70 YEARS OF PERSONAL DISPOSABLE INCOME AND CONSUMPTION IN IRELAND

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Abstract

This paper compiles annual data on personal consumption and personal disposable income for Ireland over the period 1944 to 2014. The behavior of the series is discussed, particularly with reference to economic theory. Having established that the series are cointegrated, an error correction model of changes in the variables is estimated which is stable over the entire 70-year period. A dynamic out-of-sample forecast for the period 2007-2014 fits well although it does not capture the full decline in consumption in 2009. Extensions of the model to include interest rates, household credit, house prices and unemployment are discussed.

Keywords: Ireland, historical statistics, long time series, permanent income hypothesis.

JEL Number: E3, E4, N14.

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1. Introduction

Although Ireland is a small open economy, domestic factors still play an important role in the business cycle. This was evident during the recent financial crisis when the fall in domestic demand was one of the main drivers of the decline in GDP. Personal consumption, which currently accounts for approximately 60% of domestic demand, declined almost 6.5% in real terms between 2008 and 2013.

Was this unusual, given the severity of the crisis? How did personal consumption develop during previous economic downturns in Irish history? During the crisis real personal disposable income fell by over 17%, far more than personal consumption. How has the relationship between personal disposable income and personal consumption evolved over time? While the international literature on consumption and income is extensive, there are surprisingly few studies on Irish data.[1]

Despite this dearth of studies, the economic fluctuations since the 1940s make it interesting to consider the evolution of consumption, particularly in relation to income, over the period. During this time, Ireland moved from the inward-oriented policies of the 1940s and 1950s, through the opening of the economy to international trade in the 1960s and into the global oil crises in the 1970s. These were followed by serious fiscal difficulties for the Irish State. In the 1980s, however, the economy recovered, triggering the Celtic Tiger boom of the 1990s and early-2000s, followed by the construction boom in the mid-2000s which finally ended in 2008 with one of the most expensive financial crises in history. This paper uses data over a 70-year period to examine the relationship between personal consumption and personal disposable income throughout these phases of development.

In the first instance, I collect annual data over the period 1944 to 2014 on personal consumption and personal disposable income, and examine the relationship between these variables over the sample period, focussing on the extent movements

[1] Exceptions include, Kennedy and Dowling (1970), Honohan (1979) and Lyons et al., (2009).

in personal disposable income can explain the behaviour of personal consumption. Having determined that the series are cointegrated, I estimate an error-correction model of changes in personal consumption and personal disposable income. The model shows that these variables are closely linked. While consumption responds by a fraction of any change in personal disposable income in the short run, in the long run the response is one-for-one. The estimates thus suggest behaviour that is similar to that implied by the permanent income hypothesis.

Nonetheless, a number of Irish and international studies focus on the role played by credit, lending conditions and asset prices in determining consumption demand.[2] I therefore go on to estimate some extensions of the models which, in addition to private disposable income, include financial and macroeconomic variables.

The paper is interesting for a number of reasons. First, while these data are available from official sources over the entire period, to my knowledge they have neither previously been compiled into consistent series nor analysed econometrically. Compared to shorter data samples, very long time series such as those used here can make it easier to detect the underlying dynamics in the data, since the relationships between macroeconomic data are often subject to long lags.

Second, I find that the behaviour of the savings ratio fits well with consumption theory. In particular, I find that the savings ratio tends to be low in periods when a narrative history of the macroeconomy suggests that future income was expected to grow sharply, and *vice versa*. In addition, I find that the savings ratio Granger causes changes in income as one would expect if expectations of future income were an important determinant of consumption. I also find that the savings ratio is stationary, implying that income and consumption are cointegrated.

Third, since the series are cointegrated I estimate an error correction model of changes in consumption. I find a stable relationship between changes in

[2] See, for instance, Slacalek (2009) for a panel study, and Hogan and O'Sullivan (2007) in the Irish context.

consumption and income over the entire 70-year period studied. Performing dynamic out-of-sample forecasts for this specification indicates that the model performed well through the crisis, although it fails to predict the full extent of the fall in consumption in 2009, the largest decline on record.

Finally, although there are limited time series available for the entire sample period, I test whether interest rates, credit, house prices and unemployment are significant drivers of consumption. I find that all four variables are significant, but that diagnostic tests indicate that the unemployment rate is subject to simultaneity bias and that movements in consumption impact on unemployment.

The paper is structured as follows. The next section reviews the economic developments in Ireland during the sample period. In Section 3, I discuss some theoretical considerations and empirical evidence. Section 4 discusses the compilation of the data and reviews the final series. In Section 5, the data are discussed. Here the focus is on the savings ratio, the stationarity of which confirms that consumption and income are cointegrated. Section 6 develops an error correction model of the short-run relationship between changes in consumption and income. Section 7 extends this model by testing whether financial and macroeconomic variables should also be included. Section 8 concludes.

2. Historical background

The Irish economy experienced a number of different episodes during the sample period, 1944-2014. In the first instance, it underwent three distinct monetary regimes. Although the Central Bank of Ireland was established in 1943, a one-for-one exchange rate link between the Irish punt and Sterling was the overriding priority of monetary policy. As a result, it has been argued that monetary arrangements in Ireland are best described as those of a currency board, at least until the early-1970s.[3]

[3] See Honohan (1995).

The consequence was that Irish interest rates were determined with little, if any, reference to domestic economic conditions and interest rates and inflation tended to closely follow those in Britain.

This relationship ended in 1979 when Ireland joined the European Monetary System. This second monetary regime continued to have exchange rate stability as its objective, although the Irish pound was devalued vis-à-vis the Deutsche Mark seven times between September 1979 and January 1987.[4] The pound was devalued by 8% in January 1993, and the EMS bands were subsequently broadened to +/- 15% in the summer of 1993. The third monetary regime began in January 1999 when Ireland became a founding member of European Monetary Union. As a small member of a currency union, Irish interest rates and inflation rates were again largely determined by developments outside of the domestic economy.

In terms of macroeconomic policy, at the very start of the sample period the Second World War, during which the Irish Free State remained neutral, was coming to an end. In the immediate post-war period, the Irish Free State (the Irish Republic after 1948[5]) pursued a policy of import-substituting industrialisation, in an attempt to move closer towards self-sufficiency. Out of step with much of the rest of Europe which experienced a period of strong growth in the 1950s and 1960s, and despite being in receipt of Marshall aid, Irish economic performance was comparatively poor.

Policies in the late 1950s, including Whitaker's Programme for Economic Development in 1958, began the process of reversing the policy of import-substituting industrialisation, the positive effects of which began to be seen in the 1960s and 1970s. However, the late-1960s and 1970s were marked by a policy of deficit spending by governments. Spending increased prior to the first oil crisis, with the result that deficits soared with the first oil crisis in 1973 and during the period

[4] See Artis and Taylor (1994, Table 1).
[5] 'Republic of Ireland Act' was passed by the Irish Parliament in 1948.

thereafter. However, as a small open economy, the government spending measures were largely unsuccessful in boosting aggregate demand.

Harsh fiscal measures in the early-1980s finally brought government finances and inflation under control. Alongside extremely successful efforts to attract foreign direct investment (FDI)[6], increases in labour force participation and social partnership agreements which kept wage inflation under control, fueled the Celtic Tiger boom of the 1990s. In this period Ireland 'caught-up' for the 'golden age' experienced by much of the rest of Europe after the Second World War.[7] However, the Celtic Tiger progressed from a fundamentals-driven boom during the 1990s to a credit-fueled property bubble in the early-2000s. Coinciding with the bursting of the property bubble in 2008, the global financial crisis following the collapse of Lehman Brothers in September 2008 led to a severe economic contraction.

3. Consumption: theory and empirical evidence

3.1 Theory and international evidence

The permanent income hypothesis, developed by Milton Friedman[8], is one of the most influential and studied theories of the consumption-income relationship. Consider the utility function for consumption, C_t, of a consumer who lives T periods:

$$U = \sum_{t=1}^{T} u(C_t)$$

Abstracting from the possibility that the individual has any initial level of wealth, and allowing the individual to borrow and save as they wish at an interest rate that we set equal to zero for simplicity, their budget constraint is given by:

[6] By 1995, foreign-owned manufacturing accounted for approximately 45 per cent of employment in manufacturing (Barry et al., (1999)).
[7] For a discussion see Honohan and Walsh (2002).
[8] See Friedman (1957) for the original work, and Romer (2001), Chapter 7 for a discussion and formal set-up similar to the one outlined here.

$$\sum_{t=1}^{T} C_t \leq \sum_{t=1}^{T} Y_t$$

The maximization problem[9] is therefore given by:

$$L = \sum_{t=1}^{T} u(C_t) + \lambda\left(\sum_{t=1}^{T} Y_t - \sum_{t=1}^{T} C_t\right)$$

Since the first order condition for C_t is given by:

$$u'(C_t) = \lambda$$

the marginal utility of consumption is constant in every period, implying that consumption should also be constant in every period. Thus the budget constraint becomes:

$$C_t = \frac{1}{T}\left(\sum_{t=1}^{T} Y_t\right)$$

Since this implies that consumption in any period is not determined by income in that period, but by lifetime income, the permanent income hypothesis terms the right hand side of this budget constraint 'permanent income', Y^P, and the difference between the right and the left hand side, 'transitory income', Y^T, such that, at any given time, current income is the sum of permanent and transitory income:

$$Y_t = Y^P + Y^T$$

Here, permanent income can be considered as expected average income, such that it may be above or below the current level of income depending on expectations for the future. Transitory income is the temporary deviations from permanent income that are experienced from time to time. They may persist for a single period or for a number of periods, but over the long run sum to zero.

Now, since saving is the difference between income and consumption, it can be written as:

[9] Since the marginal utility must always be positive, the budget constraint must hold with equality.

$$S_t = Y_t - \frac{1}{T}\left(\sum_{t=1}^{T} Y_t\right)$$

This implies that saving is high when current income is high relative to permanent income, i.e., when transitory income is high. As a result, perceptions of future income are important in consumption decisions. For instance, if people believe their income is likely to rise, perhaps because of a boom in the economy, their current income is below their permanent income. In anticipation of this higher future income, they will raise consumption now, reducing saving.

While it is generally believed that the permanent income hypothesis does a good job in accounting for the broad features of consumption over time, a number of studies formally reject the theory. For instance, Campbell and Deaton (1988) argue that there is little reason to believe that permanent income evolves smoothly over time, so that the implication of the theory that consumption is smooth is not warranted. Of course, if households are able to predict their future income on the basis of current information, consumption could be smooth (since information about income in the far future is discounted heavily and will therefore elicit little response in consumption today). Indeed, the authors demonstrate that the fact that consumption is so smooth appears due to the fact that it responds slowly to changes in income, which may be evidence against the permanent income hypothesis. However, it is also possible that people use simple recursive rules to update their perceptions of permanent income. This highlights how any test of the permanent income hypothesis is also a test of how expectations are formed.

An alternative argument is that credit or liquidity constraints matter. The hypothesis assumes that consumers can borrow and save freely at the same interest rate in order to smooth their consumption in response to transitory shocks to income. These are strong assumptions which are unlikely to hold in practice. For instance, Flavin (1984) uses the unemployment rate as a proxy for the proportion of the population who are

liquidity constrained, and finds that such constraints are important in explaining such excess sensitivity of consumption to current income.[10]

Overall, and recognizing the strong assumptions made by the literature, the permanent income hypothesis is unlikely to be literally true, but notions of permanent income may nevertheless be useful for understanding broad developments in consumption over time.

Campbell and Mankiw (1990) attempt to reconcile these issues with the permanent income hypothesis by incorporating liquidity constraints into a model of consumption. In the extended model, some households are credit constrained and therefore consume their current income, whereas, other households are not credit constrained and can consume relative to their expected income.[11] The authors find that this model fits the data well.

Campbell and Mankiw's (1990) model is a theoretically-founded error correction model. A number of other studies use models which cannot be directly derived from the permanent income hypothesis to understand the drivers of consumption. Of particular relevance are studies using traditional error correction models which have been employed in a number of studies (see, for instance, Davidson *et al.*, (1978) and Davidson and Hendry (1981)). These models are intuitively appealing since they suggests that consumption and income will move together in the long run, as theory suggests, but that there are other drivers of short-run deviations from this path. Recently, variations of this framework have been developed, sometimes including a lagged dependent variable, thus allowing for the role of habits, sticky expectations and adjustment costs – all of which are not considered in the permanent income

[10] On the other hand, DeJuan and Seater (1999), using data from the US Consumer Expenditure Survey between 1986 and 1991, find that the permanent income hypothesis is not generally rejected and that there is little evidence of either liquidity constraints or rule of thumb behaviour. Runkle (1991) studies panel data at the household level to determine whether liquidity constraints exist. He finds no evidence of such constraints, and argues that aggregation of data may lead to rejection of the permanent income hypothesis.

[11] DeLong and Summers (1986), Hall and Mishkin (1982) and Hayashi (1982) consider similar models.

hypothesis -- in explaining short-run deviations from the long-run relationship (see, for instance, Poterba (2000), Mehra (2001), Ludwig and Slok (2002), Sommer (2007) and Slacalak (2009)).[12]

3.2 Studies of consumption and income in Ireland

There are surprisingly few macro studies of Irish consumption and income. Kennedy and Dowling (1970) examine the determinants of the savings ratio over the period 1947 to 1968 and find that the dependency rate, the change in the population, the rate of change in credit growth and measures of taxation are significant determinants. Interestingly, they also find that while real income per capita is a significant determinant of the savings ratio, real farming income per capita has more explanatory power. Honohan (1979) examines the role of inflation in the consumption decision over the period 1947 to 1976. He argues that in periods of high inflation, such as those prevailing during the 1970s, consumers can mistake high prices of goods they usually purchase as high relative prices, rather than a reflection of a generally rising price level, and that this may lead to lower than expected consumption. Ryan (2003) examines quarterly Irish consumption data over the period 1981-1999 in an error correction framework and finds that disposable income and wealth have explanatory power in determining long-run consumption, while changes in unemployment and real interest rates determine short-run consumption. Hogan and O'Sullivan (2007), investigating the role of housing wealth in Irish consumption patterns, find that income and real interest rates are the main determinants of consumption over the period 1972-2003.[13] Slacalek (2009), using data from the 1970s to the early 2000s for a panel of 16 countries, finds that the role of

[12] Wealth is also considered an important determinant of consumption, although it does not feature in the permanent income hypothesis. For instance, Carroll, Otsuka and Slacalek (2006) use US data to estimate the short and long-run effects of changes in housing wealth. They find that the one-quarter impact of a $1 increase in wealth is to increase consumption by approximately 2 cents, while the long-run effect is approximately 9 cents. Similarly, Case, Quigley and Shiller (2005) examine the effect of house price on consumption in a panel of developed countries, and find that a 1% increase in housing wealth increases consumption by approximately 0.11%.

[13] Although they find that the marginal propensity to consume out of housing wealth is zero.

lagged consumption in determining current consumption is relatively high in Ireland, but that changes in wealth have little effect.

Other work on consumption includes Lyons *et al*., (2009), who study consumption patterns in Ireland over the period 1975 to 2003, finding that although income per capita increased rapidly, consumption patterns had not fully converged to those of higher-income countries. Some focus has also been placed on the role of Ricardian equivalence. Moore (1987) considers Irish consumption over the period 1960-1984, and finds evidence in favour of Ricardian equivalence-type behaviour.[14] However, Whelan (1991) argues that Moore's test specification and data are inappropriate, and that when these are altered accordingly, there is no evidence of Ricardian equivalence.[15]

The lack of papers examining consumption and income in the long run means that many questions are left unanswered. For instance, the finding that farming income was important in determining consumption in the 1940s and 1950s, inflation in the 1970s, unemployment in the 1980s and 1990s, and interest rates during much of the housing boom, suggests that results may to some extent be driven by the sample periods examined. What is the relationship between consumption and income in Ireland over the long run? How does consumption behaviour compare to theory? Can a stable relationship explaining consumption be identified over an extended sample period? I next turn to these questions.

[14] Walsh (1988) confirmed that Moore's results were robust to data revisions and changes in definition.

[15] There has also been discussion of expansionary fiscal contractions. Giavazzi and Pagano (1990) argue that an expansionary fiscal contraction in Ireland during the 1980s was curtailed by traditionally tight credit conditions. On the other hand, Bradley and Whelan (1997) use a small structural model to argue that external factors, rather than an expansionary fiscal contraction, explain Ireland's growth. Furthermore, Corsetti et al., (2012) find that fiscal multipliers increase during financial crises, suggesting that contractionary fiscal policy can have markedly negative impacts on consumption.

4. Data description

4.1 Compilation of the data

In this paper, I use annual real personal consumption and real personal after tax (disposable) income, hereafter referred to as 'consumption' and 'income' for simplicity. The data are all taken from official Central Statistics Office (CSO) sources. However, no single time series is available over a 70-year period. In the absence of objective criteria for constructing long time series, the current vintage of data is used as far back as possible under the assumption that it is subject to smaller measurement errors than older vintages. Older data are then spliced by re-basing the series.

Data from 1944 to 1946 are taken from a 1951 CSO publication, Tables of National Income and Expenditure (NIE). This is the earliest CSO NIE publication that I have found.[16] For the period 1949 to 1970, the CSO published NIE tables annually which are available in hard copy and contain data for the period to 1947. In particular, I use the NIEs from 1968 and 1977 which contain extended appendices providing data back to 1947 and 1960, respectively. From 1970 to 1995, data are available from the CSO's historical NIE spreadsheet which is available online. Thereafter, the CSO's online database provides the data.

One important data issue arises from a difference in the level of consumption in the CSO's online historical spreadsheet and in the NIE hard copy publications. This appears to be due to a number of adjustments which were made in 2000, and backcast to 1970.[17] While the growth rates in the various vintages of data during the

[16] Prior to this, a government White Paper in 1946, contained data for the period 1938 to 1944. However, it appears that the rubric of NIE tables was not established at this time, and some key data, such as personal income, is not available, even though private income (personal income plus corporate profits) and personal consumption are.

[17] These adjustments were made as part of an exhaustiveness exercise (a very detailed review of the estimates and items included in National Accounts data) which was carried out in the framework of GNI Own Resources (EU budget contribution) for the year 2000. This exercise identified a number of items/estimates to be included/refined. Items including tips, childcare, pension fund administration fees, rent, fuel smuggling, tobacco smuggling and revised commodity flow estimates together explain

1970s are similar (Figure 1), the level change creates a difficulty in splicing the data. This is because re-basing the pre-1970 consumption data raises the level of consumption relative to income, skewing the consumption-income ratio. In fact, the effect is to increase the nominal level of consumption above that of income for much of the early period, which is unreasonable (Figure 2).

I use three different methods of splicing the data to deal with this problem, and hereafter refer to the resulting series as Consumption 1, Consumption 2 and Consumption 3:

- Consumption 1: I estimate a trend consumption-income ratio over the entire sample period using a Hodrick-Prescott filter[18]. I then use the level of the filter in 1969 to calculate consumption in that year, and splice the older data using this figure.
- Consumption 2: This is similar to the previous method, but I use a band-pass filter[19] to estimate the level of the ratio is 1969, and splice the older data using this value.
- Consumption 3: For this method, I take the consumption-income ratio from the nominal data in each period, and use it to calculate the consumption series before 1970. This ensures that the consumption-income ratio is unaffected by the level change in the consumption data.

Figure 3 shows the three consumption measures in log differences over the period 1944 to 1970. The effect of the various methods of splicing the data is to shift down the level of consumption over the period. Table 1 shows the correlation coefficients of the changes in all three series: all are in excess of 0.98.

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most of the level shift in the data. Since the exhaustiveness exercise focuses on balanced recording of items many of these revisions were required to only one side of the accounts, thus explaining the lack of level shift in income.

[18] Since the data are annual, $\lambda = 100$ is used in the filter.

[19] With a frequency band of 2 to 8 years.

For the entire period, both real and nominal consumption data are available. Real income data are not available during the period. I use a consumption deflator, calculated from the original nominal and real consumption expenditure data to deflate the income series. I do not adjust these for the step change in consumption, since any change which affects the levels of both series equally falls out of the deflator. The consumption deflator is preferable to a GDP deflator here, since a consumption deflator takes account of the impact of taxes on income, whereas a GDP deflator will not allow for this.

4.2 Review of the final series

Figures 4 and 5 show the three measures of consumption along with the final income series in log levels and log differences. It is clear from the figures that income and consumption move closely together. Both series increase quite rapidly in the period immediately after the Second World War, before slowing in the late-1940s and through much of the 1950s as the negative effect of the policy of import substituting industrialization is felt. Towards the very end of the 1950s the series begin to grow more strongly again as the effect of the Whitaker Plan and the opening of the economy takes hold. This period of growth continues, with a brief slowdown for the oil crisis in 1973 until the late-1970s and early-1980s when tight fiscal policy was required to bring finances under control following the deficit spending during the oil crises period. Thereafter, the series begin to increase again, becoming more rapid during the late-1990s and early-2000s, before the bursting of the property bubble and the financial crisis cause the most marked and persistent reduction in income and consumption in the sample period.[20]

The same pattern is evident from the growth rates in the series presented in Figure 5. This chart also shows that there several episodes when consumption rises strongly in

[20] An interesting question is how per capita income and consumption evolved. However, the growth rate of the population (using data from the CSO interpolated using a cubic spline from 1944 until annual estimates become available in 1992) is so low and stable compared to that of both income and consumption that per capita growth rates are almost identical to those in Figure 5.

advance of income increases, for instance in 1947 consumption grows rapidly, whereas income does not grow at a similar pace until 1949. Similarly, in 1970, the growth in consumption appears to anticipate the growth in income two years later, and again in 2000, consumption growth is high in advance of strong income growth the year after. While the first instance of this, in 1947, may partly reflect increasing consumption resulting from the end of forced saving during the Second World War, these observations suggest that income expectations, which the permanent income hypothesis holds as the dominant determinant of consumption, played a crucial role in Ireland. I discuss this issue further in the next section.

5. The savings ratio

In this section I study the relationship between consumption and income data more formally. In doing so, I consider the evolution of the savings ratio, and what can be learnt from this. Letting lower case letters denote logs, the savings ratio is defined as $y_t - c_t$. Here, the savings ratio can be thought of as the fraction of income not consumed.

While a body of literature rejects the permanent income hypothesis, it is nonetheless interesting to explain some implications of this theory. In particular, it is interesting to see whether changes in the savings ratio anticipate future income, which would be expected if people base their consumption decisions today on their expectation of future income.

5.1 Narrative discussion of the savings ratio

I first take a narrative approach in considering whether historical developments in the Irish macroeconomy can explain changes in the savings ratio in light of the permanent income hypothesis.

Figure 6 shows that the savings ratio fell in the immediate post-War period, implying that consumption is high relative to income. This is consistent with

expected income rising as uncertainty about the outcome and duration of the War is dissipated[21], the Wages Standstill Order (which regulated wages from 1941 to 1945) is removed, and rationing is lifted.[22] Consumption falls relative to income in 1952 and 1953 during the Korean War. Following the experience of the Second World War, the outbreak of the Korean War resulted in hoarding and uncertainty about the scope and scale of the conflict. As a result, expectations of future income fell, since the war might have dragged on, and resulted in much greater loss and disruption than it eventually did.

The savings ratio fell again in 1958, which coincides with Whitaker's Economic Development plan.[23] It may be that there was an increase in expected income as a result of changing economic policy in that year. Another fall in the savings ratio takes place in 1970-1972, immediately before the first oil crisis. This was the period of changing government spending policy and real wage increases, which may have raised expectations of future income. The oil crisis in 1973 changed this, however, and the ratio is high throughout the period 1973-1978, as the country struggled to deal with the effects of high fuel prices, slowing economic activity and rising fiscal deficits. Thereafter, the ratio gradually declines through the late-1980s as the resulting dire sovereign debt position is brought under control, and it began to appear that Ireland may be fiscally viable.

The emergence of the Celtic Tiger boom in the 1990s resulted in an initial rise in the savings ratio, but after 1997, consumption rose rapidly relative to income, with spending actually higher than income in 2000. The ratio falls in 2006 and 2007, consistent with a belief that the property bubble was in fact fundamental, and that high income levels would persist into the future. However, the bursting of the property bubble, and the reappraisal of likely future income that resulted thereafter,

[21] In this instance, forced saving during the war may partially explain this result, as well as anticipated future income increases.
[22] CSO (2000) reports that rationing of most items was lifted in 1949.
[23] Of course, this programme, and the opening of the economy, was preceded by the export profits tax relief policy in 1956.

led to a dramatic rise in the ratio between 2007 and 2009. The recovery of the economy in more recent years is likely to have increased expectations of future income, and as a result the ratio has risen again to very high levels.

5.2 Granger causality and stationarity

I next consider two properties of the savings ratio. The first is whether the savings ratio Granger causes income, and the second is whether it is stationary.

The results of Granger causality tests are presented in Table 2 for savings ratios calculated using all three measures of consumption. This test is employed to examine whether changes in consumption anticipate changes in income as theory would suggest, and should not be interpreted as implying causality between the variables. The test is run using two lags.[24] In all cases, the null that saving does not Granger cause changes in income can easily be rejected, whereas the null that changes in income do not Granger cause saving cannot be rejected, even at the 10% level. This suggests that changes in saving anticipated changes in income and is evidence in favour of the permanent income hypothesis in Ireland.

The second test I perform is for the stationarity of the savings rate. This is because in the long run, changes in income should pass fully through to changes in consumption with the result that the two series are cointegrated. As a result, the difference between consumption and income – saving – should not trend over time, but be stable around a mean. In Table 3, I present Augmented Dickey Fuller and Elliott-Rothenberg and Stock (ERS) unit root tests for the three measures of consumption. All tests reject the null of a unit root at the 1% or 5% level, with the exception of consumption calculated using method three, when a trend is included in the ERS test. However, overall, the evidence seems in favour of the stationarity of

[24] In a VAR, the Schwarz information criteria indicates that one lag is appropriate, while the Hannan-Quinn criteria indicates that two lags are appropriate. However, a lag exclusion test indicates that the second lags are jointly significant, and they are therefore included in the test (p-value = 0.01).

savings, indicating that income and consumption are cointegrated. This suggests that, in the long run, changes in income are reflected one for one in consumption.

6. The short-run relationship between consumption and income

6.1 Specification

Since consumption and income are cointegrated and therefore in the long-run changes in income pass through fully to consumption, it is interesting to consider the short-run relationship between consumption and income. This I do in an error correction framework (for similar models see, for instance, Davidson *et al.*, (1978), Davidson and Hendry (1981), Mehra (2001) and Ludwig and Slok (2002)).

I first construct a simple model where the log change in consumption, c_t, is determined by log changes in current income, y_t, lagged log changes in income and consumption and the lagged savings ratio.[25] Since the lag structure is not known a priori, I include two lags of income and consumption in the initial model, which can thus be written:

$$(1) \qquad \Delta c_t = \alpha_0 + \alpha_1 \Delta y_t + \alpha_2 \Delta y_{t-1} + \alpha_3 \Delta y_{t-2} + \alpha_4 \Delta c_{t-1} + \alpha_5 \Delta c_{t-2} + \alpha_6 (y_{t-1} - c_{t-1}) + \varepsilon_t$$

where, Δc_t denotes change in consumption in period t, Δy_t denotes change in income and ε_t is an error term.

This model is deliberately over-parametrised and all lags are unlikely to be needed, especially when it is considered that the data are annual. However, since we have no priors about the lag patterns, I begin with this loose specification and let the data speak. I do so by using general to specific modelling. This indicates that the first lag of income and the second lags of both income and consumption are not needed and should be removed from the equation. The final specification can be written as:

[25] Here savings is the error correction term, since it is the difference between income and consumption.

$$(2) \qquad \Delta c_t = \alpha_0 + \alpha_1 \Delta y_t + \alpha_2 \Delta c_{t-1} + \alpha_3 (y_{t-1} - c_{t-1}) + \varepsilon_t$$

As would be expected, lagged savings are significant and act as an error correction term in the model, since the savings were shown to be stationary above, implying a unit long-run relationship between consumption and income. The coefficient on savings indicates the speed of adjustment to the long run relationship in response to short-run deviations.

6.2 Results

The results of the model are presented in the first column of Table 4 for consumption constructed using the first method (Consumption 1). There is no significant difference in the results if the other consumption series are used, and therefore for brevity they are not included here. The results indicate that 1% rise in current income result in a 0.49% increase in current consumption. The error correction term has a coefficient of 0.31 indicating that almost one third of any deviation from the long-run path is offset in the year after it occurs.

Over a 70-year period the relationship between the variables may have changed. However, a Bai-Perron multiple breakpoint test[26] indicates no breaks at the at the 1% level. A Quandt-Andrews test similarly fails to reject the null of no breaks in the in the equation.[27] [28] The Durbin-Watson statistic (1.79) indicates serial correlation is unlikely to be present in the residuals and a LM test for serial correlation confirms this.[29] Finally, a White test indicates no heteroskedascity present in the error term (p-value = 0.94).

[26] Test is run with a trimming of 15%, 1% critical value: 24.45, scaled F-statistic: 14.57.

[27] Maximum LR F-statistic p-value = 0.31.

[28] Furthermore, it may be expected that the shift in consumption in 1969 might have an impact on the results. To address this, I first include a dummy that takes a value of 1 prior to 1970, however, it proves to be highly insignificant (p-value = 0.81). As the consumption-income ratio rises in the 1950s, it is possible that the shift in consumption declines over time. I therefore interact the dummy variable with a linear trend, but it remains insignificant (p-value = 0.80). However, an inspection of the residuals from the regression indicates a large outlier in 1970. I therefore include a dummy that takes the value of 1 in 1970 in this and the following regressions.

[29] F-statistic (2, 61), p-value = 0.85.

One question that arises concerns the consumption of durable goods. Many studies use only the consumption of non-durable goods and services, however, such a breakdown of consumption is not available over the sample period in question. Mankiw (1982) has argued that the durability of goods can introduce a first-order moving average term into the change in consumer expenditure. However, a first order moving average term was not significant when it was introduced into the model (p-value = 0.13).

6.3 Endogeneity of income

The econometric analysis above has assumed that income is exogenous. As an exogenous shock to consumption increases demand, and is therefore likely to increase also income, this seems unlikely. This means that Δy_t could be correlated with the error term, ε_t. The question therefore arises as to whether the estimated parameter on income is subject to endogeneity bias.

To examine this possibility, I use a Durbin-Wu-Hausmann (DWH) test to determine whether or not income is endogenous. This test requires that the current change in income is instrumented, and the equation estimated using two-stage least squares (TSLS). The test statistic is distributed as a Chi-squared random variable with degrees of freedom equal to the number of regressors tested for endogeneity.

In the first instance, instruments for income must be identified. Any lagged values of income or consumption are potentially valid instruments, since they are orthogonal to ε_t if the model is correct. Furthermore, as pointed out by Goodfriend (1986), aggregate variables are not available in real time and using lagged variables as instruments can alleviate the problem of what is known to an individual when making their decision.

However, instruments must also explain income well in order to be valid. Stock and Staiger (1997) proposed that, in the case of a single variable potentially subject to simultaneity bias, for an instrument not to be weak, in the first stage regression the

F-statistic should be greater than 10. Stock and Yogo (2005) refined this further, presenting a set of critical values based on the number of endogenous variables, instrumental variables and the maximal acceptable level of bias against which the first stage F-statistic can be compared.[30] If the F-statistic exceeds the appropriate critical value, the instruments can be considered strong, at the 5% level.

While it may at first appear that lags of income are likely to be the best instruments, the permanent income hypothesis suggests that lags of consumption may be better, since consumption in one period is based on expectations of income in future periods. Since the first lag of consumption is already included in the model, it is not a candidate instrument. However, the second lag of consumption is a possible instrument. Furthermore, variables not included in the original model can also be considered as instruments. As such, lagged changes in real GDP are a possible instrument. GDP may be a particularly good predictor of future income if wages are sticky and take some time to adjust to changes in the macroeconomy.[31]

The first stage regression indicates that neither of the lags of income are significant at the 5% level. I therefore use only the first lag of GDP and the second lag of consumption as instruments. The first stage F-statistic and the Stock and Yogo (2005) critical values are presented in the second column of Table 4. Since the F-statistic exceeds the critical values, the instruments appear strong. The TSLS results are also presented in the second column of Table 4, together with the p-value for the DWH test. When income is instrumented, it remains significant in the regression, and the DWH test indicates that we cannot reject the hypothesis that income is in fact exogenous (p-value 0.28). I therefore proceed under the assumption that it is exogenous.

[30] These critical values are taken from Table 2 on page 101 of Stock and Yogo (2005).
[31] GDP data are taken from Gerlach and Stuart (2015) who describe how they are compiled in detail.

6.4 Dynamic forecast

Finally, I re-estimate the model up to 2006, and present the results in the third column of Table 4. The model passes the same stability and residual diagnostic tests as the full sample model. A dynamic out-of-sample forecast together with a 95% confidence band is then calculated for 2007-2014, the period of the financial crisis and its aftermath (Figure 7). The forecast captures the crisis period well; the actual data are within the confidence interval with the exception of 2009, at the height of Ireland's financial crisis. Indeed, this crisis is unusual since the one-period drop in consumption is by far the largest on record at -5.5%. For instance, in the period immediately after the second oil crisis consumption falls by a similar percentage, but over two periods, rather than one. The fact that shock in 2009 was so large that consumption declines very sharply even before income starts to decline, may explain the model's failure to forecast consumption in that year.

7. Extensions

Having estimated a model of the relationship between consumption and income growth that is stable over a 70-year period, in this section I consider some other variables which may influence consumption. While there are limited data series available over this extended time period, here I examine interest rates, unemployment, household credit growth and house prices.

7.1 Interest rates

Friedman (1957) argues that the rate of interest at which consumers can borrow and lend will influence consumption. Since the rate relates both to borrowing and lending, nominal short or long term interest rates may be important, and I will

therefore test each.[32] Here I use nominal short and long term interest rates from Gerlach and Stuart (2015), who describe their compilation in detail.[33]

The first column of Table 5 shows the regression results when short and long interest rates are included in the model. Since short rates are insignificant, they are dropped in the regression results in the second column. In both columns, the coefficient on the long term interest rate is significant and negative, implying that when rates fall, the return to saving declines, and people consume more of their income.

It is likely that rates are exogenous since Ireland operated on fixed exchange rate over the sample period and domestic interest rates were largely driven by external factors, rather than domestic activity. However, it is possible that long-term rates are endogenous if, for instance, interest rates rise because of high consumption, as might be the case during an economic boom. I therefore repeat the Durbin-Wu-Hausmann test, instrumenting for long term interest rates. I find that the first lag of interest rates is a strong instrument based on Stock and Yogo (2005) critical values and these, along with the results of the TSLS regression are presented in the third column of Table 5. The fact that the instruments are strong, but the coefficient on instrumented interest rates in the TSLS regression is insignificant suggests that the variable may be endogenous. However, the DWH test p-value, which is included in the third column of Table 5, indicates that the test fails to reject the null that interest rates are exogenous.

[32] Real interest rates, calculated using either the consumption deflator or CPI (which is available from the CSO for the full sample period), are not significant.

[33] In brief, the short rate is based on the annual average of the open-market rate of discount in London, quoted in Homer (1963, pp. 417-420) for the period 1944 to 1962 as a proxy for Irish short-term rates, a discount rate from the IMF for the period until 1984, and data on the short-term rate from the OECD for the most recent period. Long-term interest rates prior to 1952 are proxied using UK interest rates taken as the mid-point of annual high and low bond yields reported in Homer (1963). Thereafter, data from the IMF's International Financial Statistics (IFS) are from 1952 to the present.

7.2 Unemployment rate

The unemployment rate could matter for consumption because it signals the degree of economic uncertainty. When unemployment is low, it is possible that people feel confident in their job security, or their ability to find an alternative job quickly if necessary, and therefore they are willing to spend more. Similarly, when unemployment is high, people worry about their future income prospects since the risk of becoming unemployed seems high. As such, they may reduce consumption today. On the other hand, such uncertainty may lead people to emigrate, thus reducing the unemployment rate.[34]

Unemployment rate data are taken from Gerlach *et al.*, (2015), and are compiled using data from Mitchell (2007) for the period 1944 to 1982, while for the period thereafter data are available from the Central Statistics Office (CSO). When added individually, both unemployment and lagged unemployment are insignificant.[35] However, when both are added to the equation, they are significant (Table 5, column 4). Although the sign on lagged unemployment is counter-intuitively negative, it is smaller in magnitude than the coefficient on current employment, such that the overall effect of an unemployment shock is positive.

Again, endogeneity is a possibility. When more goods are consumed, output must increase to meet demand, and jobs are created. While the lagged unemployment rate is by definition exogenous, I next instrument the current rate using lagged GDP growth and the twice lagged unemployment rate. These are strong instruments, and the F-statistic well in excess of the Stock and Yogo (2005) critical values. The results are presented in column 5 of Table 5. The coefficient estimate for the unemployment rate is very different when it is instrumented, and the unemployment rate becomes

[34] See, for instance, the discussion in Honohan (1992) of the role of emigration in stabilising Irish unemployment rates.

[35] A Bai-Perron multiple breakpoint test indicates that there is a break in 1999. An inspection of the residuals indicates that there is a large residual in 2000; when a dummy is included for this, no break is detected.

insignificant, despite the strength of the instruments. The DWH statistic is 0.06, implying that the unemployment rate may be endogenous. It therefore appears that the unemployment rate should not be included in the model.

7.3 Credit growth

Next I consider the role of credit growth. It may be that increased credit availability leads people to borrow more, and thus increases consumption. This is a common assertion in the literature since Flavin (1984). Similarly, Blundell-Wignell *et al*., (1995) explore the effect of financial liberalization, during which credit availability increased, on consumption within the framework of the permanent income hypothesis. On the other hand, it is likely that as expectations of future incomes rise, people borrow more to increase current consumption. In this case, consumption drives credit growth rather than *vice versa*. It is therefore not entirely clear whether credit growth is endogenous or exogenous in the model. I therefore proceed to test the role of credit growth in the same manner I have the other variables above.

Credit data are collected for the personal sector from Central Bank of Ireland Quarterly Bulletins. The earliest sectoral lending data available are from 1948. At that time, lending to the 'personal and professional' sectors were categorized together. Only in 1968 was personal sector credit split out separately. Data on lending by building societies for residential mortgages is available from 1959 onwards, and these are added to bank lending from when they become available until 1996 when building societies were re-classified as banks. From 1971 onwards, the data are taken from Sherman (2015). There are two years in the series for which growth rates are not available. The first year for which there is no growth rate is 1967, since there is no overlap between the old and new series when personal and professional lending are split. I apply the 1968 growth rate to 1967. The data are made real using the CPI. Data are also missing in 1970 as a result of the bank

dispute. Here, I halved the change in the level of lending between 1969 and 1971, so that the increase is the same in each of 1970 and 1971.[36]

The OLS results are presented in column 6 of Table 5. They indicate that credit growth is significant, and that increases in credit result in increases in consumption, as would be intuitively expected. In column 7, credit growth is instrumented using lagged credit growth which is a strong instrument when it is compared to the Stock and Yogo (2005) critical values. Credit is significant at the 5% level in the TSLS estimates, but the DHW test indicates that it is just exogenous (p-value = 0.14). Using the alternative specifications of credit in 1970 returns similar results (p-value = 0.12 and 0.11, respectively).[37]

7.4 House prices

Increases in house prices may raise household wealth, leading people to consume more. I therefore next test the role of real house prices in determining consumption.[38] The data used are from Lyons (2015) where their compilation is described in full. The results including house prices in the model are reported in Column 8 of Table 5, where they are significant at the 5% level. However, endogeneity is again a possibility here, since rising consumption could reflect a boom in the economy that also affects house prices. I therefore instrument house prices using the first lag of house prices and the first lag of personal credit. These prove strong instruments based on the Stock and Yogo (2005) criteria. Column 9 reports the two-stage least squares result. Again, house prices are significant at the 5% level when

[36] Since the banks were closed, it is possible that credit growth in 1970 accounted for less than half the increase between 1969 and 1971. I therefore also calculate credit growth using two alternative methods. First, I set the growth rate equal to zero in 1970, and attributed the full increase in credit over the two-year period to 1971. Second, I assume that credit fell by 5% in 1970, and that this is 'made up' in 1971. However, the results are not significantly affected by these alternative methods, and are therefore not reported here for brevity.

[37] Here, the instrument is again lagged credit, and the first stage F-statistics are 25.96 and 20.38, respectively. The Stock and Yogo (2005) critical value is 16.38 in both cases.

[38] Other studies test the effect on consumption of changes in housing wealth (see for example Hogan and O'Sullivan (2007) and Slacalek (2009)) rather than house prices; however, housing wealth is not available over the period in question.

instrumented, however, the DWH test indicates that house prices are not endogenous (p-value = 0.26).

While the results above suggest that long-term interest rates, credit and house prices are exogenous variables, it is useful to consider the issue of endogeneity in some more detail. The DWH test may lack power, particularly in small samples. If the coefficients in the TSLS regression are poorly estimated, that is the standard errors are large, then it will always be difficult to compare the two estimates and reject that they are same. Consider Figure 8, which shows the distribution of the estimated coefficients on house price growth from the OLS and the TSLS regressions. Since the standard errors from the TSLS equation are large, it will make it difficult for a test to identify differences in the estimates.

It is important, therefore, to bear in mind that although the test results indicate these variables are exogenous determinants of consumption, there are nevertheless good reason why they may be endogenous.

7.5 Combined model

Finally, I include long term interest rates, credit growth and house prices in the basic model. The results are presented in column 10 of Table 5. Credit growth is less significant in this model (p-value = 0.08), while the other two variables remain significant at the 5% level. In addition, both a Bai-Perron multiple breakpoint test[39] and a Quandt-Andrews test[40] indicate that the model is stable. The coefficient on current income is lower than in the basic model. In this specification almost 40% of changes in current income are transmitted directly to current consumption, compared to 50% in the basic specification. In contrast, the coefficient on the error

[39] Test is run with a trimming of 15%, 5% critical value: 20.08, scaled F-statistic: 14.57.
[40] Maximum LR F-Statistic p-value=0.27.

correction term has increased; approximately 40% of any deviations from the long-run path are made up in the first period, compared to 30% in the basic model.[41]

8. Conclusions

As a small open economy, Ireland is often affected by events in the global economy. However, during the recent financial crisis, Irish exports performed well, whereas domestic demand, namely consumption, investment and government spending, collapsed. This paper has examined the largest component of domestic demand, personal consumption, considering its behaviour in relation to income and consumption theory.

In the first instance, the paper compiled 70 years of data on consumption and income for the first time. The data were then discussed in the context of the consumption theory. The behaviour of the savings ratio, taken in the context of the economic and political events of the time, is compatible with the main propositions of the permanent income hypothesis over the sample period. In particular, it Granger causes changes in income and is stationary. That said, I do not formally test whether the permanent income hypothesis is accepted on these data, since the established literature suggests that it would not be.

Since the series are cointegrated, an error correction model of changes in consumption and income can be estimated. The model is stable over the entire 70-year period and passes various other diagnostic tests. A dynamic out-of-sample forecast for the recent financial crisis period indicates that this for this model would have performed, although it fails to predict the full extent of the fall in consumption in 2009, the largest decline on record.

[41] Although not shown here, a dynamic forecast similar to that carried out for the basic model in Section 6.4 also fails to capture the 2009 decline in consumption, and in fact has only a marginally lower root mean squared error (3.2%) compared to the basic model (3.1%).

Finally, extensions of the model to include some financial and macroeconomic variables are discussed. Credit growth, house prices and long-term interest rates appear to have explanatory power. However, although formal tests suggest that these variables are not endogenous, there are a priori reasons to think that they may be. The unemployment rate appears to be endogenous.

In light of the relatively few studies of consumption and income in Ireland, and the lack of any similar study over such a time period, this paper adds significantly to our understanding of the behaviour of consumption and income in the post-War period.

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Table 1: Correlation consumption compiled using different techniques

	Consumption 1	Consumption 2	Consumption 3
Consumption 1	1		
Consumption 2	0.999	1	
Consumption 3	0.986	0.981	1

Table 2: Granger Causality tests

Savings measured using:	Income growth does not Granger cause saving	Saving does not Granger cause income growth
Consumption 1	0.90	0.00
Consumption 2	0.89	0.00
Consumption 3	0.89	0.00

Table 3: Unit root tests of the savings ratio, p-values and p-statistics

	Augmented Dickey-Fuller test, t-statistics		Elliott-Rothenberg and Stock test, p-statistic	
Saving measured using:	Intercept	Intercept and trend	Intercept	Intercept and trend
Consumption 1	-4.01***	-4.00**	1.43***	4.32**
Consumption 2	-3.78***	-3.73***	1.39***	4.70**
Consumption 3	-4.27***	-4.71***	3.46*	4.05***

Note: Lag length selected using Hannan-Quinn criterion. ***/**/* indicate significance at the 1%/5%/10% level.

Table 4: Regression results, dependent variable: change in consumption

	Dependent variable: change in consumption		
	Full sample: 1947-2014		1947-2006
Explanatory variable	(1) OLS	(2) TSLS	(3) OLS
Change in income	0.494	0.661	0.513
	(0.00)	(0.00)	(0.00)
Lagged change in consumption	0.285	0.193	0.315
	(0.01)	(0.17)	(0.00)
Lagged savings	0.308	0.334	0.322
	(0.00)	(0.00)	(0.00)
Constant	-0.014	-0.018	-0.017
	(0.09)	(0.05)	(0.08)
Dummy 1970	0.057	0.055	0.056
	(0.02)	(0.03)	(0.02)
Adjusted R-squared	0.52	0.50	0.53
Endogeneity diagnostics			
First stage F-statistic		32.54	
Stock and Yogo (2005) critical value		19.93	
Durbin-Wu-Hausmann p-value		0.29	

Note: p-values in parenthesis. Stock and Yogo (2005) critical values taken from Table 2, page 101 and are based on a maximal bias of 0.10, the lowest level of bias for which critical values are provided.

Table 5: Extensions to the model, 1947-2014 (continued on next page)

	Dependent variable: change in consumption									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Explanatory variable	**OLS**	**OLS**	**TSLS**	**OLS**	**TSLS**	**OLS**	**TSLS**	**OLS**	**TSLS**	**OLS**
Δ income	0.460	0.501	0.501	0.450	0.504	0.361	0.025	0.413	0.367	0.378
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.93)	(0.00)	(0.00)	(0.00)
Δ lagged consumption	0.327	0.325	0.326	0.061	0.247	0.204	0.168	0.146	0.046	0.177
	(0.00)	(0.00)	(0.00)	(0.46)	(0.10)	(0.04)	(0.17)	(0.16)	(0.73)	(0.06)
Lagged savings	0.557	0.568	0.575	0.341	0.317	0.226	0.116	0.274	0.251	0.408
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.39)	(0.00)	(0.01)	(0.00)
Δ nominal short interest rate	0.193									
	(0.19)									
Δ nominal long interest rate	-0.536	-0.339	-0.004							-0.227
	(0.00)	(0.00)	(0.00)							(0.01)
Unemployment rate				-1.238	-0.123					
				(0.00)	(0.85)					
Lagged unemployment rate				1.151	0.191					
				(0.00)	(0.73)					
Δ personal credit						0.105	0.29			0.061
						(0.00)	(0.03)			(0.08)
Δ house prices								0.110	0.185	0.066
								(0.00)	(0.03)	(0.03)

Table 5 continued: Extensions to the model, 1947-2014

	Dependent variable: change in consumption									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Explanatory variable	**OLS**	**OLS**	**TSLS**	**OLS**	**TSLS**	**OLS**	**TSLS**	**OLS**	**TSLS**	**OLS**
Constant	-0.001	-0.006	-0.006	-0.00	-0.021	-0.009	-0.002	-0.007	-0.003	-0.002
	(0.91)	(0.43)	(0.45)	(0.99)	(0.20)	(0.23)	(0.23)	(0.35)	(0.69)	(0.83)
Dummy 1970	0.061	0.058	0.058	0.071	0.062	0.055	0.048	0.059	0.060	0.057
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)
Dummy 2000				0.048	0.055					
				(0.01)	(0.02)					
Adjusted R-sqaured	0.62	0.61	0.61	0.76	0.69	0.62	0.44	0.60	0.59	0.69
	Endogeneity diagnostics									
First stage F-statistic/t-statistic			21.43		125.70		17.29		21.81	
Stock and Yogo (2005) critical value			16.38		19.93		16.38		19.93	
Durbin-Wu-Hausmann p-value			0.82		0.06		0.74		0.26	

Note: p-values in parenthesis. Stock and Yogo (2005) critical values taken from Table 2, page 101 and are based on a maximal bias of 0.10, the lowest level of bias for which critical values are provided.

Figure 1: Nominal growth rates of vintages of consumption data, 1970-1985

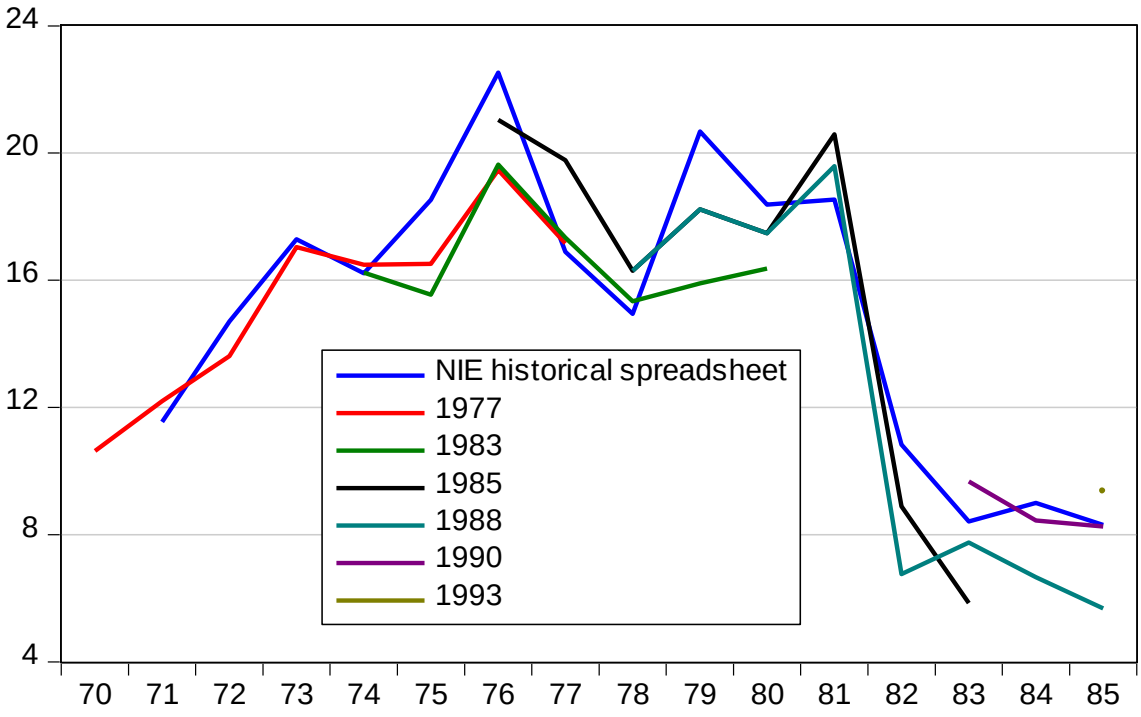

Figure 2: Data on raw and rebased pre-1970 consumption, post-1970 consumption, and income (nominal, log levels)

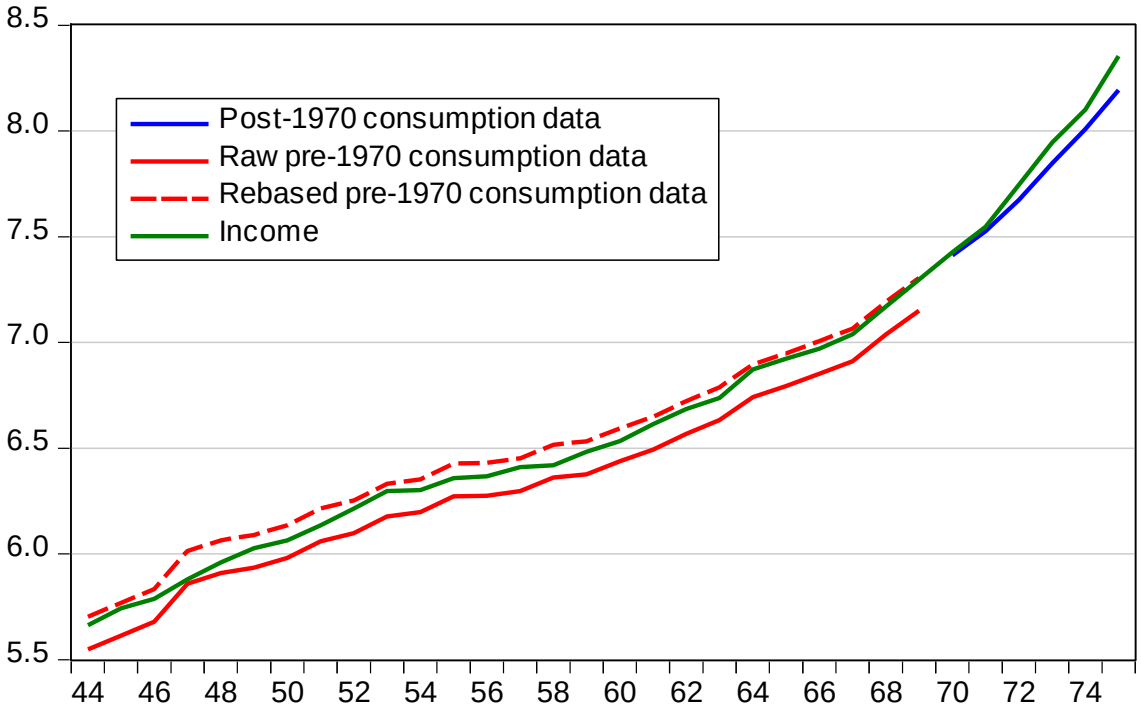

Figure 3: Three measures of real consumption in log levels, 1944-1970

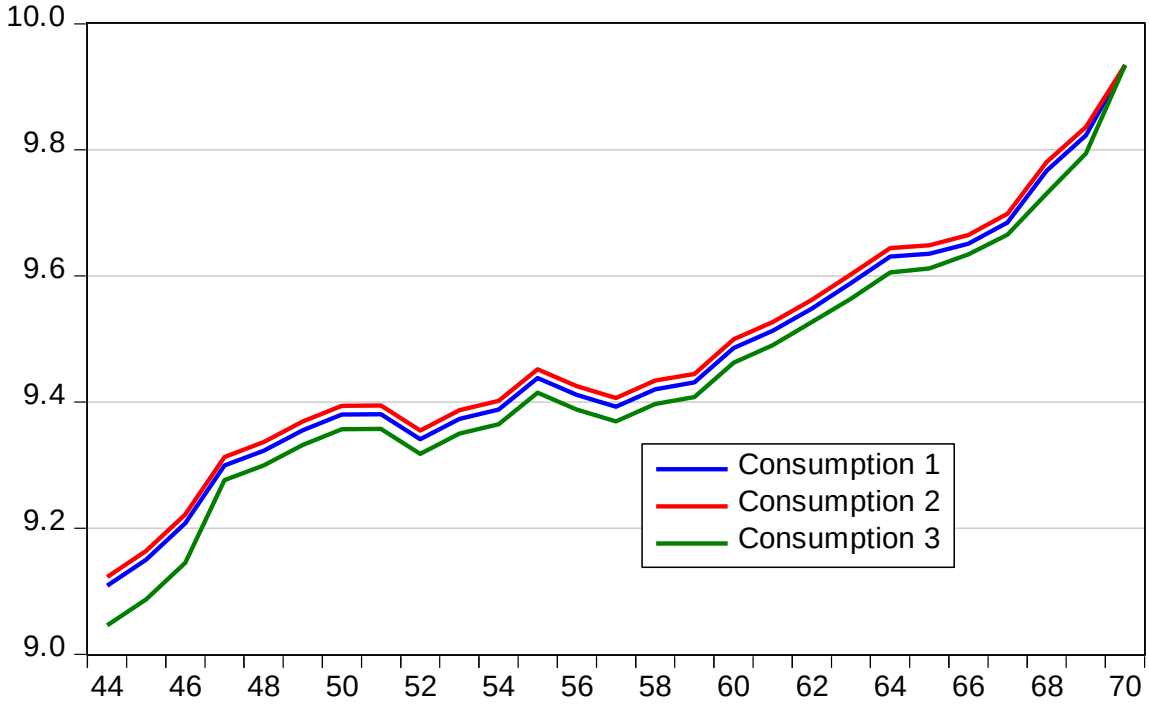

Figure 4: Real consumption and disposable income in log levels, 1944-2014

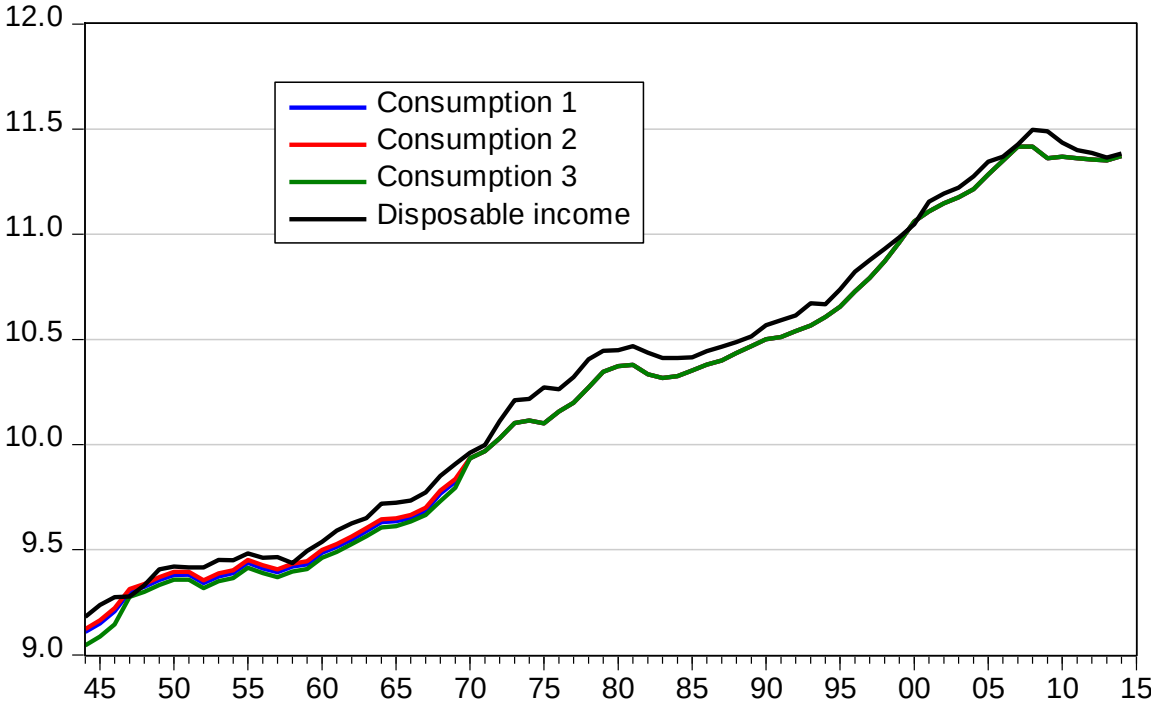

Figure 5: Real growth rates in consumption and income in log levels, 1944-2014

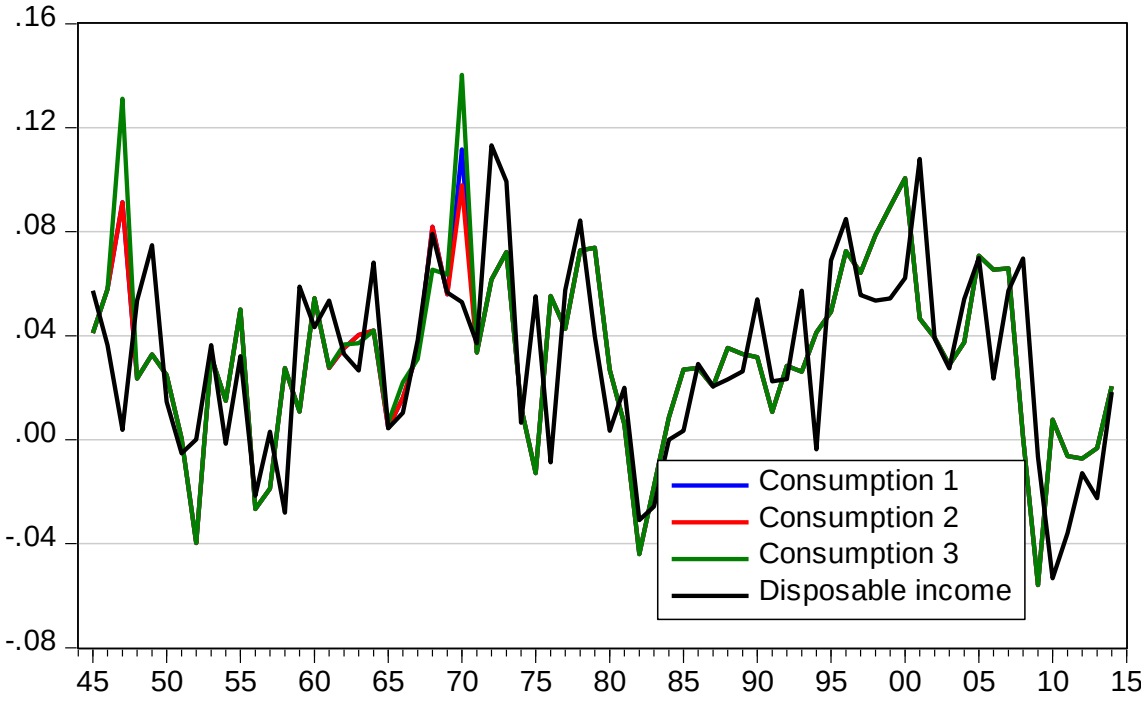

Figure 6: Savings ratio, 1944-2014

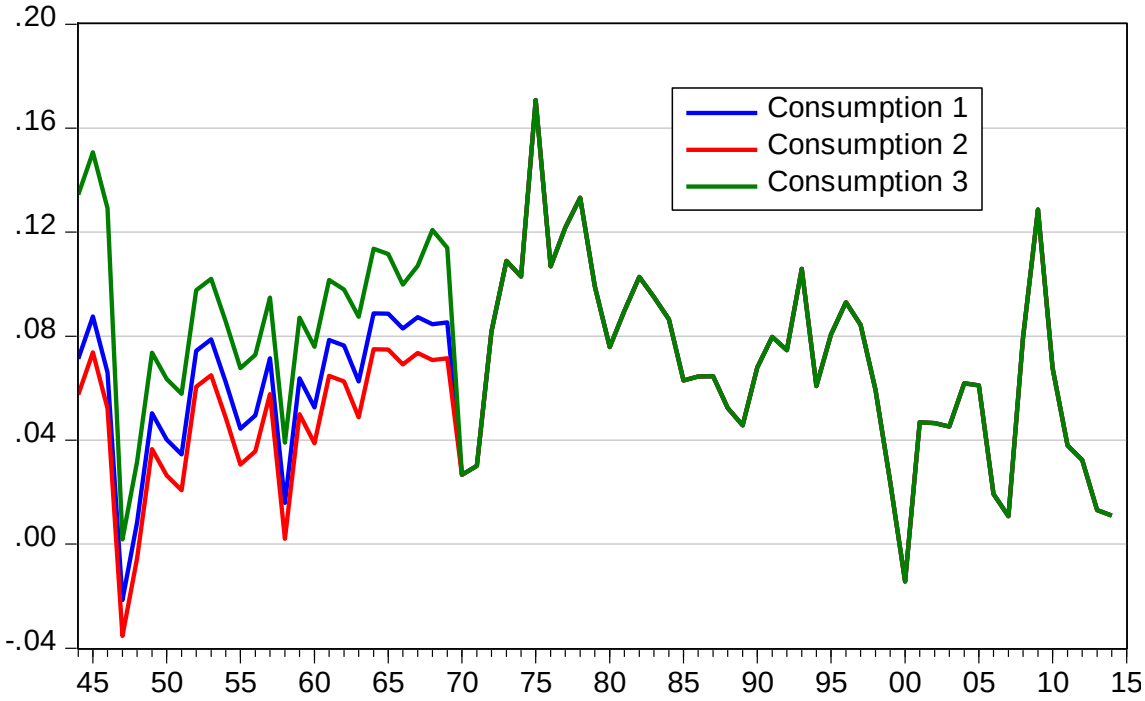

Figure 7: Dynamic out-of-sample forecast of consumption

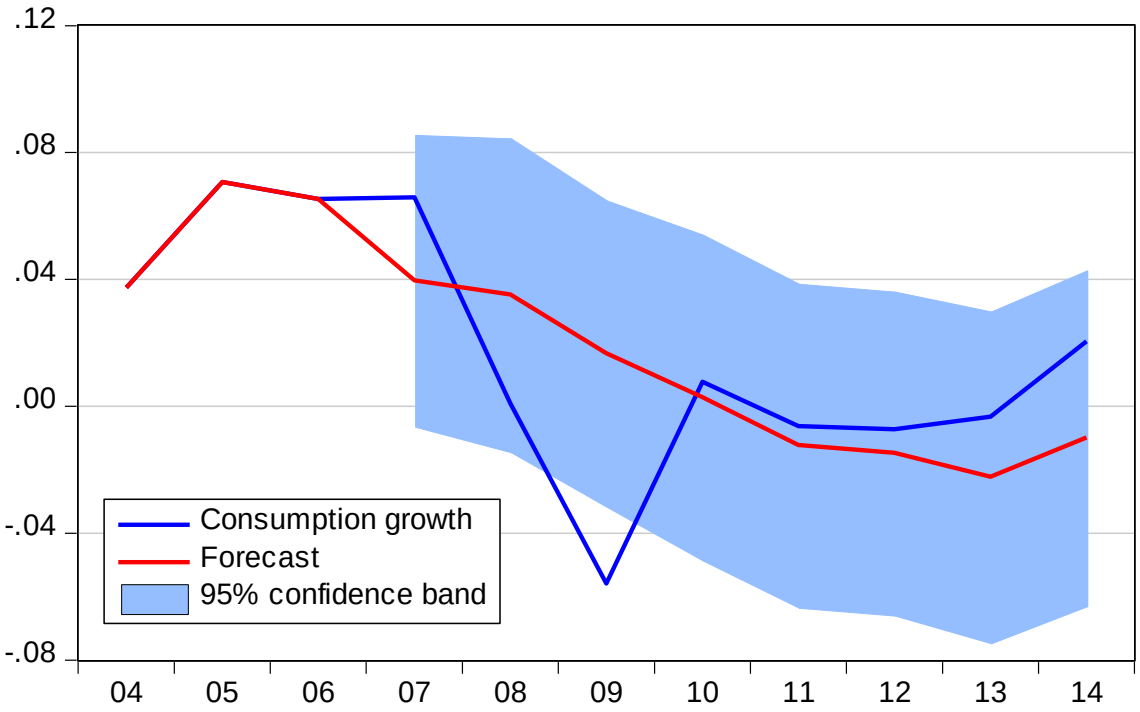

Figure 8: Distribution of coefficient on house price growth, OLS and TSLS