Autonomous Demand and Output Determination: an Empirical Investigation for the US Economy

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Abstract

This paper aims to assess the supermultiplier model by estimating the multiplier effects associated with the autonomous components of demand, namely autonomous consumption, public expenditure and exports. To do this, we use Structural VAR modelling on US quarterly data for the period 1954-2020. Our findings suggest that an expansion in autonomous demand and its components produces persistent and long-lasting effects on the output level and the estimated multipliers are larger than one. Our analysis also shows that monetary policy affects the output level passing through autonomous expenditures, in particular residential investment and consumer credit.

Keywords: Supermultiplier; Autonomous Demand; Multipliers; SVAR; US
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1 Introduction

In the aftermath of the Great Recession triggered by the collapse of the US American sub-prime market, the debate on 'secular stagnation' and the need to find adequate policy responses to boost recovery in most advanced economies have gained relevance (Summers, 2015; Gordon, 2015). Whereas supply-side approaches to secular stagnation focus on the role played by productivity and population dynamics in explaining lower growth (Gordon, 2015), demand-side stagnation approaches advocate for the implementation of expansionary fiscal policies as one of the main tools to boost economic recovery, especially in a context of ineffectiveness of monetary policy constrained at the zero-lower bound (DeLong et al., 2012; Summers, 2015).[1] Similarly, the IMF and his former chief economist Olivier Blanchard asserted the importance of using fiscal stimulus as a tool to reinvigorate economic growth, counter adverse macroeconomic shocks, and create jobs (Blanchard and Leigh, 2013; IMF, 2020). In line with this perspective, recent studies have shown that fiscal consolidation produces permanent and long-term negative effects on potential output (Ball, 2014; Fatás and Summers, 2018) through a mechanism termed 'hysteresis' (Yellen, 2016; Blanchard et al., 2015).

The key role played by demand in leading growth is no novelty, especially in the Post-Keynesian tradition and, more specifically, in demand-led growth models (Lavoie, 2014). A debate focused on the role played by autonomous demand components in macroeconomic models has recently gained momentum with the advent of contributions from different Post-Keynesian theoretical backgrounds (Allain, 2015; Lavoie, 2016; Fiebiger and Lavoie, 2019; Palley, 2019; Fazzari et al., 2020; Deleidi and Mazzucato, 2019, 2021; Nomaler et al., 2020). These contributions highlight the role of autonomous components of demand in shaping the growth rate of output and productive capacity, following the intuition developed in the Sraffian Supermultiplier model (Serrano, 1995). Because a permanent increase in autonomous components of demand generates persistent and positive effects on output, this model is also able to provide an explanation for hysteresis. While in the short run firms increase capacity utilization to meet a higher level of demand, in the long run firms adjust their capacity to the level of demand by raising investment.

Based on these premises, this paper aims to assess the Supermultiplier Model by estimating the multipliers associated with autonomous components of demand, also evaluating the persistent effects that an expansion in demand may produce on the output level. For this purpose, we use Structural Vector Autoregressive (SVAR) models on US quarterly data for the period 1954-2020. We rely on a vast literature inaugurated by Sims (1980), and extensively applied in empirical macroeconomics from different theoretical backgrounds, to assess the macroeconomic effects of fiscal and monetary policy shocks (see, among others, Bernanke and Gertler, 1995; Blanchard and Perotti, 2002).[2] Through the use of SVAR models, we are able to identify exogenous autonomous demand and monetary policy shocks. To do this, we employ a recursive identification strategy, based on a standard Cholesky decomposition, which is commonly used in the literature to isolate both fiscal and monetary policy shocks (e.g., Christiano et al., 1999; Galí et al., 2007; Bachmann and Sims, 2012). The novelties of this paper are threefold: (i) assess the multiplier effects associated with autonomous demand and its components; (ii) shed light on the transmission channels of monetary policy; (iii) evaluate the

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[1] For an in-depth review of the secular stagnation debate and an alternative approach see, among others, Di Bucchianico (2020) and Nishi and Stockhammer (2020).

[2] See Ramey (2016) and Kilian and Lütkepohl (2017) for a detailed review.

impact of pure demand shocks. Our findings suggest that an expansion in autonomous demand and its components produces persistent effects on the output level by also showing multipliers larger than one. These results restate the case for positive hysteresis (Girardi et al., 2020), and contribute to the recent debate on the topic (e.g., Blanchard et al. 2015; Fatás and Summers , 2018). In addition, our analysis shows that monetary policy affects the output level indirectly through autonomous expenditures.

The remainder of this paper is organized as follows. Section (2) reviews both the literature on the Sraffian Supermultiplier Model and the empirical literature that investigates the effect of demand components on the output level. In Section (3), we present both the data and methods employed. In Section (4), we report the empirical findings of the estimated models, by reporting elasticisticities, cumulative multipliers, and forecast error variance decomposition. Furthermore, following Perotti (2005), we report findings of cumulative multipliers associated with pure shocks. The robustness check is performed in Section (5), where we study the stability across time of the effects of autonomous demand shocks through the estimation of our models in four different sub-samples specifications. Section (6) concludes by drawing some policy implications.

2 The Role of Autonomous Demand: A Theoretical and Empirical Overview

This Section revises the literature on the Sraffian Supermultiplier Model (SSM henceforth), presenting its baseline version and discussing the role and nature of autonomous demand components, as well as the empirical literature that assesses the effect of demand on the output level.[3]

The SSM was theoretically developed by Serrano (1995), who borrowed the notion of ‘supermultiplier’ - as an expanded version of the Keynesian multiplier - from Hicks (1950). Several authors further developed the SSM approach thereafter (Bortis, 1997; Cesaratto et al., 2003; Cesaratto, 2015; Freitas and Serrano, 2015; Serrano and Freitas, 2017), engaging in the debate on the determination of long-run trends of output growth rather than of short-run cycles. In the SSM, trend growth rates of output and of productive capacity are shaped by the growth rate of autonomous demand through a combination of multiplier and accelerator effects. More recently, the stagnant growth experienced by most advanced economies has revived the literature on demand-led growth. The SSM approach has gained momentum in the international debate with the advent of contributions from different theoretical backgrounds (see, among others, Allain, 2015; Lavoie, 2016; Palley, 2019; Fazzari et al., 2020; Deleidi and Mazzucato, 2019, 2021; Nomaler et al., 2020).

The main contribution of the SSM is twofold: (i) to extend the so-called ‘Keynesian hypothesis’ to the long run, i.e. the idea of savings as determined by investment decisions also in the long run (Garegnani, 1992); (ii) to introduce the notion of autonomous components of demand in a model that does not produce Harrodian instability[4] and which combines the standard Keynesian multiplier effect with an investment function based on the flexible accelerator principle. In this sense, the SSM blends

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[3] In this section we present the main version of the SSM inspired by its original formulation. In doing so, we do not wish to oppose this model to any other formulation inspired by Kaleckian, Harrodian, and Schumpeterian traditions. On the contrary, we wish to stress the points of agreement between these strands, particularly related to the study of the role of autonomous components of demand in output determination.

[4] For a review of the static and local dynamic stability conditions of the SSM, see Freitas and Serrano (2015) and Lavoie (2016). For a mathematical and theoretical discussion on how the flexible accelerator principle is a necessary and sufficient condition that tames the Harrodian instability on the SSM, see Serrano et al. (2019).

at the micro level the prevalence of normal prices and planned capacities (in the long period), with an exogenously given income distribution that is determined from outside the system.

Before presenting the baseline version of the model, a proper clarification of the notion of autonomous components of demand is in order. On theoretical grounds, autonomous expenditures are defined as those components that are not financed by contractual incomes nor are able to affect productive capacities (Serrano, 1995). In other words, they comprise non-capacity creating potential discretionary and autonomous injection of purchasing power in the economy (Cesaratto et al., 2003). These expenditures include: (i) government expenditures, which are determined by policy decisions; (ii) exports, which depend on the level of foreign demand; (iii) autonomous consumption, which is financed in the credit market via either an endogenous money creation process or accumulated wealth. In this article, we accept the term 'semi-autonomous components' first introduced by Kalecki (1968) and then borrowed by Fiebiger and Lavoie (2019). In doing so, we agree with the notion that these components are not necessarily constant, not even on average. Moreover, despite arguing that they are independent from the current level of income, we do not wish to interpret them as 'manna from heaven'. Indeed, we are aware that these variables may be affected by other macroeconomic variables. For instance, labour productivity and innovation may affect net exports, and monetary policy could exert a certain influence on both the volume of credit borrowed by households (Pariboni, 2016; Deleidi, 2018; Deleidi and Mazzucato, 2019) and exchange rates, which in turn would affect the external competitiveness of a country (Deleidi and Mazzucato, 2019).

A basic version of the model is presented in what follows. Assuming an open economy with government sector, the output is defined by the sum of total consumption (C_t), investment (I_t), public expenditure (G_t) and net exports ($X_t - M_t$), as in equation (1):

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

Total consumption (2) is defined as the sum of induced consumption out of disposable income (C_t^y) and autonomous consumption ($\overline{C_t^a}$).

$$C_t = C_t^y + \overline{C_t^a} \tag{2}$$

As shown in equation (3), the induced component (C_t^y) is dependent on the current level of income where c indicates the marginal propensity to consume ($0 < c \leq 1$).

$$C_t^y = cY_t \tag{3}$$

Equation (4) accounts for the total amount of autonomous consumption, which is negatively impacted by the exogenously determined interest rate ($\overline{FF}$). This is in line with the Horizontalist Endogenous Money approach[5], according to which the volume of money is endogenously determined by commercial banks' lending activities and the interest rate set by the central bank. Previous contributions have discussed the inclusion of bank lending policy affecting autonomous consumption and exports in the SSM framework in a similar fashion (Pariboni, 2016; Deleidi and Mazzucato, 2019).

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[5] For an in-depth review of endogenous monetary theory and the horizontalist approach see Moore (1988), Rochon (2001), Lavoie (2014), and Deleidi (2020).

$$\overline{C_t^a} = \overline{Cc_t} + \overline{RES_t} = f(\overline{FF}) \tag{4}$$

Gross Investment (5) is fully induced (i.e. it depends on the level of aggregate demand), with investment share being represented by $0 \leq h < 1$.[6] In other words, firms increase the level of investment in the long run in order to satisfy a permanent increase in the level of demand. Conversely, in the short run, a higher level of demand is met by a flexible degree of capacity utilization, which, is thus not assumed to be equal to the normal one desired by entrepreneurs (u_n).[7]

$$I_t = h_t Y_t \tag{5}$$

Total government expenditures (6) are exogenously given in that they are determined by policy decisions.

$$G_t = \overline{G_t} \tag{6}$$

Total exports (7) are an increasing function of foreign income (${Y_t}^{foreign}$). Therefore, from a domestic perspective, they should be treated as exogenous.

$$X_t = \overline{X_t} = f({Y_t}^{foreign}) \tag{7}$$

Total imports (8) are assumed to be a linear function of income at each time, with m representing the propensity to import.

$$M_t = mY_t \tag{8}$$

Total autonomous demand (9) can thus be defined as the sum of autonomous consumption ($\overline{C_t^a}$) , government expenditure ($\overline{G_t}$), and exports ($\overline{X_t}$).

$$\overline{Z_t} = \overline{C_t^a} + \overline{G_t} + \overline{X_t} \tag{9}$$

Finally, we obtain the level of output as the product of autonomous demand ($\overline{Z_t}$) and the Super-multiplier ($1/(1 - c + m - h)$):

$$Y_t = \frac{1}{1 - c + m - h}\overline{Z_t} \tag{10}$$

At this point it is convenient to make an observation. Y_t does not correspond automatically to the level of output realized when the rate of capacity utilization is equal to the normal one, though a continuous tendency of the former to stabilize at its normal level should be assumed in the long run.[8] It is worth noticing that, although this model explains economic growth, equation (10) shows that a permanent increase in the level of autonomous components of demand (Z) leads to a persistent increase in the output level. Through such a model, we can also explain the determinants of economic growth because demand exerts long-lasting effects on GDP level, ones that go beyond business cycle

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[6] The investment share is also defined as the firms' marginal propensity to invest (Freitas and Serrano, 2015).

[7] For instance, u_n can be defined as the normal degree of capacity utilization that minimizes the costs of production (Kurz, 1986).

[8] For an in -depth review on the utilization controversy, see Nikiforos (2016); Girardi and Pariboni (2019); Gahn (2020).

fluctuations.

In line with the flexible accelerator principle, firms adjust their investment decisions whenever they experience a discrepancy between the normal and the effective rate of capacity utilisation. [9] This mechanism allows the alignment of productive capacities with the rates of actual and expected output growth. At the macroeconomic level, this adjustment mechanism can be modelled as follows:

$$\dot{h} = h_t \gamma (u_t - 1) \tag{11}$$

where $\gamma > 0$ is a reaction coefficient and u_n is assumed to be equal to one. From (5 and 10) we get the growth rate of output (12) and the growth rate of capital accumulation (13). The growth rate of capital stock (${g_t}^K$) is positively affected by the capital to potential output ratio (v) given technical conditions, whereas it is negatively affected by the depreciation rate (δ).

$${g_t}^Y = {g_t}^Z + \frac{\dot{h}}{1 - c + m - h} \tag{12}$$

$${g_t}^K = h_t \frac{u_t}{v} - \delta \tag{13}$$

The change in the actual degree of capacity utilization can be represented as follows:

$$\dot{u} = u_t({g_t}^Y - {g_t}^K) \tag{14}$$

In the long run, the equilibrium position of the economy is characterized by $u = u_n = 1$ (16) and $\dot{h} = \dot{u} = 0$. Equation (15) follows from equation (14):

$${g_t}^Y = {g_t}^K = {g_t}^Z \tag{15}$$

$$u_t = 1 \tag{16}$$

Lastly, the required investment share (h^*) is uniquely determined by the rate of growth of autonomous demand (${g_t}^Z$), the capital/output ratio (v), the normal degree of capacity utilization - normalized to 1 - and the rate of depreciation (δ).

$$h^* = v({g_t}^Z + \delta) \tag{17}$$

What equation (17) implies is that firms will adjust realized investment in order to meet either greater autonomous demand growth (${g_t}^Z$) or changes in the technical conditions of production (Garegnani, 2015), i.e. when v or δ change exogenously.

On an empirical ground, the SSM has been validated for the US (Girardi and Pariboni, 2016; Haluska et al., 2020), for European economies (Barbieri Góes et al., 2018; Gallo, 2019; Pérez-Montiel and Erbina, 2020), and for 20 OECD countries (Girardi and Pariboni, 2020). While the above-mentioned contributions investigate the long-run implications of shifts in autonomous components of demand on output growth, they do not estimate the multipliers associated with autonomous demand and its components. To fill this gap, we seek to evaluate the level effects of positive autonomous demand shocks on output through the estimation of their respective multipliers (see equations 9 and 10). In doing so, we are not disregarding that autonomous expenditure expansions have an impact

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[9] Entrepreneurs adjust capacity gradually, in view of the fact that some fluctuations of demand could be transitory.

on long-run economic growth. By demonstrating that autonomous demand produces persistent effects on the output level, we can grasp further implications for the determinants of economic growth. This argument is also in line with Fatás' (2000) findings, which confirm the existence of a strong positive relationship between long-term growth rates and the persistence of output fluctuations.

Even though not embedded in the SSM framework, a broad literature has evaluated the role of fiscal policies, housing and exports in output determination. With respect to the nexus between government expenditure and output, a vast empirical literature has focused on the estimation of fiscal multipliers. Typically, fiscal multipliers have been estimated by means of several methods based on: Dynamic Stochastic General Equilibrium (DSGE) models (e.g., Hall, 2009; Christiano et al., 2011); VAR models (e.g., Blanchard and Perotti, 2002; Ramey, 2011*a*; 2011*b*; Auerbach and Gorodnichenko, 2012); and the Local Projections (LPs) approach (e.g., Ramey, 2016; Auerbach and Gorodnichenko, 2017; Ramey and Zubairy, 2018; Deleidi et al., 2020).[10] Recent studies have also empirically shown that fiscal consolidation has produced long-term negative effects on actual and potential output and increased the debt-to-GDP ratio (Ball, 2014; Fatás and Summers, 2018; Gechert et al., 2019). By using local projections to assess the case of reverse hysteresis, Girardi et al. (2020) find that demand expansions exert positive persistent effects on GDP, participation rate, and capital stock.

As regards the real estate sector, echoing the burst of the US housing bubble and inspired by the publications of Leamer (2007; 2015), several authors have aimed to empirically assess the role of housing in leading the economic cycle (e.g., Kydland et al., 2016; Jordà et al., 2016; Huang et al., 2020). Kydland et al. (2016) use a VAR model to investigate housing dynamics during the business cycle and find that residential investment in national accounts leads GDP in both the US and Canada. Using local projections in 17 advanced economies, Jordà et al. (2016) demonstrate that mortgage credit has increasingly left its mark on business cycle dynamics. Similarly, Huang et al. (2020) use a SVAR model to show that housing indicators lead business cycles in most countries, and that whereas housing supply indicators predict short-run variations in business cycles, housing price is able to better predict long-run variations. Using a NARDL model, Pérez-Montiel and Pariboni (2021) take a step forward, and argue that residential investment in volumes does not only drive the business-cycle, but also long-run growth in the US.[11]

With respect to the exports-output nexus, most of the literature has been devoted to investigate the balance of payments constraint and export-induced economic growth, mainly adopting a cross-country perspective (e.g., Bairam, 1990; Bairam and Dempster, 1991; Abeysinghe and Forbes, 2005). Abeysinghe and Forbes (2005) use a SVAR model (for 11 Asian countries, the US, and other OECD countries) to investigate how a shock in one country affects output in the others. A second group of researchers have investigated the relationship between trade and development (e.g., Rodriguez and Rodrik, 2000; Tingvall and Ljungwall, 2012; Dreger and Herzer, 2013). Other strands of researchers have investigated non-linearities within the dynamics of exports and output growth (e.g., Taylor et al., 2001; Awokuse and Christopoulos, 2009). For instance, Awokuse and Christopoulos (2009) use a smooth

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[10] For sake of simplicity, we have reported here a brief review of fiscal multipliers estimated by using VAR models. In this investigation we rely on a recursive identification strategy (see, among others, Christiano et al., 1999; Galí et al., 2007; Bachmann and Sims, 2012). Other identification strategies include, among others, sign restriction approach, proxy SVARs, long-run restriction, the narrative approach. For an in-depth review of the identification strategies adopted in the literature, see Gechert (2015); Ramey (2016); Kilian and Lütkepohl (2017); Deleidi, Romaniello and Tosi (2021); Deleidi, Iafrate and Levrero (2021).

[11] For the sake of simplicity, we have reviewed a brief part of the literature that investigates the role of the housing sector in output determination. For a comprehensive review, see Huang et al. (2020).

transition autoregressive (STAR) model to confirm the existence of non-linearities in the relationship between exports and economic growth in five industrialized economies (Canada, Italy, Japan, UK, and the US).[12]

To the best of our knowledge, the existing literature has mainly focused on assessing the multiplier associated with government expenditures, while little to no literature assesses the multiplier associated with export and residential investment, or the one related to autonomous demand. In order to fill this gap, in this paper we employ SVAR modelling to assess the level effects produced by demand expansions and to also estimate the multipliers associated with autonomous demand and its components.

3 Data and Methods

3.1 Data

To assess the multiplier associated with autonomous demand and its components, we use seasonally adjusted quarterly data for the US provided by the Federal Reserve Bank of St. Louis and the Bureau of Economic Analysis for the period 1954Q3-2020Q1. Specifically, we build our data using the Federal Funds rate (FF), exports of goods and services (X), government consumption expenditures and gross investment (G), the sum of private residential investment,[13] and the flow of total consumer credit owned and securitized (autonomous consumption - CA). The series of autonomous consumption (Z) is constructed by simply summing up exports (X), government expenditures (G), and autonomous consumption (CA). With the exception of Federal Funds rate, variables are used in real terms (2010 USD) [14] and in log-level.[15] The considered variables are summarized in Table (1) and Appendix (B).

Table (1) Variables: descriptions and acronyms

Acronyms	**Variables**
FF	Federal Funds Rate
X	Exports of Goods and Services
G	Government Expenditure
CA	Autonomous Consumption (the sum of Private Residential Investment and Consumer Credit)
Z	Autonomous Demand ($Z = X + G + CA$)
Y	GDP

We estimate two different models. While FF, Z, and Y are included in Model 1, Model 2 considers autonomous demand as broken down and includes FF, X, G, CA, and Y.

3.2 Methods

To detect the effect of Autonomous demand on GDP level, we make use of SVAR models. Before estimating a SVAR model, a reduced-form VAR is estimated (equation 18).

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[12] For an exhaustive review of the demand-oriented theory of foreign trade and economic growth see McCombie and Thirlwall (1997). For a review of the trade-development nexus, see Rodriguez and Rodrik (2000). For the discussion on non-linearities in exports, see Taylor et al. (2001).

[13] Following Girardi and Pariboni (2016), we consider private residential investment as durable consumption since it does not create productive capacities.

[14] Variables have been deflated using their corresponding deflators.

[15] Following Auerbach and Gorodnichenko (2012) and Kilian and Lütkepohl (2017), we estimate a VAR model in levels to preserve any cointegration relationship that may exist among the considered variables.

$$y_t = c + \sum A_i y_{t-p} + u_t \tag{18}$$

where y_t is the $kx1$ vector of considered variables, c is the constant term, A_i is the kxk matrix of reduced-form coefficients, and u_t is a $kx1$ vector composed by the error terms. The optimal lag length is 6 in both models and it is obtained by minimizing the Akaike's Information Criterion (AIC).[16] Since $A_i = {B_0}^{-1} B_i$, and $u_t = {B_0}^{-1} \omega_t$, we can obtain the structural model (SVAR) as in equation (19).

$$B_0 y_t = c + \sum B_i y_{t-p} + \omega_t \tag{19}$$

where B_0 is 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 $kx1$ structural innovation vector. To obtain a structural model, an identification strategy needs to be imposed on the reduced-form VAR in equation (18). The identification requires to impose restrictions on B_0, usually retrieved from the economic theory (Kilian and Lütkepohl, 2017).

Accordingly, we set two different models using a recursive identification based on the Cholesky Decomposition[17] as summarized in (20 and 21), which refer to Models 1 and 2 respectively.

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 \\ - & - & 0 \\ - & - & - \end{bmatrix} \begin{bmatrix} FF \\ Z \\ Y \end{bmatrix} \tag{20}$$

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 \\ - & - & 0 & 0 & 0 \\ - & - & - & 0 & 0 \\ - & - & - & - & 0 \\ - & - & - & - & - \end{bmatrix} \begin{bmatrix} FF \\ X \\ G \\ CA \\ Y \end{bmatrix} \tag{21}$$

Following the endogenous money theory, in the first equation of both models we assume that the Federal Funds rate is exogenously set by the central bank (as discussed in Section 2), which implies that monetary policy can affect output and its components within the quarterly observation, while output may affect monetary policy with a delay.[18] Subsequently, in (20) we assume that autonomous demand (Z) affects the output level (Y), while output may influence Z with a delay. This issue becomes clearer when, in the identification (21), Z is broken down in order to consider its different components. Indeed, exports (X) depend on foreign income; government expenditures (G) are affected by policy decisions which are subjected to both information delays and an implementation lag; and autonomous consumption (CA) depends on the credit market, monetary policy, and accumulated wealth.

After imposing the restrictions, a SVAR model is estimated. Once the SVAR is estimated, we com-

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[16] Lag-length criteria are available upon request.

[17] In the restriction matrix, '-' indicates an unrestricted parameter and '0' represents a zero restriction.

[18] As additional robustness check, we have estimated Models 1 and 2 inverting the order of the variables in the identification matrix and placing the Federal Funds rate last following both Perotti (2005) and the empirical literature on the transmission of monetary policy (Bernanke et al., 2005; Castelnuovo and Surico, 2010). The assumption behind this alternative identification order is that the interest rate may react contemporaneously to output and autonomous demand components, whereas both public and private sectors respond slowly to interest rate shocks. These findings are in line with those obtained employing the identification strategies reported in (20) and (21), and are available upon request.

pute the impulse responses functions (IRFs) to assess the effect of autonomous demand and monetary policy shocks on the output level. IRFs are reported with a 90-per-cent confidence interval calculated through a 500-runs moving block bootstrap with respect to a 40-quarters time horizon. Since variables are in logarithmic form, IRFs are interpretable as elasticities. To estimate fiscal multipliers, elasticities need to be multiplied by the corresponding ex-post conversion factors to obtain dollar-change in response to dollar increases in the selected expenditure. Additionally, we estimate the so-called cumulative multipliers that show the cumulative response per one-dollar increase in spending. Cumulative multipliers represent the most appropriate measure for evaluating the effect of autonomous expenditures on GDP and are estimated through the ratio between the cumulative variation of output and the cumulative change in autonomous expenditures (Spilimbergo et al., 2009; Ramey and Zubairy, 2018).

Furthermore, we detect the effect of 'pure spending shocks' following the methodology developed by Perotti (2005) for the study of the effect of a pure fiscal policy shock on GDP. For clarification, in Model 1 (FF, Z, and Y), to estimate the pure effect of an autonomous demand shock (Z) on output (Y), we keep the interest rate (FF) constant throughout the horizon in which the IRFs are estimated. To do this, it is indispensable that all the coefficients are set to zero in the reduced form VAR belonging to the interest rate FF equation. The same reasoning applies when the direct effect of any of the components of autonomous demand shocks is to be evaluated.[19] Finally, we compute the forecast error variance decompositions (FEVDs) that illustrate how much of the forecast error variance of each of the variables can be explained by shocks to the other variables.

4 Empirical Findings

In this Section we report the empirical findings of Models 1 and 2. In particular, we analyse the results of the IRFs, cumulative multipliers, pure-cumulative multipliers, and the FEVDs. Figures (1 and 2) display the elasticities of output to 1% changes in FF, Z, X, G, and CA. The cumulative multipliers associated with autonomous demand (Z) and its components (X, G, and CA) are presented in Tables (2 and 3). The models are estimated both for the whole sample (1954Q3-2020Q1), and excluding the post-crisis period (1954Q3-2007Q4).

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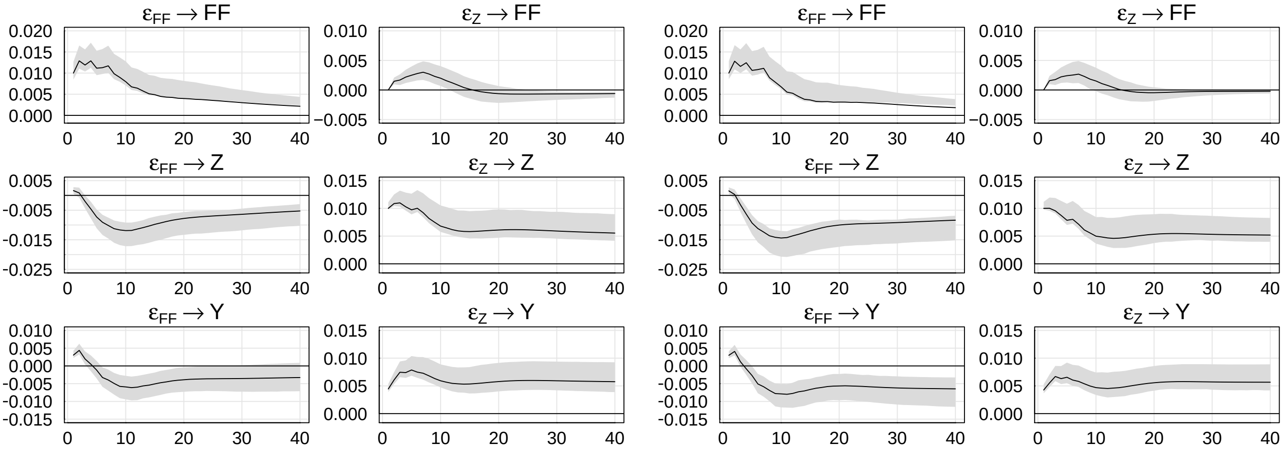
[19] Identification strategies used to estimate pure shock are available upon request.

Figure (1) **Impulse Response Functions (IRFs), Model 1:** Figures display elasticities of FF, Z, and Y to monetary policy (ε_{FF}) and autonomous demand shocks (ε_{Z}). Quarters on x-axis. Shaded grey area denotes 90% confidence bands calculated through m.b. bootstrapping (500 runs).

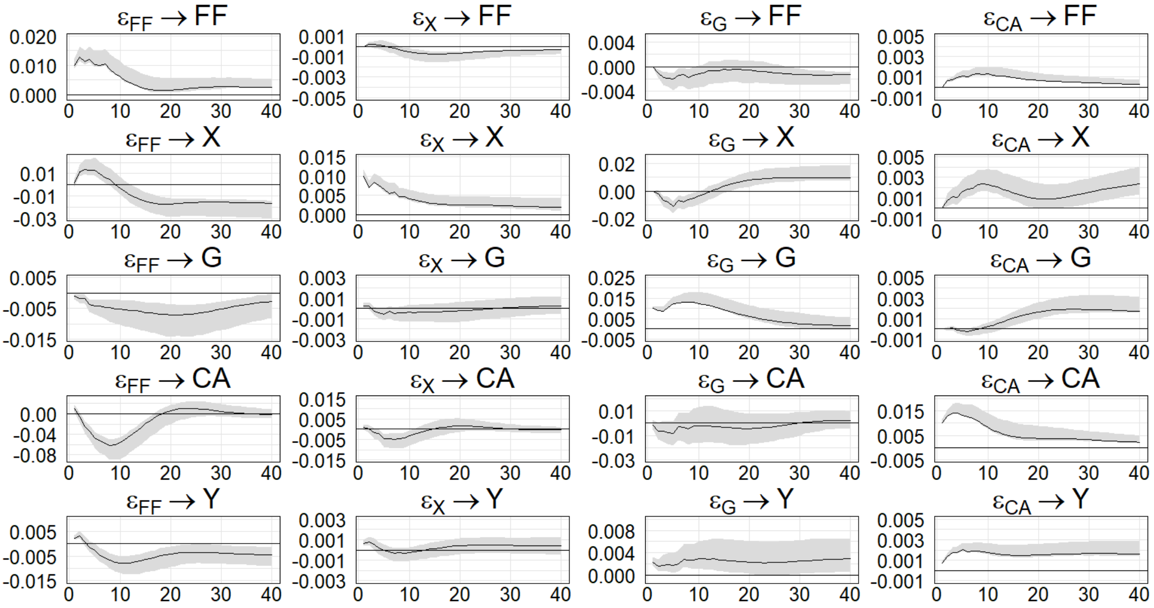


(a) 1954Q3-2020Q1

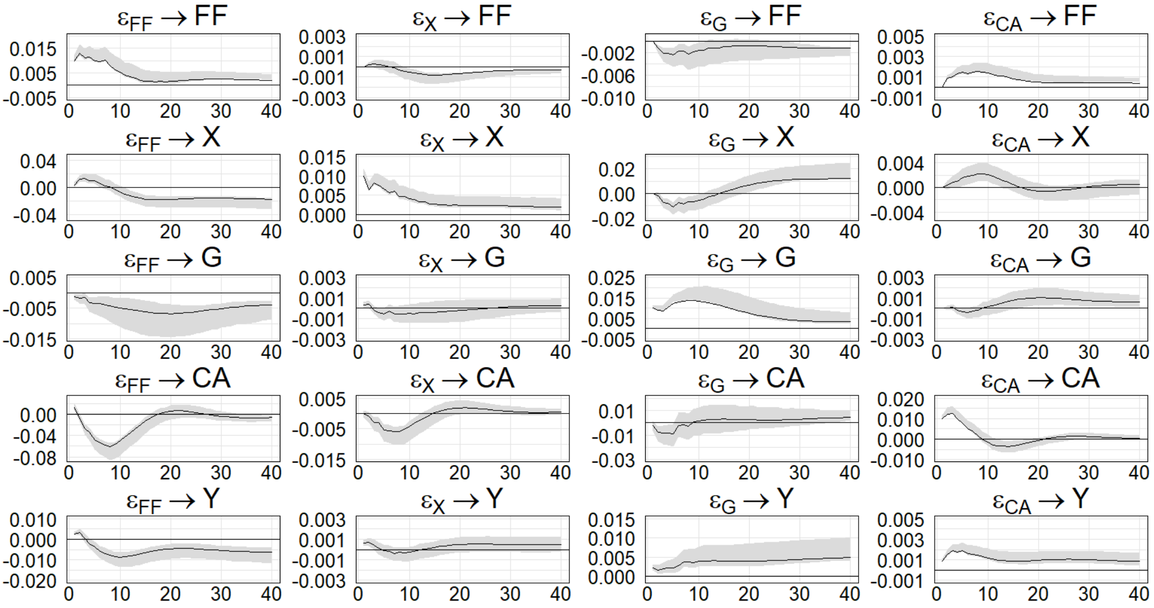
(b) 1954Q3-2007Q4

The IRFs estimated for Models 1 and 2 (Figures 1 and 2 respectively) are highly persistent. Indeed, positive shocks in autonomous demand (Model 1) and in each of its components (Model 2) engender persistent effects on the output level. When elasticities are converted into cumulative multipliers (Table 2), a one-USD increase in autonomous demand (Z) generates an impact multiplier of about 1.16, with a peak of 2.3 after 40 quarters. In the model excluding the crisis, a slightly lower impact multiplier of Z (about 1.1), combines with a higher peak (about 2.44 after 40 quarters). In Model 2, a one-USD increase in exports generates an impact multiplier of about 1.34 with a peak of about 1.72 in the second quarter in the benchmark model. In the model excluding the crisis, the impact multiplier of X is slightly lower (about 1.26) and the peak slightly higher (about 1.91 in the 40th quarter). A one-USD increase in government expenditures generates an impact multiplier of about 0.89 with a peak of about 1.40 in the 40th quarter in the benchmark model. In the model excluding the crisis, the impact multiplier of G is a slightly lower (about 0.86) and the peak is higher (about 1.97 in the 40th quarter). Lastly, a one-USD increase in autonomous consumption leads to an impact multiplier of about 1.26 with a peak of about 4.8 in the 40th quarter in our benchmark model. In the model excluding the crisis, the impact multiplier of CA is about 1.47 and its peak reaches the level of about 13.81 in the 40th quarter.

Figure (2) **Impulse Response Functions (IRFs), Model 2:** Figures display elasticities of FF, X, G, CA, and Y to monetary policy (ε_{FF}) and autonomous demand shocks (ε_X, ε_G, ε_{CA}). Quarters on x-axis. Shaded grey area denotes 90% confidence bands calculated through m.b. bootstrapping (500 runs).



(a) 1954Q3-2020Q1



(b) 1954Q3-2007Q4

Table (2) **Cumulative Multipliers:** Models 1 and 2 estimated for different sub-periods. Significant multipliers (90% confidence bands) are in bold. The impact multiplier is the multiplier at the 1st quarter; 5Q to 40Q are the multipliers at different quarters; Peak refers to the maximum multiplier.

	Impact	**5Q**	**10Q**	**15Q**	**20Q**	**25Q**	**30Q**	**35Q**	**40Q**	**Peak**
					1954Q3-2020Q1					
Model 1										
Z	**1.16**	**1.67**	**1.86**	**1.98**	**2.07**	**2.14**	**2.2**	**2.25**	**2.3**	**2.30(40)**
Model 2										
X	**1.34**	1.1	0.26	0.21	0.53	0.91	1.22	1.46	1.68	**1.72(2)**
G	**0.89**	**0.72**	**0.76**	**0.85**	**0.93**	**1.03**	**1.15**	**1.31**	**1.48**	**1.48(40)**
CA	**1.26**	**2.02**	**2.43**	**2.86**	**3.29**	**3.68**	**4.05**	**4.43**	**4.8**	**4.80(40)**
					1954Q3-2007Q4					
Model 1										
Z	**1.10**	**1.65**	**1.87**	**2.03**	**2.16**	**2.26**	**2.34**	**2.40**	**2.44**	**2.44(40)**
Model 2										
X	**1.26**	0.95	0.12	0.15	0.59	1.05	1.40	1.67	1.91	**1.91(40)**
G	**0.86**	**0.79**	**0.93**	**1.05**	**1.19**	**1.36**	**1.56**	**1.76**	**1.97**	**1.97(40)**
CA	**1.47**	**2.56**	**4.15**	**7.45**	**11.37**	**12.54**	**12.57**	**13.02**	**13.81**	**13.81(40)**

Since the effect of demand expansions on GDP is influenced by the effect of a shock in one component of autonomous demand on the other components, a more in-depth investigation is in order. Thereby, to assess the effects of each component of autonomous demand on output, we employ the method put forward by Perotti (2005) for the estimation of pure spending shocks. This enables us to isolate the shock of each autonomous demand component by holding constant both the other expenditure categories and the interest rate. Table (3) shows the cumulative output multipliers in response to pure shocks in Z as well as in X, G, and CA.[20]

Table (3) **Cumulative Multiplier - Pure Shock:** Models 1 and 2 estimated for different sub-periods. Significant multipliers (90% confidence bands) are in bold. The impact multiplier is the multiplier at the 1st quarter; 5Q to 40Q are the multipliers at different quarters; Peak refers to the maximum multiplier.

	Impact	**5Q**	**10Q**	**15Q**	**20Q**	**25Q**	**30Q**	**35Q**	**40Q**	**Peak**
					1954Q3-2020Q1					
Model 1										
Pure Z	**1.16**	**1.57**	**1.71**	**1.83**	**1.93**	**2.02**	**2.10**	**2.17**	**2.24**	**2.24(40)**
Model 2										
Pure X	**1.12**	1.46	1.65	1.90	2.14	2.38	2.61	2.82	3.02	3.02(40)
Pure G	**0.94**	**1.21**	**1.19**	1.22	1.28	1.35	1.42	1.50	1.57	1.57(40)
Pure CA	**1.26**	**1.74**	**1.97**	**2.10**	**2.22**	**2.31**	**2.40**	**2.48**	**2.56**	**2.56(40)**
					1954Q3-2007Q4					
Model 1										
Pure Z	**1.10**	**1.65**	**1.87**	**2.03**	**2.16**	**2.26**	**2.34**	**2.40**	**2.44**	**2.44(40)**
Model 2										
Pure X	**1.12**	1.60	2.32	3.04	3.56	3.94	4.21	4.41	4.56	4.56(40)
Pure G	**0.94**	**1.39**	**1.50**	1.60	1.69	1.76	1.82	1.87	1.90	1.90(40)
Pure CA	**1.47**	**2.15**	**2.81**	**3.23**	**3.47**	**3.60**	**3.70**	**3.77**	**3.82**	**3.82(40)**

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[20] IRFs of pure-cumulative multiplier including the pure monetary shock are available in Appendix (A).

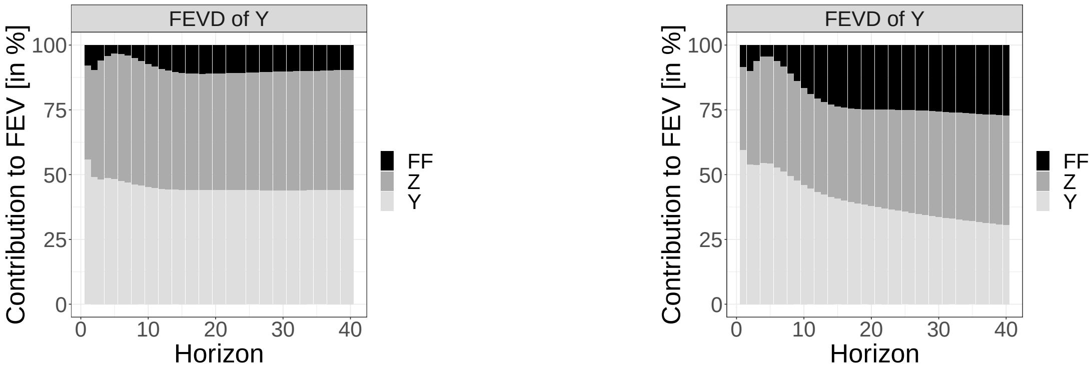
In Model 1, the isolation of the effect of autonomous demand on output gives us almost equal cumulative output multipliers both for the whole sample and for the pre-crisis model. When considering the pure shock, the peak multiplier estimated for the whole sample is slightly smaller (2.24 versus 2.30). Once again, the whole sample model shows a higher impact multiplier together with a lower peak. The results remain statistically significant throughout the time-horizon. In Model 2, considering the whole sample estimation and comparing the pure shocks with the results presented in Table (2) , the impact multipliers are the same for CA, slightly smaller for X, slightly higher for G. The peak multiplier is significantly higher for X (3.02 versus 1.72), slightly higher for G (1.57 versus 1.48), significantly lower for CA (2.56 versus 4.8). With respect to pre-crisis estimations, the impact multipliers stay the same for the pure shocks in X and G, while they slightly increase in the case of CA. The peak multiplier is significantly higher for X (4.56 versus 1.91), slightly lower for G (1.90 versus 1.97), significantly lower for CA (3.82 versus 13.81). As before, the peak multipliers of the components of demand are higher for the pre-crisis period, whereas the impact multipliers stay unchanged for both samples performing the pure shock in the case of X and G (the impact multiplier of CA increases when the pre-crisis period is considered). All impact multipliers are statistically significant performing the pure shock, while the peak multiplier is only statistically significant for CA. Accordingly, our findings confirm the validity of the theoretical model presented in Section (2). Indeed, models 1 and 2 illustrate that a rise in autonomous demand and its components engender positive and persistent effects on GDP level. The estimated multipliers attain positive values and those concerning public expenditure are in line with the main empirical literature (e.g., Blanchard and Perotti 2002, Auerbach and Gorodnichenko 2012), show to be very stable comparing both sample estimations. The highest impact multiplier is the one of autonomous consumption and the highest peak multiplier is the one associated with exports.

In addition, including the monetary shock, FF affects output mainly through the autonomous demand channel, in particular via autonomous consumption (referring to $\varepsilon_{FF} \rightarrow CA$ in Figure 2). More specifically, a 1% increase in the interest rate leads to a fall of autonomous consumption which reaches a negative effect of about -6.13% when considering the whole period, of about -6.03% when excluding the post-crisis period. A tightening of monetary policy also reduces the other autonomous components of demand, though its effect is smaller if compared to the one obtained for autonomous consumption (residential investment and consumer credit). The effect of interest rate on exports and government expenditure can be justified by means of the exchange rate channel and by public expenditure on interest payments in detriment to public consumption and investments expenditures.

The effect of monetary policy on GDP via autonomous demand is confirmed and strengthened when observing the results of the FEVDs. Figures (3 and 4) illustrate the extent to which the variability in the output level is explained by autonomous demand and interest rate shocks, as well as the amount of variation in autonomous demand (and each of its components separately) that can be explained by other autonomous expenditures and the rate of interest.

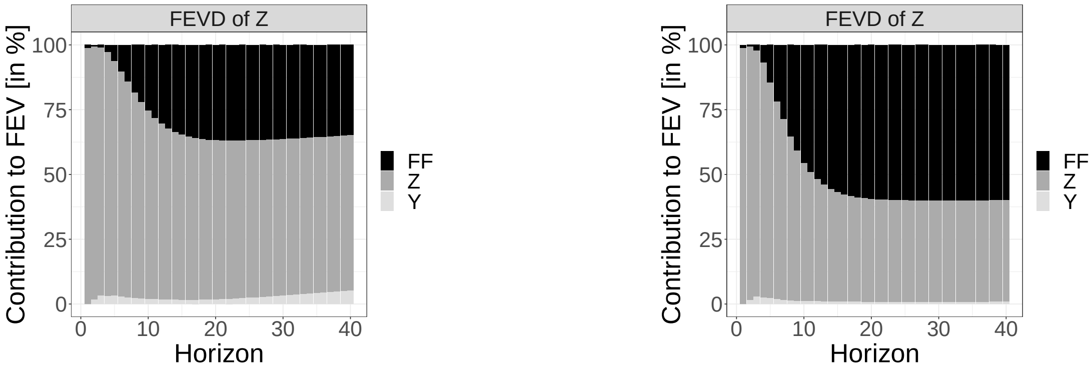
In Figure (3) we can highlight that the variability in the output level is mostly explained by autonomous demand (in both samples specifications), while the effect of monetary policy is very low. In the case of Model 1, it is worth stressing that, in the sub-sample that leaves out the post-crisis period (Figure 3c), the monetary policy has a stronger impact on the variability of output with respect to the whole sample estimation (Figure 3a). In particular, analysing Figures (3b and 3d), we can see that the contribution of monetary policy shocks (FF) to explain the variability of output passes mainly through the autonomous demand (Z) channel.

Figure (3) **FEVD, Model 1:** Quarters on x-axis and Contribution to forecast error variance in % on y-axis.



(a) FEVD of Y: 1954Q3-2020Q1

(c) FEVD of Y: 1954Q3-2007Q4



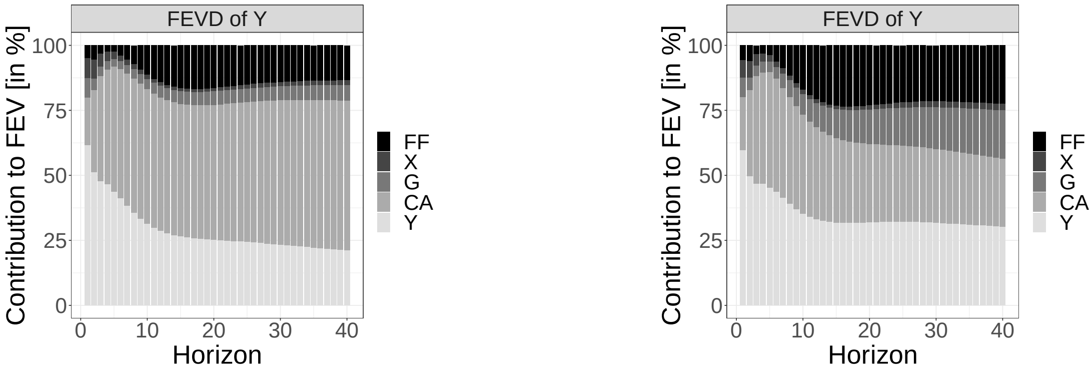
(b) FEVD of Z: 1954Q3-2020Q1

(d) FEVD of Z: 1954Q3-2007Q4

As regards Model 2 (Figure 4), we can emphasize the importance of autonomous consumption as a key factor in explaining the variability of output. When considering the divergences between the estimations of the two samples' specifications, we can stress the relatively higher contribution of interest rate and government expenditures when the crisis is omitted (Figure 4e). Furthermore, Figures (4d and 4h) show that the variability of autonomous consumption is explained by itself, as well as by variations in the Federal Funds rate (particularly true in the sub-sample that leaves out the crisis - Figure 4h). Analysing the FEVDs of autonomous demand components separately, it is clear that CA is the component mostly affected by shocks in FF, which confirms, once more, the rationality of the theoretical model presented in Section (2).

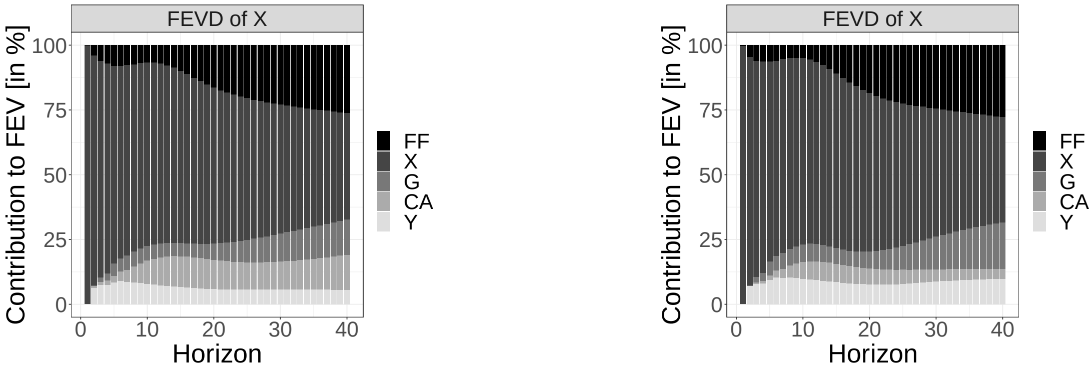
These results are in line with the findings of Deleidi (2018), which demonstrate the role of credit for house purchases in the transmission of monetary policy within the endogenous money approach. Similar conclusions can be found in a very broad literature that investigates monetary policy transmission through housing prices and credit channels (e.g., Musso et al., 2011; Cesa-Bianchi, 2013; Arestis and Gonzalez-Martinez, 2016; Ume, 2018). Furthermore, we also find that shocks in FF affect output through the export channel (even to a smaller extent than CA), supporting the argument of Deleidi and Mazzucato (2019) on the role of the exchange rate channel in monetary policy transmission.

Figure (4) **FEVD, Model 2:** Quarters on x-axis and Contribution to forecast error variance in % on y-axis.



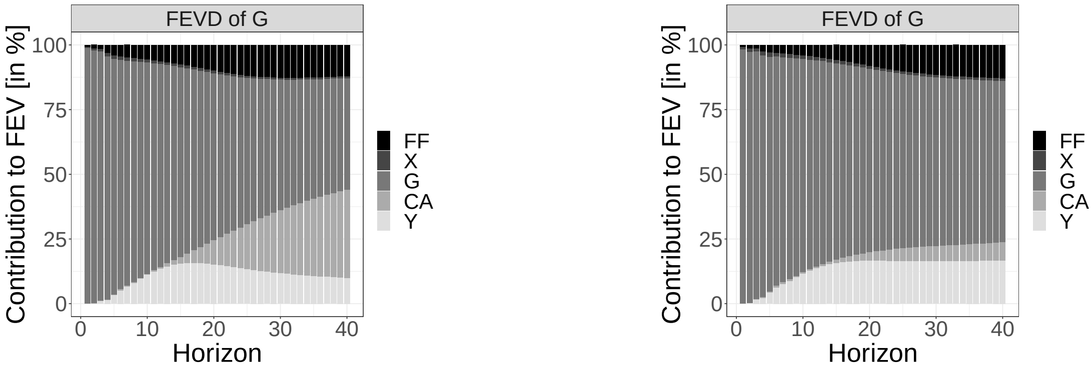
(a) FEVD of Y: 1954Q3-2020Q1

(e) FEVD of Y: 1954Q3-2007Q4



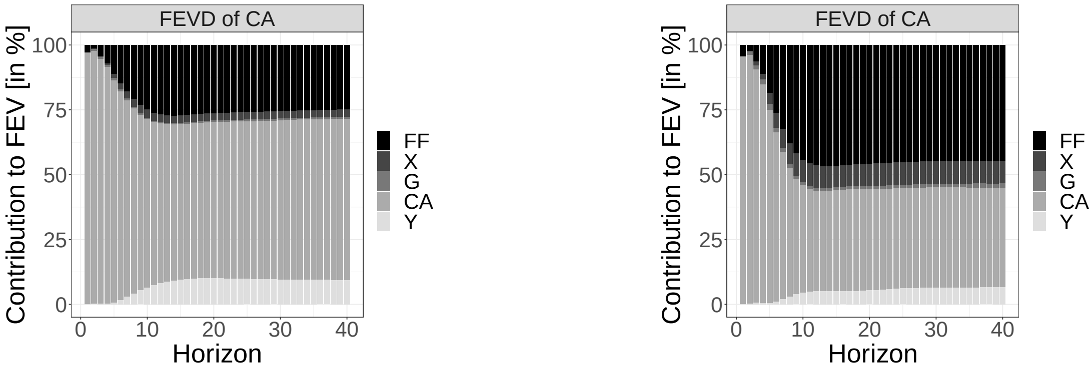
(b) FEVD of X: 1954Q3-2020Q1

(f) FEVD of X: 1954Q3-2007Q4



(c) FEVD of G: 1954Q3-2020Q1

(g) FEVD of G: 1954Q3-2007Q4



(d) FEVD of CA: 1954Q3-2020Q1

(h) FEVD of CA: 1954Q3-2007Q4

5 Robustness: Sub-sample Stability Analysis

Following the methodology introduced by Blanchard and Perotti (2002) we study the stability across time of the effects of autonomous demand shocks by repeating the estimation of our benchmark model dropping 12 years at a time.[21] Due to space constraints, in this Section we only report cumulative multipliers in Tables (4 and 5).

Table (4) **Cumulative Multiplier, Sub Sample Stability:** Models 1 and 2 estimated for different sub-periods. Significant multipliers are in bold, 90% confidence bands. The impact multiplier is the multiplier at the 1st quarter; 5Q to 40Q are the multipliers at different quarters; Peak refers to the maximum multiplier.

	Impact	**5Q**	**10Q**	**15Q**	**20Q**	**25Q**	**30Q**	**35Q**	**40Q**	**Peak**
					Excluding (1954-1968)					
Model 1										
Z	**1.23**	**1.81**	**1.89**	**1.86**	**1.82**	**1.82**	**1.84**	1.87	1.90	1.90(40)
Model 2										
X	**1.20**	**1.58**	1.65	1.74	2.00	2.32	2.63	2.91	3.17	3.17(40)
G	**1.11**	0.69	0.54	0.30	0.13	0.08	0.11	0.18	0.25	**1.11(1)**
CA	**1.38**	**2.49**	**3.02**	**3.55**	**4.11**	**4.70**	**5.27**	**5.80**	**6.29**	**6.29(40)**
					Excluding (1969-1981)					
Model 1										
Z	**1.16**	**1.71**	**1.99**	**2.14**	**2.25**	**2.35**	**2.43**	**2.49**	**2.54**	**2.54(40)**
Model 2										
X	**1.02**	0.29	-1.28	-1.89	-2.21	-2.59	-3.13	-3.84	-4.78	**1.13(2)**
G	**1.09**	**1.12**	1.11	1.21	1.30	1.43	1.60	1.81	2.04	2.04(40)
CA	**1.30**	**2.20**	**2.69**	**3.14**	**3.59**	**4.05**	**4.57**	**5.15**	**5.76**	**5.76(40)**
					Excluding (1982-1994)					
Model 1										
Z	**1.22**	**1.71**	**1.94**	**2.09**	**2.22**	**2.32**	**2.40**	**2.46**	**2.50**	**2.50(40)**
Model 2										
X	**1.24**	0.86	0.22	0.62	1.38	2.10	2.70	3.22	3.69	3.69(40)
G	**0.95**	0.75	0.90	1.00	1.10	1.22	1.36	1.52	1.68	1.68(40)
CA	**1.48**	**2.22**	**2.54**	**2.93**	**3.38**	**3.83**	**4.23**	4.58	4.90	4.90(40)
					Excluding (1995-2007)					
Model 1										
Z	**1.18**	**1.70**	**1.89**	**2.00**	**2.09**	**2.17**	**2.24**	**2.29**	**2.34**	**2.34(40)**
Model 2										
X	**1.19**	**0.51**	-1.21	-2.15	-2.71	-3.10	-3.55	-4.11	-4.75	**1.19(1)**
G	**0.90**	**0.79**	**0.85**	0.95	1.05	1.16	1.26	1.38	1.50	1.50(40)
CA	**1.57**	**2.54**	**3.22**	4.12	4.97	**5.45**	**5.75**	**6.12**	**6.58**	**6.58(40)**

As displayed in Table (4), the multiplier of autonomous demand as a whole (Z) shows to be very stable across all four sub-sample specifications, whereas the impact multiplier and the peak range from 1.16 to 1.23 and from 1.90 to 2.54 respectively. All the impact and peak multipliers of Z are statistically significant with the exception of the peak multiplier of the sample excluding the period (1954-1968). With respect to the components of autonomous demand, we can say that also government expenditures and autonomous consumption are rather stable across all four sub-sample specifications. In particular, G presents an impact multiplier that varies from 0.9 to 1.1 (all statistically significant) and a peak

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[21] The size of the sub-sample is simply determined by an equal division of the whole sample into 4 sub-periods, also taking into account the sub-sample constructed in the previous Section to exclude the post-crisis period (1954Q3-2007Q4).

ranging from 1.1 to 2.04 (statistically significant for sample that excludes the period between 1954-1968). Autonomous consumption (CA) presents an impact multiplier that varies from 1.3 to 1.57 (all statistically significant) and a peak ranging from 4.9 to 6.58 (all statistically significant with the exception of the sample excluding the period between 1982-1994). Exports, however, show to have a limited multiplier that turns negative after the 10th quarter in two specifications, namely when the periods 1969-1981 and 1995-2000 are excluded from the sample. The impact multiplier of X varies from 1.02 to 1.24 (all statistically significant) and the peak from 1.13 to 3.69 (statistically significant for the samples that excludes the periods 1969-1981 and 1995-2007). The negative effect of exports on GDP disappears when analysing the pure-shock presented in Table (5). When we consider the effect of a pure-shock on exports, the multipliers remain positive throughout all time-horizons in all sub-sample specifications.

Table (5) **Cumulative Multiplier - Pure Shock: Sub-sample Stability:** Models 1 and 2 estimated for different sub-periods. The significant multipliers are in bold (90% confidence bands). The impact multiplier is the multiplier at the 1st quarter; 5Q to 40Q are the multipliers at different quarters; Peak refers to the maximum multiplier.

	Impact	**5Q**	**10Q**	**15Q**	**20Q**	**25Q**	**30Q**	**35Q**	**40Q**	**Peak**
Excluding (1954-1968)										
Model 1										
Pure Z	**1.23**	**1.74**	**1.82**	**1.86**	1.88	1.90	1.92	1.93	1.95	1.95(40)
Model 2										
Pure X	**1.02**	**1.61**	1.91	2.08	2.23	2.37	2.51	2.65	2.78	2.78(40)
Pure G	**1.04**	1.33	1.26	1.19	1.13	1.07	1.01	0.95	0.89	1.34(4)
Pure CA	**1.38**	**2.13**	**2.34**	**2.46**	2.55	2.65	2.73	2.81	2.89	2.89(40)
Excluding (1969-1981)										
Model 1										
Pure Z	**1.16**	**1.54**	**1.74**	**1.89**	**2.03**	**2.14**	**2.24**	**2.33**	**2.40**	**2.40(40)**
Model 2										
Pure X	**0.86**	1.11	1.30	1.55	1.81	2.05	2.28	2.50	2.70	2.70(40)
Pure G	**1.12**	**1.32**	1.29	1.32	1.39	1.46	1.54	1.61	1.68	1.68(40)
Pure CA	**1.30**	**1.88**	**2.11**	**2.25**	**2.36**	2.47	2.56	2.65	2.74	2.74(40)
Excluding (1982-1994)										
Model 1										
Pure Z	**1.22**	**1.62**	**1.79**	**1.91**	**2.01**	**2.10**	**2.17**	**2.24**	**2.30**	**2.30(40)**
Model 2										
Pure X	**1.08**	1.31	1.51	1.85	2.19	2.49	2.77	3.02	3.25	3.25(40)
Pure G	**1.05**	**1.32**	1.31	1.37	1.47	1.58	1.69	1.79	1.89	1.89(40)
Pure CA	**1.48**	**2.00**	**2.22**	**2.35**	2.43	2.50	2.55	2.59	2.63	2.63(40)
Excluding (1995-2007)										
Model 1										
Pure Z	**1.18**	**1.59**	**1.73**	**1.85**	**1.95**	**2.05**	**2.14**	**2.22**	**2.28**	**2.28(40)**
Model 2										
Pure X	**1.31**	1.95	2.35	2.86	3.34	3.78	4.17	4.53	4.85	4.85(40)
Pure G	**0.98**	**1.25**	1.23	1.27	1.35	1.45	1.55	1.64	1.74	1.74(40)
Pure CA	**1.57**	**2.15**	**2.54**	**2.88**	**3.19**	3.45	3.66	3.84	3.99	3.99(40)

As displayed in Table (5), isolating the effect of autonomous demand on output gives us equal impact multipliers that remain statistically significant. The peak multipliers vary from 1.9 to 2.4 (with a higher minimum and a lower maximum). With the exception of the sample excluding the period 1954-1968, all peak multipliers are statistically significant. With respect to the components of demand, isolating the effect of a shock in CA gives us equal impact multipliers that remain statistically significant. The peak multipliers decrease, varying between 2.63 and 3.99. The impact multipliers of G slightly increase varying between 0.98 and 1.12 (all statistically significant) and the peak multipliers vary from 1.34 to 1.89 (with a higher minimum and a lower maximum). Finally, with respect to X, the impact multipliers vary between 0.86 and 1.31 (with a lower minimum and a higher maximum and remaining statistically significant) and the peak multipliers significantly increase, varying from 2.70 to 4.85. Therefore, we can argue that the temporary negative multipliers of X found in two of the sub-samples are due to negative movements in other autonomous demand components (particularly autonomous consumption - CA) as a result of an export shock in the selected samples.

6 Conclusion and Policy Implications

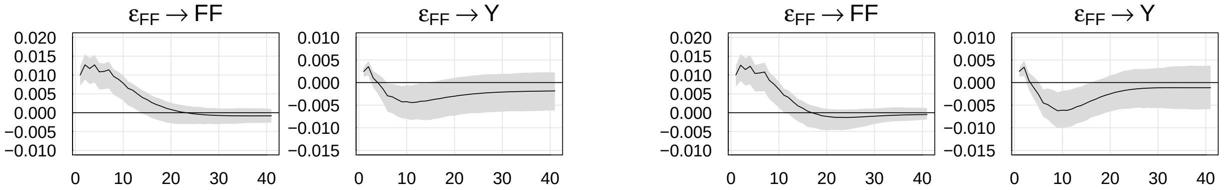
In light of the recently revived debate on the determinants of secular stagnation, hysteresis, and on the effectiveness of fiscal policy in fostering economic growth (e.g., Auerbach and Gorodnichenko, 2012; Blanchard and Leigh, 2013; Fatás and Summers, 2018), the role played by demand management policies has gained momentum in the international debate. In particular, recent contributions have shown that increases (decreases) in aggregate demand are able to produce positive (negative) effects on actual and potential output (Fatás and Summers, 2018; Girardi et al., 2020). This paper contributes to this debate by estimating the supermultiplier model, which provides a demand oriented explanation for hysteresis. According to this model, output is determined by the evolution of autonomous demand components (namely, government expenditure, exports and autonomous consumption) both in the short and long run.

We applied SVAR modelling to US quarterly data for the period 1954-2020 provided by the Federal Reserve and the Bureau of Economic Analysis. Our findings suggest that an expansion in autonomous demand and its components produces persistent effects on the output level, continuing even 10 years after the occurrence of the shock. These results were also confirmed when different sub-samples were considered. In addition, following the literature on fiscal multipliers (e.g., Blanchard and Perotti, 2002; Auerbach and Gorodnichenko, 2012), we estimated the multipliers associated with each demand component and they all attained positive values by also showing the multipliers attain positive values larger than one. Besides, when we computed the effect generated by pure spending shocks (Perotti, 2005), an expansion in autonomous demand produced a persistent effect on GDP associated with a peak multiplier of 2.24. When autonomous demand was broken down into exports, government expenditure, and autonomous consumption, the estimated peak multipliers were equal to 3.02, 1.57, and 2.56, respectively. Finally, when considering the effect of monetary policy, our estimates showed that the interest rate affects the output level through the autonomous expenditures channel, by particularly affecting autonomous consumption, and, to a lesser degree, exports.

In conclusion, in a context of ineffectiveness of monetary policy constrained at the zero-lower bound, and given that exports are mainly influenced by external markets, fiscal policy remains the key policy tool to restore economic growth. Further research needs to be done in order to build a coherent theoretical and empirical foundation able to explain which sectors and income brackets are impacted the most by a shock in each component of demand. This successive step is particularly important considering the significant shifts in income and wealth distributions (particularly in the US), which may also explain the different magnitudes of the multipliers.

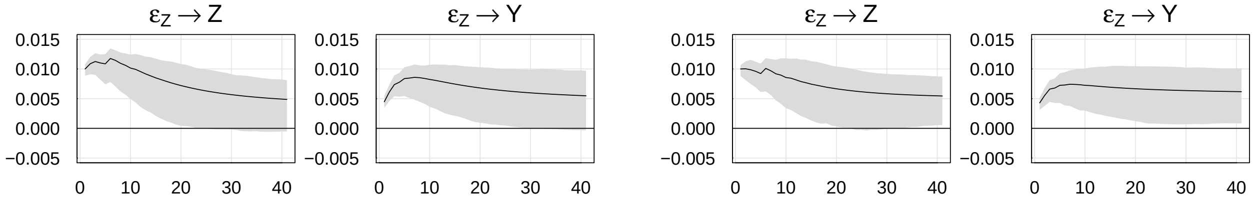
A Appendix

Figure (5) **Impulse Response Functions (IRFs), Model 1 - Pure Shocks:** Figures display elasticities of FF, Z, and Y to monetary policy (ε_{FF}) and autonomous demand (ε_Z) pure-shocks. Quarters on x-axis. Shaded grey area denotes 90% confidence bands calculated through m.b. bootstrapping (500 runs).



(a) IRF pure FF shock: 1954Q3-2020Q1

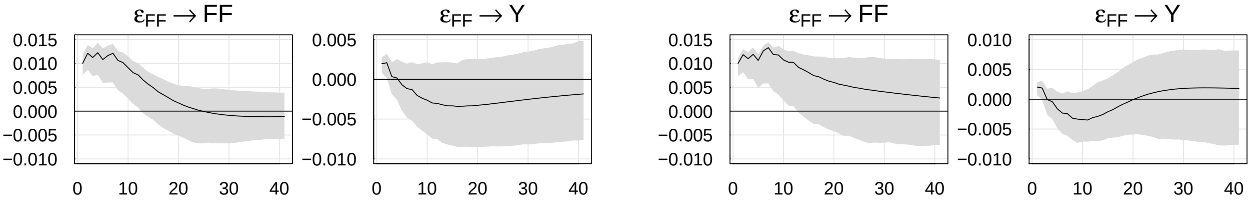
(c) IRF pure FF shock: 1954Q3-2007Q4



(b) IRF pure Z shock: 1954Q3-2020Q1

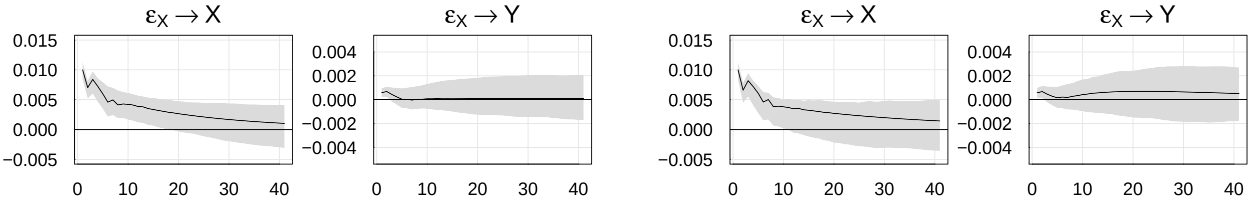
(d) IRF pure Z shock: 1954Q3-2007Q4

Figure (6) **Impulse Response Functions (IRFs), Model 2 - Pure Shocks:** Figures display elasticities of FF, Z, and Y to monetary policy (ε_{FF}) and autonomous demand (ε_Z) pure-shocks. Quarters on x-axis. Shaded grey area denotes 90% confidence bands calculated through m.b. bootstrapping (500 runs).



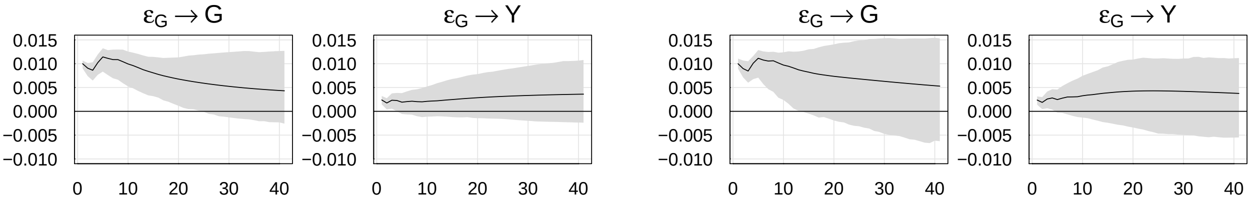
(a) IRF pure FF shock: 1954Q3-2020Q1

(e) IRF pure FF shock: 1954Q3-2007Q4



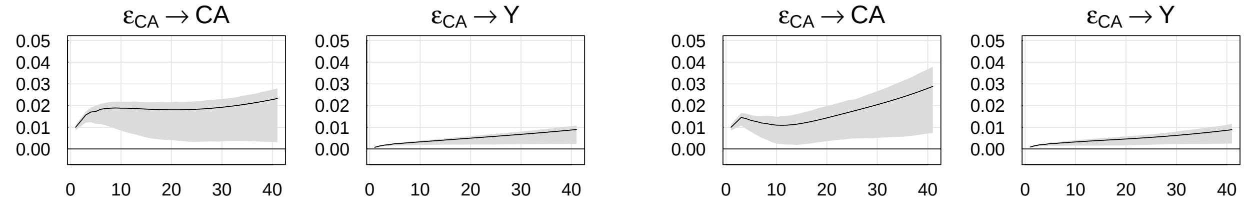
(b) IRF pure X shock: 1954Q3-2020Q1

(f) IRF pure X shock: 1954Q3-2007Q4



(c) IRF pure G shock: 1954Q3-2020Q1

(g) IRF pure G shock: 1954Q3-2007Q4



(d) IRF pure CA shock: 1954Q3-2020Q1

(h) IRF pure CA shock: 1954Q3-2007Q4

B Appendix

- FF: Effective Federal Funds Rate, Quarterly Data, Federal Reserve Economic Data, Federal Reserve Bank of St. Louis. Available at: `https://bit.ly/2VbSDcv`
- X: Exports of goods and services in Billions of Dollars, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.5. Available at: `https://bit.ly/34Dl0sj`
  Deflated using the Implicit Price Deflator for Exports of goods and services, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.9. Available at: `https://bit.ly/2z6230N`
- G: Government consumption expenditures and gross investment in Billions of Dollars, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.5. Available at: `https://bit.ly/34Dl0sj`
  Deflated using the Implicit Price Deflator for Government consumption expenditures and gross investment, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.9. Available at: `https://bit.ly/2z6230N`
- CA: Autonomous Consumption (the sum of Private Residential Investment and Consumer Credit)
  - Res: Gross Private Residential Domestic Investment in Billions of Dollars, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.5. Available at: `https://bit.ly/34Dl0sj`
    Deflated using the Implicit Price Deflator for Gross Private Residential Domestic Investment, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.9. Available at: `https://bit.ly/2z6230N`
  - CC: Flow of Total Consumer Credit Owned and Securitized in Billions of Dollars, Seasonally Adjusted, Quarterly Data, Federal Reserve Economic Data, Federal Reserve Bank of St. Louis. Available at: `https://bit.ly/31xxNHw`
    Deflated using the Implicit Price Deflator for Personal Consumption Expenditures, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.9. Available at: `https://bit.ly/2z6230N`
- GDP: Gross Domestic Product in Billions of Dollars, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.5; Available at: `https://bit.ly/34Dl0sj`
  Deflated using the Implicit Price Deflator for Gross Domestic Product, Seasonally Adjusted, Quarterly Data, Bureau of Economic Analysis, NIPA Table 1.1.9. Available at: `https://bit.ly/2z6230N`

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