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Impact of Interest Rates on Consumption in the US Economy: An Empirical Analysis

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What is the impact of interest rates on consumption in the US economy?

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Abstract

This study assessed the impact of interest rates on consumption, focusing on how changes in the housing and financial markets implicate consumer spending habits. It addressed how interest rates alter foreign consumption, therefore how imports implicate the consumption of domestic products. While the initial results were not statistically significant, further analysis showed how interest rates have only a limited and weak effect on controlling consumption. However, housing, and financial variables did influence consumption, particularly durable goods. The study concludes that monetary policy is ineffective and suggests the U.S. government explore alternative policies. Further research is warranted to assess the long-term effects on other variables on consumption.

Introduction

This paper aims to better understand the relationship between interest rates and consumption, as well as to explore the extent financial and housing markets influence consumer behaviour. The findings show an inverse relationship between interest rates and consumption, with monetary policy being a somewhat effective tool to control the consumption of goods, but not services. Additionally, housing, wealth and financial markets implicate different types of consumption, this will be explored in a later chapter.

The key research question of this paper is to assess the impact of interest rates on consumption in the US economy, and address the following 6 aims:

1. To determine the impact and degree that interest rates on the components of consumption
2. To determine the impact of other variables on consumption
3. To assess the impact of financial markets on consumption
4. To assess the impact of the housing markets on consumption
5. To assess the impact of other variables on foreign consumption in the US
6. How effective is monetary policy in the US?

This study employs a quantitative methodology, analysing time series data to explore the implications of interest rates on consumption, to address the six research aims above. Secondary data from the U.S., including the components of consumption and interest rates, and additional variables, was gathered from reliable sources such as the federal Economic Reserve, see reference list. The availability of extensive historical data ensures credible and accurate results. The hypothesis to be tested, is focused on the relationship between interest rates and consumption, see the following:

H0: $\beta_1 > 0$:there is an inverse relationship between consumption and interest rates

H1: $\beta_1 < 0$:there is not an inverse relationship between consumption and interest rates

This study provides new insights into the effect of interest rates on consumption by analysing their impact on various types of goods and services. It contributes by examining in detail the

influence of financial and housing markets on durables, nondurables, and services, covering a period marked by economic shocks and the implementation of quantitative easing.

This paper is structured into seven sections. The first section introduces the study's aims, findings, and contributions. Section two reviews key literature and background theory. The third section outlines the econometric methodology, its justifications, and limitations. Section four presents the results of the methodology. The fifth section summarises the findings and connects them to the literature. The sixth section offers a conclusion, analysing the key findings and research aims. Lastly, section seven provides some suggestions for future research.

Introduction, Motivation and Literature Review

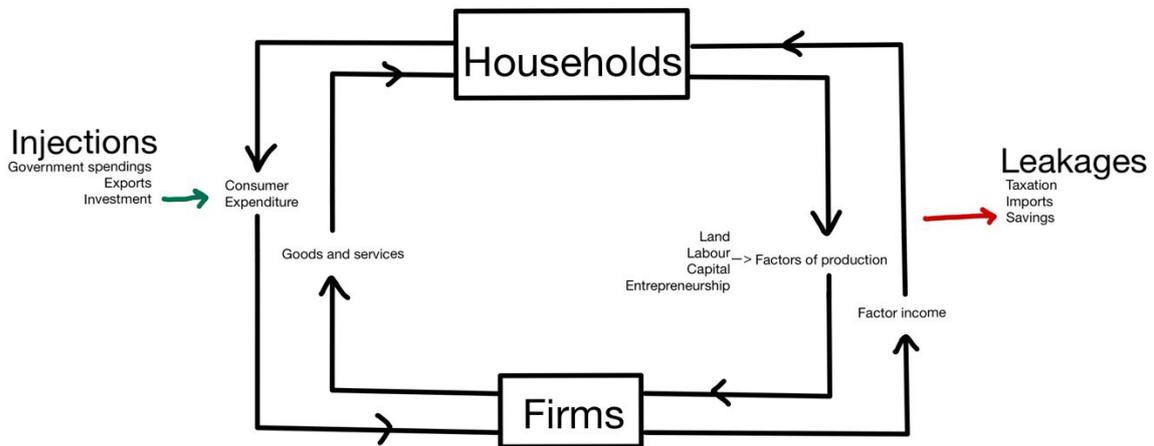
The study on consumption is an extensively investigated area, traditionally, examining the impacts of changes in income. Nevertheless, in recent years, there has been a renewed interest in the effectiveness of monetary policy, and whether interest rates play a useful role in controlling consumption.

Within the United States (US), personal consumption spending is defined as 'the value of the goods and services purchased by, or on the behalf of US residents' (Bea.gov, 2024). This is an important tool used to gage the strength of an economy as consumption makes up around 60% of aggregate demand, amounting to two thirds of GDP, as shown in the equation below:

$$AD = C + I + G + (X - M)$$

The circular flow of income demonstrates how money flows through societies, the two primary players within the model are household and firms. It separates the markets of goods and services, and markets for factors of production. When all the factors within the model are totalled this equates to the national GDP figure. Within the money supply, there are two key characteristics of the model, called leakages and injections. Injections include government spending, exports, and investments, on the other hand, leakages consist of taxation, imports, and savings, seen in Figure 2.1.

Figure 2.1: Circular Flow of Income



Source: Authors' representation.

Within the economy, when leakages exceed the level of injections, this causes economic growth to decrease and can be presented in the following equation:

$$T + M + S > G + X + I = \downarrow \text{economic growth}$$

However, when injections outweigh the quantity of leakages within the economy, economic growth will increase, shown below:

$$T + M + S < G + X + I = \uparrow \text{economic growth}$$

Despite this, in the situation where the output of leakages and input of injections are at the same level, this results in stationary economic growth, which signifies economic equilibrium, this can be shown below:

$$T + M + S = G + X + I = \text{stationary economic growth}$$

Aggregate consumption is broken into three components: durable goods, nondurable goods, and services. Durable goods are defined as goods not intended for immediate consumption and can be kept for a period of time (BEA, 2024a), this includes household appliances, vehicles, and recreational goods. The demand for these goods tends to be elastic in the short-run, and is described as volatile (Campbell and Mankiw, 1989). For example, when buying a new car, ceteris paribus, when prices rise, consumers may delay purchasing as this a luxury good and so not necessary. Despite this, in the long-run, demand becomes more inelastic, as

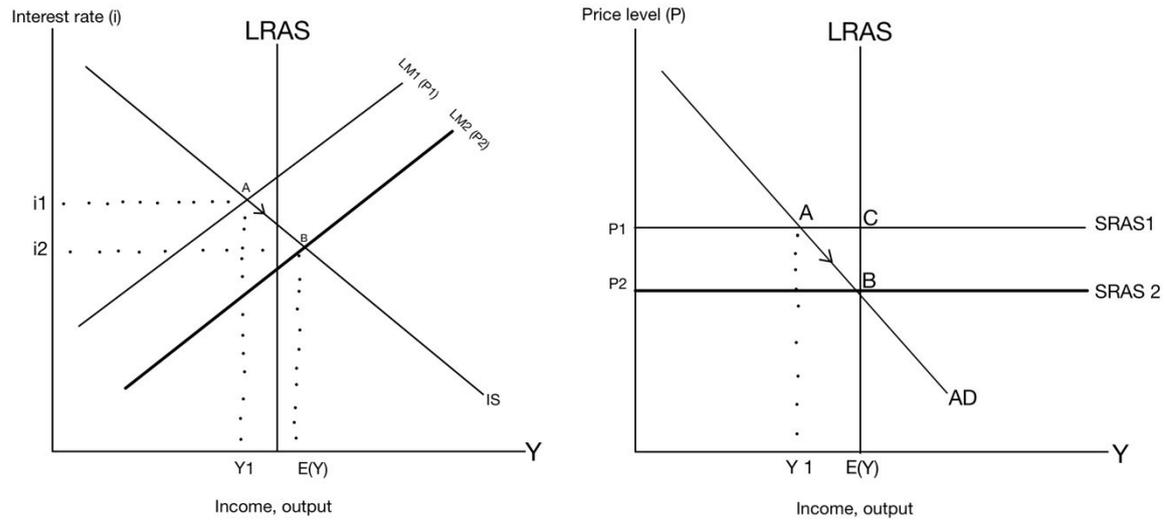
the purchase cannot be put off forever. But this gives time to plan, as in the short-term there are plenty of substitutes available, like public transport.

Nondurable goods are defined as tangible products that can be stored or inventoried, that have an average life of three years or less (Bea, 2024b). Among these are food, beverages, clothing, and gasoline. These types of goods are demand inelastic, characterised as necessities, with limited substitutes available, however, *ceteris paribus*, over time these goods become slightly more elastic as consumers are able to adjust their spending behaviour in response to these changes.

Finally, services are outlined as products that cannot be stored and are consumed at the place and time of their purchase (Bea, 2024c). This consists of health care, transport, recreational services, and financial services. The demand elasticity of services, depends on the service in question; services comparable to health care are considered necessities, and evaluated as inelastic in the short-run due to limited substitutes available. Yet, recreational services, are recognised as non-essential, are considered elastic in the short-run, and have many substitutes available. For instance, *ceteris paribus*, an individual could substitute going for coffee, for making it at home.

The background to the relationship between total output produced and interest rates can be explained by the IS-LM model (Hicks, 1980). The investment savings, or money individuals deposit in commercial banks or lend to borrowers, is the IS model, the liquidity money, or cash, is represented by the LM (Hicks, 1980). The model displays the effectiveness of interest rates, distributed between the two. As output rises, money demand will rise, in turn raising interest rates. This is represented by the upward sloping LM curve, where money demand is equal to money supply. In contrast, the downward sloping IS curve displays where total savings equals total investments at various interest rates. This means that as output rises, income rises as well, which drives up savings and lowers interest rates, seen in Figure 2.2.

Figure 2.2: IS-LM model



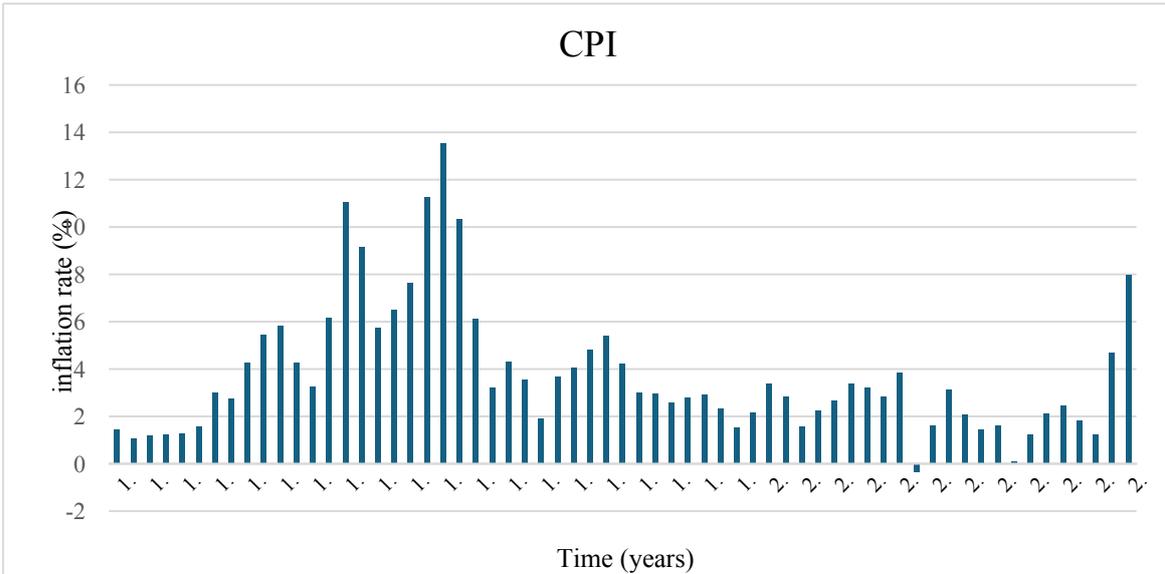
Source: Authors' representation.

Expected inflation, changes in price levels and monetary policy are major drivers influencing the LM curve. Monetary policy will increase the money supply, shifting the LM curve right and reducing interest rates, and vice versa. However, anticipated future output, government purchases and wealth impact the IS curve. In more depth, an increase in wealth, will cause savings to fall, causing the IS curve to shift rightward. Furthermore, when a household expects future output to increase, they will reduce their savings as they consume more today, which increases interest rates, shifting the IS curve to the right. In connection, the IS-LM models' fundamental assumption is that real interest rates and output will be proportionately affected by monetary and fiscal policy, because wealth, prices and wages are not flexible in the short term, this is contradicted in the findings of this study.

Economic History

Over the past 60 years, the U.S. has faced several macroeconomic shocks, with the first major even being the Great Inflation from 1965 to 1982. This was caused by Federal Reserve policies that allowed excessive growth in the money supply (Bryan, 2013). During this period, inflation peaked at 14%, seen in Figure 2.3, prompt the Federal Reserve to reconsider its macroeconomic policies and their impacts (Bryan, 2013).

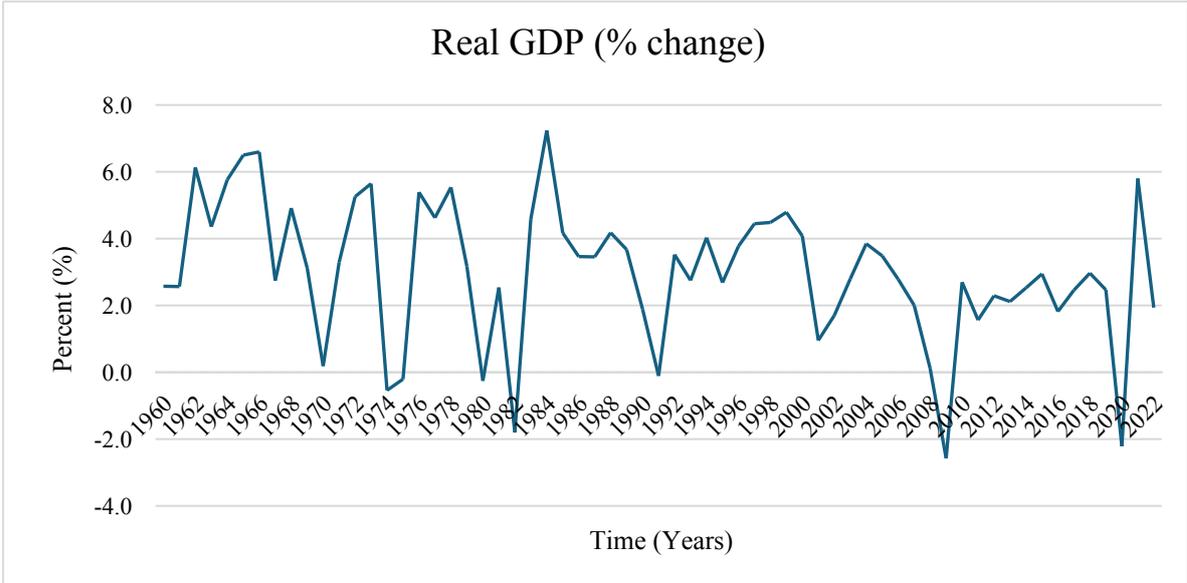
Figure 2.3: CPI in the US 1960-2022



Source: Bureau of Economic Analysis (2024).

After a long period of stability, the U.S. faced the 2008 financial crisis, triggering a global economic downturn. Real GDP fell by 4.3%, as shown in Figure 2.4, due to a sharp decline in house prices, which led to financial markets to crash and a severe economic slowdown, triggering a severe depression.

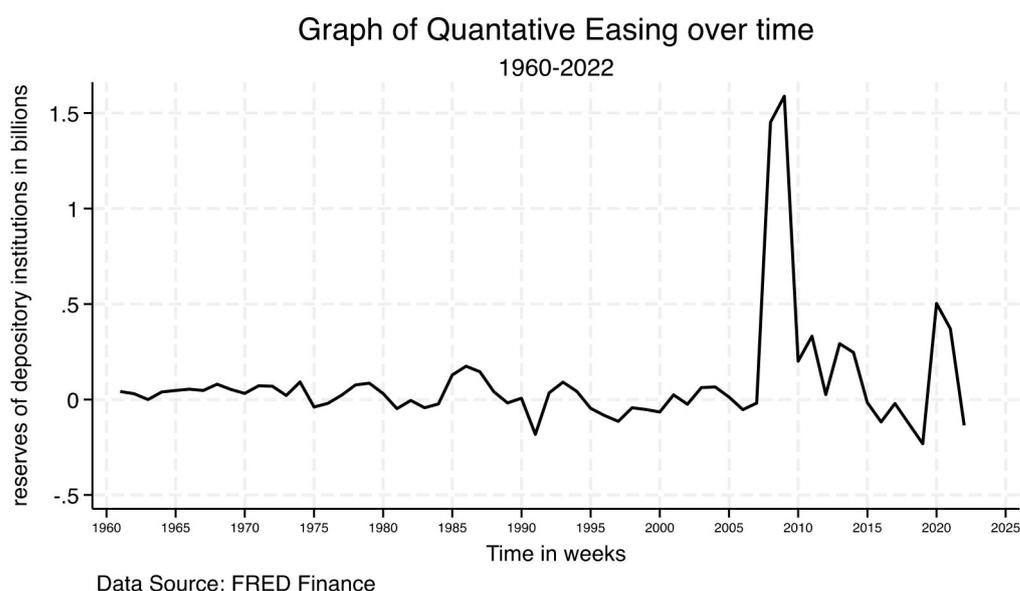
Figure 2.4: Real GDP (%) in the US 1960-2022



Source: Bureau of Economic Analysis (2024).

The U.S. central banks implemented quantitative easing (QE) in 2008, and again in 2010 and 2012, as show in Figure 2.5 (Kiley, 2024). QE was reintroduced in response to the economic impact of Covid-19 pandemic (Kiley, 2024), during which GDP fell by 9% (CBPP, 2024). The U.S. economy has not fully recovered, partly due to the economic effects of Russia’s 2022 invasion of Ukraine, which caused spikes in energy, oil, and food prices, causing another decline in GDP.

Figure 2.5: History of Quantitative Easing within the US



Source: Bureau of Economic Analysis (2024).

Previous Literature

The analysis of consumption has yielded contrasting results. Irving Fisher (1930) introduced the intertemporal budget constraint model, suggesting that consumers are rational and make forward-thinking decisions to optimize lifetime satisfaction through present and future consumption.. he argued that current consumption depends on lifetime income, with the timing of income being irrelevant due to the ability to borrow and lend between periods to maintain smooth consumption. however, Keynes (1936) contradicted this, asserting that changes in current income directly and immediately affect current consumption.

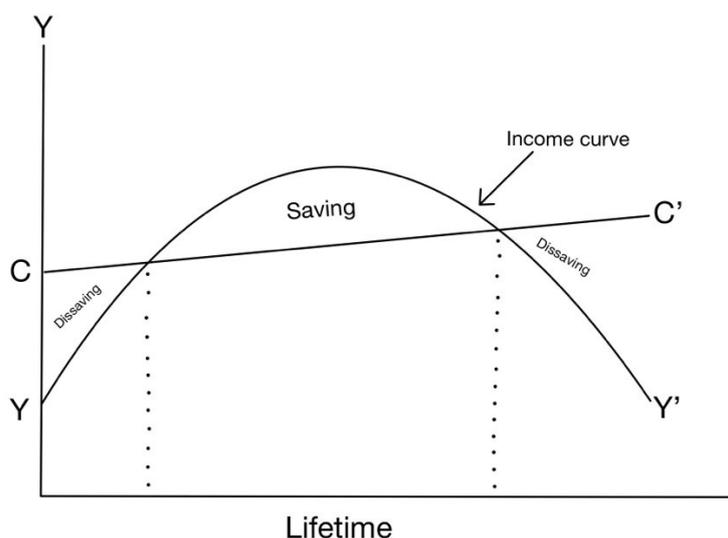
Keynes (1936) introduced the consumption function, asserting that as income increases, consumption rises, though not proportionally due to a non-linear relationship between the two (Friedman, 1957). As income grows, a smaller proportion is spent on consumption while

savings increase. Keynes (1936) also emphasized the immediate effect of income changes on consumption, a claim later contested by other studies.

Keynes (1936) identified additional factors influencing consumption, including long-term changes in interest rates, and subjective elements like enjoyment, generosity, and miscalculations (Drakopoulos, 2021). Pigou (1941) challenged Keynes by highlighting the positive relationship between wealth and consumption, further developed by Modigliani's (1954) life-cycle hypothesis, which considers both income and wealth in determining consumption.

In the 1950's, Modigliani and Brumberg introduced the life cycle hypothesis (LCH) (Modigliani 1966), which suggested that consumption in any period is based on expected lifetime income, rather than current income alone. According to this theory, consumers plan their consumption patterns over their lifetime, aiming to maintain a steady, gradually increasing level of consumption. However, consumption fluctuates depending on the consumers stage of life, seen in Figure 2.8.

Figure 2.8: LCH Model



Source: Authors' representation

Modigliani (1966) highlights wealth as a crucial factor in determining consumption, particularly when comparing different household types. High-income households, where income fluctuates more than wealth, tend to have a lower average propensity to consume

(APC) than low-income households (Drakopoulos, 2021). However, in the long run, wealth and income tend to grow together, leading to a constant APC, aligning with Kuznets findings (Santos, 2013).

The permanent Income Hypothesis (PIH) developed by Friedman (1957), posits that consumer spending is based on permanent income, not current income. Consumers do not adjust their spending in response to temporary income changes, such as salary bonuses or sick pay, which are considered transitory income, which is defined as one-off increases or decreases in non-permanent income (Hepsag, 2014). Instead, they use saving and spending strategies to adjust to temporary changes in income, aligning with the theory of consumption smoothing (Friedman, 1957).

Similarly, to Modigliani (1966), Friedman (1957) highlights the role of wealth in relation to consumption, stating that a higher proportion of wealth or assets leads to a greater propensity to consume. He also emphasises the need to access to wealth plays a role in determining the proportion of permanent income, as income can be both labour income and non-human wealth (assets and money saved). Finally, Friedman (1957) introduced interest rates, noting that higher rates encourage saving and reduce consumption, whilst lower rates have the opposite effect. This aligns with Keynes' (1936) view that in the long run, changes in interest rates influence consumer spending behaviour.

In 1978, Hall (1978) proposed that rational expectations concludes that consumption following a random walk, meaning it cannot be predicted by other variables. Hall (1978) suggested that consumer spending is driven by random economic fluctuations, such as tastes, advertising, and peer pressure, (Campbell, 1989) making it difficult for policymakers to predict or control. This illustrates how consumer decisions are made using all information available to them, so only unpredictable things influence consumption decisions (Hepsag 2014). This challenges traditional theories, which emphasise income, interest rates and wealth as key determinants of consumption. Hall's (1978) theory insinuates that monetary and fiscal policies may be ineffective in controlling growth and inflation.

Previous studies have investigated the effects of various variables on consumption and its components. Mankiw (1985) found a strong relationship between durable goods and interest rates, with higher rates increasing the relative cost of holding durable goods, compared to

nondurable goods and services. Similarly, Lee (1964) explored the impact of income on durable goods consumption, concluding that consumers increase purchases of durables as income rises but resist reducing them when income falls, a behaviour made possible by the use of credit (Lee, 1964).

The Theory

Interest rates play a fundamental role in macroeconomics, representing the cost of borrowing or the rewards of saving (BOE, 2023), significantly influencing consumer spending decisions.

The longstanding economic theory suggests that high interest rates encourage savings, while low rates promote spending and investing (BOE, 2023). This supports the idea of “smooth consumption”, where the representative consumers make rational decisions, aligning with Keynes’ (1936) theory that spending behaviour responds to long-term deviations in real interest rates.

The Federal Reserve (Fed), sets interest rates, manages the money supply, and regulates financial markets through monetary policy. This is a crucial tool for controlling inflation, aiming to keep it low and stable at 2% (+/- 1%), this ensures economic agents to plan for the future (Federal Reserve, 2020). By maintaining low and stable inflation, the U.S. government promotes steady, sustainable economic growth, fostering innovation, productivity, and investment.

The Federal Government implement fiscal policy, adjusting tax rates and government spending to influence the economy and consumer spending habits (Federal Reserve, 2017). Contractionary fiscal policy, which increases taxes, reduces household disposable income and consumption due to a larger tax burden reducing spending power. This particularly impacts durable goods, recreational services, and luxury goods, while having a limited impact on nondurable goods, like food and gasoline, lowering aggregate consumption. Tanzi (1980) highlighted the strong effect of income taxes during inflationary conditions, noting

“fiscal illusion”. In contrast, higher VAT (value added tax) makes goods and services more expensive, *ceteris paribus*, reducing aggregate consumption as individuals can afford less.

Monetary policy involves manipulating interest rates to control the money supply and expand or contract the economy, including through QE (Federal Reserve Board, 2021). QE involves the Federal Reserve purchasing securities from the open market to increase the money supply and lower interest rates, encouraging investment and lending. It is commonly used when interest rates are low (Jackson, 2022), but a liquidity trap can occur if savings remain too high, limiting its effectiveness.

A consumer’s intertemporal budget constraint refers to how household consumption is influenced by their budget, savings, and consumption choices (Black, et al., 2009). In simple terms, it’s the decision to either consume or save, based on the interest rate. Poorer households tend to save less than wealthier ones. Consumers decide between present and future consumption, aiming to maximise utility. When interest rates are high, consumers may choose to save now, and consume later. This decision is shaped by the income effect, substitution effect and wealth effect.

The income effect varies based on a household’s financial situation. For savers, a rise in interest rates increases returns, expanding their budget and allowing more present and future consumption. Conversely, for borrowers, higher interest rates increase loan repayments, reducing their budget, and limiting consumption both now and in the future, despite a potential desire to consume more.

The substitution effect explains that when interest rates rise, the opportunity cost of current consumption increases, making the present goods more expensive than future goods. As a result, households save more now and defer consumption. The wealth effect occurs when households increase consumption as the value of their assets increase, boosting consumer confidence and making them feel wealthier, even if their actual income remains unchanged. Conversely, when asset prices fall, households reduce consumption.

Apart from interest rates and income, factors like money held in financial investments also affect consumption. Financial needs vary across households and significantly influence consumer spending. Investment decisions depend on a household’s attitude to risk and

financial knowledge. Generally, more risk-loving individuals may behave less rationally in their financial decision.

Methodology

The study uses vector Autoregression (VAR) in Stata for econometric modelling. Full variable adjustments and justifications are detailed in Appendix A. The main model examines the impact of interest rates, income, and wealth on consumption components. Three sub-models explore their influence of financial markets on consumption, the relationship between the housing market and consumption, and the effects of interest rates, wealth, and income on foreign consumption.

To ensure consistency and validity within results, all variables are measured annually, and satisfy the recommendation of 30 observations at minimum, as seen in Table 3.1.

Table 3.1: Displaying the time frame of each model

	Year start	Year End	Observations
Main Model	January 1960	December 2022	62
Financial Model	January 1974	December 2022	48
Housing Model	January 1976	December 2022	46
Import Model	January 1960	December 2022	62

A key limitation of the study was restricted data availability for the MMF and ATHPI variables, leading to the creation of sub-models. MMF data was only available from 1974, and ATHPI from 1976. Both datasets meet the minimum requirement of 30 observations, but the results may still be subject to some uncertainty and inaccuracy.

Several variables were considered but ultimately excluded. The 3-month treasury bill, used by Campbell and Mankiw (1989), was rejected as it closely mirrored the interest rate, offering no new insight. The US Nasdaq stock was discarded due to instability in annual terms. Aggregate consumption was initially used but was replaced by consumption components, which provided more nuanced insights, as in studies by Mankiw (1985), Lee

(1964), and Springer (Alp, and Seven, 2019). Although the unemployment rate was included initially, it was dropped as it is not part of the IS-LM model.

Econometric Methodology

Unit Root Tests

The Augmented Dickey-Fuller (ADF) tests the null hypothesis that a unit root is present in an autoregressive time series model (Dickey and Fuller, 1979). This is completed before the VAR analysis to confirm that the variables are stationary and have no unit root. If present, implies that the data follows a trend, cycle, or seasonality. Due to challenges with the ADF test, the Phillips-perron (PP) test is also conducted to check for autocorrelation and heteroskedasticity within the errors, confirming the ADF results (Phillips and Perron, 1988). Both are evaluated against the same hypothesis.

Dynamic Correlation

The multivariate generalised autoregressive conditional heteroskedasticity (mgarch), dynamic conditional correlation (DCC) model is proposed to examine correlation between two time series, to allow for joint analysis and forecasts (Nordström, 2021). This has been applied to all models to investigate the long run impact of each variables against domestic and foreign consumption. When statistically significant, this suggests a long run correlation. However, due to shortcomings, the discussion can be found within the appendix, as the results do not have confidence bands, it is not very robust and does not have standard errors.

VECM

The vector error correction model (VECM) is used when there is a presence of cointegration within a model (Engle and Granger, 1987). Figure 3.2 on the next page was computed to assess whether cointegration was present among the variables. The results presented a potential relationship between GNI and services, however as shown in Figure 3.3, GNI and services have a meaningful connection, indicated by a slight match in the data in 2020, but cointegration is not present over the 60-year span. For this reason, a Vector Auto regression (VAR) model will be used.

Figure 3.2: Plot of Variables for Cointegration

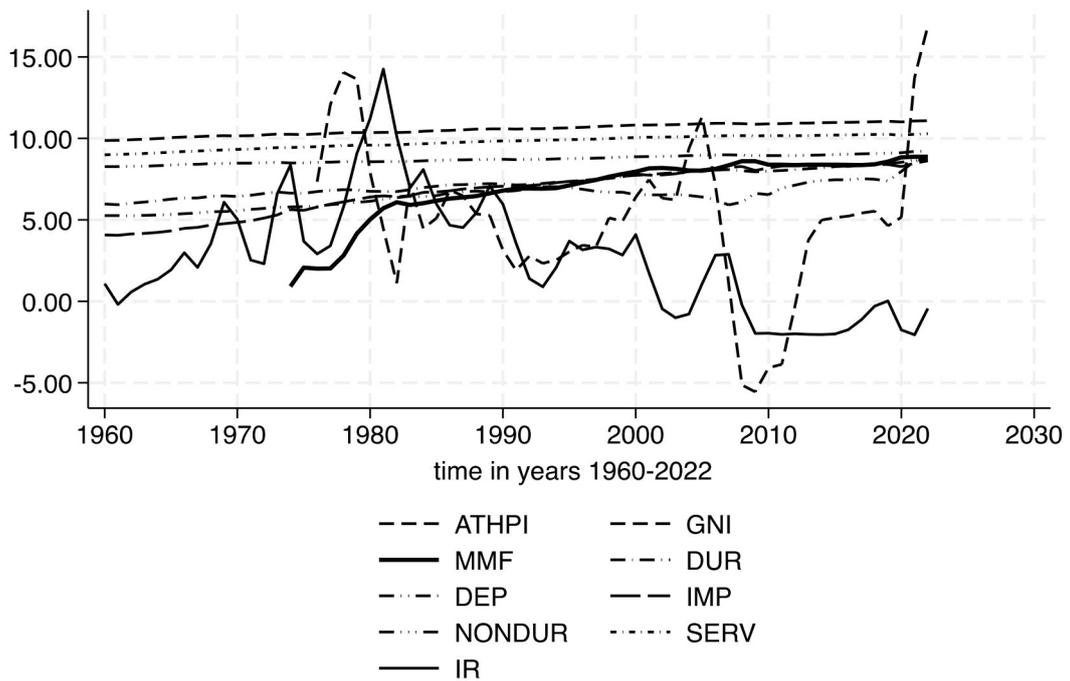
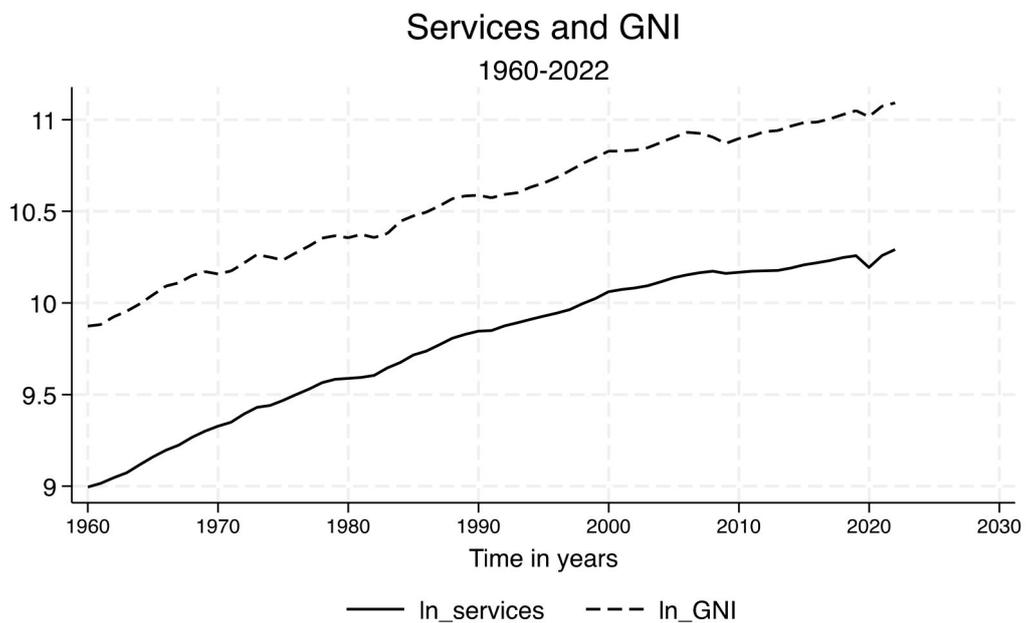


Figure 3.3: Plot of GNI and Services for Cointegration



Data source: FRED

Vector Autoregression

In 1980, Sims developed vector autoregression models; multivariate time series models that set out a simple framework to provide a systematic way to capture dynamics within multiple time series, which allows coherent and credible forecasting and structural inference (Stock and Watson, 2001).

$$Y_t = \Pi_0 + \sum_{i=1}^p \Pi_i Y_{t-i} + v_t$$

This is used to examine the dynamic relationships between variables that interact with each other in the main model, as well as the additional sub-models as previously set out.

Impulse -Response Functions

The impulse response functions are used to analyse the dynamic effects of external shocks on the variables in the models. Cholesky decomposition was applied to establish the order of the variables.

Granger Causality

The granger causality test (Engle and Granger, 1969) is used to establish whether variable X might be causing variable Y, providing that all other terms remained constant. It can be noted that if granger causality holds, it states X might cause Y, but does not guarantee causation. This is implemented after VAR, where the error terms in both equations are assumed white noise and uncorrelated (Engle and Granger, 1969). This is used to assess whether the variables granger cause each other.

To begin with, the unrestricted SSR is obtained:

$$Y_t = \alpha_0 + \sum_{i=1}^p \alpha_i Y_{t-i} + \sum_{j=1}^p b_j X_{t-j} + v_t$$

Then secondly, the restricted form is Setout:

$$Y_t = \alpha_0 + \sum_{i=1}^p \alpha_i Y_{t-i} + v_t$$

There are three outcomes: firstly, unilateral causation, if X is statistically different from zero, whilst Y is not statistically different from zero, then X granger causes Y, and vice versa. Secondly, Bi-directional causation, this occurs, when both sets of X and Y are statistically different from zero and so granger cause each other. Finally, independence, where both X and Y terms are not statically different from zero, and so there is no causation present.

Presentation of Results

Deterministic trends

A deterministic trend is usually a systematic or predictable pattern of change in the data that occurs over time, while a stochastic trend follows random fluctuations. To identify these trends, data for each variable is computed in a straight-line graph. If a deterministic trend is present, the first difference of the variable is taken to remove it. The results, detailed in Appendices B and C, show that durable goods, nondurable goods, services, checkable deposits, GNI, QE, imports and MMF exhibit deterministic trends. In contract, ATHPI and interest rates have stochastic trends, but the first difference will still be applied to check for unit roots.

Unit root tests:

Augmented Dickey-Fuller:

To test whether there is stationarity, the below equation is applied:

$$\Delta Y_t = \beta_1 + \beta_2 t + \gamma Y_{t-1} + \sum_{i=1}^m \alpha_i \Delta Y_{t-1} + \varepsilon_t$$

The variables are tested under the following hypothesis:

$$H_0: p = 1 \rightarrow Y \text{ is not stationary and has a unit root}$$

$$H_1: p < 1 \rightarrow Y \text{ is stationary and has no unit root}$$

Table 4.1: Augmented Dickey-Fuller unit root test of all variables

Variable: Column:	At Level				At First Difference			
	P-value (2)	Lags (3)	Test statistics (4)	5% critical value (5)	P-value (6)	Lags (7)	Test statistics (8)	5% critical value (9)
DUR	0.120	2	-3.046	-3.490	<0.001*	0	-5.809	-2.921
NDUR	0.071	1	-3.274	-3.489	<0.001*	0	-5.558	-2.921
SERV	0.922	1	-1.140	-3.489	<0.001*	0	-6.495	-2.921
DEP	0.901	1	-1.243	-3.489	<0.001*	0	-5.364	-2.921
GNI	0.223	1	-2.733	-3.489	<0.001*	0	-6.356	-2.921
QE	0.651	1	-1.907	-3.489	<0.001*	0	-4.541	-2.921
IR	0.308	2	-2.540	-3.490	<0.001*	0	-5.980	-2.921
IMP	0.967	1	-0.784	-3.489	<0.001*	0	-7.248	-2.921
MMF	0.526	1	-2.135	-3.512	<0.001*	0	-4.568	-2.938
HPI	0.286	1	-2.586	-3.520	<0.001*	0	-4.764	-2.944

* Stationary: A p-value less than the 5% (0.05) significance level.

These results are tested against the following hypothesis:

At level:

H_0 : The level has a unit root (null)

H_1 : The level does not have a unit root (alternative)

Table 4.1 reports all 10 variables having a unit root at level, and so the null hypothesis cannot be rejected as they are not stationary. Columns 4 and 5 reveal that all test-statistics are greater than the 5% critical values. Additionally, column 2 shows the p-values are not statistically significant at the 5% level, which supports the claims of a unit root/not stationary.

At the first difference:

H_0 : The first difference has a unit root and is not stationary (null)

H_1 : The first difference does not have a unit root and is stationary (alternative)

The differencing of each variable was performed to remove trends and test for stationarity at the first difference. according to column 6 in table 4.1, none of the variables have a unit root at level, indicating they are stationary at first difference. columns 8 and 9 show that all test-statistic are below the 5% critical value, with more negative values providing stronger evidence against a unit root. The p-values, marked with ‘*’, are all below the 5% significance level allowing rejection of the null hypothesis. Thus, the variables are integrated of order 1, denoted as I(1), making them suitable for analysis and VAR modelling.

Phillip-Perron:

Table 4.2: Phillip-Perron unit root test

Variable: Column:	At Level					At First difference				
	P-value (2)	Lags (3)	Test statistics (4) Z(t)	5% values (5)	Critical	P-value (6)	Lags (7)	Test statistic (8) Z(t)	5% values (9)	Critical
DUR	0.235**	3	-2.704	-3.488		<0.001*	0	-5.809	-2.921	
NDUR	0.368**	3	-2.423	-3.488		<0.001*	0	-5.588	-2.921	
SERV	0.960**	3	-0.867	-3.488		<0.001*	0	-6.495	-2.921	
DEP	0.964**	3	-0.826	-3.488		<0.001*	0	-5.364	-2.921	
GNI	0.543**	3	-2.106	-3.488		<0.001*	0	-6.356	-2.921	
QE	0.879**	3	-1.337	-3.488		<0.001*	0	-4.541	-2.921	
IR	0.295**	3	-2.569	-3.488		<0.001*	0	-5.980	-2.921	
IMP	0.983**	3	-0.516	-3.488		<0.001*	0	-7.248	-2.921	
MMF	0.943**	3	-1.008	-3.488		0.001*	0	-4.178	-2.938	
HPI	0.7785* *	3	-1.635	-3.516		<0.001*	0	-4.747	-2.944	

* Stationary: A p-value less than the 5% (0.05) significance level.

At level:

The same hypothesis as the ADF test applies here. Table 4.2 shows that the variables have a unit root and so are not stationary at level, which means the null hypothesis cannot be rejected. Columns 4 and 5 shows the test-statistic is greater than the 5% critical values. Column 2, supports this as the p-values are greater than the 5% significance level.

At first difference:

The same hypothesis applies as the ADF at first difference. Table 4.2, columns 8 and 9 display that is no unit root and so the variables are stationary at the first difference, indicated by a test-statistic score lower than the 5% critical value. Additionally, column 6 reports that all p-values are below the 5% significance level, concluding that the null hypothesis of a unit root can be rejected, and so in summary, all of the variables are stationary and differenced at the first order I (1).

VAR results

The lag selection order criteria are one of the most important aspects of the VAR model specification as it sets out the optimal lag for the model. The Akaike (AIC) selection has been used, which concludes that for all four models, 2 lags are optimal, this found in Appendix E.

In order to specify a VAR model, it can be estimated using ordinary least squares given the following assumptions:

1. The error term has a conditional mean of zero.
2. The possibility of large outlier is low.
3. The variables in the model are stationary.
4. No perfect multicollinearity.

A constant mean suggests that conditionally they may have a mean some distance from zero. The results for each model can be found under Appendix F. Each model shows that the residuals have a mean around zero, and so the first assumption is satisfied. A companion matrix of unit roots and an eigenvalue table were used to check that the models were stable and check for large outliers. The results, also in Appendix F, concluded that each model is stable, meeting the second assumption. The stationarity results as previously discussed, indicate all variables are stationary at the first difference, satisfying the third assumption.

To address multicollinearity and satisfy the fourth assumption, logs of variables with high values were used. The Lagrange multiplier test was conducted for each model to check for autocorrelation, with results in appendix F showing no autocorrection, ensuring stable and consistent results. The VAR model's findings are presented as impulse response functions (IRFs) and Granger causality, with the full VAR output detailed in Appendix G.

Main-Model Impulse-Response Function Results:

In the impulse response functions (IRFs) the grey area represents confidence bands that indicate statistical significance, with significance marked by ‘*’. If the confidence interval deviates significantly from the line, the results are not statistically significant. the study will focus on discussing only the one-way relationships that are relevant to achieving the studies aims. the complete results are available in Appendix I.

Figure 4.3: Nondurables goods as the response variable

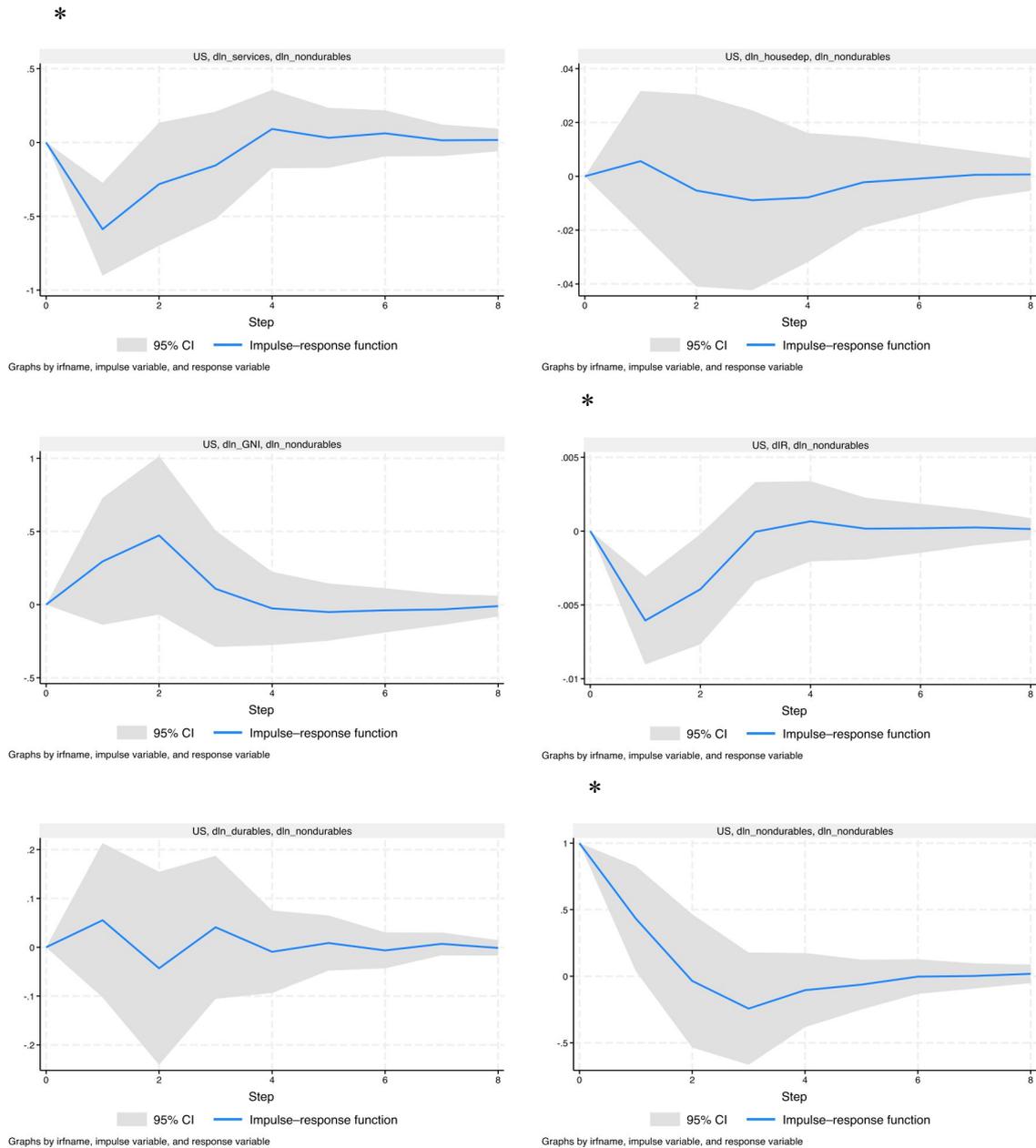


Figure 4.4: Durable goods as the response variable

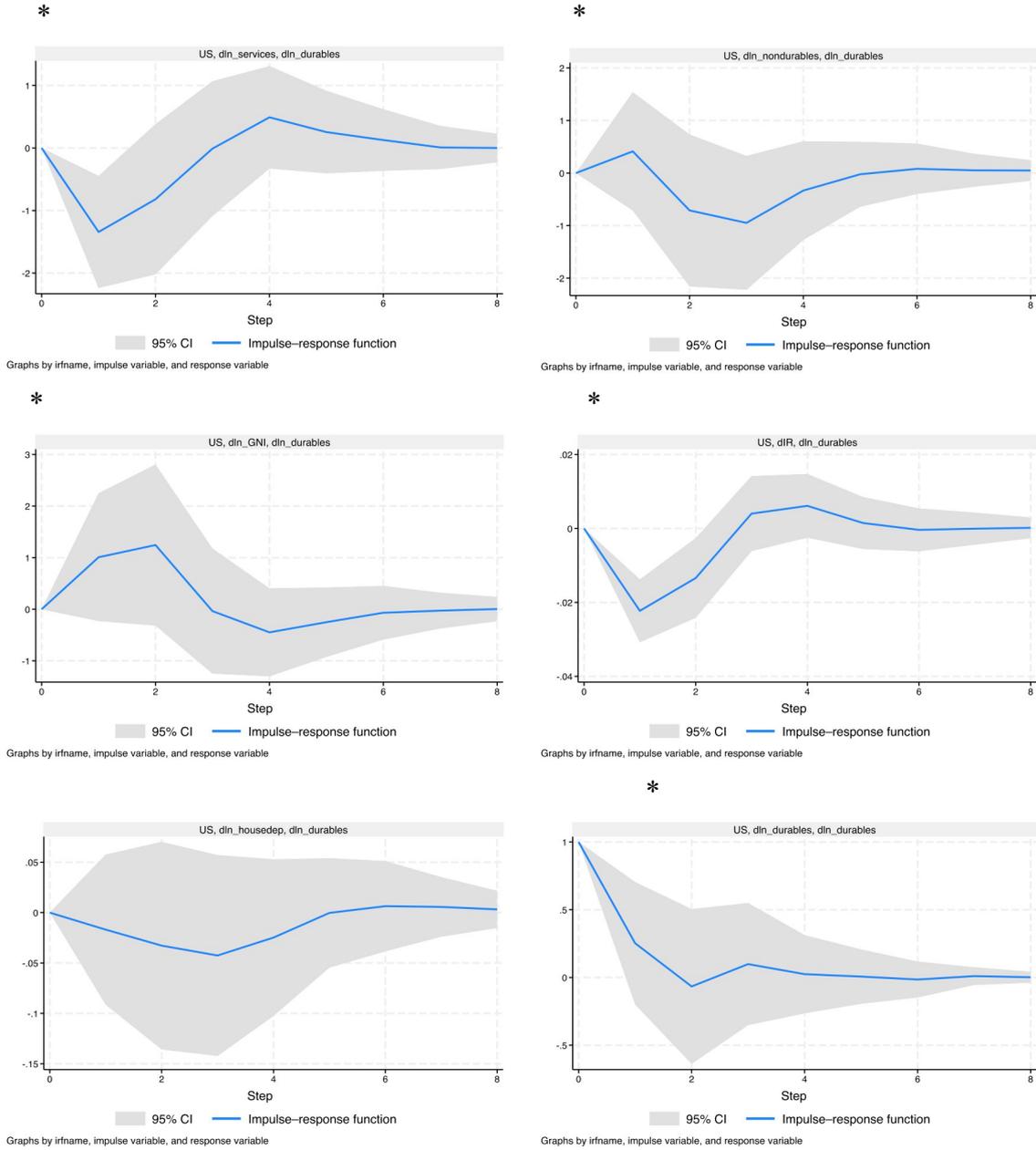
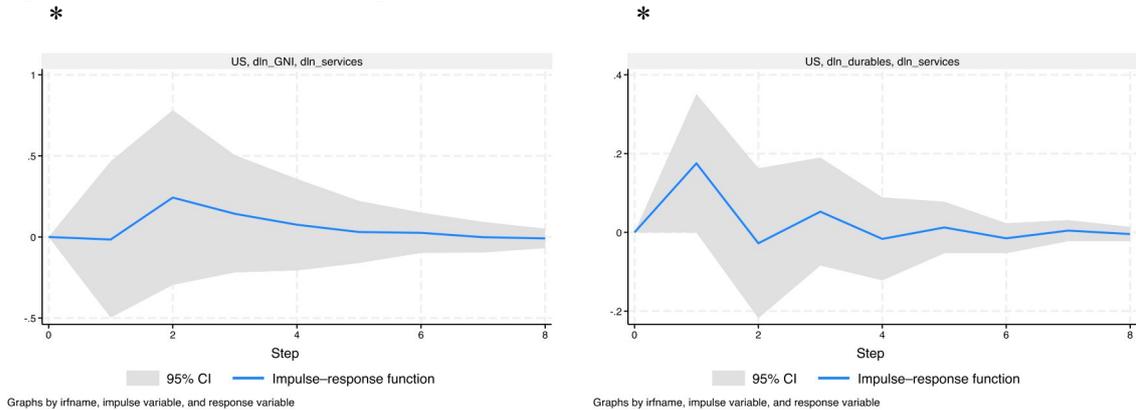
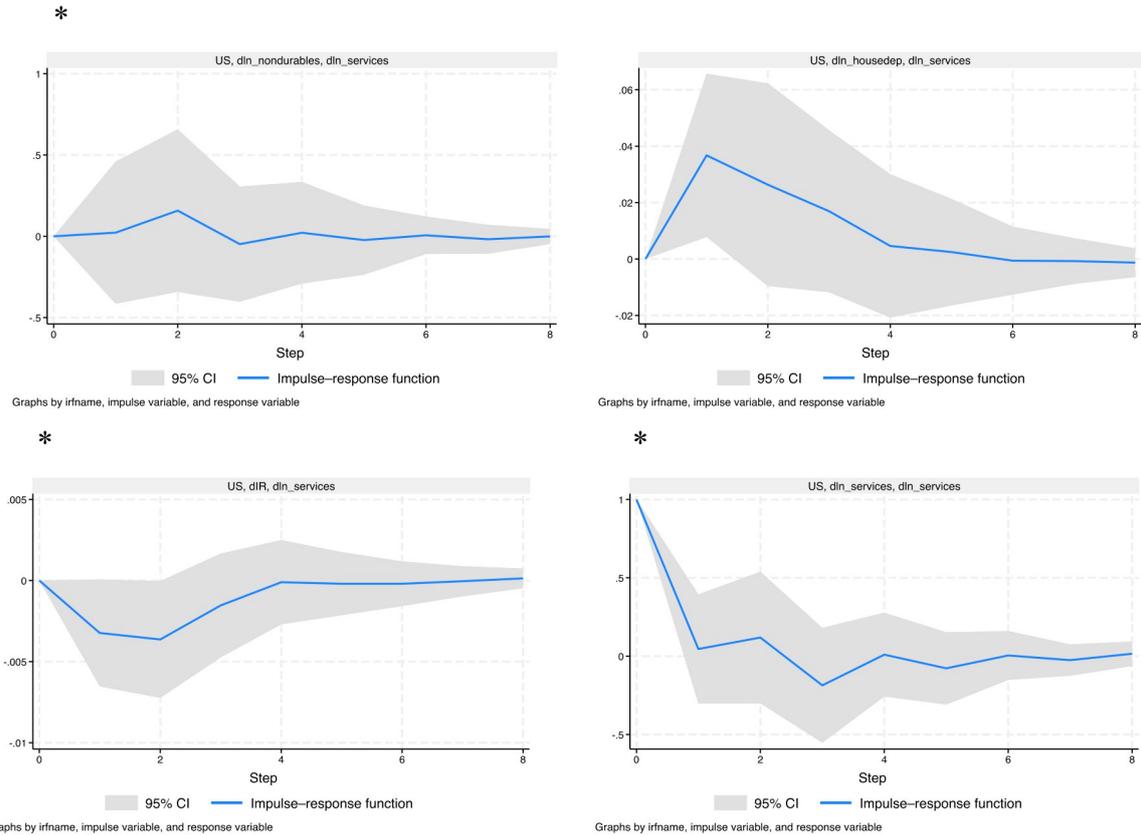


Figure 4.5: Services as the response variable





Granger Causality Results

The variables are tested under the following hypothesis, as set out:

$$H_0: \sum_{j=1}^p b_j = 0 \text{ or } X \text{ does not Granger - cause } Y$$

$$H_1: \sum_{j=1}^p b_j \neq 0 \text{ or } X \text{ does Granger - cause } Y$$

H_1 strictly implies that at least one of b coefficients is statistically different from zero

Table 4.21- Main model Granger Causality

Dependent variables: Nondurable goods (Y)	chi-square	df	Prob> chi-square
Independent variables: (X)			
Durables	0.565	2	0.754
Services	14.02	2	0.001 *
Checkable deposits	1.891	2	0.388
GNI	2.813	2	0.245

Interest rates	15.964	2	<0.001*
ALL	41.411	10	<0.001*
Dependent variables: Services (Y)	chi-square	df	Prob> chi-square
Independent variables: (X)			
Durables	4.499	2	0.105
Nondurables	0.635	2	0.728
Checkable deposits	11.120	2	0.004 *
GNI	0.041	2	0.980
Interest rates	4.332	2	0.115
ALL	29.494	10	0.001 *
Dependent variables: checkable deposits (Y)	chi-square	df	Prob> chi-square
Independent variables: (X)			
Durables	0.316	2	0.854
Nondurables	0.284	2	0.868
Services	5.545	2	0.062
GNI	1.222	2	0.543
Interest rates	2.389	2	0.303
ALL	9.870	10	0.452
Dependent variables: GNI (Y)	chi-square	df	Prob> chi-square
Independent variables: (X)			
Durables	2.170	2	0.338
Nondurables	0.495	2	0.781
Services	2.639	2	0.267
Checkable deposits	4.566	2	0.102
Interest rates	10.965	2	0.004 *
ALL	39.172	10	<0.001*
Dependent variables: Interest rates (Y)	chi-square	df	Prob> chi-square
Independent variables: (X)			
Durables	0.819	2	0.664

Nondurables	1.549	2	0.461
Services	0.903	2	0.637
Checkable deposits	2.137	2	0.344
GNI	0.983	2	0.612
ALL	9.025	10	0.530
Dependent variables: Durable goods (Y)	chi-square	df	Prob> chi-square
Independent variables:			
Nondurables	1.023	2	0.600
Services	8.638	2	0.013 *
Checkable deposits	0.861	2	0.650
GNI	3.923	2	0.141
Interest rates	26.796	2	<0.001*
ALL	44.047	10	<0.001*

When the p-value exceeds the 5% significance level this suggests that the variable is equal to zero, and therefore, variable X does not granger cause variable Y. However, if the p-value is below the 5% level of significance, then the variable is not equal to zero, and so, variable X does granger cause Y, this can be seen in the results, displayed as ‘*’.

Extended Granger Causality Results:

In addition to the main model, in order to investigate the aims of this study, granger causality was applied to the three sub-models, the full results can be found in Appendix H.

Reported results:

Granger causality:

Table 4.21 indicates that interest rates Granger-cause nondurables, durables, and imports, but there is no statistical evidence that they cause changes in services. This suggests interest rates can predictably influence domestic goods and imports, making monetary policy effective for managing foreign and domestic consumption, but not for services.

Table 4.21 shows that GNI does not Granger-cause nondurables, durables, services or imports, indicating that past GNI values are not useful for predicting future consumption.

This suggests that current income affects current consumption, but not future consumption, aligning with Keynes (1936) consumption function. It is similar to Kuznets (Santos, 2013) findings, where consumers might save additional income rather than spend it. Additionally, reliance on credit for purchasing goods makes consumption less responsive to income changes.

Table 4.21 shows that checkable deposits do not Granger-cause durables or nondurables but do Granger-cause services and imports. This means that changes in checkable deposits (a form of wealth) will lead to predictable changes in services and imports.

Table 4.23 indicates that ATHPI (current house prices) does not Granger-cause nondurables, durables, or services, meaning changes in house prices do not predict changes in consumption. Table 4.24 shows that MMF (money market funds) Granger-causes only durables, so an increase in MMF holdings lead to predictable changes in the consumption of durable goods. Both these relationships are examined within the discussion.

Impulse-Response Results:

Figure 4.3 shows that a one-unit positive shock in interest rates causes a -0.005 decrease in nondurable goods consumption, lasting for 3 periods before returning to zero. Figure 4.4 indicates a one-unit positive shock in interest rates results in a -0.02 decrease in durables consumption, with the effect converging to zero by period 3. Figure 4.5 reveals that a one-unit positive shock in interest rates leads to a -0.005 decrease in services consumption, with the effect not returning to zero until period 4.

Figure 4.4, shows that a one-unit positive shock in GNI results in a strong, positive response in durable goods consumption, with a magnitude of 1.1 lasting 3 periods. Figure 4.5 shows a one-unit positive shock in GNI increases services consumption by 0.3 with the effect converging by period 5. Figure 4.3 indicates that the relationship between GNI and nondurables is not statistically significant, as shown by the confidence intervals.

Figure 4.15 shows that a one-unit positive shock in ATHPI results in a 0.002 increase in nondurables consumption, with the effect converging to zero by period 2. Figure 4.16 indicates that the relationship between services and interest rates is not statistically significant. Figure 4.14 shows that a one-unit positive shock in ATHPI leads to a 0.003

increase in durable goods consumption, with this effect lasting only 2 periods before converging to zero.

Figures 4.10 and 4.12 show that MMF's relationship with services and nondurable goods is not statistically significant, indicating no evidence of a relationship. However, figure 4.11 demonstrates that a one-unit positive shock in MMF leads to a minimal decrease in durable goods consumption (-0.08), with the effect persisting until period 5. This suggests a weak but long-lasting negative relationship between MMF and durable goods.

Imports model Results:

The impulse response functions (IRFs) in Appendix I reveal that shocks to imports from wealth, interest rates, and income is not statistically significant. However, the dynamic correlation results offer valuable insights into the relationships between these variables. a detailed discussion and conclusion are available in Appendix D.

Results Summary

Consumption and Interest rates

The intertemporal budget constraint theory suggests that rising interest rates should lead rational households to increase savings and reduce consumption to take advantage from higher returns, this is dependable on personal references. However, this study's results only partially align with this theory, indicating some inconsistencies in the expected relationship between interest rates, savings, and consumption.

The causality results suggest that while monetary policy can influence future consumption, the observed impact of interest rate changes on consumption components is minimal and somewhat undesirable. This minimal effect indicates that households may not significantly increase savings in response to higher interest rates, instead, households may continue their regular savings contributions and not forego current consumption substantially, aligning with Friedman's (1957) and Keynes' (1936) theories on consumption behaviour.

The analysis reveals that interest rates have a lasting impact on the consumption of services. Rational consumers typically prioritise essential services, like healthcare, even when interest rates rise, to maintain utility maximisation. However, over time, if high interest rates persist,

consumers might substitute spending on non-essential services, such as dining out, to increase savings.

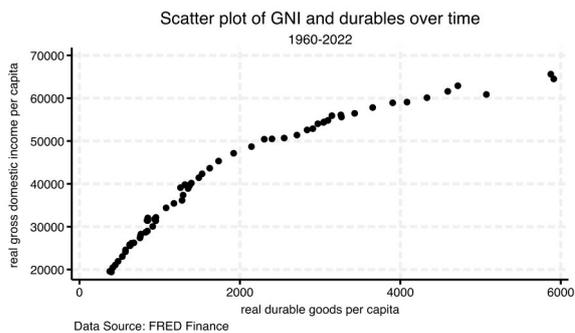
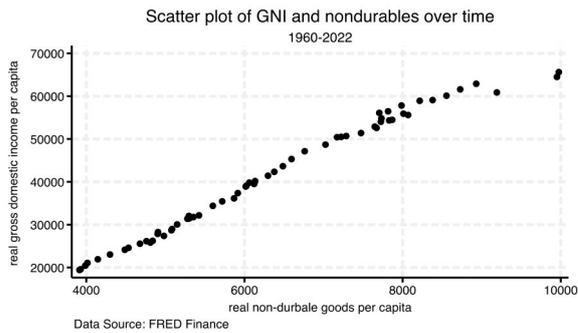
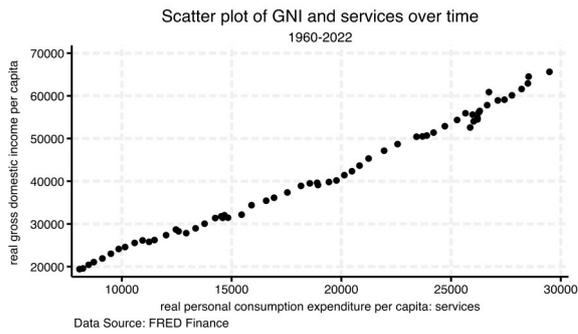
The analysis shows that interest rates have a minimal impact on nondurable goods, as rational consumers prioritise essential items like food and avoid reducing consumption to save more. Conversely, durable goods are the most receptive to changes in interest rates. Higher interest rates increase borrowing costs, leading consumers to postpone durable goods purchases and save in the short term due to higher interest repayments. This aligns with the substitution effect, where rational consumers delay consumption, alternatively saving until rates decline. This could explain why the impact on durables is short lived, as consumption can be prolonged in the short-term, but not long-term. Mankiw (1985) found similar results, highlighting the strong responsiveness of durable goods consumption to interest rate fluctuations.

The analysis concludes that higher interest rates lead to a greater reduction in the consumption of non-essential goods compared to necessities, reflecting rational, forward-thinking consumer behaviour, as described by Fisher (1930). This aligns with Springer (Alp and Seven, 2019), who found varying impacts of real interest rates on different consumption components. The results partially support the PIH (Friedman, 1957), indicating that while consumers reduce consumption with rising interest rates, the effect is minimal. Therefore, it is suggested that the Federal Reserve considers alternative policy measures, such as fiscal policy and tax rate adjustments, to control spending behaviour more effectively.

Consumption and GNI

Previous literature indicates that income is primary determinant of consumption alterations. It is generally assumed that an increase in income leads to increase in consumption, and vice versa. This relationship which highlights how income affects individuals spending capacity, is illustrated in Figure 5.1.

Figure 5.1: Plot of GNI and Consumption



Source: BEA (2024), Authors' computations.

The IRFs results align with expectations: nondurable goods, being inelastic show little response to income changes. Conversely, an increase in income has a weak impact on services, influenced by the type of service, increases in income will have a greater impact for the demand of luxury services vs necessities, based on elasticity. Durable goods are highly income elastic, meaning that increases in income significantly boost their demand, supporting Lee's (1964) findings that higher income increases purchases of durable goods.

The results indicate that while durable goods respond immediately to changes in income, services do not, partly supporting Keynes' (1936) theory of immediate consumption changes with income, but conflicting with Kuznets (Santos, 2013) finding of a long-run relationship. This discrepancy may be due to consumer credit, which allows for consumers to purchase goods despite income changes, smoothing consumption between period, which makes

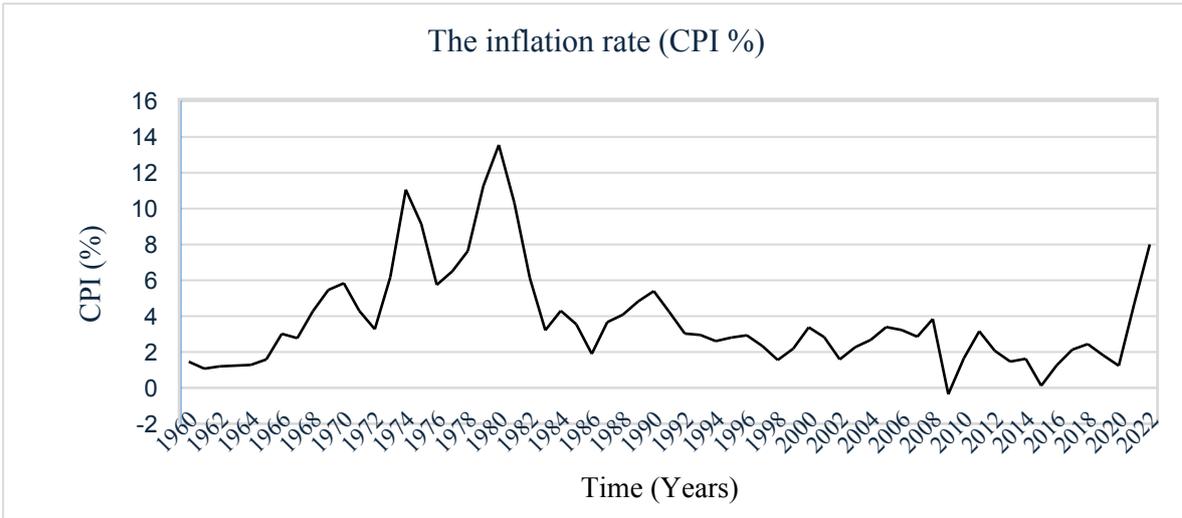
changes to current income ineffective. Overall, durable goods are the most responsive to income changes, followed by services, with no statistical evidence of an impact on nondurable goods, showing a similar trend as interest rates.

Consumption and Wealth

In contrast to previous literature suggesting a positive relationship between consumption and wealth, the components of consumption in this study are not statistically significant with household checkable deposits. This may be attributed to factors such as income inequality in the U.S., where many individuals live pay check to pay check limiting their ability to invest in checkable deposit accounts (CDA's) or accrue savings. This likely skews the data, as primary contributors to such savings are wealthier individuals, leaving the broader population unrepresented in the analysis.

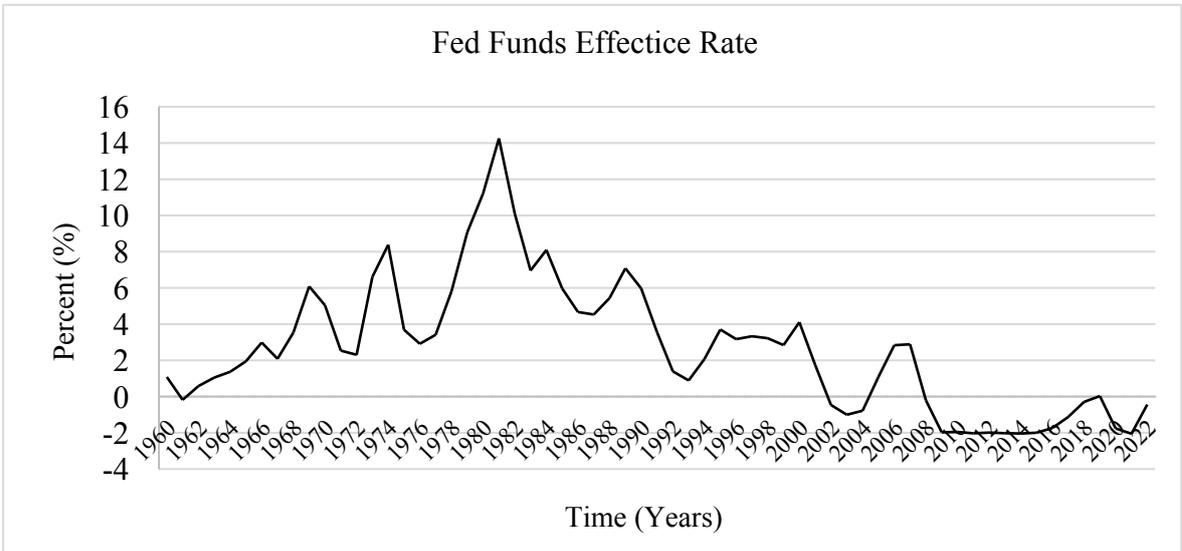
In the U.S. individuals tend to invest rising income in stocks, bonds, or mutual funds, rather than putting money into CDA's. A notable example is increasing use of money market fund (MMF) accounts, a type of interest-earning savings account. This trend has grown since the 1970s, following the Great Inflation. During this period of high inflation, interest rates approached 20%, making MMF accounts particularly attractive due to their high returns, as depicted in Figure 1.3 and 5.2.

Figure 1.3: The inflation rate in the US 1960-2022



Source: BEA (2024)

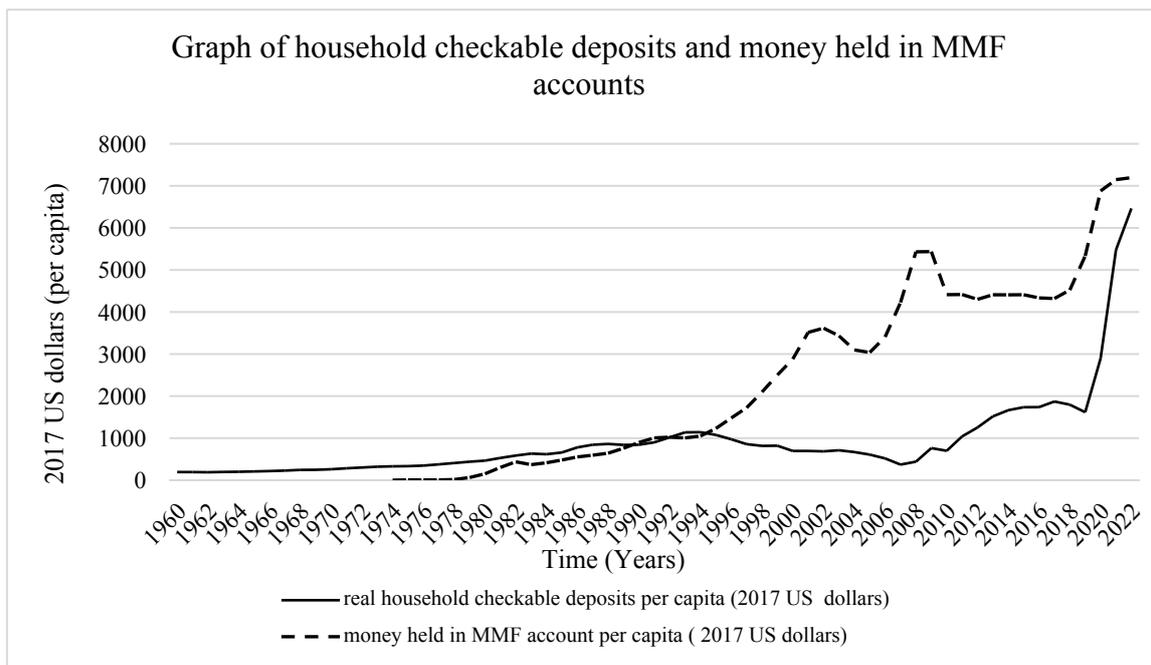
Figure 5.2: The real interest rate in the US 1960-2022



Source: BEA (2024)

Figure 5.3 shows that as money held in MMF accounts rose steadily over the 20-year period from the 1970's to the 1990's; checkable deposits started to level off and decline.

Figure 5.3: A Plot of Checkable Deposits and MMF



Source: BEA (2024)

By the mid-1990s, money held in MMF accounts sharply increased, while CDAs declined. Following the 2008 financial crisis, CDAs rose, possibly due to low consumer confidence and a desire for financial security. Simultaneously, MMF balances dipped, but both variables levelled off as the economy stabilised. In 2020, during COVID-19, there was a significant rise in both CDA and MMF balances due to reduced spending during lockdowns, seen in Figure 5.3. This trend suggests that U.S. consumers view MMF accounts and CDAs as substitutes, with an inverse relationship between the two.

Consumption and House Prices

When house prices rise, the wealth effect suggests consumers feel more confident and increase spending, even without changes in income. This can lead to a rise in mortgage equity withdrawals, providing households with inexpensive financing to support consumption. Since a home is typically a household’s largest asset, changes in its value significantly impact the economy. This was evident after the 2008 financial crisis, which caused the “most severe year over year decline in consumption” (Nardi et al, 2011), highlighted in Figure 2.4. The findings indicate that rising house prices lead to higher consumption, consistent with Pigou’s theory (Samuelson, 1941) of a positive relationship between wealth and consumption.

The relationship between house prices (ATHPI) increases and nondurable goods can be explained by the essential nature of these goods. A rise in wealth does not necessarily lead to higher consumption of essentials like food but might cause consumers to opt for higher-end products, substituting cheaper items for more expensive ones. The lack of statistically significant results between ATHPI and services could be due to the inelastic demand for essential services, like healthcare or childcare. A rise in wealth wouldn't lead to increased consumption of these services, as they are used only when necessary.

The relationship between ATHPI and durable goods reflects the wealth effect, where households are more likely to invest in durables when confidence is high. During such periods, consumers tend to purchase durable goods they may have delayed, as these are often financed through credit. In contrast, during economic downturns or times of low confidence, rational consumers avoid taking on additional credit. These findings align with Modigliani's (1966) view that current wealth influences consumption decisions.

The impact of house price increases on consumption is short-lived and minimal, suggesting that changes in house prices create only temporary consumer confidence. Consumers do not make lasting adjustments to their spending based on temporary changes in wealth, aligning with Friedman's (1957) PIH. Thus, while rising house prices may boost consumer spending in the short term, the effects are not permanent. This also supports the IS-LM model, where an increase in wealth leads to a decrease in savings, potentially shifting the IS curve to the right.

Consumption and Money Held in MMF Accounts.

The results highlight the role of financial saving within the intertemporal budget constraint, where consumers face the trade-off between saving and investing through bank accounts, stocks, bonds, and mutual funds versus spending on goods and services. The findings suggest that consumers are willing to substitute durable goods consumption for savings but are less willing to do so for services and nondurables. This can be attributed to consumer rationality, as they prioritise maintaining their standard of living by not sacrificing essential goods and services for investment purposes.

The relationship between durable goods and money held in MMF accounts is influenced by the profitability of these accounts. When interest rates are low, MMF returns decrease, making durable goods more attractive to purchase. Conversely, when interest rates rise, consumers may prefer saving over spending due to the higher costs of borrowing, leading to increased savings in MMF accounts to benefit from better returns. This reflects the substitution effect, where current consumption is deferred in favour of future consumption. However, not all consumers act rationally, low interest rates may lead some to hoard cash, posing liquidity constraints.

Conclusions

The main outcome of the study was to analyse the relationship between consumption and interest rates. The results confirmed an inverse relationship, showing that an increase in real interest rates leads to a decrease in the consumption of durable goods, nondurable goods, and services. The study also revealed that income, specifically a rise in GNI, has a greater impact on consumption than interest rates. However, while the effects of interest rates are minimal, they still play a significant role in influencing consumption patterns.

This study has several practical applications. It successfully provides insights into the research aims, showing that changes in house prices positively impact the consumption of durable and nondurable goods, supporting the wealth effect and aligning with previous literature. However, the findings contradict the IS-LM model, as real interest rates and output are not proportionally affected by monetary policy, with housing wealth leading to only short-term fluctuations in consumption.

One key finding from this chapter is that financial wealth causes long-lasting changes in the consumption of durable goods, even though it has little impact on overall consumption. This highlights the connection between financial markets and consumer spending behaviour, providing a foundation for future research. The study also noted that durable goods are the most volatile component of consumption and the most responsive to changes in other variables, aligning with Mankiw's (1985) findings.

The study concludes that monetary policy is only effective in controlling the consumption of goods, not services and its impact is weak and short term. This suggest that the Federal

Reserve should consider alternative policies, such as fiscal measures like adjusting tax rates, to manage consumption more effectively. This finding contrasts with Hall’s (1978) random walk theory, as the results conclude that consumption is influenced by changes in various factors, rather than economic fluctuations.

Suggestions for Further Studies

The study suggests repeating the research in different countries go assess if housing wealth affects consumption similarly, in poorer economies as it does in the U.S. Future research could explore the impact of financial wealth on consumption, especially through emerging assets like NFTs and Bitcoin through current data limitations hinder this. Researchers are also encouraged to focus on foreign consumption using quarterly data for more credible results on the interplay between foreign and domestic consumption to changes in interest rates, income, and wealth. Lastly, when more data is available, a comprehensive model as opposed to split models, should be developed to gain deeper insights into the relationship between consumption and other variables.

Abbreviations used

Table 1.1: Abbreviations

In text				
Durables	Durables goods	DUR	ln_durables	Log of real durable goods per capita
Nondurables	Nondurable goods	NDUR	ln_nondurables	Log of real nondurable goods per capita
Services	Services	SERV	ln_services	Log of real services per capita
Wealth	Household checkable deposits	DEP CDA’s	ln_housedep	Log of household checkable bank deposits per capita
Income	Gross national income	GNI	ln_GNI	Real gross national income per capita
QE	Quantative easing	QE	ln_QE	Log of total reserves for depository institutions
Interest rates	Federal funds effective rate Real interest rate	IR	rIR	Real federal funds effective rate (%)
Foreign consumption	Imports	IMP	ln_imports	Log of real imports per capita
MMF	Money market funds	MMF	ln_MMF	Log of real money held in money market funds accounts (mutual fund) per capita
ATHPI	All-transactions	HPI	ATHPI	Real all-transactions

	house price index			house price index %
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Appendix A: The adjustments and justifications for the variables:

The variables are adjusted per capita, to make clear, concise comparisons of economic performance and individual impacts. The data is adjusted for inflation, using 2017 US dollars to negate the effects of inflationary pressures. The following variables (Services, nondurables, imports, wealth, durables, QE, MMF and GNI) were generated as logs to allow for easier comparisons of visible trends, similar to Mankiw and Campbells (1989) study, where they generated a log-linear approximation of their model.

The following variables were collected in order to answer the research question and achieve the aims of this study:

The three components of personal consumption expenditure; Durable goods, Nondurable goods and services are adjusted for inflation, per capita and transformed into a log. These are the main variables within the VAR model.

The federal funds effective rate is the interest rate and converted from nominal to real terms. This is the main dependent variable in the model to address in impact on the components of consumption.

Population data is collected to adjust other variables into per capita terms.

Inflation data is collected to adjust variables into real terms.

Household checkable deposits are collected to address the impact of wealth on consumption. The variable has been taken in real terms, per capita and logged.

GNI data is already in real terms, adjusted per capita and logged, and collected to assess the impact of income on consumption.

Reserves of depository institutions are collected, as this is the other tool used in monetary policy alongside interest rates.

* Total money worth held in MMF accounts (MMF) is transformed into real terms, per capita, to assess the implication of financial markets on consumption. This is a type of mutual fund, also known as an interest-earning saving account.

* The all-transactions house price index (ATHPI) is calculated in real terms and as a percentage change of the index to measure the appreciation of the variable, in order to assess the change in house prices have on consumption within the economy. It is a broad measure of the movement of single-family house prices in the United States and is based on transactions involved in conventional conforming mortgages on single-family mortgages.

*Import data is adjusted in real terms, per capita, in order to assess the impact in interest rates and other variables on foreign consumption

Appendix B – Deterministic Trends at Level:

Figure 4.25: Annual data of real interest rates

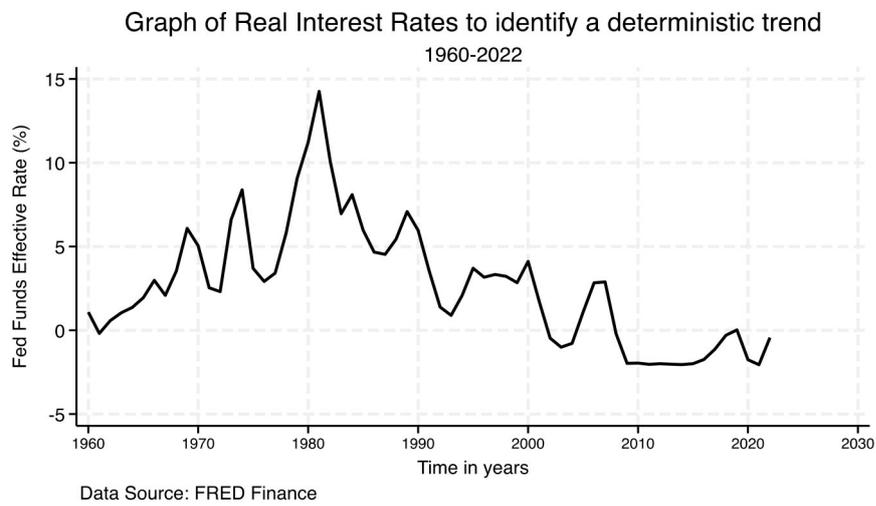
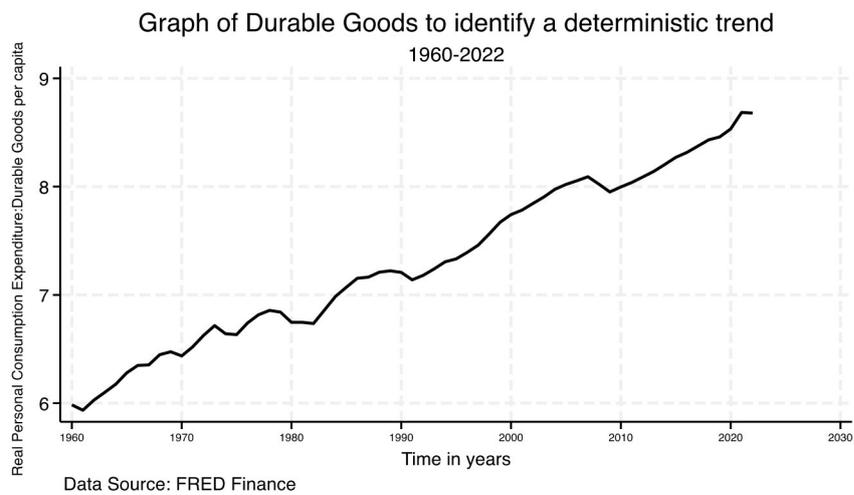


Figure 4.26: Annual data of durable goods



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.27: Annual data of nondurable goods

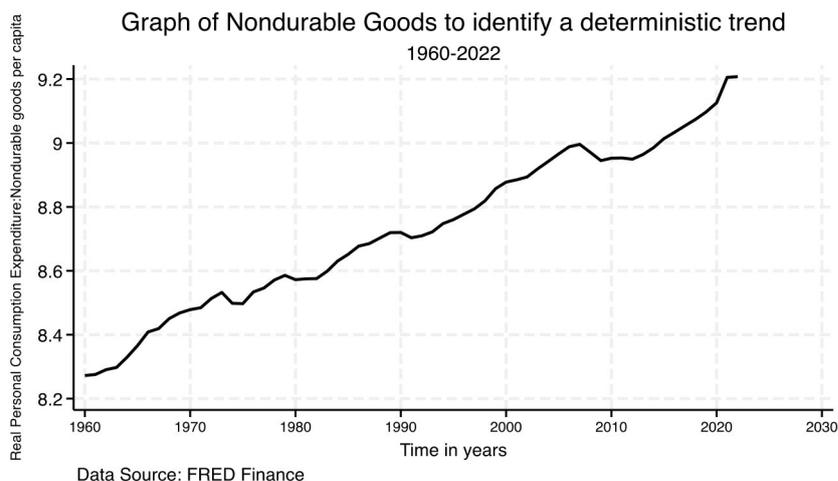
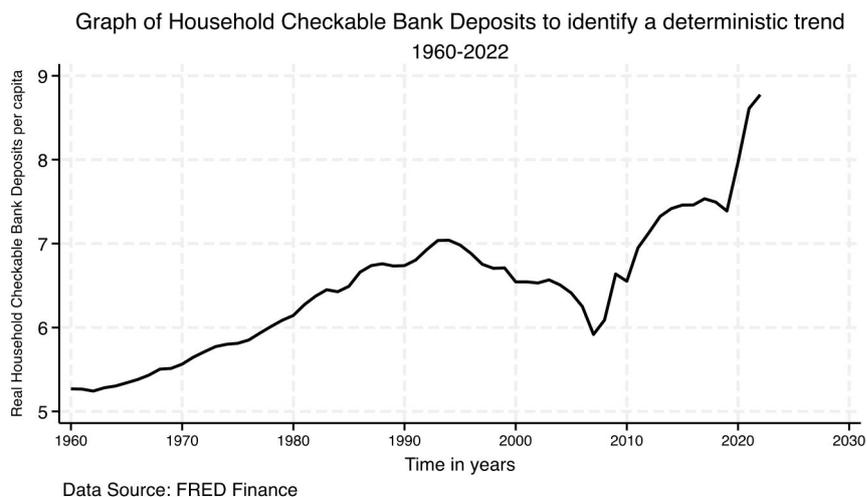


Figure 4.28: Annual data for household checkable deposits



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure GNI: Annual data for GNI

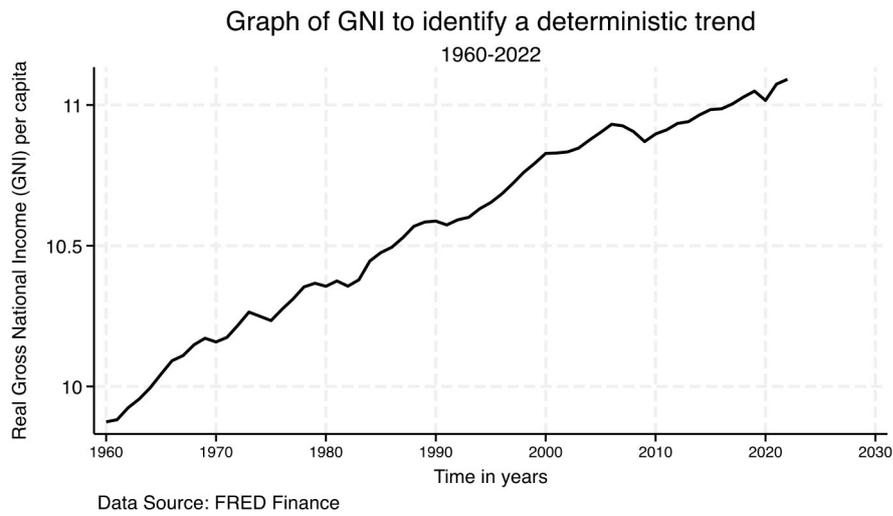
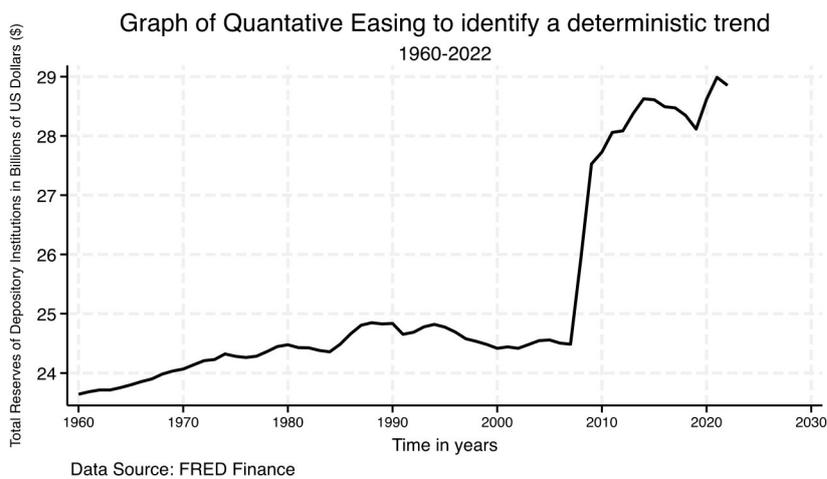


Figure 4.30: Annual data for Quantative Easing



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.31: Annual data for Imports

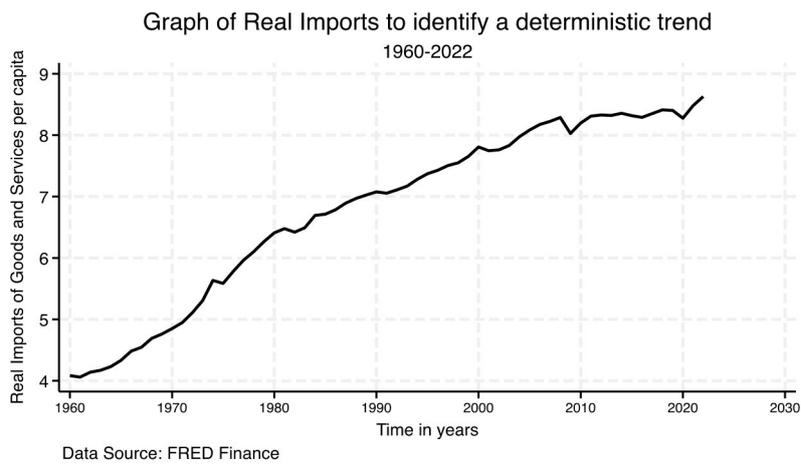
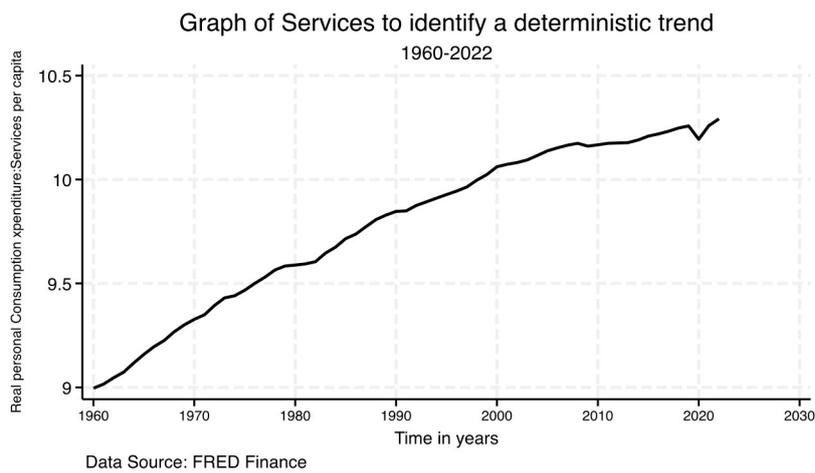


Figure 4.32: Annual data for Services



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.33: Annual data for money held in MMF accounts

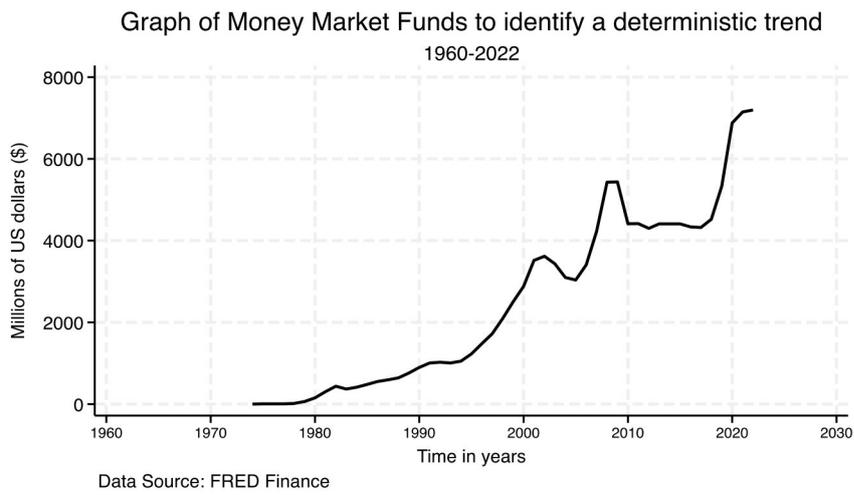
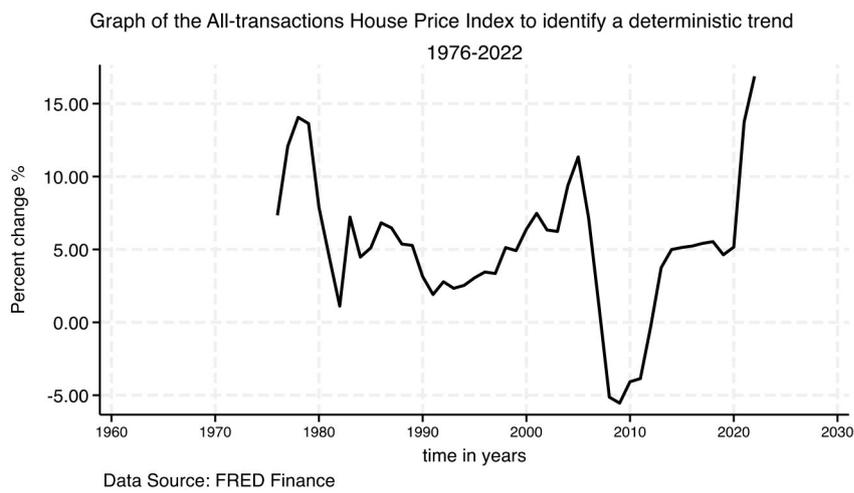


Figure 4.34: Annual data for All-transactions house price index



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Appendix C - Straight Line Graphs of the Variables at the First Difference:

Figure 4.35: Annual data for Quantative easing at the first difference

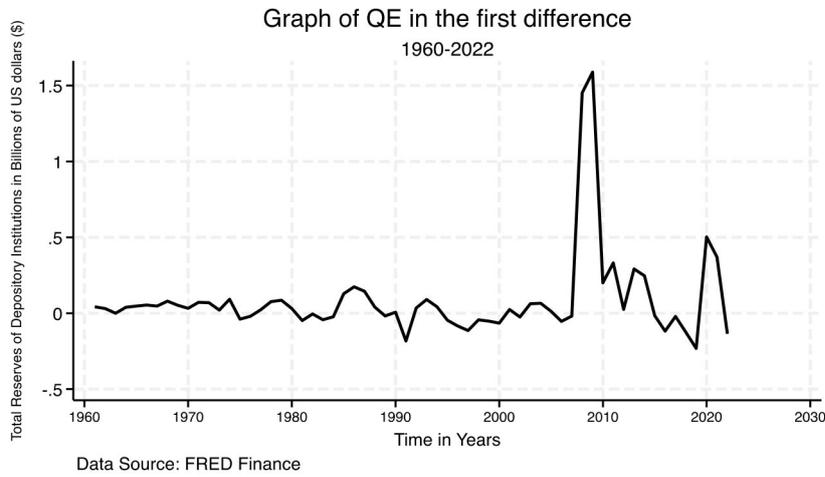
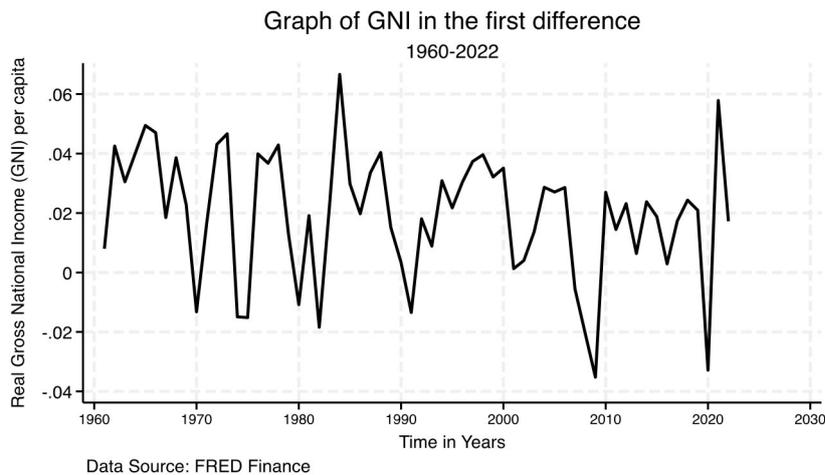


Figure 4.36: Annual data for GNI at the first difference



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.37: Annual data for Household checkable deposits at the first difference

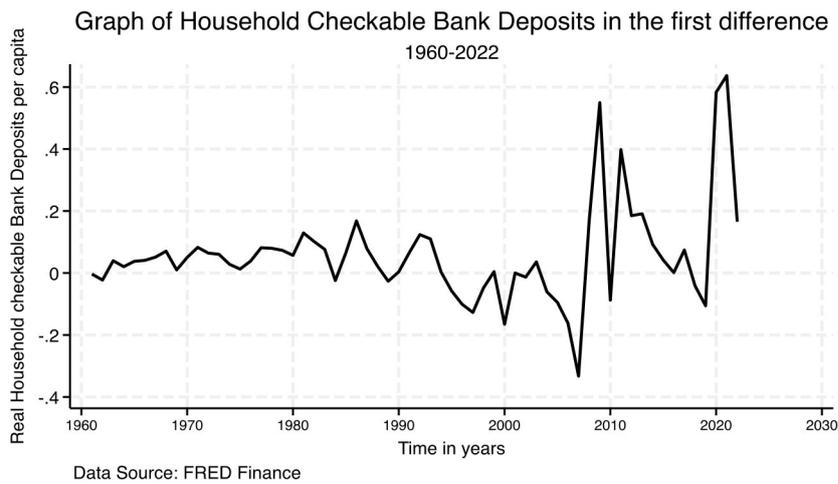
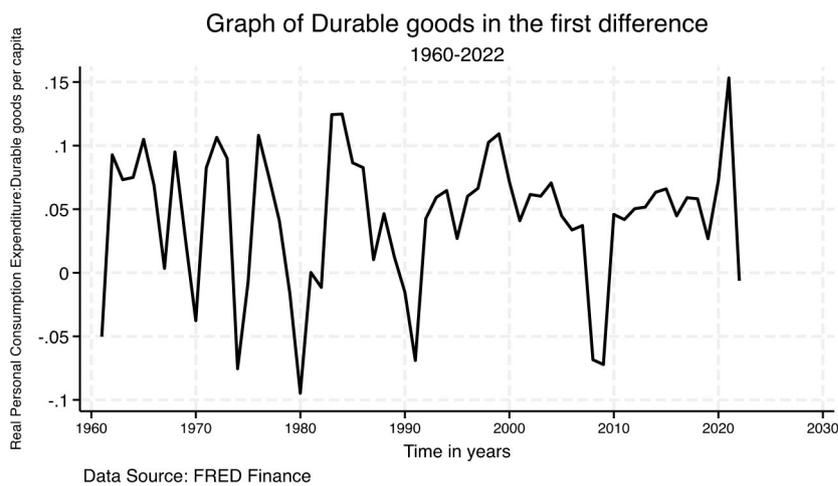


Figure 4.38: Annual data of durable goods at the first difference



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.39: Annual data of nondurable goods at the first difference

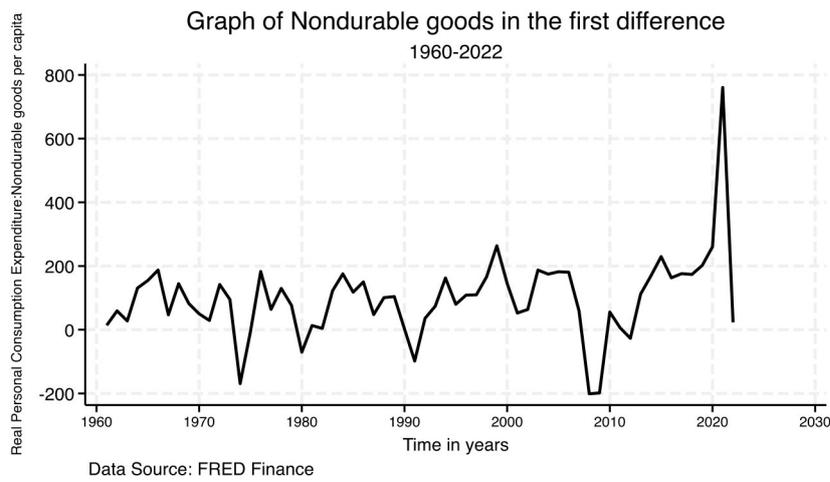
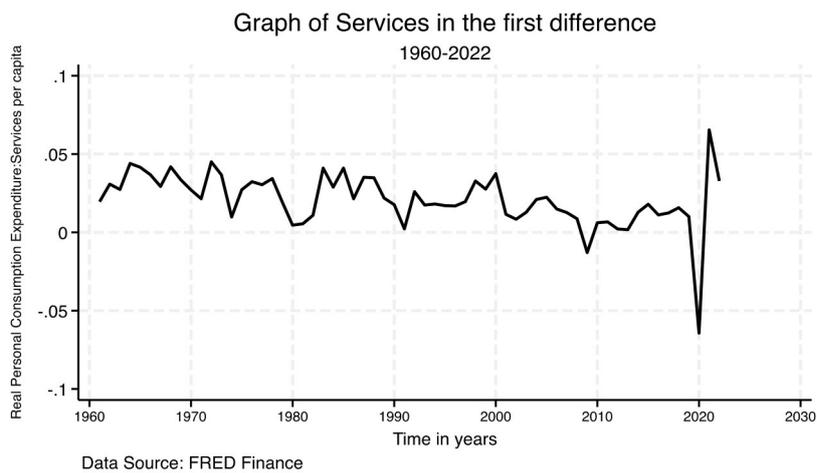


Figure 4.40: Annual data of services at the first difference



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.41: Annual data of Imports at the first difference

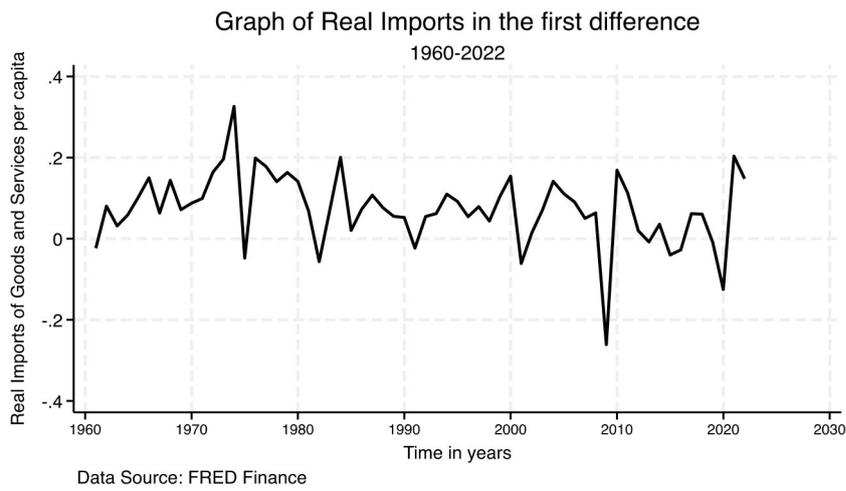
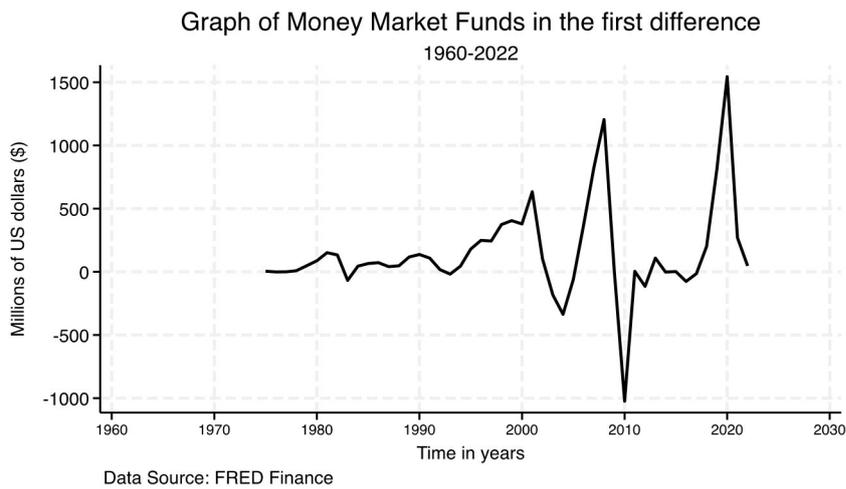


Figure 4.42: Annual data of money held in MMF accounts at the first difference



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.43: Annual data of all-transactions house price index at the first difference

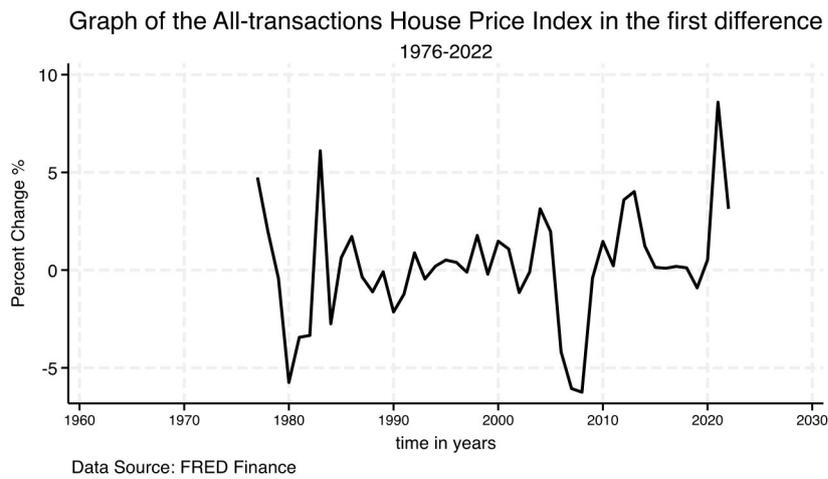
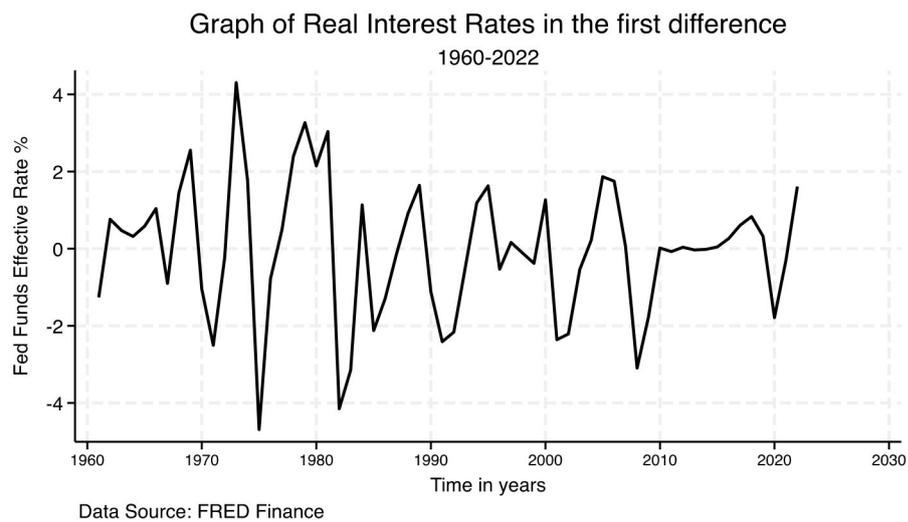


Figure 4.44: Annual data of real interest rates at the first difference



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Appendix D: Dynamic Correlation Results and Imports Discussion and Conclusion

Table 4.45: Dynamic correlation results for the main model (1960-2022) – Services

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Services			
Independent variables:			
Durable goods	-0.187	0.053	<0.001*
Nondurable goods	0.217	0.143	0.130
Wealth	-0.008	0.009	0.383
GNI	0.925	0.125	<0.001*
Interest rates	-0.004	0.001	<0.001*
_cons	0.008	0.002	<0.001*

‘*’ significant at the 5% level

Table 4.46: Dynamic correlation results for the main model (1960-2022) – Nondurable goods

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Nondurable goods			
Independent variables:			
Durable goods	0.241	0.041	<0.001*
Services	0.165	0.109	0.130
Wealth	0.013	0.008	0.114
GNI	-0.008	0.150	0.956
Interest rates	0.001	0.001	0.114
_cons	0.001	0.002	0.759

‘*’ significant at the 5% level

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.47: Dynamic correlation results for the main model (1960-2022) – Durable goods

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Durable goods			
Independent variables:			
Nondurable goods	1.497	0.253	< 0.001 *
Services	-0.882	0.252	< 0.001 *
Wealth	0.002	0.020	0.924
GNI	1.879	0.286	< 0.001 *
Interest rates	-0.010	0.002	< 0.001 *
_cons	0.002	0.005	0.690

‘*’ statistically significant at the 5% level

Figure 4.48: Dynamic correlation results of the foreign consumption model (1960-2022)

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Imports			
Independent variables:			
Wealth	-0.041	0.056	0.462
GNI	1.628	0.456	<0.001 *
Interest rates	0.017	0.006	0.002 *
_cons	0.044	0.013	0.001 *

‘*’ significant at the 5% level

Table 4.49: Dynamic correlation results of the financial model (1974-2022) – Durable goods

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Durable goods			
Independent variables:			
MMF	-0.072	0.022	0.001*
_cons	0.014	0.006	0.014 **

‘*’ significant at the 5% level ‘**’ 10% significance level

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.50: Dynamic correlation results of the financial model (1974-2022) – Nondurable goods

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Nondurable goods			
Independent variables:			
MMF	-0.011	0.008	0.155
_cons	-0.017	0.003	<0.001 *

‘*’ significant at the 5% level ‘**’ 10% significance level

Table 4.51: Dynamic correlation results of the financial model (1974-2022) – Services

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Services			
Independent variables:			
MMF	-0.002	0.008	0.791
_cons	0.018	0.003	<0.001*

‘*’ significant at the 5% level ‘**’ 10% significance level

Table 4.52: Dynamic correlation results of the housing model (1976-2022) – Durable goods

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Durable goods			
Independent variables:			
ATHPI	0.010	0.002	<0.001*
_cons	0.040	0.006	<0.001 *

‘*’ significant at the 5% level ‘**’ 10% significance level

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.53: Dynamic correlation results of the housing model (1976-2022) – Nondurable goods

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Nondurable goods			
Independent variables:			
ATHPI	0.003	0.001	<0.001 *
_cons	0.014	0.002	0.010 *

‘*’ significant at the 5% level ‘**’ 10% significance level

Table 4.54: Dynamic correlation results of the housing model (1976-2022) – Services

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: Services			
Independent variables:			
ATHPI	0.002	0.001	0.010 *
_cons	0.017	0.002	<0.001 *

‘*’ significant at the 5% level ‘**’ 10% significance level

Table 4.55: Dynamic correlation results of housedep and MMF

Variables	Coefficient	Std. error	P- value P> z
Dependent variable: housedep			
Independent variables:			
MMF	-0.014	0.085	0.872
_cons	0.064	0.029	0.028 *

‘*’ significant at the 5% level ‘**’ 10% significance level

Discussion

The following results will be interpreted against the ruling that when r falls between 0 and -1 suggests a negative correlation which means that when one variable changes, the other variable changes in the opposite direction. In contrast, when the value of r falls between 0 and 1 it suggests a positive correlation, so, when one variable changes, the other variable will change in the same direction.

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Firstly, in Table 4.46 nondurable goods and interest rates do not have a statistically significant results, which suggests limited statistical evidence to support a correlation.

Secondly, the results in Table 4.45 report that services and interest rates have a weak but negative dynamic correlation (-0.004), this is statistically significant at the 5% level. This suggest that when interest rates increase, services will move in the opposite direction, and so consumption falls.

Finally, as shown in Table 4.47 durable goods and interest rates have a weak and negative correlation (0.010), which is statistically significant at the 5% level. The correlation results show that interest rates have an inverse relationship with durable goods and services, a rise in interest rates, will reduce spending on these goods. The results indicate a stronger impact on durable goods than services, which suggest that a cutback on spending will implicate durable goods the greatest amount. This can be explained by certain services are necessities to living, and so consumers cannot cut back entirely on them. However, there is no statistical evidence to suggest a correlation with interest rates and nondurables, this is because nondurables are essential goods that are demand inelastic, and so despite any changes in consumer spending habits, they will continue to purchase these types of goods.

Tables 4.45, 4.46 and 4.47 show that the results are not statistically significant for the relationship between household checkable deposits with each component of consumption, supported by the p-values (0.924) (0.114) (0.383). Similarly, the results report that household checkable deposits and imports are not statistically significant at the 5% level, supported by the p-value (0.462).

The results within Tables 4.45, 4.46 and 4.47, show that GNI has a very strong positive long run relationship with both services (0.925) and durables goods (1.879), which are both statistically significant at 5% level. However, the results for GNI and nondurables goods are not statistically significant as indicated by the p-value 0.956.

Tables 4.50 and 4.51 show that MMF does not have a statistically significant correlation with services or nondurable goods, supported by the p-values (0.791) (0.155). However, seen in Table 4.49, durable goods and MMF have a weak, negative long run correlation (-0.072) which is statistically significant at the 5% level.

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

The findings in Tables 4.52, 4.53 and 4.54, highlights that a change in house prices within the US has a statically significant relationship with each component of consumption at the 5% level. The results show that services (0.002) have the weakest, positive correlation with ATHPI, secondly, nondurables goods (0.003), and finally, durable goods have the strongest positive correlation of the three (0.010).

Imports Model Discussion and Conclusion

Table 4.48, indicates that imports and GNI are strongly and positively correlated (1.628). As discussed within the main body text, in Chapter 5, a rise in income is associated with a rise in consumption of durable goods, one of the key products being cars; similarly, some of the main imports within the US are car parts and steel (Census.gov, 2024). It could be inferred from this that they are complimentary goods, and so an increase in demand for cars, would mean an increase in demand of car parts. In summary, the relationship between GNI and foreign consumption follows the same pattern as it does with domestic consumption.

The results from Table 4.48 shows that the relationship between foreign consumption and interest rates are averse to the relationship interest rates have with domestic consumption, indicted by a positive but weak correlation (0.017). This means that a rise in interest rates, will lead to a rise in demand for foreign consumable goods. When interest rates rise, this leads to a rise in value of the currency, which increases the exchange rate, making the dollar stronger. This promotes an increase in imports as in real terms, they become cheaper for US citizens to consume. And so, the rational consumer will substitute domestic goods for foreign goods, as this will maximise their utility, as they can consume more with the same level of income.

Additionally, the value of exports becomes more expensive, and so the demand for US goods will fall, reducing US competitiveness in foreign markets. Both of these factors implicate the US economy, as imports are leakages and exports are injections, the changes in demand of both can potentially reduce GDP. This will most likely impact durables and nondurables, as the US import large quantities of phones, household goods, as well as food, feeds, and beverages (Census.gov, 2024). It can be noted that the size of the relationship is weak and so a change in the interest rates will not have a large effect on the demand of foreign goods as the rational consumer will only substitute domestic products for foreign products when it is cheaper to do

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

so. Finally, Table 4.48 displays that foreign consumption and wealth are not statistically significant, which has been justified within the previous discussion of CDA's.

In conclusion, foreign consumption, follows a similar trend with domestic consumption when it comes to changes in income, however, changes in the interest rate will have a different effect. There is a risk that the consumption of foreign goods, could implicate the US economy. A suggestion for future researchers could be to conduct a model including domestic and foreign consumption as one, to investigate the relationship between the different components of consumption with imports, in addition to other variables. It would also be interesting to see within this extended model, if the implication of house prices and a finance variable can be differentiated from the results of domestic consumption.

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Appendix E – VAR Lag Criteria Output

Table 4.56: The optimal lag criteria for each model

	Model 1 – Main	Model 2 - Finance	Model 3 - House	Model 4 – Imports
Endogenous:	ln_durables ln_nondurables ln_services ln_GNI rIR ln_housedep	ln_durables ln_nondurables ln_services ln_MMF	ln_durables ln_nondurables ln_services ATHPI	ln_imports ln_GNI ln_housedep rIR
Exogenous:	_cons	_cons	_cons	_cons
	AIC	AIC	AIC	AIC
Lag				
0	-5.24398	-5.61027	-1.55056	6.35746
1	-19.1922	-16.517	-10.7863	- 4.68079
2	-19.9632 *	-17.8184 *	-11.3966 *	- 4.90084 *
3	-19.2813	-17.4913	-11.2324	- 4.72003
4	-19.4002	-17.217	-10.6644	- 4.51113

* Optimal lag

Table 4.57 – Main Model lags 1964-2022

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	160.698				2.1e-10	-5.24398	-5.16151	-5.03271
1	608.171	894.95	36	0.000	1.9e-16	-19.1922	-18.6149	-17.7133*
2	666.916	117.49	36	0.000	9.0e-17*	-19.9632*	-18.8911*	-17.2167
3	682.797	31.763	36	0.670	2.0e-16	-19.2813	-17.7143	-15.267
4	722.305	79.016*	36	0.000	2.1e-16	-19.4002	-17.3383	-14.1183

* Optimal lag

Endogenous: ln_durables ln_nondurables ln_services ln_GNI rIR ln_housedep

Exogenous: _cons

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.58 – Import Model lags 1964-2022

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-183.545				0.006778	6.35746	6.41245	6.49831
1	158.083	683.26	16	0.000	1.1e-07	-4.68079	-4.40588	-3.97654*
2	180.575	44.983*	16	0.000	8.8e-08*	-4.90084*	-4.406*	-3.63319
3	191.241	21.332	16	0.166	1.1e-07	-4.72003	-4.00526	-2.88898
4	201.078	19.675	16	0.235	1.4e-07	-4.51113	-3.57643	-2.11668
* Optimal lag Endogenous: ln_imports ln_GNI ln_housedep rIR Exogenous: _cons								

Table 4.59 – ATHPI Lag Criteria 1980-2022

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	37.3371				2.5e-06	-1.55056	-1.49015	-1.38673
1	251.905	429.14	16	0.000	2.4e-10	-10.7863	-10.4842	-9.96713*
2	281.027	58.243*	16	0.000	1.4e-10*	-11.3966*	-10.8539*	-9.92211
3	293.496	24.937	16	0.071	1.7e-10	-11.2324	-10.4469	-9.10253
4	297.285	7.5785	16	0.960	3.3e-10	-10.6644	-9.63733	-7.87926
* Optimal lag Endogenous: ln_durables ln_nondurables ln_services ATHPI Exogenous: _cons								

Table 4.60 – MMF Lag Criteria 1978-2022

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	130.231				4.3e-08	-5.61027	-5.5504	-5.44967
1	391.632	522.8	16	0.000	7.9e-13	-16.517	-16.2176	-15.714
2	436.915	90.566*	16	0.000	2.2e-13*	-17.8184*	-17.2796*	-16.3731*
3	445.555	17.28	16	0.368	3.2e-13	-17.4913	-16.713	-15.4036
4	455.383	19.658	16	0.236	4.6e-13	-17.217	-16.1993	-14.487
* Optimal lag Endogenous: ln_durables ln_nondurables ln_services ln_MMF Exogenous: _cons								

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Appendix F - VAR Checks

Figure 4.61: Main model roots of the companion matrix

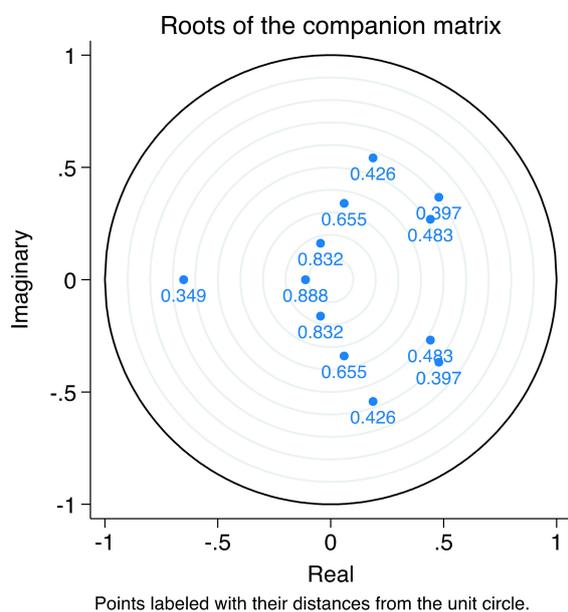


Table 4.62: Main model eigenvalue stability conditions

Eigenvalue stability condition

Eigenvalue	Modulus
-0.6512365	0.651236
0.4787505 + 0.3673916i	0.603472
0.4787505 - 0.3673916i	0.603472
0.1874022 + 0.5423168i	0.573783
0.1874022 - 0.5423168i	0.573783
0.4414442 + 0.2690163i	0.516955
0.4414442 - 0.2690163i	0.516955
0.05939963 + 0.3397643i	0.344917
0.05939963 - 0.3397643i	0.344917
-0.04517906 + 0.1621762i	0.168352
-0.04517906 - 0.1621762i	0.168352
-0.1117696	0.11177

All the eigenvalues lie inside the unit circle.

VAR satisfies stability condition.

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.63: Main model Lagrange-multiplier test

Lagrange- multiplier test

Lag	Chi2	df	Prob > chi2
1	29.7047	36	0.76129
2	25.7961	36	0.89598

H0: no autocorrelation at lag order (null)

Figure 4.64: Main model error data line graph

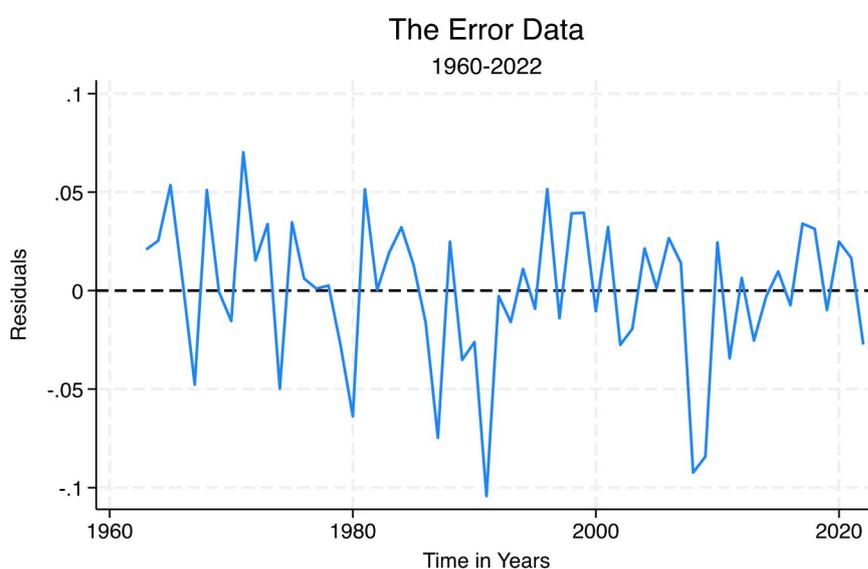
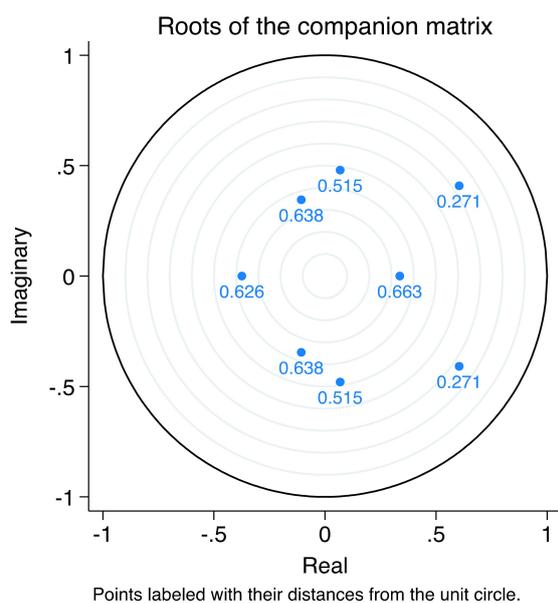


Figure 4.65: Housing model roots of the companion matrix



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.66: Housing model eigenvalue stability condition

Eigenvalue stability condition

Eigenvalue	Modulus
0.60411 + 0.4087516i	0.729402
0.60411 - 0.4087516i	0.729402
0.06819704 + 0.479803i	0.484625
0.06819704 - 0.479803i	0.484625
-0.37428827	0.374283
-0.1069652 + 0.3454459i	0.361628
-0.1069652 - 0.3454459i	0.361628
0.3365871	0.336587

All the eigenvalues lie inside the unit circle.

VAR satisfies stability condition.

Table 4.67: Housing model Lagrange- multiplier test

Lagrange- multiplier test

Lag	Chi2	df	Prob > chi2
1	16.0929	16	0.44650
2	11.8532	16	0.75402

H0: no autocorrelation at lag order (null)

Figure 4.68: Housing model error line graph

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

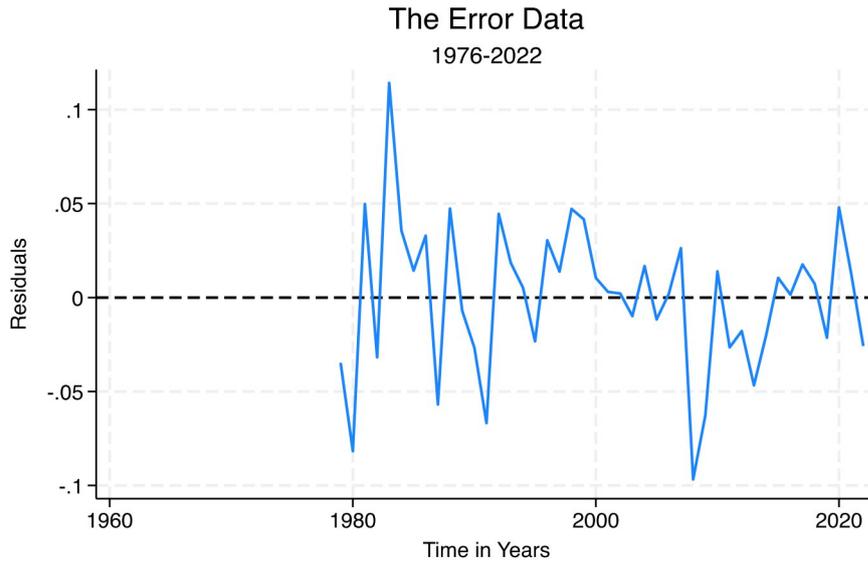


Figure 4.69: Foreign consumption roots of the companion matrix

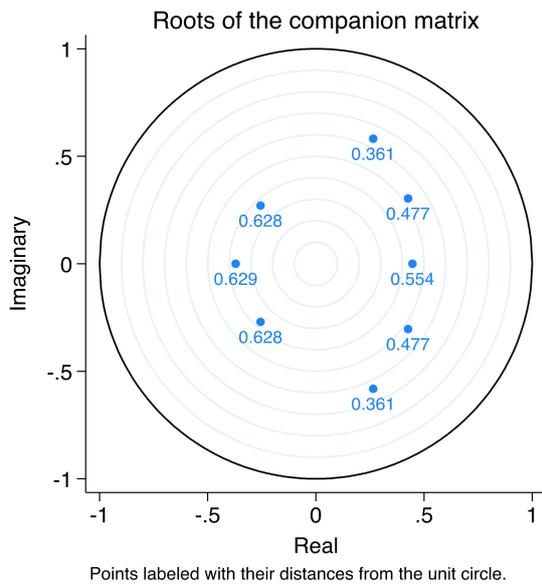


Table 4.70: Foreign consumption eigenvalue stability condition

Eigenvalue stability condition

Eigenvalue	Modulus
$0.2647922 + 0.5815139i$	0.638963
$0.2647922 - 0.5815139i$	0.638963
$0.426171 + 0.3036313i$	0.523272
$0.426171 - 0.3036313i$	0.523272
0.4463812	0.446381

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

-0.2558648 + 0.2706069i	0.372418
-0.2558648 - 0.2706069i	0.372418
-0.3705733	0.370573

All the eigenvalues lie inside the unit circle.

VAR satisfies stability condition.

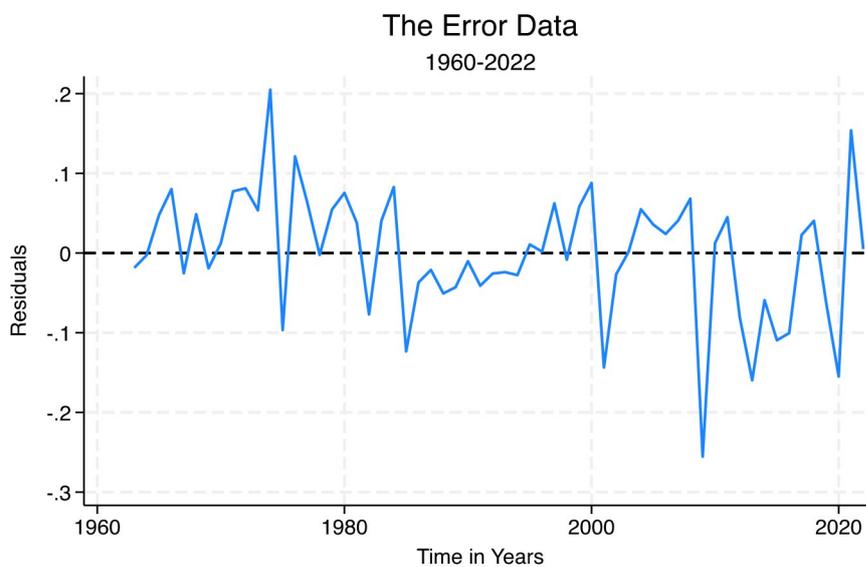
Table 4.71: Foreign consumption Lagrange multiplier test

Lagrange- multiplier test

Lag	Chi2	df	Prob > chi2
1	8.5669	16	0.93017
2	11.8386	16	0.75501

H0: no autocorrelation at lag order (null)

Figure 4.72: Foreign consumption error line graph



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.73: Financial model roots of companion matrix

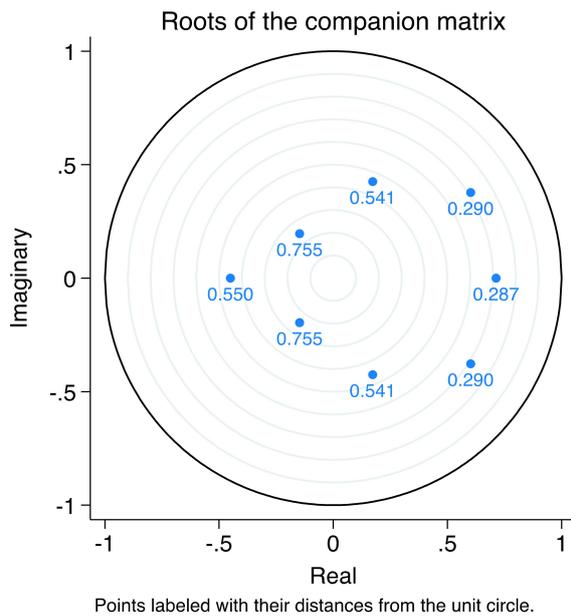


Table 4.74: Financial model eigenvalue stability condition

Eigenvalue stability condition

Eigenvalue	Modulus
0.7130559	0.713056
$0.6019172 + 0.3773497i$	0.71042
$0.6019172 - 0.3773497i$	0.71042
$0.1727351 + 0.4253724i$	0.459107
$0.1727351 - 0.4253724i$	0.459107
-0.4502837	0.450284
$-0.1474128 + 0.1959005i$	0.245168
$-0.1474128 - 0.1959005i$	0.245168

All the eigenvalues lie inside the unit circle.

VAR satisfies stability condition.

Table 4.75: Financial Model LaGrange multiplier test

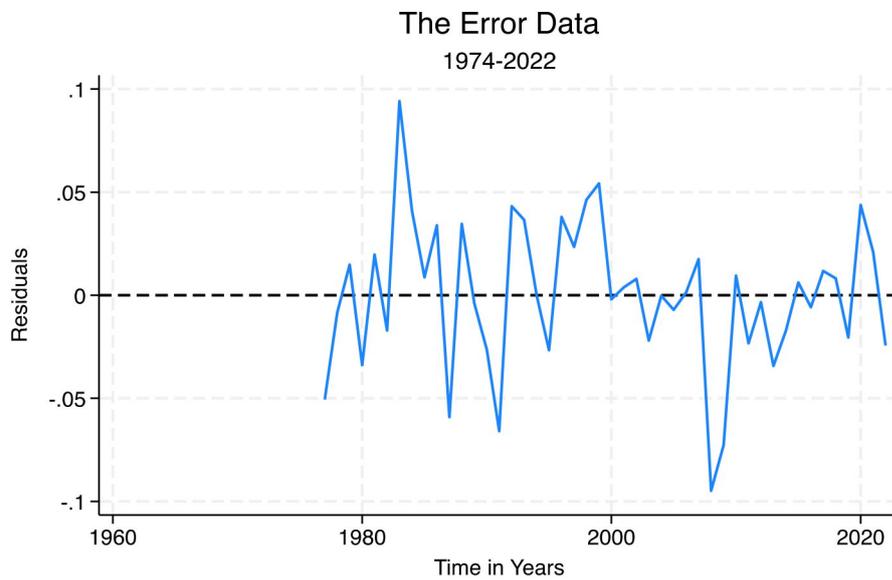
Lagrange- multiplier test

Lag	Chi2	df	Prob > chi2
1	22.3139	16	0.13334
2	11.5507	16	0.77429

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

H_0 : no autocorrelation at lag order (null)

Figure 4.76: Financial model error line graph



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Appendix G - VAR output: Main model

Table 4.77: main model VAR output

Sample:	1963- 2022	Number of obsvs:	60		
Log likelihood:	636.5662	AIC:	-18.61887		
FPE:	3.45e-16	HQIC:	-17.5539		
Det(Sigma_ml) ^{''}	2.45e-17	SBIC:	-15.89623		
Equation	Parms	RMSE	R-sq	Chi2	P>chi2
dln_durables	13	0.041157	0.5150	63.71355	<0.0001
dln_nondurables	13	0.014385	0.4714	53.51634	<0.0001
dln_services	13	0.015988	0.3589	33.59053	0.0008
dln_housedep	13	0.156781	0.2459	19.56728	0.0757
dln_GNI	13	0.018318	0.4299	45.24971	<0.0001
dIR	13	1.62296	0.3369	30.4902	0.0024

	Coefficient	Standard error	z	P> z	95% conf.	Interval
dln_durables						
dln_durables						
L1.	0.2527266	0.2303743	1.10	0.273	-0.1987988	0.704252
L2.	-0.0959394	0.2046671	-0.47	0.639	-0.4970795	0.3052007
dln_nondurables						
L1.	0.4120753	0.5740116	0.72	0.473	-0.7129686	1.537116
L2.	-0.5513081	0.6072465	-0.91	0.364	-1.741489	0.6388731
dln_services						
L1.	-1.342681	0.4569598	-2.94	0.003	-2.238306	-0.447056
L2.	0.3344907	0.5303238	0.63	0.528	-0.7049247	1.373906
dln_housedep						
L1.	-0.0168714	0.038006	-0.44	0.657	-0.0913617	0.0576189
L2.	0.0416788	0.0458958	0.91	0.364	-0.0482754	0.131633
dln_GNI						
L1.	1.008499	0.6317516	1.60	0.110	-0.2297116	2.246709

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

L2.	0.5887954	0.6223282	0.95	0.344	-0.6309456	1.808536
dIR						
L1.	-0.022283	0.0043369	-5.14	0.000	-0.030783	-0.0137829
L2.	0.0021503	0.0050743	0.42	0.672	-0.0077952	0.0120958
_Cons	0.0265	0.012276	2.16	0.031	0.0024396	0.0505605
dln_nondurables						
dln_durables						
L1.	0.0553474	0.0805212	0.69	0.492	-0.1024713	0.213166
L2.	-0.023767	0.0715359	-0.33	0.740	-0.1639748	0.1164408
dln_nondurables						
L1.	0.4332682	0.2006304	2.16	0.031	0.0400398	0.8264966
L2.	-0.122263	0.2122468	-0.58	0.565	-0.5382591	0.293733
dln_services						
L1.	-0.5877193	0.1597181	-3.68	0.000	-0.9007611	-0.2746776
L2.	0.2569702	0.1853605	1.39	0.166	-0.1063297	0.6202701
dln_housedep						
L1.	0.0056224	0.013284	0.42	0.672	-0.0204137	0.0316585
L2.	0.0181433	0.0160417	1.13	0.258	-0.0132978	0.0495844
dln_GNI						
L1.	0.295535	0.2208119	1.34	0.181	-0.1372484	0.7283183
L2.	0.1784951	0.2175182	0.82	0.412	-0.2478327	0.604823
dIR						
L1.	-0.0060549	0.0015158	-3.99	0.000	-0.0090259	-0.0030839
L2.	0.0015982	0.0017736	0.90	0.368	-0.0018779	0.0050744
_Cons	0.0053204	0.0042907	1.24	0.215	-0.0030893	0.0137301
dln_services						

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_durables						
L1.	0.175378	0.0894918	1.96	0.050	-0.0000227	0.3507787
L2.	-0.0705473	0.0795055	-0.89	0.375	-0.2263753	0.0852805
dln_nondurables						
L1.	0.0225893	0.222982	0.10	0.919	-0.4144473	0.459626
L2.	0.1684343	0.2358925	0.71	0.475	-0.2939065	0.6307751
dln_services						
L1.	0.0460876	0.1775118	0.26	0.795	-0.3018291	0.3940043
L2.	0.5622116	0.2060109	2.73	0.006	0.1584377	0.9659856
dln_housedep						
L1.	0.036772	0.0147639	2.49	0.013	0.0078353	0.0657087
L2.	0.0250628	0.0178288	1.41	0.160	-0.0098811	0.0600066
dln_GNI						
L1.	-0.0160602	0.2454118	-0.07	0.948	-0.4970585	0.464938
L2.	-0.0434883	0.2417512	-0.18	0.857	-0.5173119	0.4303353
dIR						
L1.	-0.0032332	0.0016847	-1.92	0.055	-0.0065353	0.0000688
L2.	0.0023214	0.0019712	1.18	0.239	-0.0015421	0.0061848
_cons	-0.0012317	0.0047687	-0.26	0.796	-0.0105783	0.0081149
dln_housedep						
dln_durables						
L1.	-0.4840858	0.87757	-0.55	0.581	-2.204091	1.23592
L2.	0.0998762	0.7796428	0.13	0.898	-1.429196	1.627948
dln_nondurables						
L1.	-0.1571045	2.186595	-0.07	0.943	-4.442752	4.128543
L2.	1.207951	2.313197	-0.24	0.602	-3.325833	5.741734
dln_services						
L1.	-3.921931	1.740707	-2.25	0.024	-7.333655	-0.510208
L2.	-0.4836067	2.020174	-0.24	0.811	-4.443075	3.475861

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_housedep						
L1.	0.2419842	0.1447769	1.67	0.095	-0.0417733	0.5257418
L2.	-0.008271	0.174832	-0.05	0.962	-0.3509354	0.3343934
dln_GNI						
L1.	2.604086	2.406545	1.08	0.279	-2.112656	7.320828
L2.	-0.8779009	2.370649	-0.37	0.711	-5.524287	3.768485
dIR						
L1.	-0.0253179	0.0165205	-1.53	0.125	-0.0576975	0.0070617
L2.	0.0097864	0.0193298	0.51	0.613	-0.0280992	0.0476721
_cons	0.104514	0.0467631	2.23	0.025	0.0128601	0.1961679
dln_GNI						
dln_durables						
L1.	0.1080187	0.1025319	1.05	0.292	-0.0929401	0.3089774
L2.	-0.0974841	0.0910904	-1.07	0.285	-0.2760181	0.0810498
dln_nondurables						
L1.	0.1709451	0.2554732	0.67	0.503	-0.3297732	0.6716635
L2.	-0.0036256	0.270265	-0.01	0.989	-0.5333352	0.526084
dln_services						
L1.	-0.1945135	0.2033774	-0.96	0.339	-0.5931259	0.204099
L2.	0.3475357	0.2360293	1.47	0.141	-0.1150732	0.8101445
dln_housedep						
L1.	0.0228687	0.0169152	1.35	0.176	-0.0102844	0.0560218
L2.	0.0244105	0.0204267	1.20	0.232	-0.0156251	0.0644461
dln_GNI						
L1.	0.2210028	0.2811713	0.79	0.432	-0.3300829	0.7720885
L2.	0.2357158	0.2769774	0.85	0.395	-0.3071498	0.7785815
dIR						
L1.	-0.0057862	0.0019302	-3.00	0.003	-0.0095693	-0.0020031
L2.	-0.00174	0.0022584	-0.77	0.441	-0.0061664	0.00026864

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

_cons	0.0016159	0.0054636	0.30	0.767	-0.0090926	0.0123244
dIR						
dln_durables						
L1.	-2.742152	9.084408	-0.30	0.763	-20.54726	15.06296
L2.	-6.785907	8.070688	-0.84	0.400	-22.60416	9.03235
dln_nondurables						
L1.	26.35816	22.63514	1.16	0.244	-18.20356	52.43123
L2.	0.8411354	23.9457	0.04	0.972	-44.09362	37.88143
dln_services						
L1.	17.11384	18.01941	0.95	0.342	-18.20356	52.43123
L2.	-3.106093	20.91239	-0.15	0.882	-44.09362	37.88143
dln_housedep						
L1.	1.890571	1.498698	1.26	0.207	-1.04823	4.827966
L2.	0.6225714	1.809822	0.34	0.731	-2.924614	4.169757
dln_GNI						
L1.	-3.559968	24.91201	-0.14	0.886	-52.38662	45.26668
L2.	24.32659	24.54042	0.99	0.322	-23.77175	72.42494
dIR						
L1.	0.2855594	0.1710165	1.67	0.095	-0.0496268	0.6207456
L2.	-0.4310755	0.2000973	-2.15	0.031	-8232589	-0.038892
_cons	-0.853733	0.4840807	-1.76	0.078	-1.802514	0.0950478

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.78: Finance model VAR output

Sample:	1977- 2022	Number of obsvs:	46		
Log likelihood:	401.9286	AIC:	-15.90994		
FPE:	1.48e-12	HQIC:	-15.37384		
Det(Sigma_ml)''	3.03e-13	SBIC:	-14.47883		
Equation	Parms	RMSE	R-sq	Chi2	P>chi2
dln_durables	9	0.039608	0.5056	47.60286	<0.0001
dln_nondurables	9	0.013255	0.5034	46.63742	<0.0001
dln_services	9	0.017548	0.2421	14.69411	0.0654
dln_MMF	9	0.17858	0.6549	87.30618	<0.0001

	Coefficient	Standard error	z	P> z	95% conf.	Interval
dln_durables						
dln_durables						
L1.	0.589351	0.2528501	2.33	0.020	0.0937739	1.084928
L2.	0.3867242	0.2677358	1.44	0.149	-0.1380283	0.9114768
dln_nondurables						
L1.	-0.3984257	0.7595655	-0.52	0.600	-1.887147	1.090295
L2.	-0.9128331	0.8077156	-1.13	0.258	-2.495927	0.6702605
dln_services						
L1.	-1.266073	0.3403654	-3.72	0.000	-1.933177	-0.5989692
L2.	0.1733591	0.4006159	0.43	0.665	-0.6118337	0.9585519
dln_MMF						
L1.	-0.0808488	0.0288701	-2.80	0.005	-0.1374331	-0.0242644
L2.	0.0625387	0.0252781	2.47	0.013	0.0129945	0.1120829
_Cons	0.0386593	0.0107807	3.59	0.000	0.0175296	0.0597891

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_nondurables						
dln_durables						
L1.	0.1468546	0.0846152	1.74	0.083	-0.0189882	0.3126974
L2.	0.0531476	0.0895967	0.59	0.553	-0.1224587	0.2287539
dln_nondurables						
L1.	0.2346534	0.2541855	0.92	0.356	-0.263541	0.7328478
L2.	-0.0490461	0.2702987	-0.18	0.856	-0.5788219	0.4807297
dln_services						
L1.	-0.5733982	0.1139019	-5.03	0.000	-0.7966418	-0.3501546
L2.	0.1350054	0.1340645	1.01	0.314	-0.1277562	0.397767
dln_MMF						
L1.	-0.011455	0.0096613	-1.19	0.236	-0.0303907	0.0074807
L2.	0.0080253	0.0084592	0.95	0.343	-0.0085545	0.0246051
_Cons	0.0109387	0.0036077	3.03	0.002	0.0038677	0.0180096
dln_services						
dln_durables						
L1.	0.1956397	0.1120264	1.75	0.081	-0.023928	0.4152074
L2.	-0.0154788	0.1186216	-0.13	0.896	-0.2479728	0.2170153
dln_nondurables						
L1.	0.0047573	0.336529	0.01	0.989	-0.6548275	0.6643421
L2.	0.1085284	0.3578622	0.30	0.762	-0.5928685	0.8099254
dln_services						
L1.	-0.2122142	0.1508005	-1.41	0.159	-0.5077777	-0.0833494
L2.	0.1174993	0.1774948	0.66	0.508	-0.230384	0.4653826
dln_MMF						
L1.	-0.0034963	0.012791	-0.27	0.785	-0.0285663	0.0215737
L2.	0.0149012	0.0111996	1.33	0.183	-0.0070496	0.036852
_Cons	0.0072489	0.0047764	1.52	0.129	-0.0021128	0.0166105

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_MMF						
dln_durables						
L1.	1.128359	1.140025	0.99	0.322	-1.106049	3.362766
L2.	-1.422895	1.20714	0.239	0.239	-3.788846	0.9430564
dln_nondurables						
L1.	-1.091247	3.324652	-0.30	0.763	-7.743442	5.680948
L2.	3.024526	3.641747	0.83	0.406	-4.113167	10.16222
dln_services						
L1.	3.764728	1.534605	2.45	0.014	0.7569572	6.772499
L2.	2.646972	1.806257	1.47	0.143	-0.893226	6.18717
dln_MMF						
L1.	0.9063506	0.1301666	6.96	0.000	0.6512288	1.161472
L2.	-0.2788713	0.1139715	-2.45	0.014	-0.5022513	-0.0554914
_Cons	-0.0621476	0.0486069	-1.28	0.201	-0.1574153	0.03312

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.79 – Housing model VAR output

Sample:	1979- 2022	Number of obsvs:	44		
Log likelihood:	276.4373	AIC:	-10.92897		
FPE:	2.16e-10	HQIC:	-10.38761		
Det(Sigma_ml) ^o	4.10e-11	SBIC:	-9.469176		
Equation	Parms	RMSE	R-sq	Chi2	P>chi2
dln_durables	9	0.044136	0.4172	31.49421	0.0001
dln_nondurables	9	0.013005	0.5439	52.47621	<0.0001
dln_services	9	0.01822	0.2012	11.08298	0.1970
dln_MMF	9	2.18166	0.5177	47.23796	<0.0001

	Coefficient	Standard error	z	P> z	95% conf.	Interval
dln_durables						
dln_durables						
L1.	0.7881146	0.2628281	3.00	0.003	0.272981	1.303248
L2.	0.1317301	0.2939749	0.45	0.654	-0.4444502	0.7079104
dln_nondurables						
L1.	-0.9940864	0.9136771	-1.09	0.277	-2.78486	0.7966878
L2.	-0.4761658	0.9862692	-0.48	0.629	-2.409218	1.456886
dln_services						
L1.	-1.162815	0.3768866	-3.09	0.002	-1.901499	-0.4241304
L2.	0.1342528	0.485841	0.28	0.782	-0.8179779	1.086484
dln_ATHPI						
L1.	0.0030423	0.0031105	0.98	0.328	-0.0030541	0.0091387
L2.	-0.0007267	0.0031558	-0.23	0.818	-0.0069119	0.0054585
_Cons	0.0408494	0.0123996	3.59	0.001	0.0165467	0.0651521
dln_nondurables						

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_durables						
L1.	0.1279035	0.0774447	1.65	0.099	-0.0238854	0.2796923
L2.	-0.0047223	0.0866224	-0.05	0.957	-0.1744991	0.1650545
dln_nondurables						
L1.	0.2496954	0.2692233	0.93	0.354	-0.2779726	0.7773634
L2.	-0.009437	0.2906133	-0.03	0.974	-0.5790286	0.5601545
dln_services						
L1.	-0.5830493	0.1110531	-5.25	0.000	-0.8007093	-0.3653893
L2.	0.2497032	0.1431575	1.74	0.081	-0.0308803	0.5303867
dln_ATHPI						
L1.	0.0018552	0.0009165	2.02	0.043	0.0000589	0.0036516
L2.	-0.0001926	0.0009299	-0.21	0.836	-0.0020151	0.001633
_Cons	0.0112526	0.0036536	3.08	0.002	0.0040916	0.0184136
dln_services						
dln_durables						
L1.	0.1337466	0.1084984	1.23	0.218	-0.0789063	0.3463995
L2.	-0.0758106	0.12113562	-0.62	0.532	-0.3136642	0.162043
dln_nondurables						
L1.	0.2226899	0.3771761	0.59	0.555	-0.5165616	0.9619414
L2.	0.1037449	0.4071429	0.25	0.799	-0.6942405	0.9017303
dln_services						
L1.	-0.1918254	0.15583	-1.23	0.218	-0.4967624	-0.1131116
L2.	0.2083346	0.2005606	1.04	0.299	-0.1847569	0.6014261
dln_ATHPI						
L1.	0.0003978	0.001284	0.31	0.757	-0.0021189	0.0029144
L2.	-0.000451	0.0013027	-0.35	0.729	-0.0030043	0.0021023
_Cons	0.0090509	0.0051187	1.77	0.077	-0.0009815	0.0190833

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_ATHPI						
dln_durables						
L1.	3.394625	12.99159	0.26	0.794	-22.06843	28.85768
L2.	53.07156	14.53118	3.65	0.000	24.59067	81.55185
dln_nondurables						
L1.	6.440302	45.16306	0.14	0.887	-82.07767	94.95827
L2.	-105.1714	48.75129	-2.16	0.031	-200.7221	-9.620579
dln_services						
L1.	-86.22724	18.6295	-4.63	0.000	-122.7404	-49.71408
L2.	-49.40472	24.01512	-2.06	0.040	-96.47349	-2.335953
dln_MMF						
L1.	0.2492029	0.1537512	1.62	0.105	-0.052144	0.5505498
L2.	-0.3098311	0.1559895	-1.99	0.047	-0.6155649	-0.0040973
_Cons	1.260861	0.6129108	2.06	0.040	0.0595781	2.462144

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.80- Imports Model VAR Output

Sample:	1963- 2022	Number of obsv:	60		
Log likelihood:	175.1229	AIC:	-4.637432		
FPE:	1.15e-07	HQIC:	-4.145904		
Det(Sigma_ml)”	3.43e-08	SBIC:	-3.380825		
Equation	Parms	RMSE	R-sq	Chi2	P>chi2
dln_imports	9	0.08569	0.2068	15.64289	0.0478
dIR	9	1.58483	0.3139	27.45358	0.0006
dln_housedep	9	0.150496	0.2460	19.57855	0.0121
dln_GNI	9	0.018853	0.3447	31.56389	0.0001

	Coefficient	Standard error	z	P> z	95% conf.	Interval
dln_imports						
dln_imports						
L1.	0.0381893	0.1545348	0.25	0.805	-0.2646934	0.341072
L2.	0.2672897	0.157063	1.70	0.089	-0.0405481	0.5751275
dIR						
L1.	-0.0014101	0.0079705	-0.18	0.860	-0.0170321	0.0142118
L2.	-0.0226342	0.0090374	-2.50	0.012	-0.0403471	-0.0049213
dln_housedep						
L1.	0.0472639	0.0777327	0.61	0.543	-0.1050893	0.1996172
L2.	0.1846116	0.0964728	1.91	0.056	-0.0044715	0.3736948
dln_GNI						
L1.	-0.2032638	0.7779436	-0.26	0.794	-1.728005	1.321478
L2.	0.8381423	0.737923	1.14	0.256	-0.6081601	2.284445
_Cons	0.0293188	0.0225345	1.30	0.193	-0.0148481	0.0734856
dIR						

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_imports						
L1.	-0.8991949	2.858123	-0.31	0.753	-6.501012	4.702623
L2.	3.245989	2.904881	1.12	0.264	-2.447473	8.939451
dIR						
L1.	0.237581	0.1474148	1.61	0.107	-0.0513467	0.5265087
L2.	-0.3748693	0.1671459	-2.24	0.025	-0.7024692	-0.0472693
dln_housedep						
L1.	1.858772	1.437666	1.29	0.196	-0.9590015	4.676546
L2.	1.17792	1.784264	0.66	0.509	-2.319174	4.675014
dln_GNI						
L1.	19.25763	14.38807	1.34	0.181	-8.942472	47.45773
L2.	3.891152	13.64789	0.29	0.776	-22.85822	30.64052
_Cons	-0.8012813	0.4167759	-1.29	0.055	-1.618147	0.0155845
dln_housedep						
dln_imports						
L1.	0.3104553	0.2714084	1.14	0.2153	-0.2214954	0.842406
L2.	-0.6251159	0.2758486	-2.27	0.023	-1.1655769	-0.0844627
dIR						
L1.	-0.0140938	0.0139986	-1.01	0.314	-0.0415305	0.0133429
L2.	0.0173708	0.0158722	1.09	0.274	-0.0137382	0.0484799
dln_housedep						
L1.	0.3570117	0.1365213	2.62	0.009	0.0894348	0.6245886
L2.	-0.1416283	0.1694344	-0.84	0.403	-0.4737136	0.1904571
dln_GNI						
L1.	-1.332338	1.366297	-0.98	0.329	-4.01023	1.345555
L2.	0.3840522	1.296009	0.30	0.767	-2.156078	2.924183
_Cons	0.0857018	0.0395772	2.17	0.030	0.0081319	0.1632717

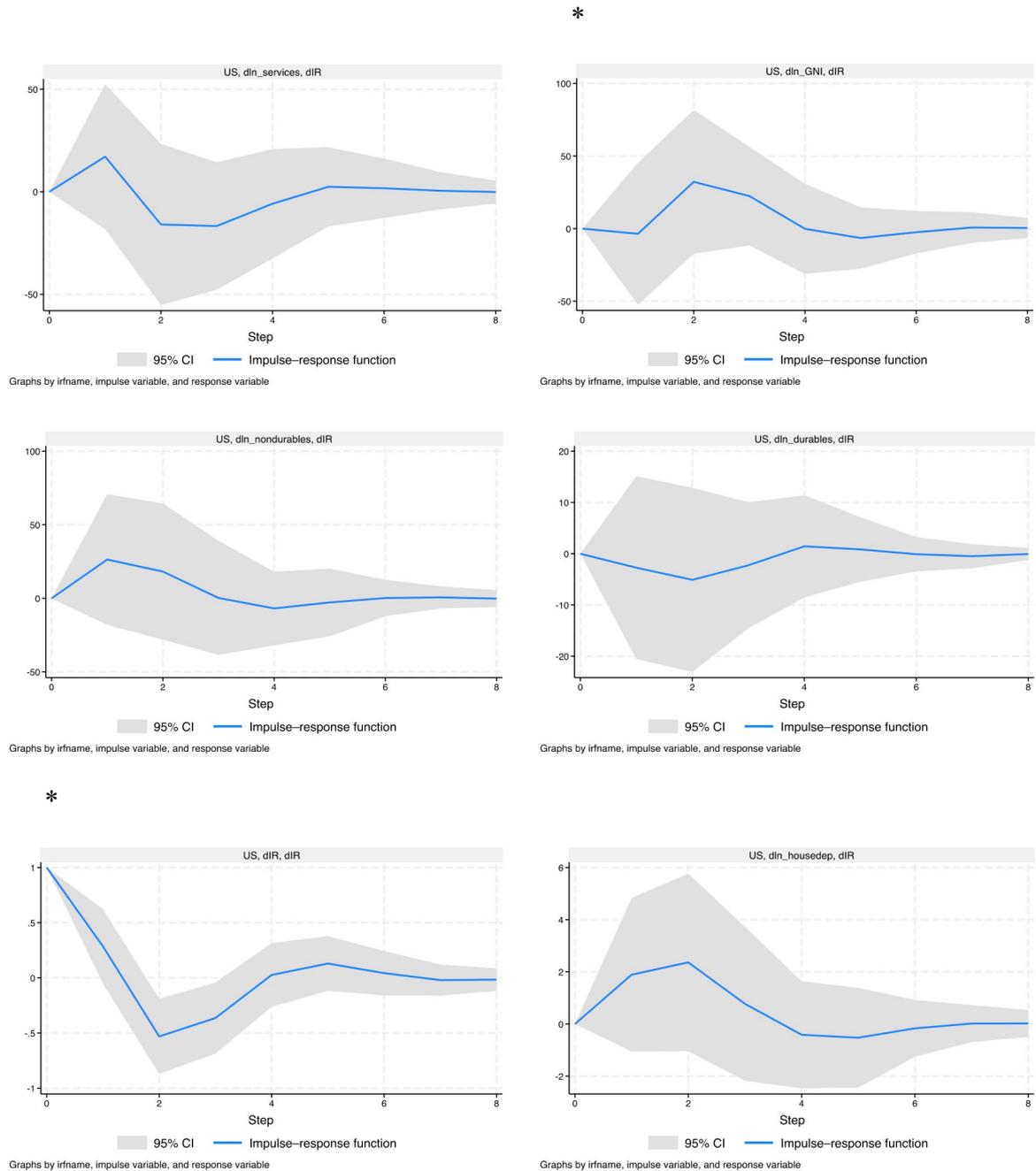
The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

dln_GNI						
dln_imports						
L1.	-0.0102327	0.034	-0.30	0.763	-0.0768716	0.0564061
L2.	0.0115492	0.0345563	0.33	0.738	-0.0561798	0.0792783
dIR						
L1.	-0.0054334	0.0017536	-3.10	0.002	-0.0088705	-0.0019964
L2.	-0.0035681	0.0019884	-1.79	0.073	-0.0074652	0.000329
dln_housedep						
L1.	0.0202206	0.0171024	1.18	0.237	-0.0132995	0.0537406
L2.	0.0113966	0.0212255	0.54	0.591	-0.0302046	0.0529978
dln_GNI						
L1.	0.3132225	0.1711596	1.83	0.067	-0.0222441	0.6486891
L2.	0.2291402	0.1623544	1.41	0.158	-0.0890686	0.0547349
_Cons	0.0068306	0.0049579	1.38	0.168	-0.0028868	0.0165479

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

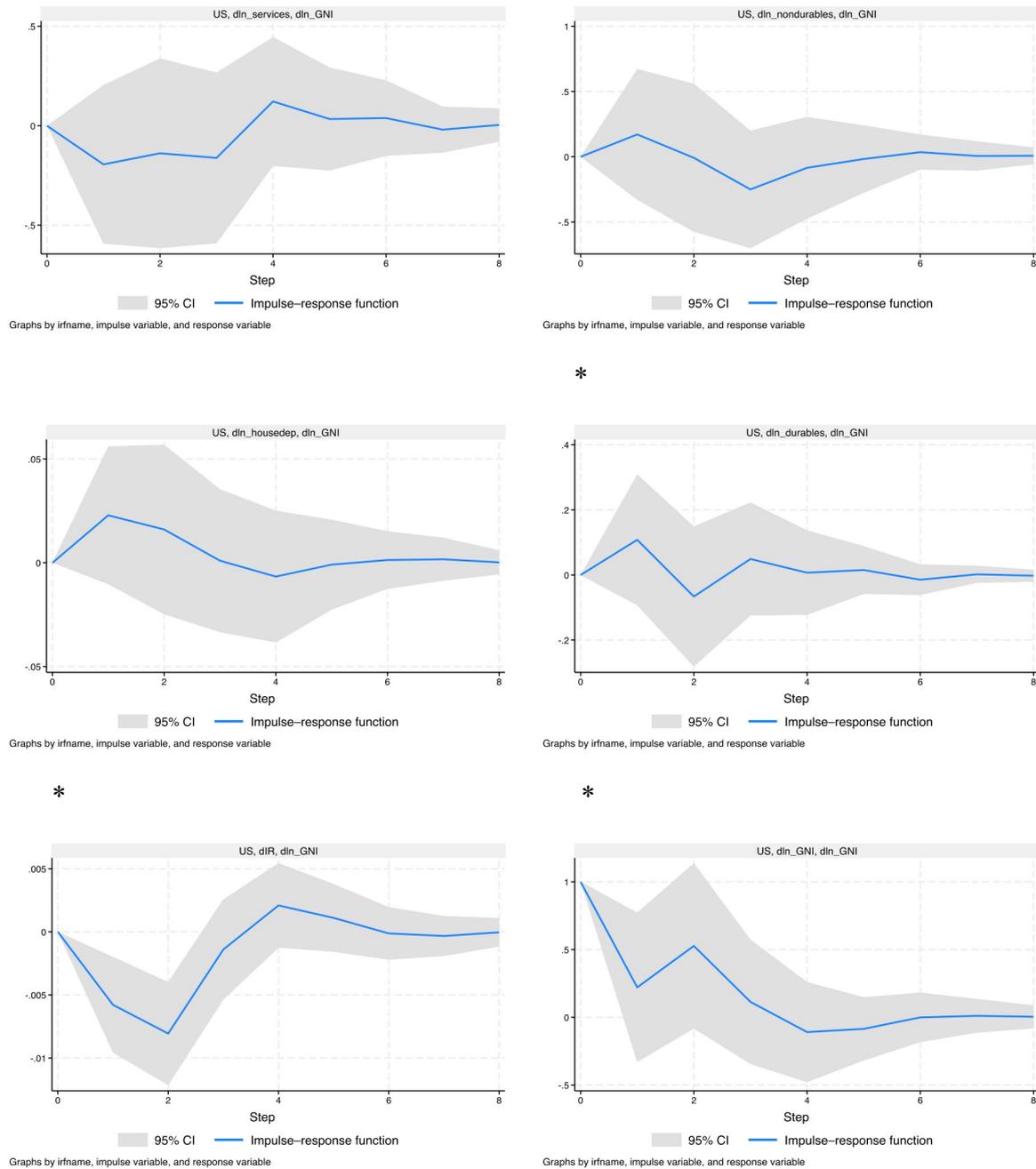
Appendix I – Extended Impulse-Response Functions results

Figure 4.6: Interest rates as the response variable



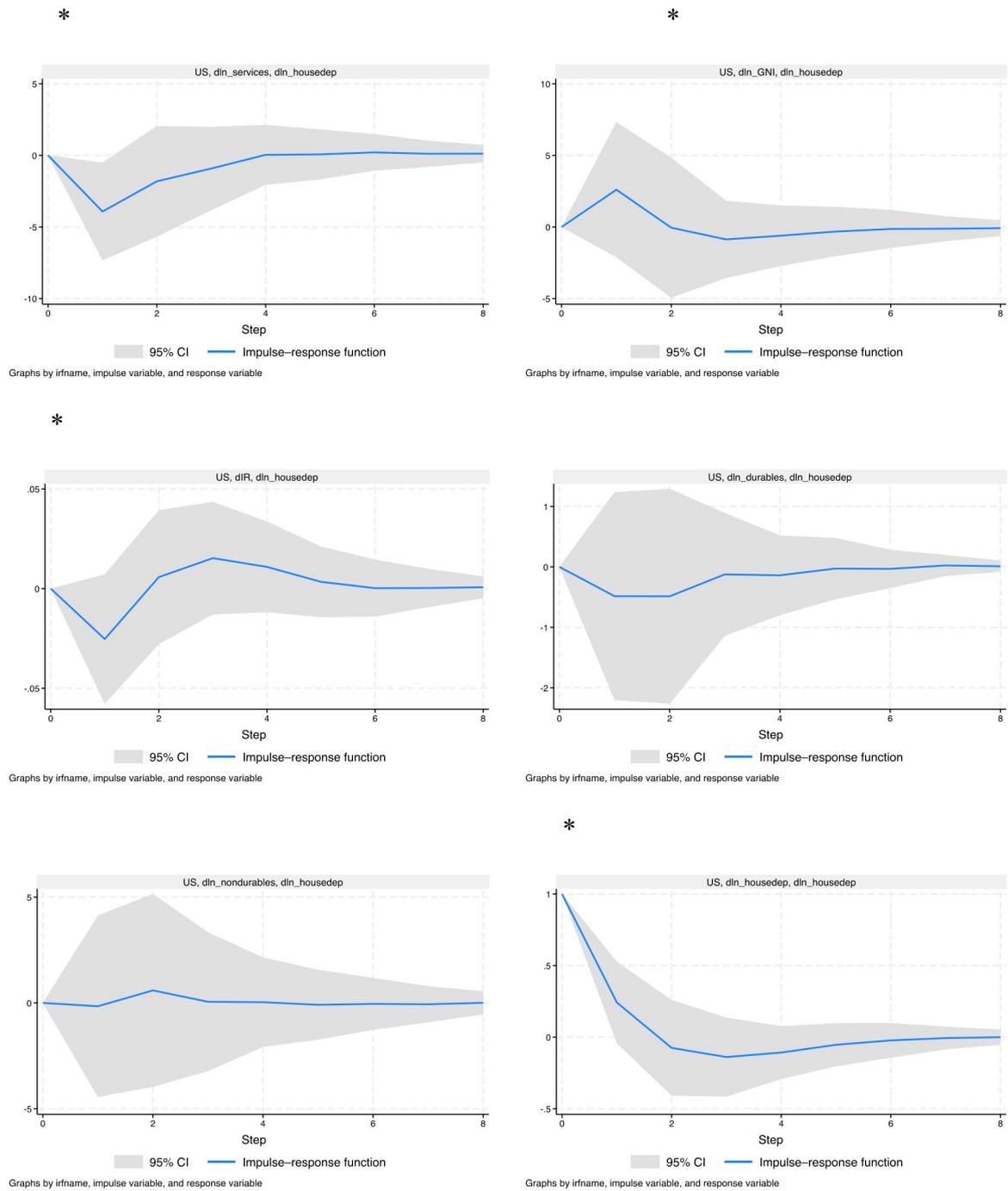
The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.7: GNI as the response variable



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.8: Household checkable deposits as the response variable



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Financial model

Figure 4.9: MMF as the response variable

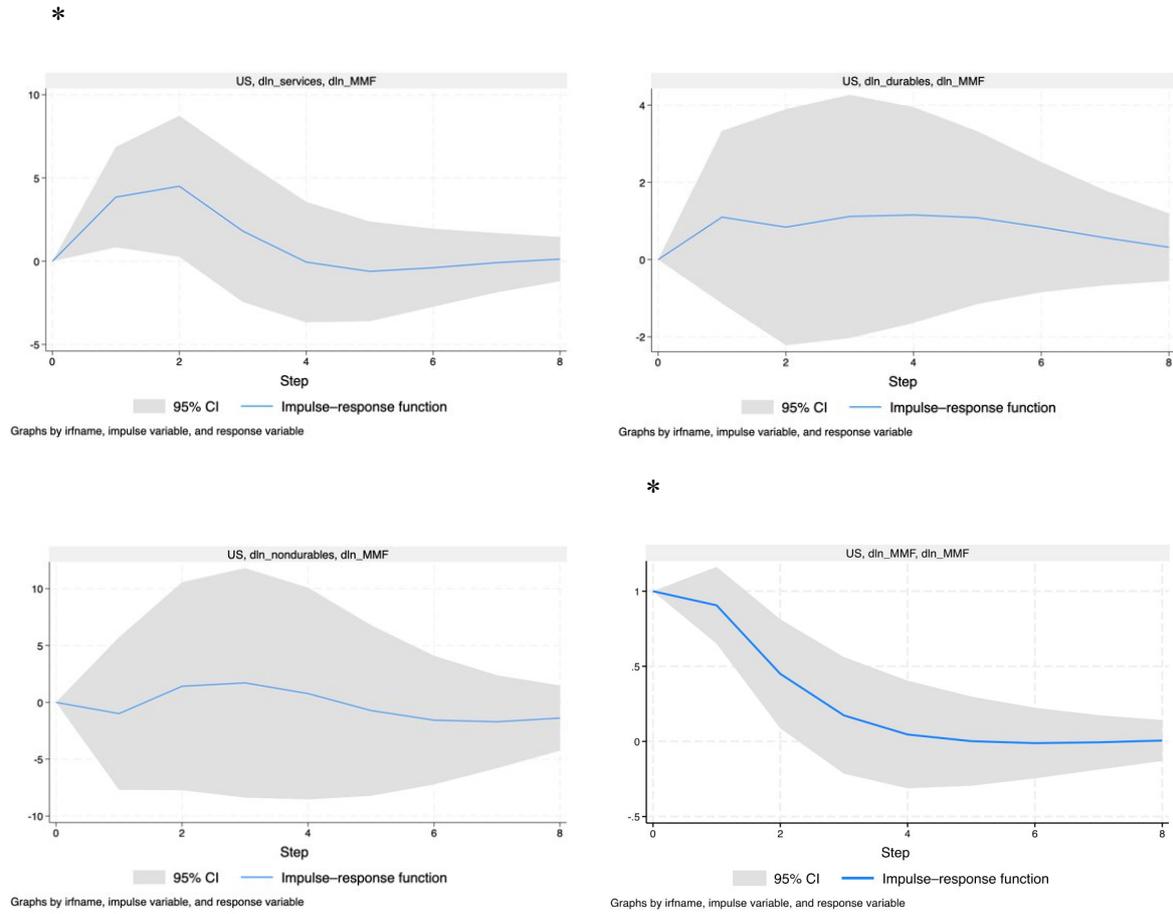
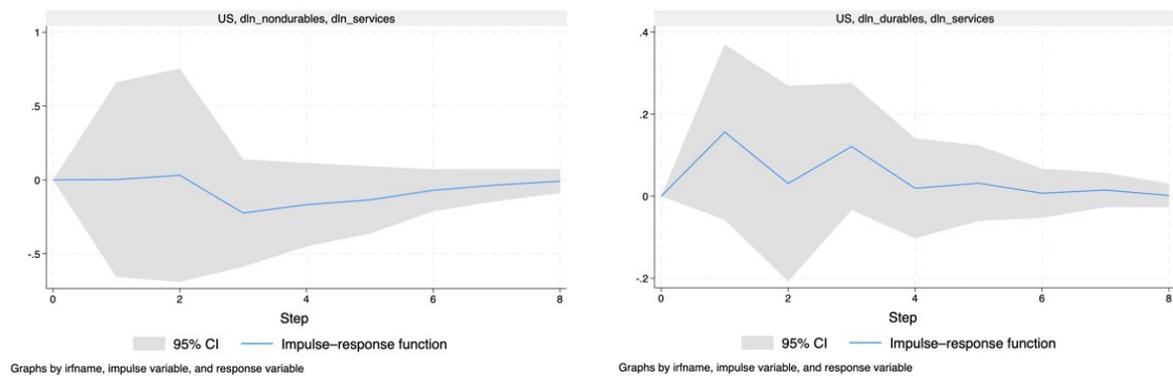


Figure 4.10: Services as the response variable



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The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

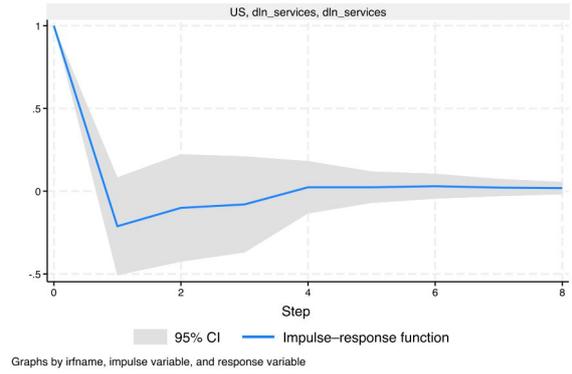
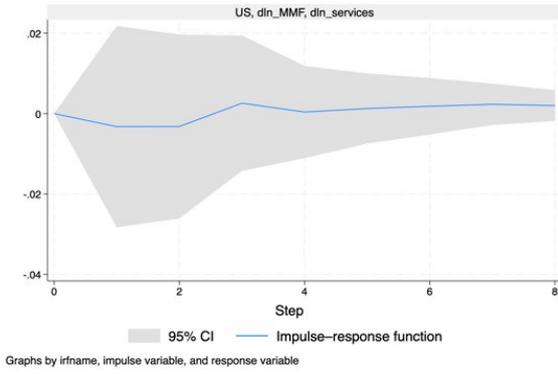
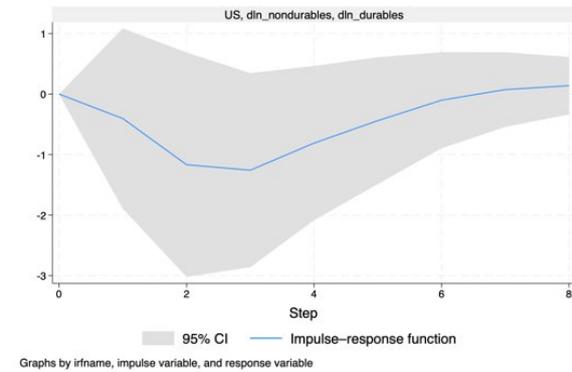
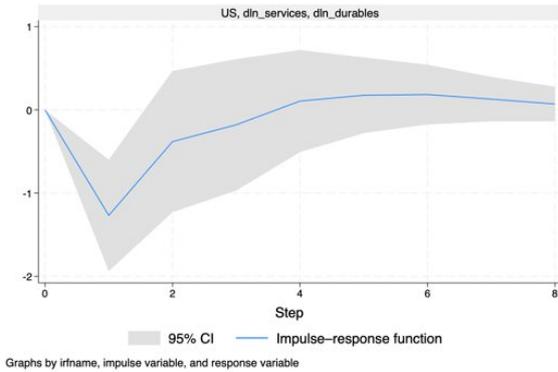
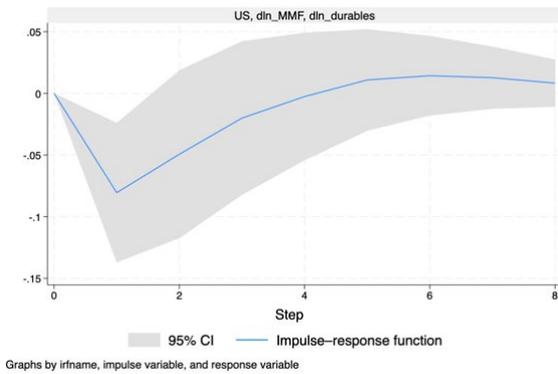


Figure 4.11: Durables as the response variable

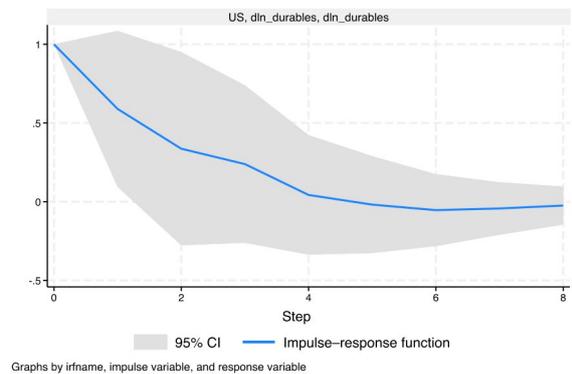
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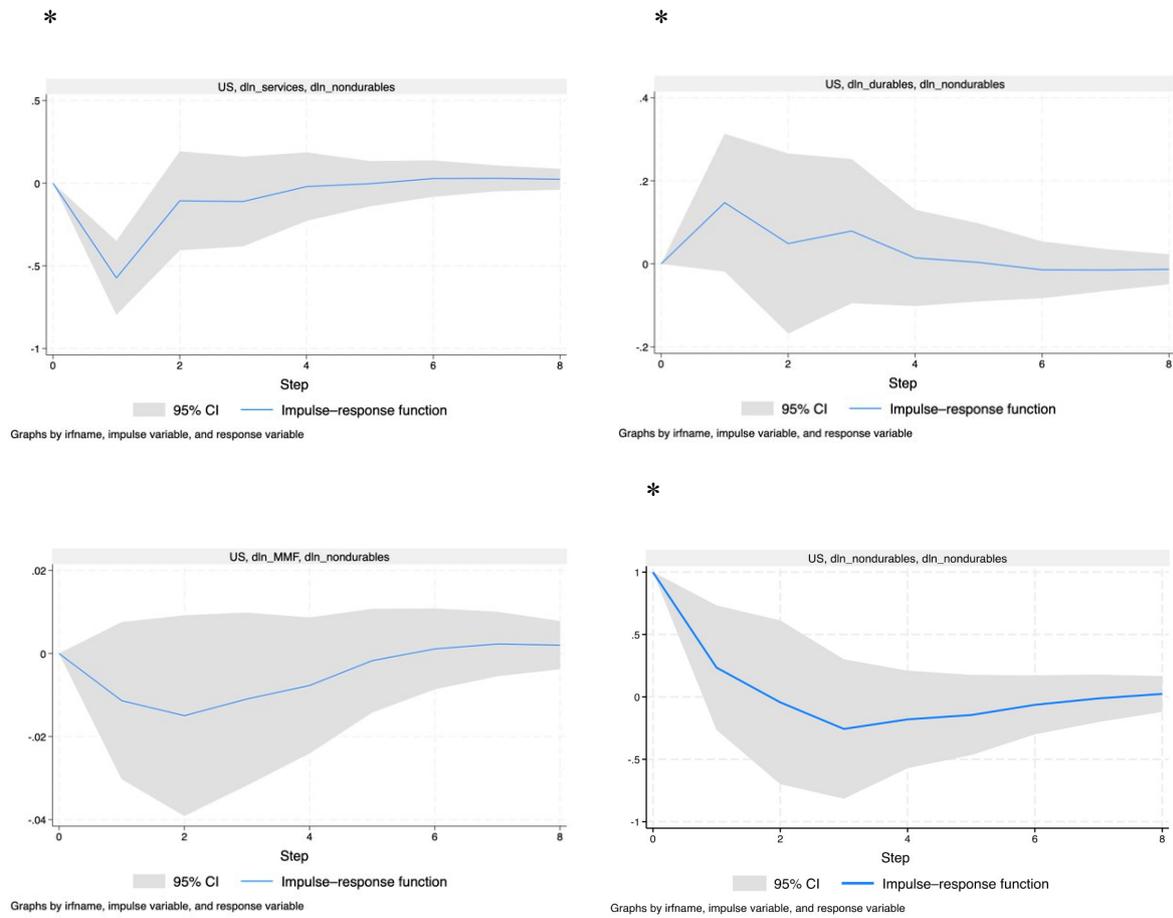


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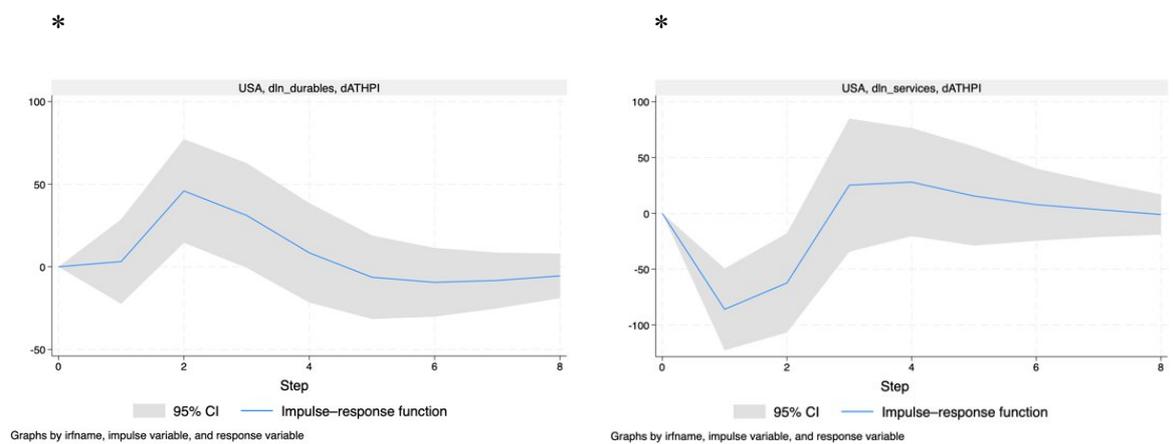
The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.12: Nondurables as the response variable



Housing model

Figure 4.13: ATHPI as the response variable



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

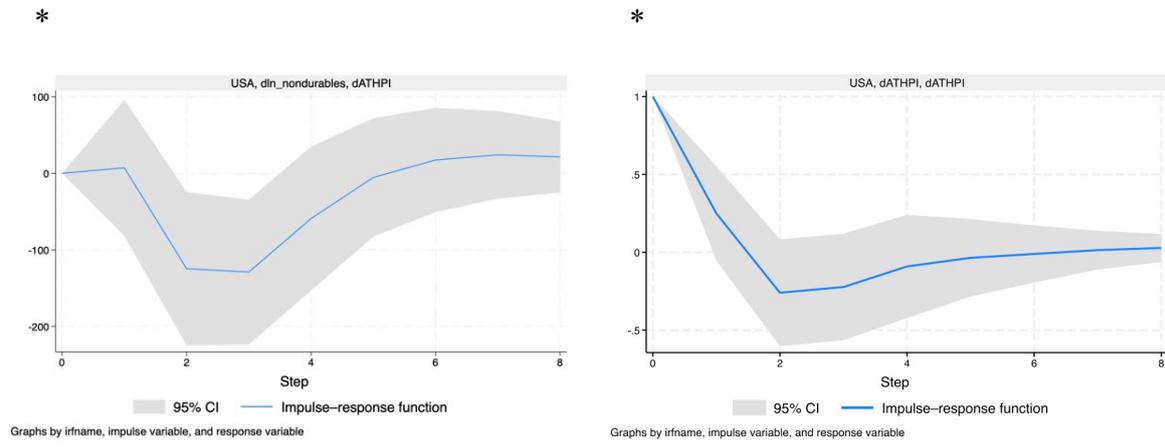
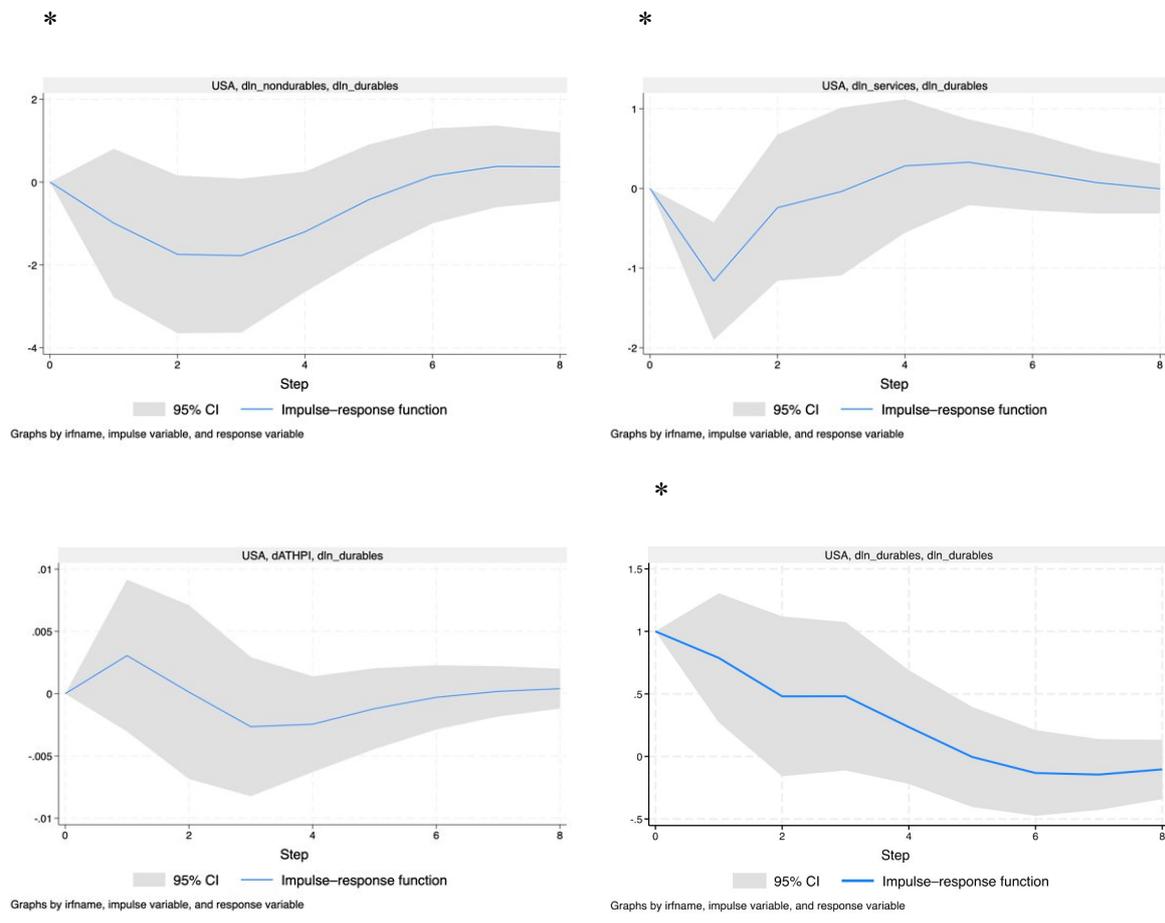


Figure 4.14: Durables as the response variable



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.15: Nondurables as the response variable

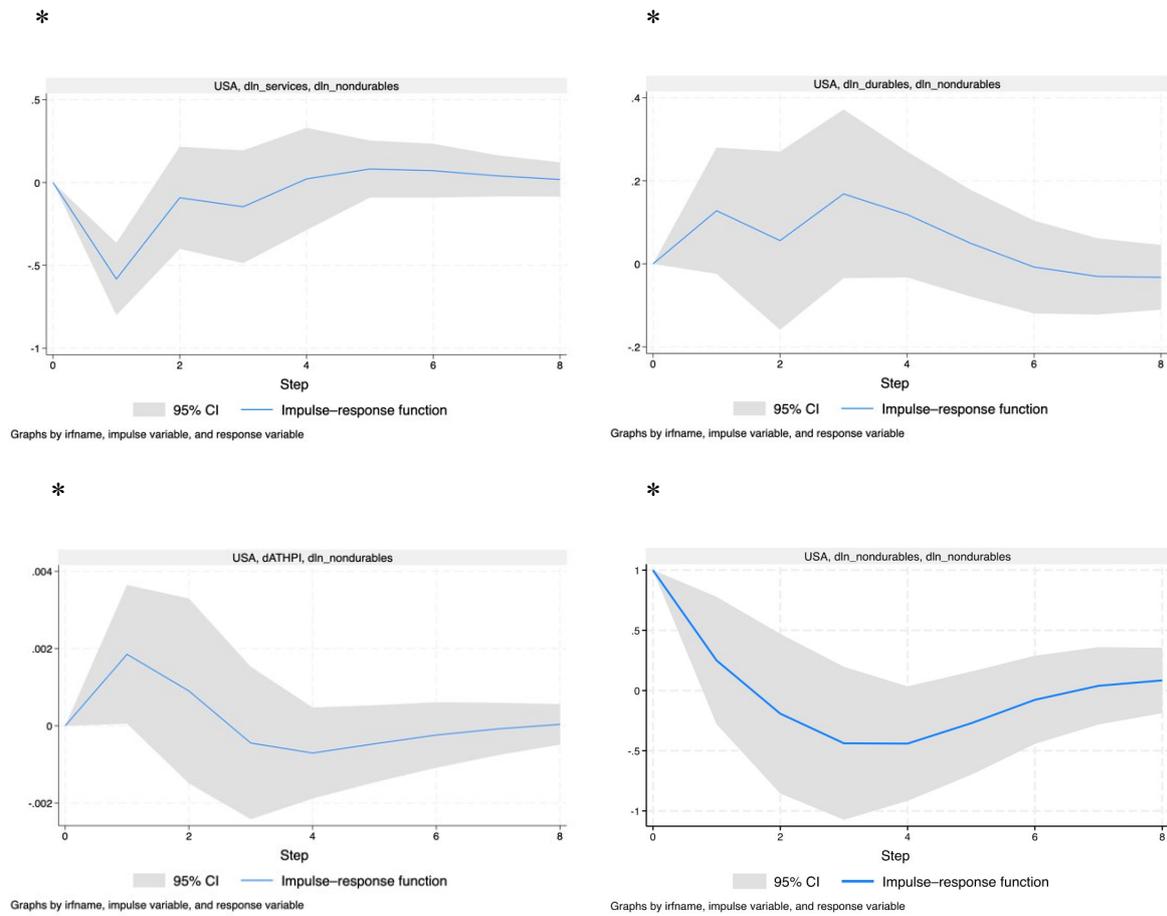
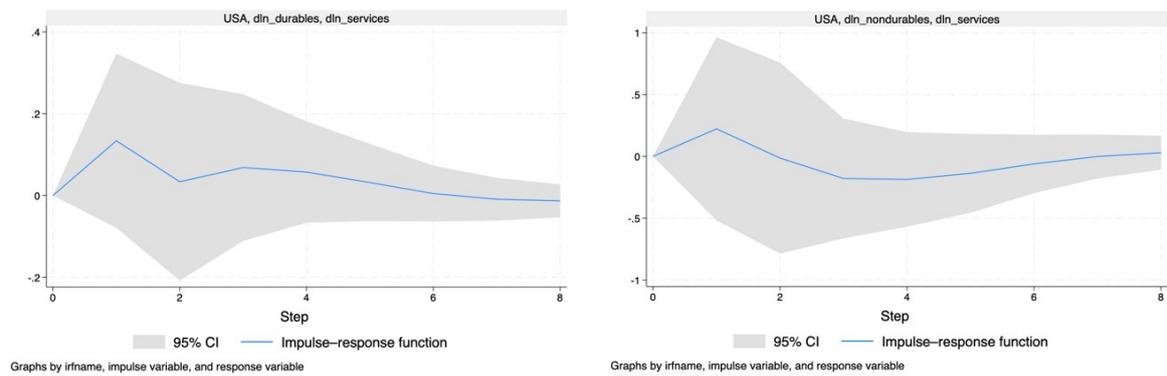
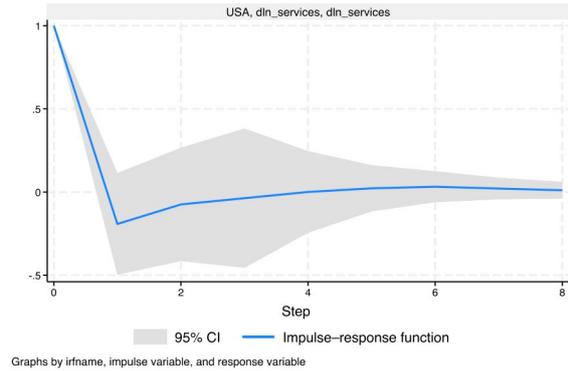
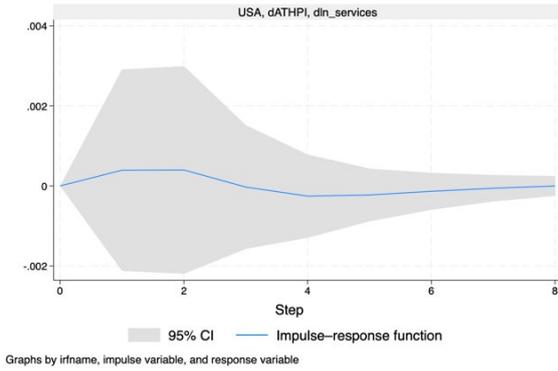


Figure 4.16: Services as the response variable



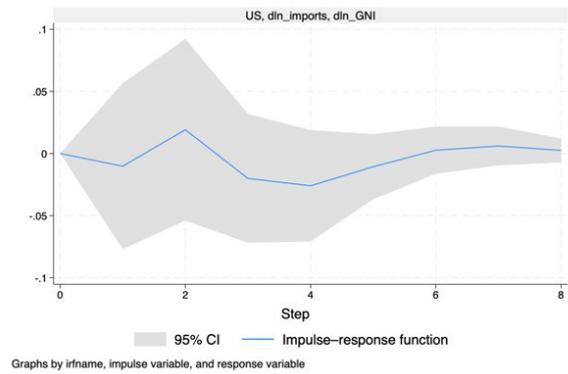
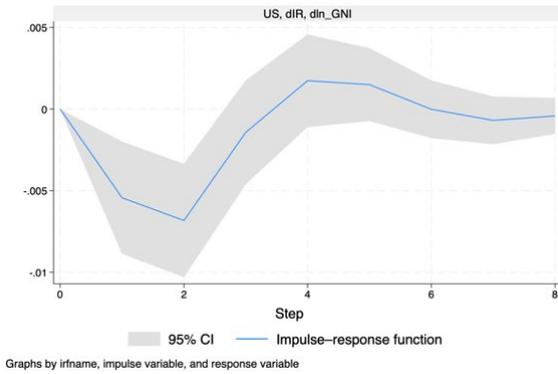
The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.



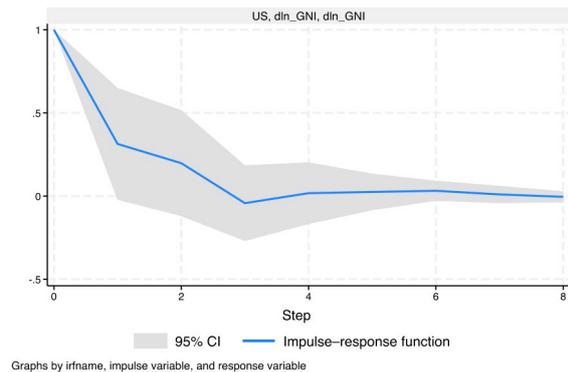
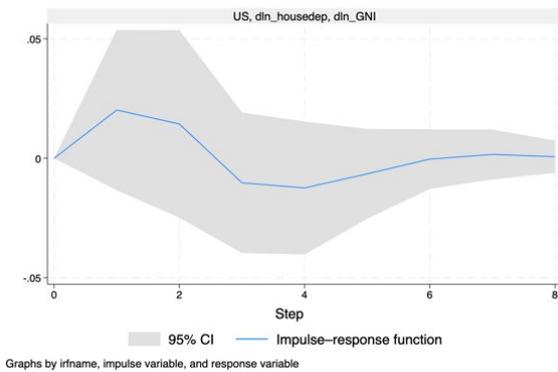
Import model:

Figure 4.17: GNI as the response variable

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The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Figure 4.18: Interest rates as the response variable

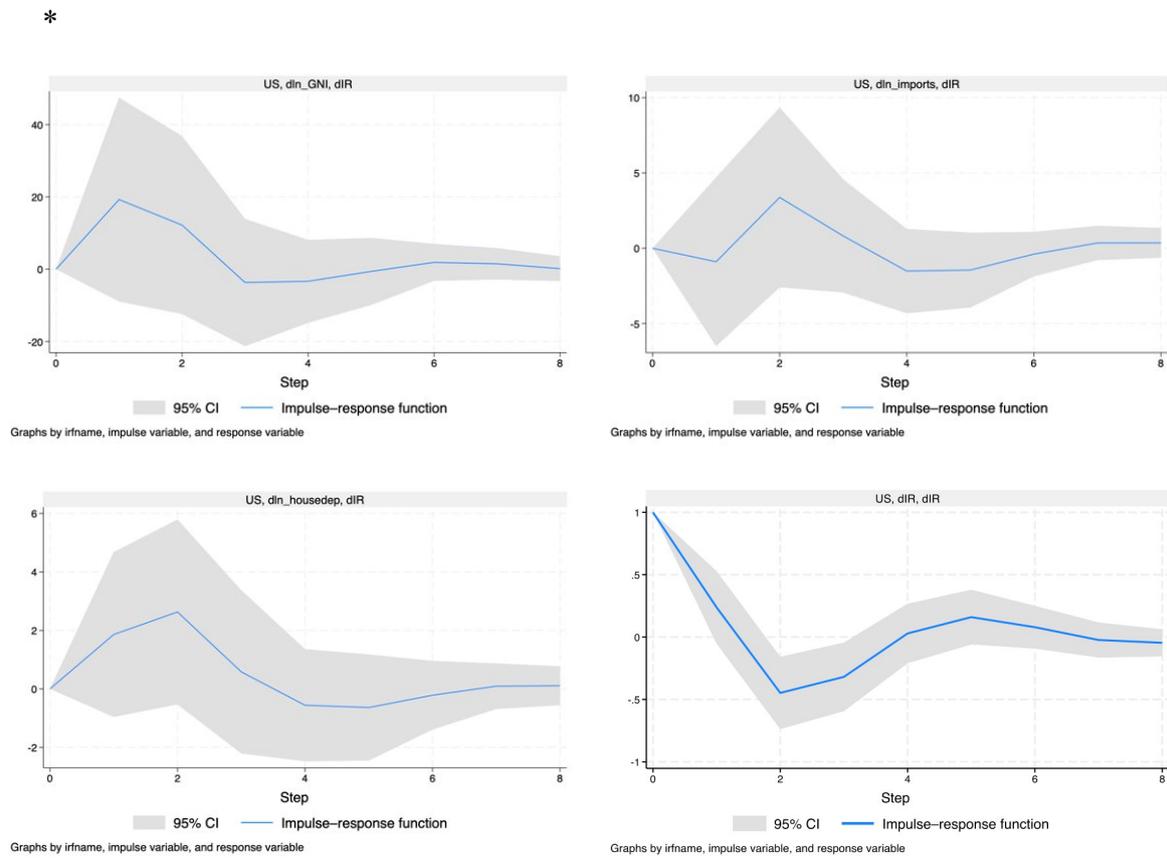
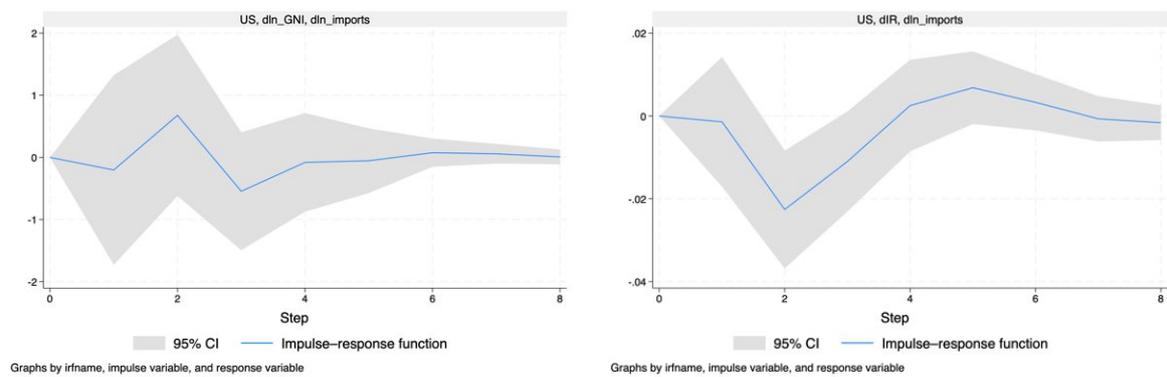


Figure 4.19: imports as the response variable



The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

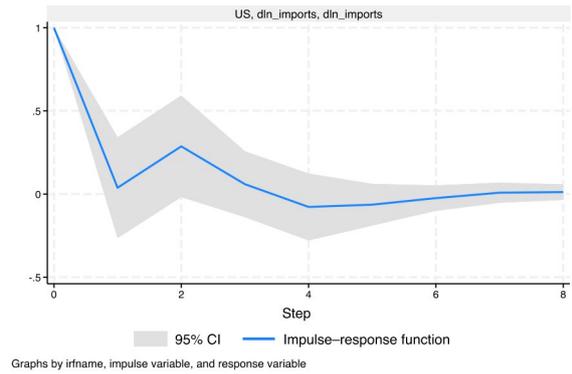
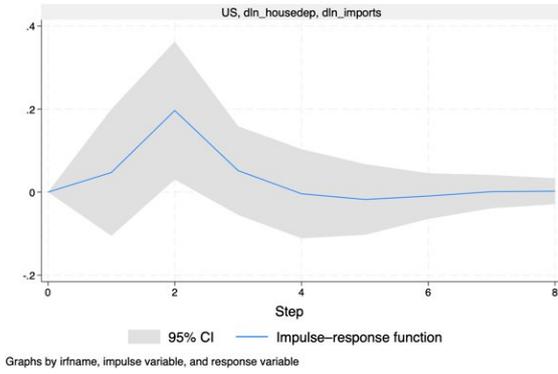
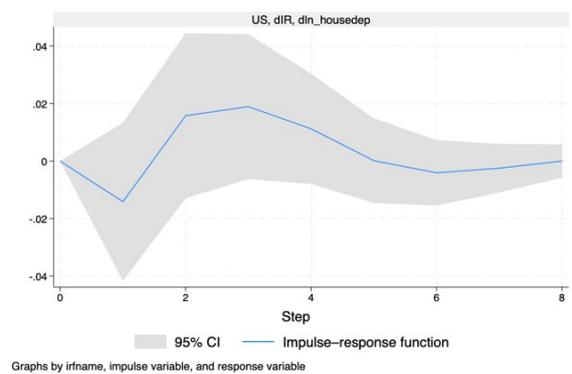
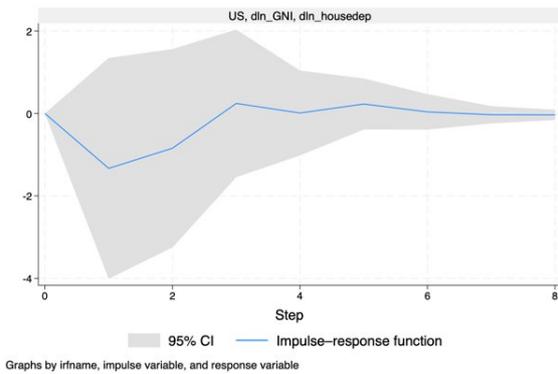
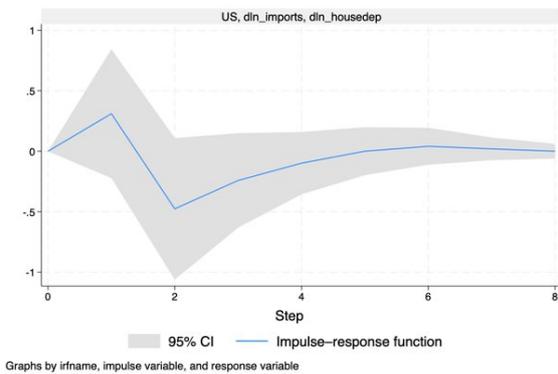


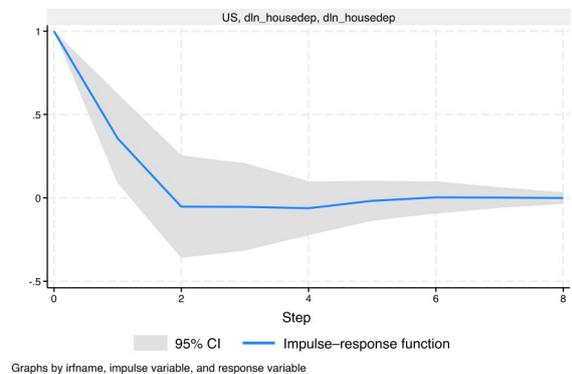
Figure 4.20: Wealth as the response variable



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The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Appendix H – Granger Causality Extended Results

Table 4.23: Granger causality results for the household model (1976-2022)

Dependent variables: ATHPI	chi-square	df	Prob> chi-square
Independent variables:			
Durables	17.117	2	<0.001 *
Services	6.556	2	0.038
Nondurables	27.06	2	<0.001 *
Dependent variables: Durables			
Independent variables: ATHPI	0.966	2	0.617
Dependent variables: Nondurables			
Independent variables: ATHPI	4.103	2	0.129
Dependent variables: Services			
Independent variables: ATHPI	0.191	2	0.910

Table 4.24: Granger causality results for the financial model (1974-2022)

Dependent variables: MMF	chi-square	df	Prob> chi-square
Independent variables:			
Durables	1.891	2	0.388
Services	8.134	2	0.017
Nondurables	0.690	2	0.708
Dependent variables: Durables			
Independent variables: MMF	9.404	2	0.009
Dependent variables: Nondurables			
Independent variables: MMF	1.578	2	0.454
Dependent variables: Services			
Independent variables: MMF	1.969	2	0.374

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.

Table 4.22: Granger causality results for the foreign consumption model (1960-2022)

Dependent variables: imports	chi-square	df	Prob> chi-square
Independent variables:			
GNI	1.328	2	0.515
Wealth	5.954	2	0.051
Interest rates	7.050	2	0.029
Dependent variables: interest rates			
Independent variables: imports	1.296	2	0.523
Dependent variables: GNI			
Independent variables: imports	0.186	2	0.911
Dependent variables: wealth			
Independent variables: imports	6.036	2	0.049

The dynamic correlation test was explored but due its shortcomings the discussion can be found within the appendix. As they do not have confidence bands, it is not very robust and does not have standard errors.