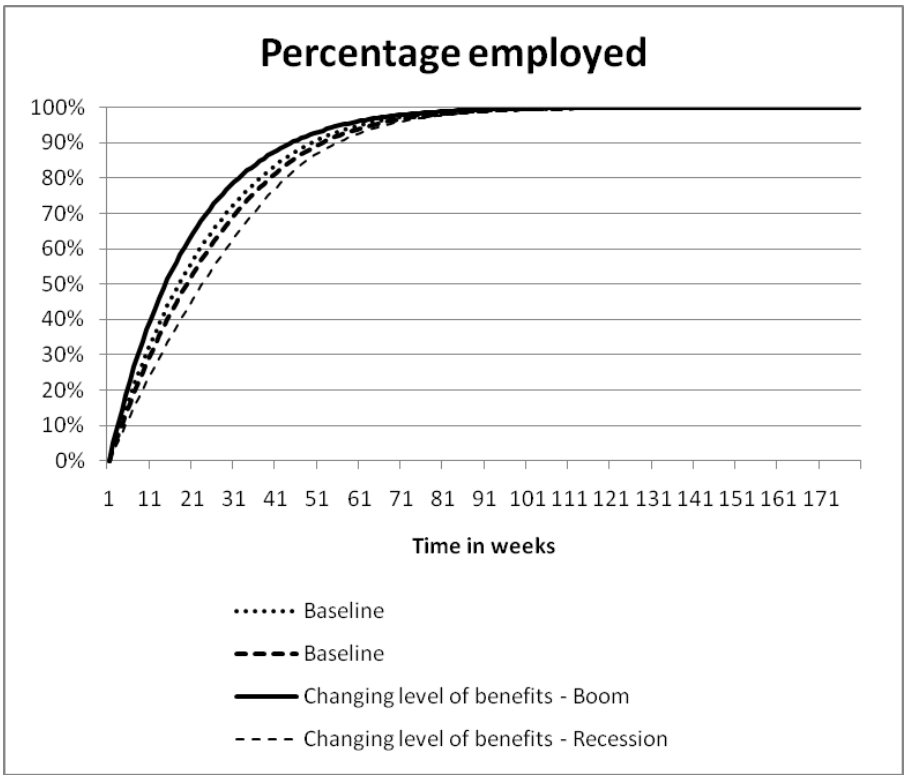

Figure 7: **Percentage of employment for baseline and changing level of benefits.**

In Figure 7 the differences in percentage employed between the *changing level of benefits - boom* and *changing level of benefits - recession* are relatively symmetric around *baseline*. So the gain by using *changing level of benefits* in a boom is offset by using it in a recession.

5.2.3 Weeks of Unemployment

Once again the only difference between the two programs is the shift in distribution in number of weeks of unemployment in the two states of the economy. In a boom the entire boxplot is three weeks less for *changing level of bene-*

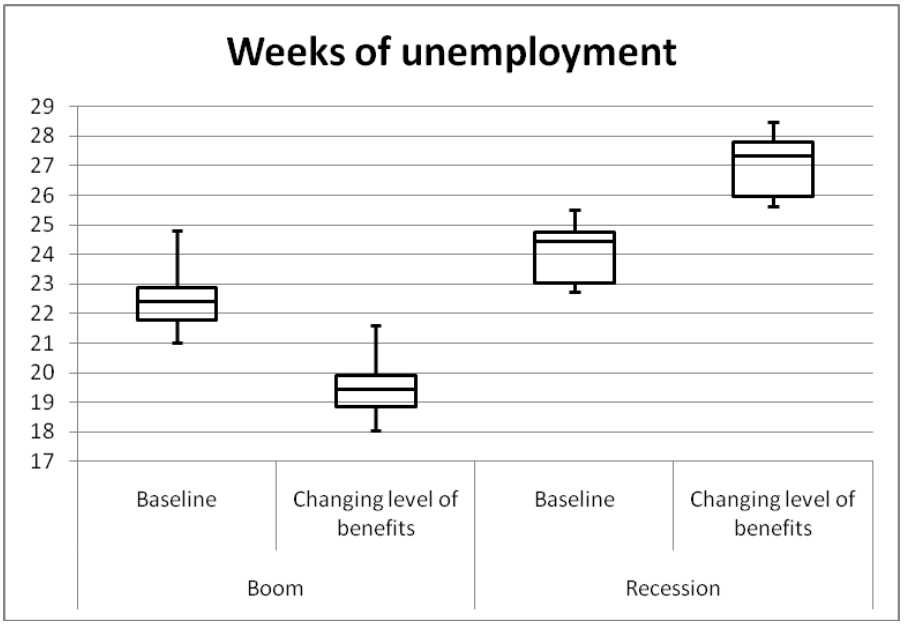

Figure 8: **Weeks of unemployment for baseline and changing level of benefits.**

fits compared to *baseline*. For the agents experiencing a recession the entire boxplot is increased with three weeks for *changing level of benefits*.

5.3 Sensitivity Analysis

The robustness of the presented results is determined by a sensitivity analysis. It is conducted under ceteris paribus which means that one parameter is changed while the others are held constant. The model's exogenous parameters, γ and β, with values taken from previous research, are the ones that will be analysed. The new values for γ will be 0.25 and 0.75 meaning that the agents will be less risk-averse and more risk-averse respectively. β will change to 0.998 and 1. When β is 1 the agents are indifferent between receiving utility today or in the future.

The sensitivity analysis shows that both *changing duration of benefits* and

changing level of benefits provides the same utility as *baseline* in all scenarios. When comparing the amount of weeks unemployed in *baseline* with *changing level of benefits* the result is inconclusive since *changing level of benefits* is sometimes, but not always, the program with the lowest amount of weeks. This implicates that the result from the main simulation of *changing level of benefits* is not robust against moderate changes in the calibrated parameters.

However, *changing duration of benefits* always has less weeks of unemployment and a lower total cost compared to the two other programs despite changes in the parameters. The conclusion of this is that our result regarding *changing duration of benefits* from the main simulation is robust against moderate changes in the calibrated parameters.

6 Conclusions

To answer the question if it is possible to provide the same utility to the unemployed in Sweden to a lower cost by using a business cycle dependent unemployment insurance we have done a simulation of the Swedish labour market based on an extension of the model used by Kiley (2003). In order to model the labour market tightness we used actual data from the Swedish Economic Tendency Indicator. We constructed three programs, *baseline*, *changing duration of benefits* and *changing level of benefits* which were then simulated and evaluated. We used estimates of weeks of unemployment, total cost, distribution of cost and search effort when comparing the two business cycle dependent unemployment insurance programs to *baseline*.

When looking at the simulated results we see that *changing duration of benefits* has a lower total cost, less weeks of unemployment and a higher search effort in a boom compared to *baseline*. This shows that there are welfare gains by implementing *changing duration of benefits*. Hence, it is possible to provide the same utility to a lower cost than the current Swedish system by using a business cycle dependent unemployment insurance. Even though the cost

savings are small, considering the total cost of the unemployment insurance in Sweden even a small saving is important.

The logic behind this result is that *changing duration of benefits* incentives the agents to search persistently for jobs early in their unemployment spell in a boom and at the same time provides them with a high insurance in a recession. This means that *changing duration of benefits* has a more optimal trade-off between incentives and insurance than *baseline*. One drawback of *changing duration of benefits* is that the search effort is lower in a recession compared to *baseline*. This might only be of a small importance because in a recession there are fewer jobs available, so a high search effort would not yield a high return. *Changing duration of benefits* would in, line with the findings of Andersen and Svarer (2009, 2010), increase the variance in the unemployment rate even though the mean is lower, which can be seen in Figure 4 and Figure 5. This is a possible drawback of the program since agents are risk averse and prefer a low variability in their utility.

Our simulation builds on the assumption that the same number of agents become unemployed in a boom as in a recession, which may not be realistic. The total cost is similarly divided among the agents who receive benefits in a boom and a recession between the *baseline* and *changing duration of benefits*; 48 and 52 per cent versus 46 and 54 per cent. Hence, it is reasonable to believe that the *changing duration of benefits* would be welfare improving even if the distribution of agents would differ.

The effects of *changing level of benefits* is similar to *baseline* but considering the large cost for those unemployed in a recession the program does not offer a better trade-off between incentives and insurance than *baseline*. Kiley (2003) concluded that programs similar to *changing level of benefits* provides both better insurance and incentives than programs like *changing duration of benefits* in an American setting. Our simulation shows that this is not the case for Sweden.

6.1 Further Research

The focus of the thesis has not been to distinguish which political efforts are necessary to implement a business cycle dependent unemployment insurance in Sweden. Neither has the purpose been to decide the exact rules necessary for the program to work. Both questions are important and we hope they will be addressed in future research.

The model used for the simulation could be both refined and elaborated. We also suggest that more programs are investigated, for example one with three different states of the economy; recession, steady state and boom. Also combinations of changes in both the duration and the level of benefits could be considered.

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