Master's thesis

NTNU
Norwegian University of Science and Technology
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Department of Engineering Cybernetics

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Is a Job Guarantee program a viable economic solution during a pandemic?

A modelling approach

Master's thesis in Cybernetics and Robotics
Supervisor: Trond Andresen

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Preface

This master's thesis is written at the Department of Engineering Cybernetics at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. It is the final thesis as a part of a 5-year-master's degree.

This thesis aims to show which choices and solutions done during the work and exploration of the field. It uses cybernetic methods applied to a macroeconomic system.

The work started fall 2020, outlined at NTNU, Trondheim. I have used a working place with a computer and MATLAB software offered by the Department of Engineering Cybernetics.

I want to thank my supervisor Trond Andresen for the cooperation with insightful advice, discussions and talks. Also, I want to thank family and friends for the support, especially Madeleine, Erik, Sigurd, Petter and Henry. At last, I am grateful for the time at the Department of Engineering Cybernetics in Trondheim.

Trondheim, 15/02/2021

Abstract

Rising rates of unemployment are a global problem. Being unemployed over a longer period can give negative social and economic consequences. A Job Guarantee program can be a solution to the world's unemployment problem. Job Guarantee (Hereafter JG) is a federally funded, locally administrated job that everyone able and willing to work is offered. The JG employment gives the same wage irrespective of profession, education or age. The program serves as a repository containing different job opportunities, with digital courses and training if a pandemic restricts the number of opportunities. Besides full-time jobs, the JG program can also offer part-time jobs. Modern Monetary Theory (MMT) is the basis for a JG program. One of the most important goals of MMT is to achieve full employment, and government deficit is not a problem according to this theory if the economy's full potential is utilised.

In this thesis, two macroeconomic models of a society are developed using cybernetic and economical methods, using a stock-flow approach. A pandemic is introduced to simulate an economic crisis. The first model is a society with zero per cent unemployment with a Job Guarantee program and includes two types of crisis support to limit the consequences of the pandemic. In the second model, there is regular unemployment and no crisis support. The pandemic has a length of 1.5 years, and the models simulate the economy over ten years to observe the economic dynamics over time.

The results in this thesis show that a Job Guarantee program with crisis support reduces the magnitude of the fluctuations in the economy. A JG program also creates a smaller deficit for the government when hit by a crisis like a pandemic compared to a "business as usual" situation with regular unemployment. The benefit of having a job instead of long-term unemployment is an additional benefit of the JG program. The results show that the difference in the total public deficit between the JG economy and the economy with unemployment is 6.4 billion NOK at the end of the period. The total deficit is 74 per cent larger at its maximum in the economy with unemployment compared to the economy with Job Guarantee. On average, there are 13.3 per cent more unemployed people in the economy with unemployment than people in the Job Guarantee program over the timespan of 10 years. There are 108 thousand more people unemployed per week than people in the JG program during the pandemic.

This thesis' contribution to existing studies is the quantified results that can be used as a foundation for testing and implanting JG programs that can make changes towards a new way of economic future.

Sammendrag

Økende arbeidsledighet er et globalt problem. Å gå arbeidsledig over lengre tid kan ha negative sosiale og økonomiske konsekvenser. Et Jobbgaranti-program kan være en løsning på verdens arbeidsledighetproblem. Jobbgaranti er en statlig finansiert, lokalt organisert jobb alle villige til og i stand til å jobbe kan få. Den tilbyr samme lønn uavhengig av profesjon, utdanning eller alder. Jobbtilbudene består av en «bank» av ledige jobber, med digital kurs og opplæring dersom en pandemi begrenser jobbmulighetene. I tillegg til fulltidsjobber, tilbyr Jobbgaranti-programmet også deltid for de som ikke kan jobbe 100%. Grunnlaget for jobbgaranti er Moderne Monetær Teori (MMT). Et av de viktigste målene til MMT er å oppnå full sysselsetting, hvor det ikke er noe problem å la staten gå med underskudd ifølge denne teorien, dersom det utnytter økonomiens fulle potensiale.

I denne masteroppgaven er to makroøkonomiske modeller av et samfunn utviklet ved hjelp av kybernetiske og samfunnsøkonomiske metoder, med en dynamisk tilnærming. En pandemi blir introdusert for å simulere en økonomisk krise. Den første modellen er et samfunn med null arbeidsledighet med et Jobbgaranti-program og inkluderer to støtteordninger under krisen for å dempe konsekvensene av pandemien. I den andre modellen er det ordinær arbeidsledighet og ingen støtteordninger. Pandemien har en lengde på 1.5 år, og simuleringen har en varighet på ti år for å observere den økonomiske dynamikken over tid.

Resultatene i denne oppgaven viser at et Jobbgaranti-program med støtteordninger demper størrelsene på svingningene i økonomien. Et Jobbgaranti-program skaper også et lavere underskudd for staten når den havner i en økonomisk krise som en pandemi, sammenlignet med en ordinær økonomi med tradisjonell arbeidsledighet. I tillegg til lavere kostnader over tid, kommer alle de positive sidene ved å ha en jobb fremfor å gå arbeidsledig i lengre perioder. Resultatene viser at forskjellen i totalt underskudd mellom økonomien med Jobbgaranti og økonomien med arbeidsledighet er 6.4 milliarder NOK i slutten av perioden. Underskuddet er 74% større på det meste i økonomien med arbeidsledighet sammenlignet med økonomien med Jobbgaranti. I gjennomsnitt er det 13.3% flere arbeidsledige i økonomien med arbeidsledighet enn personer i Jobbgaranti-programmet over en periode på 10 år. Det er 108 tusen flere mennesker som er arbeidsledige i uken enn antall mennesker i Jobbgarantien under pandemien.

Bidraget til eksisterende teori fra denne oppgaven er kvantiserte resultater som kan være grunnlaget for å teste og implementere jobbgarantier for å gjøre endringer mot en ny retning i den økonomiske fremtiden.

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1 Introduction

1.1 Background

"Look after the unemployment and the Budget will look after itself."

John M. Keynes, (1933)

Unemployment is a major worldwide problem, with even the most developed countries facing high unemployment rates. The unemployment rate in Spain for people under 25 reached nearly 53 per cent in March 2015 (Ycharts, 2020a). The coronavirus made the unemployment rate in the US almost 15 per cent (Ycharts, 2020b). The economic and social consequences of an economic crisis can last for decades after the incident, especially without any support from a government. The virus is forcing people into unemployment, which has consequences for individuals as well as for the whole society (Tcherneva, 2018). A Job Guarantee program can solve the unemployment problem. Tcherneva (2018), one of the leading advocates of JG, proposes different problems that JG can solve. Critical points of unemployment are a monetary problem with fewer people working, a problem the private sector can not solve due to business cycles, and the consequences that not only hits the unemployed person but the family as well. The expenses of these social and economic ills are already being paid for by the economy and society at large, both in real and financial terms. Long term unemployment is hard to recover from for an individual. The perception of unemployment being used as a tool against inflation and economic instability is a moral failure of the economics profession (Tcherneva, 2018). Modern Monetary Theory, a "new" theory on economic policy used in many decades, is the theoretical basis for the Job Guarantee. Fullwiler, Kelton & Wray (2012), Mitchell, Watts & Wray (2019), Kelton (2019) and Brook (2019) discuss different aspects of MMT. Kelton (2020) describes the freshest and newest ideas of MMT on how to deal with critical issues from inequality and poverty to building a prosperous society based on more jobs, increasing health care coverage, beating climate change and solid infrastructure. Mitchell (2020) explains why MMT is the new paradigm shift in macroeconomics since the government no longer needs to issue debt because it is the issuer of its own currency. According to Mitchell, the government does not need to borrow money from the non-government sector, and this belief challenges mainstream economists across the world.

The employment rate has increased significantly in Norway since the 1970s. Many women who previously stayed at home taking care of household duties and children have taken paid jobs. However, the employment rate has declined somewhat in the two last decades, except for a peak leading up to the financial crisis in 2008 (Statistics Norway, 2017). Increased education rate and increased number of people living on disability benefits are the main reasons for the declining employment rate. In addition, middle-aged and elderly have gone out of the workforce over to social security. The unemployment rate in Norway has been very low compared to other countries in Europe and has often been as low as 1 to 2 per cent of the workforce. After 2010, the rate has been steady at about 2.5 to 4 per cent, until the outbreak of Covid-19 (Statistics Norway, 2020d). A fundamental cause of the slight increase is structural unemployment. The job and working life have become increasingly more specialised, causing unemployment while there still are many available jobs on the market (Hatland & Kuhnle, 2018, pp. 103-105). Countries all over the world have different economic systems and a different level of welfare. This thesis discusses the different levels of welfares and the people's view on the different services (Hatland & Kuhnle, 2018).

Universal Basic Income (UBI) is a topic brought up for discussion once in a while. UBI is based on the same economic principle as Job Guarantee, except that UBI does not make people work, and consequently does not give the benefits of having a job. Other similar solutions to UBI are Milton Friedman's Helicopter Money and Tax Holiday (Buiter, 2014), (Rørvik & Kvello, 2009). A recent trial in Finland was finished in 2018, where a group trialled UBI to reduce unemployment (Dalen & Moen, 2010). An evaluation of this trial showed a small difference in employment for those receiving UBI compared to those who did not (Nagesh, 2019).

There are several studies of Job Guarantee and other similar economic solutions, but most of them fail to present quantitative results. Trond Andresen, (1999) & (2018), demonstrates a different proposal to analyse economic models and systems. He uses control theory on dynamic systems to examine problems. This thesis develops two unique models based on his principles, together with cybernetic and economic theories. The first is a model of a society with zero per cent unemployment which offers a Job Guarantee program instead. It also has mechanisms of how to limit the economic impacts of a crisis. The second is a model of an economy with

"business as usual", based on the same principles as the first, but with classical unemployment benefits to those who can not find a job for themselves. This model does not offer any support mechanisms during the crisis.

1.2 The problem and goal

This thesis aims to "*develop a model of an economic system with zero unemployment with a job guarantee program as a possible solution and simulate against a regular system with unemployment.*"

The overall objective of this thesis is to build a macroeconomic model with zero unemployment using a publicly funded JG program. Using stylised facts, based on a Nordic country, the model will simulate an entire economy, and the results are compared against a classical society with unemployment. The aim is to analyse the following research questions:

- How will a Job Guarantee program influence the system costs?
- How will a pandemic impact the economy?
- How will the spending, public deficit, demand and output be affected?
- Which solutions can limit the consequences of a pandemic?

Two models are developed using cybernetic methods of dynamic systems and graphical programming, using Simulink (MathWorks, 2020) to model a macroeconomic society. This study can influence the way the Government is managing a crisis in the future.

The thesis is organised as followed. Chapter 2 describes relevant background theory. Chapter 3 gives a brief explanation of the methods and tools used in this thesis. It also demonstrates how the final models are executed. Chapter 4 presents the results from the simulations using graphic and verbal explanations. Chapter 5 analyses the results, discusses and compares them to existing theory, discusses suggestions for further work and presents a conclusion for the thesis.

2 Economic theories and findings

2.1 Modern Monetary Theory

There are many different economic theories and models, which have been developing since the 1500s. According to Ogg (2019), the top notable contributors to the development of economic theory are Adam Smith (1723-1790), David Ricardo (1772-1823), Alfred Marshall (1842-1924), John Maynard Keynes (1883-1946) and Milton Friedman (1912-2006).

Keynes is a major economist regarding the macroeconomic theory of total spending in a society, focusing on output, (un)employment and inflation. Keynes' work revolves around aggregate demand, which causes streams of goods, services and money in an economy (Dalio, 2013). From Keynes, there has originated different "schools" of economics, which divides into these groups (Davidson, 2002), (Skidelsky, 2010):

- Neo-Keynesian
- New Keynesian
- Post-Keynesian
- The new neoclassical synthesis

There are two types of classical policies which can affect the economy (Correia, et al., 2008). Fiscal policy is when the government uses public spending and changed taxes to stimulate the economy either way. During a recession, the government will either reduce taxes or increase government spending on goods and services, or a combination of both. When the economy is facing a boom, the government will do the opposite; increase taxes or reduce spending.

Monetary policy is when the government uses the interest rate to change the money supply and buying or selling bonds. A selection of qualified persons in the central bank decides the interest rate and the government does the bond trading. The trading of bonds to increase the money supply is called quantitative easing (Joyce, et al., 2012). The central bank will often adjust the money supply towards an inflation target, which lies between 2 and 3 per cent. It is 2 per cent in Norway (Norwegian Central Bank, 2020), the UK (Bank of England, 2020) and the US (The Federal Reserve, 2020), while the inflation target over time in Australia lies between 2 and 3 per cent (Reserve Bank of Australia, n.d.).

The policies mentioned above are the classical policies, often named as the mainstream policies. A newer theory, often advocated by post-Keynesians is Modern Monetary Theory. This theory relies on the principles from Georg Friedrich Knapp's book State Theory of money, which is usually denoting as chartalism. This inspiration is one reason for Modern Monetary Theory (MMT) is named neo-chartalism (Alabama, 2011).

Besides, the ideas are motivating by Alfred Mitchell-Innes's Credit Theory of Money, the functional finance proposals of Abba Lerner, Hyman Minsky on the banking system and Wynne Godley's Sectoral balances approach. The ideas of MMT are also adopted and derived from Keynes (Fullwiler, et al., 2012). Some of the most outstanding speakers of MMT are Stephanie Kelton, Warren Mosler, William Mitchell, L. Randall Wray and Pavlina R. Tcherneva. MMT is facing increased popularity, and Stephanie Kelton's newest book about MMT, "The deficit myth", made it to the New York Times bestseller list for hardcover nonfiction in June 2020 (Stony Brook University, 2020).

Having a government budget with a surplus means that the government is withdrawing money from the economy. A deficit means that the government put money into the economy. If the government spends 100 dollars and only collects 90$, it can mean that it has lost 10$, but another way to see it is that there is now 10$, which is circulating in the economy. MMT allows a government budget to run with a deficit. The critical point is that a government can print money in its own currency and put it into the economy by using fiscal policy. By printing money and stimulating the economy, the risk is inflation, but as long as the economy is not running at full capacity, it will not risk inflation. Brook (2019) describes how to avoid inflation: "*Inflation only occurs when the economy is at full capacity. Then you have to suck money out using taxes*."

Instead of traditional fiscal policy, where money first needs to be collected through taxes for then to be spent by the government, MMT demonstrates how money first is put into the economy by the government's spending of goods and services. Now, the money gets collected through taxes to create a demand for government currency, determining the velocity (Kelton, 2020, pp. 25-26). The government does not need the taxes, but it is a way to make the people produce goods and services, which other people can use or buy. Taxpayers are not funding the government; the government is financing the taxpayers. For average Joe to pay taxes in a given

currency, he first needs the money to pay the fees and taxes to the government (Kelton, 2020, p. 27).

Like the monopoly game, the players first need money to buy property, paying rent, landing in jail, or they can draw a card to pay taxes to the IRS (Internal Revenue Service). The players can go broke, but the bank never can. The bank can issue as much as it needs, by writing on any ordinary paper, to make sure it never runs out of money (Kelton, 2020, p. 28). How much debt is too much?
"It is impossible really to put a number; nobody can", Kelton (2019).
«*First of all, you never have to default, because you print the money, I hate to tell you, OK?"*
Trump (2016) on dealing with the large public debt.

MMT depends on the government being the monopoly issuer of a fiat currency, in countries like the US, UK, Japan, Australia, Canada and the Nordic countries Norway, Denmark, Sweden, and Finland. The conventional view is the taxpayer paying for the government spending (Kelton, 2020, p. 2). Using taxpayer's money is pure fantasy, according to Kelton (2020, p. 3). MMT does not depend on spending an infinite amount of money either. Available technology, land, materials, factories, labour and machines defines an economy's limits. The limits lay within factors of the real economy, not in terms of spending or deficit (Kelton, 2020, pp. 3-4). There are never problems with deficit regarding rising the defence budget, getting into wars, bailing out banks or tax breaks to the wealthiest Americans, only when education and health are at stake (Kelton, 2020, p. 8). There is a difference between government money and household money.

MMT shows how federal governments do not need tax money or borrowing savings to pay for public spending. The most critical constraint on government spending lies in the inflation (Kelton, 2020, p. 9). The evidence of overspending is inflation, not deficit. Deficit in the public budget means surplus in the economy and reducing the government's budget would mean taking money from the economy. Does a large deficit mean pushing the burden over to younger and future generations? No, says (Kelton, 2020, p. 10). Just look at the post-war times. Increasing deficit will not make future generations poorer, nor will reducing it make them richer. What about the immense foreign debt? Since the US controls the dollar, China has gotten dollars through trade and then bought debt from the US treasury. This debt is no problem erasing with a keystroke.

When talking about printing paper money, it does not need to be actually printed on paper. In most cases, the money is pure digital. When the House and Senate in the US in 2018 approved the military budget of $716 billion, $82 billion more than the Congress had decided the year before, there were no discussions about where the money originated. There were no increased taxes, nor any borrowed money from savers. The Congress agreed to spend money they did not have. The US Treasury then instructs its bank, the Federal Reserve, to carry out the payment. Fed marks up the numbers in Lockheed Martin's bank account to grant new F-35-fighters. The money does not have to come from somewhere (Kelton, 2020, pp. 29-30).

A natural question to ask when the government can make its own money is why taxes are needed? As mentioned earlier, the government uses taxes to collect money from the economy to create the demand for currency to pay taxes. The government also uses taxes to encourage or discourage specific behaviour, improve public health or battle climate change. Taxes are also a way of equalling differences between wealthy and poor. Capital tax is making sure the money is spent, not just stored away under the mattress. Capital that gets put into a business is taxed less than money held in the bank (Fasting, 2020). Taxation on capital is also a way to lower the differences between rich and poor. It is also salient to regulate the money to ensure that the inflation does not explode (Kelton, 2020, pp. 32-24).

There are various critiques against MMT, and one of the arguments that comes up is that MMT is a theory made by left politicians on how to explain the government spending and increasing debt (Deist, 2020). The critiques often fail to accept that MMT has happened for many years, and MMT is not a political theory. It is a heterodox macroeconomic theory, where "both sides" of politics advocates this theory. Dalio discusses how the US will eventually print money, which will lead to devaluating the currency. He mentions that there has been no case in history where any country has been printing money without devaluing the currency (Cassidy, 2011). What he fails to include is to investigate the inflation measured against the growth.

Margaret Thatcher said in a speech from 1983 that the government owns no money itself, only the money the people earn. The only way a state can spend money is by borrowing the people's savings or increasing taxes. She was implying that the government's finances work the same way as a household (Kelton, 2020, p. 20). Former British prime minister Theresa May has also claimed the same, and these beliefs have settled among many politicians. To average Joe or Jane, this sounds reasonable, and many politicians use this in their tactics. What Deist, Dalio

and other critiques of MMT fail to consider is basic microeconomic theory. They are right at one point; printing money can lead to massive inflation. However, they fail considering what happens in the long run, in addition to the state of the economy.

Figure 2.1 shows us what happens with the prices and quantity with a sudden shift in the demand. The demand increases from D_1 to D_2, which causes a new equilibrium, with $P_1 < P_2$ and $Q_1 < Q_2$. This change shows a shock in demand in the short run. However, what happens with the price level in the long run?

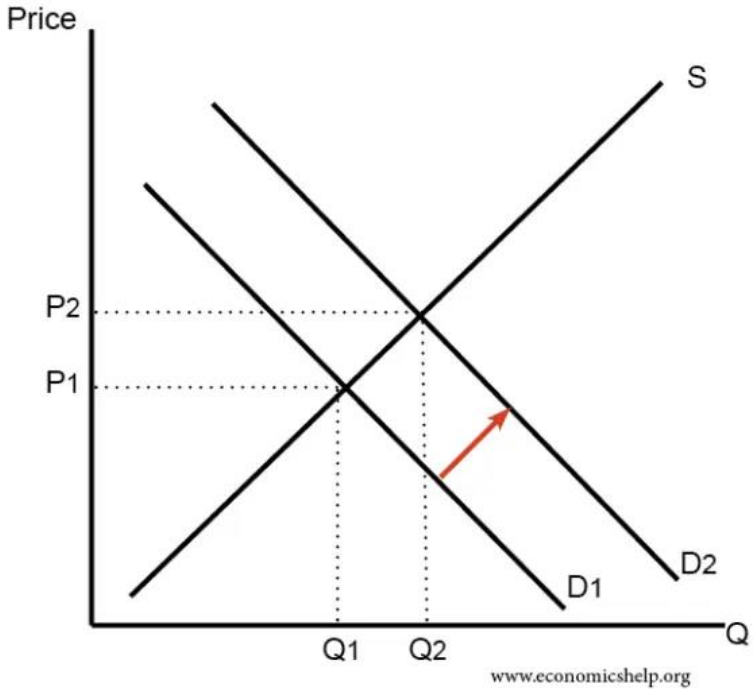

Figure 2.1: The supply and demand in the short run with a positive demand shock. The price level goes from P_1 to P_2, and the quantity goes from Q_1 to Q_2. $P_1 < P_2$ and $Q_1 < Q_2$. Source: Pettinger (2020).

Since the economy is not at full capacity, the supplier can increase its supply. This increase makes the supplier able to offer an even higher quantity due to reduced marginal costs. The price level is back at the same level as before the demand shock, as shown in Figure 2.2. The price level will only increase if there is no more capacity to offer a more generous amount, which only happens at short term, or where there is a monopoly or other constraints. Of course, an increased demand can lead to increased price levels in some areas, but there is no evidence that this will raise the price level overall since the demand is shifting (Pettinger, 2020).

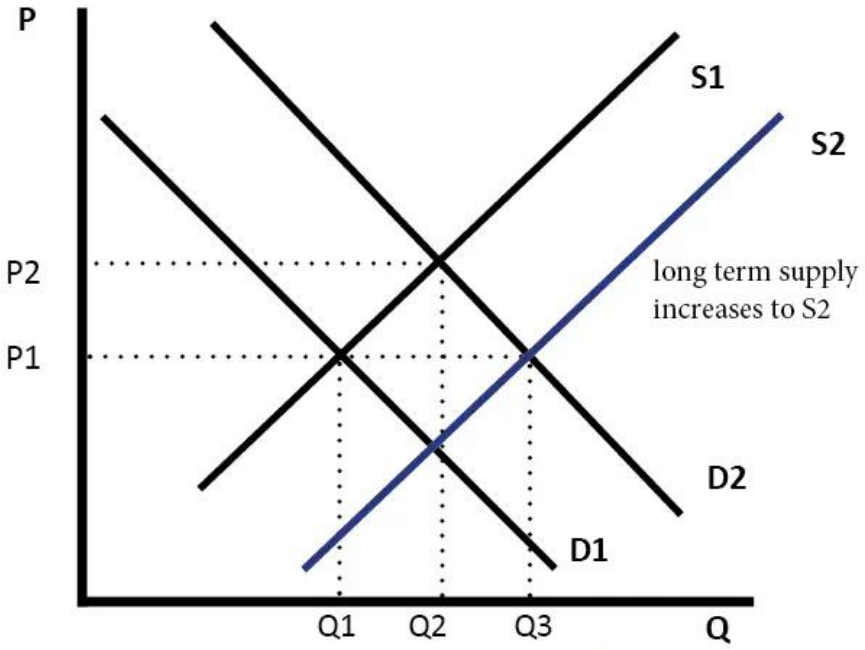

Figure 2.2: The supply and demand in the long run with a positive demand shock. The price level adjusts back to the same level as before the shock. The quantity has increased from Q1 to Q2 and ends up at Q3. Source: Pettinger (2020).

Milton Friedman suggests the idea of distributing money into the economy by having a helicopter flying over a community, dropping $1000 bills from the sky. The people believe that this event is only happening once (Buiter, 2004). The cons are that adding more money into the supply could create inflation, but it is an effective way of stimulating an economy when used right, especially during a recession. Using printed money from the central bank will not create more debt, and the interest rate can remain the same. It boosts spending and makes economic growth since it instantly increases aggregate demand when the money is collected (Buiter, 2014).

Fiat Money is money issued by the government, without value itself, as the opposite of commodity money. Commodity money would be cigarettes in a prison, which have intrinsic value. Earlier, most currencies were a part of the gold standard, which means that the money has a value exchangeable into a certain amount of gold. President Nixon abandoned the gold standard in August 1971, and the US officially left the gold standard in 1976 (Mitchell, 2020), (The Balance, 2020). The only difference between Monopoly money (from the game) and actual paper money, is that the government is establishing the decree for the real paper money. This joint agreement demonstrates that money is valuable as a payment method, both private and public (Goldberg, 2005), (Mankiw, 2014), (Bayoumi, et al., 1997).

So why do we need fiat money to explain MMT? Kelton explains this by saying:

"*MMT has always connected the value of the currency to the fact that we, the people, need the government's money in order to settle obligations to the government, in order to pay taxes and other fees and things to the government."* (Kelton, 2017).

Tax Holiday is a limited period where a country or consumers can get a short-time tax relief. The target is to boost the economy by consumers spending money on specific goods, as clothing in the first week of August, or companies in particular sectors getting a partial or full reduction in the dividend tax during a temporary period (Rørvik & Kvello, 2009), (Law, 2018).

2.2 Welfare systems

Germany's developments inspire the first initiatives for social security laws in Norway in the 1880s. A further specific social security term comes from when Great Britain passed a fabric law in 1833. The evidence for the first laws for social security is from the 1840s. These laws revolutionised the relationship between employees and the fabric owners, which raised the living standard for many people throughout the industrial revolution (Hatland & Kuhnle, 2018, pp. 15-17). The aim for the social services, from 1945, is that every person who can work should have a right and duty to work. Despite income or residence, everyone should have the ability to take a proper education and different social, medical, microeconomic and housing should not affect the case (Hatland & Kuhnle, 2018, pp. 15-17).
The United Nations Universal Declaration of human rights (2020) presents similar rights, in article 22, 23, 24 and 26. It states that everybody is entitled to social safety and have access to public goods of economic, social and cultural value. Everyone has the right to work, to choose the work, and be protected against unemployment. Furthermore, equal pay for equal work and a salary that secures a human's family and themselves a decent living is a right for everyone. Moreover, everyone has the right to get rest and spare time, to delimit the working time and have paid vacations. Article 25 and 26 states the right to other social goods to have an adequate standard of living, by having access to different goods like clothing, housing and food.

Furthermore, if hit by unemployment, sickness, disability, widowhood, old age or other lack of livelihood, the right to security should always be present. Everyone should also have the right to education and personal growth. There are also other articles in the UNs declaration that concern the same matters as those stated above (United Nations, 2020). The view on the

possibilities of working after the official retirement age is highest in Denmark. 88 per cent states in a survey from the European Commission in 2012 that people should have the option to work after official retirement age. The lowest on the list is Greece, where only 27 per cent agrees. In EU27 (the 27 member countries of the European Union in 2012), the percentage is 61. Strangely, the countries with a high level of welfare, like Norway, Denmark, Great Britain and The Netherlands, still agree that one should continue to work after the official age. By contrast, countries like Greece and Italy, where the welfare is lower than the other countries, disagree with the statement (Hatland & Kuhnle, 2018, p. 45).

In a survey from 2013, 81 per cent in Norway state that they want to use the same or more on unemployment security, which is 4 per cent points more than in 1996. Only 27 per cent want to use more on social services in total, but 78 per cent state they want to use more on education, 79 per cent more on health services, 72 per cent more on police and judiciary and 54 per cent more on retirement insurance (Hatland & Kuhnle, 2018, p. 47). A survey from Norway in 2009 tells us that about half of the participants (49 per cent) think that high income should be taxed higher. 72 per cent state that they agree with more public services rather than tax relief. 85 per cent say that the social welfare services should increase. In 2013, from another survey, 52 per cent state that they do not think that it is possible maintaining the same level of the welfare state as it is today. 61 per cent state that it is essential to even out financial differences (Hatland & Kuhnle, 2018, p. 51).

An essential question is: Can comprehensive welfare states undermine the wish and will to participate in voluntary work? In a survey done in the period from 1997 to 2009, one of the main conclusions is that Norway has a viable voluntary sector that functions well compared to perspective. Data from 2008 shows that countries with great welfare systems also have a significant part of voluntary work. These proofs show us that there is no contradiction between having a vital welfare and eager to do voluntary work. When asked about the frequency of voluntary work minimum once a week or month, the results show this: The Netherlands are stating 33 per cent in 2012, while Germany utter 31 per cent. Norway have 25 per cent, whereas Denmark has 22 per cent. Poland and Hungary admit only to have 5 and 4 per cent, which are countries who have a low level of public welfare systems (Hatland & Kuhnle, 2018, p. 53).

There is a significant difference between European countries and the US on how the government is responsible for delivering work to everyone and reducing income differences.

In 2006, 51 per cent of the US survey conducted, stated that they agree in the government is responsible for reducing income differences. About 40 per cent concur that the government should deliver work to everyone. In contrast, in Norway, 74 per cent agree to the same matter of income reduction, even though it has dropped to 58 per cent eight years later. 79 per cent in the survey from Norway think the government should be responsible for delivering work to everyone, and 91 per cent state the same in Hungary. In total, about two-thirds in the survey from the European countries say the government are responsible for reducing income differences (Hatland & Kuhnle, 2018, p. 57).

The use of welfare has increased a lot since the 1950s in Norway. In 1950, the sum of welfare services and transactions to households from the government was about 6 per cent of the Gross Domestic Product (GDP). It has increased steadily since, and in 2017, the sum of services and transactions was around 28 per cent of GDP (Hatland & Kuhnle, 2018, p. 72).
(Without the petroleum interest rate, the governments part of the cash flow profit above expected profit, which the government collects (The Norwegian Government, 2000).)

From the graph in Figure 2.3, there will be a boom in Norway of older people. More people retired per active worker, the higher will the pension burden be (Hatland & Kuhnle, 2018, p. 83). The increase in the amount of elderly in the population causes an increase in demand for health and care services. This demand results in substantial growth of public spending. In addition to this comes the increase in pension expenses. Norway uses a pay-as-you-go pension system, where today's working force pays for today's retirees among many other European countries (Oxford Reference, n.d.), (NAV, 2020a).

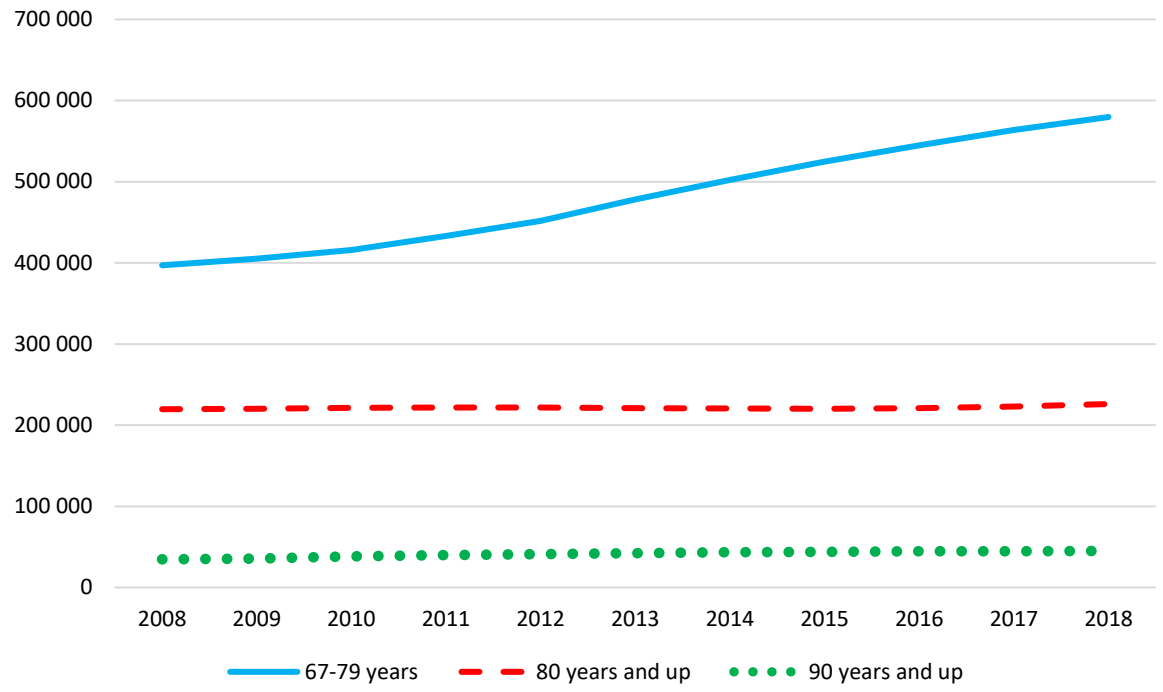

Figure 2.3: The development in population after age group in Norway from 2008 to 2018. Source: Statistics Norway (2019).

The expenses can also escalate because of an increasing standard in the public health and care service and the coverage level, getting higher than today's level. A development in technology can increase productivity, but this needs extensive investments, which will add to the existing high expenses. Since the elderly also live longer today than in the 1950s, they will also add to the expense side (Hatland & Kuhnle, 2018, p. 87). Will a reduction of welfare services increase private saving? Hatland & Kuhnle (2018, pp. 90-92) show us that reducing pension will increase the savings. People tend to determine how much money they will spend during their lifetime. A reduction in expected payments from the public could increase the savings earlier in the life, to ensure that there is enough left when the income flow stops. The results show this in the period shortly after a change, where increasing taxes fund retirement pension.

One can not voluntarily choose between social service or work. Only those who can not provide a living for themselves are entitled to receive social services, not those who just do not want to work. Working should always be the priority (Hatland & Kuhnle, 2018, p. 103). This priority is not just the government wanting to keep the expenses down. However, it lies within the protestant culture that being a part of a working community gives positive social benefits. It gives people the opportunity for social contact, provides an outlet for creative urge, and gives

people self-respect and self-value. Nevertheless, not everyone shares this belief. Working or having a job is not the only way living a fulfilling life. For various reasons, people who can not have a job, like disabled people, the expectations of people working can be an extra load.

When all other welfare options do not deliver any possibilities, the last option is a social security called social help, earlier called poverty help and later provider help. It is locally administrated and funded, where judicial assessment decides whether the applicant will receive social help or not. The total cost for social help in Norway was 6.2 billion Norwegian krone (NOK) in 2016, while the Norwegian national social insurance scheme cost was 440 billion NOK. This fraction makes the social help a relatively small provider compared to other welfare services (Hatland & Kuhnle, 2018, pp. 123-124). To be clear, the term social security is used for all the payments from the government helping people, including unemployment benefits, benefits to pensioners, disable benefits and the social help. This term may be used differently in other countries with different welfare systems than Norway.

However, despite the size, the total size of the social help costs can be a useful parameter to measure how the other welfare services meet their intended goal. If these regular welfare services do not work, the number of people living on social help will increase. Of the 130 000 people who received social help in 2016, 53 000 people had this as their primary income source. This fraction means that a significant part uses the social help as a temporary benefit while pending on other services as a job or disability benefits. A small group is not productive enough to get a job but is not sick enough to receive disability benefits. For them, the social help is the most important source of income. Men, mostly single men, are highly represented in the group among people receiving social help. Immigrants are also a big group, which is a reason that can be by the fact that they have weaker rights in the Norwegian national social insurance scheme (Hatland & Kuhnle, 2018, pp. 123-124).

The social help has a weak legitimate argument. There are no demands for having an income prior to receiving the social help, nor paid taxes. For example, there is no need to have a specific cause to receive social help, other than the need for money. Social help has been a reason for several discussion and debates. One of the main arguments discussed is setting specific demands for activity, especially for people under 30 years. A slogan, which has been vital when designing social security systems worldwide, is “workfare, not welfare” (Hatland & Kuhnle, 2018, pp. 124-125).

The per cent of GDP spent on welfare expenses in the European Union (EU) in 2015 was 29 per cent. Denmark is slightly above, Sweden equal, and Norway and the UK are somewhat below. In terms of Euros spent per inhabitant, Norway is on top with 18.7 thousand Euros spent per inhabitant, with Denmark, Sweden and the UK following. Poland is on the bottom with only 2.1 thousand Euros spent per inhabitant (Hatland & Kuhnle, 2018, pp. 248-249). Furthermore, the distribution of social welfare expenses in EU, 29 per cent is spent on health benefits, 7 per cent on disabled, 40 per cent on retirement pension, 9 per cent on children and family and 5 per cent on unemployment benefits (Hatland & Kuhnle, 2018, p. 249). Norway uses the most on disabled services, with a percentage of 16, which is a big contrast to the UK, which only uses 6 per cent of total expenses. The numbers are from 2015.

How will the welfare systems and costs develop in the future? The population in Norway is estimated to be at around 7 050 000 in the year 2060. Both immigration and longer expected lifetime are factors that contribute to the estimated increase. One crucial factor is longer expected lifetime combined with reduced expected birth rate. This extended lifetime will result in an increased elderly population, where the part of people who are 67 and above in 2018 is right below 15 per cent, with an estimation of just above 22 per cent in 2060. That is almost twice as many people, affecting the costs of retirement pensions and the health sector. The increase in immigration will not contribute enough to weigh up the "elderly boom" but will not burden the social the welfare system more than an ethnic born Norwegian. This is due to the rate of not working immigrants having fewer benefits because they have not managed to earn enough rights to receive full benefits (Hatland & Kuhnle, 2018, pp. 280-281).

In the future, Hatland & Kuhnle (2018, pp. 282-284) are expecting a shift in the types of jobs, and where labour is needed. What people will be doing 40 plus years from today may be things that no one is doing right now. The technological development will require different knowledge, competence and experience, and will demand people changing careers, perhaps to a whole other field or sector. Many jobs will disappear, but new will come. However, technological shifts will also increase productivity, like in many changes before, like the industrial revolution and agriculture. 1960, there were over 3.5 times as many people in Norway working in agriculture than it was in 2016. With the welfare state's technological development, people can work with more personal and social contact, while machines and computers do the heavy and tedious work. As the world becomes increasingly globalised, trade happens at another level than before, which will require robust solutions to handle the increased

competition from other countries, especially China and other low-cost countries. Nevertheless, it also gives an advantage since export is becoming cheaper and more manageable. There is no doubt that Norway has gained on the increased globalised trading world.

2.3 The workforce

Labour economics is a part of economics regarding the labour market. It is usual to define the population into three groups: The employed, the unemployed and the people outside the working force (Mitchell, et al., 2019, p. 66). The working force is the sum of the employed and the unemployed. The age span is between 15 and 74; people who either are not studying, are under disability insurance or are retired. Short time sickness, military service and full-time permitted up to three months are also considered a part of the working force (Statistics Norway, 2020a), (Statistics Norway, 2020b). Summarising these rules in Figure 2.4:

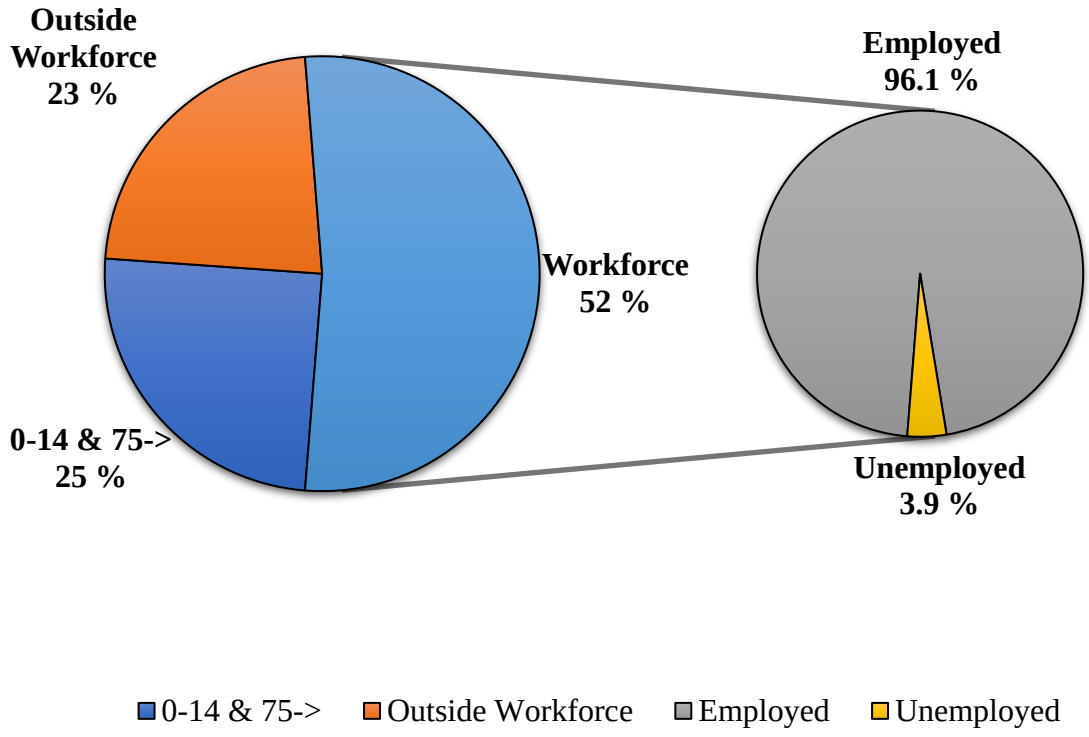

Figure 2.4: Norway's total population in 2019, divided into the workforce, people outside the workforce and people under 15 (0-14) and above 74 (75->), where the workforce consists of the employed and the unemployed. Source: Statistics Norway (2020i) & (2020j). Appendix B – Relevant numbers shows the exact numbers.

The unemployed are a part of the working force and are actively seeking work. Only seeking part-time jobs is also a part of the unemployed, even though they are currently busy studying or doing other non-paid work at home (Statistics Norway, 2005).

In statistics, one differs between private and public sector. The public sector consists of people working in the municipality, county, or government. There are also different sectors across public and private sectors. There are 16 diverse sectors in Norway, and the five biggest after people employed are health- & social services, wholesale & repair of motor vehicles, building & construction, education and industry (Statistics Norway, 2020c). Suppose one looks at the sizes in terms of created wealth. In that case, the list containing the five most prominent sectors in Norway looks like this: Oil and gas extraction, wholesale, industry, building & construction, and finance & insurance as the top five (Chaffey, 2017).

2.4 Unemployment

There are different types of unemployment, mainly divided into four categories:
Frictional unemployment is a short-term unemployment that occurs when an employer shifts from one job to another. There is a constant change in jobs created and destroyed, making a continuous movement in the workforce. The workforce itself also changes because some people retire while new graduates finishing school and studies are entering. Constant change causes this frictional unemployment (Mitchell, et al., 2019, p. 72).

Seasonal unemployment is when some workers only are occupied with work specific parts of the year because of the type of work, like agricultural work, holiday work or work at certain tourist places. Seasonal unemployment can be difficult to separate from frictional unemployment (Mitchell, et al., 2019, p. 72).

Structural unemployment occurs even though the number of available workers match the number of available jobs, due to a mismatch in the competence and knowledge needed and offered, or a mismatch in location. Structural change forces relocation and retraining and is often a long-term process. Depending on the available resources, when the labour market is tight, and the need for resources is high, private firms will handle some of the retraining internally. Furthermore, if there are excessive available resources in the labour market, and the

private firms experience a downfall, the unemployed are taking these costs independently (Mitchell, et al., 2019, p. 72).

Cyclical (demand deficit) unemployment occurs when there are not enough jobs offered in the unemployment market. This type of mass unemployment is the type one often sees during and after a financial crisis, and there is a mismatch in the preferences and the preferred level of wage. A downfall in the GDP, which can turn into a recession, will often cause a significant rise in cyclical unemployment. Different types of lack in demand will also cause the same unemployment. The economic and social costs of cyclical unemployment are vast and vital for governments to eliminate (Mitchell, et al., 2019).

Critical points of unemployment on a macroeconomic level (Tcherneva, 2018):

- A monetary problem. Fewer people are working, creating less value and putting lower levels of money into the economy, which reduces the monetary flow.
- A problem that the private sector can not solve. The private sector can not maintain zero unemployment in the long run due to business cycles.
- A challenge in the society acts as a silent epidemic which spreads like a virus, with post consequences.
- The economy is already paying for the social and economic costs of unemployment.
- Unemployment is a problem by design, which means that there is always a buffer of unemployed workers ready to work. This buffer is a public sector failure.
- A moral failure that some people must lose their jobs to stabilise the economy.

Consequences of not having a job on an individual level are many. Some of them are that being in a position outside a working environment brings the feeling of being left outside alone, social exclusion, boredom, discouragement, and low levels of happiness. The levels of satisfaction are significantly lower among people without a job compared to those who are working. This dissatisfaction can connect with lower income, but looking into people who earn the same, having a job contributes to happiness. Having a job can also be mentally stimulating and brings regularity and discipline into people's life. With increased geographic mobility, postponed family creation, more divorces and families getting torn apart, the working place and environment have become a more important arena for social interaction than before (Hatland & Kuhnle, 2018, p. 103).

Around 8 per cent of all men between 18 and 66 years in Norway live on disability benefits and around 11 per cent of all women. There can be various reason for these disabilities. However, the disability must prevent a person from doing a job he or she fits in order to receive disability benefits. A violinist with a broken middle finger can be on disability benefits, while a computer engineer with a heart disease is able to work. In 2017, about 12 per cent of the public budget was for disability benefits in Norway (Hatland & Kuhnle, 2018, pp. 108-111). A high sickness rate often follows a low unemployment rate (Hatland & Kuhnle, 2018, p. 112). When people are afraid of losing their job, they often do what they can to show up for work, even though they are entitled to stay home in case of sickness. Addressing difficulties and possible solutions to short time sickness is an interesting issue. However, this thesis will not further discuss this issue, since temporary sick people actually have a job.

People living on disability benefits have more impoverished living conditions compared to the rest of the population. They are living on 75 per cent of the average income in Norway. 11 per cent find it hard to get by financially, compared to 7 per cent among the rest of the population. The education level is low, but they have access to the same consumer goods as the rest of the population. 4 out of 10 have only completed primary school compared to 2 out of 10 among the rest. By contrast, the housing standard is higher among the disabled, much because of the age. Many have invested in their own house before becoming disabled (Hatland & Kuhnle, 2018, p. 118).

What is the government doing to reduce the number of people living on disability benefits? There have been different attempts to make the demands for receiving these benefits stricter. Demanding a certain mobility rate or commuting has also shown improvement in some cases. There have also been demands of a direct cause between the disability and the loss of income. Different attempts with temporary disability benefits have shown that it is difficult for the people who have been outside the working life for a certain time to come back to work. It has also been prime to ensure that the disability benefits do not exceed the lowest wages to secure people do not prefer not working if there are economic benefits of not working. The increase of goods and services available for disabled has been significantly over the last few years (Hatland & Kuhnle, 2018, pp. 116-118).

2.5 Job Guarantee

Tcherneva (2018) is stating the objective of the Job Guarantee program:

"To provide decent jobs at decent pay on demand to all individuals of legal working age who want to work, irrespective of labour market status, race, sex, colour, or creed."

The goal is to have a federal funded guaranteed job, organised on a local level. It aims to offer relevant, voluntarily jobs both part- and full-time. The working hours can be flexible to match those who want to spread out working hours or does not need a full-time job like students or men or women with kids. The Job Guarantee program works like a buffer stock in the economy. Having a Job Guarantee program will also establish a minimum wage for the whole economy and sort out the rough jobs by securing workers in low-paid jobs and working in harmful conditions. Making sure people always have a job to go to, the government is reducing the economic, political and socials costs of unemployment to a minimum. Furthermore, having more people contributing to the local communities could directly benefit the local environment.

Expected benefits of the Job Guarantee program (Tcherneva, 2020):

- Full employment. The JG program aims to eliminate involuntary unemployment, reducing the social and economic costs for a person their and family.
- Living income. Introducing a minimum wage in the JG program stabilises a bottom on salary, which increases the living standard for those with low-paid jobs.
- Bad job alternative. People not feeling satisfied with their current working environment can quickly get a new job without worrying about the consequences of falling behind after quitting their current job.
- Establishes a labour standard. Since everyone who wants work can now get one with a living wage, these demands fulfil all sectors.
- Inflation stabilisation. The JG program helps to tone down the effects of a crisis and makes the economy easier to stabilise. Today, a sudden negative shock in unemployment due to a financial crisis usually amplifies the adverse effects of a crisis. People who lose their jobs are at risk of falling into long-term unemployment, involuntary part-time, or can fall out of the working force. JG's primary objective is to have jobs for everyone despite the up or downturns in the economy and all business cycle stages. Ensuring everyone has a job and income, will work against the effects of an economic recession and help the economy recover faster. It stabilises the economic growth and prices. Instead of having an army of unemployed, it now has a pool of

employed individuals ready to jump into other jobs when the economy is on its way back to normal levels.

- It disrupts vicious labour market cycles. It breaks the earlier mentioned brutal differences, helping those on the bottom of the income distribution.
- Cure. The JG program is improving the physical and mental health of those who would be unemployed without it. It also helps those around the workers, like spouses and children. By raising income, the educational and labour market potential increases.
- Prevention. JG reduces suicides and mortality of JG workers and "deaths of despair" by improving the labour market conditions. It can also prevent crime since having a job and earning legal money reduces crime (Shannon, 2013).
- It is improving economic, social and environmental benefits. JG reduces homelessness, recidivism and financial crimes as well, it distributes social and public goods and services and invests in the environment, the people and the local community.

Tcherneva (2020) also describes how the Job Guarantee program can have a repository of tasks that can be performed, but that not necessarily are in immediate need. The now unemployment centres can act like community job banks that solicit projects from non-profit and local organisations. Tcherneva also suggests that the Job Guarantee program provides training, education, credentialing, and apprenticeship opportunities to make people more fit for the job market. The unemployment centres offer some courses and training today but are criticised for the relevance and quality (Sandbæk, 2013). Care jobs that address different forms of neglect are prioritised in the JG program, such as helping and caring for people in need, communities in disrepair or an environment in peril. Fullwiler (2006) demonstrates how an employment guarantee policy in the United States permanently raises employment and real GDP while still providing the economy with a robust counter-cyclical balancer.

2.6 Universal Basic Income

The idea of Universal Basic Income is an involuntary amount of money given every month to all adult members of a society (Paine, 1797, p. 8). If a person is earning enough money to pay taxes, the Universal Basic Income gets reduced up against the tax. UBI works as a negative income tax with the following formula:

$$T = -B + t * Y, \tag{2.1}$$

Where T is the tax, B is the UBI, t is the tax rate, and Y the income. If a person has zero income, the tax gets negative, and the person receives the amount of UBI from the government. The target of UBI is to replace social services like unemployment insurance and other tax deductions in today's systems.

The JG program's difference is that JG is optional, while UBI comes along with a citizenship. Unlike JG, there is no need for active work to receive the money, but the idea of these people receiving money has different advantages. A recent study in Finland from 2017 to 2018 shows a small improvement in both employment and well-being. Compared to a control group, there was just a small difference, but a critique has been that the amount was pretty low, around 6000 NOK per month. The difference was 6 more days of working for the group receiving UBI compared to the control group. UBI works the same way as the JG program in macroeconomic terms, by people receiving money which is then consumed and put into the economy. UBI is not so different from Friedman's "Helicopter Money", but JG has more advantages because it gets work done, and keeps people active, instead of just receiving money for doing nothing. In terms of actual money, the amount proposed for UBI is around 15 000 NOK per month, a total of 180 000 NOK a year. This amount is about 25k below the amount of money a single pensioner receive in Norway (Dalen & Moen, 2010), (The Norwegian Government, 2020a), (Lu, 2020).

Some founders and leaders are also UBI advocate. Former managing partner in McKinsey Norway, Martin Bech Holte, explains why Norway should consider UBI to fund an increasing level of freelancers. According to him, it is important to experiment to find solutions for new technology, which results in reduced effort to get the goods and services needed (Schultz, 2020). Elon Musk, the tech titan and one of the world's wealthiest persons, (Forbes, 2021a), claims UBI as a solution. According to Musk, UBI will be necessary to deal with artificial intelligence (AI) potential taking over most of the human's jobs in the future (Clifford, 2018). Founder of Facebook, Mack Zuckerberg, also supports UBI (Forbes, 2021b). He presents the idea of exploring UBI to offer people to have a cushion to try out new ideas (Gillespie, 2017). The same with Richard Branson, founder of Virgin Atlantic and Virgin Galactic (Forbes, 2021c). His vision is to use UBI to fix inequality and ensure income when AI potentially takes over the jobs in the future (Murray, 2018).

2.7 Economic crisis

A financial crisis is a type of economic crisis when the economy and the financial sector experience a down that affects many areas. Asset prices see a steep downfall in value, and economic institutions often come short of liquidity. This shortage will lower the money flow, and investors and capitalists will try to sell assets which often causes a panic in the economy. People can also start to withdraw money from their savings account, which affects the banks' liquidity even more. The fear of assets dropping in value creates a domino effect. A financial crisis can be limited to the bank sector but can also spread out worldwide. Over the last decades, many financial crises have occurred; some have been a stock market crash or a bubble bursting.

The biggest financial crises have been (Kenton, 2020):

- The Tulip Mania in 1637.
- Credit Crisis of 1772.
- The Stock Market Crash in 1929.
- The OPEC Oil Crisis in 1973.
- The Asian Crisis in 1997-1998.
- The Global Financial Crisis in 2007-2009.

Covid-19 is the worst global economic recession since the World War Two. According to forecasts, the global economy will shrink by 5.2 per cent (The World Bank, 2020). Even though Covid-19 has had a tremendous economic impact on the worldwide economy, it is not a financial crisis, at least not yet. However, the long-term effects of the pandemic Covid-19 are to come, and some discuss if the economic consequences will outlive the health crisis (United Nations Conference on Trade and Development, 2020). Even though the biggest GDP downfall in many countries was in March-May, the GDP has still not recovered completely, despite the optimistic forecasts (Statistics Norway, 2020e).

Moreover, the increase in private savings or hoarding is a dominant fact to examine. In Norway, the saving rate has almost doubled compared to the equivalent time the year before (Statistics Norway, 2020f). When the pandemic broke out, people kept their money, but it did not take a long time for the spending to start again (Statistics Norway, 2020g). The total private spending in Norway has only seen a small downfall compared to the same quarter in 2019. For example, the decrease in the service consumption combined with an increase in the private spending of

goods can be a zero net change, where different effects cancel out each other. The reduced consumption in foreign countries due to closed borders counteracts fewer tourists and foreigners buying goods and services domestic (Statistics Norway, 2020h).

In February 2020, the stock markets all over the world crashes, along with the virus spreading out of China's boarders. Dow Jones is down roughly 26 per cent in just four days. The crash happens because of the governments' reactions to the coronavirus, causing shutdowns all over the world (Mazur, et al., 2021). However, this downfall soon turns to a big jump, making the crash only last until the middle of April. At the end of the year 2020, Nasdaq is gaining 44 per cent for the year, S&P 500 gaining 16 per cent, and the Dow Jones is up 7 per cent (Rabouin, 2021). The oil war between Russia and Saudi Arabia has also been impacting the financial markets during the same time as the stock market crash (Perper & Bostock, 2020). Despite the fluctuations in the financial markets, the curfews, quarantines, and similar restrictions have made the biggest impacts on the whole economy (Brauner, et al., 2020).

3 Method

3.1 Dynamic models in economics

Economists tend to prefer static models, where equilibrium is found. The problem with these models and solutions, is that they often fail to capture rapid changes. The advantage of dynamic models and equations are their flexibility to model non-linear systems. Therefore, dynamic models and equations are to prefer. To describe dynamic economics, we often use differential equations, which are not usually taught in traditional economic schools (Keen, 2001). The following equation can represent the change of GDP:

$$\dot{Y}(t) = gY(t) \tag{3.1}$$

Here, Y is the GDP, t is the time, and g is the growth. As long as g is a constant, the equation can easily be solved for Y:

$$Y(t) = Y(0)e^{gt} \tag{3.2}$$

Here, $Y(0)$ is the initial value of Y at $t = 0$. Y is exponentially growing for $g > 0$ and decaying for $g < 0$. GDP can also be modelled by using a classic model from Keynes, for a closed economy (Karmakar, n.d.):

$$Y = C + I + G \tag{3.3}$$

Y is the GDP, C is private consumption, I is private investment, and G is public spending. If we modify equation (*3.1*), we end up with:

$$\dot{Y}(t) = g(Y, t) * Y(t) \tag{3.4}$$

Here, g is a function of the state Y and the time t. This addition makes the system a bit more complicated to represent by equations.

Instead, we can represent the differential equations using block diagrams. This way, it is simpler to see the dynamics of the system. A.W. Philips now more famously known for the Philips-curve, modelled the dynamic macroeconomy using interconnected sub-entities (Andresen, 1999, pp. 2-4). This is an effective method, according to Andresen, because it corresponds well to a first order time lag response, at least as a linearized approximation. Figure 3.1 shows this “vessel”-approach. With a sudden rise in income, the output will asymptotically approach the new income level. The time lag T_P is describing the speed of the adjustment. It is

the system's time constant, the value of T_P, that tells us the time for the response to reach $63.21\% = (1 - e^{-1})$ of the total change.

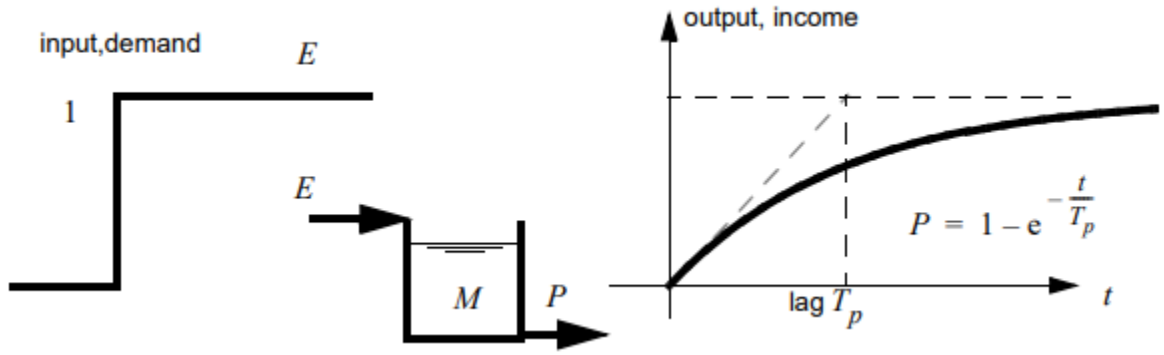

Figure 3.1: Illustrating a first order time lagged response. Source: Andresen (1999, p. 3).

When looking at a household as an agent, the transactions are discrete events. Income is usually delivered once or twice a month, which the household spends during the month. These spending transactions can be many small transactions or few significant. There is also a distinction between non-discretionary and discretionary costs. The difference between those two is what defines as needs and what defines as wants. Needs are basic spending one needs to survive. These expenditures are a certain amount of food and housing, including the interest rate on debt, electricity, insurance and health care, and some consumables like groceries. One does not need toothpaste to survive, but this is still considered as a basic need. Utility bills and gas is also a part of the non-discretionary costs, including taxes and other debt payments (Senior Finance Advisor, 2017). Discretionary costs are the spending on hobbies, travelling and luxuries.

When looking at the income and spending in thousands of households, it is possible to view this system as a continuous money flow, more specific a first order time lag. An increase or decrease in income can act like a unit step function, positive or negative, which will affect the spending over time. Figure 3.2 shows a generic microeconomic agent, which can be a household, a firm, bank, or the Government. F_i is the income flow, M is the money stock, and F_o is the outgoing flow. The grey area is the rest of the economy, and the grey arrows

demonstrate flows of labour goods and services. M is the agent's necessary liquid buffer to handle discrepancies between the in- and outflow (Andresen, 1999).

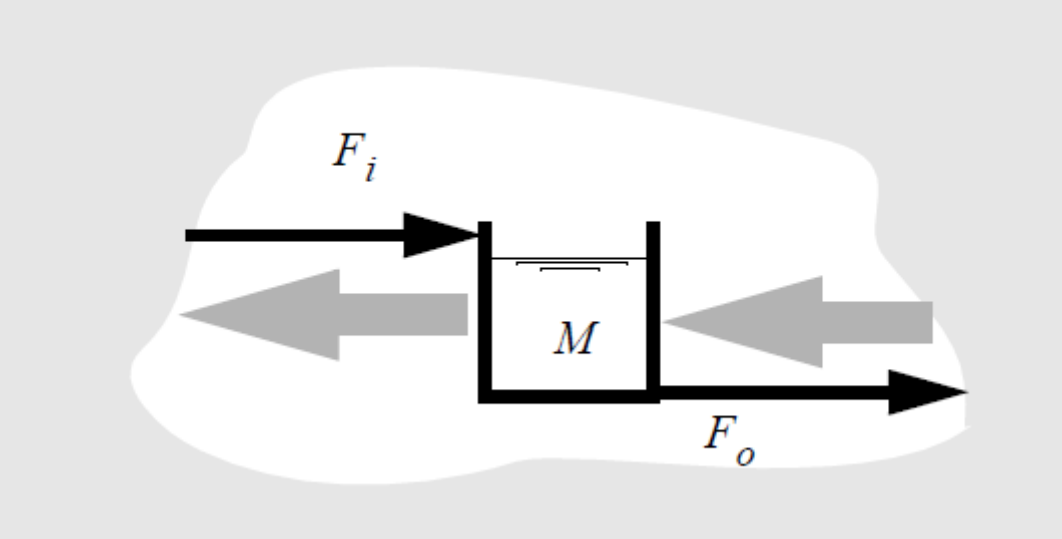

Figure 3.2: A generic microeconomic agent. Source: Andresen (1999, p. 5).

For the case of equilibrium with $F_i = F_o = F = constant$, M is also constant. τ is denoting the time constant. We have:

$$M = F\tau, \quad or \quad \tau = \frac{M}{F} \tag{3.5}$$

From equation (3.5) follows that the local velocity of money is:

$$v = \frac{1}{\tau} \tag{3.6}$$

The money velocity is different depending on the agent. Low-income households will spend their money faster in order to cover all their expenditures. A household in the public sector with high income would probably have a lower money velocity. The response to a sudden positive shift in income is shown in Figure 3.1. The outgoing flow will asymptotically move towards the new income level. The following equation describes the outflow F_o:

$$F_o(t) = \frac{1}{\tau} M(t) \tag{3.7}$$

If the agent suddenly gets zero income but still has a significant amount of money M, the outflow will be a decaying exponential curve shown in the figure below:

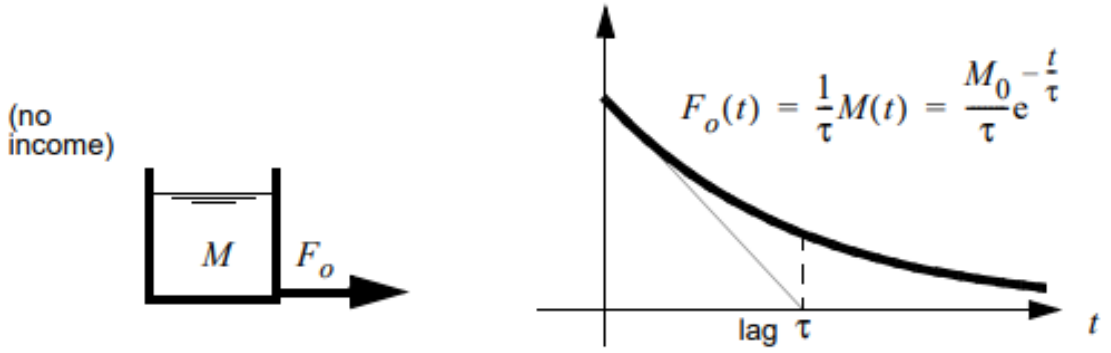

Figure 3.3: The time path for a microeconomic agent with money, but no income. Source: Andresen (1999, p. 6).

The change of the money stock M in Figure 3.2 is the ingoing flow F_i minus outgoing flow F_o. We show this in the differential equation below:

$$\dot{M}(t) = -F_o(t) + F_i(t) \tag{3.8}$$

Substituting (3.7) into (3.8) we get:

$$\dot{M}(t) = -\frac{1}{\tau}M(t) + F_i(t) \tag{3.9}$$

If we convert equation (3.9) from the time-domain to the frequency-domain using Laplace transformation we get:

$$sM(s) - M_0 = -\frac{1}{\tau}M(s) + F_i(s) \tag{3.10}$$

$$M(s) = \frac{\tau}{1+\tau s}F_i(s) + \frac{\tau}{1+\tau s}M_0 \tag{3.11}$$

Here $M_0 = M(t=0)$ is the initial money stock at $t = 0$. If the inflow $F_i(s)$ is a step input flow with the Laplace transform $1/s$ and $M_0 = 0$ (no initial money) as in Figure 3.1, we get:

$$M(s) = \frac{\tau}{(1+\tau s)s}, \tag{3.12}$$

Which transformed back to the time-domain using inverse Laplace transformation is:

$$M(t) = \tau\left(1 - e^{-\frac{t}{\tau}}\right) \tag{3.13}$$

If we insert (3.13) into (3.7), we get the spending flow $F_o(t)$, of Figure 3.1:

$$F_o(t) = \left(1 - e^{-\frac{t}{\tau}}\right), \tag{3.14}$$

Which asymptotically approaches the new input level. Considering the case in Figure 3.3 with zero income, i.e. $F_i = 0$, gives us the following equation:

$$M(s) = \frac{\tau}{1 + \tau s} M_0, \tag{3.15}$$

Which has the inverse transfer function:

$$M(t) = M_0 e^{-\frac{t}{\tau}} \tag{3.16}$$

This gives us:

$$F(t) = \frac{M_0}{\tau} e^{-\frac{t}{\tau}}, \tag{3.17}$$

Which shows us that the output is exponentially decaying.

Since households do few transactions with each other, we view the same type of households as a single first order time lag, which we represent by the differential equation:

$$\dot{M}_H(t) = -\frac{1}{T_H} M_H(t) + F_{H,i}(t) \tag{3.18}$$

Here M_H is the total amount of money in all households, $F_{H,i}$ is incoming money flow, and T_H is the average time lag for all units. The Laplace transformation of equation (3.18) is:

$$H_H(s) = \frac{1}{1 + T_H s} \tag{3.19}$$

The agent in Figure 3.2 has a behaviour that we apply to an aggregate agent such as all firms. In addition to outgoing flow, there are also many transactions between the agents in a sector, like a café buying milk from a grocery store. If we expect that all agents within a sector have the same time constant, the following transfer function is representing these units:

$$H(s) = \frac{1}{1+\tau s} \tag{3.20}$$

Every agent in the aggregated sector will have an outgoing flow with a share ρ of the agents total spending ($0 < \rho \leq 1$) (Andresen, 1999). The remaining share $(1-\rho)$ will go to other agents in the sector. We show this distribution in Figure 3.4. M_1, M_2 and M_3 are the individual money stocks. ρ is called the outside spending coefficient. The shaded arrows indicate the interaction between the agents. F_i is the incoming flow, while F_o is the outgoing flow.

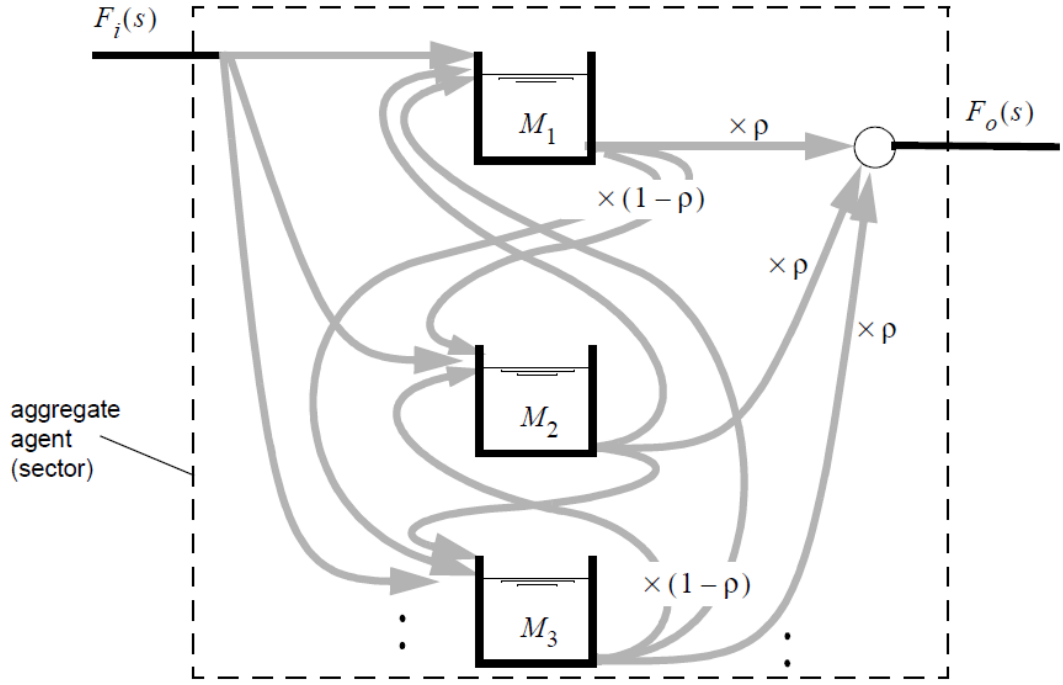

Figure 3.4: A flow network with "vessel" agents. Source: Andresen (2018, p. 58).

Combining households and firms, with no government or financial sector, we get the following model, shown in Figure 3.5. This figure is a "physical flow chart" representation of the economy. From firms F, comes profit and wages. Wages go into households, which spend their money on the firms. Profits are reinvested into the firms, which get their money from the invested profits I and the private consume from the households, denoted C.

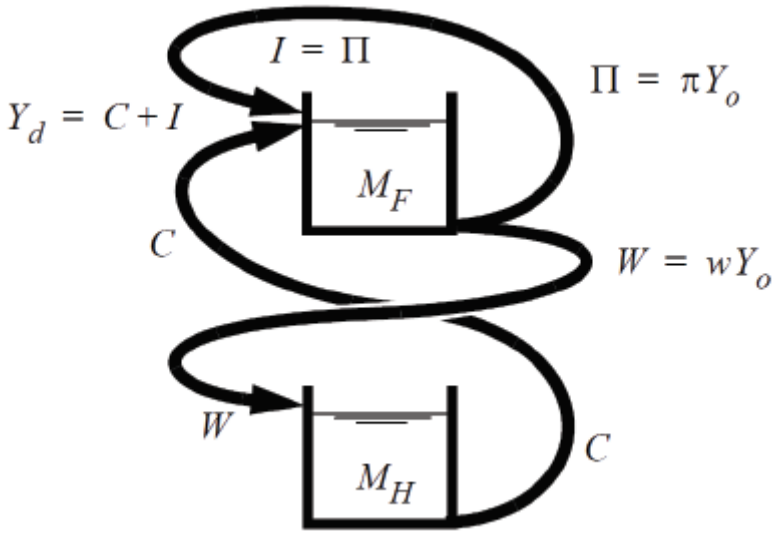

Figure 3.5: Monetary flow diagram showing a system with households and firms. Source: Andresen (2018, p. 33).

We convert Figure 3.5 into a mathematical block diagram shown in the figure below:

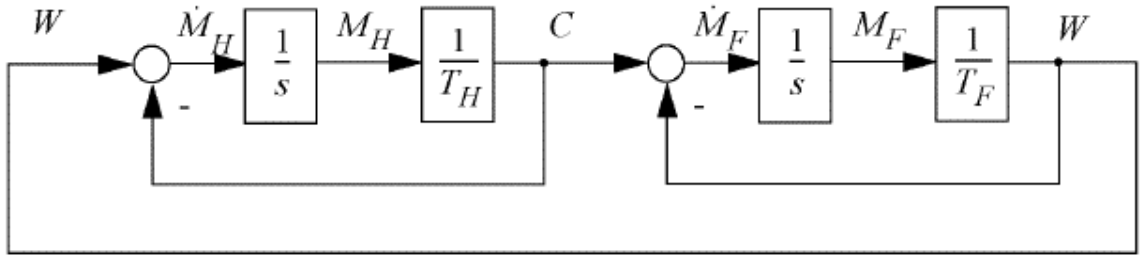

Figure 3.6: Elementary block diagram of a system with firms and households. Source: Andresen (2018, p. 33).

We reduce Figure 3.6 to a system with two inner loop sub diagrams, shown in Figure 3.7. In this figure, the household is a "worker" type, without any investments. The profits are kept inside the firm block and reinvested inside. This flow is the same as shown in Figure 3.6. This block will be split up later, where the profits will be extracted.

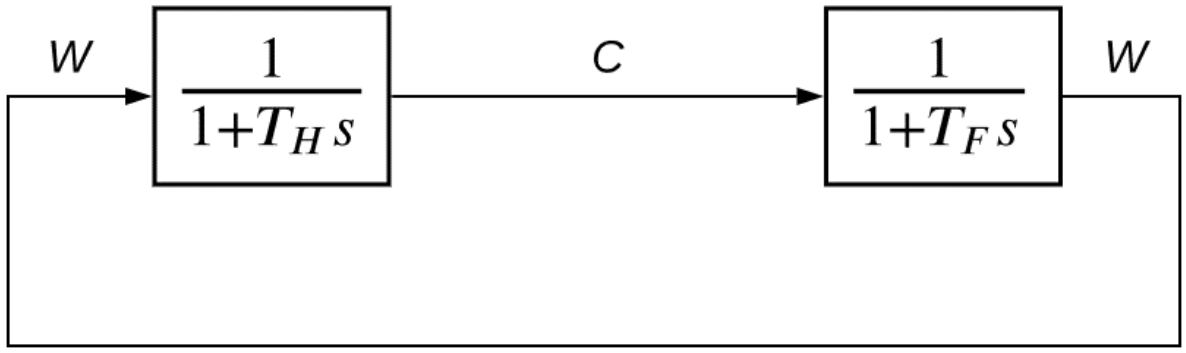

Figure 3.7: Simplified block diagram of the firm-household-system, where W is wages and C is private consume. Based on figure 2.16 in (Andresen, 2018, p. 34).

3.2 Model execution

Based on Andresen's principles, we are developing a more complex model.

The firms split into three different sectors, the public sector, private sector 1 and private sector 2. Private sector 1 is a sector that is not affected by a pandemic. It means that the income to this sector is stable throughout the whole period, and so is the output. The autonomous spending and non-discretionary flows into this sector. Private sector 2 is the sector affected by a pandemic and will experience a significant downfall in input. The public sector has no profits, and the only output is wages, while private sector 1 and 2 output both wages and profits. We simulate a pandemic, similar to Covid-19, with the shutdown of a part of or the whole society. This shutdown causes an economic recession, and we will denote the pandemic as a crisis, economic crisis, or pandemic. The number of employees is constant in both private sector 1 and the public sector. There is no transition from people outside the workforce into the workforce or the other way around. The number of people in the workforce is held constant throughout the period.

The households divide into eight different groups: Public workers, private workers 1, private workers 2, unemployed, people in Job Guarantee, people outside the workforce, capitalists 1 and capitalists 2. Public workers are people who work in the public sector. Private workers 1 work in private sector 1, and private workers 2 work in private sector 2. People outside the workforce are not able or willing to work, like disabled, retirees, students, kids or people in prison. Capitalists 1 are the owners of the firms in private sector 1 and receive profits from these firms. Capitalists 2 are the owners of the firms in private sector 2 and receive profits from

these firms. Common for all households, is that they all have consumption, which we denote as private consumption or spending C. Capitalists 1 or 2 also invest in their respective sectors 1 and 2, in addition to regular consumption. Capitalists can also be called profiteers, owners, or shareholders. The number of capitalists is kept separate from the total workforce.

A fictional country is the basis for the models, similar to a Nordic country with many welfare services, and a federal bank that prints its own currency. The currency used is NOK, and the economy uses only electronic money to avoid any limitations regarding cash or tax evasion. The private sector 1 and 2 are regular firms, and firms where the government does not own 100%. In the public sector are all companies where the government owns 100%, in addition to directories, schools, public hospitals, and municipalities. There is no possibility to extract dividends from this sector. Furthermore, there are no surplus in this sector. We divide the model into two different models, where model 1 is an economy with zero unemployment, including a Job Guarantee program instead. Model 2 is a "business as usual" situation, with regular unemployment. There are also different crisis mechanisms which we will be discussing later. Both models also include taxes and a government with government spending. There is no central bank or banking system, nor any debt or open borders.

Figure 3.8 shows a simplification of the complete system with the Job Guarantee program. We have the government with public spending G, the different households; public workers, private workers 1, private workers 2, people in the Job Guarantee program, people outside workforce, capitalists 1 and capitalists 2. The different sectors are public sector, private sector 1 and private sector 2. The households with public sectors receive wages from public firms, private workers 1 receive wages from private sector 1, and private workers 2 receive wages from private sector 2. People in the Job Guarantee and people outside the workforce receive wages or benefits from the government. Capitalists 1 receive profits from private firms 1 and capitalists 2 receive profits from private sector 2. All households have consumption, and capitalists 1 and 2 are investing into private firms 1 and 2. The aggregate demand Y_d consists of a part of G, investments I and private consumption C. We will explain the details later on.

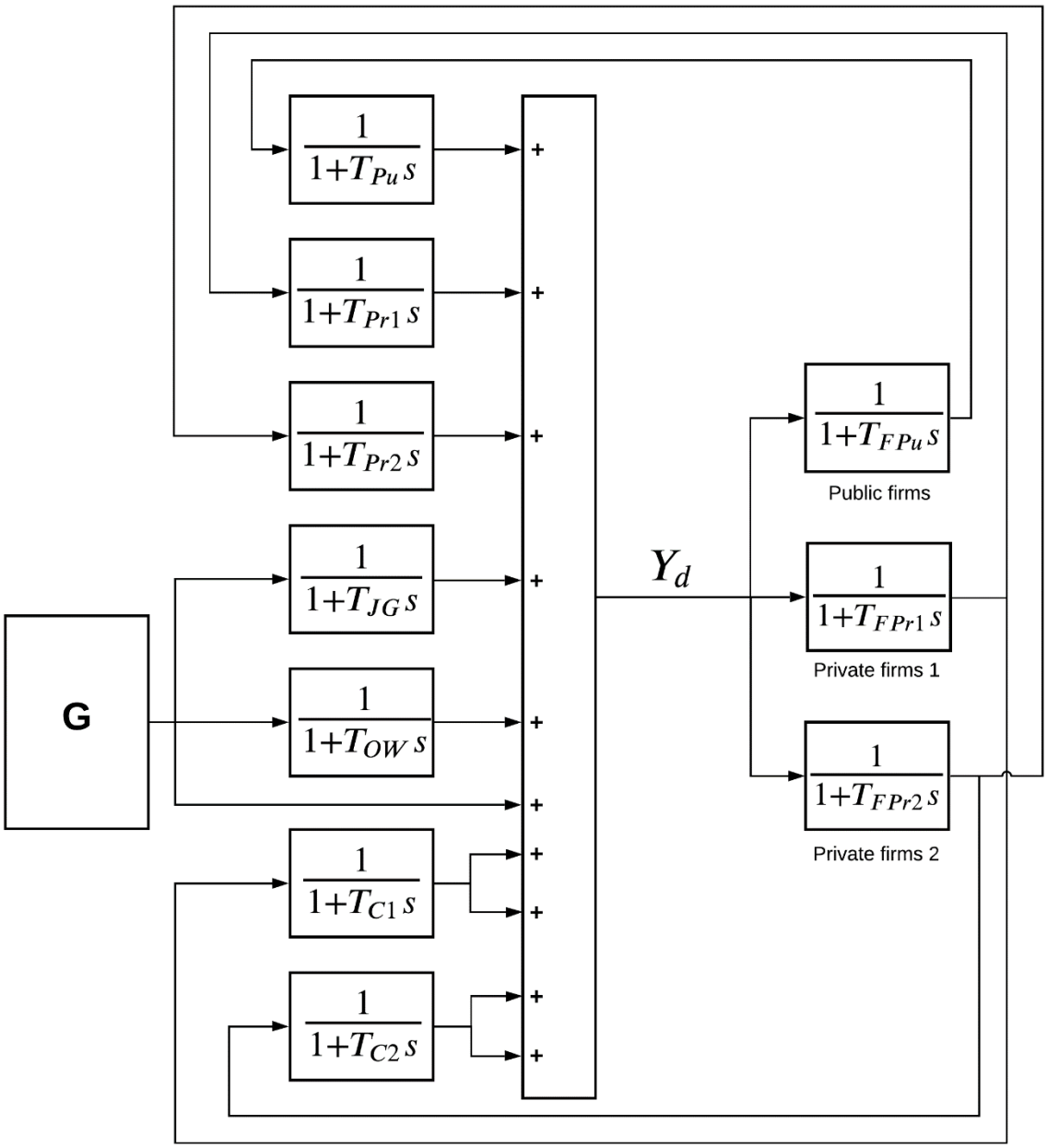

Figure 3.8: A simplified model of the complete system with Job Guarantee.

Figure 3.9 shows a simplification of the complete system with unemployment. It is identical to the system in Figure 3.8, except that there is a group of households that are unemployed instead of being in a Job Guarantee program. See the paragraph above for further details. We will now explain the details in the models. The different sectors are now presented in Figure 3.10.

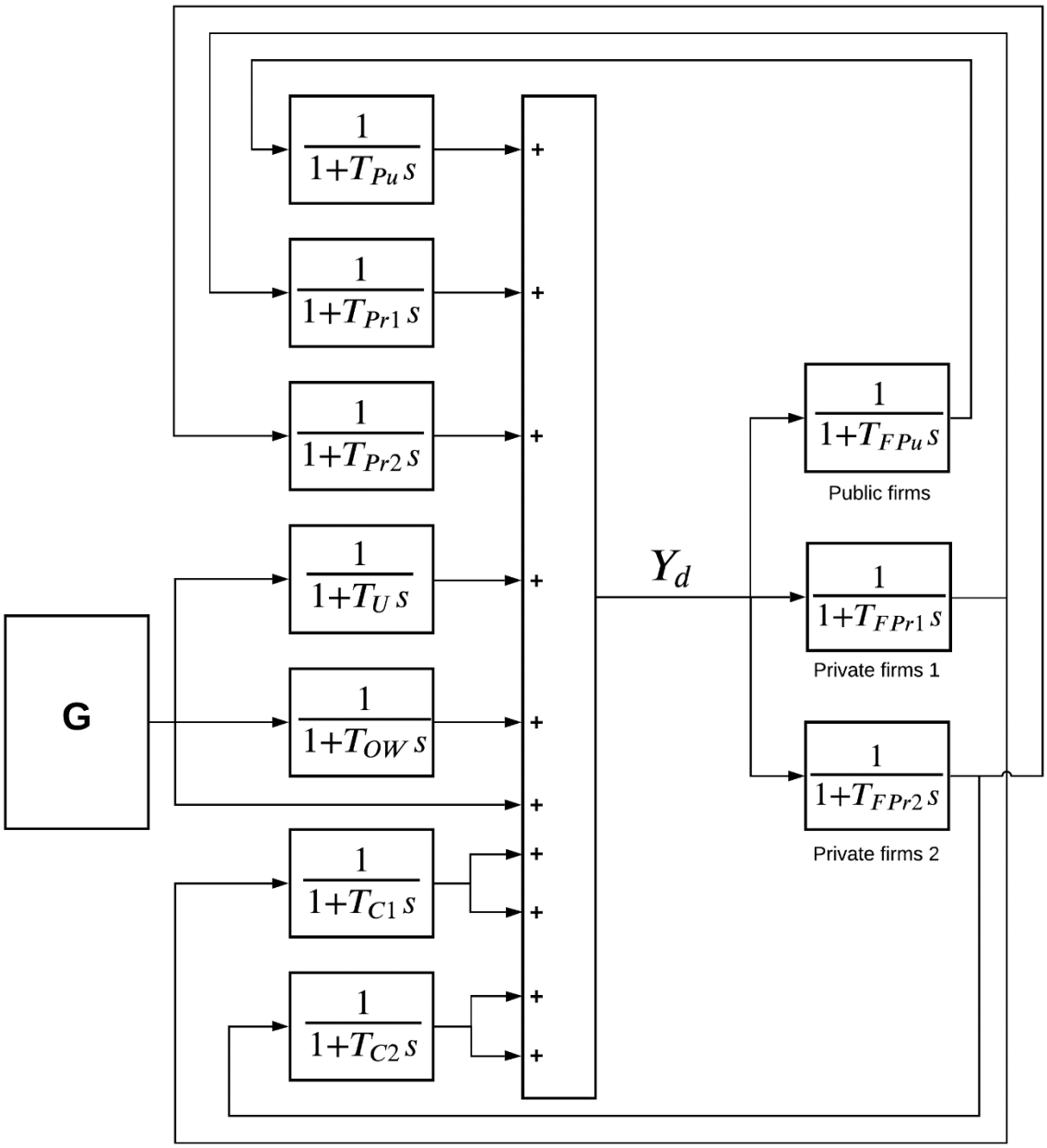

Figure 3.9: A simplified model of the complete system with unemployment.

We have three sectors called sectors or firms, shown in Figure 3.10. The public sector will be mentioned as either public firms or the public sector, even though public firm is not a 100% accurate term. There are public firms, private firms 1, and private firms 2. ξ (xi) determines how much of the flow that goes into the private sector. $(1 - \xi)$ then determines how much that goes into the public sector. From this part, ψ (psi) determines the distribution between private sector 2 and 1. ψ decides the part that streams into private sector 2, and $(1 - \psi)$ into private sector 1.

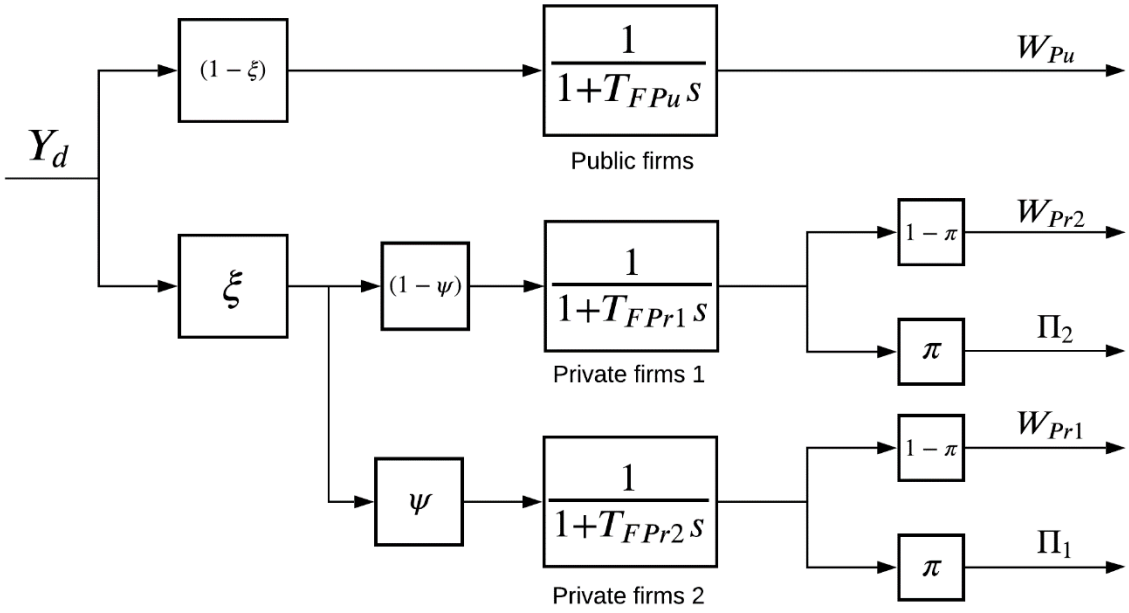

Figure 3.10: Model of the three different sectors; public firms, private firms 1 and private firms 2.

Figure 3.11 shows the different households with ingoing flow and outgoing flow. We do not include taxation here. From top to bottom we have the following households; public workers, private workers 1, private workers 2, workers in the Job Guarantee program, people outside the workforce, capitalists 1 and capitalists 2. σ $(sigma)$ denotes how much of capitalist's output they use to invest, while $(1-\sigma)$ denotes how much they use on regular consumption. In reality, a household can receive both wages and profits, but these groups are separated in these models to simplify.

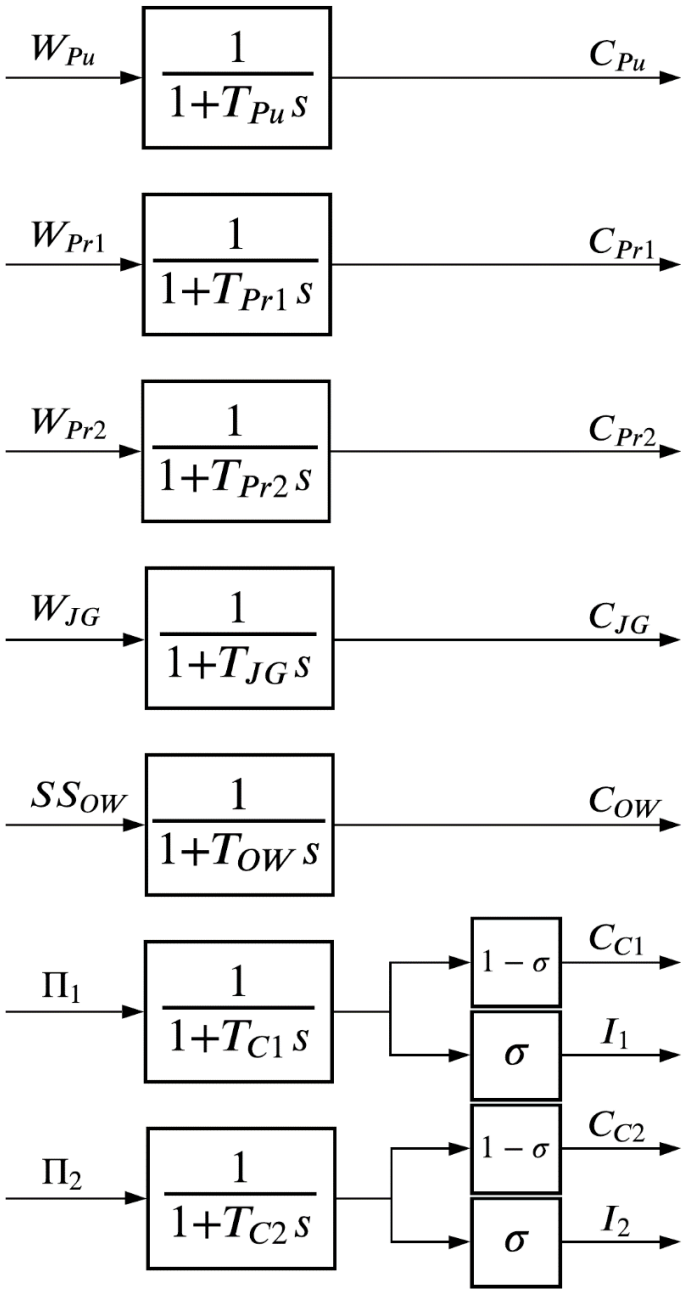

Figure 3.11: Model of the different households in the economy with Job Guarantee.

Figure 3.12 shows the households in model 2. The public workers, private workers 1, private workers 2, people outside the workforce, and capitalists 1 and 2 are the same as in the Job Guarantee model. The difference here is the households with unemployed people instead of households in the Job Guarantee program. These households with unemployed people do not receive wages, but an amount of benefits from the government.

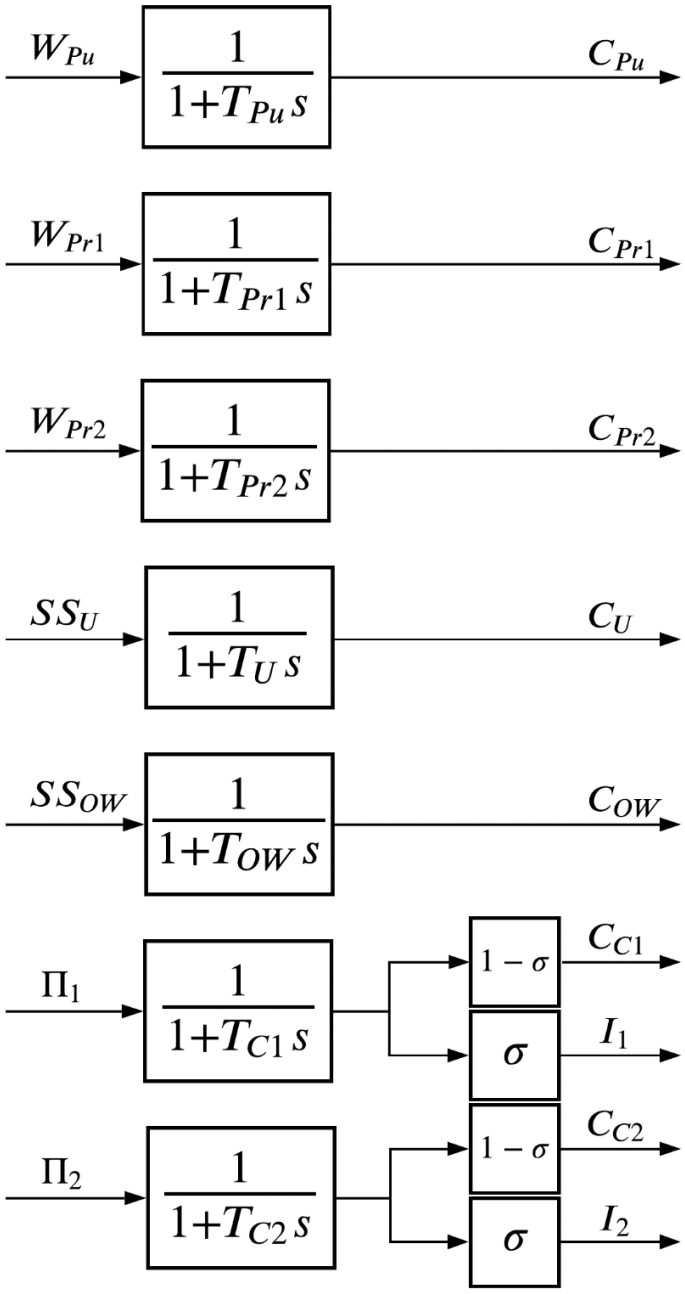

Figure 3.12: Model of the different households in the economy with unemployment.

Figure 3.13 is the subsystem that changes the time constants in the system. The change of the different time constants is used to simulate a pandemic, where different parts of a society and the people cannot use the money they want. t_1 is the time of the breakout of the pandemic, and where parts of the society shut down. g_1 is the gain for the first order system, and decides the change of the time constants. T_1 is the time constant for this first order block, and determines the response of the change. t_2 is the time of when the pandemic is officially over. In this case,

two first order blocks are used, making the opening of the society a second order system. The time constants recover towards the gain g_2. T_2 and T_3 are the time constants for the "release" scenario. The reason for using two first order blocks in series is simulating that a release or opening of the society will be slower compared to shutting down at t_1. Vaccination takes time, since health care services can not vaccinate everybody at once, it takes time to produce enough vaccines, and we are expecting that different countries and regions opens up at a different pace. Some countries can also have gotten rid of the virus without vaccination, but are still waiting to open the borders because the virus is still being active in other countries.

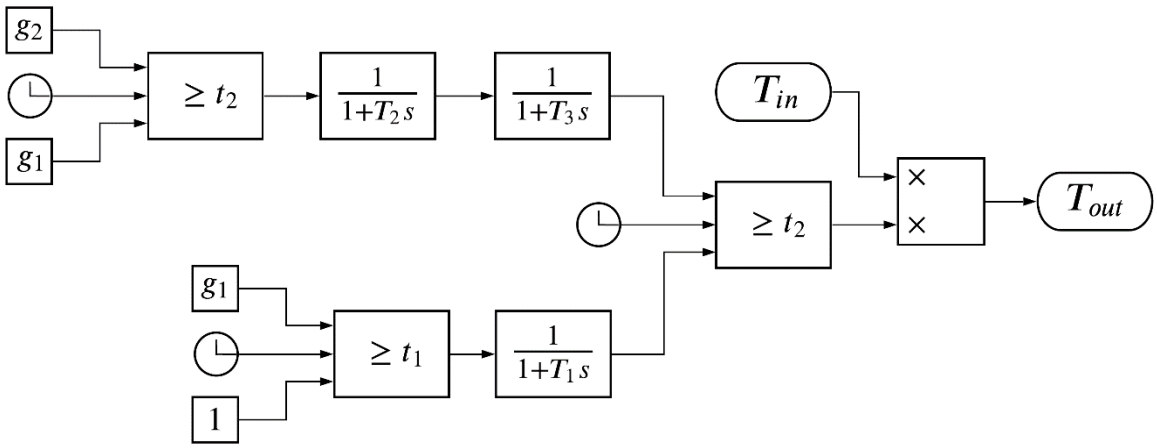

Figure 3.13: The subsystem changing the incoming time constant to simulate a pandemic.

Figure 3.14 illustrates the V_0 growing at the rate of $\approx g_r$. (To be precise, the exact input of g_r must be $\ln(1 + g_r)$. To have a growth rate of 3%, the input must be 2.96%). This growth rate can apply to units expected to grow over the years and more specific exogenous variables. This growth can apply to the total population, wages and benefits, the workforce, government spending, the difference between sectors. Depending on the time scale the growth is wanted, one must divide the growth rate by 52 if the time frame is years.

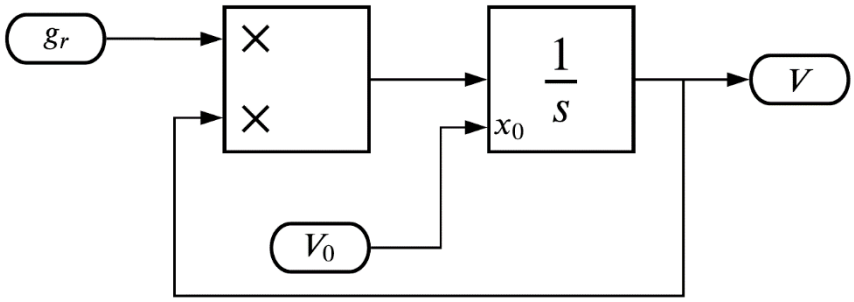

Figure 3.14: System modelling growth for the incoming value.

$$N_{JG} = TW - N_{Pr1} - N_{Pr2} - N_{Pu} \tag{3.21}$$

The number of people in the Job Guarantee program equals the total workforce minus the people in private sector 1, private sector 2 and the public sector. There is no regular unemployment. There is no specific number of capitalists 1 and 2 nor the people outside workforce. This generalisation is just for simplicity since these variables does not need to be measured, just the total flows in and out of these groups.

$$N_U = TW - N_{Pr1} - N_{Pr2} - N_{Pu} \tag{3.22}$$

The number of unemployed people equals the total of people in the workforce, minus the people employed, i.e. those in private sector 1, private sector 2 and the public sector.

$$N = \frac{W}{w} \tag{3.23}$$

We calculate the number of people in different sectors by taking the total wage *W* divided by the weekly wage rate *w*. The equation above shows this calculation.

Figure 3.15 shows the calculation of the cost for the Job Guarantee program. N_{JG} is the number of people in the Job Guarantee program, calculated from equation (3.21). w_{JG} is the Job Guarantee wage, while W_{JG} is the total wage. ζ $(zeta)$ is how much of the costs of JG that are wages. G_{JG} is the total cost of JG, covered by the government. G_ζ is the total cost of JG that are not wages. W_{JG} goes into the JG households, while G_ζ goes directly into Y_d.

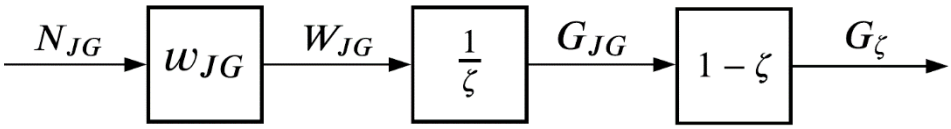

Figure 3.15: Model of the calculation of the different costs of the Job Guarantee program.

Figure 3.16 shows the calculation of the different costs of the unemployment benefits. N_U is the number of unemployed, calculated from equation (3.22), ss_U is the amount unemployed people receive, before tax every week. SS_U is the total amount all unemployed receive combined. λ $(lambda)$ is how much of the unemployment expenditures that are wages. G_U is the total cost of unemployment benefits, covered by the government. G_λ is the total cost of unemployment that are not wages. SS_U goes into the unemployed households, while G_λ goes directly into Y_d.

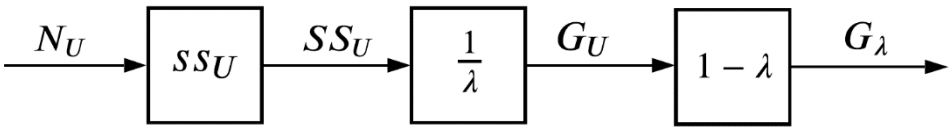

Figure 3.16: Model of the calculation of the different costs of unemployment benefits.

3.3 Aggregate demand and aggregate output

Figure 3.17 shows the sum of aggregate demand, Y_d. I_1 and I_2 goes directly into private firms 1 and 2. G_{Pr2} goes directly into private sector 2. Value added tax (VAT) applies to all private consume. Along with net private consume, G_ζ, G_{Pr2} and G_0 flows into the different sectors, determined by the variables ξ and ψ, as described earlier. Later on, we will describe how G_{Pr2} also goes into private sector 2 during the crisis period. G_{Pu} is the government support to the public sector, to cover the deficit they do not cover by deductibles. A part of Y_d flows into public sector, which is mainly deductibles. Nevertheless, where the private sector during regular times bases itself on consumption and investments, this is not enough to cover the costs in the public sector. Therefore, the government covers this deficit with government spending.

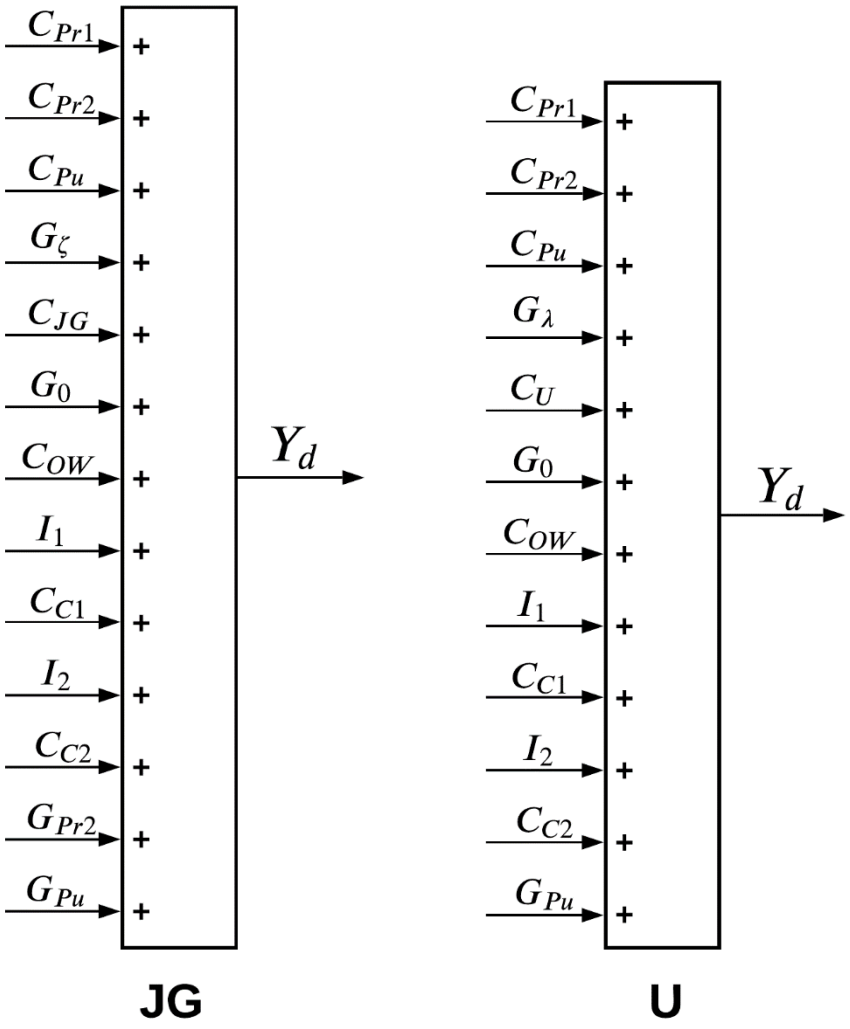

Figure 3.17: Two models of what defines the aggregate demand in both the economy with Job Guarantee and the economy with unemployment.

Figure 3.18 shows the aggregate output, Y_o. Aggregate output is what all sectors produce together, without taxes. Removing taxes from the formula, the aggregate output is what comes out of all the sectors, and the aggregate demand is what goes into the sectors. Aggregate input and aggregate demand are, therefore, equal over time. This equality given that the money stock is the same as it was initially when time goes to infinity.

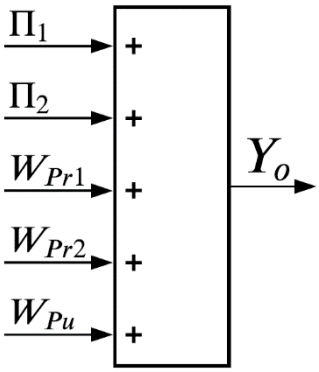

Figure 3.18: Model of the aggregate output, Y_o.

3.4 Crisis support for the JG-system

During the crisis, a public support scheme is introduced in the JG economy to counteract the impacts of the pandemic. People who are working in the Job Guarantee program will get weekly support to cover housing expenditures. This support can either be rent or interest rate payments to the bank. We set the cover to be 2 000 NOK / week. There is a delay from when applying for the support to receiving full payment. The simulation of this delay is a 50% regular time delay (transportation delay) and a 50% transfer function with time constant = 2 weeks. When a person goes out of the Job Guarantee program, this support stops immediately. We expect that 80% applies for this support because documentation is needed, and therefore the delay. We denote the support to the people in the Job Guarantee program G_{SJG}.

Private sector 2, which is affected by the crisis, receives the second crisis support. The firms receive support for their expenditures of business premises and interest payments if needed. We assume 50% of the market share in private sector 2 will pay for this support. The reason is that some companies can get an upswing, for example, when everybody is taking their summer vacation domestic and needs accommodation. However, other companies that are more based on tourism from abroad will experience a significant downfall in income. These specific costs are estimated to be 5% of the total income, so the support gives 2.5% per week of the weekly income before the crisis to the sector in total. The same delay applies here, with a 50% time delay (transportation delay) of 2 weeks and the rest a first order delay with time constant = 2 weeks. Like the support given to the JG households, this support is cut immediately after the crisis is officially over. We denote this support to private sector 2 G_{Pr2}.

3.5 Taxes and public spending

Figure 3.19 shows the total taxation of firms, both on surplus and dividends. The firms are first taxed on the surplus, with tax rate t_{Π}. This total tax is denoted Tax_{Π}. The net surplus is then gained with a factor of t_g, which is again taxed with tax rate t_{Π}. This tax is so subtracted from the net surplus, which then is the net profit that flows to the capitalists. The government collects the total tax, i.e. the tax on surplus and the tax on dividends.

Value added tax (VAT) applies to all private consumption. There are different VAT rates, but we choose an equal rate for all consumer goods and services for simplicity. Net consumption C_{n} then goes into the different firms, as described earlier. Firms can get refunds on the paid VAT (Skatteetaten, n.d.). In addition to taxes, there are different kind of fees in an economy, both public and private. Fees can be used to control or limit a certain kind of behaviour, or to pay for different expenses (The Norwegian Government, 2020). Fees are not included in the models for simplicity.

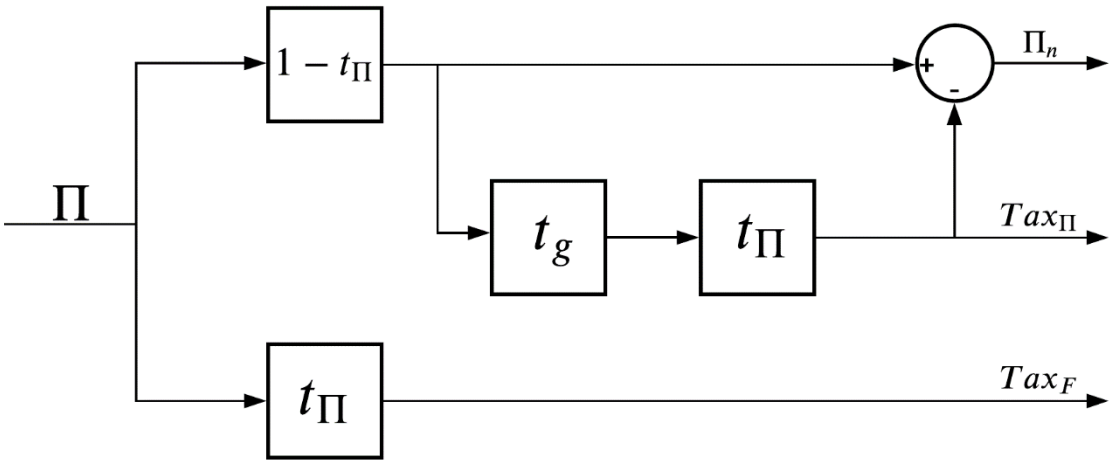

Figure 3.19: Model of taxation on firms' surplus and dividends.

Figure 3.20 shows the sum of all taxation in both models. It mainly includes the taxes from households, i.e. the tax they pay on wages or benefits they receive. Capitalists pay taxes on dividends from their firms. In addition, comes the tax on the surplus in private companies. The payroll tax is a tax the firms pay as a percentage of wages. At last comes the value added tax, the tax paid on consumer goods and services as described above.

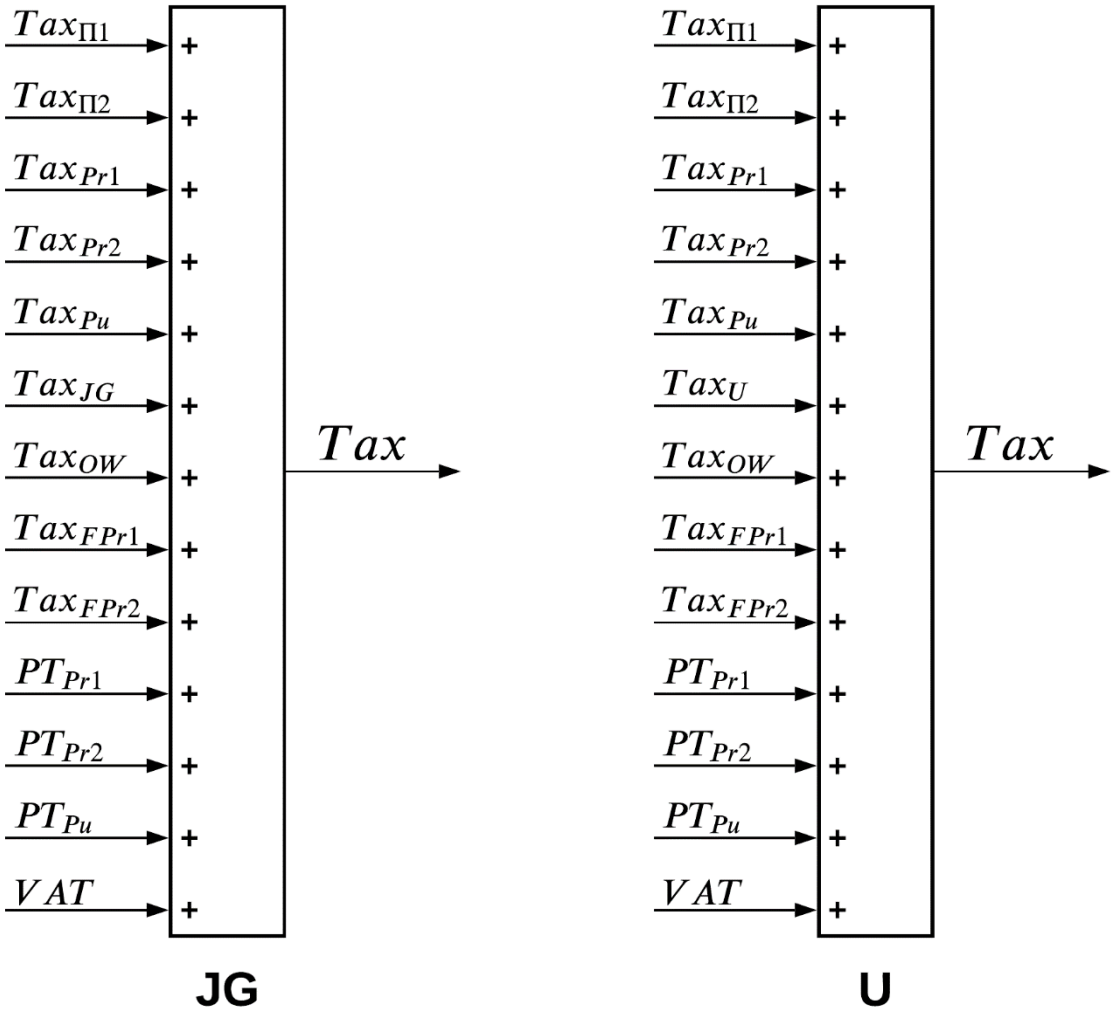

Figure 3.20: Model of all taxes in the economy with Job Guarantee and the economy with unemployment.

Figure 3.21 shows the total government spending, G. G_{ζ} is also a part of G but is included in G_{JG}. G_{Pu} is the support that covers the deficit in the public sector. As mentioned earlier, only G_{ζ}, G_{Pr2} and G_0 goes directly into Y_{d} in the JG model, along with G_{Pu}. In the model with unemployment, there are fewer public spending variables. G_{λ} is a part of G_{U}, and goes directly into Y_{d} along with G_0 and G_{Pu}.

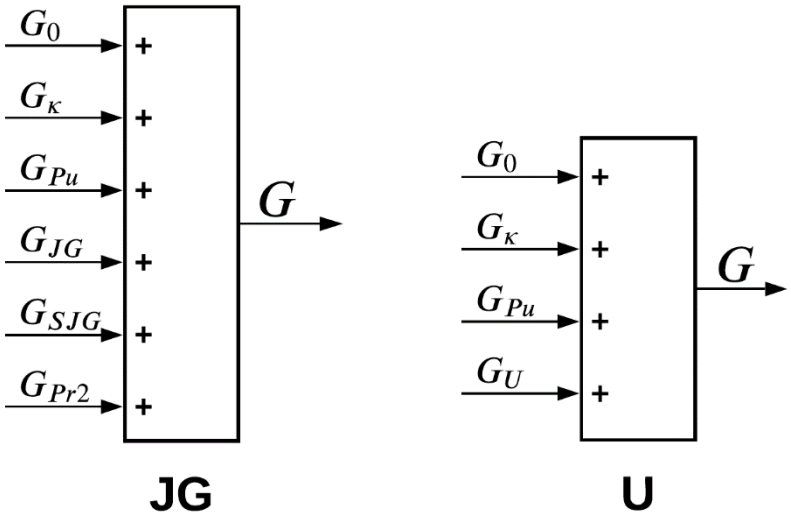

Figure 3.21: Model of the government spending in the economy with Job Guarantee and the economy with unemployment.

Subtracting the taxes T from government spending G gives us the government deficit. Running with a deficit means that a positive net stream of money flows into the economy and the economy has a surplus. If the government deficit is negative, the government is extracting money from the economy and the society is paying more in taxes than they receive.

The models presented in this chapter are just for presentation. The complete models used for simulation are far more complicated and complex than the models we show in this chapter. See the complete systems in Appendix D – Complete systems.

The next chapter shows the results from the simulations of the two models. Appendix A – Variable description and values shows the description and values of constants and variables. The most critical choice of values is the Job Guarantee wage; 150 NOK per hour, 5 625 NOK per week. We set the unemployment benefits to be 5 000 NOK per week. The total workforce is 2.8 million people. The pandemic begins in week 52, has a length of 1.5 years = 78 weeks and ends in week 130. The total period is 10 years or 520 weeks. Both models also start with the same initial level of money M to have an equal starting point. Appendix B – Relevant numbers shows the basis for the different numbers. Appendix C – Code from MATLAB and Appendix D – Complete systems describe the exact numbers and models.

4 Results

4.1 Unemployment versus Job Guarantee

Figure 4.1 shows that the economy with unemployment experiences a considerable increase of unemployment when the pandemic breaks out in week 52. The initial level of people in the Job Guarantee program compared to the total workforce is 3.5%. The initial unemployment rate in the economy with unemployment is 3.6%. The reason for the difference between the numbers in the JG-system and the U-system in week 52 is that the consumption from the JG program is higher than the U program, due to the differences in income. This income gap leads to increased flow to the sectors, and the firms can hire more people in the JG economy. We see the same gap in Figure 4.2 and Figure 4.3. The maximum number of people in the Job Guarantee program is 179.7 thousand compared to 302.7 thousand people unemployed. In per cent of the workforce, this is 6.4% for the JG-system and 10.8% for the U-system. Compared to the economy with Job Guarantee, the shift in unemployment is approximately 2.5 times higher. The increase of unemployed people is 201.1 thousand, an increase of 198% from the level of 101.6 thousand people before the outbreak, while the job guarantee program faces an increase of 80.8 thousand people, 82% up from the level of 99.0 thousand people in week 52. After the pandemic is over, the economy with unemployment faces a significant reduction of unemployed people and manages to have fewer unemployed people than the number of people in the Job Guarantee program from week 199 and out. After the overshoot in the U-system and a smaller overshoot in the JG-system, they settle towards the same level. In week 247, the JG-system has 59.8 thousand people in the Job Guarantee program, while the U-system only has 29.2 thousand unemployed in week 265. Compared to the workforce, this is 2.1% for the JG-system and only 1.0% for the U-system. The difference of people not working in regular sectors in week 520 between the economy with Job Guarantee and the economy with unemployment is 1 750 people.

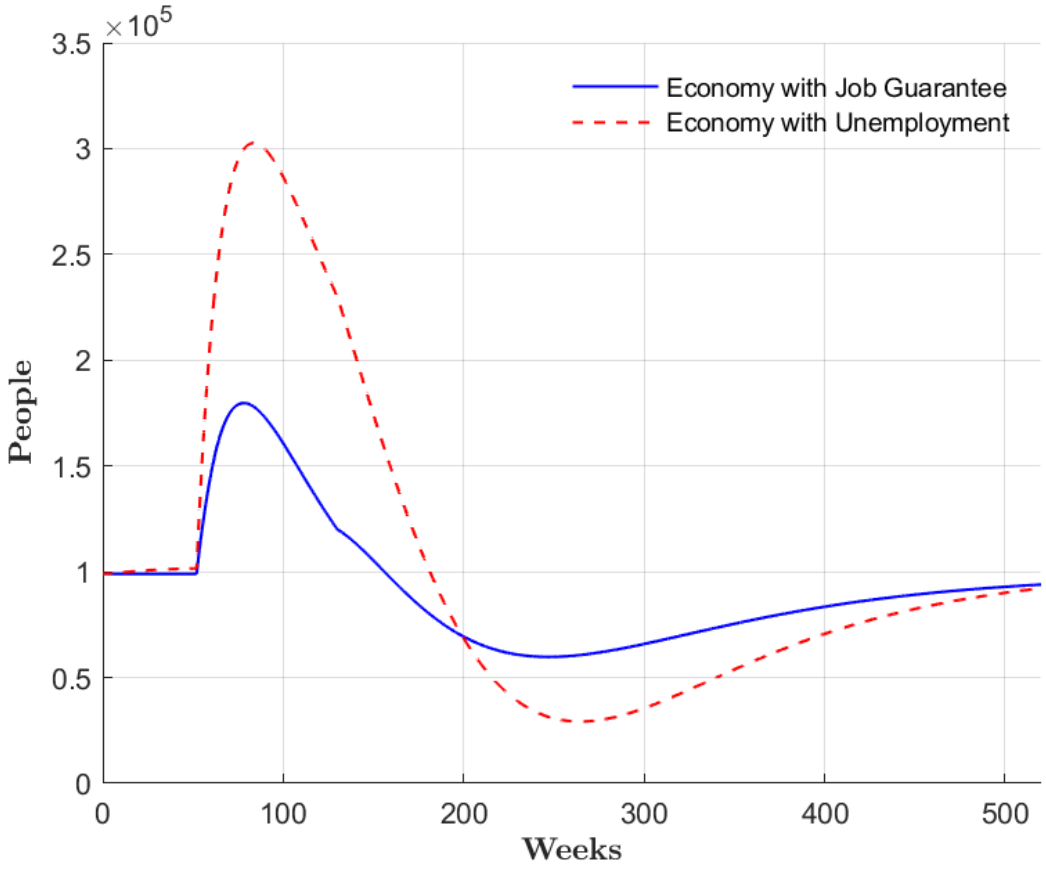

Figure 4.1: Number of people in the Job Guarantee program compared to the number of unemployed people in a regular economic system when a crisis occurs in week 52.

Figure 4.2 shows the average number of people in the Job Guarantee program compared to the number of unemployed people in the regular economy. We calculate this graph by taking the sum (integral) divided by time. The first year, the Job Guarantee program holds 99.0 thousand people, while 100.6 thousand people are unemployed. During the crisis from week 52 to 130, the average number in the JG program is 154.5 thousand people, while there is an average of 262.5 thousand people unemployed in the same period. This difference means that there are 70% more people unemployed compared to the JG program. In per cent of the workforce, there is an average unemployment rate of 9.4%, while the average per cent in the JG program compared to the total workforce is 5.5% in the crisis period. For the whole period, the average of total unemployed people is 105.1 thousand people, while in the JG program the average is 92.8 thousand people. The difference is 13.3% higher for the unemployed compared to people in the JG program, 12.3 thousand people per week.

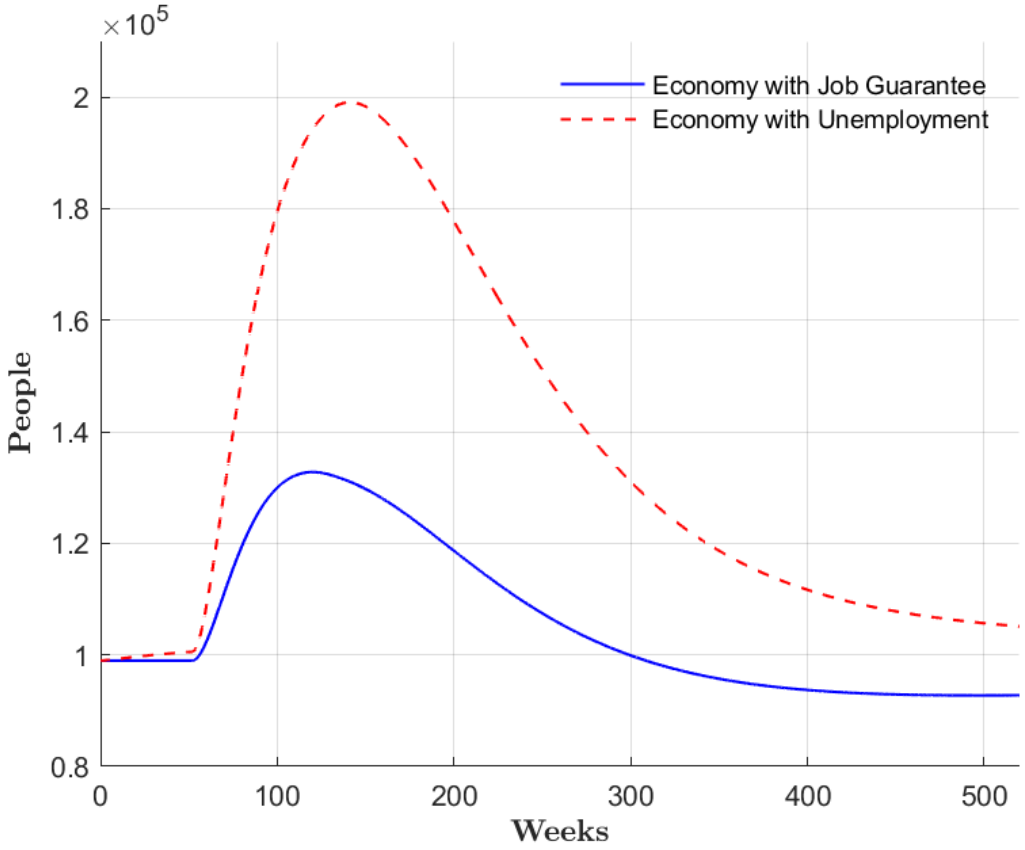

Figure 4.2: The average number of people from $(0, t)$ in the Job Guarantee program versus the number of people unemployed.

Figure 4.3 shows the number of people in private sector 2, represented by the economy with unemployment and the economy with the Job Guarantee program. The private sector 2 is the sector that is affected by the economic crisis. On average, the private sector 2 holds 1.12 million people employed in the JG economy, while the economy with unemployment holds 1.10 million people employed. During the crisis, the JG economy has 108 thousand more people employed on average per week in private sector 2 compared to the economy with unemployment. The number of people in private sector 2 in the JG economy falls 7.3% from the level of 1.11 million people employed in week 52 to the level of 1.03 million people employed in week 78. In comparison, the number of people in private sector 2 in the U-system falls 18.1% from 1.11 million people employed in week 52 and touches 0.91 million people employed in week 84. The change is 2.5 times bigger for the economy with unemployment compared to the economy with Job Guarantee. This shift is the same as in Figure 4.1. After the crisis, the unemployment system reaches a peak at 1.18 million people employed in private sector 2 in week 265. The Job Guarantee system, on the other hand, peaks at 1.15 million

people employed in week 247 in private sector 2. Towards the end of the total period, they aim at about the same level, moving back towards the initial level before the crisis.

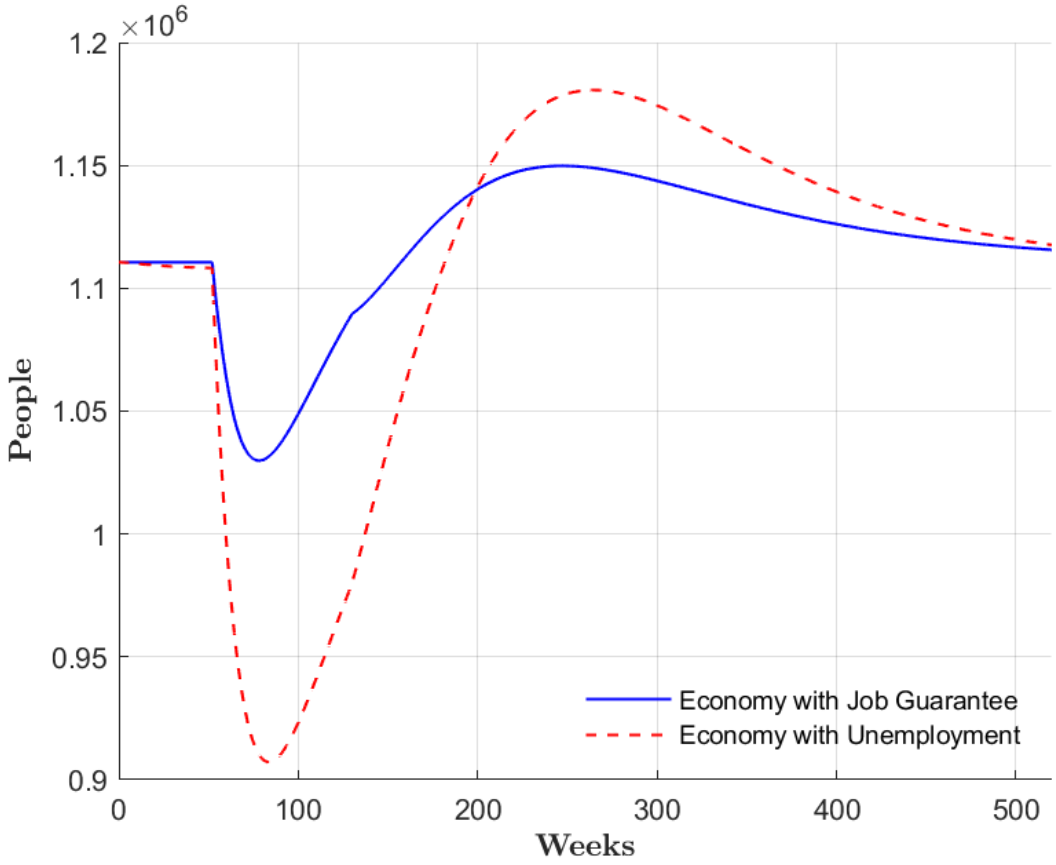

Figure 4.3: Number of people in private sector 2 in the economy with Job Guarantee versus the economy with unemployment.

4.2 Private spending

Figure 4.4 shows the consumer spending in both economies. The average private consumption per week for the whole period is 35.5 billion per week for the economy with Job Guarantee and 35.3 billion per week for the economy with unemployment. For the crisis period only, i.e. week 52 to 130, the average consumption is 34.5 billion per week for the JG-system and 33.2 billion per week for the U-system. This difference means that the consumption is almost 4% higher for the JG economy during the pandemic compared to the economy with unemployment, which is over 1.2 billion per week. The initial number of 35.5 billion in private spending per week for the JG economy in week 52 dropped down to 33.7 billion per week in week 63, a downfall of 4.9%. The U-system drops 8.4% from 35.4 billion per week in week 52 to 32.4 billion per week in week 70. The change in the U-system is 71% bigger compared to the JG-

system's drop. There is a larger amount of spending for the JG-system after week 146 compared to the consumer spending before the crisis. The U-system passes the pre-pandemic-level in week 171, 25 weeks after the JG-system. The economy with Job Guarantee peaks in week 232, 102 weeks after the end of the pandemic, with a level of 36.0 billion per week. This value is 1.7% above the initial level. The U-system peaks 24 weeks after, in week 256 with a maximum level of 36.2 billion per week, which is 2.4% above the level in week 52. Moving towards week 520, both economies settle towards the same level of consumption as before the pandemic. The consumption is higher in the JG-system compared to the U-system from week 209 to 452, a 243-week period.

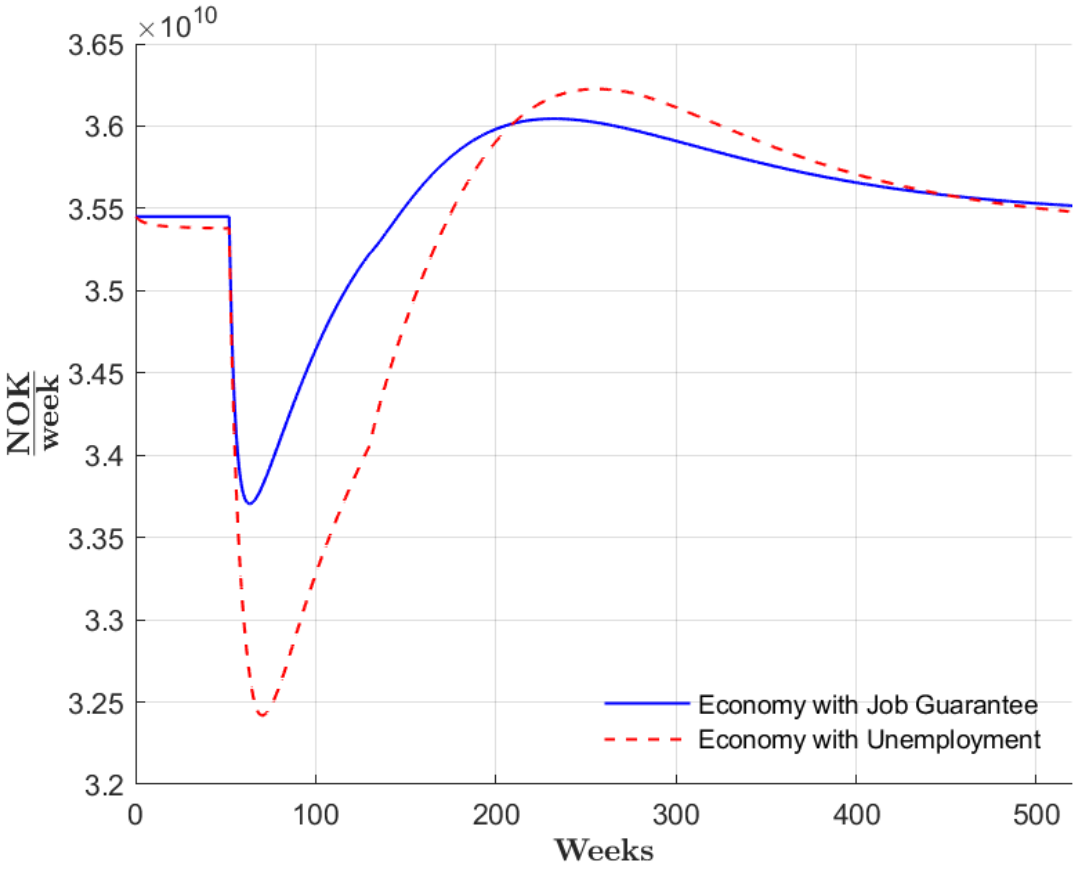

Figure 4.4: Private spending in the economy with Job Guarantee versus the economy with unemployment.

The response in the private consumption during the crisis matches real numbers at some point (Statistics Norway, 2020h). After the outbreak of a pandemic, people can not use all the money they want due to lockdowns and closed borders. The sectors affected are tourism and the

hospitality industry. The total private consumption goes down (Statistics Norway, 2020h) and fits the model's response. However, the fall is mainly because of people not spending money abroad. When people have to stay at home, they buy lots of stuff online, doing garden work or start to redecorate at home. Even though the consumption of services has declined, the wholesale has gone significantly up. Since the models used in this thesis do not have a foreign sector, the simulation of private consumption is not entirely correct. On the other hand, in the US, private consumption has declined more compared to Norway. The predictions are that the level of consumption will take until 2022 to pass the levels in 2019. While some sectors are experiencing a boost, some are taking a big hit. Some of these sectors will recover fast, but Mitterling et al. (2020) expect certain sectors, like communication, clothing, education and other goods and services to not recover until 2026 or later.

There are several predictions of what will happen when the crisis is over. Two effects can impact the response of the economy. The first cause is that people have not been able to spend money, and for the people who have got zero income reduction during the pandemic would mean an increased savings rate. The second cause is the phycological effect of being locked down, home and isolated. When the pandemic is over, this effect can cause a sudden positivism in the society, as seen in the 1920s, after World War 1 and the Spanish flu (Ringholm, 2020). This period is known as the “roaring twenties” or the “golden age twenties” (Sann, n.d.). In 1929, the Wall Street crashed (History Extra, 2019), and started the great depression, where the GDP dropped more than 15%. This drop is enormous compared to the financial crisis, where the GDP only dropped 1% from 2008 to 2009 (Lowenstein, 2015). In 1920, right after the end of the Spanish flu, the average price per earning for stocks was 5.6. Right before the stock market crash in 1929, on “Black Tuesday”, the P/E was 32. A lot has changed in the valuation of the stock market since then, but in February 2021, the P/E is 35.6. This value is somewhat below the peak before the break of the dotcom-bubble, but still 3 000 percentage points higher than the level after the Spanish flu in 1920 (Shiller, 2021). There has also been a significant increase in the private debt, which has increased almost 5% the last year (Statistics Norway, 2021), in addition to the boost in housing prices. These are 8.6% higher than the year before and went up 3.2% in January (Real Estate Norway, 2021), but these discussions are a foundation for another thesis.

4.3 Public spending

Figure 4.5 shows the public spending or government spending G in the economy with unemployment and the economy with Job Guarantee. The costs in the JG-system in this figure does not include the crisis support. During the whole period, the average spending on the JG program is 652 million per week. This amount is 4.4% higher than the unemployment benefits, which uses 625 million per week on average. During the pandemic from week 52 to 130, the unemployment benefits have a 36% higher cost than the JG program. This difference is 395 million per week. Before the crisis, the spending in the JG-system is somewhat bigger than in the U-system. After the pandemic breakout, the spending on the JG program shifts 81% up from 696 million per week in week 52 to 1.26 billion per week in week 78. The U-system increases 188% from 533 million per week in week 52 to 1.82 billion per week in week 91. This increase is 2.3 times bigger in the economy with unemployment compared to the economy with Job Guarantee. After the pandemic is over, the spending on the unemployment benefits goes down to 183 million per week in week 265. This fall is down 90% from the peak in week 91. In the JG program, the spending goes down to 420 million per week in week 247, down 67% from the peak in week 78. At the end of the period, in week 520, the difference in public spending between the JG program and the unemployment benefits is 91 million per week. The cause for the big gap between the public spending on the different programs is the different number of people in each program. In the economy with unemployment, many more do not have a job, especially during the crisis, making the costs much higher. Figure 4.1 shows the gap between the number of people in the different programs.

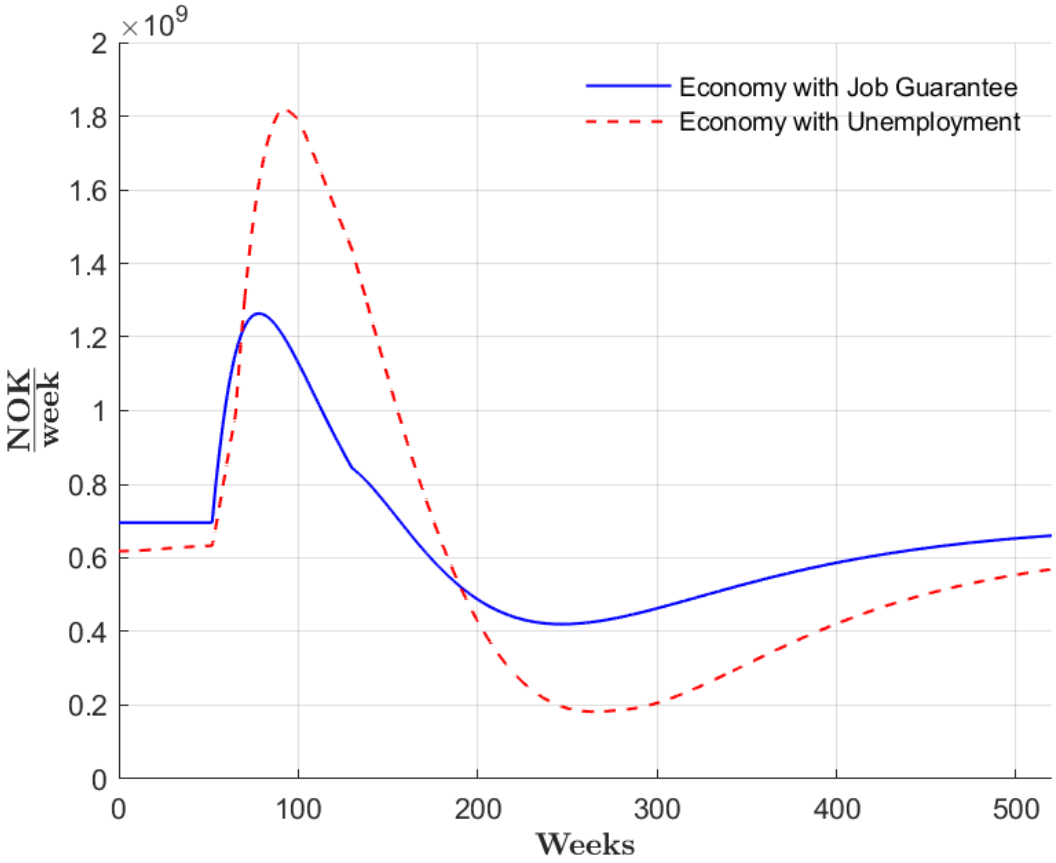

Figure 4.5: Public spending on the Job Guarantee program versus on the unemployment benefits.

Figure 4.6 shows the government spending directly on the public sector. The average spending on the public sector for the whole period is almost the same for both economies. The JG economy has 8.80 billion per week on average, while the economy with unemployment has 8.81 billion per week. During the crisis, the average spending on the public sector is only 0.4% higher for the economy with unemployment compared to the economy with Job Guarantee. Both economies use approximately the same amount in week 52 with 8.80 billion per week, where the JG-system is slightly above the U-system. The JG-system's public spending on the public sector increases 0.5% up to 8.84 billion per week, while the U-system increases 0.9% up to 8.88 billion per week. Even though the change in the U-system is 1.8 times as big as the change in the JG-system, a change below 1% is almost neglectable. After the crisis is over, the JG economy goes down to 8.78 billion per week in week 254, while the U economy goes down to 8.77 billion per week in week 278. The public spending on the JG-system's public sector is above the U-system from week 238 to week 436. Towards the end of the period, at week 520, both economies settle towards their initial values.

The slight increase of public spending during the crisis on the public sector is the government covering more of the deductibles when people cannot afford to pay. A reduction of income can also make people postponing medical treatments for those with low income. During a crisis, children may be taken out of kindergarten and daycare facilities for schoolchildren, reducing the public income from deductibles. At the same time, public buildings still need maintenance, and school and kindergarten teachers are still receiving wages. The most crucial outtake is that people in the public sector do not lose their job despite an economic crisis.

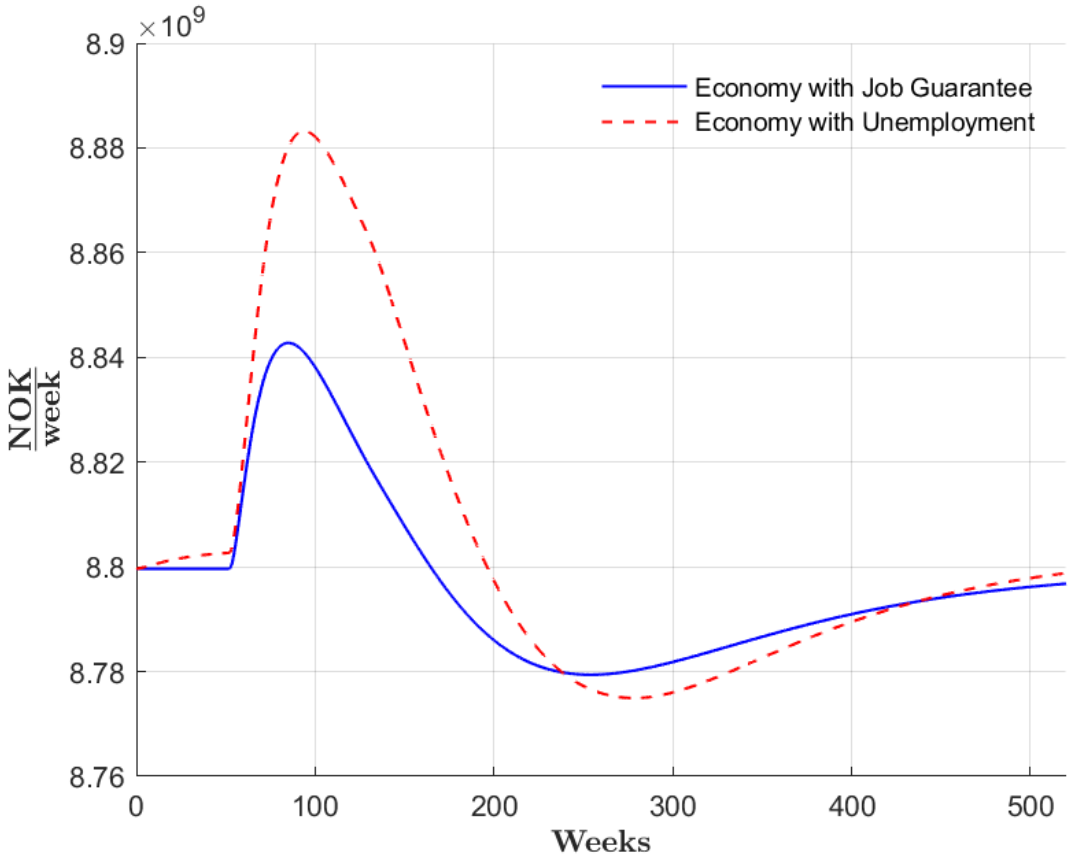

Figure 4.6: Public spending on the public sector in the economy with Job Guarantee versus the economy with unemployment.

Figure 4.7 shows the public support to people in the Job Guarantee program and private sector 2 in the economy with Job Guarantee. The support starts at the beginning of the pandemic and ends as soon as the pandemic is over. The square in the middle of the figure shows a zoomed-in view. It shows that both supports start to grow, suddenly shift upwards and then continue to grow at the same pace as before the jump. This jump happens because there is a combination

of a first order time lag and a transportation delay from applying to the payouts begin. The support to private sector 2 grows quickly and reaches its maximum pretty fast after the pandemic breakout. It lays steadily at 646 million per week before it drops down to zero in week 130 when the pandemic is over. The support to people in the Job Guarantee grows towards its peak in week 79, where the value is 287 million per week in payouts. As the support to private sector 2, the JG support also stops in week 130.

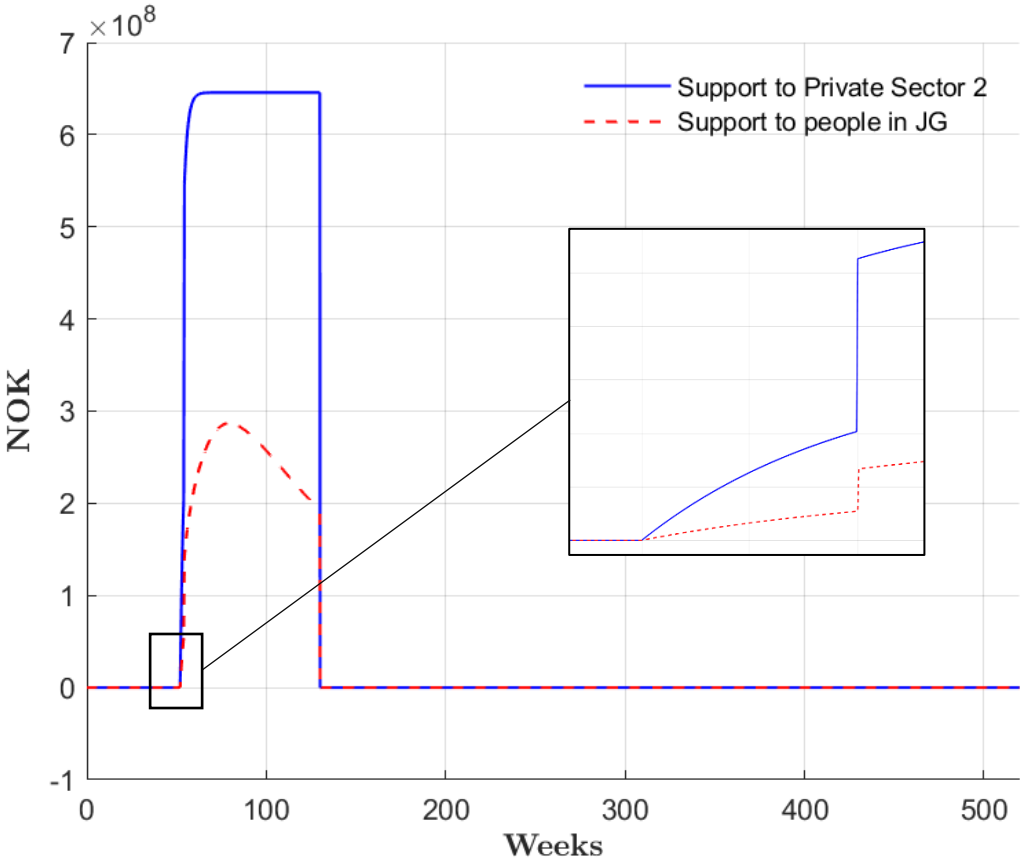

Figure 4.7: Public support in the economy with Job Guarantee during the crisis.

The economy with unemployment does not have the similar support besides general unemployment support and other social security for the people unable to work, i.e. people outside the workforce. The Figure 4.7 shows that the support to private sector 2 combined with the support to the people in the Job Guarantee program is much larger than the change in the public spending on the public sector in Figure 4.6. The support in the JG-system is vital to make sure businesses nor people go bankrupt. Having an avalanche of bankruptcies could permanently damage the economy, at least make it harder for it to recover. When most of the

non-discretionary costs are covered, a business can freeze or be put on hold during the crisis. The employees in a firm may not be able to receive wages but can enter the Job Guarantee program as a short-term solution. It is also important to mention that due to this publicly funded support, the firms in the private sector 2 do not need to be afraid of going bankrupt. Therefore the change in the time constant for private sector 2 is smaller in the JG economy compared to the economy with unemployment. There is still some gain, since there is more delay in the economy compared to regular times, due to lockdowns and the fact that people can be put in quarantine even if they have a job. These factors cause different transportation delays in the delivery of goods and services. However, the public support limits the impact of these delays to a minimum since the firms can afford to have outstanding receivables.

4.4 Public deficit

Figure 4.8 shows the sum of all taxes paid per week in both systems. It shows that both economies face a drop in taxes paid during the pandemic. This drop means the government are collecting less taxes than before the pandemic. Regarding average paid taxes per week for the whole period, the JG economy pays 29.0 billion per week, while the economy with unemployment pays 28.8 billion per week. During the crisis, the JG economy collects 4.4% more taxes per week compared to the economy with unemployment. After the crisis, the taxes paid increases, with a peak in week 243 for the JG-system with 29.4 billion paid per week. The U-system reaches its peak in week 263 with the amount of 29.6 billion paid per week. While the JG-system faces a downward shift of 3.3% compared to the value before the crisis, the U-system's negative shift is 7.8%. This change means the negative shift is 2.4 times bigger for the economy with unemployment compared to the economy with Job Guarantee.

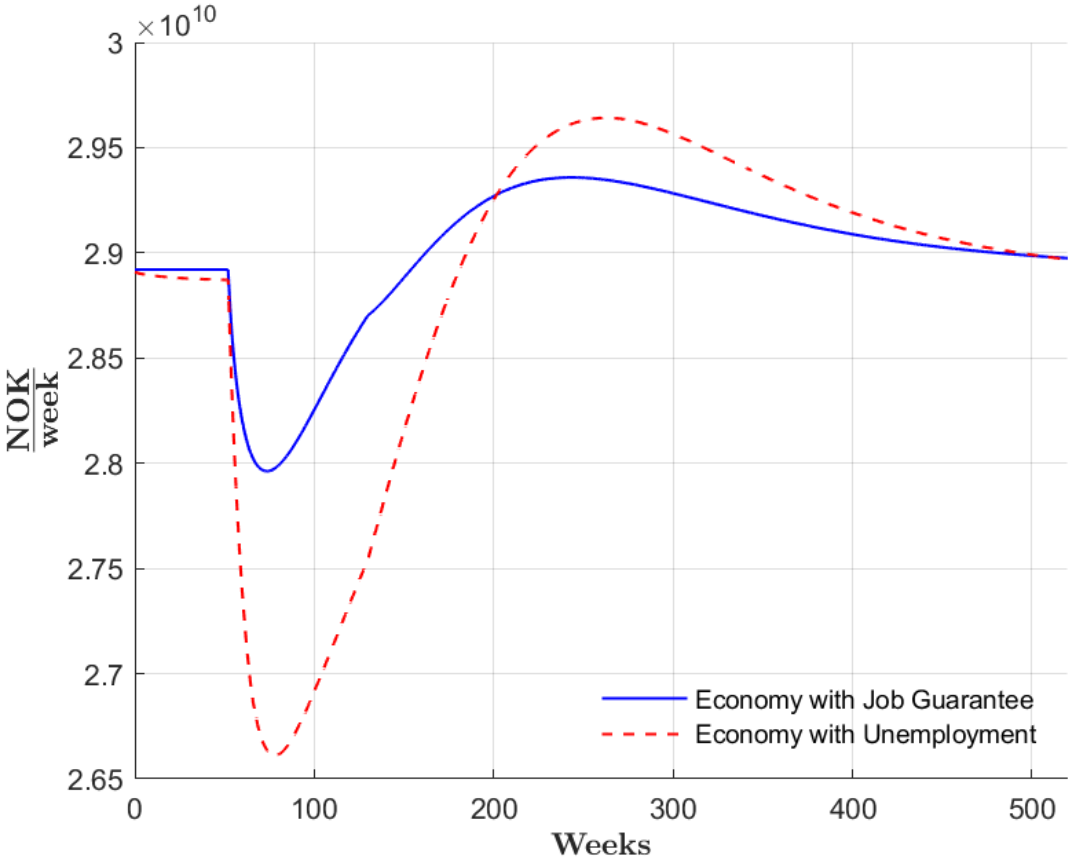

Figure 4.8: Taxes in the economy with Job Guarantee and the economy with unemployment.

Figure 4.9 shows the total government spending in the two economies. The average public spending per week for the JG economy is 29.0 billion, compared to 28.9 billion per week for the economy with unemployment. The average spending for the JG-system during the crisis period of 78 weeks is 1.5% higher compared to the economy with unemployment. The economy with Job Guarantee has a larger government spending, except from week 130 to week 193. In this 63-week-period, the economy with regular unemployment has a larger government spending compared to the Job Guarantee economy. The sudden downwards shift in week 130 in the economy with JG is the crisis support to both the Job Guarantee program and private sector 2 suddenly being stopped. From the value in week 52, the economy with Job Guarantee increases 5.3% from 28.9 billion per week to 30.5 billion per week in week 79. This change is 1.2 times the U-system's increase, which increases 4.4% from 28.9 billion per week in week 52 to 30.1 billion per week in week 91. After the pandemic, the JG economy's public spending goes down to 28.6 billion per week in week 248, a downfall of 6.0% from its peak. The public spending in the economy with unemployment falls to 28.4 billion per week in week 266, down

5.8% from its peak in week 91. At the end of the period, in week 520, the difference is 90 million per week.

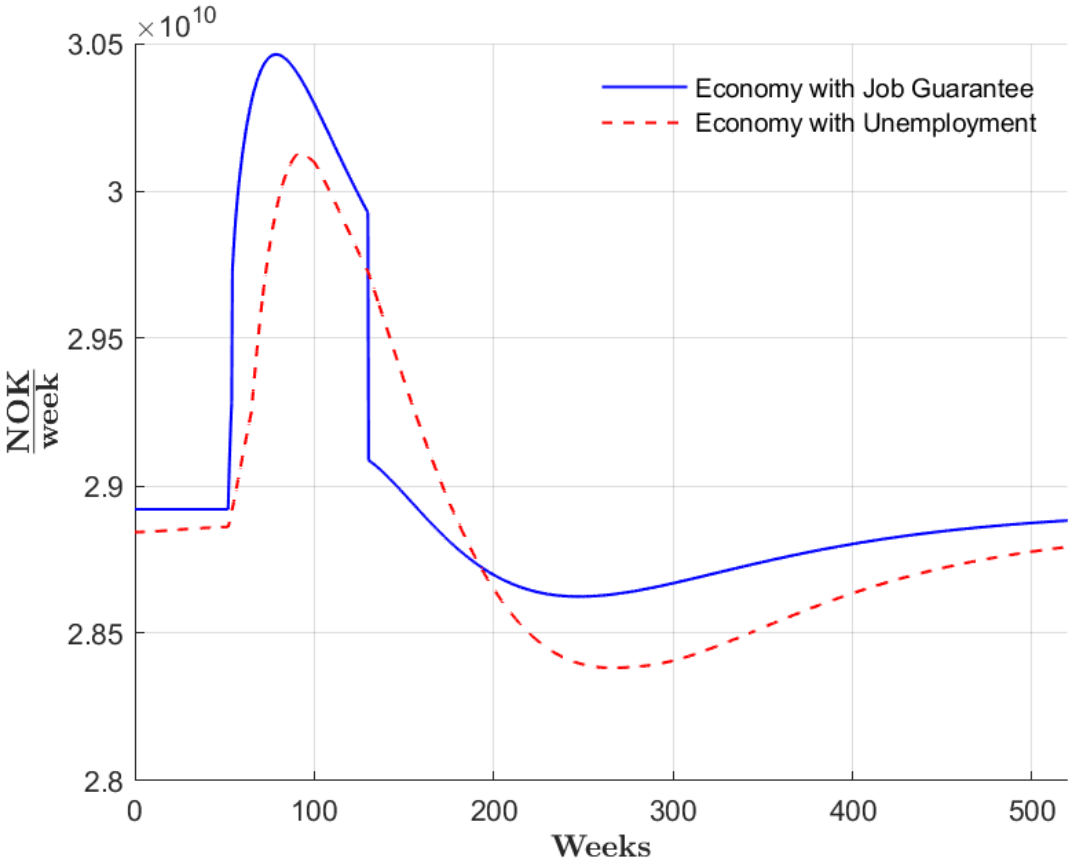

Figure 4.9: Public spending in the economy with Job Guarantee versus the economy with unemployment.

Figure 4.10 shows the public deficit per week for both economies. The public deficit is the public spending minus the taxes collected, i.e. Figure 4.9 minus Figure 4.8. After the breakout, the JG economy reaches its peak in public deficit in week 76 at 2.5 billion per week. In the U-system, the peak is 10 weeks later, in week 86 at level 3.4 billion per week. This deficit is 1.4 times larger than in the JG economy. After the crisis is over, the JG economy goes down to a negative deficit at -734 million per week in week 245. The U-system goes down to -1.26 billion per week in week 264, over 1.7 times larger than the JG-system. A negative deficit means surplus, i.e. the government collecting more money from the economy than it spends on the economy. For the economy with Job Guarantee, the deficit switches to surplus shortly after the crisis, in week 156. The economy with unemployment reaches a positive account balance

somewhat later, in week 179. Right at the beginning, we can see that the deficit is higher for the JG economy than the U economy. However, this can be because both economies start with the same level of money M. This level is a bit higher than the equilibrium in the U-economy and maybe why we see a small change at the beginning.

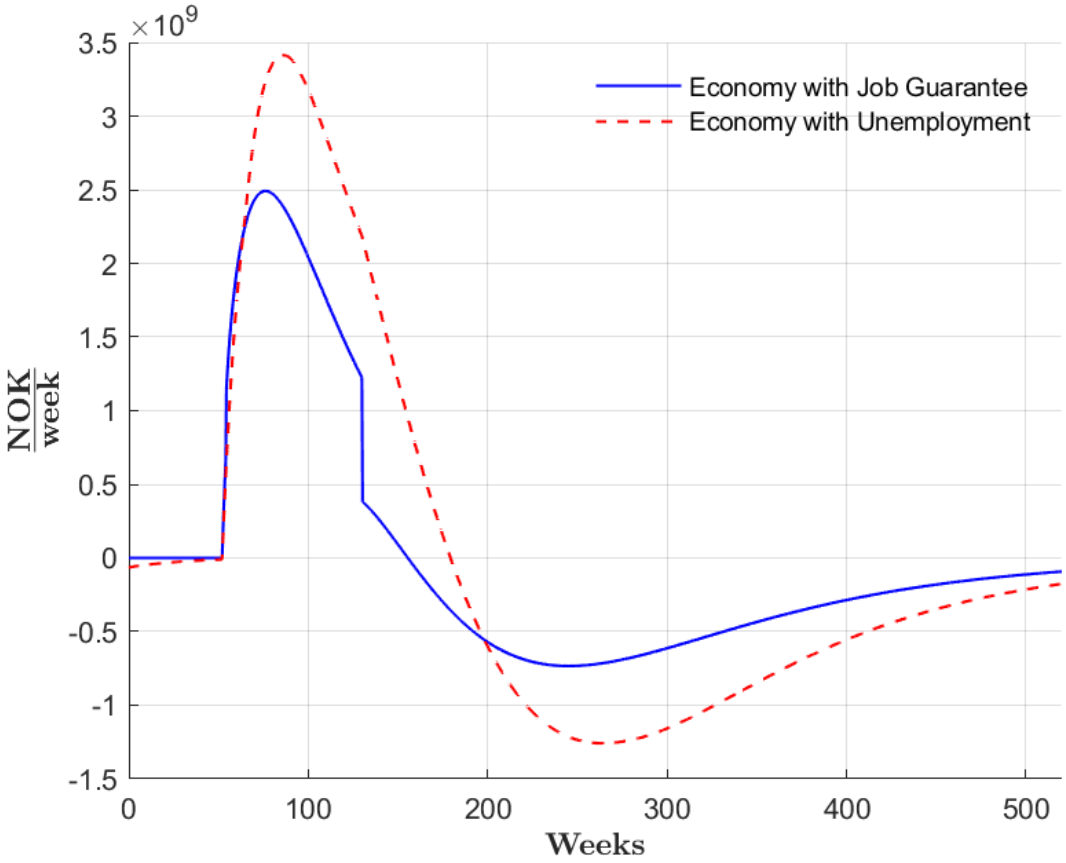

Figure 4.10: Public deficit in the economy with Job Guarantee versus the economy with unemployment.

Figure 4.11 shows the sum of the total public deficit. The two economies have approximately the same total deficit in the year before the crisis. However, around 23 weeks after the crisis' breakout, in week 75, the economy with unemployment's total public deficit exceeds the economy with Job Guarantee. From being zero, the total public deficit reaches to 156.8 billion at maximum, which it reaches in week 156. The economy with unemployment peaks 23 weeks after, in week 179, with a total public deficit of 259.1 billion at this point. The maximum deficit is about 74% larger in week 190 in the U-system compared to the maximum in the JG-system. The biggest difference in total public deficit between the economies after week 0 is 109.2 billion. Both deficits decrease as the time goes by, but even in week 520, the difference between the two economies is 6.43 billion.

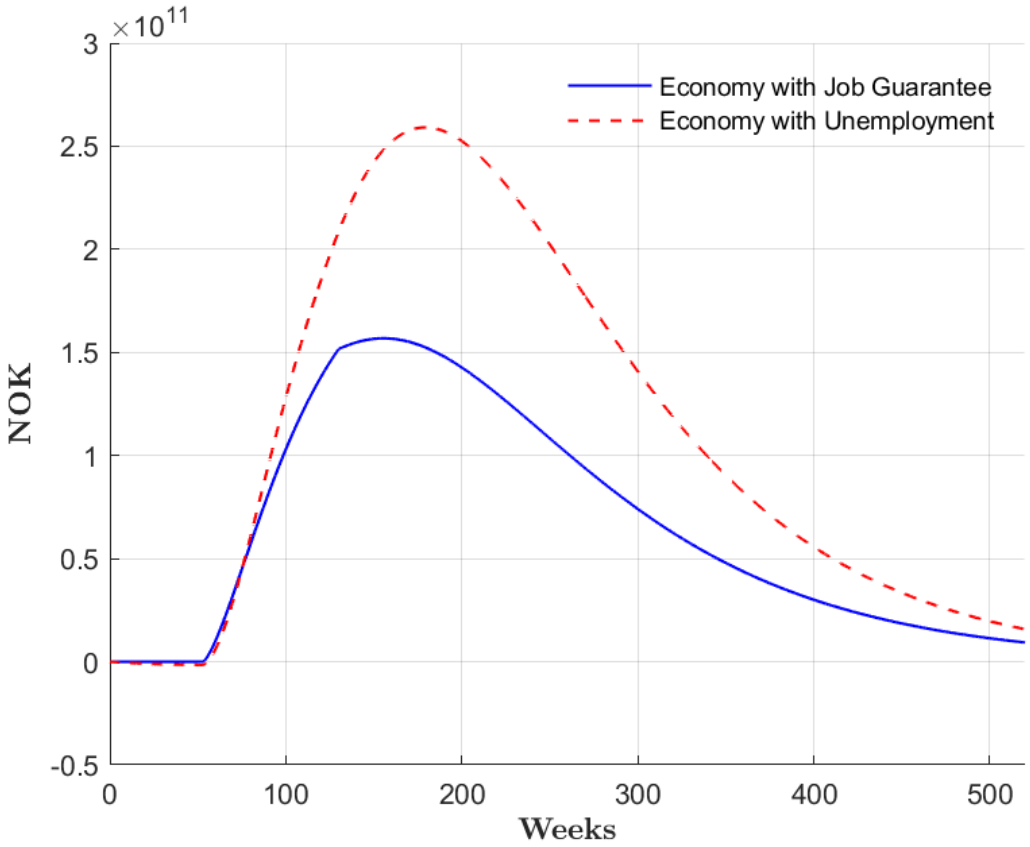

Figure 4.11: Sum of the total public deficit in the economy with Job Guarantee versus the economy with unemployment.

4.5 Aggregate demand and aggregate output

Figure 4.12 shows the aggregate demand in the economy with unemployment and the economy with Job Guarantee. The average aggregate demand per week in the JG economy is 54.1 billion, while it is 53.8 billion in the economy with unemployment. During the crisis, the average aggregate demand for the JG-system is 3.2% higher compared to the economy with unemployment. This difference equals nearly 1.7 billion per week. The aggregate demand in the U-system takes a big dip after the crisis' outbreak, with a downfall of 4.6% relative to the pre-crisis-value. We locate its minimum in week 71, with a level of 51.4 billion per week, 2.5 billion per week down from 53.9 billion per week in week 52. The JG-system jumps down from 53.9 billion per week in week 52 to 53.1 billion per week in week 63, a negative change of 800 million per week and 1.5% down. The shift is 3.1 times bigger for the economy with unemployment compared to the economy with Job Guarantee. The JG-system peaks in week 232, nearly 2 years, or 102 weeks after the pandemic is over. Its aggregate demand in this week is 54.4 billion per week, just 1.0% above the value before the crisis, but 2.5% up from the

bottom. The U-system reaches its maximum in week 256, 24 weeks after the JG-system, and 126 weeks after the end of the pandemic. That week's aggregate demand for the economy with unemployment is 54.6 billion per week, 1.1% above the initial value, but 5.9% up from the minimum level. The U-system has a higher aggregate demand than the JG-system right below half of the time, between week 210 and 441, a period of 231 weeks, or 4.5 years. Towards the end of the period of 520 weeks, both economies settle towards their initial values.

The box in the middle of Figure 4.12 is a zoomed-in section of the graph. It shows the aggregate demand in the JG-system is falling downwards but suddenly takes a big step upwards before continuing downwards again. This jump is because of the non-discretionary support kicking in after some time. The change in demand is also why the graph suddenly jumps downwards in week 130 when the crisis is over, as seen in the figure below. When the crisis is over, the crisis support pay-outs stops, which causes the sudden fall in the aggregate demand for the JG economy. The U-system does not have this kind of support, and therefore there are no sudden shifts in this economy.

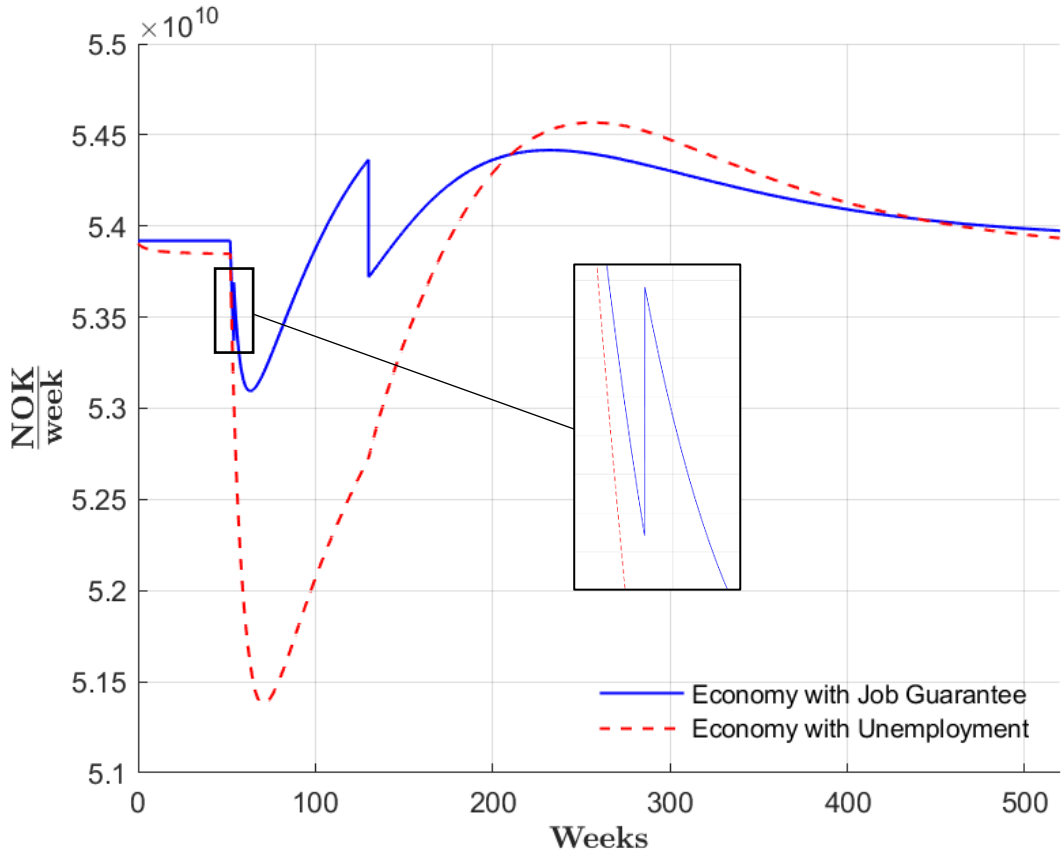

Figure 4.12: Aggregate demand in the economy with Job Guarantee versus the economy with unemployment.

Figure 4.13 shows the aggregate output in the economy with Job Guarantee and the economy with unemployment. The aggregate output is the sum of all goods and services produces in an economy (Nasdaq, 2016). On average, the aggregate output is 54.1 billion per week for the JG economy, while it is 53.8 billion per week for the economy with unemployment. For the crisis period of 78 weeks, the average aggregate output is 5% higher for the JG economy compared to the U economy. This difference equals right above 2.5 billion per week. Both economies take a dip after the pandemic breakout, but the dip is more significant for the U-system, with a downfall of 8.7% from 53.9 billion per week in week 52 to 49.2 billion per week in week 84. This shift is 2.5 times the dip in the JG-system, which only falls 3.5% from 53.9 billion per week in week 52 to 52.0 billion per week in week 78. The output of the JG-system is higher than the U-system until week 199, where the U-system is above the JG-system for the rest of the period. The U-system's aggregate output peaks in week 264 with an output of 55.5 billion per week, 12.9% up from the bottom, before settling towards its initial value as it approaches the end of the period. The same applies for the JG-system, which peaks somewhat earlier than the U-system, in week 247 with the level of 54.8 billion per week, up 5.4% from the bottom and up 1.7% from its value in week 52.

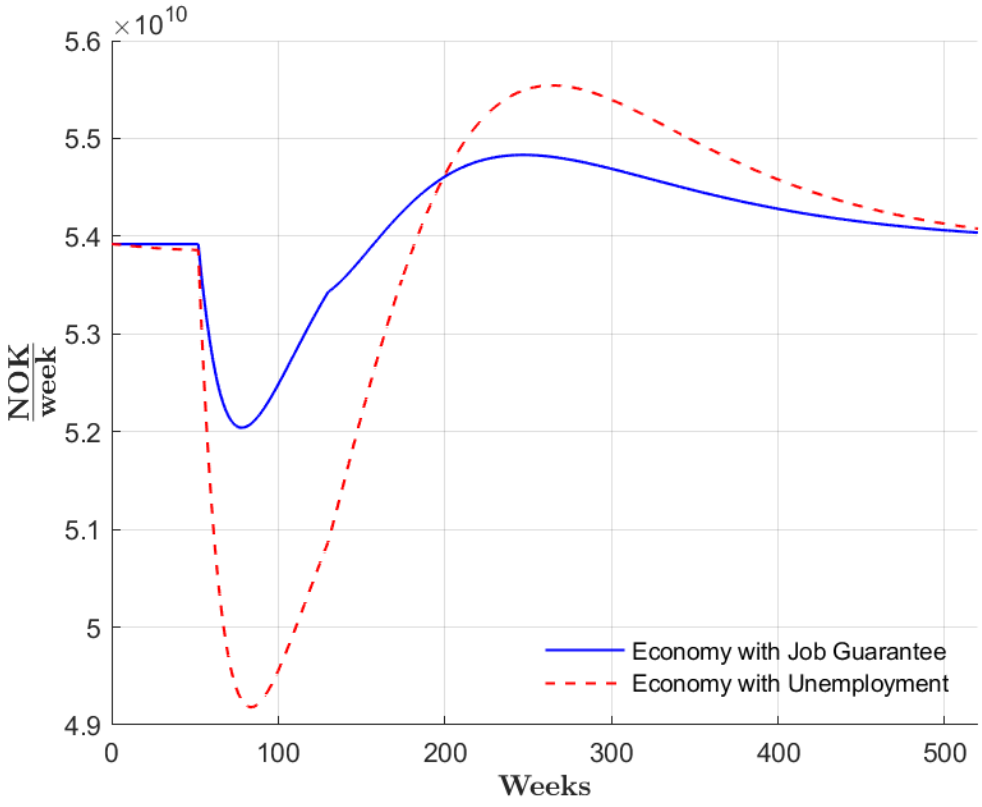

Figure 4.13: Aggregate output in the economy with Job Guarantee versus the economy with unemployment.

4.6 Impacts of economic recovery rates

Figure 4.14 shows the private spending in the economy with the Job Guarantee program with three different time constants in the recovery of the economy. The consumption in week 52 is 35.5 billion per week, and 35.2 billion per week in week 130. After that, the pandemic is over, and we see three different responses. We variate the time constant T_2 in Figure 3.13, while T_1 and T_3 are still the same. The first recovery, with a time constant = 1 week, the level of consumption peaks in week 158 at 36.7 billion per week, up 3.5% from the initial value in week 52. With time constant = 100 weeks, the second response peaks in week 232, at 36.0 billion per week, up 1.7% from the value in week 52. The last response with time constant = 500 weeks, goes up 1.2% from week 52 to 35.6 billion per week in week 301. At the end of the period, the first response is 35.5 billion per week, precisely the same as week 52. The second response is at 35.5 billion per week, more precisely 0.2% away from the value in week 52. The third and last response is at 35.6 billion per week, 0.4% away from the value in week 52.

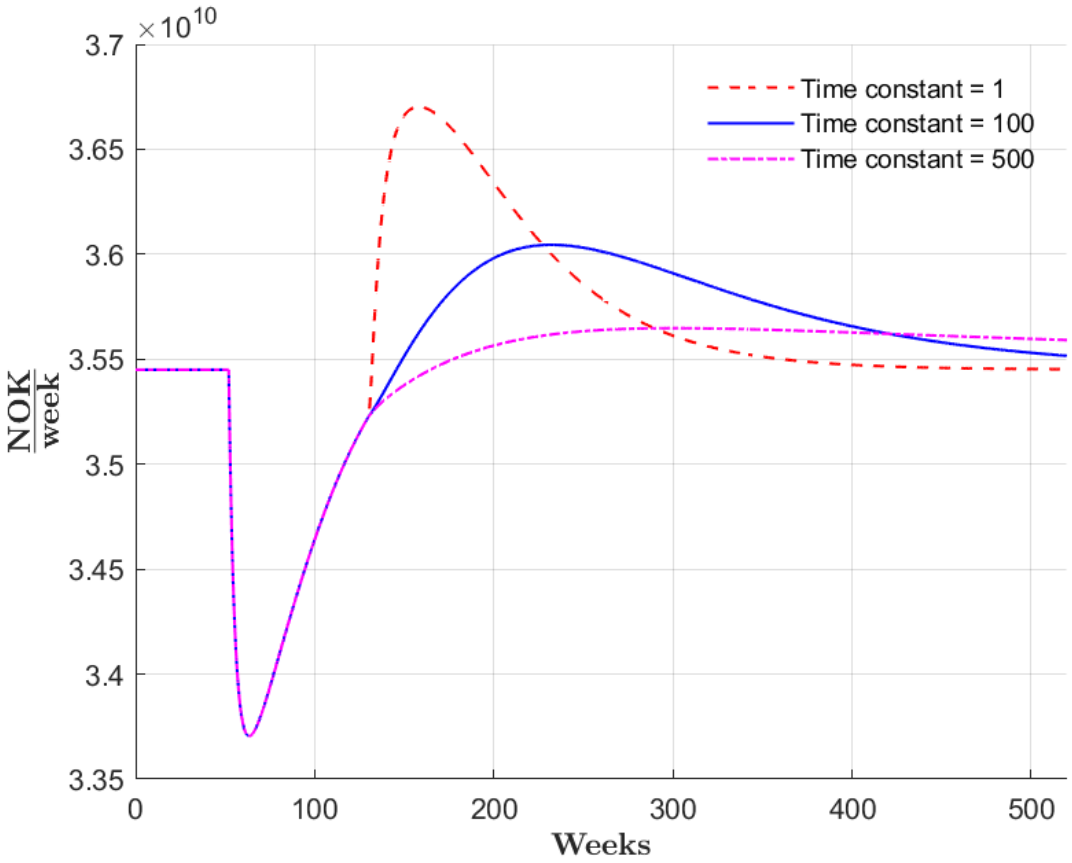

Figure 4.14: Private spending in the economy with Job Guarantee with three different recoveries.

Figure 4.15 shows the number of people in the Job Guarantee program with three different recoveries after the end of the pandemic. All three follow each other until week 130. The value in week 52, right before the pandemic breakout, is 99.0 thousand people in the Job Guarantee program. In week 130, there are 120.0 thousand people in the JG program. The first response with time constant = 1 week, goes down to 24.3 thousand people in the JG program in week 178, down 76% from week 52. The second response with time constant = 100 weeks goes down 40% to 59.8 thousand people in week 247. The third response with time constant = 500 weeks goes down to 85.8 thousand people in week 317, down 13.3% from week 52. Towards the end of the period, the first response has almost entirely recovered with 98.8 thousand people, just 0.2% away from the initial value. The second response is 5.1% away, with 94.0 thousand people. The third and last response is at 89.3 thousand people in week 520, 9.8% away from the value in week 52.

As shown in Figure 4.14 and Figure 4.15, the choice of time constant affects the recoveries of the economy. Furthermore, it is not necessarily the speed upwards that is the problem, but the height and how fast it comes to rest. What goes up must come down is a famous saying, which applies to this setting. The goal will be to limit the upwards rise after the crisis is over. To achieve this, a large time constant is desirable. It is no point for the economy to recover fast if this will cause a significant rise in people losing their jobs afterwards. The critical point is, therefore, how can a bigger time constant be applied to the economy? As described earlier, and from equation (3.6), increasing the time constant is consistent with lowering the money velocity. This adjustment will minimise the fluctuations of people going in and out of the Job Guarantee program.

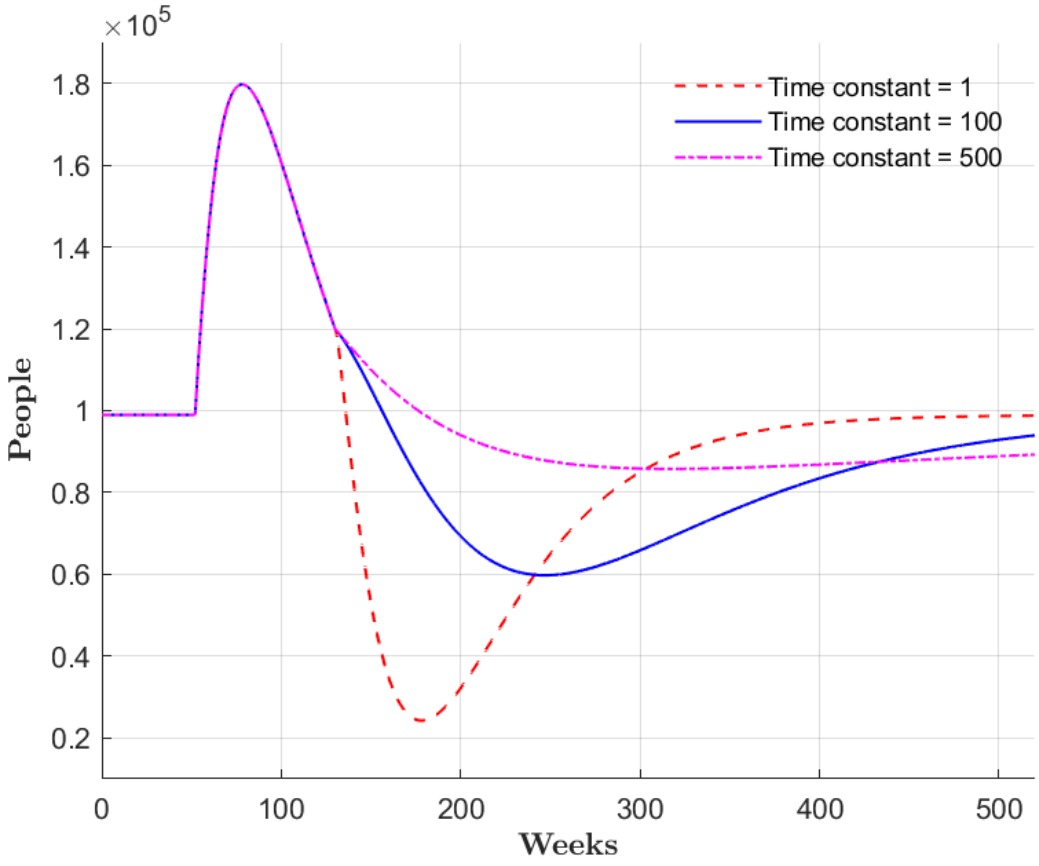

Figure 4.15: Number of people in the Job Guarantee program with three different responses.

5 Discussion and conclusion

5.1 Discussion

The choice of time constant is important for the recovery of the economy after the crisis. Andresen (2018) proposes two different solutions for the choice of the time constant, which implicates the money velocity in the system. The first solution is to introduce a fee for moving money between accounts, i.e. lowering the number of transactions. The second solution is to raise the interest rates on deposits, and by this keep it more profitable to save money. These solutions can make the recovery after the pandemic look more like the response with time constant = 500 weeks. There is no overshoot in that scenario, unlike the two other responses, and the private sector does not need to hire an excessive number of people during the boom, only to fire them when the boom is over.

To make the system more complex, we can include a central bank, regular banks and debt, public and private, and interest rates on debt and capital. The models can also include trade with the foreign sector to see how the economy will be affected by a hypothetical trade balance deficit. These models do not include any valuation of having a job or not, except for the income difference. Including all the downsides of being unemployed, the results would look even more favourable for the Job Guarantee program. Another case is how the lockdown would affect the different jobs in the Job Guarantee program. The different aspects of a pandemic bring a particular insecurity, whether people can work at all.

The results in this thesis are similar to the results in Flatgård (2013) and Kragh (2016). Like the results from this thesis, they conclude that an economy with a Job Guarantee program is a preferred solution for limiting the impacts of an economic crisis. They also address Modern Monetary Theory as a possible solution for funding the Job Guarantee program. Kragh (2016) demonstrates that a JG program maintains almost the same living standard for the households during an economic crisis. Flatgård (2013) presents a JG program based on MMT that has a higher money flow in the public sector to firms in different sectors compared to a regular economy with unemployment. This increased flow has a positive impact on the economy. The results in this thesis also substantiate the arguments from Tcherneva (2020), who presents why a Job Guarantee program is a better solution for the economy than regular unemployment, which also has social benefits for the society. This thesis also finds similar evidence as

Fullwiler (2006), where a simulation shows that a JG program works as countercyclical balancer in the economy and increases price stability compared to a “regular” economy.

Despite positive results, there must be further investigations before one can conclude. There should be a test project where we measure a Job Guarantee program against regular unemployment. Despite the positive quantitative results, this matter also has a political and social aspect that needs further considerations. Does a lawyer who loses his or her job during a crisis want to end up doing physical work at a wage at 10 per cent of the prior income instead of being able to stay home with a higher wage with today’s system? Being in the Job Guarantee program can be associated with social stigma or reduce the available time for job seeking or more education. The activities and services undertaken by the Job Guarantee program also reduce the market for companies or organisations. Finding activities without “disturbing” the regular economy and still be meaningful and not be perceived as punishment can be a challenge for the Job Guarantee program. These are arguments commonly raised by politicians, often with weights related to the right-left axis of the political landscape.

The jobs in the JG program have to be easy to handle, and purely digital jobs often demand some level of training. It is possible that the different jobs can split into small cohorts that would minimise the contact between large groups, making sure a virus does not spread. The training can also be taken a step further, with digital courses. A person in the Job Guarantee program can state some areas they want to learn more about or improve. If the pandemic limits the number of available jobs, the worker will be offered to take a course instead. Workers must spend sufficient time on the course in order to get paid. Different digital solutions can easily make sure that enough time is spent on the courses during the day. It will be similar to taking a digital home exam, without the pressure. Digital training can also apply in normal times, where a worker is granted a certain number of days per month for digital courses. The courses must be relevant for a sector's needs. However, almost despite these courses' learning outcomes, it is more useful than just being home receiving money regardless of what is done, as today's solution with regular unemployment. Digital training may not be possible for everyone, especially in the not-so-developed countries, but different solutions would be possible along with technological development. Having these training courses can also be better for the person who has lost their job. Being in the Job Guarantee program and learning computer programming is a lot less stigmatizing than saying that the person lost their job and is just being home, doing nothing in anticipation of a new job. The jobs in the JG program must also fulfil the goal of not taking away duties from the private sector in the long run.

It would also be interesting to try to measure the non-economic consequences of unemployment in the long run. These measurements will demand a more in-depth and more complex investigation. We can also model a transition for people outside the workforce from not working to working, and use a set of various numbers instead of average numbers as used in this thesis. There is also a question of how simple the model should be in order to measure desired variables, but complex enough to make it as realistic as possible.

5.2 Conclusion

The results in this thesis show that a Job Guarantee program with crisis support reduces the magnitude of the fluctuations in the economy. A JG program also creates a smaller deficit for the government when hit by a crisis like a pandemic compared to a "business as usual" situation with regular unemployment. The benefit of having a job instead of long-term unemployment is an additional benefit of the JG program. The results show that the difference in the total public deficit between the JG economy and the economy with unemployment is 6.4 billion NOK at the end of the period. The total deficit is 74 per cent larger at its maximum in the economy with unemployment compared to the economy with Job Guarantee. On average, there are 13.3 per cent more unemployed people in the economy with unemployment than people in the Job Guarantee program over the timespan of 10 years. This difference is 12 800 people per week. There are 108 thousand more people unemployed per week than people in the JG program during the pandemic. The results also show that the time constant after the end of the pandemic is important to avoid a boom resulting in people losing their job afterwards.

The models used in this thesis captures important aspects but is still a simplification of the real world. Neither a central bank, a foreign sector, regular banks or debt are included in the models. These simplifications can affect the final results and need to be investigated further to make a final conclusion.

The results indicate that a Job Guarantee program is a feasible solution to avoid or to reduce the negative impact of unemployment, especially in periods where a crisis creates significant unemployment rates. It can be tested against a control group to examine practical results. This thesis indicates that a Job Guarantee program is a viable solution during a pandemic and has positive benefits for the economy in the long run.

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Appendix A – Variable description and values

T_{FPr1} = Time constant for private firms in private sector 1 {20} [$weeks$].

T_{FPr2} = Time constant for private firms in private sector 2 {20} [$weeks$].

T_{FPu} = Time constant for public firms in public sector {4} [$weeks$].

T_{Pr1} = Time constant for private households in private sector 1 {4} [$weeks$].

T_{Pr2} = Time constant for private households in private sector 2 {4} [$weeks$].

T_{Pu} = Time constant for public households in public sector {4} [$weeks$].

T_{JG} = Time constant for households in the Job Guarantee program {4} [$weeks$].

T_{U} = Time constant for households with unemployment {4} [$weeks$].

T_{OW} = Time constant for households with people outside the workforce {4} [$weeks$].

T_{C1} = Time constant for households with capitalists from private sector 1 {4} [$weeks$].

T_{C2} = Time constant for households with capitalists from private sector 2 {4} [$weeks$].

T_{1} = Time constant for the first order block determining the time constants {30} [$weeks$].

T_{2} = Time constant for the 2. first order block determining the time constants {1, 100, 500} [$weeks$].

T_{3} = Time constant for the 2. first order block determining the time constants {50} [$weeks$].

T_{1_0} = Initial value for T_1 {30} [$weeks$].

T_{2_0} = Initial value for T_2 {146.2863} [$weeks$].

T_{3_0} = Initial value for T_3 {73.1432} [$weeks$].

T_{in} = In-value for time constant shift [$weeks$].

T_{out} = Outgoing value for time constant shift $[weeks]$.

T_H = Time constant for households $[weeks]$.

T_F = Time constant for firms $[weeks]$.

T_P = Time constant in Figure 3.1 $[weeks]$.

τ = General time constant $[weeks]$.

g_1 = The gain for the first time constant shift {1.5} [ ].

g_2 = The gain for the second time constant shift {1.0} [ ].

g_3 = The gain for the first time constant shift for private sector 2 in JG-system {1.2} [ ].

E = Input demand $\left[{NOK}/{week} \right]$.

P = Output flow $\left[{NOK}/{week} \right]$.

F_i = Incoming flow $\left[{NOK}/{week} \right]$.

F_o = Outgoing flow $\left[{NOK}/{week} \right]$.

F = Constant flow $\left[{NOK}/{week} \right]$.

$F_{H,i}$ = Incoming flow for households $\left[{NOK}/{week} \right]$.

H_H = Transfer function for households $\left[{NOK}/{week} \right]$.

H = General transfer function $\left[{NOK}/{week} \right]$.

t = Time variable, usually $[weeks]$.

g = Growth rate [ ].

v = Money velocity $\left[{1}/{week} \right]$.

t_1 = Time of breakout of the pandemic / economic crisis {52} $[weeks]$.

t_2 = Time of the end of the pandemic / economic crisis {130} $[weeks]$.

s = complex variable in the s-plane, the Laplace Transformation from t-plane [ ].

ξ = value determining the distribution that goes into private sector {0.95} [ ]; $0 < \xi < 1$. The share that goes into public sector is $1 - \xi$.

ψ = value determining the flow distribution between private sector 1 and 2 {0.6} [ ]; $0 < \psi < 1$. ψ is the part that goes to private sector 2, $1 - \psi$ the part that goes into private sector 1.

π = value determining how much of output from firms that is profit {0.4} [ ]; $0 < \pi < 1$. $1 - \pi$ is the share that goes to wages.

σ = value determining the distribution of how much of capitalists output that goes to investments {0.4} [ ]; $0 < \sigma < 1$. $1 - \sigma$ is the share that is consumption.

κ = value determining the how much that is used on people outside the workforce, and is a gain of G_0 {0.5} [ ]; $0 < \kappa < 1$.

ζ = value determining the part of the total cost of the Job Guarantee program that are wages {0.8} [ ]; $0 < \zeta < 1$. $1 - \zeta$ is the share of Job Guarantee costs that are not wages.

λ = value determining the part of the total cost of Unemployment program that are wages {0.8} [ ]; $0 < \lambda < 1$. $1 - \lambda$ is the share of Unemployment costs that are not wages.

ρ = Outside spending coefficient, determines how much of the outgoing flow from an individual agent in an aggregate sector that goes out of the sector [ ]; $0 < \rho < 1$. $1 - \rho$ is the share that stays within the aggregate sector.

e = Euler's number [ ].

d_U = The delay and time constant for when unemployed people get benefits {13} $[weeks]$.

d_{JG} = The delay and time constant for when people in the Job Guarantee program receive support during a crisis {2} $[weeks]$.

d_H = How long time after the end of the crisis people in the Job Guarantee program receive support {0} $[weeks]$.

d_{Pr2} = The delay and time constant for when firms in private sector 2 receive support {2}[$weeks$].

d_F = How long after the end of the crisis private sector 2 receive support {0} [$weeks$].

s_{JG} = The amount people in the Job Guarantee program receive per week during crisis {2000} $\left[NOK/_{week}\right]$.

s_{Pr2} = The rate of the earlier income per week firms in private sector 2 receive as weekly support during crisis people {0.05} [ ]; $0 < s_{Pr2} < 1$.

r_{JG} = The rate of people in the Job Guarantee program who are qualified to receive support during crisis {0.8} [ ].

r_{Pr2} = The rate the firms in private sector 2 get covered their non-discretionary expenditures, more specific housing costs and interest rate payments {0.5} [ ].

Y_d = Aggregate demand $\left[NOK/_{week}\right]$.

Y_o = Aggregate output $\left[NOK/_{week}\right]$.

Y = GDP, income, or production per week $\left[NOK/_{week}\right]$.

$\dot{Y}$ = GDP, income, or production per week per week (time derivative of Y) $\left[NOK/_{week^2}\right]$.

W_{Pr1} = Total weekly wage for all households in private sector 1 $\left[NOK/_{week}\right]$.

W_{Pr2} = Total weekly wage for all households in private sector 2 $\left[NOK/_{week}\right]$.

W_{Pu} = Total weekly wage for all households in public sector $\left[NOK/_{week}\right]$.

W_{JG} = Total weekly wage for all households in Job Guarantee program $\left[NOK/_{week}\right]$.

SS_U = Total weekly benefits for all unemployed households $\left[NOK/_{week}\right]$.

SS_{OW} = Total weekly benefits for all households outside workforce $\left[NOK/_{week}\right]$.

W = Total gross weekly wage $\left[NOK/_{week} \right]$.

W_n = Total net weekly wage $\left[NOK/_{week} \right]$.

Π_1 = Total weekly benefits for all households with capitalists in private sector 1 $\left[NOK/_{week} \right]$.

Π_2 = Total weekly benefits for all households with capitalists in private sector 2 $\left[NOK/_{week} \right]$.

Π = Total weekly profits $\left[NOK/_{week} \right]$.

Π_n = Total net weekly profits $\left[NOK/_{week} \right]$.

w = Weekly wage $\left[NOK/_{week} \right]$.

w_{Pr1} = Weekly wage for a person in private sector 1 {12000} $\left[NOK/_{week} \right]$.

w_{Pr2} = Weekly wage for a person in private sector 2 {12000} $\left[NOK/_{week} \right]$.

w_{Pu} = Weekly wage for a person in public sector {11000} $\left[NOK/_{week} \right]$.

w_{JG} = Weekly wage for a person in the Job Guarantee program {5625} $\left[NOK/_{week} \right]$.

ss_U = Weekly benefits for an unemployed person {5000} $\left[NOK/_{week} \right]$.

C = Total weekly private consume $\left[NOK/_{week} \right]$.

C_n = Total net weekly private consume $\left[NOK/_{week} \right]$.

C_{Pr1} = Total weekly spending for households in private sector 1 $\left[NOK/_{week} \right]$.

C_{Pr2} = Total weekly spending for households in private sector 2 $\left[NOK/_{week} \right]$.

C_{Pu} = Total weekly spending for households in public sector $\left[NOK/_{week} \right]$.

C_{JG} = Total weekly spending for households in the Job Guarantee program $\left[NOK/_{week}\right]$.

C_U = Total weekly spending for unemployed households $\left[NOK/_{week}\right]$.

C_{OW} = Total weekly spending for households outside workforce $\left[NOK/_{week}\right]$.

C_{C1} = Total weekly spending for capitalists in private sector 1 $\left[NOK/_{week}\right]$.

C_{C2} = Total weekly spending for capitalists in private sector 2 $\left[NOK/_{week}\right]$.

I_1 = Total weekly investments for capitalists in private sector 1 $\left[NOK/_{week}\right]$.

I_2 = Total weekly investments for capitalists in private sector 2 $\left[NOK/_{week}\right]$.

I = Total weekly investments for capitalists $\left[NOK/_{week}\right]$.

N = Number of people $[People]$.

N_{Pr1} = Number of people in private sector 1 $[People]$.

N_{Pr2} = Number of people in private sector 2 $[People]$.

N_{Pr} = Number of people in private sector $[People]$.

N_{Pu} = Number of people in public sector {850000} $[People]$.

N_{JG} = Number of people in Job Guarantee program $[People]$.

N_U = Number of unemployed people $[People]$.

TW = Total number of people in the workforce {2800000} $[People]$.

g_r = Growth rate per week {0} $\left[1/_{week}\right]$.

V = Outgoing value from the growth calculation $\left[NOK/_{week}\right]$ or $[People]$.

V_0 = Initial value for the growth calculation $\left[NOK/_{week}\right]$.

x_0 = Initial value for integral $\left[NOK/_{week}\right]$ or $[People]$.

Tax = Total taxes per week $\left[{NOK}/{week}\right]$.

Tax_{Pr1}= Tax on wages for private workers 1 per week $\left[{NOK}/{week}\right]$.

Tax_{Pr2}= Tax on wages for private workers 2 per week $\left[{NOK}/{week}\right]$.

Tax_{Pu} = Tax on wages for public workers per week $\left[{NOK}/{week}\right]$.

Tax_{JG} = Tax on wages for workers in the Job Guarantee program per week $\left[{NOK}/{week}\right]$.

Tax_{U} = Tax on benefits for Unemployed people per week $\left[{NOK}/{week}\right]$.

Tax_{OW}= Tax on benefits for people outside workforce per week $\left[{NOK}/{week}\right]$.

$Tax_{\Pi 1}$ = Tax on profits from private sector 1 $\left[{NOK}/{week}\right]$.

$Tax_{\Pi 2}$ = Tax on profits from private sector 2 $\left[{NOK}/{week}\right]$.

Tax_{FPr1} = Tax on surplus for firms in private sector 1 per week $\left[{NOK}/{week}\right]$.

Tax_{FPr2} = Tax on surplus for firms in private sector 2 per week $\left[{NOK}/{week}\right]$.

Tax_{F} = Tax on surplus from firms $\left[{NOK}/{week}\right]$.

Tax_{Π} = Tax on profits $\left[{NOK}/{week}\right]$.

PT_{Pr1} = Pay roll tax from firms in private sector 1 $\left[{NOK}/{week}\right]$.

PT_{Pr2} = Pay roll tax from firms in private sector 2 $\left[{NOK}/{week}\right]$.

PT_{Pu} = Pay roll tax from firms in public sector $\left[{NOK}/{week}\right]$.

VAT = Value added tax from private consume $\left[{NOK}/{week}\right]$.

t_{Π} = Tax rate on surplus and profits {0.22} [ ]; $0 < t_{\Pi} < 1$. $1 - t_{\Pi}$ is the share of net surplus.

t_g = Tax rate gain on surplus {1.44} [ ].

t_r = Tax rate on regular wages {0.25} [ ]; $0 < t_r < 1$. $1 - t_r$ is the rate of net wages.

t_{JG} = Tax rate on wages for workers in Job Guarantee {0.20} [ ]; $0 < t_{JG} < 1$.

t_U = Tax rate on benefits for unemployed people {0.20} [ ]; $0 < t_U < 1$.

t_{OW} = Tax rate on benefits for people outside workforce {0.10} [ ]; $0 < t_{OW} < 1$.

t_{PT} = Pay roll tax rate {0.14} [ ]; $0 < t_{PT} < 1$.

t_{VAT} = Value added tax rate {0.20} [ ]; $0 < t_{VAT} < 1$.

G = Total government spending $\left[NOK/_{week}\right]$.

G_0 = Net government spending, autonomous and exogenous $\left[NOK/_{week}\right]$.

G_{Pu} = Government support to public sector to cover wages $\left[NOK/_{week}\right]$.

G_{JG} = Government spending on the Job Guarantee program $\left[NOK/_{week}\right]$.

G_U = Government spending on Unemployed people $\left[NOK/_{week}\right]$.

G_κ = Government spending on people outside workforce $\left[NOK/_{week}\right]$.

G_ζ = Government spending on the Job Guarantee program that is not wage $\left[NOK/_{week}\right]$.

G_λ = Government spending on Unemployed people that is not wage $\left[NOK/_{week}\right]$.

G_{SJG} = Government Support to people in the Job Guarantee program during crisis $\left[NOK/_{week}\right]$.

G_{Pr2} = Government Support to Private sector 2 during crisis $\left[NOK/_{week}\right]$.

$(G - T)$ = Public deficit per week $\left[NOK/_{week}\right]$.

$\Sigma(G - T)$ = Sum of total public deficit $[NOK]$.

M = Total money stock $[NOK]$.

M_1 = Money stock number one $[NOK]$.

M_2 = Money stock number 2 $[NOK]$.

M_3 = Money stock number 3 $[NOK]$.

M_{Pr1} = Money stock for workers in private sector 1 $[NOK]$.

M_{Pr2} = Money stock for workers in private sector 2 $[NOK]$.

M_{Pu} = Money stock for workers in public sector $[NOK]$.

M_{JG} = Money stock for workers in the Job Guarantee program $[NOK]$.

M_U = Money stock for Unemployed people $[NOK]$.

M_{C1} = Money stock for capitalists in private sector 1 $[NOK]$.

M_{C2} = Money stock for capitalists in private sector 2 $[NOK]$.

M_{OW} = Money stock for the people outside workforce $[NOK]$.

M_{FPr1} = Money stock for firms in private sector 1 $[NOK]$.

M_{FPr2} = Money stock for firms in private sector 2 $[NOK]$.

M_{FPu} = Money stock for firms in public sector $[NOK]$.

M_0 = Initial money stock $[NOK]$.

M_H = Money stock for households $[NOK]$.

$\dot{M}_H$ = Change in money stock for households per week $\left[{NOK}/{week}\right]$.

M_F = Money stock for firms $[NOK]$.

$\dot{M}_F$ = Change in money stock for firms per week $\left[{NOK}/{week}\right]$.

M_{Pr1_0} = Initial money stock for workers in private sector 1 $\{2.66548086145*10^{10}\}$ $[NOK]$.

M_{Pr2_0} = Initial money stock for workers in private sector 2 $\{3.998222*10^{10}\}$ $[NOK]$.

M_{Pu_0} = Initial money stock for workers in public sector $\{2.8050*10^{10}\}$ $[NOK]$.

M_{JG_0} = Initial money stock for workers in the Job Guarantee program {1.7814819*10^9} $[NOK]$.

M_{U_0} = Initial money stock for Unemployed people {1.7814819*10^9} $[NOK]$.

M_{C1_0} = Initial money stock for capitalists in private sector 1 {1.468138864*10^{10}} $[NOK]$.

M_{C2_0} = Initial money stock for capitalists in private sector 2 {2.202208575*10^{10}} $[NOK]$.

M_{OW_0} = Initial money stock for the people outside workforce {2.3310*10^{10}} $[NOK]$.

M_{FPr1_0} = Initial money stock for firms in private sector 1 {3.4437743682*10^{11}} $[NOK]$.

M_{FPr2_0} = Initial money stock for firms in private sector 2 {5.16566185686*10^{11}} $[NOK]$.

M_{FPu_0} = Initial money stock for firms in public sector {4.14492986*10^{10}} $[NOK]$.

Appendix B – Relevant numbers

What	Value	Unit	When	Source
Population, 0-14	934,958	People	2019	(Statistics Norway, 2020i)
Population, 15-74	4,003,208	People	2019	(Statistics Norway, 2020i)
Population, 75->	390,046	People	2019	(Statistics Norway, 2020i)
Population, 15->	4,393,254	People	2019	(Statistics Norway, 2020i)
Population, 0->	5,328,212	People	2019	(Statistics Norway, 2020i)
Population, 15-74	4,006,000	People	Q1, 2019	(Statistics Norway, 2020j)
Workforce	2,800,000	People	Q1, 2019	(Statistics Norway, 2020j)
Employed	2,692,000	People	Q1, 2019	(Statistics Norway, 2020j)
Unemployed	108,000	People	Q1, 2019	(Statistics Norway, 2020j)
Outside workforce	1,206,000	People	Q1, 2019	(Statistics Norway, 2020j)
Government employees	305,028	People	Q4, 2019	(Statistics Norway, 2020k)
Municipality employees	504,095	People	Q4, 2019	(Statistics Norway, 2020k)
County employees	45,411	People	Q4, 2019	(Statistics Norway, 2020k)

What	Value	Unit	When	Source
Private employees	1,845,958	People	Q4, 2019	(Statistics Norway, 2020k)
Public employees	854,534	People	Q4, 2019	(Statistics Norway, 2020k)
Municipality and county employees	549,506	People	Q4, 2019	(Statistics Norway, 2020k)
Sum all sectors	2,700,492	People	Q4, 2019	(Statistics Norway, 2020k)
Average wage in government, including universities and colleges	51,260	NOK per month	Q4, 2019	(Statistics Norway, 2020l)
Average wage in municipality	43,250	NOK per month	Q4, 2019	(Statistics Norway, 2020l)
Average wage in private sector	47,800	NOK per month	Q4, 2019	(Statistics Norway, 2020l)
Average wage in public sector	46,109	NOK per month	Q4, 2019	(Statistics Norway, 2020l)
Average wage all sectors	47,265	NOK per month	Q4, 2019	(Statistics Norway, 2020l)
Gross profit in non-financial firms	1.04E+12	NOK	2018	(Statistics Norway, 2020m)
Labour costs	940,948,000,000	NOK	2018	(Statistics Norway, 2020m)
Profit in percent of sum and wages in firms	52.60 %	NOK	2018	(Statistics Norway, 2020m)

What	Value	Unit	When	Source
People doing prison sentence	3,791	People	2018	(Statistics Norway, 2020n)
Actually imprisoned	3,552	People	2018	(Statistics Norway, 2020o)
Non-active jobseekers, but still wants to work	199,000	People	Q3, 2020	(Statistics Norway, 2020p)
Number of people on disability benefits, 18-67	364,005	People	2019	(Statistics Norway, 2020q)
0-50 per cent	28,452	People	2019	(Statistics Norway, 2020q)
51-99 per cent	33,414	People	2019	(Statistics Norway, 2020q)
100 per cent	302,140	People	2019	(Statistics Norway, 2020q)
Number of people on disability benefits, 18-67	357,200	People	2020	(NAV, 2020b)
Available jobs	63,300	Positions	Q3, 2020	(Statistics Norway, 2020r)
Minimum wage, holiday and harvest assistance	123.15	NOK	2019	(Arbeidstilsynet, 2019)
Accommodation, dining and catering	134.09	NOK	2019	(Arbeidstilsynet, 2019)

What	Value	Unit	When	Source
Proposal hourly wage, job guarantee	150	NOK per hour	N.A.	N.A.
A working year in hours	1,950	Hours	2020	(Statistics Norway, 2020s)
Proposal weekly wage, job guarantee	5,625	NOK per week	N.A.	N.A.
Tax per cent, given wage proposal	19.5 %	N.A.	2020	(Skatteetaten, 2020)
Proposal yearly wage, job guarantee	292,500	NOK per year	N.A.	N.A.
Low rate retirement pension, with spouse	158,621	NOK per year	2020	(The Norwegian Government, 2020b)
Ordinary rate retirement pension, with spouse	183,587	NOK per year	2020	(The Norwegian Government, 2020b)
High rate retirement pension, with spouse	193,188	NOK per year	2020	(The Norwegian Government, 2020b)
Special rate retirement pension, single	204,690	NOK per year	2020	(The Norwegian Government, 2020b)
Special rate retirement pension, with spouse	300,704	NOK per year	2020	(The Norwegian Government, 2020b)
Ordinary rate disabled, with spouse	231,080	NOK per year	2020	(The Norwegian Government, 2020b)
Ordinary rate young disabled, with spouse	269,594	NOK per year	2020	(The Norwegian Government, 2020b)
High rate disabled, single	251,350	NOK per year	2020	(The Norwegian Government, 2020b)

What	Value	Unit	When	Source
High rate young disabled, single	294,931	NOK per year	2020	(The Norwegian Government, 2020b)
Maximum rate disabled	399,378	NOK per year	2020	(Pedersen, 2020)
Number of retirees	977,084	People	September, 2020	(NAV, 2020d)
Average rate from Norwegian national social insurance scheme	244,300	NOK per year	2019	(NAV, 2020e)
Number of retirees living abroad	50,000	People	June 2020	(NAV, 2020)
Number of retirees living on minimum wage	140,322	People	September, 2020	(NAV, 2020d)
Tax percentage, given average retirement rate	5.7 %	N.A.	2020	(Smarte Penger, 2020a)
Number of people living on disability benefits	362,000	People	2019	(Statistics Norway, 2020t)
Total payments of disability benefits	9.23E+10	NOK	2019	(Statistics Norway, 2020t)
Average payment	254,972	NOK per year	2019	(Statistics Norway, 2020t)
Tax percentage given average payment	17.3 %	N.A.	2020	(Smarte penger, 2020b)
Government revenue on VAT	3.07E+11	NOK	2019	(Statistics Norway, 2020u)

What	Value	Unit	When	Source
Pay-roll tax to the Norwegian national social insurance scheme	1.96E+11	NOK	2019	(Statistics Norway, 2020u)
Membership fees to the Norwegian national social insurance scheme	1.51E+11	NOK	2019	(Statistics Norway, 2020u)
Total payments to retirees	2.55E+11	NOK	2019	(Statistics Norway, 2020v)
Payments to disabled	9.99E+10	NOK	2019	(Statistics Norway, 2020v)
Other pensions	6.46E+09	NOK	2019	(Statistics Norway, 2020v)
Pensions in total	3.61E+11	NOK	2019	(Statistics Norway, 2020v)
Work-related payments	1.09E+11	NOK	2019	(Statistics Norway, 2020v)
Education payments	1.34E+10	NOK	2019	(Statistics Norway, 2020v)
Social payments	1.82E+10	NOK	2019	(Statistics Norway, 2020v)
Whereas introductory benefits to immigrants	3.55E+09	NOK	2019	(Statistics Norway, 2020v)
Other payments	3.56E+09	NOK	2019	(Statistics Norway, 2020v)
Provider payments	1.98E+10	NOK	2019	(Statistics Norway, 2020v)
Sum payments	5.25E+11	NOK	2019	(Statistics Norway, 2020v)

What	Value	Unit	When	Source
Public spending	8.67E+11	NOK	2019	(Statistics Norway, 2020w)
Public gross investments	2.13E+11	NOK	2019	(Statistics Norway, 2020w)
Sum public spending and investments	1.08E+12	NOK	2019	(Statistics Norway, 2020w)
Sum public spending and investments per week	2.08E+10	NOK per week	2019	(Statistics Norway, 2020w)
Yearly average wage, accrued	29,700	NOK per year	1970	(Statistics Norway, 2020x)
Yearly average wage, accrued	519,800	NOK per year	2015	(Statistics Norway, 2020x)
Yearly average wage, accrued	575,700	NOK per year	2019	(Statistics Norway, 2020x)
Change in wage compared to 1970	1,650.17 %	N.A.	2015	(Statistics Norway, 2020x)
Change in wage compared to 1970	1,838.38 %	N.A.	2019	(Statistics Norway, 2020x)
Change in wage compared to 2015	10.75 %	N.A.	2019	(Statistics Norway, 2020x)
Real average wage, 2010 prices	204,100	NOK per year	1970	(Statistics Norway, 2020x)
Real average wage, 2010 prices	476,200	NOK per year	2015	(Statistics Norway, 2020x)
Real average wage, 2010 prices	481,700	NOK per year	2019	(Statistics Norway, 2020x)
Change in wage compared to 1970	133.32 %	N.A.	2015	(Statistics Norway, 2020x)

What	Value	Unit	When	Source
Change in wage compared to 1970	136.01 %	N.A.	2019	(Statistics Norway, 2020x)
Change in wage compared to 2015	1.15 %	N.A.	2019	(Statistics Norway, 2020x)
Inflation relative to 1970	0 %	N.A.	1970	(Statistics Norway, 2020y)
Inflation relative to 1970	681.30 %	N.A.	2015	(Statistics Norway, 2020y)
Inflation relative to 1970	765.60 %	N.A.	2019	(Statistics Norway, 2020y)
Inflation relative to 2015	0 %	N.A.	2015	(Statistics Norway, 2020y)
Inflation relative to 2015	10.80 %	N.A.	2019	(Statistics Norway, 2020y)
GDP, Mainland Norway, accrued prices	84,684,000,000	NOK	1970	(Statistics Norway, 2020z)
GDP, Mainland Norway, accrued prices	2.61408E+12	NOK	2015	(Statistics Norway, 2020z)
GDP, Mainland Norway, accrued prices	3.06841E+12	NOK	2019	(Statistics Norway, 2020z)
Change in GDP compared to 1970	2,986.87 %	N.A.	2015	(Statistics Norway, 2020z)
Change in GDP compared to 1970	3,523.36 %	N.A.	2019	(Statistics Norway, 2020z)
Change in GDP compared to 1970	17.38 %	N.A.	2019	(Statistics Norway, 2020z)

What	Value	Unit	When	Source
Cost of housing	44 000	NOK per employee	N.A.	(Næringseiendom, n.d.)
Income for firms	5,900,605 million	NOK per year	2019	(Statistics Norway, 2020m)
Payed interest rate on debt	134,012 million	NOK per year	2019	(Statistics Norway, 2020m)
Estimated housing and debt expenses for firms in percent of income	5%	N.A.	N.A.	N.A.

Appendix C – Code from MATLAB

Main Script

```
% Script for running models
%-----------------------------------------------------------------------

sigma                   =               0.40;
%       How much of the profit capitalists use to invest

ksi                     =               0.95;
%       How much of the outcome that goes into private firms

zeta                    =               0.80;
%       How much of the JG cost that are wages

rho                     =               0.80;
%       How much of the Unemployment costs that are wages

pi                      =               0.40;
%       How much of Private Firms output that's profit

t                       =               0.25;
%       Taxes

t_OW                    =               0.1;
%       Tax Rate for People Outside Workforce

t_n                     =               0.22;
%       Taxes on surplus and dividend from Private Firms

t_g                     =               1.44;
%       Dividend gain before tax

t_P                     =               0.14;
%       Payroll Tax Rate

t_VAT                   =               0.20;
%       Value Added Tax Rate
```

```
t_JG                    =               0.20;
%       Tax Rate Job Guarantee

t_U                     =               0.20;
%       Tax Rate Unemployed

iota_0                  =               0.5;
%       How much of G that is used on people Outside Workforce initially

G_net_0                 =               1.295*(10)^10;
%       The public spending per week


T_Pr                    =               4;
%       Time Constant for Private Workers

T_Pu                    =               4;
%       Time constant for Public Workers

T_JG                    =               4;
%       Time constant for Job Guarantee

T_C                     =               4;
%       Time constant for Capitalists

T_U                     =               4;
%       Time constant for Unemployed

T_OW                    =               4;
%       Time constant for people Outside Workforce


T_F_Pr                  =               20;
%       Time constant for Private Firms

T_F_Pu                  =               20;
%       Time constant for Public Firms
```

```
N_Pr_1_0                =               740000;
%       Initial number of workers in Private Sector 1

N_Pr_2_0                =               1110000;
%       Initial number of workers in Private Sector 2

N_Pu_0                  =               850000;
%       Initial number of workers in Public Sector

N_JG_0                  =               100000;
%       Initial number of people in Job Guarantee

N_U_0                   =               100000;
%       Initial number of Unemployed

N_WS_0                  =               2800000;
%       Initial number of Workforce

N_P_15                  =               4500000;
%       Number of people from 15 and older

N_P                     =               5500000;
%       Number of people in Population

N_OW_0                  =               N_P_15-N_WS_0;
%       Initial number of people Outside Workforce



w_Pr_0                  =               12000;
%       Weekly wage for Private Workers

w_Pu_0                  =               11000;
%       Weekly wage for Public Workers

w_JG_0                  =               5625;
%       Weekly wage for Job Guarantee.(150 per hour)

p_C                     =               15000;
%       Weekly profits for Capitalists
```

```
ss_U_0                  =               5000;
%       Weekly payment for Unemployed

ss_OW                   =               5000;
%       Weekly payment for people Outside Workforce

W_Pu_0                  =               w_Pu_0*N_Pu_0*(1-t_P)^(-1);
%       Total Weekly wage in the public sector

W_Pr_0                  =               w_Pr_0*N_Pr_0*(1-t_P)^(-1);
%       Total Weekly wage in the private sector

Y_Pr_1                  =               0.4;
%       Initial part of Y_Pr that goes into Private Sector 1

Y_Pr_2                  =               0.6;
%       Initial part of Y_Pr that goes into Private Sector 2

Y_d_F_Pr_1_0            =               2.4*10^10;
%       Start value for Y_d in Private Sector 1


M_F_Pr_1_0              =               3.4437743682*10^11;
%       Initial value for M for Private Firms 1

M_F_Pr_2_0              =               5.16566185686*10^11;
%       Initial value for M for Private Firms 2

M_F_Pu_0                =               4.14492986*10^10;
%       Initial value for M for Public Firms


M_Pr_1_0                =               2.66548086145*10^10;
%       Initial value for M for Private Workers 1

M_Pr_2_0                =               3.998222*10^10;
%       Initial value for M for Private Workers 2

M_Pu_0                  =               N_Pu_0*w_Pu_0*(1-t)*T_Pu;
%       Initial value for M for Public Workers
```

```
M_JG_0                  =               1.7814819*10^9;
%       Initial value for M for Job Guarantee

M_C_1_0                 =               1.468138864*10^10;
%       Initial value for M for Capitalists 1

M_C_2_0                 =               2.202208575*10^10;
%       Initial value for M for Capitalists 2

M_U_0                   =               1.7814819*10^9;
%       Initial value for M for Unemployed

M_OW_0                  =               G_net_0*iota_0*(1-t_OW)*T_OW;
%       Initial value for M for people Outside Workforce



TimeGain1               =               1.5;
%       1st gain for the Time Constants

TimeGain2               =               1.0;
%       2nd gain for the Time Constants

TimeGain3               =               1.2;
%       1st gain for Private Sector 2


TimeGain_Init_1         =               1;
%       Initial value for the TimeGainValue Nr. 1

TimeGain_Init_3         =               30;
%       Initial value for the TimeGainValue Nr. 3

TI                      =               1.5-((exp((-(78/30)))*(1.5-1)));
%       Gain for TimeGain_Init_2

TI2                     =               (1.2-((exp((-(78/30)))*(1.2-1))));
%       Gain for Time constants in Pr_2

TimeGain_Init_2         =               30*1;
%       Initial value for the TimeGainValue Nr. 2
```

```
TimeGain_Init_4         =               100*(TI);
%       Initial value for the TimeGainValue Nr. 4

TimeGain_Init_5         =               100;
%       Initial value for the TimeGainValue Nr. 5

TimeGain_Init_6         =               50*(TI);
%       Initial value for the TimeGainValue Nr. 6

TimeGain_Init_7         =               50;
%       Initial value for the TimeGainValue Nr. 7



SampleTime              =               -1;
%       The sample time for constants

SimTime                 =               0.01;
%       How often to sample to workspace

SimDec                  =               10;
%       How many decimals in variables to workspace

ShockTime1              =               52;
%       Time of financial 1st shock kicks in

ShockTime2              =               130;
%       Time of financial 2nd shock kicks in



Weeks_in_year           =               52;
%       Number of weeks in a year

GDP_GR                  =               0;
%       Annually growth rate

P_GR                    =               0;
%       Rate of population growth per year in per cent
```

```
W_GR                    =               0;
%       Growth Rate of Wages

W_GR_Pu                 =               0;
%       Growth Rate of Public Wages

JG_GR                   =               0;
%       Growth Rate of Job Guarantee Wages

U_GR                    =               0;
%       Growth Rate of Unemployed benefits



D_U                     =               13;
%       Delay in Unemployment benefits in weeks

D_JG                    =               2;
%       Delay in Non-Discretionary Support in JG

D_L                     =               0;
%       How many weeks after crisis support is available for households

l_JG                    =               2000;
%       Weekly crisis Support for people in JG

l_JG_R                  =               0.8;
%       Rate of JG-people who takes the support

S_Pr_2                  =               0.025;
%       How much of income the year before given as support under crisis

D_Pr                    =               0;
%       How long after the crisis is over Support is given to Pr 2

Second_O                =               1;
%       Second order system for Time Constants on or off
```

Plot Script

```
%%       Plotting all the graphs from Simulink:
weeks    =    520;
width    =    1;
%        Number of weeks in simulation

close all;

%%       Figure no. 1:
figure('name', 'Number in JG vs Unemployed');
hold on;
plot(JG.t,JG.N_JG,'LineWidth',width,'Color','blue');
plot(U.t,U.N_U,'LineWidth',width,'Color','red','LineStyle','--');
hold off;
%        Plotting Number of JG vs JG
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'});
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(1),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','N_JG_U.png'));



%%       Figure no. 2:
figure('name','Public Spending');
hold on;
plot(JG.t,JG.G,'LineWidth',width,'Color','blue');
plot(U.t,U.G,'LineWidth',width,'Color','red','LineStyle','--');
%        Plotting G in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
```

```
saveas(figure(2),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'G.png'));



%%       Figure no. 3:
figure('name','G_{JG} vs G_{U}');
hold on;
plot(JG.t,JG.G_JG,'LineWidth',width,'Color','blue');
plot(U.t,U.G_U,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting G spent on JG vs G spent on U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'});
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(3),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'G_JG_U.png'));



%%      Figure no. 4:
figure('name','Public Spending on Public Sector');
hold on;
plot(JG.t,JG.G_Pu,'LineWidth',width,'Color','blue');
plot(U.t,U.G_Pu,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting G spent on Public Sector in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(4),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'G_Pu.png'));
```

```
%%      Figure no. 5:
figure('name','Taxes');
hold on;
plot(JG.t,JG.T,'LineWidth',width,'Color','blue');
plot(U.t,U.T,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting T in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','southeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(5),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'Taxes.png'));



%%      Figure no. 6:
figure('name','Public Deficit');
hold on;
plot(JG.t,JG.GT,'LineWidth',width,'Color','blue');
plot(U.t,U.GT,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting G-T in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'});
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(6),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'GT.png'));



%%      Figure no. 7:
figure('name','Sum of Total Public Deficit');
```

```
hold on;
plot(JG.t,JG.sumGT,'LineWidth',width,'Color','blue');
plot(U.t,U.sumGT,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting sum of G-T in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{NOK}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(7),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'sumGT.png'));


%%      Figure no. 8:
figure('name','Private Spending');
hold on;
plot(JG.t,JG.C,'LineWidth',width,'Color','blue');
plot(U.t,U.C,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting Consume in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','southeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(8),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'C.png'));



%%      Figure no. 9:
figure('name','Number of People in Private Sector');
hold on;
plot(JG.t,JG.N_Pr,'LineWidth',width,'Color','blue');
plot(U.t,U.N_Pr,'LineWidth',width,'Color','red','LineStyle','--');
```

```
%       Plotting Number of Private Workers in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','southeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(9),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'N_Pr.png'));



%%      Figure no. 10:
figure('name','Number of people in Public Sector');
hold on;
plot(JG.t,JG.N_Pu,'LineWidth',width,'Color','blue');
plot(U.t,U.N_Pu,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting Number of Public Workers in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northwest');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
ylim([8.4*10^5 8.6*10^5]);
legend boxoff;
saveas(figure(10),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'N_Pu.png'));



%%      Figure no. 11:
figure('name','Money Supply');
hold on;
plot(JG.t,JG.M,'LineWidth',width,'Color','blue');
plot(U.t,U.M,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting M in JG vs U
```

```
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(11),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'M.png'));



%%      Figure no. 12:
figure('name','Aggregate Demand');
hold on;
plot(JG.t,JG.Y_d,'LineWidth',width,'Color','blue');
plot(U.t,U.Y_d,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting Y_d in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','southeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(12),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','Y_d.png'));



%%      Figure no. 13:
figure('name','Total Workforce');
hold on;
plot(JG.t,JG.TW,'LineWidth',width,'Color','blue');
plot(U.t,U.TW,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting Y_d in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
```

```
    'Location','northwest');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
ylim([2.7*10^6 2.9*10^6]);
legend boxoff;
saveas(figure(13),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','TW.png'));


%%      Figure no. 14:
figure('name','Number of People in Private Sector 1');
hold on;
plot(JG.t,JG.N_Pr_1,'LineWidth',width,'Color','blue');
plot(U.t,U.N_Pr_1,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting Number of Private Workers 1 in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
ylim([7.3*10^5 7.5*10^5]);
legend boxoff;
saveas(figure(14),fullfile('C:\','Users','torjust','Desktop','Plots',...
    'N_Pr1.png'));



%%      Figure no. 15:
figure('name','Number of People in Private Sector 2');
hold on;
plot(JG.t,JG.N_Pr_2,'LineWidth',width,'Color','blue');
plot(U.t,U.N_Pr_2,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting Number of Private Workers 2 in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','southeast');
```

```
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(15),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','N_Pr2.png'));



%%      Figure no. 16:
figure('name','Number of People Employed');
hold on;
plot(JG.t,JG.E,'LineWidth',width,'Color','blue');
plot(U.t,U.E,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting Number of People Employed in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','southeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(16),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','N_E.png'));



%%      Figure no. 17:
figure('name','Output of the Economy');
hold on;
plot(JG.t,JG.Y_o,'LineWidth',width,'Color','blue');
plot(U.t,U.Y_o,'LineWidth',width,'Color','red','LineStyle','--');
%       Plotting The Economy's Output in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','southeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
```

```
legend boxoff;
saveas(figure(17),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','Y_o.png'));



%%      Figure no. 18:
figure('name','Total Public Spending');
hold on;
plot(JG.t,JG.sumG,'LineWidth',width,'Color','blue');
plot(U.t,U.sumG,'LineWidth',width,'Color','red','LineStyle','--');
%       Total Public Spending in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northwest');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{NOK}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(18),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','sumG.png'));

%%      Figure no. 19:
figure('name','Total Taxes Paid');
hold on;
plot(JG.t,JG.sumT,'LineWidth',width,'Color','blue');
plot(U.t,U.sumT,'LineWidth',width,'Color','red','LineStyle','--');
%       Total Taxes Paid in JG vs U
hold off;
grid;
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northwest');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{NOK}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(19),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','sumT.png'));
```

```
%%      Figure no. 20:
figure('name','Public Support during Crisis');
hold on;
plot(JG.t,JG.G_Pr_2,'LineWidth',width,'Color','blue');
plot(JG.t,JG.G_S_JG,'LineWidth',width,'Color','red','LineStyle','--');
%       Public Support during Crisis in Economy with JG
hold off;
grid;
legend({'Support to Private Sector 2','Support to people in JG'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{NOK}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(20),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','G_S.png'));

%%      Figure no. 21:
figure('name','Total Public Support during Crisis');
hold on;
plot(JG.t,JG.sumG_S,'LineWidth',width,'Color','blue','LineStyle','-');
%       Total Public Support during Crisis in Economy with JG
hold off;
grid;
legend({'Total Public Support'},'Location','southeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{NOK}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(21),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','sumG_S.png'));

%%      Figure no. 22:
figure('name','Private spending with different dynamics');
hold on;
plot(JG2.t,JG2.C,'LineWidth',width,'Color','red','LineStyle','--');
plot(JG1.t,JG1.C,'LineWidth',width,'Color','blue');
plot(JG3.t,JG3.C,'LineWidth',width,'Color','magenta','LineStyle','-.');
%       Private spending with different dynamics
hold off;
grid;
```

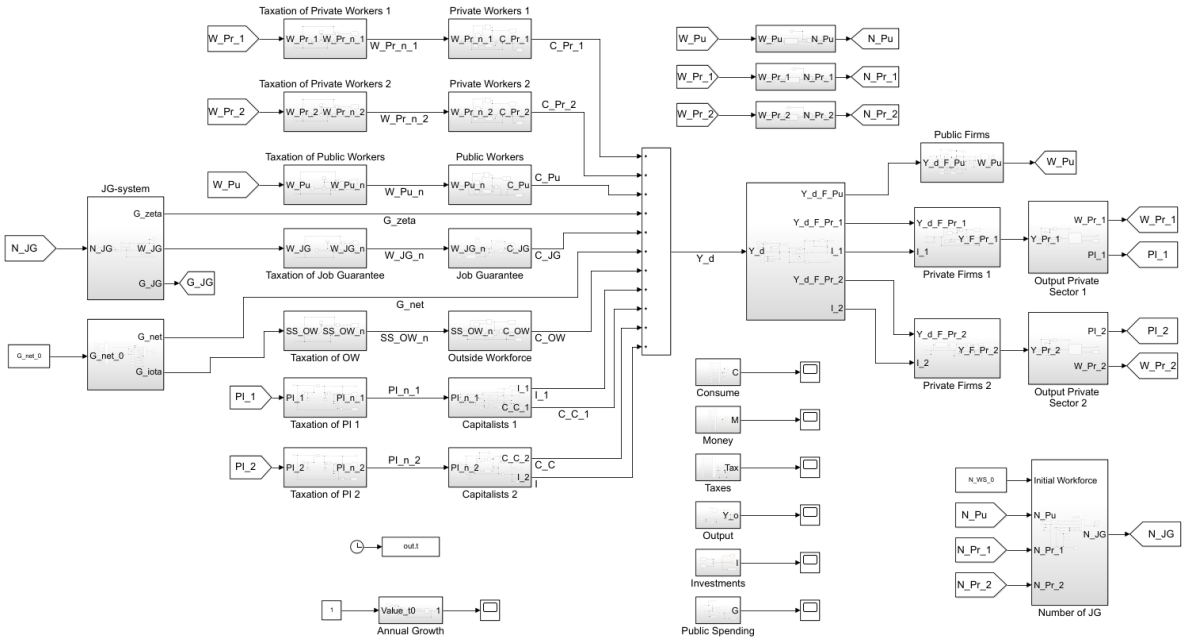
```
legend({'Time constant = 1','Time constant = 100','Time constant =
500'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\frac{\textbf{NOK}}{\textbf{week}}$','Interpreter','latex');
xlim([0 weeks]);
legend boxoff;
saveas(figure(22),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','C_JG_dyn.png'));

%%      Figure no. 23:
figure('name','Number in JG with different dynamics');
hold on;
plot(JG2.t,JG2.N_JG,'LineWidth',width,'Color','red','LineStyle','--');
plot(JG1.t,JG1.N_JG,'LineWidth',width,'Color','blue');
plot(JG3.t,JG3.N_JG,'LineWidth',width,'Color','magenta','LineStyle','-.');
%       Number in JG with different dynamics
hold off;
grid;
legend({'Time constant = 1','Time constant = 100','Time constant =
500'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
ylim([0.1*10^5 1.9*10^5]);
legend boxoff;
saveas(figure(23),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','N_JG_dyn.png'));



%%      Figure no. 24:
figure('name','Average in JG and unemployed');
hold on;
plot(out.t,out.avgJG,'LineWidth',width,'Color','blue');
plot(out.t,out.avgU,'LineWidth',width,'Color','red','LineStyle','--');

%       Average number in JG and U
hold off;
grid;
```

```
legend({'Economy with Job Guarantee','Economy with Unemployment'},...
    'Location','northeast');
xlabel('$\textbf{Weeks}$','Interpreter','latex');
ylabel('$\textbf{People}$','Interpreter','latex');
xlim([0 weeks]);
ylim([0.8*10^5 2.1*10^5]);
legend boxoff;
saveas(figure(24),fullfile('C:\','Users','torjust','Desktop',...
    'Plots','avg.png'));
```

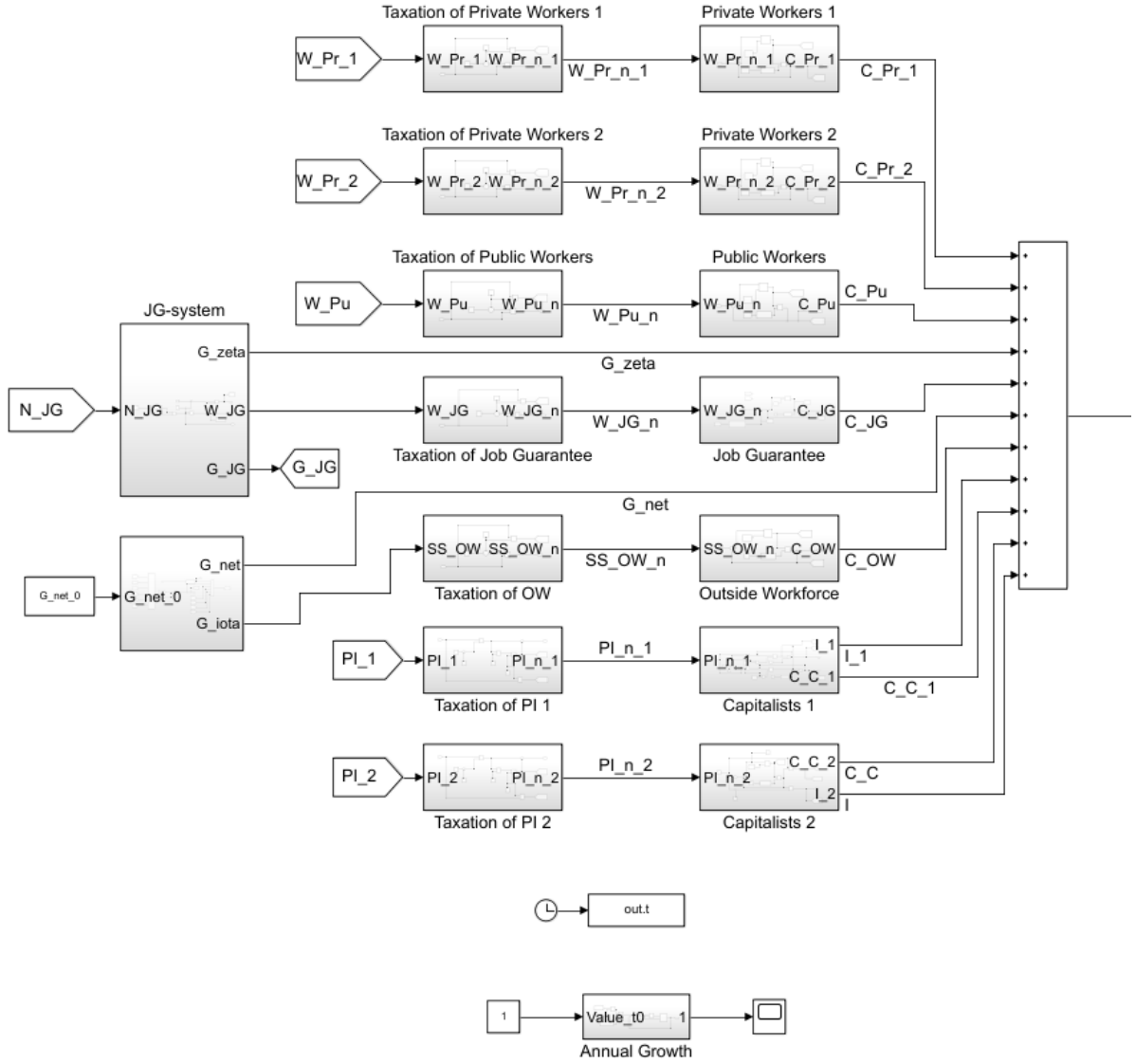
Appendix D – Complete systems

JG-system

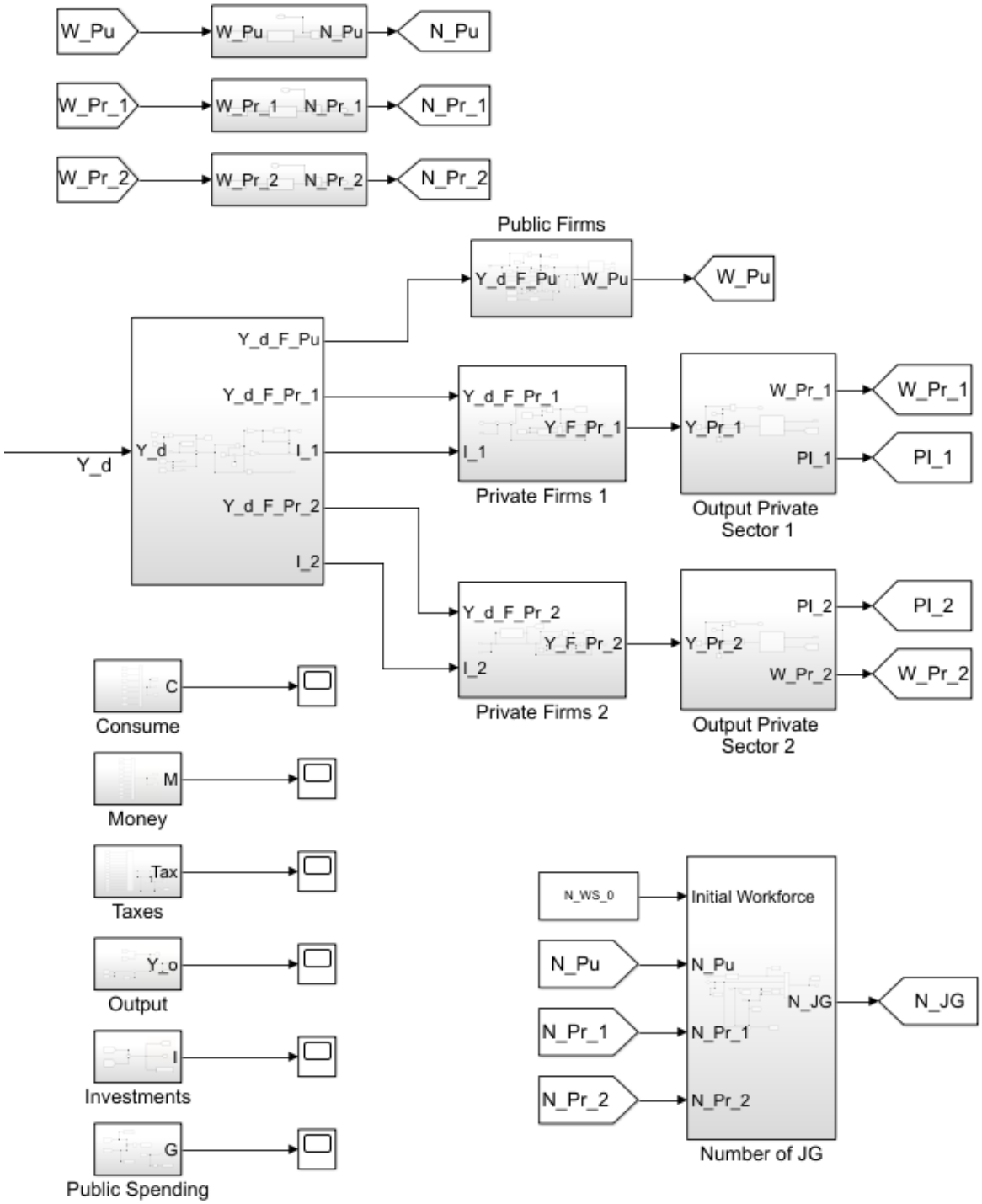
Overview



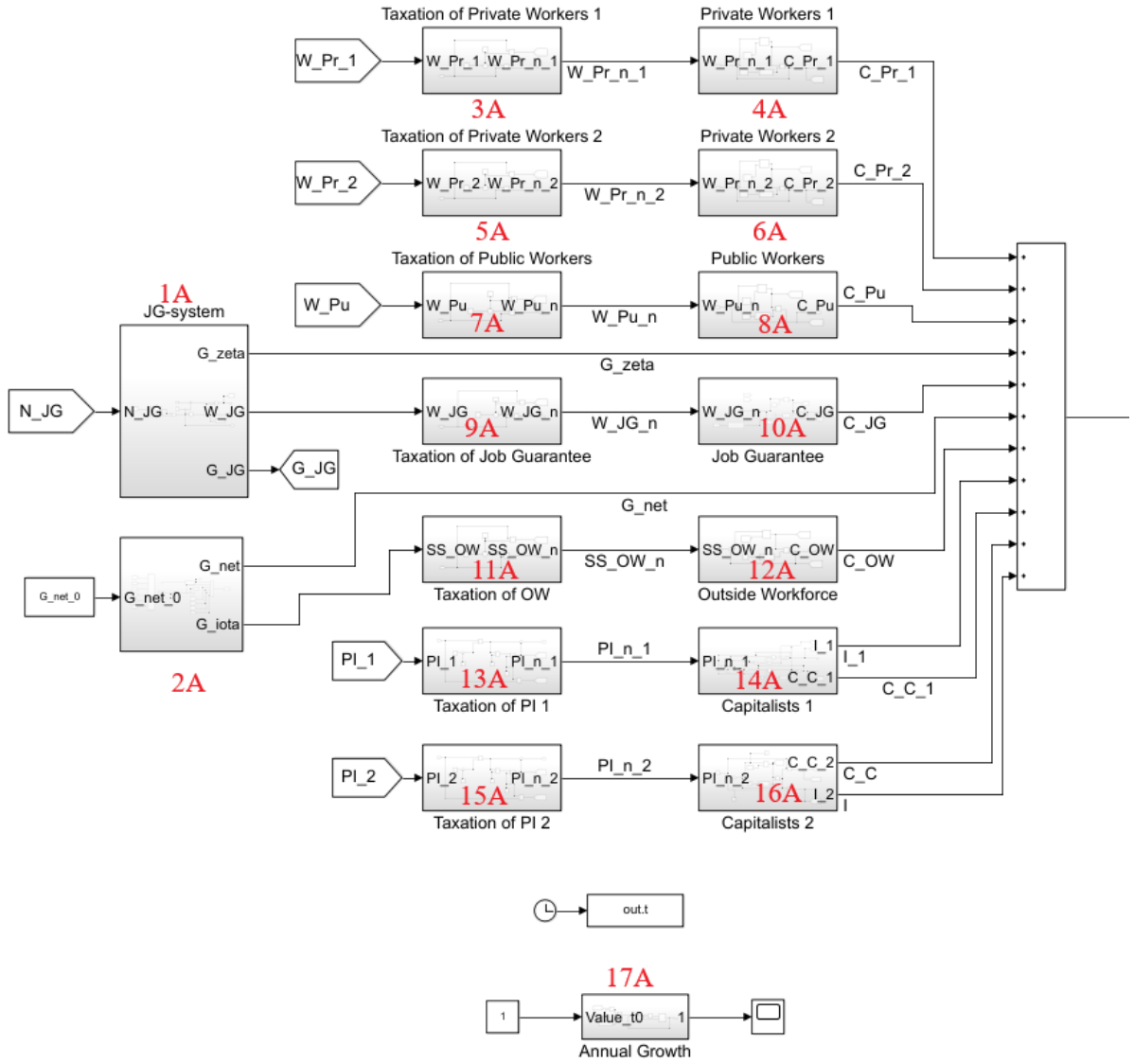
Part 1 of the system



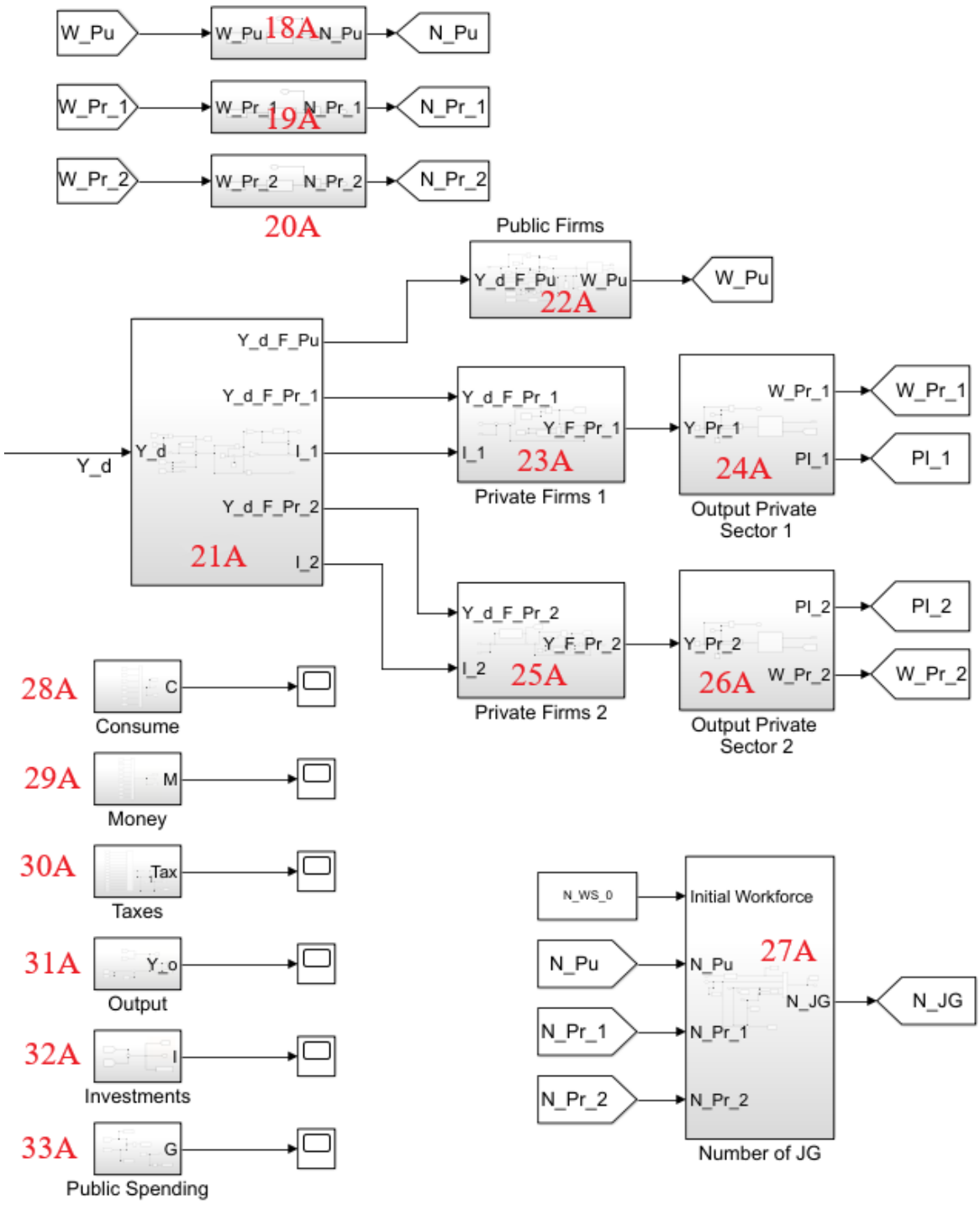
Part 2 of the system



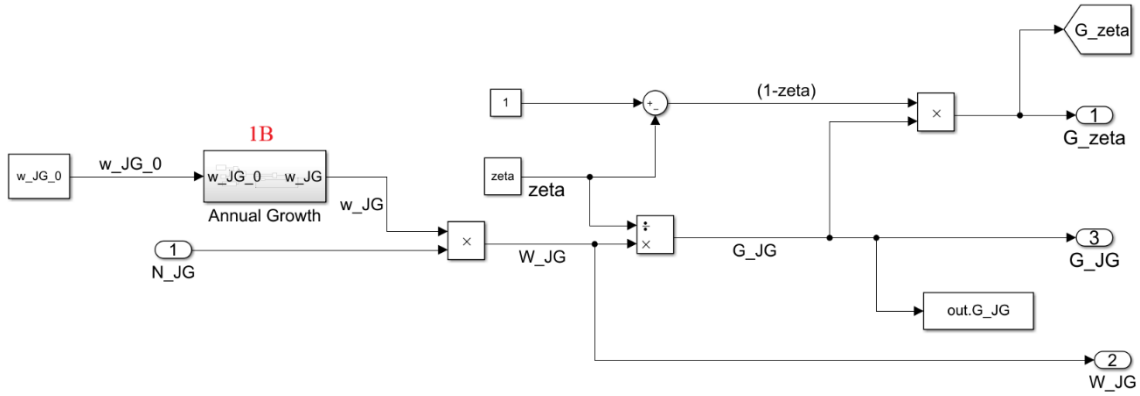
Part 1 with codes for mapping



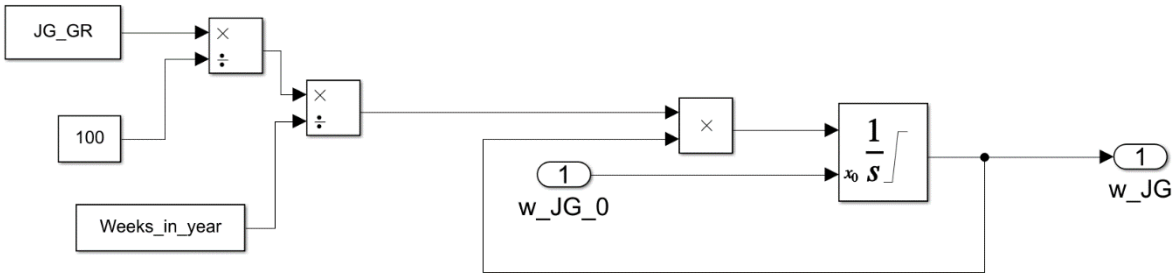
Part 2 with codes for mapping



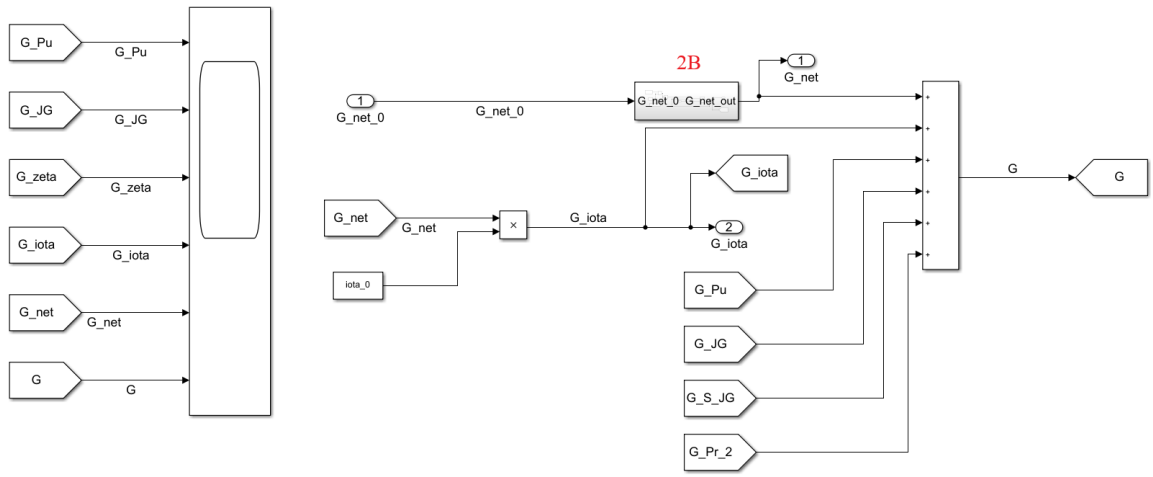
1A


w_JG_0
w_JG_0
1B
w_JG_0
w_JG
Annual Growth
w_JG
1
N_JG
1
zeta
zeta
(1-zeta)
G_zeta
1
G_zeta
W_JG
G_JG
3
G_JG
out.G_JG
2
W_JG

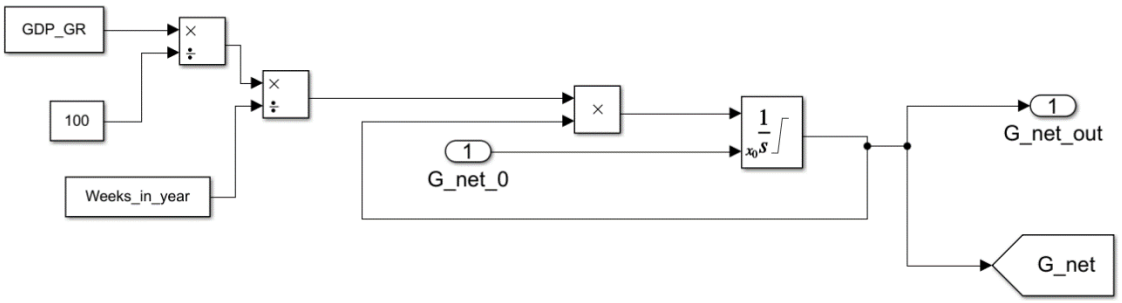
1B


JG_GR
100
Weeks_in_year
1
w_JG_0
1
s
1
w_JG

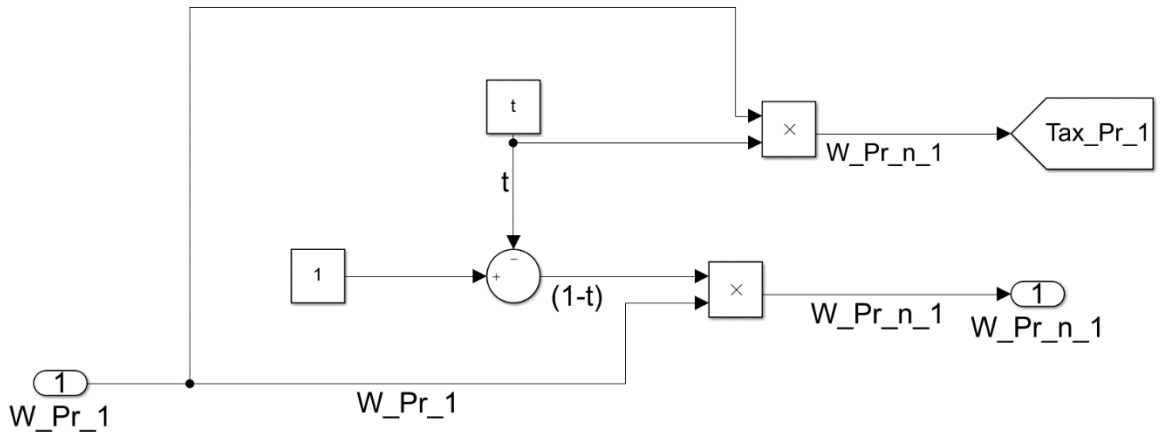
2A


G_Pu
G_Pu
G_JG
G_JG
G_zeta
G_zeta
G_iota
G_iota
G_net
G_net
G
G
2B
1
G_net_0
G_net_0
G_net_0 G_net_out
1
G_net
G_net
G_net
G_iota
G_iota
2
G_iota
iota_0
G_Pu
G_JG
G_S_JG
G_Pr_2
G
G

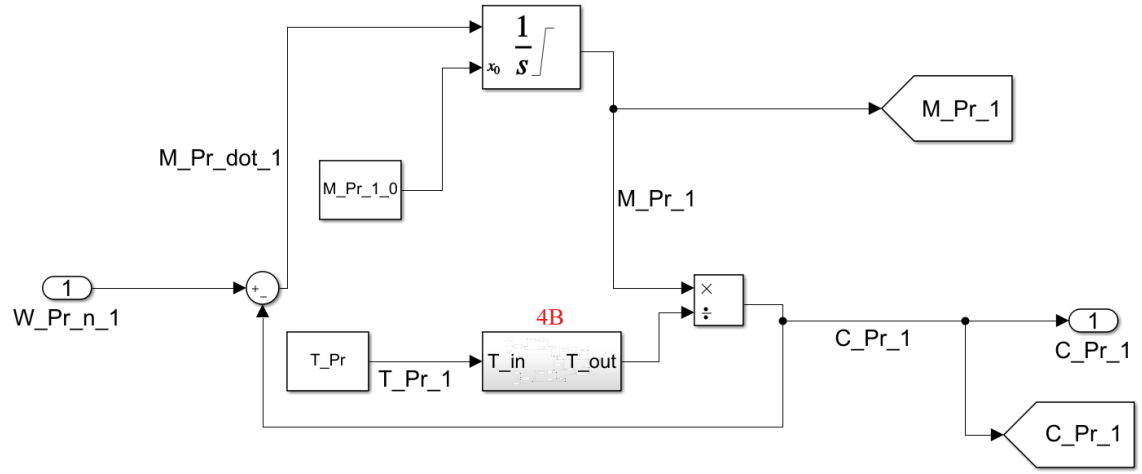
2B


GDP_GR
100
Weeks_in_year
1
G_net_0
1
G_net_out
G_net

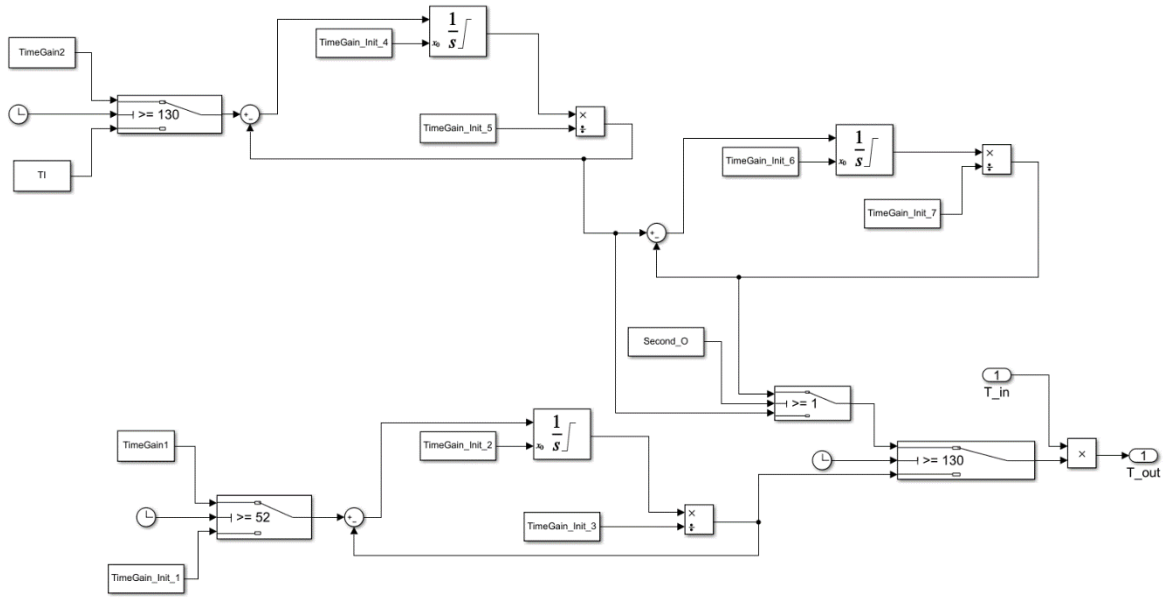
3A


t
t
1
(1-t)
W_Pr_n_1
Tax_Pr_1
W_Pr_n_1
1
W_Pr_n_1
1
W_Pr_1
W_Pr_1

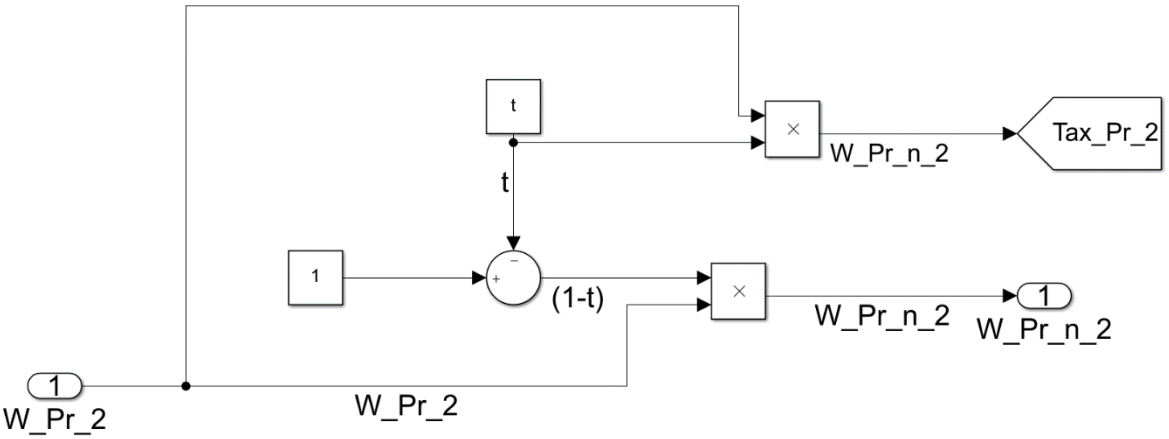
4A


M_Pr_dot_1
M_Pr_1_0
M_Pr_1
M_Pr_1
1
W_Pr_n_1
4B
T_Pr
T_Pr_1
T_in
T_out
C_Pr_1
1
C_Pr_1
C_Pr_1

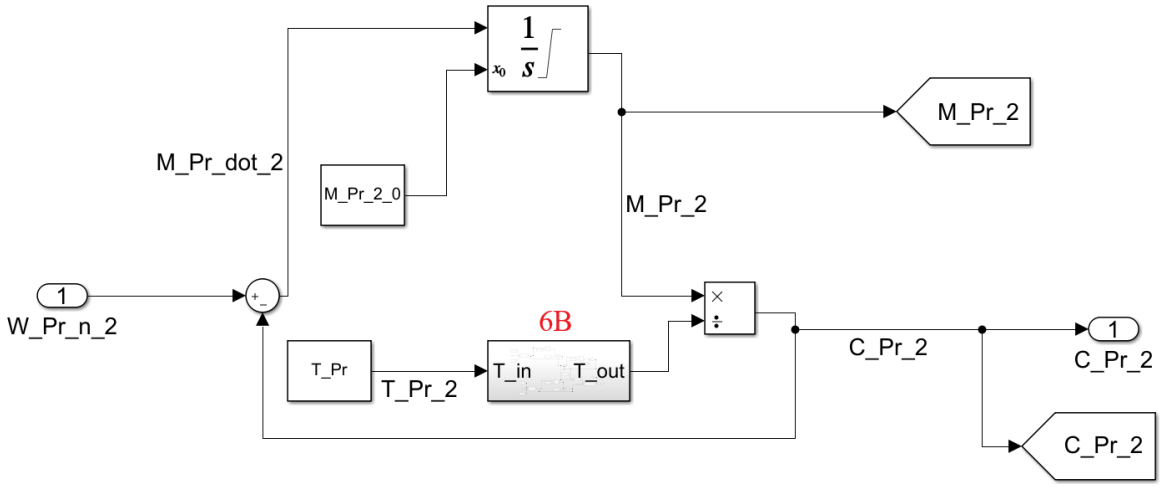
4B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
>= 130
T_out
TimeGain1
>= 52
TimeGain_Init_2
TimeGain_Init_3
TimeGain_Init_1

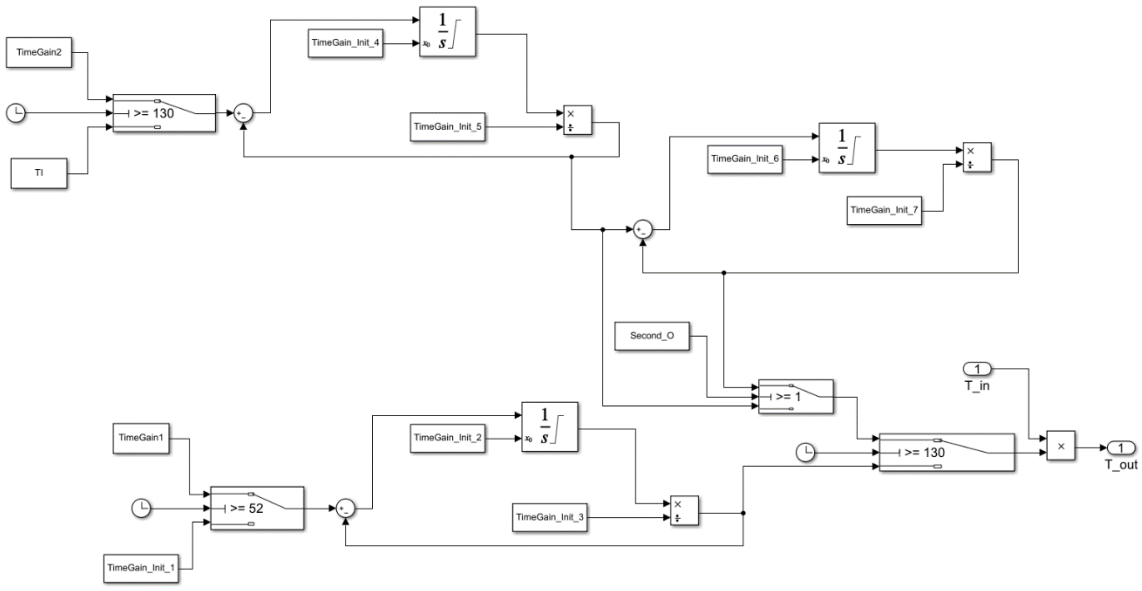
5A


t
W_Pr_n_2
Tax_Pr_2
t
1
(1-t)
W_Pr_n_2
1
W_Pr_n_2
1
W_Pr_2
W_Pr_2

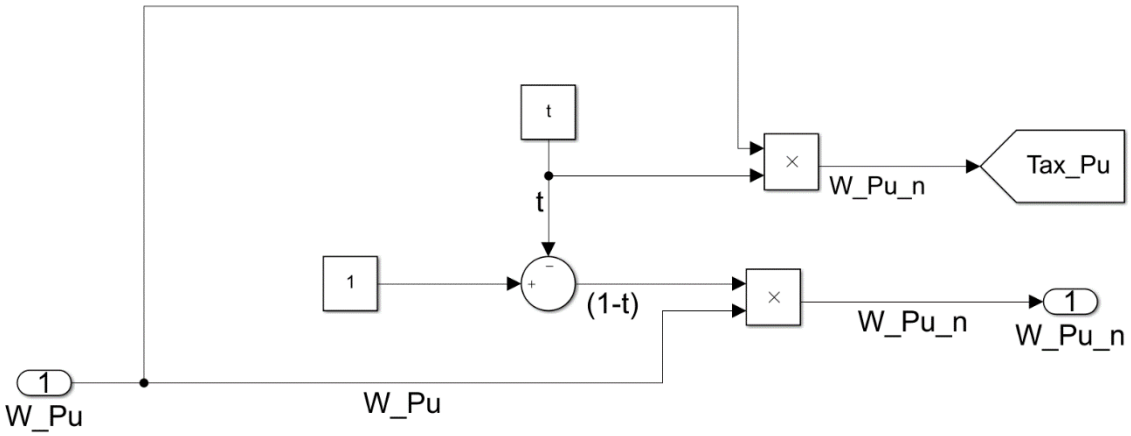
6A


1
W_Pr_n_2
M_Pr_dot_2
M_Pr_2_0
M_Pr_2
M_Pr_2
6B
T_Pr
T_Pr_2
T_in
T_out
C_Pr_2
1
C_Pr_2
C_Pr_2

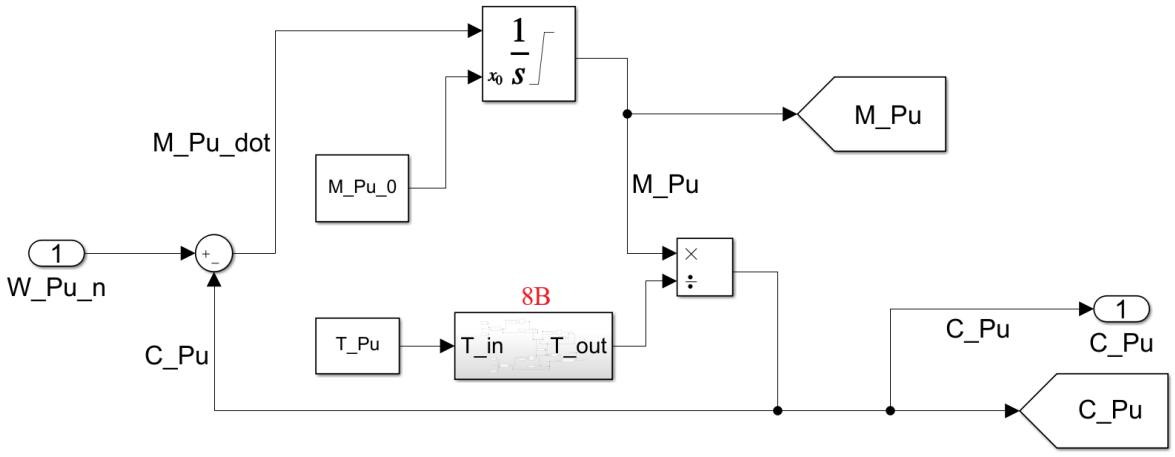
6B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
1
T_in
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3
>= 130
1
T_out

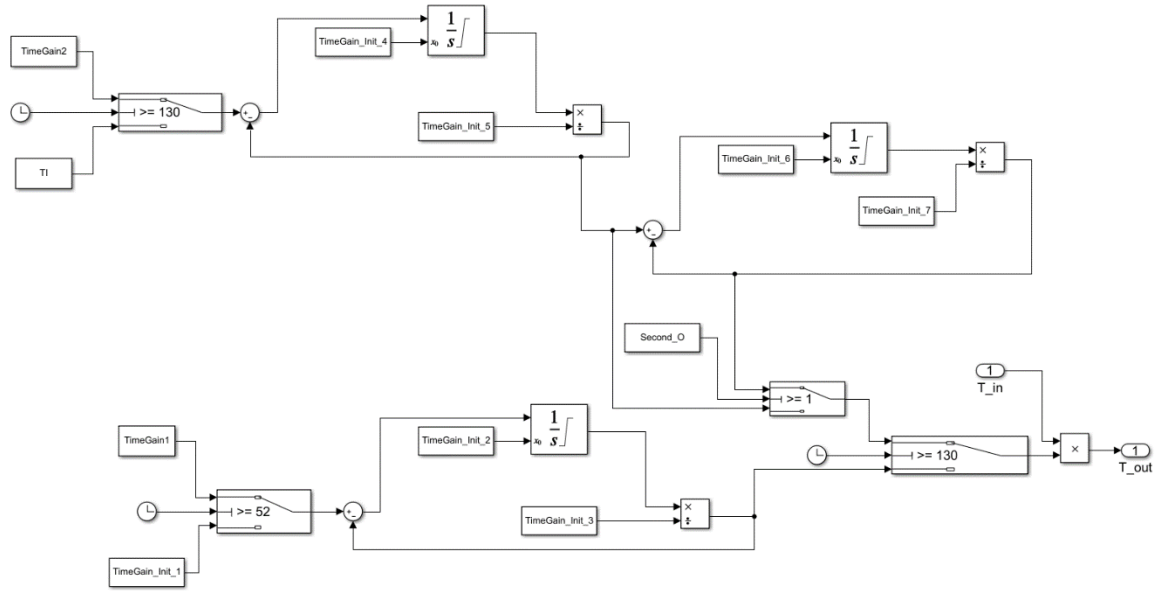
7A


t
t
W_Pu_n
Tax_Pu
1
(1-t)
W_Pu_n
1
W_Pu_n
1
W_Pu
W_Pu

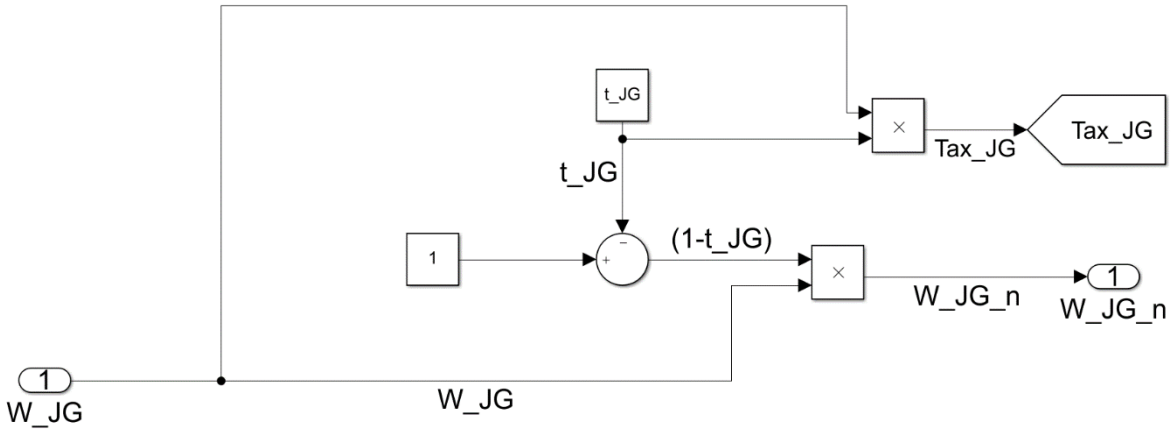
8A


M_Pu_dot
M_Pu_0
M_Pu
M_Pu
1
W_Pu_n
8B
T_Pu
T_in
T_out
C_Pu
C_Pu
1
C_Pu
C_Pu

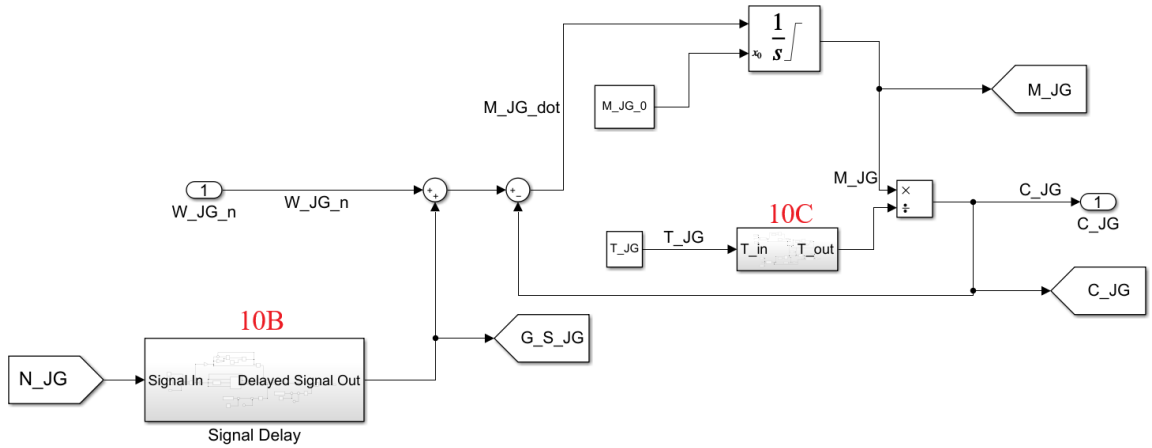
8B


TimeGain2
TI
>= 130
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
T_out
>= 130
TimeGain1
TimeGain_Init_1
>= 52
TimeGain_Init_2
TimeGain_Init_3

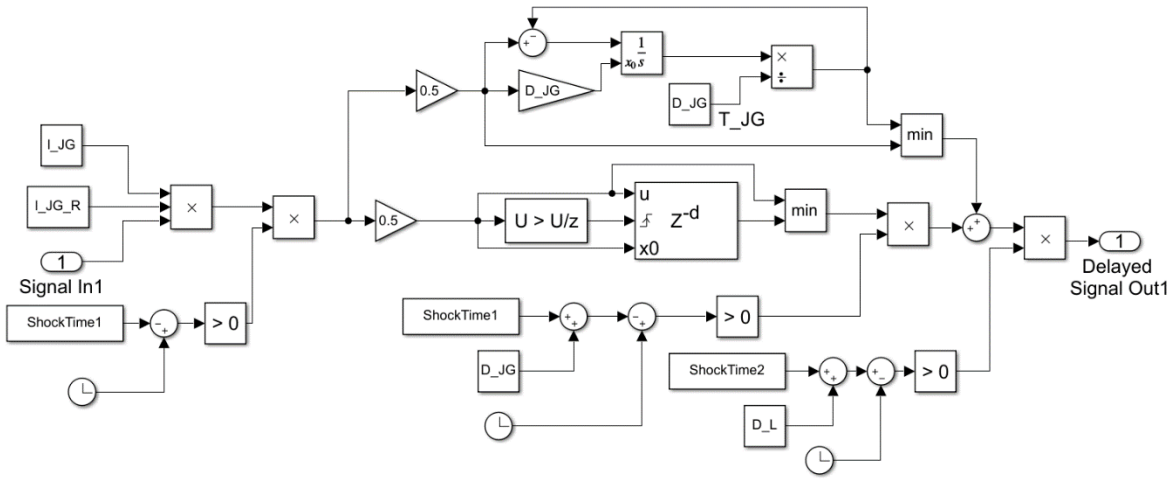
9A


t_JG
Tax_JG
Tax_JG
t_JG
1
(1-t_JG)
W_JG_n
W_JG_n
1
W_JG
W_JG

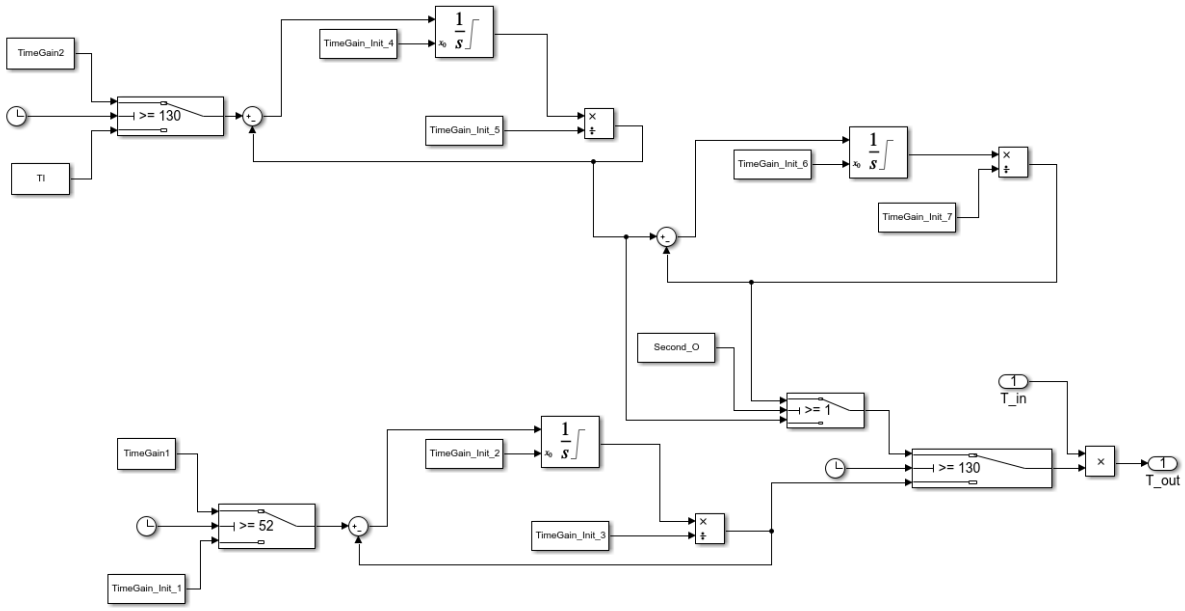
10A


M_JG_dot
M_JG_0
M_JG
W_JG_n
W_JG_n
M_JG
C_JG
C_JG
10C
T_JG
T_JG
T_in
T_out
C_JG
10B
N_JG
Signal In
Delayed Signal Out
G_S_JG
Signal Delay

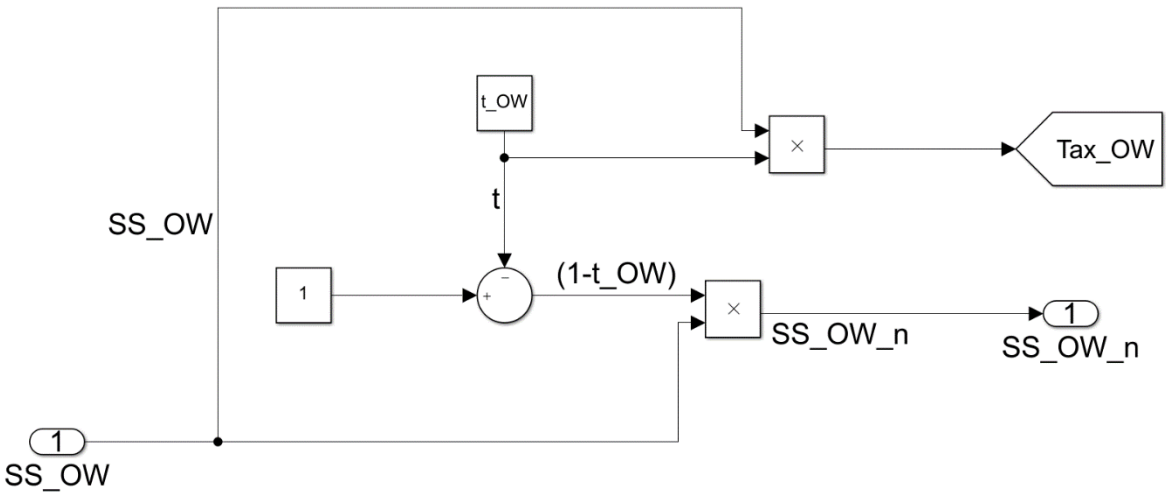
10B


I_JG
I_JG_R
Signal In1
ShockTime1
> 0
0.5
0.5
D_JG
D_JG
T_JG
min
U > U/z
u
z-d
x0
min
ShockTime1
> 0
D_JG
ShockTime2
> 0
D_L
Delayed
Signal Out1

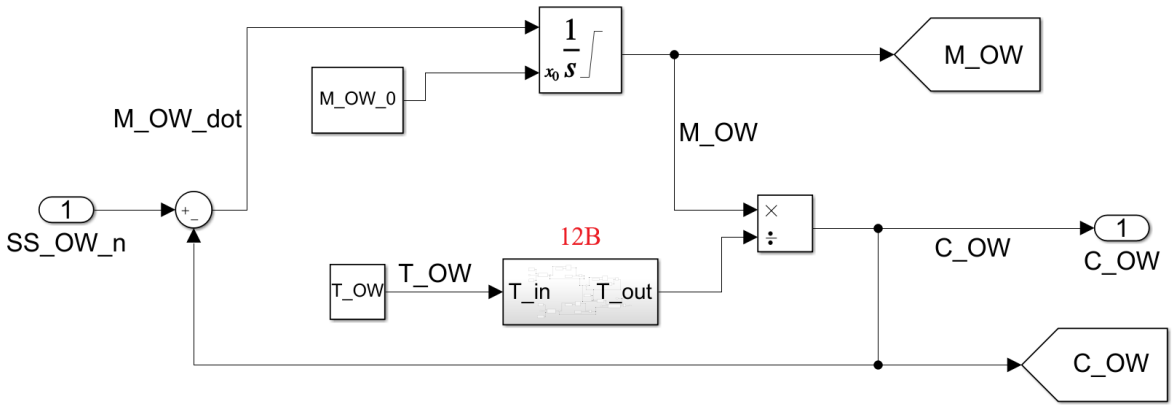
10C


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
T_out
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3
>= 130

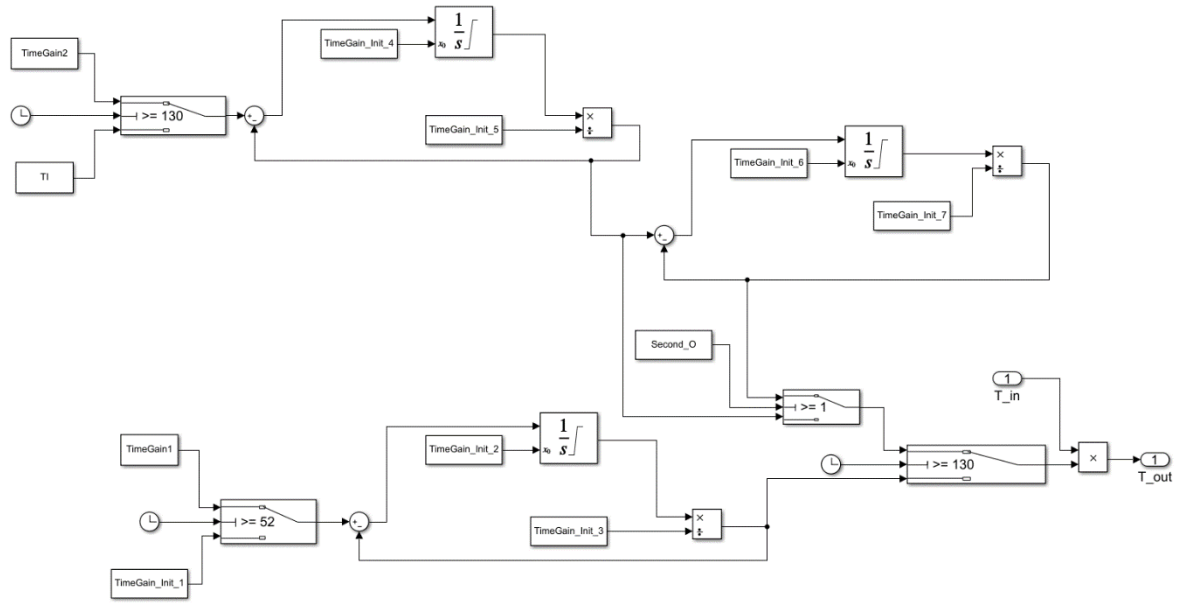
11A


t_OW
Tax_OW
t
SS_OW
1
(1-t_OW)
SS_OW_n
SS_OW_n
1
SS_OW

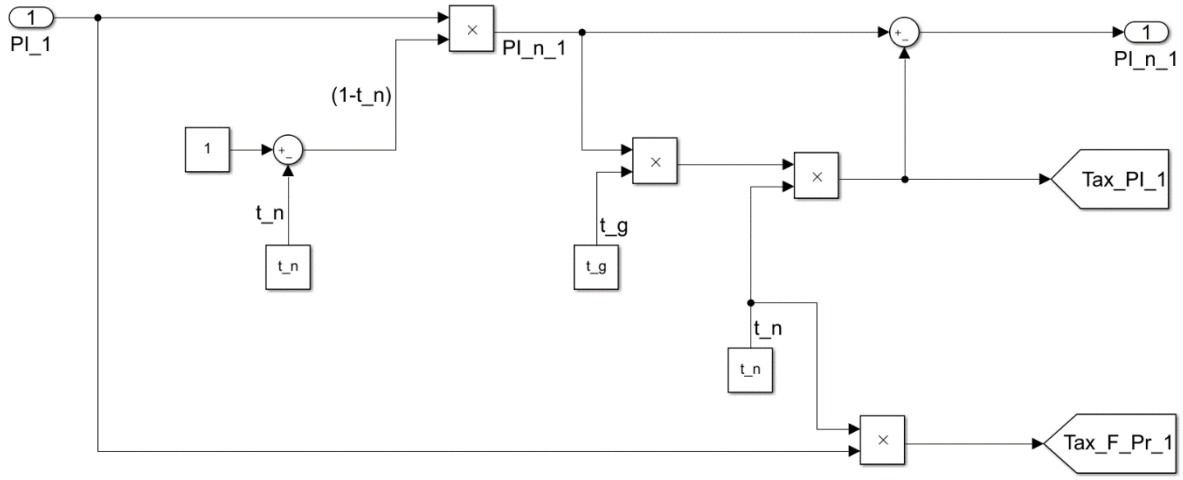
12A


M_OW_dot
M_OW_0
M_OW
M_OW
1
SS_OW_n
12B
C_OW
1
C_OW
T_OW
T_OW
T_in
T_out
C_OW

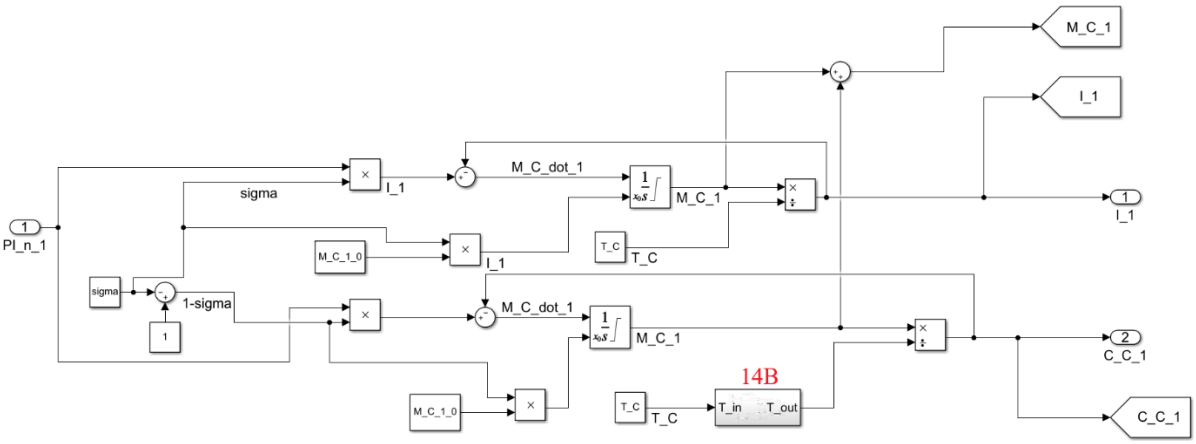
12B


TimeGain2
TimeGain_Init_4
>= 130
TimeGain_Init_5
TI
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
1
T_in
TimeGain1
TimeGain_Init_2
>= 130
1
T_out
>= 52
TimeGain_Init_3
TimeGain_Init_1

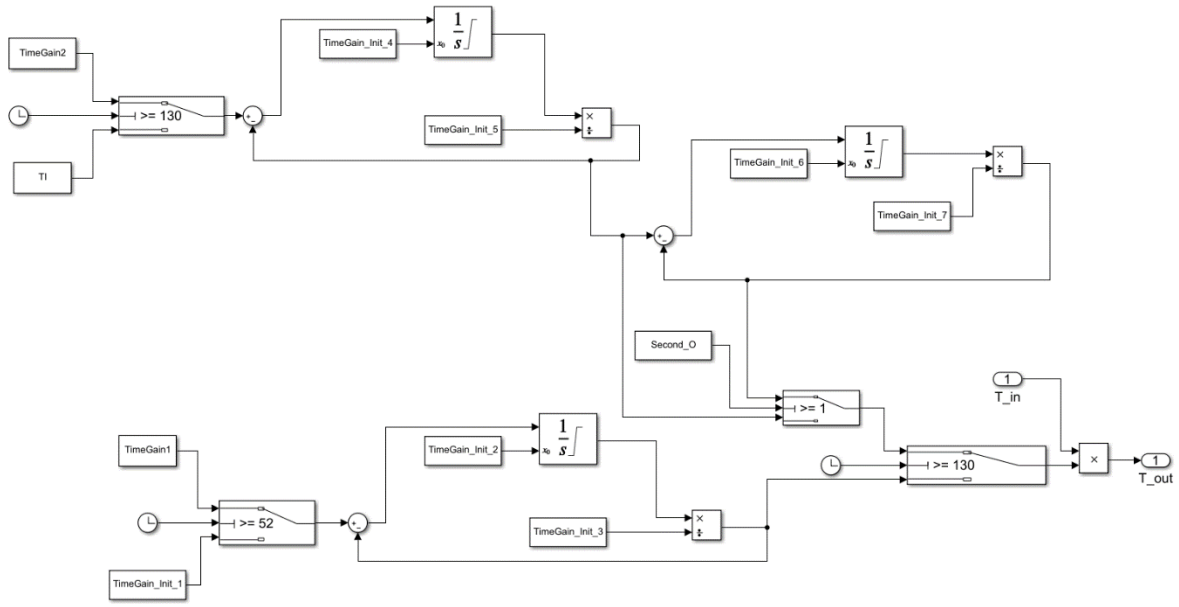
13A


1
Pl_1
Pl_n_1
(1-t_n)
1
t_n
t_n
t_g
t_g
t_n
t_n
Tax_Pl_1
Tax_F_Pr_1
1
Pl_n_1

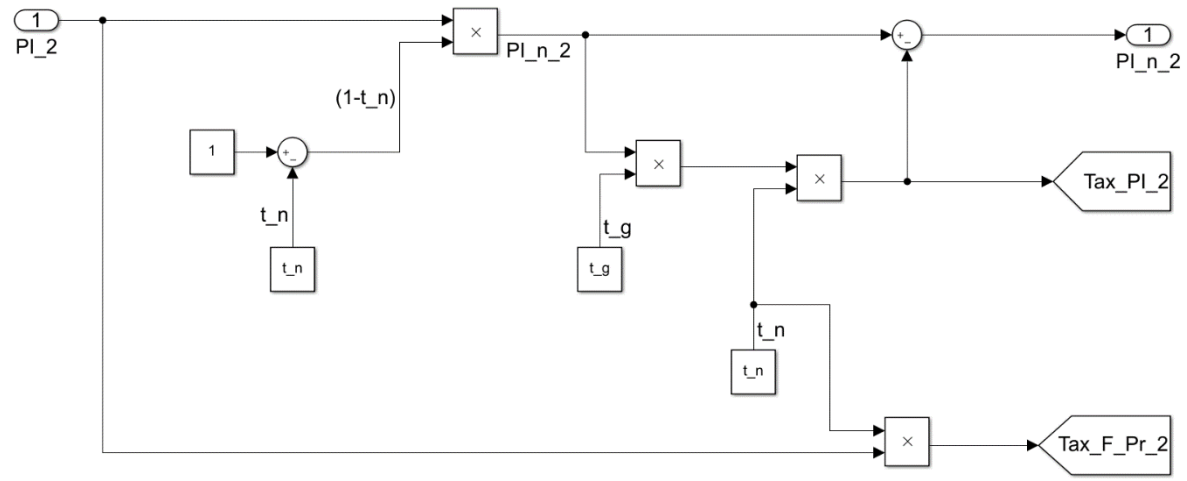
14A


M_C_1
I_1
1
I_1
2
C_C_1
C_C_1
1
Pl_n_1
sigma
I_1
M_C_dot_1
M_C_1
M_C_1_0
I_1
T_C
T_C
sigma
1-sigma
1
M_C_dot_1
M_C_1
M_C_1_0
T_C
T_C
T_in
T_out
14B

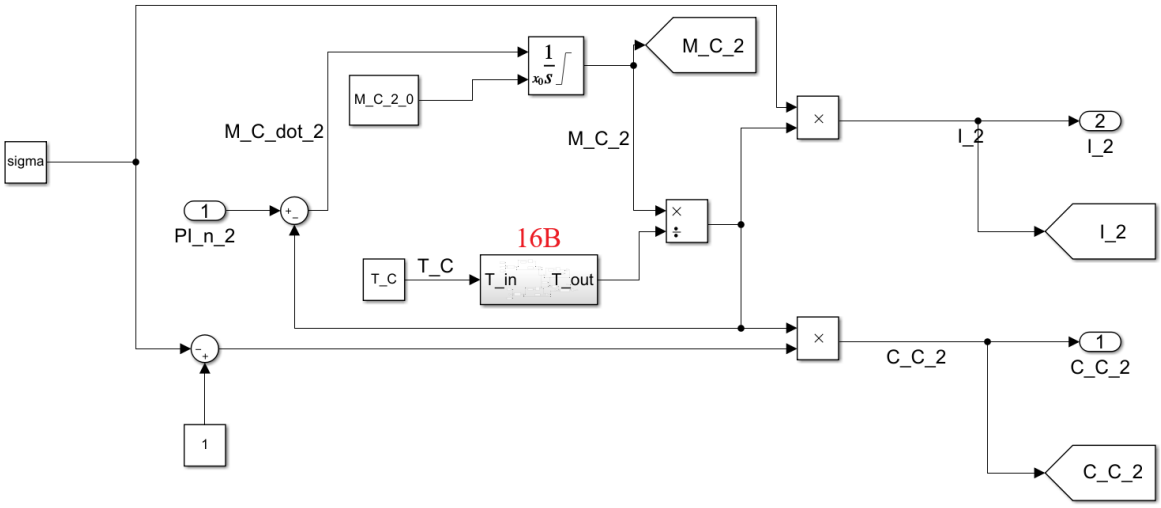
14B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
T_out
>= 130
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3

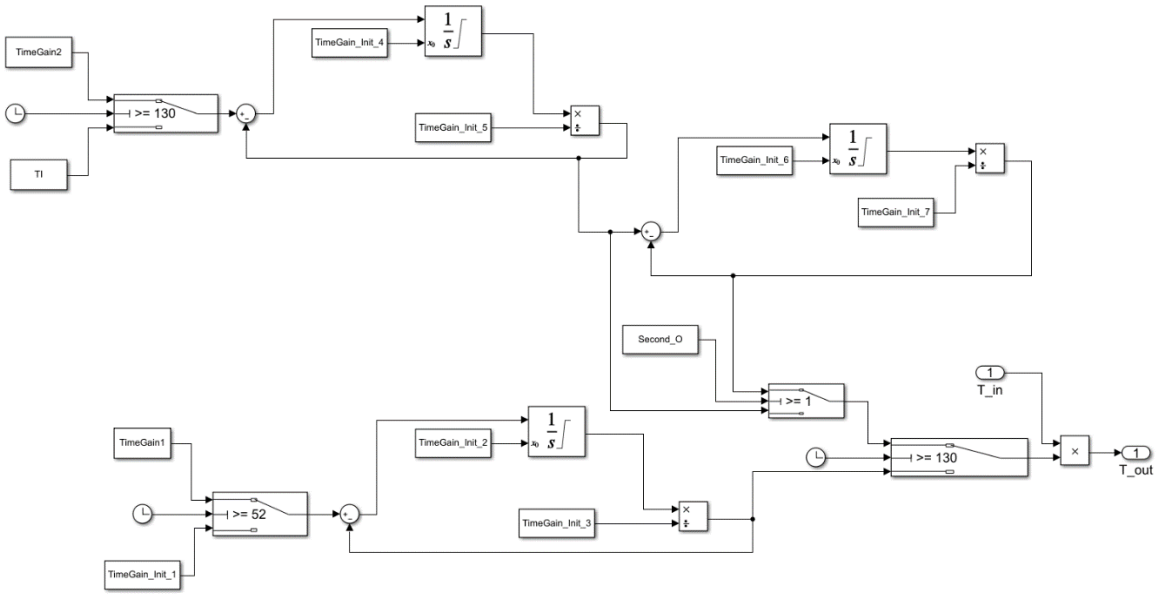
15A


1
PI_2
(1-t_n)
1
t_n
t_n
PI_n_2
t_g
t_g
t_n
t_n
1
PI_n_2
Tax_PI_2
Tax_F_Pr_2

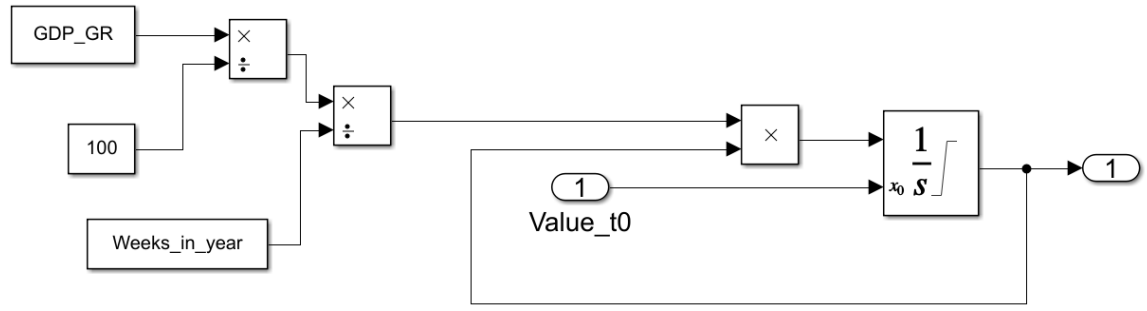
16A


sigma
M_C_dot_2
M_C_2_0
M_C_2
M_C_2
I_2
2
I_2
1
PI_n_2
16B
T_C
T_C
T_in
T_out
I_2
C_C_2
1
C_C_2
1
C_C_2

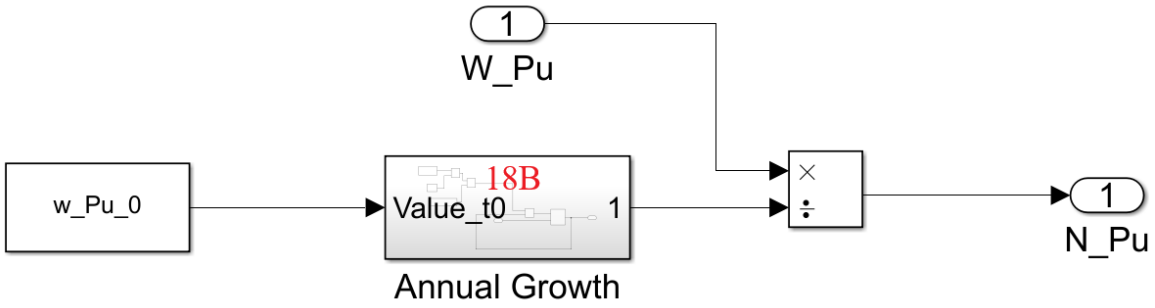
16B


TimeGain2
TimeGain_Init_4
I >= 130
TimeGain_Init_5
TI
TimeGain_Init_6
TimeGain_Init_7
Second_O
I >= 1
1
T_in
TimeGain1
TimeGain_Init_2
I >= 130
1
T_out
I >= 52
TimeGain_Init_3
TimeGain_Init_1

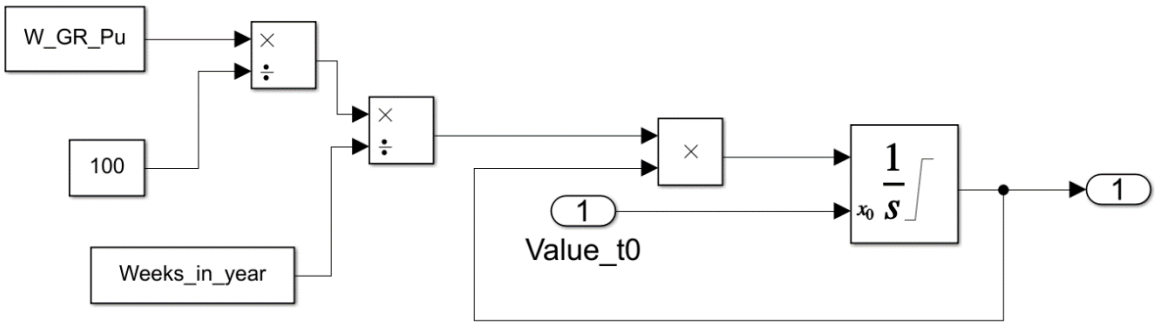
17A


GDP_GR
100
Weeks_in_year
1
Value_t0
1
1

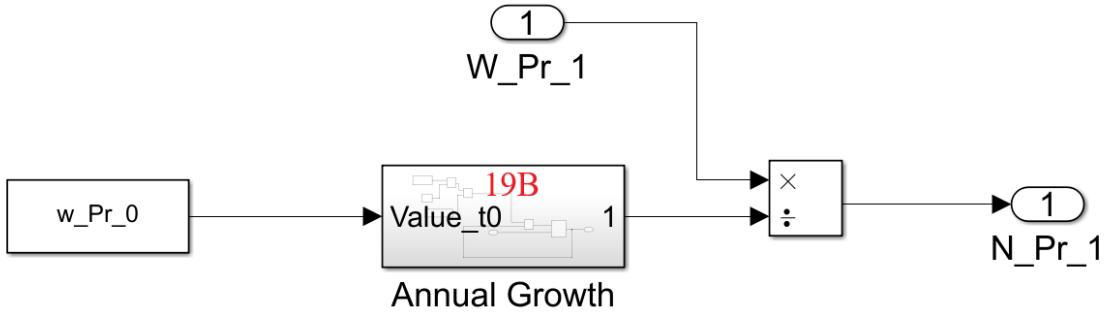
18A


1
W_Pu
w_Pu_0
18B
Value_t0
1
Annual Growth
1
N_Pu

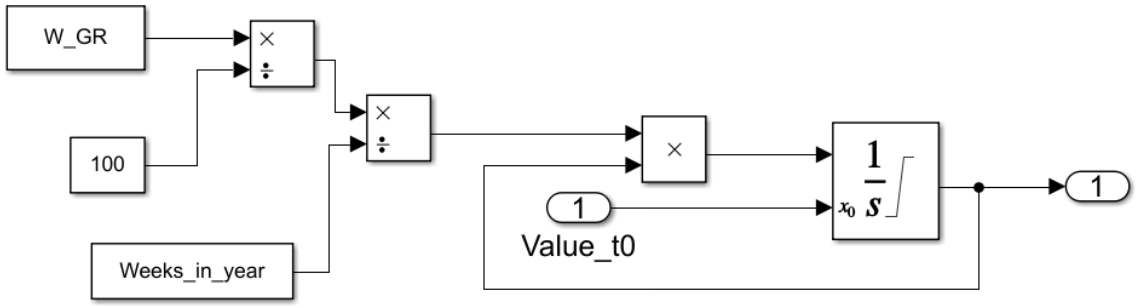
18B


W_GR_Pu
100
Weeks_in_year
1
Value_t0
1
1

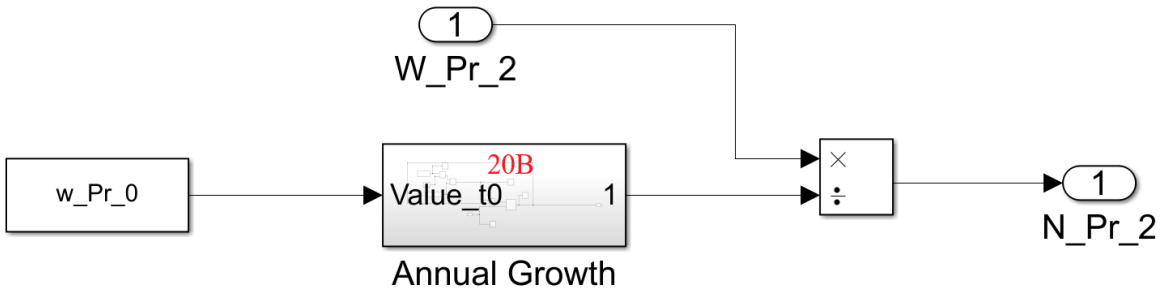
19A


1
W_Pr_1
w_Pr_0
19B
Value_t0
1
Annual Growth
1
N_Pr_1

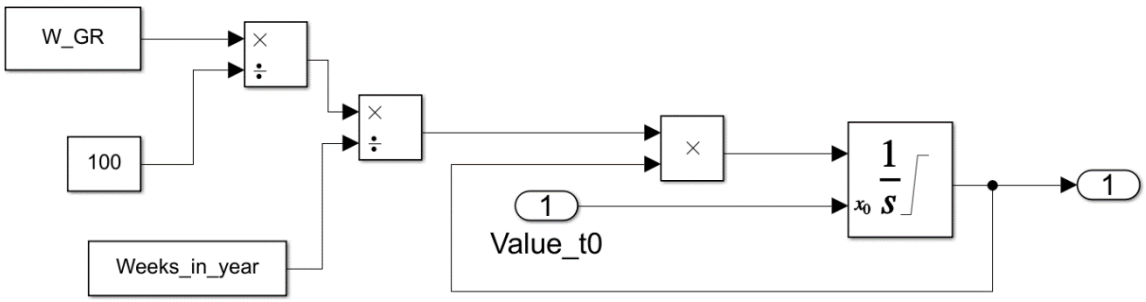
19B


W_GR
100
Weeks_in_year
1
Value_t0
1
s
1

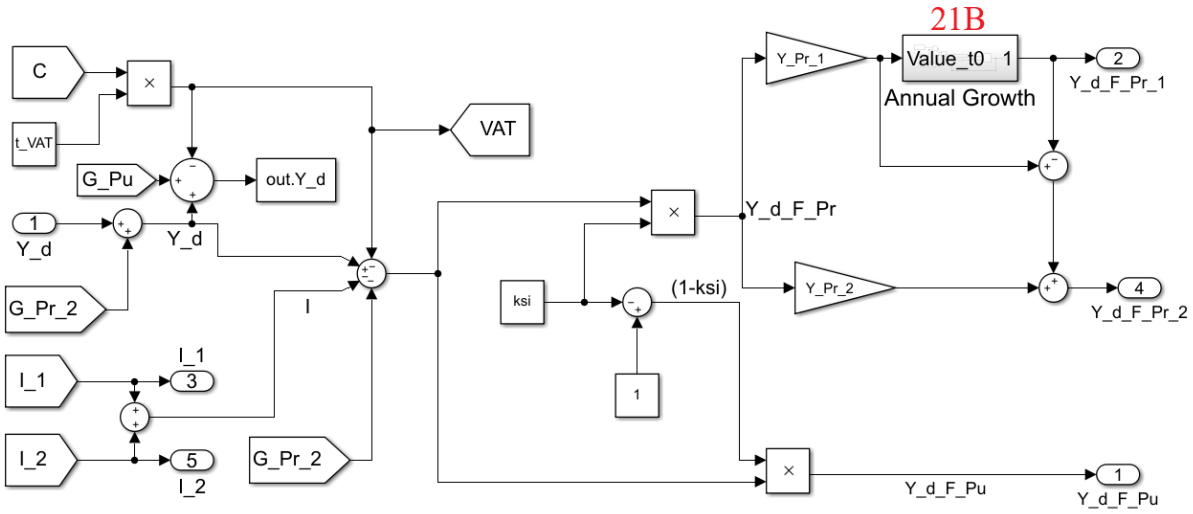
20A


1
W_Pr_2
w_Pr_0
20B
Value_t0
1
Annual Growth
1
N_Pr_2

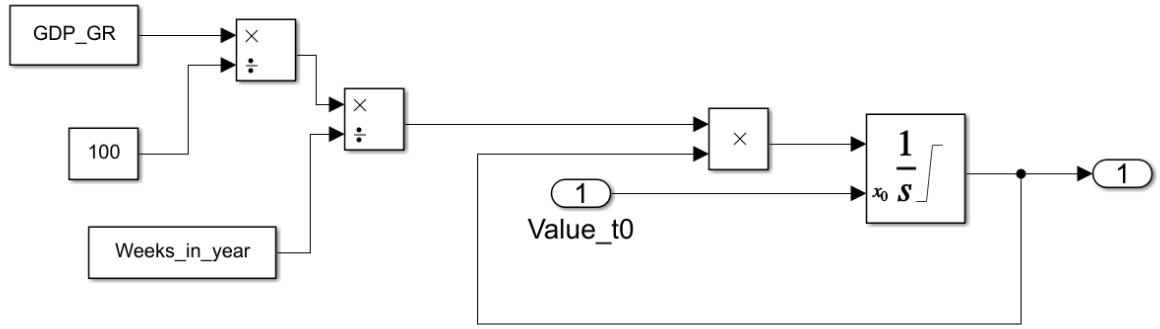
20B


W_GR
100
Weeks_in_year
1
Value_t0
1
1
x_0 s

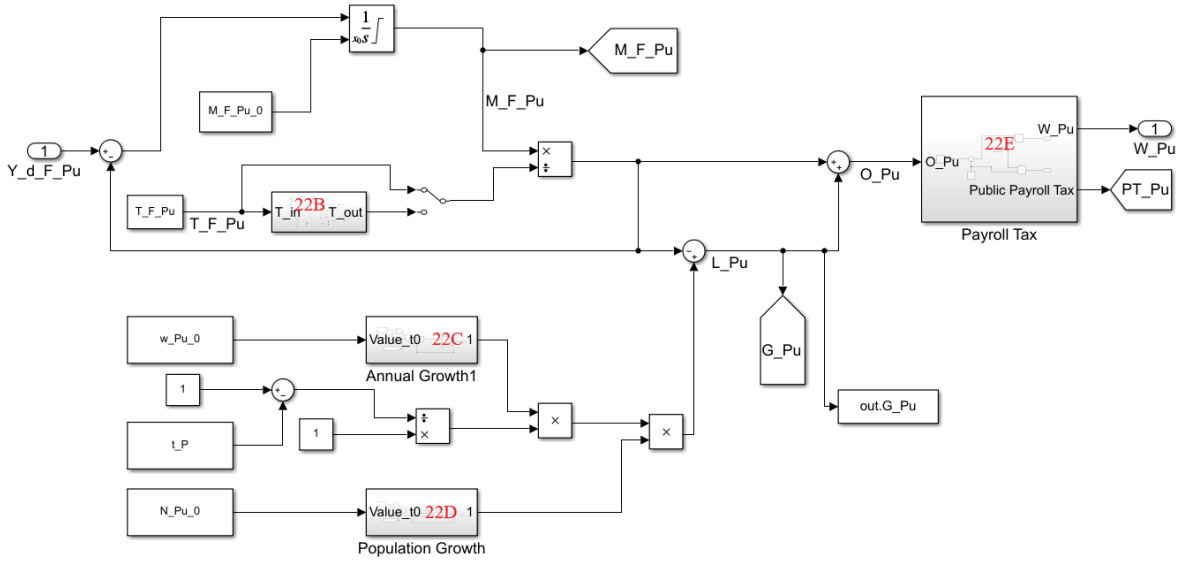
21A


21B
C
t_VAT
G_Pu
out.Y_d
1
Y_d
Y_d
G_Pr_2
I_1
I_1
3
I_2
5
I_2
I
VAT
G_Pr_2
ksi
(1-ksi)
1
Y_d_F_Pr
Y_Pr_1
Y_Pr_2
Value_t0 1
Annual Growth
2
Y_d_F_Pr_1
4
Y_d_F_Pr_2
Y_d_F_Pu
1
Y_d_F_Pu

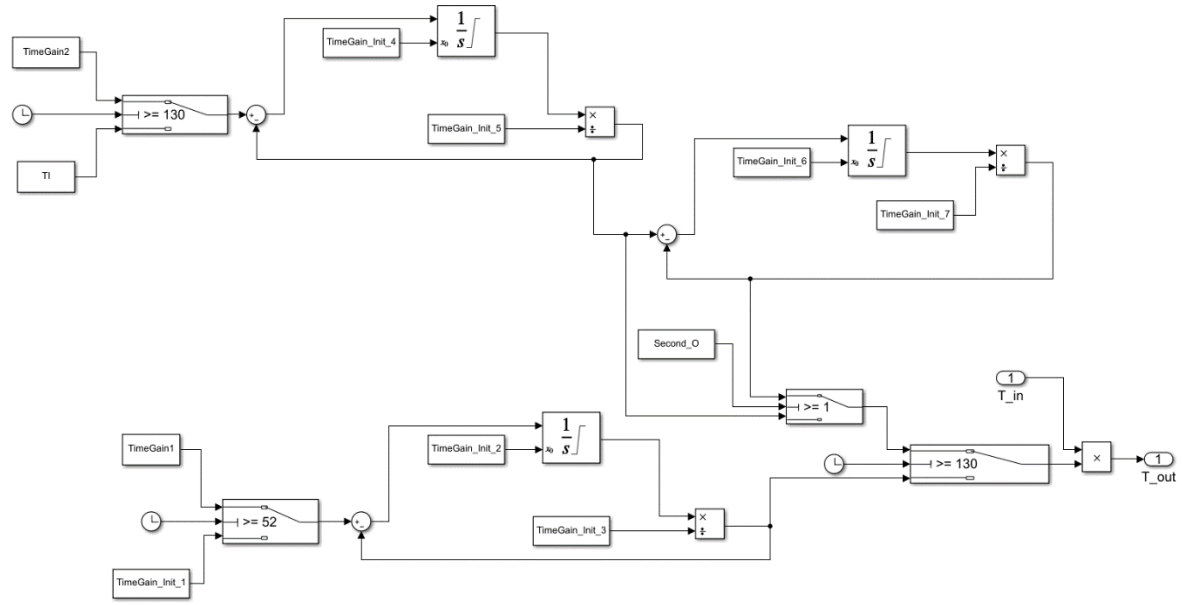
21B


GDP_GR
100
Weeks_in_year
1
Value_t0
1
1

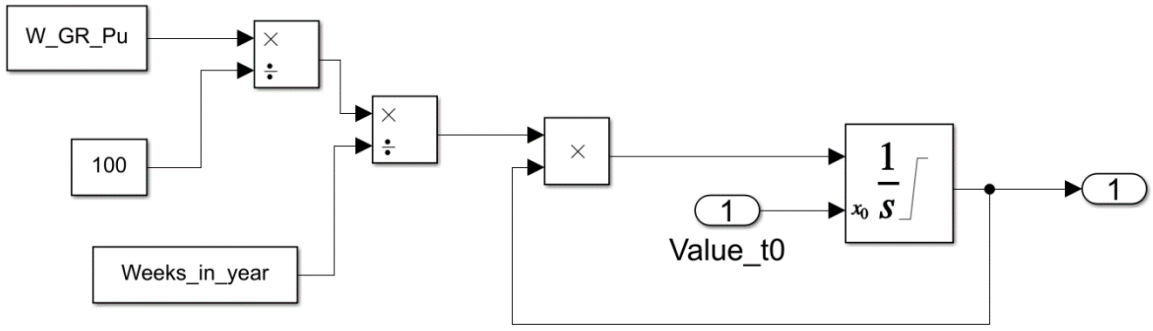
22A


1
Y_d_F_Pu
M_F_Pu_0
M_F_Pu
M_F_Pu
T_F_Pu
T_F_Pu
22B
T_in
T_out
O_Pu
O_Pu
22E
W_Pu
Public Payroll Tax
Payroll Tax
1
W_Pu
PT_Pu
L_Pu
G_Pu
out.G_Pu
w_Pu_0
Value_t0
22C
1
Annual Growth1
1
t_P
1
N_Pu_0
Value_t0
22D
1
Population Growth

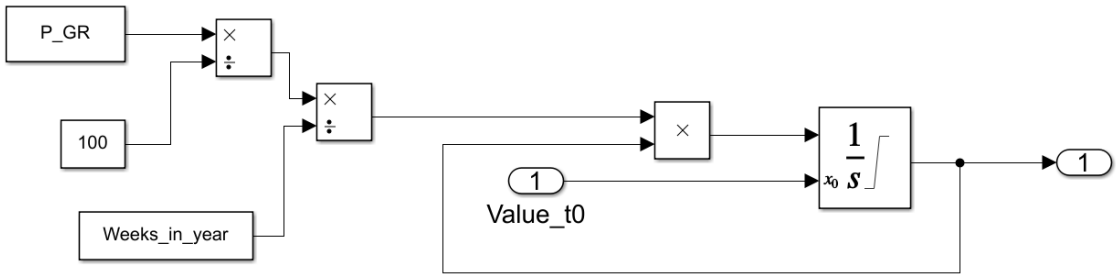
22B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
>= 130
T_out
TimeGain1
>= 52
TimeGain_Init_2
TimeGain_Init_3
TimeGain_Init_1

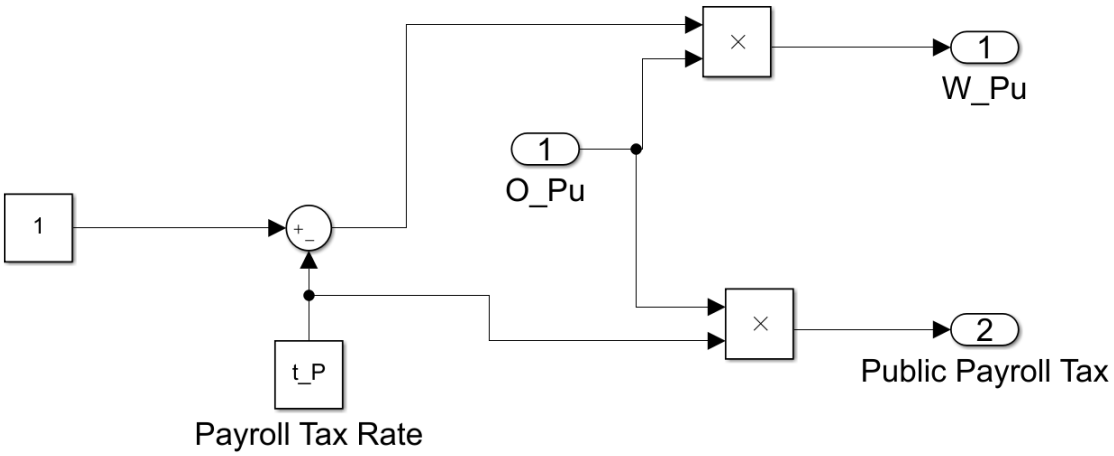
22C


W_GR_Pu
100
Weeks_in_year
1
Value_t0
1

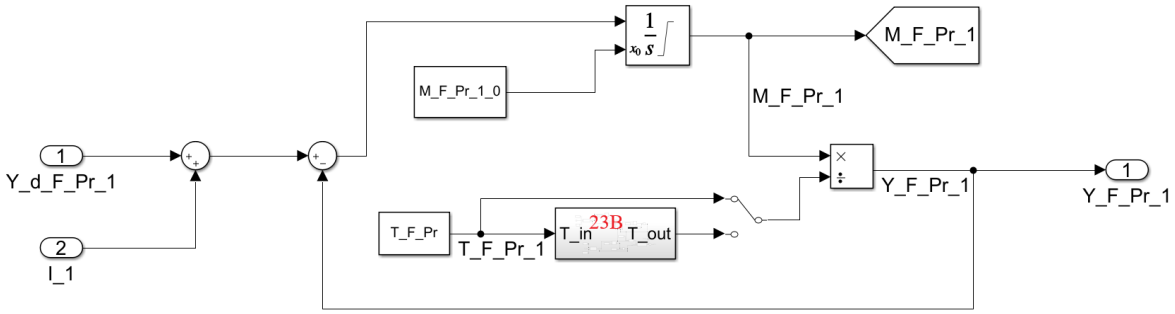
22D


P_GR
100
Weeks_in_year
1
Value_t0
1
1

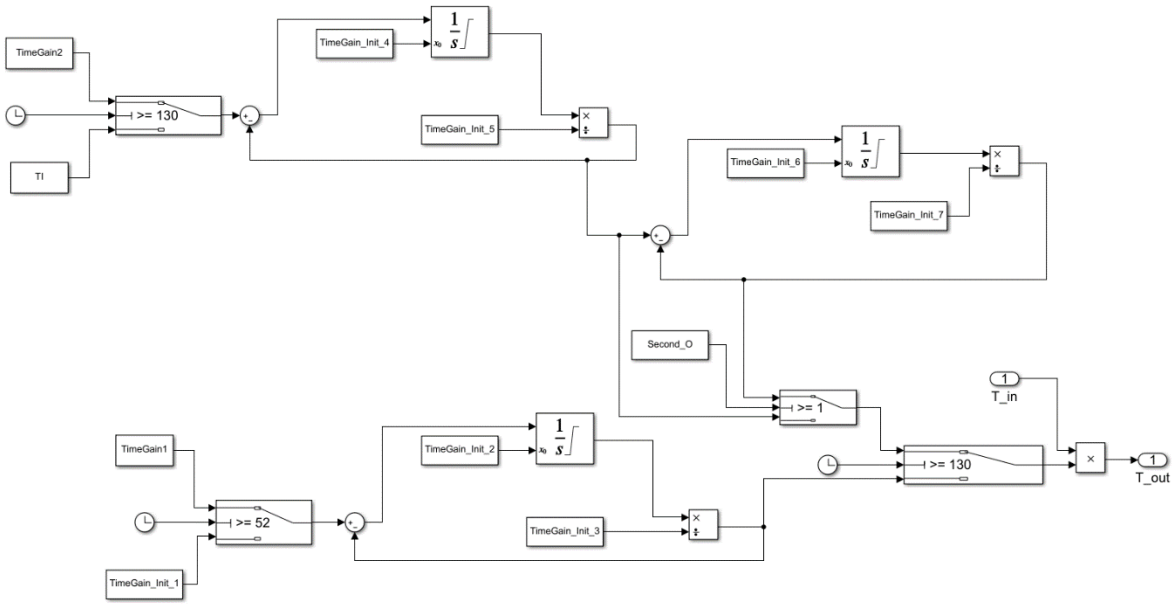
22E


1
1
W_Pu
1
O_Pu
1
2
Public Payroll Tax
t_P
Payroll Tax Rate

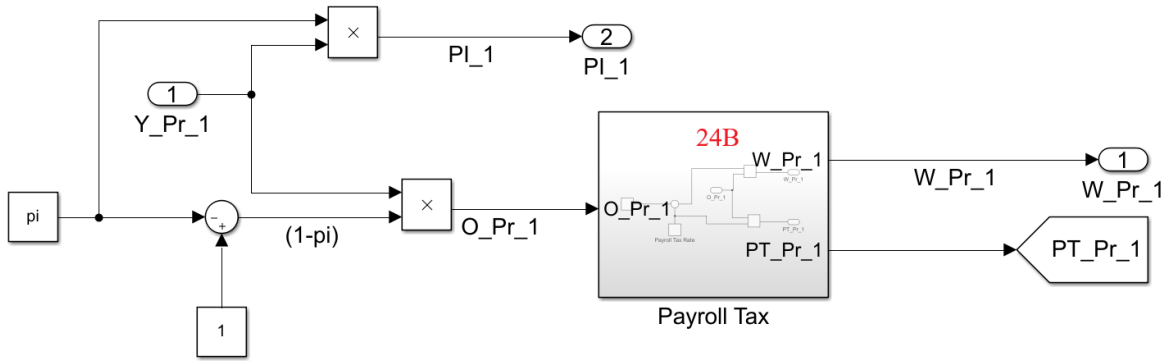
23A


1
Y_d_F_Pr_1
2
I_1
M_F_Pr_1_0
M_F_Pr_1
M_F_Pr_1
T_F_Pr
T_F_Pr_1
T_in
T_out
Y_F_Pr_1
1
Y_F_Pr_1

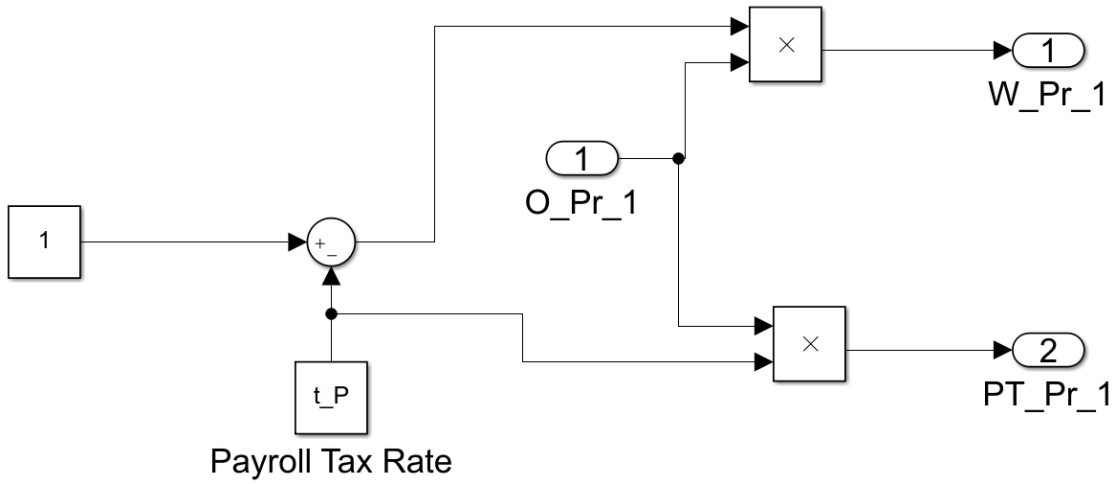
23B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
T_out
>= 130
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3

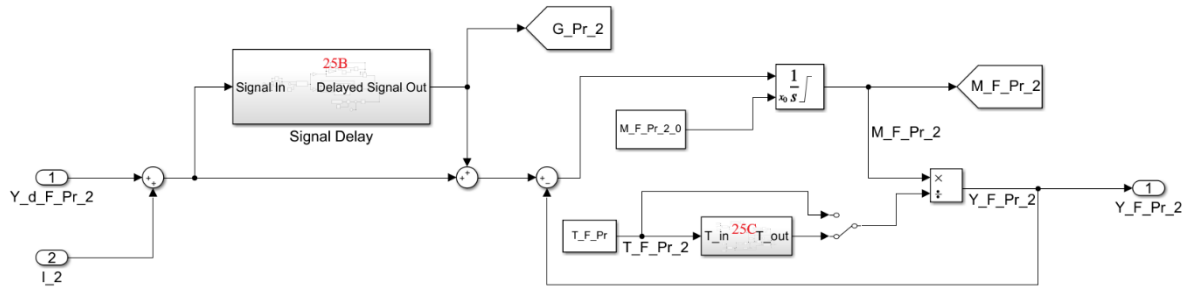
24A


PI_1
PI_1
Y_Pr_1
pi
(1-pi)
O_Pr_1
1
24B
W_Pr_1
O_Pr_1
PT_Pr_1
Payroll Tax
W_Pr_1
W_Pr_1
PT_Pr_1

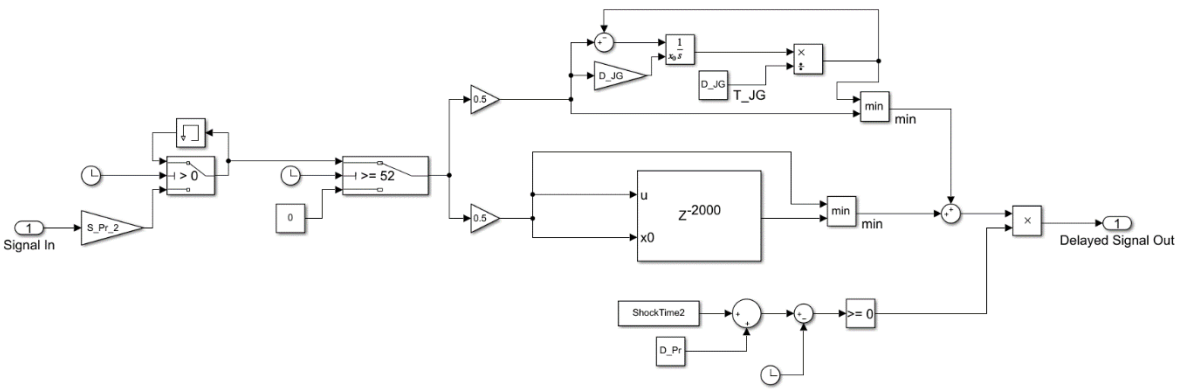
24B


1
W_Pr_1
1
O_Pr_1
1
2
PT_Pr_1
t_P
Payroll Tax Rate

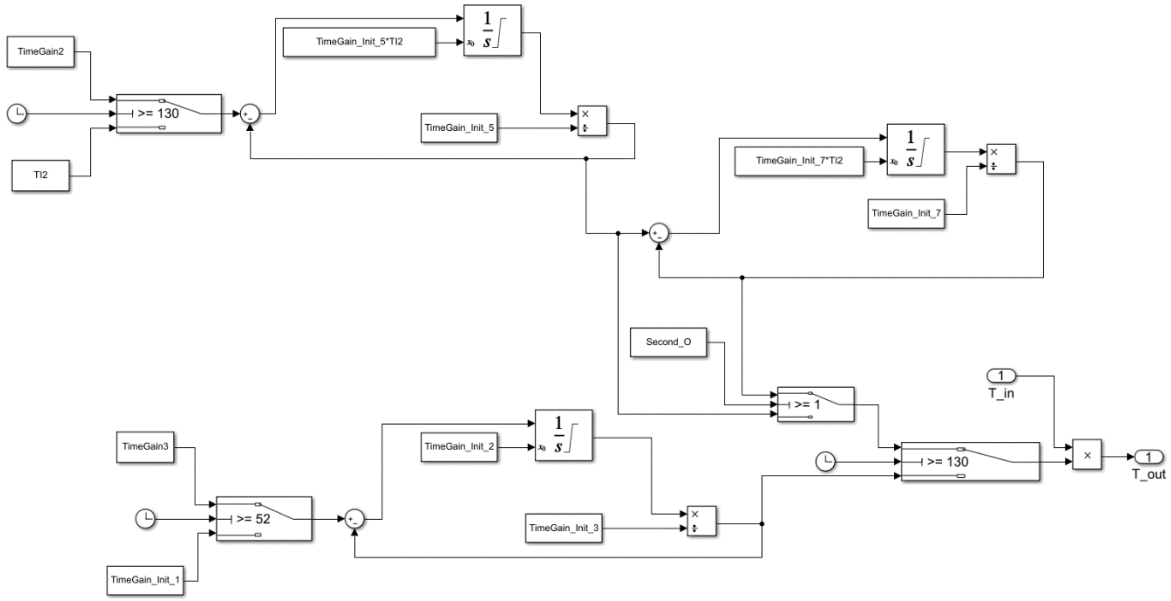
25A


G_Pr_2
25B
Signal In
Delayed Signal Out
Signal Delay
M_F_Pr_2
M_F_Pr_2_0
M_F_Pr_2
1
Y_d_F_Pr_2
2
I_2
T_F_Pr
T_F_Pr_2
T_in
25C
T_out
Y_F_Pr_2
1
Y_F_Pr_2

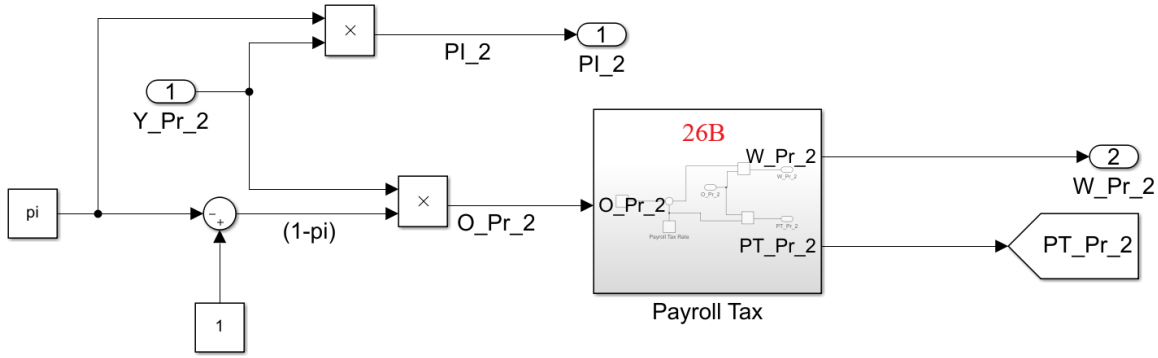
25B


D_JG
D_JG
T_JG
min
min
0.5
0.5
> 0
>= 52
0
u
z-2000
x0
min
min
1
Signal In
S_Pr_2
1
Delayed Signal Out
ShockTime2
D_Pr
>= 0

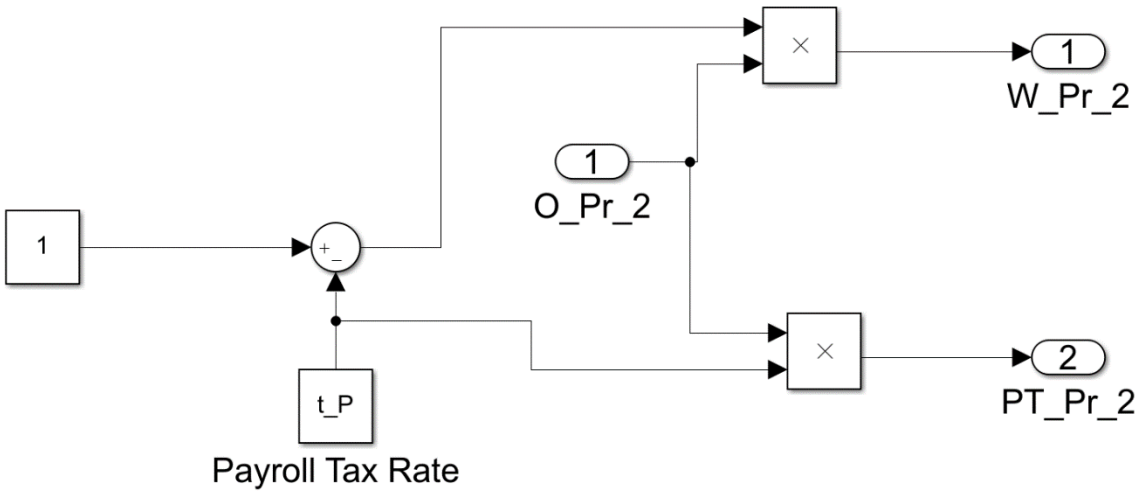
25C


TimeGain2
>= 130
TI2
TimeGain_Init_5*TI2
TimeGain_Init_5
TimeGain_Init_7*TI2
TimeGain_Init_7
Second_O
>= 1
T_in
TimeGain3
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3
>= 130
T_out

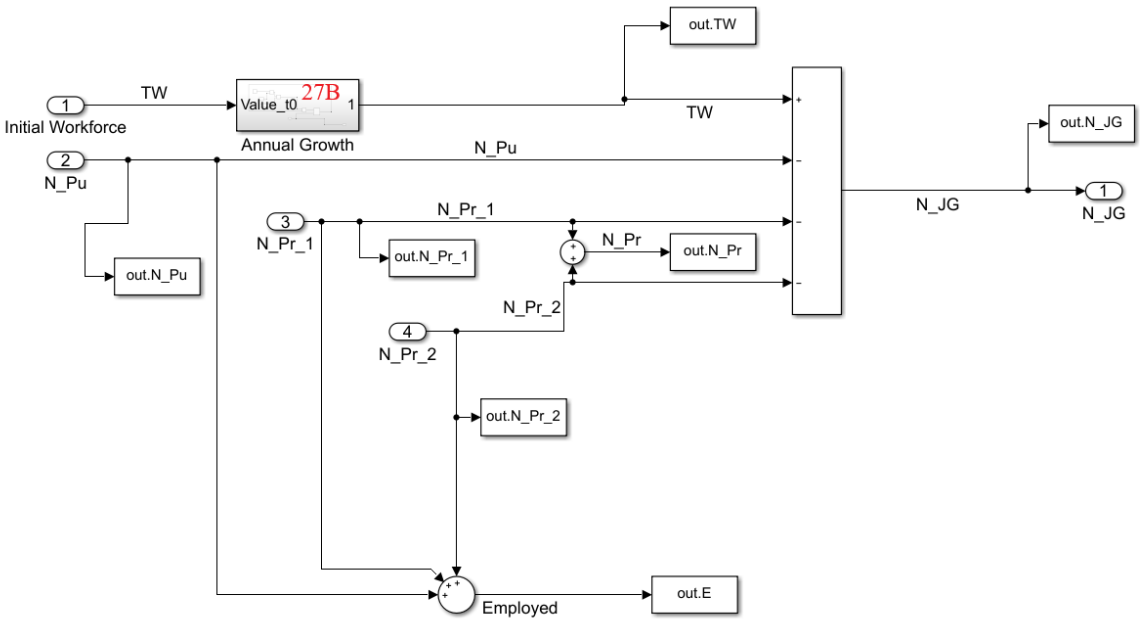
26A


PI_2
PI_2
1
Y_Pr_2
26B
W_Pr_2
2
W_Pr_2
pi
(1-pi)
O_Pr_2
O_Pr_2
PT_Pr_2
PT_Pr_2
1
Payroll Tax

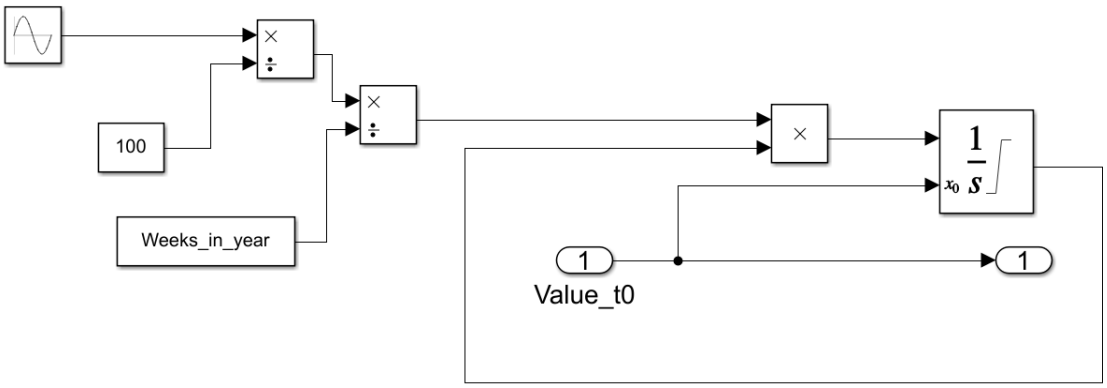
26B


1
W_Pr_2
1
O_Pr_2
1
+
_
2
PT_Pr_2
t_P
Payroll Tax Rate

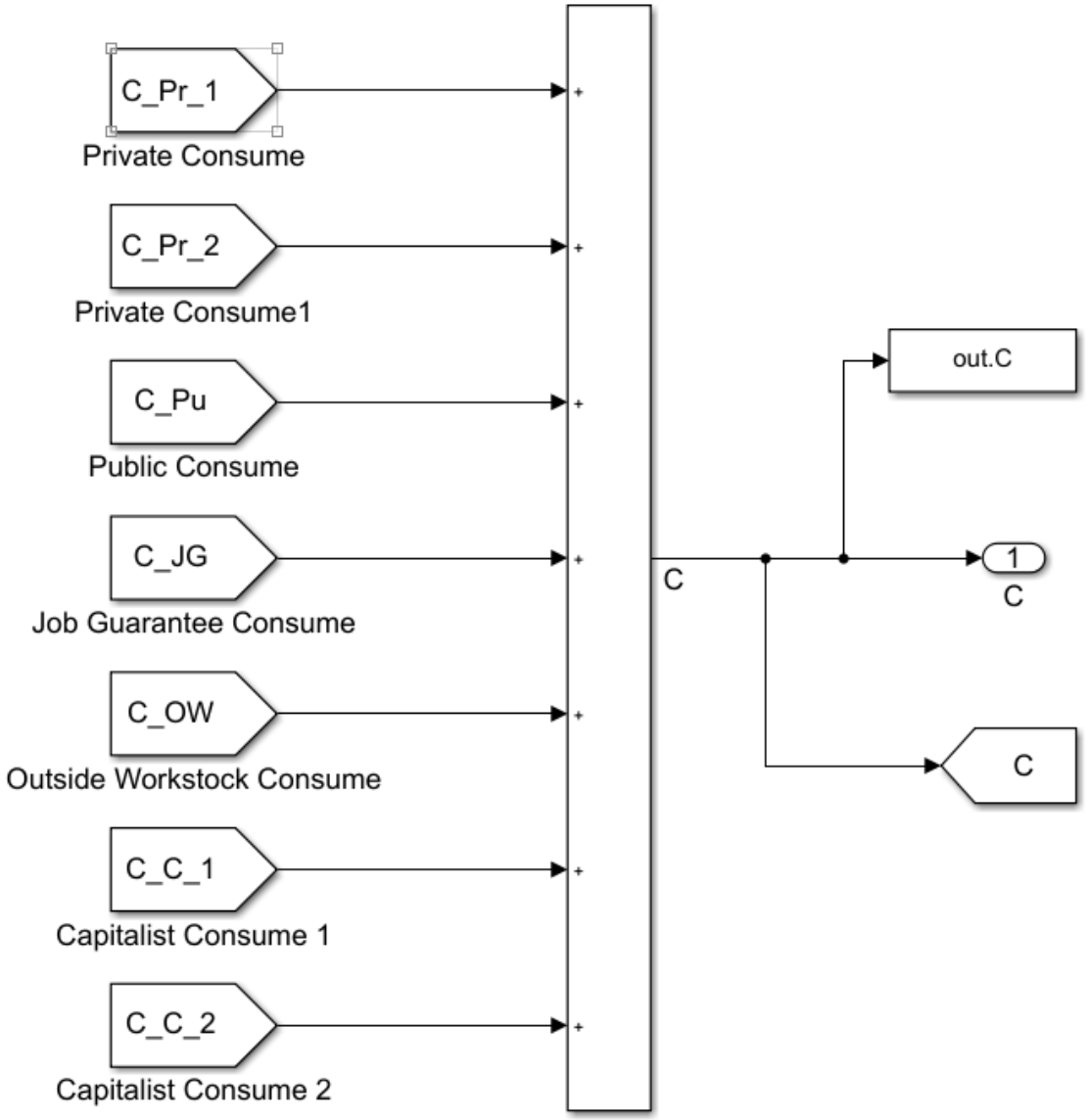
27A


out.TW
1
Initial Workforce
TW
Value_t0
27B
1
Annual Growth
TW
out.N_JG
2
N_Pu
N_Pu
N_JG
1
N_JG
3
N_Pr_1
N_Pr_1
out.N_Pr_1
N_Pr
out.N_Pr
out.N_Pu
N_Pr_2
4
N_Pr_2
out.N_Pr_2
out.E
Employed

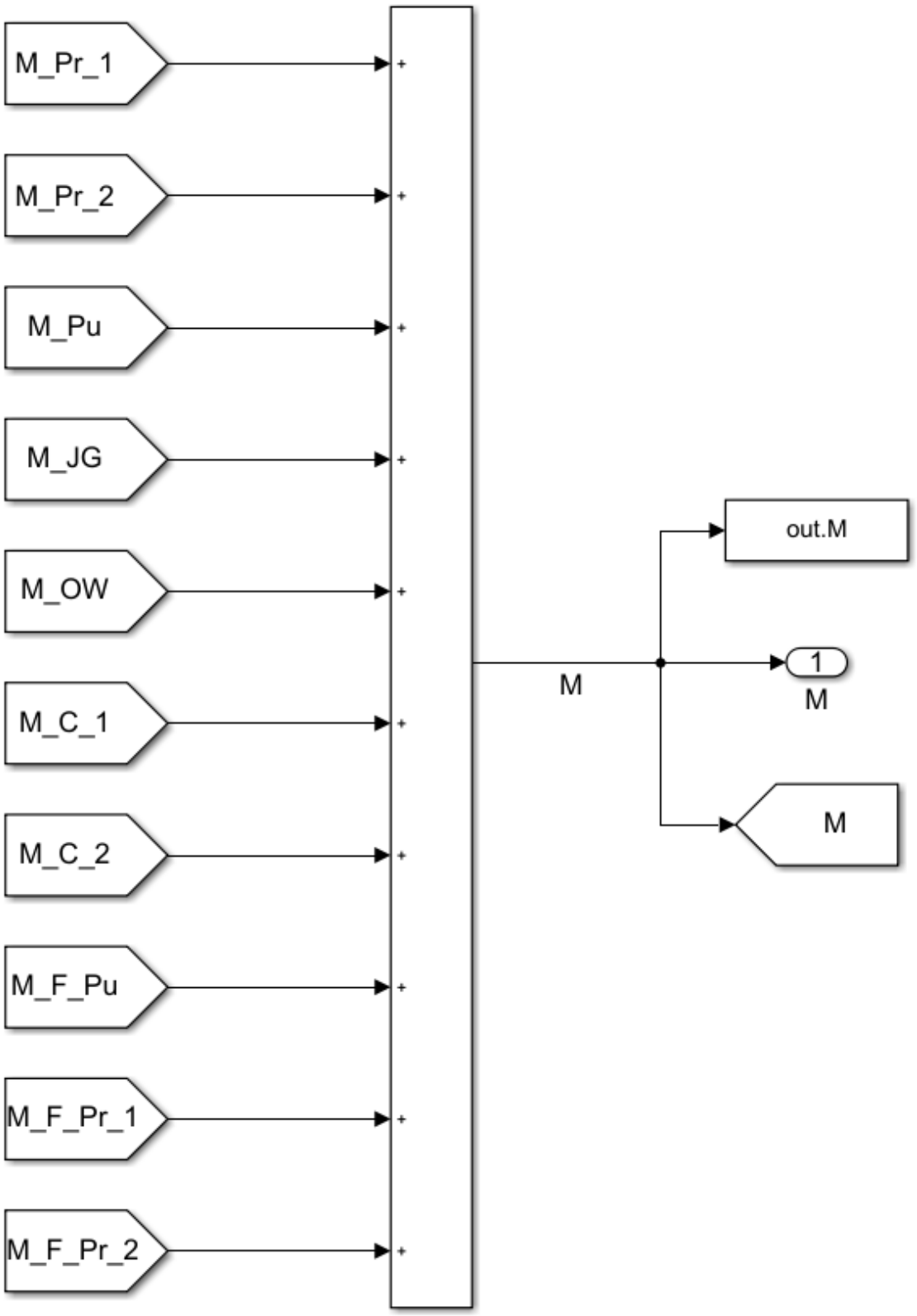
27B



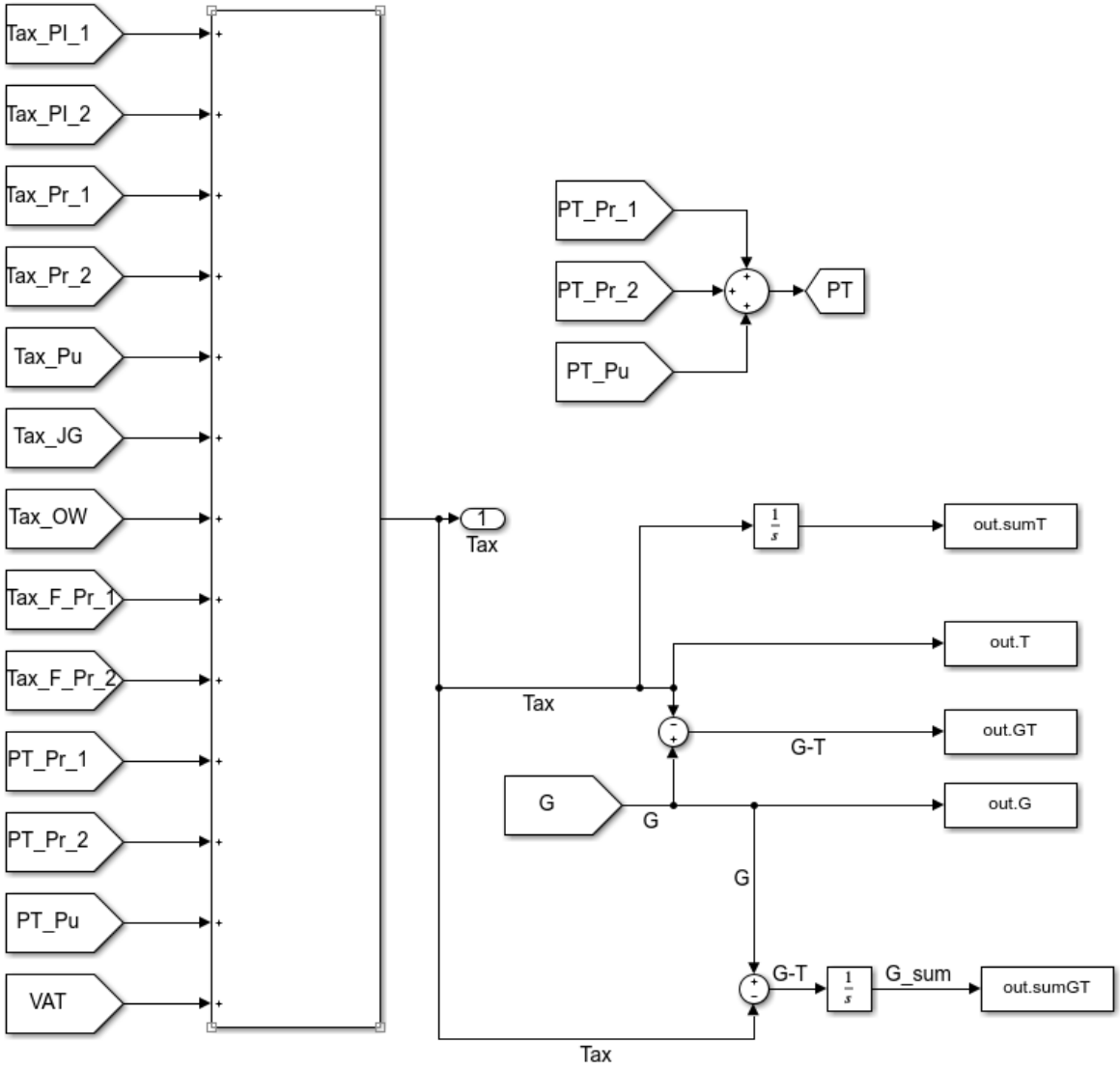
28A


C_Pr_1
Private Consume
C_Pr_2
Private Consume1
C_Pu
Public Consume
C_JG
Job Guarantee Consume
C_OW
Outside Workstock Consume
C_C_1
Capitalist Consume 1
C_C_2
Capitalist Consume 2
C
out.C
1
C
C

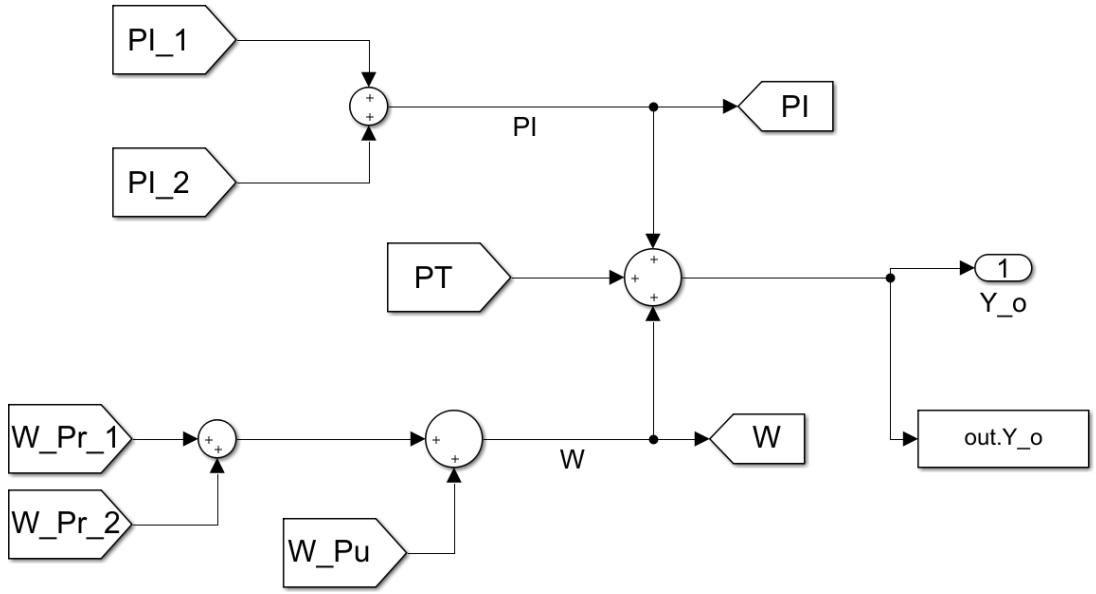
29A



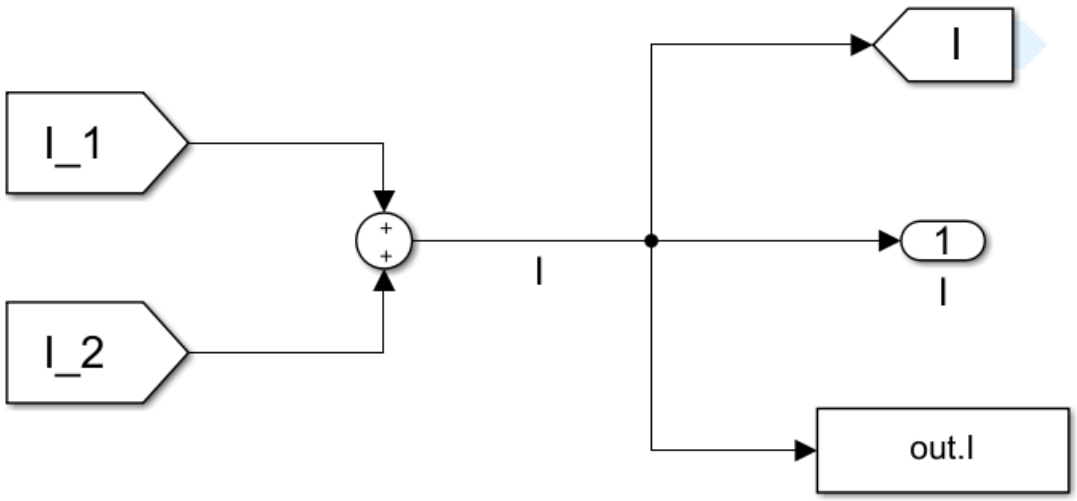
30A


Tax_PI_1
Tax_PI_2
Tax_Pr_1
Tax_Pr_2
Tax_Pu
Tax_JG
Tax_OW
Tax_F_Pr_1
Tax_F_Pr_2
PT_Pr_1
PT_Pr_2
PT_Pu
VAT
1
Tax
PT_Pr_1
PT_Pr_2
PT_Pu
PT
1/s
out.sumT
out.T
Tax
G-T
out.GT
G
G
out.G
G
G-T
1/s
G_sum
out.sumGT
Tax

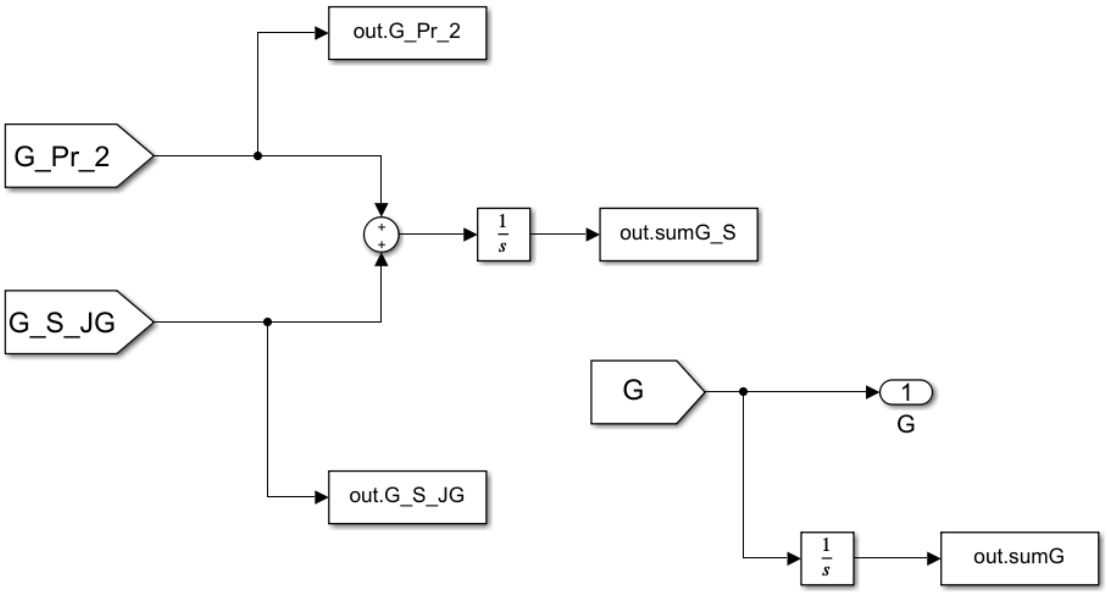
31A



32A

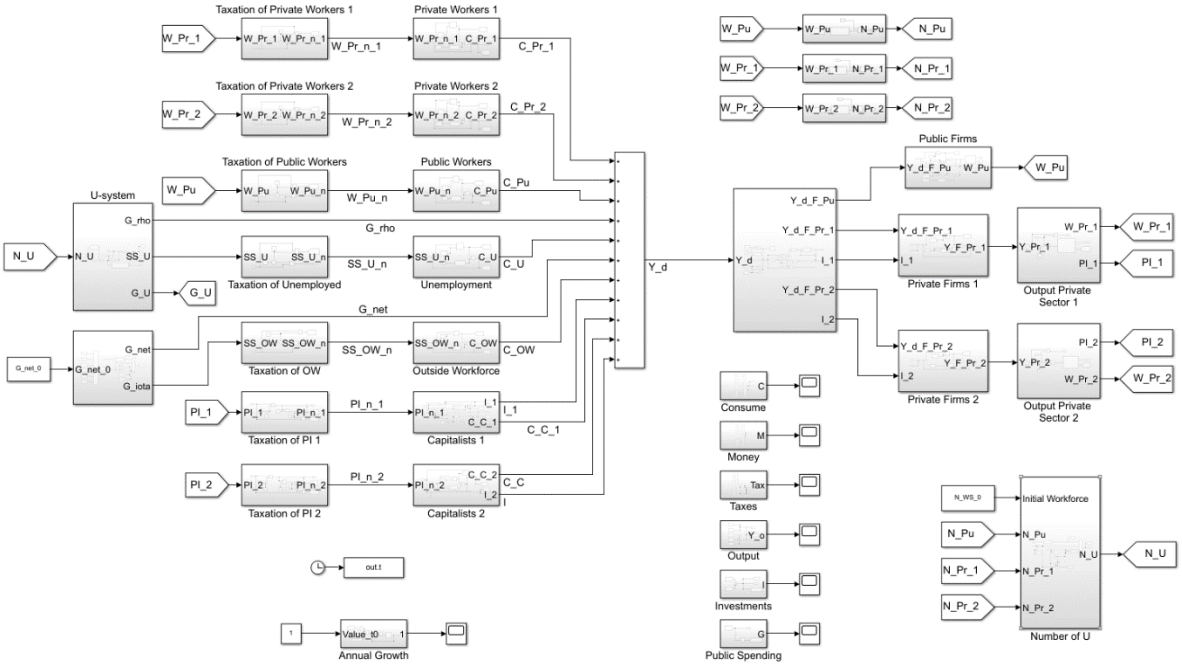


33A

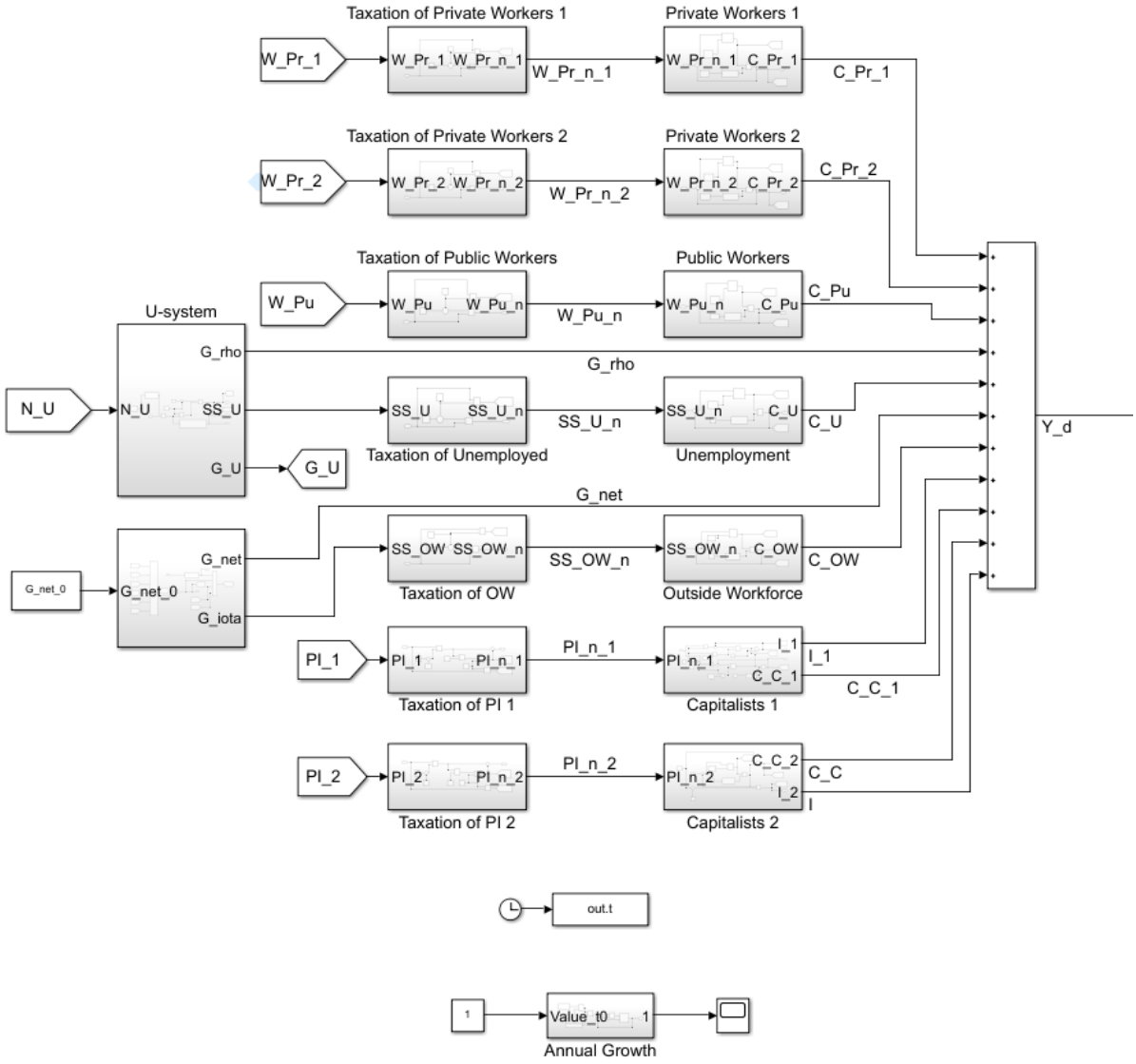


U-system

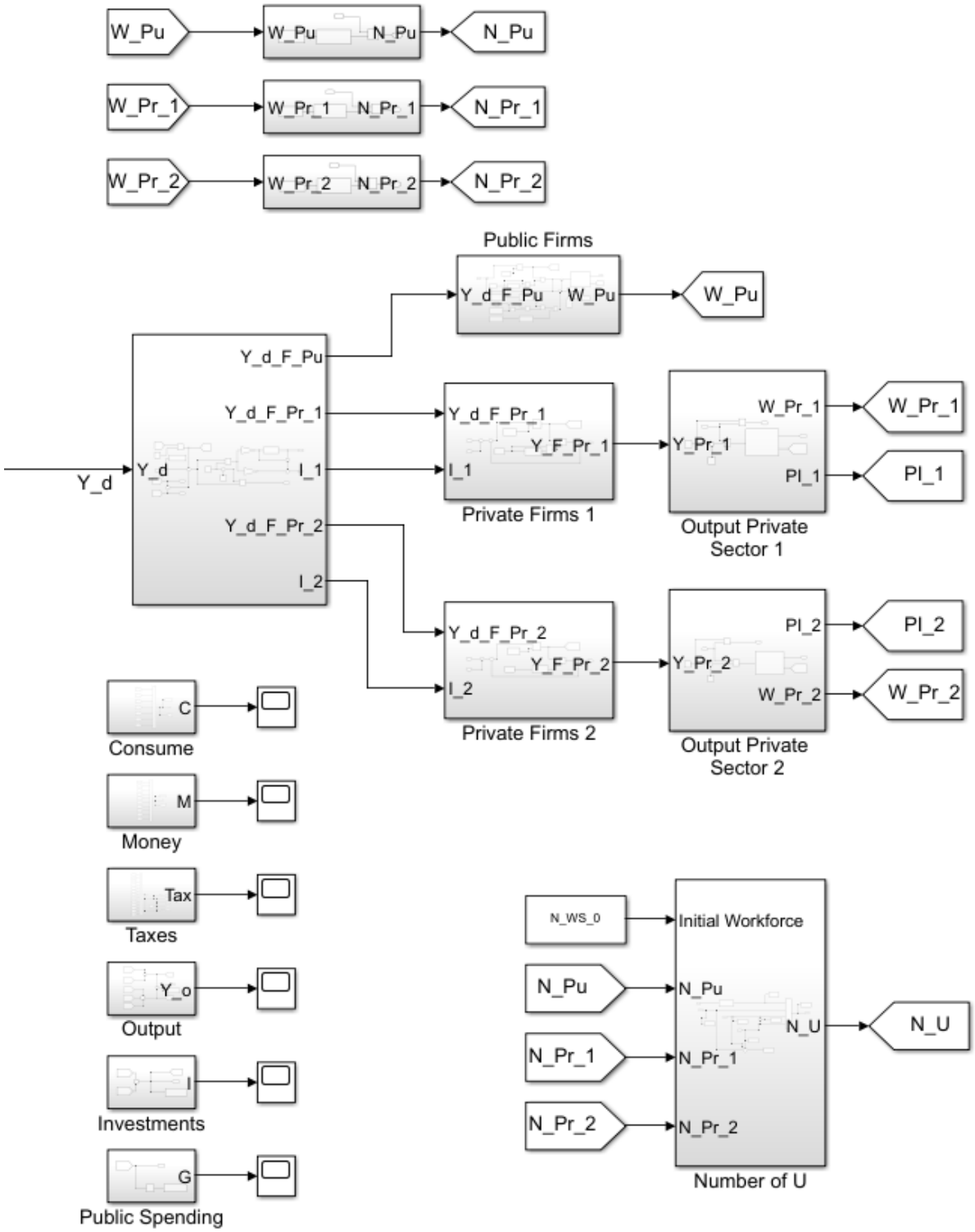
Overview



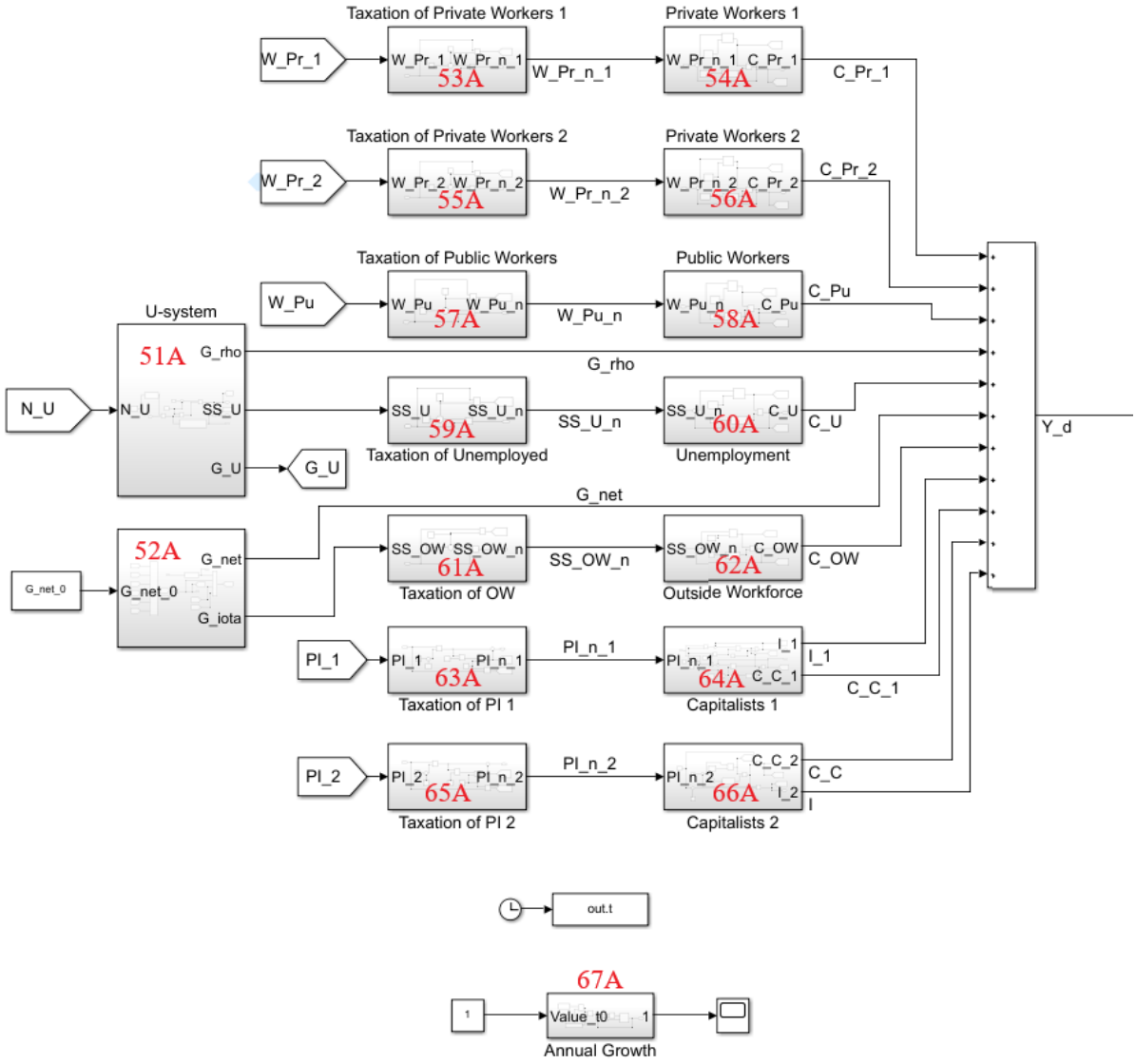
Part 1 of the system



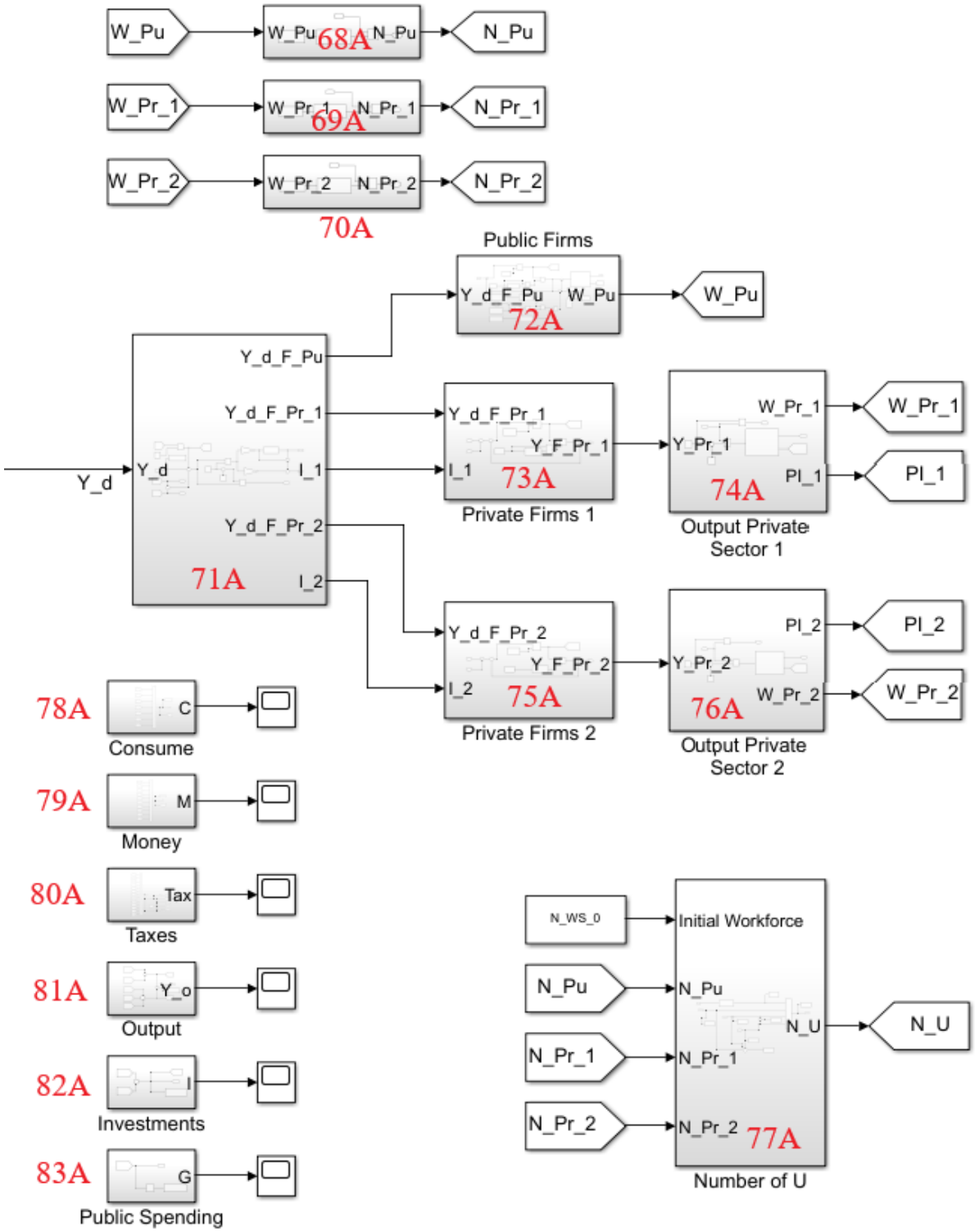
Part 2 of the system



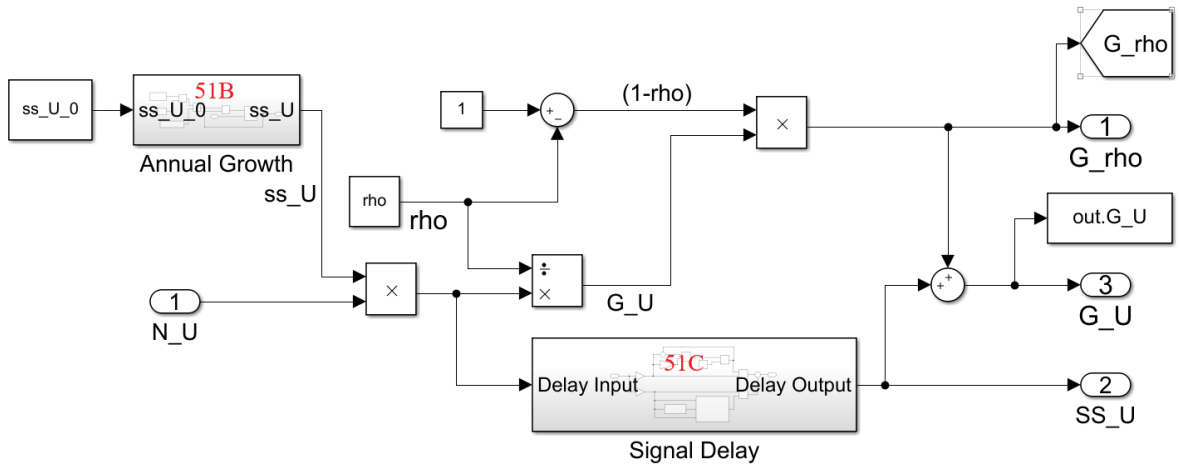
Part 1 with codes for mapping



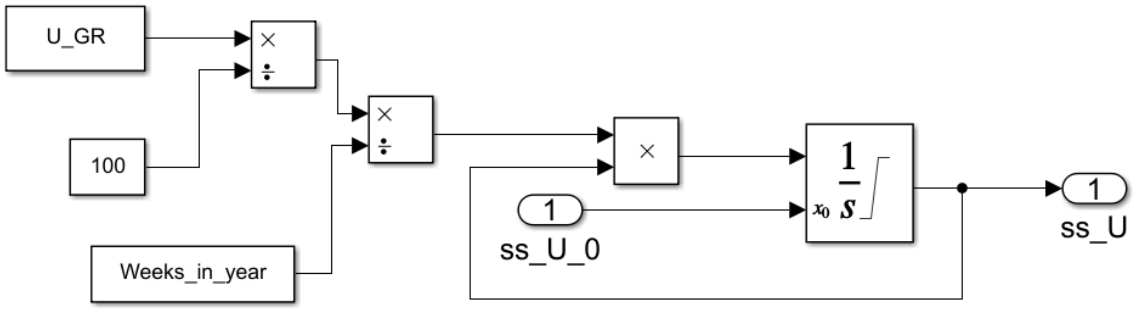
Part 2 with codes for mapping



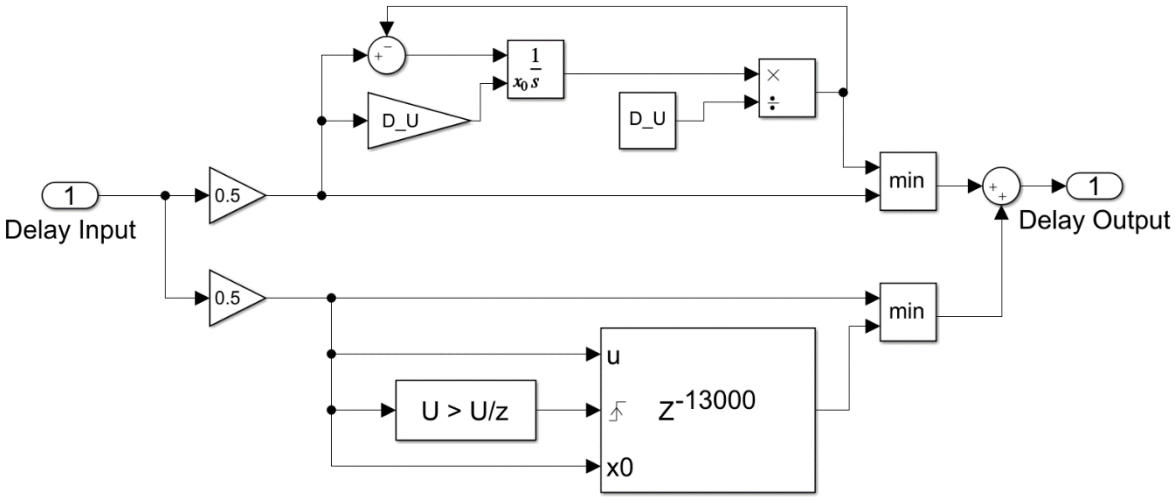
51A


ss_U_0
51B
ss_U_0
ss_U
Annual Growth
ss_U
rho
rho
1
(1-rho)
G_rho
1
G_rho
out.G_U
1
N_U
G_U
3
G_U
51C
Delay Input
Delay Output
2
SS_U
Signal Delay

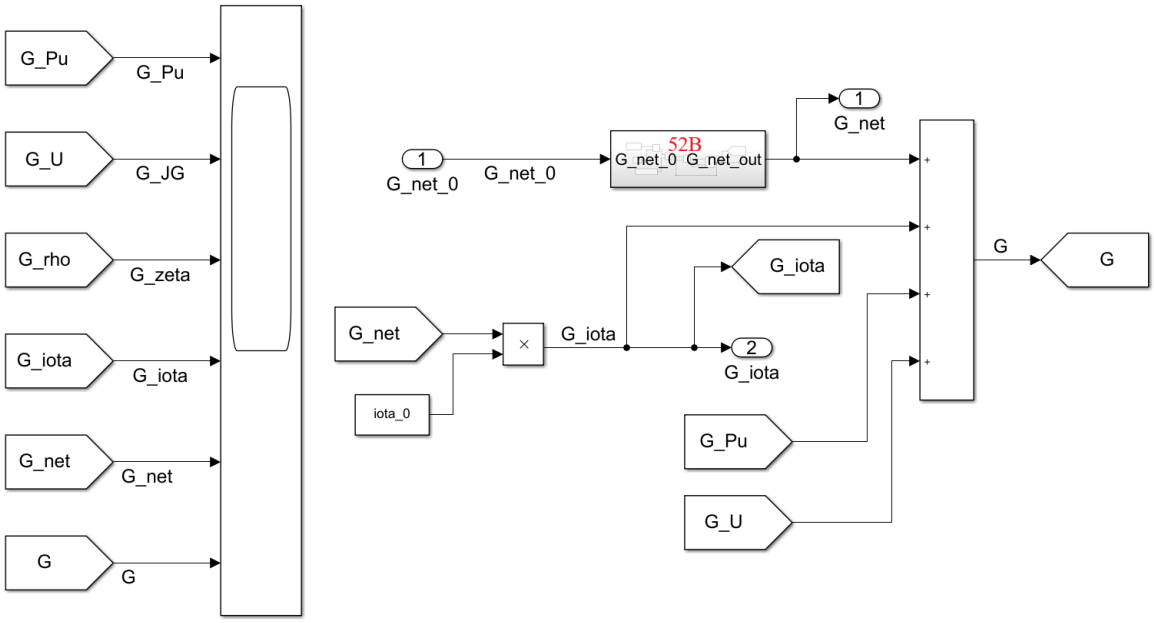
51B


U_GR
100
Weeks_in_year
1
ss_U_0
1
ss_U

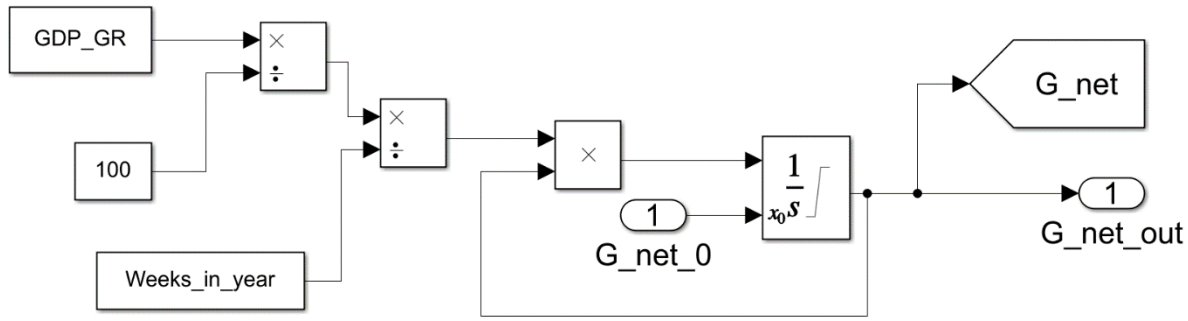
51C


1
Delay Input
0.5
0.5
D_U
1
x0 s
D_U
min
min
1
Delay Output
u
U > U/z
Z-13000
x0

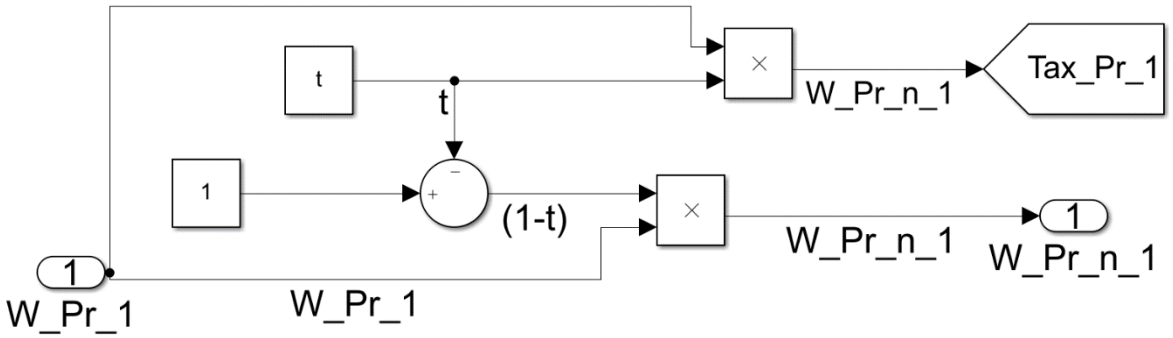
52A


G_Pu
G_Pu
G_U
G_JG
G_rho
G_zeta
G_iota
G_iota
G_net
G_net
G
G
1
G_net_0
G_net_0
52B
G_net_0
G_net_out
1
G_net
G_net
G_iota
iota_0
G_iota
2
G_iota
G_Pu
G_U
G
G

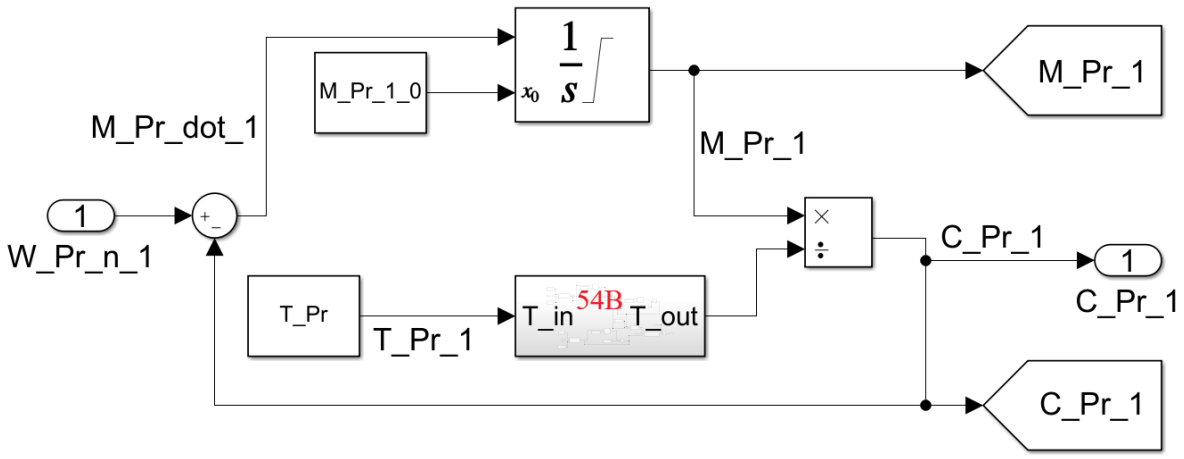
52B


GDP_GR
100
Weeks_in_year
G_net
1
G_net_out
1
G_net_0

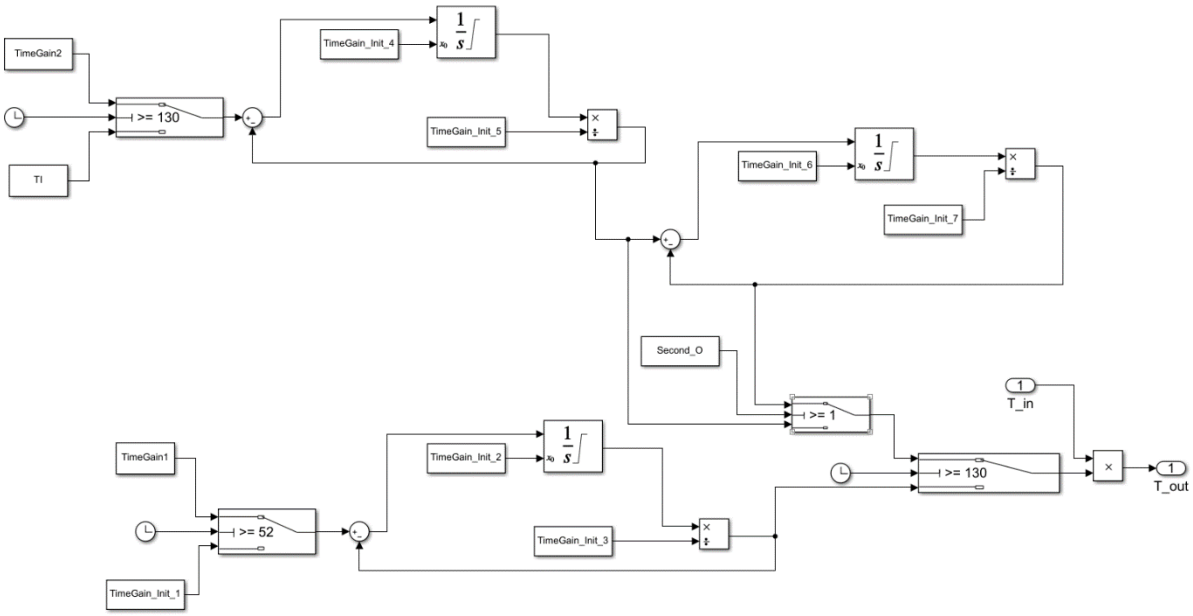
53A


t
t
Tax_Pr_1
W_Pr_n_1
1
(1-t)
1
W_Pr_n_1
1
W_Pr_n_1
1
W_Pr_1
W_Pr_1

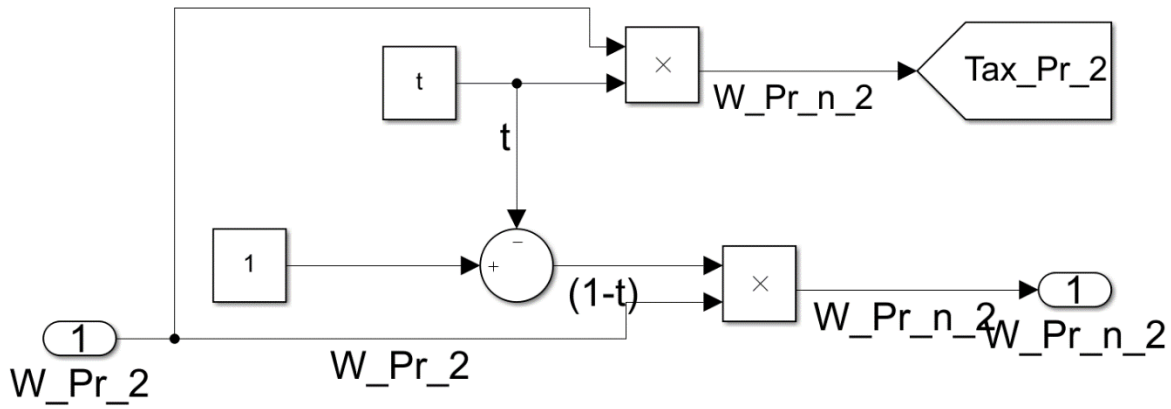
54A


M_Pr_1_0
M_Pr_1
M_Pr_dot_1
M_Pr_1
1
W_Pr_n_1
C_Pr_1
1
C_Pr_1
T_Pr
T_Pr_1
T_in
54B
T_out
C_Pr_1

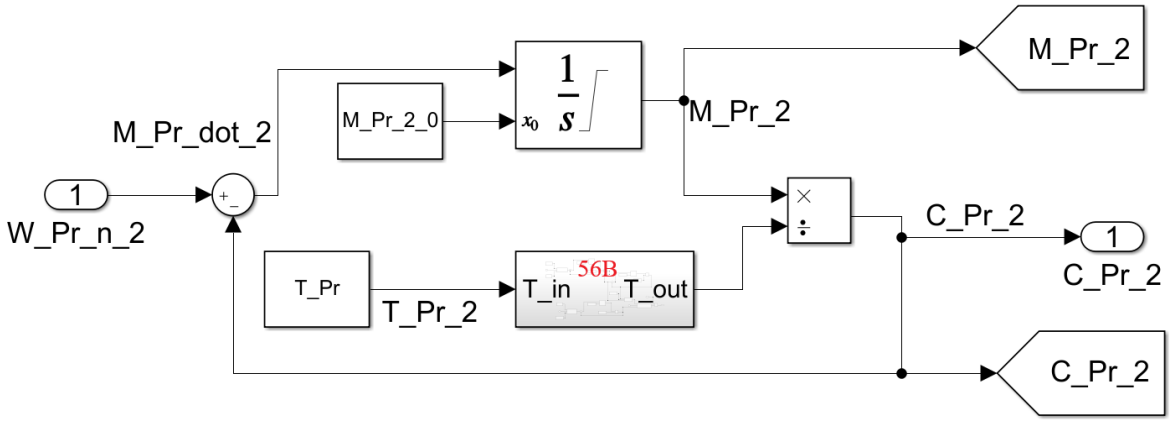
54B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
T_out
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3
>= 130

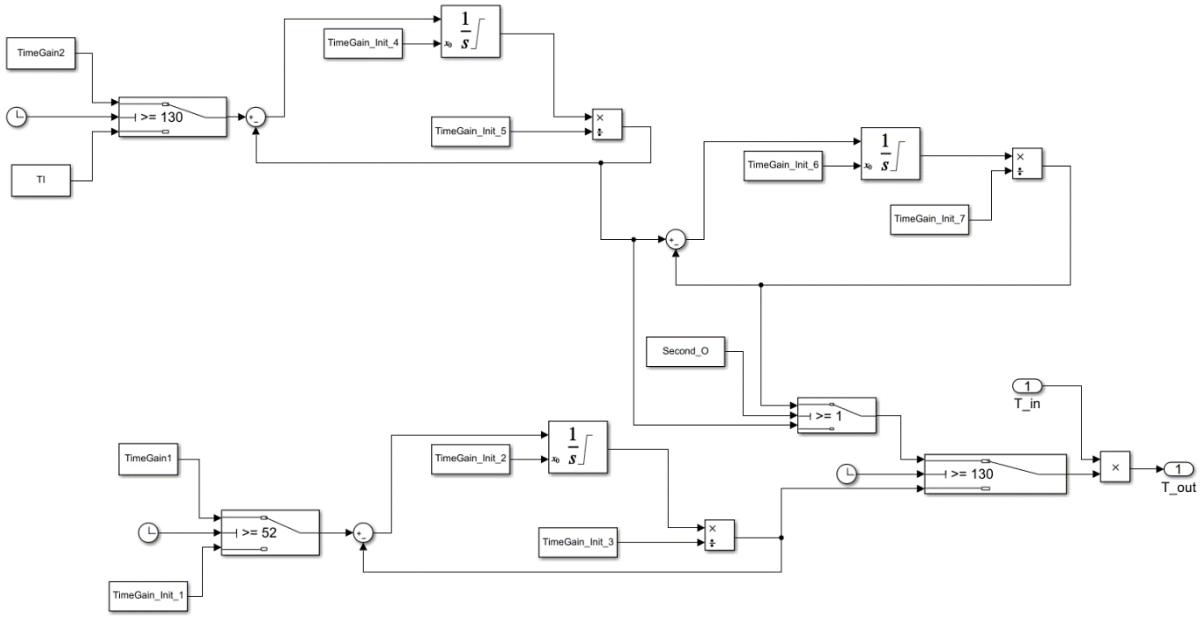
55A


t
W_Pr_n_2
Tax_Pr_2
t
1
(1-t)
W_Pr_n_2
1
W_Pr_n_2
1
W_Pr_2
W_Pr_2

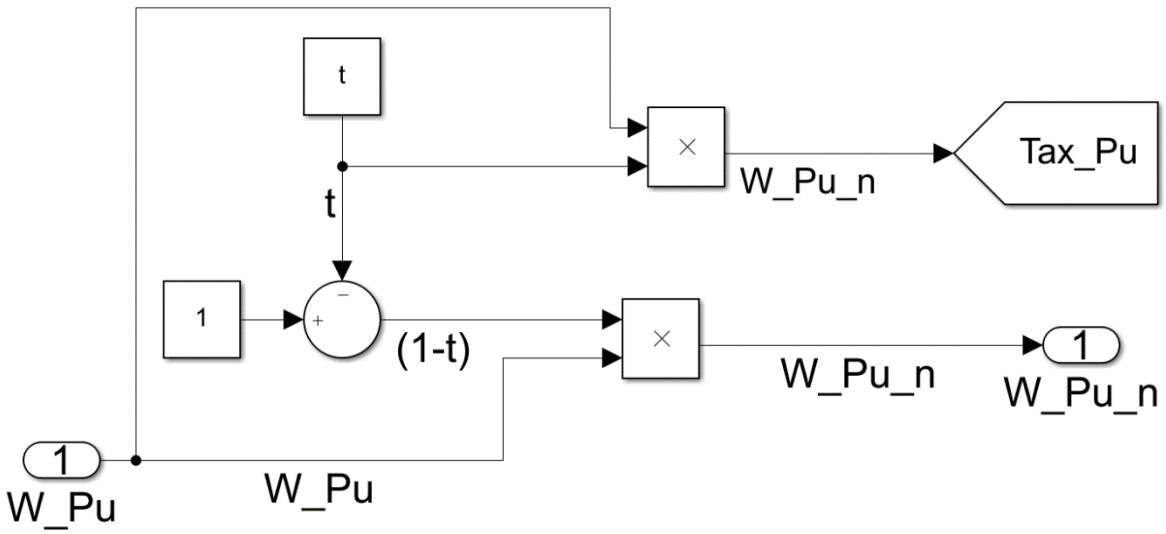
56A


M_Pr_2
M_Pr_dot_2
M_Pr_2_0
M_Pr_2
1
W_Pr_n_2
C_Pr_2
1
C_Pr_2
T_Pr
T_Pr_2
56B
T_in
T_out
C_Pr_2

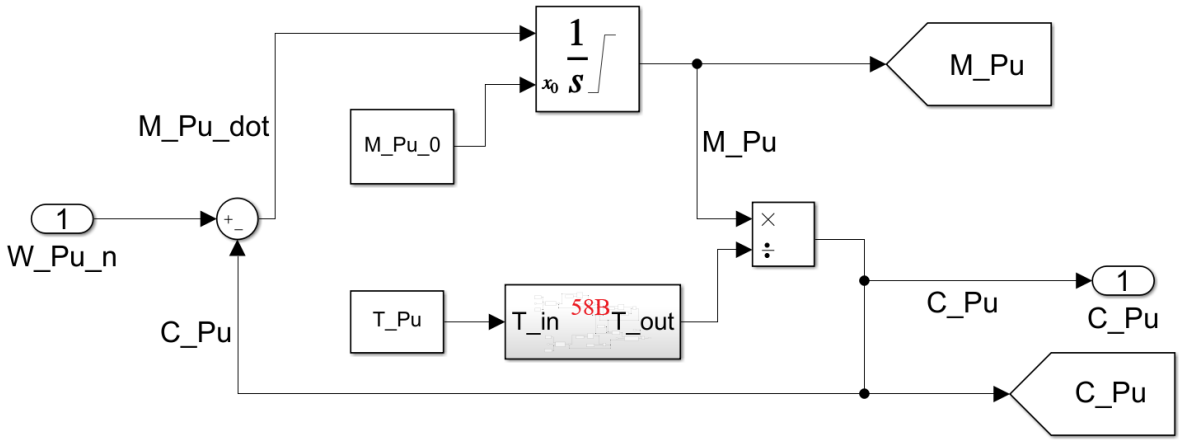
56B


TimeGain2
TimeGain_Init_4
>= 130
TimeGain_Init_5
TI
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
1
T_in
TimeGain1
TimeGain_Init_2
>= 130
>= 52
TimeGain_Init_3
TimeGain_Init_1
1
T_out

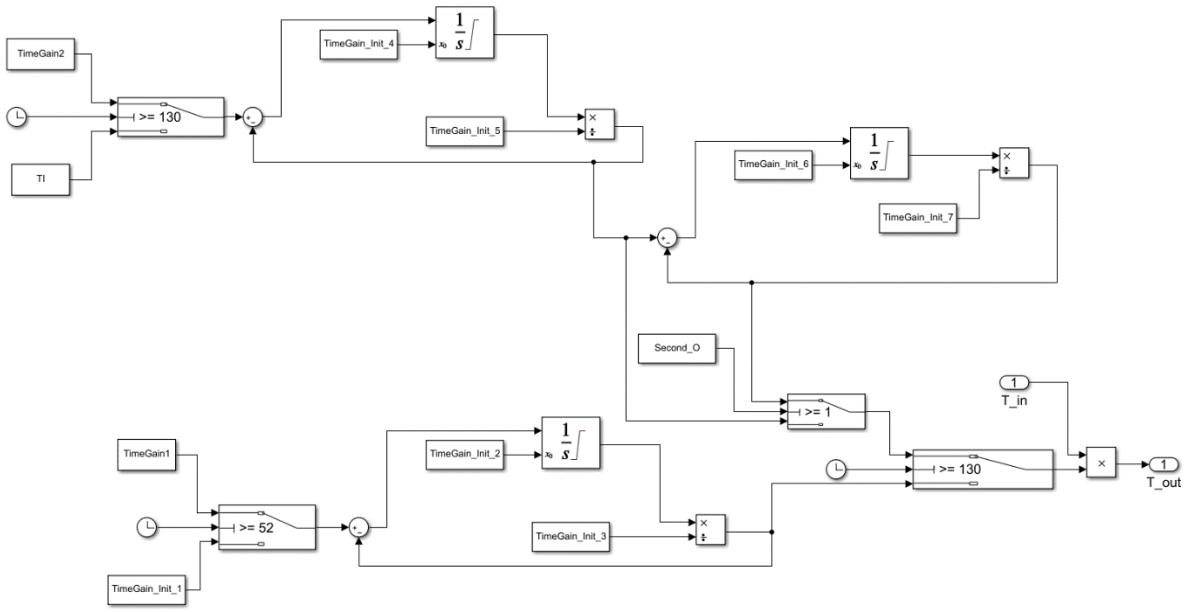
57A


t
t
1
(1-t)
W_Pu_n
Tax_Pu
W_Pu_n
1
W_Pu_n
1
W_Pu
W_Pu

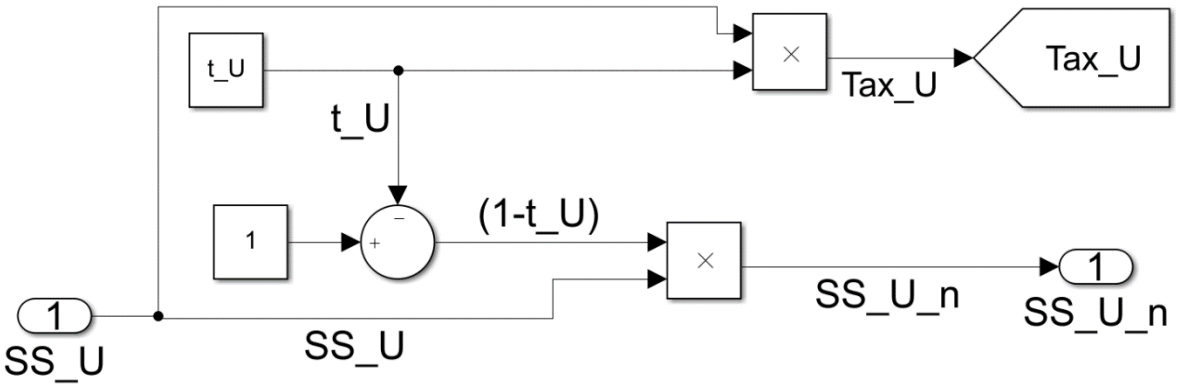
58A


M_Pu_dot
M_Pu_0
M_Pu
M_Pu
1
W_Pu_n
C_Pu
T_Pu
T_in
58B
T_out
C_Pu
1
C_Pu
C_Pu

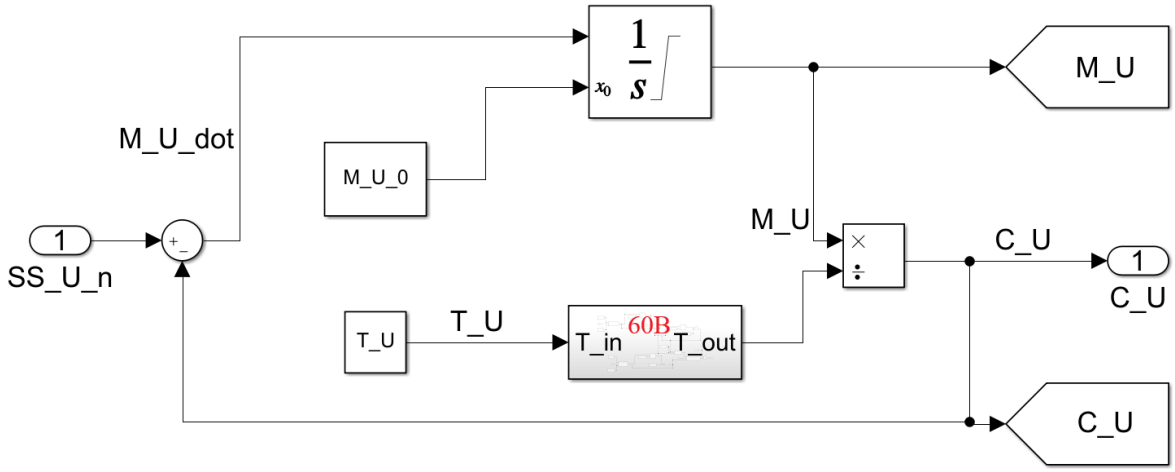
58B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3
>= 130
T_out

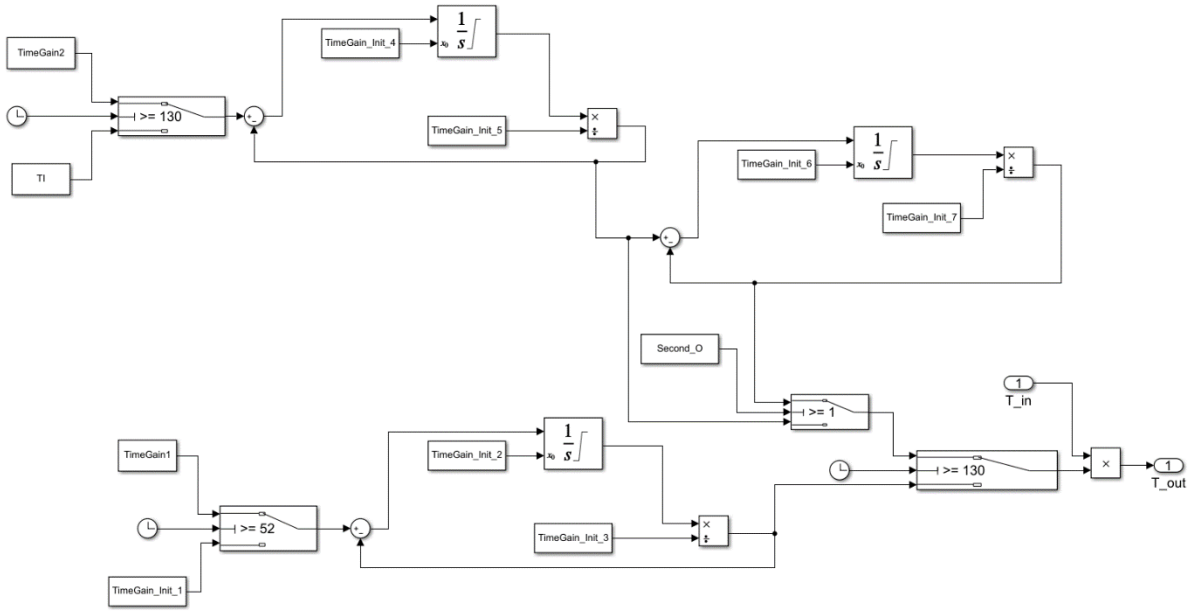
59A


t_U
t_U
Tax_U
Tax_U
1
(1-t_U)
SS_U_n
SS_U_n
1
SS_U
SS_U

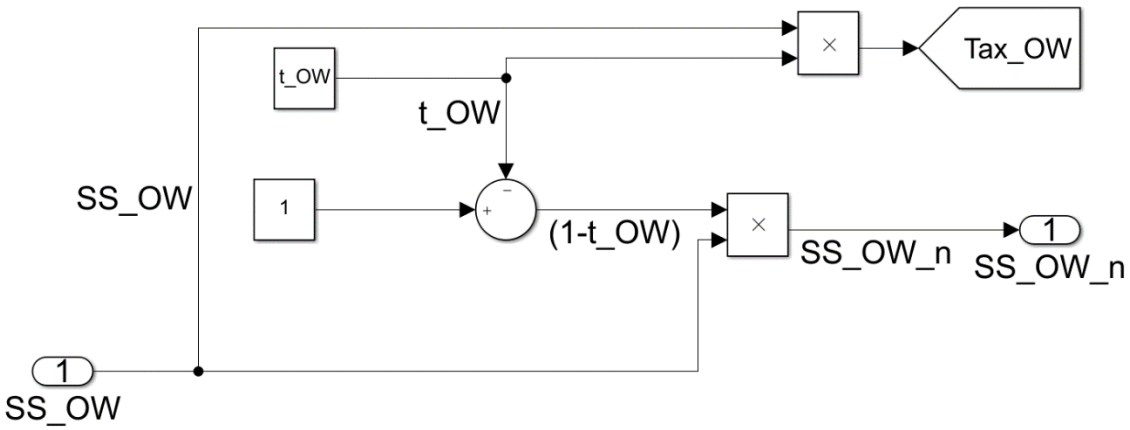
60A


M_U_dot
M_U_0
M_U
1
SS_U_n
M_U
C_U
1
C_U
T_U
T_U
60B
T_in
T_out
C_U

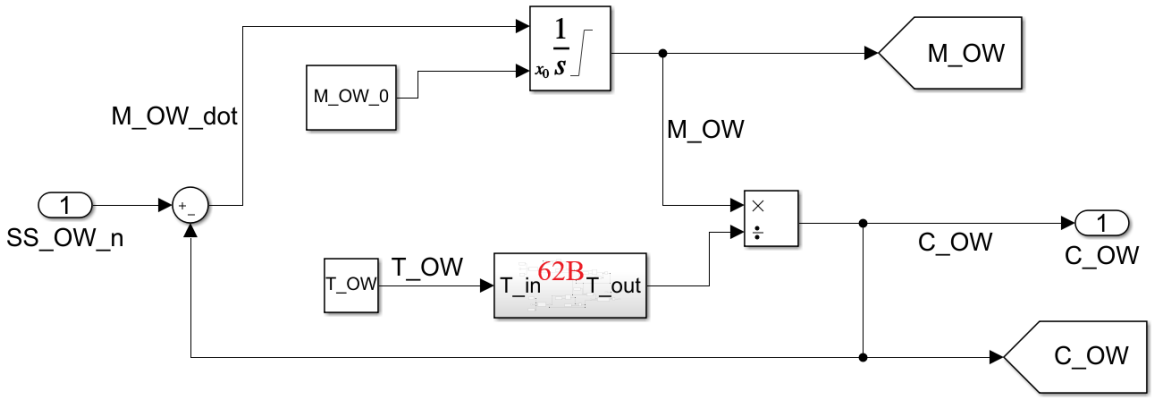
60B


TimeGain2
TimeGain_Init_4
>= 130
TimeGain_Init_5
TI
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
TimeGain1
TimeGain_Init_2
>= 130
T_out
>= 52
TimeGain_Init_3
TimeGain_Init_1

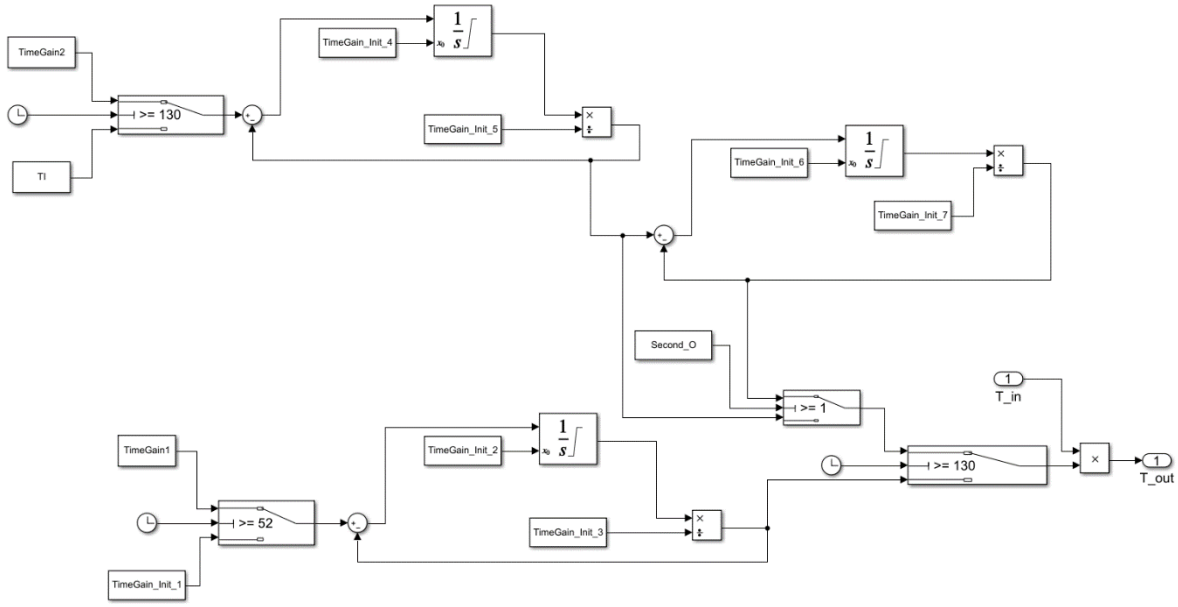
61A


t_OW
t_OW
Tax_OW
SS_OW
1
(1-t_OW)
SS_OW_n
1
SS_OW_n
1
SS_OW

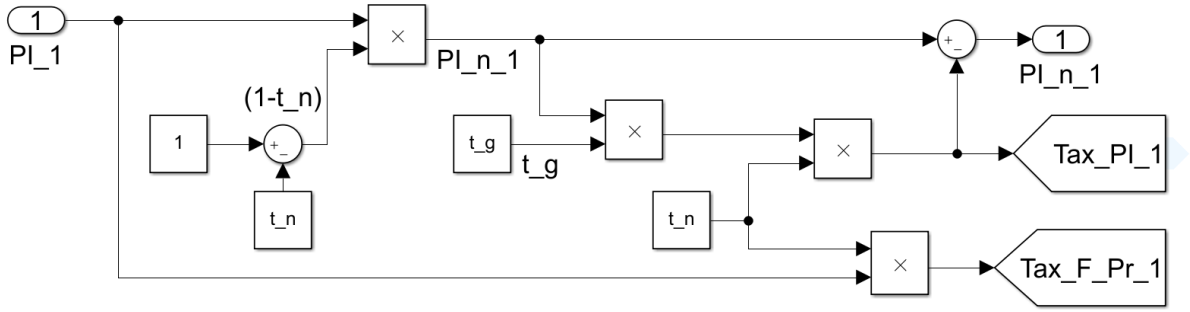
62A


1
s
M_OW
M_OW_0
M_OW_dot
M_OW
1
SS_OW_n
C_OW
1
C_OW
T_OW
T_OW
T_in
62B
T_out
C_OW

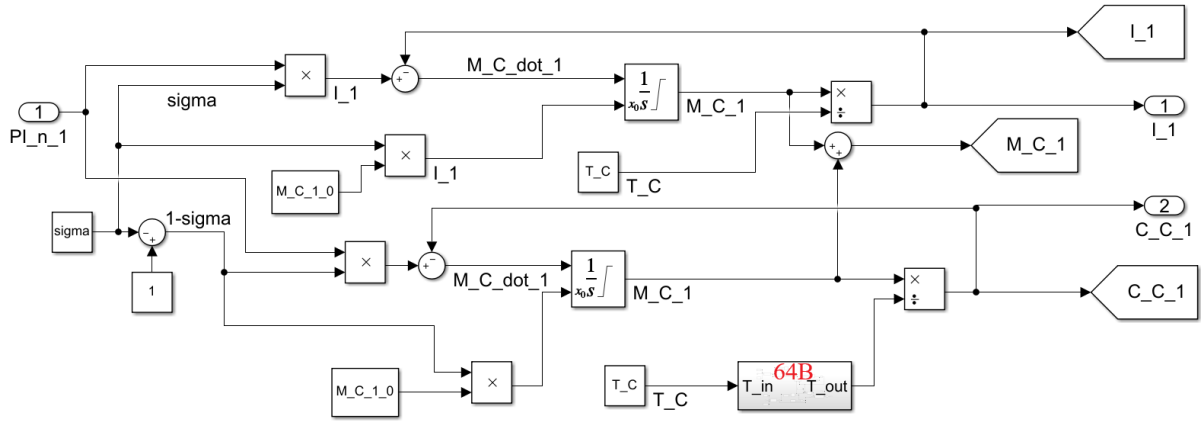
62B


TimeGain2
TI
>= 130
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
T_out
TimeGain1
TimeGain_Init_1
>= 52
TimeGain_Init_2
TimeGain_Init_3
>= 130

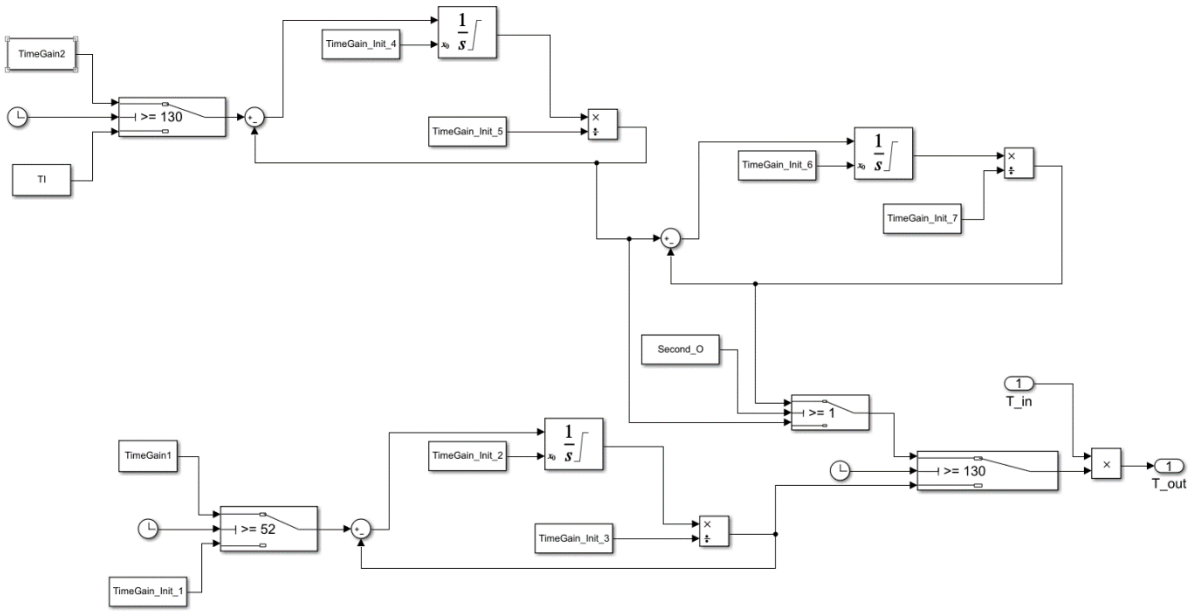
63A


1
PI_1
(1-t_n)
1
t_n
PI_n_1
t_g
t_g
t_n
PI_n_1
1
Tax_PI_1
Tax_F_Pr_1

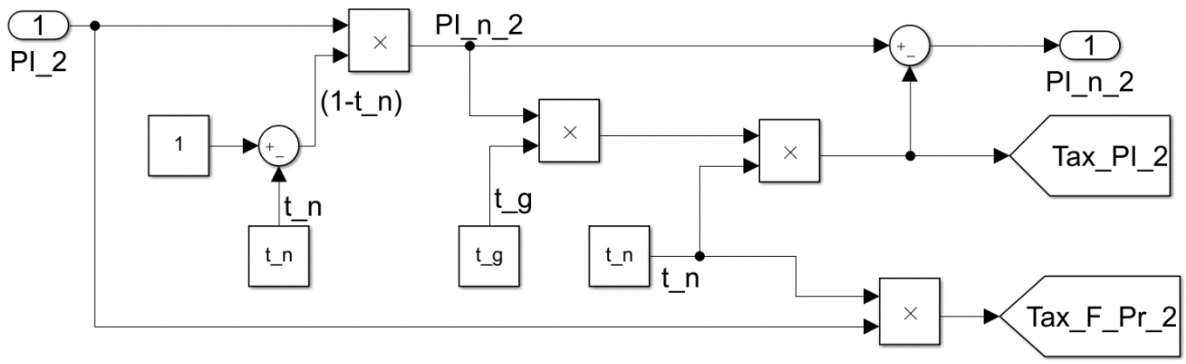
64A


1
PI_n_1
sigma
I_1
M_C_dot_1
M_C_1
I_1
1
I_1
M_C_1
T_C
T_C
M_C_1_0
I_1
sigma
1-sigma
1
2
C_C_1
M_C_dot_1
M_C_1
C_C_1
M_C_1_0
T_C
T_C
T_in
T_out
64B

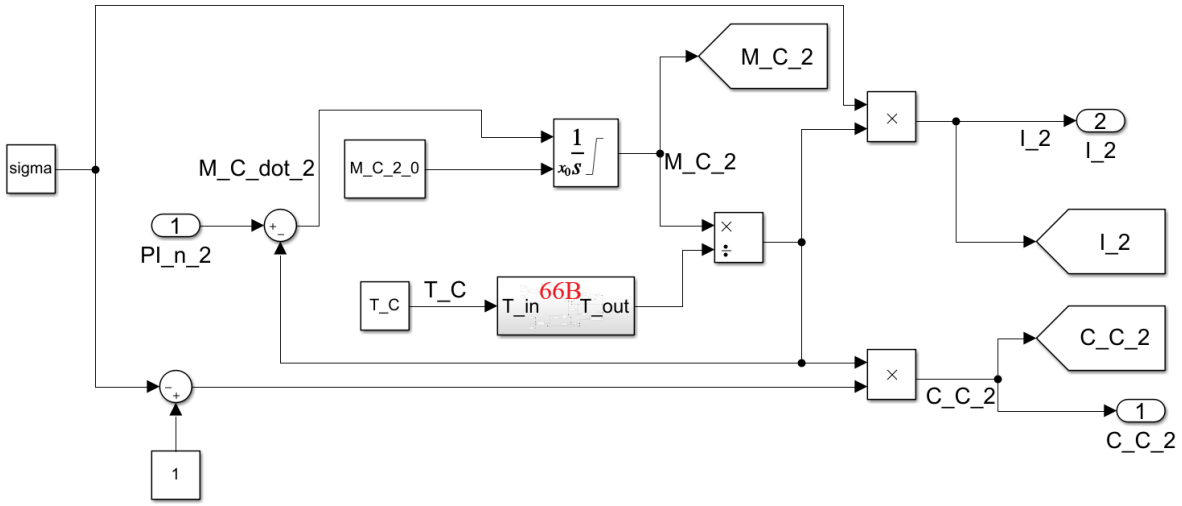
64B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3
>= 130
T_out

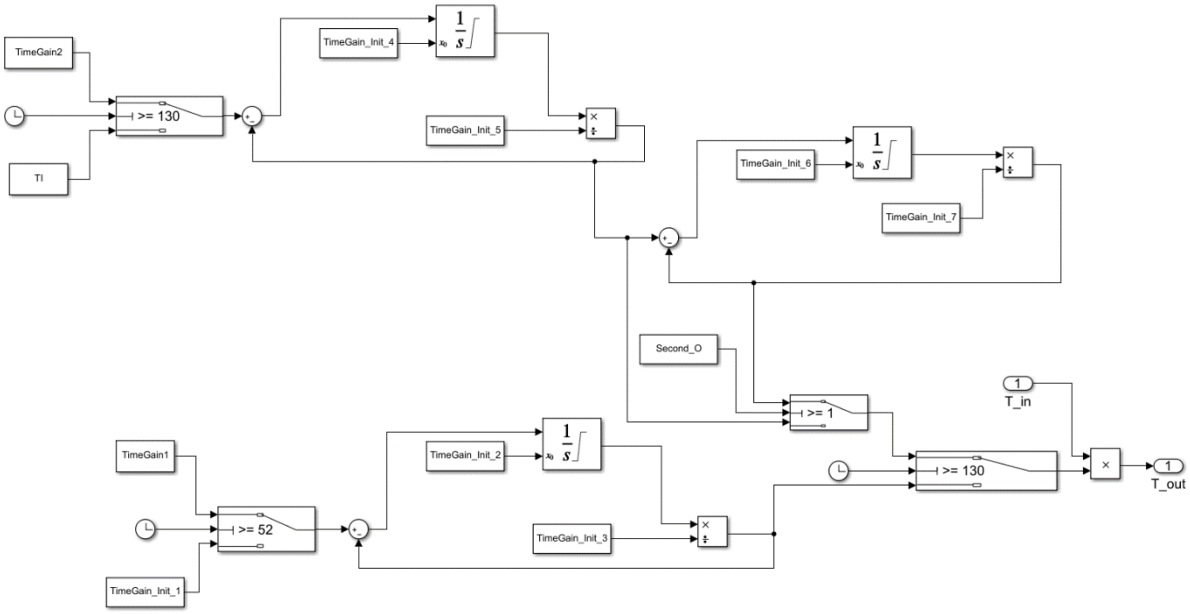
65A


1
Pl_2
Pl_n_2
(1-t_n)
1
t_n
t_n
t_g
t_g
t_n
t_n
1
Pl_n_2
Tax_Pl_2
Tax_F_Pr_2

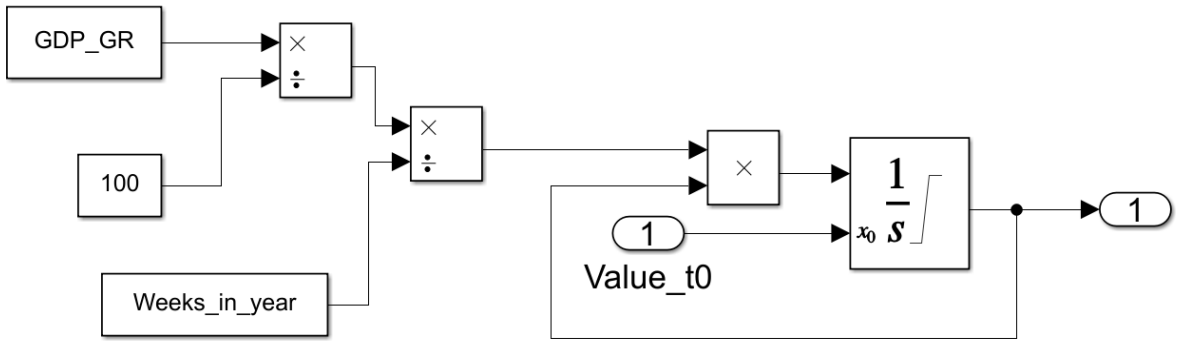
66A


sigma
M_C_dot_2
M_C_2_0
M_C_2
M_C_2
1
Pl_n_2
T_C
T_C
T_in
66B
T_out
I_2
2
I_2
I_2
C_C_2
C_C_2
1
C_C_2
1

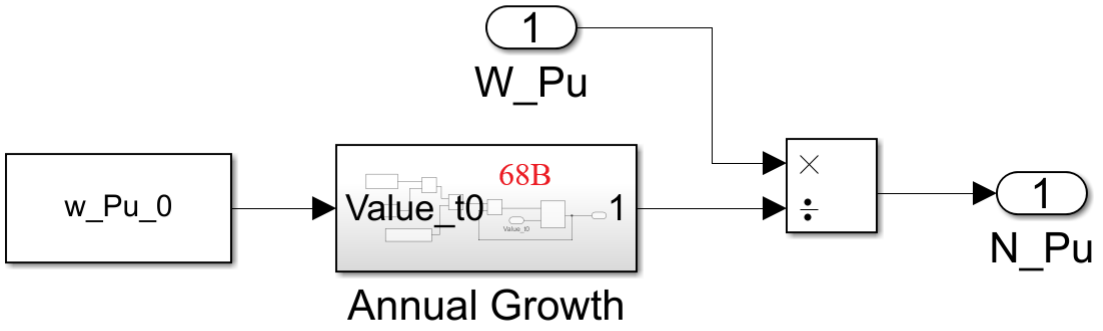
66B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
TimeGain1
>= 52
TimeGain_Init_2
TimeGain_Init_3
TimeGain_Init_1
>= 130
T_out

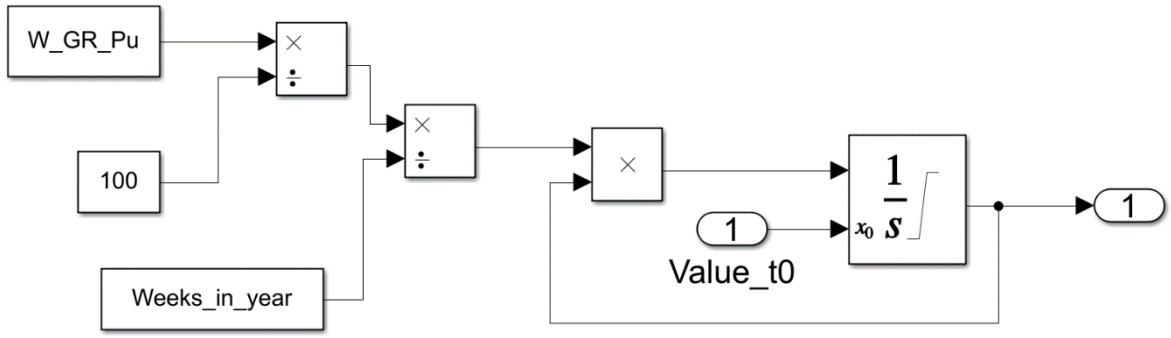
67A


GDP_GR
100
Weeks_in_year
1
Value_t0
1

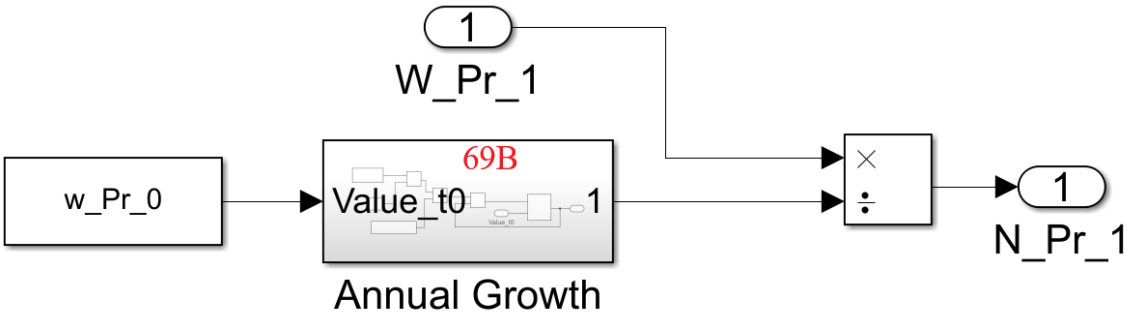
68A


1
W_Pu
w_Pu_0
68B
Value_t0
1
Annual Growth
1
N_Pu

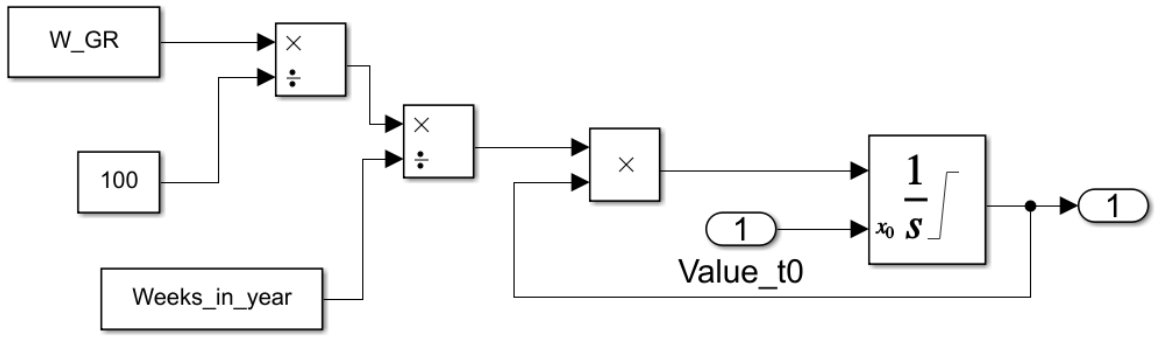
68B


W_GR_Pu
100
Weeks_in_year
1
Value_t0
1
1

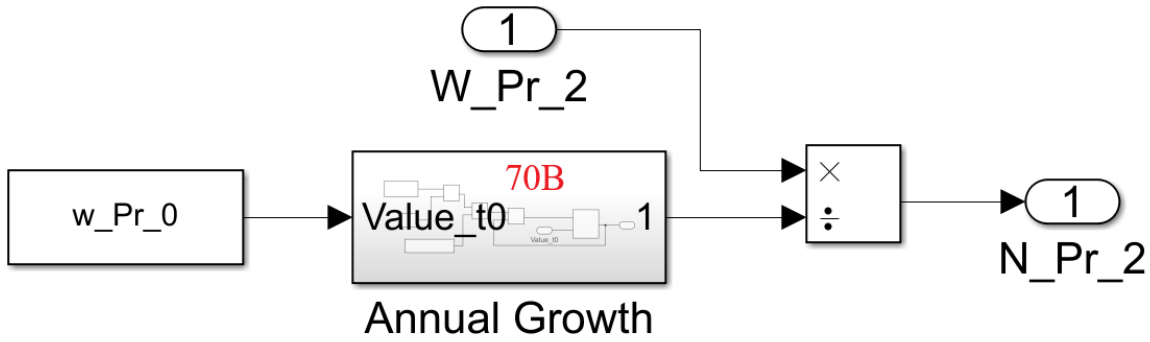
69A


1
W_Pr_1
w_Pr_0
69B
Value_t0
1
Annual Growth
1
N_Pr_1

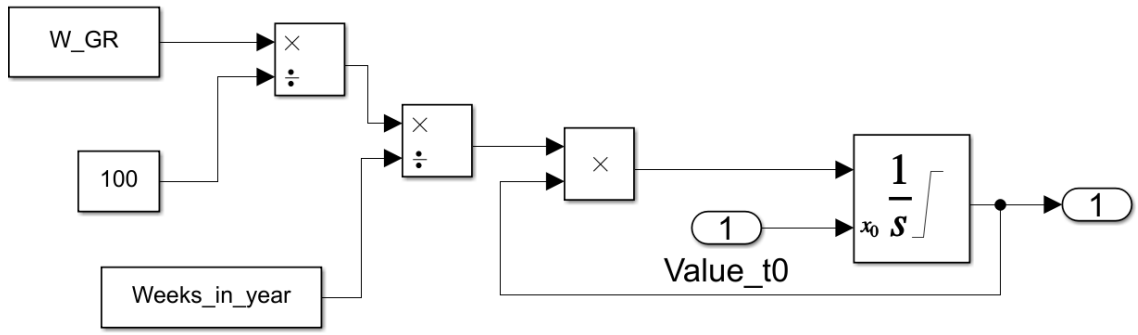
69B


W_GR
100
Weeks_in_year
1
Value_t0
1

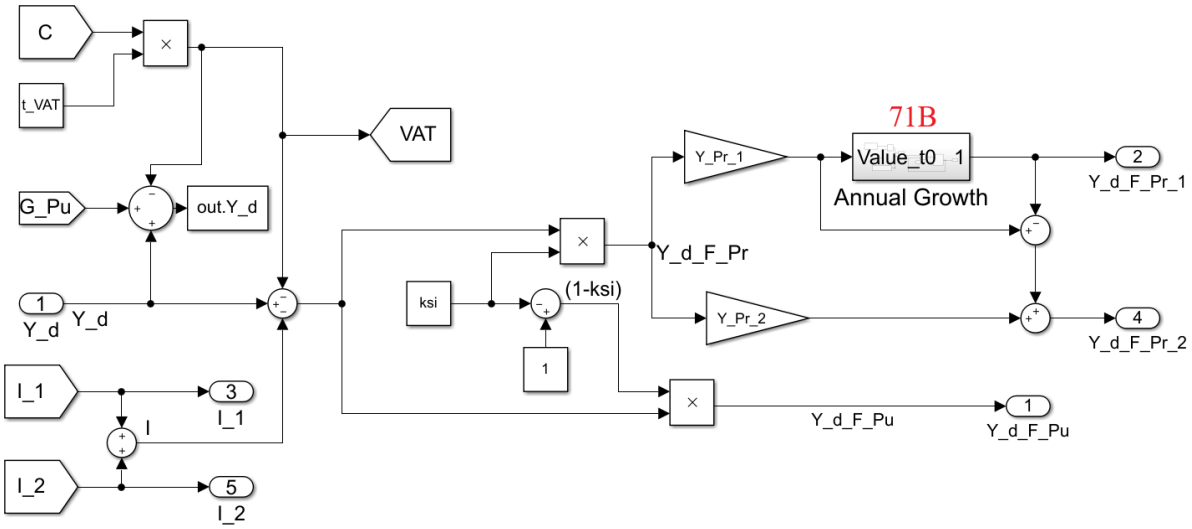
70A


1
W_Pr_2
w_Pr_0
70B
Value_t0
1
Annual Growth
1
N_Pr_2

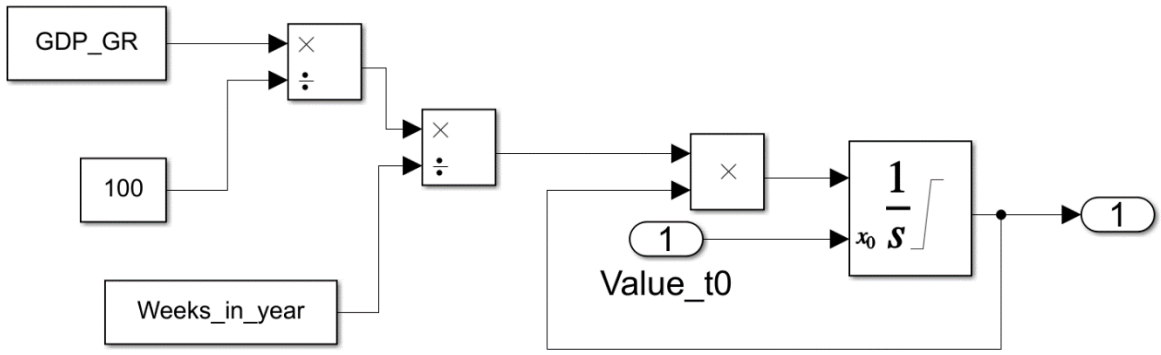
70B


W_GR
100
Weeks_in_year
1
Value_t0
1

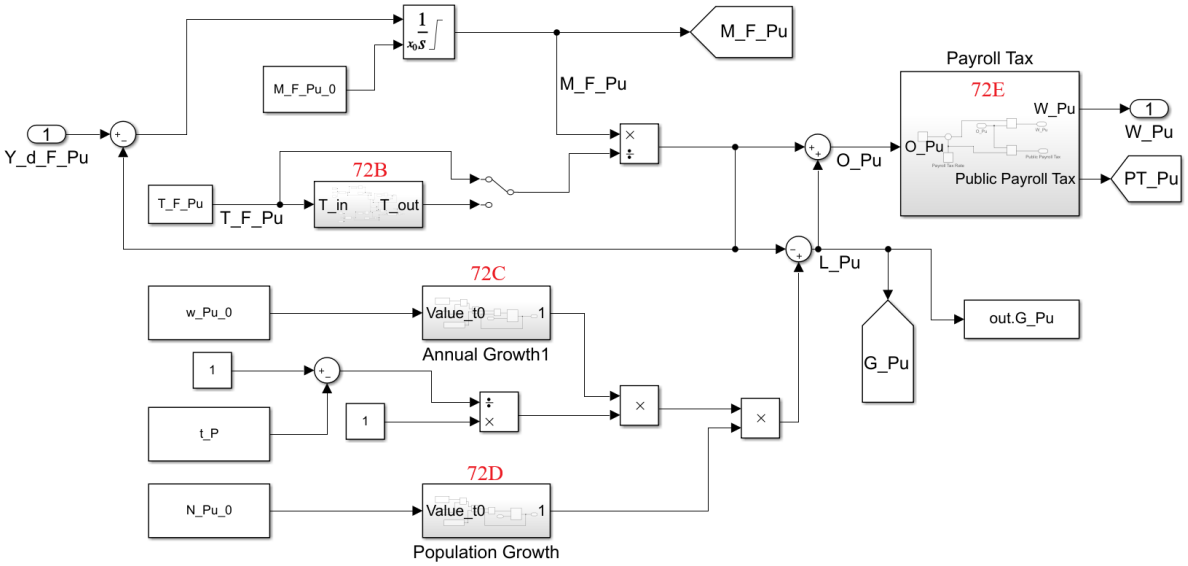
71A


C
t_VAT
VAT
G_Pu
out.Y_d
1
Y_d
Y_d
I_1
3
I_1
I
I_2
5
I_2
ksi
(1-ksi)
1
Y_d_F_Pr
Y_Pr_1
Y_Pr_2
71B
Value_t0 1
Annual Growth
2
Y_d_F_Pr_1
4
Y_d_F_Pr_2
Y_d_F_Pu
1
Y_d_F_Pu

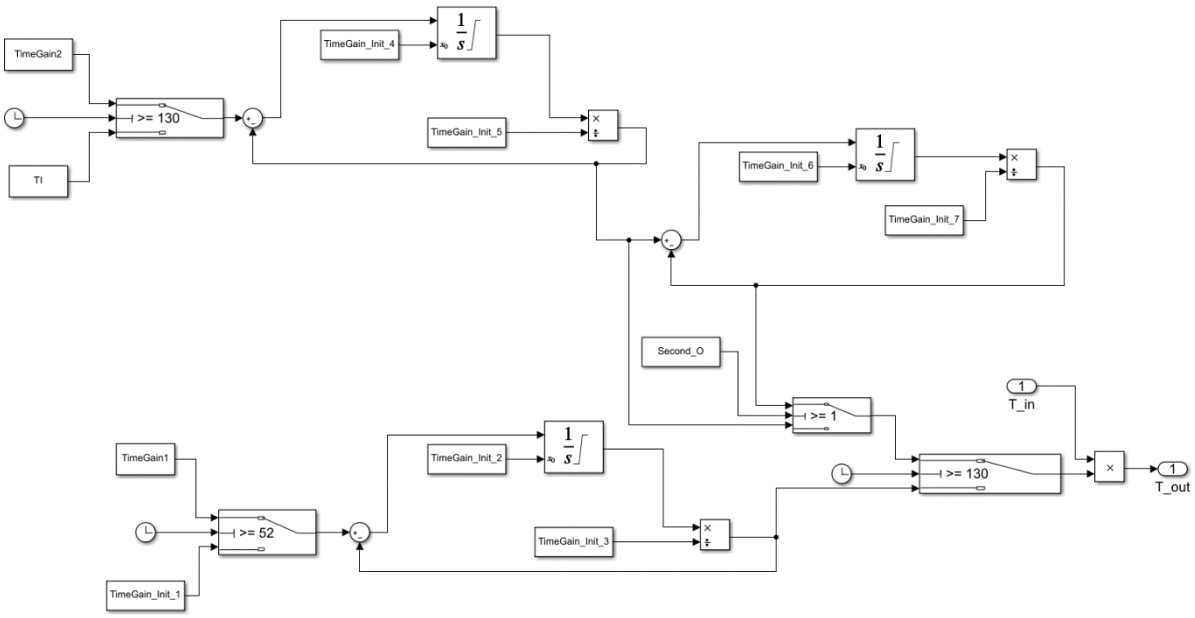
71B


GDP_GR
100
Weeks_in_year
1
Value_t0
1
S
x0
1

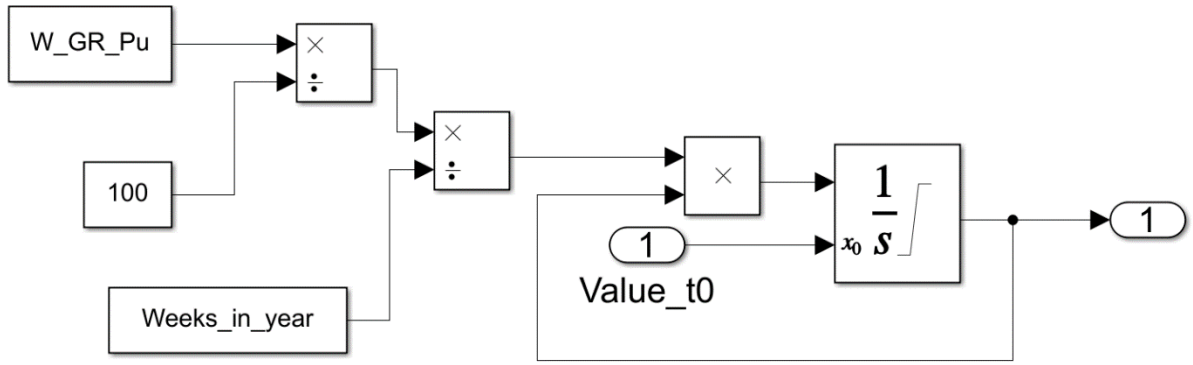
72A


1
Y_d_F_Pu
M_F_Pu_0
M_F_Pu
M_F_Pu
T_F_Pu
T_F_Pu
72B
T_in
T_out
O_Pu
Payroll Tax
72E
W_Pu
1
W_Pu
O_Pu
Public Payroll Tax
PT_Pu
L_Pu
72C
w_Pu_0
Value_t0
1
Annual Growth1
1
t_P
1
G_Pu
out.G_Pu
72D
N_Pu_0
Value_t0
1
Population Growth

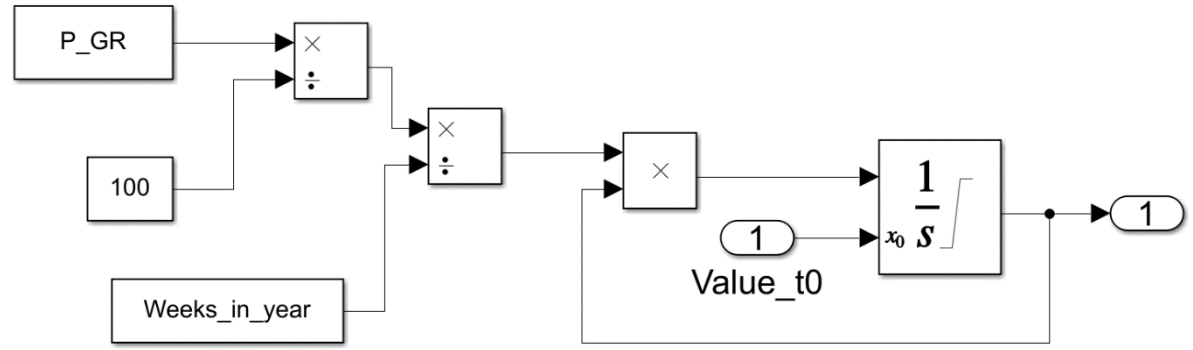
72B


TimeGain2
>= 130
TI
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
1
TimeGain1
>= 52
TimeGain_Init_1
TimeGain_Init_2
TimeGain_Init_3
>= 130
1
T_out

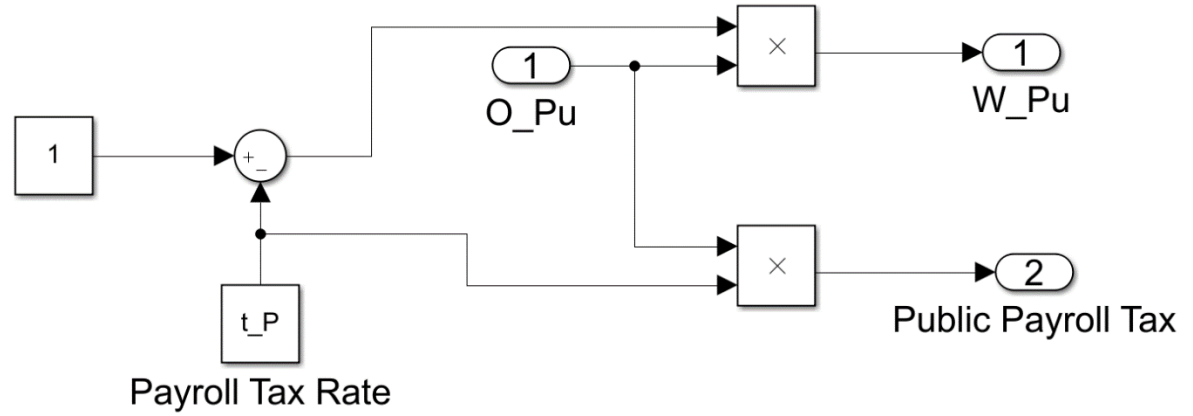
72C


W_GR_Pu
100
Weeks_in_year
1
Value_t0
1
1

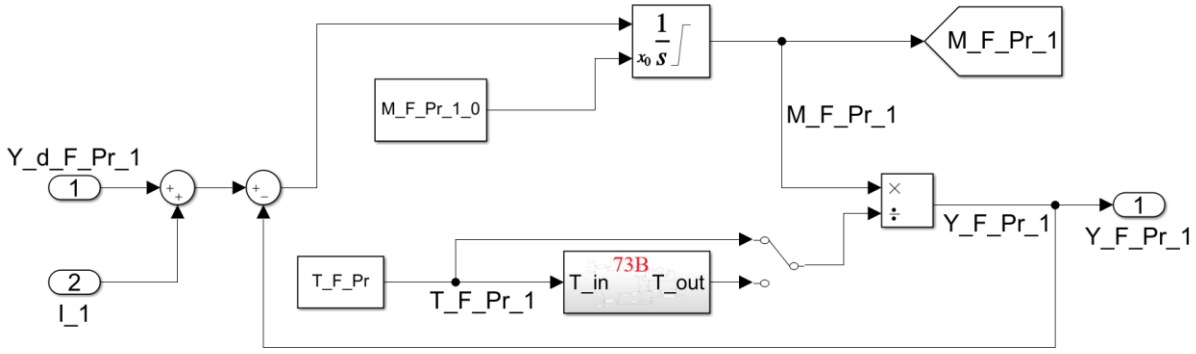
72D


P_GR
100
Weeks_in_year
1
Value_t0
1
1

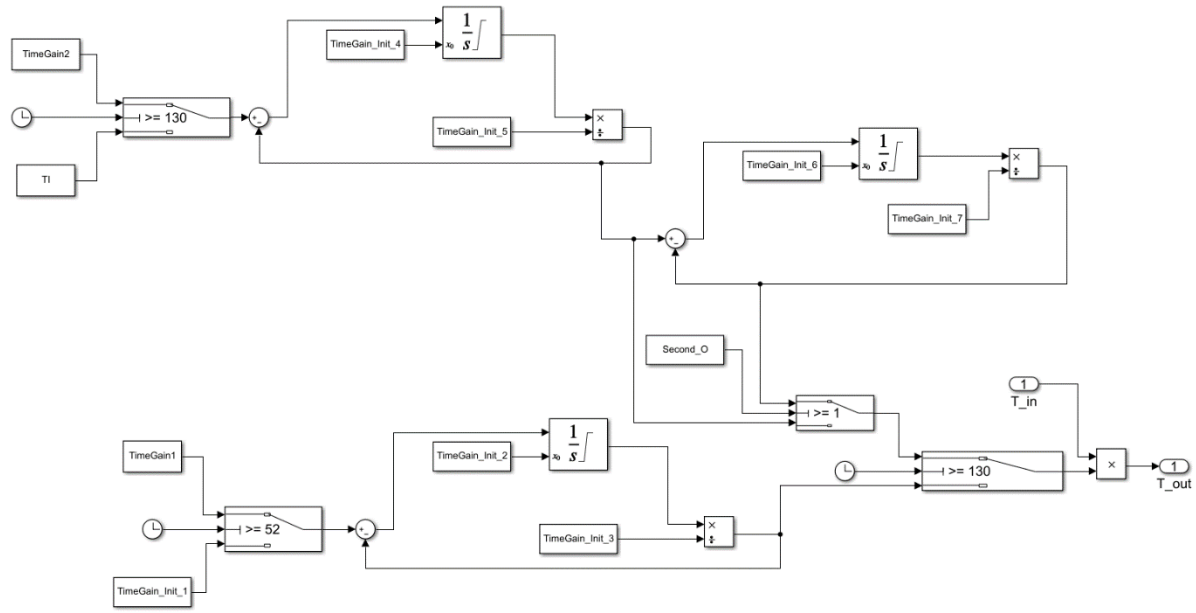
72E


1
1
O_Pu
1
W_Pu
2
Public Payroll Tax
t_P
Payroll Tax Rate

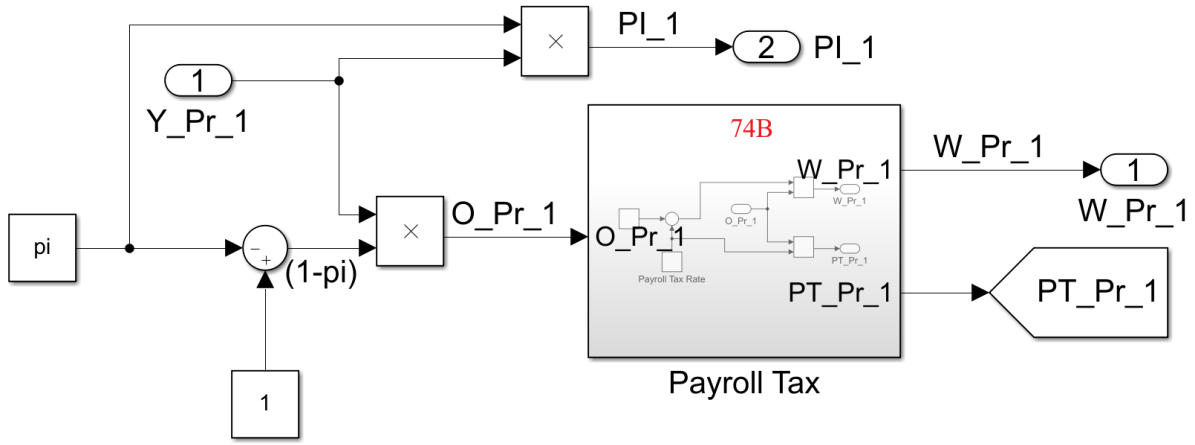
73A


Y_d_F_Pr_1
1
2
I_1
M_F_Pr_1_0
M_F_Pr_1
M_F_Pr_1
T_F_Pr
T_F_Pr_1
73B
T_in
T_out
Y_F_Pr_1
1
Y_F_Pr_1

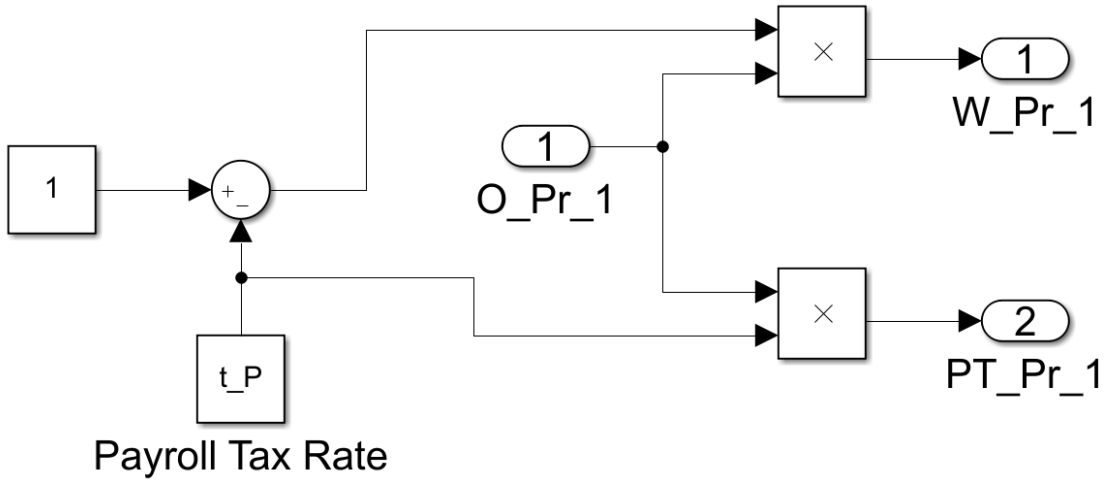
73B


TimeGain2
TI
>= 130
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
T_in
TimeGain1
TimeGain_Init_1
>= 52
TimeGain_Init_2
TimeGain_Init_3
>= 130
T_out

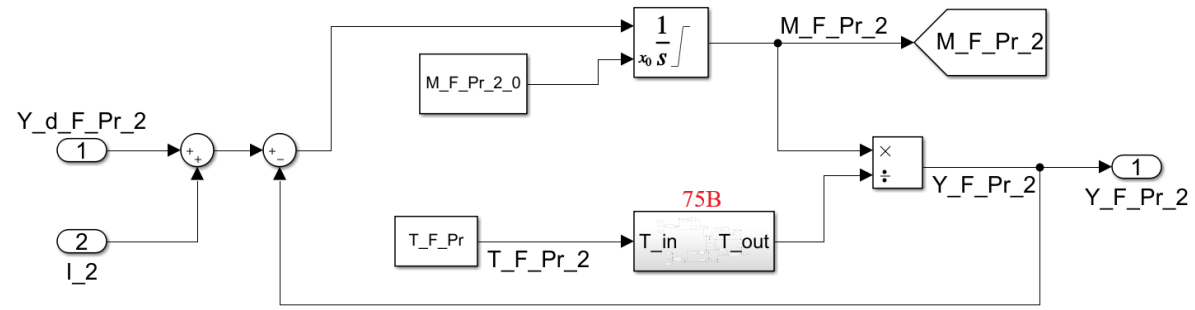
74A


PI_1
2
PI_1
1
Y_Pr_1
74B
W_Pr_1
1
W_Pr_1
pi
O_Pr_1
O_Pr_1
(1-pi)
PT_Pr_1
PT_Pr_1
1
Payroll Tax

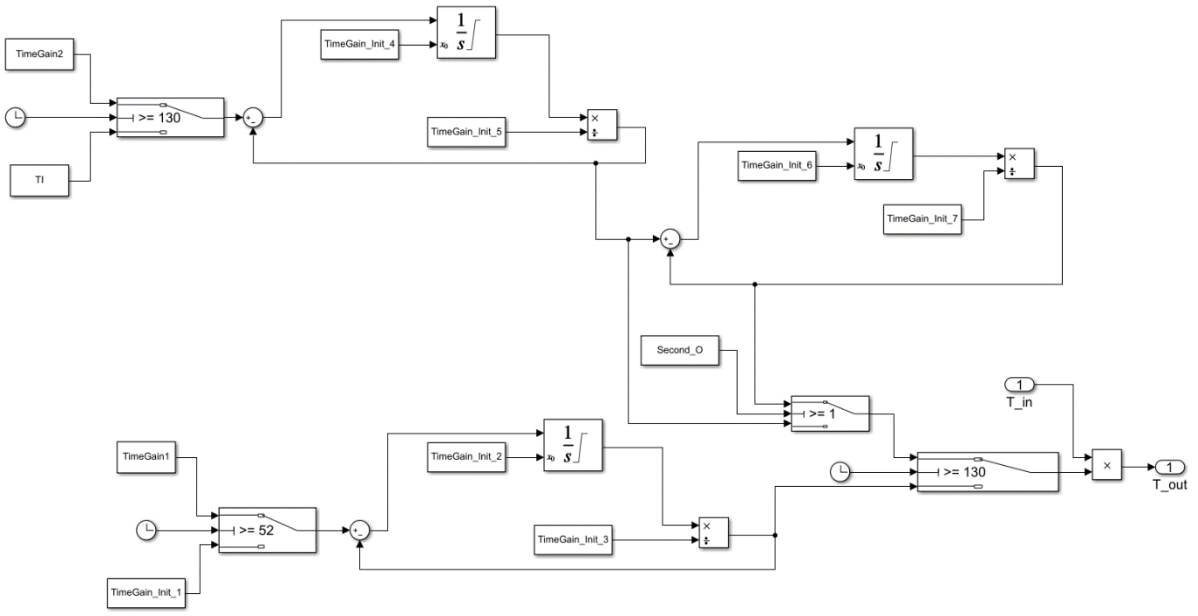
74B


1
W_Pr_1
1
1
O_Pr_1
2
PT_Pr_1
t_P
Payroll Tax Rate

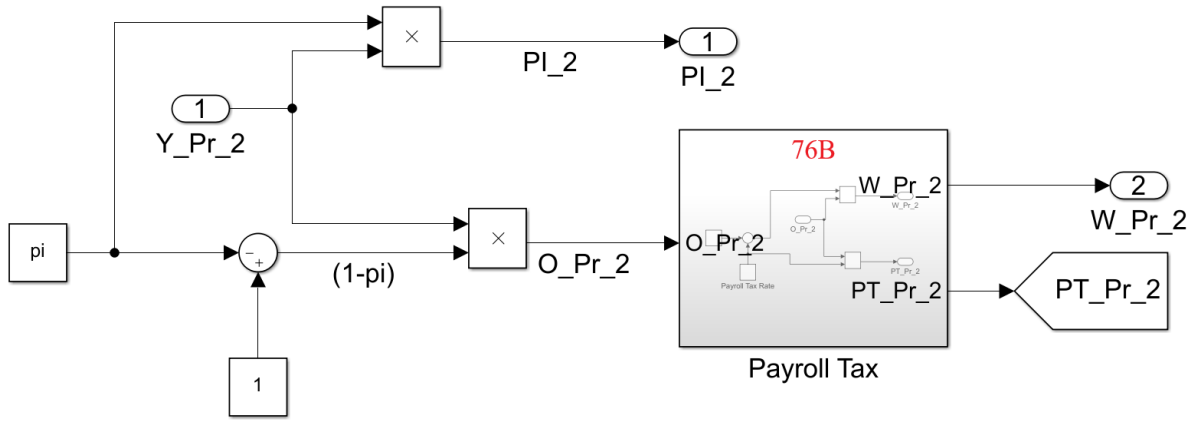
75A


Y_d_F_Pr_2
1
2
I_2
M_F_Pr_2_0
M_F_Pr_2
M_F_Pr_2
Y_F_Pr_2
1
Y_F_Pr_2
75B
T_F_Pr
T_F_Pr_2
T_in
T_out

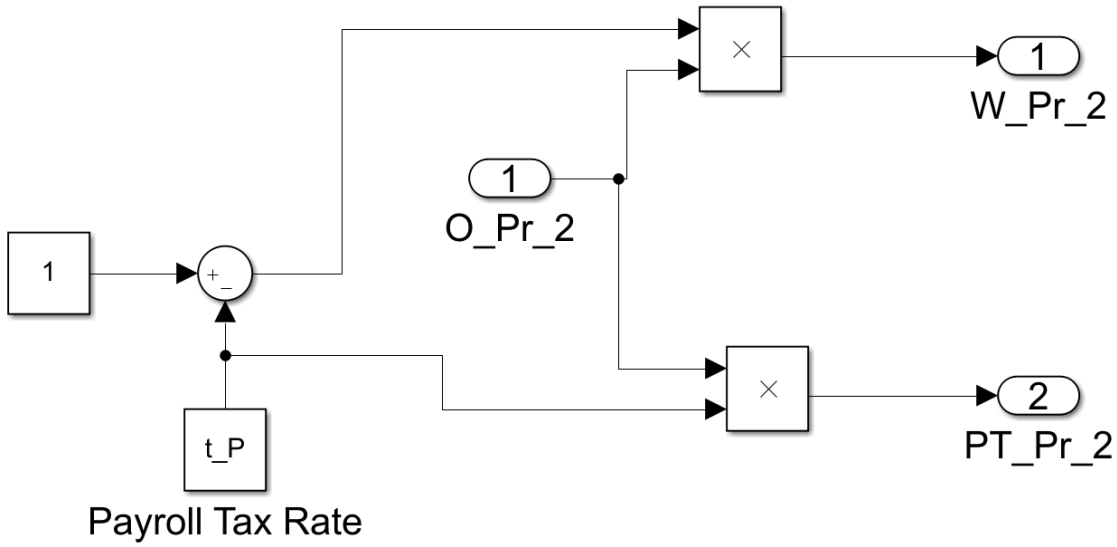
75B


TimeGain2
TI
>= 130
TimeGain_Init_4
TimeGain_Init_5
TimeGain_Init_6
TimeGain_Init_7
Second_O
>= 1
1
T_in
TimeGain1
TimeGain_Init_1
>= 52
TimeGain_Init_2
TimeGain_Init_3
>= 130
1
T_out

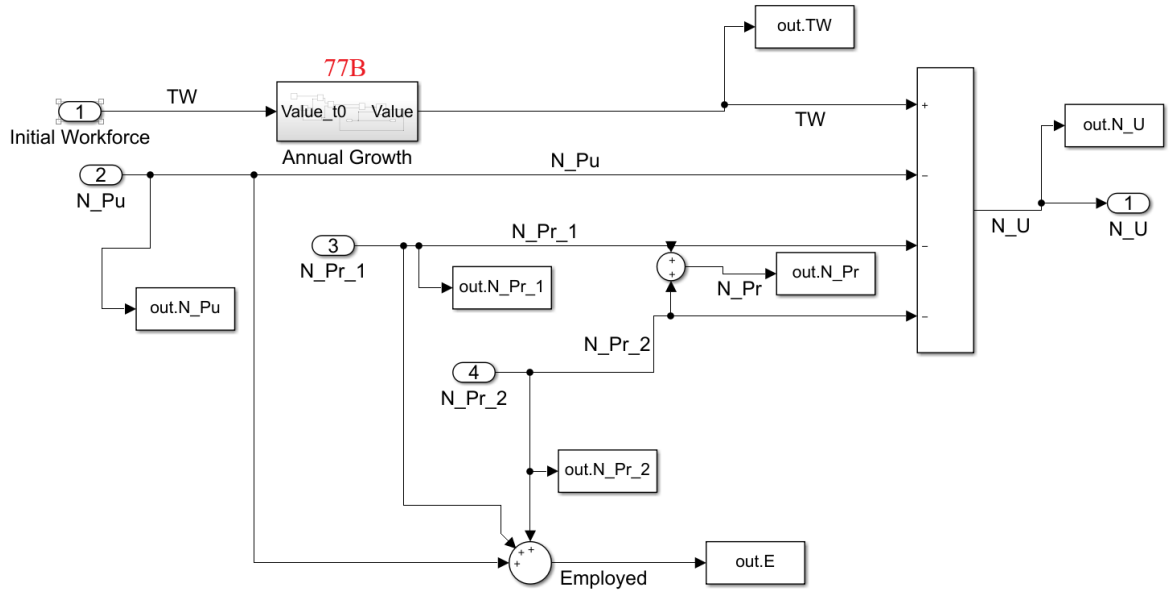
76A


PI_2
1
PI_2
1
Y_Pr_2
76B
W_Pr_2
2
W_Pr_2
pi
(1-pi)
O_Pr_2
O_Pr_2
PT_Pr_2
PT_Pr_2
1
Payroll Tax

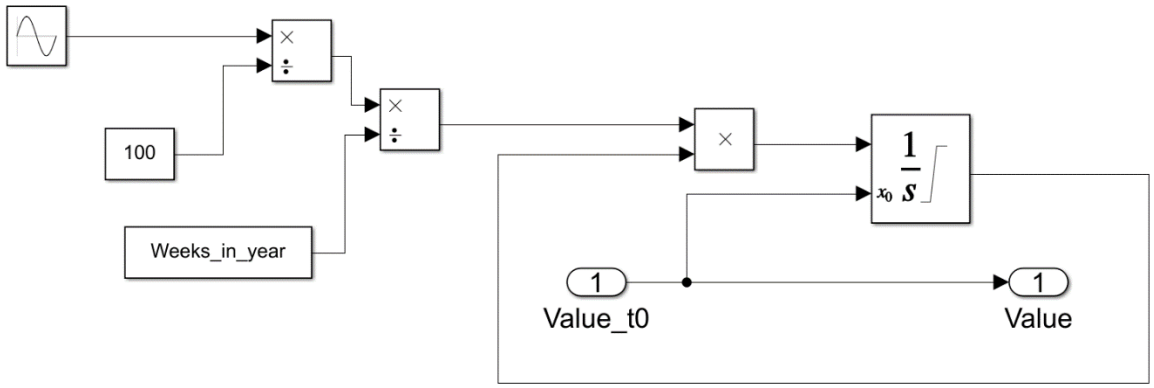
76B


1
W_Pr_2
1
O_Pr_2
1
2
PT_Pr_2
t_P
Payroll Tax Rate

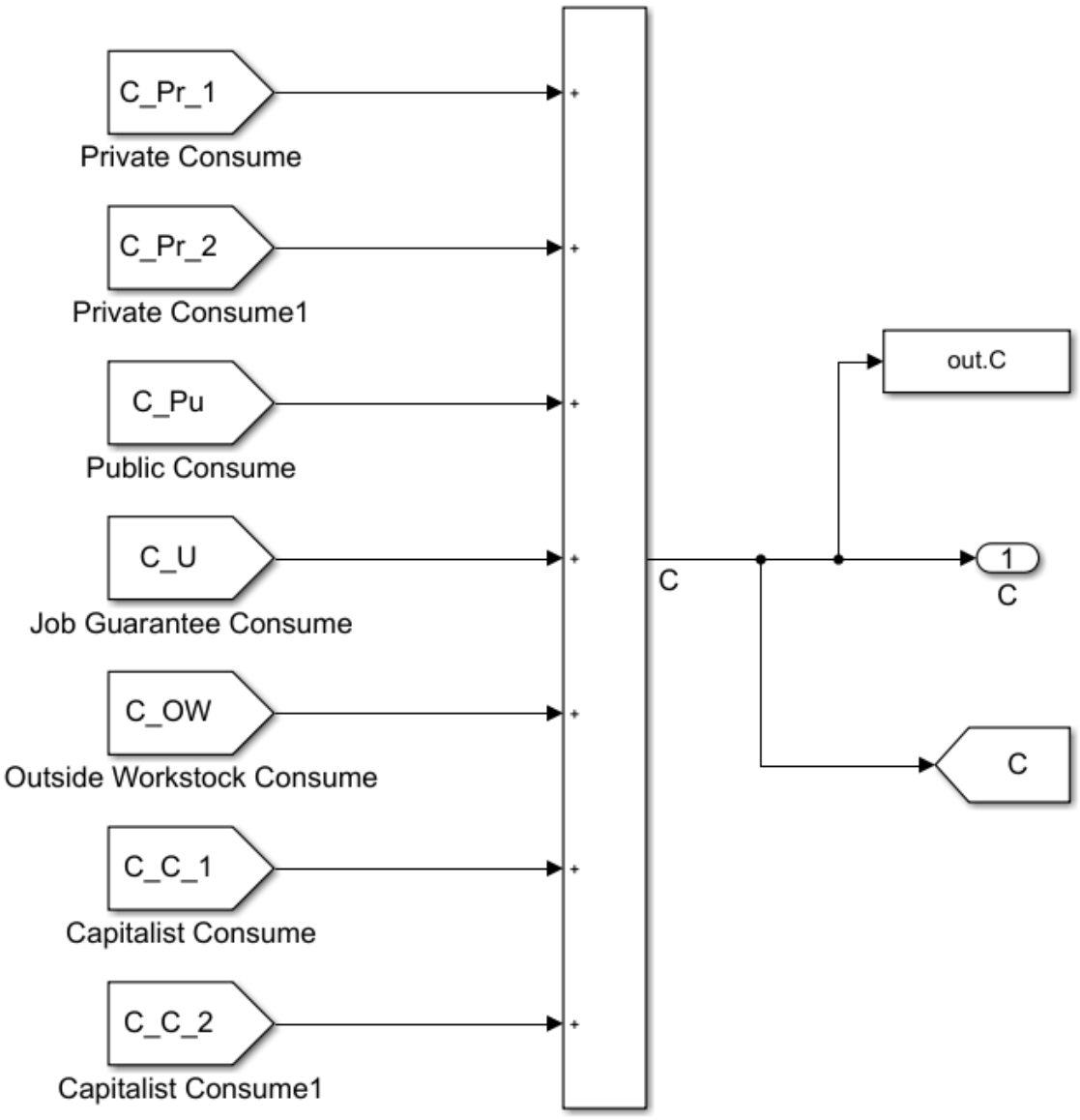
77A


77B
1
Initial Workforce
TW
Value_t0
Value
Annual Growth
out.TW
TW
2
N_Pu
N_Pu
out.N_Pu
3
N_Pr_1
N_Pr_1
out.N_Pr_1
N_Pr
out.N_Pr
4
N_Pr_2
N_Pr_2
out.N_Pr_2
Employed
out.E
N_U
out.N_U
1
N_U

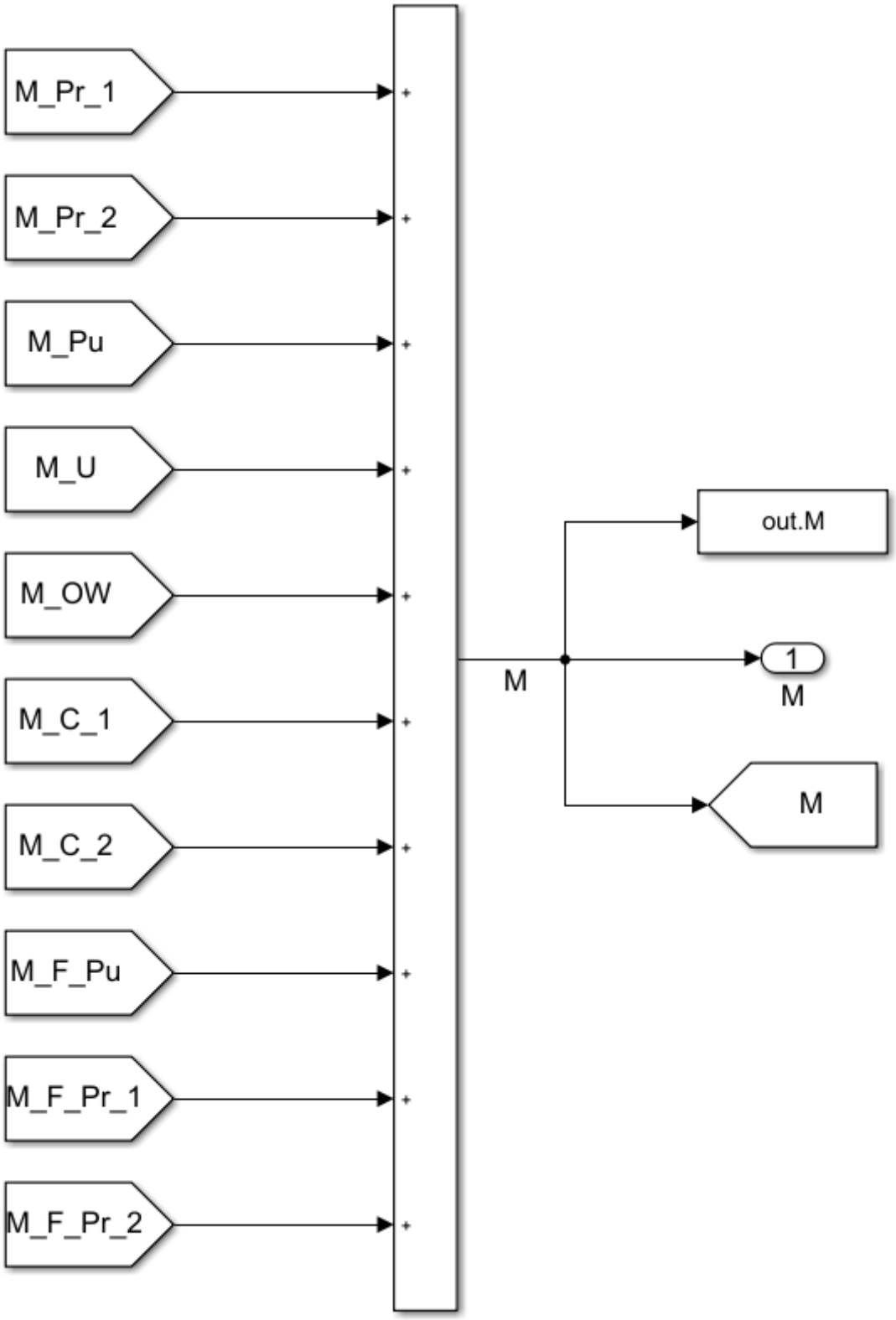
77B


100
Weeks_in_year
1
Value_t0
1
Value

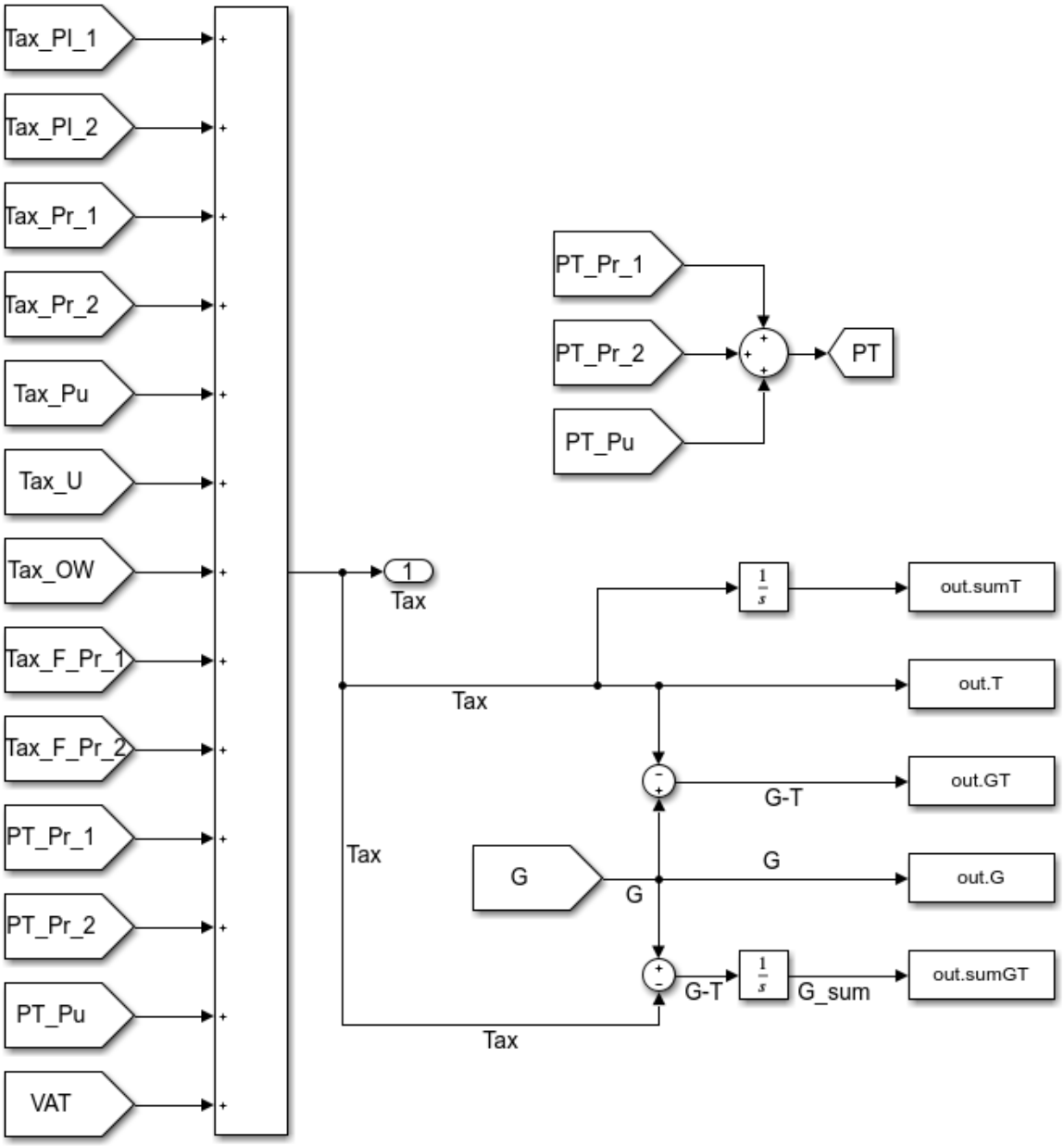
78A


C_Pr_1
Private Consume
C_Pr_2
Private Consume1
C_Pu
Public Consume
C_U
Job Guarantee Consume
C_OW
Outside Workstock Consume
C_C_1
Capitalist Consume
C_C_2
Capitalist Consume1
C
out.C
1
C
C

79A



80A


Tax_Pl_1
Tax_Pl_2
Tax_Pr_1
Tax_Pr_2
Tax_Pu
Tax_U
Tax_OW
Tax_F_Pr_1
Tax_F_Pr_2
PT_Pr_1
PT_Pr_2
PT_Pu
VAT
1
Tax
PT_Pr_1
PT_Pr_2
PT_Pu
PT
Tax
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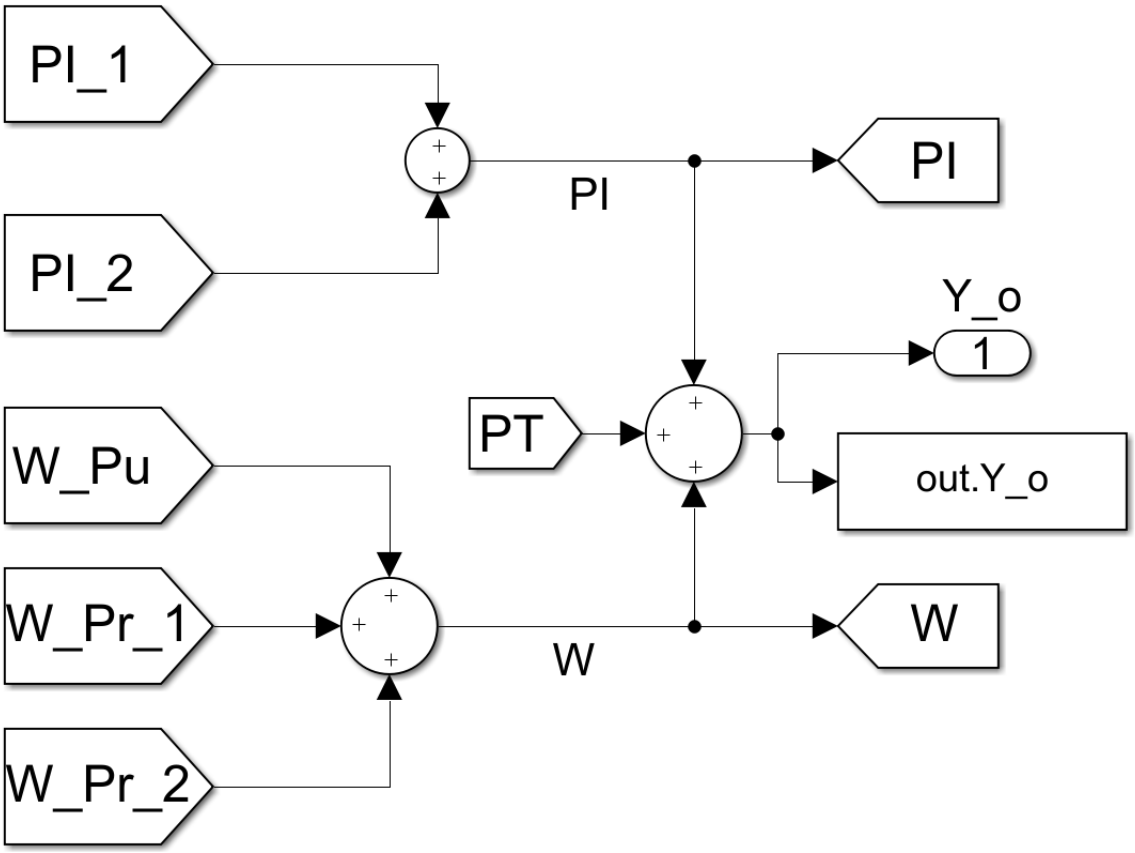
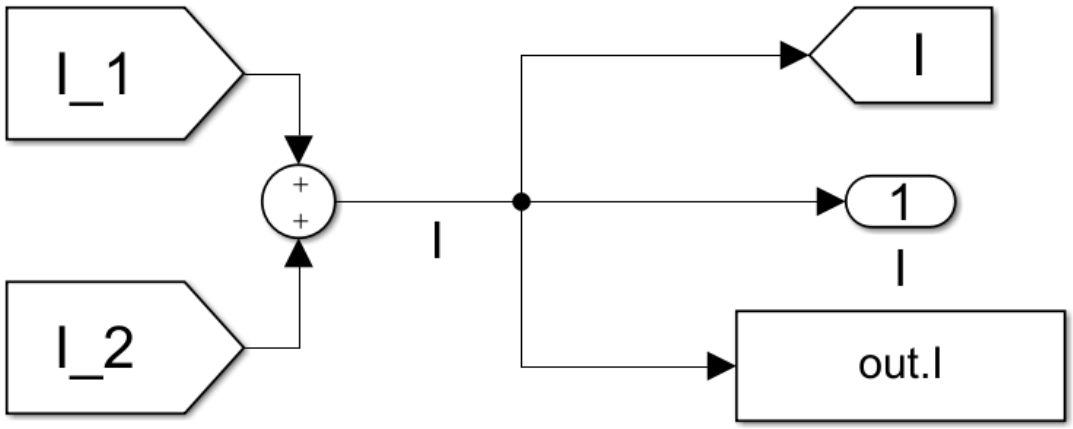
G-T
G_sum
out.sumGT
Tax

81A



82A



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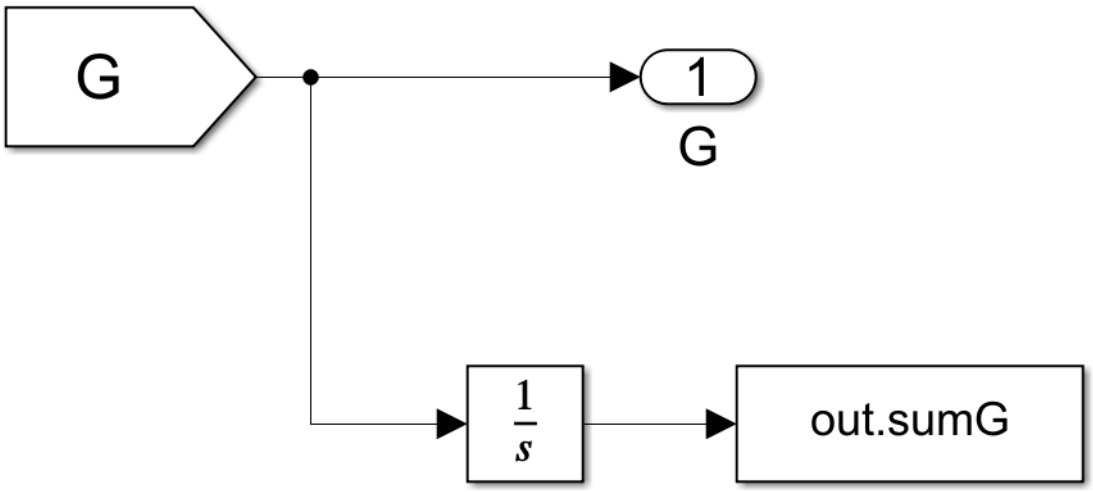

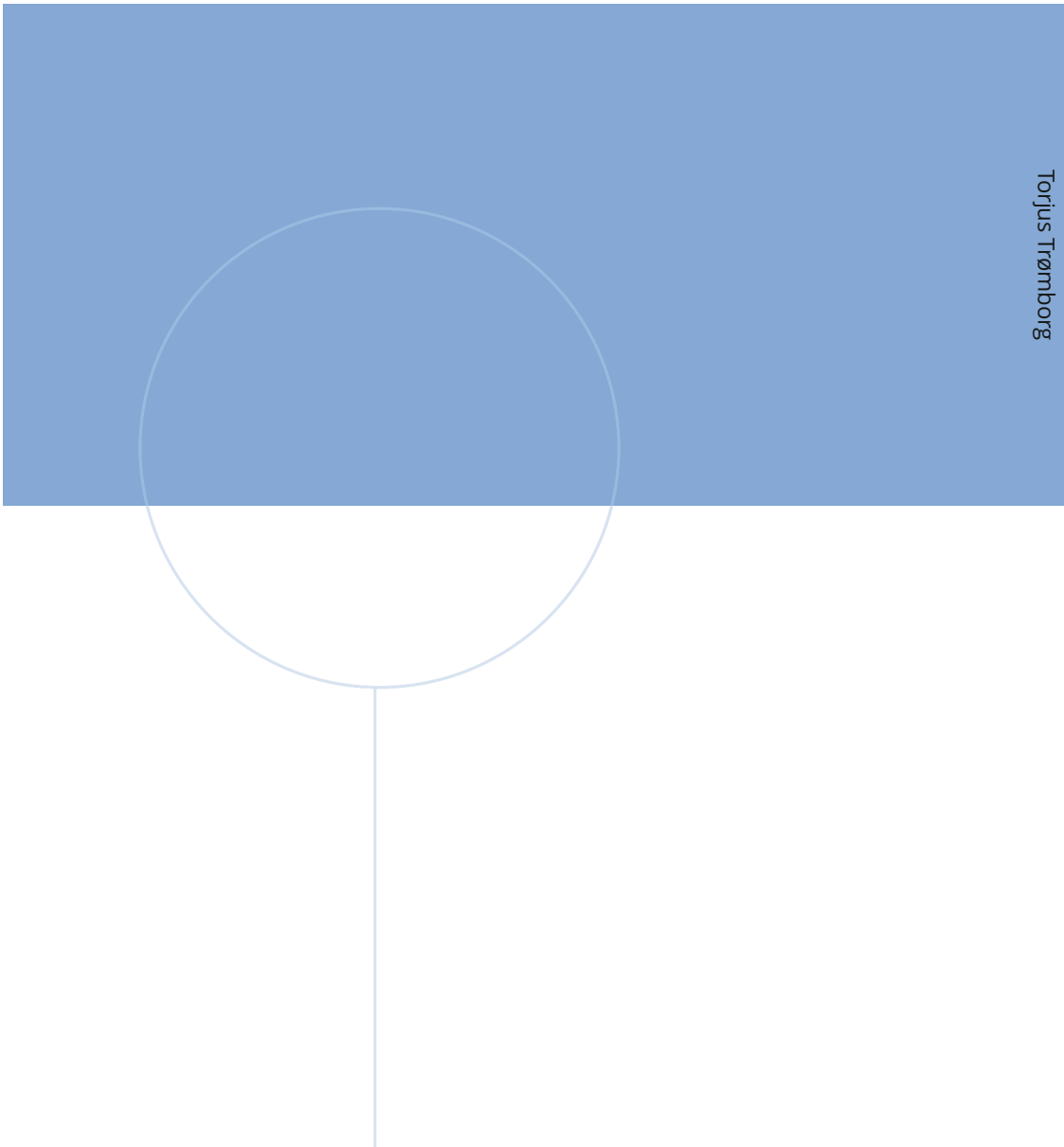

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