A Work Project, presented as part of the requirements for the Award of a Master's degree in Finance from the Nova School of Business and Economics.

The impact of the interest rate spike on household finances

Analyzing Income, Asset Holdings, Mortgage Contract and Liquidity Constraints on Saving

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ABSTRACT PAGE

This thesis explores the impacts of rising interest rates on household finances through group and individual analyses. The group study highlights the macroeconomic context of interest rate spikes, their effects on borrowing, savings, and financial stability across households. It examines how these changes influence housing markets, mortgage costs, and consumer behavior in an environment of economic uncertainty.

Tenure Choice and Housing Cost Burden in the UK: This analysis highlights how renters face higher financial strain compared to homeowners, during periods of rising housing costs.

Household Factors Influencing Mortgage Equity Withdrawal in the Netherlands: This study reveals that older homeowners and households facing liquidity constraints are more likely to use mortgage equity withdrawal as a financial strategy.

Preferences for Fixed vs. Variable Interest Rates in the UK: The analysis identifies a clear preference for fixed-rate mortgages during rising interest rates, driven by economic uncertainty and demographic factors.

Impact of Income, Assets, and Liquidity Constraints on Savings: This research uncovers how income levels, mortgage contracts, and liquidity constraints shape savings behavior, particularly among households facing financial pressure.

Keywords: Housing, Mortgages, Interest Rates, Savings

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Introduction

Relevance of Interest Rates & Mortgages

The macroeconomic environment is composed of several forces and dynamics among all countries on the globe, encompassing gross domestic product, unemployment rates, inflation, and many others. Small changes have effects on a global scale and impact households' and companies' everyday lives.

Yearly inflation, a general and prolonged increase in prices, is ideally stable at 2% per year, but this is not always the case, as many factors contribute to and influence its growth. In the context of high inflation, increasing interest rates is an often-used countermeasure by monetary policymakers. By increasing borrowing costs, both households and businesses will have higher interests to pay and consequently spend less on other things. Because it is less attractive to spend money, prices must go down as demand decreases, and so inflation is regulated. As inflation declines, so will interest rates until an equilibrium is reached.

The increase in rates at the central bank level affects commercial banks, consequently impacting households. The repercussions are many for businesses and households, with loans, savings and investments all being affected. In this context, borrowing costs are higher, thus disincentivizing businesses from making investments, slowing growth and job creation.

For families and households, this change in borrowing costs means adapting your spending and/or savings if you have loans, or disincentivizes you from getting loans for house or car purchases. Since many households resort to mortgages to get a house, and since this is the highest liability on their balance sheet, changes in interest rates could greatly impact the families' finances.

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At the end of 2021, as a response to the increasing inflation, interest rates were increased, which has affected households in a variety of ways. We will explore the topics of variable vs fixed interest rate choice, housing cost burden in different tenure types, consumption and saving changes when mortgage payments increase, and equity withdrawal through the years 2017 to 2023.

During 2011 until 2018, the global economy was recovering from the 2008 financial crisis. The economic output of most countries was well below the levels that would have prevailed if the output has followed the pre 2008 crisis trend. 85% of the economies which suffered from the banking crisis are currently operating bellow the pre-crisis output trend. This crisis affected fertility rates, and migration rates in advance economies, which led to a reduced labour force growth in the future. The crisis also reinforced pre-existing trends of inequality, exacerbating political and social tensions (Chen, Mrkaic, & Nabar, 2018).

The countries with better supervised regulated banks and flexible exchange rates were the ones which suffered less damage. Unfortunately, that was not the landscape for most banks, being this crisis, the wakeup call they needed to change policies. Banks started to create stricter banking regulations and received capital injections to cushion output losses which supported their recovery. Major banks such as the central banks significantly lowered their interest rates to stimulate economic activity by making borrowing cheaper and incentivizing investing and spending.

The global economy slowly recovered from the 2008 financial crisis and global GDP growth averaged a little more than 3.5% per year. Growth in Europe continued to be tentative, helped by fiscal consolidation and structural reforms. Both the UK and the Netherlands experienced comparable positive trajectories economically, though, neither country was inscrutable to external interventions by way of both the Eurozone crisis, and latterly through Brexit.

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Inflation and Interest rates 2011-2018

Since 1992, the UK economy has experienced consistent growth (measured by adding up the value of the goods and services produced in the country). However, from April to June 2008, the economy started contracting, The GDP started to decrease, and the UK entered a recession. During this period, the UK´s GDP decreased by over 5%. The UK economy took five years to return to its size before the recession. Between October 2007 and April 2009, the Official Rate from the Bank of England went from 5.75% to 0.5% and the Bank of England initiated "Quantitative Easing" to stimulate the Economy.

From the end of 2009 until 2011, the UK gradually emerged from the recession, facing challenges related to high public debt, weak global demand, and low consumer confidence. The recovery from the 2008 crisis was also hindered by the beginning of the Eurozone debt crisis in 2010. The CPIH (Consumer Prices Index including Housing Costs) rate was at 1% in September 2009, and a 3-year high was reached in September 2011 with the CPIH rate being 4.5%. This increase happened mainly because gas, electricity, and fuel prices rose significantly higher than the year before. Lots of people lost their jobs, employers stopped hiring, and by the end of 2011. By the end of 2011, almost 2.7 million people were looking for work. The quarterly unemployment rate reached 8.4%, the highest rate since 1995. The interest rates were kept low with the main goal of stimulating economic growth after the financial crisis. The bank continued its QE program, injecting an additional 75 billion pounds into the banking system, exceeding economists' expectations. QE was aimed at stimulating economic growth, it is debated whether it contributed to inflationary pressures, in the context of rising energy prices. The interest rates were kept at 0.5%, with the primary goal of stimulating the economy. The low interest rates also allowed the recovery of the housing market.

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In 2011, the UK saw a return to growth, and 2012 saw a slip backward into negative territory (also called a "double dip" recession). The euro-area economy remained weak, but global activity continued to expand at a moderate pace. The period of weak demand paired with stagnant productivity meant that CPI inflation was still above the 2% target. By October 2012, the Bank of England had bought 375 billion pounds worth of assets, primarily government bonds.

From June 2013 until December 2013, inflation decreased from 2.9% to 2%, hitting the desired target value. This happened mainly because of the appreciation of sterling and a revival in productivity growth. The rates were kept low with the intention of stimulating economic growth and consequently, mortgage rates were accessible.

2014 was a year marked by the fastest economic growth since 2006, growing faster than previously estimated. ONS figures showed that Household disposable income grew by 4.5% during the year. Asset and commodity prices fell again and inflation at the end of the year was inferior to 1% (0.5%).

In February 2015, Britain recorded its first instance of zero since data collection began. According to the MPC, two-thirds of the deviation from the 2% goal could be attributed to unusually low contributions from movements in energy, food, and other goods prices, and around a third of the deviation of inflation from the target reflected on more generalized subdued inflationary pressures resulting from weak growth in domestic costs. The MPC voted by a majority to maintain the Bank Rate at 0.5%. They projected moderate growth in global demand, with a significant increase in private domestic demand in the UK. Increased household spending was supported by rising real incomes due to lower food and energy prices. Wage growth and credit conditions were favorable; however, slow global growth could weigh on the economy. Maintaining the current interest rate was seen as necessary to ensure growth continued at the same pace.

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The UK ended 2015 as one of the fastest growing of the major developed economies. Unemployment was falling, the housing market was performing well, and household spending was strong. The same thing was expected for the first half of 2016, with some uncertainty for the second half of the year mainly due to the Brexit referendum. This historic vote would determine whether the UK remained in the European Union, introducing a potential shift in trade relationships, foreign investment, the labor market, regulatory measures, and currency stability.

On 23 June 2016, the British electorate voted to leave the European Union with a majority of approximately 52%. As soon as the results were clear, the pound depreciated sharply against the US dollar and the euro, and the outlook for growth in the short to medium term weakened significantly. After this, inflation was predicted to increase since the currency rates fell and import prices would be much higher. The inflation ended up increasing surpassing the 2% target in February 2017. During this period, the MPC chose to decrease the interest rates again reaching 0.25%, due to a weakness in demand relative to the available supply. The MPC was limited in what it could do to stimulate the economy since the rates were already low and it would be hard for certain banks to reduce even more the deposit rate. They complimented this decrease on rates with an expansion of the asset purchase scheme for UK government bonds of 60 billion pounds.

From this period onwards, the decisions made were marked by negotiations between the UK and the EU to establish what would be the terms of the UK´s withdrawal. Inflation was determined by the effects on import prices of the referendum-related fall in sterling. The uncertainty of these discussions caused market participants to downgrade their expectations about the future performance of the UK economy.

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2018 went on to be the weakest year in terms of economic growth since 2012, with Brexit and global worries declining sharply the investment done. GDP growth dropped significantly in the final quarter of 2018, to a rate of 0.2 percent from 0.6 percent in the quarter before. In the final months of 2018, major economies were affected by increasing trade tensions between the U.S.A and China, with Brexit being a major challenge for Britain.

In early 2020, COVID-19 caused an unprecedented economic crisis. Strict Lockdown measures were implemented, GDP contracted, and household consumption collapsed. To diminish the impact that this recession had, there were interest rate cuts.

In March 2020, the Bank of England reduced the Bank rate from 0.75% to 0.25% and a little after, to a historical low of 0.1%.

2021 was a year marked by a significant recovery for the UK economy with a GDP growth of 7.5%, one of the highest since World War II.

2022 and 2023 were marked by significant interest rate hikes, with the Bank of England shifting to a strategy of monetary tightening. In 2022, inflation peaked at 11.1% in October 2022 with interest rates ending at 3.5% by December 2022. In 2023, Inflation began to stabilize, falling to 6% late in the year. The inflation remained above the 2% target, leading to further interest rate increases. In August 2023, the Bank Rate peaked at 5.25%, a 15-year high. This shift in monetary policy had greater implications for mortgage holders, especially those with ARMs. The increase in rates resulted in a significant payment hike for them. These borrowers, who initially benefited from lower-interest rates, experienced an immediate reduction on their household budgets, in contrast with mortgage payers with FRMs.

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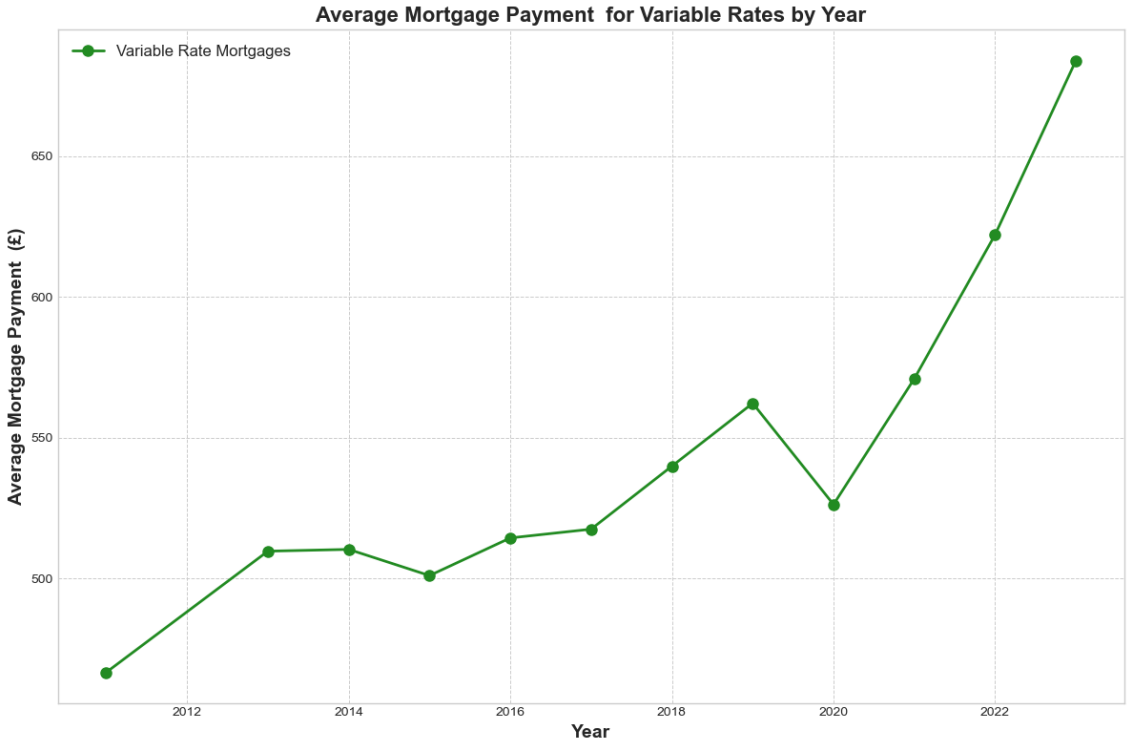

Figure 1 - Average Mortgage Payment for ARMs per year

There was a general increase in the average Mortgage Monthly Payments from 2011 forward, with a constant growth until around 2020. After 2020, there was a sharp rise in the average mortgage payment. This increase in Monthly Mortgage Payments from our data reflects the interest rate increases, especially from the start of 2022 until the 5.25% achieved in September 2023. These payments were even harsher for the households since the annual inflation for 2022 and 2023 was 9.1% and 7.3% respectively.

This increase in monthly mortgage payments is significant, but it is especially harsher on people whose household falls into the first annual income quintile (from 0 to 14,500). For these people, the monthly mortgage payment is majorly impactful on the monthly budget and can even lead to cuts in consumption.

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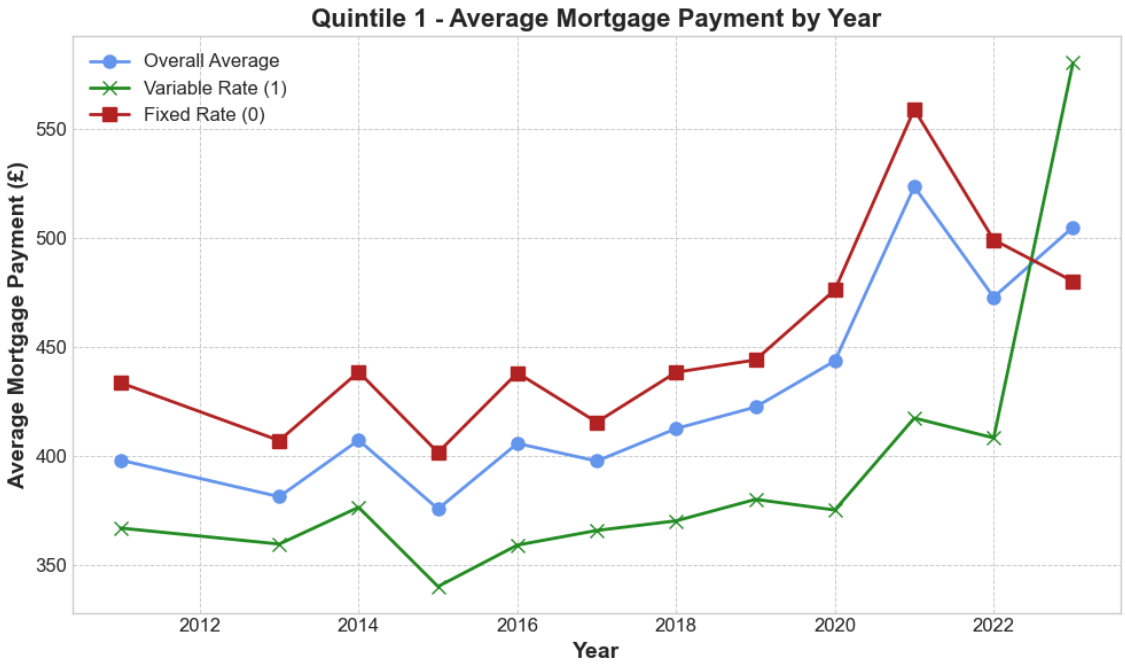

Figure 2 - Average Mortgage payment per year: ARMs VS FRMs (Quintile 1)

Like the previous graph, between 2011 and 2019, the mortgage payments for all three groups remained relatively stable, around 400 £ per month. There was a significant difference between both rates. Starting in 2021, there was a spike in fixed payments while the variable mortgages were still relatively close to the previous prices. In 2022 and 2023, This group had the steepest rise due to the interest rate hikes. In 2023, the monthly mortgage payments for ARMs were close to 600£. Now, imagine a household in this income group, where the monthly income, deriving from the first quintile of annual income of 14500£, corresponds to a monthly income of around 1200£. When we compare this to a monthly mortgage payment of 600£, we find that it takes up about 50% of their monthly income. This shows how much financial pressure these households are under, making it harder for them to keep the same consumption level and pay for other necessary expenses.

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Previously, I utilized the variable be23 as an indicator of household liquidity constraints. I used this variable to analyse the relationship between changes in ARMs payments and the proportion of households with variable rates experiencing liquidity constraints.

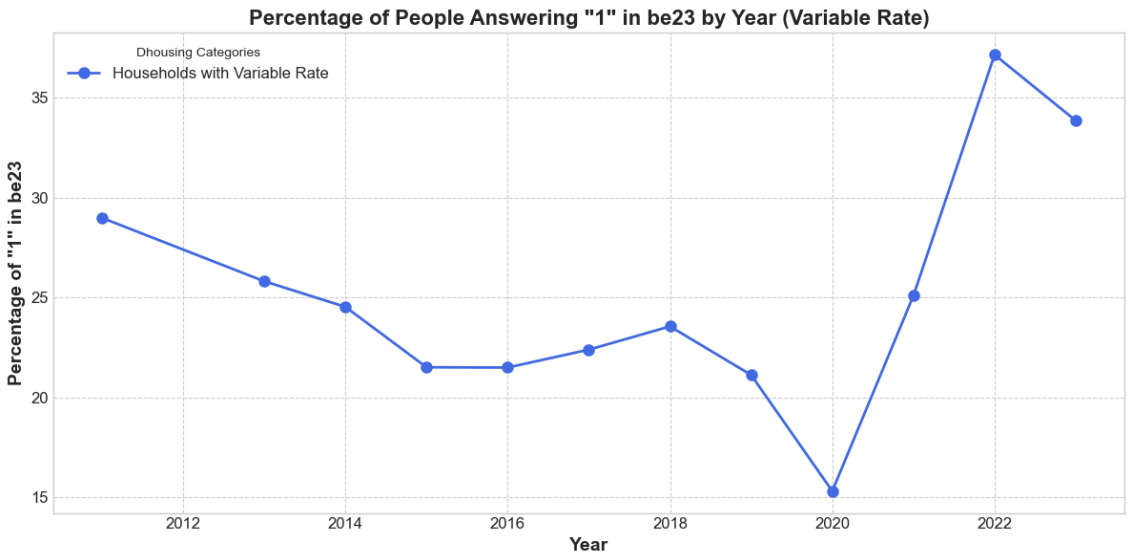

Figure 3 - Liquidity constrained households with variable rate

Firstly, we see that from 2011 until 2015, the percentage of liquidity-constrained households declined, reaching almost 20%. There was a slight increase from 2015 until 2018, and from 2018 until 2020 there was a significant decline. This trend is following the changes in the interest rates since in 2020 we reached a historic low of 0.1%. In this year, the percentage of liquidity-constrained households dropped to 15%, a distant value from the one we would observe in 2023. From 2020 onwards, there was a massive increase, reaching a peak value of 35% in 2022. This again reinforces the previous claim that variable mortgage rates for low-income households increase their financial pressure significantly.

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Mortgage and Renting Evolution 2011-2018

In the United Kingdom, in 2012, the ownership of residential stock corresponding to households (including private renting) and non-profit organizations (excluding housing associations) was estimated at £4,223 billion (Mitchell 2014). In mid-2013, ONS estimated the whole UK's residential market to be £4,615 billion, which has been growing steadily since the 2008 crisis.

In the UK, similar to the rest of the globe, the two most common options for housing tenure are owning and renting, flats or houses.

In 2011, out of the 22.8 million dwellings, 65% were owner-occupied and 18% were rented to private landlords, these numbers staying consistent in 2012 (Ministry of Housing, Communities & Local Government 2013, Ministry of Housing, Communities & Local Government 2014). Furthermore, tenure depends significantly on age, with most renters being more than 92 years of age, although this number has been decreasing, followed by 21-year-olds or younger, a number which, on the other hand, has been growing.

For all tenure types, suburban residential is the most common area, consistently in the following years, with 54% of all homes being terraced or semi-detached houses. When looking at housing conditions, in 2011 and 2012, private rented homes and converted flats were the most likely to be the worst category in the dwelling condition scale, representing another cost for the household. Still, a downward trend in overall repair costs can be seen over the years.

Over the years, privately rented dwellings have been increasing, while owner-occupied has remained fairly stable. In 2013, dwellings had increased to 23.3 million, 63% owner-occupied, 19% privately rented and 17% rented from social landlords 2012 (Ministry of Housing,

Communities & Local Government 2014). Three years later, in 2016, owner-occupied dwellings stayed consistent at the same %, representing an increasing number of people over 65 years of age, and a decreasing number of people 35 or under (Ministry of Housing, Communities & Local Government 2017).

On what concerns first-time buyers, in 2015, 61% were between 25-34 years old, this age group increasing over the years compared to 16-24, and nearly 50% are a couple with no children. This household is also most likely within the fourth- or fifth-income quintile, as 72% of first-time homebuyers are, compared to private renters who follow a relatively uniform distribution, slightly normally shaped (Ministry of Housing, Communities & Local Government 2016).

Moreover, in 2016, the privately rented sector had the highest housing costs, at a weekly cost of £184, followed by mortgagors at £159. Going further, if we look at the London area alone, it was cheaper to have a mortgage than to rent, as compared to European countries and cities, London's rent prices were by far the highest. Additionally, the proportion of income spent on housing was much greater in the city, in the case of mortgagors, 22%, and renters 45% of income, while in the whole of the UK, mortgage expenses represent 18% of income and rent 35%. These numbers change significantly depending on whether the couples have dependent children (Ministry of Housing, Communities & Local Government 2017).

In this same year, 94.6% of mortgagors had no difficulty in keeping up with payments, while 9% of renters were in arrears, other debts or responsibilities being the main factor (26%), followed by unemployment (21%) (Ministry of Housing, Communities & Local Government 2017).

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In 2017, out of the 64% of owner-occupiers, 53% outright owned their home, more commonly couples without children, while the others had a mortgage. The following year, the portion of household income spent on housing remained the same for mortgagors but increased to 41% for private renters (Ministry of Housing, Communities & Local Government 2018; Ministry of Housing, Communities & Local Government 2019).

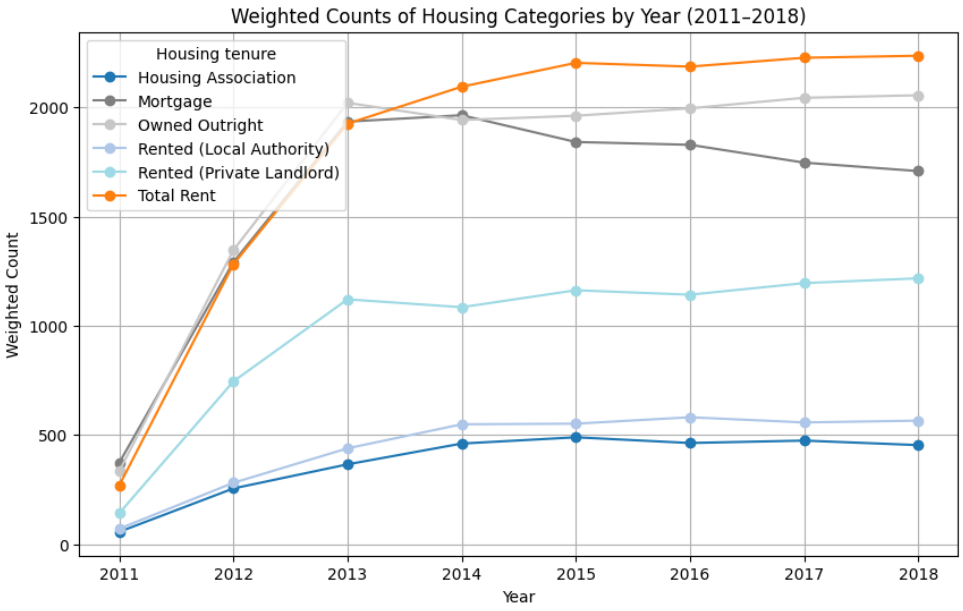

Figure 4: Housing categories over the years 2011-2018

Looking at salaries per housing tenure type for 13,758 observations in our dataset, they have been increasing for owner-occupiers and mortgagors in the years 2016, 2017 and 2018, but that was not the case for households renting to local authorities or renting to private landlords, which had a decrease in average salary in 2017, and a raise in 2018. In this last year, the average salary for outright owners was £4,455 per month, while mortgagors and private landlord renters earned an average of £3,348 and £2,971.

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In our dataset, looking at the housing cost burden1 over the years 2016, 2017 and 2018, the average was 0.1227. Mortgagors had an average burden of 0.162, 0.171 and 0.164 in 2016, 2017 and 2018, while private landlord renters had 0.306, 0.318 and 0.295, for the same years. The maximum burden was consistently higher for this rent type compared to households with a mortgage.

Over the years 2011 to 2018, when asked if the household feels heavily, somewhat, or not burdened, by loan and interest payments, the most common response was always not burdened. Still, from 2016 to 2018, a growing trend of households who feel heavily burdened can be identified, especially compared to the decrease in households that feel somewhat and no financial pressure at all (Figure 5).

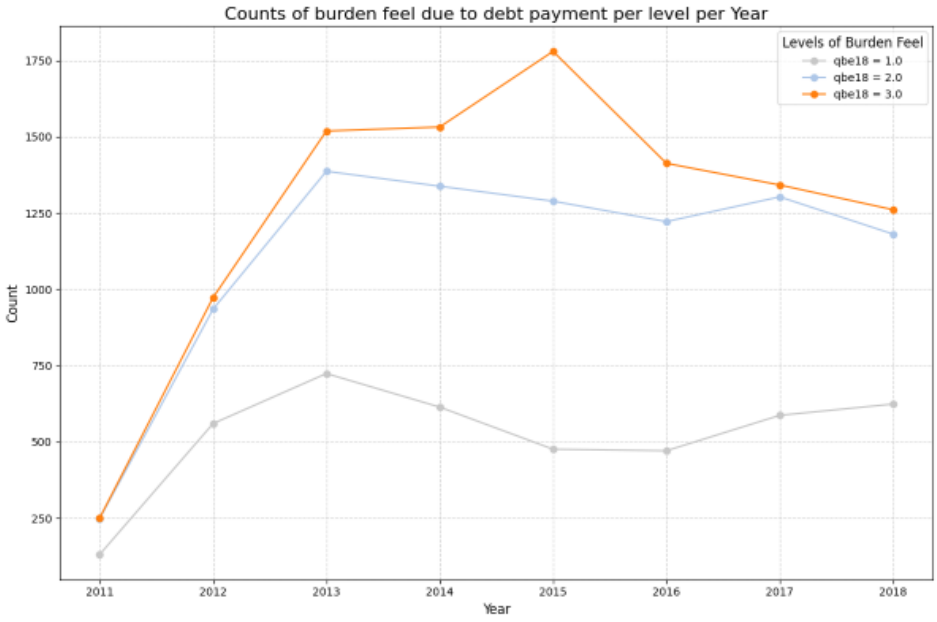

Figure 5 - Number of burden feel due to debt payment per year

[1] For renters: monthly rent payment/monthly income; for mortgagors: monthly mortgage payment/ monthly income.

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House Price Trends and Regional Variations

The period after the 2008 financial crisis was a period of recovery, the lower the interest rates allowed for cheaper mortgages which helped to stabilize the housing markets that were severely impacted by the crisis. The Bank of England reduced their bank rate from 5% in October 2008 to 0.5% by March 2009, where it remained until 2016 (Bank of England).

By December 2019, the average price for a property in the UK was £230,776, representing a 2.5% annual price increase for that year. This was the lowest annual growth for the UK since July 2013. The house price growth was the strongest in the Northern Ireland, followed by Wales and West Midlands. On the contrary, due to the 2016 Brexit referendum, London experienced a slowdown in house price growth, showing a consistent decrease in prices each month since July 2018. This shows a clear regional divide in the UK housing market.

On the other hand, the Dutch housing market experienced a house price decrease of 20% right after the 2008 financial crisis in the years of 2012 and 2013. This decrease followed by an extremely low-interest-rate environment due to the ECB monetary policies, led to an increase in housing demand post-crisis. In 2018, new-build Dutch homes showed a price increase of 13% (Statistics Netherlands (CBS), 2019). The recovery was perceived on the major cities, with Amsterdam and Utrecht showing the highest price increase, exceeding 10% annually by the late 2010s (Rabobank, 2018). The rural areas showed less housing demand, leading to slower housing price growth, reflecting the disparities in demand and economic activity.

The mortgage markets have a significant impact on housing prices and affordability through the cost of credit and mortgage availability.

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In the UK, a Mortgage Market Review was implemented by the Financial Conduct Authority in 2014. The MMR introduced more stringent checks on borrowers' affordability, to avoid irresponsible lending practices and prevent over-extending borrowers beyond their means. These new lending standards mandated borrowers to prove themselves capable of maintaining repayments, both at existing rates of interest but also during potential future rate increases, hence effectively stress-testing their finances (Financial Conduct Authority). These checks and tests made the access to liquidity inaccessible to certain individuals, which motivated new innovations such as buy-to-let mortgages and equity release products. The buy-to-let mortgage was designed to accommodate the landlords seeking to expand their property empire. The equity release products allowed older borrowers to access extra income without having to move or sell their current property. By 2018, a raft of specialist lenders emerged to take advantage of its ability to cater for more complex borrower profiles, such as self-employed, contractors and older borrowers. Growth in the later-life lending market was driven by the increasing numbers of specialist products that met the individual needs of borrowers aged 55-plus, enabling them to generate income in retirement or fund retirement itself through tailored solutions (UK Finance, 2019).

In the Netherlands, banks remain the dominant mortgage providers, holding approximately 69% of outstanding mortgage loans by the end of 2018. According to the statistics from De Nederlandsche Bank (DNB), interest-only mortgages accounted for more than half of outstanding mortgage debt as of the second quarter of 2017, reflecting a preference for lower initial payments among borrowers and the tax incentives, resulting in high loan-to-values.

In the last years, although, the Dutch housing market has undergone significant changes in lending standards. Such measures included reducing the maximum allowed LTV ratio from 106% to 100%

by 2018 and limiting mortgage interest tax deductibility to curb debt growth (Dutch Securitisation Association, 2022).

These new lending standards have made housing less affordable, with homeownership becoming more prevalent among higher-income households, underlining a growing disparity in housing wealth distribution. More than half of the Dutch housing stock is owner-occupied, while the rest belongs to the rental sector. The rental market is divided into a relatively large social housing segment and a smaller private rental segment. It is important to note that the share of social housing in the Netherlands is higher than in neighboring countries such as Belgium and Germany.

Dutch house prices are more volatile, while their supply is more inelastic compared to neighboring countries.

Looking at the period after the COVID-19 pandemic, there were significant changes in the way people behave. The option to work remotely remained a viable alternative for most corporations. This led people to stay longer periods at a time in their houses, and fewer commutes allowed these individuals to opt for housing further away from the city center. These results led to a flattening of the variation on the housing prices according to the distance from the city center (OECD, 2023).

This behavior of moving further away from the city and looking for a bigger house can be seen in the UK where detached house prices saw a growth of 25.9% which compared to the 13.3% growth in the prices of flats is much lower (Lloyds Banking Group, 2023).

On the other hand, Dutch house pricing has been increasing due to the high demand and low supply. The interest rate has been decreasing, allowing people to purchase their houses with an NHG

guarantee[2] at a cheaper price. Previously this guarantee would've cost the buyer 4.55% for a 10-year fixer period, and now it decreased to 3.6%. To fix the low supply, smaller landlords are getting impacted by rent control system and higher taxes on property ownership, motivating them to sell their properties to the tenants (IAmExpat, n.d.).

Looking at the mortgage equity withdrawal in the UK, in 2022 there was a 31% increase of new equity being released, totaling £5.58 billion. These releases can arrive in different schedules and amounts, although 63% are now being delivered in fixed amounts and only 3% are variable. These new features on equity release products have increased its adoption. The Equity Release council has acknowledged the need for flexibility with such products, introducing the new rule of ad hoc capital repayments. For instance, homeowners can now have an active management of their borrowing process, which allows the customers to pay back some of the loan when they choose to, reducing the amount of interest accrued over time and improving their ability to manage their debt (Professional Paraplanner, 2023). Previously, such products would not allow such repayment until the property was sold.

In the Netherlands, equity withdrawal products are limited in availability. However, it is expected for the interest in these products to grow as the population ages and the need for retirement funding solutions increases (Netspar, n.d.). As the global mortgage equity release market is projected to reach $50 billion by 2033, there is an incentive to develop this market in the Netherlands. This growth is sustained by the rising costs of living, which amplifies the need for products that allow

[2]The National Mortgage Guarantee is a government-backed insurance program designed to shield borrowers from residential debt in cases where they are unable to meet their monthly payment obligations.

homeowners to access their home equity (European Pensions and Property Asset Release Group [EPPARG], n.d.). The introduction of flexible options like the Home Equity Mortgage by ABN AMRO indicates a shift towards providing homeowners with more control over their finances, particularly in retirement.

Currently, equity release products are mainly offered by insurance companies, with very few banks involved, due to lack of funds and the nature of their business (Money Release, n.d.). If the funds were no impediment this could be a major opportunity for banks, due to the close relationship they gain with their clients throughout their lives.

Mortgage Fixed and Variable Rate Evolution 2011-2018

There is no doubt that the size and shape of the mortgage market have changed considerably over the last decade since the global financial crisis. Significant conduct and regulation changes were brought by the crisis to shield borrowers and businesses against the possibility of a future recession or economic shock (Bank of England 2024a).

Between 2011 and 2018, the UK mortgage market experienced a significant shift in preferences between fixed and variable-rate mortgages, influenced by a combination of economic conditions, policy decisions, and broader market trends (UK Finance 2024).

From 2011 to 2012, the UK was still recovering from the 2008 financial crisis. The Bank of England had set the base interest rate at a low 0.5% in 2009 to stimulate economic recovery, and this low rate remained in place until 2012 (Bank of England 2024a). Given this low and stable rate, variable-rate mortgages became a popular choice because they offered lower monthly payments than the relatively higher fixed rates, which were averaging around 4.5% at the time (UK Finance

2024). For many borrowers, the appeal of reduced initial costs outweighed the security of locking in a fixed rate. Economic recovery was gradual, and there was little expectation that the Bank of England would raise interest rates soon, further reinforcing the attractiveness of variable rates for those looking to save on their mortgage costs (Financial Times 2024).

As the economy showed signs of recovery around 2013, fixed-rate mortgage rates began to decline, averaging around 4% by 2014 (Bank of England 2024a). Meanwhile, the Bank of England's commitment to a low base rate kept variable rates steady and affordable, allowing borrowers to continue benefiting from reduced monthly payments (ONS 2024). On the other hand, the fall in fixed-rate mortgage rates attracted more borrowers who were interested in securing a low rate over a long period (UK Finance 2024). The stabilization of the economy allowed the possibility of future rate increases, making fixed rates appear more attractive even to individuals who previously selected variable rates (Financial Times 2024). Consequently, a gradual change started as more and more borrowers chose the stability of fixed-rate mortgages (BBC Business News 2024).

The trend towards fixed rates became more pronounced in 2015 and 2016, as fixed mortgage rates dropped to historic lows, reaching around 3.7% (UK Finance 2024). The Bank of England maintained the base rate at 0.5%, and competitive mortgage products offered by lenders pushed both fixed and variable rates down (Bank of England 2024b). However, in August 2016, shortly after the Brexit referendum, economic uncertainty and concerns about potential impacts on growth led the Bank of England to take further action. To support economic stability, it reduced the base rate from 0.5% to 0.25%, marking the lowest rate in UK history at that time (Bank of England 2024a). Borrowers were able to affordably secure long-term stability with fixed rates at all-time lows. The certainty that their rates would not rise abruptly encouraged more borrowers to choose

fixed-rate agreements, which accounted for most new mortgage contracts (BBC Business News 2024).

As inflation signaled a growing economy in 2017, the Bank of England hinted at a possible change in its low-rate policy. This expectation came true in November when the base rate increased from 0.25% to 0.5% (Bank of England 2024b). Although fixed rates increased slightly, they remained attractive to borrowers who were cautious about additional rate hikes (UK Finance 2024). Furthermore, the impending uncertainty surrounding the Brexit discussions contributed to a more conservative economic environment, with many borrowers viewing fixed-rate mortgages to protect their finances from the potential instability caused by the UK's exit from the European Union (Financial Times 2024).

By 2018, the trend toward fixed-rate mortgages was observed more clearly. In August, the Bank of England raised the base rate again, from 0.5% to 0.75%, leading many fixed-rate mortgages to average around 4.36% (Bank of England 2024a). Despite the increase, fixed-rate options remained the top choice for many borrowers due to their predictability (UK Finance 2024). With the escalation of Brexit negotiations and the possibility of economic disruptions, fixed-rate mortgages' predictability became even more appealing, even with rising costs (BBC Business News 2024). The Bank of England's shift toward higher rates and the economic uncertainty surrounding Brexit solidified fixed-rate mortgages as the dominant choice for UK borrowers. Conversely, borrowers now viewed variable rates as riskier due to concerns that additional rate increases would cause a significant rise in their mortgage payments (ONS 2024). In summary, the period from 2011 to 2018 saw a clear shift in the UK mortgage market, as fixed-rate mortgages increasingly outpaced variable rates in popularity. Early in the decade, borrowers leaned toward variable rates due to low

costs and stable economic conditions. However, as fixed rates declined and the possibility of future rate increases grew, borrowers leaned toward the predictability and stability of fixed-rate mortgages (UK Finance 2024). By the end of 2018, fixed-rate mortgages had become the preferred choice, reflecting the impact of economic signals, Bank of England policy shifts, and Brexit related uncertainty on the choices of UK borrowers. This trend underscored the value of stability in a volatile economic environment (BBC Business News 2024).

Figure 6 - Interest rate type choice (2011-2018)

The graph confirms the trends described in the text, showing a clear shift in mortgage preferences between 2011 and 2018. Early in the period, variable rates were more popular, but from 2014 onward, fixed-rate mortgages became dominant as rates declined and economic uncertainty grew. By 2018, the preference for fixed rates, driven by concerns over rising interest rates and Brexit-related uncertainty, is clearly reflected in the graph.

Introduction

Households are crucial elements for the national economy mainly due to their significant contribution to the country's circular flow of income. Firstly, Households are the primary consumers of goods and services, driving demand and supporting business revenue. Household consumption accounts for an average of 59.35% of GDP across OECD countries, underscoring its crucial impact on economic growth. Secondly, households enable firms to produce goods and services by supplying labor in exchange for wages, further fueling economic activity (Polaski, 2003). Thirdly, Household savings determine to an important extent the availability of credit to finance investments by enterprises and the government.

One important factor for households is the constitution of their portfolio, as it directly impacts their ability to generate wealth and manage their finances effectively. A well-structured household portfolio can significantly enhance the household´s capacity to generate capital, enhancing financial stability. It also influences the household´s economic security and long-term planning, safeguarding against monetary policy shocks and unexpected financial challenges. Additionally, the portfolio´s liquidity is a determinant factor in the household´s flexibility (Campbell 2006).

One of the most important financial commitments for households is the mortgage, which plays a critical role not just in household finance but also in the broader economy. Mortgage allows families to purchase homes, supporting the housing market, a key sector of the economy. Besides that, mortgage debt will have a large influence on household consumption patterns and overall financial health, making it a central issue in discussions on economic stability and growth (Guiso and Sodini 2013). The mortgage contract is a vital decision because it will represent a long-term

liability that will last for decades, its duration and financial burden will impact the household´s portfolio over an extended period (Campell and Cocco 2015).

The structure of mortgages is highly dependent on country and time. In the US, most residential mortgages have 30-year fixed rate terms; while compared to the UK, most mortgage products are fixed for a shorter period (typically fixed for between 2 and 5 years) after which they convert to ARMs (guy). These differences in how the housing market operates influence how monetary policy shocks, such as changes in interest rates, affect households (Cloyne, Ferreira, and Surico 2020).

Being a major and long-term liability in the balance sheet of most households, mortgages play a key role in the transmission of monetary policy (Di Maggio et al. 2017). The role it plays is determined by the predominant rate choice, it's important to keep in mind that in an economy majorly composed of ARMS, monetary transmission tends to be (Bernanke and Gertler 1995), for instance, recently when inflation increased and the central banks increased monetary policy rates, mortgage payments increased. For borrowers with FRMs, however, payments stayed the same. The increase in payments for households with ARMs resulted in less disposable income for the households and bigger implications for their consumption (Rubio 2011).

The choice between fixed-rate mortgages and adjustable rates is also not homogenous, which can lead to heterogeneous effects on the transmission of monetary policy across different countries and over time (Slacalek, Tristani, and Violante 2020).

In recent years, interest has increased in understanding household responses to temporary economic shocks, particularly within the framework of Heterogeneous Agent New Keynesian (HANK) models, such as those by Kaplan, Moll, and Violante (2018), Luetticke (2021), and Auclert,

Rognlie, and Straub (2020). These models offer insights into how households, differentiated by income, wealth, and financial obligations, adapt their consumption and savings in response to economic fluctuations. The role that mortgage contract structures play in moderating or amplifying the effects of monetary policy on household behavior, especially in times of interest rate hikes, is central to this thesis.

Understanding how households with varying mortgage contracts and socioeconomic conditions react to these economic shocks is crucial to understanding the role mortgage contracts play in shaping the direct impact of monetary policy. This thesis focused on how households' behavior has shifted according to the interest rate hikes that started in 2022. It compared households with varying mortgage contracts concentrating on consumption, savings, and labor participation changes. To answer this question, I used household surveys from the central bank, featuring representative samples of the country´s population. My main objective was to shed light on the heterogeneous impacts of monetary policy on household financial behavior and the critical role mortgage contracts play in shaping these outcomes.

Literature Review

Household balance sheets play a crucial role in the transmission of monetary policy, as they determine how changes in interest rates impact household spending behaviors. When interest rates fluctuate, the financial obligations and assets of households including savings, debt, and mortgages directly influence their ability to spend or save, thereby shaping the broader economic response. As interest rates rise or fall, households with high levels of debt may feel the effects more intensely, particularly when major financial obligations, like mortgages, are involved (Iacoviello 2005; Mian, Rao, and Sufi 2013; Cloyne, Ferreira, and Surico 2020; Mitman et al. 2016; Bilbiie 2017; Kaplan,

Moll, and Violante 2018; Slacalek, Tristani, and Violante 2020; Luetticke 2021). Iacoviello (2005) developed a monetary business cycle mode with nominal loans and collateral constraints tied to housing values. Iacoviello's model showed that nominal debt interacts with monetary policy in ways that stabilize the economy in response to supply shocks but amplify the effects of demand shocks, suggesting that housing price fluctuations and borrowing constraints should be considered in policy design. (Mian, Rao, and Sufi 2013) provide empirical data showing how household balance sheets impact monetary policy transmission. They argue that high levels of household debt can significantly reduce consumption, particularly during economic downturns. When interest rates rise, households with greater debt are less likely to adjust their spending patterns, as they prioritize debt repayment over consumption. This leads to a weaker transmission of monetary policy, particularly when households are financially constrained. Cloyne, Ferreira and Surrico (2020) build upon these insights by doing an empirical investigation whether differences in household balance sheets affect the transmission mechanism of interest rate changes. They first show that most of the aggregate consumption response to a temporary unanticipated interest rate change is driven by households with a mortgage. They also show that when interest rates fall, households with a mortgage increase their spending considerably, while outright homeowners without mortgage debt do not change their expenditure at all. Their findings are consistent with Mian, Rao and Sufi, emphasizing the marginal propensity to consume varies with the composition of household balance sheets resulting in a heterogeneous response. Relative to the importance of how household balance sheet shapes monetary policy transmission, Heterogeneous Agent New Keynesian (HANK) models add more depth to this analysis, capture variations in households' behavior based on other financial characteristics such as income levels, asset holdings, and liquidity constraints. For instance, Kaplan, Moll, and Violante (2018) demonstrate that the transmission of monetary policy varies significantly

depending on household liquidity positions and debt levels. They categorize households as either "Hand-to-Mouth" (with minimal liquid assets relative to their income) or wealthier households, with the former group responding more acutely to interest rate changes due to their greater marginal propensity to consume (MPC). Slacalek, Tristani and Violante (2020) constructed simplified assumptions to isolate and better understand the role of each monetary transmission channel. They found that the differences in homeownership rates, mortgage market institutions (prevalence of adjustable-rate mortgages), and labor market institutions imply that the strength of the transmission channels varies considerably across different countries. They mostly contrast Spain and Germany (Spain has a significantly bigger amount of AMR and are twice as likely to own their home), adding up all the factors, aggregate nondurable consumption responds very strongly in Spain (nearly 2%) and much less so in Germany (0.4 %).

As mentioned before, one of the most important financial obligations for a household is the mortgage (Di Maggio et al. 2017). which typically represents the largest transaction individuals will ever make. Mortgages are not merely loans, they are complex financial products that can vary in terms, structure, and interest rates, influencing household financial stability. In the United Kingdom, mortgage payments account for approximately 15%-20% of homeowners pre-tax income (Hancock and Wood 2004), highlighting their significant impact on household finances.

Mortgages also require a substantial amount of time to repay, traditionally spanning 25 years; however, a recent report from the Bank of England's Financial Policy Committee (FPC) revealed that almost half of all new mortgages issued in the final three months of 2023 were for terms of 30 years or more. According to UK Finance, in 2005, the typical mortgage term for a UK first-time buyer was 25 years, which increased to 30 years by mid-2022. With the increase in mortgage terms,

the burden of monthly payments will be smaller, opening space for increases in consumption, saving more or investing in other assets. Although the monthly payments are smaller, the longer the mortgage, the more interest the household is paying, and in the case of an ARM, the increased repayment period results in increased exposure to future interest rate hikes. Fixed Rate mortgages can be seen as a liability to the household that is "hedged" against interest rate fluctuations for the fixed term. Households with ARMs, on the other hand, are exposed to the risk associated with variable interest rates, which can lead to fluctuating monthly payments after an initial fixed period. The distinct characteristics between Fixed Rate Mortgages and Adjustable-rate mortgages have significant implications for the economy. Given the importance of mortgage decisions for households, it is no surprise that the choice between ARMs and FRMs is one of the most studied topics in household finance (Campbell and Coco 2003; Koijen, Van Hemert, and Van Nieuwerburgh 2009; Badarinza, Campbell, and Ramadorai 2018).

It is due to the fundamental distinction between ARM and FRMs that the prevailing belief has been that a larger proportion of ARMs in the economy strengthens the transmission of monetary policy (Bernanke and Gertler 1995; Rubio 2011; Garriga, Kydland, and Šustek 2017; Bernan, Calza, Monacelli, and Straca 2013; Jappelli and Scognamiglio 2018; Di Maggio et al. 2017; Keys et al. 2014). Bernanke and Gertler (1995) discuss how changes in interest rates, driven by monetary policy, impact household consumption mainly through the credit channel They highlight that monetary tightening increases mortgage costs, especially for borrowers with ARMs. As interest expenses rise, household cash flows decline, reducing their financial stability and leading to lower spending on consumer goods and housing. This effect is magnified by the weakening of borrower's balance sheets, which worsens the reduction in consumption and amplifies the transmission of monetary policy shocks into the real economy. Rubio created a New Keynesian Model with a

housing market and a group of constrained individuals who need housing collateral to obtain loans. The model predicted that interest rate shocks affect those borrowers who have variable-rate mortgages. Garriga Kydland and Sustek (2017) provided a quantitative analysis of the role of the long-term nominal aspect of mortgages in the monetary transmission mechanism at the aggregate level, studying both the FRM and ARM contracts, concluding that the real effects of the nominal shock are stronger under ARM than under FRM. Expanding on this foundational understanding, Bernan, Calza, Monacelli, and Stracca (2013) studied how the structure of housing finance affected the transmission of monetary policy shocks. They highlighted how the transmission to consumption was stronger only in countries where mortgage equity release was common, and the mortgage contracts were predominantly of the variable-rate type. While they provided a multi-country analysis in several industrialized countries, Japelli and Scognamiglio (2018) brought depth to those findings by focusing specifically on the Italian mortgage market. They found that consumption of ARM holders increased relative to FRM but the implied marginal propensity to consume not being statistically different zero. This aligns with broader evidence from Di Maggio et al. (2014) and Keys et al. (2014), suggesting that the extra resources available to ARM holders may be directed not only towards boosting consumption but also towards deleveraging, helping to reduce household debt burdens.

This analysis mainly addressed three connected subjects:

Firstly, it examined how changes in interest rates disproportionally affect households with ARMs compared to those with FRMs. Households with ARMs face variable payment obligations, exposing them to monetary policy shifts, mainly interest rate hikes. This exposure was analyzed in

conjunction with other indicators of liquidity constraints, highlighting the interaction between mortgage types and financial stress.

Secondly, HANK models add more depth to these insights by introducing variations in household behavior based on income levels, asset holdings, and liquidity constraints. These papers refer to a gap in empirical evidence on the spending response to anticipated income changes (Colarieti, Mei, and Stantcheva 2024), a gap I tried to fill with my study.

Thirdly, a WLS model is used to empirically assess the significance of key variables, including income quintiles, demographic characteristics, mortgage types (ARMs and FRMs), and expectations for the future. With this approach, I tried to evaluate the direct impact of these variables on household savings behavior, showing the heterogeneous responses to economic and monetary policy changes.

For our analysis, I used survey-based data, which offers valuable insights into household financial behavior by capturing detailed, self-reported information on consumptions, savings, and mortgage payments. However, survey data has its limitations; response bias can affect the reliability of self-reported data, as respondents may misreport values or spending due to various factors (Bound, Brown, and Mathiowetz 2001). Knowing this, household surveys continue to be one of the best resources for economic research (Meyer, Mok, and Sullivan 2015).

Data and Empirical Framework

To investigate how different households adjust their consumption in response to monetary policy changes, I used the Bank of England household survey data. This annual survey asks people questions about their income and spending. I chose this survey because it provides a timelier update

of development in household finances than other surveys, which are typically published with a longer lag. This survey contains detailed information on household expenditure, household income, and the household balance sheet. Besides that, the survey provides information on the demographics and information on the current mortgage contract of the household. This information enables us to compare households across various income levels and evaluate the proportion of monthly mortgage payments with each household´s portfolio. Our focus is on the years 2022 and 2023 due to the consecutive interest rate increases during this period. These rate hikes provide a unique opportunity to examine how households adjust their consumption and financial priorities in response to tightening monetary policy.

Data Quality

Originally, our dataset contained answers to the survey from 2011 until 2023 having 71142 entries in total, as mentioned earlier, the focus of our study was on periods of high interest rates, so I ended up only including data from 2022 and 2023.

This filtered dataset had 11967 entries. The dataset included variables of different styles and categories: Socioeconomic Variables, Behavioral Variables, Financial Variables and Event-Specific Variables.

Data Cleaning

To avoid redundancy and keep only pertinent information, the dataset was subject to filtering. The original dataset did not have a direct quantitative variable related to consumption patterns. While it included variables like household monthly spending, monthly savings, and monthly debt payments, which were more indicative of financial expenses rather than a breakdown of

consumption behavior, these were the closest available indicators. As a result, I only kept the rows that did not have missing values in the key variables: monthly spending (spq01free_1), monthly savings (be2afree_1), and monthly debt payments (qbe17free_1). From this point onward, the dataset had 2010 records. Many variables contained real values, while others had value ranges. Ideally, I tried to avoid using the categorical data if I had the real values at our disposal since if those values were needed for a calculation, using the midpoint of a range for calculations I was already introducing bias into the sample, so I prioritized using the actual values when possible. Two variables had some missing values in the real value and were filled in the categorical variable where the household annual and monthly income variables. To address this issue, I mapped the annual income variable to numerical value to facilitate further analysis. Since I used the midpoint of categorical ranges, I acknowledged that this approach might have introduced a small bias in our sample. After creating the continuous annual income variable, I used it to separate the responses by income quintile (Fisher, Johnson, Smeeding, & Thompson, 2020) for later analysis. Then I proceeded to look for outliers in the sample, mainly focusing on monthly spending, monthly savings and monthly debt payments. To identify outliers in an easier way, I computed the spending-to-income ratio, the saving-to-income ratio and the debt-to-income ratio. I adopted a conservative approach by removing only extreme cases. My methodology involved using boxplots for each quintile, checking the distribution of data, and comparing them to the outliers. I was left with 1999 records. An essential part of my analysis involved classifying the households based on their asset positions. Firstly, I focused on the savings variable and used the continuous one, which had 5% of values not filled but the categorical variable was filled and again I replaced the continuous values that weren´t filled by the midpoint of the categorical ranges. This allowed me to be consistent throughout the data imputation. The same methodology was used for the House value variable

(be04) and I excluded the rows that owned a house or had a mortgage and did not fill this variable. I repeated this process for two variables, the Mortgage Debt variable (be07) and the Unsecured Debt Variable (boe97combined). Additionally, rows that contained responses such as "Don't know" or "Prefer not to answer" for any of the relevant variables were deleted to ensure that the data used was complete and relevant. As a result of these exclusions, the final data set contained 1,876 records.

Variable Construction and Classification

HANK models account for the fact that households have significant differences in their asset positions. Many households hold little wealth, and these "hand-to-mouth" households are often believed to have larger marginal propensities to consume (MPCs) (Aguiar, Bils, & Boar 2024). In our study, I built a classification for hand-to-mouth households since they are an important factor in understanding household behavior in HANK models. I followed Zeldes (1989), Kaplan et al. (2014), and Aguiar, Bils and Boar (2024) to do our classification. Zeldes (1989) defined a household as hand-to-mouth based on net worth (H2MNW) if their net worth is less than two months of labor earnings. Kaplan et al. (2014) focused on liquidity rather than wealth. They identify constrained households as those with negative liquid wealth with an absolute value greater than 16.5% of annual earnings (H2MLIQ) (Table 2 and 3). For the income Heterogeneity, I distributed the income variable across quintiles. For the liquidity constraints, I classified households as liquidity constrained if they gave an affirmative answer on be23: "Have you been put off spending because you are concerned that you will not be able to get further credit when you need it, say because you are close to your credit limit, or you think your loan application would be turned down?" (Cox and Jappelli 1993; Crook 2001; Duca and Rosenthal 1993; Jappelli 1990) (Table 4 and 5). I use the variable spq03: "How do you expect your household to change its spending over

the next 12 months" having in mind the importance of household expectations in financial behavior (Knutson and Kuhnen 2011), which suggests that negative financial outcomes can lead to disproportionate pessimism about the household's future state.

Methodology

Given the absence of direct consumption data, I chose to predict monthly savings as a proxy, assuming that unspent income translates into savings. This way I could verify empirically the relevance and explanatory powers of the variables commonly used in HANK models to understand household financial behavior in terms of consumption and savings. Additionally, I incorporated the mortgage factor, separating households with fixed-rate mortgages and those with variable-rate mortgages, to capture the different impacts of alternative mortgage structures on savings behavior.

I chose to do a multiple linear regression because it allowed me to quantify what is the direct impact of the chosen variables in monthly savings. With the coefficients, I could directly measure the magnitude and direction of these relations (Nimon and Oswald 2013). I could also verify if the variables are statistically significant or not.

With this model, I could use multiple explanatory variables at once, isolating the contribution of each.

Regression Analysis

To conduct a valid and robust multiple linear regression, several transformations were made to prepare the data and ensure it met the obligations of the model.

First, the dependent variable (be2a) was log-transformed. The original data showed a high positive skew (8.7) and extremely high kurtosis (94.97), indicating the presence of outliers and a long right tail. After the log transformation, the skewness decreased to -0,59 and kurtosis to -0.58, bringing the distribution closer to normal. This transformation helped with the issues of non-normality and reduced the influence of outliers (Mullahy and Norton 2022).

Secondly, dummy variables were created for the H2m (hand-to-mouth) and BE23 (liquidity-constrained) categories. These variables are binary by nature, indicating whether an individual falls into this category or not. By converting these categorical variables into dummies, I ensured that I could study the specific effect of being hand-to-mouth or liquidity-constrained on the dependent variable.

Thirdly, the quintiles of income (represented as quintil_2, quintil_3, quintil_4, quintil_5) were included as dummy variables. These quintiles represent distinct income brackets. The use of dummy variables here is important because by breaking income down into discrete groups, we can better capture the differences in behavior.

Similarly, the expectations for the future (represented as spq03_2.0, spq03_3.0, spq03_4.0, spq03_5.0) were transformed into dummy variables. This variable captures the expectations related to future spending, I could isolate the effect of the different expectations on household savings, since expectations about the future can influence present behavior, including savings decisions.

The mortgage rate type (represented as is_variable and is_fixed) was used to create binary dummy variables, representing whether an individual has a variable or fixed rate. This is particularly

important as fixed and variable-rate mortgages can influence saving differently, and this model can account for these differences.

The age variable (fgenage) was included to account for the effect of age on the dependent variable, since it can significantly influence saving amount.

The interaction between the number of children in the household (nochildren) and other adults in the household (otheradults) was also included to capture the combined effects of these household characteristics on the savings variable. The effects of having a child depend on the number of adults in the household, that is why the interaction was made.

Additionally, the regression analysis incorporated the weights provided by the survey to adjust for the complex survey design and ensure the results are representative of the population. These weights account for factors such as unequal probabilities of selection, stratification, and clustering in the survey design (Heeringa, West, and Berglund 2010).

With these transformations, and adding an interaction term, the model could better capture the relations between the dependent variable and the independent variables, leading to a better understanding of factors influencing savings behavior.

Table 1 1– WLS Regression Coefficients, Standard Error and P-value

Variables	Coefficient	Standard Error	P-value
Constant	5.4613	0.346	0.000***
Hand-to-Mouth	-1.8820	0.146	0.000***
Liquidity Constrained	-0.4977	0.136	0.000***
Age	-0.0234	0.004	0.000***
Number of Children	-0.4880	0.155	0.002***
Number of Adults	-0.0383	0.069	0.576

Number of Children * Number of adults	0.1738	0.057	0.002***
Second Quintile	0.9802	0.153	0.000***
Third Quintile	1.3926	0.213	0.000***
Fourth Quintile	2.0505	0.165	0.000***
Fifth Quintile	2.6132	0.223	0.000***
Increase spending a little	0.6155	0.178	0.001**
Same spending	0.3479	0.182	0.055
Decrease spending a little	-0.0918	0.215	0.669
Decrease spending a lot	-0.8559	0.242	0.000***
Has Adjustable Rate Mortgage	-0.6389	0.251	0.011*
Has Fixed Rate Mortgage	-0.6263	0.150	0.000***

Note: *p<0.1; **p<0.05; ***p<0.01

If an individual is Hand-to-Mouth, the log of their savings is expected to decrease by 1.8820 units. In terms of percentage, this suggests that being hand-to-mouth decreases savings by about 84.8% compared to individuals who are not Hand-to-Mouth.

If an individual is liquidity-constrained, their log of savings is expected to decrease by 0.4977 units. In terms of percentage, this means that being liquidity-constrained decreases savings by about 39.2% compared to individuals not liquidity-constrained.

The age variable was considered significant, and it suggests that as age increases by one year, the savings are expected to decrease by 2.3%.

The number of children in the household was also significant, and with a coefficient of -0.4880, it means that for each additional child, savings are expected to decrease by 38.6%.

The number of adults was not considered a significant variable, but the interaction between the number of children and the number of adults was. The coefficient was 0.1738, suggesting that the

presence of adults in the household mitigates the negative effect of having more children on savings. The effect becomes less negative in approximately 19%.

For the quintiles, all of them were significant as expected, with significant jumps in savings in all of them. This was expected since higher income groups tend to save more due to having more disposable income. This trend was present across all quintiles, with increases of 166,5%, 302.53%, 677.18%, and 1264.26%, respectively. These results confirm that as income rises, households are better positioned to save more, as the pressures of daily expenses are reduced, and discretionary income increases.

The expectations related to future consumption were also significant. Households that expected to increase their spending in the coming year were predicted to have higher savings (coefficients of 0.6155, meaning an increase of approximately 85.05%). On the other hand, households expecting to decrease their spending exhibited a significant reduction in savings, those anticipating a "decrease in spending a lot" were predicted to have approximately 57.5% lower savings compared to those anticipating a significant increase in their spending habits. Households expecting to spend a bit more and to maintain the same spending habits were not considered significant.

Interestingly, the mortgage type also played a crucial role in explaining savings behavior. Households with an adjustable-rate mortgage were predicted to have significantly lower savings, with a coefficient of -0.6389, indicating a 47.2% decrease in savings.

Similarly, households with a fixed-rate mortgage (is_fixed_1) also showed a negative effect on savings, with a coefficient of -0.6263, leading to a 46.54% decrease in savings. The model explains 28.7% of the variance in savings (R-squared), with an adjusted R-squared of 28.1%. The F-statistic

of 46.69 indicates the model is statistically significant, meaning at least one predictor is related to savings behavior. While the explanatory power of the model is modest, the primary goal of this analysis was to evaluate the significance of variables derived from HANK models, alongside having an ARM and a FRM.

I did a histogram of the residuals, a QQ-Plot of the residuals, and the Shapiro-Wilk test to assess the normality of the residuals (Appendix 1, 2, and 3). The results indicate that the residuals are not normally distributed. The graph shows a slight height around the left side, which may be attributable to the many values from the dependent variable close to 0. Even after applying the logarithmic transformation to the dependent variable, the issue persisted suggesting that it is a characteristic of the data itself (Appendix 4). The log transformation was not able to fully eliminate this feature, which is consistent with the distribution of savings data, where many individuals report low or no savings, mainly in the first quintile of income. Despite the non-normality of the residuals, given the robustness of weighted least squares (WLS) estimators under large sample sizes, the results are still considered reliable for this analysis (Knief and Forstmeier 2021).

I did a VIF (Variance Inflation Factor) to check for multicollinearity (Appendix 5). All values of the variables were below 10, indicating no multicollinearity. Additionally, to complement the VIF analysis, I examined the correlation matrix (Appendix 6) of the independent variables. The correlation coefficients were all below 0.8, further supporting the absence of multicollinearity among the predictors.

To test for the presence of autocorrelation in the residuals, I performed the Durbin-Watson test (Appendix 7). This test checks if the residuals are correlated across observations, which would

break the assumption of independent errors. The statistic was close to 2, suggesting that the residuals were independent.

To detect influential outliers, I computed the Cook´s Distance (Appendix 8). Cook´s distance measures the influence of each observation on the estimated coefficients. None of the observations had a Cook´s Distance greater than 0.1, indicating no data points had a disproportionate impact on the model´s parameter estimates.

Limitations

The analysis was done using survey data, which, while detailed, may suffer from self-reporting errors or biases. Households might misstate income, savings, or spending for a lot of reasons, leading to inaccuracies (Meyer and Sullivan 2003).

Consumption behavior, a key variable indicator for monetary policy transmission, is not directly measured in the dataset. I used savings as a proxy for unspent income. This simplifies the analysis, but it does not fully capture household consumption patterns.

Despite log transforming the dependent variable, the residuals were still non-normally distributed. This reflects the natural skewness of savings data and could have an impact on the model, despite having used WLS with a large enough sample.

The model focuses on a limited set of explanatory variables, mortgage types, income quintiles, liquidity constraints, and expectations. However, it is possible that other significant factors that influence saving behavior were not used.

The model´s R-squared value of 28.7% indicates that, while it is statistically significant, the analysis only explains a portion of the variance in savings. This suggests the presence of unobserved factors not captured in the current framework.

Conclusion

This analysis highlights the significant challenges faced by households with ARMs during periods of rising interest rates, particularly those in the lowest income quintile. The findings highlight the amplified financial vulnerability of liquidity-constrained households and hand-to-mouth households under monetary tightening.

Households with ARMS are disproportionally affected by rising interest rates due to their exposure to variable payments. The analysis shows a correlation between rising interest rates and the percentage of liquidity-constrained households with ARMs. ARMs often consume nearly 50% of monthly income for the lowest income group, leaving little room for essential expenses and forcing reductions in consumption.

However, the analysis has several limitations. The model focuses on a subset of explanatory variables and may omit other relevant factors, such as household wealth or employment volatility, that could influence financial behavior. The short time frame (2022–2023) limits the ability to assess long-term impacts or lagged effects of monetary policy. Additionally, the use of survey data introduces potential biases, and the reliance on savings as a proxy for consumption may not fully capture household adjustments to economic shocks.

Policymakers should consider these limitations while addressing the regressive effects of monetary tightening, focusing on improving liquidity access for low-income households and stabilizing

payments for ARM holders. Future research should expand on these findings by incorporating additional variables and exploring longer-term household responses.

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Appendix

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Table 2 – Percentage of H2M, Net-Worth H2M and Liquidity Constrained H2M

Variable	Percentage in the Dataset
H2MNW	25.79%
H2MLIQ	5.89%
H2M	27.80%

Table 3 - Percentage of Hand-to-Mouth (H2M) households by quintile

Percentage of Hand-to-Mouth (H2M) households by quintile	
First quintile	45.04%
Second quintile	28.5%
Third quintile	20.63%
Fourth quintile	18.02%

Fifth quintile	13.89%

Table 4 -Percentage of Liquidity Constrained in the Dataset

Variable	Percentage in the Dataset
Liquidity Constrained (be23)	32.3%

Table 5 - Percentage of Liquidity Constrained (be23) households by quintile2

Percentage of Liquidity Constrained (be23) households by quintile	
First quintile	40.57%
Second quintile	27.47%
Third quintile	28.04%
Fourth quintile	30.04%

Fifth quintile	35.56%

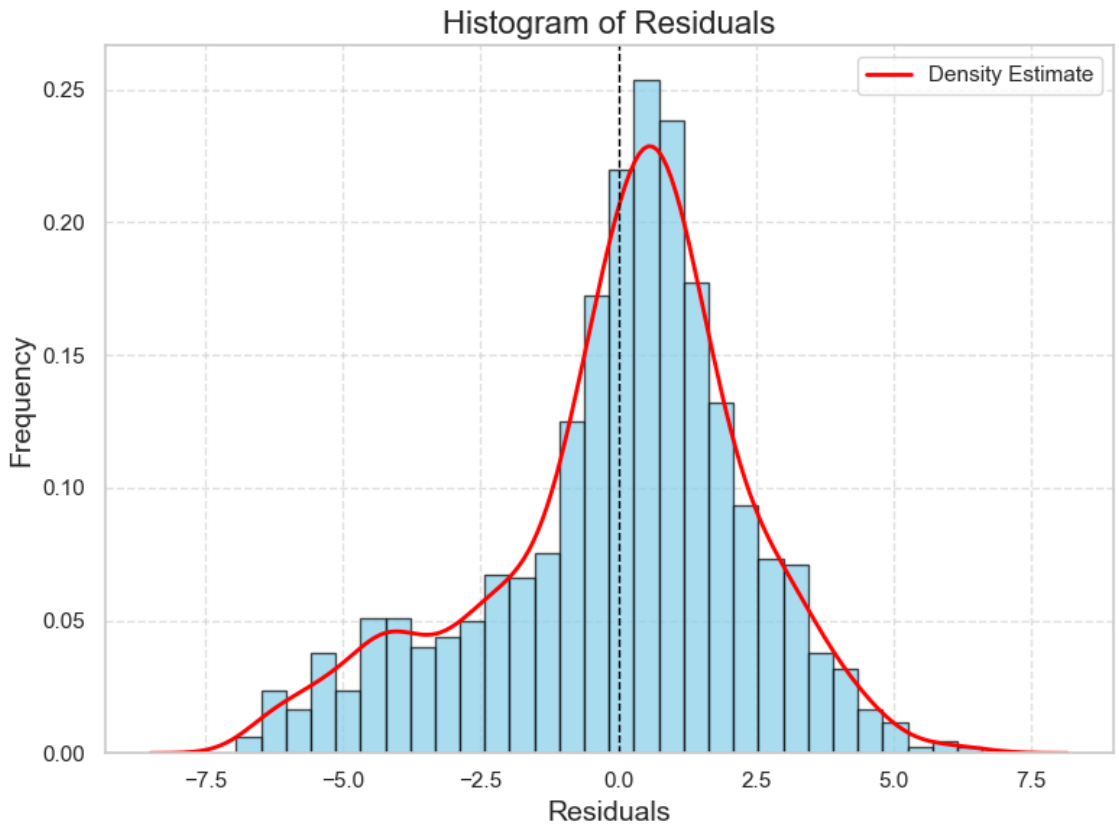

Figure 1 – Histogram of the Residuals

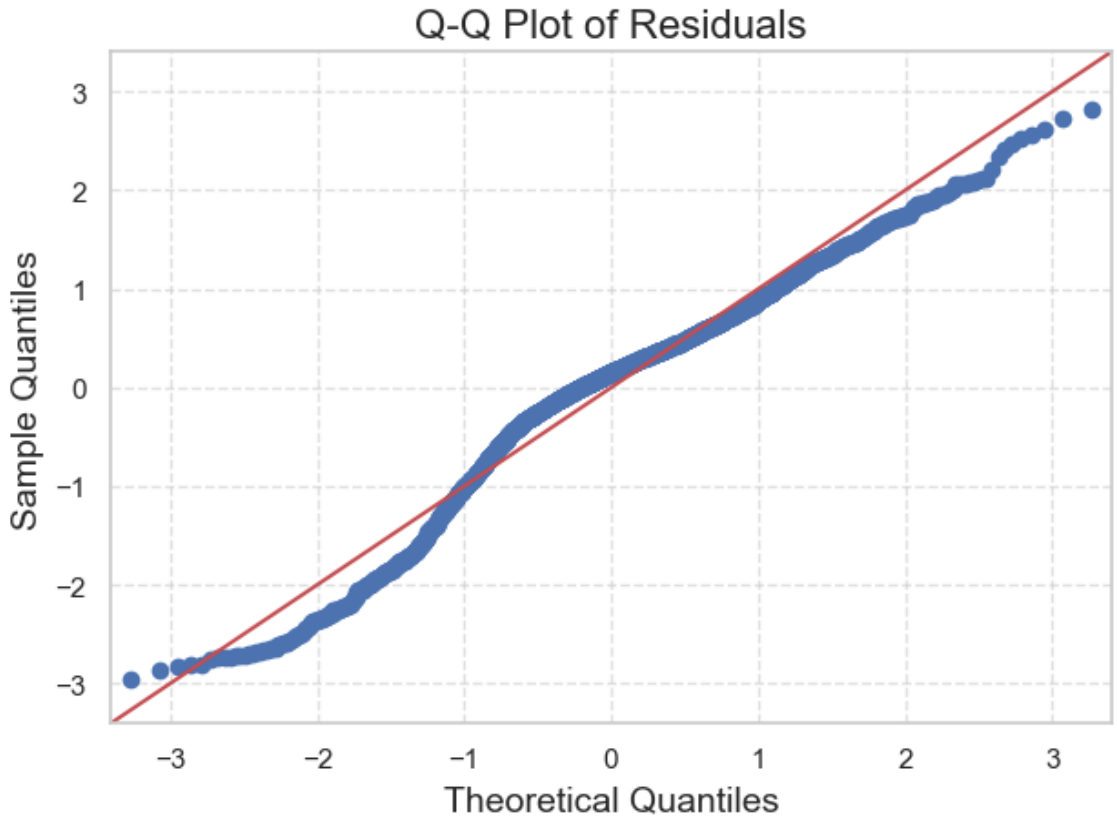

Figure 2 – Q-Q Plot of Residuals

Table 6 – Shapiro-Wilk Test3

Shapiro-Wilk Test	p-value = 1.29×10−20
Residuals are not normally distributed (reject null hypothesis)	

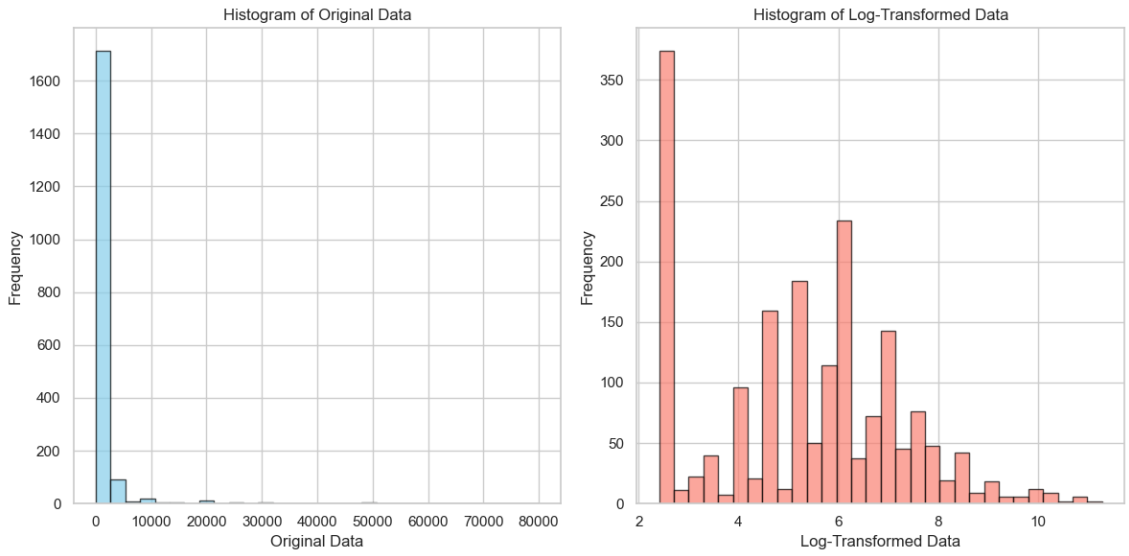

Figure 3 – Frequency of savings, normal vs Log-Transformed

Table 7 – VIF Test4

Variable	VIF
Constant	38.675684
Hand-to-Mouth	1.440713
Liquididy Constrained	1.405760
Age	1.662826
Number of Children	1.314417
Number of Adults	1.193417
Second Quintile	1.597539
Third Quintile	1.347202
Fourth Quintile	1.812797
Fifth Quintile	1.483949
Increase spending a little	2.422790
Same spending	2.379461
Decrease spending a little	1.744319

Decrease spending a lot	1.579323
Has Adjustable Rate Mortage	1.077091
Has Fixed Rate Mortage	1.268475

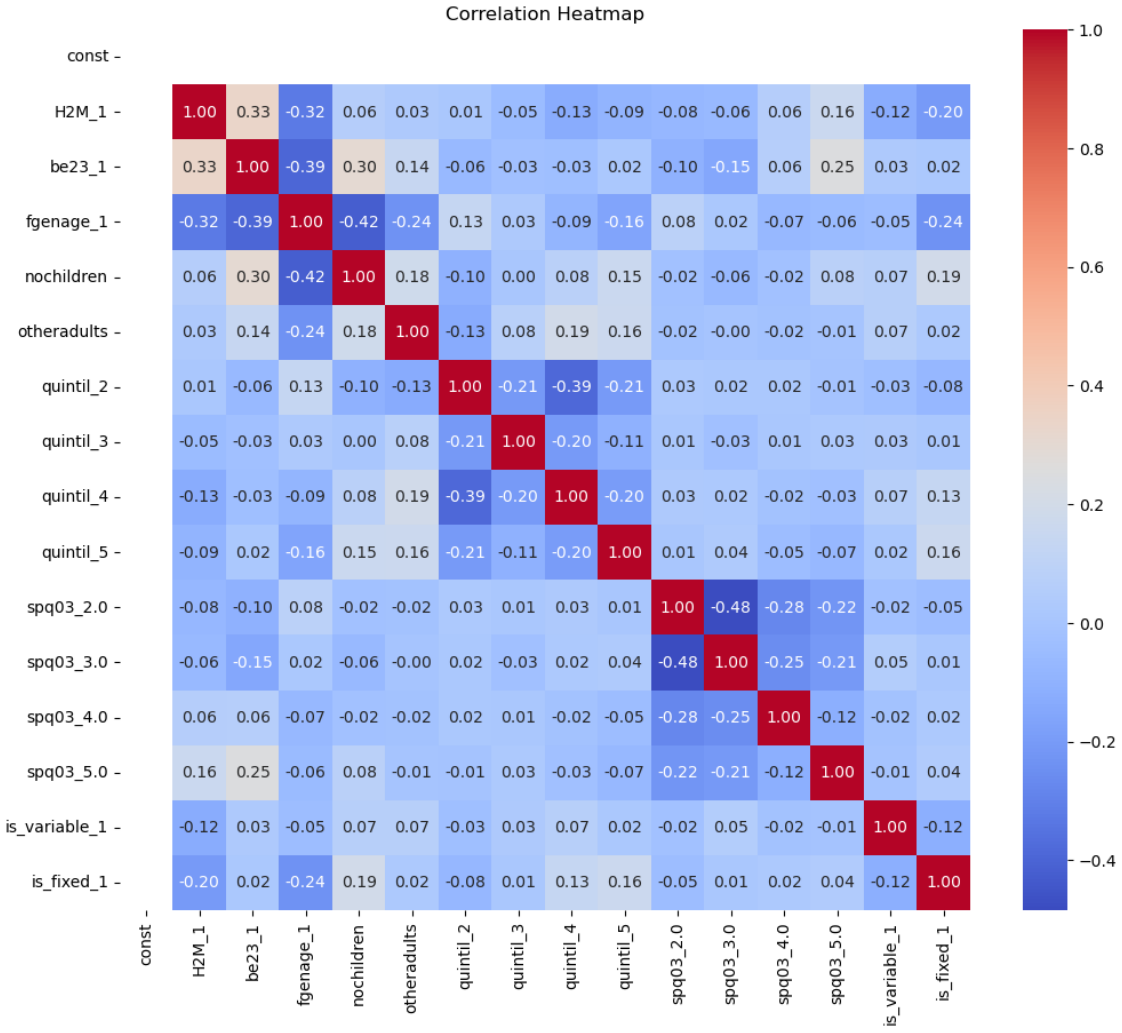

Figure 4 – Correlation Heatmap

Table 8 – Durbin-Watson Statistic5

Durbin-Watson statistic	1.9421
No significant first-order autocorrelation	

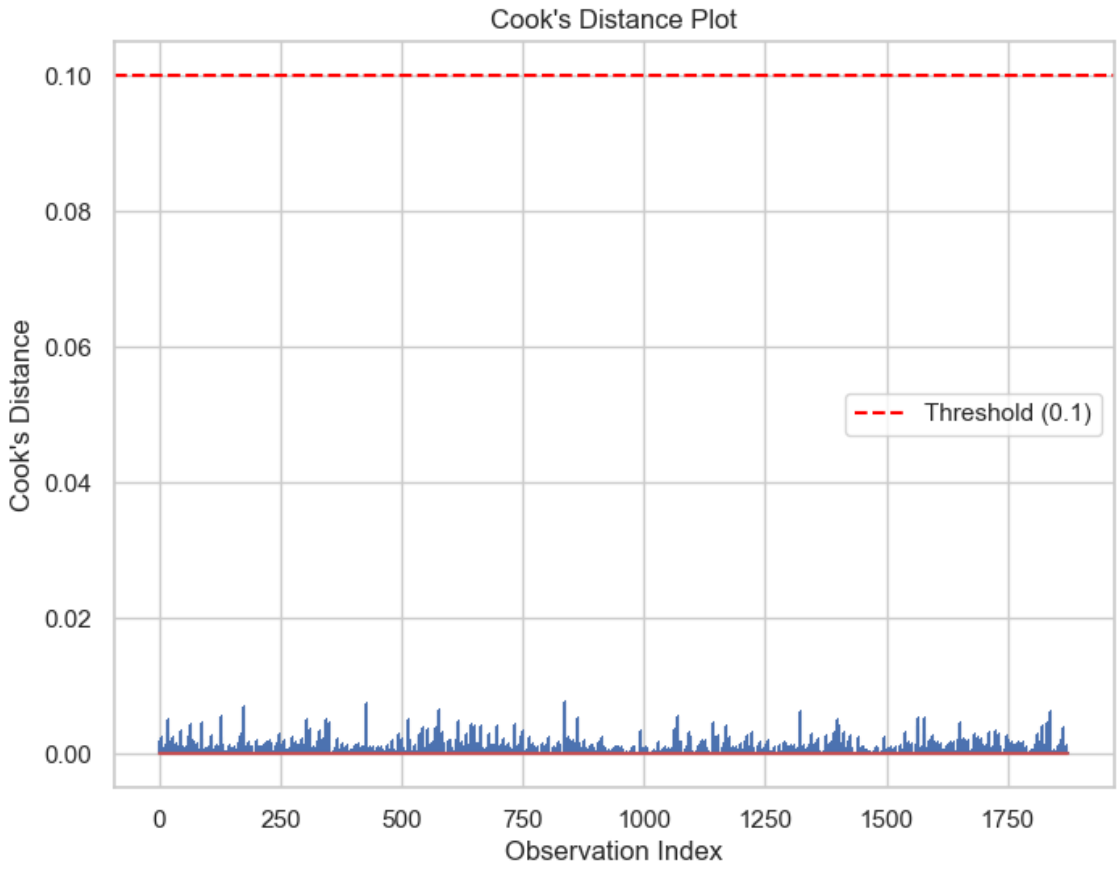

Figure 5 -Cook´s Distance Plot7