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„Wealth Inequality and Welfare Implications of a Bequest Tax“

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Abstract

In this thesis I am developing an overlapping generations model to quantitatively evaluate changes in inequality and welfare resulting from intergenerational transfers. I use Austria as a country of reference for which I calibrate my model. Since there is no bequest tax in Austria this allows for a counterfactual exercise when I introduce a bequest tax into the economy. I find that in terms of inequality the bequest tax I choose for my model does not give a clear indication in which direction inequality is going. However, in terms of welfare there is a clear message that a bequest tax increases welfare in my model. By setting the bequest tax to 100% I find that even though the economy would be more equal, the welfare would be decreased drastically.

Kurzfassung

In dieser Arbeit entwickle ich ein überlappendes Generationenmodell, um sowohl Ungleichheitsmaße als auch Wohlfahrtsmaße zu evaluieren, die sich mit intergenerativen Transfers befassen. Das Referenzland, auf das sich mein Modell bezieht, ist die österreichische Wirtschaft. Da es in Österreich keine Erbschaftssteuer gibt, ermöglicht dies eine kontrafaktische Betrachtung, wenn ich eine Erbschaftssteuer in der Wirtschaft einführe. Die Simulationsergebnisse liefern für die Erbschaftssteuer die ich einführe in Bezug auf die Ungleichheit keinen klaren Hinweis darauf, in welche Richtung sich die Ungleichheit entwickelt. Im Hinblick auf die Wohlfahrt gibt es jedoch eine klare Botschaft: Eine Erbschaftssteuer in meinem Modell erhöht die Wohlfahrt. Wenn ich die Erbschaftssteuer auf 100% erhöhe, stelle ich fest, dass, obwohl die Kapitalverteilung gleicher wird, die Wohlfahrt drastisch sinkt.

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1. Introduction

The importance of inequality both in terms of wealth and income has increased in the past. There is also a growing public interest in these economic phenomena, not purely an academic concern. In this thesis I am keen to find some answers to questions concerning wealth inequality and welfare. More specifically, I want to analyse intergenerational wealth transfers, how these transfers affect welfare and inequality and how a bequest tax could influence both welfare and inequality. The assumption that a decrease in wealth inequality goes hand in hand with an increase in welfare may seem cogent at first, but as I will show this may not be the case. The trade-off between inequality and welfare is one aspect that I am trying to analyze with my thesis. Specifically, how much does a bequest tax change the concentration of wealth? And secondly, does the economy benefit from a bequest tax and at what cost?
I am calibrating my model economy towards the Austrian economy. This means that I will use parameters that were estimated for the Austrian economy or closely related economies. Subsequently, I will compare key distributional features of the Austrian economy with those same features from my simulated economy. Austria is an interesting case to study for one particular reason: the country has not had a bequest tax since 2008. This has the advantage that the base line case in my model can be fitted so that it corresponds to the Austrian data. Afterwards, the bequest tax can be introduced as a counterfactual exercise and both welfare and inequality measures can be studied.
In the past several studies were concerned with specific aspects of inequality. First and foremost, de Nardi (2004) who is mostly concerned with fitting a wealth distribution towards the observed wealth distribution in the US and Sweden using intergenerational transfers. Second, there is a rich literature with the main goal to find different channels that influence wealth inequality and more specifically intergenerational transfers. Examples here include de Nardi & Fella (2017) and Fagereng et al. (2020). Finally, there is a strand of literature that is trying to find the optimal bequest tax in terms of welfare, for example Piketty & Saez (2013).

The remaining thesis is structured as follows: in chapter 2 I will discuss relevant literature and distinguish my thesis from these works. In chapter 3 I will present distributional data for the Austrian economy. In chapter 4 I will discuss my model in great detail and report the parameters that are used to solve the model numerically. In chapter 5 I will provide the results my model produced including distributional data and the comparison with data for the Austrian economy. In chapter 6 I will take a step back and discuss how my simulated results could change if certain assumptions were not taken. Finally, in chapter 7 I will summarize my findings and discuss future research paths that could be taken from this thesis.

2. Literature

In this chapter I will provide a short overview over related literature and put my thesis in context with these papers.
de Nardi & Fella (2017) explore the importance of different channels that can contribute to a concentrated wealth distribution. The first channel that is discussed are intergenerational linkages. With regards to this channel the authors find that how one models the bequest motive is pivotal to how well the model can explain the concentrated wealth distribution that can be observed in the data (de Nardi & Fella, 2017, p. 285 ff.). In de Nardi (2004) different experiments are conducted to see how important a bequest motive is in explaining the wealth distribution observed in the data. When both the bequest motive and a productivity inheritance are introduced the model does better, especially for the top 1% of the wealth distribution (de Nardi, 2004, p. 754). She finds that only a full bequest motive is able to generate this distribution, an accidental bequest motive is not sufficient because richer households dissave too much in their retirement (de Nardi, 2004, p. 756). This thesis will borrow from de Nardi (2004) in the modeling approach, but the emphasis is on welfare implications without the ambition to fit the wealth distribution perfectly.
In addition to a bequest motive de Nardi & Fella (2017) discuss heterogeneity in preferences which can contribute to a concentrated wealth distribution similar to what is seen in the data. Although a high degree of heterogeneity in preferences is necessary, which is a point that could not be reasonable (de Nardi & Fella, 2017, p. 289). Hendricks (2007) inspects two types of heterogeneity. First in return rates and second in the discount factor. The latter is important in explaining the observed distribution of wealth at retirement and could be a possible extension for this thesis. Due to the fact that this thesis is concerned with a counterfactual exercise I will abstract away from this in my model to not over-complicate it.
In a next step the authors discuss earnings risk as a potential channel for an uneven wealth distribution. One of the first authors discussing risky earnings to account for the wealth distribution was Huggett (1996). In the calibration that best fitted the wealth Gini of the time Huggett used a zero borrowing constraint and uncertain life time. Even though his model reassembled the wealth Gini perfectly his model could not account for the very high concentration of the top percentiles (Huggett, 1996, p. 482). With the goal of accounting for higher wealth percentiles using an earnings process Castañeda et al. (2003) found that in order for an earning process to be sufficient to describe the wealth distribution it has to be of a specific type. Their calibrated earnings process shows that people who draw a high state are very likely to draw a very low state in a following periods (Castañeda et al., 2003, p. 843). This uncertainty for high earners means that these people will save a lot, because they expect to earn less in future periods. In addition,

the relative wage of agents who drew the highest efficiency are 1,000 times larger then the wage of agents who drew the lowest efficiency type. An additional exercise performed by Castañeda et al. (2003) is that after calibrating the model and finding their results they abolish the estate tax that was previously present in their model to evaluate how the wealth Gini changes due to that policy change. What they found is that the Gini index for wealth only changed slightly from 0.79 to 0.8 (Castañeda et al., 2003, p. 852). Furthermore, de Nardi and Fella discuss medical expenses as a savings motive, especially for older generations (de Nardi & Fella, 2017, p. 291). This savings motive can explain why people in the higher wealth percentiles hold wealth even when they are at the end of their lives. Since de Nardi & Fella (2017) are considering an economy shaped like the US economy and I am considering an economy which resembles a welfare state (like Austria) saving for medical expenses is not as important in the context of my model. For example, the Austrian government and public health insurance providers are responsible for 75.2% of all medical expenses (Statistics Austria, 2020a). From this one can infer that the individual in Austria does not have to pay the majority of their medical expenses out of pocket. Especially if one would disentangle the remaining 24.8% which also include private insurance companies.

Besides the theory of wealth accumulation one has to account for the theory on inheritance taxation. The link between the bequest motive and the effect a tax could have on the bequest is examined by Cremer & Pestieau (2011). What they find is that if the bequest motive would only be accidental, then the amount parents bequeath to their children should not be affected by a bequest tax (Cremer & Pestieau, 2011, p. 375). Setting this in comparison to what de Nardi (2004) found about the explanatory power of accidental bequests one can infer that a bequest tax will have an effect on savings behaviour if one considers non-accidental bequests. In their representative agent model Cremer and Pestieau find that with a purely altruistic bequest motive the savings tax (= bequest tax) should be equal to zero in the steady state. Nevertheless, they find evidence for taxing bequests when they investigate a joy of giving motive which is a reason why I am using a joy of giving bequest motive (similar to de Nardi) (Cremer & Pestieau, 2011, p. 383). In comparison, I will not use a representative agent model but will use a Bewley model which has heterogeneous agents (Bewley, 1977).
Piketty & Saez (2013) try to find an optimal inheritance tax. There is a trade-off that has to be considered when talking about a bequest tax. On the one hand, by taxing a bequest one hurts both the giver and the receiver, since their utility is decreased. On the other hand, one can decrease lifetime recourse inequality, which would speak in favor of such a tax (Piketty & Saez, 2013, p. 1858). Lifetime recourse inequality means that a potential bequest tax could redistribute asset such that these asset are distributed more equal. What I am assuming is that this more equal distribution could increase the overall welfare in the economy.

In the next section I will discuss some facts about the Austrian wealth distribution.

3. The Austrian Wealth Distribution

In this chapter I will give a brief overview over the data concerned with the Austrian wealth distribution.
In accordance with my argument about medical expenses Fessler & Schürz (2015) find that social security is a subsidy for private wealth. They calculate that a 1€ increase in pension leads to a 0.61€ decrease in private wealth. According to Fessler & Schürz (2015) the average Austrian bequest is 265.000€ with around 35% of Austrians receiving a bequest. Before the abolishment of the Austrian bequest tax in 2008 the tax contributed only 0.12% (2006) to the total tax revenue of Austria (Cremer & Pestieau, 2011, p. 371). The Austrian bequest tax was dependent upon the relationship between the bequeather and the bequeathed. The lowest percentage was 2% for the closest relation (children and spouses) and the small amount of 7,300€. The highest tax was 60% for the farthest away relation and amounts of over 4,380,000€ [1].
The relative importance of inheriting in Austria compared to other European countries is the highest for the countries analysed by Fessler and Schürz. They found that inheriting would lead to an increase in ones position in the wealth distribution that is equal to a 52 percentile increase in the income distribution (Fessler & Schürz, 2015, p. 30). This shows how important an intergenerational transfer is in Austria, an agent who does not receive a transfer would have to increase his or her own position on the income distribution by 52 percentiles in order to be at the same position on the wealth distribution as an agent who receives an intergenerational transfer. In addition to Fessler and Schürz's findings Humer et al. (2016) find that households who receive bequests are over-represented in the top 1% of the wealth distribution by a factor of four.

Top	1%	5%	20%	50%	Gini
Share	22.6	43.1	72.8	96.4	0.739

Table 3.1.: Gini and wealth share of different top percentage groups in Austria[2]

In table 3.1 the shares of wealth for different groups in the wealth distribution are presented. Top 1% for example corresponds to the group that is in top 1% of the wealth distribution. These numbers show how unequal wealth is distributed in Austria. For example, the top 1% holds more than 20% of the total wealth in Austria.

In the next chapter I will describe my methodology, present the parameters I used and the solving algorithm.

[1] Erbschafts- und Schenkungssteuergesetz 1955, BGBl. I Nr. 9/2007.
[2] The share of wealth is for 2018 and the Gini for 2019 Source: Credit Suisse (2018).

4. Methodology

This chapter is structured as follows: The first part is a description of my model, followed by the specification of the parameters used to solve the model and lastly the depiction of the solving algorithm.

4.1. The Model

This subsection describes the characteristics of the model. Starting with the general dynamic of how periods are defined, going over how preferences are specified and finishing with prescribing the value functions. The general framework that I am working in is a Bewley model[3] which means that I have individual earning shocks which over the life-cycle produce heterogeneous agents (Bewley, 1977). These agents are equal when they enter the economy, they start out with zero assets, but due to their individual earnings history these agents can potentially produce a very concentrated wealth distribution.

Periods:

Period	Generation 1	Generation 2	Generation 3
t=1	20-24		
t=2	25-29		
t=3	30-34	(0-4)	
t=4	35-39	(5-9)	
t=5	40-44	(10-14)	
t=6	45-49	(15-19)	
t=7	50-54	20-24	
t=8	55-59	25-29	
t=9	60-64	30-34	(0-4)
t=10	65-69	35-39	(5-9)
t=11	70-74	40-44	(10-14)
t=12	75-79	45-49	(15-19)

Table 4.1.: Model periods

Starting from 20 years of age the model has 12 periods where each period represents 5 years. Before that the agents are not explicitly modeled. Households have children when they are 30 (in period 3) which means when their child enters the model at age 20 they are 50 and just start period 7. After period 9 (when agents are 65 years old)

[3]More on the Bewley model can for example be found in Ljungqvist & Sargent (2004) in chapter 17

they retire and get a pension from the government. After period 12 all agents die with certainty at the age of 80. In table 4.1 I trace three generations explicitly to increase comprehensibility.
Utility function: $u(c_t) = \frac{c_t^{1-\eta}}{1-\eta}$. This utility function represents a classic constant relative risk aversion (CRRA) utility function where consumption is the variable of concern. The second utility function is the utility of a parent of bequeathing to their children which is given by: $\phi(b)$, where $\phi(b) = \phi_1 \left(\frac{\frac{b}{\phi_2}^{1-\eta} - 1}{1-\eta} \right)$. ϕ_1 reflects a scaling factor that is used to control the overall size of bequests in the economy. ϕ_2 is an indicator of how much of a luxury good a bequest is. What that means is that it helps to concentrate bequests at the upper end of the distribution. The specification of the utility of parents to leave a bequest for their children follows de Nardi (2004). Nevertheless, the exact values for ϕ_1 and ϕ_2 were estimated in the model for the method (see section 4.2.1).
Earnings Process: The wage of every agent in the economy is defined by an efficiency process and a productivity level. The efficiency process is age dependent but equal for all agents. The data for this process comes from de Nardi (2004), where yearly efficiency profiles for agents between the age of 20 and 64 are provided. Since this model has 5-year periods the 45 data points were put into 9 equal groups of 5 and the mean was calculated. De Nardi uses the estimation from Hansen (1993). In a last step I normalized the efficiency profile s.t. the mean of it is equal to 1. Bayer & Juessen (2012) estimated a wage risk for Germany and I use their auto-correlation (ρ) and variance parameter (σ^2) to calculate the transition probabilities for the Markov chain. The individual wage stages are calculated using data from Statistics Austria (2020b). The wage of an agent is then $w(t, i) = e(t) * p(i)$ where $e(t)$ is the efficiency in the respective period $t \in [1, 9]$ and $p(i)$ the productivity in state $i \in [1, 6]$. Specific details on the earnings process can be found in the appendix. The earnings from assets are represented by the risk-free interest rate (r).
Pension: This is a state dependent transfer which the government distributes. State dependent means that the transfer depends on the income state the agent was in his or her last period of work. The money comes from a proportional tax (τ_l) on labor income which every agent has to pay during their working periods.
Bequest tax: The type of bequest tax (τ_b) is a flat tax which has an exemption threshold. So every asset above this exemption threshold that is left by one generation is taxed at the same rate. To find the exact percentage tax (τ_b) and the exemption threshold (exm) I am using the welfare measure Consumption Equivalent Variation (CEV). Following Mas-Colell et al. (1995) who describe how equivalent variation is defined that first appeared in Hicks (1939), I will use this measure in a slightly different setup which can for example be seen in Exler (2019). What distinguishes CEV from equivalent variation discussed by Mas-Collel et al. is that equivalent variation measures a change in prices, which is not possible since there are no prices in my model. The exact formulation of CEV is

$$V_\xi(a) = \mathbb{E} \sum_{k=1}^{12} \beta^{k-1} * u(c_k(1+\xi)) = V_{tax}(a)$$

$$\xi = \left(\frac{V_{tax}(a)}{V(a)}\right)^{\frac{1}{1-\eta}} - 1 \tag{4.1}$$

ξ is a percentage that evaluates how much more consumption an agent, would need to be indifferent between the scenario without the bequest tax and the scenario with the bequest tax. It is important to note here that ξ is equal for all agents since I assume that the agents do not know which income state they will be assigned when they enter the economy. The two scenarios between which the agent needs to be indifferent are represented by $V_\xi(a)$ and $V_{tax}(a)$. The former is the scenario without the tax, where consumption is increased by ξ, the latter is the scenario including the bequest tax. This means that as ξ increases the compensation would have to increase. The goal is to find the bequest tax that gives the highest ξ.

Government: The role of the government in this economy is to collect the taxes and redistribute the collected taxes to the agents in the economy. This ensures that the budget clears and no assets are left unaccounted for.

The redistribution of bequests is not done at once, but the revenue the government collects is split such that there is a constant transfer each period. This means that all agents receive an additional transfer (T_b) in each period. This transfer is not state dependent which means that everybody in the economy receives the same amount of assets per period.

Restrictions: The borrowing limit is set to 0, which means agents are not allowed to hold debt in any period. Another restricting assumption that I make is that there is no social mobility in my model. Each child will be born into the same income state his or her parent is in. This assumption is necessary to allow for an easy matching between parents and children.

Households and their value functions: The household chooses this period's consumption (c) and next periods asset (a') holdings. After period 6 the agents will receive a bequest, because their parents die with certainty. The respective value functions are dependent on period in which the agents currently are in.

- From period t=1 to t=6 (20 to 49 years old) the agents will survive with certainty, in addition they will not receive any bequests since their parents are younger than 80. In period 1 they receive their parents' productivity (pp) through a one-to-one mapping.

  $$V(t,a,p,pp) = max_{c,a'}\{u(c) + \beta E_t V(t+1,a',p',pp)\} \tag{4.2}$$

  subject to,

  $$a' = (1+r)a + (1-\tau_l)w_i - c + T_b\omega$$

  The expectation operator in equation 4.2 represents the fact that the agents do not know which productivity shock they will receive in the next period.

- In period t=7 (50 to 54 years old) the agents will survive with certainty, but contrary to period 1 through 6 there is the possibility of a bequest if the parent has saved enough money. The bequest arrives in this period because parents are 6 periods ahead of their children which means that if the child is 50 the parent is 80 and dies. This can be seen in table 4.1.

$$V(t,a,p,pp) = max_{c,a'}\{u(c) + \beta E_t V(t+1,a',p',pp)\} \tag{4.3}$$

subject to

$$a' = (1+r)a + (1-\tau_l)w_i - c + b + T_b\omega$$

where b is the bequest received from the parents.

- From period t=8 to t=9 (55 to 64 years old) the agents have received their bequest in the previous period, which means they will not receive anything except for wages in these two periods.

$$V(t,a,p,pp) = max_{c,a'}\{u(c) + \beta E_t V(t+1,a',p',pp)\} \tag{4.4}$$

subject to

$$a' = (1+r)a + (1-\tau_l)w_i - c + T_b\omega$$

The value function 4.4 is equivalent to value function 4.2. The difference between those periods lies only in the fact that in period 1 through 6 the agent still waits for his or her bequest and in period 8 and 9 the agent has already received the bequest.

- From period t=10 to t=12 (65 to 79 years old) the agents are retired which means that they receive a transfer (T) from the government and they do not expect any bequest because their parents are already dead. They know for sure that at the end of this period they will die and leave a bequest to their children.

$$V(t,a) = max_{c,a'}\{u(c) + \alpha V(t+1,a') + (1-\alpha)\phi b(a')\} \tag{4.5}$$

subject to

$$a' = (1+r)a + T - c + T_b\omega$$

α represents a ticker variable which is 1 in periods 10 and 11 and 0 in period 12. This transforms the value function in the last period into one where the agents think about current consumption (c) and about the bequest he or she will leave to their child $\phi b(a')$. The uncertainty that was present in all previous value functions was due to individual productivity shocks, since after retirement the agents do not work anymore this uncertainty disappears. The agents know that after this final period they will die and therefore they only care about current consumption and leaving a bequest to their children.

- ω is a dummy variable which is 0 if there is no bequest tax and 1 if the tax is introduced. This simply accounts for the fact that if there is no tax the government has no revenue it can redistribute to the agents in the economy.

4.2. Solving the Model

To solve this model I am using the following solution procedure:

1. start with 0 bequests for all income states
2. solve each period's state dependent value function, starting from the last (backwards iteration)
3. simulate the economy using a Markov simulation with 1,000,000 agents
4. calculate the mean bequest of each state
5. calculate the difference between the old bequest and the new bequest
6. if the difference is $>$ 1e-8 go to point 1, but use the newly calculated bequest otherwise the model is solved

In point 6 I state the convergence limit, this number is so small to ensure, that agents will not change their bequests from generation to generation. There should be no movement. After the simulation the program produces the asset life cycle of all 1,000,000 agents. An asset life cycle describes the asset level in each period of each individual agent. From this matrix one can calculate the share of different percentiles in the wealth distribution, determine the expected value of an agent entering the model and evaluate mean bequests and assets held. Especially evaluating the mean bequest is important in my model, this is point 4 in the solving algorithm. For this exercise I take the last period's asset holdings, sort them by size and then group them according to the stationary distribution, calculate the mean and assign it to the respective group. For example, in state 1 there are 38.38% of the total population (1,000,000 agents) so there are 383,800 agents in state 1. The mean of the first 383,800 sorted assets is then the mean bequest of state 1. There is an underlying assumption I made in order to use this specific exercise, namely parents and children will be in the same income state, so there is no social mobility in my model. This assumption is necessary, otherwise I would have had to define a matching function between parents and children. Moreover, I argue that this assumption is not too unrealistic. In Austria the upward earning mobility is relatively low compared to other OECD countries (Förster & Königs, 2020), which does not mean that Austria has no social mobility, but the simplifying assumption that there is no social mobility in my model is justifiable.

4.2.1. Model Calibration

In this subsection I will explain which parameters I have chosen to fit my model towards the Austrian economy.
The discount factor β is calculated using the interest rate. $\beta = \frac{1}{1+0.03} \approx 0.97$
The risk aversion parameter η is taken from the literature, in Gandelman & Hernandez-Murillo (2015), where the authors estimate specific risk aversion parameters of different countries, including Austria. They find that Austria has a risk aversion parameter (η) of

1.08.
To estimate the transition probability matrix which corresponds to the earnings risk, I have used an estimation from Bayer & Juessen (2012). It has to be mentioned here, that Bayer and Juessen are estimating autocorrelation (ρ) and variance (σ^2) using German data. What I am assuming is that these two parameters will look similar in the Austrian labor market. This assumption combined with the income states I estimated using data from Statistics Austria are a good approximation, in light of the scarce data on Austrian earnings processes.
The labor tax is a flat tax at 30 %, although Austria has a progressive tax plan for income taxation I am using this flat tax to ensure that every agent has a pension during their retirement and to ensure that the model is not too complicated.
The bequest tax is a flat tax, which means that every agent has the same tax. The amount of the tax and the exemption are determined to maximize the agents welfare, $\tau_b \in$ [0,1] and $exm \in [0, 20]$. As mentioned above the welfare measure that I am using in this thesis is the CEV.
The parameters for the bequest utility function ϕ_1 and ϕ_2 are chosen by me following two different criteria: First, the mean bequest in my model has to equal the mean bequest left in Austria, which is 268,500 € (Humer et al., 2016, p. 6). Second, the lower income states should not leave a bequest, because only approximately 35% of all households leave a bequest to their heirs in Austria (Humer et al., 2016, p. 6). The second criterion was introduced after seeing that lower income states were leaving bequests as high as their income from 8 periods which would mean they save everything and spend nothing because the utility of leaving a bequest is too strong. To counter this behaviour I have introduced ϕ_2 which is also used by (de Nardi, 2004), the author classifies this variable as an indicator of how much of a luxury good a bequest is.

Parameter	Value
β	0.97
η	1.08
r	3%
ρ	0.922
σ^2	0.0423
τ_l	30%
τ_b	[0%,100%]
exm	[0,20]
ϕ_1	0.857
ϕ_2	1.98

Table 4.2.: Parameters

This concludes the discussion of parameters. In the next chapter I will present the results of my numerical exercise.

5. Simulation Results

In this chapter I am going to present the results of my model. I am starting with finding the bequest tax that maximizes the CEV. Afterwards, I examine the differences in the share of the top 1 through top 50 and the wealth Gini. As a control exercise I will evaluate what changes if there is no bequest utility. After discussing these results I will continue to analyse an age depended asset distribution and where my model differs from the observed data. In a final step I will look at the life-cycle distribution of assets and see where changes occurred after the policy change was implemented.

5.1. Finding the Bequest Tax

The first part after solving the baseline model (without any bequest tax) was to use the welfare parameter of CEV to find the bequest tax and the exemption threshold for the tax that gave me the highest CEV. For that exercise I calculated the model solution using bequest taxes from 0% to 100% in 2.5% increments (41 different taxes) and exemption amounts from 0 to 20 (21 exemption amounts) that means in total there where 861 different combinations to choose from.

In figure 5.1 I present the evolution of the CEV for three different exemption levels: 0, 2 and 4. I chose to only include three exemption levels in order to ensure the legibility of the graph. The exemption amount plays a big role in how high the tax revenue is going to be. Increasing the exemption amount means that especially smaller bequests are taxed proportionally less than higher bequests. For example if state 3 leaves a bequest of 4 and state 6 leaves a bequest of 40 and the exemption amount is 2, then in state 3 only 50% of their estate would be taxed and for state 6 95% would be taxed. Now if the exemption amount is increased to 3 for state 3 there is a big change, since now only 25% of their estate is taxed, but for state 6 the change is negligible, still 92.5% of their estate is taxed. Nevertheless, if the exemption amount is increased that also means that the total revenue the government can achieve could be decreased, since in terms of population there are more agents in state 3 than in state 6. In this example I talked mostly about tax revenue, when I am actually concerned with welfare, since the role of the government is simply to redistribute the collected taxes, tax revenue can translate welfare. This example should illustrate that choosing these parameters is not as straightforward as it may seem. For that reason I calculated different combinations to ensure that I find the pair that brings the agents in my model the highest welfare level.

In figure 5.1 it becomes visible that the exemption level that leads to the highest CEV is 2, inside this level the optimal tax is 37.5%. This combination gives a CEV of 0.91%. This means that an agent that is about to enter the model needs to be compensated with an increase in consumption of 0.91% in order to be indifferent between the economy

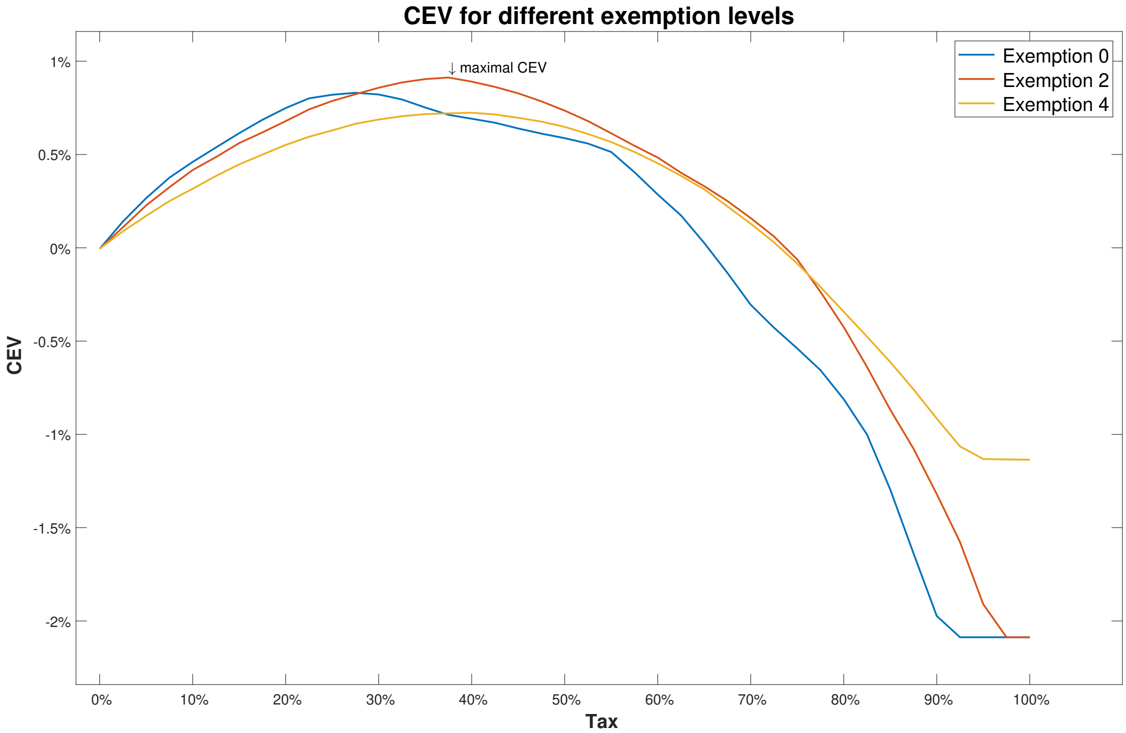


Figure 5.1.: Consumption equivalent variation

without the bequest tax and the economy with the bequest tax. To reiterate, without this increase in consumption an agent who could choose in which economy he would want to be born into would choose the economy with the bequest tax. One important remark here is that I am assuming that the agent does not know which productivity level he or she is going to be assigned in their first period. This can also be seen in equation 4.1, where the expectation operator indicates that the agent does not know his or her type.

The final bequest tax is $\tau_b = 0.375$ and the exemption amount $exm = 2$. With these parameters I can calculate the differences between the two scenarios, without and with the bequest tax.

5.2. Wealth Distribution

In this section I will present the wealth distribution and discuss changes between the model without and with the bequest tax. In table 5.1 one can see how my model performs compared to the actual wealth distribution in Austria. The second row displays the wealth distribution without a bequest tax. This is the current state in Austria. In the subsequent row, the bequest tax is introduced.

In table 5.1 one can see that my model performs relatively well compared to the data.

Scenario	Top 1%	Top 5%	Top 20%	Top 50%	Wealth Gini
Data	22.60	43.10	72.80	96.40	0.739
Model without bequest tax	20.05	41.03	70.65	92.79	0.649
Model with bequest tax	21.71	43.55	71.14	92.19	0.645

Table 5.1.: share of total wealth of the top percentage groups of the wealth distribution[4]

However, the wealth shares that I compute in my numerical exercise are consequently a little lower than the ones computed by other economists using the HFCS. One reason for this might be the fact that in my model negative wealth is not allowed whereas in the real world people often smooth their consumption paths by taking out a loan. This probably also explains why the Gini coefficient for wealth is not as high in my model as it is in the data. In this simulated economy every agent has at least some non-negative amount of assets which could explain why the Gini is lower then in the data. Nevertheless, even without negative asset holdings the asset distribution in my simulated economy is highly concentrated. When I present the life-cycle distribution of assets in figures 5.2 and 5.3 I will show that even though all agents start with zero assets, they diverge relatively quickly, and for agents in the lower income states there is no way to catch up.
Besides the slight underestimation, the pattern seen in the data can also be seen in my model. The top 1 % for example holds around 20 % of all assets which is a very high concentration at the top. One factor that is responsible for this extreme concentration is the transition probability matrix. Represented in appendix A.1, the probability that an agent which is currently in state 6 will also be in state 6 in the next period is only 0.57. This high uncertainty means that these agents save a large proportion of their income in order to insure against future shocks. This fact corresponds to what Castañeda et al. (2003) found in their calibration. In chapter 6 I will discuss how the assumptions that I made influenced the results. There are other channels of wealth accumulation that I abstract from that are responsible for the highly concentrated wealth distribution in Austria.
The top 50 % in my model hold significantly fewer assets than what the data found for that same top percentage group. One explanation, as mentioned already, is that I have a zero borrowing constraint which means agents in my model are not allowed to hold negative wealth. As I will present in table 5.4 there are certain age groups in Austria where lower percentiles have negative wealth, this increases the share of the upper percentiles since they are the ones lending the assets. Taking this fact into account my model still performs relatively well.

By comparing the model without and with the bequest tax one sees that the model with the bequest tax generates a larger degree of wealth inequality for the top 1 through 20. Only for the top 50 % there is a slight decrease in the share of the total wealth they hold. In addition, also the Gini indicates that the model with the bequest tax is only slightly more equal.

In addition to looking at measures of inequality, I analyzed what happens with the

[4]The Data column corresponds again to data from 2018 and 2019 Source: Credit Suisse (2018).

amount of bequest that is left by the agents. Table 5.2 shows how the absolute amount of bequests changed when the bequest tax was introduced. It is important to note here that the bequest amount in the scenario with the bequest tax is the before tax amount, what the next generation receives is then the after tax amount which is also presented later in the text.

Scenario	State 1	State 2	State 3	State 4	State 5	State 6
Without Bequest Tax	0	0	4.59	10.28	20.43	39.81
With Bequest Tax	0	0	1.24	8.83	19.12	38.67

Table 5.2.: Bequest amounts

The amount of bequest in my model is state dependent which means that the bequest depends on the state the agent is in during period 7 (when the agents' parents die). State 1 and state 2 do not bequeath anything to their children. This is by design because Humer et al. (2016) show that in Austria only around 35% of households receive a bequest. In the stationary distribution state 1 and state 2 account for 69.64% of the population, which means in my economy only 30.36% of all agents receive a bequest. In table 5.2 there are a number of interesting facts. First, state 3 which is the first state that leaves a bequest reduces the amount of bequest quite drastically. This may seem counterintuitive at first, but there are factors that can explain this sharp decrease. One could argue for example that in the scenario including the bequest tax, the agents do not need to ensure against bad shocks since they receive a constant transfer per period. This transfer is not state dependent which means it is equal for all agents in the economy. That could explain why the bequest amount decreased beyond the exemption amount of 2. Moreover, it could also be that there are fewer people leaving a bequest, which would also depress the mean amount of state 3. These two explanations are possibly cohesive. The latter one can be checked. As described in section 4.2 to find the mean bequest I first sorted the assets and then found groups and calculated the mean. To see what happens in group 3 I looked closer at the assets of group 3 in both scenarios. The analysis revealed that both cases are in fact true. The maximum bequest that is left in state 3 is 7.74 without the bequest tax and 4.48 with the bequest tax. In addition, a histogram analysis shows that the number of zero bequests is higher in the tax scenario. In the tax free scenario there are 38,800 agents who leave a zero bequest, in the tax scenario there are 146,000 agents leaving a zero bequest. The histogram can be found in appendix A.2 figure A.1. The exact reason why agents in the tax scenario are saving fewer assets can not be determined with certainty. Although, the additional transfer may be the reason why they save less, as explained above.

Second, other states do not exhibit such a sharp decrease in the bequest amount left. One could argue here that for these states the utility of leaving a bequest is high enough so that they are willing to leave a similar sized bequest, even if the next generation does not receive the whole amount. Finally, one could also look at how much the next generation receives, so the after tax bequests. $b_{\text{after tax}} = \begin{pmatrix} 0 & 0 & 1.24 & 6.27 & 12.70 & 24.92 \end{pmatrix}$. Here it becomes apparent how much the amount of bequest received changes compared to

the scenario with no bequest. This significant difference will be visible in the graphical representation in figure 5.2 and 5.3 where the increase in assets is visibly lower in the scenario with the bequest tax.
Furthermore, an interesting change after the bequest tax is introduced is that the mean bequest rises. This is due to the fact that there are more agents leaving zero bequests. This corresponds to figure A.1 where I showed that after the tax is introduced there are more agents leaving a zero bequest. Since more people are leaving a bequest and the bequests of agents that are on the top of the wealth distribution do not change as much, this leads to the mean of the bequests left to be higher.
Moreover, the overall change of assets is an interesting factor for any new tax. I am comparing the mean life-cycle assets on the aggregate level to have a clear figure. The mean assets in the scenario without the bequest tax are 3.00, in comparison the mean bequest in the scenario including the bequest tax are 2.66. This is a decrease of over 11%, which is quite substantial. Nevertheless, it is important to reiterate that even if 11% of assets are no longer held in the economy, the welfare increases.
In the following section I will show how the wealth distribution changes if there is no bequest utility.

5.3. No Bequest Utility

To see how important the mechanism of bequest is in my economic model I solved the model without the utility of leaving a bequest and analysed the difference between both Gini and different shares the wealth percentiles hold in the economy. In table 5.3 it

Scenario	Top 1	Top 5	Top 20	Top 50	Wealth Gini
Data	22.6	43.1	72.8	96.4	0.739
Model with bequest utility	20.05	41.03	70.65	92.79	0.649
Model without bequest utility	20.19	39.57	65.80	90.34	0.600

Table 5.3.: Wealth distribution without bequest utility

becomes apparent that the bequest utility has a strong influence on the wealth distribution. The only exception is the top 1 %, this group is able, even without bequests, to hold a similar share of the total wealth in the economy. This is probably due to the fact that wages in the higher income states are disproportionately higher than wages in the lower income states. For example, a state 6 agent earns over 30 times as much as a state 1 agent does. So even without an additional bequest an agent who earns a high wage is able to save more and they do so because they save to ensure against the high risk of loosing their large income and because bequests are modeled as luxury goods. However, the changes become apparent when looking at the other top percentage groups. For all other groups there is a sharp decrease in the share of wealth the group holds. Especially the top 20 % see a big decrease. This change can also be seen in the Gini index. In the model with bequest utility the Gini is 0.649 and in the model without bequest utility the Gini index decreased to 0.6. This exercise shows that the additional utility that agents

receive from leaving a bequest contributes towards wealth inequality.
Up until this point I have provided evidence that shows that my model economy is more equal when there is no bequest utility. Another aspect I am interested in besides wealth inequality is welfare. The implication of having no bequest utility or taxing bequests at 100% are equivalent so I will use the terms interchangeably. In either case the utility is equal to 0, since the amount that enters the bequest utility is the after-tax amount, which is what the next generation receives. After establishing this equivalence figure 5.1 where I presented that the CEV for three different exemption levels can be consulted to evaluate how the expected welfare of an agent entering the economy at 20 would change. For this analysis the line with 0 exemption is the relevant one since there can not be any utility from leaving a bequest. At the 100% tax level with a 0 exemption amount the CEV would be -2.08%. This means that agents would be willing to forego 2.08% of their consumption in the scenario with bequest utility but without the bequest tax and then they would be indifferent between the scenario without a bequest tax and the scenario with the 100% bequest tax. What that means is that the scenario with no bequest utility is worse in terms of welfare compared to the scenario with bequest utility and no tax. Or looking at it the other way round, agents would have to be compensated with an increase in consumption of 2.08% when they are in the scenario without bequest utility. After getting the compensation they are indifferent between their current scenario and the one without any bequest tax, but bequest utility.
This result can be explained in the following manner: the increase in welfare stems from the additional transfer per period every agent receives, agents in the lower two income states do not bequeath any assets which means they only profit in the tax scenario. For all other agents there is a trade-off between a lower bequest utility since bequests are taxed and an additional transfer that increases their fixed income every period as well. In addition, especially for agents in state 3 there is also not as much necessity to insure, because they receive additional funds. This can also be seen in figure A.1. Since in expectation it is much more likely to end up in either state 1 or state 2 there is a welfare increase when the tax is introduced up until the maximum that I found in section 4.1. However, when the tax is set to 100% without any exemption amount the government does not receive any revenue from the bequest tax that it could redistribute. The curves in figure 5.1 bring to mind a Laffer curve, which has tax revenue on the y-axis and tax rate on the x-axis (Laffer, 2004). The argument I am making follows a similar path as the argument for the optimal tax rate in the Laffer curve case. Subsequently, this means that the lower income states do not receive their additional per period transfer, so their expected utility does not increase. For the higher income states the case is even worse, they do not receive any utility because their bequests are taxed at 100% so they do not leave any assets behind, this also means they do not receive any bequests from their parents. In addition, they also do not receive any transfer. Since in this scenario no one benefits the CEV is negative which means that there is a decrease in welfare.
An additional interesting outcome of this exercise is the change in the mean assets in the overall economy. In subsection 5.2 I compared the mean assets over the life-cycle of all agents and found that these are reduced from 3.00 to 2.66 if the bequest tax is introduced. In this subsection I tax bequests at 100% which means there are no bequests

and subsequently the overall mean assets are reduced to 2.14. The bequest tax of 37.5% leads to a decrease in the mean asset of over 11%, the bequest tax of 100% leads to a decrease in the mean asset of over 28%. This shows how destructive it could be for the overall asset level in the economy if bequests were abolished.

This exercise showed that on the one hand wealth inequality is being influenced by bequest utility, this result may be intuitive, but to quantify the importance is still interesting. On the other hand, welfare in the economy would be worse if there would be no bequest utility compared with the no tax scenario. This result shows that even as inequality is decreasing welfare is not increasing but is decreasing in my model. That is an important message, as it shows that one single measure is often not sufficient to quantify how a policy change affects an economy.

In the next section I will analyze the age dependent wealth distribution to get a closer picture of the life-cycle dynamics of the model.

5.4. Age-Dependent Wealth Distribution

In this section I discuss the age-dependent wealth distribution. This is an important feature of a life-cycle model. I did this analysis to show that the point of measurement has a great impact on how unevenly wealth is distributed, both in the data and in my model. The data for Austria for this analysis comes from Hammer (2015) who estimates the mean wealth per household for three wealth groups and four age groups. The income groups represent the lowest 33% (low), the middle 34% (middle) and the top 33% (high) of the wealth distribution. The age group Hammer uses are 16-34, 35-49, 50-64 and 65+. Here I had to make the assumption that the distribution for 16-34 and 20-34 would look approximately the same, since my model only starts to report wealth for agents 20 years and older. The second assumption is that 65+ and 65-79 have the same distribution, since in my model there are no agents that survive beyond their 80$^{\text{th}}$ birthday, although in the real world there are people who are older than 80 years old. In addition, Hammer reports negative wealth for both the low households in the age groups of 20-34 and 35-49, this would not be possible in my model, since I have a zero bound on assets, which means agents are not allowed to hold negative wealth. Hammer uses the HFCS data set in his analysis which is consistent with the other papers I use for Austrian data.

In table 5.4 we see the direct comparison between what Hammer (2015) estimated for Austria using the HFCS and what my model produces for the two different scenarios. What becomes instantly apparent when looking at the first age group (20-34) is that both models without and with the bequest tax over-predict the wealth shares of both low and middle wealth groups. There are a couple of assumptions to consider here. First and foremost, I am assuming that every agent starts at the age of 20 with zero assets, which means in the first period assets are equally distributed (all have zero) and in the following periods they start to diverge, which takes some time to translate into the uneven wealth distribution we see in the data. Second of all, as mentioned above I am not allowing for negative assets, which in the real data can happen. Therefore, my model is over-predicting the assets of the low group even more, which has negative assets both in the age group

Age Group	Source	Low	Middle	High
20-34				
	Data	-3.61	7.76	95.85
	Model without Bequest Tax	0.47	18.38	81.15
	Model with Bequest Tax	0.45	17.93	81.62
35-49				
	Data	-0.18	12.6	87.58
	Model without Bequest Tax	1.44	19.31	79.25
	Model with Bequest Tax	1.39	18.94	79.67
50-64				
	Data	1.8	17.43	80.77
	Model without Bequest Tax	1.32	13.20	85.48
	Model with Bequest Tax	1.55	15.10	83.35
65-79				
	Data	1.5	15.80	82.70
	Model without Bequest Tax	1.14	9.31	89.55
	Model with Bequest Tax	1.38	10.20	88.43

Table 5.4.: Age dependent wealth shares[5]

between 20-34 and 35-49 in the estimation by Hammer. Keeping these differences in mind there are clear similarities between the shares that represent the Austrian data and the shares that my model calculated without the bequest tax. Especially for the age groups 50-64 and 65-79 my model is closely in line with what the data presents.

The very low wealth shares for the 20 to 34 year old low and middle groups is worth a closer inspection. One argument that could explain these very low wealth shares, in case of the lowest third even negative, could stem from the fact that people between the age of 20 and 34 are starting out in the economy and often take out loans to finance their home or desired career path. These expenses do not appear in my model, in addition, as mentioned above, there is a zero lower bound on assets. The middle 34% of the wealth distribution is able to increase their wealth share to 12.6% in the next age cohort. Moreover, also the lowest 33% are able to first decrease their debt and then to turn their debt into a small asset holding at the age of 50. At the age of 50 my model is also able to depict the wealth share of the lowest third quite well.

As expected here the bequest tax did not alter the wealth distribution too much. Nevertheless, there are some interesting aspects that can be analyzed. Especially since in table 5.4 it becomes visible when the bequest is being transferred which was not visible in section 5.2. Since the bequest enters the budget constraint in period 7 (when agents are 50) age group 3 is where the bequests are transferred. For the two age groups before that the difference between the two scenarios without and with the bequest tax is not very significant. What is visible is that the low and middle wealth groups hold slightly less of the total assets, which may again be due to the fact that they receive a constant

[5]Source for the Data columns: Hammer (2015).

transfer from the government and they do not need to ensure as much against bad shocks as they do in the scenario without the bequest tax and subsequently without the transfer. By comparing the wealth shares of the high group between age group 2 and 3 it becomes apparent that this group received a high bequest. Between the age of 35-49 the high group has 79.25 % of all assets, in the next age group, after receiving the bequest (without the bequest tax) the same group holds 85% of all assets. This share gets decreased to 83.35% if the bequest tax is introduced. On the contrary, for the middle group there is a visible increase of the share of assets they hold in the scenario including the bequest tax. Almost all of the share that was deduced from the the highest third is transferred to the middle. This conclusion is possible since each row of table 5.4 has to equal 100.
In the last age group (65-79) the effects from the bequest tax are not as pronounced anymore. The highest wealth group already reaches the wealth share they had in the scenario without the bequest tax when they die. In my discussion of figure 5.3 I will offer an explanation for this phenomenon.

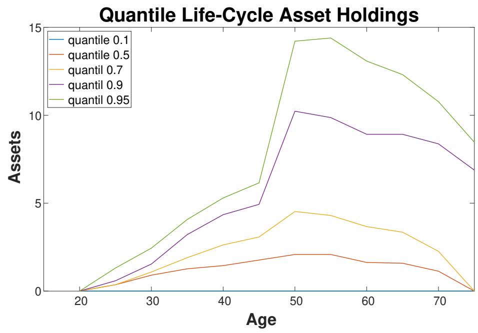
This section provided a closer look into the different stages of life and how the wealth distribution changes as people age. This section showed the limitation of my model, where for one the assumption that there are no negative assets allowed and for another especially in younger years my model is vastly over-predicting the share of assets held my the middle 34 %. Besides these limitations this section provided additional evidence that my model is able to represent key distributional data of the Austrian economy. Moreover, by not looking at the wealth distribution aggregated over time, the impact of the bequest tax in the age group between 50 and 64 became clearer. This closer look also showed that even when their estate is taxed at over 30%, which means they also receive over 30% less from their parents, the richest 33% still holds almost the same share of the total wealth in the last age group from 65 until they die.

5.5. Wealth Distributions across the Life-Cycle

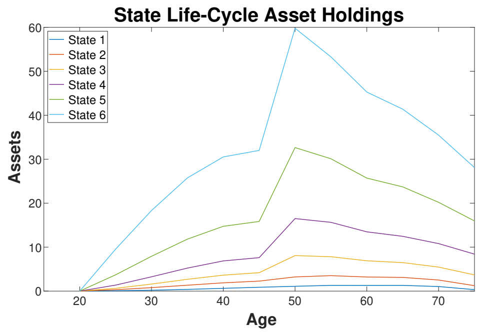
In this section I will investigate the life-cycle development of assets and find out how this factor changes as agents progress through their life. This is the graphical equivalent to section 5.4 where I discussed how the shares of different age groups compared to each other. In this section I am analyzing assets themselves, not wealth shares. Of especial interest here will be the bequest that agents receive when they are 50 years old.

Figure 5.2 consists of two sub-figures. Sub-figure 5.2a represents the life-cycle development of different quantiles of the wealth distribution. Sub-figure 5.2b shows the mean asset for each state and year. To detail, the figure shows the mean of each agent that has the respective state per period. These two sub-figures show a very different picture, the relatively smooth sub-figure 5.2b shows how a theoretical life-cycle would look like for an agent who would receive the same shock (i.e. does not change his or her state). This is theoretical because I am not controlling for individual agents here but simply calculating the mean of each agent that is in the specific state in that period.

Inspecting figure 5.2a clearly shows that at the age of 20 years (model period 1) the



(a) Quantile



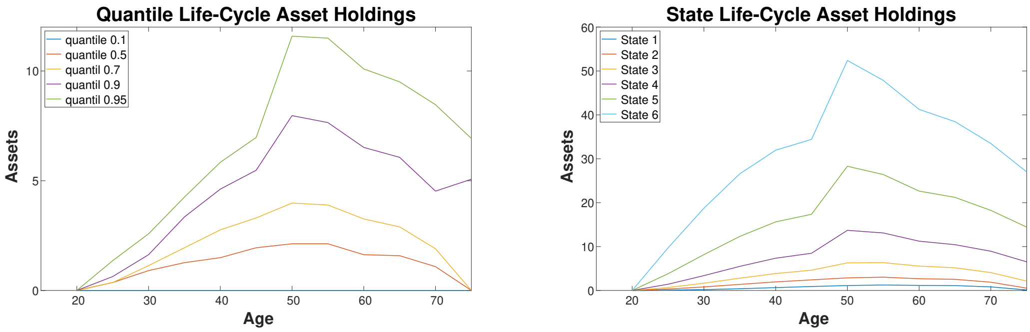
(b) State

Figure 5.2.: Life-cycle asset holdings without bequest tax

agents enter the economy with zero assets. The swift divergence of agents in the 95$^{\text{th}}$ quantile is apparent, but this divergence can also be seen for all other quantiles that stray away from the 10$^{\text{th}}$ quantile. This divergence happens at different speeds for the different quantiles and some converge back to the 10$^{\text{th}}$ quantile. What this means is that they do not leave any bequests. By looking at the stationary distribution in appendix A.1 it becomes apparent why that is the case and how it connects to table 5.2. State 1 and 2 combined account for almost 70% of the population and in table 5.2 I presented that state 1 and 2 do not leave any bequests. This is the graphical representation of the table. Another result that is clearly visible is that both the 90$^{\text{th}}$ and 95$^{\text{th}}$ quantile leave sizable bequests. The comparably very large bequest of state 5 and 6 are not visible in this figure since they are above the 95$^{\text{th}}$ quantile. Consulting the stationary distribution it becomes evident that state 5 and 6 make up only the top 3.14% of the population. In figure 5.2b the analysis of state 5 and 6 are possible, since there I am plotting a theoretical life-cycle where each year the state dependent assets are pooled and the mean is calculated, as explained above. This figure, although being theoretical in nature, shows some interesting features that are not captured by figure 5.2a. For example the end of the life-cycle lines correspond exactly to 5.2 since the calculation method is equivalent. In addition, in this figure it becomes evident how much each state receives as a bequest. Even for state 3, which receives around 4.6 in assets, there is a visible jump in the life-cycle asset line. Up until the sharp jump in period 7, the asset lines are almost hump-shaped for the higher income states. This hump-shape is not so clearly visible in figure 5.2a.
The 10$^{\text{th}}$ quantile which represents the assets of the lowest 10 % stays at 0 during the whole life-cycle in figure 5.2a. In table 5.4 a more pronounced behavior becomes apparent, not only the lowest 10% hold 0 assets but also the lowest 33% only hold a share that is slightly above 0 during all of their life. Although, the wealth share and the absolute amount of assets are not the same this comparison shows a similar picture. For instance, the lowest 33% in age group 20 to 34 only holds 0.47% of all assets. By multiplying that percentage with the sum of all assets in that age group and dividing by the number of agents (1/3 of 1,000,000) it becomes evident that each agent in the lowest group between 20 and 34 only holds 0.0077 assets. This exercise should show that even if the share of

assets and the total amount of assets are not directly comparable, they first of all can be transformed in such a way that they are comparable and second of all that even when not transformed they convey the same message.

Figure 5.3 presents the same figures as 5.2 but for the scenario including the bequest tax.



(a) Quantile (b) State

Figure 5.3.: Life-cycle asset holdings with bequest tax

The first difference that surfaces is that figure 5.3a has a much lower maximum asset value for the 95$^{\text{th}}$ quantile than figure 5.2a has. This follows directly from the bequest tax, although the amount of assets that is left is not changed too much for the higher income states. This same amount is taxed and the next generation only receives the after tax amount. Keeping in mind that the bequest tax is 37.5% with an exemption amount of only 2 this means that the after tax bequest is substantially lower. Comparing figure 5.3b with its non tax counterpart figure 5.2b two aspects become apparent. For one, also in this figure pair the bequest amount that the agents receive at the age of 50 is materially lower in the tax scenario. For another, the decrease in assets after the bequest is received is not as sharp in the tax scenario depicted in figure 5.3b. The economic interpretation of the slope is that agents in the scenario without the tax case have a certain utility of leaving a bequest, according to that utility they find the optimal bequest amount and since they have a larger asset base than the agents in the tax scenario they consume their assets more quickly which leads to a sharper decrease in figure 5.2b. This comparison shines some light on how the two scenarios lead to relatively equal bequest amounts for the upper income states. I presented those amounts in table 5.2, which showed that especially agents in state 5 and 6 are leaving almost equal bequest, regardless of the tax regime. By inspecting the two figures it is revealed that agents in the scenario without the bequest tax have a higher asset level due to their higher bequest, but they also consume more of their assets leading to a steeper decline.

In the next section I will disclose the main shortcomings my modeling approach entails.

6. Model Limitations

In this section I will explain some of the shortcomings that result from my modeling approach. Since the scope of this thesis is limited I made a couple of simplifying assumptions that allowed me to solve my model.

First and foremost, agents in my model are only able to accumulate wealth through labor. This assumption sets the focus solely on labor and does not allow for other forms of wealth accumulation. For example, de Nardi & Fella (2017) discuss entrepreneurs as an additional channel of wealth accumulation. What they discuss is the difference in savings behavior between agents with and without entrepreneurial ability. They find that agents with high entrepreneurial ability exhibit not only buffer-stock savings behavior but they want to accumulate capital due to higher returns on their business activities (de Nardi & Fella, 2017, p. 295). Buffer-stock saving is what I have in my model where agents save because they want to ensure themselves against an uncertain future. Entrepreneurial saving as de Nardi Fella describe it results from higher returns of entrepreneurial activity. These agents want to accumulate as much wealth as possible to further increase their business activities. If I had included entrepreneurs into my model the relative importance of labor income as the driver for wealth inequality could be smaller. Peter (2020) finds that the wealth share of entrepreneurs in Austria is especially high compared to other European countries. This points towards the fact that for a more in-depth analysis of Austria's wealth inequality the differentiation between workers and entrepreneur is important.

The second shortcoming of my model that has to be addressed is the assumption that agents can only obtain utility from either consumption or leaving a bequest. This means that every agent has a fixed labor supply of one. There is no trade-off between labor and leisure. When agents receive additional transfers it could be that they would change their labor supply and choose to work less and enjoy more leisure time. Hines (2013) studies both income and substitution effects of an estate tax. He finds that both magnitude and sign of the effect of an estate tax on labor supply are not clear (Hines, 2013, p. 487). The tax reduces the labor supply due to the decrease of return to labor and increases the labor supply for agents wanting to leave a bequest since the after-tax bequest is lower after the tax is introduced (Hines, 2013, p. 487-488).

Third, my model abstracts from uncertain death. This means that every agent dies at the age of 80 with certainty. If this was not the case figure 5.2 and 5.3 would look very different. In my simulation every agent receives their bequest in the same period, which means there are big jumps in the asset level in both figures when the agents are 50 years old. If death would not be certain there would not be such a big jump because bequests would be distributed over time. Some agents may die earlier, while others survive longer. For legatees this would mean that they can not expect their inheritance at a certain point

but they have to plan with an expected value. In addition to the changed figures my results could change in two ways. First, since agents do not know when they will die the total bequest amount could increase because of accidental bequests. An accidental bequest is when an agent dies and he or she did not expect this and wanted to consume more of their wealth but didn't because they thought they would be alive in the next period. Second, it could be that agents who no longer know when they will receive their bequest save more in earlier periods to ensure against the scenario where they receive their bequest later in life. They do not have to do that in my model since they know exactly when they will receive their bequest.
Finally, I am assuming a constant population and no technical growth. These assumptions are also taken to simplify my model. A constant population growth allows me to match each bequest one-to-one from parent to children generation. Since I am abstracting from endogenous wage determination and the wages I am using are exogenously determined via the stationary distribution I have no room for technology in my model. Including growth both in terms of population and technology could potentially add an interesting layer in my simulation. It could be that there is more movement between generations if there is technological advancement. The economy could produce more and by doing so generate higher wages and subsequently higher bequests. This would mean that over many generations as wage increases there is also a higher bequest base in the economy.

In this chapter I disclosed what the major shortcomings of my model are. This is an important step to show what assumptions I took and how results could change If these assumptions would not have been taken. Moreover, this section shows that it is not possible to directly compare my simulated results with the Austrian economy. Even though the wealth distribution in my model is more or less similar to the Austrian wealth distribution there are many simplifying factors that do not allow for a direct comparison. Policy recommendations or behavioral derivations are not possible. The simulation results can only hold inside my model and are not applicable towards any real economy. Nevertheless, my results provide an interesting base on which it is possible to talk about the trade-off between welfare and inequality. How these two interact and what role a potential bequest tax can have.

In the next section I will conclude my thesis, reiterating the main results and depicting future avenues of research that I think could follow from this thesis.

7. Conclusion

In this chapter I will sum up the main findings of my thesis, put them into context to each another and also in context to the literature and finally discuss potentially interesting research path that could stem from this work.
The title of my thesis is *Wealth Inequality and Welfare Implications of a Bequest Tax* therefore the first step after solving the baseline model was to find a measure of welfare that I can work with in order to find a bequest tax that optimizes welfare for the agents in the model economy. I determined the combination of bequest tax percentage and exemption amount using the CEV welfare measure. Figure 4.1 shows how the maximum value was attained.
In the next step I showed the aggregate life-cycle data which my model produced. The first takeaway was that the aggregate wealth distribution does not change too much when the bequest tax is introduced, especially for agents in the higher percentiles. That result would indicate that a bequest tax is not the right tool to reduce wealth inequality. Second, in table 5.2 I showed that the amount of bequests left is almost not affected by the bequest tax for states 4,5 and 6. Only agents in state 3 decreased their bequest amount quite drastically. One reason for the acute decrease is that agents do not need to insure as much against future risks because they receive a fixed transfer each period from the government. An important point in terms of a policy perspective was the reduction of mean assets by over 11%, this is something that has to be taken into account if a new policy is introduced. Is it possible that all these assets are consumed instead of saved or are they destroyed by the tax?
One defining aspect that showed that intergenerational transfers affect wealth inequality in general was presented in section 5.3. The complete taxation of bequests or the removal of the bequest utility showed that an economy without such behaviour has a more equal wealth distribution in my model framework. Even though the removal of bequests reduces wealth inequality in my model the economy is not better off in terms of welfare. The CEV for a 100% bequest tax is -2.08%, which shows that even if inequality is decreasing welfare is not increasing.
Finally, the life-cycle analysis revealed how the savings behavior of different age groups changes if the bequest tax is introduced. Especially interesting was the reduction of the slope in figure 5.3b compared to figure 5.2b where agents in the scenario without a bequest tax reduce their assets faster to end up at the same bequest level as agents who are in the scenario including the bequest tax.
It is critical to note here that my model takes a first cut at the important question of how a bequest tax can influence wealth inequality and welfare and it is not intended to be used at face value. There are many factors which contribute to the dynamics of an economy and the scope of this thesis was to first reproduce wealth levels that are observed in the

data and afterwards investigate a simple bequest tax and potential welfare gains. In chapter 6 I gave a detailed discussion about what the main shortcomings of my modeling approach were.
How does my thesis compare to other studies regarding bequest taxation? Nekoei & Seim (2018) analyse what effect an inheritance tax had in Sweden. Sweden disestablished its inheritance tax in 2004, the two authors find that the majority of heirs consume their inheritance after 7 years while the wealthiest agents leave their inheritance intact (Nekoei & Seim, 2018, p. 36). In figures 5.2 and 5.3 I present the history of the asset holdings of the agents in my simulation. Here it becomes apparent that my simulation corresponds with what Nekoei & Seim (2018) find. Except for agents at the top of the wealth distribution all agents consume their inheritance in under 10 years. However, the authors find that inheritances reduce certain measures of inequality (Nekoei & Seim, 2018, p. 36), this is due to a high intergenerational mobility in Sweden. In chapter 5.3 I investigate how my simulation would change if there would be no bequest. I find that in terms of wealth distribution the economy would be more equal. Compared to Sweden the intergenerational mobility in Austria is low and in my simulation there is no intergenerational mobility (Bukodi et al., 2019). Children are born into the same income state their parents are in. In terms of welfare Piketty & Saez (2013) analyze the optimal bequest tax per percentile and find that the lower 70% of the population have an optimal bequest tax rate of approximately 50%. Only the top 30% have an optimal tax rate below 50% and the top 20% even have a negative optimal bequest tax. This is due to the fact that bequests are highly concentrated in the two countries (US and France) that Piketty & Saez (2013) analyze. In my thesis I do not calculate the optimal bequest tax per percentile but I calculate the weight CEV for different bequest taxation amounts. The objective is to find the bequest tax that gives the person who does not know his or her type the highest expected utility.
A study that is concerned with a very similar topic is Heer (2001). Calibrating his model for the US economy Heer finds that a bequest tax of 95% leads to a welfare gain in terms of CEV of 2.43% (Heer, 2001, p. 457). In comparison for the Austrian economy I find a bequest tax of 37.5% leading to the highest CEV of 0.91%. Heer uses uncertain death which means he has accidental bequests in his model, which I do not. This could explain the big difference between the tax rates we find. Heer also finds that a model without a bequest motive has a lower Gini than a model with a bequest motive (Heer, 2001, p. 454). Moreover, two studies who also produce similar results are Castañeda et al. (2003) and Cagetti & De Nardi (2009). Both studies approach the exercise from the other direction, they calibrate their respective benchmark case (for the US economy) including an estate tax and afterwards eliminate that tax. In my model there is no difference between an estate tax and a bequest tax. Since every agent has exactly one child he or she will bequeath the estate to one person. Both studies find that the elimination of the estate tax does not change wealth inequality drastically. The former study finds an increase in the wealth Gini from 0.79 to 0.8 when they eliminate the estate tax (Castañeda et al., 2003, p. 852). Also Cagetti & De Nardi (2009) find that wealth inequality increases only by a small amount. In addition, Cagetti De Nardi find that in terms of welfare the elimination of the estate tax in their model is not beneficial for most of the population

(Cagetti & De Nardi, 2009, p. 106).
These are the avenues for future research that I think could enrich this thesis and the considerably more qualified literature that is concerned with wealth inequality and intergenerational wealth transfers. First, including a more sophisticated way of matching different generations with each other could show the robustness of my results. Furthermore, modeling the probability of death could add towards my thesis since it amplifies the uncertainty in the economy. In my model agents know for certain that they will inherit at the age of 50, if their parents saved enough. If not all parents die at the age of 80 there would be some bequests that are received earlier and others that are received later. Second, investigating different measures of welfare and how these measures evaluate the policy change could also shed some light on the robustness of my results. Third, differentiating between workers and entrepreneurs and introducing different asset classes (money, real estate, bonds or stocks) could help to get a more detailed look at which exact channels drive wealth inequality. Lastly, investigating different forms of bequest taxes could also be worthwhile. I only evaluated welfare gains for a flat tax with different exemption amounts. There could be additional gains by introducing a progressive tax or a more sophisticated way of exempting different assets classes that could add to the message my thesis can convey.
This thesis first showed how a bequest tax could bring potential welfare gains. In addition, the discussion about welfare versus inequality is in my opinion a very relevant discussion. In the realm of my model I presented the case that a bequest tax could bring an increase in welfare, even though wealth inequality is mostly unaffected by this policy change.
The main take away from this thesis is that an increased focus on welfare indicators would be favorable when analyzing any policy recommendation. A policy could be beneficial in terms of welfare even when it does not change the wealth distribution. The bequest tax I introduced in my model is not effective at changing the wealth distribution but it increases welfare.

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A. Appendix

A.1. Earnings process

The individual earnings process is a product of efficiency and income state. The former is age dependent, the latter state dependent. To find the risk that is connected with the income level I use the autocovariance and variance parameter from Bayer & Juessen (2012) and translate it into a six state transition probability matrix using Tauchen (1986) method.

$$P = \begin{pmatrix} 0.7957 & 0.1977 & 0.0066 & 1.7951e-05 & 3.6196e-09 & 5.1070e-14 \\ 0.2427 & 0.5876 & 0.1651 & 0.0045 & 1.0162e-05 & 1.6674e-09 \\ 0.0132 & 0.2717 & 0.5761 & 0.1360 & 0.0031 & 5.6624e-06 \\ 8.9999e-05 & 0.0181 & 0.3119 & 0.5574 & 0.1104 & 0.0021 \\ 6.8376e-08 & 1.4917e-04 & 0.0246 & 0.3532 & 0.5322 & 0.0898 \\ 5.4698e-12 & 1.3690e-07 & 2.4347e-04 & 0.0330 & 0.3946 & 0.5721 \end{pmatrix}$$

Using the ergodic distribution of this transition probability matrix I calculated the six income states. Each state has a certain weight in the economy. Using these weights I calculated the mean of that group in the Austrian economy using wage data from Statistics Austria (2020b). The ergodic distribution is $p_{ss} = \begin{pmatrix} 0.3838 & 0.3126 & 0.1898 & 0.0824 & 0.0256 & 0.0058 \end{pmatrix}$. With this distribution I calculated the mean income of each group according to the Austrian data. This exercise lead to these income states
$w_i = \begin{pmatrix} 9.16 & 24.16 & 38.31 & 62.34 & 117.14 & 281.29 \end{pmatrix}$. These wages are in thousand euros per year, to normalize the individual wages I calculated the mean wage in my economy and divided each individual income state by the mean wage. This means that an income of 1 in my economy is equal to the mean income in the Austrian economy.
The final wages are: $w_i = \begin{pmatrix} 0.33 & 0.86 & 1.36 & 2.22 & 4.17 & 10.01 \end{pmatrix}$

A.2. Bequest changes

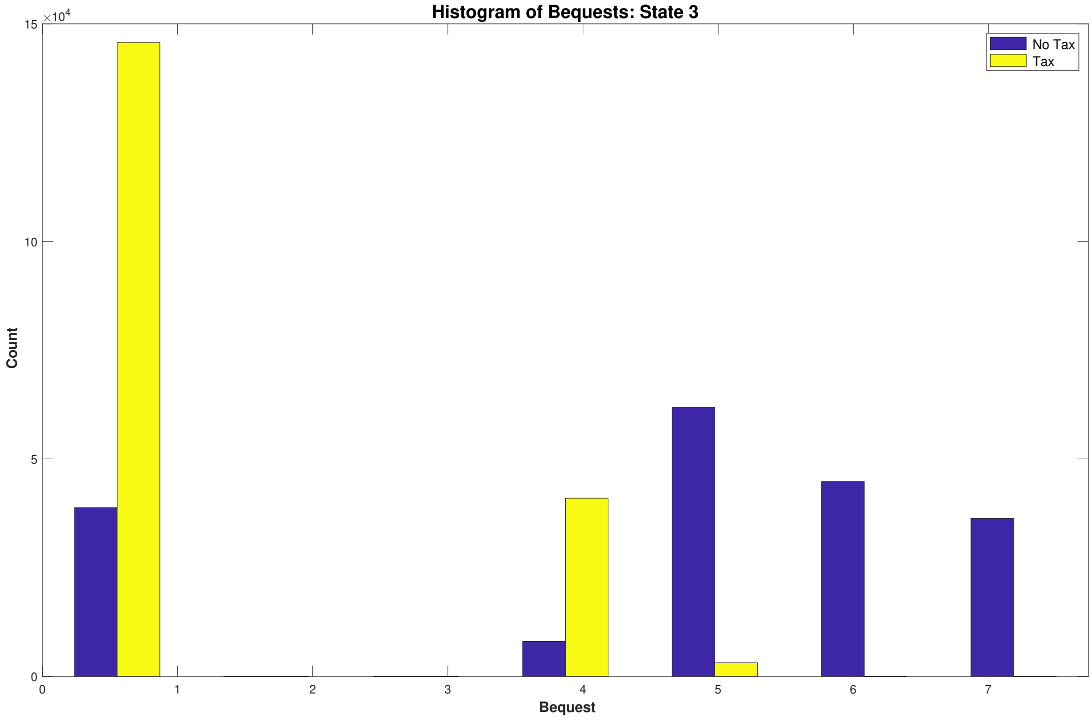

Figure A.1.: Histogram of bequests left by state 3 agents