Monetary Policy, Income Distribution and Autonomous Demand in the US

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Abstract

In this paper we explore the empirical implications of considering monetary and distribution shocks on semi-autonomous demand under a supermultiplier framework. In particular, we investigate the effect of changes in financial variables - the federal funds rate - and distributive variables - the wage share of income - on autonomous expenditure (e.g.: private residential investment and consumer credit), as well as economic growth. We use quarterly data for the United States economy from 1968 to 2022 and apply a SVAR model. We find that: (i) the federal funds rate, our financial variable, has a negative and statistically significant effect on autonomous expenditure, whether we define it to be given by residential investment added to consumer credit or to durable goods consumption; (ii) a positive shock in the wage share does seem to have a positive and significant effect on consumption and output, however, this effect is measured to be transitory; (iii) a positive shock in aggregated autonomous demand has a positive, persistent, and statistically significant effect on induced consumption and, output, as well as on the adjusted wage share; (iv) a positive shock in private residential investment has a positive, persistent and statistically significant effect on other autonomous components of demand and output; (v) while residential investment positively influences consumer credit, the inverse does not hold.

Keywords: supermultiplier, financial and distributional shocks, SVAR, US, semi-autonomous expenditure.

JEL Codes: C32; D33; E11; E12; E31; E52.

1 Introduction

The relationship between distribution and growth is no novelty in the post-Keynesian research agenda. In fact, as argued by Lavoie (2014) it is one of the commonalities among different schools of thought that can be classified as post-Keynesians. On the one hand, the neo-Kaleckian literature establishes a theoretical connection between income distribution and demand-led growth, which happens through the specification of the investment function and that was recently enriched by the inclusion of debt-dynamics (see, among others, Dutt, 2006; Hein,2012; Setterfield and Kim, 2016; 2017). On the other, scholars of the supermultiplier model have explored the role of autonomous demand-led growth, studying in particular the role of private residential investment and household credit-finance consumption in driving growth (see, among others, Pariboni, 2016; Fagundes, 2017; Pérez-Montiel and Pariboni, 2022; Petrini and Teixeira, 2022; 2023). However, considering the first-generations of supermultiplier models, many scholars have criticized the approach challenging the exogeneity of autonomous demand. Nevertheless, as recently argued by Serrano et al. (2022), defining the exogeneity of autonomous demand components is a simplifying assumption, which can be relaxed.

In light of this debate, the aim of this paper is to empirically explore the effects that changes in income distribution (controlling for monetary policy) have on semi-autonomous demand components, and, therefore, on output. In particular, in this empirical exercise we attempt to explore the connections suggested in the theoretical work developed by Avritzer and Brochier (2022) between a semi-autonomous household credit-financed demand component and the financial and income distribution variables.

To estimate the effect of changes in monetary policy as well as in functional income distribution on semi-autonomous expenditures and output, we apply Structural Vector Autoregressive (SVAR, henceforth) models relying on US quarterly data for the period 1968-2022. We estimate six different models exploring the many possibilities of definition of what a semi-autonomous demand might look like. In these estimations, we explore the possibility of it being defined by residential investment added to consumer credit, or added to durable goods consumption. Furthermore, we explore the connections between these two components, as well as the results of further considering the division of consumer credit into revolving and non-revolving credit or even the effect of incorporating home-equity lines of credit into the estimations.

Our findings suggest that a contractionary monetary policy shock has negative persistent, and statistically significant effects on house prices, autonomous expenditures, consumption and output, particularly affecting private residential investment, in line with recent empirical literature (Deleidi, 2018; Barbieri Góes, 2023; Barbieri Góes and Deleidi, 2022). A positive shock in the wage share does seem to have a positive and significant effect on consumption and output, however, this effect is measured to be transitory. A positive shock on house prices were also found to have positive and statistically significant effect on both residential investment and home equity loans (HELOCs). A positive shock to aggregated autonomous consumption has a positive, persistent, and statistically significant effect on induced consumption and output as well as on the adjusted wage share. Lastly, whereas a positive shock to private residential investment has a positive, persistent, and statistically significant effect on consumer credit, durable consumption, induced consumption and output; durable consumption and consumer credit do not seem to impact residential investment.

The remainder of this paper is organized as follows. Section (2) reviews the theoretical and empirical literature on credit-financed demand-led growth and distribution, while also discussing the transmission channels of monetary policy. In Section (3), we present our data and introduce the methods and identification strategies employed. In Section (4), we report the empirical findings of the estimated models presenting and analysing impulse response functions (IRFs, henceforth). Section (5) concludes with a summary of our results.

2 Theoretical and empirical review

2.1 Demand-led growth, income distribution and household debt

Under a neo-Kaleckian framework, there is a well established theoretical connection between income distribution and demand-led growth, which happens through the specification of the investment function.[1] More recently, this literature has also incorporated household debt dynamics into their theoretical models. For instance, Dutt (2006), Setterfield and Kim (2016, 2017), and Hein (2012) have all suggested possible routes for incorporating household debt dynamics into neo-Kaleckian model but in ways that endogeneize this consumption to current income. As a result, this credit-financed consumption becomes fully determined by the demand component that is driving growth, which, in their case, is firms' investments.

Meanwhile, under a supermultiplier framework household debt dynamics has been explored as the autonomous component of demand that drives growth. For example, both Pariboni (2016) and Fagundes (2017) have developed theoretical models for which household credit-financed consumption is the autonomous component of demand driving growth. In both cases credit-financed consumption is assumed to be growing at an exogenously given rate. Additionally, Teixeira and Petrini (2023) have also suggested that residential investment could play the role of the exogenous autonomous component of demand driving economic growth.

However, as suggested in Serrano et al. (2022), defining autonomous demand as exogenously given

[1]See Blecker (2002) for the many possibilities for this relationship when assuming an investment function as specified in Bhaduri and Marglin (1990).

is only a simplifying assumption that was taken in the first versions of the supermultiplier model. Nonetheless, this is not a necessary assumption for the model. In fact, many have started exploring the possibility of a semi-autonomous demand under this framework (see Fiebiger and Lavoie 2019). More recently, Avritzer and Brochier (2022) have suggested a supermultiplier model that assumes a household credit-financed consumption that is autonomous, but endogenous to income distribution and interest rates. In their model it is then possible to describe a theoretical relationship between a demand-led growth and variables that describe the financial aspect of the economy, as well as income distribution. Furthermore, this connection is the result of the specification of debt-financed consumption, which is the driver of economic growth in the model. The aim of this paper is to explore this same relationship through an empirical investigation for the United States economy.

In terms of empirical investigation, the neo-Kaleckian literature has a long tradition of estimating growth and demand regimes.[2] However, to the best of our knowledge, the channel of transmission for the relationship between income distribution and growth is always assumed to be the investment function, without a more profound empirical investigation of it.

Finally, under a supermultiplier framework, several papers have began empirically exploring the many possibilities for the drivers of autonomous growth.[3] Barbieri Góes and Deleidi (2022), for instance empirically assess the magnitude and persistence of multipliers associated with autonomous demand components reassuring their long-run implications, while controlling for monetary policy in the US.[4] While Pérez-Montiel and Pariboni (2022) show that residential investment is an important driver of business cycle in recent US history. [5]

The aim of this paper is to empirically explore the effects that changes in income distribution and the federal funds rate have on autonomous consumption, as well as residential investment, and, thus, on demand-led growth. We therefore, attempt to explore the connections suggested in the theoretical work developed by Avritzer and Brochier (2022) between a semi-autonomous household credit-financed consumption and the financial and income distribution variables.

[2]See Hein (2014) for a very detailed description of these estimations. Furthermore, see Blecker (2016), Rolim (2019) and Avritzer et al. (2021) for some critiques of the empirical findings in this literature.

[3]This exploration has also had many contributions in theoretical terms, such as Petrini and Teixeira (2022), Morlin (2022a), Freitas and Christianes (2020), among many others.

[4]Beyond the supermultiplier literature, we also have Cynamon and Fazzari (2015) arguing that the increase in inequality is highly associated with the increase in household debt, and, as a consequence financial instability. Kim (2016) presents empirical results that provide a support for the view of the household debt-driven business cycles.

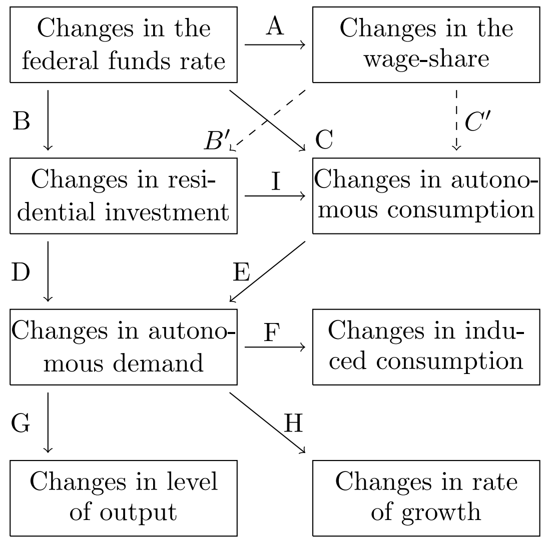
[5]See also Morlin et al. (2022) for a growth decomposition empirical exploration for the United States, among other countries, following the initial contribution of Freitas and Dweck (2013).

2.2 The transmission mechanisms from interest rate to growth, and to income distribution

As mentioned in the previous section, Avritzer and Brochier (2022) have emphasized the role that interest rates have on credit financed consumption, and, therefore, demand-led growth through the development of theoretical models. However, to the best of our knowledge there has not yet been a literature investigating this connections from an empirical perspective. The exceptions are: i) Stockhammer and Wildauer (2018), which empirically investigates the effects of interest rates changes, among other factors, in household debt, but without focusing on its effect on autonomous demand; and ii) Deleidi (2018) and Barbieri Góes and Deleidi (2022), which explore the connections between interest rate and autonomous demand components from a supermultiplier perspective.

It is also important to mention that there is an extensive literature that investigates the impacts of monetary policy on income, wealth and consumption inequalities in the United States. See, for instance, McKay and Wolf (2023) for a very detailed account of the many transmission mechanisms of monetary policy on consumption inequality under a neoclassical framework. Furthermore, for a detailed analysis of the effect of monetary policy on functional income distribution in 15 advanced economies see Di Bucchianico and Lofaro (2023). But once again, this literature does not focus on how these transmission mechanisms might reflect on the autonomous components of demand.

Finally, Barbieri Góes (2023) gives a very detailed account of the effects of monetary policy on autonomous demand, focusing on private residential investment and consumer-credit and following the supermultiplier approach. In her paper she investigates the transmission mechanism from monetary policy into autonomous consumption through changes in house prices, and own-interest rates. Our aim is to further contribute to this literature by investigating the mechanisms through which both the wage share and the changes in monetary policy affect autonomous demand, exploring the theoretical channels highlighted by Avritzer and Brochier (2022) . Given that this empirical work focuses on the United States, we define our autonomous demand to be given by credit financed consumption and residential investment. The connections can be summarized in the chart flow of figure 1.



Source: Authors' representation

Figure 1: Flow chart

Model 1, represented in figure 2 starts by investigating the possibilities for flows A to H, as well as B' and C'. In other words, it explores the effects of changes in the financial variable and income distribution on autonomous demand. In this first step, this is done by assuming an autonomous demand that is given by the sum of private residential investment and consumer credit. Furthermore, the federal funds rate is assumed to be our most exogenous variable influencing all other variables, including income distribution within the quarterly observation.

In further iterations of this first model, represented in figures 8 to 12, we discuss: i) the possibility of a Taylor rule type of dynamic; ii) an endogenous income distribution; iii) the extension of the results to growth rates and, therefore, longer-term observations; iv) the sub-sample stability analysis dropping from our sample the post-crisis period (i.e. 1968Q2-2007Q1) ; and v) the further breakdown of our wage-share data into real wage rate and labor productivity. It is important to mention that even though, we do explore the possibility of endogenous income distribution, i.e.: changes in the wage-share being explained by changes in all of the variables of this first model, as well as its breakdown into real wage rate and labor productivity, a more detailed exploration of this is left for further empirical work.[6]

[6] We acknowledge that the relationship between income distribution and wage-share can be further divided into the relationship between interest rate and prices, on one hand, and interest rate and unemployment and labor productivity on the other hand. And, therefore, requires further exploration than what we have done in our robustness checks. There is an extensive literature that deals with some of these dynamics (see, for instance Cucciniello et al., 2022;

Model 2, represented in figure 3, explores the same flows of model 1, but now further detailing the connections between our two components of autonomous consumption: residential investment and consumer credit. A connection between the two is explored through the investigation of flow I in figure 1. Models 3 and 4, represented in figures 4 and 5, respectively investigate the same flows mentioned above but assuming an autonomous consumption that is explained by households consumption of durable goods. Model 5, presented in figure 6 explores the division of consumer credit into revolving versus non-revolving consumer credit. While revolving credit is the type of credit you can keep adding on, such as credit card payments, non-revolving credits are those credits for which you take one unique loan, and pay the loan back into installments, commonly associated with student loans and automobile loans. Finally, figure 7 explores the connections between residential investment and Home Equity Lines of Credit (HELOCs), which is a revolving type of secured loan, where the collateral is the borrower's property.

The point of developing these many specifications for our estimations is to engage in the discussion of what could be considered autonomous demand when thinking about the United States economy. As mentioned above, to the best of our knowledge the empirical debate on the composition of autonomous demand and its explanatory variables, is still quite incipient in this literature. We are then interested in exploring the many possibilities of defining what this autonomous demand could look like for US households. Now that we have connected the different models that are estimated in this paper with the relationship presented above in figure 1, we are ready to move on to a discussion of the methodology used in each of the estimations.

3 Data and Methodology

3.1 Data

To estimate the effect of changes in monetary policy as well as in the functional income distribution on autonomous expenditures and output, we use seasonally adjusted quarterly data for the US in the period 1968-2022. We estimate six different models. In the first model, we include the federal funds rate (FF), the adjusted wage share (WS_{Adj}), the sum of private residential investment and consumer credit (AD_CC), total consumption expenditure of goods and services net of consumer credit (IC_CC), and output (Y). In the second model, we split our autonomous demand variable of the first model (AD_CC) into private residential investment (RES) and consumer credit (CC). In

Morlin, 2022b; Rochon and Setterfield; 2007). However, since our aim is to investigate the effect of distribution on semi-autonomous demand while controlling for the role of monetary policy, we leave a further exploration of wage-share analysis of the separate effect of monetary policy on nominal wages, employment, and labour productivity for future research.

the third model we include the federal funds rate (FF), the adjusted wage share (WS_{Adj}), the sum of private residential investment and consumption of durable goods (AD_DC), total consumption expenditure of non-durable goods and services (IC_DC), and output (Y). In the fourth model, we split our autonomous demand variable of the third model (AD_DC) into private residential investment (RES) and consumption of durable goods (DC). In the fifth model, we split the consumer credit (CC) variable of model two into non-revolving consumer credit ($NRCC$) and revolving consumer credit (RCC). Finally, in the sixth model, we explore the connections between residential investment (RES) and home equity loans ($HELOC$). With the exceptions of the Federal Funds rate (FF), the adjusted wage share (WS_{Adj}), and house prices (HP) variables are used in real (2012 USD) terms, deflated using their corresponding deflators, and in log-level. A summary of variables, acronyms, description, and sources can be found in Table (1) in Appendix (A).

3.2 Methods

Before estimating all SVAR models, reduced-form VARs are estimated following Equation (1), where u_t is a $kx1$ vector composed by the error terms, A_i is the kxk matrix of reduced-form coefficients, c is the constant term, and y_t is the $kx1$ vector of all considered variables.[7]

$$y_t = c + \sum A_i y_{t-p} + u_t \tag{1}$$

Since $A_i = B_0{}^{-1} B_i$ and $u_t = B_0{}^{1} \omega_t$, where B_0^{-1} is the inverse of the kxk matrix of contemporaneous relationships between the k variables in y_t, B_i is the kxk matrix of autoregressive slope coefficients, and ω_t is the $kx1$ vector of structural innovations; the structural model presented in Equation (2) can be retrieved from (1).

$$B_0 y_t = c + \sum B_i y_{t-p} + \omega_t \tag{2}$$

In particular, to isolate the structural innovation $kx1$ vector (ω_t, in Equation 2) from the reduced form error term (u_t in Equation 1) we can orthogonalize the reduced-form errors by making them mutually uncorrelated (Kilian and Lütkepohl, 2017). In order to do so, we need to impose restrictions in the matrix B_0, which needs to be lower triangular. Since we estimate six different models, as described in the previous Subsection, we apply six different identification strategies summarized in the systems of Equations (3), (4), (5), (6) and (7) below.

[7] The optimal lag length is obtained by minimizing the Akaike's Information Criterion (AIC) and is available upon request.

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 \\ - & - & 0 & 0 & 0 \\ - & - & - & 0 & 0 \\ - & - & - & - & 0 \\ - & - & - & - & - \end{bmatrix} \begin{bmatrix} FF \\ WS_{Adj} \\ AD\_CC \\ IC\_CC \\ Y \end{bmatrix} \quad (3)$$

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 \\ - & - & 0 & 0 & 0 & 0 \\ - & - & - & 0 & 0 & 0 \\ - & - & - & - & 0 & 0 \\ - & - & - & - & - & 0 \\ - & - & - & - & - & - \end{bmatrix} \begin{bmatrix} FF \\ WS_{Adj} \\ RES \\ CC \\ IC\_CC \\ Y \end{bmatrix} \quad (4)$$

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 \\ - & - & 0 & 0 & 0 \\ - & - & - & 0 & 0 \\ - & - & - & - & 0 \\ - & - & - & - & - \end{bmatrix} \begin{bmatrix} FF \\ WS_{Adj} \\ AD\_DC \\ IC\_DC \\ Y \end{bmatrix} \quad (5)$$

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 \\ - & - & 0 & 0 & 0 & 0 \\ - & - & - & 0 & 0 & 0 \\ - & - & - & - & 0 & 0 \\ - & - & - & - & - & 0 \\ - & - & - & - & - & - \end{bmatrix} \begin{bmatrix} FF \\ WS_{Adj} \\ RES \\ DC \\ IC\_DC \\ Y \end{bmatrix} \quad (6)$$

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 & 0 \\ - & - & 0 & 0 & 0 & 0 & 0 \\ - & - & - & 0 & 0 & 0 & 0 \\ - & - & - & - & 0 & 0 & 0 \\ - & - & - & - & - & 0 & 0 \\ - & - & - & - & - & - & 0 \\ - & - & - & - & - & - & - \end{bmatrix} \begin{bmatrix} FF \\ WS_{Adj} \\ RES \\ NRCC \\ RCC \\ IC\_CC \\ Y \end{bmatrix} \quad (7)$$

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 \\ - & - & 0 & 0 & 0 & 0 \\ - & - & - & 0 & 0 & 0 \\ - & - & - & - & 0 & 0 \\ - & - & - & - & - & 0 \\ - & - & - & - & - & - \end{bmatrix} \begin{bmatrix} FF \\ WS_{Adj} \\ HP \\ RES \\ HELOC \\ Y \end{bmatrix} \quad (8)$$

The first equation of the models assumes that the Federal Funds rate (FF) is exogenously set by the Central Bank, in accordance with the Post-Keynesian endogenous monetary theory and in line with recent empirical literature (Deleidi, 2018; Barbieri Góes, 2023; Barbieri Góes and Deleidi, 2022).[8] This assumption implies that monetary policy can affect output and its components within the quarterly observation, while output may affect monetary policy with a delay. The wage share

[8] In order to perform a robustness test we re-estimate Model 1 inverting the order of the federal funds rate (FF) in the identification matrix following the empirical literature that investigates the transmission channels of monetary policy (see, among others, Perotti, 2004; Castelnuovo and Surico, 2010; Bjørnland and Jacobsen, 2010). The result of Model 1 allowing interest rates to react contemporaneously to output, autonomous demand, and the wage share is very similar to the estimates obtained using the identification strategy reported in the system of equations (3). In fact, this confirms that our results are not model dependent. The IRFs using this alternative ordering can be found in Appendix (B).

(WS) is assumed to affect autonomous demand, consumption and thus, output within the quarterly observation. Whereas, output, autonomous demand and consumption may affect the wage share with a delay. [9] Moreover, we assume that our autonomous demand variables (AD_CC and AD_DC) have a direct impact on the output level (Y), whereas output may have a lagged impact on them. Following Leamer (2007; 2015); Teixeira (2015) and Petrini and Teixeira (2022; 2023), in the models in which our autonomous demand variable is split, we assume that private residential investment (RES) contemporaneously affects consumer credit (CC) and durable consumption (DC). This same reasoning applies for the last model. In particular, we order private residential investment first followed by non-revolving consumer credit ($NRCC$) and revolving consumer credit (RCC).[10] Finally, for the same reasons mentioned above in the sixth and last model we order private residential investment followed by home equity loans (HELOCs).

4 Empirical Findings

In this section we report the empirical results of models 1 to 6, as described above, by analyzing the IRFs for each model.[11] IRFs show quarters on x-axis and shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

Figure (2) displays IRFs of interest rate (FF), wage share (WS), autonomous demand (AD_CC)[12], induced consumption net of consumer-credit (IC_CC), and output (Y) to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{AD_CC}). A positive shock in the federal funds rate (ε_{FF}) leads to a very small positive (statistically significant at the 95% level for 5 quarters) effect on the wage share (WS), followed by a negative, persistent and statistically significant effect

[9] Following Di Bucchianico and Lofaro (2023) and the recent literature on the endogeneity of distribution within the SSM approach (Morlin and Pariboni, 2022), we perform an additional robustness test placing the adjusted wage share (WS) at last in the identification matrix of Model 1. The result of Model 1 allowing the wage share to react contemporaneously to output, autonomous demand, and the interest rate is very similar to the estimates obtained using the identification strategy reported in the system of equations (3). The IRFs using this alternative identification strategy are reported in Appendix (B).

[10] For a visual representation of the identification strategy adopted, see Figure (1) in Subsection (2.2).

[11] It is worth stressing that, since we estimate our models using the sum of private residential investment and consumer credit (AD_CC), total consumption expenditure of goods and services net of consumer credit (IC_CC), output (Y), private residential investment (RES), consumer credit (CC), the sum of private residential investment and consumption of durable goods (AD_DC), total consumption expenditure of non-durable goods and services (IC_DC), consumption of durable goods (DC), non-revolving consumer credit ($NRCC$), revolving consumer credit (RCC), home equity loans ($HELOC$), and house prices (HP) in log-levels, the IRFs of these variables to structural shocks in these variables should be interpreted as elasticities.

[12] As emphasized in Table 1, this autonomous demand variable is calculated as the sum of residential investment and consumer credit.

in autonomous demand (AD_CC), and thus in output (Y).[13] A positive shock in the adjusted wage share (ε_{WS}) has a short vivid effect on consumption net of consumer-credit (IC_CC) and output (Y) and a negative effect (statistically significant at the 84% level until the 7th quarter) on autonomous demand (AD_CC). A positive shock in autonomous demand (ε_{AD_CC}) has a positive, persistent, and statistically significant effect on consumption net of consumer-credit (IC_CC) and, output (Y), as well as on the adjusted wage share (WS). Lastly, a positive shock in consumption net of consumer-credit (ε_{IC_CC}) has a positive but not statistically significant effect on autonomous consumption (AD_CC) and a positive and persistent effect on output (Y).

[13]It should be noted that in this empirical contribution we are not investigating explicitly the role of monetary on functional income distribution. For an in-depth analysis of the effect of a contractionary monetary policy shock on the labor share of income as well as on real wages, the interested reader should see Di Bucchianico and Lofaro (2023). Our results are similar to the ones obtained by them (i.e. an increase in the policy rate leads to a temporary increase in the wage share).

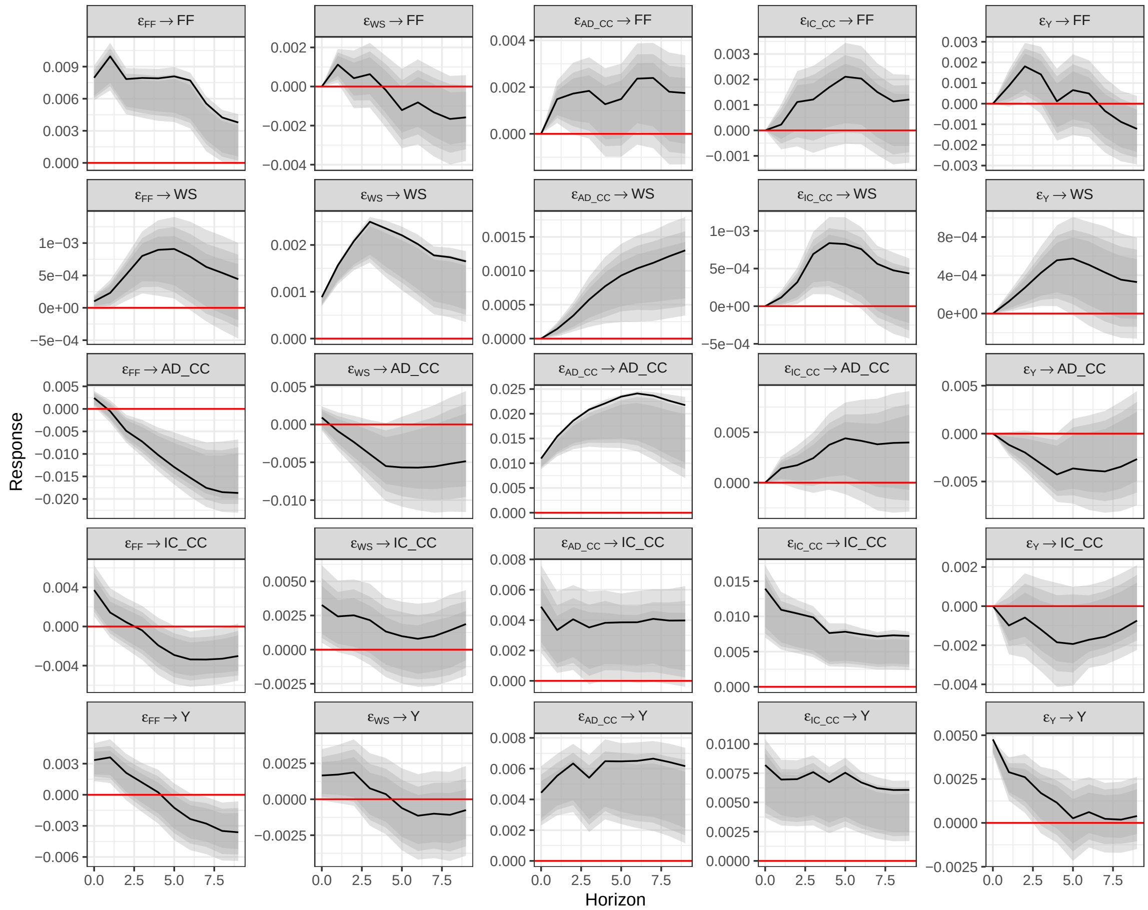


Figure 2: **Impulse Response Functions (IRFs), Model 1:** Figures display IRFs of FF, WS, AD_CC, IC_CC, and Y to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{AD_CC}). Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

Beyond these results for our first model, a few robustness checks can be found in Appendix (B). We find that the negative and statistically significant effect of interest rates on autonomous demand and, therefore, output is kept throughout all of our robustness check estimations. The same thing can be said for the positive, and statistically significant, effect of autonomous demand - here defined as the sum of residential investment and consumer credit - on output. Another interesting result that seems to hold in most robustness checks has been the positive effect of the federal funds rate on the adjusted wage-share. More specifically, once the wage-share is broken down into labor productivity and real wage rate we find that the federal funds rate has a negative, persistent and statistically significant effect on both of these variables, which then translates into an overall positive effect on the wage-share.

Figure (3) displays IRFs of interest rate (FF), wage share (WS), private residential investment (RES), consumer credit (CC), induced consumption net of consumer-credit (IC_CC), and output (Y) to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{RES} and ε_{CC}). First, a positive shock in the federal funds rate (ε_{FF}) leads to a negative, persistent and statistically significant effect in private residential investment (RES), consumer-credit (CC), induced consumption (IC_CC) and output (Y). It is worth stressing that the magnitude of the effect of a shock in the interest rate is much bigger on private residential investment when compared to the other variables considered. This, in fact, confirms that the real estate sector is one of the main channels through which monetary policy affects economic activity, in line with recent empirical literature (see, among others, Deleidi 2018; Barbieri Góes and Deleidi, 2022; Barbieri Góes 2023).

Second, a positive shock in the adjusted wage share (ε_{WS}) has a persistent negative effect (statistically significant at the 68% level) on consumer credit (CC), and a positive and short vivid effect on induced consumption net of consumer credit (IC_CC) and output (Y). Third, a positive shock in private residential investment (ε_{RES}) has a positive, persistent and statistically significant effect on consumer credit (CC), output (Y) as well as on the adjusted wage share (WS). However, a positive shock in consumer credit (ε_{CC}) has only a very short-run effect on output (Y) and does not trigger private residential investment (RES).

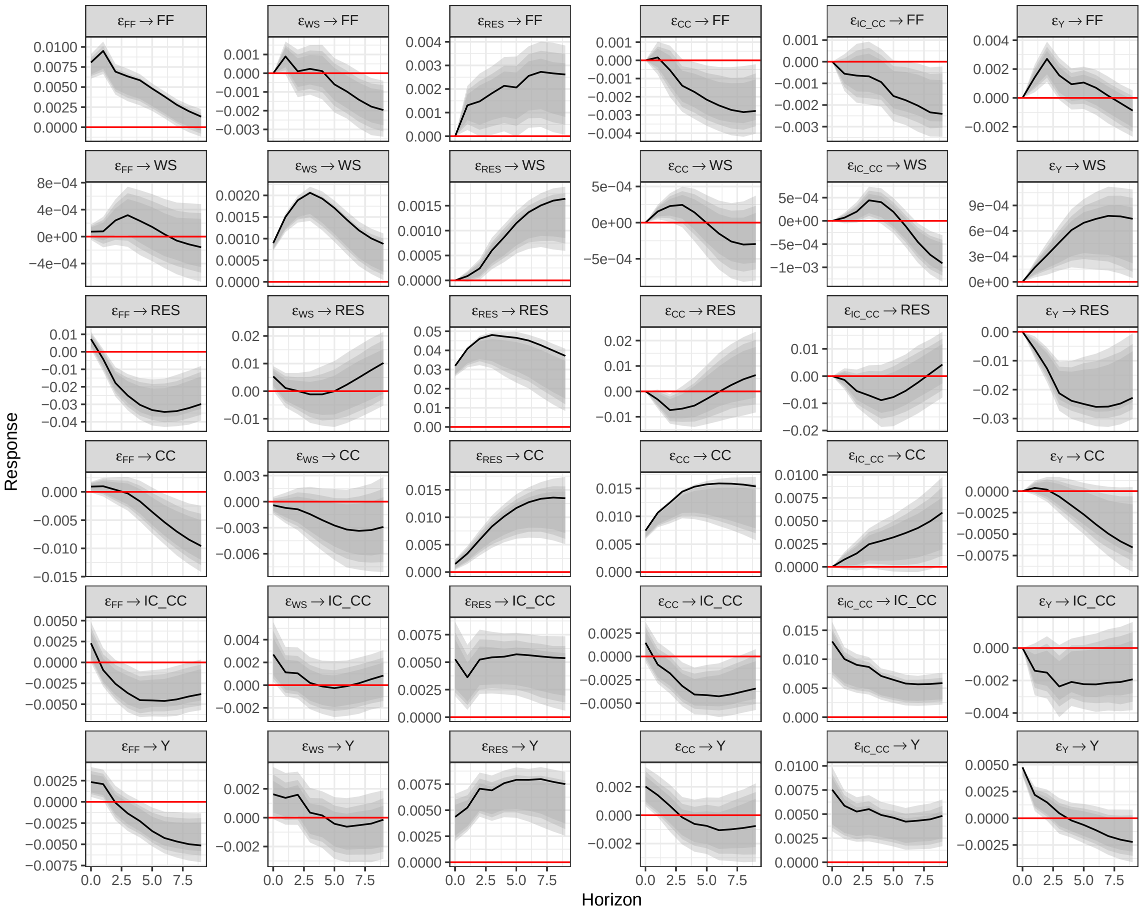


Figure 3: **Impulse Response Functions (IRFs), Model 2:** Figures display IRFs of FF, WS, RES, CC, IC_CC, and Y to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{RES}, ε_{CC}). Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

Figure (4) displays IRFs of interest rate (FF), wage share (WS), autonomous demand (AD_DC)[14], induced consumption of non-durable goods and services (IC_DC), and output (Y) to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{AD_DC}). First, a positive shock in the policy rate (ε_{FF}) has a negative persistent and statistically significant effect in autonomous demand (AD_DC), consumption of non-durable goods and services (IC_DC), and thus on output (Y).

[14]As emphasized in Table 1, this autonomous demand is calculated as the sum of residential investment and the consumption of durable goods.

Second, a positive shock in the wage share (ε_{WS}) has a negative (statistically significant for 5 quarters) effect in autonomous demand (AD_DC) and in output (Y). Third, a positive shock in autonomous demand (ε_{AD_DC}) has a positive, persistent and statistically significant effect in the wage share (WS), consumption (IC_DC), and output (Y). Lastly, a positive shock in non-durable goods and services consumption has a transitory positive effect in the wage share and a transitory positive effect (statistically significant for 6 quarters) in output (Y).

It is interesting to observe at this point that a few parallels can be drawn with figure 2. While the effect of the interest rate shock on autonomous demand seems to be the same, and, therefore, independent of how we define autonomous demand, the same cannot be said for the shocks on income distribution. If first, we could not find a significant effect of a shock of income distribution on autonomous demand when we had defined it as the sum of residential investment to consumer credit, now we have been able to capture a negative, and statistically significant, effect of wage share on autonomous demand (when defined as residential investment plus consumption of durable goods), as well as on output.

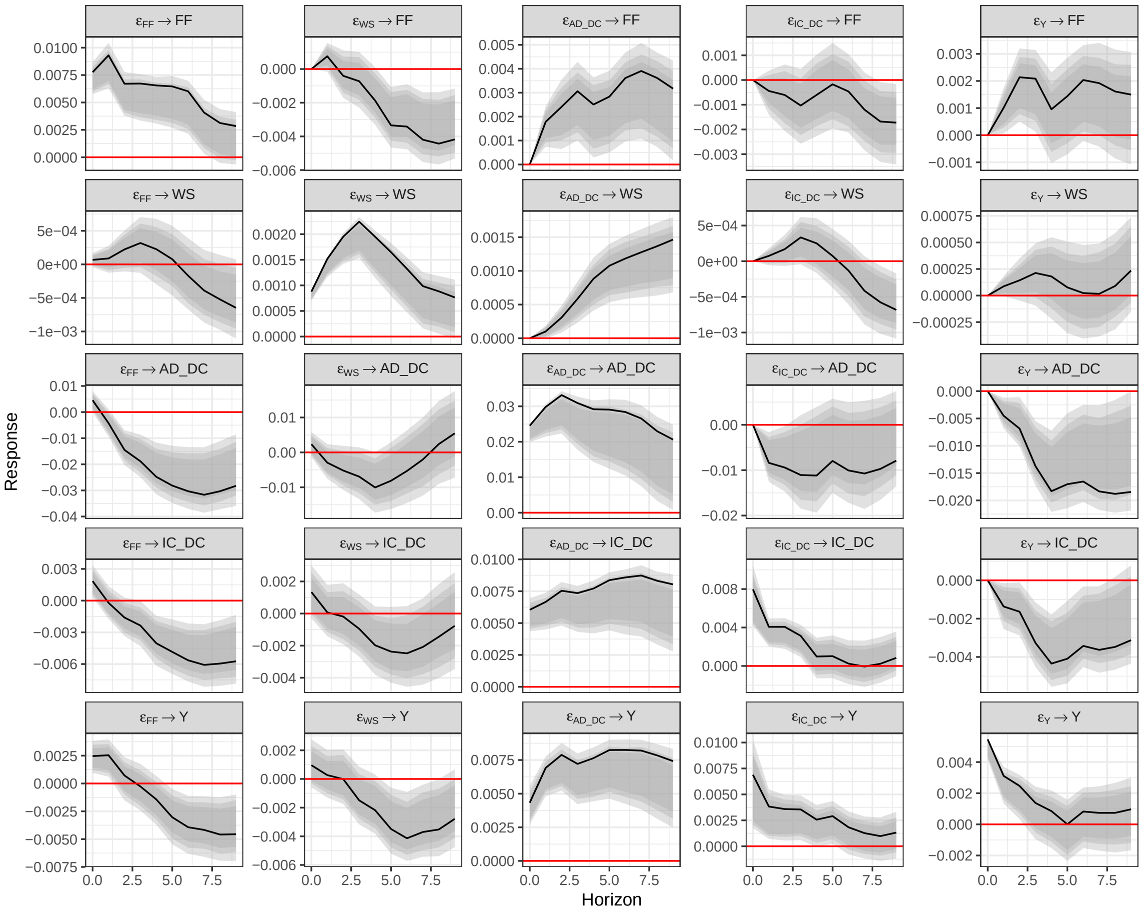


Figure 4: **Impulse Response Functions (IRFs), Model 3:** Figures display IRFs of FF, WS, AD_DC, IC_DC, and Y to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{AD_DC}). Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

Figure (5) displays IRFs of interest rate (FF), wage share (WS), private residential investment (RES), durable-goods consumption (DC), induced consumption of non-durable goods and services (IC_DC), and output (Y) to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{RES} and ε_{DC}).

First, a positive shock in the federal funds rate (ε_{FF}) leads to a negative, persistent and statistically significant effect in private residential investment (RES), durable consumption (DC), non-durable consumption of goods and services, and thus output (Y). Again the magnitude of the response of private residential investment to a shock in the policy rate is bigger when compared to the other variables. Second, a positive shock in the adjusted wage share (ε_{WS}) has a short vivid positive effect on consumption of non-durable goods and services (IC_DC) and output (Y), as well as a short vivid negative effect on residential investment (RES) and the consumption of durable goods (DC).

Third, a positive shock in private residential investment (ε_{RES}) has positive, persistent and statistically significant effects on durable consumption (DC), consumption of non-durable goods and services (IC_DC), and output (Y). Fourth, a positive shock in durable consumption (ε_{DC}) has no effect on private residential investment (RES) and positive and statistically significant effects on consumption of non-durable goods and services (IC_DC) and output (Y).[15]

Once again, a few parallels can be drawn with figure 3. We seem to have found an indication that autonomous consumption, independently of whether we define it to be consumer credit or durable consumption, seems to be affected by residential investment, and not the other way around. Furthermore, both residential investment and autonomous consumption seem to have an effect on induced consumption and output.

[15]The effect on output is statistically significant in the first 6 quarters.

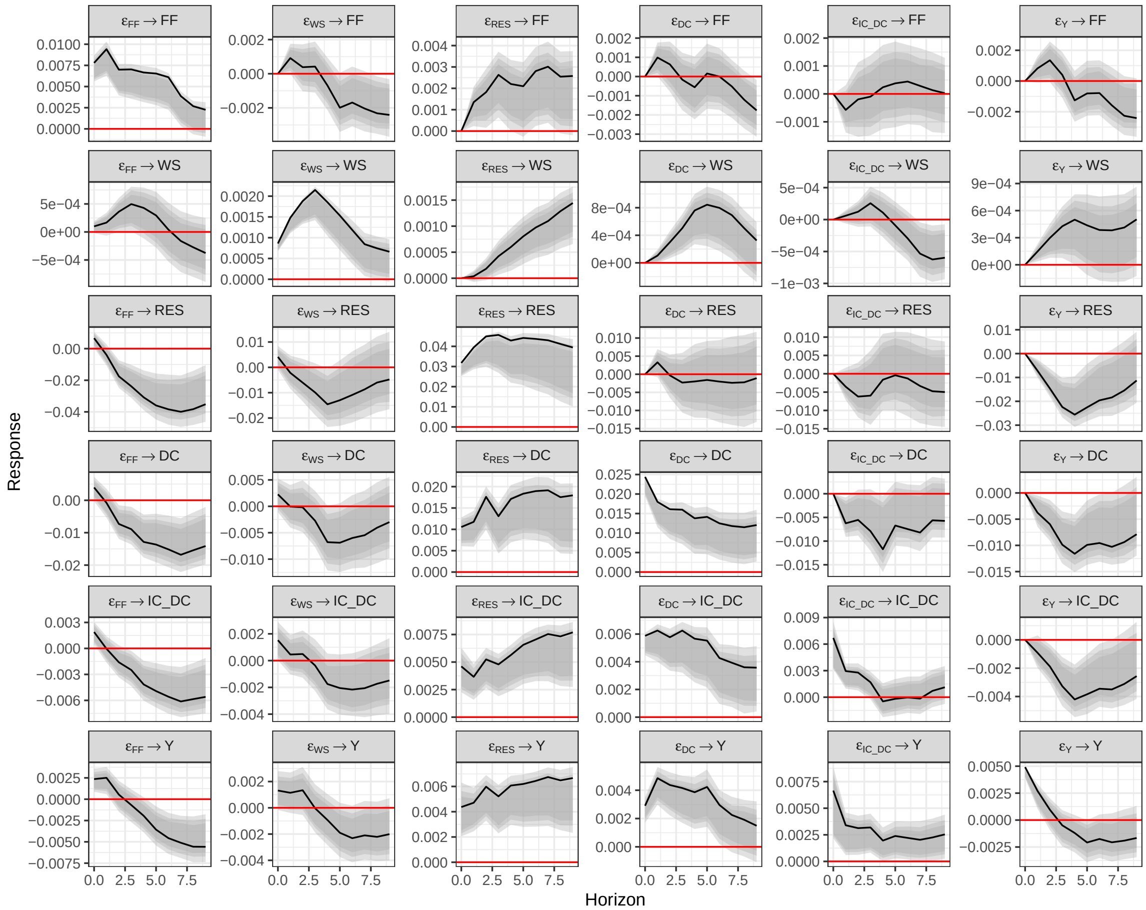


Figure 5: **Impulse Response Functions (IRFs), Model 4:** Figures display IRFs of FF, WS, RES, DC, IC_DC, and Y to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{RES}, ε_{DC}). Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

Figure (6) displays IRFs of interest rate (FF), wage share (WS), private residential investment (RES), non-revolving consumer credit ($NRCC$), revolving consumer credit (RCC), induced consumption net of consumer credit (IC_CC), and output (Y) to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{RES}, ε_{NRCC}, and ε_{RCC}).

First, we find that, once again, shocks in the monetary policy has negative and statistically significant effects on all of the components of our autonomous demand (RES, $NRCC$, and RCC). This is a similar result to what we had found in figures 2 and 3. However, differently from these initial results we now have income distribution having a negative, and statistically significant effect, on the non-revolving consumer credit component of autonomous demand. Secondly, we also observe that while residential investment positively affects the other two components of autonomous demand, as well as output, the inverse cannot be said. Non-revolving consumer credit negatively affects only the revolving consumer credit, while revolving consumer credit has a slightly positive effects on non-revolving.

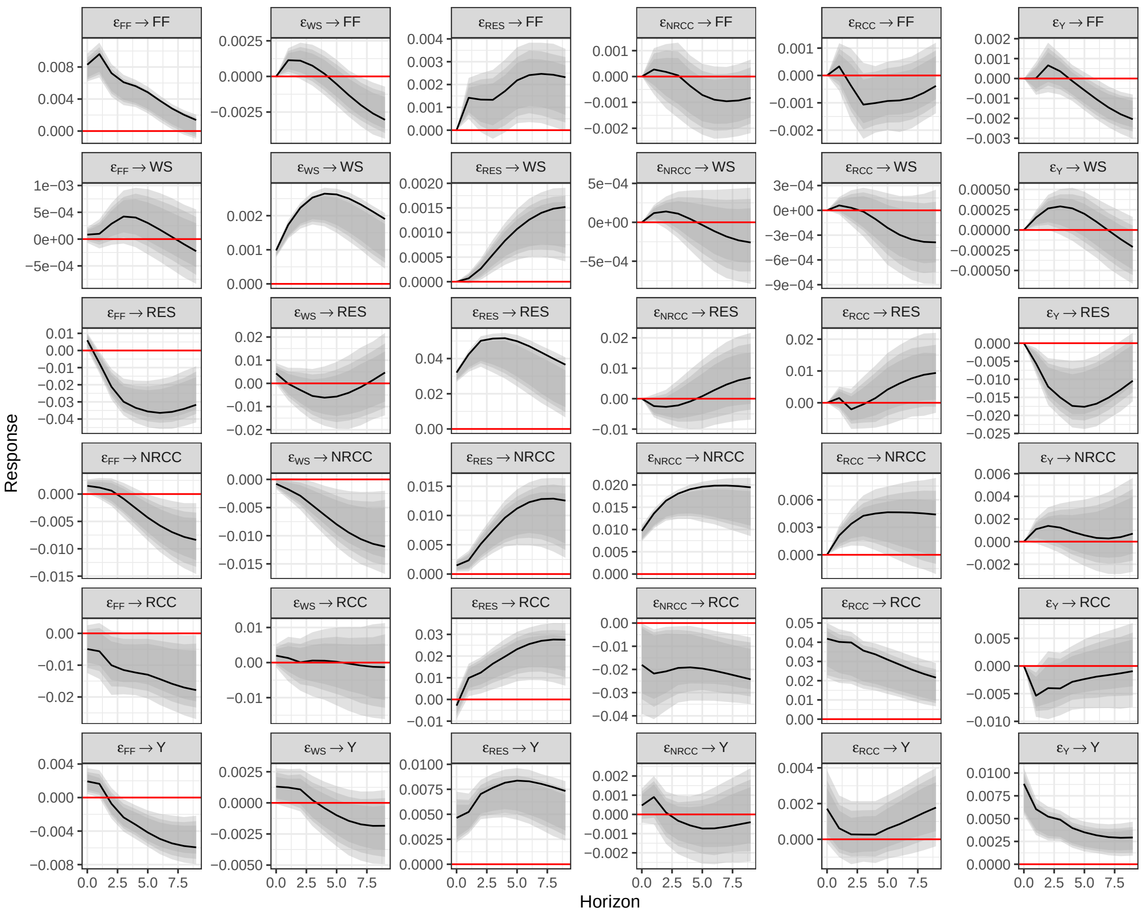


Figure 6: **Impulse Response Functions (IRFs), Model 5:** Figures display IRFs of FF, WS, RES, $NRCC$, RCC, IC_CC, and Y to monetary policy (ε_{FF}), distribution (ε_{WS}) and autonomous demand shocks (ε_{RES}, ε_{NRCC}, ε_{RCC}). Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

Finally, Figure (7) displays IRFs of interest rate (FF), wage share (WS), house prices (HP), private residential investment (RES), home equity lines of credit ($HELOC$), and output (Y) to monetary policy (ε_{FF}), distribution (ε_{WS}), house prices (ε_{HP}), and autonomous demand shocks (ε_{RES} and ε_{HELOC}). It is important to emphasize that while all of the previous models were estimated using data from 1968 Q1 to 2022 Q2 for this model we have decided to sub-sample our data and work with observations only from 1968 Q1 to 2007 Q1. Following the results found in the robustness checks for structural breaks in our first model estimation, we decided to sub-sample our observations for this estimation given the instability in home equity lines data after the 2008 financial crisis.

We observe that, as expected, monetary policy has a negative, persistent and statistically significant effect on house prices, residential investment, as well as on home equity loans. However, this does not seem to translate into a statistically significant effect on output. It is also interesting to observe that the increase in the interest rate seems to have that same positive statistically significant effect on wage share, which was also estimated in figures 2 and 5. Moreover, when accounting for changes both in interest rates, the wage-share does not seem to have a statistically significant effect on any of our variables under study. House prices seem to have a positive, persistent and statistically significant effect on residential investment, home equity loans and total output. Finally, residential investment seems to have a small negative, transitory effect on HELOCS, as well as a positive, persistent and statistically significant effect on output, which was already captured in previous estimations.

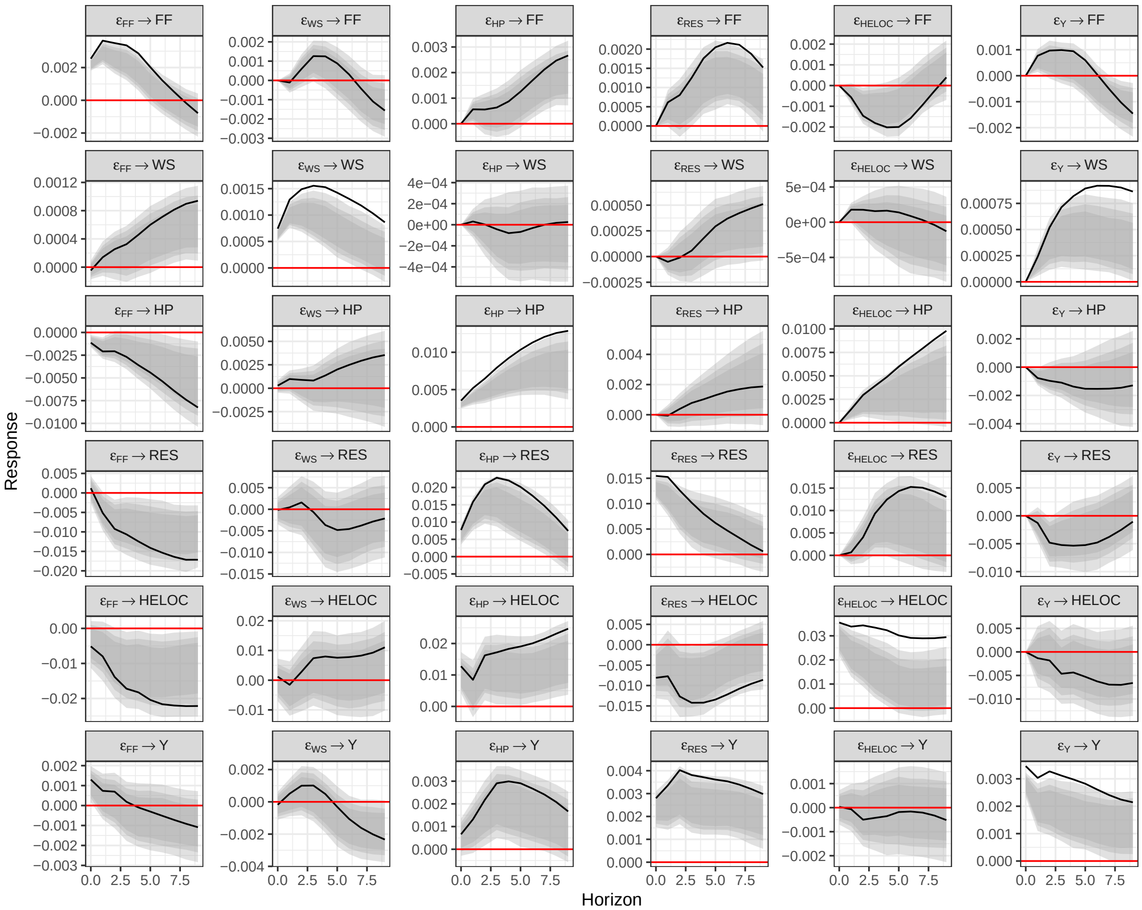


Figure 7: **Impulse Response Functions (IRFs), Model 6:** Figures display IRFs of FF, WS, HP, RES, $HELOC$ and Y to monetary policy (ε_{FF}), distribution (ε_{WS}) and house prices shocks (ε_{HP}). Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

5 Conclusion

In light of the recently revived debate on the exogeneity of autonomous demand components in demand-led models (Serrano et al., 2022), a discussion on the role played by distribution has gained momentum within the theoretical and empirical literature (Avritzer and Brochier, 2022; Morlin and Pariboni, 2022). This paper contributes to this debate by empirically exploring the effects that changes in monetary policy and in functional income distribution have in autonomous demand components, and, therefore, on output. Specifically, we empirically assess theoretical connections suggested in the contribution by Avritzer and Brochier (2022) between a semi-autonomous house-

hold credit-financed demand component and the financial and income distribution variables.
To this purpose we estimate five different SVAR models relying on US quarterly data for the period 1968-2022. In particular, we explore the possibility of autonomous demand being defined by residential investment added to consumer credit, or added to durable goods consumption, as well as the connections between these two components. Further estimations also explored the connections between monetary policy and income distribution with further division of consumer credit into revolving and non-revolving consumer credit, as well as home equity lines of credit (HELOCs) and their connections to residential investment, and, therefore, autonomous demand.
Our findings suggest that, first of all, contractionary monetary policy has a negative and statistically significant effect on autonomous expenditure, be it defined as residential investment added to consumer credit or to durable goods consumption. This first results is furthermore in line with other recent empirical literature for the United States economy. Secondly, we find that a positive shock on income distribution seems to have some negative effect on autonomous consumption - when defined as durable consumption or non-revolving consumer credit - and output. However, this last effect is measured to be transitory. Although the results are unclear when considering the effects of income distribution on private residential investment, we have been able to capture an effect of the federal funds rate on income distribution. More precisely, we have estimated that a contractionary monetary policy has a negative and statistically significant effect on both the real wage rate and on labor productivity, which results in the overall positive effect on wage-share captured in figures 2 and 5.
Similar to other results of the supermuliplier literature, we have also found that a positive shock in overall autonomous consumption has a lasting and statistically significant impact on consumption, output, and the adjusted wage share. We also show that a positive shock in private residential investment has positive, persistent and statistically significant effects on other autonomous components of demand and output. Furthermore, although residential investment positively influences consumer credit, the reverse is not true, even when we look into home equity lines of credit. Finally, when house prices and home equity loans are incorporated into our estimations, we estimate a negative effect of an increase in the federal funds rate on both of these variables. Here again, we find that residential investment will have an effect on output, however, we have not been able to estimate a statistically significant effect of residential investment on home equity loans, which, in our estimations seem to only be affected by changes in the federal funds rate, as well as home prices.
In conclusion, we have found interesting empirical evidences for the recent developments of the semi-autonomous demand hypothesis under a supermultiplier theory. We have found that when defining autonomous demand as the result of residential investment and credit financed consumption there is statistical evidence to further explore models which would incorporate monetary policy

and income distribution as variable that could be explaining the behavior of this so-called semi-autonomous components of demand. Furthermore, we have also found some empirical evidence that some components of demand might be more autonomous than others, as seems to be here the case for residential investment. Finally, it is important to mention that this paper is a first exploration to many of these questions and still leaves some questions for further exploration, specially on the connections between monetary policy and income distribution, which seems to also be an emerging field of theoretical contributions in the supermultiplier literature.

A Data Sources

Acronyms	Description	Source
FF	Federal Funds Rate	Federal Reserve Bank of St. Louis.
	Quarterly Data	Available at: https://bit.ly/2VbSDcv
WS	Adjusted Wage Share	AMECO Database.
	Seasonally Adjusted, Quarterly Data	Available at: http://bit.ly/3JFww7z
HP	Nominal House Prices	OECD Data.
	Price Index, Quarterly Data	Available at: https://bit.ly/3F2ZMlN
RW	Hourly Compensation[f]	Bureau of Labor Statistics, OPT Data.
	Index, Seasonally Adjusted, Quarterly Data	Available at: https://bit.ly/46Ixeda
$PROD$	Labor Productivity	Bureau of Labor Statistics, OPT Data.
	Index, Seasonally Adjusted, Quarterly Data	Available at: https://bit.ly/46Ixeda
RES	Gross Private Residential Domestic Investment	Bureau of Economic Analysis, NIPA Table 1.1.5.
	Billions of US Dollars, Seasonally Adjusted, Quarterly Data [a]	Available at: https://bit.ly/34Dl0sj
CC	Total Consumer Credit Owned and Securitized	Board of Governors of the Federal Reserve System, Table G.19.
	Billions of US Dollars, Seasonally Adjusted, Monthly Data [b]	Available at: http://bit.ly/3KHgRp0
$NRCC$	Non-revolving consumer credit	Board of Governors of the Federal Reserve System, Table G.19.
	Billions of US Dollars, Seasonally Adjusted, Monthly Data [b]	Available at: http://bit.ly/3KHgRp0
RCC	Revolving consumer credit	Board of Governors of the Federal Reserve System, Table G.19.
	Billions of US Dollars, Seasonally Adjusted, Monthly Data [b]	Available at: http://bit.ly/3KHgRp0
$HELOC$	Revolving Home Equity Loans, All Commercial Banks	Board of Governors of the Federal Reserve System, Table H.8.
	Billions of US Dollars, Seasonally Adjusted, Weekly Data[b]	Available at: https://bit.ly/46eQ4Zo
DC	Total consumption expenditure of durable goods and services	Bureau of Economic Analysis, NIPA Table 1.1.5.
	Billions of US Dollars, Seasonally Adjusted, Quarterly Data [c]	Available at: https://bit.ly/34Dl0sj
IC_CC	Personal Consumption Expenditures of goods and services net of CC	Bureau of Economic Analysis, NIPA Table 1.1.5.
	Billions of US Dollars, Seasonally Adjusted, Quarterly Data [b]	Available at: https://bit.ly/34Dl0sj
IC_DC	Total consumption expenditure of non-durable goods and services	Bureau of Economic Analysis, NIPA Table 1.1.5.
	Billions of US Dollars, Seasonally Adjusted, Quarterly Data [d]	Available at: https://bit.ly/34Dl0sj
AD_CC	Autonomous Demand	
	$(RES\_CC = RES + CC)$	
AD_DC	Autonomous Demand	
	$(RES\_DC = RES + DC)$	
Y	Gross Domestic Product in Billions of Dollars	Bureau of Economic Analysis, NIPA Table 1.1.5;
	Seasonally Adjusted, Quarterly Data [e]	Available at: https://bit.ly/34Dl0sj

[a]Deflated using the Implicit Price Deflator for Gross Private Residential Domestic Investment, Seasonally Adjusted,

[b]Deflated using the Implicit Price Deflator for Total consumption expenditures of goods and services, Seasonally Adjusted,

[c]Deflated using the Implicit Price Deflator for Total consumption expenditure of durable goods and services, Seasonally Adjusted,

[d]Deflated using the Implicit Price Deflator for Total consumption expenditure of non-durable goods and services, Seasonally Adjusted,

[e]Deflated using the Implicit Price Deflator for Gross Domestic Product, Seasonally Adjusted,

NOTE: All price deflators above are Quarterly Data, from Bureau of Economic Analysis, NIPA Table 1.1.9., available at: https://bit.ly/2z6230N

[f]Deflated using the Consumer Price Deflator from Bureau of Labor Statistics, Office of Productivity and Technology;

Table 1: Variables used in the Empirical Model presented in Section (3): Acronyms, Descriptions and Data Sources

B IRFs Robustness checks

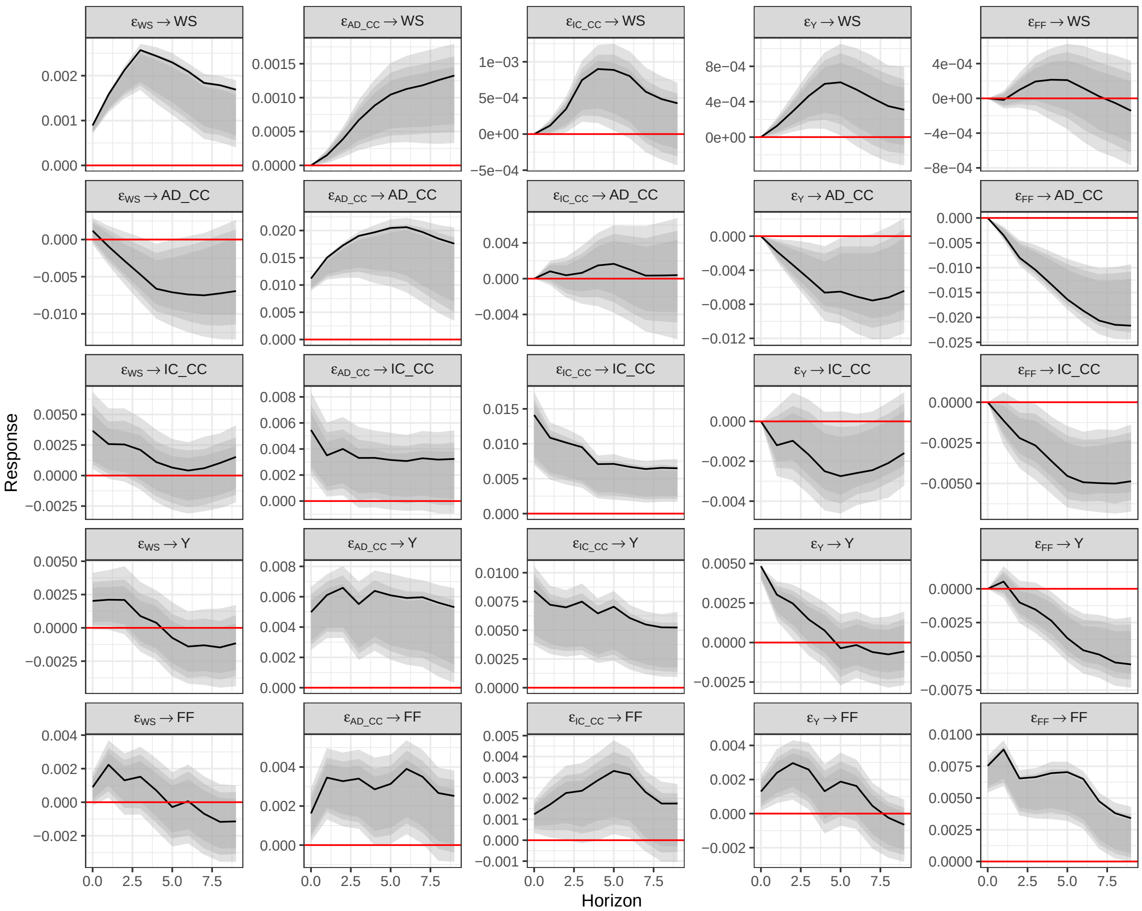


Figure 8: **Impulse Response Functions (IRFs), Model 1 Taylor Rule:** Figures display IRFs of WS, AD_CC, C, Y, and FF to distribution (ε_{WS}), autonomous demand (ε_{AD_CC}), and monetary policy (ε_{FF}) shocks. Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

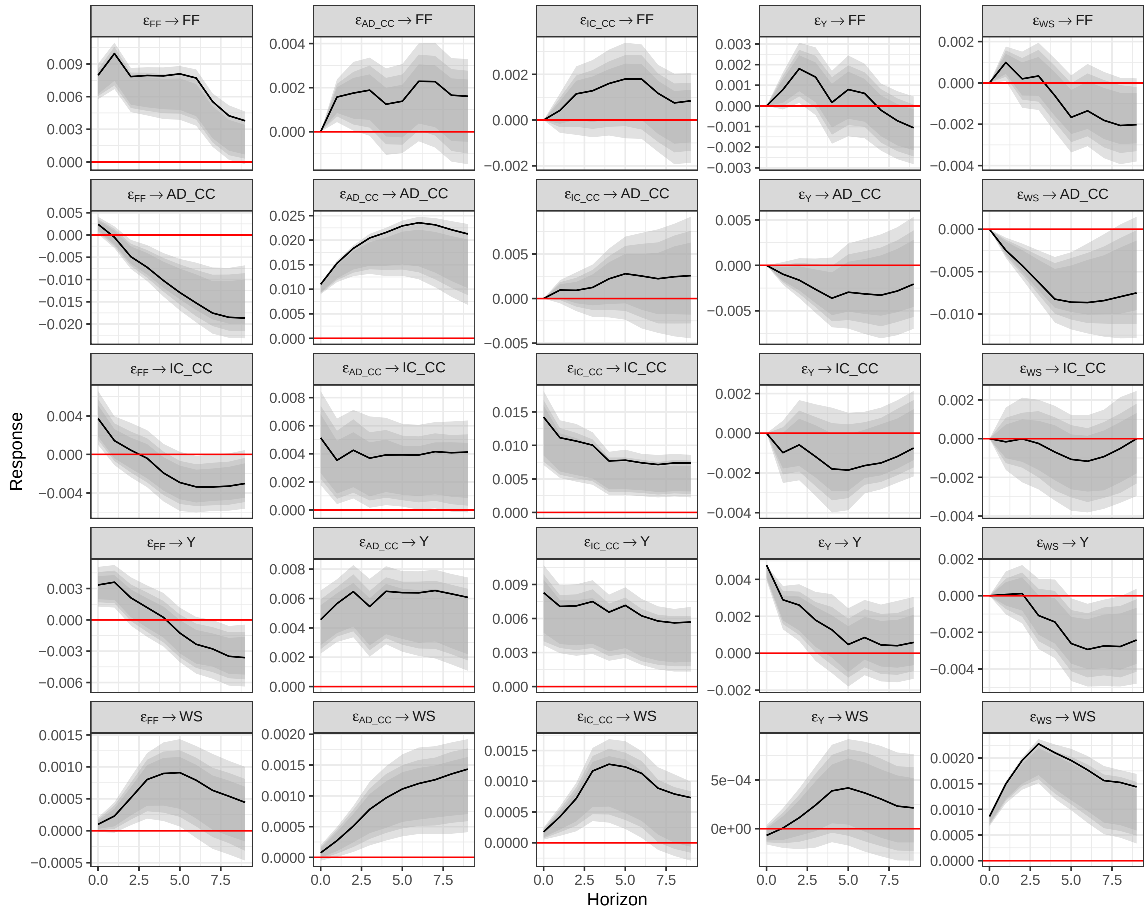


Figure 9: **Impulse Response Functions (IRFs), Model 1 Endogenous Distribution:** Figures display IRFs of FF, AD_CC, C, Y, and WS to monetary policy (ε_{FF}), autonomous demand (ε_{AD_CC}), and distribution (ε_{WS}) shocks. Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

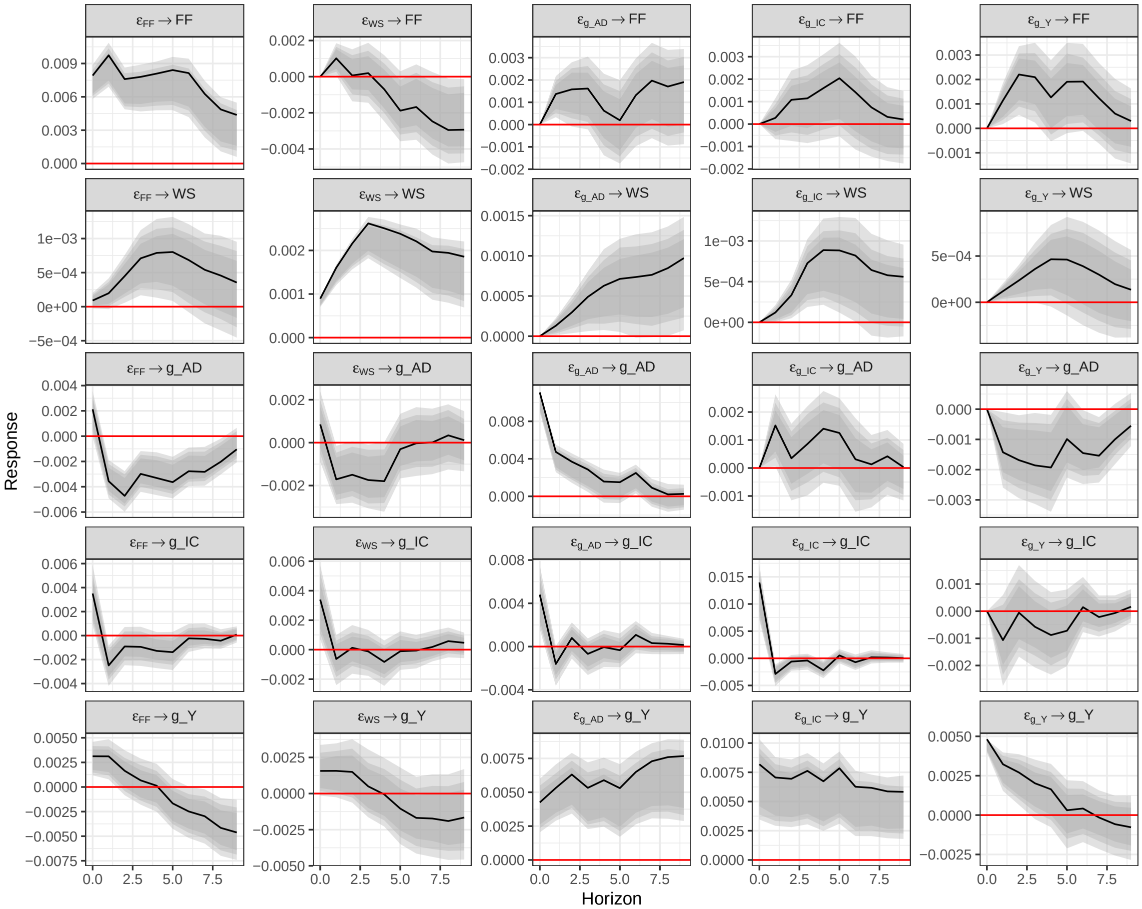


Figure 10: **Impulse Response Functions (IRFs), Model 1 Growth Rates:** Figures display changes in FF, WS, g_AD, g_IC, and g_Y to monetary policy (ε_{FF}), distribution (ε_{WS}), and growth of autonomous demand (ε_{g_AD}) shocks. Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

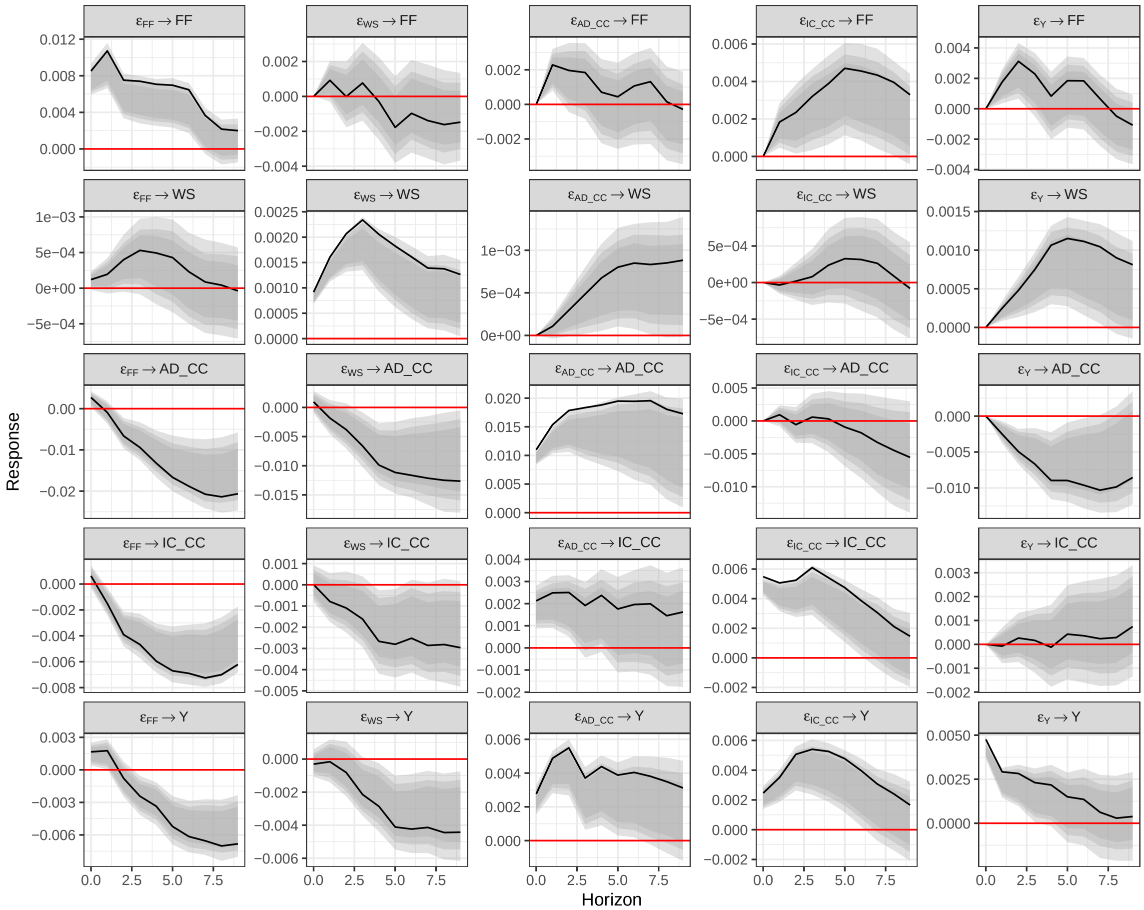


Figure 11: **Impulse Response Functions (IRFs), Model 1 Before Structural Break:** Using data from 1968Q1 to 2007Q1, figures display changes in FF, WS, AD_CC, IC_CC, and Y to monetary policy (ε_{FF}), distribution (ε_{WS}), and growth of autonomous demand ($\varepsilon_{AD\_}$) shocks for the data between the second quarter of 1968 and the first quarter of 2007. Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

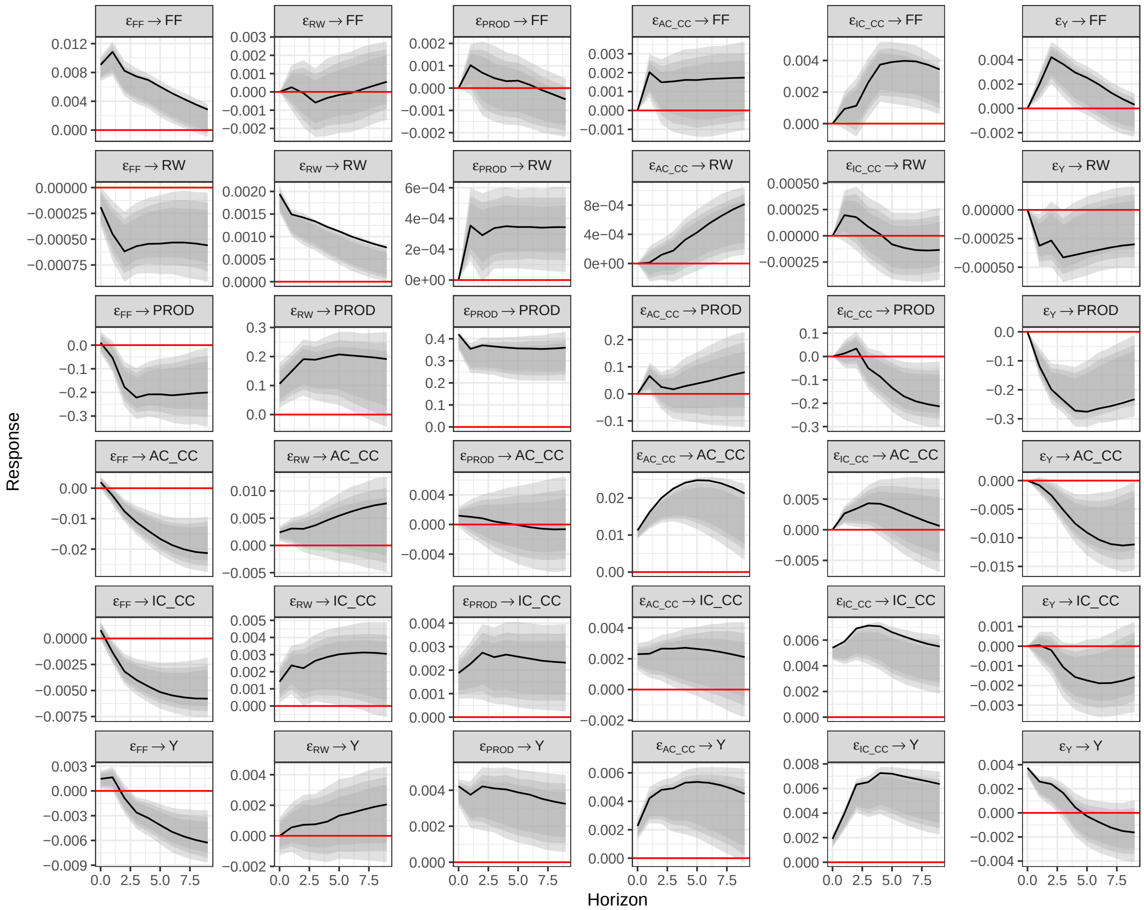


Figure 12: **Impulse Response Functions (IRFs), Model 1 Productivity and Real Wage Growth:** Figures display changes in FF, RW, $PROD$, AC_CC, IC_CC, and Y to monetary policy (ε_{FF}), real wage (ε_{RW}), and productivity (ε_{PROD}) shocks. Quarters on x-axis. Shaded grey areas denote 95%, 90%, and 84% confidence bands calculated through m.b. bootstrapping (1000 runs).

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