"Explaining Regional Consumption in the UK"

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Explaining Regional Consumption in the UK

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1. **Introduction**

This study involved building econometric models for the eleven standard regions of the UK to explain consumption at the regional level for the period 1972 to 1991. The main objectives for this research are threefold. The first is to illuminate the causes of the 1980s consumption boom in the UK followed by a sharp reversal in the early 1990s. The second is to illuminate a number of controversies surrounding the permanent income/life-cycle theory of consumption. Both of these two objectives should be met more convincingly by bringing to bear evidence from a mass of disaggregated regional data than by a single macroeconomic data set. The third objective is to illuminate specifically regional issues. Let us consider each of these objectives in more detail.

In the mid to late 1980s, consumer spending grew more rapidly than income for several years on end, and the UK ran into balance of payments and inflation problems which led to short term interest rates being doubled between Spring of 1988 and the end of 1989. Most macroeconomic forecasting models for the UK failed to predict this consumption boom. There has been much controversy about the causes of the boom and particularly the relative role of expectations of improved after tax income growth as against rising asset prices, especially those of housing, and financial liberalization. For instance, King (1990) puts most weight on an exogenous shift in expectations, associated with supply side improvements constituting a 'Thatcher miracle'. The main features of this 'miracle' were believed to be record productivity growth in manufacturing, a newly flexible labour market with much reduced union power and a tax system with low marginal tax rates which had transformed work incentives. In contrast, Muellbauer and Murphy (1990), place less weight on shifts in expectations and more weight on asset prices and financial liberalization.
Prima facie evidence for the latter view comes from similar experiences in the Scandinavian economies of financial deregulation and booms in debt, house prices and consumer spending during the 1980s (Berg, 1994). Yet none of these economies had the benefit of the supply side 'Thatcher miracle' on which an exogenous shift in expectations might have been based.

The first important reason for examining regional consumption functions in the UK is to help distinguish the above different interpretations of events. There were substantial regional variations in the behaviour of incomes, house prices, debt, and unemployment in these years. With eleven district regions in the UK there is more scope to pin down the different influences, than using only a single macro data set.

The latter argument holds also for the second reason for modelling regional consumption: a more general investigation of alternative hypotheses about consumption. The simple life-cycle/permanent income hypothesis of Modigliani and Brumberg (1954) and Friedman (1957) and its rational expectations form (Hall, 1978), has, in recent years increasingly come into question (Deaton, 1992), (Muellbauer and Lattimore, 1994). In cross-sections, consumption and income age profiles follow each other more closely than life-cycle theory would suggest. Furthermore, the old do not dissave on the scale envisaged by the theory. In time-series data, consumption changes which under rational expectations should be independent of predictable income changes, appear not to be so. These and other phenomena can be explained by a combination of credit constraints, by uncertainty about income, consumption needs and length of life, and by lagged responses due to habits or adjustment costs. Incorporating such complications into economic theory results in models that can be fitted to data which are necessarily approximate, i.e. do not match the theory exactly. Inevitably, different investigators will take different approximations and focus more on some features than others. However, a limited span of macroeconomic data, where many of the variables are trending, will typically contain insufficient variation to be able to estimate robust specifications. There is widespread
scepticism about the usefulness of equations estimated on macro data, which scepticism has been deepened by the UK consumption function breakdown in the 1980s. In this context, models which explain data in a number of countries or regions should have more credibility than a model which has only been fitted to a single data set.

The third reason for studying regional consumption functions is to address specifically regional issues. The log ratios of regional consumption per head to the UK average, move strikingly differently between the regions, as illustrated in Figure 1. From 1980 to 1986 relative consumption levels in the South (i.e. the South East including London, the South West and East Anglia) rose strongly, followed by a major reversal in the South East. The early 1980s were generally a period of relative decline in consumption levels in the North, the North West, Yorkshire and Humberside, the West Midlands and the East Midlands. Scotland, Wales and Northern Ireland each have their own distinctive patterns. Indeed, the highest correlation coefficient between any two regions' relative consumption changes is only 0.54 (Northern Ireland and the North).

The regional data should throw particular light on the role of housing and credit markets in generating, amplifying and transmitting shocks. For example, higher income growth in one region will lead, other things being equal, to higher capital appreciation of houses. This could amplify the multiplier process by which consumption is raised, generating local employment and income, which in turn feed back via consumption and wealth. But the source of the shock could also be in increased credit availability, or lower interest rates, which favour the regions with the most expensive housing relative to income, and hence the biggest debt to income ratios.

The outline of the paper is as follows. Section 2 explains briefly the derivation of an approximate consumption function which incorporates credit constraints, uncertainty, income expectations, interest rate effects, a wealth effect and behaviour lags. This serves as a skeleton to introduce the specification which is actually estimated later in Section 6. The next two sections add important details to this basic skeleton. Section 3 discusses
wealth effects and, in particular, housing wealth effects, in greater detail. Section 4 discusses issues raised by financial liberalization. Section 5 discusses previous work on regional consumption in the UK and discusses the main ways in which this work needs extension. Section 6 discusses our specification and presents results for our estimated model. Section 7 draws implications from our results for the various issues raised in this introduction.

2. Derivation of a Consumption Model

As a prelude to the empirical specification which we apply to regional time series data, we give here a brief sketch of the derivation of a 'solved out' or 'structural' consumption function. At the individual level, such a consumption function is the solution to an intertemporal utility maximizing problem. Under various simplifying assumptions on preferences, linear intertemporal budget constraints, and no uncertainty, no habits or adjustment costs, Modigliani and Brumberg (1954) showed that individual consumption was a linear function of assets and non-property income. In the aggregate, where real consumption is \( c_t \), the real asset level at the end of the previous period is \( A_{t-1} \) and \( y_t \) is real non-property income

\[
c_t = aA_{t-1} + by_t
\]

where \( a \) depends on the distribution of assets and the population over different demographic groups, and \( b \) depends on the corresponding distribution of income and the population. Strictly speaking, \( a \) and \( b \) evolve slowly over time and should therefore have time subscripts. If their evolution is sufficiently gradual, they can be approximated by constants.
We now derive a log—approximation of (1) convenient for working with trending data and plausibly proportional disturbances:

\[
\frac{c_t}{y_t} = b(1 + \frac{a}{b} \frac{A_{t-1}}{y_t}) \epsilon_t
\]  

(2)

Since \(\frac{a}{b} \frac{A_{t-1}}{y_t}\) tends to be small\(^2\), and writing \(\frac{a}{b} = \gamma\),

\[
\ln c_t \approx \ln b + \ln y + \gamma \frac{A_{t-1}}{y_t} + \epsilon_t
\]  

(3)

Habits or adjustment costs introduce a partial adjustment mechanism into (3):

\[
\Delta \ln c_t \approx \beta (\ln b + \ln y_t + \gamma \frac{A_{t-1}}{y_t} - \ln c_{t-1}) + \epsilon_t
\]  

(4)

Probabilistic income expectations introduce expected income growth, \(E_t \Delta \ln y_{t+1}^m\), defined as some weighted average of forward—looking growth rates, and a measure of income uncertainty \(\theta_t\). Also, if real interest rates are variable, the real interest rate \(r_t\) enters the model. Incorporating these additional variables, a simple linearization gives

\[
\Delta \ln c_t \approx \beta [\beta_0 - \beta_1 r_t - \beta_2 \theta_t + \ln y_t + \beta_3 E_t \Delta \ln y_{t+1}^m + \gamma A_{t-1}/y_t - \ln c_{t-1}] + \epsilon_t
\]  

(5)

\(^2\) Also note that \(\ln(1+x) \approx x\) when \(x\) is small.
In principle, $\beta_3$ and $\gamma$ should also depend upon $\theta_t$ and $r_t$ since discount factors applied to expected incomes increase with income uncertainty and real interest rates, but we will suppress this complication to avoid cluttering the model.

Equation (5) refers to the behaviour of forward-looking households who do not face credit constraints. Assuming that $\pi$ is the consumption share of credit-constrained households and is constant, aggregate log-consumption is approximately given by (6)

$$\ln c_t = \pi \ln c_t^C + (1 - \pi) \ln c_t^U$$  \hspace{1cm} (6)

where $c_t^C$ is the consumption of the credit-constrained and $c_t^U$ that of the credit-unconstrained. Now assume that, for the credit-constrained, consumption equals non-property income$^3$, then

$$\ln c_t^C = \ln y_t^C$$  \hspace{1cm} (7)

If the non-property incomes of both types of households move in parallel, then, attaching $u$ superscripts in equation (5) to indicate unconstrained by credit, we can use equation (6) to aggregate equations (5) and (7). A one period lag of (6), implying that

$$\ln c_{t-1}^u = \frac{\ln c_{t-1}^u - \pi \ln c_{t-1}^C}{1 - \pi}$$  \hspace{1cm} (8)

can be used to replace unobserved lagged credit-unconstrained consumption.

$^3$ This assumption is made in much of the Euler equation consumption literature, see Hall and Mishkin (1982), Campbell and Mankiw (1989,1991).
The result is that the rate of growth of aggregate per capita consumption is given by

$$
\Delta \ln c_t = \beta (\ln y_t - \ln c_{t-1}) + \pi (1-\beta) \Delta \ln y_t
+ (1-\pi) \beta_0 \beta_1 r_t - \beta_2 \theta_t + \beta_3 E_t \Delta \ln y^m_{t+1} + \gamma A_{t-1}/y_t + (1-\pi) \epsilon_t
$$

(9)

However, the assumption that credit-constrained households just spend current income is an oversimplification. Some credit-constrained households will have debt which, in the UK, is mostly at variable interest rates. When interest rates change, the cash flows of such households will alter. We cannot observe the debt levels of such households, but the effect can be proxied by \((DB_{t-1}/y_t) \Delta r_n\), where \(DB/y\) is the average debt to income ratio of all households and \(rn\) is a nominal interest rate on borrowing.

Previous UK researchers, such as Townsend (1976), have argued that personal disposable income in the form of government transfer payments or "current grants" is all spent in the quarter in which it is received. If this is correct, everywhere in (9) we should replace \(c_t\) by \(c_t - cg_t\) and \(y_t\) by \(y_t - cg_t\), where \(cg_t\) is the per capita level of real current grants. It can also be shown that to an approximation\(^4\), this is equivalent to adding a term \((1-\beta)(1-\pi) \Delta (\frac{cK}{y})\) to (9).

The advantage of this formulation is that it preserves the dependent variable to be the rate of growth of aggregate consumption, for comparability with other studies. Also the hypothesis about the role of current grants can be tested by estimating the coefficient on \(\Delta \frac{cK}{y}\) unrestrictedly.

The treatment of wealth above is oversimplified. In Section 3, we argue that wealth effects differ according to the liquidity characteristics of different types of wealth. Moreover, housing wealth is special because housing has consumption, as well as wealth,

\(^4\) The approximation uses \(\ln(c-cg) \approx \ln c - cg/c \approx \ln c - cg/y\) and ignores the modification to the growth expectations and asset to income ratio terms in (9).
purposes. Financial liberalization, discussed in Section 4, had consequences for the liquidity characteristics of different assets. In both respects, equation (9) requires further modification before being implemented empirically.

3. **Housing Wealth Effects on Consumption**

A major focus of this research is to illuminate the effects of housing wealth on consumption. To achieve this, the role of asset effects in general must be examined. Assets are accumulated to provide for retirement and bequests, and for "rainy days" that can arise earlier because of income falls due to, for example, unemployment, ill health, or consumption needs (eg., paying for a child’s education or medical bills). Assets are also accumulated to purchase "big ticket" durables such as a car or furniture.

In this section, we suggest that marginal propensities to spend are less for illiquid assets than for liquid ones. We also discuss the special role of house prices for expenditure decisions, where a positive wealth effect is offset, in part, by a negative price effect.

Households typically hold a balance of liquid assets, which can easily be converted into expenditure when needed, and illiquid assets, that typically yield a higher rate of return. Illiquidity has the following dimensions: (1) capital uncertainty: for example, equity or property prices might be low just as cash is needed for spending; (2) transactions costs: stock brokers charge commission; in some countries, transaction costs, including taxes, of selling a house can be over 10 per cent; (3) transactions restrictions: pensions are usually only accessible at retirement; tax benefits from many savings schemes are lost if they are cashed in early; (4) indivisibilities: houses, yachts or paintings can only be sold as units.

Different assets have different liquidity characteristics. Housing, pension funds and life insurance funds are at the illiquid end of the spectrum. However, note that a general easing of credit relaxes these constraints, at least in part: if housing or a painting can be
used as collateral for a loan, the market value can, to a degree, be accessed. On the other hand, lenders, bearing in mind default risk and the volatility of asset prices, are unlikely to offer 100 per cent collateral—backed loans — though the UK and Scandinavian housing markets seem to have been a temporary exception in this respect after financial deregulation in the 1980s.

As far as spending decisions are concerned, differences in liquidity suggest associating different spendability weights with different types of assets and debt. The characteristics of illiquidity are complex and multi-dimensional and it is no easy matter to formulate the budget constraint to reflect points (1) to (4) above. If one were to do so one could associate shadow prices or Lagrange multipliers with each of the constraints. One could then measure the marginal utility of increasing each asset by £1 relative to the marginal utility of increasing current income by £1. Cash then has a relative shadow price or spendability weight of 1 and less liquid assets would have lower spendability weights. 5 One would expect the assets with the highest long—term after—tax returns to have the lowest spendability weights. This is analogous to the index number approach to measuring monetary aggregates, see Barnett (1981), where liquidity is indirectly measured by potential return foregone. However, one would expect spendability weights on illiquid assets to increase with financial deregulation — even though, in the short term, returns on such assets increased after deregulation. Potentially, as we shall see, the increased spendability of illiquid assets could be the most important consequence of financial liberalization.

It is important to note that owner—occupied housing wealth, which is the most important single asset for the majority of households, has spending consequences which differ from those of illiquid financial assets in at least one significant respect. This is

5 There are previous studies which have allowed different weights on liquid and illiquid assets, e.g., Patterson (1984), and there are a number which have included liquid asset effects, e.g., Zellner, Huang and Chau (1965), Hendry and von Ungern Sternberg (1981).
because housing services also appear in the utility function. Housing is the consumer durable par excellence. It is distinguished by the low rate of physical depreciation and also by its different treatment in national accounts statistics compared with other durables. Purchases of houses are not regarded as spending to be included in total consumer expenditure. Instead, the imputed value of owner-occupied housing services is included both in consumption and in income in the national accounts. This recognizes the asset acquisition aspect of house purchase.

In general, the relative price of durables enters the consumption function for non-durables, as well as its own expenditure equation. Similarly, the demand for non-housing consumption will be affected by the price of housing. To see how, let us consider a permanent change in the price of housing after which the relative prices of non-housing consumption and housing are expected to remain fixed.\(^6\) Let \( H \) be housing stock and \( p^* \) its relative price; let \( h \) be the flow of services from housing and \( c \) be non-housing consumption. Distinguishing \( h \) and \( c \) at different points in time over a \( T \) period horizon gives rise to two vectors with \( T \) elements each. With a fixed real interest rate, relative prices through time of the elements of each of these vectors are fixed so we can treat the vectors of housing and non-housing consumption like two single goods of permanent housing and non-housing consumption. Effectively, using the Hicks aggregation theorem (see Deaton and Muellbauer (1980), p.120–122), we have reduced a 2\( T \) (two goods over \( T \) periods) dimensional optimization problem to a two good problem with a budget constraint of the form

\[
c + p^* h = \frac{r}{1+r} W
\]

where \( W \) is life-cycle wealth and \( r \) is the real interest rate.

\(^6\) Miles (1993) has considered this problem. The derivation that follows reaches the conclusion more simply.
We are interested in the effect on non-housing consumption of a permanent increase in the relative price of houses. Total differentiation gives

\[ dc + dp^*h + p^*dh = \frac{r}{1+r}dW \]

where \(dW = dp^*H\) if we hold constant the other elements of life-cycle wealth and the real interest rate \(r\). Thus

\[ \frac{\partial c}{\partial p^*} = \frac{r}{1+r}H - h \quad \frac{p^*\partial h}{\partial p^*} \]

\[ = \frac{r}{1+r}H - h \quad (1 + ehp) \]

where \(ehp\) is the own price elasticity of demand for housing services. On UK data, estimates suggest \(ehp \approx -0.6\) or \(-0.7\).

The implication is that for those with housing wealth, the wealth effect \(\frac{r}{1+r}H\) of a house price rise is likely to dominate the combined income and substitution effect \(b(1 + ehp)\) from facing a higher house price. For those without housing wealth, there is no wealth effect so that the negative effect remains. The smaller the proportion of people who are not owner-occupiers, but have aspirations in that direction, the more the wealth effect dominates at the aggregate level. One might expect non-owner-occupiers to save more when real house prices rise. Their saving would also depend on the size of the required deposit as a proportion of the price of a house when obtaining a mortgage. In the UK and in Scandinavia in the 1980s, financial deregulation reduced these deposit/value ratios. Further, those living in a deregulated private rented sector may anticipate having to pay higher rents in the future when they see real house prices rise, and hence save more. In the UK, the deregulated private rented sector is under 7 per cent of households.
It is important to note the difference between housing wealth increases and house price increases, as emphasized by Miles (1993). The accumulation of owner-occupied housing capital through investment, and the transfer of publicly-owned housing into private hands at discounts of around 50 per cent, experienced in the UK in the 1980s, are household wealth increases that do not rest on increases in real prices. Such increases have clearly positive expenditure implications.

Increases in real house prices tend to redistribute wealth between young households and older households since the young have typically accumulated less housing wealth. To the extent that older households may have higher marginal propensity to spend out of housing wealth as out of other assets, this redistribution adds to the aggregate spending effect.

Life-cycle theory, under the assumption of point expectations (i.e., ignoring uncertainty), predicts that households which are older, and therefore have shorter time horizons, have higher propensities to spend out of assets. However, empirical evidence, see for example, Borsch-Supan and Stahl (1991), suggests that retired households are not the dissavers implied by simple life-cycle theory. There are at least three reasons for this: uncertainty about length of life, uncertainty about needs as well as income, and the bequest motive. The last of these may have different implications for houses than for other assets for several reasons. One is that the inheritance tax treatment of housing often differs from that for other assets, making it on occasion more tax-efficient to make bequests in the form of housing. Another reason is that inheriting a housing asset provides insurance against the risk of high house prices to an inheritor without housing assets. Finally, because of transactions costs and the specific locational and other characteristics of a house, parents may be able to influence their children’s life-style in a way which would not be possible if they left more easily cashable assets.

Evidence is accumulating that house prices have the dual effects implied by theory: a positive wealth effect, which depends on the degree of liquidity of houses, and a negative
relative price effect. Indeed, it is impossible to obtain sensible wealth effects for the aggregate Japanese consumption function without a negative price of land\textsuperscript{7} effect (see Murata (1994)). Lattimore (1993) finds a similar effect for Australia. In the UK, it is hard to pin down a negative relative price effect on aggregate data, but with regional UK consumption data there may be more scope. A recent survey on the consumption effects of house price increases in a range of OECD countries finds mixed effects, consistent with the dual role of house prices (Kennedy and Andersen, 1994).\textsuperscript{8}

4. The Role of Financial Liberalization

Financial deregulation has been an important phenomenon in many countries, particularly in the 1980s. Moves in this direction started a little earlier in the US than the UK with regulatory ceilings on interest rates paid by savings and loans institutions phased out after the mid 1970s. The move to targeting monetary aggregates made interest rates increasingly volatile at this time and interest rate regulation increasingly out of place both in the US and the UK. Furthermore, the UK abandoned exchange controls in 1979 which opened up its domestic credit markets to international capital movements.

To understand the financial deregulation that occurred in the UK and the Scandinavian countries in the 1980s, it is helpful to understand the preceding regime of credit controls. The UK and Scandinavian countries in the 1970s had very progressive income tax systems and tax deductibility by household of interest payments on debt, though in some cases, as in the UK, restricted to mortgage debt. After the first oil shock of 1973–4, inflation rose sharply in these countries while nominal interest rates rose only moderately. Real interest rates became negative, and hugely negative given tax

\textsuperscript{7} In the absence of good house price indices, the price of land is the best alternative proxy.

\textsuperscript{8} However, this was not on the basis of formal econometric work or a comprehensive model of consumption.
deductibility of interest payments. To illustrate, with inflation at 15 per cent, the nominal borrowing rate at 13 per cent, a marginal tax rate of 50 per cent implies an after tax real interest rate of $6.5 - 15 = -8.5$ per cent. At a marginal tax rate of 80 per cent, common for higher incomes at this time, the real interest rate was $2.6 - 15 = -12.4$ per cent. This created strong incentives to borrow and indeed a demand for credit which was held in check by rationing.

In the UK from 1979, nominal interest rates rose, and foreign exchange controls were abandoned. The "corset" which had restricted bank lending was removed in 1980, and the banks, suffering losses from Third World lending in the 1970s, were anxious to enter domestic mortgage markets. These markets became much more competitive. Restrictions on building societies were progressively relaxed, culminating in the 1986 Building Societies' Act, and a new breed of mortgage lenders, often financed by overseas banks, entered the market. Credit became so easily available, that by 1986–88, many first-time buyers were offered 100 per cent loan to value ratios. From 1980 to 1989, household debt to income ratios in the UK more than doubled to one of the highest ratios in the world, and there was a boom in house prices, in which real prices in the UK doubled over the same period. These developments were not solely the result of financial deregulation, since there was sustained economic growth and falling unemployment from 1986 to 1990. But it is hard to deny the connection.\(^9\)

As far as the consumption equation is concerned, financial liberalization can have several effects on the parameters apart from those on income or on asset values and debt. Most obviously, it could reduce the consumption share of the credit–constrained, \(\pi\).

However, Euler equation evidence for the UK appears to suggest that rather than

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\(^9\) Similar developments occurred somewhat later in Scandinavia, first with Denmark, followed by Norway, then Sweden and finally Finland, see Englund (1990), Lehmussaari (1990), Koskela and Viren (1992) and Berg (1994). In all countries, debt to income ratios grew strongly, real house prices boomed and household savings ratios fell sharply — to negative levels in all cases, according to Berg (1994).
decreasing, the consumption share of the credit–constrained actually rose in the UK during the 1980s (see Japelli and Pagano (1989), and Campbell and Mankiw (1991)). This suggests that modelling the effect of financial liberalization as a reduction in $\pi$ in the context of 'solved out' or 'structural' consumption functions may not be very helpful. An alternative approach in the context of the 'solved out' or 'structural' consumption function is a shift in the spendability coefficients associated with illiquid assets and debt. Financial liberalization, by making asset–backed credit more easily available, made these illiquid assets more spendable. This makes good sense in the context of the shadow price interpretation of these weights above. It is also plausible that it would have increased the negative spendability weight on debt, giving it a value close to $-1$ to correspond with a weight of 1 on liquid assets. During the credit rationing regime of the 1970s, a household with big debts could count itself lucky, even though, with given assets and income, lower expenditure would still be associated with a bigger debt.

There are other possible effects. During credit rationing, the intertemporal substitution, which is partly represented by the real interest effect, is less likely to be operative.\(^\text{10}\) Thus, we would expect more powerful real interest effects after financial liberalization. More subtly, since part of the uncertainty discount factor applied to future expected income growth rests on the possibility of future credit rationing, it is possible that expected income growth could have a more powerful effect with financial liberalization.

It is too much to ask aggregate time series models to pick up all these possibilities, though there is some empirical support in the UK for both of the last two. Distinguishing such effects is especially hard because international financial liberalizations reduced the balance of payments constraints on UK and Scandinavian economic growth. In the

\(^{10}\) However, when inflation and interest rates both rise and credit is rationed, a 'front–end loading problem' arises for borrowers whose cash debt service payment rises, as a bigger fraction of the long–term burden of interest charges and debt repayment is loaded onto the current period. This can give rise to a negative nominal interest rate effect on aggregate spending, incorporated in Section 2's consumption model in the form of a weighted interest rate change effect.
UK this gave rise to the Burns–Lawson doctrine\textsuperscript{11}, which claimed that, as long as the government did not run a deficit, the balance of payments deficit was self-correcting as the private sector made the necessary adjustments. Indeed, in forecasting income growth in the UK, Muellbauer and Murphy (1993b) found that the coefficient on the lagged balance of payments deficit fell in the 1980s, reducing the balance of payments constraint on growth. Since the rise of the Burns–Lawson doctrine occurred at about the same time as domestic financial liberalization, it is hard to separate precisely the direct growth effect of international financial liberalization from the effect via the higher spendability of illiquid assets or a lower weight on credit constrained households.

5. **Previous UK Research on Regional Consumption Function**

There are two notable previous studies of regional consumption data in the UK. Green and Hadjimatheou (1990) pooled the annual regional accounts data for the eleven standard UK regions for the period 1974–1985, and estimated a consumption function of the error correction form, explaining regional log consumption by regional log personal disposable income, regional inflation, the regional log unemployment rate, lagged log housing wealth, the regional rate of population growth and dummy variables reflecting regional differences in the average propensity to spend and two outliers. The results look quite plausible:

\textsuperscript{11} See Muellbauer and Murphy (1990).
\[ \Delta \ln c_t = \text{dummies} + 0.33\Delta \ln y_t - 0.42(\ln c - \ln y)_{t-1} - 0.80\Delta \ln p_t \]
\[ + 0.16\Delta \ln p_{t-1} - 0.044\ln u_t + 0.020(\ln HA - \ln y)_{t-1} \]
\[ - 0.92\Delta \ln pop_t + 0.20\Delta \ln c_{t-1} \]

(5.8) (6.7) (10.6) (3.0) (7.1) (6.3) (3.2) (2.9)

\[
\text{s.e.} = 0.0151, \text{ DW} = 2.14
\]

where for each region in each year, \( c, y \) are per capita real consumption and disposable income respectively, calculated by deflating nominal figures by \( p \), the regional price index published by The Reward Group; \( u \) is the unemployment rate; \( HA \) is an estimate of the value of the owner-occupied housing stock also deflated by \( p \); and \( pop \) is the population. The estimates in (10) are for OLS estimates, treating disturbances as independent and homoscedastic across regions.

The housing wealth effect is of a plausible magnitude: a 20% increase in real housing wealth results in a long-run increase in consumption of 1%. Although there is no explicit allowance for debt and financial assets, it can be argued that the negative inflation effect proxies the effects of these other assets. Green and Hadimatheou interpret the unemployment rate as a proxy for income uncertainty.

Carruth and Henley (1993), define housing wealth in net terms as gross housing wealth minus mortgage debt. They allocate the national mortgage stock to regions on the basis of current year building society figures on new mortgages granted, not an ideal procedure. For 1974 to 1989 they obtain:
\[
\Delta \ln c_t = \text{dummies} + 0.42 \Delta \ln y_t - 0.30 (\ln c - \ln y)_{t-1} - 0.22 \Delta \ln p_t
\]
\[
(7.1) \quad (5.3) \quad (5.6)
\]
\[
+ 0.001 (\ln \text{NHA} - \ln y)_{t-1} + 0.07 \Delta \ln \text{NHA}_{t-1},
\]
\[
(0.1) \quad (3.8)
\]

s.e. = 0.021, DW = 1.8

where NHA is net housing equity.

As can be seen, the two major differences from Green and Hadjimatheou's equation, apart from the different definition of housing assets, are the exclusion of an unemployment rate effect and the inclusion of the lagged rate of change of net housing wealth. There is little justification in economic theory for the inclusion of the latter (except as a proxy for income expectations), which will be positively correlated with the lagged level of net housing wealth. It seems likely that the exclusion of the lagged rate of change would make the apparently insignificant lagged levels effect appear significant.

Carruth and Henley also give results which include time dummies; results for split samples which suggest parameter stability is problematic; and the results of allowing different coefficients in each region, which suggests considerable heterogeneity in parameter estimates.

The theoretical background we have provided in Sections 2, 3 and 4 suggests that the models by Green and Hadjimatheou and Carruth and Henley need considerable extension. Mortgage debt, non-mortgage debt and financial assets are important parts of the average portfolios of consumers and need to be brought explicitly into the model. Income expectations, a key ingredient of life-cycle consumer theory, need to be introduced. Income uncertainty has been much emphasized in the consumption literature of recent years. Carruth and Henley omit uncertainty proxies and it is far from clear that the
log-level of unemployment, adopted by Green and Hadjimatheou is a plausible proxy. Finally, there is the issue of the potential impact of financial liberalization on regional as well as national consumption.

There are also problems on the data front. The regional price indices by the Reward Group which are used in both previous studies differ from national data largely because of housing costs. One can have misgivings about the way these are measured which rests on the costs of outright purchase of houses.

There are also problems with Regional Accounts data on incomes. As already noted by Holmans (1990), Regional Accounts figures on personal disposable income show little of the rise in relative affluence in the South East in the 1980s displayed by unemployment rates and in earnings figures from the New Earnings Survey. Our own research on regional house prices demonstrates that regional earnings figures are significantly superior to regional accounts income figures in explaining house prices. It is hard to make sense of the Regional Accounts income figures, and they also contradict other data sources, such as the Family Expenditure Survey. One can only hope that no attempt has been made at the regional level to reconcile consumption and income figures, since otherwise the former will be contaminated also. Both the above studies used Regional Accounts income figures. There can be little doubt that their results would alter with improved income estimates.

These are the main issues on which our approach differs from that of the previous two studies. The next section describes in detail the way we have built on Sections 2, 3 and 4 in dealing with them.
(6) **Empirical Specification and Results**

(a) **Empirical specification**

Turning now to the specification of an empirical consumption function, the model set out in eq (9) needs to be augmented in a number of ways as noted above. Two of these, discussed at the end of Section 2, are the inclusion of a weighted interest rate change effect and the change in the ratio of current grants to non-property income. Also the income uncertainty proxy or proxies need to be made specific. The proxies found to work best were a mixture of changes in the unemployment rate both in the region and in the South East. The upshot of Section 3 was that total assets should be disaggregated into at least three components: liquid assets, debt and illiquid assets, with, in general, different coefficients; and a negative real house price effect should be included. Section 4 pointed out that financial deregulation was likely to have increased the coefficient on illiquid assets and the (negative of the) coefficient on debt. It seems plausible that at the peak of financial liberalization, negative debt and positive liquid assets should have similar marginal spending implications and we impose this constraint. An index of financial liberalization, was derived in Muellbauer and Murphy (1993b) from data on loan to value ratios for first-time home buyers and other information, including interest rates, house prices and incomes. This index was used to model shifts in the asset and debt coefficients.

One version of the resulting equation for the ith region is given as eq. (12).
\[ \Delta \ln c_{it} = \alpha_{i0} + \beta(\ln y_{it}^* - \ln c_{it-1}) + \pi(1-\beta)\Delta \ln y_{it}^* + (1-\pi)(1-\beta)\Delta \left( \frac{c_R}{y} \right)_{it} \]

\[ - \beta_{21} \Delta^2 u_{it} - \beta_{22} \Delta u_{it} + \beta_{23i} \Delta u_{it-1} + (1-\pi)\beta_3 E_t \Delta \ln y_{it+1} \]

\[ - \beta_4 \left( \frac{DB_{it-1}}{y_{it}} \right) \Delta r_t - \beta_5 \Delta c_t - \beta_6 \Delta \text{strikes} \]

\[ + (1-\pi)\beta_6 \gamma_{1/it} - \gamma_{1/it}(1+\phi \text{FLIB}_{it-1}) + \gamma_{2/it}(1+\phi \text{FLIB}_{it-1}) \left( \frac{ILA_{it-1}}{y_{it}} \right) \]

\[ - \beta_7 (DPR_{it-1} \ln (hr_{it-1}/y_{it})) \] (12)

We will now go through the variables in equation (12), briefly explaining their role and definition. Here \( i \) refers to region and \( t \) to the year, \( c_{it} \) is real per capita consumer spending, \( y_{it} \) is real per capita non-property disposable income and \( c_{it} \) is current grants to the personal sector, all from CSO Regional Accounts data.

Since there are question marks over the accuracy of regional accounts personal per capita income data, \( y_{it}^* \) is a weighted average of regional income data from three possible sources: the Regional Account's figure \( y_{it} \), a figure based on the New Earnings Survey and the National Account's UK figure. This is explained in more detail below.

Note that regional consumption and regional income measures are converted to real terms using the UK consumer expenditure deflator. We did not follow Green and Hadjimatheou (1990) and Carruth and Henley (1993) in adopting regional price indices published by the Reward Group for reasons explained above. The omission of well measured regional price deflators could well induce an element of residual autocorrelation into the estimated model.
Income uncertainty is proxied by changes in \( u_{it} \), the regional unemployment rate and use \( \gamma_{it} \) the unemployment rate in the South East. For income expectations, \( E_t \Delta \ln y_{it+1}^* \) is derived from a forecasting model for national real per capita non-property disposable income (see Muellbauer and Murphy (1993b)) and a regional model for one year ahead forecasts of the log deviation of regional earnings and regional accounts non-property disposable incomes from the respective UK average (see Appendix).

The change in the rates of interest on borrowing \( \frac{DB_{it-1}}{y_{it}} \Delta nr_t \) is the debt/income weighted. More than two thirds of debt is mortgage debt so that the dominant interest rate is the after-tax building society mortgage interest rate. Bank base rate is assumed to apply to non-mortgage debt. We include also the change in an indicator of the tightness of controls on lending conditions for consumer durables measured by \( \Delta cc \). These controls were abolished in 1982 but before 1979 were an important short-term macro policy instrument. Earlier studies of consumer durable expenditure and of total consumer expenditure have often included such an effect, see Townend (1976), Allard (1979) and Cuthbertson (1980). Drawing on our UK consumption function, Muellbauer and Murphy (1993b), we also included the change in the incidence of long-duration strikes, \( \Delta \)strike distributed over the regions in proportion to data on average hours of work lost by region. This captures a mixture of income uncertainty generated by major strikes and temporary credit rationing of strikers' families.

The national mortgage stock was distributed over the regions on the basis of information on regional shares of mortgage interest payments from the Family Expenditure Survey, the General Household Survey and some checks from Labour Force Survey Housing Trailers. Non-mortgage debt to income ratios for each region were calculated on the following basis: assume that regionally, non-mortgage debt is proportional to financial assets. Suppose the ratio of asset income to disposable income in region \( i \) divided by the UK ratio, \( \frac{rA_i}{y_d^i} / \frac{rA_i}{y_d} \), is \( a_i \). Then we assume that in the \( i \)th region the non-mortgage
debt/income ratio equals $a_1$ times the UK figure. Taking a mid-sample year as typical, the regions with $a_1$ below unity were the North, Yorkshire and Humber, the North West, the West Midlands, Scotland and Northern Ireland, while the remainder had ratios above unity. Given the dominance in debt of mortgage debt, the crudeness of this assumption probably does not matter very much.

The liquid asset to income ratio, $LA_{i-1}/y_{it}$ and the illiquid financial asset to income ratio, $ILFA_{i-1}/y_{it}$, were computed similarly as $a_1LA_{i-1}/y_{i}$ and $a_1ILFA_{i-1}/y_{i}$. The crudeness of these assumptions is probably more serious and there may be both level and trend divergences of the true regional asset to income ratios from these estimates. Such divergences are likely to induce positive serial correlation in the residuals. The simple alternative hypothesis $a_1=1$, for all $i$, produces a notably worse fit and some aggravation of tendencies towards positive autocorrelation. Clearly, a more sophisticated approach using benchmarks from an asset survey with a regional dimension and/or more detailed data on different kinds of asset income from the Family Expenditure Survey would be desirable in future work. Still, our approach is preferable to omitting financial assets and non-mortgage debt altogether, as in the two previous studies of regional consumption discussed above. The total debt to income ratio in region $i$, $DB_{i-1}/y_{it}$ is thus defined as

$$NMD_{i-1}/y_{it} + MS_{i-1}/y_{it}$$

where $NMD$ is non-mortgage debt and $MS$ is the mortgage stock. Similarly, the total illiquid asset to income ratio $ILA_{i-1}/y_{it}$ is defined as

$$ILFA_{i-1}/y_{it} + HA_{i-1}/y_{it}$$

where $ILFA$ is illiquid financial assets and $HA$ is owner-occupied housing wealth. Regional data on gross housing wealth are obtained by apportioning national data in proportion to regional shares derived from numbers of owner-occupied homes per region and average prices per region.

Debt and illiquid assets are both scaled by a term that depends on the financial liberalization index FLIB developed by Muellbauer and Murphy (1993b). For present
purposes, FLIB = 0 in 1989 and −1 at its trough in the 1960s. The coefficient $\phi$ proves to be relatively hard to estimate: there is little difference in the goodness of fit over the range 0.2 to 0.8 in which $\phi$ might plausibly lie. The aggregate time series evidence for the UK over a longer sample period suggests $\phi \approx 0.5$ and this value was imposed.\textsuperscript{12}

The implication of this formulation is that when FLIB=0, liquid assets and negative debt are equivalent, while in earlier years, before financial liberalization, when FLIB = −1, one £ of extra debt was equivalent to a reduction of only 50p in liquid assets.

The last term in (12) represents the negative effect of higher real house prices, interacted with the downpayments to value ratio for first-time buyers. Thus, the higher are percentage down payments, DPR, required to be made by first-time buyers and the higher are house prices relative to income, $hp/y$, the the smaller will be consumer spending — after account has been taken of the wealth effects of higher real house prices on consumption.

There appeared to be an outlier in consumption for the three southern regions in 1986, East Anglia, the South East and the South West, probably reflecting a surge connected with Big Bang in the City of London,\textsuperscript{13} and a dummy was included for this observation.

(b) Results

Estimates for eq (12) are shown in Table 1. The equations were estimated via the seemingly unrelated regression (SUR) option in the TIMES Series Processor package (TSP). This computes least squares as a first step, imposing all the specified parameter restrictions, by minimizing the trace of residuals. Given the first step parameter estimates,\textsuperscript{12} The point estimate was 0.60 with a standard error of 0.71 at the 1st step of the Seemingly Unrelated Regression method used for estimation and 0.35 (0.45) at the second step which imposes the covariance matrix estimated at the first. The remaining parameter estimates are remarkably insensitive to variations in the value of $\phi$ in the range 0.2 to 0.8.

\textsuperscript{13} This financial market reform generated a surge of take-overs and buy-outs by foreign banks, triggering large cash payments and salary increases in the City.
### Table 1: Parameter estimates of eq (12) for 11 UK standard regions 1972-1991

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Estimate</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>adjustment coeff</td>
<td>0.386</td>
<td>(0.026)</td>
</tr>
<tr>
<td>$\pi$</td>
<td>fraction of credit constrained</td>
<td>0.17</td>
<td>(0.048)</td>
</tr>
<tr>
<td>$\beta_{21}$</td>
<td>acceleration of regional $u$</td>
<td>0.46</td>
<td>(0.054)</td>
</tr>
<tr>
<td>$\beta_{22}$</td>
<td>two year change in $u$</td>
<td>0.99</td>
<td>(0.065)</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>relative weight of expected income</td>
<td>0.57</td>
<td>(0.107)</td>
</tr>
<tr>
<td>$\beta_4$</td>
<td>effect of debt weighted $\Delta$ interest rate</td>
<td>1.09</td>
<td>(0.14)</td>
</tr>
<tr>
<td>$\beta_5$</td>
<td>effect of $\Delta$ credit controls</td>
<td>1.02</td>
<td>(0.114)</td>
</tr>
<tr>
<td>$\beta_6$</td>
<td>effect of $\Delta$ strikes</td>
<td>0.29</td>
<td>(0.039)</td>
</tr>
<tr>
<td>$\gamma_1$</td>
<td>effect of liquid asset/income</td>
<td>0.100</td>
<td>(0.022)</td>
</tr>
<tr>
<td>$\gamma_2$</td>
<td>effect of illiquid asset/income</td>
<td>0.045</td>
<td>(0.0047)</td>
</tr>
<tr>
<td>$\beta_7$</td>
<td>effect of deposit w/td rel house prices</td>
<td>0.007</td>
<td>(0.024)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>intercept</th>
<th>$\beta_{231}$</th>
<th>$\Delta$use$_{-1}$</th>
<th>D1986</th>
<th>se</th>
<th>$R^2$</th>
<th>DW</th>
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</thead>
<tbody>
<tr>
<td>North</td>
<td>-0.25(0.026)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0137</td>
<td>0.828</td>
<td>1.68</td>
</tr>
<tr>
<td>North West</td>
<td>-0.32(0.026)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0104</td>
<td>0.867</td>
<td>1.43</td>
</tr>
<tr>
<td>Yorks &amp; Humber</td>
<td>-0.33(0.025)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0066</td>
<td>0.955</td>
<td>1.12</td>
</tr>
<tr>
<td>W Midlands</td>
<td>-0.28(0.022)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0108</td>
<td>0.884</td>
<td>1.46</td>
</tr>
<tr>
<td>E Midlands</td>
<td>-0.32(0.027)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0131</td>
<td>0.835</td>
<td>1.26</td>
</tr>
<tr>
<td>East Anglia</td>
<td>-0.30(0.030)</td>
<td>0.90(0.22)</td>
<td>0.027(0.009)</td>
<td>0.0115</td>
<td>0.903</td>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td>South East</td>
<td>-0.24(0.035)</td>
<td>0.75(0.15)</td>
<td>0.025(0.005)</td>
<td>0.0067</td>
<td>0.941</td>
<td>1.86</td>
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<tr>
<td>South West</td>
<td>-0.29(0.032)</td>
<td>0.89(0.28)</td>
<td>0.046(0.011)</td>
<td>0.0173</td>
<td>0.634</td>
<td>1.39</td>
<td></td>
</tr>
<tr>
<td>Wales</td>
<td>-0.33(0.030)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0108</td>
<td>0.830</td>
<td>1.92</td>
</tr>
<tr>
<td>Scotland</td>
<td>-0.29(0.023)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0017</td>
<td>0.873</td>
<td>1.36</td>
</tr>
<tr>
<td>N Ireland</td>
<td>-0.41(0.077)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0191</td>
<td>0.703</td>
<td>1.21</td>
</tr>
<tr>
<td>Region</td>
<td>$\rho_1$</td>
<td>$\rho_2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
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<td>------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>0.07(0.14)</td>
<td>-0.28(0.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North West</td>
<td>0.03(0.13)</td>
<td>-0.38(0.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North West</td>
<td>0.23(0.18)</td>
<td>0.27(0.24)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midlands</td>
<td>0.09(0.16)</td>
<td>-0.13(0.16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midlands</td>
<td>0.25(0.17)</td>
<td>-0.16(0.18)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>East Anglia</td>
<td>0.35(0.18)</td>
<td>-0.34(0.19)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South East</td>
<td>0.04(0.19)</td>
<td>-0.12(0.17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South West</td>
<td>0.55(0.18)</td>
<td>-0.31(0.15)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Wales</td>
<td>-0.13(0.17)</td>
<td>-0.26(0.16)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Scotland</td>
<td>0.22(0.17)</td>
<td>0.03(0.17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>0.28(0.15)</td>
<td>-0.28(0.16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Parameter estimates of residual autocorrelation 1974-1991
it then computes the covariance matrix of residuals and holds this fixed in estimating generalized least squares. This is a specification in which a great deal of symmetry in the sense of identical coefficients has been imposed across regions. One exception to this is the intercept $\alpha_{10}$ which reflects, in part, differences in long-term propensities to save or spend across regions and systematic measurement errors in consumption, income, debt or assets across regions. Another exception is in the term $\beta_{23i} \Delta \text{use}_{t-1}$ which, like the 1986 dummy effect, is different from zero for the three southern regions, allowing a shorter lag from South East unemployment changes in the South than in the rest of the UK. Finally, the weights which link income $y_{it}^*$ with its three components were allowed to vary by region.

It should be emphasized that these Table 1 results incorporate the results of a number of tests against alternative hypotheses. For example, the restriction on the effect of the change in the current grants to income ratio $\Delta(\text{cg/y})_{it}$ which stems from the theoretical model was tested and accepted. In the UK model, income uncertainty was proxied by a combination of the change in the UK unemployment rate and the absolute deviation of the current income growth from a five year average. For the regions we do not have a long enough time series for the latter variable and the UK absolute deviation proves insignificant given the combination of regional and South East or UK changes in the unemployment rate. The combination of the acceleration of the regional unemployment rate and the two year change in the South East unemployment rate\textsuperscript{14} was arrived at by testing down from more general lag structures and checking for regionally varying parameters. The leading role played by the South East in the business cycle as well as the likelihood that South East unemployment proxies middle class unemployment better than does unemployment in the other regions probably accounts for the special role it plays in all regions. It is noteworthy that for the South East the net unemployment effect is

\textsuperscript{14} In its place, the two year change in the UK unemployment rate gives broadly similar results though with a somewhat worse fit.
approximately \(-\Delta \text{use}_t + \Delta \text{use}_{t-1}\) \(- 0.5 (\Delta \text{use}_t - \Delta \text{use}_{t-1}) + 0.5 \Delta \text{use}_{t-1}\)

\(-1.5 \Delta \text{use}_t\). If one were to aggregate the unemployment changes across regions, it can also be seen that they aggregate approximately to \(\Delta u_t\), i.e., the change in the national unemployment rate, which is just the form found to work best in our UK consumption function.

Let us comment on the parameter estimates in more detail. \(\beta\) estimated at 0.39 (0.025) says that 39% of a regional income or wealth change feeds through into regional consumption in the first year.\(^{15}\) This is lower than national estimates of more like 60 to 65%. The difference is likely to be partly the result of measurement errors at the regional level, which are bound to be more severe than at the national level. It may also be the case that simultaneity may be biasing the coefficient upward at the national level. At the national level there are fewer leakages so that a consumption shock may feed back within the year biasing up the income coefficient.

The proportion of credit-constrained consumption, \(\pi\), is estimated at 0.17 (0.048). But recall that current grants were found to feed immediately into expenditure. With current grants accounting for about 20% on average of income, this would suggest 35 to 40% for \(\pi\), well within the range of estimates for Euler equation models for a range of countries by Campbell and Mankiw (1991). We have assumed \(\pi\) is constant over the period. This may not be a totally absurd approximation for much of the period. The beginnings of financial liberalization in the UK coincided with the rise in unemployment. Further, economic theory tells us that the desire to borrow is greatest when consumers are most optimistic about future income relative to current circumstances. It is conceivable that in the mid 1980s the desire to borrow may have grown together with credit availability keeping a substantial fraction of consumers feeling credit-constrained.

\(^{15}\) This is not quite accurate because of the \(\pi(1-\beta)\Delta \ln y^*_i\) term which increases the first year income effect to 48%.
The coefficient on expected income growth, $\beta_3$, is estimated at 0.59 (0.11), suggesting that consumers who are not credit rationed put a weight of around 60% on next period's expected income relative to 40% on current income. Our UK model suggested that it was hard to distinguish a model including one year ahead forecasts from one including also two year ahead forecasts and we did not attempt to include the latter in our regional model. At any rate, our results suggest a substantial and highly significant forward-looking element in consumer behaviour.

In our regional model we were unable to find a significant real interest rate effect. However, the change in nominal interest rates on borrowing, weighted by the debt to income ratio, proved highly significant, $\beta_4$ being estimated at 1.08(0.14). With debt to income ratios of around 1 at the end of the period, this implies that a rise in the mortgage rate from 8% to 9% has an impact effect of 1% on consumption. Even though it is only a temporary effect, this seems large to be a pure consumption effect. Interestingly, our research on income forecasting models shows a strong negative effect from increases in base rates at the national level on income growth in the two following years. However, our forecasting models for earnings growth relative to the UK average suggests some positive feedthrough from debt-weighted mortgage interest costs into earnings at the regional level. It is possible that we have not apportioned the effect of interest rate increases accurately between those effects operating via income expectations and those operating on consumption via current cash flows.

Two other significant negative temporary effects on consumption come from the change in consumer credit controls, $\Delta cc$, and from a measure of the change in long-duration strikes. The strike measure used in our UK consumption model was apportioned across regions in accordance with regional figures on person hours lost in strikes. This variable probably reflects some mixture of a short-term increase in uncertainty, associated for example with the 1984 miners' strike and a short term increase
in credit rationing of the strikers' households. The parameter estimates of the Δcc and Δstrike variables are marginally lower than UK estimates but fairly comparable.

Turning now to the asset effects, the spendability at the peak of financial liberalization of liquid assets γ_1 at 0.10(0.022) is somewhat over twice as high as that of illiquid assets γ_2 at 0.045(0.0046). This is consistent with theory. Our estimates are in line with our estimates for UK and US consumption functions. In overall magnitude they make good sense in the context of life-cycle theory and are comparable in magnitude with wealth effects found in many consumption functions going back to Ando and Modigliani (1963) and Stone (1964, 1966), despite the crude specification of many of the earlier studies. As noted above, the effect of financial liberalization has been approximately to double the spendability of illiquid assets and the negative spendability of debt, comparing the peak of credit availability in 1989 with the mid 1970s or 1960s when credit was much less freely available.

To give some idea of the magnitude of the housing wealth effects consider a consumer with housing wealth three times as large as of non-property income. The model implies that a 10% increase in real house prices in the long-run raises the consumption of such a household by about 1.4%. On the average, the housing wealth to non-property income ratio in 1991 was around 2.8. Taking into account the fact that the wealth effect is scaled by (1−π)=0.83, where π is the consumption share of the credit constrained, a 10% increase in real house prices raises average consumption by around 1.2% in the long run.

But the model also allows for a small offsetting negative effect via the last term in (12), \(-β_5 DPR_{it-1} \ln(hp_{it-1}/y_{it})\). The coefficient \(β_5\) is estimated at 0.0070 (s.e. = 0.0024), while in recent years, the deposit to house price ratio for first time buyers, DPR, has been

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16 For example, hardly any studies distinguished liquid from illiquid assets, Patterson (1984) being a rare exception.
around 0.15. The implied offset to the housing wealth effect from a 10% increase in real
house prices is trivial. The only surprise is that an effect so small could be estimated!

The 1986 dummy is significant in the southern regions suggesting a short-term
jump of consumption of 2½% in East Anglia and the South East and 4½% in the South
West. The interpretation suggests above was in terms of the 'Big Bang' of financial
reforms in the City of London. Given the strength of financial services in the southern
regions and commuting patterns to London, it seems plausible that this effect would be
absent elsewhere in the economy.

Let us now discuss the construction of the composite income measure $y^*_i$. In our
companion paper, Muehlbauer and Murphy (1994), we discovered that earnings data from
the New Earnings Survey gave a better explanation of the evolution of regional house
prices than did the regional accounts data on income. In this paper we define $lny^*_i$ as a
weighted average of three different income measures:

$$
lny^*_i = \lambda^*_{1i} lny_i + \lambda^*_{2i} lny_{UK} + (1-\lambda^*_{1i} - \lambda^*_{2i}) lne_i
$$

where $y_i$ is the regional accounts measure of real personal disposable per capita
non-property income, $y_{UK}$ is the UK equivalent and $e^*_i = [(1-ty_i)e_i/(1-ty_{UK})e_{UK}]y_{UK}$,
and $e_i$ is average male earnings in region $i$ and $(1-ty_i)$ is the ratio of personal disposable
income to total personal income, i.e., $ty_i$ is the average effective rate of income tax in
region $i$ derived from the regional accounts data. In other words, $e^*_i$ uses regional
earnings relativities to adjust national non-property income data to get estimates of
regional income.

We actually estimate the composite income effect in the form

$$
\beta lny^*_i = \lambda_{1i} lny_i + \lambda_{2i} lny_{UK} + (\beta -\lambda_{1i} - \lambda_{2i}) lne_i
$$
Table 3: Estimates of $\lambda_{1i}$ and $\lambda_{2i}$ corresponding to Table 1

<table>
<thead>
<tr>
<th>Region</th>
<th>$\lambda_{1i}$</th>
<th>$\lambda_{2i}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>North W</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>Yorks &amp; Humber</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>W Midlands</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>E Midlands</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>E Anglia</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>South East</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>South West</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>Wales</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>Scotland</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
<tr>
<td>N Ireland</td>
<td>0.26 (0.10)</td>
<td>0.33 (0.07)</td>
</tr>
</tbody>
</table>

In Table 3 we show estimates of $\lambda_{1i}$ and $\lambda_{2i}$, which we obtained subject to the restrictions $\lambda_{1i} \geq 0$, $\lambda_{2i} \geq 0$. In the majority of regions, the $\lambda$’s are zero implying that $e_{i}^{*}$ is the income measure which gives the best fit. For reasons we do not understand, the UK income measure gives a better fit than either of the local measures in Northern Ireland and the North West. In the East Midlands and the South East the regional accounts figure does best while in Wales, a weighted average of $\ln y_i$ and $\ln e_i^{*}$ with weights 60% and 40%, fits best.

(c) Diagnostics and Specification Tests

In terms of the overall fit of the different equations, the equation standard errors tend to be inversely correlated with the size of the region. Thus, with the exception of Yorkshire and Humberside, where there is evidence of residual autocorrelation which makes the fit spuriously good, the biggest region (the South East) has the smallest standard error while the smallest region (Northern Ireland) has the largest, see the population figures in
the last column of Table 1. Given the dependence of regional data on surveys, the smaller the region, the more serious should be sampling error. Not surprisingly, the equation standard errors are higher than for the corresponding UK equation.

Generally speaking, there is some indication of positive residual autocorrelation as revealed by a Lagrange multiplier test. An overall test of up to second order autocorrelation differing by region gives an F-statistic of 1.46 with 20 and 168 degrees of freedom. This is insignificant at the 5% level and just significant at the 10% level. The coefficients $\rho_1$ and $\rho_2$ on residuals lagged one and two years respectively are shown in Table 2. As noted above, the difficulties in measuring regional asset and debt data and the absence of satisfactory regional price deflators could well account for this. We do not take it as symptom of mis-specification of the underlying model since an aggregate UK model of similar form does not suffer from serially correlated residuals.

One of the most important types of tests is to examine the hypothesis of equality of parameters across regions. Carruth and Henley (1993) found considerable heterogeneity in parameters across regions for their specification. With only 20 observations and 17 parameters per region in the most general form of (12), it is clearly impossible to test the specification shown in Tables 1 and 3 against such an alternative. We proceeded instead in a more piecemeal fashion, relaxing restrictions singly or in pairs. Results are shown in Table 4. The first section of Table 4 relaxes the restriction that the $\beta$ coefficient, i.e., the speed of adjustment, differs across regions. A formal test can be computed by comparing the trace of residuals when the restrictions $\beta_i = \beta$, for all $i$, are imposed and when they are relaxed, holding fixed the covariance matrix used in computing the GLS estimator. For the latter we take the covariance matrix of residuals corresponding to the SUR estimates of the parameters of the restricted model. These tests are shown in the last line of Table 4. The restriction $\beta_i = \beta$ can be easily accepted: the F-statistic with 10 restrictions and 174 degrees of freedom under the maintained hypothesis is 0.73 compared with a critical value at the 5% level of 1.64. The point estimates of $\beta$ lie in a range 0.26 to 0.50, and given the
<table>
<thead>
<tr>
<th>$\beta_1$</th>
<th>DW</th>
<th>SE</th>
<th>$\beta_{21}$</th>
<th>DW</th>
<th>SE</th>
<th>$\pi$</th>
<th>$\beta_5$</th>
<th>DW</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.42(0.5)</td>
<td>1.68</td>
<td>0.0136</td>
<td>0.43(0.23)</td>
<td>1.70</td>
<td>0.0139</td>
<td>0.13(0.12)</td>
<td>0.0138</td>
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<tr>
<td>0.40(0.5)</td>
<td>1.44</td>
<td>0.0105</td>
<td>0.48(0.16)</td>
<td>1.37</td>
<td>0.0106</td>
<td>0.02(0.11)</td>
<td>0.0108</td>
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<tr>
<td>0.43(0.04)</td>
<td>1.40</td>
<td>0.0054</td>
<td>0.64(0.11)</td>
<td>1.68</td>
<td>0.0051</td>
<td>0.17(0.06)</td>
<td>0.0062</td>
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<td></td>
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<tr>
<td>0.36(0.4)</td>
<td>1.53</td>
<td>0.0109</td>
<td>0.39(0.14)</td>
<td>1.40</td>
<td>0.0110</td>
<td>0.04(0.10)</td>
<td>0.0103</td>
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<tr>
<td>0.34(0.06)</td>
<td>1.31</td>
<td>0.0135</td>
<td>0.32(0.26)</td>
<td>1.22</td>
<td>0.0134</td>
<td>0.23(0.14)</td>
<td>0.0130</td>
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<tr>
<td>0.45(0.06)</td>
<td>1.41</td>
<td>0.0109</td>
<td>0.39(1.26)</td>
<td>1.60</td>
<td>0.0110</td>
<td>0.19(0.11)</td>
<td>0.0112</td>
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<tr>
<td>0.32(0.05)</td>
<td>1.82</td>
<td>0.0072</td>
<td>0.44(0.30)</td>
<td>1.70</td>
<td>0.0071</td>
<td>0.15(0.10)</td>
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<tr>
<td>0.26(0.09)</td>
<td>1.58</td>
<td>0.0175</td>
<td>1.65(1.76)</td>
<td>1.41</td>
<td>0.0175</td>
<td>-0.15(0.17)</td>
<td>0.0168</td>
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<tr>
<td>0.32(0.05)</td>
<td>2.07</td>
<td>0.0106</td>
<td>0.30(0.17)</td>
<td>2.06</td>
<td>0.0102</td>
<td>0.10(0.08)</td>
<td>0.0105</td>
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<tr>
<td>0.50(0.07)</td>
<td>1.23</td>
<td>0.0111</td>
<td>0.92(0.23)</td>
<td>1.36</td>
<td>0.0108</td>
<td>0.18(0.14)</td>
<td>0.0122</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.38(0.06)</td>
<td>1.23</td>
<td>0.0197</td>
<td>0.39(0.31)</td>
<td>1.31</td>
<td>0.0191</td>
<td>-0.03(0.24)</td>
<td>0.0195</td>
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<tr>
<td>$\beta_2$</td>
<td>see above</td>
<td>0.38(0.22)</td>
<td>0.39(0.021)</td>
<td>see above</td>
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<tr>
<td>$\beta_{21}$</td>
<td>0.15(0.037)</td>
<td>0.17(0.037)</td>
<td>see above</td>
<td></td>
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<td></td>
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<tr>
<td>$\beta_{22}$</td>
<td>0.46(0.047)</td>
<td>see above</td>
<td>0.43(0.042)</td>
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<tr>
<td>$\beta_3$</td>
<td>1.03(0.053)</td>
<td>see above</td>
<td>1.04(0.051)</td>
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<tr>
<td>$\beta_4$</td>
<td>0.62(0.096)</td>
<td>0.63(0.095)</td>
<td>0.56(0.087)</td>
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<tr>
<td>$\beta_5$</td>
<td>1.14(0.11)</td>
<td>1.10(0.12)</td>
<td>1.15(0.11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$\beta_6$</td>
<td>1.11(0.086)</td>
<td>1.10(0.083)</td>
<td>see above</td>
<td></td>
<td></td>
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<tr>
<td>$\beta_7$</td>
<td>0.32(0.034)</td>
<td>0.31(0.033)</td>
<td>0.31(0.033)</td>
<td></td>
<td></td>
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<tr>
<td>$\beta_8$</td>
<td>0.120(0.030)</td>
<td>0.131(0.020)</td>
<td>0.130(0.019)</td>
<td></td>
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<tr>
<td>$\beta_9$</td>
<td>0.054(0.0078)</td>
<td>0.050(0.0044)</td>
<td>0.048(0.0040)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>$\gamma$</td>
<td>0.0066(0.0028)</td>
<td>0.0076(0.0028)</td>
<td>0.0080(0.0023)</td>
<td></td>
<td></td>
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</table>

$F_{(0.74)} = 0.73, F_c = 1.64$  $F_{(2.164)} = 0.68, F_c = 1.89$  $F_{(2.164)} = 1.01, F_c = 1.89$
<table>
<thead>
<tr>
<th></th>
<th>$\beta_1$</th>
<th>$\beta_2$</th>
<th>DW</th>
<th>SE</th>
<th>$\gamma_1$</th>
<th>DW</th>
<th>SE</th>
</tr>
</thead>
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<tr>
<td>nn</td>
<td>-0.03(0.38)</td>
<td>0.82(0.65)</td>
<td>1.54</td>
<td>0.0128</td>
<td>0.145(0.072)</td>
<td>1.63</td>
<td>0.0141</td>
</tr>
<tr>
<td>nw</td>
<td>0.42(0.26)</td>
<td>1.75(0.44)</td>
<td>1.26</td>
<td>0.0099</td>
<td>0.161(0.055)</td>
<td>1.38</td>
<td>0.0107</td>
</tr>
<tr>
<td>yh</td>
<td>1.05(0.20)</td>
<td>1.07(0.32)</td>
<td>1.24</td>
<td>0.0044</td>
<td>0.113(0.031)</td>
<td>1.10</td>
<td>0.0063</td>
</tr>
<tr>
<td>wm</td>
<td>0.71(0.24)</td>
<td>0.97(0.43)</td>
<td>1.44</td>
<td>0.0111</td>
<td>0.117(0.041)</td>
<td>1.47</td>
<td>0.0110</td>
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<tr>
<td>em</td>
<td>0.11(0.32)</td>
<td>0.59(0.52)</td>
<td>1.25</td>
<td>0.0123</td>
<td>0.099(0.047)</td>
<td>1.29</td>
<td>0.0134</td>
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<tr>
<td>ea</td>
<td>1.17(0.27)</td>
<td>0.85(0.47)</td>
<td>1.71</td>
<td>0.0099</td>
<td>0.143(0.037)</td>
<td>1.46</td>
<td>0.0116</td>
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<tr>
<td>se</td>
<td>0.66(0.17)</td>
<td>0.75(0.22)</td>
<td>1.94</td>
<td>0.0065</td>
<td>0.108(0.024)</td>
<td>1.98</td>
<td>0.0069</td>
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<tr>
<td>sw</td>
<td>0.77(0.40)</td>
<td>0.77(0.63)</td>
<td>1.44</td>
<td>0.0178</td>
<td>0.134(0.046)</td>
<td>1.50</td>
<td>0.0178</td>
</tr>
<tr>
<td>wv</td>
<td>0.31(0.30)</td>
<td>0.80(0.45)</td>
<td>1.92</td>
<td>0.0102</td>
<td>0.138(0.032)</td>
<td>2.00</td>
<td>0.0106</td>
</tr>
<tr>
<td>sc</td>
<td>0.89(0.35)</td>
<td>1.26(0.55)</td>
<td>1.24</td>
<td>0.0119</td>
<td>0.104(0.068)</td>
<td>1.21</td>
<td>0.0127</td>
</tr>
<tr>
<td>ni</td>
<td>0.48(0.50)</td>
<td>1.58(1.16)</td>
<td>1.13</td>
<td>0.0195</td>
<td>-0.04 (0.178)</td>
<td>1.25</td>
<td>0.0193</td>
</tr>
</tbody>
</table>

$\beta$ 0.40(0.022) 0.38(0.021)
$\pi$ 0.13(0.04) 0.14(0.037)
$\beta_1$ 0.42(0.043) 0.44(0.042)
$\beta_2$ 1.00(0.053) 1.02(0.052)
$\beta_3$ see above 0.60(0.085)
$\beta_4$ see above 1.12(0.11)
$\beta_5$ 1.10(0.084) 1.11(0.083)
$\beta_6$ 0.33(0.0033) 0.31(0.083)
$\gamma_1$ 0.107(0.019) see above
$\gamma_2$ 0.044(0.0039) $\gamma_2/\gamma_1$ 0.39(0.047)
$\beta_7$ 0.0102(0.0025) 0.0086(0.0028)

$F_{26,164} = 1.37, F_\alpha = 1.90$
$F_{10,174} = 0.37, F_\alpha = 1.64$
estimated standard errors, the acceptance of the constraint $\beta_1 = \beta$ which corresponds to an estimate of 0.39, looks plausible. The remaining parameters of the model are estimated to have values very close to those in Table 1, the same being true of the equation standard errors and Durbin Watson statistics.

The second section of Table 4 shows the results of relaxing the constraints $\beta_{21i} = \beta_{21}$ and $\beta_{22i} = \beta_{22}$ on the two sets of unemployment coefficients, where $\beta_{21}$ corresponds to the acceleration of the local unemployment rate, and $\beta_{22}$ to the two year change of the unemployment rate in the South East. Again the restrictions can be accepted, and in most cases the point estimates for the regions are within one standard error of the estimate imposing symmetry across regions. However, it must be recalled that for the three southern regions we have allowed an offset to the effect of the lagged change in the unemployment rate in the South East. One way of thinking of this is that unemployment in the South East feeds through more quickly into consumption in the southern regions than it does elsewhere in the economy.

The third section of Table 4 relaxes the constraint $\pi_1 = \pi$ and $\beta_{5i} = \beta_5$, where $\pi$ is the proportion of credit-constrained households, and $\beta_5$ is the coefficient on the change in consumer credit controls. There appears to be little systematic pattern in the point estimates of the $\pi_1$ but some tendency for the southern regions to have higher estimated $\beta_5$'s. This suggests that when credit controls came on, they may have had a disproportionately larger effect in the southern regions which perhaps relied more heavily on credit finance for durable goods purchases. But the hypothesis of symmetric effects is easily acceptable.

The fourth section of Table 4 relaxes constraints on $\beta_3$, the relative weight of next year’s expected income compared with current income, and on $\beta_4$, the coefficient on the weighted interest rate change. Again the F-test of symmetry versus heterogeneity can be accepted although the point estimates of $\beta_3$ are fairly heterogeneous. This may well be an indication of the income measurement problems already alluded to.
The last section of Table 4 relaxes the constraint on the general level of wealth effects, while keeping the ratio between $\gamma_2/\gamma_1$, i.e., the relative effect of illiquid and liquid assets constant across regions. The results suggest that the hypothesis of symmetry of wealth effects is easily accepted. The estimated ratio of $\gamma_2/\gamma_1$ at 0.39 seems very plausible and in line with estimates for the US in Muellbauer and Murphy (1993a).

Generally speaking for Table 4, the equation goodness of fit and Durbin Watson statistics are close to those for the restricted model in Table 1.

One further test of the model is to examine parameter stability over time. The downturn of 1990 and 1991 marks a sharp contrast to the boom conditions of the mid to late 1980s. Estimating the model up to 1989 gives the parameter estimates shown in Table 5 and an F-test for parameter constancy $F_{22,162}$ of 1.39. The parameter estimates are very similar to those in Table 1 and the same is true for the income weights corresponding to Table 3. Repeating the exercise by estimating the model up to 1984 gives further evidence of remarkable parameter stability, as the left-hand side of Table 6 shows. However, it is quite possible that, had data only up to 1984 been available, the form of parsimonious model selected from the more general specification underlying equation (12), would not have been identical. One reason is that the the results on the left-hand side of Table 6 hold fixed the covariance matrix estimated for the Table 1 model for the period 1972–1991. Re-estimating up to 1984 with a covariance matrix estimated on 1972–84 leads to some notable parameter shifts, shown in the right-hand side of Table 6. One difference is that the New Earnings Survey based measure of income in the South East accounts for more than half the weight of composite income during 1972–84, for the South East in contrast to the period as a whole, where it contributes none. Another is a substantial increase in the estimate of $\pi$, the share of credit-constrained households, to 0.40 (s.e = 0.034). This may be an indication that $\pi$ did fall in the mid to late 1980s. If that is the case, a model which allows $\pi$ to vary over time would be desirable. The other main shift is that the Table 6 results attribute an even bigger effect (indeed an implausibly
Table 5: main parameter estimates for 1972-91 and 1972-89

GLS with 1972-91 covariance matrix held fixed

<table>
<thead>
<tr>
<th></th>
<th>1972-91</th>
<th>1972-89</th>
</tr>
</thead>
<tbody>
<tr>
<td>adjustment coeff</td>
<td>0.39 (0.021)</td>
<td>0.35 (0.025)</td>
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<tr>
<td>fraction of credit constrained</td>
<td>0.14 (0.037)</td>
<td>0.17 (0.041)</td>
</tr>
<tr>
<td>acceleration of regional u</td>
<td>0.44 (0.041)</td>
<td>0.44 (0.047)</td>
</tr>
<tr>
<td>two year change in SE u</td>
<td>1.02 (0.051)</td>
<td>1.00 (0.059)</td>
</tr>
<tr>
<td>relative weight of expected income</td>
<td>0.56 (0.082)</td>
<td>0.59 (0.100)</td>
</tr>
<tr>
<td>effect of debt weighted ∆ interest rate</td>
<td>1.14 (0.112)</td>
<td>1.15 (0.130)</td>
</tr>
<tr>
<td>effect of ∆ credit controls</td>
<td>1.12 (0.084)</td>
<td>1.12 (0.088)</td>
</tr>
<tr>
<td>effect of ∆ strikes</td>
<td>0.31 (0.0032)</td>
<td>0.32 (0.034)</td>
</tr>
<tr>
<td>effect of liquid asset/income</td>
<td>0.123 (0.0185)</td>
<td>0.116 (0.024)</td>
</tr>
<tr>
<td>effect of illiquid asset/income</td>
<td>0.047 (0.0038)</td>
<td>0.053 (0.0059)</td>
</tr>
<tr>
<td>effect of deposit wr'd rel house price</td>
<td>0.0073 (0.0021)</td>
<td>0.0056 (0.0026)</td>
</tr>
<tr>
<td>1EM</td>
<td>0.31 (0.09)</td>
<td>0.29 (0.09)</td>
</tr>
<tr>
<td>2SE</td>
<td>0.33 (0.07)</td>
<td>0.35 (0.07)</td>
</tr>
<tr>
<td>1W</td>
<td>0.25 (0.05)</td>
<td>0.18 (0.05)</td>
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<td>2NN</td>
<td>0.36 (0.07)</td>
<td>0.27 (0.08)</td>
</tr>
<tr>
<td>2SE</td>
<td>0.14 (0.07)</td>
<td>0.12 (0.07)</td>
</tr>
<tr>
<td>2NI</td>
<td>0.33 (0.14)</td>
<td>0.22 (0.14)</td>
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</table>
Table 6: main parameter estimates for 1972-84

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GLS with 1972-91 covariance matrix</th>
<th>GLS with 1972-84 covariance matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>adjustment coeff</td>
<td>0.35 (0.039)</td>
</tr>
<tr>
<td>$\pi$</td>
<td>fraction of credit constrained</td>
<td>0.17 (0.053)</td>
</tr>
<tr>
<td>$\beta_{21}$</td>
<td>acceleration of regional u</td>
<td>0.47 (0.052)</td>
</tr>
<tr>
<td>$\beta_{22}$</td>
<td>two year change in SE u</td>
<td>1.02 (0.090)</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>relative weight of expected income</td>
<td>0.52 (0.11)</td>
</tr>
<tr>
<td>$\beta_4$</td>
<td>effect of debt weighted $\Delta$ interest rate</td>
<td>1.43 (0.20)</td>
</tr>
<tr>
<td>$\beta_5$</td>
<td>effect of $\Delta$ credit controls</td>
<td>1.06 (0.106)</td>
</tr>
<tr>
<td>$\beta_6$</td>
<td>effect of $\Delta$ strikes</td>
<td>0.29 (0.05)</td>
</tr>
<tr>
<td>$\gamma_1$</td>
<td>effect of liquid asset/income</td>
<td>0.130 (0.032)</td>
</tr>
<tr>
<td>$\gamma_2$</td>
<td>effect of illiquid asset/income</td>
<td>0.047 (0.008)</td>
</tr>
<tr>
<td>$\beta_7$</td>
<td>effect of deposit wt'd rel. house price</td>
<td>0.0055 (0.0031)</td>
</tr>
</tbody>
</table>

| $\lambda_{1EM}$ |         | 0.39 (0.12)                           | 0.44 (0.06)                         |
| $\lambda_{2SE}$ |         | 0.36 (0.08)                           | 0.15 (0.04)                         |
| $\lambda_{1W}$  |         | 0.22 (0.07)                           | 0.17 (0.03)                         |
| $\lambda_{2NN}$ |         | 0.30 (0.15)                           | 0.37 (0.07)                         |
| $\lambda_{2SE}$ |         | 0.01 (0.11)                           | 0. ( - )                             |
| $\lambda_{2NI}$ |         | 0.18 (0.15)                           | 0.11 (0.11)                         |
big effect) to the debt/income weighted interest rate change than the full sample estimates, compensated for by a smaller coefficient in the change in credit controls.

To what extent these conclusions are robust to the systematic measurement errors from which, we suspect, the data suffer, must be uncertain. We suspect UK consumption in the years shortly after the 1973 oil shock may be over—estimated. Initial estimates have been heavily revised up, big revisions still being made 15 years after the event and on the basis of scant new evidence. Sefton and Weale (1994), who have carried out a rebalancing exercise of the UK national accounts, conclude that these revisions have gone too far. As the sample in the 1980s is reduced, so the relative importance of the suspect mid 1970s observations increases and it is not clear whether the shift in parameter estimates this induces is genuine.

7 Conclusions

This study involved building econometric models for the eleven standard regions of the UK to explain consumption at the regional level. The models cover the period 1972 to 1991.

Our analysis confirms the impact of housing wealth and mortgage debt on consumption. Estimates of regional housing wealth have been made from data on the regional owner—occupied housing stock and regional house prices. Estimates of regional mortgage stock have been made by apportioning the national mortgage stock on the basis of regional shares of mortgage payments. Other assets and debts have been apportioned on the basis of regional shares of property income in total income.

We find that consumer expenditure at the regional level responds to income changes, with 48 percent of the effects being felt after one year and 70 percent within two years, and with wealth effects feeding through a little more slowly. This speed of response is somewhat slower than for the UK as a whole.
Changes in illiquid assets such as housing and stocks and shares now have about a third of the effect on consumption from changes in net liquid assets. Financial liberalisation appears to have increased both the spendability of illiquid wealth and the drag on spending from debt.

As real house prices increase there is an increase in housing wealth, which drives up consumer spending. However, there is an offsetting negative effect in that first-time buyers and prospective first-time buyers have to pay more or save more as a result of the price rises. This negative effect, however, appears to be weaker than in other countries.

For given interest rates, lenders have somewhat tightened up credit since the end of the 1980’s and are taking a more systematic approach to risk assessment. This partial reversal of financial liberalisation will imply a lower overall increase in consumption for each percentage point increase in real house prices than occurred in the late 1980s.

The change in interest rates on borrowing, weighted by the debt/income ratio, also has a significant impact on consumption. Consumer spending in the South East, South West and East Anglia, where debt/income ratios rose dramatically in the mid 1980s, was therefore most heavily cut when interest rates rose between 1988 and 1990, and was then held down further by the massive fall in real asset values, particularly in housing.

An important non-housing influence on consumption in each region in the short-run is the rate of change of unemployment within the region and in the South East. This suggests some leading indicator role for the South East in consumption as well as in house prices. We interpret these unemployment change effects as proxies for income uncertainty.

One important feature of our modelling is the explicit incorporation of income expectations. These are measured from forecasting models both for income at the UK level and for different measures of income at the regional level relative to the UK. Our estimates give a highly significant role to income expectations, suggesting that some
forward-looking behaviour is widespread among UK consumers. Despite this, wealth effects remain highly significant and of plausible magnitudes.

This research on regional consumption and our parallel research on regional house prices throws doubts on the CSO's Regional Accounts measures of personal disposable income. The New Earnings Survey data generally gives a better explanation of changes in consumption and house prices due to changes in income.

Let us now return to the three main motivations for this study of regional consumption raised in the Introduction. The first was to throw light on the causes of the 1980s consumption boom and the subsequent downturn in the early 1990's. The role both of income expectations and of wealth effects, particularly housing wealth effects, was confirmed. The claim by King (1990) that the faster rise of consumption than of income in the late 1980s was almost entirely due to a shift in income expectations can be decisively rejected. Given a propensity to spend out of illiquid assets, including housing, of around 0.04, the UK rise in the illiquid asset to income ratio between 1983 and 1989 from 3.9 to 6.1, eventually raises the consumption to income ratio by 0.085. Our model also attributes part of the rise, for example, between 1986 and 1988, to falling interest rates, and falling unemployment which reduced income insecurity, and to financial liberalization. In our story, the latter made illiquid assets relatively more spendable but precisely how much is hard to determine.

The fall in the consumption to income ratio from its peak in 1988, according to these results, was initially the result of increasing unemployment and the increase in our other measure of income uncertainty, higher nominal interest rates impacting on much more indebted households and worsening income expectations, themselves partly the result of higher interest rates. The overall weighted asset to income ratio peaked in 1990 and subsequently fell sharply, contributing to the fall in the consumption to income ratio. The downturn in the housing market was a major element in this fall. The stagnation of house prices, which continued in 1994, together with high levels of debt relative to income, is
playing a major role, according to our model, in keeping consumer expenditure restrained in 1994, despite low interest rates and economic recovery.

The second reason for studying regional consumption is to throw light on more general controversies surrounding the life-cycle/permanent income hypothesis. As explained in detail in Muellbauer and Lattimore (1994), an aggregate consumption function can out of necessity only be approximately theory consistent. The reasons lie in the analytical representation of behaviour under uncertainty and under credit constraints and in problems of aggregation. Into our functional form (12) we have built effects of income uncertainty proxied by very significant changes in unemployment rates. We have also built in several effects stemming from credit constrained behaviour. First, the data support the hypothesis that current grants from government such as state pensions, unemployment benefits and income support are spent over the course of a year, one for one with income. Secondly, the data suggest that around 17% of the remaining consumption is made by credit constrained households. Thirdly, the data suggest that, in the short-term, higher interest rates on existing debt reduce consumption by reducing cash flows of heavily indebted households.

As far as hypotheses about income expectations are concerned, our results suggests that, on the average, there is a mixture of myopic and forward looking behaviour. The hypothesis of purely myopic behaviour is overwhelmingly rejected (the t-ratio is 5.3). There appear also to be sizeable lags in behaviour which can be rationalized in terms of habits or adjustment costs.

Finally, we find significantly lower propensities to spend for illiquid assets than for liquid assets, though there are indications that financial liberalization has improved the relative liquidity of illiquid assets.

These results shed important light on recent controversies in the consumption literature reviewed by Deaton (1992) and Muellbauer and Lattimore (1994). The simplest form of the rational expectations permanent income theory implies that consumption
changes are unforecastable. The empirical rejection of this hypothesis (a rejection often termed the 'excess sensitivity of consumption') should, on our results, be due to a mixture of credit constraints, uncertainty, partial myopia and adjustment lags.

The same phenomena also provide part of the explanation for 'the excess of smoothness of consumption'. The point here is that, on the face of it, the time series characteristics of aggregate income data appear to be consistent with the idea that income changes are highly persistent, i.e., permanent. Under the permanent income hypothesis, consumption changes should then have a similar variability to income changes. In fact, consumption is substantially less volatile than income. Credit constraints, uncertainty, partial myopia and adjustment lags would all tend to smooth consumption fluctuations and so help account for the 'excess smoothness' of consumption.

The third reason, discussed in the Introduction, for studying regional consumption functions is to help understand some of the specifically regional differences in economic outcomes and the processes bringing about these outcomes. In the period 1980–87, the southern regions of the UK all experienced more favourable changes in economic conditions than the rest of the UK. Relative unemployment tended to fall and relative house prices, relative incomes and relative consumption levels tended to rise.

In this paper, we shed light on two links in the chain of connections: the determinations of consumption given income, unemployment changes, housing and other wealth, debt etc., and the determination of income via our regional forecasting model for deviations of income from the UK average, see the Appendix. Our evidence strongly supports the importance of housing wealth in explaining consumption. The sources of increases in housing wealth are various including the sale of council houses to tenants at large discounts and real house price appreciation due to lower interest rates, financial liberalization, higher incomes or restricted supply, see Muellbauer and Murphy (1994) for empirical evidence on house price determination.
The implication is that housing and credit markets play an important role in generating, amplifying and transmitting shocks. In the Appendix we provide evidence that, in the short-run, relative house price rises feed through into relative incomes and we list five possible explanations for this finding. Also in the short-run, real house price changes feed on last year’s changes in house prices as well as on the income growth which may be the partial result of their own past rises. Regional house prices and indeed income and unemployment can thus diverge for considerable periods, contributing to regional over-shooting and regional mis-match of employment opportunities.
Appendix: regional income forecasts

To construct regional income forecasts, we combined forecasts of UK per capita real personal disposable non–property income with forecasts of relative income or earnings in each region compared with the UK average. Our forecasting models for relative income, \( \frac{y_i}{y_{UK}} \), and earnings, \( \frac{e_i}{e_{UK}} \), incorporated lags of relative unemployment changes, lags of relative house prices, the lagged financial liberalization measure, lagged mortgage interest rates weighted by the deviation of log debt–to–income ratios from the UK average and a lagged measure of the regional–UK difference in smm, the share of non–manual male employment in total male employment. We expected relative house prices to have a short–run positive effect on subsequent relative earnings for five possible different reasons:

1. House price increases affect the local cost of living and this is eventually reflected in pay.
2. Higher house prices discourage people from living in the region, thus restricting the supply of labour and putting upward pressure on pay.
3. Greater levels of housing collateral finance small businesses.
4. Feelings of greater wealth encourage consumption which feeds back into regional incomes by increasing demand for locally produced goods and services.
5. Higher house prices may anticipate higher future incomes.

Debt service costs may be expected, in the short–run, to have a bigger effect on subsequent pay in more heavily indebted regions, as workers demand bigger cost of living increases or as employers have to pay more to attract workers to those regions. The financial
liberalization proxy may be expected to have a bigger impact on employment and incomes in those regions where financial services are already more important than elsewhere.

For relative earnings we obtained the following:

$$\Delta \ln (e_i/e_{UK})_t = \alpha_i - 0.59 \ln (e_i/e_{UK})_{t-1} - 0.23 (\Delta^2 u_i - \Delta^2 u_{UK})_{t-1}$$

$$- 0.72 (\Delta^2 u_i - \Delta^2 u_{UK})_{t-2} + 0.032 \ln (hp_i/hp_{UK})_{t-1} - 0.025 \ln (hp_i/hp_{UK})_{t-3}$$

$$+ 0.42 (\ln (DB_i/e_i) - \ln (DB_{UK}/e_{UK}))_{t-2} \text{ abmr}_{t-1}$$

$$+ 0.31 (\ln (DB_i/e_i) - \ln (DB_{UK}/e_{UK}))_{t-2} \Delta \text{ abmr}_{t-1}$$

$$+ 0.26 (\text{snm}_i - \text{snm}_{UK})_{t-2} + \theta_1 \text{ avflih}_{t-1}$$

(13)

Table 7: Estimates of $\alpha_i$, $\theta_i$ and diagnostics for eq (13)

<table>
<thead>
<tr>
<th>Region</th>
<th>$\alpha_i$</th>
<th>$\theta_i$</th>
<th>DW</th>
<th>$R^2$</th>
<th>s.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>0.011(0.005)</td>
<td>-0.19(0.026)</td>
<td>2.02</td>
<td>0.667</td>
<td>0.0065</td>
</tr>
<tr>
<td>North West</td>
<td>-0.008(0.002)</td>
<td>-0.06(0.016)</td>
<td>1.52</td>
<td>0.637</td>
<td>0.0037</td>
</tr>
<tr>
<td>Yorks &amp; Humber</td>
<td>-0.007(0.004)</td>
<td>-0.11(0.022)</td>
<td>2.09</td>
<td>0.582</td>
<td>0.0060</td>
</tr>
<tr>
<td>W Midlands</td>
<td>-0.015(0.004)</td>
<td>-0.11(0.036)</td>
<td>1.09</td>
<td>0.134</td>
<td>0.0119</td>
</tr>
<tr>
<td>E Midlands</td>
<td>-0.019(0.005)</td>
<td>-0.08(0.030)</td>
<td>2.25</td>
<td>0.408</td>
<td>0.0099</td>
</tr>
<tr>
<td>E Anglia</td>
<td>-0.031(0.004)</td>
<td>0.04(0.025)</td>
<td>2.70</td>
<td>0.433</td>
<td>0.0086</td>
</tr>
<tr>
<td>South East</td>
<td>0.019(0.007)</td>
<td>0.19(0.019)</td>
<td>1.17</td>
<td>0.392</td>
<td>0.0039</td>
</tr>
<tr>
<td>South West</td>
<td>-0.046(0.004)</td>
<td>0.01(0.024)</td>
<td>2.23</td>
<td>0.476</td>
<td>0.0082</td>
</tr>
<tr>
<td>Wales</td>
<td>-0.005(0.005)</td>
<td>-0.25(0.028)</td>
<td>1.44</td>
<td>0.266</td>
<td>0.0078</td>
</tr>
<tr>
<td>Scotland</td>
<td>0.019(0.004)</td>
<td>-0.17(0.024)</td>
<td>1.32</td>
<td>0.576</td>
<td>0.0072</td>
</tr>
<tr>
<td>N Ireland</td>
<td>-0.019(0.008)</td>
<td>-0.18(0.040)</td>
<td>2.60</td>
<td>0.730</td>
<td>0.0136</td>
</tr>
</tbody>
</table>
It is noteworthy that the financial liberalization effect is positive in the southern regions and negative elsewhere reflecting a rise in relative earnings in the South in the 1980s.

For relative per capita non-property disposable income from CSO regional accounts sources, $y_i$, we obtained the following:

$$\Delta \ln(y_i/y_{UK})_t = \alpha_i' - 0.51 \ln(y_i/y_{UK})_{t-1} - 0.16 \Delta (u_i/u_{UK})_{t-1}$$

$$- 0.0063 (\Delta^{2}u_i - \Delta^{2}u_{UK})_{t-1} + 0.051 (\ln(hp_i/hp_{UK})_{t-1} - \ln(hp_i/hp_{UK})_{t-3})$$

$$+ 0.31 (\ln(DB_i/e_i) - \ln(DB_{UK}/e_{UK}))_{t-2} \Delta abmr_{t-1}$$

$$+ 0.24 \text{aw}(rmn_i - rmn_{UK})_{t-1} + \theta_i' \text{avlib}_{t-1}$$

(14)

Table 8: Estimates of $\alpha_i'$, $\theta_i'$ and diagnostics for eq (14)

<table>
<thead>
<tr>
<th>Region</th>
<th>$\alpha_i'$</th>
<th>$\theta_i'$</th>
<th>DW</th>
<th>$R^2$</th>
<th>s.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>-0.013(0.005)</td>
<td>-0.12(0.041)</td>
<td>1.56</td>
<td>0.431</td>
<td>0.0147</td>
</tr>
<tr>
<td>North West</td>
<td>-0.018(0.003)</td>
<td>-0.05(0.025)</td>
<td>1.40</td>
<td>0.398</td>
<td>0.0087</td>
</tr>
<tr>
<td>Yorks &amp; Humber</td>
<td>-0.015(0.005)</td>
<td>-0.03(0.030)</td>
<td>2.59</td>
<td>0.383</td>
<td>0.0102</td>
</tr>
<tr>
<td>W Midlands</td>
<td>-0.017(0.005)</td>
<td>-0.10(0.043)</td>
<td>0.90</td>
<td>0.059</td>
<td>0.0158</td>
</tr>
<tr>
<td>E Midlands</td>
<td>-0.009(0.005)</td>
<td>0.00(0.025)</td>
<td>2.59</td>
<td>0.295</td>
<td>0.0084</td>
</tr>
<tr>
<td>E Anglia</td>
<td>-0.017(0.005)</td>
<td>0.09(0.004)</td>
<td>1.87</td>
<td>0.353</td>
<td>0.0131</td>
</tr>
<tr>
<td>South East</td>
<td>0.036(0.008)</td>
<td>0.06(0.03)</td>
<td>1.71</td>
<td>0.409</td>
<td>0.0097</td>
</tr>
<tr>
<td>South West</td>
<td>-0.015(0.004)</td>
<td>-0.01(0.04)</td>
<td>1.45</td>
<td>0.133</td>
<td>0.0136</td>
</tr>
<tr>
<td>Wales</td>
<td>-0.036(0.007)</td>
<td>-0.17(0.052)</td>
<td>2.81</td>
<td>0.518</td>
<td>0.0178</td>
</tr>
<tr>
<td>Scotland</td>
<td>-0.012(0.004)</td>
<td>0.04(0.035)</td>
<td>1.50</td>
<td>0.600</td>
<td>0.0129</td>
</tr>
<tr>
<td>N Ireland</td>
<td>-0.067(0.008)</td>
<td>0.16(0.035)</td>
<td>2.68</td>
<td>0.574</td>
<td>0.0098</td>
</tr>
</tbody>
</table>
Compared with eq (13), eq (14) has somewhat different unemployment dynamics, no levels effect from the mortgage interest rate, and a rather different pattern of regional impacts of financial liberalization. The positive coefficient for Northern Ireland probably reflects some quite different factors — perhaps a higher level of transfer payments. The relatively smaller coefficient for the South East than in Table 7 is a symptom of the fact that the regional accounts income measure, \( y_{SE}/y_{UK} \), rose rather less in the 1980s than did the earnings measure, \( e_{SE}/e_{UK} \). In other respects the two equations have a broadly similar structure. Relative unemployment shocks, relative house price changes and interest rate changes with a differential impact varying with debt, have respectively negative, positive and positive short-run effects on subsequent relative incomes.
References


Lehmussaari, O P, (1990), "Deregulation and Consumption Saving Dynamics in the Nordic Countries", *IMF Staff Papers*, 37, no 1.


Muellbauer, John and Anthony Murphy, (1990), "Is the UK Balance of Payments Sustainable?", *Economic Policy*, 347–82.


Glossary and Sources for Eq (12)

\( c_{it} \) is real per capita consumer expenditure in region \( i \). (Source: CSO Regional Accounts).

\( y_{it}^* \) is the weighted average of three different measures of real per capita disposable non-property income: \( y_i \), \( e_i^* \) and \( y_{UK} \), where \( y_i \) is the Regional Accounts measure, \( e_i^* = [e_i(1-t_y)]/e_{UK}(1-y_{UK}) \) and \( e_i \) is male earnings from the New Earnings Survey, and \( t_y \) the Regional Accounts measure of tax rate on income, and \( y_{UK} \) is the UK measure, see Table 3 for the weights.

\( c_{g_{it}} \) is real per capita current grants from government to households. (Source: CSO Regional Accounts).

\( u_{it} \) is the unemployment rate. (Source: Dept of Employment Gazette).

\( u_{SE_{it}} \) is the unemployment rate in the South East. (Source: Dept of Employment Gazette).

\( E_t \Delta \ln y_{it-1}^* \) is the one year ahead forecast of \( \Delta \ln y_i^* \) using models for \( \ln(y_i/y_{UK}) \) and for \( \ln(e_i/e_{UK}) \) described in the Appendix and a forecast for \( \ln y_{UK} \) from Muellbauer and Murphy (1993b).

\( \left( \frac{DB_{it-1}}{y_{it}} \right) \Delta r_i \) is the debt/income ratio weighted change in interest rates on borrowing, an average of the mortgage rate and bank base rate. (Source: see below for \( DB_i \) and Financial Statistics for interest rate data).

\( \Delta cc_{it} \) is the change in a measure of consumer credit controls (hire purchase conditions). Defined as in Townend (1976), Allard (1980).
\( \Delta \text{strikes}_t \) is the change in a measure of the incidence of long-duration strikes, see Muellbauer and Murphy (1993b), distributed over regions according to regional shares of working hours lost in strikes. (Source: Dept of Employment Gazette).

\[ \frac{\text{LA}_{it-1}}{y_{it}} \]

is the liquid asset to income ratio defined as \( \frac{\text{LA}_{it-1}}{y_{it}} \) where \( a_i \) is the 1980 ratio of interest, dividend and profit income to disposable income in region \( i \) divided by the UK equivalent, (Source: Regional Trends) and \( \frac{\text{LA}_{it-1}}{y_{it}} \) is the UK ratio of personal sector liquid assets to non-property disposable income. (Source: Financial Statistics).

\[ \frac{\text{DB}_{it-1}}{y_{it}} \]

is the debt to income ratio defined as \( \frac{\text{NMD}_{it-1} + \text{MS}_{it-1}}{y_{it}} \), where NMD is personal sector non-mortgage debt and \( MS_i \) is an estimate of the regional mortgage stock obtained from national mortgage stock data from Financial Statistics and regional shares of mortgage interest payments from the Family Expenditure Survey, General Household Survey and Labour Force Survey Housing Trailers.

\[ \frac{\text{ILA}_{it-1}}{y_{it}} \]

is the illiquid asset to income ratio defined as \( \frac{\text{ILFA}_{it-1} + \text{HA}_{it-1}}{y_{it}} \) where \( \frac{\text{ILFA}_{it-1}}{y_{it}} \) is the UK ratio of illiquid financial assets. (Source: Financial Statistics) and \( HA_i \) is an estimate of the value of the owner-occupied housing stock in region \( i \), obtained by applying the share of region \( i \), defined as \( H_1 h_{1i}/\sum_{j} H_1 h_{1j} \) where \( H_1 \) is the number of owner occupied houses and \( h_{1i} \) is the average price of houses in region \( i \), (Source: Housing and Construction Statistics) to the UK value of the owner-occupied housing. (Source: National Income and Expenditure Blue Book).

\[ \text{FLIB} \]

is the index of financial liberalization from Muellbauer and Murphy (1993b), scaled to 0 in 1989 and -1 in the 1960's.
DPR$_i$ is an estimate of first time buyers' downpayment/house price ratio. (Source: Dept of the Environment, Housing and Construction Statistics).

$\frac{h_{pit-1}}{y_{it}}$ is the average price of houses to income in region i. (Source: Housing and Construction Statistics for Dept of the Environment mix-adjusted house price indices scaled by 1985 average house prices for $h_{pi}$, and CSO Regional Accounts for $y_i$).
Figure 1: Log-ratios of Per Capita Consumer Expenditure in Each Region to the UK Average, 1972-1991

Key: nn = North, nw = North West, yh = Yorkshire and Humberside, wm = West Midlands, em = East Midlands, ea = East Anglia, sw = South West, ww = Wales, sc = Scotland, ni = Northern Ireland, se = South East