# Household debt, house prices and consumption in the United Kingdom: a quantitative theoretical analysis

### Summary of Working Paper no. 379 Matt Waldron and Fabrizio Zampolli

Between 1987 and 2006 household debt and residential house prices in the United Kingdom increased substantially. During this period total household debt and house prices as a percentage of income both grew by more than 50%. These phenomena were accompanied by some large changes to the macroeconomic environment faced by UK households, which may have been seen as potentially long-lasting. In particular, the inflation rate fell to a low and stable level; long-run real interest rates fell both in the United Kingdom and internationally; and the population became older with the ageing of the baby-boom generation. Lower inflation eliminates the so-called front-end loading of mortgage repayments which means that, for a given initial level of repayments, consumers can borrow more as a fraction of their income than when inflation and nominal interest rates are higher. A lower long-run real interest rate lowers the current and future expected cost of housing as well as the cost of borrowing, all else equal. These two changes, together with the passing of the baby-boom generation through middle age, are likely to have boosted the demand for housing and other assets, and therefore to have been important determinants of the observed rise in house prices and debt over that period. However, it is not clear, a priori, how quantitatively important these changes were in terms of their ability to explain the increases in house prices and debt, or how they would have continued to affect the household sector balance sheet and the housing market in the subsequent years or decades. Moreover, while there did not appear to be a large amount of uncertainty about the inflation target and the future inflation rate, there was considerable uncertainty about the persistence of the low level of the real interest rate.

In this paper we set out to investigate these issues. Specifically, we are interested in understanding to what extent changes in demographics, lower inflation, and the lower real interest rate can explain the observed rise in UK house prices and debt over the two decades after 1987. It should of course be clear that, although these are all matters of great interest to policymakers, the long-run real interest rate is a structural aspect of the real economy which is unaffected by monetary policy. We are also interested in how these factors might affect the long-run equilibrium of the economy, and how the economy might adjust to that equilibrium. However, we do not attempt to explain the behaviour of house prices and consumption in the extreme conditions faced by households in 2008 and 2009.

The workhorse of our analysis is an 'overlapping generations' model calibrated to the UK economy. It recognises that households do not live forever, and that at any one time there are households in different parts of their lives — some young, some middle aged and

some retired. The model incorporates: housing and non-durable consumption; financial wealth; loan to value and loan to income borrowing constraints; realistic demographics; and bequests. The results suggest that demographic factors can be important in explaining the evolution of the household sector's aggregate balance sheet, but are not alone capable of producing the size of the movements in debt and house prices that we have observed in the data. Moreover, the effects of demographic change are too gradual to account for the sharp rises in debt and house prices that occurred during the second half of that period. What instead emerges from our analysis is that the main driver of the rise in house prices and debt is the decline in the real interest rate, most of which occurred after the turn of the century, and which was an international phenomenon. Crucial to that conclusion is the assumption that households perceived low global real interest rates as being permanent. In that case, the model can explain the rise in debt and much of the rise in house prices.

However, it should be noted that the extent to which the model can quantitatively explain the rise in house prices depends in large part on the period of comparison. For example, the model can more than explain the rise in UK house prices between 1992–96 and 2002–06, but not between 1997–2001 and 2002–06. In addition, comparisons are further complicated by the division of model time periods into five-year chunks (which helps to ensure that the computational demands of our exercises are not excessive). The model only more than explains the rise in house prices between 1992–96 and 2002–06 if the level of house prices in 2002–06 is taken to be the average prevailing over that period. If instead, the level of house prices in 2002-06 is taken to be that prevailing in 2006, the model cannot explain all of the rise in UK house prices over that period. All of that suggests that care should be taken not to draw precise quantitative conclusions from our analysis. Nevertheless, and consistent with standard economic theory, one implication of our results is that the level of long-term real interest rates is a crucial factor in determining the equilibrium level of debt and house prices.

A by-product of a fall in the real interest rate is strong consumption and a corresponding decline in financial wealth. So, we are unable to explain some features of the data. That is, that the increase in house prices was not accompanied by a consumption boom, but was instead accompanied by an accumulation of both financial assets and financial liabilities. This failing, together with the abstract nature of our model and its reliance on assumptions about unobservable parameters, means that there is some uncertainty around the conclusion that the rise in debt and house prices observed at the end of 2006 was to be expected.

### Evaluating and estimating a DSGE model for the United Kingdom

### Summary of Working Paper no. 380 Richard Harrison and Özlem Oomen

It is impossible to conduct monetary policy without some understanding of how the economy works, and consequently economic models are vital in this process. The Bank of England uses many such models, some very abstract and others largely data driven. In this paper, we examine one that is both rich in theory and consistent with the data. We estimate it using UK macroeconomic data from 1955–2007.

Our approach has two stages. First, we derive predictions about the relationships between key economic variables in both the short run and long run, using judgement to select sensible values for the parameters so that we can deliver specific results. We then compare these with the actual behaviour of UK data. This comparison helps us to identify those relationships that fail to match data closely and hence where additional features may be required. In the second step, we incorporate these features, called 'structural shocks', and estimate the parameters that best fit the data. The shocks that we add are in the form of movements in the demand and supply curves that determine prices and quantities. We find that they are crucial in helping the model match reality.

We work with four key sectors: households, businesses, the monetary policy maker and the rest of the world. Households receive income from working and interest from past saving. They choose how much of their total income to spend on goods and services and how much of it to save, depending on the real rate of interest earned on saving. A higher real interest rate will, other things equal, encourage households to save more. Businesses produce the goods and services that households buy. They set the prices for their products and decide how much labour and capital to employ in order to maximise their profits. Importantly, businesses face costs of adjusting their prices which means that they find it best to change them gradually. The monetary policy maker sets the nominal interest rate by adjusting it in response to changes in inflation and output. The rest of the world, modelled using a set of estimated equations, affects the domestic economy through the demand for the goods and services that it produces.

Together, these features allow us to describe how households, businesses, the monetary policy maker and the rest of the world interact. The values of the parameters are an important determinant of the consequent behaviour of macroeconomic variables. For example, there is a parameter that determines

the willingness of households to substitute consumption spending today for consumption spending in the future. If households are less willing to substitute consumption today for future consumption, then their saving and consumption decisions will be less affected by changes in the real interest rate. Similarly, there are parameters that determine the costliness to businesses of changing prices (an example of a 'friction'). Other things equal, if prices are more costly to adjust, a business prefers to adjust the amount of labour and capital it employs in response to a change in the demand for its products, rather than changing the price that it charges. To evaluate the model, we use data on consumption, gross domestic product, investment, total hours worked, real wages, the nominal interest rate and inflation. We choose the longest available data set in order to gain as much information as possible about the parameters, while recognising that there will be a trade-off against accuracy if, as is likely, their values change over time.

When we compare the model's predictions about the relationships between key variables to the behaviour of UK data, we find some important differences. In many cases, the model predicts a much stronger relationship between variables in the short run than we observe in the data. And it predicts a weaker long-run correlation between the movements in consumption and output. It also predicts that real wages are less variable than we observe in the data.

So before we estimate the parameters, we incorporate additional shocks in the form of random movements in the demand and supply curves. For example, we assume that a household's preferences for spending versus saving may vary somewhat over time. This means that, in some periods, households will be inclined to save less, even when the real interest rate is high (and vice versa). When we estimate the model, we find that these structural shocks are very important in helping it to better match the behaviour of the data. Our estimation results also suggest that the parameters that determine the costliness of adjusting prices are more in line with similar work using US data, rather than in studies using data from the euro area. But we do not have the whole story. For example, the estimated model does not explain nominal interest rates well. Ways to explore this could include extending the approach to allow for the fact that monetary policy may change over time.

## All together now: do international factors explain relative price comovements?

### Summary of Working Paper no. 381 Özer Karagedikli, Haroon Mumtaz and Misa Tanaka

Recent research has found that a common component explains a greater proportion of quarterly inflation movements in industrialised countries after the mid-1980s relative to the period before that. There are two possible explanations for this finding. First, the increased comovement in inflation rates could reflect adoption of similar monetary policy across the industrialised countries. For example, it has been argued that the central banks of Japan, Germany and the United States have pursued an implicit form of inflation targeting since the beginning of the 1980s; and during the 1990s, inflation targeting has been explicitly adopted in a number of industrialised countries. Second, it could reflect the increased integration of global product and factor markets, which subjects the relative prices of similar products in different countries to common demand and cost shocks. Although the overall inflation rate in an economy is ultimately determined by domestic monetary policy, fluctuations in relative prices can affect headline inflation rates in the short run.

This paper examines the extent to which the increased comovement in inflation rates across countries can be attributed to greater global integration of product markets by using a statistical approach to decompose fluctuations in quarterly inflation rates into a world factor, country-specific factors, and category-specific factors. The world factor captures the common pattern in inflation rates across all product categories across all countries. Country-specific factors capture the common pattern in inflation rates across all product categories within the same country. Finally, the category-specific factors capture the common pattern in inflation rates across countries for the same product categories (eg clothing).

The point of this exercise is that the international common component found in previous research may not necessarily be the one that affects every single sector or products in different economies. It may also be product specific. For example, the international factors affecting rice prices across countries may be different from international factors affecting car prices. Therefore, analysis that ignores these good-specific factors may underestimate the true nature and the size of the contribution of international factors in explaining cross-country comovements in national inflation rates. Our approach allows us to explore this issue further. If it is indeed the adoption of similar monetary policy rather than global integration of product markets that is driving the international comovement in inflation rates, then we should not find any evidence for comovement in product category inflation rates. By contrast, if the international comovement in inflation rates is driven by integration of global markets, which subjects prices of similar products to global cost and demand shocks, we would expect to see cross-country comovement in product category inflation rates.

We find that product category factors explain a significant proportion of fluctuations in quarterly inflation rates for products that are intensive in primary commodities; but this is less evident for other traded goods. We also find that both the world factor and product category factors have become more significant in explaining the fluctuations in quarterly inflation rates for most product categories. Finally, the sharp pickup in inflation rates during 2007–08 was captured by our estimated world factor, but in some countries the rise in the inflation rate also reflected country-specific factors.

# Time-varying dynamics of the real exchange rate. A structural VAR analysis

### Summary of Working Paper no. 382 Haroon Mumtaz and Laura Sunder-Plassmann

Recent empirical studies have provided strong evidence to suggest that the persistence and volatility of macroeconomic variables has evolved over time in industrialised countries. In particular, this literature (albeit conducted on data prior to the onset of the financial crisis and consequent recession) shows that inflation was less volatile and persistent in recent years than in the 1970s. Moreover, measures of real economic activity were also less volatile. A strand of this literature also suggests that the transmission of shocks to the macroeconomy may have changed over time. One limiting feature of these studies, however, is the absence of any role for the real exchange rate in the models used. Instead, exchange rate dynamics have been investigated in an alternative strand of research using empirical models that do not allow for changes in the transmission of shocks. This is surprising given the weight of evidence that indicates a change in the dynamics of macroeconomic fundamentals such as output and inflation.

The aim of this paper is to reconcile these two empirical strands of the literature. We estimate a system of equations (a vector autoregression) to capture the relationship between the real exchange rate and output and inflation for four industrialised economies — the United Kingdom, Japan, euro area and Canada *vis-à-vis* the United States. Our model

allows this dynamic relationship to change over time. In addition it allows the volatility of shocks hitting these economies to change over time.

Our results are as follows. The effect of demand shocks on the real exchange rate has increased over our sample for the United Kingdom, euro area and Canada, with the current response (using data to 2008 Q4) larger than in the 1970s and the early 1980s. Similarly, nominal shocks (defined as an appreciation of the real exchange rate that leads to a fall in output and inflation) have a larger impact on the real exchange rate after the mid-1980s. A model that keeps the relationship between the real exchange rate and the macroeconomy fixed is unable to capture these changes in real exchange rate dynamics. There is also evidence that the relative importance of these shocks has changed over time. Nominal shocks are important for inflation in the late 1980s but less so in the more recent period. Supply shocks appear to have a limited role in explaining real exchange rate fluctuations. For Canada and Japan demand shocks have become a more important source of output fluctuations over the past ten years. Demand shocks have been the most important factor for the real exchange rate for all countries and throughout the sample, accounting for around 80% of exchange rate fluctuations on average.