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Basic income: an Agent-based Simulation model

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Abstract

This thesis focuses on the question whether basic income is economically plausible, and if so, under which circumstances. It begins with an overview and discussion of the history, the most common arguments in favor and against and a case study of basic income. The focus lies both with the ethical and the economic argumentation. Then an Agent-based simulation model of an economy is constructed in NetLogo and various experiments with different basic income schemes are undertaken within it. For instance, with different limitations regarding the age of recipients. Finally, the results are discussed and some policy suggestions put forward.

Keywords: *Agent-based simulation, basic income, NetLogo, social welfare, welfare economics*

Contents

1 Introduction

The concept of basic income is interesting from many viewpoints. There are several ethical arguments for its existence, and what is more interesting is that they come from such different sources; ranging from socialist to liberal. What they all have in common is that they claim that basic income would improve the lives of people. That in itself could be argued to serve as a justification for investigating whether the concept is plausible to implement. The debate about basic income is becoming increasingly popular, and is moving from being solemnly discussed on a theoretical level, to be commonly considered as plausible to implement. The fact that Switzerland will hold a referendum over basic income in 2016 is one good example on how basic income looks more and more like something that might actually happen at some point. But, is it plausible? There are many arguments against it, both economic and indeed ethical. What would the implications be from this viewpoint? This thesis is thus about basic income. Again, basic income is - in different ways - argued from almost all political directions to have the potential to increase human well being. Some argue that it should be a fundamental human right to have the means to seek what one considers a good life, and that basic income therefore should be a right. Others argue that it has the potential to reduce bureaucratic arbitrariness and state invasion into the private sphere of individuals. In the same diverse way, there is a strong literature against basic income, branding it as economically implausible, or a waste of resources. With such potential to improve or disimprove human lives, the author of this thesis argues that now, especially with the concept is becoming increasingly popular and more potential implementation attempts approaching, there are good reasons to investigate the pros and cons, and analyze whether the concept actually is plausible, and in that case, in which context?

In section 2, the thesis begins with a review of the literature and theorizing pro and against basic income. Each main discourse is being discussed in terms of doubts, plausibility and consistency. First the argumentations in favor of basic income is being reviewed, starting from the view of basic income as a fundamental right, then as a right based on common resources, and finally from a classic liberal perspective, where it is justified in terms of efficiency and by reducing state intervention. Then, the argumentation against basic income is presented, there are some economic examples and liberal objections, and a re-

view of a set of experiments on how incentives to provide labor is affected. The sections ends with a view at the very specific case of Alaska, where a kind of basic income structure has been implemented since the 1970's.

Section 3 is dedicated to introducing and justifying the use of object-oriented Agent-based simulation modeling as a means of analyzing basic income. The reader is provided with definitions and some history of Agent-based modeling, and to how it differs from its predecessor which is microsimulation. Some fundamental work of researchers and simulation experts is introduced and explained, so as to prepare the reader to understand how and why the basic income model is built.

After having introduced the reader to object-oriented Agent-based simulation modeling, section 4 explains and discusses the initial idea and assumptions behind which variables to include in the basic income model, and how they are to interact and affect each other. First the so called state-variables are being considered, then the method variables and finally the environmental variables of the model.

In section 5, everything of the previous section is put into context as the initial model structure is being explained.

Section 6 finally introduces and explains the main code. There is information on how the agents of the model are created, initiated and how they will interact. The environment is explained in terms of how the economy of the model is thought to function. The assumptions implicit in the code are being continuously explained.

Moving on from the introductory model and code, in section 7 the flexibility is explained in terms of the user settings of the economical context. The model contains a number of settings which the user may change in accordance with the kind of economy they want to simulate. The section lays out the assumptions behind and justification of which these settings are.

Before using a simulated version of Italy as an example of the model's flexibility, section 8 provides a brief discussion on simplifications and the dangers of over-simplifications, in order to argue and give the reader a chance to asses

whether the model is acceptable, and a constructive way of performing such research.

The study case of Italy using real world data is undertaken in Section 9. Here the values for Italy are presented and explained and the way they are implemented in the model is shown and discussed.

Then in section 10 the user settings previously argued for, are set to resemble Italy with the data discussed in the preceding section, so as to show the way the model is intended to be used, and a snap shot of how the simulated Italian economy looks is presented.

Section 11 advance the already initiated discussion of the flexibility of the model, by explaining it in terms of the many various ways that the basic income structure can be implemented and so tested in the model.

The experiments are undertaken in section 12. Several experiments are undertaken, with simulated Italy and a simulated version of Sweden. In these two settings, different basic income structures are being tested, and the implications of the outcomes briefly reviewed. The experiments regards the effect of basic income when used instead of a traditional well-fare system, and the effect of implementing basic income only to certain age groups, and as a pension system.

The results of the experiments are discussed in section 13, together with reasoning about how they relate to theory, and what their implications are. Then there is some suggestions for further research and how to extend the model, and some hints on which policies to implement is provided.

The thesis then finishes with section 14 about conclusions, providing a review of the work and its results, and some further discussion on future research stemming from the outcome of this thesis.

2 Basic income

In this initial section the concept of basic income will be introduced, and the main literature pro and against it will be presented and discussed. There will also be a thorough discussion of the case of Alaska, where there is a basic income structure implemented.

2.1 Basic income: Background

The debate surrounding basic income has tended to be somewhat immoderate Van Parijs (2004). The arguments in favor present it as some universal salvation, while the arguments against seem to regard it as a ridiculously naive and economically implausible non-option. Given the complexity of reality both the extremes seem unconvincing. Thus, the intention with this thesis is to make a thorough overview of the current state of information regarding basic income, and use this information in order to make an as realistic as possible NetLogo simulation model in which experiments can be undertaken and evaluated. The simulation will be of a standard economy in which basic income is introduced. Within the model it is intended to be possible for the user to test different settings, for instance with basic income only for older age groups, as a kind of pension scheme. With the outcomes of the experiments as a starting point, an analysis of whether basic income is economically plausible, and if so, in which specific setting(s) will be performed. Throughout the thesis, but especially in the initial parts in which intended purpose and arguments pro and con are treated the ethical dimensions will be discussed. As which seem to be "key variables" are being found, and upon testing them, the model will be extended to include them.

2.2 Definition and intended purpose of basic income

The Basic Income Earth Network (BIEN) is a network of basic income proponents, consisting of academics and activists. They provide the following definition of basic income:

> A basic income is an income unconditionally granted to all on an individual basis, without means test or work requirement. It is a form of minimum income guarantee that differs from those that now exist in various European countries in three important ways:

1. it is being paid to individuals rather than households;
2. it is paid irrespective of any income from other sources;
3. it is paid without requiring the performance of any work or the willingness to accept a job if offered.[1]

This is a common and wide definition which encapsulates the core of the concept. With this as a starting point, there are several different specifications and suggestions on the implementation of basic income. Right wing proponents tend to include into the concept the eradication of all other welfare benefits; as a means to reduce administrative costs and rent-seeking behavior of bureaucrats. As in the case of Alaska, which shall soon be discussed further, the payments are in the form of dividends from an investment fund based in the region's oil production. As such, the payments fluctuate, and are nowhere near to be sufficient to serve as a sole source of income for individuals.

2.3 In favor of Basic Income

There are two main discourses attempting to legitimize basic income. Both rest on a mixture of ethical and economic argumentation. The first one, of which one of the main proponents is Left-Libertarian Phillipe Van Parjis, is mainly ethical, with economics as means, rather than as an end goal. Van Parjis bases his support of the basic income on the foundation of what he refers to as real freedom. This concept of freedom contains not just the freedom of not being prevented from acting according to one's will, but also includes the actual means, as in resources or capacities, to be able to act according to one's will. The foundation of Van Parijs (2004) legitimization of a basic income structure rest mainly on ethical motivations even though economic arguments are never absent. The end goal is real freedom for all, and the tool is basic income. Real freedom is framed as a fundamental right to citizens, and there is a clear focus on equality issues. This is maybe the more common way of arguing in favor of basic income; with human dignity and the right to some good life as main motivations. The other discourse is more focused on administrative efficiency and economic gains, with the ethical ingredient being freedom from state coercion as a welcome side effect. It is often championed by those in favor of a lower degree of state intervention. Note that the both discourses tend to blend; they are not mutually exclusive. In the following subsections I will present three cases in favor of basic

[1] http://www.basicincome.org/basic-income/

income. The first one legitimizes basic income on the grounds of real freedom as a human right. The second one is founded on the idea that the earth belongs to its human inhabitants, including future generations, and thus its yield should be shared equally. The third justifies basic income in that it would be an efficient replacement of the welfare state.

2.3.1 Real Freedom: Van Parjis

The core of Van Parijs (2004) idea of basic income is to "Give all citizens a modest, yet unconditional income, and let them top it up at will with income from other sources.". The broadest definition of basic income is, he writes, an income paid to all members of a society on an individual basis, by some political community, without any requirements to meet. The income should meet the same level as the one which would be required to "satisfy basic needs", or so that it would "replace all other transfers". However, Van Parjis provides a narrower definition, and a more elaborate proposal on how a basic income structure could be arranged. He begins by laying out what basic income is, and what it is not. First of all, the concept is of an income as in a pure cash transfer, of which use is unrestricted. It is to be paid on a regular basis; or as a basic endowment. Its to be drawn from public resources; not necessarily a nation-state; but something tied to the government. For instance it can be the province or the commune. In fact, as will be more thoroughly discussed later in this paper, the state of Alaska did introduce basic income. Alaska funded the experiment by means of a diversified investment fund based on their oil resources. Basic income could even be at European Union or United Nations level. There is the question whether the income should be redistributive or not. In case of a redistributive ambition, there have been proposals of funding it by means of a sort of Tobin tax, or by a bit tax. In the contrasting case, as for instance in Alaska, other funding is required. Another issue is whether only national citizens should enjoy the benefit, or also for instance individuals with legal permits in the country. And at which age it should begin to be paid out. And should it be given to retired citizens? In that case how? In combination with pensions? This particular issue will be further highlighted in the experimental part of this thesis. Regarding prison inmates, Van Parjis suggests that the basic income could be revoked for the period in which an individual is incarcerated. He briefly mentions the topic of other long term inmates of institutions, such as retirement homes and mental health facilities. The author further raises the topic whether

basic income should be paid to each equally, whether it should be irrespective of income. Then there are two possibilities presented: either that the relatively richer contribute relatively more to the funding of the basic income, or instead a (partial) abolition of existing benefits. Van Parjis states that although the basic income is given to both poor and rich, its main motivation is not to make things better for the rich. Instead he gives three reasons why the scheme is better for the poor than means-tested income, given only to poor. In a way, he provides reasons for why its better for the poor to give to the rich.

1. Fewer of the poor will lack information of the available benefits, and therefore fewer will miss out of the opportunity.

2. The aspect of humiliation connected to having to apply for benefits will be eradicated in the case of basic income. There would be no humiliating control schemes; and the beneficiaries will not be identified as needy or as burdens to society. The stigma of relying on social welfare will decrease.

3. A regular and reliable payment will not be interrupted by finding a job, which will positively affect risk taking incentives of the poor.

On top of this, the author argues, "Since you can keep the full amount of your basic income, whether working or not, whether rich or poor, you are bound to be better off when working than out of work.". Thus the often discussed effect on incentives of benefit schemes is no more a problem, if one accepts the non-satiation assumption, i.e. that more is always better.

Concluding his definition of basic income, Van Parjis states that the income is to be paid out without work requirement, and regardless of individuals' desire to work.

The second section of Van Parjis article is dedicated to the question "Why do we need a basic income?". He provides three main points.

1. The weakest in society would be endowed with bargaining power, and as such would eradicate the expansion of what he refers to as "lousy jobs".

2. Basic income would not, as is feared in the case of conditional benefits, "nurture an idle underclass". Beneficiaries could easily increase their disposable incomes by working.

3. Basic income appeals to the previously mentioned concept of real justice; and would allow all citizens to pursue their idea of a good life.

Furthermore, Van Parjis raises the question whether basic income is affordable. First, he reminds the reader the basic income is not by definition set as the level enough to satisfy basic needs. It could be both more or less. It is neither part of the definition that all other cash benefits should be replaced by basic income. With this in mind, affordability of basic income can only be assessed from case to case, with the specific structure in mind. For one of the extremes, to completely replace all other benefits with public income, Van Parjis states that it would obviously be affordable, but that this kind of basic income is not what is suggested. The other extreme would be to keep all benefits, and complement them with basic income to provide the equal opportunity for all citizens to live comfortably. Neither this is what is suggested and a scheme of this sort would not be affordable. According to the author suggestions like the above has not been seriously proposed by any basic income supporters. Moreover, and somewhat paradoxically, Van Parjis states that thanks to the lower costs related to not having to assess the beneficiaries, giving basic income to all would be cheaper than giving benefits only to those in need. However, there is a trade-off. In order to provide a higher level of material incentives for the lowest earners, the more material incentives need to be decreased at higher levels. Van Parjis exemplifies this as follows:

> To keep the reform budget-neutral while remaining able to pay for everyones basic income, one must compensate the lowering of the rate at which the lowest layer of everyones income is taxed by raising the rate at which higher layers are taxed. But while every earner has income in the lowest layer, not everyone earns income in higher layers, and the higher the layer, the fewer the tax payers involved. Suppose one starts from a basic income scheme of the sort depicted in Figure 2, i.e. with a tax rate of 100 percent on the lowest layer of income which mimics the effective rate of existing guaranteed minimum income schemes (Figure 1). Lowering by 20 percent the average rate of tax in the monthly income range comprised, say, between 0 and 500 Euro will need to be offset by an increase in the rate of tax higher up. By how much? It depends on how many taxpayers have an income in the income bracket over which the tax increase is being considered. If it is in the 500-1,000 Euro range, most incomes will still be affected by the rise, and budget neutrality may be achieved with, say, a 25 percent increase of the tax rate

> in that range. But if it is in the 2,000-2,500 range, a far smaller number of taxpayers will be affected, and the tax rate that balances the budget will need to rise by, say, over 50 percent. Once this is realized, the following conclusion is inescapable. If one is to finance a significant reduction of the effective marginal tax rate on the lowest earnings, one will have to significantly raise it on a broad range of rather modest earnings. Concentrating the increase on the higher brackets would quickly make them rocket towards 100 percent and make much of the corresponding incomes vanish (if only for domestic tax purposes).

Van Parjis argumentation rests on the premise of real freedom. So in order to agree with his argumentation, this basic premise must be accepted. As often is the case with value arguments, they are subjective and not suitable for positivist measurements. However, given that the right to real freedom is accepted, furthermore the non-satiation assumption also needs to be accepted. However, given that this is a very common assumption in mainstream economics, it is acceptable. Instead, a few other issues needs to be addressed. First of all, Van Parjis argues that fewer would miss out of the income scheme due to lack of information. But is it the case that this is the reason people miss out? In for instance Lusardi 2008 it is argued to be the case. Furthermore, Lusardi finds that what is referred to as "Financial literacy" plays a big role. Currie (2004) finds that social security take up is increased by automatic enrollment, but she also finds that transaction costs are more important than the stigma. Low take-up is also a problem in non-means tested social security schemes. Overall, Van Parjis argumentation seems to hold from a theoretical point of view.

2.3.2 The people's endowment: Widerquist

The main idea of Widerquist (2014) is that "the people as a whole own the environment and the resources within it". From this premise he develops the endowment model, which basically consists of the idea that the government should create and maintain a permanent endowment fund of publicly held financial and physical assets, and rent some of these assets out to the private industry. The revenue from this fund should go to government spending and to an unconditional basic income dividend. On basis on the argument that the people own the resources, they are entitled to this dividend. The goal of the government is to continuously increase the value of the portfolio in order to

make sure that the future generations will receive more valuable endowments. The model is similar to how private households manage resources, rather than traditional government resource management. Widerquist argues that the government is giving up resources for free in not charging market prices for the resources they privatize. He exemplifies his model as being the extension of "Sovereign Wealth Funds" (SWF), which is a government held financial investment fund, set aside to benefit the citizens. One example of a SWF is the Alaska Permanent Fund. These kinds of funds ensure that all citizens benefits from the regions resources, and in the view of the author, are a good example of how government resource management can benefit the people. However, SWFs are just a small part of Widerquist's endowment model. He writes, referring to the United States: "Right now, few resource based industries pay the market value of the resources they appropriate; governments devote little of their resource revenue to SWFs; and only one of those SWF pays a dividend.". The full model has four features as follows. The government do the following

1. Charge profit-maximizing market prices for resources they privatize
2. apply the model to all resources they privatize
3. the privatization of non-renewable resources must be accompanied by saving and investing enough of the profit so as to endow a fair share to future generations
4. take into account environmental, social and political impact when privatizing and make sure that their decisions will benefit all people of today and future generations

The author point out that no one could with ease claim that the poorest inhabitants in Mexico or Nigeria have benefited from their nation's extensive oil export. Instead, Norway has an oil-export based SWF which supports the pension system of the country. The fund is more valuable than the Norwegian national debt of 759 billion dollars (2015). These assets, the author claims, will keep growing and benefit future generation long after the end of oil-exports. He writes:

> The success of these SWFs ought to inspire imitation. If it is a good idea for Alaskans and Norwegians to be paid for their share of their countrys oil, it must also be a good thing for Namibians

> to be paid for their share in the countrys diamonds, for Jamaicans to be paid for their countrys beach resorts, for South Africans to be paid for the countrys gold, for the Swiss to be paid for their banking system, and so on around the world. However, because the SWF is a relatively new idea that has been tried only in limited circumstances, I'm worried that they will give people the impression that the endowment model is more limited than it is.

There are three common misconceptions according to Widerquist. The first is that the resources are more important than the fund. Instead, he argues, the important thing is the transformation from physical to financial endowments; and for governments to stop giving away resources for free. In oil-resource rich countries and regions such as Alaska, Norway, Qatar, the UAE, Kuwait and Saudi Arabia, most of government spending is financed by resource revenue, and taxes are very low. In this way, citizens identify themselves more as "owners of shared resources" than as taxpayers. The assertion of ownership of the people is crucial to Widerquist's idea. He argues that nobody properly manages, owns or takes responsibility for the environmental system as a whole, and that the "obvious candidate" for being the manager of the "people's portfolio" would be the government

The second misconception is that not all nations are resource rich. This has no significant impact if we consider that resource affluence may explain why Qatar is richer than Yemen, but not why Singapore is richer than Yemen. It is not a question of resources, rather it is a question of resource usage and ownership. The author does not claim that better resource management would make all countries equally wealthy, but instead that it would improve conditions for those who are the worst off. Then he claims that all nations have valuable resources, but most of them are being privatized without compensation to the citizens. He compares bottled water to oil, stating it is equally a resource, but differently from oil, companies can access water for free. He further exemplifies with beaches in developing countries, and how their exploitation generally does not benefit the locals, more than with a few low-skill employment opportunities. He explains it as follows:

> The beach resort industry is - financially speaking - just as much a resource export as the oil industry. The beaches of many developing countries are dotted with - and sometimes dominated by - resorts. Yet, to the best of my knowledge, there are no beach-resort-real-

estate dividends. Not only are taxes on resorts often low; sometimes governments offer corporate subsidies for their development

Widerquist exemplifies Norway as a country which is successfully spreading the profits of the common natural resource among its citizens, and contrasts it with Mexico and Nigeria. However, it could easily be argued that it is not the SWF which is the key variable as to why the first example is so successful, while the two others are not. For instance, according to Transparency International, Norway is the fifth least corrupt country in the world, with an overall score of 93 out of 100, while Mexico is number 103 with a score of 35, and Nigeria number 136 with a score of 27. There are a total of 174 countries evaluated. This indicates that there might be degree of corruption, rather than the way states manages natural resources, which is the key to how much citizens benefit.

2.3.3 The right wing case for basic income

The main arguments for right wing advocates of basic income revolve around reducing the welfare sector and reducing the role of the state as some sort of moral judge, examining people's life in order to see if they are eligible for welfare or not. Often the right-wing case also rest on the premise that the state spends too much on welfare, and that it spends its resources badly. Zwolinski (2011) presents the classic liberal view of basic income. He determines that the moral justification of basic income from a classical liberal point of view differs from the traditional one. Someone on the political left would implicitly accept that redistribution is legitimate, while this is usually not the case for a right-wing individual. Thus, the liberal basic income would likely be smaller than the leftist basic income. From a classic liberal point of view, there is a limited role for redistribution, if the society in question is striving to reach the ideal of a "cooperative venture for mutual advantage". Furthermore, as mentioned initially in this section, two strong pragmatic liberal reasons to prefer basic income over traditional selective redistribution is that the state's entering into the private sphere will be significantly reduced. This is both a (liberal) moral good and a cost saving. If the state has no reason or justification for investigating whether the poor is "deserving" or "undeserving", it will not intrusively gather information about intimate features of individuals' personal life. This will protect individual integrity, and at the same time save the state a large amount of money, since the gathering and check-up of the information is costly and require huge bureaucracies. This leads us to the second liberal argument

in favor of basic income; what Zwolinski refers to as the "Public Choice Considerations". According to public choice theory, there is an inherent mechanism in bureaucracy which makes it expand beyond the limits of efficiency and requirement. A basic income structure would not require much bureaucracy, and thus it is desired from a classic liberal perspective. What is missing from this analysis is the fact that the welfare sector often is a huge employer, and with reducing the welfare sector, many jobs would disappear. Furthermore, this kind of scheme would only be an improvement if the welfare sector is malfunctioning in some way, for instance with heavy red tape or corruption. This is not necessarily always the case. There are examples of countries with low corruption, well functioning bureaucracy and big government. A final objection to this would be that the moral and efficiency based claim that those who have less should be granted more from the state would disappear.

2.4 Against Basic Income

The main critique against the concept of basic income consists of questions regarding the effect on work disincentives and the misery of being out of the labor market, whether welfare bureaucracy elimination is unlikely, (why would basic income administration be immune to lobbying?), the role of personal responsibility, affordability, taxes and accountability, and the fact that redistribution does not necessarily create wealth. Furthermore, much of the critique revolves around experimental evidence based findings regarding work incentives and negative income taxes (NIT). This section will provide an overview of the common cases against basic income, and then a summary of the empirical evidence supporting the opponents.

2.4.1 Liberal objections to basic income

The above mentioned Zwolinski (2011) also points out two classic liberal objections against basic income. The first one raises the question whether basic income is inherently exploitive against hard workers. He explains:

> But on the classical liberal case for BI that I have sketched in this paper, the only reason BI provides money to individuals who are already wealthy, or who are poor by virtue of their own moral fault, is that some people have a legitimate moral claim to redistribution, and the moral costs of discretionary redistribution are just too high.

> To live off the work of others against whom has no legitimate moral claim, simply because the system cannot be acceptably designed in a way that prevents you from doing so, would indeed seem to be a form of exploitation.

The other objection, which the authors finds more troublesome, but less noticed, is the potential anti-immigration pressure that could stem from a basic income structure. He argues that already with this welfare structure, it is common for populists to play on people's fear that outsiders will take advantage of the system. With a basic income structure, this problem could become larger, and leading pressure to restrict immigration, with negative outcomes for the American economy and cultural diversity, and obviously also would be unfair and have a negative impact on potential immigrants. Furthermore, Zwolinski argues that other critics would be contingent to the specific suggestion of implementation and structure of the basic income. These two critiques are mainly related to the case in which basic income replaces the existing welfare. If instead the basic income would be a supplement, the classic liberal objections would regard the justification of coercive redistribution, and effects on long-run growth. Even in the case of a substitute, there is room for some worry that the new basic income administrative structure would just hatch new entitlements, rather than removing old ones.

In a 2013 Bloomberg View post, economic journalist Megan McArdle raises some doubt about the potential efficiency gains in bureaucracy of basic income McArdle (2013). According to her, eliminating all current income security would be far from enough to sustain a basic income system. Given that at the time total government income security spending was under 600 billion dollar annually, and that there was 253 million adult U.S. inhabitants, would end up in each getting less than 3 000 dollar a year. This is far less than the current government support, and obviously not enough to live off. [2]
As pointed out by Mazie (2013) in the Economist,

> Raising the floor for all by adopting an annual UBI would make no dent in the wealth gap. Everybody from a homeless person to a middle-class teacher to a hedge-fund billionaire would receive the same cheque from the government.

[2] http://www.bloombergview.com/articles/2013-12-04/four-reasons-a-guaranteed-income-won-t-work

2.4.2 Experimental evidence: Moffitt and Burtless

1968 - 1978 the Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, Office of Income Security Policy conducted four income maintenance experiments which can be found at Irp.wisc.edu (2011). One objective was to find out what effect cash transfers from the government in form of a negative income tax to the poor would have on work incentives.

The negative income tax was introduced by Milton Friedman. A simple explanation is that it is the mirror image of a progressive tax; those who earn sufficiently low wages receive payments from the government, instead of paying taxes.

The experiments took place in New Jersey, Pennsylvania, rural North Carolina and Iowa, Seattle, Denver and Gary, Indiana. In three of the tests, specific groups were studied; married heterosexual couples in New Jersey, Pennsylvania and the rural areas, African-Americans and both couples and female headed families in Gary. In Seattle and Denver, all family types and ethnicities were studied. All experiments were conducted using classical experimental methods. Robert Moffitt of John Hopkins department of Economics has provided a thorough review of the results in Moffitt (1981). In the experiments, families belonged to either an experimental group or a control group, in which the experimental group would be granted NIT benefits. The result was measured as the difference in work efforts between the experimental group and the control group. In different experiments, the generosity of the NIT benefits were of different levels, in order to capture the effect on work effort. The benefits were paid out without work requirements, and regardless of the family members were "voluntary" or "involuntary" unemployed. However, for the sake of work incentives, the NIT rate was less than 100 percent with the benefit formula being as follows:

$$B = G - tY \tag{1}$$

Where B is the benefit, G is the guaranteed amount paid to a family with no income, Y the income level of the family and t the benefit-reduction rate. Thus, an additional dollar of income reduces the benefit of the family by t dollars with t = [0 , 1], so total income increase by $1 - t$ dollars. For different experiments, different levels of reduction rate t and guaranteed income G was tried. The results of the experiment were consistent with expectations; a negative effect on the work effort. Furthermore, the magnitude of work disincentives varied

Table 1. Average differences in weekly hours between control and experimental groups in four test areas

Area and source of estimate	Husbands		Wives		Female heads of families	
	Absolute difference	Percentage difference	Absolute difference	Percentage difference	Absolute difference	Percentage difference
New Jersey-Pennsylvania						
U.S. Department of Health, Education and Welfare:[1]						
White	−1.9	5.6	−1.4	30.6	—	—
Black	0.7	2.3	0.1	2.2	—	—
Spanish-speaking	−0.2	0.7	−1.9	55.4	—	—
Hall:[2]						
White	[3] −2.4	7.1	[3] −1.5	32.8	—	—
Rural (nonfarm)						
U.S. Department of Health, Education and Welfare and Bawden:[4]						
North Carolina blacks	[3] −2.9	8.0	[3] −5.2	31.3	—	—
North Carolina whites	2.1	5.6	−2.2	21.5	—	—
Iowa whites	−0.5	1.2	−1.2	20.3	—	—
Seattle-Denver						
Keeley and others[5]	[3] −1.8	5.3	[3] −2.1	14.6	[3] −2.6	11.9
Gary						
Moffitt[6]	−1.6	4.7	0.2	3.7	[3] −2.0	27.8

[1] See *Summary Report: New Jersey Graduated Work Incentive Experiment* (U.S. Department of Health, Education and Welfare, 1973).
[2] See Robert Hall, "Effects of the Experimental Negative Income Tax on Labor Supply," in Joseph A. Pechman and P. Michael Timpane, eds., *Work Incentives and Income Guarantees* (The Brookings Institution, 1975).
[3] Significant at 10-percent level (15 percent for New Jersey Department of Health, Education and Welfare estimate).
[4] See *Summary Report: Rural Income Maintenance Experiment* (U.S. Department of Health, Education and Welfare, 1976).
[5] See Michael Keeley, Philip Robins, Robert Spiegelman, and Richard West, "The Labor Supply Effects and Costs of Alternative Negative Income Tax Programs," *Journal of Human Resources*, Winter 1978, pp. 3–36.
[6] See Robert A. Moffitt, "The Labor Supply Response in the Gary Income Maintenance Experiment," *Journal of Human Resources*, Fall 1979, pp. 477–87.

NOTE: Hours differences are regression-adjusted for differences between experimental and control group members in years of education, age, and similar variables.
Dashes indicate data not available.

Figure 1: Effect in work incentives of NIT Source: Moffitt (1981)

positively with G and t. The table below shows the results on reduction in hours of work due to the NIT.

There are two obvious objections here. First of all, how relevant are US figures from the 1960's to this analysis? How much have the world changed since then, and how different is it from the European case? This can only be completely answered with new experiments in the new, European context. But even without them, a qualified guess would be that the situation is different. Perhaps this can be used as a proxy, but the question remains, how good of a proxy? Furthermore, is NIT a good proxy for basic income? The only thing which can be said is that there is reason to believe that unconditional cash transfers in some cases lowers some individuals work effort. By how much, and under which circumstances we cannot answer based on this.

2.5 The Alaska Case Study

As already noted in this thesis, Alaska is often brought up in the basic income discussion, due to its Permanent Fund Dividend program, which is a basic income guarantee dividend program. In Goldsmith (2010) Scott Goldsmith of the University of Alaska Anchorage describe the program's structure, economic effects and unintended consequences. The paper intends to provide insights on how implementation of basic income guarantees could be structured in other places. He begins by concluding that the implementation must differ from case to case, and that the program is conditional to the institutional, economic, po-

litical, and social environment (which encourages the use of a simulation model). Therefore, he begins with giving some stylized facts about Alaska. The state of Alaska is vast, its one of the nation's largest states. In contrast, its population is quite small. There is free movement of goods, services, people, capital and information, and the state follows federal legislation. With this comes the problem of lack of control; there are some problems related to the limits in the state's control of its political and economic environment. The main driving force for the state economy is the natural resources production; mainly petroleum, and federal government spending. The main source of growth since 1959 is Arctic oil development, and the petroleum industry provides one-third of the states employment opportunities. Due to its isolated location and to the fact that prospects of economic development is mainly attributed to natural resource exploitation, Alaska is sometimes characterized as a frontier or island economy. Before becoming a state of its own in 1959, the Alaska economy was that of a colony. Most of the wealth created from natural resources fell upon non-habitants. Still today, a significant share of the natural resources is owned by the federal government. But about 34 percent is owned by the state government (24 percent) and the Native American community (10 percent). State ownership of the oil made the state government able to capture the value and economic rent from oil production through taxes and royalties. Goldsmith writes:

> This has given rise to the notion espoused by former Governor Wally Hickel, that Alaska is the "Owner State." This is the idea that the residents own the resources and actually have the obligation, spelled out in the state constitution, to develop those resources for the benefit of all Alaskans.

The cumulative value of oil production since becoming a state has been about 500 billion, of which the state has been able to collect 150 billion. Because of this, the state has not only been able to reduce the taxes to the point that most taxes except those on petroleum have been phased out. But also, they have been able to expand public welfare and to create the Alaska Permanent Fund, the basic income guarantee which is in the form of a savings account. Due to the petroleum dependence, the state economy has been strong since the 1970's. But there are regional differences. The rural regions, mainly inhabited by the Native American population, are characterized by few employment opportunities, and high dependence on government assistance and hunting and fishing. The federal government is still important for the economy, and the natural re-

source production is dominated by large international companies, for whom the well-being of Alaska residents is not a concern. These two facts has contributed to the prevalence of the idea that "Alaska is in a struggle to take control of its own economic future and that shared ownership of its natural resources is a vehicle to accomplish that goal."

The Alaska Permanent Fund dividend (PFD) follows the common basic income definition in that its universal, unconditional, individual, regular, uniform and given as cash. However, due to its annual fluctuations in payments and due to being small relatively to poverty measures, it does not wholly fit the traditional definition. The PFD was founded 1976, when the Prudhoe Bay field, which is the largest oil field ever to have been discovered in North America began producing oil. The initial motive for the fund was to save some of the public grosses yielded from the non-sustainable resource. Its fund balance is invested in an assets portfolio in order to maximize the rate of return in the long-run. The fund is constitutionally prohibited from being spent by authorities. In the beginning its growth was slow, but with the Iranian revolution in 1979 and the related jump in oil prices it rapidly grew. Accordingly public expenditures grew. But, there was an unequal distribution with the main beneficiaries being interest groups which mainly consisted of government employees and the construction industry, and those benefiting from low-interest loans; such as students, pensioners and fishermen. Due to these inequalities, annual cash payments were suggested so as to assure that the benefits from natural resources would gain all citizens. The original scheme consisted of distributing shares to all adult Alaska citizens, one for each year of residence, up to 25 shares. Then a cash distribution of 50 dollars per share was to be given each year to all the shareholders. In addition, with the goal of disincentivize rapid population turnover so as to reduce stability, as a reward for being a long-term citizen, also the shareholders were to be awarded an additional share each year. However, this was ruled unconstitutional due to discriminating in favour of long-term residents, and so was never implemented. Instead, in 1982, it was passed that every Alaska citizen was to be given an equal amount out of the fund, regardless of age. The size of the dividend is half of the funds earnings averaged over the five years prior, divided over the number of citizens eligible for the payment. 95 percent of Alaska residents are eligible; all who lived in the state no less than a year and intend to keep living there in the future are entitled to the dividend. Initially there was a low degree of legislative support for the PFD. There was a common attitude among lawmakers that something more beneficially could

be done with public spending, and there was a worry that beneficiaries would spend the cash unwisely, drop out of the labor market, and so become economic burdens. The counterargument was that there is no better way to increase utility of individuals than to let them decide for themselves what benefits them the most, rather than having the government deciding in their place. Today, there is no constitutional guarantee for an annual distribution, and in theory the legislative body has the authority to eliminate payments entirely. The only guarantee for the PDF to persist is its political popularity. Contrary to what could be expected, the administration of the program has created a small, but growing in size, complexity and arbitrariness, bureaucracy. It was implemented to interpret the rules of the dividend and confirm eligibility. All must apply for a dividend every year by filling out the appropriate paperwork. As mentioned initially, the size of the dividend fluctuates annually, with the lowest value being 331 dollars (1984) and the highest 3 269 dollars (2008). Due to being invested in stocks and real estate in order to maximize its long-run return, its in the nature of the fund to fluctuate, sometimes dramatically, on an annual basis. However, this has not been a significant source of problem, because there is a sort of social trust; the people believes in the funds management and understand that it will necessarily fluctuate. Despite being a small share of total personal income (3 percent of average p.c. income in 2009), the dividend adds a significant amount to before taxes purchasing power into the economy. In 2009 the addition was 900 million dollars, which is more or less equivalent to total wages in the retail trade sector, or the state government wages. This makes the fund a stabilizing and diversifying factor into the economy, equivalent to that of adding a completely new industry. According to the author, it has also grown in the eyes of the people from temporary cash distribution into a permanent entitlement. Goldsmith states that the question most frequently asked to him as an economist about the PFD is what people spend their cash on. His answer relies on the permanent income hypothesis assuming to which people's spending pattern depends on their future expectations of average income. If we assume that the PFD is expected to continue over an indefinite horizon, people will treat it as a permanent increase in their income. And so, the additional consumption due to the dividend will be spread over their lifetime, and spent on the same types of goods and services that they would have spent their income on, in absence of the PFD. As a consequence, spending should not increase at the time of the annual distribution. However, it does. The main reasons for this is that companies are aware of when the payment takes place and so launch

specific campaigns aimed at making people spend; for instance advertising, sales and special offers. With this in mind consumers are only rational in increasing their spending, given that they will obtain greater values for the same price. Another reason is that people tend to spend their checks on expensive durable goods, such as snow machines, thanks to the increased liquidity. The third, and somewhat banal reason for increase in spending during the payment period is that it coincides with Christmas, a season famous for its increase in people's consumption. In 1994 the Permanent Fund Corporation issued an informal survey which showed that of respondents intended to save half or more of the dividend. Despite this, there is no quantitative evidence of any significant accumulation of wealth accelerating private sector investments. Be that as it may, the bulk of the cash from dividends makes its way into the economy and increases Alaskan employment, population and income. Goldsmith explains:

> A rough estimate of the total (direct and indirect) macroeconomic effects of this increase in purchasing power is 10 thousand additional jobs, 15 to 20 thousand additional residents (drawn to the state because of the jobs), and 1.5 billion in additional personal income.

And further highlights:

> Consequently as an addition to the "safety net" the dividend has been one factor in the decline in the official poverty rate since Alaska attained statehood, particularly among Native Americans. The Native American poverty rate fell from 25 percent to 19 percent between the census years of 1980 and 1990.

Ceteris paribus, according to economic theory, unconditional payment such as the PFD should reduce labor supply and increase wage rates. However, only one percent of respondents in an 1984 study of the program stated that they worked less due to the dividend. This is likely because the lower-income citizens who are the ones more sensitive to unconditional income increases, prefer to work more, but are constrained in employment opportunities, rather than stay out of the labor market because of leisure preferences. There are a number of unanticipated effects of the dividend; most are attributed to it growing larger than intended when implemented. The most important effect is the so called "population magnet" effect. The dividend obviously serves as an incentive to move to Alaska. It could be assumed that this effect would be stronger among

low-income individuals who are not closely connected to the labor market. Furthermore, the senior population (over 65 years of age) is increasing at a higher rate than in any of the other North American states. Demand for public services for lower-income households has steadily increased. However, the author states that its hard to isolate how much of this can be attributed to the dividend. An increase in the population will reduce the dividend size and increase demand for public services. Given that the source of revenue is an exhaustible and non-growing natural resource, there will be an increased need of taxation to support the public services. Demand for fixed resources such as land will also increase, and thus its price will increase. If labor market attached individuals are also attracted to Alaska by the dividend, labor supply and unemployment rate will increase, and wage rate decrease. The dividend will thus lead the state into a new equilibrium with lower wages and a greater population. If this wage decrease takes place, an increased part of the benefit of the dividend will go to business hiring people at a lower wage rate. This would be an unanticipated redistributive effect. Regarding the Native American population, of which the bulk lives in rural areas with low opportunities, there could be two effects. Less people will migrate out of these areas to where opportunities are better, but the dividend provides much needed cash. The effect is twofold, but its hard to weight the effects. As mentioned earlier, companies makes efforts to increase consumption during dividend season. This has resulted in a kind of "consumption frenzy", in which people are at risk to misallocate their personal income. Alaska oil production has been declining since 1989. At some point oil revenues will not be enough to fund public services and a new source of income must be found. Neither of the two viable options, use earnings of the Permanent Fund or to tax individuals, is enough to replace petroleum revenues. Furthermore, the author claims that the 29 years of dividend have made Alaskans somewhat spoiled; they feel entitled to the dividend and view it as their share of the state's natural resources. The generation growing up with the dividend has never paid for public services and have so adopted a view of the state as the provider of no-cost services and cash to citizens. There is no or little sense of community of the sort that stems from the common responsibility of choosing and funding public services. There are two conflicting views of the dividend. One, more socialist, being that the dividend is a government program of income distribution, while the other, opposite, view is that the government merely distributes the ownership share to shareholders of a natural resource.

Obviously, Alaska is an extremely specific example. It is a wast area with a relatively small population, with a huge natural resource. In a way, it is the perfect "biotop" for basic income. The dividends increases employment, which somehow contradicts the earlier discussed income maintenance experiments findings. This supports the view that voluntary and involuntary unemployment needs to be analyzed separately.

3 Theoretical method: Object-oriented Agent-based Simulation models

The method chosen for this model is Object-oriented Agent-based simulation. The program used for the modeling is NetLogo, which is an agent-based integrated modeling environment. This section will provide a definition of this type of modeling, based on several noteworthy earlier works and analyses, and also a discussion on how it differs from its predecessors, and a discussion on how it improves the analysis. First there will be a discussion on the leap forward provided by Agent-based simulation.

3.1 Why agent based models?

In Boero *et al.* (2015) we are provided with a discussion on what agent based models can do to overcome the limits faced by traditional analytic modeling tools. One noteworthy concern to the traditional approach is where to draw the line between theoretical and empirical work, i.e. between theory and data. There are examples of successful integration of the two, but the issue remains; there is a trade-off between theoretical clarity and more immerse empirical studies. One of the reasons behind this is the rigidity, or lack of flexibility of traditional tools. Their technical limitations has the researchers to compromise and sacrifice some realism. It is not known what the consequences of these compromises are. Agent based models avoids this trade off by allowing a higher degree of integration between theory and empiric data. The flexibility of agent based models allows the researcher to choose their preferred level of realism, bounded only by which data and knowledge is available of the subject of interest, "but not by the formalism they adopt, as is the case with equation-based models". Boero writes:

> This feature of ABMs has a great impact on causality. In fact, the ability to realistically model the mechanism generating a phenomenon generates the ability to investigate which mechanism are responsible for a phenomenon, their complex interplay and the conditions under which one mechanism, or cause, prevails over others. When testing equation-based models over empirical data, on the contrary, it is often difficult to discern causality from spurious correlation and to investigate endogeneity.

The fact that causal mechanisms can be robustly identified provides a great opportunity for policy makers to develop effective measures. This is one of the main points of this thesis and the related model. As will be further explained at a later point, the model is intended to be used as a "reasoning machine", in which different settings and assumptions can be tested to investigate their implications. From this, policy suggestions can then be developed and proposed. With agent based models, policy can also be evaluated ex ante, which provides a valuable opportunity to suggest the proper modifications to policy which does not result in the desired outcome. Furthermore, given that the dynamics leading to outcomes can be observed and analyzed, the researcher can be more certain about their results. Similarly, uncertainty can be analyzed. Since causal mechanisms can be modeled, also the sources of uncertainty can be investigated. Given that social phenomena often are complex, so are the casual mechanisms behind them; and there is obviously reason to believe that these mechanisms are multiple. Agent based modeling allows for this, and allows for influences and feedback, and continuous updating of variables, mechanisms and other parts of the model, including social networks and their interactions. Social dynamics and social networks are hard to implement into standard utility functions, so they are often neglected in traditional analysis, for the sake of simplicity. Instead, with agent based models social dynamics and their interactions with markets and incentives can be implemented into the analysis. To conclude, agent based models furthers the realism possible to implement into modeling, and is thus a useful tool to analyze hypothetical situations.

3.2 Defining Agent-based Simulation models

Gilbert (2008) offers a clear definition of Agent-based modeling which highlights its purpose.

> First, agent-based modeling is a form of computational social science. That is, it involves building models that are computer programs. The idea of modeling is familiar in most of the social sciences: One creates some kind of simplified representation of "social reality" that serves to express as clearly as possible the way in which one believes that reality operates.

The social reality represented in this model is the one of a fairly smooth functioning market economy, in which basic income is being introduced. One of

the main contributions of this specific model is however its great flexibility in allowing the user to modify both the social reality and the basic income structure. The flexibility of the model will be further highlighted in sections 7 and 11. The model of this thesis build on the theoretical basis provided by Axtell and Epstein (2010), with some differences which will be discussed. Axtell and Epstein have built a model on retirement, in which agents, cohorts of agents and social networks are objects. Soon to follow is an explanation of how, and which of these concepts will be used in the basic income model. But first there will be a brief explanation of how Agent-based simulation models differ from its predecessor microsimulation.

3.3 Richiardi: Agent-based Simulation models and microsimulation

Richiardi (2014) characterizes agent-based simulation models by three features as follows:

1. there are a multitude of objects that interact with each other and with the environment,

2. these objects are autonomous, i.e. there is no central, or "top-down" control over their behavior and more generally on the dynamics of the system, and

3. the outcome of their interaction is numerically computed.

Generally, the intention with these kind of models is to discover possibly unexpected macroeconomic outcomes of individual based interactions. Basically, micro simulations are without interaction among agents. With micro simulations the behavior of the agents is programmed, but they do not interact. Instead, agent-based simulation models take social interaction into account, and can be used to discover the outcomes of such. Agent-based modeling stems from microsimulations. The first traces of agent-based modeling in microsimulations can be found in the works of Bergmann (1974) and Eliasson *et al.* (1978) who respectively made simulations of the US and Swedish economies. What they added to microsimulation, was that they explicitly considered labor supply and labor demand interactions. Moreover, they had a structural way of modeling the behavior of firms and workers. Broadly defined, dynamic microsimulation

simulates "state and behaviors of individuals, households, firms and other economic units evolving in a given environment, such as a market, a state or an institution". Often the goal is to investigate outcomes of various policy and to observe the underlying micro dynamics of macro outcomes. In the 1950s, as this kind of modeling was pioneered by Guy Orcutt, emphasis was put on the individual economic units, and their heterogeneous decision making. The main differences between microsimulation and agent-based modeling is that the latter is oriented toward theory rather than policy, which is the case for the former. Agent-based models moreover are often closed models, while microsimulations often instead rely on a partial equilibrium approach. The way Bergmann performed her microsimulation of the US economy was deeply influenced by Orcutt, but departs in the following way, Richiardi (2014) writes:

> The behavior of all actors is modeled in a structural sense: workers, firms, banks, financial intermediaries, government and the central bank act based on pre-defined decision rules, rather than being described in terms of transition probabilities between different states.

The recent development of these models is far more complex, but the goal is still the same: creating a model which is able to "track real data, simulate policy options and provide policy guidance.". However, it is still uncommon to empirically validate agent-based models, and generally the validation is based on "more or less sophisticated calibration". Concluding, the main difference between agent-based models and microsimulation is that the agent-based models take into account and exploit interaction between agents, extending the microsimulation approach. This opens up for interdisciplinary between economics and fields such as behavioral science and, as shown by Epstein, neuroscience.

3.4 Axtell and Epstein: Object oriented Agent-Based Computational Models

Axtell and Epstein (2010) wrote an interesting paper with a model on retirement and how the decision to retire is made. They used an object oriented approach to Agent-based simulation. The author of this thesis finds their method very interesting and their ideas are being used into the basic income model. Therefore follows here a brief summary of their model and object-oriented Agent-based modeling. Thereafter comes an explanation to how their ideas have been implemented into the model of this thesis.

The idea of Axtell and Epstein is:

> Compactly, in agent-based computational models a population of data structures representing individual agents is instantiated and permitted to interact. One then looks for systematic regularities, often at the macro-level, to emerge, that is, arise from the local interactions of the agents. The shorthand for this is that macroscopic regularities "grow" from the bottom-up. No equations governing the overall social structure are stipulated in multi-agent computational modeling, thus avoiding any aggregation or misspecification bias. Typically, the only equations present are those used by individual agents for decision-making. Different agents may have different decision rules and different information; usually, no agents have global information, and the behavioral rules involve bounded computational capacities - the agents are "simple". This relatively new methodology facilitates modeling agent heterogeneity, boundedly rational behavior, non-equilibrium dynamics, and spatial processes. A particularly natural way to implement agent-based models is through so-called object-oriented programming.

In the appendix of their paper, they describe the implementation of the model, in other words how they have implemented agents as objects. They explain that objects are memory blocks which incorporates both data which is referred to as "instance variables" and functions used to transform the data. These functions are called "methods". In Agent-Based modeling the data of an object is interpreted as an agent's "state information" and the functions as the agent's "rules of behavior". These behavioral rules are the same to all the agents, but since they have different local state information, the input into the behavioral methods will differ and so the behavior of the turtles. Axtell and Epstein (2010) explains:

> A population of agents that have the same behavioral repertoire but local state information is then conveniently implemented as multiple instantiations of a single agent object type or class.

3.4.1 Objects in the model

3.4.2 Agents as objects

In Axtell and Epsteins retirement model, the agents, when represented as objects, have state variables which are unique, or "local" to each individual agents, and they have behavioral methods which are the same to all. To clarify, the state variables in this example are age, type (whether they are rational, imitate others or act randomly), employment status and at which age they will die. The behavioral method, i.e. the decision all agents make, is if they should retire or not.

3.4.3 Social networks as objects

The model contains also social networks, which are objects. Their local information - their state variables - is size in terms of how many agents they contain, and their methods are functions to conclude how many of the agents in the network are retired and eligible to retirement.

3.5 Implementation into the Basic income model

In NetLogo, a network is not an object, but a set of turtles and links. There is a network extension called nw which is used for this model. The network is a context made of agents and links. Here we depart from the Axtell and Epstein approach: only agents and links are objects; all other are constructions around the agents. For instance, cohorts, which in Axtell and Epsteins model are implemented as objects, are in NetLogo instead attributes of the agents; the agents are participating in a given cohort. What Axtell and Epstein basically does is creating individuals, with their individuality based on state variables. Translated into reality our state variables are building blocks of who we are; our gender, our age, our various propensities and other things which affect how we make decisions. In the initial idea of the basic income model the state variables are education, wealth, income, social capital, incentive type, risk type, health, happiness with life, employment, employment history, wage, fertility, being family head, being divorced and or re-married or not, and sense of social safety. Obviously these variables are not static; most of them can and will change during the agents lifetime. They impact each other, and are influenced by the environment, and by the outcomes of behaviors. Behaviors will be decided by the so called behavioral methods. In the initial model, these decision rules are

whether to adjust consumption, self-fulfillment consumption, investments, and labor supply, whether to have (more) children, and whether to invest more in the children one already has. The environment in which the agents operate will initially consist of a simple economy with levels of corruption, tax rates and gender equality which can be set by the user. Then a traditional needs based welfare or security net will be introduced. Its costs varies with corruption levels, social capital and its size. Included into these administrative costs are the follow ups, for instance of controlling that unemployed are actively seeking employment. Obviously the welfare sector is also an employer, and as such provides wage tax incomes. Into this variable we will find child support, unemployment support, poverty relief, and pensions. The environmental and state variables, and the behavioral methods, with their interrelations will be further discussed later in this thesis. The magnitude and direction of the effects of variables on each other are based on assumption for which the reasoning behind will be provided. The way agents behave behind their state variables and their methods will be based on Epstein's work on how the neural basis of learning can be implemented into agents in simulation models. The following section is summarizing a seminar given by Epstein in which he explains his research, and his concept agent zero.

3.6 Epstein's seminar: December 18th 2013

Joshua Epstein is one of the most influential contributors to Agent-based modeling, and has written a fundamental book on the so called "Agent Zero", which is a new way of modeling behavior Epstein (2014). Traditionally, the agents in simulation models have followed the standard assumption of being a rational economic agent. Instead, so as to model human behavior in a way more corresponding to reality, Epstein developed "Agent Zero", who is an agent with a neuro base. In a 2013 seminar, Epstein elegantly explained the core of this concept. Below is a brief summary of the seminar, which is introduced into this thesis because it is building on Epstein's ideas of the Agent Zero which some of the Basic Income model is coded.

Epstein (2013) begins his seminar by mentioning David Hume's work "Reason is a slave to the passion", and the famous Aristotelian notion that "man is a social animal". The idea of Agent Zero is building on this. Agent Zero is a ground breaking next generation agent, driven by passion and reason (and of the passion and reason of others). It is endowed with distinctive, cognitive, effortful, social modules; grounded in neuroscience. It is far from the rational

behavior of homo economicus. Epstein has used collective dynamics from different fields, creating several NetLogo models which are replicable in every detail. The skeletal equations of Agent Zero are binary actions; in the simplest model the action is zero or one. For instance, flee the snake or do not. Behavior is modeled as a binary action. Another example is the disposition to work. It is defined on stimulus base and can be conditioned on stimuli. To learn to fear something, creating a disposition. Each agent has an action and a disposition to act, which is based on emotion, reason and passion. Each agent also has weights that affect them; they are affected by the dispositions of everybody else. Agents are endowed with affective and deliberative functions, V(t) and P(t), which are defined on a stochastic stimulus space. Their sum is the solo disposition. The weights ($\omega_j i$ is the weight of j on i) are presumed to be unconsciously carried by the agents.

$$D_i^{solo}(t) = V_i(t) + P_i(t)$$

$$D_i^{total}(t) = D_i^{solo}(t) + \sum \omega_{ji} D_j^{solo}(t)$$

Then, there is a simple threshold which can be homo- or heterogeneous. The action rule is simple: take binary action if and only if the total disposition exceeds the threshold. The action rule is $D_i^{total}(t) > \tau_i$ with action threshold $\tau_i \geq 0$. Behavior is not input into the disposition equation; nobody's behavior enters, and therefore it does not either enter the actual action mechanism. This means that we are not dealing with the imitation of behavior; because the behavior is not visible to the other agents. With this the assumption of imitation of behavior is replaced with the assumption of transmission of disposition. Disposition is passion plus reason plus the sum of everybody else's passion and reason.

3.6.1 Generalized learning model: Rescorla Wagner conditioned learning

The Rescorla - Wagner model is a 1970's model on Pavlovian influences on decision making which tries to explain the conditioning which affects how strongly a signal and a stimuli are associated Rescorla (2008). Epstein continues the seminar by asking what the probabilities are? Every agent has memory; they are operating on a landscape of stimuli; carrying a moving average of their experienced evidence. And the weights are built up by affective homophily. Epstein has developed this model in different ways, but the interest of this thesis is how he developed it as an agent-based, stochastic and spacial version. However, an

important theme in his book is to enrich models with both this version and deterministic, non-spatial ones. The model is explained in the context of fear. Fear is explained as an emotion which plays a role in many social behaviors: for instance mass flights and witch hunts. The circuit of fear has been studied for long and it involves the amygdala. The amygdala is centrally implicated in fear. If you imagine a bear jumping at you, there is a stimuli which is processed by the thalamus, which sends an activation pattern to the amygdala. This procedure releases hormones which generates behavior such as freezing, or dilation of pupils etcetera. There are inputs to and outputs from the amygdala; the fear response. This is the architecture implicated in fear. The survival circuit is automatic, fast, and inaccessible to deliberation. In addition to the pure acquired fear machinery we also have an associative machinery. We are able to wire fear from direct stimulus, but also to associate things with fear and condition it on them. A classic experiment on this examined the effects on the amygdala. It is similar to the stimulus experiments by Pavlov. Blue light is shown simultaneously with shocks. Initially the blue light is meaningless. There is no need to be conditioned to not like shocks. The unconditional response is the amygdala response. The light and the shock are displayed many times. In the end the blue light is enough to trigger the amygdala response. There is a neural connection between stimulus and shock. In the Rescorla-Wagner model this is the product of some learning rate minus the gap and the current association: the association between blue light and shock on Tuesday, minus the same association of Monday.

$$v_{t-1} - v_t = \alpha\beta(\delta - v_t)$$

here learning rates (α, β) are encoding the surprise and the salience of stimuli. In order to learn we have to have elements both of surprise and salience. However, the gain in association is marginally diminishing. In this way, it can be explained what Hume observed, and that flame and heat, cold and snow has always been associated. It is natural instinct; no reasoning can produce it or prevent it. It is typically non-conscious, which has deep implications for social dynamics. We are harnessing the same innate machinery; the survival circuitry, which are encoding novel threats. We do not need to learn fear; instinct tells us to. In the seminar, an example of the effect on us of a charging BMW and a charging wild animal on our ancestors is given. It is invaluable for us to have this fear; not to have to be hit by a BMW before we understand its danger, but it is a double edged sword. We can over-generalize. For instance; the Pearl

Harbor incident contained elements of salience and of surprise. This conditioned Americans against the Japanese. Same happened with Arabs and Americans after 9/11. The case of 9/11 is a good example of over-generalization because of its many associative traits. Few people in the United States had heard the word "Al-Qaeda" before. There was not much mainstream association with Arab imagery and culture. But, when the attacks happened, the Qur'an, and Islam became very associated to 9/11. It was a very over-generalized reactions against Muslims. This process produced the over generalization. In addition to being illicit; the associations can persist. If I have learned to be afraid of hippos, I will continue fearing them. It makes no sense to stop on being scared of hippos on Tuesday if I was scared of them on Monday. So, the question becomes, how to extinct fear? Mathematically the solution is to set the maximum associative strength to zero. Fear dies out if stimuli is stopped or if it is overwritten by other things. The function is the one of radioactive decay; it is a question of calculating the half-life of fear.

3.6.2 Contagious fear

We do not fear what the rat fears, but we fear how the rat fears. One can learn fear; but its also contagious in some sense. Epstein asks whether there is any neural basis. The answer is yes. Consider a different application of the experiment on amygdala reactions to blue light and shocks. The real subject of this experiment is a person watching the conditioning exercise. He is not wearing a shock cuff. But after watching the other persons conditioning he also reacts to the blue light. He gets the fear without direct stimuli, he acquire it from others. I can observe someone else be burned and learn to be scared of fire; this makes sense. But, it also leads to baseless, over-generalized fears. Reason may be a slave to the passion, but sometimes we do reason. But we reason with incomplete information. This is the concept of bounded rationality: we take in imperfect local information and make a biased appraisal of it (usually with sample-selection bias). Agents who are driven by strong unconscious emotions like fear also influences each other. What are we learning about the neural basis of conformity? If someone gets rejected, the regions reacting are the physical pain regions. We conform because rejection is physically painful. And Epstein encodes this by giving weight to other agents. The model produces networks and explain why they even happen: through affective homophily. The model contains three agents, which is the smallest number needed for a majority.

They live in a yellow region. Each patch is an endogenous population: it is a landscape of trials. The agents have emotions and they form emotions because of activations on the landscape. Some regions will become active in each run. The agents are not observing each other but they are connected; for instance through social media. The landscape activates stochastically and becomes orange, this symbolizes ambushes. Blue agents are occupying soldiers. The agents move on the landscape and condition on the trials. They are forming an emotion: a fear of the yellow. They are also taking data within their vision. What is the probability that a random site will be an armed site? The forecast is based on a moving average. The deliberate piece is that they look around, and get evidence from the immediate environment and form a forecast; a bad and biased forecast, but never the less, deliberate. Their emotions are based on conditioning. The deliberation is based on estimates (it is a probability based appraisal). Then this is weighted through these weights, they based on others. Once they reach over the threshold: they destroy something. The first result was that agent number 0 (who is an agent zero) has no evidence of yellow wrong doing, there was not in any of the trials. But he still wipes out his village. This can translate into a person who does not dislike people of another ethnicity, and who has no experience of any wrong doing by any individual from that ethnicity, but he still joins a racist lynch mob. Why does he do that? The situation is that the total disposition is greater than the threshold, but his solo disposition is not. He takes action in a group which he would not take alone. You may be the only agent in the group with that ordering; and despite being negatively disposed; you might even act first. No stimuli what so ever; the estimate is zero; you have no feelings against the yellow population; but because the total disposition exceeds threshold you are actually the first one to act. That is the core computational parable of Epstein's book. The agent goes first, without stimuli. This is a troubling result. Is the agent a leader? Or just susceptible? All the other agents are out of his immediate vision; so he is not repeating their behavior. Its the disposition. He went first because he is the most disceptible. Is he a leader? No, just the most susceptible. Epstein states that a king is history's slave.

3.6.3 Three agents: Possible Empirical Interest

Darley made a famous experiment on by-stander effects. The subject is alone in a room and smoke starts flowing in from under the door. The smoke enters

the room, and when risk exceeds the threshold the subject exits the room and reports the smoke. In the next trial there are two confederates who are in the room, filling in forms politely. The subject then leaves the room much later after the smoke enters. It is the same physical environment but it stimulates different reaction with people around. This is crude and simple, but it captures something.

3.6.4 Networks

Why do networks happen at all? Can we build a model in which networks take place and occur? How does the weights change? Epsteins answer is homophily of affect. But the more passionate peer should have the stronger connection: scale by total strength. Affect will be updated using the sum of the affects, times one minus the absolute affective difference. When updating agents like this; they start with no connection and then with common experiences develop strong connections and so weights increase. When we allow weights to increase through affective homophily it emboldens people to act where they would not have acted alone. For instance, the Arab spring was essentially leaderless. The Tunisian uprising inspires the idea that freedom of cyber assembly was the way these revolutions happened. This is a departure from the earlier literature which was more about preferential attachment. The attachment was a function of degree: the rich get richer; and the highly connected nodes get connected. This new hypothesis is that weights are the product of strength and homophily. And as people drift out of the common experience, the links break. One of the extensions of the model is the model of economic cycles. Here we have the supply effect: winter fruit prices go up because of low supply; there are no strawberries grown in Boston in winter time. And there are seasonal demand cycles: we celebrate Christmas for instance. And there is Christmas associated advertisement. People are subject to those stimulus. The economic cycles model crudely mimics data. Karl Marx wrote "men make their own history, but they do not make it just as they please; they do not make it under circumstances chosen by themselves, but under circumstances directly encountered, given, and transmitted from the past." and "The tradition of all the dead generations weights like a nightmare on the brain of the living". How can this be modeled? A child is born into a hostile environment and inherits the memory string of his mother. But when he moves away to a peaceful world; those things are overwritten by other memories; the nightmare is over-written. Science begin as

parable and ends as probability. Epstein concludes by stating that the Agent zero is not a rational individual, it is not a homo economicus.

4 Initial model design: definitions and impacts

This section introduces the theoretical foundation behind how the variables included in the model should affect each other. This is the basis of how the interactions and effects goes. However, during the process of building, testing and experimenting with the model some effects have been altered. Nonetheless, the core of what is stated in this section is consistent with the final version of the model. The full code is provided in the first Appendix, whereas the explanation of the key points of the code can be found in section 6. This is then extended in section 11. In the experiments section, number 12, the final alterations to the code are being represented. All through the thesis, the assumptions are being stated and explained.

4.1 State variables

Education

Men are slightly less educated than women. The probability to be more educated increases with age. Wealthier individuals are more likely to be educated. Higher income individuals are more likely to be educated. Social capital: Trusting the system makes me more likely to undertake education, because it feels like a worth wile investment. Being a risk lover decreases the probability to undertake traditional higher education because you are likely to invest in other types of activities; for instance being an entrepreneur. Thus the effect of secondary and tertiary education is negative. Health has positive effect on education. Happiness increases with education. The probability that you are or have been previously employed increases with education. Wage increases with education. The probability of being the family head increases with education. Education effect on incentives: Education is attractive both from a idealistic and a material standpoint; thus there is no clear direction of the effect here.

Wealth

Wealth is the monetary values accumulated by an individual.

Being male increases wealth and income, with the opposite true for women. For both genders they increase with age and with education. Being more materialistic is likely to increase you wealth and income. Good health has a small positive impact on wealth and income, as has happiness. The probability to be employed increases wage and income. Wealth and income

increases with employment and employment history, and married people tend to have higher levels. Being the main provider of your family increases wealth and income, but divorce decreases them.

Income

Income other than wage.

Social Capital

Social capital is in this paper defined as "levels of trust towards other people and society's institutions". If the agents parents have levels 0 25 of social capital, the offspring gets a random value between 0 and 25.

Initial values are randomized, but with women in general having higher initial levels of social capital. Education generates social capital. People with higher wealth are likelier to have higher social capital levels, given that they are likely to be in a beneficial position in society. Instead, if you are poor, there is a possibility that you feel that society has failed you. Idealistic people are more likely to have high social capital; thus the effect of social capital on incentive type is negative; social capital makes you more idealistic. There is a small negative effect on social capital from being a risk taker, whereas being healthy and or happy has positive effects on social capital. Visa vi someone who is unemployed an employed individual has higher social capital, ceteris paribus. Social capital also tend to be higher with those who have a history of being employed. For idealistic people, social capital increases with wage, whereas it decreases for materialistic people. Social capital decreases with divorces. Social capital is higher for those with a higher sense of social safety.

Incentive type

This variable goes from 0 which implied a completely idealistic person to 100 which is wholly materialistic. Idealistic here means that other things than monetary values are driving the individual's behavior.

Randomly assigned with bias towards materialist. However will be affected toward idealism as social capital increases. Generally, wealthier people are more likely to be materialistic. Happy people tend to be more idealistic. Being employed increases the probability of being materialistic, so does having a history of being employed, and increases in wage. Being in a marriage and also being head of the family increases materialism. But, also divorcing increases materialistic tendencies with agents. Individuals

with a higher sense of social safety tends to be more idealistic.

Risk

This variable is defined from 0 which implies risk hater to 100 (risk lover). Its initially randomly assigned, but with a bias towards risk aversion for women. When people age then become more risk averse. Getting a divorce lowers income and thus increases risk aversion. In general, by taking higher risks, one may reach higher values. This, in combination with the fact that taking risks are less dangerous for those with higher levels of wealth to fall back on, makes me assume that higher levels of wealth has a positive impact on the risk taking level. Risk loving increases after a certain income. This is because its likely to assume having some income to fall back on in case of failure generally makes people more comfortable with taking risks, as to increase their potential profits. For women, having children or planning to have children there is an effect towards risk aversion, and for both genders there is such an effect from being the family head. This is because with more people to provide for, risks become more expensive. With a higher sense of social safety, individuals move towards riskier behaviors.

Health

Physical health or ability of an individual.

Health decreases with age with increasing speed at the higher ages. Health increases with education, and also with income, but in this case with diminishing marginal utility, given the inevitable fact that also billionaires die eventually. The same goes for happiness with life; its increasing, but with diminishing marginal utility. Social capital is beneficial for health, but being a risk lover decreases general health. More happy people are healthier. Being, or having been employed increases health, and health increases with income. For women, there is for a large decrease in health after having more than three children, and a small decrease for any child. Married people are in general healthier, and health increases if you are the family head. It is also increased by a sense of social safety. However, health decreases with divorces.

Happiness with life

This variable encapsulates mental well being, as well as feeling happy about life.

Happiness increases with education, wealth and income. Also with social capital, since trusting the system makes you happier. Healthy people are happier than less healthy people. Employment and having been previously employed increases happiness. Happiness also increases with wealth; this assumption is supported by the words of Franoise Sagan - "Money may not buy happiness, but I'd rather cry in a Jaguar than on a bus". Having children and being the family head increases happiness. There is data supporting the idea that being married increases happiness, but only if the marriage is happy. Given that this is too subjective to be convincingly modeled, this effect will be left neutral in the model. Divorce, however, has a negative impact on happiness. Social safety increases happiness.

Employment

Being employed

The probability of being or having been employed increases with age and with education level. It also increases with wealth, income and social capital. Materialistic people tend to work more and harder, and thus are more likely to be or having been employed. Health and happiness also increases the probability. Its harder to get a job if you have been previously unemployed so it makes sense to assume that that someone who is employed also is likely to have a history of employment. Having children increases the probability of being employed for men, but reduces it for women. Being married and being family head increases the probability of being employed.

Employment history

Having a history of being employed; this makes it easier to get future employment.

Wage

Labor income, including from being self-employed

Wages increases with age, education, and wealth for both genders. There is a gender wage gap in favor of men. Materialistic individuals are more directed towards labor which gives higher wages. Being healthy increases the probability of being employed and also the wage. Being a happy person makes you more likely to be employed and have a higher wage. Being, and having been, employed increases wage and income. Wage decreases with having children for women, but there is no effect for men. Married people

and family heads have higher wages.

Fertility

Wanting to increase the number of children.

This increases with age, until the age of 40, where it starts decreasing rapidly. Higher levels of social capital has a positive effect until three children. There is a higher probability that you will want to have children if you feel that the society to which you will birth them is a good society. Health increases the want of getting children. Happiness also has this effect, but smaller. Employment, increases in the wage and being married increases the will to have children between zero up until three children, but has no effect after that. Divorce has a negative effect.

Family head

One of, or both of the adults in the family network has the main responsibility to provide for the family. Their income is supposed to uphold at least a minimum level of consumption for the family.

The probability of being family head increases with age, education, wealth, and employment. Being materialistic and thus likely richer makes you likelier to be the main provider of your family. If you are healthy you are more likely to be the family head. Having children reduces the probability of being family head for the woman, but increases it for the man. Being married has a gender neutral positive effect.

Divorced

The probability of being divorced and or re-married increases with age, but social capital decreases the probability of divorce. This is because people with higher levels of social capital has a higher trust in social institutions, such as the institution of marriage. Being employed has a small positive effect. The probability of being re-married is higher with higher levels of wealth and employment and with higher levels of social capital. And obviously also for divorced people. Other than that, the effects of being re-married are the same as for the married variable.

Re-married

Safety

How much a person have to fall back on in case of reduced income; for instance as a result of unemployment. This variable depend on the welfare

	Gender	Age	Education	Wealth	Income	Social capital	Incentive type	Risk type	Health	Happiness	Employment	Employment history	Wage	Fertility	Married	Family head
Gen			-	+	+			+	+		+	+	+			+
Age			+	+	+			-	-		+		+	+	+	+
Educ				+	+	+	+-	+-	+	+	+	+	+	+-	+	+
Wea			+		+	+		+	+	+	+	+	+	+-	+	+
Inco			+	+		+		+	+	+	+	+			+	+
SC			+	+	+		+-			+	+	+	+	-		
Inc			+	+-	+-	+-					+-	+-	+-			
Risk				+-	+-						+-	+-	+-			
Heal										+				+	+	+
Hap									+					+		
Emp				+	+	+	+		+	+			+	+	+	+
Emh				+	+	+			+	+	+		+		+	+
W				+	+				+	+				+	+	+
Fert									- (if fem)	+					+	
Mar				+	+	+		+-	+	+	+		+	+		+
FH						+	+	-								

Figure 2: State variables inter-relations

system of the economy, his or her own wealth, wage and income and the family's wealth, wage and income.

An individuals social safety net is increased by wealth, income, social capital, employment, employment history, and if he or she is married. It is also increased by the family's total accumulated wealth, and depends on the welfare structure of the economy.

4.2 Behavioral methods

Adjust consumption

Consume more or less. Consumption increases with age, up to the retirement age. It also increases with education, wealth, income, being a risk taker, health, happiness, employment, wage, fertility, being married, being family head and feeling socially safe. Increasing consumption has a positive impact on happiness, and a one-to-one negative correlation with wealth.

Adjust self-fulfillment consumption

Self-fulfillment consumption is a form of luxurious consumption, which

	Adjust consumption	Adjust investments	Adjust labour supply	Have children	Invest in children
Gender					-
Age	+	-		+	
Education	+		+	- >3	+
Wealth	+	+		- >3	+
Income (not wage)	+	+	+-	+ 1-3 - >3	+
Social capital			+		+
Incentive type			+-		
Risk type	+	+		-	
Health	+		+	+	+
Happiness	+		+	+	+
Employment	+	+		+ 1-3	+
Employment history			+		
Wage	+	+	+	+-	+
Fertility	+		- (with uneven gender effects)	+	
Married	+		+-	+	+
Family head	+	-	+		+

Figure 3: State variables and behavioral methods relations

thus does not include consumption of necessity goods. Instead its undertaken by those who have already fulfilled their basic needs, and seek to further increase their utility and happiness. An example could be a trip. This variable increases in the same way as consumption, but with the exception that for it to grow social safety and wealth must be above respective threshold levels. Increasing self-fulfillment consumption has a large positive impact on happiness, and a one-to-one negative correlation with wealth.

Adjust investments

Adjust investments towards more risky investments, which have higher potential profits. After retirement age, investments tend to be less risky. Wealth and income increases the risky consumptions, and so does obviously being a risk lover. Employment, wage and level of social safety increases the level of risk taking in investments, whereas being the family head decreases it. Riskier investments increases or decreases wealth and income with a probability; the probability of success depends on the risk level; and is related to the potential pay-off which is higher for higher levels of risk.

Adjust labor supply

This does not refer to unemployment, because being unemployed is not a choice. This is how much an individual chooses to offer his or her labor. Depending on incentive type, the inputs into the decision function has more or less impact. Education, social capital, health, happiness, employment history, wage and being family head increases labor supply. Fertility decreases it, with a larger negative impact for women. Being married decreases labor supply for women, and increases it for men; depending on the level of gender equality in the economy. Increasing labor supply increases employment and wage.

Have children

This refers to the decision to go from no children to children, and to increasing the number of children. Age increases this variable, up to age 40. From zero to three children it increases with education, wealth, income and employment. For more than three children it decreases with the same variables. It increases with health, happiness, fertility, being married and feeling safe. Having children decreases wealth, and makes the individual less risk loving. It increases happiness. For women, it decreases employment and wage, but increases them for men.

Invest in children

This refers to putting more resources into the children's education, happiness and health. Women tend to invest more into their children. Investment in children increases with education, wealth, income, social capital, health, happiness, employment, wage, being married and being family head. Investing in the child increases the child's education and social capital. But it decreases the wealth of the parent with a one-to-one relationship.

4.3 Environmental variables

Gender equality

If this variable is set to one, all differences between male turtles and female turtles disappear. It goes from 1 to 100 following the European Union Gender Equality Index (EIGE).

Welfare security net

The levels of monthly payments in the form of, child support, pensions,

unemployment support and poverty relief

Tax rates

The sum of the tax incomes goes into the welfare and security net, repaying debt, or basic income, depending on how the user chooses to set up the interface. The various taxes consist of consumption taxes, income taxes, wage taxes, and wealth taxes.

Corruption

The value of this variable gives the fraction of tax incomes which actually goes into the three variables mentioned above. What goes into corruption will be assumed a dead weight loss. Corruption negatively influences social capital.

5 Initial model structure

The model is structured as follows. All agents have initial functions for their state variables, of which some are already functions of other state variables and/or the environment. Others are set randomly. For instance, for the adults in the model, education is initiated randomly, but enters positively into the initial wage function, given the assumption that education increases the wage. A gender weight is implemented where relevant, and some of the functions differ between adults, children and retired agents. Some features of children are functions of their parents features. In this way, the model creates agents as individuals with local state information. Similarly, all agents have development functions of their state variables. Age increases only with time, and gender does not change. But other than that, state variables continuously develop as a function of (some of) each other, the developments of the environment and outcomes of behavior. The frame of the behavioral method functions are the same for all agents in the same age category. But, their outcome depends on the state variable information and the weights given to other agents. Furthermore, the action threshold differs between individuals. The weights to other agents and the threshold level depends on some state variables, the environment, and on the weights of the agents networks. The outcome of the agent's behavior affects directly the state variables of the agent making the decision, and so indirectly the environment. Choices on consumption and labor supply directly affects the treasury. The environment is initially set up according to the will of the user. The environmental variables affect both agents behavior, and their changes in the state variables. The corruption level has a negative impact on social capital. There are two types of networks. One is the family network, which affects some state variables; for instance safety, and also improves the economic situation of network members. In order to make the model more realistic, noise is added in the form of random elements entering most of the functions.

6 Calibrated basic model

The first version of the calibrated model is an attempt to imitate a generic average European Union country in which effects of taxes, welfare measures such as income schemes and gender equality resembles those observed by economic literature. In this section each of the sections of the model will be discussed, together with some comments on how it differs from the theoretical initial model and why.

6.1 Setting up the turtles

In this section the the initial agents are created and their initial variable values are set. The initial agents are 100 male turtles, 100 female turtles, 50 children and a random number between 10 and 60 retired turtles. Each adult turtle is assigned an age between 18 and 65 (which is the retirement age in this model). Female turtles are pink, while male are blue and retired are black while children are red. Apart from color, female and male adult turtles are coded in the same way. The underlying assumption here is that it is societal differences - such as the wage gap -, rather than biologically inherent differences, which incentivizes them to act gender specific. However, this assumption can easily be altered. For the initial calibration it was found useful to initially create men and women equal in order to see that they act similarly in the perfectly equal setting, and so use it as a simple way to control for errors in the code and how different variables interact.

```
set-default-shape fems "person business"
create-fems 100
[
setxy random-xcor random-ycor
set age 18 + random(47)
set color pink
set risk random(100)
set work_will 1 + random(500)
set SC random(100) - random(25)
set incent random(100)
set happy (educ + health + SC + emp + emp_hist + safe) * 0.1 + random(25)
set educ 1 + random(10) + (wealth * 0.0002) + (income + SC + health) * 0.001
set fert random(100)
```

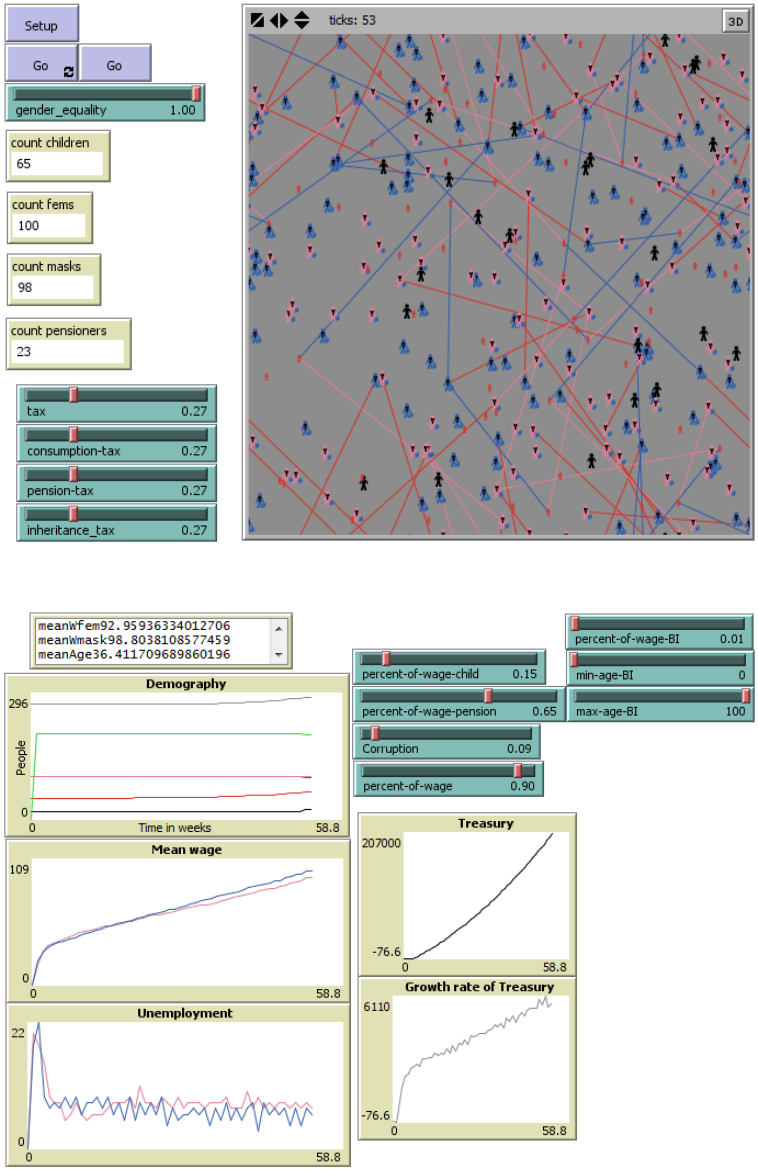

Figure 4: Interface of the model

```
set kids 0
if work_will > 100
[set job random(2)]
```

6.2 Setting up family networks

In this section the female turtles older than 25 and younger than 45 are asked to set a male turtle within the same age group as partner. The involved turtles are then assigned value 1 to the binary variable married, which can take values 1 or 2.

```
to setup-networks
ask fems
[ if (age < 45) and (age > 25) and (married = 0) and random(100) < 50 [
set partner one-of masks-here with [married = 0 and age < 45 and age > 25]
if partner != nobody
[ create-family-with partner [ set color red ]
set married 1
ask partner [set married 1 set partner myself]
]]]
end
```

With the command "to have child" female turtles in the age span 25 - 45 who have fertility values above 100, less than three children and is married with a partner of fertility above 60 are asked to reproduce. If all the mentioned criteria are fulfilled a child turtle is created and it is linked to its "parents". The links between parents and the links between parents and the child are networks, and in this way networks of families are created. The idea of families, other than to see effects on reproduction and population, is that being a member of a family increases financial security, and the sense of safety, which impacts financial and labor decisions. The author of this thesis acknowledges the fact that in reality relationships are far from this homogeneous, but argues that this simplification does not have economic impacts large enough to be significant. After a child is born, their individual variable values are set in a similar way as in the set up phase of the initial turtles

```
to have_child
ask fems with [age > 25 and age < 45 and fert > 100 and kids <
3 and married = 1 and partner != nobody and [fert] of partner > 60]
```

```
[ hatch-children 1 [
setxy random-xcor random-ycor
set shape "person"
set size 0.5
set age 0
set color red
move-and-age-child
create-family-with myself [ set color pink ] set mum myself
create-family-with partner [ set color blue ] set dad [partner] of mum ]
if fert > 100 [ set fert 100 ]
set fert fert - random(50)
set kids kids + 1
set health health - random(health * 0.1) * (1 - gender_equality)
if partner != nobody [
ask partner [ set kids kids + 1 ]]]
end
```

6.3 The children

The children can also be eligible for basic income, depending on age. If they do not have a mother, they find new "parents" and create networks with them. When they reach the age 18, with 50 percent probability they become adult males or females, and are from there updated in the same way as adult turtles. Their breed is changed from child to male of female.

```
to update_child
ask children
[
ifelse age > min-age-BI and age < max-age-BI
[ set BI-eligible 1]
[ set BI-eligible 0]
]
ask children with [ mum = nobody]
[
set mum one-of fems with [kids = 0]
if [partner] of mum != nobody [ set dad [partner] of mum
create-family-with mum [ set color pink ]
if dad != 0 [create-family-with dad [ set color blue ]
```

```
]]]
ask children with [age > 18]
[
ifelse random(100) > 50
[
set breed masks
set size 1
set color blue
...
update_masks ]
[
set breed fems
set size 1
set color pink
...
update_fems ]
```

6.4 Moving, aging and continuously updating

By the move and age section the agents are simply asked to randomly move around, and for each tick increase their age. The fact that each step increases their age by 0.0192307 is because one tick is equal to one week, so in one year - 52 weeks - their age increases by one. If their wealth becomes less than one, it is translated into debt. If their health is equal to 1, which is dangerously close to 0 for which value they die and disappear from the model, they give their wealth to their children and/or partner. The transfer is taxed, and the value of the tax can be altered in the interface. The same thing happens for turtles at an age above a certain threshold. When they reach the age of 65, the turtles retire. The assumption here is that the retirement age is 65.

```
to move-and-age
rt random 50
lt random 50
fd 1
set age age + 0.0192307
if health > 100 [set health 100]
if wealth < 1 [set debt debt - wealth set wealth 1 ]
if health < 1 [
```

```
ask out-link-neighbors
[ set wealth
wealth + ((([wealth] of myself)) * (1 - inheritance_tax)) / [kids] of myself ]
ask my-links [die]]
set wealth 0
if age > 98 [
ask out-link-neighbors
[ set wealth
wealth + ((([wealth] of myself)) * (1 - inheritance_tax)) / [kids] of myself ]
ask my-links [die]]
set wealth 0
if health < 0 [die]
if age > 110 [die]
end
```

As the program is running, continuously the state variables are being updated and impact each other. In the third and forth rows, it is decided whether the turtle is eligible for basic income. This, as will be further explained later, is decided by the turtles age. In the interface the user can choose which age groups are eligible for basic income. Turtles younger than 30 update their education level as a function of age, their wealth and their social capital. Happiness is a function of health, social safety and the change in consumption. Social capital depends positively on education, happiness and safety, but their positive impact is decreased by the corruption level of the society. Risk depends on how safe the turtles feels, and is decreasing exponentially with age. Social safety depends on whether or not the turtle has a job, and the level of unemployment-benefit (if unemployed), and also of wealth and negatively on debt.

```
ask masks [
ifelse age > min-age-BI and age < max-age-BI
[ set BI-eligible 1] [ set BI-eligible 0]
if educ < 0 [set educ 1]
if age < 30 [
set educ educ + ((age + wealth * 0.0001 + sc) / educ)
if educ < 0 [set educ 1]]
if happy <= 0 [set happy 1]
set happy happy + ((health + safe + d-consumption) * 0.1) / happy
set sc sc + ((educ + happy + safe) * 0.00001) * (1 - corruption)
```

```
set risk safe - exp(age * 0.00000001)
if risk > 100 [ set risk 100 ]
if risk < 0 [ set risk 1]
ifelse job = 1
[ set safe safe + ((0.0001 * (wealth - (mean-wealth / 2)) + debt) / safe)]
[ set safe
safe + ((0.0001 * (wealth - (mean-wealth / 2)) + debt + unemployment-benefit) / safe)]
```

Once every month (which in the model is every four ticks), the turtles update their investments, depending on their risk levels. If the investment does not pay off the risk level of the turtle will decrease by half. In the opposite case of a successful investment, instead the turtles risk level increases by a value randomly chosen between 0 and 25. Income increases by the profit of the investment, minus the initial investment and final wealth is the original wealth, plus the income (which also includes the turtles wage if employed, otherwise the unemployment benefit, and child support if the turtle has children) minus consumption. If the turtle is eligible for basic income, this is also added to their income.

```
if ticks mod 4 = 0
[ ifelse debt < 0
[set investments (wage * (risk * 0.01))]
[set investments 0]
set income income - investments
ifelse random-float(100) < 75 and investments > 0
[set profit 0 set risk risk / 2 ]
[set profit
investments + ((risk * 0.01) * investments) set risk risk + random(25) ]
set income
profit + (unemployment-benefit * (1 - job)) + (wage * (1 - tax)) + (child-support * kids)
set d-wealth income + (wage * (1 - tax)) - consumption
set wealth wealth + income - consumption
ask masks with [ BI-eligible = 1 ] [ if ticks mod 4 = 0
[ set income income + basic-income ]]
```

When the turtles reaches the retirement age of 65, they change their breed from adult to pensioner.

```
ask masks with [ age > 65 ]
[set breed pensioners
```

```
set color black
]
```

6.5 Continuously updating pensioners

The retired turtles move in the same way as the other turtles. They are updated to reduce their fertility to zero and their income is set as their profit and the net pension received, after taxes. Their health is now a negative exponential function of their age.

```
to update_retired
ask pensioners [ set fert 0
ifelse age > min-age-BI and age < max-age-BI
[ set BI-eligible 1] [ set BI-eligible 0]
]
ask pensioners with [ ticks mod 4 = 0] [
set income profit + pension * (1 - pension-tax)
set wage 0
set wealth wealth + income - consumption
set health health - exp(age * 0.001)
move-and-age
adjust_consumption
]
end
```

6.6 The jobs

There are two ideas related to jobs in this model. The first is that there are two kinds of unemployment and that they need to be analyzed differently. There is voluntary and involuntary unemployment. The first refers to situations in which an individual is unemployed, but not due to being unable to find employment, but instead because of leisure preferences. Involuntary unemployment is instead unemployment due to the inability of finding a job, for instance because of external reasons such as lack of jobs. The second idea is that the state is a big employer, and that the number of state jobs is a function of the size of the welfare state. In the model this is coded such that there are 150 initial jobs (recall that there can be up to 200 initial adult turtles who possibly are out to seek employment) and that the number of jobs provided by the state

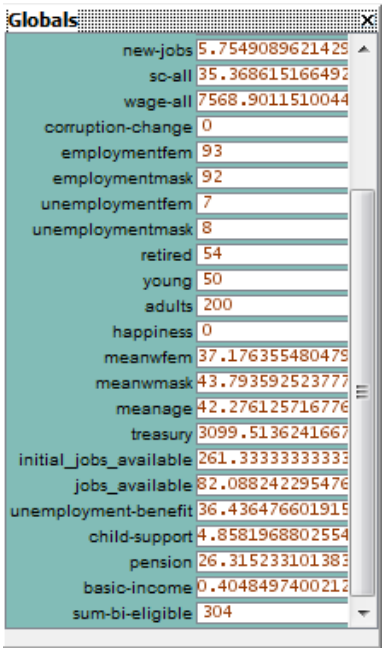

Figure 5: With the globals monitor the user can observe available jobs and unemployment

depend on the size of the welfare sector; represented by the level of child and unemployment support, and of pension size.

```
to setup-jobs
set new-jobs 1
set initial_jobs_available
150 + (percent-of-wage-child + percent-of-wage + percent-of-wage-pension) / 3 * 200
set jobs_available initial_jobs_available
end
```

When turtles decide whether to work, they take into account the value of their "work will" variable, which is a new addition, their health and whether there are jobs available. Then in the outcome of the model it can be seen how many available jobs there are, the work will of the turtles and unemployment levels. In this way it can be seen which kind of unemployment is present. As a results of this, policy makers can observe outcomes and pinpoint the specific reasons to why people are out of the labor force.

```
ask fems with [job = 0] [
```

```
if work_will > 100 and health > 50 and jobs_available >= 1
[set job 1
data
]]
```

As the attentive reader might have already guessed, the "work will" variable, which is a function that depends positively on social capital and wages, and negatively on corruption and unemployment benefits, is the variable related to voluntary unemployment. If a turtle's non-labor income exceeds their wage, their "work will" reduces over ten.

```
[ if unemployment-benefit + (child-support * kids) + basic-income >
(0.1 * (100 - incent)) * (meanWfem * (1 - tax))
[set work_will work_will / 10 ]]
```

6.7 The choice functions

The three choice functions in the model are the functions inspired by Epstein's work. However, in the initial model they are as simple as possible. In later versions the functions thresholds will be of different kinds, so as to test the implications of different assumptions. The functions regards the choice of adjusting consumption, investments and labor. The different threshold assumptions will be further discussed at a later point in this thesis.

6.7.1 The consumption choices

The turtles with non-negative incomes will initially consume between 80 and 90 percent of their income. The last 10 percent are randomized. The value is based on EU averages.

```
to adjust_consumption
if income > 0 [
set d-consumption 0.8 * income
set consumption d-consumption + random(10)
set consumption consumption + (consumption - d-consumption) / d-consumption]
end
```

Then consumption follows a standard growth rate as seen below, where C is consumption and δC is the past value of consumption.

$$C = \delta C + \frac{C - \delta C}{\delta C}$$

There is also the choice of self-fulfillment consumption. As discussed earlier, this is the consumption except necessity goods, which is undertaken by economic and socially well-off turtles.

```
to adjust_SFconsumption
ask turtles [
if wealth > 2 * mean-wealth and SC > 1.5 * SC-all
[ set consumption consumption * 1.5 ]
]
end
```

If the turtles wealth is more than two times of the mean wealth, and their social capital 1.5 times greater than the mean social capital, they will increase their consumption by 1.5.

6.7.2 The investment choice

Again, in the initial model the choices are as simple as possible. If the turtles wealth is more than 50 percent more than mean wealth, and their risk is above 75 and they do not have debt, they will increase their investments according to their risk level.

```
to adjust_investments
if wealth > 1.5 * mean-wealth and risk > 75 and incent > 60 and debt > 0
[ set investments investments * (1 + (risk * 0.01)) ]
end
```

As discussed earlier, the outcome of the investment is decided in the "update" section.

6.7.3 The labor choice

New jobs can be created by turtles who become "employers". If their wage is higher than the mean wage, and their risk higher than 75, they will create between 0 and 1 new jobs (employs another turtle) and so makes a profit, the turtles wage increases by 1.1 percent.

```
to adjust_labour
ask one-of turtles with [shape = "person business"] [
if random(100) > 75 and wage > meanwfem and risk > 75
[ set new-jobs new-jobs + random(2)
```

```
set wage wage * 1.1 ]]
```

As earlier mentioned, if the welfare grants exceeds the wage, weighted by the turtles incentive type, “work will ” decreases by times.

```
ask fems
[ if unemployment-benefit + (child-support * kids) + basic-income >
(0.1 * (100 - incent)) * (meanWfem * (1 - tax))
[set work_will work_will / 10 ]]
ask masks
[ if unemployment-benefit + (child-support * kids) + basic-income >
(0.1 * (100 - incent)) * (meanWmask * (1 - tax))
[set work_will work_will / 10 ]]
ask fems with [job = 0] [
if work_will > 100 and health > 50 and jobs_available >= 1
[set job 1
data
]]
ask masks with [job = 0] [
if work_will > 100 and health > 50 and jobs_available >= 1
[set job 1
data
]]
```

Turtles with too low “work will” or health will stop working. Also these thresholds are of course assumptions and up for discussion.

```
ask turtles with [shape = "person business"]
[if work_will < 100 [ set job 0 ]
if health < 25 [set job 0 ]]
end
```

6.8 The treasury and basic income

The treasury is continuously updated and consists of tax incomes discounted by the corruption level, and child supports, pensions and unemployment benefits paid out, and basic income. Benefits and taxes are paid out and received once every month. The negative impact of paying out child support, pensions and unemployment benefits are increased by the corruption level. Tax incomes are

Figure 6: The sliders with which the user can change values of the treasury inputs

from wages, pensions, inheritance and consumption. The tax levels, the corruption level and the structure of the possible basic income scheme can all be adjusted in the interface with sliders. As can be seen in the code below, the treasure function is set as follows (where T stands for treasury, δT stands for the growth in treasury, C for consumption, t for wage tax, t_C for consumption tax, t_P for pension tax, W for wages, P for pension, R for number of retired turtles, K for corruption, ub for unemployment benefit, U for unemployment, cs for child support, y for number of children, BI^e for basic income eligible turtles and BI for basic income:

$$\delta T = ((\sum \delta C_i \times t_C) + (\frac{t_C}{1 - t_C} \times \sum W_i) + (P \times R \times t_P)) \times (1 - K)$$

$$-(((P \times T) + (ub \times U) + (cs \times y) + (BI^e \times BI))$$

```
to update_treasury
set unemployment-benefit ((meanWmask + meanWfem) / 2) * percent-of-wage
set child-support ((meanWmask + meanWfem) / 2) * percent-of-wage-child
set pension ((meanWmask + meanWfem) / 2) * percent-of-wage-pension
set basic-income ((meanWmask + meanWfem) / 2) * percent-of-wage-BI
set d-treasury
(sum-consumption * consumption-tax + (
((tax / (1 - tax)) * wage-all) +
```

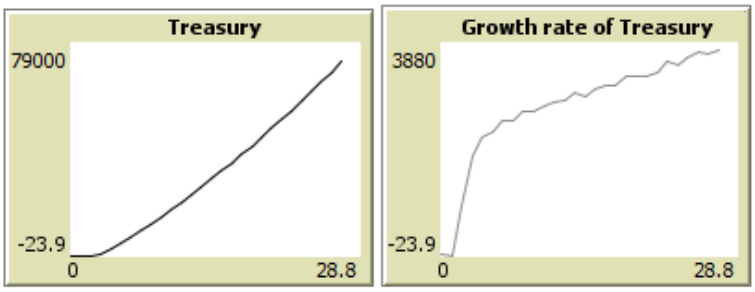

Figure 7: The treasury and its growth rate

```
(pension * retired * pension-tax)) * (1 - corruption) -
(unemployment-benefit * (unemploymentMASK + unemploymentFEM)) * (1 + corruption) -
(pension * retired) * (1 + corruption) -
(child-support * young) * (1 + corruption) -
(sum-BI-eligible * basic-income) ) / 4
set treasury treasury + d-treasury
if ticks > 1 [ set g-treasury d-treasury / (treasury - d-treasury) ]
end
```

7 Model flexibility: economic settings

As briefly mentioned before, one of the main points of this model is to be a "reasoning machine" in which different settings and assumptions can be tested. Settings in this context basically means "country" characteristics, and the idea is that the user may "tune" the program into resembling the economy they wish to analyze. After providing the right data to the model, some fine-tuning calibration is undertaken in order to have the model resemble the real life setting as close as possible. After doing so, experiments can be made and the implications of them analyzed. To further highlight the meaning of this the following pages will discuss how Italy could be modeled using the program, based on its characteristics as a country. As so often, there are underlying assumptions. Here they are related to the characteristics considered important in a basic income context. Obviously it can be argued that other characteristics are more important, or that some are redundant in the context. However, for such an argument to be fruitful, the assumption and their justifications need to be provided. Therefore follows here a list of the "assumed-to-be-important" characteristics, and the reasoning behind the belief that they do matter.

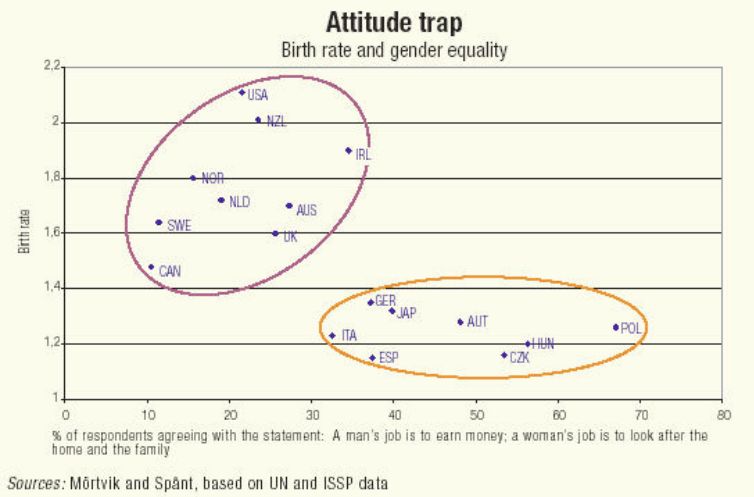

Figure 8: The relationship between gender equality and birth rates. Source: Mörtvik and Spånt (2005)

- Gender equality
  - This variables affects the workings of a basic income structure in two ways. First of all through its effect on labor choices. Key for a basic income structure to be functional is that enough people still find large enough incentives to work and so pay taxes and in other ways contribute to the continued functioning of society. With high levels of gender inequality, monetary incentives for females to work decreases, and since the female population accounts for around half of all the population, decreased female incentives to supply labor would have large impacts. The second way through which this variable has an effect is through fertility rates. An OECD survey Jaumotte (2005) found that attitudes towards gender equality impacted birth rates in making them more balanced. The effect of this was that countries with higher equality levels faced less problems with an aging population structure, and had an over all more robust economies, with a steady supply of labor. This can be seen in Figure 8 above.
- Child support
  - Those who do decide to have children could be induced to work less, given a generous child support scheme. However, this effect could also be the opposite, and as argued above, a reliable child support structure could boost birth rate balance, and so lead to economic gains.
- Taxes
  - The taxes being considered in this model are wage, consumption, inheritance and pension taxes. There need not be any deeper explanation to why this matters; tax income is usually one of the main sources of income for the state, and the foundation for welfare. However, it should be noted that they also affect people's attitude and incentives. Excessive taxation might stifle incentives, especially combined with tax income wastage by the state.[3]

[3] A very common attitude towards basic income which the author of this thesis has noted in the various discussions on the subject is that there is a fear of people that they will be the ones working and providing for everyone else, who instead will slack and enjoy their "free money". Van Parijs (1991) addresses this attitude in a paper humorously named "Why Surfers Should Be Fed: The Liberal Case for an Unconditional Basic Income" where he discuss the case of

- Unemployment benefits
  - The premise behind this assumption is that a not negligible reason behind why labor is supplied is that people want, or need, money. It is not argued that this is the unique motivation to supply labor, but nevertheless a significant one. And therefore it is a reasonable belief that the effect of providing people with money without them working would reduce labor supply. Again, an opposite effect could equally eloquently be argued. As argued regarding taxes, the negative effect on incentives due to taxation is related to how the tax income is being used by the state, or perhaps, how it is perceived to be used. A generous unemployment benefit scheme in an over all well functioning welfare state could boost people's belief that they live in a society which cares for them, and thus incline them to work more, and pay more taxes.
- Pensions
  - Similar arguments as the latter in the above bullet point can be applied here. Obviously, pensions are a cost to society and thus to tax payers, but there could also be an attitude that pension is something older citizens are entitled to, since they have earned it throughout their lives. And so, an overall well functioning society which is able to provide for its elderly citizens could signal to the younger that working hard and paying taxes is the way to go.
- Corruption levels
  - As previously noted, the usage and perceived usage of state resources is assumed to affect social capital and incentives to work. And corruption is a signal, or proxy, for how well managed a state's incomes are. There is a great deal of evidence supporting the view that corruption lowers social capital and through this growth.[4] In the basic income model, corruption works not only through the reduced effect of tax incomes, but also affecting attitudes of the agents.

1971 Hawaii, in which a law was stated so as to reduce what was referred to as "wellfare hippies, who had been arriving in considerable numbers to take advantage of the beaches and of a comparatively generous assistance law"

[4]See for instance Bjørnskov (2003), Svendsen *et al.* (2003) and Rothstein (2013)

All of these variables can be fully controlled by the user through the sliders on the interface, and the idea is that they should be used so as to mimic the society of interest, so as to speculate on what might happen as a consequence of various policy. Soon we shall continue with the example of "Italy", but first a brief discussion on flexibility, simplifications and how the model is intended to be used.

8 Simplifications or over-simplifications?

The intention of this model, as of most economic models, is to further the knowledge about its subject matter, and also to reason about possible outcomes of interventions. For this to be possible there are two criteria which needs to be fulfilled.

- The model needs to be simple enough so as to provide clarity.
- The model must be advanced enough to capture the complexity of reality.

Think of it as a geographical map. A map which exactly replicates the real life landscape it intends to guide us through would first of all be at least several miles wide and such a map would be absurd, not to mention impossible to put in one's pocket. Therefore, the map constructor needs to understand the landscape to such an extent that they are able to scale it down. Every tree, rock or road sign can and should not be drawn on the map, only those needed for the map user to find their way. However, would the map lack something fundamental, such as road names, or bridges, it would be equally useless as the humongous real life replica, earlier mentioned. The very same, if somewhat silly, reasoning applies to economic models, and the intention with this model is to find the right balance between clarity and complexity. As will be noticed in the Italian example in the forthcoming section, many simplifications will be done. Thus, the experiment outcome will not provide us with precise estimates, but serves as a hint if a certain structure would work in a certain environment, and points out for us the direction in which further research would potentially be fruitful. Such further research would demand other models, more customized to the specific context. For instance, a country's tax structure obviously consists of more than different percentages. First of all, taxation can be flat or progressive, following various schemes. Second, and perhaps even more fundamental, their workings are affected by social perceptions, corruption − both public and private −, the various redistributive schemes etc.. In the model, this is simplified to boil down to that tax incomes are put into more or less constructive use depending on the levels of public corruption, and people's will to contribute and pay taxes are also affected by this. However, also corruption and its complex implications can hardly be described by a simple number. Transparency International (which is

the organization providing the measure of corruption used in this model) writes on their homepage:

> What does a number mean to you? Each year we score countries on how corrupt their public sectors are seen to be. Our Corruption Perceptions Index sends a powerful message and governments have been forced to take notice and act.
>
> Behind these numbers is the daily reality for people living in these countries. The index cannot capture the individual frustration of this reality, but it does capture the informed views of analysts, businesspeople and experts in countries around the world.[5]

This goes well with the reasoning of corruption as intertwined with social perceptions, and should give a good hint on the overall situation. However, it does not take private corruption into account. Thus, as a first indicator of how different policy would impact the Italian structure, the model in this paper is sufficient, argues its creator. And it must be clarified that the main purpose of the model is this. But, to provide more precise analysis of specific situations, other kinds of models should be complimentary used. There is a difference between a model as a tool for comparison and a model as a policy tool. With this discussion, the author would like to state that she feels confident in that the model simplifies reality, without over-simplifying it, for its purpose.

[5] http://www.transparency.org/research/cpi/overview

9 Country profile: Italy

9.1 Gender equality

According to the European Institute for gender equality EIGE (2013), Italy's Gender Equality Index is 40.9. The index goes from zero to 100, and the EU-27 score is 54. The index takes into account work, money, knowledge, time, power, health and violence, including structural violence. To represent this, the slider of Italy is set to 41.

Figure 9: The gender equality slider

9.2 Child support

In Italy, child benefits are fully means-based and it is one of few EU countries without universal child benefits. As seen in Bradshaw (2011) the average level of child benefits for a couple of two, with one earner and two children is 6 % of average earnings. This is also regulated by a

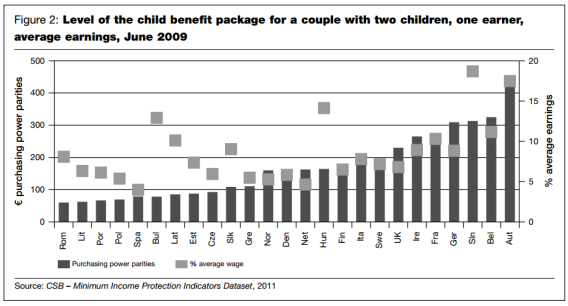

Figure 10: Average child benefits Bradshaw (2011)

slider in the model which is constructed to set how large as a percentage of average earnings child benefits per child is.

9.3 Taxes

Italy's income tax is progressive as follows in Table 1. Source: agenziaentrate.gov.it (2015)

Table 1: Italian income tax rates

Annual income (1000 Euro)	**Tax rate (%)**
up to 15	23
15 - 28	27
28 - 55	38
55 - 75	41
more than 75	43

In the model this simplifies into the average of the three lowest values, and what is set in the slider is 29 %. There are of course other ways to estimate an average tax rate, and to model Italy more realistically there should be different rates for different income groups. However, referring to the above discussion on simulation models as maps of reality, the author of this thesis argues that this simplification is acceptable for the current purpose of the model. The Italian Value Added Tax (VAT), which is a consumption tax, is currently at 22 % for standard goods, and reduced to between $4 - 10$ % for special goods, food, medicines etc. However, in this model demonstration consumption tax will be set to 22 %. The Italian pension system is subject to change, and taxation also depends on the retired persons personal profile. However, on average, as of 2008, it was 15 % OECD (2008). The level of inheritance tax depends on the relationship the receiver had with the deceased, but on average it is 6 %.

9.4 Unemployment benefits

In the OECD.org (2013) Benefits and Wages: Country specific information the Italian unemployment benefits system is explained as follows:

> There were three main types of unemployment benefits available prior to 2013:
>
> – a) Ordinary unemployment benefits (included in our model up to and including 2012),

- b) Wage supplementation funds (known as Cassa Integrazione Guadagni henceforth CIG, either ordinary or special), and
- c) Mobility benefits.

The reform of the unemployment benefits presented in 2011 was introduced gradually starting in 2013 and will be in full operation in 2017. This reform changed the former scheme in a radical way. The new Assicurazione Sociale per l'Impiego (ASPI), Social Insurance for Employment replaces ordinary unemployment benefits and mobility benefits. In our modeling, the ASPI has replaced the Ordinary Unemployment Benefits from 2013. Unemployment insurance is compulsory for private sector employees. Unemployment benefits are paid only to workers who were hired with permanent or fixed term contracts, while atypical workers who pay social security contributions to a special fund known as gestione separata are not eligible for these benefits.

In the initial months of unemployment the benefit is at 75 % of previous wage, and is then reduced over time. To implement this into the model the value for Italian unemployment benefits is set to 60 % of average wage rate.

9.5 Pensions

In a Green Paper the European Commission Ec.europa.eu (2010) estimated Italian pensions after the pension reform to be approximately 56 % of the salary they had prior to retirement. In the model this is simplified to 56 % of average wages in the whole economy.

9.6 Corruption level

In the 2014 Transparency International Corruption Perceptions index Italy's score was 43, giving them a ranking of the 69th most corrupt country out of the 175 countries investigated. The Corruption Perceptions index takes into account the perceived levels of public sector corruption. It goes from 0 (Highly corrupt) to 100 (Very clean). This is implemented into the model by setting the slider for corruption to 57.

10 Simulated Italy

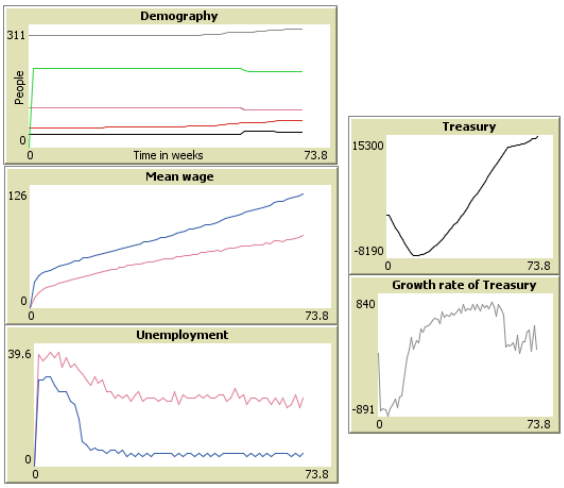

Figure 11: Interface outcomes for Italy

As can be seen from Figure 11, the demographic structure is quite stable with population (the gray line) increases and fertility (the red line represents children in the model) at a reasonable level. However, female wages are well above male ones, and female unemployment rates are very high (around 20 %) whereas the male population is doing considerably better. The treasury is increasing, but its growth rate is fluctuating quite a lot. Given that this model does not take the financial sector into account, which has been one of the main sources of instability in the Italian Euro economy, the snapshot picture rather well captures Italy's profile. However, before starting with the experiments, some further calibration can be done in order to have the simulated Italy resemble the real Italy even more.

11 Model flexibility: basic income structure(s)

As, hopefully, made clear in earlier parts of this thesis, there are many different theorizing about which kind of basic income structure would work. In this model the user can try different schemes, based on which age groups are eligible for basic income, and how much as a part of average income it should be. Given that Alaska is such a specific example, and that it is not plausible to assume rich natural resources generating revenues for every economy, such structure has not been modeled. Instead, the basic income is based on tax income. The user may also try out different levels of other parts of the welfare structure, for instance lowering unemployment benefits, as would be argued by some right wing proponents of the scheme. Another assumption has been made here. Recall the treasury function of section 6.8. There it can be seen from the code that the only part of the treasury unaffected by corruption is the basic income structure. This is a reflection of the argumentation that universal (or age-based) basic income would imply very little bureaucracy, and therefore less room for public corruption. However, as pointed out in section 2.5, there is no guarantee that this is necessarily true. Therefore, which furthers the role of the model as a reasoning machine, an additional part has been added to the formula, which the user can choose to activate by removing the ;-sign in front of it. If doing so, also the basic income structure is being affected by corruption. Different weights can also easily be added to the impact of corruption, for instance if the user has reasons to believe that there is an effect of corruption, just not as big as in the traditional welfare sector.

```
- (sum-BI-eligible * basic-income) ;* (1 + corruption)
```

The treasury formula then becomes:

$$\delta T = ((\sum \delta C_i \times t_C) + (\frac{t_C}{1 - t_C} \times \sum W_i) + (P \times R \times t_P)) \times (1 - K)$$

$$-(((P \times T) + (ub \times U) + (cs \times y) + (BI^e \times BI)) \times (1 + K))$$

By using the sliders the user can set the maximum and minimum ages for being eligible for basic income, and how large part of average wage it shall be. In this way many different experiments can be made. In Figure 12 the sliders has been set so that the basic income is paid out to everyone

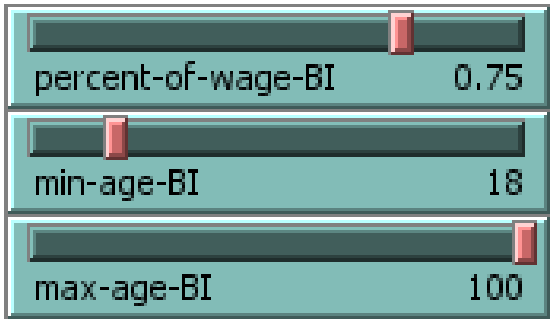

Figure 12: The sliders for basic income

from ages 18 and up, and it is 75 % of average population wages.

11.1 Model flexibility: threshold assumptions

Recall Epstein (2013) and the binary decision rule used by turtles in order to make decisions. Recall that

$$D_i^{solo}(t) = V_i(t) + P_i(t)$$

$$D_i^{total}(t) = D_i^{solo}(t) + \sum \omega_{ji} D_j^{solo}(t)$$

Where V stands for the affective and P the deliberate parts of the disposition to act. Recall also that the total disposition to act is decided in part by the sum of everybody else's dispositions, weighted by individual thresholds of the turtles. In this section will follow a brief discussion on the assumption of these thresholds, and what enters into the affective and deliberate fractions of the disposition. First, by referring to the decision to consume.

```
set v-consumption incent + risk + health + happy + fert + safe
set p-consumption (0.8 * income) + educ
set disp-consumption v-consumption + p-consumption
set total-disp-cons
disp-consumption + (consumption-others - disp-consumption) * w-consumption
if income > 0 and total-disp-cons > tau-consumption [
set d-consumption 0.9 * income
```

```
set consumption d-consumption + random(10)
set consumption consumption + (consumption - d-consumption) / d-consumption
]
```

From the code it can be seen that what enters into the affective part of the decision is what kind of incentive type the turtle is (idealistic or materialistic, where materialism increases the will to consume), being a risk taker, being healthy, being fertile and feeling socially safe. The deliberate part consists of the turtles income and education. The individual weights, which decide how much the disposition of other affect the turtle, can be either randomized, where each turtle is given a value between 1 and 100, or set as a function of social capital and education. The user can choose which assumption on the weights suits them the best by again using the ;-sign to select which one not to use.

```
set w-consumption random(101)
;set w-consumption (SC + educ) * 0.1
```

The threshold, referred to as "tau-consumption" in the model, is then defined. How to go about this depends on the theoretical background one believes is correct. The possibly most straightforward way is to simply set it as the mean of all the turtles total disposition to consume, as follows below.

```
set tau-consumption mean [total-disp-cons] of turtles
```

In this case all those turtles who are more disposed to consume than the population average will choose to increase their consumption (by 10 % of their income and so consume between 90 % to 100 %, while the rest consumes 80 % - 90 % of their income), whereas the others wont. However, this assumption on the threshold might be too simplistic. Given that consumption is a rather smooth variable, as seen in for instance Campbell and Deaton (1989), it is probably a good objection that being above the mean is too little a reason to increase consumption by such a considerable amount. Perhaps it would be more reasonable to assume that only those who's total disposition to consume is 1.5 times greater than the mean will do so, as on the code below. Or even larger. The point is that it is easy to change this variable, following reasoning, and testing the various assumptions.

```
set tau-consumption (mean [total-disp-cons] of turtles) * 1.5
```

The same reasoning, but with other variable inputs, can be used for the labor supply choice. In the code below it can be seen that the threshold "tau-labor" is either being above the mean, or 1.5 times the mean disposition to make a decision about labor. The variables entering into the affective part are social capital, health, happiness, in a positive way, whereas fertility and being married enters negatively. The deliberate variables entering are education and the mean wage of the population, for the females, who have the value of gender equal to zero, only the female mean wage is taken into account, and respectively for the males with male mean wage and gender equal to one.

```
to adjust_labour
;set tau-labour mean [total-disp-labour] of turtles
set tau-labour (mean [total-disp-labour] of turtles) * 1.5

set v-labour
SC + health + happiness - fert - (married * (1 - gender) * random(100))
meanWfem * (1 - gender) + meanWmask * gender
set disp-labour v-labour + p-labour
set total-disp-labour disp-labour + (labour-others - disp-labour) * w-labour

if total-disp-labour > tau-labour [
ask one-of turtles with [shape = "person business"] [
if random(100) > 75 and wage > meanwfem and risk > 75
[ set new-jobs new-jobs + random(2) / new-jobs
set wage wage * 1.1 ]]
ask fems
[ if unemployment-benefit + (child-support * kids) + basic-income >
(0.1 * (100 - incent)) * (meanWfem * (1 - tax))
[set work_will work_will / 10 ]]
ask masks
[ if unemployment-benefit + (child-support * kids) + basic-income >
(0.1 * (100 - incent)) * (meanWmask * (1 - tax))
[set work_will work_will / 10 ]]
ask fems with [job = 0] [
```

```
if work_will > (160 * (1 + (1 - gender_equality))) and health > 50
and jobs_available >= 1
[set job 1
data
]]
ask masks with [job = 0] [
if work_will > 160 and health > 50
and jobs_available >= 1
[set job 1
data
]]
]

end
```

12 Experiments

In this section the experiments and results will be demonstrated and explained. Initially the Italian structure will be used to test different implementation structures, and later a simulated version of Sweden will be used. The reason for this is that Sweden is significantly different from Italy in many of the key variables, and thus the same structure is likely to produce different outcomes, which is interesting to discuss. Before each experiment there will be a brief discussion on its theoretical relevance and reasonability, and after each experiment there will be a short theoretical discussion about the results. The time limit for all experiments will be two years, which in the model corresponds to 104 ticks, since one tick represents one week. This is achieved by adding the following code to the"to go" command:

```
if ticks > 104 [stop]
```

In order to fit the model to the various scenarios to be simulated, some additions and alternations will be made to the code. These will be continuously presented and explained, in relation to the earlier discussions on the model's flexibility and simplifications. In the first Appendix the full code will then be provided. The model has been calibrated pre the experiments so as to resemble the real life situation, prior to making changes. This is further discussed in the rest of this section.

12.1 Experiments: Italy

The first experiment will test the (right wing) idea of basic income as a substitute for the welfare state. Even though Van Parijs (2004) argued that this is not a plausible suggestion, and that there are ethical objections, to which we shall return shortly, given that this idea is a major theorizing among many proponents, it seems only fair to test its implications.

12.1.1 Experiment 1: Basic income as a substitute for the welfare state in Italy

First of all, there need to be some clarity on the assumptions used. The first experiment will follow the theory and assume that corruption does

not enter into the basic income administration. However, there is reasons to believe this is not the case. Recall section 2.5 in which the case of Alaska was discussed. In Goldsmith (2010) it was concluded that the bureaucracy related to the Alaskan basic income was increasing in complexity and size, as well as in arbitrariness. This is an indicator that also basic income structures are possibly subject to arbitrariness and thus corruption. Alternative assumptions could be that corruption does play a role, either first entering with half the impact of how it enters the rest of the welfare structure; and then with full impact. In the subjective view of this thesis' author, the more plausible of the three is the assumption that corruption does enter, but with less impact. This belief is due to the fact that the administration certainly will be new, but most likely appointed by the old governance, and thus will inherit some of the corrupt structures, if there is corruption initially. The question is, how big is this impact?

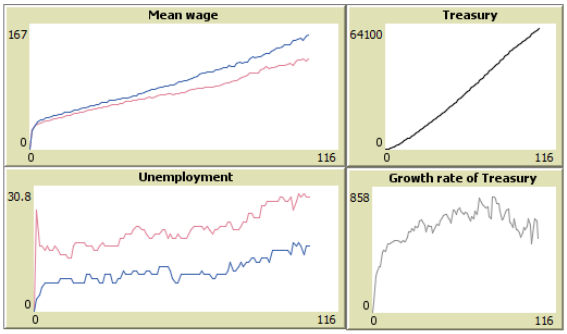

Figure 13: Italy before basic income

Figure 13 is of a simulation of Italy with its welfare system as described in section 10. As can be seen in the figure, the system is sustainable, with unemployment rates of about 27 % for women and 16 % for men, wage growth, but with a considerable gender gap, positive growth rates of the treasury, and average will to work at about 15 %. The last indicator is based on the agents social capital, education, health, average wages, wage tax, corruption and the available welfare, with some noise added, as can be seen in the code below. The functions is as follows (where ww is will to work, and Δ ww is the change in will to work):

$$\Delta ww = SC + educ + health + \mu(w) \times (1-t) \times (1-K) - ub - (BI^e \times BI) - (cs \times y)$$

$$ww = ww + \Delta ww$$

It has been calibrated in the various experiments, which can be seen from the Appendices.

```
set d-work_will (sc + educ + health)
+ random(100) - random(100)
+ ((meanWmask * (1 - tax)) * (1 - corruption))
- (unemployment-benefit * ub-eligible) - (basic-income * BI-eligible)
- (child-support * kids)
set work_will work_will + d-work_will ]
```

The very first experiment was undertaken with universal basic income for all citizens, including children, at a level of 60 % percent of median income, which is the EU threshold for being at risk of poverty. As such it is a good example of a level of income which it is possible to survive of, but not very comfortably so. Even though it perhaps makes little sense, all children were included into the basic income structure too. In this setting, despite removing all other state benefits, including pensions. The system was not self sustainable, growth rates were strongly negative, and unemployment rose to 45 % and 33 % for men and women respectively. The work will decreased and the gender wage gap increased. These results are pictured in Figure 14. However, it is not plausible to give each child 60

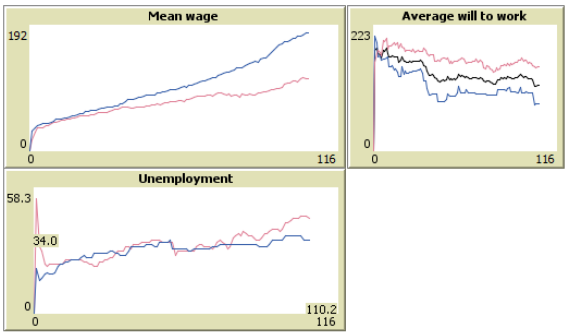

Figure 14: Universal basic income as a substitute for the welfare state, children included

% of the average adult population wage every month. Very few allowances are of that magnitude, and there is little reason to why a child, who in all European Union countries have the right to be taken cared of, and

very often is provided for by their parents, should be given such a check. A more realistic implementation would be basic income for all citizens of age 18 and above, which is the age of majority in most of the European Union. With this additional change, the results differ slightly, but not enough for the structure to be self sustainable. The negative growth rate is less negative, but still negative, and unemployment rates keep being at rather high levels (approximately 28 % and 33 % for men and women respectively).

A step forward would be to reduce the level of the basic income, so as to see it as additional cash, rather than an income large enough to substitute wages and keep households above subsistence level. While testing the model it was found that the level for which growth stays positive (and so, the basic income structure is self sustainable) was 29 % of median or 34 % of mean income. Depending on whether one believe that the median or the mean of population income is a better measure, one can choose in the model using the following code:

```
set basic-income ((meanWmask + meanWfem) / 2) * percent-of-wage-BI
;set basic-income medianW * percent-of-wage-BI
```

Keep in mind that these experiments were made under the assumption that corruption does not enter the basic income administration. From these experiments it can be concluded that a low level basic income, not enough to live from, but yet a significant contribution to households' liquidity is likely to be economically plausible, given that the rest of the welfare structure is dismantled. Based on evidence from Alaska, this is likely to increase consumption, given that it is perceived as a permanent addition to income over the life cycle. However, there are two main objections to be discussed. The first one is technical, and the other ethical. The technical objection is that it is outright naive to believe that a welfare structure could be dismantled in a frictionless manner. First of all, consider the role of the state as an employer. Taking away a huge employer is likely to be detrimental for any economy. Referring back to the discussion about simplifications *visa vi* over-simplifications. Dismantling a whole welfare structure with the touch of a slider is by any definition an enormous over-simplification. There is a huge literature of the self-perpetuating bureaucracy, perhaps beginning with Max Weber, cited in

Breiner (1996), wrote:

> Once fully established, bureaucracy belongs among those social structures that are hardest to destroy. Bureaucracy is the specific means of transforming "communal action" into rationally ordered "social action". As an instrument for "the societalization" of relations of domination, bureaucracy was and is a means of power of the first rank for the one who controls the bureaucratic apparatus. For otherwise equal conditions, systematically ordered and directed social action is superior to every resistance through mass action or communal action. Where bureaucratization of administration has been completely introduced, there has been created practically an indestructible form of relations of domination.

The second objection, the ethical one, regards loosing the redistributive, egalitarian motif of state intervention. One might ask, why would the state give money to those who do not need it? Why subsidize those who already are doing well? One technically plausible answer could be to incentivize parts of the population to behave in a desired manner, but this is not the case here. For the reason behind this theorizing is to reduce bureaucratic arbitrariness and power. But there is an obvious trade-off between simplifying the system, and finding those who are in more need (and thus, according to some social justice view, more entitled to assistance).

12.1.2 Experiment 2: Basic income and the pension system in Italy

At a recent seminar, Boeri (2015), current chairman of the Italian National Institute of Social Security (INPS), in charge of the Italian pension system, presented figures showing that the age group 59 and older were those struck worse by the 2008 economic crisis. Especially in terms of re-employment rates. That is, many lost their jobs, and they were among the least likely to find new employment. Without too much speculation, it may suggest that there is labor market discrimination against this group. In Rymkevitch and Villosio (2007) it is found that:

> Currently, Italy has the second highest dependency ratio (individuals over 65 in relation to the population aged 20-64), among the OECD countries. Only Sweden has a higher ratio. In Italy, this ratio reached almost 30% in 2000 and is expected to more than double by 2050. Only Japan is expected to have a higher ratio by 2050. According to the statistics for 2006, in Italy, 19.8% of the population were over the age of 65. In addition, those over 80 have increased to 5% of the population. An additional concern is the employment rate of older people. The employment rate for those aged 55-64 in Italy was 31.4% in 2005, about 10 percentage points below the European average and far below the Stockholm target of 50%. The situation is even worse for older women, for whom the employment rate is 20.8%, the lowest in the EU.

Keep in mind that this was even before the crisis. Whitehouse (2009) sums up the problem:

> Older workers - those close to retirement - are the group most acutely affected by both the economic and the financial crisis. They are often among the first to lose their jobs during a downturn and among the most vulnerable to long-term unemployment. Unemployment or early retirement can permanently reduce their old-age incomes due to an incomplete contribution history. People in this age group do not have much time to wait for markets to recover and losses to be recouped. Even postponing retirement may only allow them to offset part of their losses.

These facts indicate that basic income perhaps could play a role in improving the lives of people in this age group. Therefore, these experiments will investigate the role of basic income as an unconditional security net for the older workers. In a country with high youth employment, the rate of unemployment for people under 25 was 40.9 % in April 2015 according to Ec.europa.eu (2015b), problems for older workers who want to retire, and older workers who would like to stay in the labor force, perhaps basic income for the age group 59-65 could be a solution?

The median age in Italy is 44.5 years over-all, and 43. and 45.6 for men and women respectively. By adding 6 years to women on average, and 4 to men in the setup of the model, we reach simulations in which the mean age ranges from 41 to 47 years.

```
set age 18 + 6 + random(47)
set age 18 + 4 + random(47)
```

The upper row is for women and the lower is for men. In this way, we are better simulating the specific situation we are interested in. Figure

Figure 15: Italy before basic income

15 provides us with a snapshot of the situation pre-basic income. As is the case also in real Italy, female unemployment (about 29.4 %) exceeds male (14.7 %) and results in a gender wage gap of 9.46 % (which however is smaller than in more gender equal countries, due to the fact that such a small part of the female population is employed, as noted by the European Commission in Ec.europa.eu (2015a). From the same source we find that the true Italian gender wage gap is at 6.7 %). As compared to real Italy, unemployment and the gender wage gap is thus slightly higher. The average "work will" is at 16 % and noticeable the value is slightly larger for women than for men. Despite lower wages, women are more incentivized to work. Given how the model is constructed, this is due to different values of the local information variables "social capital", "health" and "incentive type". In order to avoid modeling an economy in which the age group 59-60 is given both a basic income and unemployment benefits, which seems quite unfair, some new lines of code have been implemented. With the lines

```
ifelse age < min-age-BI
[ set ub-eligible 1] [ set ub-eligible 0]
```

the variable "ub-eligible" is created. Its meaning is to define which turtles are eligible for unemployment benefit. Those who are younger than the minimum age to obtain basic income (i.e. 59 years old) are eligible for unemployment benefits, whereas those older are not. However, they will obtain a basic income, regardless if they are unemployed or not. In the first version of this experiment, those older than 65 are not eligible for basic income, however they are entitled to the same pension as in the original example (56 % of the mean wage). In the first version the basic income is set at a level of 60 %. What was found during the simulations is that it will increase unemployment, however, not to levels for which the system is not self-sustainable. The picture below is an example of the effect on unemployment rates (which are increased to 19 % for men and 35 % for women), but shows that the system nevertheless is sustainable from a growth viewpoint.

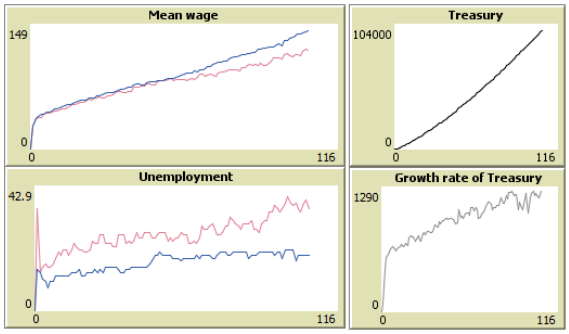

Figure 16: Basic income (60 %) to the age group 59 65

In the same setting, but with a universal basic income, the effect on (voluntary) unemployment rates were that about 60 % of the women would be unemployed and 30 % of the men. Obviously this situation was not sustainable. However, those simulations were undertaken to estimate the disincentivizing effect. Would Italy have been completely gender equal, the average unemployment would have been at about 35 - 40 % for both genders. There is a rather obvious answer to why the effects differ so. The effect on unemployment depends on the size of the age group 59 - 65. A younger worker is not disincentivized in the way suggested by for instance Moffitt (1981), since he or she is not eligible to the "free money". The assumption used was that corruption did not enter into the basic income

administration. As previously noted, there is strong reasons to believe that corruption will not be eradicated in the new basic income administration. But there are definitely some evidence suggesting that corruption could be lower and bureaucracy less complicated.

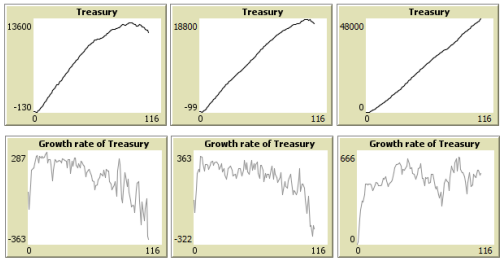

Figure 17: Corruption: full, half, and no impact

Therefore, some experiments were performed so as to conclude the role of corruption. First corruption was allowed to enter with the same impact as it does for the traditional welfare sector. In this setting, the basic income could not be implemented at the level previously used. The same happened when corruption was allowed to enter, but only with 50 % of the impact. Several simulations were performed in order to find the threshold impact percentage of corruption for which a basic income could be implemented. First, the minimum value for which it occasionally worked was 40 %. However, this result was very unrobust, and it was found that for the structure to be guaranteed to function, the level needed to be at 25 %. These results are summarized in the table below.

Table 2: Threshold levels for corruption impact

Corruption assumptions	
Full impact	*Not sustainable*
50 % of full impact	*Not sustainable*
Min value for sustainability (40 % of full impact)	*Sometimes sustainable*
Min robust value for sustainability (25 % of full impact)	*Sustainable*

When experimenting with the basic income as a substitute for pensions, the results of the simulations shows that the over-all structure in terms

of unemployment rates and growth were sustainable, even for higher values of basic income (for the population aged 65 and above) than for the former pension which was 56 %. The initial experiments were made at levels of 60 % for which the whole system worked fine. This is again due to the assumption that corruption does not enter into the basic income administration.

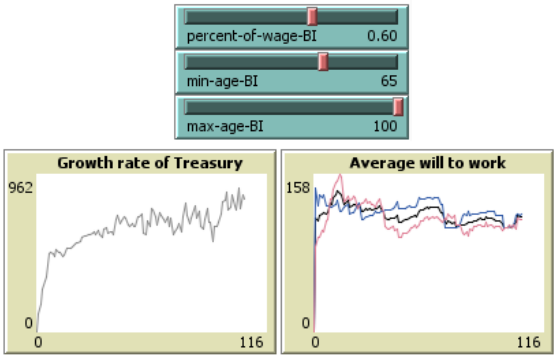

Figure 18: Basic income (60 %) instead of pensions

12.2 Experiments: Sweden

12.2.1 Short country profile: Sweden

According to the European Institute for gender equality, Sweden's gender equality index score is 74.3. Child support consists of the so called Barnbidrag, which is 1 050 SEK per child and month Forsakringskassan.se (2015). Mean and median wages for women are 28 400 SEK and 26 100 SEK, and for men 32 900 SEK and 28 800 SEK. Thus the mean income for both sexes is 30 650 SEK. The fertility rate as for 2013 is 1.7 children per woman according to Data.worldbank.org (2015). Thus an approximation of child support into the model is 5.8 % of average income.[6] The Transparency international TI (2015) corruption perception index score is 87 for Sweden, so the setting in the model will be 13. According to OECD, in Wilson and Lundberg (2013) it says that

[6]The calculation used was

$$\frac{(1050 \times 1.7)}{30650} \tag{2}$$

> Future gross pension replacement rates in Sweden are around the OECD average for low and average income earners, and above average for high income earners. A full career low income earner and average worker can expect a total pension replacement rate of 70.2% and 55.6% respectively upon retirement. This is slightly below the OECD average for low income earners at 71.0% and slightly above average income earners at 54.4%. High earners in Sweden fair better with a replacement rate of 67.9% compared to the OECD average of 48.4%. The average effective age of labor market exit is high in Sweden and was 66.1 for men and 64.2 for women compared to the OECD average which was 64.2 for men and 63.1 for women in 2012.

The tax levels are 31.4 % for incomes, on average about 27 % for pensions.[7] The consumption tax is 25, 12 or 6 %, depending on the good. Therefore it will be modeled as an average of the three, i.e. 14 %. There is no inheritance in Sweden since 2005. The max unemployment benefit in Sweden is 80 % of the former wage, however it may not be more than 680 SEK per day and to be eligible for it the individual needs to have been a paying member of a union for more than 12 months. In the model this is therefore set as 70 %. The part of the pension which is provided by the state is on average 43 % of the former income, according to Pensionsmyndigheten, the Swedish pension authority, as explained in Hellekant (2014), which is the value which will be used in the model. How ever, the Swedish pension consists of two other parts: private pension and pension from the employer.

With these values, after calibration (which is being presented in the third Appendix), the outcome is the one which can be seen in Figure 19. In the simulations, the unemployment rate is slightly higher than the real one, ranging from around 8 % up to 15 %, whereas the real Swedish unemployment rate is 7.8 % at the moment. The Swedish gender wage gap (15.9 % according to Ec.europa.eu (2015a)) is significantly larger than the Italian one, while the employment rate gap between men and women is smaller. The gender wage gap values resulting from the simulations are consistent with this.

[7] Based on a calculation for an average Swedish pensioner which can be found at https://www.minpension.se/vad-blir-det-efter-skatt

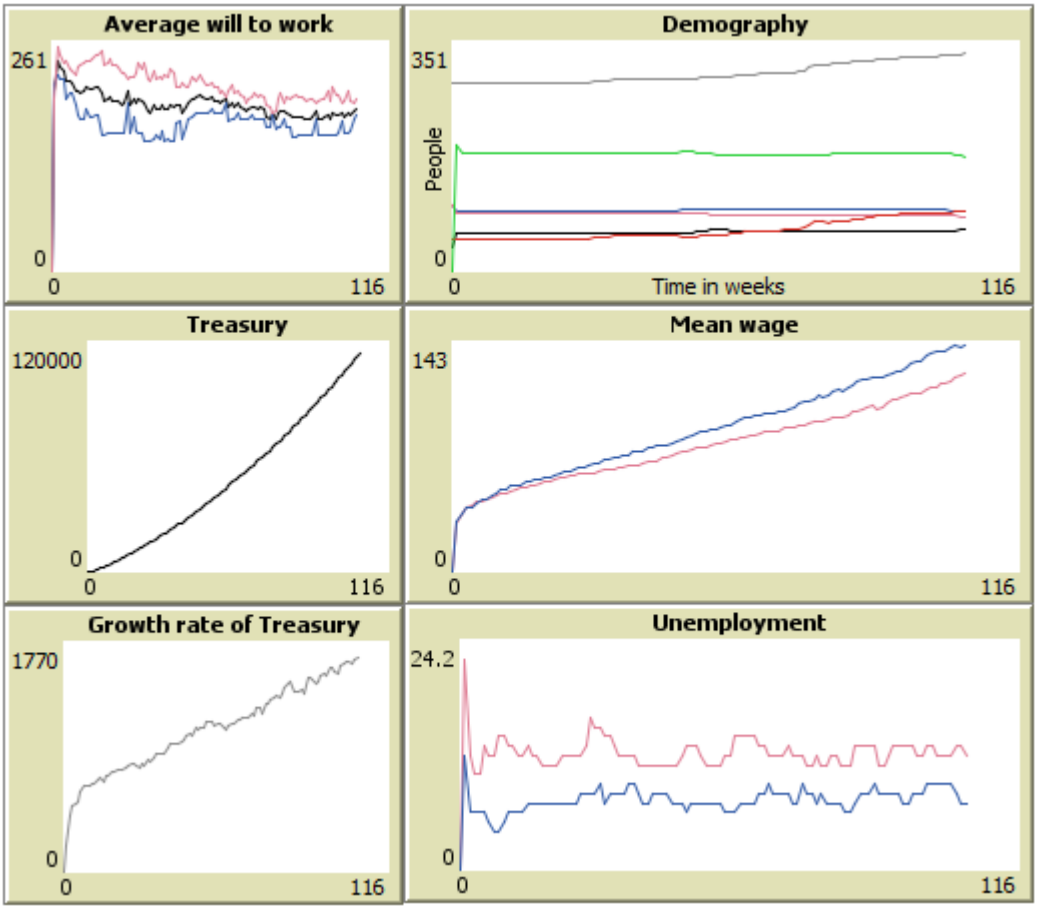

Figure 19: Sweden before basic income

12.2.2 Experiment 3: Basic income as a substitute for the welfare state in Sweden

While performing experiments based on the same theorizing as experiment 1, but for Sweden, it was found that a basic income level of 60 %, with all other welfare benefits disable, was not economically plausible, not even when assuming zero impact of corruption in the basic income administration. On average, unemployment increased for both men and women, and given the initially low levels of corruption, cost savings from eradicating corruption were not large enough for growth to be sustainable, not at any time during the experiments. This result further highlights the key role

played by corruption. The highest level of universal basic income instead of welfare state for which the system could sustain itself was 45 %. These

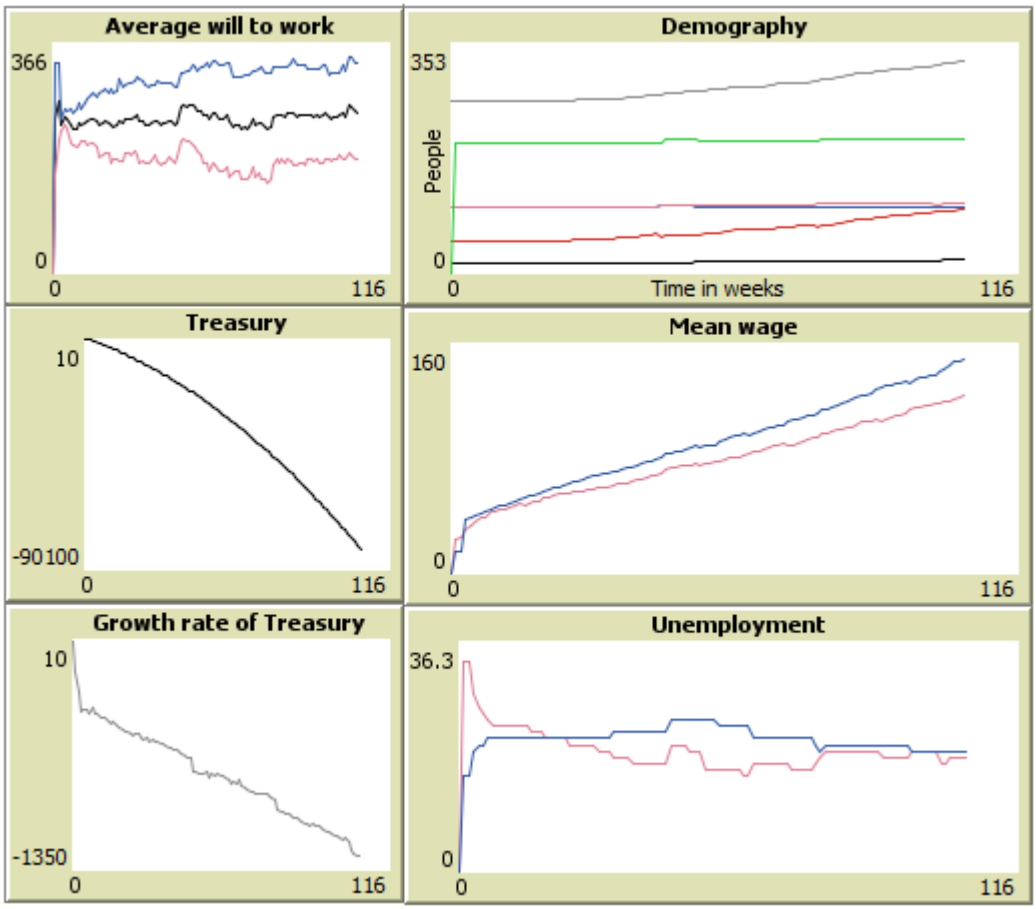

Figure 20: Basic income as a substitute for the welfare state

results are summarized in Figure 20. To note is that it differs significantly from 19 in terms of the negative treasury trend. The average work will is at a similar level, but is more gender dispersed after the basic income structure is implemented. Another thing to take note of is that this is a model of unemployment, but not a model which take part time jobs into account. It is probably reasonable to suspect that with a basic income corresponding to 60 % of median income, some agents would keep working, but chose to decrease their hours worked. Would it be of interest to further investigate effects on hours worked, the model could be extended

with the choice of time spent on labor.

12.2.3 Experiment 4: Basic income and the pension system in Sweden

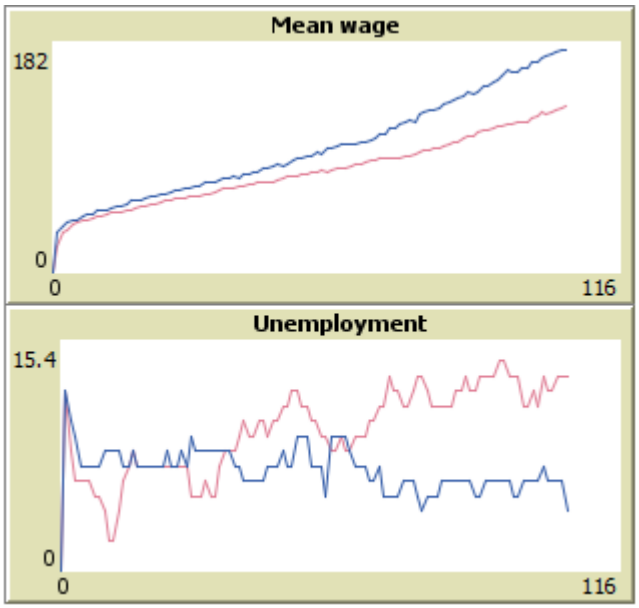

Figure 21: Basic income for the age group 59-60, gendered effects?

In Sweden, the median age is 41.2, which is slightly lower than the one of Italy, which we recall is 44.5. The median age for women is 42.2 while for men it is 40.2. In order to replicate this in the model, again these lines of code is manipulated, but with lower values than those for Italy.

```
set age 18 + 5 + random(47)
set age 18 + 3 + random(47)
```

By doing this the simulated mean age ranges from 39 to 44. First, the experiments for which the age group 59-65 were given a unconditional basic income were replicated for Sweden. The main finding was that this structure is economically plausible, and did not increase unemployment significantly. However, there was a slight tendency towards increasing gender differences. In some of the simulations female unemployment would

rise. And example of this can be seen in the figure below. On average, however, the experiment outcomes were favorable for this type of basic income structure. When the same experiment was performed, but with higher values for basic income, the results were similar and the possible gendered effect tended to disappear. However, average unemployment would increase more, but it was still economically plausible. For a basic income level of 85 % for the older workers, average unemployment rose to about 15 - 20 %. With a 60 % of mean income level of basic income for all older than 18, the effects on unemployment were quite consistent with what was found for Italy. On average unemployment would rise to 30 % (recall that for Italy it was 30 % for men and 60 % for women, so in a more gender equal setting the results are consistent). Again, this would not be economically sustainable, this simulation was just undertaken to note the effects on incentives to work. The final experiment tests basic income as a pension structure in Sweden. Not surprisingly, it was found that there was no significant effect on unemployment rates, and that the scheme was economically plausible, even when corruption was allowed to enter with full impact. This results suggests that, given that pension systems often

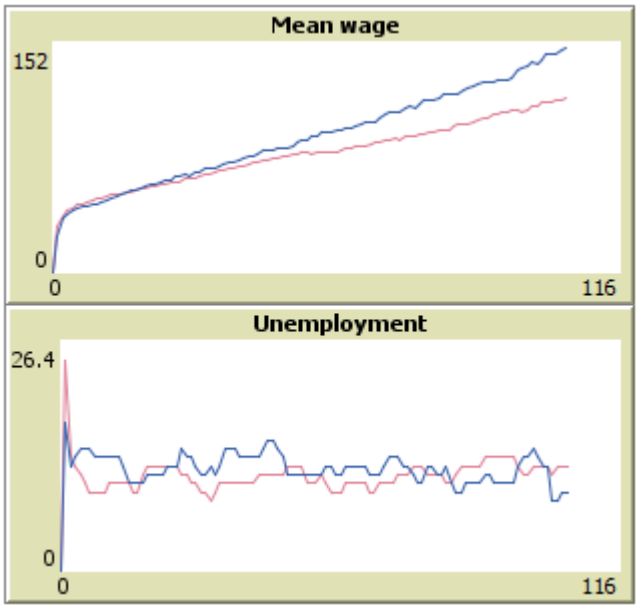

Figure 22: Basic income for the age group 59-60, no gendered effects

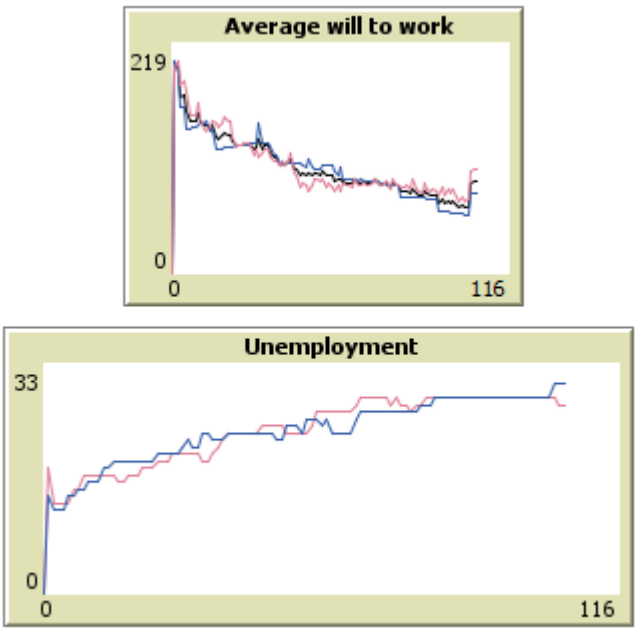

Figure 23: The effect on work incentives of universal basic income, 60 %

are complex, even in countries with low levels of corruption, there could be cost savings from removing the complex bureaucratic pension structure in favor of an unconditional basic income for retired people. Given that in Sweden the role of the state granted part of the pension is being reduced, as seen in Hellekant (2014), and private pension savings becomes increasingly important, perhaps a simpler structure, such as the basic income one is claimed to be (a claim which is however being questioned), could be an improvement.

13 Results, discussion, & suggestions for further research

The main message of the simulations is that they way the basic income affects incentives, and how it is affected by corruption, is key. These two findings shall be more thoroughly discussed below, and put into context. Then, some suggestions for future research to move forward with the subject matter will be given, and finally some policy suggestion is provided.

13.1 Basic income instead of a traditional welfare system?

From the first experiment, testing the idea that a universal basic income structure could substitute the welfare state, and so reduce costs of bureaucracy, and limit state intervention in people's personal lives, there are several conclusions to be drawn. A small universal basic income for adults is theoretically plausible in lieu of the traditional welfare state, depending on the initial level of corruption and on the assumptions on how corruption enters the basic income administrative structure. However, neither is is plausible that the new administration would be immune to corruption, nor that a welfare state could be dismantled without enormous frictions. In the experiments on Italy and Sweden, the highest sustainable level of basic income found by the model was 34 % and 45 % respectively of median income, which is far from enough to live from. It is to be viewed as an additional cash inflow to households. Based on the theory, this inflow is likely to increase household consumption, but in accordance with the permanent income hypothesis, this increase is only to be expected if the households perceive the basic income as a permanent addition which they can expect in the foreseeable future. This is not to be taken for granted, especially not in the setting for which such a structure would be more well adjusted, i.e. in a more corrupt setting. It is reasonable to believe that those in a highly corrupt society are less likely to believe what they are told by their society, and thus they might not initially dare spending their additional cash, and so the anticipated effect of increased consumption might fail to present itself, or at least be more modest than expected. Furthermore, there is an obvious objection to be made. The traditional

idea of a welfare state is that it is to provide for those who are in need. Not only because it is considered human or ethical, but it serves a stabilizing purpose too. Depending on which basic ethical premise one accepts to be more correct, it can easily be argued that removing needs based assistance in favor of universal grants would be subsidizing those already well off, which could be deemed both unethical and sort of a waste.

13.2 Basic income for older workers and as pensions?

From the second set of experiments, testing the basic income in older age groups and as a substitute for the pension system, instead the most important results were regarding incentives. One of the main objections against basic income, for which there is also some evidence, as earlier discussed, is that it risks reducing people's incentives to work and thus increase unemployment. This is a valid objection, it is straight forward to assume that the need and want for money is one of the main reasons people work. Of course it can be argued that other things matter too, such as being interested in the subject field of one's work, self-fulfillment, wanting to contribute to society etcetera. But, the importance of monetary incentives cannot be denied. This model has tried to take into account both the fact that people are different, and thus react to incentives differently, and that monetary incentives yet are of great importance. What was found in the experiments was that the disincentivizing effect of basic income can be circumvented by introducing basic income only to certain groups. The relevant group was older workers, of whom many in Italy have been trapped in a delicate situation. They were struck the hardest by the 2008 crisis in terms of unemployment and low re-employment rates, and many cannot retire without making a significant financial loss. Thus, there is a group identified for which it would not matter very much how incentivized they are to work, and for which a great deal of suffering would be reduced from introducing basic income. The experiments showed that it is plausible without any detrimental effects on unemployment rates to introduce basic income for the age group 59-65 years old.

13.3 Corruption is key

The results of the experiments depended to a large extent on the assumptions made on corruption. The key for basic income to be productive in terms of administration is that the corruption plaguing other institutions does not follow into the new, simpler structure. However, the deeper the corruption, the more likely it is to survive re-structuring and follow into the new institutions. Corruption, in terms of what it does to social trust levels, is also likely to affect the way people will perceive the basic income. The theory in favor of basic income instead of a traditional welfare structure also argues that a positive effect would be to reduce the somewhat invasive role of the state. First of all, regardless of corruption levels there is a monetary cost of identifying the individuals more in need of assistance, and to monitor that they fulfill the criteria to receive aid. But, it is argued, there is also a immaterial cost to allowing a state such insight in personal matters. We end up in a trade-off between identifying and assisting the disadvantaged versus saving in on costs and higher levels of personal integrity. In the second set of experiments, the dependence on corruption impact was estimated. For Italy, in order to make economically plausible an unconditional basic income for older workers, the impact of corruption in administration needed to be reduced to 25 % of the full effect. Of course it is abstract to speak about 25 % corruption impact, but it nevertheless suggests us that we need to estimate corruption costs, and analyze how they would be reduced, should a new institution be implemented. The experiments on basic income for older workers also provided a suggestion that there is an escape from the above mentioned trade-off. Without being invasive into individuals' private matters, using already existing theory and data it was possible to identify a disadvantaged group and provide them with assistance. Another point is that, as previously discussed, bureaucracy have a tendency to be self-perpetuating and thus, even if one would find it desirable to dismantle the large bureaucratic structure which is the welfare state, it is most likely not possible in any even remotely friction free manner. But, perhaps instead of performing this dubious metamorphosis, selecting one of the departments, for instance the pension system, and implementing basic income there, would be more plausible. The experiments suggested that basic income as a pension scheme could be functional.

13.4 Incentives and the age structure

The fact that basic income has a disincentivizing effect which risk reducing labor supply should not be ignored. The experiments were consistent with previous theory and empirical studies and showed that basic income indeed increases voluntary unemployment. However, if we return to the older workers, in Italy, many suffer from involuntary unemployment, and so their incentives to supply labor does not really matter. Providing them with a basic income would reduce suffering, while not significantly negatively affect the work incentives of those out of the group. Unconditionally keeping this group at a sufficient income level could thus solve the dilemma of a large group being involuntary unemployed, while introducing higher liquidity levels into the economy. Again, the effect on consumption of this liquidity cannot be taken for granted, but provided that it is seen as a stable grant, theory and the study of Alaska suggests that it would increase consumption. In the case of Italy, another potentially positive effect could be to reduce involuntary youth unemployment, which is at raging high levels. This thesis has however not examined this, so it will have to remain a speculation for now. The costs and benefits of such a scheme would depend on the age structure of the population, and on the effects of consumption.

13.5 Further research

As already pointed out, this model was designed to provide an initial hint of where and how basic income could be plausible. It would be beneficial to then further develop it and adapt it to the plausible structure one finds more interesting. This thesis argues that the idea of providing Italian older workers in the age group 59-60 seems plausible from both a theoretical and ethical viewpoint. The model experiments also showed that it is likely to be economically plausible. A modified extension of the model to further inquire about this structure should include the following:

- Effects on migration
    - The initial model was of a closed economy, but results would be more likely to resemble reality if they took into account the fact demographic effects of basic income. As pointed out in

Zwolinski (2011), there could be unwanted effects in terms of anti-immigration pressure and populist fear mongering about the system being taken advantage of.

- Hours worked
  - The initial model only took into account the binary choice to be employed or not. However, it would be constructive and interesting to investigate the effect on the choice to reduce or increase labor supply in terms of hours worked.
- Extended consumption effects
  - As previously noted, part of the economic outcome of basic income structure is the effect they have in terms of consumption. A model extension aimed at being realistic enough so as to provide policy suggestions need therefore contain a more sophisticated consumption choice method.
- Extended effects on involuntary unemployment
  - In the specific case of Italy and older workers, and in general, it would be constructive to see if basic income to one group frees additional jobs to other groups. In this case, youth unemployment effects.

Further research should focus on the points above, and also on estimating the actual costs of corruption and the potential cost savings. This, however, would be suited better by data based estimation. The estimates should then be used into the extended model.

13.6 Policy suggestions

As hinted above, further research with a more specifically adapted model should be undertaken before any proper policy advice can be provided. However, the results of this thesis does suggest that basic income for the older workers in Italy would work, and there is reasons to believe that the effects of it would be positive. As a first step perhaps the structure could be temporarily tested in one or a few specific municipalities. But, more research should definitely be undertaken. What can surely be said, which is perhaps not very surprising, is that measures to rid the structure of corruption are of fundamental importance, and that the policy maker

should take the age structure and employment patterns of the group of interest into account.

14 Conclusion

Right after the introduction, in the second section of this thesis, the reader was provided with the background of basic income theory, and basic income was defined as an unconditional of performance and other income cash grant given on an individual basis. Then it was discussed in terms of its pros and cons, and the views of its opponents and supporters was presented. The concepts of Real Freedom and the people's Endowment were introduced to the reader, and also liberal arguments in favor and against basic income, and some experimental evidence suggesting that basic income would reduce labor supply. The section ended with a review of the case of Alaska, where there exists a basic income structure in terms of an investment fund based on the region's oil. It was deemed too specific a case to generalize around, given the huge size, small population and natural resource richness.

Section three introduced the theoretical method which is Object-oriented Agent-based Simulation. First it was defined and explained, and then some arguments on how this kind of modeling have moved the theorizing forward was presented. It was explained to differ from its predecessor micro-simulation in that it does not only simulate economic units in given environments, but it takes into account also the interactions of the agents. Intertwined with explanations on how they were to be implemented in the model, important concepts based on previous researchers were presented and explained. The first concept was that of object-oriented modeling, as done by Axtell and Epstein. This concept explains how agents are made into simulated individuals by being provided with local state variables containing information unique to them. The agents then use their unique local information into behavioral methods which are the same to all agents. The second concept was Epstein's Agent Zero, which is a way of modeling behavior considering neuroscience.

The fourth section explained the initial model design of the thesis in terms of its state variables, behavioral methods and environmental variables. Here the assumptions behind the variables interactions and the theoretical base of the model were stated. Then in the fifth section, the structure of the initial model is further explain so as to clarify how everything is interrelated, before reaching the initially calibrated model, introducing

and explaining the actual NetLogo code. As is pervading throughout the thesis, it is explained and discussed the way the assumptions have been integrated into the simulation model.

Section 7 argues the flexibility of the model by explaining how to use it in order to imitate and simulate different economic settings. The assumptions behind which variables are important to decide an economic setting are presented as gender equality, the child support and pension levels, the taxes, unemployment benefits and corruption levels, and their importance is being discussed and argued for. Before moving on to demonstrating the flexibility of the kind of basic income structure which can be introduced, in section 8 there is a short discussion on how to properly use simplifications in modeling so as to provide clarity, without risking over-simplifications that make the outcomes less realistic or even wrong. Section 9 uses Italy as an example, with real data from EU sources in order to create a simulated version of the country. Then the thesis moved on to section 11 in which it discusses the model flexibility in terms of how basic income can be introduced. It can be implemented to any age group, at any level of mean wages.

After concluding how the model works in the previous sections, the experiments were presented. First the simulated version of Italy was used and the right wing idea of basic income as a substitute for the welfare state was simulated. It was found to be economically plausible for low levels of basic income, lower than any minimum income. However, it was argued as practically implausible and ethically doubtful. Instead, basic income was tested at an age group which empirically have been disadvantaged in the labor market: older workers in the age span between 59 and 60 years old. It was found to be economically plausible, and some arguments were put forward as to why it could be a potentially good use of basic income. Some experiments on basic income as a pension system were undertaken with positive results. The same experiments were done on a simulated version of Sweden. It was found that corruption plays a key role, and that the assumptions on how it enters the model were fundamental for the outcomes. Another important finding was related to how to minimize the negative impact on the will to supply labor of basic income. This finding was related to the older workers. Since the basic income only applied to them, work incentives of other workers in the economy were not

affected, and since the basic income eligible group is subject to involuntary unemployment in Italy, whereas basic income affects the voluntary employment choice, the reduction in employment due to introducing the basic income structure, was small enough for the scheme to be economically plausible. These results are further discussed in section 13. There some further theorizing on the ethical implications are undertaken, and the key role of corruption discussed. Then some suggestions are presented to continue and extend the model to include migration and consumption effects, hours worked and effects on involuntary unemployment. Finally, a hint towards what kind of policy should be implemented is suggested.

14.1 Further research and extensions

The results of this thesis gave some interesting hints regarding how basic income could plausibly be introduced with beneficial effects. Given the fact that the life quality of older workers likely could be improved in Italy without too large negative effects on voluntary employment, it could be valuable to undertake further experiments. The way forward, after this thesis reviewed, identified and suggested a possible solution to the problems with basic income, would be to extend the model so that it closer resembles Italy. This would mean reducing the flexibility, in favor of the ability to pin point a specific setting. In other words, move beyond the more general "reasoning machine" towards a closer representation of one specific actual setting, where the reasoning is more context bound. In addition to the variables already suggested to be included in future versions of the model; migration and consumption effects, hours worked and effects on involuntary unemployment, the extended model should be programmed to include the country specific contexts of Italy. For instance, the tax system should be progressive, and the population structure more adapted. It would also be constructive for unemployment to be structured into age groups, and not only into gender. In the context of the experiment, what seems to be the key variables to focus on is effects on incentives in relation to voluntary visa vi involuntary unemployment and the age structure in terms of how big the impact of a reduction of voluntary incentives to work would be. In order to do this in a constructive manner, the very first step would be to gather data on age specific unemployment, and to supplement it with surveys dedicated to the purpose of identifying voluntary

and involuntary unemployment patterns in the specific group.

References

agenziaentrate.gov.it (2015). *Agenzia delle Entrate - Income tax for individuals*.
URL http://www1.agenziaentrate.gov.it/english/italian_taxation/income_tax.htm

Axtell, R. L. and Epstein, J. M. (2010). *Computational Model of the Timing of Retirement*. In ≪Behavioral dimensions of retirement economics≫, p. 161.

Bergmann, B. R. (1974). *A microsimulation of the macroeconomy with explicitly represented money flows*. In *Annals of Economic and Social Measurement, Volume 3, number 3*. NBER, pp. 475–489.

Bjørnskov, C. (2003). *Corruption and social capital*. Citeseer.

Boeri, T. (2015). *Reforming the Labor Market: Recent Developments in Italy and Spain*.
URL http://www.carloalberto.org/eventi/collegioaperto/show/collegio-aperto-reforming-the-labor-market-recent-developments-in-italy-and-spain

Boero, R., Morini, M., Sonnessa, M. and Terna, P. (2015). *Agent-based models of the economy*.

Bradshaw, J. (2011). *Child benefits in the European Union.*. In ≪Poverty.≫, vol. 139(Summer 2011), pp. 13–16.

Breiner, P. (1996). *Max Weber & democratic politics*. Cornell University Press.

Campbell, J. and Deaton, A. (1989). *Why is consumption so smooth?*. In ≪The Review of Economic Studies≫, vol. 56(3), pp. 357–373.

Currie, J. (2004). *The take up of social benefits*. Tech. rep., National Bureau of Economic Research.

Data.worldbank.org (2015). *Fertility rate, total (births per woman) — Data — Table*.
URL http://data.worldbank.org/indicator/SP.DYN.TFRT.IN

Ec.europa.eu (2010). *GREEN PAPER towards adequate, sustainable and safe European pension systems*.
URL http://ec.europa.eu/social/BlobServlet?docId=5551&langId=en

— (2015a). *Gender pay gap - The situation in the EU*.
URL http://ec.europa.eu/justice/gender-equality/gender-pay-gap/situation-europe/index_en.htm

— (2015b). *Unemployment statistics - Statistics Explained*.
URL http://ec.europa.eu/eurostat/statistics-explained/index.php/Unemployment_statistics

EIGE (2013). *Gender Equality Index - Report*.
URL http://eige.europa.eu/content/document/gender-equality-index-report

Eliasson, G. *et al.* (1978). *A micro-to-macro model of the Swedish economy*. In *IUI conference reports*, vol. 1. p. 1.

Epstein, J. (2013). *Toward Neurocognitive Foundations for Generative Social Science*.
URL http://media.cph.ohio-state.edu/mediasite/Play/665c495b7515413693f52e7ef9eb4c661d

Epstein, J. M. (2014). *Agent_Zero: Toward Neurocognitive Foundations for Generative Social Science*. Princeton University Press.

Forsakringskassan.se (2015). *Barnbidrag - Försäkringskassan*.
URL http://www.forsakringskassan.se/privatpers/foralder/barnet_fott/barnbidrag

Gilbert, G. N. (2008). *Agent-based models*. 153. Sage.

Goldsmith, O. S. (2010). *The Alaska Permanent Fund Dividend: A Case Study in Implementation of a Basic Income Guarantee*. In .

Hellekant, J. (2014). *Pensionen allt lägre del av slutlönen. Svenska Dagbladet*, 2014. Available: http://www.svd.se/pensionen-allt-lagre-del-av-slutlonen [Last accessed: 29 June 2015].

Irp.wisc.edu (2011). *IRP Negative Income Tax Archive - Information Sources for Income Maintenance Experiments*.
URL http://www.irp.wisc.edu/research/nit/NIT_index.htm

Jaumotte, F. (2005). *Women and work: Resolving the riddle*. In ≪Organisation for Economic Cooperation and Development. The OECD Observer≫, (248), p. 12.

Mazie, S. (2013). *A government-guaranteed basic income: The cheque is in the mail*.

McArdle, M. (2013). *Four Reasons a Guaranteed Income Won't Work*.

Moffitt, R. A. (1981). *The negative income tax: would it discourage work?*. In ≪Monthly Labor Review≫, pp. 23–27.

Mörtvik, R. and Spånt, R. (2005). *Does gender equality spur growth?*. In ≪OECD Observer≫, (250).
URL http://www.oecdobserver.org/news/archivestory.php/aid/1664/Does_gender_equality_spur_growth_.html

OECD (2008). *Pension Country Profile: Italy*. Extract from the OECD Private Pensions Outlook 2008.
URL http://www.oecd.org/finance/private-pensions/42566263.pdf

OECD.org (2013). *Benefits and Wages: Country specific information*.
URL http://www.oecd.org/els/soc/benefits-and-wages-country-specific-information.htm

Rescorla, R. (2008). *Rescorla-Wagner model*. In ≪Scholarpedia≫, vol. 3(3), p. 2237.

Richiardi, M. (2014). *The missing link: AB models and dynamic microsimulation*. In *Artificial Economics and Self Organization*. Springer, pp. 3–15.

Rothstein, B. (2013). *Corruption and social trust: Why the fish rots from the head down*. In ≪Social Research: An International Quarterly≫, vol. 80(4), pp. 1009–1032.

Rymkevitch, O. and Villosio, C. (2007). *Age discrimination in Italy*. In ≪LABORatorio R. Revelli Working Papers Series≫, vol. 67.

Svendsen, G. T. *et al.* (2003). *Social capital, corruption and economic growth: Eastern and Western Europe*. Aarhus School of Business, Department of Economics.

TI (2015). *How corrupt is your country?*.
URL `https://www.transparency.org/cpi2014/results`

Van Parijs, P. (1991). *Why surfers should be fed: the liberal case for an unconditional basic income*. In ≪Philosophy & Public Affairs≫, pp. 101–131.

— (2004). *Basic income: a simple and powerful idea for the twenty-first century*. In ≪Politics & Society≫, vol. 32(1), pp. 7–39.

Whitehouse, E. (2009). *Pensions during the crisis: Impact on retirement income systems and policy responses*. In ≪The Geneva Papers on Risk and Insurance-Issues and Practice≫, vol. 34(4), pp. 536–547.

Widerquist, K. (2014). *A People's Endowment*. In ≪SelectedWorks of Karl Widerquist≫.

Wilson, S. and Lundberg, K. (2013). *Pensions at a glance 2013 SWEDEN*. OECD and G20 Indicators.
URL `http://www.oecd.org/sweden/OECD-PensionsAtAGlance-2013-Highlights-Sweden.pdf`

Zwolinski, M. (2011). *Classical Liberalism and the Basic Income*. In ≪Basic Income Studies≫, vol. 6(2).

A First Appendix: the Code

```
extensions [ nw ]
__includes [
  "setup-turtles.nls"
  "setup-networks.nls"
  "move-and-age.nls"
  "move-and-age-child.nls"
  "update_masks.nls"
  "update_fems.nls"
  "update_child.nls"
  "update_retired.nls"
  "adjust_consumption.nls"
  "adjust_SFconsumption.nls"
  "adjust_investments.nls"
  "adjust_labour.nls"
  "setup-jobs.nls"
  "have_child.nls"
  "update_treasury.nls"
  ]

globals
[ mean-WW mean-WW-mask mean-WW-fem medianW consumption-others labour-others
all-profit all-investments GDP mean-wealth d-treasury g-treasury sum-consumption
avg-consumption d-wealth new-jobs SC-all wage-all corruption-change
employmentFEM employmentMASK unemploymentFEM unemploymentMASK retired
young adults happiness meanWfem meanWmask meanage treasury initial_jobs_available
jobs_available unemployment-benefit child-support pension basic-income sum-BI-eligible
]

breed [ masks mask ]
breed [ fems fem ]
breed [ pensioners pensioner ]
breed [ children child ]

undirected-link-breed [ families family ]
undirected-link-breed [ societies society ]
```

```
links-own [ weight ]

turtles-own [ BI-eligible w wage mum dad consumption d-consumption disp-consumption
total-disp-cons v-consumption p-consumption tau-consumption tau-labour disp-labour
 w-labour total-disp-labour v-labour p-labour w-consumption debt partner gender
age educ wealth income SC incent risk health happy safe ]


fems-own [ job ub-eligible work_will d-work_will emp emp_hist fert married
fam_head kids investments profit ]

masks-own [ job ub-eligible work_will d-work_will emp emp_hist fert married
fam_head kids investments profit ]

pensioners-own [ emp emp_hist married fam_head investments profit kids fert ]

to setup
  clear-all
  ask patches [ set pcolor gray ]
  setup-jobs
  setup-turtles
  set treasury 0
  set employmentFEM count fems with [ job = 1]
  set employmentMASK count masks with [ job = 1]
  reset-ticks
end

to go
  data

  setup-networks
  have_child
  move-and-age-child
  update_child
  update_masks
  update_fems
  update_retired
```

```
  update_treasury
  tick
  if ticks > 104 [stop]
end

to data
  set meanWfem mean [wage] of fems with [job = 1]
  set meanWmask mean [wage] of masks with [job = 1]
  set medianW median [wage] of turtles with [ shape = "person business" and job = 1]
  set wage-all sum [wage] of fems + sum [wage] of masks
  set meanage mean [age] of turtles
  set unemploymentFEM count fems with [ job = 0]
  set unemploymentMASK count masks with [ job = 0]
  set employmentFEM count fems with [ job = 1]
  set employmentMASK count masks with [ job = 1]
  set retired count pensioners
  set young count children
  set adults count turtles with [ shape = "person business"]
  set jobs_available initial_jobs_available
- employmentFEM - employmentMASK + new-jobs

  set SC-all mean [SC] of turtles with [ shape = "person business"]
  set mean-wealth mean [ wealth ] of turtles
  set sum-consumption sum [ consumption ] of turtles
  set avg-consumption mean [ consumption ] of turtles
  set sum-BI-eligible count turtles with [ BI-eligible = 1]
  set all-profit mean [profit] of turtles with [ shape = "person business"]
  set all-investments mean [investments] of turtles with [ shape = "person business"]
  set consumption-others
sum [v-consumption] of turtles + sum [p-consumption] of turtles

  set labour-others sum [v-labour] of turtles + sum [p-labour] of turtles
  set mean-WW mean [work_will] of turtles with [ shape = "person business"]
  set mean-WW-mask mean [work_will] of masks
  set mean-WW-fem mean [work_will] of fems
output-print word "meanWfem" meanWfem
output-print word "meanWmask" meanWmask
```

```
output-print word "meanAge" meanage
end

to setup-turtles
  set-default-shape children "person"
  create-children 50
  [
    setxy random-xcor random-ycor
    set color red
    set size 0.5
    set age random(18)
  ]


  set-default-shape fems "person business"
  create-fems 100
  [
    setxy random-xcor random-ycor
    set gender 0
    set age 18 + random(47)
    set color pink
    set investments random(wage)
    set risk random(100)
    set emp_hist 1 + random(10) + random(5)
    set emp emp_hist + random(10)
    set work_will 1 + random(150)
    set income profit + (wage * job) + (unemployment-benefit * (1 - job))
    set SC random(100) - random(25)
    set incent random(100)
    set happy (educ + health + SC + emp + emp_hist + safe) * 0.1 + random(25)
    set educ 1 + random(10) + (wealth * 0.0002) + (income + SC + health) * 0.001
    set fert random(100)
    set kids 0
    if work_will > 100
    [set job random(2)]
    ifelse job = 0
    [ set wage 0 ]
```

```
    [ set wage
 ln(((age + educ + ((emp - emp_hist) / emp_hist))
+ random(10) - random(10))) * (1 - tax)]

  ]

  set-default-shape masks "person business"
  create-masks 100
  [
    setxy random-xcor random-ycor
    set gender 1
    set age 18 + random(47)
    set color blue
    set investments random(wage)
    set risk random(100)
    set emp_hist 1 + random(10) + random(5)
    set emp emp_hist + random(10)
    set work_will 1 + random(150)
    set income profit + (wage * job) + (unemployment-benefit * (1 - job))
    set SC random(100) - random(25)
    set incent random(100)
    set happy (educ + health + SC + emp + emp_hist + safe) * 0.1 + random(25)
    set educ 1 + random(10) + (wealth * 0.0002) + (income + SC + health) * 0.001
    set fert random(100)
    set kids 0
    if work_will > 100
    [set job random(2)]
    ifelse job = 0
    [ set wage 0 ]
    [ set wage
 ln(((age + educ + ((emp - emp_hist) / emp_hist))
+ random(10) - random(10))) * (1 - tax)]

  ]

  set-default-shape pensioners "person"
  create-pensioners 10 + random(50)
```

```
[
  setxy random-xcor random-ycor
  set gender random(2)
  set age 65 + random(35)
  set color black
  set educ 1 + random(10) + (wealth * 0.2) + (income + SC + health) * 0.01
  set emp_hist 1 + random(100)
  set emp emp_hist + random(100)
  set investments random(100)
  set income profit + pension
  set wealth (1000 + random(1000) * age) * 0.1 + educ + income + health + happy
  set SC (educ + wealth - incent + health + happy + emp_hist) * 0.1
  set incent random(100)
  set risk random(100) - (exp(age)) * 0.01
  set happy (educ + health + SC + emp + emp_hist + safe) * 0.1 + random(25)
  set income (pension + (wage * 0.3)) * (1 - pension-tax)
]


ask turtles
[
  set w-labour random(100)
  set w-consumption random(100)
  set health 100 + random(100) - age
  set consumption 0.9 * income
  set safe 1 + random(100)
  if risk > 100 [set risk 100]
  if risk < 0 [set risk 0]
  if SC > 100 [set SC 100]
  if SC < 0 [set SC 0]
  if incent > 100 [set incent 100]
  if incent < 0 [set incent 0]
  if happy > 100 [set happy 100]
  if happy < 0 [set happy 0]
  if educ > 100 [set educ 100]
  if educ < 0 [set educ 0]
]
```

```
end

to update_fems
  ask fems [
    if w-labour = 0 [ set w-labour random(100) ]
    if w-consumption = 0 [ set w-consumption random(100)]
    ifelse age > min-age-BI and age < max-age-BI
[ set BI-eligible 1] [ set BI-eligible 0]

    ifelse age < min-age-BI [ set ub-eligible 1] [ set ub-eligible 0]
    ;set ub-eligible 1
    if educ < 0 [set educ 1]
    if age < 30 [
      set educ educ + ((age + wealth * 0.0001 + sc) / educ)
      if educ < 0 [set educ 1]]
    if happy <= 0 [set happy 1]
    set happy happy + ((health + safe + d-consumption) * 0.1) / happy
    set sc sc + ((educ + happy + safe) * 0.00001) * (1 - corruption)
    set risk safe - exp(age * 0.00000001)
    if risk > 100 [ set risk 100 ]
    if risk < 0 [ set risk 1]
    ifelse job = 1
    [ set safe safe + ((0.0001 * (wealth - (mean-wealth / 2)) + debt) / safe)]
    [ set safe safe
+ ((0.0001 * (wealth - (mean-wealth / 2)) + debt + unemployment-benefit) / safe)]


    if age < 50 [
      set d-work_will 4 * (sc + educ + health) * gender_equality
+ random(100) * gender_equality - random(100)
+ ((meanWfem * (1 - tax)) * (1 - corruption))
- (unemployment-benefit * ub-eligible) - (basic-income * BI-eligible)
- (child-support * kids)

      set work_will work_will + d-work_will ]
    if age > 50 [
      set d-work_will sc + random(25) - random(25)
```

```
- (age * 0.0001) + ((meanWfem * (1 - tax) * 0.01) * (1 - corruption) * 100)
- (unemployment-benefit * ub-eligible) - (basic-income * BI-eligible)

      set work_will work_will + d-work_will]
    if work_will > 1000 [set work_will 1000]
    if work_will < 0 [set work_will 0]
    if work_will < 1 [ set job 0 ]
    if health < 25 [set job 0 ]
    move-and-age
    adjust_labour
    adjust_consumption
    if ticks mod 4 = 0 [ ifelse debt < 0 [set investments (wage * (risk * 0.01))]
[set investments 0]

      set income income - investments
      ifelse random-float(100) < 75 and investments > 0
[set profit 0 set risk risk / 2 ]

[set profit investments + ((risk * 0.01)  * investments)
 set risk risk + random(25) ]

      set income profit + (unemployment-benefit * (1 - job))
+ (wage * (1 - tax)) + (child-support * kids)

      set d-wealth income + (wage * (1 - tax)) - consumption
      set wealth wealth + income - consumption
    ]
    if wealth < 0 [ set debt debt + wealth set wealth 0 ]
    if age < 45 [ set fert fert + 1]
    if age > 45 [ set fert fert - age]
    if age < 60 [
      ask fems with [wage > meanWfem]
[ set health health + (((happy + safe) * 0.00005
+ (0.005 * ( wealth - (mean-wealth / 2)))) * 0.05) / health ]

      ask fems with [wage < meanWfem]
 [ set health health + (((happy + safe) * 0.00001
```

```
+ (0.001 * ( wealth - (mean-wealth / 2)))) * 0.01) / health ]]

    if age > 60 [ set health health - (age * 0.0001) ]
    if health < 1 [die]
    if job = 1
[ set wage wage + (((((age + educ + ((emp - emp_hist) / emp_hist))
+ random(100) - random(100)))) / (1 + wage)) * (1 - tax)

      set income wage * (1 - tax)
      if wage < 0 [ set wage 0 set job 0]]
    if job = 0 and ticks mod 4 = 0
[ set wage 0 set income income + (unemployment-benefit * ub-eligible)
+ (basic-income * BI-eligible) ]

    set wealth wealth + income - consumption
  ]
  ask fems with [ age > 65 ]
    [set breed pensioners
      set color black
    ]
end
to update_masks
  ask masks [
    if w-labour = 0 [ set w-labour random(100) ]
    if w-consumption = 0 [ set w-consumption random(100)]
    ifelse age > min-age-BI and age < max-age-BI
[ set BI-eligible 1] [ set BI-eligible 0]
    ifelse age < min-age-BI [ set ub-eligible 1] [ set ub-eligible 0]
    ;set ub-eligible 1
    if educ < 0 [set educ 1]
    if age < 30 [
      set educ educ + ((age + wealth * 0.0001 + sc) / educ)
      if educ < 0 [set educ 1]]
    if happy <= 0 [set happy 1]
    set happy happy + ((health + safe + d-consumption) * 0.1) / happy
    set sc sc + ((educ + happy + safe) * 0.00001) * (1 - corruption)
    ;set incent incent + (0.1 * wealth + educ - sc - happy)
```

```
    set risk safe - exp(age * 0.00000001)
    if risk > 100 [ set risk 100 ]
    if risk < 0 [ set risk 1]
    ifelse job = 1
    [ set safe safe + ((0.0001 * (wealth - (mean-wealth / 2)) + debt) / safe)]
    [ set safe safe +
((0.0001 * (wealth - (mean-wealth / 2)) + debt + unemployment-benefit) / safe)]



    if age < 50 [
      set d-work_will 4 * (sc + educ + health) + random(100)
- random(100) + ((meanWmask * (1 - tax)) * (1 - corruption))
- (unemployment-benefit * ub-eligible) - (basic-income * BI-eligible)
- (child-support * kids)

      set work_will work_will + d-work_will ]
    if age > 50 [
      set d-work_will sc + random(25) - random(25)
- (age * 0.0001) + ((meanWmask * (1 - tax) * 0.01) * (1 - corruption) * 100)
- (unemployment-benefit * ub-eligible) - (basic-income * BI-eligible)

      set work_will work_will + d-work_will]
    if work_will > 1000 [set work_will 1000]
    if work_will < 0 [set work_will 0]
    if work_will < 1 [ set job 0 ]
    if health < 25 [set job 0 ]
    move-and-age
    adjust_labour
    adjust_consumption
    if ticks mod 4 = 0 [ ifelse debt < 0
[set investments (wage * (risk * 0.01))] [set investments 0]

      set income income - investments
      ifelse random-float(100) < 75 and investments > 0
        [set profit 0 set risk risk / 2 ]
        [set profit investments
+ ((risk * 0.01)  * investments) set risk risk + random(25) ]
```

```
      set income
profit + (unemployment-benefit * (1 - job))
+ (wage * (1 - tax)) + (child-support * kids)

      set d-wealth income + (wage * (1 - tax)) - consumption
      set wealth wealth + income - consumption
    ]
    if wealth < 0 [ set debt debt + wealth set wealth 0 ]
    if age < 45 [ set fert fert + 1]
    if age > 45 [ set fert fert - age]
    if age < 60 [
      ask masks with
[wage > meanWmask] [ set health health
+ (((happy + safe) * 0.00005
+ (0.005 * ( wealth - (mean-wealth / 2)))) * 0.05) / health ]

      ask masks with
[wage < meanWmask]
[ set health health + (((happy + safe) * 0.00001
+ (0.001 * ( wealth - (mean-wealth / 2)))) * 0.01) / health ]]

    if age > 60 [ set health health - (age * 0.0001) ]
    if health < 1 [die]
    if job = 1 [ set wage wage +
 (((((age + educ + ((emp - emp_hist) / emp_hist))
+ random(100) - random(100)))) / (1 + wage)) * (1 - tax)

      set income wage * (1 - tax)
      if wage < 0 [ set wage 0 set job 0]]
    if job = 0 and ticks mod 4 = 0
[ set wage 0 set income
income + (unemployment-benefit * ub-eligible) + (basic-income * BI-eligible) ]

    set wealth wealth + income - consumption
  ]
```

```
  ask masks with [ age > 65 ]
    [set breed pensioners
      set color black
    ]
end

to update_child
  ask children
  [
    ifelse age > min-age-BI and age <
max-age-BI [ set BI-eligible 1] [ set BI-eligible 0]

    if ticks mod 4 = 0
[ set income income + (basic-income * BI-eligible) ]
  ]
  ask children with [ mum = nobody]
  [
    set mum one-of fems with [kids = 0]
    if [partner] of mum != nobody [ set dad [partner] of mum
      create-family-with mum [ set color pink ]
    if dad != 0 [create-family-with dad [ set color blue ]
    ]]]

  ask children with [age > 18]
  [
    ifelse random(100) > 50
    [
      set breed masks
      set size 1
      set color blue
      set investments random(100)
      set risk random(100)  * (1 - gender_equality)
      set emp_hist 1 + random(10) + random(5)
      set emp emp_hist + random(10)
      set work_will random(500)
      if ticks mod 4 = 0 [set income income + profit + (wage * job)
+ (unemployment-benefit * (1 - job)) + (basic-income * BI-eligible)]
```

```
      set SC random(100) - (random(25) * (1 - gender_equality))
      ;set incent random(100)
      set happy (educ + health + SC + emp + emp_hist + safe) * 0.1 + random(25)
      set educ (1 + random(10) + (wealth * 0.0002)
+ (income + SC + health) * 0.001) * (1 - gender_equality)

      if educ < 1 [set educ 1]
      set fert random(100)
      set kids 0
      if work_will > 50 [
        set job random(2)]
      ifelse job = 0
      [ set wage 0 ]
      [ set wage
 ln((age + educ + ((emp - emp_hist) / emp_hist))
+ random(10) - random(10)) * (1 - tax)]

      update_masks
    ]

    [
      set breed fems
      set size 1
      set color pink
      set investments random(1000)
      set risk random(100)
      set emp_hist 1 + random(10) + random(5)
      set emp emp_hist + random(10)
      set work_will random(500)
      if ticks mod 4 = 0 [set income income + profit + (wage * job)
+ (unemployment-benefit * (1 - job)) + (basic-income * BI-eligible)]

      set SC random(100) - random(25)
      set happy (educ + health + SC + emp + emp_hist + safe) * 0.1 + random(25)
      set educ 1 + random(10) + (wealth * 0.0002) + (income + SC + health) * 0.001
      set fert random(100)
```

```
      set kids 0
      if work_will > 50 [
        set job random(2)]
      ifelse job = 0
      [ set wage 0 ]
      [ set wage
 ln(((age + educ + ((emp - emp_hist) / emp_hist)) + random(10)
- random(10)) * gender_equality) * (1 - tax)]

      update_fems
    ]
  ]
end

to update_retired
  ask pensioners [ set fert 0
    ifelse age > min-age-BI and age < max-age-BI
[ set BI-eligible 1] [ set BI-eligible 0]
  ]
  ask pensioners with [ ticks mod 4 = 0] [
    set income profit + pension * (1 - pension-tax) + (basic-income * BI-eligible)
    set wage 0
    set wealth wealth + income - consumption
    set health health - exp(age * 0.001)
    move-and-age
    adjust_consumption
  ]
end

to move-and-age
  rt random 50
  lt random 50
  fd 1
  set age age + 0.0192307
  if health > 100 [set health 100]
  if wealth < 1 [set debt debt - wealth set wealth 1 ]
  if health < 1 [
```

```
    ask out-link-neighbors
    [ set wealth
 wealth + ((([wealth] of myself)) * (1 - inheritance_tax)) / [kids] of myself ]

    ask my-links [die]]
  set wealth 0
  if age > 98 [
    ask out-link-neighbors
    [ set wealth wealth
+ ((([wealth] of myself)) * (1 - inheritance_tax)) / [kids] of myself ]

    ask my-links [die]]
  set wealth 0
  if health < 0 [die]
  if age > 110 [die]
end

to move-and-age-child
  ask children [
  rt random 50
  lt random 50
  fd 1
  set age age + 0.0192307]
end

to setup-networks
  ask fems
  [ if (age < 45) and (age > 25) and (married = 0) and random(100) < 50 [
    set partner one-of masks-here with [married = 0 and age < 45 and age > 25]
    if partner != nobody
    [ create-family-with partner [ set color red ]
      set married 1
      ask partner [set married 1 set partner myself]
    ]]]
end

to setup-jobs
```

```
  set new-jobs 1
  set initial_jobs_available
150 + (percent-of-wage-child + percent-of-wage + percent-of-wage-pension)
/ 3 * 200

  set jobs_available initial_jobs_available
end

to have_child
  ask fems with
[age > 25 and age < 45 and fert > 100
and kids < 3 and married = 1
and partner != nobody and [fert] of partner > 60]

    [ hatch-children 1 [
      setxy random-xcor random-ycor
      set shape "person"
      set size 0.5
      set age 0
      set color red
      move-and-age-child
      ;update_child
      create-family-with myself [ set color pink ] set mum myself
      create-family-with partner [ set color blue ] set dad [partner] of mum ]
    if fert > 100 [ set fert 100 ]
    set fert fert - random(50)
    set kids kids + 1
    set health health - random(health * 0.1) * (1 - gender_equality)
    if partner != nobody [
      ask partner [ set kids kids + 1 ]]]
end

to adjust_consumption

  if income > 0 [
    set d-consumption 0.8 * income
    set consumption d-consumption + random(10)
```

```
    set consumption consumption
+ (consumption - d-consumption) / d-consumption]

  ;set tau-consumption mean [total-disp-cons] of turtles
  set tau-consumption (mean [total-disp-cons] of turtles) * 1.5

  set v-consumption incent + risk + health + happy + fert + safe
  set p-consumption (0.8 * income) + educ
  set disp-consumption v-consumption + p-consumption
  set total-disp-cons disp-consumption
+ (consumption-others - disp-consumption) * w-consumption

  if income > 0 and total-disp-cons > tau-consumption [
    set d-consumption 0.9 * income
    set consumption d-consumption + random(10)
    set consumption consumption + (consumption - d-consumption) / d-consumption
  ]

end

to adjust_investments
  if wealth > 1.5 * mean-wealth
and risk > 75
and incent > 60
and debt > 0
[ set investments investments * (1 + (risk * 0.01)) ]

end

to adjust_labour
  set tau-labour mean [total-disp-labour] of turtles
  ;set tau-labour (mean [total-disp-labour] of turtles) * 1.5

  set v-labour  SC + health + happiness - fert
- (married * (1 - gender) * random(10))

  set p-labour educ + meanWfem * (1 - gender) + meanWmask * gender
```

```
  set disp-labour v-labour + p-labour
  set total-disp-labour disp-labour + (labour-others - disp-labour) * w-labour

  if total-disp-labour > tau-labour [
    ask one-of turtles with [shape = "person business"] [
      if random(100) > 85 and wage > 2 * meanwfem and risk > 95
      [ set new-jobs new-jobs + random(2) / new-jobs
        set wage wage * 1.1 ]]
    ask fems
      [ if (unemployment-benefit * ub-eligible)
+ (child-support * kids) + (basic-income * BI-eligible)
+ (random(income) * married) > (0.1 * (100 - incent)) * (meanWfem * (1 - tax))

        [set work_will work_will / 2 ]]

    ask masks
    [ if (unemployment-benefit * ub-eligible) + (child-support * kids)
+ (basic-income * BI-eligible) + (random(income) * married)
> (0.1 * (100 - incent)) * (meanWmask * (1 - tax))

      [set work_will work_will / 2 ]]

    ask fems with [job = 0] [
      if work_will > 100 * (1 + (1 - gender_equality)) * 1.5
 and health > 50 and jobs_available >= 1
        [set job 1
          data
        ]]
    ask fems with [job = 1] [
      if income - wage > (1 - (incent * 0.1) * wage) + (100 - incent)
      [ set work_will work_will / 1.5  ]]

    ask masks with [job = 0] [
      if work_will > 100 and health > 50 and jobs_available >= 1
        [set job 1
          data
        ]]
```

```
    ask masks with [job = 1] [
      if income - wage > (1 - (incent * 0.1) * wage) + (100 - incent)
      [ set work_will work_will / 1.5 ]]

    if work_will < 1 [ set job 0 ]
    if health < 25 [set job 0 ]]

end

to adjust_SFconsumption
  ask turtles [
    if wealth > 2 * mean-wealth and SC > 1.5 * SC-all
    [ set consumption consumption * 1.5 ]
  ]
end

to update_treasury
  set unemployment-benefit ((meanWmask + meanWfem) / 2) * percent-of-wage
  set child-support ((meanWmask + meanWfem) / 2) * percent-of-wage-child
  set pension ((meanWmask + meanWfem) / 2) * percent-of-wage-pension
  set basic-income ((meanWmask + meanWfem) / 2) * percent-of-wage-BI
  ;set basic-income medianW * percent-of-wage-BI
  set d-treasury
 (sum-consumption * consumption-tax + ((tax / (1 - tax)) * wage-all)
+ ((pension * retired * pension-tax)) * (1 - corruption / 2)
- (unemployment-benefit * (unemploymentMASK
+ unemploymentFEM)) * (1 + corruption / 2)
- (pension * retired) * (1 + corruption / 2)
- (child-support * young) * (1 + corruption / 2)
- (sum-BI-eligible * basic-income)) / 4

  set treasury treasury + d-treasury
  if ticks > 1 [ set g-treasury d-treasury / (treasury - d-treasury) ]
end
```

B Second Appendix: Italy

From setup turtles

```
set age 18 + 6 + random(47)
set age 18 + 4 + random(47)
```

From update fems

```
set d-work_will 4 * (sc + health) * gender_equality
+ random(100) * gender_equality - random(100)
+ ((gender_equality * meanWfem * (1 - tax)) * (1 - corruption))
- (unemployment-benefit * ub-eligible) - (basic-income * BI-eligible)
- (child-support * kids)
set work_will work_will + d-work_will ]
```

From adjust labor

```
ask fems with [job = 0] [
if work_will >
100 * (1 + (1 - gender_equality)) * 1.5
and health > 50
and jobs_available >= 1
[set job 1
data
]]
```

C Third Appendix: Sweden

From setup turtles

```
set age 18 + 5 + random(47)
set age 18 + 3 + random(47)
```

From update fems

```
set d-work_will
4 * (sc + health) * gender_equality + random(100) * gender_equality -
random(100) + ((meanWfem * (1 - tax)) * (1 - corruption)) -
(unemployment-benefit * ub-eligible) -
(basic-income * BI-eligible) - (child-support * kids)
set work_will work_will + d-work_will ]

set wage wage + (((((age + educ + ((emp - emp_hist) / emp_hist)) +
random(100) - random(100) -
random(44) * (1 - gender_equality)))) / (1 + wage)) * (1 - tax)
```

From update masks

```
set d-work_will
4 * (sc + health) + random(100) - random(100) +
((meanWmask * (1 - tax)) * (1 - corruption)) -
(unemployment-benefit * ub-eligible) -
(basic-income * BI-eligible) - (child-support * kids)
set work_will work_will + d-work_will ]
```

From adjust labor

```
ask fems with [job = 0] [
if work_will > 100
and health > 50 and jobs_available >= 1
[set job 1
data
]]
```