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Centre for Economic Policy Research
25–28 Old Burlington Street
London W1X 1LB
Tel: (44 171) 878 2900

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ABSTRACT

Consumption, 'Credit Crunches' and Financial Deregulation*

We examine whether credit contributes to business cycle fluctuations by directly affecting consumption rather than through the now well-understood investment channel. Examining UK data we argue that consumers face a rising interest rate schedule whereby additional borrowing leads to higher interest rates. At a certain level of debt this schedule may become vertical and consumers face a credit ceiling. Using this assumption we find consumption growth depends on the interest rate, the borrowing wedge, and the debt-income ratio, and that we can potentially account for the failings of the rational expectations permanent income hypothesis (REPIH). Risk aversion and the interest rate schedule interact such that agents choose not to hold much debt, however, and so consumers are not much affected by 'credit crunches', although the more efficient the capital market, the bigger the impact. Calibrating our model and performing simulations suggests the sharp increases in UK consumption in the late 1980s were more likely due to income revisions than financial deregulation *per se*.

JEL Classification: E2, E3, E5
Keywords: consumption, credit constraints, credit crunch, financial deregulation, precautionary saving

Andrew Scott
Department of Economics
Harvard University
Littauer Building
Cambridge MA 02138
USA
Tel: (1 617) 495 5305

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NON-TECHNICAL SUMMARY

Standard Keynesian models give a key role to consumption, via the multiplier, in determining output fluctuations. Crucial to this importance is a close connection between current consumption and current income, a link which is broken if consumers can borrow freely in capital markets. A large literature, however, finds evidence that credit constraints exist and cause current consumption and current income to be closely linked. This suggests that variations in credit supply might, through consumption, have a significant business cycle effect. A large recent literature has examined the importance of credit and *investment* for business cycle fluctuations, but little work has focused on *consumption.* The aim of this paper is to examine the influence that cyclical ('credit crunches') and structural (financial liberalization) changes in credit supply have on consumption.

Understanding how credit affects consumption requires a model of capital market imperfections. Examining UK data we find that a large number of individuals borrow, that they hold different types of debt and that the borrowing rate varies across different forms of debt. We argue that this gives the consumer the opportunity to borrow more, but at ever-higher interest rates. The consumer therefore faces an upward sloping interest rate schedule, which beyond a certain level of debt may become vertical such that a credit ceiling exists (i.e. consumers cannot borrow more than a certain amount).

Focusing on the consumer's optimization problem we find that in the presence of an upward sloping interest rate schedule aggregate consumption growth depends on the interest rate, the wedge between the borrowing and lending rate, and the debt to income ratio. This formulation thus has the potential to explain previous rejections of the rational expectations permanent income hypothesis (REPIH), to rationalize the predictive role for the borrowing wedge, and to explain the importance of credit in driving consumption fluctuations. Using simulations we examine the consumption behaviour of risk averse individuals in the presence of an upward sloping interest rate schedule. For even moderate levels of risk aversion we find that the threat of having to pay high borrowing rates means that consumers rarely borrow. Instead they accumulate precautionary balances and so avoid the threat of having to pay penal interest rates in bad income states of the world. As a result, consumers hold very little non-secured debt and individual consumption is very closely tied to individual income. Because the interest rate schedule slopes upwards below a credit ceiling, the correlation between individual income and individual consumption is even more marked than in an economy where imperfect capital markets are manifested solely as borrowing constraints.

Having examined the behaviour of individual consumers we use our model to consider in general equilibrium the issues of financial deregulation and cyclical variation in loan supply. We argue that if 'credit crunches' or financial deregulation are to have a substantial direct influence on consumption then it is important to assume that the consumer credit market does not close. Otherwise fluctuations in the cost of intermediation are simply too small to have any influence on consumption and aggregate consumption is essentially equal to aggregate income. Assuming that an economy has access to a global capital market we examine the impact of credit crunches (as modelled by an increased slope to the interest rate schedule) on consumption. We find that: first, the direct impact of credit crunches on consumption is small. Because agents are risk averse they hold very little debt and so the income effect from the higher borrowing rates associated with credit crunches are small. Second, because empirically-observed substitution effects are small the higher borrowing rates bring forward only a small increase in expected consumption growth. Therefore the overall effect on the level of consumption is not large. Somewhat paradoxically, the more perfect capital markets are (e.g the flatter is the interest rate schedule), the bigger the effect of a credit crunch. In this case agents hold more debt and so there is a bigger income effect. Therefore cyclical variations in credit supply have only a small direct impact on consumption.

Examining financial liberalization we also conclude that structural changes in loan supply have only a modest impact on consumption. Lower borrowing rates caused by financial deregulation bring forth a positive income effect as debtors now have more resources to spend on consumption. The lower borrowing rates tend to lower consumption growth through the substitution effect, however. The overall result is that consumption shows only a modest increase. By comparison, sustained increases in income expectations cause substantial shifts in consumption. Examining UK data from the late 1980s we conclude that revisions to income expectations are the most likely explanation for the consumption surge rather than financial liberalization *per se*.

"but all, it is said, can have some money if they choose to pay enough for it."
W.Bagehot "*Lombard Street*", John Murray, London, 1919

1. Introduction

In standard Keynesian models the multiplier gives a key role to consumption in determining output fluctuations. Empirically this importance is confirmed by the fact that U.K (non-durable) consumption accounts for more than 2/3 of GDP, that consumption growth is correlated 0.57 with GDP growth and that detrended consumption (as estimated by the Hodrick-Prescott filter) is correlated 0.975 with detrended GDP. Crucial to the Keynesian multiplier is a consumption function linking current consumption directly to current income but if consumption is determined by the Rational Expectations Permanent Income Hypothesis (e.g Hall (1978)) this link is broken. However, a standard empirical finding is that the REPIH does not hold because consumption displays an excess dependence on current income (e.g Flavin (1981), Hall and Mishkin (1982), Campbell and Mankiw (1989), Zeldes (1989)). All these studies suggest this excess dependence is due to capital market imperfections, normally assumed to be credit rationing. As shown in Tobin and Dolde (1971) and Heller and Starr (1979), loan market imperfections can justify the existence of a consumption function and the Keynesian multiplier and reinstate the central role of consumption in business cycle fluctuations.

The importance of credit in accounting for business cycles has recently been the subject of renewed interest, motivated in part by the world recession of the early 1990s when high levels of debt, declining asset prices and the weak balance sheets of financial institutions raised fears of a "credit crunch" (e.g Bernanke and Lown (1991), Feldstein (1991)). Additional motivation came from a number of studies which stressed the importance of the pricing i.e interest rate wedges, and output i.e loan supply, of financial intermediaries in propagating business cycles see, *inter alia*, Stock and Watson (1989), Bernanke and Blinder (1992), Kashyap, Stein and Wilcox (1993), Gertler and Gilchrist (1994)). In addition a number of theoretical studies (e.g Scheinkman and Weiss (1986), Bernanke and Gertler (1989), Greenwald and Stiglitz (1993), Kiyotaki and Moore (1995)) proposed different economic mechanisms whereby variations in credit supply have important real effects. However, the focus in all these studies is the interaction between output, *investment*, credit and asset prices, ignoring the crucial Keynesian link between credit markets, *consumption*[1] and labour income. The purpose of this paper is to assess whether this is an

[1] We use "consumption" to refer to non-durable consumption and services and include durable consumption as part of "investment".

important omission, that is whether cyclical variations in loan supply also have a significant direct impact on consumption.

Crucial in assessing how variations in loan supply affect consumption is an understanding of how consumer credit markets operate and a model of credit market imperfections. Section 2 examines data on U.K loan markets and concludes that (a) consumers hold significant levels of debt and (b) there is wide diversity in the interest rates charged on loans. We examine a number of explanations for this diversity and argue that it presents the consumer with the option of borrowing more but at higher interest rates. As a consequence we suggest the most appropriate way of modelling agents' borrowing opportunities is by an upward sloping interest rate schedule which in the limit may become vertical so that there is credit rationing. Section 3 shows how this potentially makes consumption growth highly cyclical, accounting for the observed failings of the REPIH. Under certain distributional assumptions consumption growth depends on the deposit rate, the difference between the loan and deposit rate (rationalising the predictive power of interest rate wedges) and the debt to income ratio (suggesting the potential importance of credit crunches). To understand the implications of this model of imperfect capital markets we utilise simulations, paying particular attention to the relative importance of, and interaction between, precautionary savings and imperfect capital markets. As stressed by Deaton (1991) and Xu (1995), in the face of credit *constraints* agents will hold higher balances for precautionary reasons in an effort to avoid these constraints binding. In the face of an upward sloping interest rate schedule this interaction between precautionary saving and imperfect capital markets is even more marked - the threat of agents having to pay higher interest rates means consumers choose to hold even less debt. The result is that consumption is more closely correlated with individual rather than aggregate income, in contradiction to the standard full insurance result.

However, while these results are useful in understanding the properties of our model they are partial equilibrium in nature and so cannot be used to examine business cycle problems. To understand the impact of cyclical and structural changes in loan supply Section 4 considers the joint determination of consumption, interest rates and loans in a stochastic dynamic general equilibrium model. We propose a simple stylised model of financial intermediaries which captures our assumption of an upward sloping interest rate schedule. We calibrate the model using U.K data and argue that if equilibrium models are to enable financial deregulation or "credit crunches" to have a substantial impact on aggregate consumption it is crucial to assume the consumer loan market does not close. Given the openness of the U.K economy,

especially its financial sector, this seems a realistic assumption to make. Section 5 uses our model to assess the importance of cyclical variations in loan supply on consumption. We find "credit crunches" do have an impact on consumption and that the impact is bigger the closer capital markets are to the efficient paradigm. The intuition is simple, when interest rates do not rise so sharply with borrowing then agents hold lower levels of precautionary savings (e.g they borrow more) and so are more exposed to variations in loan supply. However, in no case do we find the impact of "credit crunches" on consumption to be substantial. For plausible values of risk aversion the associated income and substitution effects are too small to have a sizeable influence on consumption growth.

While the early 1990s and fears of a "credit crunch" focused attention on cyclical variations in credit the experience of the late 1980s raises a number of questions about *structural* changes in loan supply. During this period the Anglo-Saxon and Scandanavian countries experienced significant financial deregulation and all these economies saw a dramatic increase in consumption and credit, large falls in the savings rate and a burgeoning current account deficit. An unresolved policy issue is the extent to which these phenomena were an automatic consequence of financial deregulation or due to the interaction of financial innovation with upwards revisions to income expectations. In section 6 we again use simulations to try and shed light on these issues. Our model predicts that while financial innovation has significant effects on consumption these are relatively drawn out and that the sharpness of the 1980s consumer boom suggests rising income expectations were the more important factor. A final section concludes.

2. The U.K Personal Loan Market

As the focus of this paper is the link between non-durable consumption and loan supply we ignore the large part of U.K personal sector borrowing (around 85%) which is in the form of mortgage finance for house purchase. Instead, we focus on unsecured credit extended to the personal sector where there is normally little or no collateral given to the financial intermediary (FI). This category covers a variety of loans including overdraft facilities, bank loans, credit cards, retailer accounts, etc. Our reason for focusing on this category is that unlike mortgage borrowing it closely resembles the concept of negative net assets which we shall use when we model consumer's decisions. While consumer credit is small compared to mortgage borrowing it is still equivalent to approximately 16% of total consumption and so can be expected to exert a significant influence.

Table 1 lists the amount of consumer credit outstanding (in real terms) between 1980 and 1993 and its distribution between categories. The data is taken from the CSO's *Annual Abstract of Statistics* and shows that the bulk of consumer credit (around 70% or more) is accounted for by bank loans although an increasing amount is attributable to credit card borrowing (15% by 1993). In 1990 outstanding consumer credit was £60bn, or more than £1000 for every man, woman and child in the country. Given that not everyone is a debtor and that banks cannot lend to children the average consumer credit extended to a debtor is substantially larger. This suggests that even if loans markets are characterised by credit rationing the constraint does not bind at zero assets for everyone, consumers can and do borrow large amounts[2].

There is no micro data offering precise information on assets and debt in the U.K. However, the study of Banks, Dilnot and Low (1994) offers some insight into how many individuals have negative financial assets and the average size of debt across categories. Using the Financial Research Survey, carried out by National Opinion Polls, Banks, Dilnot and Low (1994) analyse the income, asset and debt position of 6622 randomly selected adults in 1991/92. Unfortunately, each interviewee was asked only about which range their income/assets/debt fell in so that no exact point estimates are available. However, using the midpoints of the bands it is possible to document (at the risk of some inaccuracy) the extent to which individuals hold debt. From their sample of 6622 there are 2084 individuals who have negative financial assets (excluding housing wealth), or approximately a third. Of these individuals with negative net financial assets the mean level of indebtedness was £2471 (with a median of £1500) . Consistent with Table 1, the majority of this debt is in the form of a bank loan (with a mean of £1656) with credit cards making up the largest remaining category (mean debt of £289 on the main credit card and £426 the average level of borrowing across three further credit cards, storecards and mail order accounts). Table 2 shows the proportion of interviewees who have negative net financial assets by income band and by age group. The breakdown by age group is broadly consistent with life cycle stories, with the proportion of net debtors only declining significantly after the 40 year age band. The breakdown by income band shows surprisingly little variation in the proportion of interviewees with negative assets, with the lower income bands having the smallest number of net debtors. Clearly only individuals with significant income levels are either able to borrow or prepared to have a negative net asset position. The fact that so many high income (and presumably high consumption) individuals have negative financial assets suggests that variations in loan supply could have a

[2] Table 1 overstates the amount of unsecured debt held by the personal sector as some of the items in Table 1 reflect loans for the purchase of consumer durables, such as cars. However, as the resale price of durables is significantly less than the purchase price such loans may still represent unsecured debt to a significant extent.

substantial impact on aggregate consumption.

A noticeable feature of the U.K retail loan market is the variety of borrowing rates associated with different loans. Table 3 lists some observations on different interest rates (I am grateful to Andrew Haldane for making available the data in Dale and Haldane (1993)). The table shows : (i) the deposit rate is at a discount to the base rate (the central bank determined interest rate) (ii) the mortgage rate is a variable mark up over the base rate, but compared to other loan categories the mark up is small (iii) interest rates on personal loans and credit cards are more than double the deposit rate (iv) there exists a significant mark up between personal loans and credit cards. No official statistics are available for rates payable on retail store cards or retail loans, however, periodical advertisements reveal a range between 0% to 43.7% APR.

One potential explanation for this variety of interest rates is that loans from different FIs may be imperfect substitutes. For instance, as emphasised by Brito and Hartley (1995), credit cards offer useful liquidity services and several credit card firms now include services such as automatic insurance on all card purchases. Credit cards also enable the consumer to avoid interest payments if the balance is paid in full each month. However, it is unlikely these factors account for the *entire* interest rate differential with respect to bank loans. Enquiries with one major bank revealed they offer two credit cards, one with an interest rate of 22% but no insurance or other benefits while another card carries an interest rate of 24.5% but includes additional benefits[3]. The same FI offers a loan at 19.5% suggesting that it is not these extra services which justify the mark up. The evidence, for the U.S, in Ausubel (1991) and Canner and Fergus (1987) also suggests the ability to borrow interest free for a month is not a definitive attraction. Ausubel (1991) calculates that roughly 75% of credit card holders pay interest on an average balance of $1000. Canner and Fergus's (1987) evidence is more modest, using the 1983 Michigan survey they find that 27% of consumers "hardly ever" and 26% "sometimes" pay their outstanding balance in full. In other words, credit card holders do not use their accounts solely for transactions reasons but often as an additional source of loan finance.

But if credit cards have such high borrowing rates why don't consumers always use bank loans? Brito and Hartley (1995) argue consumers may rationally choose to borrow on credit cards ahead of bank loans

[3] The lack of a cross-sectional dataset prevents any more rigorous statement of interest rates in the U.K credit card industry. Enquiries with other banks suggests the numbers quoted in the text are representative of the major banks in the industry. No information on either debt payments or borrowing rates is provided in Banks, Dilnot and Low (1994).

because the latter have high arrangement fees. For instance, even taking their most unfavourable case for credit cards (see their Table 1) they argue that if there exists a $100 loan arrangement fee then with loan rates of 7% and credit card interest at 21% consumers prefer credit card borrowing for loans less than $1363. According to this perspective, interest rates only partly reflect the attractiveness of loans due to the existence of high fixed costs. However, our enquiries suggests this is not a realistic description of the U.K consumer credit market. For instance, a major high street bank offers an automatic overdraft of £250 to all cheque account customers at an interest rate of 16% per annum. For an additional £15 per annum fee they provide an extra borrowing facility of £2500 at 19.5%. There is also an option of a credit card with a limit of £5000, interest of 22% and an annual fee of £10. Using these numbers in a suitably modified (to allow for the credit card arrangement fee) version of Brito and Hartley's equation (23) we get dramatically different results from their Table 1. Comparing the overdraft facility of £250 with credit card borrowing we find consumers choose the credit card only if they borrow less than £132. Comparing credit cards with the extended overdraft facility the overdraft is preferred when borrowing more than £395. The mean level of indebtedness shown in Table 1 and Banks, Dilnot and Low (1994) suggest consumers should first exploit bank finance before resorting to credit card facilities. Comparing credit cards with store finance is made easier by the fact that store finance offers no additional services other than a loan facility and incurs no arrangement fee. Comparing an interest rate of 46% with a credit card purchase Brito and Hartley's equation (23) suggests that for any purchase over £76 the consumer should use credit cards. Using a less extreme rate of 32.5% offered by a major high street retailer, credit cards should still be preferred for any expenditure over £279. This argument suggests that individuals will first utilise bank credit and only when this is no longer forthcoming resort to credit card finance and only after this has been exploited use store cards. The implication is that as an individual's debt increases so their marginal borrowing rate rises[4].

Is this suggestion of an upward sloping interest rate schedule consistent with any theoretical model of the loan market? It is not consistent with the credit rationing model of Stiglitz and Weiss (1981) where for adverse selection reasons banks do not raise borrowing rates but simply limit loan supply. This model of loan markets has implicitly been the microeconomic justification of the various papers on consumption and imperfect capital markets (e.g Zeldes (1989), Deaton (1991)). However, Milde and Riley (1988) examine a more general version of Stiglitz and Weiss where agents can choose the size of loan they wish to borrow.

[4] We are not suggesting that in a cross-section agents with larger debts will have higher borrowing rates. The actual borrowing rate paid by an individual will depend on a range of individual specific variables. Our claim is only that each individual faces a non-decreasing interest rate schedule.

This extension enables borrowers to use loan size to signal to banks their characteristics. The result is that the more that individuals borrow the higher the interest rate that they face[5]. At some point however credit rationing may occur, at certain levels of debt a consumer may be unable to obtain additional loan financing at ***any*** interest rate. What our evidence and the model of Milde and Riley suggests is that there exists a significant range of debt over which imperfect capital markets are defined by a non-decreasing interest rate schedule which at some credit ceiling may become vertical. However we are not arguing that all observed interest rate differentials can be accounted for by this upward sloping loan schedule, loans from different FIs are undoubtedly imperfect substitutes. Our argument is that *some* of these differentials represent an upward sloped interest rate schedule.

3. Optimal Consumption when Capital Markets are Imperfect

In this section we examine the consumer's optimality conditions when borrowing rates rise with debt. We demonstrate the analytical tractability of this model compared with alternative formulations of borrowing constraints (e g Deaton (1991)) and we show how this model has the potential to explain a number of rejections of the REPIH. To understand more fully the implications of our model and the important interaction between precautionary savings and capital market imperfections we perform simulations. Our focus in this section is on understanding the theroetical implications of our model of capital market imperfections for consumption rather than assessing the importance of this channel as a propagation mechanism. In particular, our aim is to assess the differences between our model of imperfect capital markets and the credit rationing model analysed in Deaton (1991) and also to focus on the relative importance of credit constraints and precautionary saving.

(i) Maximisation Problem

We assume utility is defined only over current consumption. Each period individuals receive an endowment y_{it} where $\ln y_{it} = \ln y_{at} + \epsilon_{it}$, y_{at} is a component common to all agents and ϵ_{it} is an i.i.d individual

[5] No micro dataset exists which enables us to more rigorously examine the hypothesis of an upward sloped interest rate schedule (the Banks et al (1994) paper having no interest rate data). This is disappointing as our model of imperfect capital markets has the potential of discriminating between budget set and preference based hypothesis of consumption behaviour (see Attanasio (1995)). The only relevant existing dataset is an aggregate time series. However, as this consists of only 20 annual observations any econometric study is infeasible. As a consequence we use simulations extensively in what follows.

specific shock. In a general equilibrium setting the role of capital markets is to allow consumers to smooth out idiosyncratic risk ϵ_{it}, fluctuations in y_a being unavoidable. Agents are assumed to choose their asset holdings to maximise lifetime utility subject to an intertemporal budget constraint, that is

$$\max_{\{a_{it}\}} \quad E_t \sum_{j=0}^{\infty} \beta^j u(c_{it+j}) \; s.t \quad a_{it+j+1} = a_{it+j}\phi(a_{it+j}) + y_{it+j} - c_{it+j} \tag{1}$$

where $\phi(.)$ denotes $1+i_t$ and i_t is the interest rate the consumer receives/pays on their current asset holdings and is potentially a function of a_t.

Before examining the agent's first order condition it is necessary to consider some regularity conditions which ensure a well defined solution to (1). These conditions are intimately connected with our economic modelling of capital market imperfections. The first issue is the need to rule out Ponzi games (i.e. consumer's continually rolling over infinite debt). Magill and Quinzii (1994) consider this issue in the context of infinite horizon models with incomplete insurance and impatient consumers. They show that for every equilibrium which satisfies a transversality condition there is an equilibrium which imposes sequential borrowing constraints (potentially time varying) which never bind. In other words, we can ensure the transversality condition holds by imposing non-binding credit constraints while still maintaining our hypothesis of an upward sloping interest rate schedule. The non-binding nature of these credit constraints is reflected in our simulation results where for precautionary reasons agents never let their debt accumulate to a point where they approach the credit floor. In our simulations we imposed the constraint that borrowing can never exceed a multiple of 5 times current income and in no case did this bind.

The second regularity issue concerns the differentiability of $\phi(a_{it})$, the interest rate schedule. If there exists a wedge between the deposit and borrowing rate, or if the loan rate jumps at particular levels of debt, $\phi(.)$ is not continuously differentiable. As shown in King (1986) it is still possible to utilise an Euler equation approach, but different Euler equations hold depending upon which segment of the interest rate schedule is relevant. Diáz-Gimènez et al (1992), in considering a model with a deposit rate and only one borrowing rate, abstract from the complications of a wedge in $\phi(.)$ at zero assets by using standard simulation techniques without apparently encountering any problems. However, in order to simplify our analysis we assume $\phi(.)$ is continuously differentiable. In other words, at zero assets the loan and deposit rate are

identical and there are no steps anywhere else in the interest rate schedule. With this assumption we can characterise the consumer's behaviour over all possible asset ranges in terms of a single Euler equation. This in turn enables us to show how an upward sloping interest rate schedule accounts for rejections of the REPIH and to derive analytical expressions for consumption growth considerably increasing the tractability of the model. We believe this assumption is unlikely to be misleading even if jumps/kinks in the interest rate schedule are important empirically. We do not rule out either sharply rising or flat interest rate schedules, therefore we can get arbitrarily close to any interest rate schedule (including credit rationing) while still maintaining continuous differentiability.

Under these assumptions the first order condition for (1) is

$$E_t\beta\frac{u'_{t+1}}{u'_t}\phi_{t+1}(1-\eta_{t+1})=1$$
$$where\ \eta_{t+1} = -\frac{\partial\phi_{t+1}}{\partial a_{t+1}}\frac{a_{t+1}}{\phi_{t+1}} \qquad (2)$$

and u'_{t+1} denotes the marginal utility of consumption at time t+1. For $a_t \leq 0$, $\eta \leq 0$ and (2) shows debtors have faster consumption growth when they are at an upward sloping part of the interest rate schedule. The intertemporal price which determines the slope of the consumption profile consists of (i) a term reflecting the interest rate, ϕ_{t+1} and (ii) the marginal cost of the last unit of a loan, η_{t+1}. When $\eta=0$ (e.g positive asset holdings) (2) collapses to the standard Euler equation under perfect capital markets (e.g Hall (1978)). Altonji and Siow (1987) outline a similar model to (2) but concentrate on the empirical rather than theoretical properties of this specification. They test one implication of (2), an asymmetry in the way consumers respond to income shocks, and find (weak) evidence in support of the model.

Using the budget constraint and assuming a CRRA utility function[6] ($u(c_t) = (c_t^{1-\sigma}/(1-\sigma)$, where σ is the coefficient of relative risk aversion) we can re-write (2) as

$$E_t\beta(\frac{c_{t+1}}{c_t})^{-\sigma}(\phi_{t+1}+\frac{\partial\phi_{t+1}}{\partial a_{t+1}}(\phi_t a_t+y_t-c_t))=1 \qquad (3)$$

[6] CRRA has become standard in the Euler equation literature due to its empirical success. Using this utility function has the disadvantage that our simulations reflect both capital market imperfections and precautionary behaviour but has the obvious advantages of increased realism and the ability to assess the important interplay between these factors.

For debtors facing a rising interest rate schedule ($\phi'<0$) consumption growth depends negatively upon lagged income (as in Hall or Mishkin (1982) and Zeldes (1989)) - higher income/savings last period results in a lower loan rate this period, and a lower loan rate produces a slower rate of consumption growth because of intertemporal substitution. Equation (3) suggests the coefficient on the loan rate should be the same as that for the deposit rate (consistent with Zeldes' (1989) findings), agents still face intertemporal trading opportunities in contrast to the credit rationing model. Kinks in the interest rate schedule can be easily analysed by (2) or (3). For interest rates between steps in the schedule $\eta=0$ and the standard Hall model applies. However at kink points, ϕ' tends to minus infinity and for (3) to hold consumption must tend to cash in hand.

For simplicity the above analysis assumed interest rates depended only on the level of asset holdings, but this can be easily generalised. For instance, the loan rate might depend on the asset-income ratio in which case the relevant intertemporal price is $\phi(a_{t+j}/y_{t+j})+ \phi'(a_{t+j}/y_{t+j})a_{t+j}/y_{t-j}$, so consumption growth depends positively on the debt to income ratio. Equations (2) and (3) also remain valid if $\phi(.)$ is a function of the demographic characteristics of the borrower or other relevant exogenous variables.

(ii) An Analytical Euler Equation

While (2) and (3) are consistent with some of the features of micro-data studies the most important rejection of standard Euler equation models is that the serial correlation properties of rates of return are very different from those of consumption growth (see Singleton (1991)). In this section we derive an analytic expression for consumption growth which can potentially account for these differences.

Assume $\phi=r_t$ for $a_t>0$ and $= r_t e^{-\gamma a_t / y_t}$ for $a_t \leq 0$, so that the borrowing rate rises with the debt/income ratio but is constant for creditors. Assume in the spirit of Hansen and Singleton (1983) that $\Delta \ln c_t$ and $\phi_t(1-\eta_t)$ are jointly distributed log normally so that the Euler equation for debtors is[7]

[7] Using the approximation $\ln(\phi(1-\eta)) = \ln\phi + \ln(1-\eta) \approx \ln \phi - \eta$ for small η.

$$\Delta \ln c_{t+1} = \alpha + \frac{1}{\sigma}\ln(1+R_{t+1}) + \frac{\gamma}{\sigma}\frac{D_{t+1}}{Y_{t+1}} + \epsilon_{t+1}$$
$$\approx \alpha + \frac{1}{\sigma}R_{t+1} + \frac{\gamma}{\sigma}\frac{D_{t+1}}{Y_{t+1}} + \epsilon_{t+1} \quad (4)$$

where D denotes a consumer's debt and $\alpha=(\sigma/2)Var_t(\Delta \ln c_{t+1} - (\phi_{t+1}(1-\eta_{t+1})/\sigma))$. Therefore consumption growth depends positively upon the borrowing rate and the debt to income ratio. Combining (4) with the standard Euler equation for creditors and denoting the proportion of debtors by θ we have

$$\sum \Delta \ln c^{i}_{t+1} \approx \alpha^{*} + \frac{1}{\sigma}r_{t+1} + \frac{\theta}{\sigma}(R^{*}_{t+1} - r_{t+1}) - \gamma\frac{\theta}{\sigma}\frac{D^{*}_{t+1}}{Y^{*}_{t+1}} + \epsilon_{t+1} \quad (5)$$

where a * denotes an average value across debtors and α^{*} is an average over all creditors and debtors. Aggregate consumption growth therefore depends positively upon the deposit rate, the wedge between the borrowing and deposit rate and the debt to income ratio[8]. The presence of both the wedge and debt to income ratio adds significant extra dynamics to consumption over and above rates of return.and also suggests credit may have an important propagation role to play through non-durable consumption.

(iii) Simulation Evidence

In this section we use simulations in order to understand the implications of an upward sloping interest rate schedule under more general conditions than the previous sub-section. The analysis is similar to Section 2 of Deaton (1991) - for stationary income process and under assumptions regarding constant interest rates and discount factors we examine the implications of our model for consumption fluctuations. These simulations enable us to contrast the implications of our model of capital market imperfections with

[8] The left hand side of (5) is the sum of individual changes in log consumption rather than the change in the log of aggregate consumption. As shown by Attanasio and Weber (1993) the difference between these two concepts is Theil's measure of entropy which may itself be an important source of dynamics for aggregate consumption growth. Equation (5) confirms Deaton's (1992) suggestion that liquidity constraints introduce too much heterogeneity to be meaningfully examined using aggregate data. Although the linearity of (4) ensures aggregation to (5) the variance term α will introduce significant cross-sectional and possibly time series variation as will the θ and γ terms.

Deaton's model of credit rationing and also enable us to assess the relative importance of, and interaction between, precautionary saving and liquidity constraints. The aim of this sub-section is to understand the partial theoretical properties of our model before we proceed to a general equilibrium analysis. In a later section we will consider a more empricially based calibration exercise, for now our aim is to draw comparisons with the analysis of Deaton (1991), Section 2.

We assume a CRRA utility function and choose $\beta=1/1.06$ and assume $\ln y_i \sim N(y, \sigma_\epsilon^2)$ where y is interpreted as aggregate income. In other words, each individual experiences temporary i.i.d disturbances around a constant aggregate average income. To simplify our simulations we assume $\phi(a_t) = r$ for $a_t \geq 0$, $= re^{\gamma a}$ for $a_t < 0$ and for this section only we assume r is a constant=0.04 in order to focus more clearly on understanding the effect of an upward sloping interest rate schedule as opposed to the business cycle implications of stochastic variations in rates of return. As $\gamma \to 0$ the model tends to the perfect capital market case while as $\gamma \to \infty$ we come closer to the pure credit rationing model. To solve the model we use the parameterised expectations approach of den Haan and Marcet (1990) and to check the accuracy of our solution we use the test statistic of den Haan and Marcet (1994)[9].

This choice of β and r immediately make clear one important distinctive feature of our model. Under perfect capital markets the standard case to consider is $\beta r=1$. If instead $\beta r>1$, consumption rises continuously financed by rising capital income while if $\beta r<1$ consumers always wish to borrow and roll over infinite amounts of debt violating the no-Ponzi condition. When $\beta r=1$ individual consumption is constant and asset markets are used to smooth out purely idiosyncratic shocks so that individual consumption is correlated more with aggregate than individual income (see Mace (1991) and Cochrane (1991)). However, if $\beta r=1$ but $\gamma>0$ we change dramatically this full insurance property. Even though individuals can borrow i.e. there is no missing market, agents choose never to do so. Instead they accumulate enough initial assets to finance consumption in low income periods rather than go into debt and in this way avoid the higher interest rates associated with borrowing. Therefore when $\beta r=1$ even the smallest slope to the interest rate schedule destroys the full insurance result. To examine the case where consumers hold debt we onsider the case where $\beta r>1$ but $\gamma>0$ such that over some range of debt $\beta\phi(a_t) <$

[9] Solving the model represents a standard application of the PEA (see den Haan and Marcet (1990) for details). We use a third order polynomial in the state vector (the interest rate, asset holdings and the income disturbance) and a convergence criteria of 6 decimal places for the coefficients of the polynomial. To assess the accuracy we sampled 5000 times a 1000 period model and found our solution passed the accuracy test at approximately the 5% level (with 4.6% and 5.2% of simulations in the 5% upper and lower tails respectively).

1. Under these assumptions, consumers will never hold infinite amounts of debt but sometimes let their net assets go negative.

Our simulation results are shown in Table 4. The simulations are based on 1000 periods but all statistics quoted exclude the first 200 observations so as to remove any initial condition effects. Every column is based on exactly the same income sequence so that differences result entirely from variations in the degree of prudence and capital market imperfections. The strength of precautionary behaviour is summarised by σ, the degree of relative risk aversion for which we use the values 1 (the estimate of Attanasio and Weber (1993) using U.K micro data), 5 (the estimate of Acemoglu and Scott (1994) using U.K aggregate data) and an intermediate value of 2. In the absence of any econometric studies we selected values for γ, the slope of the interest schedule, of 0.001, 0.002 and 0.004. These values resulted in "plausible" variation in the interest rates paid by consumers (that is simulated borrowing rates are in the range suggested by Table 3).

Table 4 reveals that an upward sloping interest schedule can potentially account for observed rejections of the REPIH. Consumption is not constant and equal to aggregate income but significantly volatile and for given risk aversion, the steeper the interest rate schedule the more volatile is consumption. This lack of consumption insurance can be seen in the case where σ=1 and individual consumption and income growth are correlated by 80%. As the final column shows this arises because agents only rarely borrow, when γ=0.004 an individual is in debt only 15% of the time, when γ=0.001, 37.4%. Agents hold precautionary balances in part to minimise the likelihood of paying borrowing rates significantly higher than their rate of time preference so the interaction of precautionary behaviour and a rising interest rate schedule deters individuals from ever holding substantial amounts of unsecured debt (debt never rises above 6% of an individual's income in our simulations, compared to the 9% gearing in Banks, Dilnot and Low (1994)). As a result consumers are rarely in the neighbourhood of a credit ceiling. In turn this implies that the distribution of borrowing rates is concentrated in the range 0.04-0.10 with higher values only rarely being experienced. Thus our upward sloping interest rate schedule preserves the findings of Deaton (1991) that precautionary saving means credit constraints bind less often. However, the effect of precautionary behaviour is even stronger in our model - agents save not only to avoid credit constraints but also to avoid high income gearing. As a result the volatility of consumption growth is much more closely tied to income growth than in Deaton's simulations (see his Table 1).

In the absence of risk aversion the impact of credit imperfections on consumption is unambiguous - consumption growth becomes closely tied to income growth and so the volatility of consumption increases. However, when agents are prudent the impact of credit imperfections on consumption depends upon the degree of risk aversion. As risk aversion increases the consumer becomes more concerned about paying higher interest rates. As a consequence, agents accumulate precautionary saving balances so as to offer some insurance against moving into debt and the volatility of consumption falls as does the correlation between consumption and income growth. Notice that our assumption of an upward sloping interest rate schedule makes the precautionary savings induced by capital market imperfections larger. Under credit rationing, consumers accumulate precautionary balances (see Xu (1995) for an analysis) to avoid hitting the credit ceiling. In our model, consumers are not only anxious to avoid the credit ceiling but also the higher borrowing rates implied by the interest rate schedule. As a consequence, comparing the rows of Table 4 we see that for proportional changes in risk aversion and imperfect capital markets it is the precautionary behaviour that dominates. Moving down the columns we see that both the volatility of consumption, its correlation with income and the number of periods in which agents borrow all decline as risk aversion increases.

4. Solving for Consumption and Interest Rates

We now consider a general equilibrium version of our model so that we can examine via simulations the impact of structural and cyclical changes in loan supply. Doing so requires specifying (i) how output is determined (ii) the technology and market structure of FIs (iii) calibrating our model (iv) how to close the model.

(i) *Output Determination*

We assume an endowment economy whereby each individual's income is given by an exogenous stochastic sequence. We concentrate on an endowment economy because our focus is on consumption rather than the investment/debt/asset price channel that has recently been stressed in the literature. The introduction of capital and a means whereby variations in loan supply can affect investment is desirable in future work but would only make identification of a direct credit-consumption link more difficult.

(ii) *Financial Intermediaries*

In this sub-section we specify the technology and market structure of FIs. Rather than attempt to justify the existence of financial intermediaries (see Diamond (1984), Boyd and Prescott (1986)) or a particular model of FI operations, we specify a reduced form model which is consistent with a range of theoretical justifications.

We assume the existence of a loan bank who has access to funds at the rate r_t. This FI loans funds to consumers and we assume each loan of size L_i incurs costs to the loan bank of $\lambda(L_i, w_t)$ where w_t is a stochastic disturbance affecting the efficiency of financial intermediaires and $\lambda_L(.) \geq 0$, $\forall L_i$. The shock w_t is intended to capture events such as an increase in bad loans, asset price deflation or any other event which influences the balance sheets or efficiency of the credit industry. There is free entry into the loan market and loans from different FIs are perfect substitutes. As a consequence a zero profit condition determines that the borrowing rate on a loan of size L_i is

$$R_{it} = r_t + \lambda(L_i, w_t)/L_i \tag{6}$$

The mark up between an individual's borrowing rate and the market deposit rate, μ_i, is therefore $\lambda(L_i, w)/L_i$ which we assume is non-decreasing in L_i. Credit rationing occurs when $\lambda_L(L_i, w_t) \to \infty$ (the interest rate schedule becomes vertical) and the value of L at which λ_L becomes infinite can be thought of as a credit ceiling. We concentrate on L and w as arguments of $\lambda(.)$ although other variables, such as demographic characteristics, will also have a role.

(iii) Calibrating Utility Functions and Income Processes

We assume utility is of the CRRA form and because we no longer use a representative consumer (our simulations aggregate over 1000 consumers, introducing more consumers does not significantly alter our results) we use the estimate of $\sigma=1$ from the U.K microeconometric study of Attanasio and Weber (1993) and choose an annual discount rate of 6%. On aggregate data, the logarithm of U.K labour income follows an ARIMA(1,1,0) process with AR coefficient equal to 0.2. In specifying individual income we follow Deaton (1991) in assuming

$$\ln y_{it}=\ln y_{it-1}+\alpha+\epsilon_{at}+\chi\epsilon_{at-1}+u_{it}+v_{it}-v_{it-1} \quad (7)$$

where ϵ_{at} is an aggregate income shock, u_{it} and v_{it} are idiosyncratic shocks and α is the trend rate of growth in labour income. This specification implies individual income is the sum of a common IMA(1,1) component, a purely idiosyncratic random walk and a transitory white noise term. Deaton (1991) chooses α and χ so that (7) matches the properties of U.S aggregate and micro income studies. Unfortunately, there are no micro labour income studies for U.K data, we therefore select α and χ so that (7) matches UK aggregate and U.S micro data. This involves α=0.02, χ=0.21 and an annual variance for U.K aggregate labour income shocks of 0.021.

(iv) *Does the loan market close?*

To solve the model we use den Haan and Marcet's (1990) solution algorithm to derive individual decision rules[10]. This technique requires specifying laws of motion for all the exogenous variables, which for the consumer includes the interest rate. However, in a general equilibrium model the interest rate process cannot be specified separately from the consumer's optimal consumption decisions. This raises the issue of what assumptions we make regarding how the loan market clears. One assumption is to assume that every period the demand for consumer loans equals the supply of deposits so that

$$\begin{gathered}\int a_{it}dx=0 \\ \text{and} \\ \int c_{it}dx+\int_{i\in S\,:\,a_{it}<0}\lambda(L_{it},v_t)L_{it}=\int y_{it}dx\end{gathered} \quad (8)$$

In this case, the personal sector is like a closed economy as aggregate consumption plus the total cost of intermediation must equal aggregate labour income. For plausible assumptions on $\lambda(.)$ FI costs are small and (8) implies aggregate consumption is approximately equal to aggregate income. As a result financial innovation only impacts on lending and borrowing rates and not the dynamics of consumption which are always determined by income, limiting our ability to examine the business cycle implications of variations in loan supply on consumption. A similar problem relates to analysing financial innovation. When aggregate income is independent of financial innovation the main impact of an increased ability to borrow is a change

[10] We solve for a fixed polynomial using 50000 observations and a convergence criteria of 1e-7, and then performed 1000 replications of a 500 period model to assess the accuracy of our simulation using den Haan and Marcet (1994), finding a third order polynomial to be accurate.

in the structure of deposit and loan rates rather than an increase in consumption. Consider two economies in which the borrowing rate depends positively on an individual's debt-income ratio i.e. $R_t=r_t e^{\gamma a_t/y_t}$ but in one economy $\gamma=0.9$ and the other, which benefits from less capital market imperfections, $\gamma=0.1$ (these parameters, justified in section 5, are significantly larger than in Section 3 because in the case of non-stationary income the schedule must be defined by the debt-income ratio to ensure the stationarity of the borrowing rate). Simulating these economies[11] we find the economy with the steeper interest rate schedule has a much higher average mark up of the borrowing rate over the deposit rate (3.5% as compared to 1.3%). However, the deposit rate in the economy with less imperfect capital markets is considerably higher (4.1% against 1.4%). In both models the borrowing rate is similar, it is the deposit rate and wedge that differ with the model with greater capital market imperfections requiring a lower deposit rate to ensure asset market equilibrium (see Huggett (1993) for a similar point in relation to the equity premium puzzle).

Therefore, to break the link between consumption and income and so enable financial innovation or "credit crunches" to have a substantial impact on consumption it is necessary to assume the personal loan market does not clear. As a consequence, we assume FIs have access to savings from a global capital market such that r_t is the world real interest rate. In our simulations we specify this world interest rate as an exogenous stochastic process obtained by fitting an AR(1) model to a GDP weighted average of G7 interest rates over the period 1970-1994. Note that while the deposit rate r_t is exogenous, the borrowing rate is still determined endogenously. Obviously if the personal loan market does clear then our findings represent overestimates of the impact of loan supply on consumption fluctuations. However, given the openness of the U.K economy, and particularly its financial sector, we believe this is an unlikely source of error.

5. Cyclical Loan Supply

In this section we simulate our model to gauge the impact of cyclical variations in loan supply on consumption. Because our intention is for these simulations to have some empirical relevance we calibrate our model using U.K data We consider two different economies which differ in the degree of capital market imperfection : one economy has a steeply sloped interest rate schedule and the other a relatively flat

[11] An appendix explains the non-trivial solution procedure. Our previous simulations used a standard application of the PEA solution technique but this is not applicable in this model. The problem arises due to the fact that individual's decision rules depend upon the stochastic process for interest rates which in turn depends upon all individual consumption decisions. We therefore use a recursive procedure until a fixed point is reached.

schedule. The motivation for this latter issue is that after a significant period of financial deregulation in the 1980s, the early 1990s witnessed a deep and prolonged global recession and heightened fears of financial collapse (see Feldstein (1991)). This suggests, and is confirmed by our simulations, that economies with more perfect capital markets are more susceptible to "credit crunches". While we calibrate our model on U.K data our aim in this section is not to try and precisely match the time series properties of U.K consumption and credit. Instead our aim is to use our model to try and assess the relative orders of magnitude of changes in loan supply on consumption.

We maintain the same functional form for $\phi(.)$ but where the debt income ratio rather than debt defines the slope of the interest rate schedule i.e $R_t = r_t e^{\gamma a_t/y_t + w_t}$. To introduce cyclicality into loan supply we assume

$$w_t = -\psi(\epsilon_{at} + \chi\epsilon_{a}) + \rho w \tag{9}$$

Equation (9) introduces two channels of persistence and cyclicality in loan supply and loan rates. If $\psi>0$ the efficiency of FIs varies over the cycle such that the borrowing wedge is countercyclical. In all our simulations $\psi=0.1$ so that the contemporaneous correlation between income growth and the borrowing wedge is consistent with U.K data[12]. To introduce additional persistence in the borrowing wedge we also allow $\rho>0$. The w_t term is intended to capture the impact on borrowing rates of any events which alter the ability of FI to lend. As the experience of the early 1990s have shown, conditions such as weak balance sheets can persist for extended periods of time potentially making w an autoregressive process (this cyclical feature is stressed in the theoretical work of Kiyotaki and Moore (1995)). To calibrate the persistence of w we regressed the borrowing rate on the deposit rate and the debt-income ratio (this specification motivated by our choice of ϕ) allowing (via maximum likelihood) for an AR(1) error process. The point estimate of ρ was 0.58 but with a standard error of 0.165. In order to allow cyclical variations in loan supply to have as large an influence as possible on consumption we assume $\rho=0.9$, at the top of the 95% confidence interval. This makes variations in the interest rate wedge highly persistent and serves to place an *upper* bound on the impact of credit on consumption fluctuations. If $\rho<0.9$ then the wedge will be less persistent and the cyclical impact of variations in loan supply on consumption will be lower than that calculated below.

[12] On U.K data both the wedge and the borrowing rate are counter-cyclical , the borrowing rate having a correlation of -0.25 with consumption growth and -0.22 with GDP growth. The wedge has a contemporary correlation of -0.28 with consumption growth, and correlations of -0.22 and -0.20 for consumption one and two years ahead respectively.

We examine the impact of cyclical fluctuations in loan supply under two different assumptions for capital markets. In one case γ=0.9 and the interest rate schedule rises sharply while in the other γ=0.1 and capital markets operate more efficiently. These values are chosen to represent the U.K economy in 1979, before exchange controls were lifted and financial deregulation began, and in 1993 when the whole deregulation process seemed to be at an end. These values are taken from Scott (1995) who estimates a time varying parameter model for (5) on annual U.K data for the period 1971-1991. Because of the extreme shortage of degrees of freedom and the heroic aggregation assumptions required for these estimates we do not quote them here but simply use the estimated profile for γ as a guide to calibrating our model. Choosing these two scenarios enables us to assess the extent to which economies which have undergone financial deregulation are more or less sensitive to changes in loan supply.

Fig. 1 shows these two models subject to the same exogenous sequence for world interest rates and a negative aggregate income shock in period 2. In the period of the adverse income shock (which sets in motion a *positive* shock to the interest wedge through (9)) both economies experience a sharp fall in consumption, with the economy with the steepest interest rate schedule declining the most. Consumption falls because agents build up their balances aware that borrowing rates will be high in the next few periods. The next period consumption growth is determined by intertemporal substitution effects and so the economy with the most imperfect capital markets (and highest intertemporal price) has the fastest consumption growth. However, the economy with more efficient capital markets experiences the biggest cumulative consumption loss from the move into recession . The reason for this larger welfare loss is simple, when capital markets are more efficient consumer debt is greater so the economy is more sensitive to a shock to FIs. In other words, the bigger is the FI industry the more sensitive the economy is to a shock to this sector. Therefore even though financial deregulation offers consumers the ability to increase their consumption smoothing over the business cycle, if FIs themselves are hit by aggregate shocks an additional source of cyclicality in consumption is introduced.

These results therefore suggest non-durable consumption can act as an additional propagation mechanism to investment/durable expenditure in the presence of credit cycles. However, our simulations suggest this effect is quantatively small. This is due to a combination of factors. Firstly, for "credit crunches" to have a substantial impact upon consumption agents need to be highly leveraged but in the presence of both precautionary behaviour and an upward sloping interest rate schedule this is not the case for consumer

debt. As a result credit crunches have only a small income effect on consumption. Secondly, estimates of the intertemporal elasticity of substitution suggest either a modest or small value. This leads to only small substitution effects and so non-durable consumption responds only slightly to the higher borrowing rates associated with credit crunches.

6. Financial Deregulation

During the 1980s the U.K experienced substantial financial deregulation. Beginning in 1979 with the removal of exchange controls and followed in 1980 with the abolition of the 'corset', a device for penalising bank lending, a series of events contributed to increase competition and potentially loan supply. As a consequence, between 1980 and 1989 consumer credit rose from 4.9% of GDP to 9.5% and mortgage debt from 32% to 58%. In 1975 total liabilities of the household sector represented 55% of disposable income, by 1990 this had risen to 114%. Fig. 2 shows the impact of this financial deregulation on the mark up between the deposit and borrowing rate. Between 1981 and 1985 this mark up fell by 8.2%, more than halving in absolute terms. Figs. 3 and 4 show growth in non-durable U.K consumption and income over this period as well as the savings rate and the consumer credit to income ratio. From 1982 onwards consumption grew strongly and for much of the period outpaces income leading to the dramatic fall in the savings rate shown in Fig. 4. There exists a substantial debate over whether this surge in consumption was a direct result of financial deregulation or whether the crucial factor was an increase in income expectations (see Muellbauer and Murphy (1990), King (1990) and Attanasio and Weber (1994)).

In this section we use our model economy to investigate the relative impact of financial deregulation and income expectations. We stress our intention is not to investigate whether a calibrated version of our model is able to exactly mimic the post-war experience of the U.K economy, our focus on an endowment economy rules out such an exercise. Instead, our aim is to use our theoretical model to establish some orders of magnitude for the influence of financial deregulation and revisions to income expectations. We compare two different economies : in one scenario the interest rate schedule becomes progressively flatter as γ falls from 0.9 to 0.1 in steps of 0.1 over an 8 year period. Under the other scenario the economy experiences the same process of deregulation but two years into this process experiences a permanent increase of 1% in its long run growth rate (from 2.2% to 3.2%, motivated by the fact that average U.K income growth between 1984 and 1988 was approximately 1% above its post-war trend). These model

economies were simulated for 100 periods, with financial innovation beginning in year 50 (shown as period 0 in Figures 5 - 6) and with long run income growth changing in period 52 (the same timing as for the U.K). To enable comparison the same income shocks and interest rate sequence were assumed for both models. The figures show the average outcome over 500 simulations.

Figs. 5 and 6 show the simulations relative to the case of no financial deregulation or increased income growth (e.g 1% in Fig. 5 reveals that consumption growth is 1% higher relative to the no innovation/no change in trend income growth scenario). Fig. 6 confirms the obvious result that the economy which experiences both increased long term growth and financial deregulation experiences the largest increase in credit. Fig. 5 shows consumption growth under the various scenarios. To understand this figure it is necessary to distinguish between the income effect of financial deregulation which increases consumption (due to lower debt payments) and the substitution effect, which leads to lower consumption growth due to a lower relative intertemporal price. During the initial period of deregulation consumption rises more rapidly than it otherwise would have done due to the income effect but as deregulation proceeds and consumption adjusts to its new optimal level consumption growth is actually slower after deregulation due to the substitution effect. However, as was the case with cyclical variations in loan supply the difference between the two consumption profiles (with and without deregulation) is nowhere large. This is due to the combination of high levels of risk aversion, which means that consumers hold little debt and so lessening the income effect of financial deregulation, and low estimates of the intertemporal elasticity of substitution which minimises the substitution effects of deregulation. In addition, not only are each of these effects relatively small but they are also offsetting leading to an even smaller overall impact.

By contrast, Fig. 5 suggests income revisions lead to a much more dramatic change in consumption and savings behaviour. In period 2, when income growth increases permanently, consumption growth is 1.6% higher when upwards revisions to permanent income are combined with deregulation (compared to 0.4% without income revisions). Increases in aggregate income growth affect everyone and also in an unambiguous manner leading to a significant effect on aggregate consumption. Thus our results offer some support to the findings of Attanasio and Weber (1994) who claim the U.K consumption boom of the late 1980s was more attributable to income revisions than financial liberalisation. An obvious caveat to this conclusion is that ours is an endowment economy. As stressed by King and Levine (1993) growth in FIs may stimulate capital accumulation and growth such that perhaps financial innovation itself was responsible

for the surge in U.K income shown in Fig. 4. However, two points go against this. Firstly, our model suggests savings decrease during a period of deregulation, so that there is less capital accumulation. Secondly, the largest estimate in King and Levine (1993) of the elasticity of GDP growth with respect to changes in the debt to GDP ratio is 0.024. If we assume that *all* of the 20% rise in this ratio between 1979 and 1991 was due to an increase in loan supply this only leads to an increase in long run GDP growth of 0.4%, insufficient to explain the magnitude of consumption changes in Fig 4.

7. Conclusion

The aim of this paper has been to assess whether imperfections in capital markets lead to variations in loan supply having a substantial direct impact on consumption. Crucial to this task is an adequate characterisation of credit market imperfections. Using U.K loan market data we argue the market is best characterised by an upward sloping interest rate schedule such that consumers can always borrow more but at ever higher interest rates. Studying the implications of this interest rate schedule on optimal consumption we find the model can account for numerous rejections of the REPIH, in particular an excess dependence of consumption on income and the different serial correlation properties of consumption growth and rates of return. Under certain distributional assumptions we showed how consumption growth depends on the deposit rate, the borrowing wedge and the debt to income ratio. However, our simulations reveal that due to an interaction between an upward sloping interest rate schedule and precautionary behaviour the impact of cyclical variations in credit supply on consumption is limited. To avoid having to pay high borrowing rates consumers accumulate precautionary balances and as a consequence they hold little debt and so are little affected by variations in loan supply. Interestingly the more efficient are capital markets (i.e. the flatter the interest rate schedule) the larger the impact of "credit crunches". We also used our model to assess the response of consumption to financial deregulation and find that structural changes to the efficiency of loan intermediaries can have a significant effect on consumption. However, for our model economy to show abrupt shifts in consumption growth, similar to the U.K experienced in the late 1980s, substantial upwards revision to income expectations are needed rather than financial deregulation alone. Financial deregulation produces offsetting income and substitution effects on consumption which produce a significant cumulative effect but not a large short run impact.

In arriving at these conclusions we made strong assumptions regarding the existence of an upward sloping

interest rate schedule, its differentiability and the absence of market clearing in the consumer loan market. An obvious issue is how dependent our conclusions are on these assumptions. If loan markets are characterised by a binding credit constraint then variations in loan supply will be more important so long as the borrowing rate is not too large relative to the deposit rate. With a flat interest rate schedule agents are not discouraged from increasing their debt and will be closer to their credit ceiling. However, the evidence of Table 3 shows there is not a single borrowing rate but a multitude which rise quite sharply. It is these high and increasing borrowing rates that persuade consumers to hold only small amounts of debt. We argued in the text that our differentiability assumption was not as extreme as it appeared because it still enables us to approximately arbitrarily well any interest rate schedule which contains discrete jumps. Allowing discrete jumps will change some of the details of our simulations but will not change our intuition. The final assumption we made was that the consumer loan market does not necessarily clear. However, dropping this assumption will only serve to lessen the impact of "credit crunches" on consumption - by assuming the personal loan market does not clear we place an upper bound on the consumption effect. All of this suggests that our finding that consumption responds little to "credit crunches" is robust to a wide range of loan market models, confirming the current consensus is correct in focusing on credit and investment as the more important propagation mechanism.

Appendix - Using Parametrised Expectations to Solve a General Equilibrium Model

Assuming a CRRA utility function our Euler equation is

$$(\frac{c_{it}}{y_{it}})^{-\sigma}=E_t(\frac{c_{it+1}}{y_{it+1}})^{-\sigma}\Phi_{it+1}(1-\eta_{it+1}) \tag{10}$$

Using the PEA we substitute a polynomial in the state variables for the right hand side of (10) e.g

$$(\frac{c_{it}}{y_{it}})^{-\sigma}=f(x_{it}, r_{it}) \tag{11}$$

where we have drawn a distinction between r_t, the interest rate paid on deposits (the borrowing rate simply being a function of the deposit rate), and $\mathbf{x}_{it}$ a vector of all other state variables. Assuming that the polynomial f(.) is separable such that $f(\mathbf{x},r)=g(\mathbf{x})h(r)$ we have

$$c_{it}=y_{it}g(x_{it})^{-\frac{1}{\sigma}}h(r_t)^{-\frac{1}{\sigma}} \tag{12}$$

Our market clearing condition is that

$$\int a_{it+1}d\Delta_i=0 \qquad \forall t \tag{13}$$

Summing across all agents' transition equations we have

$$\int\Phi_t a_{it}d\Delta_i+\int y_{it}d\Delta_i=h(r_t)^{-\frac{1}{\sigma}}\int y_{it}g(x_{it})^{-\frac{1}{\sigma}}d\Delta_i \tag{14}$$

From our market clearing condition it must be the case that

$$r_t\int_{i:S\in\, a_{it}>0} a_{it}d\Delta_i=r_t\int_{i:S\in\, a_{it}<0} a_{it}d\Delta_i \tag{15}$$

and utilising our assumption that the borrowing rate $R_t = r_t e^{-\gamma a_{it}/y_{it}}$ we can re-write (14) as

$$r_t\int_{i\in S:\ a_{it}<0} a_{it}(e^{-\gamma a_{it}/y_{it}}-1)d\,\Delta_i=h(r_t)^{-\frac{1}{\sigma}}\int y_{it}g(x_{it})^{-\frac{1}{\sigma}}d\Delta_i-\int y_{it}d\,\Delta_i \tag{16}$$

when h(.) is linear and $\sigma=1$ (16) can be solved relatively easily for the period t equilibrium interest rate. Therefore the PEA approach is to assume a stochastic process for interest rates and a given polynomial and construct consumption data via (11) and then use (16) to solve for the equilibrium interest rate. Having arrived at a new polynomial using the standard PEA approach the process is started again but where the stochastic process for interest rates is now given by the solved values for r_t given from (17). The process is continued until the stochastic process for interest rates generated by (16) is consistent with the process assumed in (11). We have not attempted to prove either convergence or uniqueness of the fixed point. However, for our model while the approach was very computationally intensive it did converge on an

apparently sensible solution.

Table 1 : Consumer Credit Outstanding, £m 1990 Prices

Year	Bank Personal Loans	Credit Card Loans	Non-Bank Credit Company Loans	Building Society Loans	Retailers' Loans
1980	16073	2670			2979
1981	16816	2575	1877		2722
1982	19210	3079	2007		2734
1983	21424	3751	2665		2793
1984	24120	4591	3052		2777
1985	26674	5403	3689		2883
1986	30242	6618	4519		2541
1987	34655	7266	5201	85	2643
1988	39037	7624	5261	323	2708
1989	41669	7713	5559	618	2535
1990	42672	9012	5480	779	2447
1991	40876	9188	5170	689	2354
1992	38655	8895	4517	668	2310
1993	36099	9179	5523	677	2305

Table 2 : Distribution of Debtors by Income and Age

Income Band	Proportion	Age Band	Proportion
None	0.28	<25	0.38
<£2500	0.16	25-29	0.43
£2501-4500	0.24	30-34	0.40
£4501-6500	0.22	35-39	0.40
£6501-7500	0.23	40-44	0.31
£7501-9500	0.29	45-49	0.26
£9501-11500	0.32	50-54	0.15
£11501-13500	0.32	55-59	0.13
£13501-15500	0.38	60-64	0.07
£15501-17500	0.43	65-69	0.06
£17501-20000	0.40	70+	0.03
£20001-25000	0.39		
£25001-35000	0.37		
£35000+	0.35		

Columns show proportion of each income and age band who report negative net financial assets. Source: Banks. Dilnot and Low (1994).

Table 3 : Personal Sector Interest Rates, 10/90-1/94

Date	Base Rate	Deposit Rate	Mortgage Rate	Personal Loan Rate	Credit Card Rate
10/90	14.0	12.3	15.4	26.9	32.1
4/91	12.0	9.9	13.8	26.9	28.1
7/91	11.0	8.9	12.5	23.6	28.1
5/92	10.0	7.8	11.0	22.6	28.1
8/92	10.0	7.2	10.7	22.6	26.8
10/92	8.0	5.0	10.7	22.1	26.8
12/92	7.0	4.0	9.3		25.3
3/93	6.0	3.0	8.0		23.1
1/94	5.5	2.75	7.6		22.3

Personal Loan rates not available after 10/92.

Table 4 : Partial Equilibrium Simulation Evidence

	$\sigma_{\Delta \ln C}$	Cor($\Delta \ln C_t$, $\Delta \ln Y_t$)	Cor($\Delta \ln C_t$, $\Delta \ln Y_{t-1}$)	Cor($\Delta \ln C_t$, $\ln Y_{t-1}$)	Maximum Interest Rate	Mean Interest Rate	Proportion of periods agent borrows
σ=1, γ=0.004	0.109	0.788	0.057	-0.223	1.32	1.049	0.153
σ=1, γ=0.002	0.098	0.785	0.047	-0.209	1.22	1.049	0.238
σ=1, γ=0.001	0.087	0.781	0.037	-0.191	1.15	1.048	0.374
σ=2, γ=0.004	0.090	0.712	0.142	-0.110	1.36	1.049	0.108
σ=2, γ=0.002	0.079	0.719	0.115	-0.106	1.24	1.048	0.167
σ=2, γ=0.001	0.065	0.727	0.079	-0.100	1.15	1.048	0.278
σ=5, γ=0.004	0.084	0.571	0.299	0.052	1.36	1.048	0.105
σ=5, γ=0.002	0.067	0.595	0.241	0.049	1.24	1.047	0.132
σ=5, γ=0.001	0.042	0.640	0.138	0.030	1.15	1.046	0.143

σ refers to the coefficient of relative risk aversion, γ determines the slope of the interest schedule where for $A_t<0$, $r_t=re^{-\gamma a}$ where r=1.04. Corr(.) denotes the correlation between two variables, Maximum interest rate is the highest interest rate paid by the consumer over the 1000 period simulation, mean interest rate is the average over all periods paid and the final column denotes the proportion of periods in which the consumer held negative assets. For all rows the same incomes draws were used, this sequences has a variance for $\Delta \ln y_t$ of 0.10.

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Figure 1 : Consumption Growth and "Credit Crunch"

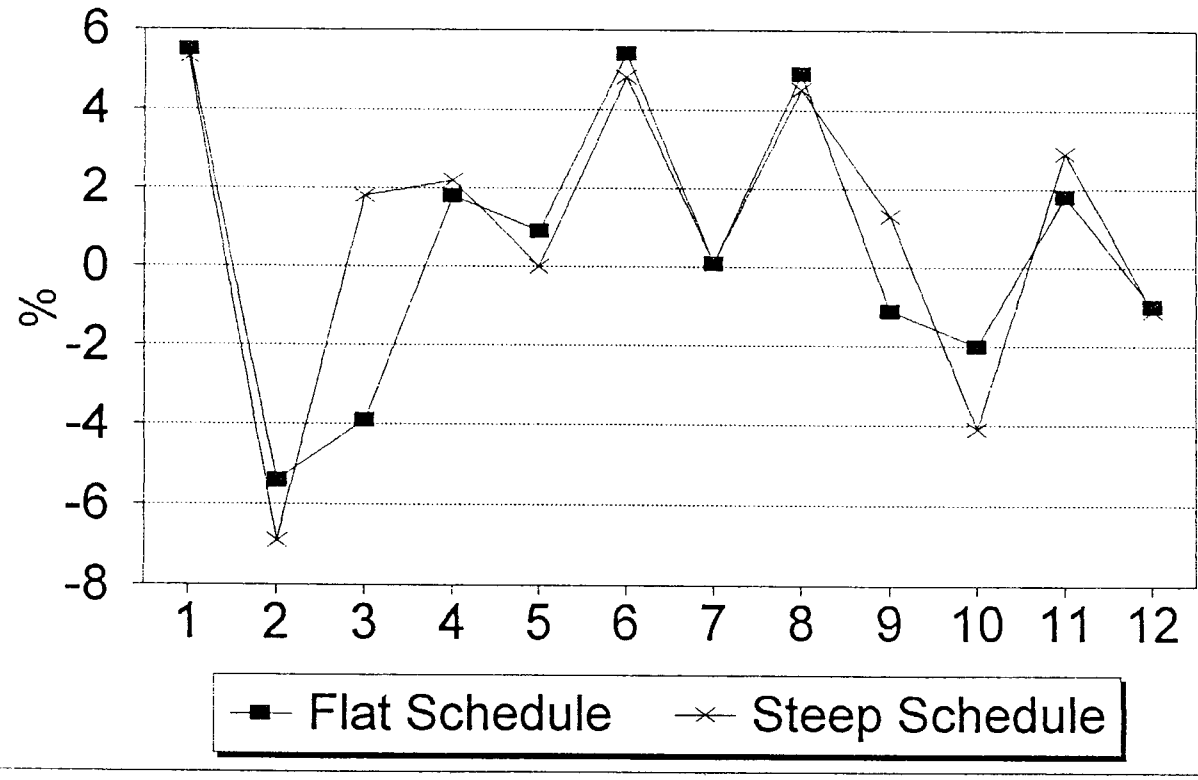

Figure 2 : Mark up of Borrowing Rate over Base Rate

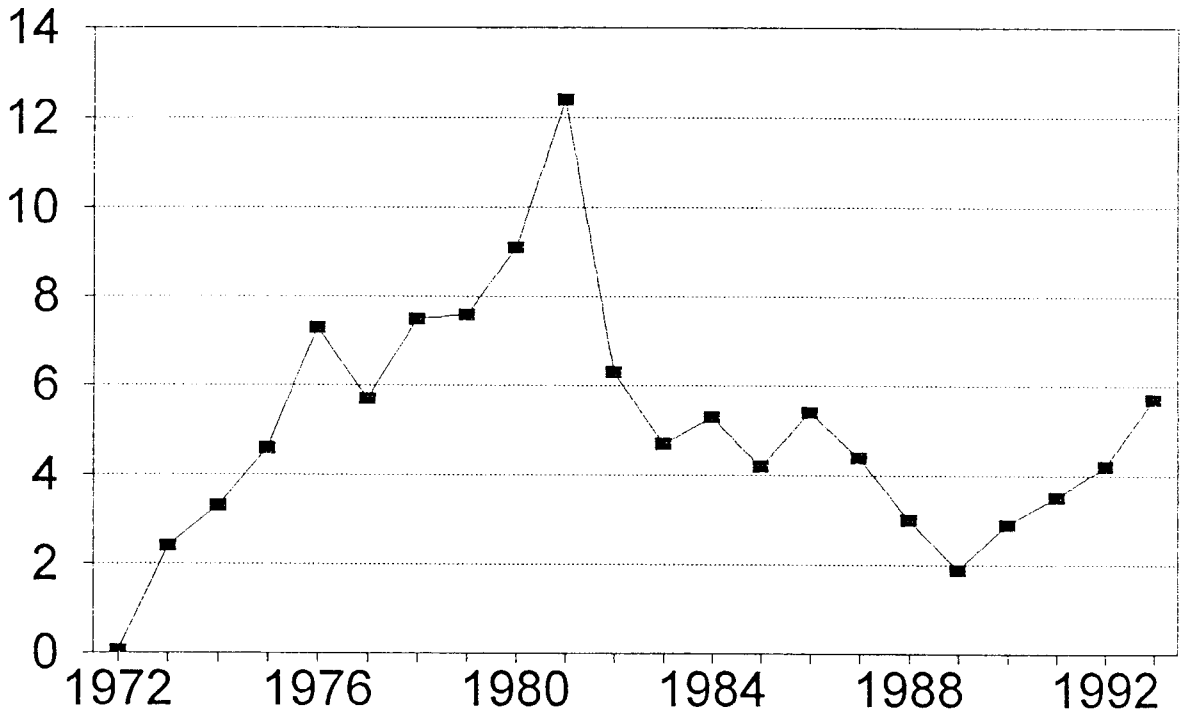

Figure 3 : U.K Non-durable consumption and labour income growth

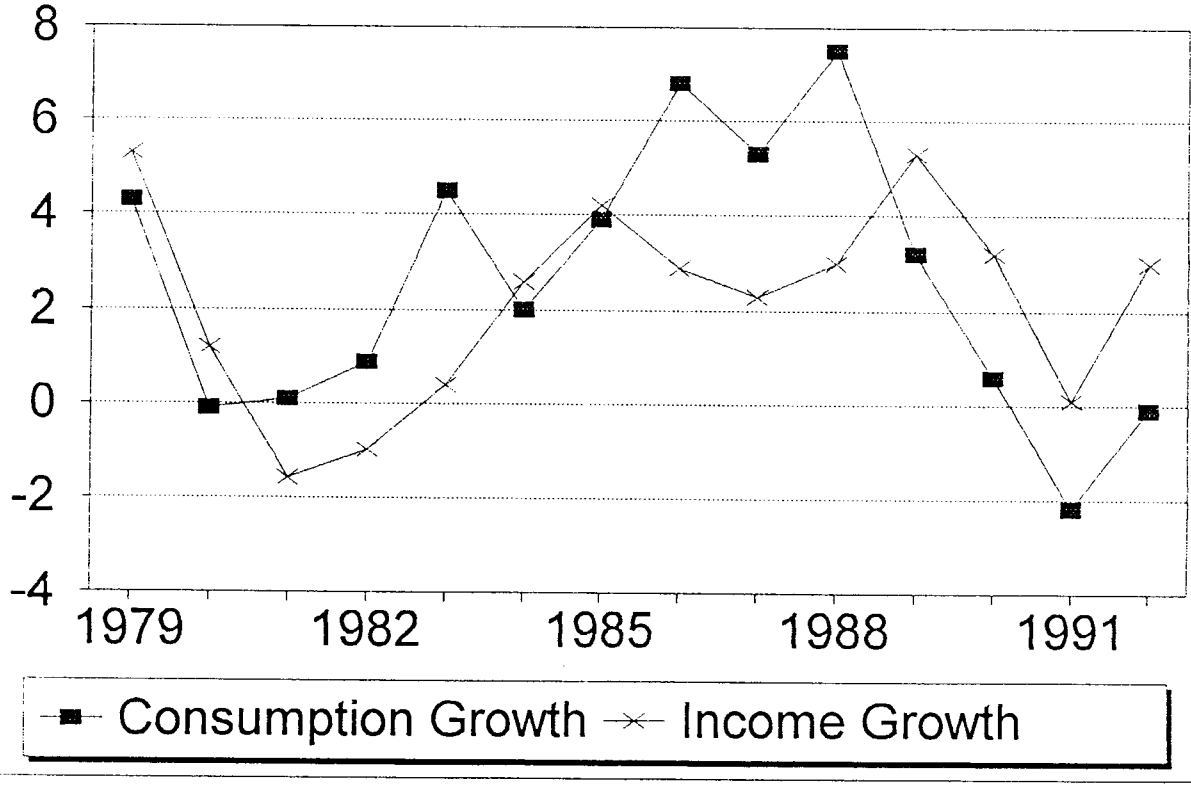

Figure 4 : Saving Rate and Credit to Income Ratio

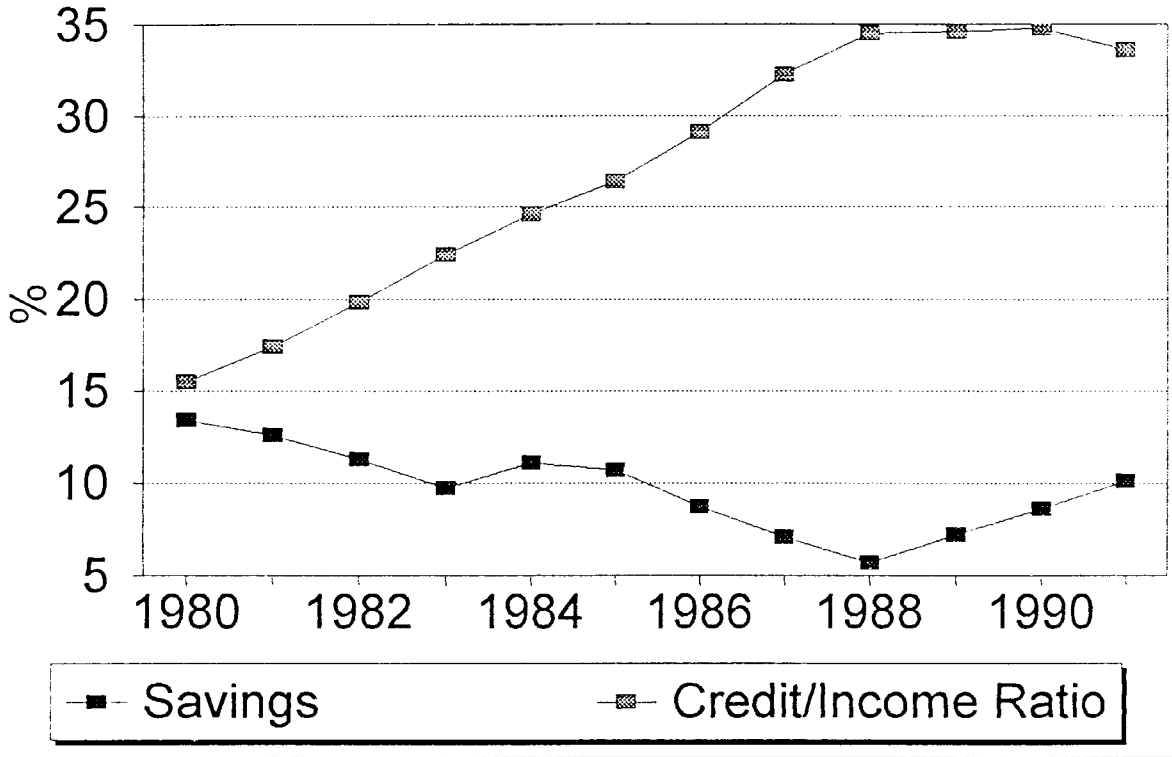

Figure 5 : Consumption, Financial Deregulation and Income Revisions

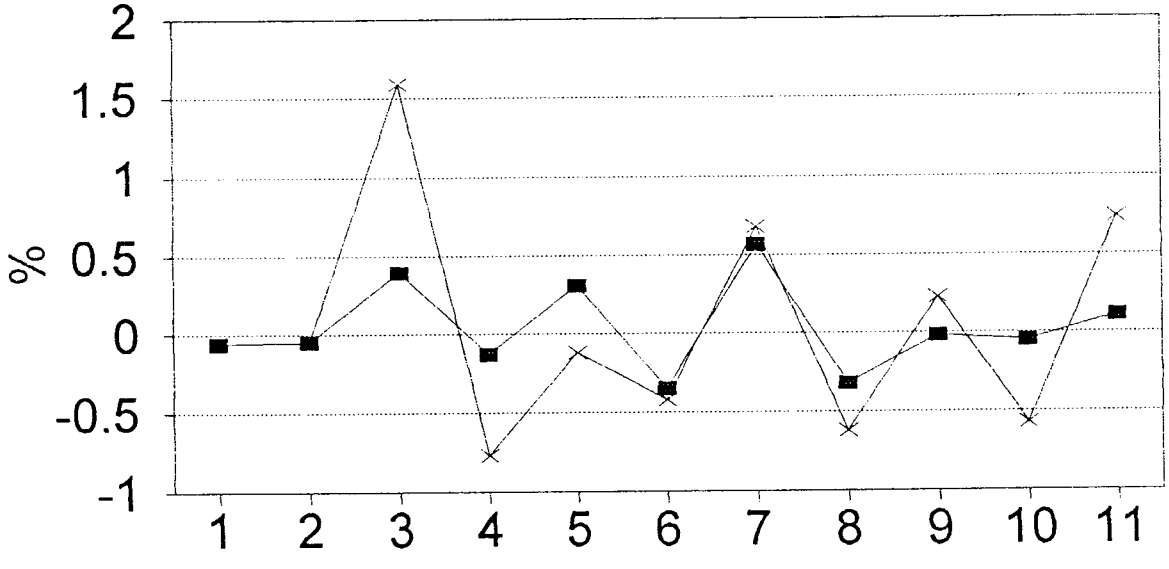

Figure 6 : Credit, Financial Deregulation and Income Revisions