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Resurgence of inflation: Assessing the role of Macroeconomic Policies

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Abstract

After decades of relative consumer price stability, inflation is now making a come-back as a central topic in economic and political discussions, against a backdrop of various policy challenges. The aim of this paper is to provide a nuanced assessment of the different channels through which monetary, fiscal and income policies can affect prices and output in a small open economy, as well as discuss which policy measures are desirable and practically feasible when such an economy experiences inflationary shocks. To do so, we adopt a comprehensive modelling approach and build an empirical stock-flow-consistent model using sectoral national account data for Denmark over the period 2005Q1-2020Q1. We then replicate the inflationary environment in which Denmark and several other countries are currently operating and introduce a monetary policy reaction which leads to a modest reduction in inflation at the cost of further contracting the economy. Taking monetary tightening as a forced policy response in the case of a small open economy with fixed exchange rate, we explore a number of policies that, within the current institutional and legal framework, can potentially mitigate the adverse effects of inflation. Specifically, we introduce fiscal interventions - in the form of tax cuts on income and production - along with wage- and price-based income policies. Our main conclusion is that a close coordination of fiscal and income policies can help reduce the effects of adverse shocks to income without increasing inflation. Finally, we address a question of political relevance by exploring the effects of different policies on public budget and debt. Overall, we find that of all the policies implemented, monetary policy has the most dramatic effects on public debt sustainability.

Key words:
Inflation, Fiscal policy, Monetary policy, Income policy, Stock-flow consistent model

JEL codes:
E12, E52, E64, E61

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1. Introduction

While inflation targeting has emerged as the core priority of monetary policy since the 1980s, the interest in inflation as a research topic somewhat faded a decade later in the Western world. The primary reason was that prices in most advanced economies remained low and stable – which was considered unquestionable evidence of the appropriateness and efficiency of monetary policy – while other pressing economic issues came to the spotlight, such as repeated financial crises and fluctuating unemployment. The situation, however, changed dramatically after the Covid-19 crisis in 2021-22, i.e., when Covid lockdowns were eased (and later on lifted), aggregate demand increased sharply, which combined with the disorderly reopening of global supply chains created supply shortages and progressively pushed the prices up for many goods and services, including energy prices. The situation deteriorated further as the increase in global energy prices was further fuelled by the unanticipated geopolitical developments.

Despite being one of the oldest debates in macroeconomics, the mechanism through which prices change and adjust remains highly controversial. The controversy not only exists between Post-Keynesian (PK) and mainstream macroeconomic theories, but also within the mainstream (i.e., between Neo-Classicals and New-Keynesians). The New-Keynesian (NK) views have dominated the mainstream macroeconomic thinking since the 1980s (Galí and Gertler 2007) and evolved into what is also known as the NCM (New Consensus Macroeconomics) (Arestis 2009). Focusing on the determinants of inflation, NCM places a greater emphasis on aggregate demand and inflation expectations channels to explain inflation (Galí 2018), whereas PK theory, while not completely ruling out the effects of aggregate demand and inflation expectations, places a greater emphasis on the cost-push factors of inflation (Setterfield (2006); Gnos and Rochon (2007); Lima and Setterfield (2008)).

Shifting the emphasis from one channel to the other is nontrivial and entails different policy responses against inflation. Most central banks, inspired by the NCM view, have adopted a policy framework, whose central objective is to stabilise inflation and output through interest rates. This framework leaves no space for fiscal policy in achieving non-inflationary growth, as fiscal expansion (leading to an increase in aggregate demand) is associated with increasing inflation, to which the central bank will respond by raising interest rates, leading to a decline in demand (Christiano, Eichenbaum and Trabandt (2018)). This has progressively led countries to disregard the role of discretionary fiscal policy while solely focusing on finding the optimal rate of interest that can stabilise prices and output (Godley and Lavoie (2012)). Moreover, fiscal policy is also discouraged due to public debt concerns, which is more of a political or a legal constraint than an economic one.[5] Operating within this policy framework, the policy response to tame post-Covid inflation is not surprising. That is, when prices surged, and the risk of recession was looming large, most central banks immediately responded to the situation by increasing interest rates. By contrast, the indeterminate role that fiscal policy should play, has yet again resulted in a lot of confusion in dealing with the situation. For example, the Central Bank of Denmark recommends fiscal tightening (more than in other EU countries) to reduce inflation and avoid a wage-price spiral (Danmarks Nationalbank (2022a); Danmarks Nationalbank (2022b)). The Ministry of Finance, on the other hand, argues that such a tight fiscal policy might be risky, and can drag the economy in to a recession (Ministry of Finance 2022). The Ministry, instead, suggests adopting packages to help households and possibly firms to deal with the current level of inflation. The situation is similar in other EU countries where there are calls for aid packages but also fiscal tightening. A consensus seems to be developing that following interest rate increases, fiscal policy should accommodate monetary policy by pursuing fiscal tightening, while at the same time, redirecting some expenditures to subsidies and aid packages (IMF (2022); Schnabel (2022)). The exact form of how the policy should be implemented is unclear.

The aim of this paper is to support rational decision making by providing an assessment of the various channels through which monetary, fiscal and income policies can affect prices and output, as well as discuss which policy measures are desirable and practically feasible when an economy experiences inflationary shocks. We adopt a stock-flow-consistent approach and build a model for a small open economy with fixed exchange rate, using Denmark as a case study. We use a stock-flow consistent approach for two main reasons: (i) it allows us to model the transmission channels of interest and capture the various feedback effects that might play an important role in evaluating different policy responses, and (ii) it conveniently allows us to assess the financial costs associated with various policy measures by exploring the balance sheets effects and providing an assessment of the (public) debt dynamics in the face of various shocks.

The dynamics of prices in relation to wages and employment, even though appear in earlier publications, have not received much attention in a coherent and comprehensive modelling framework within the PK tradition, as inflation was not a major concern until recently. Some recent empirical SFC models such as, Zezza and Zezza (2020), Pierros (2021), Valdecantos (2022), Mazier and Reyes (2022), Canelli et al. (2022), Muysken and Meijers (2022), and Byrialsen and Raza (2022) endogenise prices and wages, but do not investigate in depth the dynamics of inflation and the labour market. The resurgence of inflation in the Western world calls for a thorough investigation of this issue. Therefore, this paper places a stronger emphasis on the labour market dynamics, and more specifically, the dynamics of prices and wages in the economy.

[5] For example, EU member states are politically bound to keep public budget deficits below 3% of GDP and public debt below 60% of GDP.

From a theoretical point of view, this paper augments the PK theory of wage and price determination and investigate empirically the issue of inflation in a stock-flow consistent model. We validate our proposed price- and wage-setting using Danish quarterly data over the period 2005Q2-2020Q1. We then utilise the advantages of a comprehensive and data-rich framework and explore a broad variety of feedback effects to provide a thorough assessment of the issue. To the best of our knowledge, this is the first paper that centrally addresses the issue of inflation and discuss different policies to tame inflation in an empirical stock-flow consistent framework.

The rest of the paper is organised as follows. Section 2 reviews the literature on different macroeconomic policies to tame inflation and discuss the policy challenges posed by the recent resurgence of inflation. Section 3 presents the data and central equations of our model. Section 4 discusses the results. Section 5 concludes this paper.

2. A review of macroeconomic policies to tame inflation

Inflation is one of the core historical debates in macroeconomics, which dominated both academic and political discussions for decades. From being declared as public enemy number one by the US president Gerald Ford in 1974 to forming the core objective of monetary policy, inflation once received a lot of attention in the literature. History of macroeconomics is rich in describing episodes of high inflation – identifying its drivers and effects – and the desperate attempts of policy makers to tame it.[6]

2.1 Policy implications in Post-Keynesian and New Consensus Macroeconomics frameworks

The nature of prices and wages is one of the least agreed upon topics in macroeconomics, and so is the policy response to tame inflation. While there are conflicting explanations of this topic, the explanation proposed by NCM – which draws heavily on the NK view – has been the most dominant and influential in the policy circles (Arestis and Sawyer 2008). The narrative embedded in NCM implies that prices and wages are not fully flexible for various reasons, which makes money non-neutral in the short run. The short run non-neutrality of money paves the path for aggregate demand shocks to have real effects only in the short run. However, in the long run, when prices and wages adjust, money becomes neutral, as a result of which the real effects of aggregate demand shocks vanish, and the economy ends up only experiencing nominal shifts (Gali 2015). In a nutshell, production capacity or the long-run (potential) output is independent of aggregate demand shocks (Blanchard (2018); Furlanetto et al (2021)). Most central banks convinced by this narrative adopted inflation-targeting while using interest rates to smooth short-run economic fluctuations around the long-run potential output (Blanchard 2018). This

[6] For example, see a detailed survey by Laidler and Parkin (1975).

prevailing policy framework associates expansionary fiscal policy (and fiscal deficits in particular) with long-run inflation, and therefore advises against the use of discretionary fiscal policy, especially during episodes of high inflation. In some cases, it even proposes fiscal tightening to reduce inflation via the aggregate demand channel. This was also suggested by several economists from IMF and ECB to help fight post-covid inflation (Adrian, T and Gaspar, V. (2022); Schnabel (2022)). Apart from being inflationary in the long-run, fiscal policy is said to have weak short-run effects on the GDP for at least two reasons: i) Fiscal policy (in the form of public spending) leads to crowding out of private investment and consumption (Smets and Wouters (2003)), which considerably lowers the multiplier.[7] ii) Fiscal policy increases inflation, to which the central bank in an inflation-targeting regime responds by increasing interest rates, which reduces demand, thereby offsetting the effects of fiscal policy to some degree.

While there exists an apparent consensus on price and wage rigidities in the short run between PK theory and NCM, this agreement is superficial as there are fundamental differences regarding the drivers of prices and wages, as well as the factors which make them non-flexible in the short run.[8] NCM explains barriers to price adjustment through various theories, such as menu costs, Calvo pricing, coordination failure, nominal contracting, implicit contracts, etc (Melmies (2010)). Post-Keynesians, on the other hand, argue that firms seek price and profit stability and, for a variety of reasons (such as fears of losing market share), are reluctant to change prices frequently. Prices are determined by a markup over production cost, and as long as there are no dramatic changes in production costs, prices will remain stable.

Overall, the disagreements between PKs and NCM on the issue of prices can be linked to a broader disagreement in the way nominal and real economic variables interact, something that has been extensively covered in the literature (Kriesler and Lavoie (2007); Hein and Stockhammer (2010); Melmies (2010); Stockhammer (2011)). Crucially, PK theory emphasises the endogeneity of money and does not view monetary non-neutrality as an outcome of price stability (or rigidity); it views money as non-neutral even in the long run after nominal adjustments have taken place. Thus, aggregate demand shocks can have real economic effects beyond the short run. Furthermore, PK theory while emphasising the cost push channels does not view aggregate demand as the main driver of inflation under normal circumstances (when production capacity of the economy is intact, and the economy is not supply constrained). Shifting the emphasis from

[7] Since empirical evidence at large rejects this effect, some DSGE models take care of the issue by introducing non-Ricardian households with “hands to mouth condition” in which a fraction of households is forced to consume all their income in the current time period. This allows consumption to increase in response to public spending shocks (see, Gali et al (2007)).

[8] See, e.g., (Davidson 2006), Fontana (2009), Fontana & Palacio-Vera (2002, 2006), Gnos & Rochon (2007), Hein (2006a), Kriesler & Lavoie (2007), Lavoie (2004, 2006), Palley (2006, 2007), Rochon & Rossi (2006), Sawyer (2002), Seccareccia (1998), Setterfield (2006, 2009), Smithin (2007), Stockhammer (2008) and Wray (2007).

aggregate demand channel to cost push channels, when explaining inflation, has important policy implications. Foremost, it implies that pursuing a discretionary fiscal policy may not be inflationary, at least not of the magnitude suggested by the NCM. Second, this theory implies that interest rate policy may not only be ineffective against inflation, but in contrast, can increase prices by increasing financing costs, which can also create issues of financial instability.[9] It is important to highlight that PK economists, even though emphasising the cost push factors, are not entirely dismissive of the demand-pull view, but rather associate it with a high degree of resource utilisation. That is, if there is a dramatic shift in aggregate demand to an extent that it poses challenges to the supply sector (e.g., if the production capacity of the economy, for whatever reason, is not able to meet the purchase orders placed by the buyers), prices will increase, which usually is not the case in normal circumstances.

2.2 Resurgence of inflation and current policy challenges

When it comes to the post-covid period, one can reconcile the NCM and PK explanations to explain the resurgence of inflation. It can be argued that there are strong interdependencies between the aggregate demand and cost push channels of the post-covid inflation. Firstly, at a global level, most governments offered strong stimulus packages during the Covid-crisis to prevent the erosion of purchasing power, which after the economic reopening, increased aggregate demand dramatically. The simultaneous increase in aggregate demand at a global level posed challenges to the already disrupted supply side, which apart from increasing the price of final goods and services, also raised input prices (including raw materials and energy prices). Secondly, producers in countries facing high input prices passed the cost through to consumers, resulting in high inflation.

The current episode of inflation poses significant policy challenges. Pursuing a standard monetary policy response by increasing interest rates can reduce prices to some extent via the aggregate demand channel. However, interest rate hikes are rather ineffective against cost push channels, and can lead to an economic downturn, thereby, increasing the risks of stagflation. Furthermore, interest rate hikes lead to higher costs of public (and private) borrowing, raising debt sustainability concerns, which can reduce the fiscal space available to policy makers. While the ongoing situation presents obvious policy challenges, most central banks seem convinced that increasing interest rates is the right step forward (most central banks have started increasing the

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[9] Even within DSGE models, when the financial cost channel (referred to as "working capital" channel) is included in the Taylor-rule, the effect of interest rate on inflation is considerably weakened or even reversed (Christiano, Trabandt, and Walentin (2010)). However, it should be highlighted that this mechanism is usually not included in these models.

interest rates aggressively, at the time of writing). On the other hand, confusion has remained with regards to what exact role fiscal policy should play, as discussed earlier.

To come up with a rational policy response, it is important to consider two sequential processes in decision making. Firstly, understanding the drivers of inflation and assessing which factors contribute – and how much – to inflation. Secondly, assessing the various trade-offs associated with different policy responses, e.g., interest rate hikes are assumed to reduce prices, but what are the potential consequences of such a policy for growth, employment, and debt sustainability. Understanding both these processes is a matter of empirical inquiry, albeit a complex one to conduct given the interdependency amongst the drivers of inflation, which our paper attempts to address through an empirical stock-flow consistent model.

3. Presentation of the model

3.1 Data and estimation

To explore a broad variety of channels through which nominal and real economic variables interact and get a deeper understanding of the pricing mechanism, we build an empirical stock-flow-consistent model using sectoral national account data for Denmark over the period 2005Q1-2020Q2. The data consists of 5 financial assets (deposits, loans, securities, equities, and insurances) and 5 institutional sectors (households, non-financial corporations (hereafter 'firms'), financial corporations, Government, and the rest of the world)[10].

After constructing the databank, we first define the key accounting relationships through which we link the stocks (or balance sheets) and flows (income or production side) of the economy. The stock-flow consistency of the model ensures that there are no leakages of stocks and flows[11] and that all institutional sectors are connected. We then remove seasonal fluctuations and estimate the equations involving structural parameters using dynamic regressions. While estimating the structural parameters, we also log-linearise certain relationships, if theoretically intuitive. Even though our estimation strategy attempts to choose a functional form that attempts to best fit the data for a given dependent variable, our choice of variables in every equation is purely based on theory. Furthermore, we also include dummies in some of the behavioural equations, to control for the effects of structural breaks.

[10] Note: the technical terms used for assets and institutional sectors are different in the system of national accounts, however, we use simplified terms for a broad audience.
[11] In simple words, this implies that every asset has a counterparty and that every transaction (or flow) has both a receiver and a sender.

The full model description (including the estimations and simulation codes) along with the data bank are included in the appendix. In what follows, we only focus on describing the central equations of the model.

3.2 Model description

A first set of key equations in the model pertain to the real side of the economy. The entire output of the economy, equivalent to GDP, is assumed to be entirely produced by the firms. The standard GDP identity in nominal terms is represented in equation 1:

$$Y_t = C_t + I_t + G_t + X_t - M_t \tag{1}$$

where C_t represents private consumption, I_t represents gross fixed capital formation, G_t represents government spending on goods and services, X_t represents exports, and M_t represents imports of the economy. All components of GDP, except G_t, are endogenous in the model.

Before going through the GDP components in more details, we will first present the core equations determining the wage and price setting behaviours in the model.[12]

Labour market: wage- and price-setting

To produce a given level of output, firms hire workers and pay wages to them. The number of people employed in the economy is determined by the level of aggregate demand.[13] Assuming all other factors constant, an increase in aggregate demand requires more workers to produce; on the other hand, if productivity increases for a given level of output, firms need less workers. The equation determining the level of employment is represented by equation (2):

$$N_t = \frac{y_t}{a_t} \tag{2}$$

Where y_t represents real GDP and a_t represents real productivity, which is exogenous in the model.

[12] Note that the variables represented in capital letters represent nominal variables whereas variables written in small letters represent real variables.
[13] We do not assume constraints on the labour supply.

The number of individuals unemployed in the economy is the difference between the labour force (*LF*) and the number of individuals (*N*) employed. This is represented by equation (3) as follows:

$$UN_t = LF_t - N_t \tag{3}$$

The labour force is exogenous and is determined as a fraction of the Danish population as shown in equation (4):

$$LF_t = \emptyset Pop_t \tag{4}$$

Turning to the wage-setting in the model, our equation is in line with the view of conflicting claims from workers and firms mediated through a wage bargaining process. Specifically, the nominal wage rate is determined by 3 main factors, namely the targeted or desired wage rate (W_t^T) of the labour union (which is a choice variable), labour productivity (A_t), and unemployment rate (UR_t). The equation in its general form can be represented as follows:

$$W_t = f(W_t^T, UR_t, A_t)$$

The nominal targeted wage W_t^T of the union, apart from an autonomous desire for higher wage rate, is determined by inflation expectations. Specifically, the labour union wants prevailing wages to increase by the rate of expected (annual) inflation. The targeted wage equation is represented by (5a):

$$W_{t+1}^T = \alpha_0 + W_t.(1 + E_t^H(\pi_{t+1})) \tag{5a}$$

where α_0 is an autonomous desire for higher wage, W_t is the prevailing wage rate, and $E_t^H(\pi_{t+1})$ represents workers (current) expectations of future inflation. We assume that inflation expectations are backward looking, so that $E_t^H(\pi_{t+1}) = \pi_t$, with π_t representing realised annual inflation.[14]

[14] Annual inflation is defined as:

$$\pi_t = \left(\frac{P_t^c}{P_{t-4}^c} - 1\right)$$

The wage negotiation takes place every year,[15] and the labour union implements new wages in the very next period that follows the wage negotiations. For the ease of representation, the component of targeted wage determined by inflation can be defined as: $W_{t+1}^{\pi} = W_t(1 + \pi_t)$. Thus, the targeted wage can also be written as shown in equation (5b):

$$W_t^T = \alpha_0 + W_t^{\pi} \tag{5b}$$

To estimate the wage equation, we feed the targeted wage W_t^T as an explanatory variable in the wage rate equation and estimate all the parameters in one step. It is important to highlight that targeted wage rate of the union only affects the long run dynamics of wages, as the bargaining process does not take place every quarter (but once a year). For this reason, the targeted wage rate does not explain the short run fluctuations of wages around a long run path, but only helps explaining the long run tendency of wages. The estimated equation in its specific form is represented as follows:

$$\Delta \ln W_t = 0.01 - 0.33 * \Delta UR_{t-4} + 0.62 * \Delta \ln A_t - \mathbf{0.47} * [\mathbf{\ln W_{t-1}} + \mathbf{0.38} * \mathbf{\ln W_{t-1}^{\pi}} + \mathbf{0.53} * \mathbf{\ln A_{t-1}}] \tag{5c}$$

Focusing on the implications of equation (5c), the estimates suggest that wage rate in the short run (and in each quarter) is affected by the rate of unemployment and productivity, with the effect of former being weaker and delayed. The long-run estimates of the variables along with the error correction coefficient[16] are reported in the later part of equation.[17] In the long run, the wage rate is affected by the targeted wage of the union and productivity while unemployment rate was found to have no effect beyond the short run. The absence of the long run relationship between prices and unemployment can also be observed in the data, where unemployment has remained low and stable (within a corridor of 3-7 percent since the great financial crisis) while the wage rate has followed an upward trend.

Real wages (w_t) are determined by dividing the nominal wage by the consumer price index as shown in equation (6):

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[15] In Denmark, wages in different sectors are negotiated with different frequencies. For example, in some private sectors, wage negotiations take place every year whereas in the public sector, wage negotiations take place every 3 years. Since, we assume all workers are employed in the private sector, we impose a frequency of 1 year. While targeted wages affect wage once every year, other variables in the equation affect wages every quarter, which explains the quarterly fluctuation in wages.

[16] The error correct coefficient in the context of equilibrium can be considered as the speed of adjustment from short-run to long-run equilibrium.

[17] From now own, the long-run effects along with the error correction coefficient will be reported in the later part of the equation to clearly distinguish between the short-run and long-run effects.

$$w_t = \frac{W_t}{P_t^c} \qquad (6)$$

Our wage-setting implies that the response of wages to inflationary shocks is sluggish. This is a reasonable assumption as most workers have wage contracts and the process of wage negotiations is not instantaneous. Thus, if the economy is hit by an inflationary shock, the purchasing power of workers will reduce in the short run as they will experience lower real income.

We now focus on the dynamics of domestic prices. We augment the standard PK equation of pricing, by adding various drivers of inflation. Prices of final consumption goods (*CPI*) set by the firms are determined by the cost push factors and a demand-pull factor. The latter is proxied by the difference between the real domestic demand (dd_t) and the production capacity of the economy (y^s); this can also be considered a measure of resource utilisation.[18] While the demand side explanation of prices is not convincing in normal times,[19] it is also not entirely irrelevant especially during episodes of dramatic changes in aggregate demand in the face of supply side disruptions, as was the case in the post-Covid period. In addition, there are two main reasons, we augment the standard PK price equation with the demand-pull channel. i) we include it to distinguish the effects of cost-push factors on prices from those of demand-pull factors. ii) From an empirical point of view, leaving out the demand-pull factors can create an upward bias in the cost-push factors.[20]

To capture the effect of cost-push factors, we for now use the most standard factors including, wage to productivity ratio ($\frac{W_t}{A_t}$) and import prices (P_t^m). The price equation in its general form can be represented as:

$$P_t^c = f\left(\frac{W_t}{A_t}, P_t^m, dd_t - y^s\right)$$

After log-linearising the pricing equation, the error correction version of the estimated equation can be represented as follows:

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[18] Production capacity of the economy is proxied by using the long-run trend of GDP using HP-filer.

[19] For example, Melmies (2010) compiles empirical evidence on the main factors due to which firms change prices: the evidence at large suggests that labour costs and material costs are the two biggest causes of price changes, while demand never appears as the main factor.

[20] For example, some demand-pull factors (such as household consumption) are positively correlated with some of the cost push factors (such as wages).

$$\Delta \ln P_t^c = -0.18 * \Delta \ln P_{t-1}^c - 0.28 * \Delta \ln P_{t-2}^c - 0.08 * \Delta \ln P_{t-3}^c + 0.41 * \Delta \ln P_{t-4}^c + 0.038 * \Delta \ln W_t + 0.13 * \Delta \ln(P_{t-1}^m) + 0.05 * \Delta \ln(P_{t-2}^m) + 0.00000016 * (dd_t - y^s) - \mathbf{0.043} * [\mathbf{ln}(\boldsymbol{P_{t-1}^c}) - \mathbf{2} * \mathbf{ln}(\boldsymbol{W_{t-1}}) + \mathbf{1.62} * \mathbf{ln}(\boldsymbol{A_t}) - \mathbf{0.8} * \mathbf{ln}(\boldsymbol{P_{t-1}^m})] \quad (7)$$

The short run estimates of equation (7a) suggest that changes in logged prices (representing quarterly inflation) are positively affected by cost push factors (wages and import prices) and aggregate demand. The estimate on demand-channel of inflation implies that an increase in domestic demand relative to the production capacity of the economy increases inflation. The log-linearised functional form of the equation reveals some interesting insights: the long-run estimates (representing drivers of price levels) suggest that an increase in productivity can lower prices (with an elasticity of 1.62), but this effect is lower than the price hikes associated with the cost of production associated with wages (which has an elasticity of 2).[21] Import prices also increase domestic price levels with a long-run elasticity of 0.8.[22]

While the process of wage adjustment in response to inflationary shocks is sluggish, the process of price adjustment in response to the changes in cost of production (e.g., changes in import prices) is relatively faster in our model. We assume that firms are not bound by any price agreement and can therefore adjust prices quickly if the cost of production rises. This is also in line with the recent analysis of ECB, indicating that producer prices were quickly passed on to industrial prices, as emphasised by the president of ECB in her speech, Lagarde (2022).

Goods market: Aggregate demand

We now explain the characteristics of the goods market while focusing on aggregate demand. We start by defining households nominal consumption as, $C_t = c_t \cdot P_t^c$. The real consumption (c) is assumed to be a function of real disposable income and net financial wealth (in real terms). The aggregate disposable income part of the households consists of two components. The first component of disposable income ($yd1$) consists of wages and social benefits received by the households, which we will refer to as labour income for the sake of simplicity. The second component of disposable income ($yd2$) consists of capital income (or property income). Net financial wealth (fnw) of the households is defined as the difference between financial assets and liabilities of the households. The specific function form of consumption function is given by equation (8):

[21] The theoretical literature assumes symmetric effects of wages and productivity on prices but with opposite signs. That is, price is assumed to be a function of wage to productivity ratio.
[22] The long-run coefficients of this equation capture the relationship between prices in levels (not inflation) and its regressors.

$$\Delta\ln(c_t) = -0.39 * \Delta\ln(c_{t-2}) - 0.19 * \Delta\ln(c_{t-3}) + 0.13 * \Delta\ln(yd1_t) + 0.03 * \Delta\ln(yd2_{t-1}) - \mathbf{0.21} * [\mathbf{ln}(\boldsymbol{c_{t-1}}) - \mathbf{0.76} * \mathbf{ln}(\boldsymbol{yd1_{t-1}}) - \mathbf{0.03} * \mathbf{ln}(\boldsymbol{yd2_{t-1}}) - \mathbf{0.21} * \mathbf{ln}(\boldsymbol{fnw_{t-2}})] \quad (8)$$

The estimated equation for real consumption is in line with theory indicating that consumption positively responds to income and wealth, both in the short-run as well as in the long-run. The propensity to consume out of labour income (with a long run elasticity of 0.76) is much higher than the propensity to consume out of capital income (which has a long run elasticity of 0.03). We also find that net financial wealth has a modest long run effect of 0.21 on consumption.

Investment, or gross capital formation, consists of two types of investments: investment in machinery and equipment as well as in buildings and dwellings. We differentiate between these two types of investments because investments in buildings and dwelling form a major portion (roughly 30 – 40 percent) of the total investment. From a theoretical point of view, our investment function related to equipment and machinery is very similar to the Neo Kaleckian investment function (Hein 2014), where investment to capital stock $\left(\frac{i^{NFC}_{equip,t}}{k^{NFC}_{equip,t-1}}\right)$ positively depends on capacity utilization (u_t) and profit share (Π_t). Moreover, we augment the standard investment equation with a proxy for Tobins q, which is defined as the ratio of the market value of the outstanding shares to the nominal capital stock (including both machinery and equipment as well as buildings and dwellings). From an empirical point of view, the specific function form of our estimated equation is given by:

$$\Delta\ln\left(\frac{i^{NFC}_{equip,t}}{k^{NFC}_{equip,t-1}}\right) = -0.07 - 0.17 * \Delta\ln\left(\frac{i^{NFC}_{equip_{t-1}}}{k^{NFC}_{equip,t-2}}\right) - 0.22 * \Delta\ln(\mathrm{q}_t) - \mathbf{0.41} * \left[\mathbf{ln}\left(\frac{\boldsymbol{i^{NFC}_{equip_{t-1}}}}{\boldsymbol{k^{NFC}_{equip,t-2}}}\right) - \mathbf{1.07} * \mathbf{ln}(\boldsymbol{\Pi_{t-1}}) - \mathbf{1.09} * \mathbf{ln}(\boldsymbol{u_{t-1}}) - \mathbf{0.14} * \mathbf{ln}(\boldsymbol{q_{t-1}})\right] \quad (9)$$

The estimates of equation (9) suggest evidence of a long-run static relationship, where investment positively depends on profit share, capacity utilization, and Tobins q.

Following the same estimation strategy, firms' investment in buildings and dwellings is given by the following equation:

$$\Delta\ln\left(\frac{i^{NFC}_{BD,t}}{k^{NFC}_{BD,t-1}}\right) = 0.42 - 0.44 * \Delta\ln\left(\frac{i^{NFC}_{BD_{t-1}}}{k^{NFC}_{BD,t-2}}\right) - 0.14 * \Delta\ln(\Pi_t) + 1.2 * \Delta\ln(u_t) - 0.012 * \Delta\ln(q_t) - \mathbf{0.37} * \left[\mathbf{ln}\left(\frac{\boldsymbol{i^{NFC}_{BD_{t-1}}}}{\boldsymbol{k^{NFC}_{BD,t-2}}}\right) - \mathbf{1.2} * \mathbf{ln}(\boldsymbol{\Pi_{t-1}}) - \mathbf{2.3} * \mathbf{ln}(\boldsymbol{u_{t-1}}) - \mathbf{0.18} * \mathbf{ln}(\boldsymbol{q_{t-1}})\right] \quad (10)$$

Once again, the estimates of equation (10) reveal the existence of a long-run relationship, where investment to capital stock $\left(\frac{i_{BD,t}^{NFC}}{k_{BD,t-1}^{NFC}}\right)$ positively depends on profit share (Π_t), capacity utilization (u_t), and Tobins *q*.

We now focus on the interaction of the domestic economy with the rest of the world. First, we define the real exchange rate as the ratio of domestic prices P_t^c to foreign prices P_t^f times the nominal exchange rate (xr):

$$rer_t = \left(\frac{P_t^c}{P_t^f}\right) xr \tag{11}$$

We now define our equations for trade balance, in which the real exchange rate plays a crucial role. Focusing on exports (x_t), both the real exchange rate and income (or GDP) of the trading partners (y_t^{TP}) are the two main drivers of exports. The specific functional form of the export equation can be represented as follows:

$$\Delta \ln(x_t) = 0.60 + 1.30 * \Delta \ln(y_{t-4}^{TP}) - 0.63 * \Delta \ln(rer_t) \ \mathbf{- 0.61} * [\mathbf{\ln(x_{t-1}) + 0.39 * \ln(rer_{t-1})} - \mathbf{1 * \ln(y_{t-1}^{TP})}] \tag{12}$$

The estimates are consistent with the theory, indicating that exports are positively affected by real depreciation (or a fall in *rer*) and an increase in economic activity of the trading partners. There is also evidence of the existence of a long-run static relationship between these variables with an error correction coefficient of 0.61, as represented by the later part of equation (12).

Finally, real imports (m_t) are defined as a function of real exchange rate and the income of the economy. This equation can be represented as follows:

$$\Delta \ln(m_t) = -3.75 - 0.12 * \Delta \ln(m_{t-2}) + 0.28 * \Delta \ln(rer_{t-1}) + 0.38 * \Delta \ln(rer_{t-3}) + 1.22 * \Delta \ln(y_t) - \mathbf{0.30} * [\mathbf{\ln(m_{t-1}) - \ 1.8 * \ln(y_{t-1})}] \tag{13}$$

The estimates of equation (13) suggest that a real appreciation (or an increase in *rer*) as well as an increase in aggregate income can positively affect Danish imports. However, we found that the effect of the real exchange rate is confined to the short run, and income is the only driver of real imports in the long run.

Finally, we assume that government consumption of goods and services *(G)* is exogenous. Total government expenditures, including social transfers *(STR),* are financed through tax revenues *(T)* and borrowings by issuing bonds. The tax revenue of the government comes from three different types of taxes (with different rates): taxes on labour income (which includes wages and social benefits), taxes on capital income (or property income), and taxes on production.

Financial market

Our model, even though focusing on the labour market, has an explicit financial market which captures the interaction between production (or real side of the economy) and financing (or financial side of the economy). The primary reason we include an explicit financial market is to ensure that the effects of the real side of the economy on the balance sheets and the resultant feedback effects from balance sheet to the real side of the economy are properly captured. This feature is essential for studying the debt dynamics associated with different policies.

The overall dynamics of the financial market are broadly similar to other empirical SFC models in the literature. The financial market is primarily demand driven, that is, financial corporations fulfil all the demand for credit as long as the borrowers fulfil the criteria for borrowing. Households also borrow loans from financial corporations. Households allocate their wealth in various financial assets. Overall, the household portfolio allocation in our model is in line with the idea of Tobin's portfolio allocation theory discussed in Godley and Lavoie (2006). That is, investment in a particular asset is determined by its relative rate of return viz-a-viz other assets in the portfolio. The government sector issues long term (mostly 10 years) bonds, a large proportion of which are held domestically by the financial corporations (pensions funds in particular) and households. Firms finance their investment via different sources including, retained earnings, equities, and loans (supplied by the financial sector). Since the Danish economy has persistent current account surpluses, the foreign sector borrows from Denmark, which takes the form of Danish private sector purchasing foreign equities or supplying credit.

4. Results and Discussion

After estimating our structural equations, we carry out model validation where we numerically solve the model as a system of equations and compare the results with the actual data. Figure 1 shows that the model simulation is able to replicate the dynamics of the variable of our interest. Even though the model fails to predict the fluctuations in some quarters, it is able to capture the overall trajectories of almost all the variables to a satisfactory level. We therefore rely on the performance of the model and use the model simulations presented in Figure 1 as our benchmark or baseline scenario, against which we will compare different scenarios.

Figure 1: Data vs Model simulations

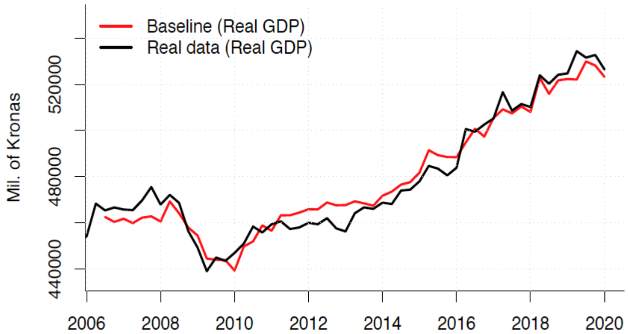


Figure 1a: GDP (baseline vs data)

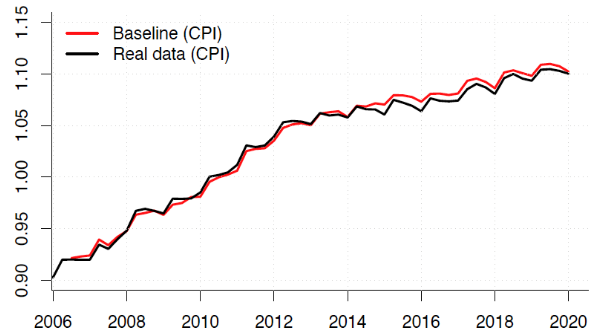


Figure 1b: CPI index (baseline vs data)

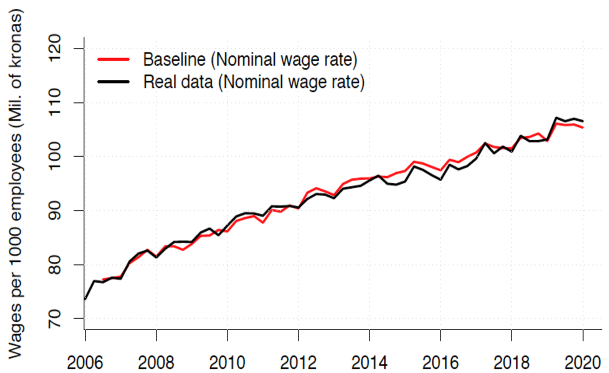


Figure 1c: Nominal wages (baseline vs data)

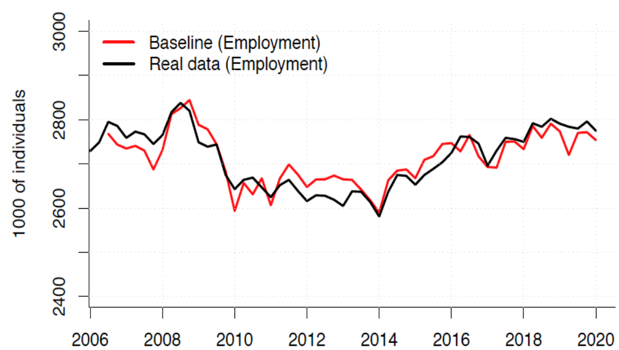


Figure 1d: Employment (baseline vs data)

We now proceed to analysing the interaction between nominal and real economy by introducing various scenarios. Our analysis can be categorised into two phases or scenarios. In the first phase, we introduce various shocks, attempting to recreate the environment of high inflation faced by the Danish economy at the time of this writing.[23] In the second phase of the analysis, we assess various policy interventions and provide useful insights to decision makers in combating inflation.

4.1 Scenario 1: The current economic environment

In order to recreate the environment in which the Danish economy has been operating recently, we introduce 2 shocks to the model.[24]

(i) **Cost-push (or high import price) shock:** Denmark's import price index during 2022Q1-2022Q2 increased from roughly 100 index points to 130 points. The real

[23] It is important to highlight that we are only creating the post-Covid inflationary environment and not the Covid-crisis per se. The shocks faced by the Danish economy during the Covid-19 crisis are explicitly discussed in an SFC model by Byrialsen and Raza (2021).

[24] Since, our model sample ends before the covid-19 crisis, we introduce these shocks in 2014 because the economy was growing at a steady rate, along the lines of what could be called a "long-term equilibrium".

exchange rate, however, has remained unaffected as the economy experienced a simultaneous rise in global and domestic prices. To recreate this scenario, we introduce the import price shock as realistically as possible; we use the post-covid import price index and (after rescaling and adjusting the base values of the two indices) impose it on the import price index of the model in time period *(t).* The way we introduce the shock implies permanent level (and temporary growth) effect on import prices, i.e., import price level aggressively grows, reaching its peak within 2-3 quarters, after which it grows with the same speed as the baseline. Overall, we adjust foreign (exogenous) prices in such a way that Denmark's real exchange rate is not directly affected by the shock.[25]

(ii) **Monetary policy intervention:** In response to the resurgence in inflation, most central banks (including the Fed, ECB and Bank of England) have increased interest rates and small open economies with fixed exchange rates like Denmark have followed suit. The general interest rates in Denmark have sharply increased: specifically, 3 and 5 years fixed interest rates on mortgage loans have increased by roughly 150-350 basis points whereas long term interest rates on 10 years and 30 years bond have increased by roughly 250-300 basis points. To introduce monetary tightening, we increase all interest rates by 300 basis points. This shock is introduced 2 quarters after the import price shock, but is temporary in nature, lasting for 2 years (as inflation is expected to be below its target after 2 years).

To provide an assessment of the role played by monetary policy, we present the results of scenario 1 *with* and *without* monetary policy intervention. The effects of scenario 1 (with and without monetary policy intervention) on our key variables are presented in Figure 1 with the x-axis label representing each year. We first focus on scenario 1 *without* monetary policy intervention which is introduced in period *t*. Figure 2 shows that GDP, in response to import price shock, falls and remains below the baseline. Unemployment rate roughly follows the same trajectory as real GDP, i.e., it falls and remains below the baseline since economic activity is persistently below the baseline. Inflation increases considerably, reaching its peak in roughly 4-6 quarters, as increased import prices are passed on to domestic prices.

[25] Our model has 2 global price indices: i) import price index, and ii) a weighted foreign price index used to calculate Denmark's real exchange rate viz-a-viz its trading partners. To prevent import prices, affecting real exchange rate, we also adjust the weighted foreign price index in such a way that Denmark's competitiveness is unaffected as a result of the import price shocks. This is in line with the actual development that a simultaneous rise in global and domestic prices has not affected the real exchange rate.

Focusing on individual components of GDP, private consumption gradually falls and permanently remains below the baseline. The persistent fall in consumption is due to stagnating nominal wages, whereas real income persistently falls as prices keep rising. In the medium term, the price level stabilises after reaching its peak (and inflation gradually falls), which results in consumption stabilising at a level lower than the baseline. Investment also permanently falls below the baseline as a result of the overall contraction in the economy. Exports remain unaffected as real exchange rate (and thereby competitiveness) remains unaffected, whereas imports fall due to a reduction in aggregate income.

Figure 2: Scenario 1 *with* and *without* monetary policy (MP) intervention:

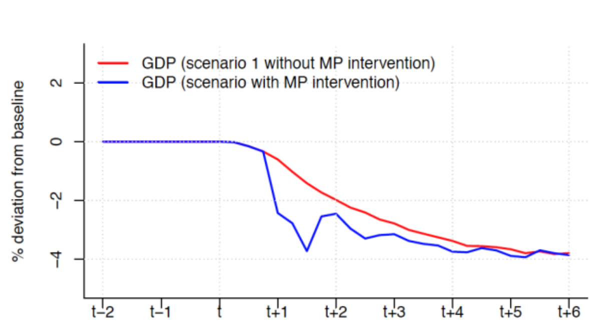


Figure 2a: GDP (scenario 1)

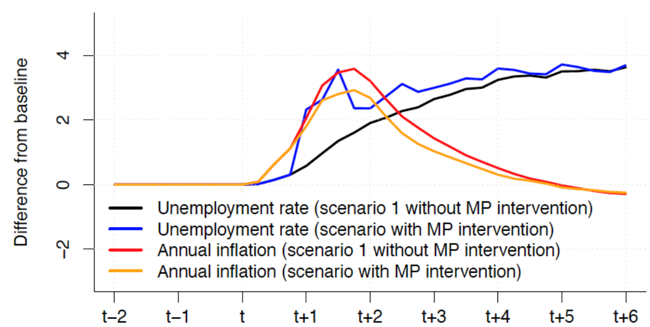


Figure 2b: Unemployment and inflation rate (scenario 1)

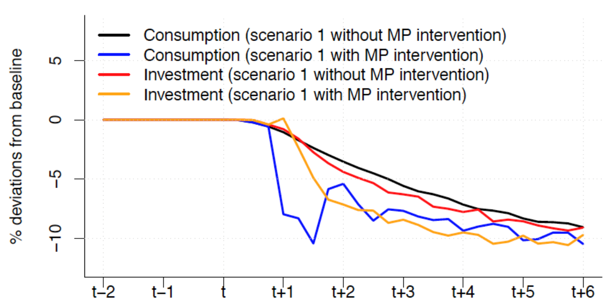


Figure 2c: Consumption and Investment (scenario 1).

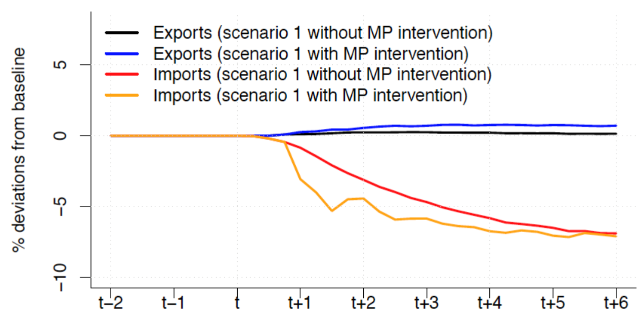
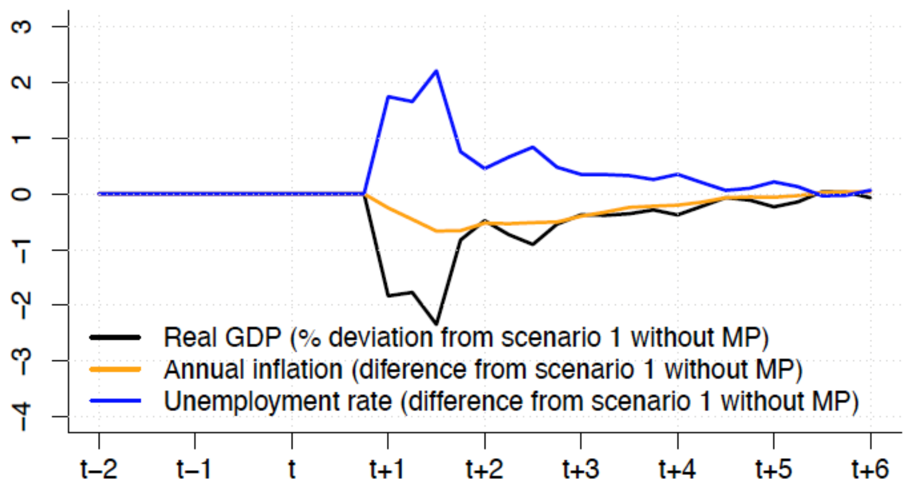


Figure 2d: Exports and Imports (scenario 1)

We now focus on scenario 1 *with* monetary policy intervention, which is introduced 2 quarters after import price shock. We can see that increasing interest rates leads to a further decline in GDP, driven by a fall in both consumption and investment. The effects of interest rate on domestic demand primarily occur through the cash flow channel for households and firms. The reason is that, for both households and firms, interest-bearing debt exceeds interest-bearing assets. Thus, a rise in interest rate increases interest expenses, which in turn lowers labour income (and profits) leading to a fall in consumption and investment. The overall economic contraction further amplifies the decline in investment through the accelerator-mechanism. Monetary policy intervention leads to a small positive effect on trade balance as increases in interest rates lower domestic prices, which slightly improves the real exchange rate. However, this positive effect is negligible and is completely offset by the contractionary effects of higher interest rates on domestic demand, leading to a fall in GDP.

To provide a clear overview of the role played by monetary policy, we compare the results of scenario 1 *with* and *without* monetary policy intervention. We do so by using scenario 1 *without* monetary policy as our reference model. Figure 3 clearly shows the policy trade-offs associated with monetary policy intervention. It shows that monetary policy intervention leads to a small reduction in inflation at a cost of further contracting the economy. In the short run, a 300 basis points increase in interest rates reduces inflation by 0.8 percent while reducing GDP by 2 percent and increasing unemployment by 2 percent, compared to the situation *with* no monetary policy intervention.

Figure 3: Evaluating monetary policy intervention



Note: the results are obtained by comparing the results of scenario 1 *with* MP intervention and scenario 1 *without* MP intervention. Real GDP is computed as the deviation of GDP in scenario 1 *with* MP intervention from the GDP in scenario 1 *without* MP intervention. Unemployment and inflation rate curves are computed as the difference between the two scenarios.

The main reason for the modest effect of monetary policy on inflation is that the interest rate hike reduces domestic demand, which in turn has a limited effect on domestic prices. The effects of interest rate on prices are likely to be stronger if inflation was mainly demand induced, but the ongoing episode of inflation in many countries like Denmark is pre-dominantly driven by cost push channels via high import prices. The adverse effects of monetary tightening could be even more pronounced than what is suggested by our model, if we took into consideration the effects of interest rates on asset prices.[26] Firstly, an increase in the risk-free interest rate affects the discount rates used in the valuation of fixed-income financial assets such as bonds. Secondly, higher interest rates render financial operations such as margin calls and share buybacks more expensive to finance, which propagates the fall of asset prices from fixed-income to other compartments. Thirdly, in the spirit of Minsky (1992), financial arrangements made during times of lower interest rates involving high leverage can become untenable when interest rates rise, and the liabilities have to be rolled over. These aspects put together can pose challenges to the stability of the financial system, and even trigger long lasting recessions.

Although raising interest rates does not appear to be an entirely desirable policy move, small open economies with fixed exchange rates do not have the option of diverging too much from foreign interest rates. For now, we take monetary policy intervention as a forced policy in Denmark, and discuss other possible options that, within the current institutional and legal framework, can potentially reduce the adverse effects of inflation.

Scenario 2: Fiscal intervention

Denmark is a country with strong labour unions, where the risk of wage-price spiral is relatively high. The Danish central bank in this regard has repeatedly concluded that fiscal tightening is required to avoid wage-price spiral, even though the rationale for such recommendations is not entirely clear. Contrary to the conclusions of the Danish central bank, it can be argued that a close coordination of fiscal and income policies can weaken the wage-price spiral on top of reducing the adverse effects of the shocks on income. The most important question in this regard is, which policy tools should be specifically targeted, as the implementation of fiscal and income policies can take different forms. To address this question more formally, we introduce two fiscal interventions:

- **i)** **Lower labour income tax:** Labour income in our model consists of wage income and social benefits received by the households. The labour income tax rate – estimated to be around 38 percent – is reduced by one percentage-point.

- **ii)** **Lower indirect taxes:** Taxes on production and products in our model are taxes paid by the firms. The indirect tax rate – estimated to be around 16 percent in the baseline – is lowered by one percentage-point. This reduction reallocates income

[26] Asset prices and house prices are kept exogenous in the model, so the effect of a change in the level of interest rate on these prices are therefore beyond the scope of this paper. The expectation, however, is that making these prices endogenous would only support and reinforce the result presented in this scenario.

towards the firms through higher level of profits (via higher gross operating surplus).

We introduce both these shocks temporarily, each lasting for 2 years. These two shocks are implemented in the same quarter, in which interest rates were increased (i.e., two quarters after import price shock). While implementing these policies, we propose that the government should closely coordinate with the workers and employers union, and subject tax cuts to the condition that relevant parties will take into account these tax reliefs, when negotiating wages and setting prices.[27] In other words, the proposed tax cuts should be offered in coordination with wage- and price-based income policies. For the labour union specifically, this means that the targeted wage should be lowered by the amount that the workers are able to secure as a result of lower tax rate on labour income. This can result in a wage growth that is lower than the rate of inflation, thereby weaking the wage-price spiral. We introduce this condition in the model by modifying the targeted wage equation (5a), where the workers, while negotiating wages, take tax reductions into account. The alternative specification can be represented as follows:

$$W_{t+1}^{T} = \alpha_0 + W_t(1 + E_t^H(\pi_{t+1}) + Trate_n^H - Trate_b^H) \tag{13}$$

where $Trate_b^H$ in equation (13) represents the baseline tax rate on labour income and $Trate_n^H$ represents the reduced tax rate. As seen from equation 13, a reduction in the tax rate therefore reduces the targeted wage set by the workers.

Similarly, to implement price-based income policy, the government in coordination with producers should implement tax reliefs, such that lower taxes on production (and products) are taken into account in pricing decision. For this purpose, the price equation (7a) can be modified, so that an additional cost push factor, i.e., tax rate on production (and products), is introduced in the model. The alternative price equation can be represented as follows:

$$\Delta \ln P_t^c = -0.11 * \Delta \ln P_{t-1}^c - 0.29 * \Delta \ln P_{t-2}^c + 0.17 * \Delta \ln W_t + 0.16 \Delta \ln(P_t^m) + 0.0000002 * (dd_t - y^s) + 0.021 * Trate_{t-2}^{NFC} - \mathbf{0.057} * [\ln(\boldsymbol{P_{t-1}^c}) - \mathbf{2.2} * \ln(\boldsymbol{W_{t-1}}) + \mathbf{2.1} * \ln(\boldsymbol{A_t}) - \mathbf{1.4} * \ln(\boldsymbol{P_{t-1}^m})]$$
(14a)

where $Trate_t^{NFC}$ in equation (14a) is the tax rate levied on production (and products), defined as:

$$Trate_t^{NFC} = \theta + \varepsilon_t \tag{14b}$$

[27] In case of a deadlock in the wage negotiation process, the Danish government can also legally intervene in the wage negotiation process and demand workers to return to work at prevailing wages. The government has done so in the past occasions to end strikes.

θ is the policy parameter (representing indirect tax rate on production and products) estimated to be 0.16 in the baseline, which is calculated by taking the average of total taxes paid on production (and products) as a ratio of GDP); ε_t is the random fluctuation or deviations from the average tax rate (θ) observed in the sample. We feed the indirect tax rate, $Trate_t^{NFC}$ into the price equation to get an estimate of the relationship between indirect taxes and price levels. We then reduce θ from 0.16 to 0.15 to introduce the effects of indirect taxes on prices as described earlier. Our estimations suggest that indirect taxes positively affect prices which is in line with empirical evidence based on micro studies (Gautier et al 2022).

We now visualise the results of scenario 2 and scenario 1 against a common baseline. Figure 4 shows the effects of scenario 2 in which fiscal policy (in the form of tax reliefs on labour income and production) and income policy (in the form of considering tax reliefs in price and wage decisions) are jointly implemented. The results suggest that a well-coordinated fiscal and income policy reduces the fall in GDP while slightly lowering inflation and unemployment. It is clear that fiscal intervention in the form of tax reliefs partially mitigate the effects of adverse shocks on wages and profits, which in turn, leads to a less severe decline in consumption and investment than in scenario 1. These positive effects of discretionary fiscal policy on real variables are undisputed but the important question here concerns the impact of this policy on inflation.

Figure 4: Scenario 2 fiscal and income policies jointly implemented

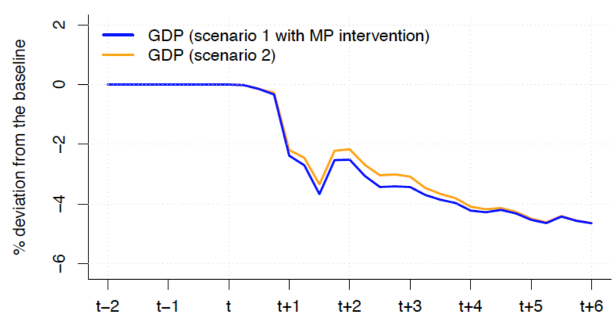


Figure 4a: Real GDP

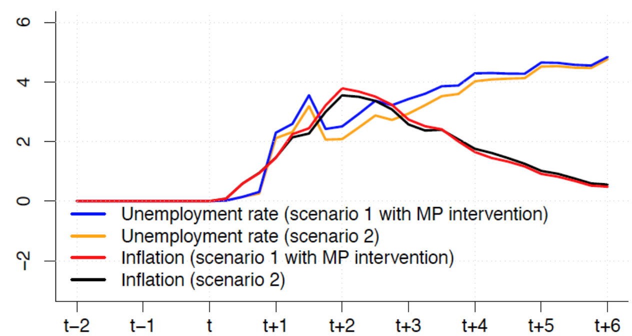
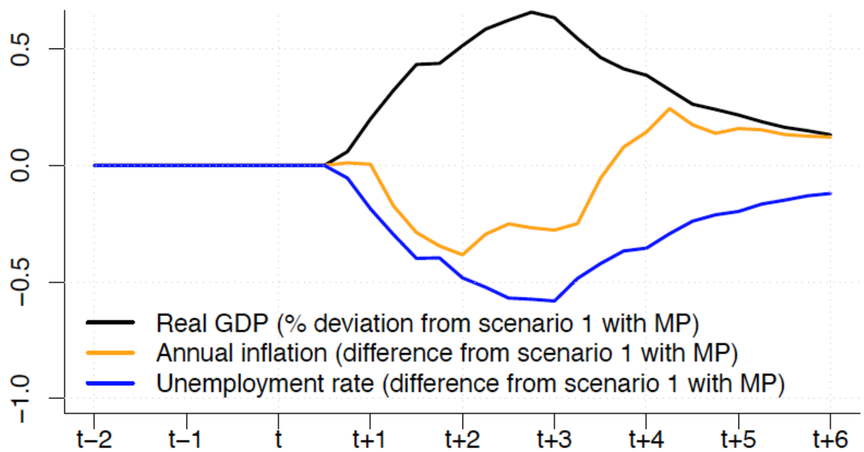


Figure 4b: Unemployment and Inflation

To provide a clear evaluation of the policy presented in scenario 2, we now use scenario 1 (*with* monetary policy intervention) as a reference model and compare its result with that of scenario 2. Figure 5 shows that a fiscal intervention combined with income policy has the effect of persistently increasing GDP (peaking at 0.5 percent) while lowering unemployment and inflation (reducing it by 0.2 percent in the short run), compared with scenario 1.

Figure 5: Evaluating discretionary fiscal policy in the presence income policies



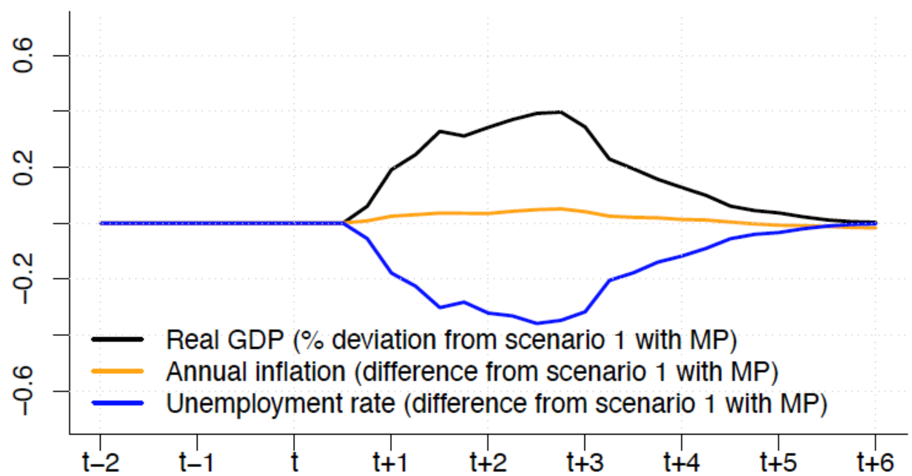
Note: The results are based on the comparison of scenario 2 (tax cuts on income and production) with scenario 1. Real GDP is computed as deviation from scenario 1 whereas unemployment and inflation are computed by subtracting the results of scenario 2 from scenario 1.

This result might seem puzzling at first glance, but this can be linked to the underlying theory and our model estimates, indicating that the effects of cost-push factors on prices are stronger than those of demand-pull factors. Thus, the deflationary effects of income policies (resulting in relatively lower production costs) dominate the inflationary effects of aggregate demand associated with discretionary fiscal policy.

Theoretically, it can be argued that well-coordinated fiscal and income policies can be effective, but implementation of income policies is not without practical problems. While it is easy to gauge and administer wages in relation to tax cuts, providing a measure of how exactly taxes on production (and products) affect price decisions is more complicated. Even though empirical evidence at large suggests a positive relationship between production taxes and prices, the estimate of this relationship, apart from predicting the direction of the relationship, is of little value in the process of policy implementation. The reason is that price mark-ups differ considerably across the firms and measuring mark-ups is a complicated task which poses clear challenges to the implementation of price-based income policies across the board. The government instead of following a broad price-based income policy should pursue a targeted price-based income policy by engaging with specific sectors which are the biggest contributors to price increases.

Given the complexities involved in gauging the effects of indirect tax cuts on prices, especially at an aggregate level, we do not claim to have a reliable estimate of this effect. It is quite possible that the gains associated with price-based income policies suggested by our model are exaggerated. Thus, we relax this assumption and explore the effects of discretionary fiscal policy in which we exclude price-based income policy such that firms totally disregard tax cuts in their pricing decisions. Thus, we revert to our original model by using the price equation specified in equation (7). We then introduce a discretionary fiscal policy (by lowering both the direct and indirect taxes) as described in i) and ii) when presenting scenario 2. In other words, this time a discretionary fiscal policy is jointly implemented with a wage-based income policy while excluding the deflationary effects associated with a price-based income policy. Here again, we use scenario 1 (*with* monetary policy intervention) as our reference model for comparison. Figure 6 shows that a discretionary fiscal policy has positive effect on GDP and employment whereas the effect on inflation, even though positive, is negligible. Once again, it can be argued that economic gains associated with a discretionary fiscal policy can outweigh its adverse inflationary effects.

Figure 6: Evaluating discretionary fiscal policy in the presence of wage-based income policy



Are these policies affordable:

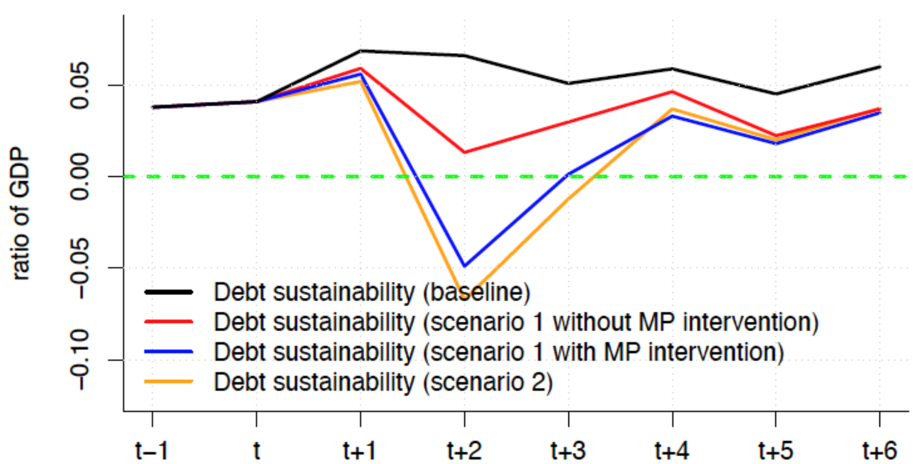
We now address a question of political relevance by exploring whether such policy measures are affordable when purely focusing on public budget and debt. To do so, we perform an assessment of the public debt by following the approach of Canelli et al. (2022). Here, we test the sustainability of public debt by exploring whether the primary balance covers the net debt burden. Specifically, we test the following condition:

$$\frac{T-(G+STR)}{Y} \geq (r-g_y).\frac{D}{Y}$$

Where *T* denotes tax revenue, *G* denotes government expenditure on goods and services, *STR* denotes social transfers, *Y* denotes nominal GDP, *r* denotes the interest rate on government debt, g_y denotes nominal growth rate, and *D* represents the total stock of net public debt which in our model is in the form of government bonds with 10 years fixed interest rates. It is important to highlight that increases in interest rates in our model do not affect interest payments on public debt previously secured at low interest rates, but only affects the new borrowing. To visualise the debt sustainability condition, we simply subtract the right-hand side of the above equation from the left-hand side and plot the difference of the two terms as a ratio of GDP.

Figure 7 shows debt sustainability condition in the face of various shocks. The results suggest that the most dramatic effect on public debt occurs after increases in interest rates. This happens for two main reasons: 1) the government pays more interest on its newly issued debt, and 2) economic activity contracts, which lowers tax revenues, leading to a further increase in debt to GDP ratio.

Figure 7: Debt sustainability condition



When increases in interest rates are followed by a fiscal intervention (as in scenario 2), the situation deteriorates further in the short run, however, in the medium term, a discretionary fiscal policy leads to a slightly better outcome than scenario 1 (*with* MP intervention). That is, public debt in the medium run is sustainable as the persistent positive effects of fiscal intervention on the real side of the economy kick in. Overall, monetary policy intervention not only has the effect of contracting the economy, but it also reduces the fiscal space available to policy makers as many countries are politically bound to keep public debt and deficit within a certain threshold.

Our analysis demonstrate that policy makers are faced with a clear dilemma. On the one hand, if they choose to intervene and pursue fiscal and income policies, it can dampen the reduction in economic activity, but at the cost of a larger public deficit and higher public debt. On the other hand, if policy makers abstain from undertaking any form of fiscal intervention, the economy may end up in a situation of high unemployment and inflation. In Denmark's case, one can build a case that the government should pursue a discretionary fiscal policy with the acceptance of larger public deficit for at least two reasons. Firstly, the overall fiscal position of the government sector is sound and has improved over the last couple of years. An increase in the public debt would not push Denmark beyond the current boundaries of the European fiscal framework – which is on hold for the foreseeable future. Secondly, given the persistent surplus on Danish current account, there would be no need of financing the government deficit through foreign credit.

Conclusion

After decades of relative price stability, inflation is making a come-back, against a backdrop of theoretical divergences on its nature and ways to fight it. While monetary policy is assigned a clear role in dealing with inflation, the role and form of fiscal policy intervention has been the subject of disagreements between institutions. To address these problems in a complex and nuanced way in the case of small open economies whose monetary policy freedom is hindered by fixed exchange rates, we built an empirical stock-flow-consistent model using sectoral national account data for Denmark over the period 2005Q1-2020Q1. The stock-flow consistency of the model ensures that there are no leakages of stocks and flows[28] and that all institutional sectors are connected. We then estimate the structural parameters and numerically solve the model, finding that our model is able to replicate the dynamics of our key variables.

First, we replicate the inflationary environment in which Denmark and several other countries are currently operating. We then introduce a monetary policy intervention finding that it can lead to a modest reduction in inflation at the cost of further contracting the economy. We argue that monetary policy needs a more cautious approach, but also acknowledge the constraint that many small open economies with fixed exchange rates like Denmark do not have the option of diverging from foreign interest rates. Taking monetary policy tightening as a given condition, we explore a number of policies that within the current institutional and legal framework, can potentially reduce the adverse effects of inflation. In this regard, we explored the effects of fiscal intervention – in the form of tax cuts on income and production – along with income policies in such a form that workers (and producers) consider tax reliefs in their wage (and price) agreements. Our conclusion is that a close coordination of fiscal and income policies can help reduce the effects of adverse shocks to income while reducing or having no effect on inflation.

[28] In simple words, this implies that every asset has a counterparty and that every transaction (or flow) has both a receiver and a sender.

Finally, we addressed a question of political relevance by exploring the effects of different policies on public budget and debt. In this regard, we performed an assessment of public debt sustainability in the face of various shocks. Overall, we find that monetary policy has the most dramatic effects on public debt sustainability, which in turn reduces the space available to fiscal policy. That is, fiscal intervention (after monetary tightening) further increases debt in the short run, however, in the medium run the public debt is sustainable as the positive effects of fiscal and income policies kick in.

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Appendix 1:

Table A1: Transaction Flow Matrix of the economy

	Households		Non-Financial Corporations		Financial Corporations		General Government		Rest of the World		Total
	Current	Capital	Current	Capital	Current	Capital	Current	Capital	Current	Capital	
Private Consumption	$-C_t$		C_t								0
Investment (Buildings and Dw.)		$-I^H_{BD_t}$	I_{BD_t}	$-I^{NFC}_{BD_t}$		$-I^{FC}_{BD_t}$		$-I^G_{BD_t}$			0
Investment (Equipment)		$-I^H_{E_t}$	I_{E_t}	$-I^{NFC}_{E_t}$		$-I^{FC}_{E_t}$		$-I^G_{E_t}$			0
Investment (Inventories)			$-I^H_{INV_t}$	$-I_{INV_t}$							0
Government Consumption	G^H_t		G^{NFC}_t				$-G_t$				0
Net Exports			NX_t						$-NX_t$		0
Wage Bill	WB^H_t		$-WB_t$						WB^{RW}_t		0
Gross Operating Surplus	GOS^H_t		GOS^{NFC}_t		GOS^{FC}_t		GOS^G_t				0
Net Indirect Taxes			$-NIT^{NFC}_t$				NIT^G_t		$-NIT^{RW}_t$		0
Net Interest on Assets	NIA^H_t		NIA^{NFC}_t		NIA^{FC}_t		NIA^G_t		NIA^{RW}_t		0
Net Income on Insurance	NII^H_t		NII^{NFC}_t		NII^{FC}_t		NII^G_t		NII^{RW}_t		0
Net Dividends	ND^H_t		ND^{NFC}_t		ND^{FC}_t		ND^G_t		ND^{RW}_t		0
Direct Taxes	$-DT^H_t$		$-DT^{NFC}_t$		$-DT^{FC}_t$		DT^G_t		$-DT^{RW}_t$		0
Social Contributions	$-SC^H_t$				SC^{FC}_t		SC^G_t		SC^{RW}_t		0
Social Benefits	SB^H_t				$-SB^{FC}_t$		$-SB^G_t$		SB^{RW}_t		0
Other Current Transfers	OCT^H_t		$-OCT^{NFC}_t$		OCT^{FC}_t		$-OCT^G_t$		OCT^{RW}_t		0
Saving/Current Account	$-S^H_t$	S^H_t	$-S^{NFC}_t$	S^{NFC}_t	$-S^{FC}_t$	S^{FC}_t	$-S^G_t$	S^G_t	CA_t	$-CA_t$	0
Capital Transfers		KT^H_t		KT^{NFC}_t		$-KT^{FC}_t$		$-KT^G_t$		$-KT^{RW}_t$	0
Others		$-NP^H_t$		$-NP^{NFC}_t$				NP^G_t		NP^{RW}_t	0
Net Lending		NL^H_t		NL^{NFC}_t		NL^{FC}_t		NL^G_t		NL^{RW}_t	0
Adjustment variable		Adj^H_t		Adj^{NFC}_t		Adj^{FC}_t		Adj^G_t		Adj^{RW}_t	0
Δ Interest Bearing Assets		$-\Delta NIBA^H_t$		$-\Delta NIBA^{NFC}_t$		$\Delta NIBA^{FC}_t$		$-\Delta NIBA^G_t$		$-\Delta NIBA^{RW}_t$	0
Δ Equities		$-\Delta EQ^H_t$		ΔEQ^{NFC}_t		$-\Delta EQ^{FC}_t$		$-\Delta EQ^G_t$		ΔEQ^{RW}_t	0
Δ Securities		$-\Delta SEC^H_t$		ΔSEC^{NFC}_t		$-\Delta SEC^{FC}_t$		ΔSEC^G_t		$-\Delta SEC^{RW}_t$	0
Δ Insurance		$-\Delta INS^H_t$		$-\Delta INS^{NFC}_t$		ΔINS^{FC}_t		$-\Delta INS^G_t$		$-\Delta INS^{RW}_t$	0
Δ Loans		ΔL^H_t		ΔL^{NFC}_t		$-\Delta L^{FC}_t$		$-\Delta L^G_t$		ΔL^{RW}_t	0
Rev. Interest Bearing Assets		$-Rev^H_{NIBA}$		$-Rev^{NFC}_{NIBA}$		Rev^{FC}_{NIBA}		$-Rev^G_{NIBA}$		$-Rev^{RW}_{NIBA}$	0
Rev. Equities		$-Rev^H_{EQ}$		Rev^{NFC}_{EQ}		$-Rev^{FC}_{EQ}$		$-Rev^G_{EQ}$		Rev^H_{EQ}	0
Rev. Securities		$-Rev^H_{SEC}$		Rev^{NFC}_{SEC}		$-Rev^{FC}_{SEC}$		Rev^G_{SEC}		$-Rev^{RW}_{SEC}$	0
Rev. Insurance		$-Rev^H_{INS}$		$-Rev^{NFC}_{INS}$		Rev^{FC}_{INS}		$-Rev^G_{INS}$		$-Rev^{RW}_{INS}$	0
Rev. Loans		Rev^H_L		Rev^{NFC}_L		$-Rev^{FC}_L$		$-Rev^G_L$		Rev^{RW}_L	0
Rev. Buildings and Dwellings		$-Rev^H_{BD}$		$-Rev^{NFC}_{BD}$		$-Rev^{FC}_{BD}$		$-Rev^G_{BD}$			0
Rev. Equipment		$-Rev^H_E$		$-Rev^{NFC}_E$		$-Rev^{FC}_E$		$-Rev^G_E$			0
Δ Net Worth		$-\Delta W^H_t$		$-\Delta W^{NFC}_t$		$-\Delta W^{FC}_t$		$-\Delta W^G_t$		$\Delta NIIP$	0

Appendix 2: List of equations of the full model and related symbols

As done in the paper, capital letters denote nominal variables and lower-case letters denote real variables.

Non-Financial Corporations

$$Y_t = C_t + I_t + G_t + X_t - M_t \tag{A. 1}$$

$$y_t = c_t + i_t + g_t + x_t - m_t \tag{A. 2}$$

$$P^y_t = \frac{Y_t}{y_t} \tag{A. 3}$$

$$I_t = I^N_{BD_t} + I^H_{BD_t} + I^G_{BD_t} + I^F_{BD_t} + I^N_{E_t} + I^H_{E_t} + I^G_{E_t} + I^F_{E_t} \tag{A. 4}$$

$$i_t = i^N_{BD_t} + i^H_{BD_t} + i^G_{BD_t} + i^F_{BD_t} + i^N_{E_t} + i^H_{E_t} + i^G_{E_t} + i^F_{E_t} \tag{A. 5}$$

$$\Delta \ln P^c_t = -0.11 * \Delta \ln P^c_{t-1} - 0.29 * \Delta \ln P^c_{t-2} + 0.17 * \Delta \ln W_t + 0.16 \Delta \ln(P^m_t) + 0.0000002 * (dd_t - y^s) + 0.021 * Trate^{NFC}_{t-2} - 0.057 * [\ln(P^c_{t-1}) - 2.2 * \ln(W_{t-1}) + 2.1 * \ln(A_t) - 1.4 * \ln(P^m_{t-1})] \tag{A. 6}$$

$$\ln(P^g_t) = 0.04 + 0.84 * \ln(P^C_t) + \varepsilon_t \tag{A. 6a}$$

$$\ln(P^{BD}_t) = -0.02 + 0.98 * \ln(P^C_t) + \varepsilon_t \tag{A. 6b}$$

$$\ln(P^{EQUIP}_t) = -0.01 + 0.304 * \ln(P^C_t) + \varepsilon_t \tag{A. 6c}$$

$$\ln(P^x_t) = 0.01 + 0.63 * \ln(P^C_t) + \varepsilon_t \tag{A. 6d}$$

$$S^N_t = Y_t - WB_t - B2^H_t - B2^G_t - B2^F_t + NIA^N_t + NII^N_t + ND^N_t - NIT^N_t - DT^N_t - OCT^N_t \tag{A. 7}$$

$$WB_t^N = wage_t * N_t^N \quad (A.\ 8)$$

$$N_t = \frac{y_t}{a} \quad (A.\ 9)$$

$$NIT_t^N = \theta^{Y,N} * Y_t \quad (A.\ 10)$$

$$NIA_t^N = i_{t-1}^D IBA_{t-1}^N + i_{t-1}^S SEC_{t-1}^N + i_{t-1}^L L_{t-1}^N \quad (A.\ 11)$$

$$NII_t^N = i_{t-1}^I INS_{t-1}^N \quad (A.\ 12)$$

$$ND_t^N = div_t EQ_{t-1}^N \quad (A.\ 13)$$

$$DT_t^N = \theta^N * Y_t \quad (A.\ 14)$$

$$B2_t = YF_t - WB_t^N \quad (A.\ 15)$$

$$\Pi_t = \frac{B2_t}{YF_t} \quad (A.\ 16)$$

$$\Delta\ln\left(\frac{i_{BD,t}^{NFC}}{k_{BD,t-1}^{NFC}}\right) = 0.42 - 0.44 * \Delta\ln\left(\frac{i_{BD_{t-1}}^{NFC}}{k_{BD,t-2}^{NFC}}\right) - 0.14 * \Delta\ln(\Pi_t) + 1.2 * \Delta\ln(u_t) - 0.012 * \Delta\ln(q_t) - 0.37 * [\ln\left(\frac{i_{BD_{t-1}}^{NFC}}{k_{BD,t-2}^{NFC}}\right) - 1.2 * \ln(\Pi_{t-1}) - 2.3 * \ln(u_{t-1}) - 0.18 * \ln(q_{t-1})] \quad (A.\ 17)$$

$$\Delta\ln\left(\frac{i_{equip,t}^{NFC}}{k_{equip,t-1}^{NFC}}\right) = -0.07 - 0.17 * \Delta\ln\left(\frac{i_{equip_{t-1}}^{NFC}}{k_{equip,t-2}^{NFC}}\right) - 0.22 * \Delta\ln(q_t) - 0.41 * [\ln\left(\frac{i_{equip_{t-1}}^{NFC}}{k_{equip,t-2}^{NFC}}\right) - 1.07 * \ln(\Pi_{t-1}) - 1.09 * \ln(u_{t-1}) - 0.14 * \ln(q_{t-1})] \quad (A.\ 18)$$

$$u_t = y_t/_{(bd_{t-1}^N + e_{t-1}^N)} \quad (A.\ 19)$$

$$q_t = \frac{EQ_{s,t}^N}{BD_t^N + E_t^N} \quad (A.\ 20)$$

$$I_{BD_t}^N = i_{BD_t}^N * p_t^{BD} \quad (A.\ 21)$$

$$I_{E_t}^N = i_{E_t}^N * p_t^E \quad (A.\ 22)$$

$$i_t^N = i_{BD_t}^N + i_{E_t}^N \quad (A.\ 23)$$

$$I_t^N = I_{BD_t}^N + I_{E_t}^N \quad (A.\ 24)$$

$$BD_t^N = BD_{t-1}^N + I_{BD_t}^N - \delta_{BD} BD_{t-1}^N + BD_{t-1}^N \Delta p_t^{BD} \quad (A.\ 25)$$

$$E_t^N = E_{t-1}^N + I_{E_t}^N - \delta_E E_{t-1}^N + E_{t-1}^N \Delta p_t^E \quad (A.\ 26)$$

$$e_t^N = \frac{E_t^N}{p_t^E} \quad (A.\ 27)$$

$$bd_t^N = \frac{BD_t^N}{p_t^{BD}} \quad (A.\ 28)$$

$$NL_t^N = S_t^N - I_{BD_t}^N - I_{E_t}^N - I_{INV_t} - NP_t^N + KT_t^N \quad (A.\ 29)$$

$$EQTR_t^N = EQTR_{d,t}^N - EQTR_{s,t}^N \quad (A.\ 30)$$

$$EQTR_{s,t}^N = EQTR_{d,t}^{H,N} + EQTR_{d,t}^{F,N} + EQTR_{d,t}^{G,N} + EQTR_{d,t}^{W,N} \quad (A.\ 31)$$

$$EQ_{s,t}^N = EQ_{d,t}^{H,N} + EQ_{d,t}^{F,N} + EQ_{d,t}^{G,N} + EQ_{d,t}^{W,N} \quad (A.\ 32)$$

$$EQ_t^N = EQ_{t-1}^N + EQTR_t^N + EQ_{CG_t}^N \quad (A.\ 33)$$

$$IBA_t^N = IBA_{t-1}^N + IBATR_t^N + IBA_{CG_t}^N \quad (A.\ 34)$$

$$IBATR_t^N = NL_t^N + EQTR_t^N + LTR_t^N + SECTR_t^N - INSTR_t^N \quad (A.\ 35)$$

$$FNW_t^N = IBA_t^N - EQ_t^N - SEC_t^N - L_t^N + INS_t^N \quad (A.\ 36)$$

$$NW_t^N = FNW_t^N + BD_t^N + E_t^N + INV_t^N \quad (A.\ 37)$$

Households

$$YD_t^{H,1} = (1 - \theta^{H,1})[NIA_t^H + NII_t^H + ND_t^H + B_{2_t}^H] \quad (A.\ 38)$$

$$YD_t^{H,2} = (1 - \theta^{H,2})[WB_t^H + SB_t^H - SC_t^H + OCT_t^H] \quad (A.\ 39)$$

$$YD_t^H = YD_t^{H,1} + YD_t^{H,2} \quad (A.\ 40)$$

$$WB_t^H = wage \cdot N_t^H \quad (A.\ 41)$$

$$NIA_t^H = i_{t-1}^D IBA_{t-1}^H + i_{t-1}^S SEC_{t-1}^H + i_{t-1}^L L_{t-1}^H \quad (A.\ 42)$$

$$NII_t^H = i_{t-1}^I INS_{t-1}^H \quad (A.\ 43)$$

$$ND_t^H = div_t EQ_{t-1}^H \quad (A.\ 44)$$

$$NSBEN_t^H = NBEN_t^H - NPEN_t^H \quad (A.\ 45)$$

$$\Delta\ln(NPEN_t^H) = 0.092 * \Delta\ln(NPEN_{t-1}^H) + 0.269 * \Delta\ln(WB_t^H) - 46.166 * \Delta ln\left(\frac{Ret_{t-1}}{Pop_{t-1}}\right) - 0.609 * \ln(NPEN_{t-1}^H) + 0.363 * \ln(WB_{t-1}^H) - 0.954 * \ln\left(\frac{Ret_{t-1}}{Pop_{t-1}}\right) \quad (A.\ 46)$$

$$\Delta\ln(NBEN_t^H) = -28.18 + 1.65 * \Delta\ln(POP_t - LF_t) + 0.001 * \Delta(UN_t) + 0.0005 * \Delta(UN_{t-1}) - 0.77 * \ln(NBEN_{t-1}^H) + 0.0004 * (UN_{t-1}) + 2.48 * \ln(POP_{t-1} - LF_{t-1}) \quad (A.\ 47)$$

$$yd_t^1 = \frac{YD_t^{H,1}}{P_t^c} \quad (A.\ 48)$$

$$yd_t^2 = \frac{YD_t^{H,2}}{P_t^c} \quad (A.\ 49)$$

$$\Delta\ln(c_t) = -0.39 * \Delta\ln(c_{t-2}) - 0.19 * \Delta\ln(c_{t-3}) + 0.13 * \Delta\ln(yd1_t) + 0.03 * \Delta\ln(yd2_{t-1}) - 0.21 * [\ln(c_{t-1}) - 0.76 * \ln(yd1_{t-1}) - 0.03 * \ln(yd2_{t-1}) - 0.21 * \ln(fnw_{t-2})] \quad (A.\ 50)$$

$$C_t = c_t \cdot P_t^c \quad (A.\ 51)$$

$$\Delta\ln W_t = 0.01 - 0.33 * \Delta UR_{t-4} + 0.62 * \Delta\ln A_t - 0.47 * [\ln W_{t-1} + 0.38 * \ln W_{t-1}^{\pi} + 0.53 * \ln A_{t-1}] \quad (A.\ 52)$$

$$W_{t+1}^T = \alpha_0 + W_t.(1 + E_t^H(\pi_{t+1})) \quad (A.\ 52a)$$

$$\pi_t = \left(\frac{P_t^c}{P_{t-4}^c} - 1\right) \quad (A.\ 52b)$$

$$w_t = W_t / P_t^C \quad (A.\ 53)$$

$$\Delta\ln\left(\frac{i_{BD_t}^H}{bd_{t-1}^H}\right) = 0.45 - 0.39 * \Delta\ln\left(\frac{i_{BD_{t-1}}^H}{bd_{t-2}^H}\right) - 0.43 * \Delta\ln\left(\frac{i_{BD_{t-3}}^H}{bd_{t-4}^H}\right) + 0.62 * \Delta\ln\left(\frac{P_{t-1}^{BD}}{P_{t-1}^I}\right) + 0.65 * \Delta\ln\left(\frac{P_{t-2}^{BD}}{P_{t-2}^I}\right) + 0.21 * \Delta\ln\left(\frac{yd_{t-2}^H}{bd_{t-3}^H}\right) - 0.68 * \Delta\ln\left(\frac{L_{t-1}^H}{BD_{t-2}^H}\right) - 0.16 * \ln\left(\frac{i_{BD_{t-1}}^H}{bd_{t-2}^H}\right) + 0.53 * \left(\frac{yd_{t-1}^H}{bd_{t-2}^H}\right) - 0.64 * \left(\frac{P_{t-1}^{BD}}{P_{t-1}^I}\right) - 0.32 * \left(\frac{L_{t-1}^H}{BD_{t-2}^H}\right) \quad (A.\ 54)$$

$$\Delta\ln\left(\frac{i_E^H}{e_{t-1}^H}\right) = -0.62 * \Delta\ln\left(\frac{i_{E_{t-1}}^H}{e_{t-2}^H}\right) - 0.25 * \left(\frac{i_{E_{t-2}}^H}{e_{t-3}^H}\right) + 0.19 * \left(\frac{yd_{t-1}^H}{e_{t-2}^H}\right) \quad (A.\ 55)$$

$$I_{BD_t}^H = i_{BD_t}^H * P_t^{BD} \quad (A.\ 56)$$

$$I_{E_t}^H = i_{E_t}^H * P_t^{EQUIP} \quad (A.\ 57)$$

$$i_t^H = i_{BD_t}^H + i_{E_t}^H \quad (A.\ 58)$$

$$I_t^H = I_{BD_t}^H + I_{E_t}^H \quad (A.\ 59)$$

$$E_t^H = E_{t-1}^H + I_E^H - \delta_E E_{t-1}^H + E_{t-1}^H \Delta P_t^E \quad (A.\ 60)$$

$$BD_t^H = BD_{t-1}^H + I_{BD}^H - \delta_{BD} BD_{t-1}^H + BD_{t-1}^H \Delta P_t^{BD} \quad (A.\ 61)$$

$$NL_t^H = YD_t^{H,1} + YD_t^{H,2} - C_t - I_{BD_t}^H - I_{E_t}^H + KT_t^H - NP_t^H \quad (A.\ 62)$$

$$INSTR_t^H = NPEN_t^H + INSXTR_t^H \quad (A.\ 63)$$

$$INS_t^H = INS_{t-1}^H + INSTR_t^H + INS_{CG_t}^H \quad (A.\ 65)$$

$$IBATR_t^H = NL^H + LTR_t^H - EQTR_t^H - INSTR_t^H - SECTR_t^H \quad (A.\ 66)$$

$$IBA_t^H = IBA_{t-1}^H + IBATR_t^H + IBA_{CG_t}^H \quad (A.\ 67)$$

$$\Delta\left(\frac{EQ_t^H - EQ_{rv,t}^H}{EQ_{t-1}^H + SEC_{t-1}^H + IBA_{t-1}^H}\right) = 0.07 + 6.85 * \Delta ibd_{t-1} + 0.16 * \Delta\left(\frac{DIV_{t-1}^H + EQ_{rv_{t-1}}^H}{EQ_{t-2}^H}\right) - 0.10 * \left(\frac{EQ_{t-1}^H - EQ_{rv,t-1}^H}{EQ_{t-2}^H + SEC_{t-2}^H + IBA_{t-2}^H}\right) - 2.14 * ibd_{t-1} + 0.16 * \left(\frac{DIV_{t-2}^H + EQ_{rv_{t-2}}^H}{EQ_{t-3}^H}\right) \quad (A.\ 68)$$

$$EQ_{d,t}^{H,N} = \zeta_1 EQ_t^H \quad (A.\ 69)$$

$$EQ_{d,t}^{H,F} = \zeta_2 EQ_t^H \quad \text{(A. 70)}$$

$$EQ_{d,t}^{H,W} = EQ_t^H - EQ_{d,t}^{H,N} - EQ_{d,t}^{H,F} \quad \text{(A. 71)}$$

$$\Delta\left(\frac{LTR_t^H}{YD_t^H}\right) = 1.27 + 0.13 * \Delta\left(\frac{LTR_{t-2}^H}{YD_{t-2}^H}\right) - 26.26 * \Delta i_t^L + 0.26 * \Delta ln\left(\frac{i_{BD_{t-3}}^H}{yd_{t-3}^H}\right) - 0.72 * \left(\frac{LTR_{t-1}^H}{YD_{t-1}^H}\right) - 0.49 * \left(\frac{L_{t-2}^H}{YD_{t-2}^H}\right) \quad \text{(A. 72)}$$

$$L_t^H = L_{t-1}^H + LTR_t^H + L_{CG_t}^H \quad \text{(A. 73)}$$

$$FA_t^H = IBA_t^H + EQ_t^H + INS_t^H + SEC_t^H \quad \text{(A. 74)}$$

$$FL^H = L_t^H \quad \text{(A. 75)}$$

$$FNW_t^H = FA_t^H - FL_t^H \quad \text{(A. 76)}$$

$$W_t^H = FNW_t^H + E_t^H + BD_t^H \quad \text{(A. 77)}$$

$$fnw_t^H = \frac{FNW_t^H}{P_t^c} \quad \text{(A. 78)}$$

$$w_t^H = \frac{W_t^H}{P_t^c} \quad \text{(A. 79)}$$

Financial Sector

$$S_t^F = B2_t^F + NIA_t^F + NII_t^F + ND_t^F - DT_t^F + SC_t^F - SB_t^F + OCT_t^F \quad \text{(A. 80)}$$

$$NIA_t^F = i_{t-1}^D IBA_{t-1}^F + i_{t-1}^S SEC_{t-1}^F + i_{t-1}^L L_{t-1}^F \quad \text{(A. 81)}$$

$$NII_t^F = i_{t-1}^I INS_{t-1}^F \quad \text{(A. 82)}$$

$$ND_t^F = div_t EQ_{t-1}^F \quad \text{(A. 83)}$$

$$DT_t^F = \theta^F * [B2_t^F + NIA_t^F + NII_t^F + ND_t^F] \quad \text{(A. 84)}$$

$$E_t^F = E_{t-1}^F + I_E^F - \delta_E E_{t-1}^F + E_{t-1}^F \Delta p_t^E \quad \text{(A. 85)}$$

$$BD_t^F = BD_{t-1}^F + I_{BD}^F - \delta_{BD} BD_{t-1}^F + BD_{t-1}^F \Delta p_t^{BD} \quad \text{(A. 86)}$$

$$NL_t^F = S_t^F - KT_t^F - I_E^F - I_{BD}^F \quad \text{(A. 87)}$$

$$IBATR_t^F = -(IBATR_t^N + IBATR_t^G + IBATR_t^H + IBATR_t^W) \quad \text{(A. 88)}$$

$$IBA_t^F = IBA_{t-1}^F + IBATR_t^F + IBA_{CG_t}^F \quad \text{(A. 89)}$$

$$SECTR_t^{F\sim W} = SECTR_t^W \quad \text{(A. 90)}$$

$$SECTR_t^{F\sim dom} = SECTR_t^{F\sim W} + NL_t^F + IBATR_t^F + INSTR_t^F - LTR_t^F - EQTR_t^F \quad \text{(A. 91)}$$

$$SECTR_t^F = SECTR_t^{F\sim dom} + SECTR_t^{F\sim W} \quad \text{(A. 92)}$$

$$SEC_t^F = SEC_{t-1}^F + SECTR_t^F + SEC_{CG_t}^F \quad \text{(A. 93)}$$

$$L_t^F = -(L_t^N + L_t^G + L_t^H + L_t^W) \quad \text{(A. 94)}$$

$$LTR_t^F = L_t^F - L_{t-1}^F - L_{CG_t}^F \quad \text{(A. 95)}$$

$$EQTR_t^F = EQTR_{d,t}^F - EQTR_{s,t}^F \quad \text{(A. 96)}$$

$$EQTR_{s,t}^F = EQTR_{d,t}^{H,F} + EQTR_{d,t}^{N,F} + EQTR_{d,t}^{G,F} + EQTR_{d,t}^{W,F} \quad \text{(A. 97)}$$

$$EQ_{s,t}^F = EQ_{d,t}^{H,F} + EQ_{d,t}^{N,F} + EQ_{d,t}^{G,F} + EQ_{d,t}^{W,F} \quad \text{(A. 98)}$$

$$EQ_t^F = EQ_{t-1}^F + EQTR_t^F + EQ_{CG_t}^F \quad \text{(A. 99)}$$

$$INSTR_t^F = INSTR_t^H + INSTR^W \quad \text{(A. 100)}$$

$$INS_t^F = INS_{t-1}^F + INSTR_t^F + INS_{CGt}^F \quad \text{(A. 101)}$$

$$FNW_t^F = -IBA_t^F + EQ_t^F + SEC_t^{F\sim H} + L_t^F - INS_t^F \quad \text{(A. 102)}$$

$$W_t^F = FNW_t^F + E_t^F + BD_t^F \quad \text{(A. 103)}$$

Government

$$DT_t^G = DT_t^N + DT_t^H + DT_t^F + DT_t^W \quad \text{(A. 104)}$$

$$NIT_t^G = NIT_t^N + NIT_t^W \quad \text{(A. 105)}$$

$$OCT_t^G = -(OCT_t^H + OCT_t^N + OCT_t^F + OCT_t^W) \quad \text{(A. 106)}$$

$$SB_t^G = -(SB_t^H + SB_t^W - SB_t^F) \quad \text{(A. 107)}$$

$$SC_t^G = (SC_t^H - SC_t^W - SC_t^F) \quad \text{(A. 108)}$$

$$NIA_t^G = i_{t-1}^D IBA_{t-1}^G + i_{t-1}^S SEC_{t-1}^G + i_{t-1}^L L_{t-1}^G \quad \text{(A. 109)}$$

$$NII_t^G = i_{t-1}^I INS_{t-1}^G \quad \text{(A. 110)}$$

$$ND_t^G = div_t EQ_{t-1}^G \quad (A. 111)$$

$$E_t^G = E_{t-1}^G + I_E^G - \delta_E E_{t-1}^G + E_{t-1}^G \Delta P_t^E \quad (A. 112)$$

$$BD_t^G = BD_{t-1}^G + I_{BD}^G - \delta_{BD} BD_{t-1}^G + BD_{t-1}^G \Delta p_t^{BD} \quad (A. 113)$$

$$NL_t^G = B2_t^G + NIA_t^G + NII_t^G + ND_t^G + NIT_t^G + DT_t^G + SC_t^G - SB_t^G - OCT_t^G - G_t - I_{E_t}^G - I_{BD_t}^G + NP_t^G - KT_t^G \quad (A. 114)$$

$$SECTR_t^G = NL_t^G - LTR_t^G - IBATR_t^G - EQTR_t^G - INSTR_t^G \quad (A. 115)$$

$$SEC_t^G = SEC_{t-1}^G + SECTR_t^G + SEC_{CG_t}^G \quad (A. 116)$$

Rest of the world

$$\Delta \ln(x_t) = 0.60 + 1.30 * \Delta \ln(y_{t-4}^{TP}) - 0.63 * \Delta \ln(rer_t) - 0.61 * [\ln(x_{t-1}) + 0.39 * \ln(rer_{t-1}) - 1 * \ln(y_{t-1}^{TP})] \quad (A. 117)$$

$$\Delta \ln(m_t) = -3.75 - 0.12 * \Delta \ln(m_{t-2}) + 0.28 * \Delta \ln(rer_{t-1}) + 0.38 * \Delta \ln(rer_{t-3}) + 1.22 * \Delta \ln(y_t) - 0.30 * [\ln(m_{t-1}) - 1.8 * \ln(y_{t-1})] \quad (A. 118)$$

$$rer_t = xr_t \frac{P_t^C}{P_t^*} \quad (A. 119)$$

$$M_t = m_t * P_t^m \quad (A. 120)$$

$$X_t = x_t * P_t^x \quad (A. 121)$$

$$NIT_t^W = \theta^{Y,W} * Y_t \quad (A. 122)$$

$$NL_t^W = M_t - X_t + NIA_t^W + NII_t^W + ND_t^W + WB_t^W - NIT_t^W - DT_t^W + SC_t^W + SB_t^W + OCT_t^W + NP_t^W - KTR_t^W \quad (A. 123)$$

$$CAB_t = -[M_t - X_t + NIA_t^W + NII_t^W + ND_t^W + WB_t^W - NIT_t^W - DT_t^W + SC_t^W + SB_t^W + OCT_t^W] \quad (A. 124)$$

$$NIA_t^W = i_{t-1}^D IBA_{t-1}^W + i_{t-1}^S SEC_{t-1}^W + i_{t-1}^L L_{t-1}^W \quad (A. 125)$$

$$NII_t^W = i_{t-1}^I INS_{t-1}^W \quad (A. 126)$$

$$ND_t^W = div_t EQ_{t-1}^W \quad (A. 127)$$

$$IBA_t^W = IBA_{t-1}^W + IBATR_t^W + IBA_{CG_t}^W \quad (A. 128)$$

$$EQ_t^W = EQ_{t-1}^W + EQTR_t^W + EQ_{CG_t}^W \quad (A. 129)$$

$$INS_t^W = INS_{t-1}^W + INSTR_t^W + INS_{CG_t}^W \quad (A. 130)$$

$$IBATR_t^W = NL_t^W - EQTR_t^W - INSTR_t^W + L_t^W - SEC_t^W \quad (A. 131)$$

$$FNW_t^W = IBA_t^W + EQ_t^W + INS_t^W + SEC_t^W - L_t^W \quad (A. 132)$$

Labour market

$$Y_t^F = Y_t - T_t^{PN} \quad (A. 133)$$

$$WS_t = \frac{WB_t^N}{Y_t^F} \quad (A. 134)$$

$$N_t = \frac{y_t}{a} \quad (A. 135)$$

$$N_t^N = N_t + N_t^W \quad (A. 136)$$

$$N_t^W = \frac{WB_t^W}{wage_t} \quad (A. 137)$$

$$UN_t = LF_t - N_t \quad (A. 138)$$

$$UR_t = \frac{UN_t}{LF_t} \quad (A. 139)$$

$$LF_t = part * Pop_t \quad (A. 140)$$

$$Ret_t = \frac{Pop_{(65+),t}}{Pop_t} \quad (A. 141)$$

Symbols:

N = non-financial corporations, F = financial corporations, G = government, H = Households, W = Rest of the World

Notation	Description
Y	Nominal GDP
C	Nominal Private Consumption

I	Nominal Gross fixed capital formation
X	Noninal Exports of goods and services
M	Nominal Imports of goods and services
P_t^y	GDP deflator
y	Real GDP
c	Real Private Consumption
i	Real Gross fixed capital formation
x	Real Exports of goods and services
m	Real Imports of goods and services
$I_{BD_t}^N$	Nonfinancial corporations Nominal Investment in Buildings and Dwellings
$I_{BD_t}^F$	Financial corporations Nominal Investment in Buildings and Dwellings
$I_{BD_t}^H$	Households Nominal Investment in Buildings and Dwellings
$I_{BD_t}^G$	Government Nominal Investment in Buildings and Dwellings
$I_{E_t}^N$	Nonfinancial corporations Nominal Investment in Equipment
$I_{E_t}^F$	Financial corporations Nominal Investment in Equipment
$I_{E_t}^H$	Households Nominal Investment in Equipment
$I_{E_t}^G$	Government Nominal Investment in Equipment
P_t^C	Price deflator on consumption
WB_t^N	Wage bill paid by firms
WB_t^H	Wage bill received by households
WB_t^W	Wage bill received by the rest of the world
N_t^N	Total Employment
N_t^H	Employment hired to the households
N_t^W	Employment hired to the rest of the world
UN_t	Unemployment
ur_t	Rate of unemployment
LF_t	Labour force
POP_t	Population
Ret_{t-1}	Retired people
$wage_t$	Wage rate
YD_t^H	Disposable income
yd_t^1	Disposable income of profit
yd_t^2	Disposable income on wages/transfers
$NPEN_t^H$	Change in pension entitlements
$NBEN_t^H$	Benefits received by the households
$S_t^N, S_t^F, S_t^H, S_t^G, S_t^W$	Savings
$B2_t$	Aggregate gross operating surplus
$B_{2_t}^N, B_{2_t}^F, B_{2_t}^H, B_{2_t}^G$	Sectoral gross operating surpluses
$NIA_t^N, NIA_t^F, NIA_t^H, NIA_t^G, NIA_t^W$	Net interest income on interest bearing assets
$NII_t^N, NII_t^F, NII_t^H, NII_t^G, NII_t^W$	Net interest income on insurance
$ND_t^N, ND_t^F, ND_t^H, ND_t^G, ND_t^W$	Net dividends
$NIT_t^N, NIT_t^W, NIT_t^G$	Net indirect taxes
$DT_t^N, DT_t^F, DT_t^G, DT_t^H, DT_t^W$	Income taxes
$SC_t^H, SC_t^F, SC_t^G, SC_t^W$	Social contributions
$SB_t^H, SB_t^F, SB_t^G, SB_t^W$	Social benefits
$OCT_t^H, OCT_t^N, OCT_t^F, OCT_t^G, OCT_t^W$	Other current transfers
YF_t	GDP at factor costs
Π_t	Profit share

a_t	Labour productivity
u_t	Capacity utilization
q_t	Tobin's q
rer_t	Real exchange rate
xr_t	Nominal exchange rate
$BD_t^N, BD_t^F, BD_t^G, BD_t^H$	Stock of buildings and dwellings
$E_t^N, E_t^F, E_t^G, E_t^H$	Stock of capital of equipment
$NL_t^N, NL_t^F, NL_t^G, NL_t^H, NL_t^W$	Net lending
CAB_t	Current account balance
$NP_t^N, NP_t^F, NP_t^G, NP_t^H, NP_t^W$	Net acquisitions of non-produced non-financial assets
$KT_t^N, KT_t^F, KT_t^G, KT_t^H, KT_t^W$	Capital transfers
$EQ_t^N, EQ_t^F, EQ_t^G, EQ_t^H, EQ_t^W$	Stock of Equities
$EQTR_t^N, EQTR_t^F, EQTR_t^G, EQTR_t^H, EQTR_t^{NW}$	Transaction of equities
$EQ_{CG_t}^N, EQ_{CG_t}^F, EQ_{CG_t}^G, EQ_{CG_t}^H, EQ_{CG_t}^W$	Capital gains on equities
$EQTR_{d,t}^N$	Nonfinancial corporations' demand for equities (flow)
$EQTR_{s,t}^N$	Nonfinancial corporations' supply of equities (flow)
$EQTR_{d,t}^F$	Financial corporations' demand for equities (flow)
$EQTR_{s,t}^F$	Financial corporations' supply of equities (flow)
$EQ_{d,t}^{H,N}$	Households demand for equities issued by nonfinancial corporations
$EQ_{d,t}^{H,F}$	Households demand for equities issued by financial corporations
$EQ_{d,t}^{H,W}$	Households demand for equities issued by the rest of the world
$IBA_t^N, IBA_t^F, IBA_t^G, IBA_t^H, IBA_t^W$	Stock of interest-bearing assets
$IBATR_t^N, IBATR_t^F, IBATR_t^G, IBATR_t^H, IBATR_t^W$	Transaction of interest-bearing assets
$IBA_{CG_t}^N, IBA_{CG_t}^F, IBA_{CG_t}^G, IBA_{CG_t}^H, IBA_{CG_t}^W$	Capital gains on interest-bearing assets
$L_t^N, L_t^F, L_t^G, L_t^H, L_t^W$	Stock of loans
$LTR_t^N, LTR_t^F, LTR_t^G, LTR_t^H, LTR_t^W$	Transaction of loans
$L_{CG_t}^N, L_{CG_t}^F, L_{CG_t}^G, L_{CG_t}^H, L_{CG_t}^W$	Capital gains on loans
$SEC_t^N, SEC_t^F, SEC_t^G, SEC_t^H, SEC_t^W$	Stock of securities
$SECTR_t^N, SECTR_t^F, SECTR_t^G, SECTR_t^H, SECTR_t^W$	Transaction of securities
$SEC_{CG_t}^N, SEC_{CG_t}^F, SEC_{CG_t}^G, SEC_{CG_t}^H, SEC_{CG_t}^W$	Capital gains on securities
$SECTR_t^{F\sim dom}$	Domestic securities issued by Financial corporations
$SECTR_t^{F\sim W}$	Domestic securities held by the rest of the world
$INS_t^N, INS_t^F, INS_t^G, INS_t^H, INS_t^W$	Stock of insurance technical reserves
$INSTR_t^N, INSTR_t^F, INSTR_t^G, INSTR_t^H, INSTR_t^W$	Transaction of insurances
$INS_{CGt}^N, INS_{CGt}^F, INS_{CGt}^G, INS_{CGt}^H, INS_{CGt}^W$	Capital gains on insurances
$FNW_t^N, FNW_t^F, FNW_t^G, FNW_t^H, FNW_t^W$	Financial net wealth of each sector
$W_t^N, W_t^F, W_t^G, W_t^H, W_t^W$	Net wealth of each sector

Parameters

$\theta^{y,N}, \theta^{y,W}$	Net indirect tax rate
$\theta^{H,1}, \theta^{H,2}$	Income tax rate levied Households
θ^N	Income tax rate levied on nonfinancial corporations
θ^F	Income tax rate levied on financial corporations
P_t^{BD}	Price deflator of building and dwellings

P_t^E	Price deflator of Equipment
P_t^m	Price deflator of imports
P_t^x	Price deflator of exports
P_t^G	Price deflator of public consumption
P_t^*	International price index
δ_{BD}, δ_E	Depreciation rates of the capital stock
i_t^D	Interest rate on interest-bearing assets
i_t^S	Interest rate on securities
i_t^L	Interest rate on loans
i_t^I	Interest rate on insurance technical reserves
div	Dividend distribution rate
ζ_1	Households share of equities issued by nonfinancial corporations
ζ_2	Households share of equities issued by financial corporations