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Financial Innovation and Consumption in the United Kingdom

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Abstract

The last decade has seen widespread deregulation of domestic financial markets in the United Kingdom. This paper uses regional household data to investigate the connection between consumption and financial innovation. It is concluded that deregulation has led to a significant increase in the forward looking nature of consumption.

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### Summary

The last decade has seen widespread financial deregulation in the United Kingdom. These changes lowered the cost of financial intermediation, particularly for households, probably the sector most affected by government regulation. By lowering the cost of financial intermediation, deregulation enabled consumers to react more to changes in their permanent income. The household sector became more forward looking, with consumption and saving reacting more to changes in permanent, rather than current, income.

The paper investigates size of these effects using a model of consumption incorporating both forward-looking behavior and the effects of liquidity constraints. The is estimated using regional data on consumption and income. The parameters representing liquidity constraints are allowed to vary with proxies for financial innovation. The results indicate that financial deregulation was associated with a significant rise in the proportion of consumption associated with forward-looking behavior, from 40 percent before deregulation to some 70 percent currently. As a corollary, the intertemporal elasticity of substitution for consumption has also risen.

Next, a test for the optimality of consumption patterns across regions is derived and tested. This test strongly rejects optimality before and during financial deregulation, but not afterwards. This provides further evidence of the importance of financial innovation in consumption behavior.

This move toward more forward-looking consumption behavior coincides with a steady fall in the household saving rate in the United Kingdom. The study implies that this reduction largely reflects optimal behavior, corresponding to rising asset prices. In addition, as consumption behavior moves closer to the forward-looking paradigm, it becomes less easy to predict how changes in income and wealth will effect its path, since surprises in these variables become more important than their predictable elements. This makes fiscal policy a less effective tool for short-term demand management, while at the same time lowering the size of standard Keynesian multiplier effects. At the same time, the increase in the importance of changes in the real interest rate implies that monetary policy will have larger intertemporal effects upon consumption. Any country considering deregulating its financial markets should take these effects on consumption into account.



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## I. Introduction

The last decade has seen widespread financial deregulation in the United Kingdom. At the same time household consumption behavior has also changed, the most dramatic illustration being the steady fall in the household saving ratio over the decade. This paper uses regional household data for the United Kingdom to look at the connection between household behavior and financial innovation. It is concluded that, as a result of deregulation, consumption behavior became significantly more forward looking. These changes, together with the large rise in household wealth in the 1980s, help explain the fall in the personal saving ratio. 1/

The early 1980s saw a general deregulation in the United Kingdom's domestic financial markets, with differences in regulations between financial intermediaries being sharply reduced. The Special Bank Deposit scheme (corset) was abolished June 1980; in August 1981 new monetary control mechanisms were announced that abolished the requirement that banks hold 1 1/2 percent of liabilities in non-interest-bearing deposits at the Bank of England and replaced it with the requirement that all licensed deposit takers hold at least 1/2 percent of liabilities at the Bank; in August 1984 building societies (thrifts) were made liable for full corporation tax on certain operations which had been previously exempt; and in October 1987 the range of financial services that building societies were allowed to offer was widened. As a result competition increased, both between banks and building societies as they moved into each others services (Bank of England (1984a) p. 42), and within each sector. 2/ Other important changes in domestic financial markets included the abolition of all remaining controls on hire purchase agreements in July 1982, and the slashing of fixed commissions on trading in government securities in February 1984.

The effect of these changes was to lower the cost of financial intermediation, particularly for households, who were probably the sector most affected by government regulation. By lowering the cost of financial intermediation, deregulation enabled consumers to react more to changes in their permanent income. This implies that the household sector became more forward looking, with consumption and saving reacting more to changes in permanent, rather than current, income.

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1/ While household saving has fallen, rises in corporate and government saving ratios have largely offset the effect of this decline on total saving. Financial deregulation has also occurred in many other countries too. General summaries of the process of financial liberalization in industrial countries can be found in Mathieson and Rojas-Suarez (1990) and OECD (1987).

2/ An indicator of this change is the move by Barclays Bank to unilaterally lower its base lending rate in March 1984. Previously, all clearing banks had synchronized their lending rate changes.

The size of these effects is investigated using a model of consumption which incorporates both forward-looking behavior and the effects of liquidity constraints, which is estimated over the period 1974-87 using regional data on consumption and income. The parameters representing liquidity constraints are allowed to vary with proxies for financial innovation. The results indicate that financial deregulation was associated with a significant rise in the proportion of consumption associated with forward-looking behavior. As a corollary, the intertemporal elasticity of substitution for consumption has also risen. 1/

Next, a test for the optimality of consumption patterns across regions is derived and tested. This test strongly rejects optimality before and during financial deregulation, but not afterwards. This provides further evidence of the importance of financial innovation in consumption behavior. While these results pertain to the United Kingdom, the conclusion, that financial deregulation has a significant effect on consumption behavior of the household sector, clearly has wider implications.

## II. Estimating the Size of Liquidity Constraints in Consumption

### 1. The model

Much of the recent empirical work on consumption has focused on the Euler equation characterization of optimal behavior. As formulated by Hall (1978), this assumes that rational, forward-looking consumers maximize the expected value of lifetime utility, subject to an intertemporal budget constraint. 2/ Together with more technical assumptions, the solution to the optimization problem yields the equation:

$$U'(C_{t-1}) = E_{t-1}(\beta(1+R_{t-1})U'(C_t)) \quad (1)$$

where  $U(C_t)$  is the one-period utility function,  $C_t$  is the consumption,  $E_t$  is the mathematical expectation conditional on the information available at  $t$ ,  $\beta$  is a subjective discount factor and  $R_t$  is the real interest rate.

The Euler equation states that consumption should approximate a random walk, that is, the change in consumption should not be predictable. However, empirical work has shown that certain variables (e.g. current

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1/ Muellbauer and Murphy (1989) using a somewhat different approach, also conclude that financial deregulation had a significant effect on U.K. consumption.

2/ Carroll and Summers (1989) argue that the observed correlation between consumption and income growth indicates that consumption smoothing takes place over periods of several years rather than over a lifetime. The relevance of the Euler equation approach, however, is not invalidated by this criticism.



disposable income, stock prices) have enough predictive power to reject the hypothesis in formal statistical tests. 1/

The failure of the "random walk" type models of consumption has often been attributed to the effects of liquidity constraints, where by "liquidity constraints" is meant an inability to use capital markets to smooth consumption. 2/ To model this, the permanent income hypothesis is nested in a more general model in which a fraction  $\lambda$  of consumption accrues to individuals who are liquidity constrained and thus unable to smooth their consumption path through borrowing, while  $(1-\lambda)$  accrues to individuals who behave according to the permanent income hypothesis. 3/ For the liquidity-constrained group in any region it is assumed that consumption expenditures are a constant fraction of current income, so that the expected rate of growth of aggregate consumption is equal to the rate of growth of real disposable income. Mathematically,

$$C_{1t}/C_{1t-1} = Y_t/Y_{t-1} \quad (2)$$

where  $C_{1t}$  and  $Y_t$  refer respectively to the consumption and real disposable income of the liquidity constrained consumers.

In contrast, consumption of the group that is not liquidity constrained evolves according to the Euler equation (1) above. This can be approximated by,

$$E_{t-1}\{C_{2t}/C_{2t-1} - (\beta(1+R_{t-1}))^\sigma\} = 0, \quad (3)$$

where  $C_{2t}$  denotes the current consumption of the forward looking consumers, and  $\sigma$  is the intertemporal elasticity of substitution of consumption. 4/

Weighing equations (2) and (3) by the proportion of aggregate consumption in the two categories yields the following equation:

$$E_{t-1}\{C_t/C_{t-1} - (1-\lambda)(\beta(1+R_{t-1}))^\sigma - \lambda Y_t/Y_{t-1}\} = 0 \quad (4)$$

1/ See for example Flavin (1981), Hall and Mishkin (1982), Hayashi (1982) and Hansen and Singleton (1982).

2/ Work on liquidity constraints includes Zeldes (1986) and Hall and Mishkin (1982) on the microeconomic side, and Campbell and Mankiw (1987 and 1989) and Jappelli and Pagano (1989) on the macroeconomic side.

3/ The model formulation in this section builds on Campbell and Mankiw (1987). A similar approach is used by Jappelli and Pagano (1989), Delong and Summers (1986), and Bayoumi and Koujianou (forthcoming).

4/ For a deviation see Bayoumi and Koujianou (forthcoming).

Equation (4) is the expression used in the empirical work below.

The effect of financial deregulation on consumption can be measured by estimating equation (4) allowing the proportion of consumption associated with liquidity constraints,  $\lambda$ , to vary with a proxy for deregulation. A fall in the coefficient indicates that financial deregulation has reduced the importance of liquidity constraints, and gives a measure of the importance of this effect of financial liberalization. It also implies a rise in the impact of real interest rates upon consumption, since forward looking consumers are sensitive to changes in real interest rates.

The model was estimated using data on regional levels of per capita consumption and disposable income for the United Kingdom. These pooled data allow a comparison of the results from different regional models, which can be used as a test of the validity of the model. In addition, cross-equation restrictions can be imposed, allowing more accurate estimation of coefficients. Such restrictions are used to test whether financial deregulation has resulted in a fall in the importance of liquidity constraints and to obtain a relatively accurate estimate of a key macroeconomic variable, namely, the intertemporal elasticity of consumption with respect to the real interest rate.

## 2. Estimation results

Regional per capita consumption and per capita disposable income were calculated for the period 1971-87 using data from Regional Trends. The data cover each of the 10 standard regions in Great Britain. <sup>1/</sup> Since Great Britain is a financially integrated area, the risk-free real interest rate was calculated using the Treasury bill rate and the national level of inflation. A constant term was included in the expression for the real interest rate since rates faced by the household sector are above the risk-free rate.

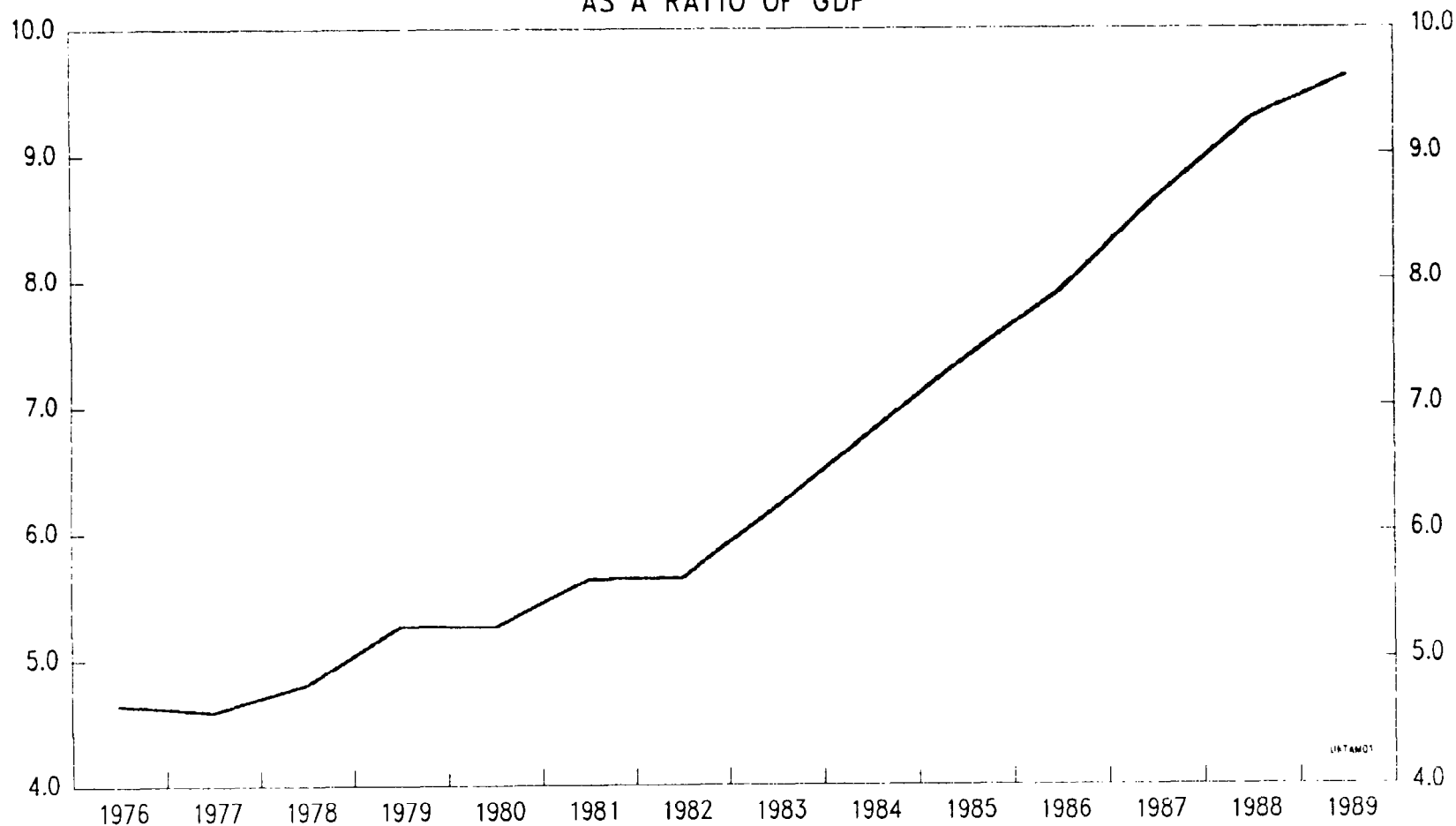
Unlike international financial markets, where the onshore/offshore interest rate differential is generally regarded as a good proxy for deregulation, there is no generally accepted measure for the degree of domestic deregulation. Since the focus of this paper is on the effects of deregulation on consumption, the main proxy variable used for financial innovation is the ratio of the stock of personal sector consumer credit to GDP. This would seem to be a reasonable measure of the degree to which consumers use financial markets to smooth their consumption behavior. <sup>2/</sup> Chart 1 shows the behavior of this aggregate over the period 1976-1988,

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<sup>1/</sup> These are the North, Yorkshire and Humberside, the East Midlands, East Anglia, the South East, the South West, the West Midlands, the North West, Wales and Scotland.

<sup>2/</sup> Jappelli and Pagano (1989) use the stock of consumer loans as a proxy for financial liberalization in an international comparison of liquidity constraints.

CHART 1  
UNITED KINGDOM  
TOTAL OUTSTANDING PERSONAL SECTOR CREDIT  
AS A RATIO OF GDP



Source: Central Statistical Office, Financial Statistics.



unfortunately changes in coverage make it impossible to use data before 1976. The Chart shows that the variable is relatively stable in the late 1970s, and then starts to rise steadily in the early 1980s, which is in line with the chronology for deregulation discussed in the introduction. It was converted into a proxy variable by assuming the ratio in 1976 held for earlier years; the scale of the variable was then adjusted so it equalled zero in 1976 and unity in 1987, the last data point in the sample. As a test of the robustness of the findings, results using a cruder dummy variable are also reported.

The following system of equations were estimated,

$$C_{a,t}/C_{a,t-1} = (\lambda_a + dum * \lambda'_a) * (Y_{a,t}/Y_{a,t-1}) + \{1 - (\lambda_a + dum * \lambda'_a)\} * (\beta(R_{t-1} + \alpha))^\sigma + \epsilon_{a,t}$$

$$C_{b,t}/C_{b,t-1} = (\lambda_b + dum * \lambda'_b) * (Y_{b,t}/Y_{b,t-1}) + \{1 - (\lambda_b + dum * \lambda'_b)\} * (\beta(R_{t-1} + \alpha))^\sigma + \epsilon_{b,t}$$

⋮

$$C_{r,t}/C_{r,t-1} = (\lambda_r + dum * \lambda'_r) * (Y_{r,t}/Y_{r,t-1}) + \{1 - (\lambda_r + dum * \lambda'_r)\} * (\beta(R_{t-1} + \alpha))^\sigma + \epsilon_{r,t}$$

(5)

where the subscripts a, b, ..., r refer to different regions and dum is a dummy variable which is zero before deregulation and one after the full impact of deregulation has occurred. The coefficient  $\lambda_r$  represents the level of liquidity constraints before deregulation in region r, while  $\lambda'_r$  represents the shift in this coefficient resulting from the change in regime. Hence the sum of these coefficients represents the level of liquidity constraints after deregulation. Two cross equation restrictions are imposed: The intertemporal elasticity of substitution,  $\sigma$ , is constrained to be the same in all regions, which amounts to assuming that the utility function U is the same across areas; a similar constraint is imposed on the coefficient  $\alpha$ , the degree to which interest rates faced by the household sector deviate from the risk-free rate.

Since the variables in equations (5) represent expected values, it is necessary to estimate the model using instrumental variable techniques. Three stage nonlinear least squares was used, with the instruments being a constant, and second lags of the change in national disposable income, the change in national consumption, the ratio of consumption to income and the nominal interest rate. First lags were not used since the data are time averages. Time averaging of a random walk process (which is the approximate

process followed by the consumption of forward-looking agents) induces serial correlation between the variable and its first lag. Accordingly, first lags are not appropriate instruments. 1/ National variables were used in the instruments in order to conserve degrees of freedom.

Initially, both the coefficients representing the level of liquidity constraints and the change in liquidity constraints due to deregulation were freely estimated for each region. The results confirm both the importance of liquidity constraints on consumption and that financial deregulation led to a significant easing of them. The estimates of the initial level of liquidity constraints were mostly between zero and one, and generally different from zero at conventional levels. Of the estimates of the change in the level of liquidity constraints due to deregulation 9 out of 10 were negative, confirming that financial innovation had reduced the level of liquidity constraints throughout the economy. 2/ However, the coefficients themselves were imprecisely estimated, and often indicated negative levels of liquidity constraints after deregulation.

In order to obtain a more accurate estimate of the size of the shift in liquidity constraints, a cross-equation restriction was imposed, which made the percentage fall in liquidity constraints equal across regions. This restriction means the fall in liquidity constraints due to deregulation is larger in regions where they were high initially than in regions where they were low, while preserving the ordering of the coefficients. An F-test of the implied coefficient constraints indicates that the restriction could not be rejected at conventional levels of significance.

The results from the model are shown in Table 1. The first column shows the coefficient estimates, while the second shows their standard errors; the third and fourth column show the  $R^2$  and Durbin-Watson statistics for the separate regional equations where appropriate. The data on the equation for the North being in the row showing the liquidity constraint coefficient for that region and similarly on other rows for other regions. The estimates are extremely satisfactory. All the estimates of the liquidity constraint parameters are between zero and unity, as predicted by the theory. The results indicate that liquidity constraints were an important component of consumption before deregulation; over 35 percent of consumption was subject to liquidity constraints in 9 of the 10 regions. Of the 10 coefficients, 7 are significantly different from 0 at conventional levels of significance.

Turning to the effects of deregulation on consumption, the coefficient  $d$ , which estimates the fall in liquidity constraints after

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1/ The original result is proved in Working (1960). Similar restrictions are imposed in Campbell and Mankiw (1987 and 1989) and Hall (1988).

2/ Using a simple sign test, the hypothesis of no change in the level of liquidity constraints can be rejected at the 5 percent level.

Table 1. Results From the Basic Model With a  
Cross-Equation Restriction on the Reduction in  
Liquidity Constraints

Estimating Equation:

$$C_{R,t}/C_{R,t-1} = \lambda_R(1+d*dum)(Y_{R,t}/Y_{R,t-1}) + (1-\lambda_R(1+d*dum))(\alpha+R_{t-1})^\sigma + \epsilon_{R,t}$$

Coefficient	Estimate	Standard Error	R <sup>2</sup>	DW
$\lambda_{North}$	0.36	0.45	0.30	1.99
$\lambda_{Yorkshire}$	0.50	0.28	0.25	1.62
$\lambda_{East Midlands}$	0.63	0.15	0.53	2.25
$\lambda_{East Anglia}$	0.80	0.22	0.40	1.97
$\lambda_{South East}$	0.65	0.24	0.59	1.56
$\lambda_{South West}$	0.58	0.16	0.02	1.59
$\lambda_{West Midlands}$	0.90	0.15	0.71	2.30
$\lambda_{North West}$	0.56	0.26	0.58	1.71
$\lambda_{Wales}$	0.98	0.14	0.64	2.46
$\lambda_{Scotland}$	0.24	0.20	0.60	2.00
d	-0.52	0.19		
$\sigma$	0.40	0.12		
$\alpha$	0.059	0.021		

Notes: Subscripts stand for different regions. The variable dummy is zero before 1983 and one thereafter. The estimation was carried out using nonlinear three-stage least squares. The instruments were a constant, the second lags of the change in national consumption, the change in national disposable income, the ratio of national consumption to disposable income, and the nominal interest rate.

deregulation, indicates a 52 percent fall in the size of liquidity constraints by 1987. The coefficient has a standard error of only 19 percent, and is significant at the 1 percent level. The results indicate that the proportion of aggregate consumption associated with liquidity-constrained consumers fell from around 60 percent in the 1970s to 30 percent of consumption by 1987. This provides strong evidence that financial deregulation resulted in a significant fall in the importance of liquidity constraints in consumption. <sup>1/</sup> The effects of future rises in the ratio of consumer credit to GDP on liquidity constraints can also be calculated; for example, the further 1 percent rise in the ratio between 1987 and 1989 implies a further fall in the proportion of consumption associated with liquidity constraints from 30 percent to below one quarter.

The intertemporal elasticity of consumption with respect to the real interest rate,  $\sigma$ , is large and significantly different from zero. It indicates that every 1 percent rise in the real interest rate lowers the current consumption of forward-looking consumers by 0.40 percent. However, since the real interest rate does not affect the consumption of liquidity-constrained individuals, the effect of real interest rates on aggregate consumption is considerably lower. Before deregulation, about 60 percent of consumption is estimated to have been associated with liquidity constraints, implying an intertemporal elasticity of substitution of aggregate consumption of 0.16. After deregulation, the fall in the importance of liquidity constraints means that the elasticity rises to nearly 0.3. <sup>2/</sup> Finally, the parameter  $\alpha$  implies that costs of borrowing for the household sector were 5.9 percent above the risk free rate.

The summary statistics for the regional equations show the model to have considerable explanatory power; the  $R^2$  statistics indicate that over half of the variance in regional consumption growth is explained in six of the regions, while the Durbin-Watson statistics indicate no problems with autocorrelation of the disturbances.

The expectation operators in equation (4) implies that the errors in the equations should be orthogonal to all prior information. This implication of the rational expectations hypothesis can be tested by taking the errors in the equations and regressing them against predetermined variables; a significant correlation would indicate a rejection of the theory. The residuals for each of the equations were regressed on a constant, and the second lags of the growth of real consumption and

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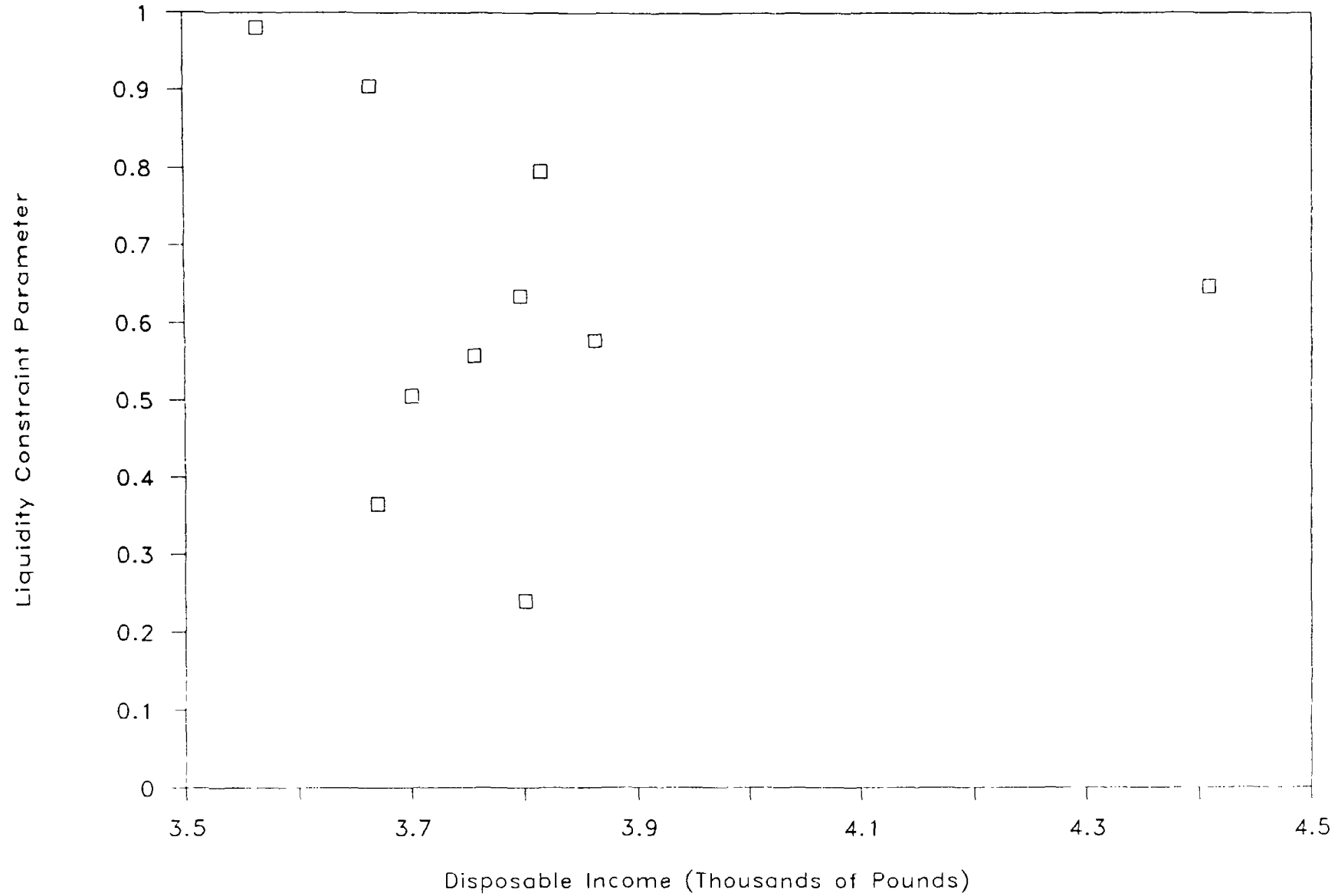
<sup>1/</sup> Using national data on several OECD economies, Bayoumi and Koujianou (forthcoming) provide evidence that financial deregulation produced similar reductions in liquidity constraints across different countries.

<sup>2/</sup> However, since the services from durable goods services are spread over time, this does not necessarily imply that the intertemporal elasticity of true consumption is as large as that estimated in the model.



## CHART 2

### LIQUIDITY CONSTRAINTS AND INCOME





disposable income for that region. 1/ None of these variables were significant at the 5 percent level in any of the equations.

It is interesting to look at the relationship between the estimated level of liquidity constraints with per capita disposable income in the regions. Since liquidity constraints would be expected to be higher in poorer areas, a negative correlation should be evident. 2/ Chart 2 shows a scatter plot with the estimated liquidity constraint parameters on the vertical axis and the level of disposable income in 1985 prices averaged over the 1974-1982 period on the horizontal axis. The negative correlation, which can be confirmed by the use of formal regression techniques, implied that each rise of £80 in personal disposable income per capita in 1985 prices is associated with a fall of 1 percentage point in the amount of consumption affected by liquidity constraints.

Overall, the model appears to fit the data well. The liquidity-constraint coefficients are correctly signed, generally significantly different from zero, and are negatively correlated with average disposable incomes. The general fall in these coefficients over the period of financial deregulation is further evidence that these coefficients do indeed represent liquidity constraint effects, rather than being spurious correlations caused by (say) the substitutability of consumption and leisure. These results present powerful positive evidence that the model is a useful description of the behavior of consumption.

One concern is that the dummy variable being used may not be a perfect measure of the process of financial deregulation. In order to investigate the importance of the precise path of the proxy variable, a second proxy variable for financial innovation was experimented with. This alternative was a dummy variable which assumes that the effects of financial deregulation are zero before 1981, and then build up evenly to full effect by 1985. The results from using the direct proxy variable, shown in Table 2, are generally similar to those in Table 1. 3/ The coefficients representing liquidity constraints prior to deregulation are all between 0 and 1 and are never more than two standard deviations away from those reported in Table 1. The estimate of the intertemporal elasticity of substitution,  $\sigma$ , and the premium over the risk free interest rate,  $\alpha$ , are both very similar. The estimated fall in liquidity constraints due to financial innovation 37 percent and is statistically significant at the 1 percent level. These results confirm that the basic thesis, that

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1/ The errors are orthogonal to the instruments by construction. However, this test looks at whether the errors depend upon regional variables, rather than the national variables used as instruments.

2/ Japeilli and Pagano (1989) provide evidence that such a relationship exists between the  $\lambda$  parameters and economic development across countries.

3/ In order to make the estimates comparable with those using the original dummy, it was made equal to zero in the early 1970s and unity from 1985 onwards.

Table 2. Results When the Financial Deregulation  
Effects are Phased in Evenly

Estimating Equation:

$$C_{r,t}/C_{r,t-1} = \lambda_r(1+d*dum)(Y_{r,t}/Y_{r,t-1}) + (1-\lambda_r(1+d*dum))(a+R_{t-1})^\sigma + \epsilon_{r,t}$$

Coefficient	Estimate	Standard Error	R <sup>2</sup>	DW
$\lambda_{\text{North}}$	0.42	0.46	0.31	2.00
$\lambda_{\text{Yorkshire}}$	0.47	0.26	0.22	1.66
$\lambda_{\text{East Midlands}}$	0.59	0.14	0.54	2.19
$\lambda_{\text{East Anglia}}$	0.70	0.20	0.49	2.11
$\lambda_{\text{South East}}$	0.62	0.22	0.55	2.09
$\lambda_{\text{South West}}$	0.51	0.15	0.03	1.56
$\lambda_{\text{West Midlands}}$	0.89	0.14	0.72	2.30
$\lambda_{\text{North West}}$	0.55	0.25	0.61	1.32
$\lambda_{\text{Wales}}$	0.94	0.13	0.62	2.24
$\lambda_{\text{Scotland}}$	0.22	0.18	0.57	1.78
d	-0.37	0.15		
s	0.41	0.12		
a	0.057	0.015		

Notes: Subscripts stand for different regions. The variable dummy is zero before 1981 and then rises in even steps of 0.2 to 1.0 in 1985 and stays at that level. The estimation was carried out using nonlinear three-stage least squares. The instruments were a constant, the second lags of the change in national disposable consumption, the change in national disposable income, the ratio of national consumption to disposable income, and the nominal interest rate.

financial innovation produced a significant fall in the level of liquidity constraints associated with consumption, is robust to this alternative measure of the level of financial innovation.

### III. The Optimality of Consumption Across Regions

Thus far, deviations from forward-looking behavior have been estimated using a specific model of consumption. In this section, deviations from forward-looking behavior are tested against an unspecified alternative. Hence, the results in this section provide a test of how robust the earlier results are to relaxing the assumptions of the specific model.

A simple 'random walk' expression for the optimal behavior of consumption between regions is derived, where optimal is defined as fully forward-looking behavior. The implications tested against the regional data set before, during, and after financial deregulation. Optimality is firmly rejected for pre-deregulation and intermediate periods, but not for the period after financial deregulation. This provides further evidence that changes in domestic financial markets have had an important effect of consumption behavior.

Recall from equation (3) that the optimal consumption path for any region can be defined as,

$$E_{t-1}(C_{r,t}/C_{r,t-1} - (\beta(1+R_t))^{\sigma}) = 0, \quad (3')$$

where the subscript  $r$  defines a region. Maintaining the assumptions that  $\beta$ ,  $\sigma$ , and  $R_t$  are equal across regions, the right hand sides are equal across different areas, and hence relative growth rates are a random walk.

Mathematically,

$$E_{t-1}(C_{a,t}/C_{a,t-1} - C_{b,t}/C_{b,t-1}) = 0, \quad (6)$$

for any two regions  $a$  and  $b$ . In particular, region  $b$  can be thought of as the behavior of the aggregate economy. The optimality of consumption across different regions can be tested by regressing the difference in consumption rates on prior information, and seeing if the coefficients are significant.

The difference between regional consumption growth and growth for the United Kingdom as a whole was regressed on a constant, and second lags of the growth in relative consumption, growth in relative income, and the ratio of consumption to income, were all measured in comparison to the aggregate for the United Kingdom. <sup>1/</sup> These independent variables are region-specific versions of the instrumental variables used earlier, excluding the

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<sup>1/</sup> First lags were not used for the same reasons they were not admissible instruments.

nominal interest rate. The equations were estimated as a system using Zellners' seemingly unrelated regressions; in order to retain degrees of freedom, and hence increase the power of the test, the coefficients were constrained to be equal across regions. <sup>1/</sup> Estimation was carried out over three time periods, pre-deregulation (1974-79), transition (1980-83), and post-deregulation (1984-87). These periods were chosen to be similar lengths, so that comparisons between them are not too distorted by variations in the accuracy of the estimated standard errors.

Table 3 reports F-statistics for the hypothesis that all the coefficients in the regression are zero, plus critical values for the statistic. For the pre-deregulation and transition periods optimality is decisively rejected, the associated F-statistics being 45 and 128. By contrast, for the post-deregulation period the F-statistic is 1.11, well within the 5 percent critical value. Hence, for the period since 1984, the test cannot reject optimality.

Table 3 shows a clear break in consumption patterns in the early 1980s, which moved decisively towards optimality after 1984. These results confirm the conclusions from the earlier analysis, that financial innovation in the early 1980s had a major effect on consumption behavior. Furthermore, since the test used variables that were measured as deviations from aggregate U.K. data, the results are unaffected by changes in aggregate behavior. Hence, they do not simply reflect macroeconomic changes, such as the fall in the household saving rate over the 1980s.

#### IV. Conclusions

This study has looked at the effect of financial deregulation on the behavior of the household sector in the United Kingdom using regional data on consumption and disposable income. A model of consumption incorporating both liquidity constraints and forward-looking behavior was estimated, and the effect of financial innovation was measured by comparing the size of the parameters representing the size of liquidity constraints on consumption before and after financial deregulation.

The results indicate that deregulation has had a substantial effect on the behavior of consumption. They suggest that before deregulation about 60 percent of aggregate consumption was subject to liquidity constraints. After deregulation this proportion has fallen considerably, probably to around 30 percent of consumption in 1987, and one quarter currently. A corollary to this fall in the importance of liquidity constraints is that the impact of real interest rates on aggregate consumption increases. The intertemporal elasticity of consumption with respect to real interest rates is estimated to have risen considerably, from 0.15 before deregulation to

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<sup>1/</sup> Results using different sets of independent variables, and allowing coefficients to vary across equations, produced similar results.

Table 3. Tests of the Optimality of Regional  
Consumption Patterns

	Pre- Deregulation 1974-79	Transition 1980-83	Post- Deregulation 1984-87
F-statistic	45.15	128.40	1.11
Critical value (5%)	2.82	2.88	2.88

Notes: The change in regional consumption relative to the U.K. average were regressed upon a constant, and the second lags of the consumption income ratio, the change in consumption, and the change in income, all measured relative to the U.K. average. The F-statistic tests the hypothesis that all the coefficients are zero. The model was estimated using seemingly unrelated regressions, with the coefficients constrained to be the same across regions.

nearer 0.3 currently. These results are robust to the use of different proxy variables to measure the process of deregulation.

Next, a test of whether consumption behavior between regions is optimal was then derived and calculated. Like the earlier analysis, the results indicate a decisive move towards optimality in the 1980s. Furthermore, since this test looks at the deviations between regional and U.K. data, these results are not simply a reflection of changes in macroeconomic variables.

This move toward more forward-looking consumption behavior coincides with a steady fall in the household saving rate in the United Kingdom. The implication of this study is that this reduction reflects optimal behavior, presumably corresponding to rising asset prices, particularly in the housing sector. While second best considerations must always be kept in mind, there is a presumption that this raised welfare.

These shifts in the factors underlying the behavior of consumption have other important implications. As consumption behavior moves closer to the forward-looking paradigm, it becomes less easy to predict how changes in income and wealth will effect its path, since surprises in these variables become more important than their predictable elements. This makes fiscal policy a less effective tool for short-term demand management, while at the same time lowering the size of standard Keynesian multiplier effects. At the same time, the increase in the importance of changes in the real interest rate implies that monetary policy will have larger intertemporal effects upon consumption. Any country considering deregulating its financial markets should take these effects on consumption into account.



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