Financial Liberalization, Consumption and Debt in South Africa.*

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Abstract: South Africa experienced substantial rises in the ratios of consumption and household debt to income from 1983, for which conventional explanations in terms of income, income expectations, interest rates and wealth prove inadequate. This paper emphasizes the role of substantial financial liberalization, which is of interest for two reasons. The first is to help understand South Africa's low saving rate, an endemic problem. The second is that unlike the UK, Scandinavia, Mexico and other countries, South Africa's financial liberalization occurred without an asset price boom, thus illuminating the direct role of financial liberalization. Previous attempts to model financial liberalization are not fully satisfactory. Our methodological innovation is to treat financial liberalization as an unobservable, proxied by a spline function, and entering both consumption and debt equations, which are jointly estimated. We also clarify the multi-faceted effects of financial liberalization on consumption. The comprehensive solved-out consumption function uses our own constructed set of personal wealth estimates at market value and income forecasts from a forecasting equation (allowing underlying macro-fundamentals to enter the model). The empirical results corroborate the theory in the paper, confirming the importance for consumer spending of extensive financial liberalization, of fluctuations in a range of asset values and asset accumulation, and of income expectations. Results suggest that households largely pierce the corporate veil. The paper also throws important light on the monetary policy transmission mechanism in South Africa.

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1. Introduction

Although the implications of financial liberalization have aroused interest, controversy, and a growing literature (such as Bayoumi 1993a, 1993b; Schmidt-Hebbel and Serven 1997; Bandiera et al 2000; Honohan 1999), there has not been an entirely satisfactory applied analysis of these implications in the consumption literature. One major difficulty has been to find an indicator of credit market deregulation with which to model the direct and interaction effects of financial liberalization.

We distinguish three facets of financial liberalization, which the previous literature does not bring out clearly. Financial liberalization reduces credit constraints on households engaging in smoothing consumption when they expect income growth; reduces deposits required of first-time buyers of housing; and increases the availability of collateral-backed loans for households which already possess collateral. Financial liberalization makes possible greater borrowing, and this can give rise to asset booms, which make further borrowing and spending possible. The consumption to income ratio can rise sharply, as seen in the U.K. and Scandinavia in the 1980s, and Mexico in the 1990s. In this paper, we introduce several methodological innovations in the measurement of the effect of financial liberalization on consumption, and apply these to South African data.

Since the early 1980s, South Africa has experienced substantial rises in the ratios to income of consumption and household debt (Figure 1). Conventional explanations in terms of income, income expectations, interest rates and wealth prove inadequate. This paper argues that South Africa's extensive financial liberalization is an essential part of the explanation, and is particularly interesting for two reasons.

First, low saving rates, especially in the personal and government sectors, are the symptom of a persistent structural weakness in South Africa (see Aron and Muellbauer, 2000), which in the 1990s has been reflected in high real interest rates and dependence on capital inflows. Second, in South Africa, unlike in the U.K., Scandinavia, Mexico and other countries, real house prices have declined almost continuously (from 1984), despite the process of financial liberalization. This makes it easier to identify the direct effects of financial liberalization on consumption, disguised in other countries by the correlation with asset prices.

The most comprehensive South African consumption function to date comes from the South African Reserve Bank (SARB) model (Pretorius and Knox, 1995), where an error correction approach is employed to model separately the four components of consumption, durables, semi-durables, non-durables and services. Absent from this model are relative prices, assets and debt, proxies for expectations and measures of financial liberalization. These are important omissions. Fluctuations in asset prices and changes in financial liberalization can lead to huge forecasting errors when these variables are absent (Muellbauer and Lattimore, 1995). The omission of asset stock variables is not surprising since the SARB does not construct these measures, but this makes it impossible to test rigorously whether households "pierce the corporate veil".

Our paper remedies most of these problems in estimating quarterly personal consumption models for South Africa of the solved-out type (as opposed to the Euler equation form). An important innovation in this paper is to treat financial liberalization as an unobservable indicator entering both consumption and debt equations. This indicator is proxied by a linear spline function and the parameters are estimated, subject to cross-equation restrictions, from a joint estimation of the household consumption and debt equations. Indeed we find evidence that both the consumption function and debt equation are subject to major structural breaks when allowance is not made for financial liberalization.

In contrast, most econometric models (e.g. Bank of England, 1999; Brodin and Nymoen, 1992) do not attempt to distinguish the direct effects of financial liberalization on consumption from wealth effects. This can lead to exaggeratedly large estimates of, for example, housing wealth effects on consumption, and subsequent model failure.

Further, while consumption theory puts great weight on income expectations, expectations are hardly ever treated empirically in modelling consumption functions of the solved-out form. We generate income forecasts from a separate income-forecasting model (including equity prices, interest rates, capacity utilisation, and government budget surpluses as regressors), which will also capture shifts, for instance, in monetary policy. This model generates linkages between personal sector and government sector saving rates, missing in previous work. By incorporating important regime shifts in the economy, the resulting consumption function should be fairly immune from the Lucas critique.

Finally, although there is a theory on asset liquidity and illiquidity, assets are frequently neglected in consumption modelling, or else are treated somewhat cavalierly, by adding up all assets as if they had equal "spendability". We have elsewhere constructed wealth estimates on a market value basis, in what appears to be the first systematic attempt to construct such figures for South Africa (Muellbauer and Aron, 1999). Wealth is disaggregated into liquid and illiquid wealth measures, and the reweighted components of personal sector wealth and debt variables are used in our models: gross liquid assets, personal sector debt, and financial and physical illiquid assets.

Our research also throws light on the monetary transmission mechanism in South Africa, highlighting some of the policy dilemmas faced by the Reserve Bank. The main three transmission channels are, first, the direct effect of interest rates on consumption, given income, income expectations and assets; secondly, the indirect effects via income and income expectations; and finally, indirect effects via asset prices. We quantify the first two of these, and part of the third, through our estimated asset effects.

2. Theoretical Foundations of the Consumption Function

Since the seminal paper of Hall (1978), the permanent income hypothesis (PIH) for an infinitely-lived representative agent endowed with rational expectations (RE) has exerted a powerful influence on empirical work on consumption. Under a number of simplifying assumptions Hall derived a martingale property for the intertemporal efficiency condition on consumption, or the Euler equation:

$$c_t = c_{t-1} + e_t \qquad (2.1)$$

where ε_t is a stochastic variable, unpredictable from information dated t-1, capturing news about permanent income. Note that equation (2.1) embodies the extreme consumption smoothing implication of the PIH, since at t-1, the consumer plans future consumption levels to be the same as the current level.

Solving this efficiency condition and its equivalents for all future periods gives the solved-out form of the consumption function

$$c_t = rA_{t-1} + y_t^P \qquad (2.2)$$

where y_t^P is expected permanent non-property income, r is the real rate of return, and A_{t-1} is the real asset stock at the end of the previous period.

Making explicit and generalising all the assumptions leading to equations (2.1) and (2.2) essentially defines much of the consumption research agenda of the last 20 years. These assumptions can be summarized as follows[1]:

(i) It is assumed there are no credit restrictions, no other non-linearities in the budget constraint, and no "worst-case" scenarios, such as where income shrinks to zero. Concern with these issues has spawned a large literature on credit restrictions, capital market imperfections and the buffer-stock motive for saving.[2]

(ii) A quadratic utility function is assumed so that equation (2.1) is linear, implying the irrelevance of income uncertainty - given assumption (i) above, and exact aggregation across households with identical preferences.[3]

(iii) Additive preferences are assumed both across time and with separability between consumption and leisure.[4]

(iv) Consumption is assumed measured by expenditure on non-durables or services and by the flow of services from durables not subject to transactions costs.

(v) The market real interest rate is assumed constant and to be the same as the subjective discount rate, which, in turn, is the same across all consumers. If the real interest rate is stochastic, real interest rate expectations enter the Euler equation, interacting with

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[1] This outline broadly follows Muellbauer and Lattimore (1995). Deaton (1992) contains an excellent discussion of many of these points.

[2] See Campbell and Mankiw (1989, 1991), Deaton (1991, 1992) and Carroll (1992, 1997). Such issues are widely believed to be a major reason for the 'excess sensitivity' of consumption changes to predictable income changes in aggregate data, contradicting equation (2.1). Even if the consumer faces no short-term credit restrictions, but is merely constrained to have non-negative net assets at the end of life with probability 1, this can be sufficient to violate equations (2.1) and (2.2). Under income uncertainty, the "worst-case" scenario about future incomes can then constrain current consumption below the level implied by equation (2.2), particularly if survival puts a lower floor on consumption. As this literature indicates, there are no closed-form mathematical representations of buffer-stock saving behaviour, though various approximations are possible.

[3] Concern with the precautionary saving motive has also led to a large literature (e.g. Skinner, 1988; Zeldes, 1989; and Kimball, 1990). Income uncertainty then enters the Euler equation where higher uncertainty at t-1 about future income lowers consumption at t-1, and, *ceteris paribus*, raises Δc_t. As far as the solved-out consumption function is concerned, even excluding violations of assumption (i) above, analytical representations of the effect of income uncertainty on consumption have been obtained only in the not altogether plausible case of exponential preferences. More generally, the non-linearity of the Euler equation necessitates approximations both in aggregating micro-behaviour and in deriving the solved-out consumption function (and at both the micro- and the aggregate data levels).

[4] This is necessary to get the clean form of equation (2.1), without further lags in consumption entering, or such as arise in habit models, or variations in leisure influencing intertemporal substitution in consumption. Models with habit formation have become an important research topic, see Hayashi (1985), Muellbauer (1988) and Constantinides (1990).

consumption, which leads to the consumption capital asset pricing model, see Breedon (1979) and Campbell (1999).[5]

(vi) Consumers are assumed to hold rational expectations.[6]

(vii) Consumers are assumed infinitely-lived, or to have Barro (1974)-style dynastic features, which makes their behaviour similar to those of infinitely-lived consumers.[7]

Much research, not only that summarised above, suggests that the representative consumer REPIH model should not be regarded as an adequate approximation to behaviour. For instance, cross-sectional surveys suggest that consumption follows income more closely over the life-cycle than can be explained by the variation of need with age, e.g. due to the arrival and departure of children from the household (Deaton, 1992). Attanasio (1999), however, disagrees with Deaton on this issue.

Further, although the Euler and solved-out consumption functions in the canonical REPIH model are *theoretically* equivalent, empirical versions of equations (2.1) and (2.2) are no longer equivalent or equally useful for at least four reasons. First, it should be obvious that an explicit income-generating mechanism is needed to estimate equation (2.2). Therefore, the *empirical* solved-out consumption model is at least a two-equation model to generate income forecasts as well as consumption. Secondly, incorporating some of the generalizations (i) to (vii) above, which entails considerable approximations, means that the generalized equations (2.1) and (2.2) will be *different* approximations to the underlying theoretical relationships, as well as weakening claims for the theoretical consistency of the Euler equation.[8]

Thirdly, the solved-out consumption function does not throw away long-run information in the data on consumption, income and assets. The literature on 'equilibrium

[5] This implies a set of relationships among asset returns assuming no transaction costs or trading restrictions in the set of assets under consideration, i.e. largely assuming away the phenomenon of "illiquidity".

[6] If this is violated, the martingale property of equation (2.1), and of its extensions to Euler equations with stochastic interest rates and uncertainty, would cease to hold. Though it would be foolish to assume that consumers, particularly the more affluent and better educated, do not use information about their private circumstances and the economy to predict future circumstances, RE remains an extreme assumption. Cochrane (1989) has shown that the utility gains from optimal intertemporal consumption choices are low compared with simple alternative rule of thumb behaviour. With forces of natural selection less powerful for consumers than for firms operating in a competitive environment, arguably many households would adopt rules of thumb under normal circumstances.

[7] See Gali (1990, 1991) and Clarida (1991) for consequences of finite lives.

[8] Transitory consumption and time-aggregation raise additional problems in Euler equation estimation, though they can be satisfactorily dealt with using appropriately-dated instruments.

correction models' and cointegration, (e.g. Davidson *et al*, 1978; Engle and Granger, 1987; and Banerjee *et al,* 1993) emphasizes the importance of extracting long-range information. In the Euler approach, the asset data are not used at all; and, by differencing, consumption and income, which are typically non-stationary, are reduced to stationarity.

Fourthly, the solved-out approach is directly relevant for policy analysis. For instance, the effects of a tax reform (which would alter the profile of future household income) could be analysed via the income-forecasting model incorporated in the solved-out approach.

The approximations needed to obtain policy-relevant consumption functions of the type described in the next section are no more extreme than those popularly made in the Euler equation context to incorporate credit constraints or myopia, by, for example, Hall and Mishkin (1982), Campbell and Mankiw (1989, 1991), and many others. Indeed, we argue that the traditional approximations are quite limited. In our more general solved-out consumption models, we also include the possibility that not all households have rational expectations and build in parameter shifts due to financial deregulation. Furthermore, the Lucas critique (Lucas, 1976, 1981) is addressed directly, by building an income-forecasting model which recognizes the importance of policy feed-back rules and is sensitive to possible shifts in these feed-back rules.

2.1 Derivation of a Solved-Out Consumption Function

(a) A model for credit-unconstrained households.

At the individual level, a solved-out consumption function is the solution to an intertemporal utility-maximizing problem, the case of the canonical REPIH, equation (2.2), being the classic example. To log-linearize equation (2.2), note that

$$c_t / y_t = rA_{t-1} / y_t + y_t^P / y_t = rA_{t-1} / y_t + (y_t^P - y_t) / y_t) + 1 \qquad (2.3)$$

Noting that $\log(1 + x) \cong x$, when x is small, and that rA_{t-1} / y_t is small for most consumers, and that $(y_t^P - y_t) / y_t \cong \log(y_t^P / y_t)$,

$$\log c_t = \log y_t + rA_{t-1} / y_t + \log(y_t^P / y_t) \qquad (2.4)$$

Introducing habits or adjustment costs implies a partial adjustment form of equation (2.4), see Muellbauer (1988).

Further, extending the model from static to probabilistic income expectations, introduces a measure of income uncertainty, θ_t , as well as expected income growth, measured by $E_t \Delta \log ym_{t+1}$, where $\Delta \log ym_{t+1}$ is defined as a weighted moving average of forward-looking growth rates. If real interest rates are variable, theory suggests the real interest rate r_t enters the model. Incorporating these three additional variables, and partial adjustment, a simple linearization gives the following generalisation of the canonical REPIH model equation (2.2):

$$\Delta \log c_t \approx \beta (\alpha_0 - \alpha_1 r_t - \alpha_2 \theta_t + \log y_t + \alpha_3 E_t \Delta \log ym_{t+1} + \gamma A_{t-1} / y_t - \log c_{t-1}) + \varepsilon_t \qquad (2.5)$$

where β measures the speed of adjustment. In principle, α_3 and γ should also depend upon θ_t and r_t , since discount factors applied to expected incomes increase with income uncertainty and real interest rates. We will suppress this complication for simplicity.

In practice, there are a number of reasons why income growth expectations embodied in $E_t \Delta \log ym_{t+1}$ are likely to reflect a limited horizon. Under income uncertainty, precautionary behaviour is approximately equivalent to discounting future income by the real interest rate and an uncertainty premium (see Muellbauer and Lattimore, 1995, p.250). With anticipated credit constraints, under buffer-stock saving theory (see Deaton 1991, 1992), a further shortening of horizons is suggested.[9] Finally, with aggregate data it is hard to forecast income beyond about 3 years. Indeed, widely used time series models lose almost all their forecasting power even sooner, see Muellbauer (1996). This suggests that the log of income in the more distant future is best forecast in practice by near-term log-income plus some constant.

(b) Aggregating credit-constrained and unconstrained consumption using conventional assumptions.

Equation (2.5) refers to the behaviour of forward-looking households who do not face credit constraints. We now outline the implications of the conventional method of introducing credit

9 Incidentally, Friedman (1957, 1963) himself suggests a practical horizon of about 3 years.

constraints. Assuming that π_t is the consumption share of credit-constrained households, aggregate log-consumption is approximately given by

$$\log c_t \cong p_t \log c_t^c + (1 - p_t) \log c_t^u \tag{2.6}$$

where c_t^c is the consumption of the credit-constrained and c_t^u that of the credit-unconstrained. In the Euler equation literature, a widespread assumption is that for the credit-constrained, consumption equals non-property income (see Hall and Mishkin, and Campbell and Mankiw, *op cit.*), that is,

$$\log c_t^c = \log y_t^c \tag{2.7}$$

To derive the form of the aggregate consumption function, we can define ϕ_{1t} as the deviation of the log of average income of credit-unconstrained households from average log income, and ϕ_{2t} as the corresponding deviation for credit-constrained households.

$$\log y_t^u = f_{1t} + \log y_t \tag{2.8}$$

and

$$\log y_t^c = f_{2t} + \log y_t \tag{2.9}$$

One expects $\phi_{1t} > 0$ and $\phi_{2t} < 0$, since credit-constrained households, on average, are likely to have lower incomes. We now make the simplifying assumption that ϕ_{1t} and ϕ_{2t} evolve slowly, so that $\Delta \log y_t^c \approx \Delta \log y_t$.

By definition, if p_t^y is the income share of credit-constrained households,

$$(1 - p_t^y) f_{1t} + p_t^y f_{2t} \approx 0 \tag{2.10}$$

since $\log y_t \approx (1 - p_t^y) \log y_t^u + p_t^y \log y_t^c$.

It follows that

$$f_{1t} / f_{2t} = -p_t^y / (1 - p_t^y) \tag{2.11}$$

This expression implies that f_{1t} and f_{2t} are, respectively, proportional to p_t^y and $-(1-p_t^y)$, with the factor of proportionality depending, among other things, on p_t^y and the shape of the income distribution. Note that the consumption share, π_t , and the income share, p_t^u, of credit-constrained households do not coincide, though they should be highly correlated over time.

To obtain the average consumption function, note that

$$\Delta \log c_t = (1-p_t)\Delta \log c_t^u + p_t \Delta \log c_t^c \qquad (2.12)$$

Consumption growth for those unconstrained by credit, $\Delta \log c_t^u$, can be expressed by rewriting equation (2.5) as

$$\Delta \log c_t^u = b\left[f(x_t) + \log y_t^u + g A_{t-1}^u / y_t^u - \log c_{t-1}^u \right] + e_t \qquad (2.13)$$

where $f(x_t) = a_0 - a_1 r_{1t} - a_2 q_t + a_3 E_t \Delta \log ym_{t+1}$.

For the credit-constrained, the consumption growth, $\Delta \log c_t^u$, is

$$\Delta \log c_t^c \approx \Delta \log y_t. \qquad (2.14)$$

From equation (2.6), the expression $\log c_{t-1}^u \cong [\log c_{t-1} - p_{t-1}(f_{2t-1} + \log y_{t-1})]/(1-p_{t-1})$ can be substituted into equation (2.13). The result further simplifies by using the assumption that π_t as well as ϕ_{1t} and ϕ_{2t} evolve only slowly, so that $p_{t-1} \approx p_t$ and $f_{2t-1} \approx f_{2t}$. Thus, substituting into equation (2.12) gives

$$\Delta \log c_t \approx b\left[(1-p_t) f(x_t) + [(1-p_t) f_{1t} + p_t f_{2t}] + g A_{t-1} / e^{f_{1t}} y_t^u + \log y_t - \log c_{t-1} \right]$$
$$+ (1-b) p_t \Delta \log y_t + (1-p_t) e_t \qquad (2.15)$$

Note that the asset holdings of unconstrained households will equal the average per capita asset level, if credit-constrained households hold no assets i.e. $(1-p_t) A_{t-1}^u = A_{t-1}$.

(c) A critique

Most of the literature conceives of the effect of financial liberalization as a reduction in π_t. We now ask what effect this limited conception of financial liberalization has on the long-run solution for consumption in this model. The model has quite restrictive implications. The effect of a reduction in π_t depends on three components in equation (2.15).

The first component is the term $(1-p_t)f(x_t)$: as π_t falls, this term falls too, provided that $f(x_t) < 0$. There are good reasons why $f(x_t)$ should be negative. The long-run solution from equation (2.13) is $\log c^u = \log y^u + f(x) + g A^u / y^u$. This can be thought of as an extension of the canonical REPIH (equation (2.2)) - which assumes certainty equivalence - to incorporate the effects of income uncertainty and variable real interest rates via the term, $f(x_t)$. Uncertainty reduces consumption for given income and assets, hence $f(x_t)$ is negative (indeed our later empirical evidence supports this).

The second component in equation (2.15) is the term

$$(1-p_t)f_{1t} + p_t f_{2t} \tag{2.16}$$

Subtracting equation (2.10) from equation (2.16) yields

$$(1-p_t)f_{1t} + p_t f_{2t} = \left(p_t^y - p_t\right)\left(f_{1t} - f_{2t}\right) \tag{2.17}$$

Note that $f_{1t} - f_{2t} > 0$. But the income share of credit-constrained households is likely to exceed the consumption share. Credit unconstrained households can spend more than this level of income, as a result of their holding assets. Thus, it is likely that $p_t^y - p_t > 0$, and hence $(p_t^y - p_t)(f_{1t} - f_{2t}) > 0$. Furthermore, as π_t falls, so $f_{1t} - f_{2t}$ must fall, while the difference, $p_t^y - p_t$, is also likely to narrow. Thus, the second component of equation (2.15) is likely to fall with π_t.

Finally, the third component in equation (2.15), the term $g A_{t-1} / e^{f_{1t}} y_t$, is the only component which unambiguously increases as π_t falls, since ϕ_{1t} falls with π_t.

To summarize, a major restriction of the model in equation (2.15) is that it cannot generate a *direct* positive effect of financial liberalization on log(c/y). The only way a long-run rise in log(c/y) can occur is through an increase in the coefficient on the asset-to-income ratio.[10] Another serious restriction is that equation (2.15) implies a counter-intuitive result for an important *interactive* effect: namely, that financial liberalization actually *increases* the negative effect of income uncertainty on consumption via the $(1-p_t)f(x_t)$ term.

Unfortunately, much of the consumption literature that tries to incorporate financial liberalization is based on this theoretical model with its unappealing results. Moreover, the fact that π_t depends not only on the institutional credit regime, but also on the level of real interest rates, is typically neglected in the literature. Many more households would like to borrow when real interest rates are negative, and will feel credit-constrained when they cannot. Conversely, when real interest rates are high many fewer households will want to borrow in the first place, and so fewer will be credit-constrained.

(d) A more general treatment of the consequences of financial liberalization

Clearly, the approach we have above outlined to modelling the behavioural implications of relaxing credit constraints suffers from major defects. Perhaps the most important of these is the failure to distinguish among the three types of credit constraints which are important in practice. The first constraint falls on households desiring to smooth consumption over time, when they expect their future income to be higher. This type of constraint is relaxed by greater competition in consumer credit markets, higher borrowing limits on credit cards and bank loans and access to multiple credit cards. Deaton (1991, 1992) challenges the assumption made by Hall and Mishkin (1982), and by Campbell and Mankiw (1989, 1991), that those credit-constrained in this way simply spend their income. In Deaton's model, many of the credit-constrained save to build up a small buffer stock of liquid assets to guard against the next downturn in income and the consequent loss of utility if the household relied only on its current income. The greater the income uncertainty, and the more severe the credit constraints, the greater will be this buffer-stock saving motive. Therefore, on average for the credit-constrained households, one expects consumption to be less than income, $\log c_t^c < \log y_t^c$. A reduction in the severity of credit constraints narrows this

[10] Note, however, that the income growth expectations component of $(1-\pi_t)f(x_t)$ can also generate a rise when these expectations are positive.

difference, and moreover, reduces the negative effect of income uncertainty on consumption. Note also that Deaton's analysis implies that the sharp distinction between the behaviour of the unconstrained in equation (2.5), and the constrained in equation (2.7), is invalid. In particular, as the buffer-stock asset holdings of the credit-constrained increase, their behaviour approximates that of equation (2.5) more closely.

The second type of credit constraint to be distinguished has been emphasized by Jappelli and Pagano (1994). It concerns potential first-time buyers in the housing market. A major motive to borrow is not to finance non-durable consumption but to acquire owner-occupied housing. Suppliers of mortgage credit apply rules setting upper limits to loan-to-income and loan-to-value ratios to reduce default risk. Young credit-constrained households then have to save to build up the minimum deposits required to get onto the owner-occupied housing ladder.[11] Once again such households will consume less than income, the difference depending on the ratio of house prices to income and on the minimum deposit as a fraction of the value of the house. A reduction in credit constraints in the form of a reduction in the minimum deposit as a fraction of the value of the house, will raise the consumption of these households relative to income.

Most of these potential first-time buyers of housing are not credit-constrained in the sense of the first constraint discussed above. The savings they are building up for a future housing deposit can, meanwhile, be run down or increased in anticipation of shorter-term income fluctuations and in response to changes in real interest rates. Their behaviour is thus better approximated by equation (2.5), but with an explicit direct positive effect of financial liberalization on consumption.

Finally, a third type of credit restriction should be distinguished, which concerns the use of collateral, whether housing or pensions, by those who already own collateral. In a number of countries, the relaxation of rules and spread of competition has made it easier to obtain loans backed by housing-equity (see Poterba and Manchester, 1989). A rise in house prices then makes it possible to increase debt or to refinance other debt at the lower interest rates made possible by collateral backing. Effectively, such liberalization of credit conditions increases the "spendability" or liquidity of previously more illiquid housing wealth. In most countries, however, direct access to pension assets as loan collateral is not possible.

Taking these different considerations together, it is clear that the aggregate consumption function represented in equation (2.15) requires major modifications. We consider first the component of equation (2.15) represented by equation (2.13). Many of the unconstrained households engaging in short-term intertemporal substitution will nevertheless be affected by some or all of the three types of credit constraints distinguished. Suppose that financial liberalization relaxes all three constraints simultaneously, and that we can observe a univariate indicator, FLIB, of the ease of credit conditions. Relaxing the first type of credit constraint implies a positive, direct effect of FLIB on consumption, and also an indirect effect via interaction with income uncertainty (reducing the role of the latter in the $f(x_t)$ term of equation (2.13)). An easing of the second type of credit constraint, the housing deposit constraint, also generates a positive, direct effect of FLIB on consumption. This has a further indirect effect. Saving for a housing deposit is also an increasing function of the house price to income ratio. Easing the credit constraint reduces the negative contribution this makes to the aggregate effect of house prices on consumption. Finally, when the asset term $g\,A^u_{t-1}/y^u_t$ is disaggregated into the main liquid and illiquid asset types, we need to interact at least the housing asset component with FLIB to reflect the greater "spendability" of housing wealth with a reduction of the third type of credit constraint.

Turning to the component of equation (2.15) represented by equation (2.7), which largely reflects the behaviour of those subject to the first type of credit constraint, on the arguments of Deaton (1991, 1992) it is plausible that it should be replaced by

$$\log c^c_t = \log y^c_t - g(q_t, FLIB_t) \qquad (2.18)$$

where g > 0, and $\dfrac{\partial g}{\partial q_t} > 0, \dfrac{\partial g}{\partial FLIB_t} < 0$ and $\dfrac{\partial^2 g}{\partial q_t FLIB_t} < 0$. However, as such households build up buffer-stocks of liquid assets, the role of intertemporal substitution increases so that behaviour increasingly resembles that of households following equation (2.13). Replacing equation (2.7) by equation (2.18) in equation (2.15), results in the addition of two terms, $bp_t g_t$ and $(1-b)p_t \Delta g_t$.

As noted above, the consumption share of credit-constrained households, π_t, is diminishing both in $FLIB_t$ and in the real rate of interest r_t . In practice, it is likely that identifying separately all the multiple channels through which FLIB operates will prove impossible. We investigate below four possible channels: through π_t ; a direct positive effect

[11] Owner-occupation has advantages in many societies, for example a preferred tax status, lower long-

on consumption; and interaction effects with income uncertainty and with assets, particularly housing.

In practice, another important modification concerns the aggregation of assets into a single quantity, A, in equations (2.5) or (2.13), which is an oversimplification. We argue that wealth effects differ according to the liquidity characteristics of different types of wealth. Households usually hold a balance of assets—liquid assets, which can easily be converted into expenditures when needed, and illiquid assets, which typically yield higher rates of return. This suggests that we should associate different weights reflecting different propensities to spend with different types of assets and debt.[12]

Housing, pension funds, and life insurance funds are at the illiquid end of the spectrum.[13] Pension wealth is likely to have a delayed impact on consumption. Contractual saving contribution rates often respond with considerable lags to changes in the asset values of such pension funds, suggesting that we should test for longer lags on consumption.

3. Empirical Results for South Africa[14]

3.1 Wealth Data

The SARB does not compile balance sheet wealth estimates on a market value basis of the type produced by the US Federal Reserve Board, the Bank of England and the Office of National Statistics in the UK and comparable organizations in Japan and elsewhere. With some difficulty, it is possible to derive estimates for South Africa from existing data. The wealth estimates on a market value basis used in this paper were constructed in Muellbauer and Aron (1999), and appear to be the first systematic attempt to construct such figures for South Africa.

run costs than renting and the elimination of agency costs of landlords.

12 Several studies, such as Patterson (1984), allow different weights on liquid and illiquid assets, whereas others, such as Zellner, Huang, and Chau (1965) and Hendry and von Ungern Sternberg (1981), include the effects of liquid assets alone.

13 Housing wealth is a special case because housing has consumption as well as wealth value (housing services also appear in the utility function). Thus an increase in the real price of housing has both an income and a substitution effect on consumption, partly offsetting the wealth effect. See Miles (1994), and, for a simple derivation, see Muellbauer and Lattimore (1995).

14 The computations were performed in Hall, Cummins and Schnake's Time Series Processor (TSP 4.4) package.

There were two main problems in deriving these wealth estimates for the personal sector. Most asset data published by the SARB are on a book-value and not on a market-value basis, and required revaluation adjustments using appropriate asset price indices. Secondly, for some asset classes, e.g. household liquid assets and directly-held bonds, the SARB publish only flow-of-funds data and no benchmarks. Appropriate estimates of the relevant benchmarks needed to be made, and the flows of funds data cumulated, and, where necessary, revalued to market prices. Further, there are problems of omission of some wealth components.[15]

The estimates of illiquid and liquid personal wealth are shown in Figure 2. The household liquid assets ratio seems to have been relatively stable in the 1970s. In the 1980s, however, households' holdings of liquid assets relative to non-property income fell sharply. This coincided with both a drop in the personal saving ratio, as implied by the income and expenditure accounts, and a switch to saving in pension and retirement funds offering superior returns to those on liquid assets.

Pension wealth has grown relative to income since the 1980s despite the fall in the personal saving ratio, and has greatly exceeded the growth of debt.[16] Yet, although pension wealth is now the single biggest asset, its growth has been offset to a considerable degree by the decline of housing wealth relative to income.

3.2 Financial Liberalization

An indicator of the degree of credit market liberality, FLIB, is required to drive the direct, positive effects on consumption; the varying parameter π_t ; the "spendability" weights of asset components; and other possible interaction effects, for example with income uncertainty and income growth. Proxying FLIB by the ratio of debt to income, as in Bayoumi (1993a,

[15] The SARB has not attempted any estimates of gold and foreign assets held by the personal sector. Despite exchange controls, there were inevitable loopholes, which suggests a significant undercounting of asset ownership. Non-housing assets owned by unincorporated businesses are also omitted. A third problem concerns the relationship between explicit funding of pensions and perceived entitlements, particularly for public sector pensions. There could have been considerable fluctuations in the relationship between recorded pension wealth and the perceived levels relevant for expenditure decisions. This problem is not unique to South Africa, however.

[16] Three factors behind this growth are the relaxation of restrictions on official pension funds (for government employees), which had prevented their holding of equities (Mouton Report 1992); improvement in the returns on government and parastatal bonds with deregulation of interest rates after 1980 and declining inflation in the 1990s; and relaxation of prescribed holdings of government bonds for all pension funds.

1993b) and Sarno and Taylor (1998), is not ideal because this ratio responds with a lag to deregulation and depends too on income expectations, asset levels, uncertainty, and interest rates. Bandiera et al (2000) propose the technique of principal components to summarize the composite information in a set of dummy variables reflecting different facets of financial liberalization. However, the weights do not reflect the *behavioural* impact of financial liberalization. A flexible technique linking institutional information with behavioural responses is needed.

Our innovation is to treat financial liberalization as an unobservable indicator entering both household debt and consumption equations. The indicator, *FLIB*, is proxied by a linear spline function, and the parameters of this function are estimated jointly with the consumption and debt equations (subject to cross-equation restrictions on the coefficients in the spline function).

The government initiated financial liberalization following the de Kock Commission reports (1978, 1985) advocating a more market-oriented monetary policy. Interest and credit controls were removed from 1980, and banks' liquidity ratios were reduced substantially between 1983 and 1985. However, there may have been a temporary reversal after the third quarter of 1985 as a result of South Africa's international debt crisis, when net capital inflows dropped sharply. Competition intensified in the mortgage market following the 1986 Building Societies Act, and amendments to the Act in 1987-88. Demutualization and takeovers in 1989-90 consolidated the stronger competition in the credit market. In the 1990s pensions were increasingly used to provide additional collateral for housing loans; while from 1995, special mortgage accounts ("access bond accounts") allowed households to borrow and pay back flexibly from these accounts up to an agreed limit set by the value of their housing collateral. After the 1994 elections more black South Africans obtained formal employment, particularly in the public sector, gaining access to credit that they may previously have been denied.[17] Exchange controls on nonresidents were eliminated in early 1995: large nonresident capital inflows from mid-1994 induced a temporary endogenous financial liberalization. Finally, exchange controls on domestic residents, in existence since before the 1960s, were partially relaxed after 1997.

This qualitative portrait has implications for our univariate measure of financial liberalization, FLIB.[18] The first is of a monotonic rise in the indicator: that is, no reversals,

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[17] Note, however, that total formal employment continued to decline.

[18] A more detailed account of financial liberalization in South Africa is contained in Aron and Muellbauer (forthcoming).

with the possible exception of a temporary episode after late 1985. The second is for particularly strong rises in 1984, in and after 1987, some consolidation in the early 1990s, and a renewed rise after 1994. Unfortunately, available information on institutional changes does not permit further quantitative implications to be drawn.

We define FLIB using a linear spline function. Define a dummy, D, which is zero up to 1983Q4 and is 1 from 1984Q1. The 4-quarter moving average, DMA84, then takes the values 0.25, 0.5, 0.75 and 1 in the 4 quarters, respectively, of 1984, and the value 1 thereafter. We define DMA85 to be the 4-quarter lag of DMA84, and define DMA86 to DMA97 to be the corresponding 8- to 48-quarter lags of DMA84. We then define the spline function:

$$FLIB = d84 \times DMA84 + d85 \times DMA85 + ... + d97 \times DMA97 \tag{3.1}$$

where up to 14 parameters (i.e. d84 to d97) are estimated.[19] The “knots” in the spline function occur in the first quarter of each year (i.e. it can shift shape in the first quarter of each year). Under the constraint that the parameters to be non-negative (i.e. that there is no reversal in financial liberalization), in practice only six parameters are needed to define FLIB. Eight parameters are required when a reversal in 1996 is permitted (see below).

The estimated parameters for *FLIB* in the model reflect the key institutional changes in credit markets. Our estimated indicator shows strong rises in 1984, 1988, and 1995, with more moderate increases in 1989, 1990, and 1996 (Figure 3). The indicator, FLIBR, which permits a 1986 reversal, otherwise moves very similarly. It is noteworthy that both the consumption function and debt equation are subject to major structural breaks (failing Chow tests) when allowance is not made for financial liberalization.

3.3 Income-forecasting Equations

During the 1980s in South Africa, there were significant regime changes with the move to new operating procedures for monetary policy and a series of internal financial liberalizations. Periodically, serious political crises entailed the increasing international isolation of South Africa, reflected in diminished trade and finance, while its mineral dependency as a primary exporter gives an important role to terms of trade shocks in determining income growth.

We derive a 4-quarter-ahead forecasting model for the rate of growth of real per capita disposable non-property income, and build in allowances for these features as well for a more standard income-expenditure approach for analysing the deviations of income from trend. A smooth stochastic trend satisfactorily represents long-run changes in productivity growth of the kind one might expect in an economy subject to such regime changes. Further, an institutional measure of the shift in monetary policy in the early 1980s is crossed with the interest rates. By incorporating important regime shifts in the model, the consumption function including these income growth forecasts should be fairly immune to the Lucas critique.

Income is modelled using an extended version of stochastic trend models of the type recommended by Harvey (1993) and Harvey and Jaeger (1993), and was estimated using the STAMP programme of Koopman et al (1995).[20] The model has the following linear reduced form:

$$\Delta_4 \log y_{t+4} = a_0 + STOCH_t + a_1 \log y_t + \sum_{i=2}^{n} a_i X_{it} + \sum_{j=1}^{n} \sum_{s=0}^{k} b_j \Delta X_{jt-s} + e_t \qquad (3.2)$$

where y_t is real per capita disposable non-property income; $STOCH_t$ is constructed to be a smooth stochastic I(2) trend reflecting the underlying capacity of the economy to produce and to sustain personal incomes; and the X_{jt} include a range of possible determinants of income, discussed below.

This equation can be reformulated as an equilibrium correction formulation with a long-run solution given by

$$\log y = -(a_0 + STOCH + \sum_{i=2}^{n} a_i X_i)/a_1 \qquad (3.3)$$

[19] We also test for evidence of financial liberalization back to 1980, when interest rate controls on deposit accounts first began to be lifted. However, as we shall see, we can exclude such effects.

[20] The background for the approach, tailored for the U.S. economy, is set out in Muellbauer (1996), which successfully forecasts income growth up to three years ahead. The key variables are the change in nominal (and sometimes real) short-term interest rates, the real exchange rate (a measure of international competitiveness), the trade surplus to GDP ratio, the government surplus to GDP ratio and the change in a real share price index. These variables explain the deviation in income from trend, where the trend is represented either by a linear trend subject to changes in slope or a smooth stochastic trend, which does not impose changes in trend *a priori* but allows them to be estimated flexibly. Parameter shifts in the income-forecasting relationships appear to take place at broadly the

We report the coefficients of equation (3.2) directly. Note that the difference between log y and STOCH/α_1 is I(1), given the low variance of the I(2) variable, STOCH. Hence, one can think of equation (3.3) as representing a cointegrating relationship in which the deviation from trend of log y is cointegrated with those X_j components, which are I(1).

The set of explanatory variables X_j include the level of real interest rates and changes in nominal interest rates, the government surplus to GDP ratio, capacity utilisation and a real stock market price index. Poor data for unemployment in South Africa precluded the inclusion of an unemployment rate, as in Muellbauer (1996). We proxy the expected negative effect of unemployment on subsequent growth in real non-property income by using the two-year change in log capacity utilization Δ_8 log(CAPUT), which is I(0). The model also captures the changing sensitivity of income growth to interest rates as the monetary policy regime changed, by employing a dummy indicator constructed from the changing prescribed liquid asset requirements for commercial banks in the 1980s. The variables are defined in Table 1, where stationarity and other statistics are presented.

A general-to-specific testing procedure on quarterly data for 1966-97 was applied to a version of equation (3.2) with a restricted lag structure. For lags longer than three, we restrict the dynamics to fourth differences or four-quarter moving averages, to prevent overparameterisation. This gives the parsimonious equation shown in the first column of Table 2. In the process of simplification from the general forms, the data suggested several transformations, in particular, moving average versions of some of the key regressors. Two other forecasting equations are reported for shorter samples to demonstrate parameter stability, given that Chow tests are unavailable in STAMP.[21]

In the parsimonious equations reported, the only I(1) variables are the real interest rate and the real share price index, which are expected to form a cointegrating vector with the deviation of log income from the stochastic trend.

Turning to the parameter estimates, nominal rises in interest rates and levels of real rates have strong negative effects on subsequent growth. The shift toward more market-oriented monetary policy in the 1980s appears to have weakened the influence of changes in

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dates suggested by prior information about policy regimes, corroborated by the shifts in the estimated feedback rules, and in the direction predicted by theory.

[21] The forecasts are based on full-sample estimates, not recursive estimates, since recursive estimation is unavailable in STAMP. However, stability tests for the equation carried out over different samples confirm parameter stability so that the recursive forecasts are unlikely to differ much from those based on a full-sample parameter estimates.

nominal rates. The shift is picked up by interacting Δ_4 (PRIME) with the liquid asset ratio measure, where PRIME is the prime rate of interest for borrowing from banks.[22] Before the shift, high liquidity ratios and other quantitative methods of controlling credit growth were correlated with changes in nominal rates, exaggerating the apparent influence of interest rates on growth. After the shift, firms and households could also refinance more easily, so that higher interest rates had a weaker effect on expenditures. However, although most of the effect of changes in nominal interest rates disappears, the greater volatility of interest rates in the market regime means that the proportion of the variance of growth explained by interest rates remains high. Figure 4 shows the composite contribution of the interest rate effects to the explanation of future income.

The contribution of the stochastic trend is also shown in Figure 4. This reflects a decline in the underlying growth rate in the early 1980s into negative values, associated with more rapid population growth, as well as the productivity losses resulting from South Africa's increasing isolation - for example, the inefficient production of petrol from coal, under trade sanctions which constrained oil imports. From the late 1980's the underlying rate of decline of income per head was less steep.

The model suggests that government deficits have persistent negative effects on subsequent income growth.[23] These effects could reflect typical concerns that budget deficits will be followed by higher taxes or lower government expenditures; but these deficits may also signal political shocks. In the past, political unrest was often followed by higher social or military expenditures, which thus may serve as a proxy for a direct negative effect on growth through falling investment. Changes in capacity utilization, proxying changes in labor market tightness, have the expected positive effects on nonproperty income. Finally, the JSE index, sensitive to changes in the price of gold and other minerals, captures the positive effect that improving terms of trade have on income, and may also reflect other information about the future embodied in share prices. The empirical contribution of these variables is shown in Figure 5.

To test for parameter stability, two sample breaks were chosen. The first, from the third quarter of 1989, coincides with the new monetary regime of Governor Stals and an increased momentum of political change under the new President de Klerk, initiated by the

[22] The liquid asset measure in itself proved insignificant in the equation, as was the interactive effect with RPRIME (expressed as a moving average).

release of political prisoner, Nelson Mandela. The second, from the second quarter of 1994, captures the transition to a democratic government. The parameter estimates from the shorter samples, as well as other samples not reported, are close to those of the full period suggesting that once structural change has been accounted for as described above, the remaining parameters are stable. There is no evidence of autocorrelated residuals. Tests for normality and heteroscedasticity are also satisfactory.

3.4 The Household Debt Equation

In contrast to the vast literature on consumption, little has been written on the theory of debt holding by consumers, and little systematic econometric work exists. The canonical REPIH model of the representative consumer has little to contribute to understanding the determination of aggregate household debt. In this model there is only a single asset, so that it can explain only the evolution of aggregate net wealth. In practice, consumers have multiple motives for holding debt. These include consumption smoothing through temporary income downturns; or in anticipation of higher future income, financing the acquisition of consumer durables and housing, human capital investment through education or training, or portfolio investment in financial assets when returns prospects look favourable; and to offset what could otherwise be excessive amounts of saving implied by occupational pension rules.

Given asymmetric information between lenders and borrowers, assets have an important collateral role. Most debt is backed by collateral in the form of durables, housing and other assets. Moreover, since much of household saving in liquid asset form is recycled by the financial system into lending for other households, it is clear that the current end-of-period household debt should depend on liquid and illiquid asset stocks as well as on debt at the end of the previous period. Variables such as income, interest rates and proxies for income uncertainty, reflecting economic conditions during the period, will also influence current debt. Indeed, we expect long-run proportionality, given income, between household debt and asset holdings. This makes a log formulation convenient, linking the debt to income ratio with log ratios to income of the various assets, and to the log of real income.

Financial liberalization could impact in several ways on this long-run relationship. A direct, positive effect on debt could result from the different facets of financial liberalization,

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[23] In contrast, in the U.S. (Muellbauer, 1996), there is evidence that before the heightened concern with government deficits in the 1980s, there was a negative "Keynesian" response of output to the government surplus.

with, for example, more freely available credit card loans, lower housing downpayments as a fraction of house values, and housing equity loans more freely available to existing owners. There may also be (indirect) interaction effects from financial liberalisation. One expects increased coefficients on housing and pension wealth to income ratios, in part because of their more liberal use as collateral. A reduced coefficient on liquid assets is likely, as bank lending then becomes less constrained by liquid deposit holdings of the personal sector. However, in the long-run, debt should move in proportion to assets as a whole, even after financial liberalization. Other possible interaction effects are with income uncertainty, expected to become less of a constraint on debt after financial liberalization; and with income growth expectations, which should become more significant, reflecting the desires of households to borrow. One might also expect a negative real and/or nominal interest rate effect, the latter representing cash limits on debt service ratios.

To summarize, in the long-run, we expect effects from assets, income and the real or nominal interest rate on borrowing (income uncertainty, income, inflation, and interest rate dynamics might be expected to be relevant in the shorter run):

$$\begin{aligned}\log RDB0 = a_0 + a_1 FLIB + a_2 FLIB \times \log RLA + a_3 FLIB \times \log RHA \\ + a_4 FLIB \times \log RPA + a_5 \log RYN + a_6 \log RIFA\end{aligned} \tag{3.4}$$

where log(RDB0) is log ratio of household debt (end of quarter) to current seasonally-adjusted personal disposable non-property income; log(RLA), log(RPA), log(RHA) and log(RIFA) are the log ratios, respectively, of liquid assets, pension assets, housing assets and directly-held, illiquid financial assets such as bonds and equities (all end of previous quarter) to the above measure of current income[24]; and log(RYN) is the log of real per capita personal disposable non-property income.

From the above discussion, the coefficients $a_1,...,a_4$ should shift with financial liberalization; homogeneity in wealth would imply $a_2 + a_3 + a_4 + a_6 = 1$; and we also expect $a_5 > 0$.

Following a general-to-specific testing procedure in an error correction model, we estimated an equation for log(RDB0) for 1970Q2 to 1983Q4, prior to the period of significant

[24] Directly-held illiquid financial assets such as bonds and equities, IFA, could also be included with pension assets. However, it seems plausible that their potential use as collateral has not been much affected by financial liberalization.

financial liberalization. The results are shown in Table 3 (see Table 1 for definitions of variables). The long-run solution for the parsimonious equation in the first column comes through strongly and supports the hypothesis of homogeneity of debt with respect to wealth:

$$\begin{aligned} \log RDB0 = -7.81 + 0.47 \log RHA + 0.47 \log RPAMA + 0.57 \log RLA \\ + 0.84 \log RYN \end{aligned} \qquad (3.5)$$

where the asset measures are as above, with RPAMA the four quarter moving average of last quarter's pension assets (reflecting delays by which pension and insurance funds adjust contribution rates to changing asset values). However, no significant positive effect from directly-held illiquid financial assets, log(RIFA), could be found.

All the variables in equation (3.5) are I(1), and evidence supports cointegration in the period 1970-83. The hypothesis of asset homogeneity can easily be accepted. We can also accept the hypothesis of equal coefficients on housing and pension asset wealth for this period.

Turning to the short-run effects, both real and nominal interest rate level effects are perverse[25] though insignificant; but the change in the nominal rate has a significant negative effect. Another negative short-run effect is due to Δlog(YN), the growth rate of nominal non-property income (needed, as the dependent variable is deflated by current income while the assets terms are deflated by lagged income). Income growth expectations have a positive but insignificant effect. The lagged change in capacity utilisation (proxying income uncertainty) has a significant positive effect.

As noted above, financial liberalization will have both direct and interactive effects on this relationship. As well as increasing the effects of log(RHA) and perhaps log(RPAMA), and reducing the effects of log(RLA), one would expect income uncertainty to matter less to households when credit is easily available. We build in these interaction effects when we estimate over the full sample to 1997Q4. The results suggest a significant rise in the housing wealth coefficient and a significant fall in the income uncertainty effect. However the shift in the pension wealth effect is insignificant.

The precise functional form estimated is as follows:

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[25] The findings of Aron and Muellbauer (forthcoming) suggest two possible explanations for this result. The interest policy rule appears to raise interest rates with excess money growth (strongly correlated with credit growth) and with financial liberalization. These sources of endogeneity are likely to bias the estimated effects of interest rates on debt.

$$\begin{aligned}\Delta \log RDB0 = {} & b_0 - b_1 \log RDB0_{t-1} + b_2\Delta_4 \log PRIME_{t-1} + b_3 \log RYN + b_4\Delta \log YN \\ & + b_5 \log RHA + b_5 \log RPAMA + b_6 FLIB \times \log RHA + b_7 \log RLA \qquad (3.6) \\ & - b_6 FLIB \times \log RLA + b_8(1 + b_9 FLIB) \times \Delta \log CAPUT_{t-1} + q_1 FLIB\end{aligned}$$

where $\beta_1 = 2\beta_5 + \beta_7$ reflects the homogeneity of debt with respect to wealth.

The full-sample results for the debt equation, estimated jointly with the consumption equation, and imposing cross-equation parameter restrictions for the FLIB function, are shown in Table 3, column 1. Both direct and interactive effects from financial liberalization are incorporated. The FLIB spline function is shown in equation (3.1)′, where coefficients are estimated subject to non-negativity restrictions[26]:

FLIB = 0.109 DMA84 + 0.230 DMA88 + 0.061 DMA89 + 0.051 DMA90
(5.8) (8.3) (2.3) (2.2)
+ 0.118 DMA95 + 0.074 DMA96
(5.9) (3.3) (3.1)′

Our estimates suggest a direct, long-run effect of financial liberalization on the log of household debt of around 32 percent (coefficient θ_1 of 0.13), given the estimated value of FLIB is 0.64 at the end of 1996. The interaction effects suggest that financial liberalization effectively doubled the long-run coefficient on housing wealth from 0.46 before 1984 to 1.0 for the full sample to 1997. Similarly, the coefficient on liquid assets was reduced from 0.57 to 0.03. Thus, the total long-run impact of FLIB can be calculated as $FLIB(q_1 + b_6(\log RHA - \log RLA)) / b_1$. Comparing debt in 1996/97 with debt in 1983 gives a total effect on the log of the debt-to-income ratio of 0.38 (a rise of around 46 percent). This calculation takes income and assets as given, however.

Examining the short-run interaction between FLIB and the income uncertainty proxy, $\Delta\log$ (*CAPUT*), suggests that by the end of the period the rise in FLIB has almost eliminated the uncertainty effect. The other parameters of the debt equation are quite stable over the two

[26] Given that these coefficients are otherwise unrestricted, an identifying restriction is needed on the direct effect of FLIB in either the consumption and debt equations. We set the long-run direct effect of FLIB in the consumption equation to be $\theta_2 = 0.3333$.

sample periods, 1970-97 and 1970-83, shown in columns 1 and 2, respectively, of Table 3, and diagnostics are generally satisfactory.

3.5 The Consumption Equation

In Section 2, we explained the various extensions required to the aggregate consumption equation (2.15) to incorporate different aspects of financial liberalization, a range of weights for different types of assets, and the argument that many credit-constrained households do not only spend current income. Before turning to an explicit model incorporating these features, two income measurement issues should be considered.

First, although self-employment is part of the theoretical definition of non-property income, these data are not separately available in the South African national accounts. The real, per capita, non-property income measure RYN consists of tax-adjusted income from employment and transfers from the government. We assume self-employment (a major component of property income in other countries) is highly correlated with property income in South Africa. If tax-adjusted, self-employment income were a constant fraction j of property income RYP, we could replace RYN by $RYN + jRYP = RYN(1 + j\ RYP/RYN)$. In our log-formulation, this suggests RYP/RYN as an additional regressor.

The second issue concerns the measurement of RYN. In constructing quarterly national income accounts, small timing discrepancies may arise between quarters, particularly in tax payments. Thus, the income relevant for consumption in quarter t is more likely to be a moving average of current and last quarter's recorded income e.g. $\lambda \log(RYN)_t + (1-\lambda) \log(RYN)_{t-1}$ instead of $\log(RYN)_t$. This will influence the short run dynamics. Aggregating across credit-constrained and unconstrained consumers leads to the income growth term in $\pi(1-\beta)\Delta \log y_t$ being replaced by a weighted average of current and lagged growth, and similarly in the 'equilibrium correction' term $\beta(\log y_t - \log c_{t-1})$. Empirically, we also examine an alternative weighting: $\lambda\log(RYN)_t + (1-\lambda)\log(RYNMA)_t$, where RYNMA is the 4-quarter moving average of RYN. Note that this will give a weight of $\lambda+(1-\lambda)/4$ to current income.

As discussed in Section 2, the consumption share of credit-constrained households, π, should be a diminishing function of FLIB and of the real interest rate. In practice, given a number of other interaction effects, it seems this effect cannot be estimated with any accuracy. However, there does appear to be some variation in π with the moving average of the real interest rate, RPRIMA. This suggests working with the specification $\pi_t = \pi_0 + \pi_1 RPRIMA_t$ but allowing a direct effect of FLIB on consumption and testing for the full range of interaction effects (with assets, income uncertainty, income growth expectations and the real interest rate). After allowing the coefficients of income growth expectations, income uncertainty and the real interest rates to be weighted by $(1-\pi_t)\beta$ as in equation (2.15), only income uncertainty and possibly housing wealth interacts significantly with $FLIB_t$.

The resulting equation takes the following form (see Table 1 for variable definitions and summary statistics):

$$\begin{aligned}
\Delta \log RC_t = {} & c_0 + c_1 Q1DU75 + \beta(\lambda \log RYN_t + (1-\lambda)\log RYNMA_t - \log RC_{t-1}) \\
& + \pi_t (1-\beta)(\lambda \Delta \log RYN_t + (1-\lambda)\Delta \log RYNMA_t) + \beta c_2 RYP_t / RYN_t \\
& + \beta (c_3 RLADB_t + c_4 (RHA_t + RIFA_t + RPAMA_t) + c_5 FLIB_t RHA_t) \qquad (3.7) \\
& + (1-\pi_t)\beta (c_6 \Delta_4 \log RYNMA_{t+4}^{forecast} + c_7 RPRIMA_t \\
& + c_8 (1+\beta_9 FLIB_t)\Delta \log CAPUT_{t-1} + c_9 DST78_t + c_{10} DST84_t) + \beta\theta_2 FLIB_t
\end{aligned}$$

Note that Q1DU75 is a pre-1976 seasonal to reflect mismeasured seasonal correction in the data before that date. DST78 and DST84 are dummies taking values +1, -1 in successive quarters, reflecting shifting of expenditure in anticipation of increases in sales tax in 1978 and in 1984. We expect β, λ and π to lie between zero and one; $c_2 > 0$, to reflect some consumption impact from property income[27]; and $c_3 > c_4$ (liquid assets minus debt are more spendable than directly-held stocks and shares, housing and pension wealth). We test below for equal weights on RHA, RIFA and RPAMA. We expect $c_5 > 0$, since FLIB increases the "spendability" of housing wealth (the effect of FLIB on the "spendability" of pension wealth, however, being empirically very small). Finally, $c_6 > 0$ (growth expectations), $c_7 < 0$ (real interest rate), $c_8 > 0$, $\beta_9 < 0$ (Δlog(capacity utilization), an uncertainty proxy which weakens as FLIB rises)[28] and $\theta_2 > 0$, so that FLIB has a direct positive effect on consumption. Either θ_1 in the debt equation, or θ_2 , has to be set at same value to identify the coefficients on the components of the FLIB spline function.

[27] As argued above, this is a proxy for self-employment income. "Property income" also includes dividend payments from incorporated and non-incorporated enterprises, so that $c_2 > 0$ could also reflect an element of myopia by households about the corporate veil.

[28] Note that β_9 is constrained to be the same in the debt and consumption equations, so that the proportionate reduction in the uncertainty effect with financial liberalization is the same for debt as for consumption. This restriction passes an empirical test.

This equation corresponds closely to the theory discussed in section 2, and tests of more general dynamics all accept this specification. Estimation results are given in Table 4, column 1. The adjustment speed is relatively high, suggesting around 60 percent of a full adjustment to shocks takes place in the current quarter. The consumption share of credit-constrained consumers of 0.35 when the real interest rate is zero, is within the 0.2 to 0.6 range suggested by Euler equations studies by Campbell and Mankiw (1991).[29] Given enormous income and wealth disparities in South Africa, this would suggest a rather higher *proportion* of credit-constrained households. Note that π_t falls as the real interest rate rises. Given $\pi_1 = 3.5$, then $\pi_t = 0.175$ at a 5 percent real prime rate. In practice, higher real interest rates have accompanied financial liberalization, and the model then implies a lower consumption share of credit-constrained households.

For credit-unconstrained households, the income growth expectations effect is significant, suggesting a weight on next year's income of about 30 percent of that on current income. The real interest rate effect is significantly negative suggesting that a rise in the real rate of 1 percent will cut consumption of credit-unconstrained consumers by 0.25 percent in the long-run. When FLIB is 0, the short-run income uncertainty effect represented by the Δ log(capacity utilization) term suggests a 1 percent improvement in utilization over one quarter results in a 0.6 percent boost to short-term average consumption. But when FLIB reaches its peak value of 0.64, the effect is eliminated. Note that for aggregate consumption these effects are all weighted by $1-\pi_t$ so that when the share of credit-constrained consumption falls the effects are bigger.[30]

For credit-unconstrained consumers, the long-run wealth effects are large.[31] They imply a marginal propensity of 0.15 to spend from liquid assets and 0.07 from illiquid assets, consistent with shorter time horizons than theorists often attribute to consumers. Thus, housing assets are about half as spendable as liquid assets when FLIB is 0. When the coefficients on the four major asset-to-income ratios, RLADB, RHA, RIFA and RPAMA are estimated separately, the results (with standard errors in parentheses) are 0.165 (0.046), 0.073 (0.011), 0.055 (0.020) and 0.076 (0.020). The hypothesis that the three illiquid assets have

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[29] The freely estimated coefficient is 0.32, but with a standard error of 0.30. Setting the coefficient to 0.35 guarantees that π remains non-negative over the sample period.

[30] Given the positive correlation between FLIB and RPRIMA, this therefore compensates in part for the negative interaction between income uncertainty and FLIB measured by β_9.

[31] Note that in the simpler model version before financial liberalization, the logic of the model is that log (consumption/non-property income) is cointegrated with the ratios of property income, liquid

the same coefficients is easily accepted. The increase in "spendability" as FLIB rises is not accurately estimated: the point estimate is 0.01, with a standard error of 0.07. This is probably the result of the trend-like decline in RHA since 1984. We therefore restrict the coefficient to zero. However, the rise in FLIB also has a direct effect on consumption measured by $\theta_2 = 0.333$, which is an identifying restriction, as noted earlier. Noting that FLIB peaks at 0.64, this implies a direct long-run impact of FLIB on the log of consumption of 0.213, when comparing 1996/97 with 1983, that is, around 24 percent.

In Figure 6, we show the estimated contribution of fluctuations in the different variables in equation (3.7) to the variations in the log of consumption to income. It is important to realise that these are partial equilibrium effects. Thus, the striking direct contribution of financial liberalisation was partly offset by three factors themselves influenced by financial liberalization (see Aron and Muellbauer, 2000, for further discussion). These factors were the rise in real interest rates, the deterioration in the liquid assets minus debt balance and the rise in property income relative to non-property income.

Estimates for the short sample, 1970:2 to 1983:4, when FLIB is zero, are reported in Table 4, column 2. The parameter estimates are much in line with the full sample estimates. Indeed, the full sample equation's standard error is below that for the short sample, suggesting the parameter shifts have been handled successfully.

In the full-sample estimates discussed so far, we have imposed the restriction of no reversals in FLIB. However, as noted in our discussion of financial liberalization in South Africa, the debt crisis in the second half of 1985, associated with large net outflows, could also have had a negative impact on domestic credit conditions, despite liberalization of domestic institutional arrangements. We allow for this in a specification of FLIB in which DMA86 and DMA87 are freely estimated. We then estimate

$$\begin{aligned} FLIBR = {} & \underset{(6.2)}{0.126}\, DMA84 - \underset{(2.6)}{0.057}\, DMA86 + \underset{(1.6)}{0.041}\, DMA87 + \underset{(6.8)}{0.220}\, DMA88 \\ & + \underset{(2.5)}{0.060}\, DMA89 + \underset{(2.2)}{0.049}\, DMA90 + \underset{(6.1)}{0.117}\, DMA95 + \underset{(3.7)}{0.079}\, DMA96 \qquad (3.1)'' \end{aligned}$$

The corresponding estimates of the other parameters are shown in column 3 of Tables 3 and 4. These estimates are quite robust to the more general specification of FLIB.

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assets minus debt and illiquid assets, to non-property income (these are all I(1) variables). A

In the results discussed so far, we have used a very simple proxy for income uncertainty, $\Delta \log CAPUT_{t-1}$, the lagged rate of the rate of change of capacity utilization. However, we also experimented with a wide range of alternatives. These included linear combinations of the rate of acceleration in consumer prices, the residuals and their absolute values from our income-forecasting equation, and more naïve residuals taken as the deviation between current income growth and the moving average of income growth over the previous four years. To improve identification, these linear combinations were estimated subject to the restrictions of proportional coefficients in the consumption and debt equation and the restriction of the same percentage impact of FLIB on this composite effect. However, $\Delta \log CAPUT_{t-1}$ is statistically preferred against these more general models.

As noted above, our specification makes an allowance for temporary income mis-measurement in the quarterly national accounts. We measure the log of current income as $\lambda \log RYN_t + (1-\lambda)\log RYNMA_t$, where λ is estimated at 0.51 implying a weight of 0.63 on RYN and 0.37 on the moving average of the previous three quarters. For this specification the four-quarter moving average of forecast income growth gives slightly better results than forecast growth dated t, even though it uses older information, on average. In an alternative specification where the log of current income is measured as $\lambda \log RYN_t + (1-\lambda)\log RYN_{t-1}$, λ is estimated at 0.80 (t = 12.7).

Under this specification, forecast growth dated t is preferred to its moving average, and the estimated coefficient is 0.19 (t = 2.1). All other parameter estimates are very similar to those in columns 1 of Table 3 and 4, though the consumption equation standard error at 0.00740 (versus 0.00718 in column 1) is higher, while the fit of the debt equation is unchanged.

We can test some hypotheses on whether households pierce the corporate veil and on Ricardian equivalence. It is important to note that our model assumes that the corporate veil is pierced, except to the extent that dividend payments enter the property income/non-property income ratio, RYP/RYN. This has a coefficient of 0.073, implying property income has only around 7 percent of the spending effect of non-property income. As noted above, most of this is probably reflecting self-employment income (included in the available measure of property income). To investigate further, we need a measure of corporate dividend payments received by the personal sector, which is not available from the national accounts. One way of estimating these is to multiply the average dividend yield on equities

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cointegration test supports this logic.

quoted on the Johannesburg Stock Exchange by our estimate of equities held directly and indirectly by the personal sector. After tax-adjustment it can be tested whether the ratio of these dividend payments (including lagged effects) to non-property income is significant when included in our consumption function. In the event they are not significant, and this result, together with the large wealth effect in the consumption function, suggest that affluent South African households largely pierced the corporate veil.

Regarding Ricardian equivalence, note that our model already incorporates an important negative effect on consumption from high government deficit to GDP ratios in the preceding three years, via income growth expectations. We can test whether there is an additional direct effect on consumption from this source by entering annual moving averages of the government surplus to GDP ratios for the current and the last two years in the consumption equation. These effects are jointly and individually insignificant.

Another way of testing Ricardian equivalence is by examining the "spendability" coefficients of the government fixed interest components in wealth, part of which is directly-held and part entering via pension wealth. The net effect in the model of column 1, Table 4, is captured by the coefficient, c_4 (directly-held government securities$_{t-1}$ + four quarter moving average of pension fund-held government securities$_{t-1}$)/income. To make the test as tight as possible, we multiply this term by c_{11} and test $c_{11} = 0$ versus $c_{11} < 0$. The point estimate is for a negative c_{11}, but the hypothesis of a zero effect can be accepted.

4. Conclusions

This paper has argued that previous attempts to measure the effects of financial liberalization on consumption are unsatisfactory. Attempts to do so through Euler equations, modified as in Hall and Mishkin (1982) and Campbell and Mankiw (1989, 1991), suffer from four major limitations, two of these being mainly theoretical, and the other two, empirical.

The theoretical limitations arise from two assumptions: that credit-constrained households simply spend their income; and that the effect of financial liberalization is confined to reducing the proportion or consumption share of credit-constrained households.

The first of these has been shown to be inadequate by Deaton's (1991, 1992) buffer-stock model of consumption, under income uncertainty and credit constraints. The second assumption fails to recognize that there are three distinct elements of liberalization in credit markets. The literature predominantly focuses on one of these: the easing of restrictions on credit for consumers wishing to smooth consumption over time in response to higher expected future income (e.g. through easier access to unsecured bank loans and credit-card facilities). At least as important, however, are the two which operate mainly through mortgage markets: the reduction in down-payments by first-time home buyers, discussed by Japelli and Pagano (1994); and the more generous attitudes to new borrowing secured by existing housing collateral.

The easing of credit in the mortgage market has the implication that consumption to income ratios will be raised as young consumers have to save for fewer years to accumulate the deposit required to access the housing ladder, while the 'spendability' of housing collateral of home-owners is increased.

Neglect of these theoretical effects reduces the usefulness of conventional modified Euler equations as empirical approximations. This is compounded by two empirical limitations. The first is endemic to the Euler equation approach: the neglect of long-run information, the importance of which is emphasized in the econometric literature on cointegration. The other empirical problem in the literature has been to identify proxies for financial liberalization. Of these, the debt to income ratio has perhaps proved the most popular, but it risks confounding income, income expectations, interest rates and asset holdings with financial liberalization.

This paper addresses each of these issues using data from South Africa. Apart from its intrinsic interest, South Africa is unusual for having experienced an extended period of credit market liberalization without having a boom in house prices, making it easier to distinguish the direct effects of liberalization from wealth effects.

The determinants of personal consumption in South Africa from 1970 to 1997 were examined by means of a quarterly solved-out consumption function for households estimated jointly with an equation for household debt. This allowed a fuller treatment of a range of extensions and approximations to theoretical behaviour than is usual in the literature. Particular innovations were the inclusion of disaggregated asset effects, financial liberalization and income expectations, in addition to the more usual consumption determinants. The effects of financial liberalization were captured through a spline function common to both the consumption and household debt equations. The parameters incorporate qualitative information on the timing of key institutional changes in credit markets. We tested for the major channels of financial liberalization on consumption in South Africa: the channel through the consumption-share of credit-constrained households; a direct effect on the consumption to income ratio; and interaction effects with various assets and with income uncertainty proxies. Finally, we estimated households' income forecasts one year ahead, taking account of important parameter shifts in the South African economy, for instance due to political shocks and monetary policy changes. These forecasts were then used in the consumption model.

Our empirical consumption and household debt model corroborates the theory in this paper, confirms the relevance of financial liberalization, and implies that fluctuations in asset values have important implications for consumer spending and increasing household debt in South Africa. Moreover, income expectations are a significant factor and give a role for other macro-fundamentals to enter the model. The main factors explaining the consumption to income ratio in South Africa include positive effects from the asset to income ratios, financial liberalization and expected income growth; and direct, negative effects of real interest rates and income uncertainty. Even though the general equilibrium effects are likely to be substantially less than the partial equilibrium effects, the practical role of financial liberalization in lowering personal saving rates in South Africa is hard to deny, see Aron and Muellbauer (2000).

The consumption model estimates throw light on the monetary transmission mechanism in South Africa, showing that there are multiple channels for the effect of interest rates on consumption expenditure. A rise in short-term interest rates has negative direct effects on consumer spending, but there appear to be even larger *indirect* effects via income expectations and asset prices. In the absence of wealth stock data for South Africa, these apparently large asset effects have not previously been measured. Given the multiple possible influences on asset prices - including foreign interest rates and foreign equity prices - to quantify the marginal effect of domestic interest rate changes alone requires separate models for the main asset prices of equities, bonds and housing, in addition to the consumption function and income forecasts. This remains an important task for future work.

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Table 1: Statistics and Variable Definitions

Variable	*Definition of Variable*	*Mean*	*Std. Deviation*	*I(1)*	*I(2)*
(1965q1-1997q4)	***Income-forecasting Equation***				
$\Delta_4$log(RYN)	Annualised real income growth rate (seas. adj.)	6.74E-3	3.54E-2	-5.20**	-
log(RYN)	Log of real income(nppdi) per capita (seas. adj.)	8.14	1.06E-1	-2.20	-3.84**
RPRIMA	Real prime interest rate/100 (4 quarter MA)	3.56E-2	4.02E-2	-3.28*	-3.78**
Δ_4PRIME	Annual change of prime interest rate/100	4.31E-3	2.79E-2	-4.81**	-
$\Delta_8$log(CAPUT)	2 year growth rate in the manufacturing capacity utilisation index	-2.21E-3	3.65E-2	-4.96**	-
GSURMA12	Gov. surplus to GDP ratio (12 quarter MA)	-4.27E-2	1.44E-2	-3.48**	-
Monetary regime shift dummy	Dummy progressing from 0 to 1 in 1983:2-1985:4 , derived from short term liquid asset requirements	-	-	-	-
NΔ_4PRIME	Monetary regime shift dummy x Δ_4 PRIME	6.67E-4	2.19 E-2	-5.31**	-
RLJSER	Log ratio of the all-share JSE index to the consumer price deflator	4.78	2.48E-1	-3.38*	9.49**
(1970q2-1997q4)	***Debt Equation***				
Δ log(RDB0)	Growth rate of debt (eocp) to annualised current income	4.49E-3	2.50E-2	-6.52**	-
log(RDB0)	Log of ratio of debt (eopp) to annualised current income	-5.57E-1	1.61E-1	1.23	-6.47**
Δ_4 log(PRIME)	Annual growth rate of prime interest rate/100	3.30E-2	1.93E-1	-4.44**	-
Δ log(CAPUT)	Growth rate in manufacturing capacity utilisation index	2.01E-4	9.49E-3	-5.15**	-
log(RYN)	Log of real income (nppdi) per capita (seas. adj.)	8.18	6.93E-2	-2.12	-3.81**
log(RHA)	Log ratio of housing wealth (eopp) to annualised current income	5.81E-1	1.85E-1	-1.05	-4.77**
Δ log(YN)	Nominal per capita nppdi growth rate (seas. adj.)	2.87E-2	1.89E-2	-9.91**	-
log(RPAMA)	Log ratio of pension assets (eopp, 4 quart. MA) to annualised current income	-7.75E-2	3.90E-1	-1.03	-5.06**
log(RLA)	Log ratio of liquid assets (eopp) to annualised current income	-4.31E-1	3.01E-1	-1.24	-4.68**
(1970q2-1997q4)	***Consumption Equation***				
Δ log(RC)	Growth rate of real personal consumption (seas. adj.)	1.26E-3	1.50E-2	-9.85**	-
RYP/RYN	Ratio of property income to non-property income	2.34E-1	6.27E-2	-3.94**	-
Log(RC)	log of real personal consumption (seas. adj.)	8.32	4.60E-2	-2.38	-9.68**
Log(RYN)	Log of real income (nppdi) per capita (seas. adj.)	8.18	6.93E-2	-2.12	-3.81**
Δ log(RYN)	Real income growth (seas. Adj.)	5.44E-4	1.92E-2	-3.81**	-
Δ_4 log(RYN (+4))^{forcst}	Forecast annualised real income growth rate (from section 2.2, (b))	-6.60E-4	3.27E-2	-3.54**	-
RPRIMA	Real prime rate/100 (4 quart. MA)	3.52E-2	4.37E-2	-2.31	-6.97**
Δ log(CAPUT)	Growth rate in manuf. Capacity Utilisation index	-2.01E-4	9.49E-3	-5.15**	-

Variable	*Definition of Variable*	*Mean*	*Std. Deviation*	*I(1)*	*I(2)*
RLADB	ratio of (liquid assets (eopp) – debt (eopp)) to annualised current income	1.20E-1	2.70E-1	0.15	-5.57**
RIFA	Ratio of directly-held securities (eopp) to annualised current income	3.79E-1	1.29E-1	-2.17	-9.80**
RHA	Ratio of housing wealth (eopp) to annualised current income	1.82	3.31E-1	-1.29	-4.75**
RPAMA	ratio of pension assets (eopp, 4 quart. MA) to annualised current income	1.00	4.33E-1	2.46	-4.90**

1. eopp is “end of previous period”, eocp is “end of current period”, MA is “moving average”, nppdi is “non-property personal disposable income”
2. Constructed asset data are not seasonally-adjusted
3. For a variable X, the augmented Dickey-Fuller (1981) statistic is the t ratio on π from the regression: $\Delta X_t = \pi X_{t-1} + \Sigma_{i=1,k} \theta_i \Delta X_{t-i} + \psi_0 + \psi_1 t + \varepsilon_t$, where k is the number of lags on the dependent variable, ψ_0 is a constant term, and t is a trend. The kth-order augmented Dickey-Fuller statistic is reported, where k is the last significant lag of the 5 lags employed. The trend is included only if significant. For null order I(2), ΔX replaces X in the equation above. Critical values are obtained from MacKinnon (1991). Asterisks * and ** denote rejection at 5% and 1% critical values.

Table 2: Forecasting equations for real (disposable per capita) non-property income

Dependent variable Δ_4 log(RYN) (+4)	1966q2-1997q4 ***1***	1966q2-1989q2 ***2***	1966q2-1994q1 ***3***
Regressors			
Log(RYN)	-0.82 (10.3)	-0.85 (9.1)	-0.84 (9.8)
RPRIMA	-0.33 (3.6)	-0.35 (3.1)	-0.34 (3.4)
Δ_4 PRIME	-0.40 (3.9)	-0.41 (3.8)	-0.40 (3.7)
$\Delta_8$log(CAPUT)	0.30 (4.7)	0.30 (4.7)	0.30 (4.7)
GSURMA12	0.73 (2.9)	1.3 (3.7)	0.91 (3.0)
NΔ_4PRIME	0.036 (2.7)	0.036 (2.7)	0.036 (2.8)
RLJSER (-1)	0.03 (3.3)	0.03 (2.7)	0.03 (2.9)
Diagnostics			
s.e	0.015139	0.015437	0.015729
DW	1.87	1.97	1.83

1. Absolute values of asymptotic t-ratios in parentheses.
2. The equations include an I(2) stochastic trend, where the trend component is specified as
   $m_t = m_{t-1} + b_{t-1} + h_t \quad h_t \sim NID(0,s^2_h)$,
   $b_t = b_{t-1} + z_t$
   $z_t \sim NID(0,s^2_z)$, and we set $s^2_h = 0$ (see Koopman et al, 1995).

Table 3: Estimates of the Debt Equation

Dependent variable Δlog (RDBO)		1970:2-1997:4 ***1*** (FLIB without reversals)	1970:2-1983:4 ***2*** (pre-FLIB sample)	1970:2-1997:4 ***3*** (FLIB with reversals after debt crisis)
Regressors				
Intercept	β_0	-2.32 (8.0)	-2.41(7.3)	-2.52 (8.9)
Speed of adjustment	β_1	0.297	0.314	0.345
$\Delta_4$log(PRIME)	β_2	-0.023 (2.8)	-0.036 (3.6)	-0.033 (3.8)
log(RYN)	β_3	0.248 (7.7)	0.258 (5.4)	0.267 (8.5)
Δlog(YN)	β_4	-0.703 (9.0)	-0.596 (6.1)	-0.654 (8.5)
log(RHA)	β_5	0.138 (8.7)	0.138 (6.0)	0.153 (9.1)
And shift with FLIB	β_6	-0.250 (3.3)	-	0.299 (3.5)
log(RPAMA)	β_5	0.138 (8.4)	0.138 (8.4)	0.153 (9.1)
log(RLA)	β_7	0.169 (5.8)	0.176 (3.4)	0.192 (6.6)
And shift with FLIB	$-\beta_6$	-0.250 (3.3)	-	-0.299 (3.5)
Δ log(CAPUT) (-1)	β_8	0.49 (2.6)	0.40 (1.8)	0.45 (2.5)
And shift with FLIB	β_9	-1.36 (2.8)	-	-1.36 (2.5)
	θ_1	0.129 (2.3)	-	0.137 (2.2)
Diagnostics				
s.e		0.0127	0.0113	0.0121
R^2		0.740	0.758	0.763
DW		2.19	2.18	2.32
LM1		1.13	0.80	3.14
LM2		3.82	1.65	4.40
LM3		4.33	6.11	4.91
LM4		4.79	6.14	5.46

1. Absolute values of asymptotic t-ratios in parentheses.
2. Note that $\beta_1 = -(2\beta_5 + \beta_7)$: t-ratios are not reported for β_1
3. Critical values (0.05) for LM1 to LM4, respectively, are 3.84, 5.99, 7.82, 9.49.

Table 4: Estimates of the Solved-Out Consumption Function

Dependent variable Δlog (SRC)		1970:2-1997:4 ***1*** (FLIB without reversals)	1970:2-1983:4 ***2*** (pre-FLIB sample)	1970:2-1997:4 ***3*** (FLIB with reversals after debt crisis)
Regressors				
Intercept	c_0	-0.096 (6.4)	-0.114 (5.9)	-0.09 (6.0)
Seasonal (first quarter up to 1975)	c_1	-0.013 (3.3)	-0.010 (2.3)	-0.013 (3.3)
Speed of adjustment	β	0.625 (9.3)	0.742 (7.9)	0.596 (8.8)
Weight on current income	λ	0.51 (5.4)	0.57 (4.9)	0.51 (5.1)
Consumption share of credit-constrained	π_0	0.35	0.35	0.35
Variation of π_0 with RPRIMEma	π_1	3.5 (1.8)	-	3.8 (1.9)
Property/non-property income ratio	c_2	0.073 (2.4)	0.079 (2.2)	0.079 (2.4)
Δ_4 log(RYNMA(+4))^{forcst}	c_6	0.28 (2.1)	0.10 (0.6)	0.30 (2.1)
RPRIMA	c_7	-0.25 (2.6)	-0.17 (1.1)	-0.29 (2.7)
Δ log(CAPUT) (-1)	c_8	1.06 (3.5)	1.50 (3.5)	1.02 (3.2)
And shift with FLIB	β_9	-1.36 (2.8)	-	-1.36 (2.5)
RLADB	c_3	0.14 (4.8)	0.15 (4.0)	0.13 (4.3)
RHA	c_4	0.068 (11.1)	0.066 (10.6)	0.069 (10.4)
And shift with FLIB	c_5	-	-	-
RPAMA + RIFA	c_4	0.068 (11.1)	0.066 (10.6)	0.069 (10.4)
Sales tax dummy 1978	c_9	0.048 (3.6)	0.043 (3.1)	0.051 (3.6)
Sales tax dummy 1984	c_{10}	0.052 (3.2)	-	0.053 (3.2)
Direct FLIB effect	θ_2	0.33	-	0.33
Diagnostics				
s.e		0.00718	0.00832	0.00731
R^2		0.770	0.764	0.762
DW		2.03	2.15	2.00
LM1		0.03	0.50	0.02
LM2		3.85	1.14	4.50
LM3		7.80	6.96	7.79
LM4		8.27	7.68	7.84

1. Absolute values of asymptotic t-ratios in parentheses.
2. Δ_4 log (RYNMA(+4))^{forcst} defined as the 4-quarter moving average of the 4-quarter ahead income growth forecast from Table 2, column 1.
3. Critical values (0.05) for LM1 to LM4, respectively, are 3.84, 5.99, 7.82, 9.49.

Figure 1 : Personal consumption and household debt relative to personal disposable non-property income

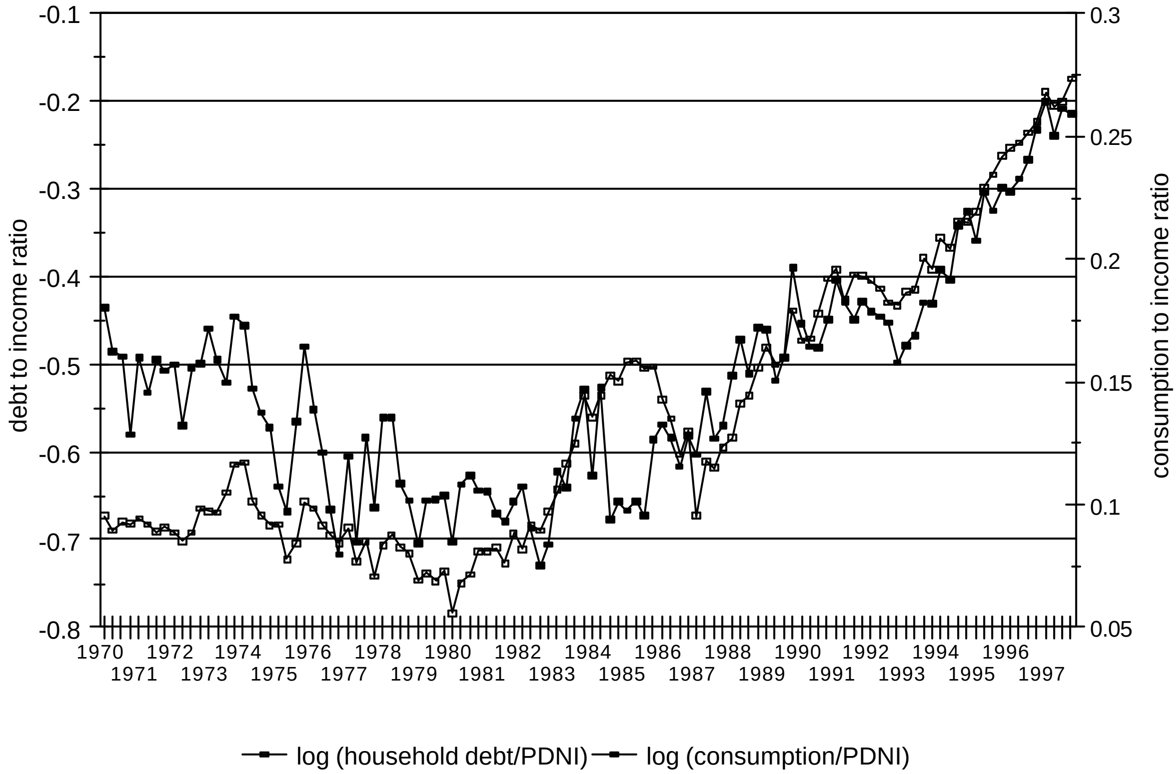


Figure 2 : Debt, liquid and illiquid assets relative to personal disposable non-property income

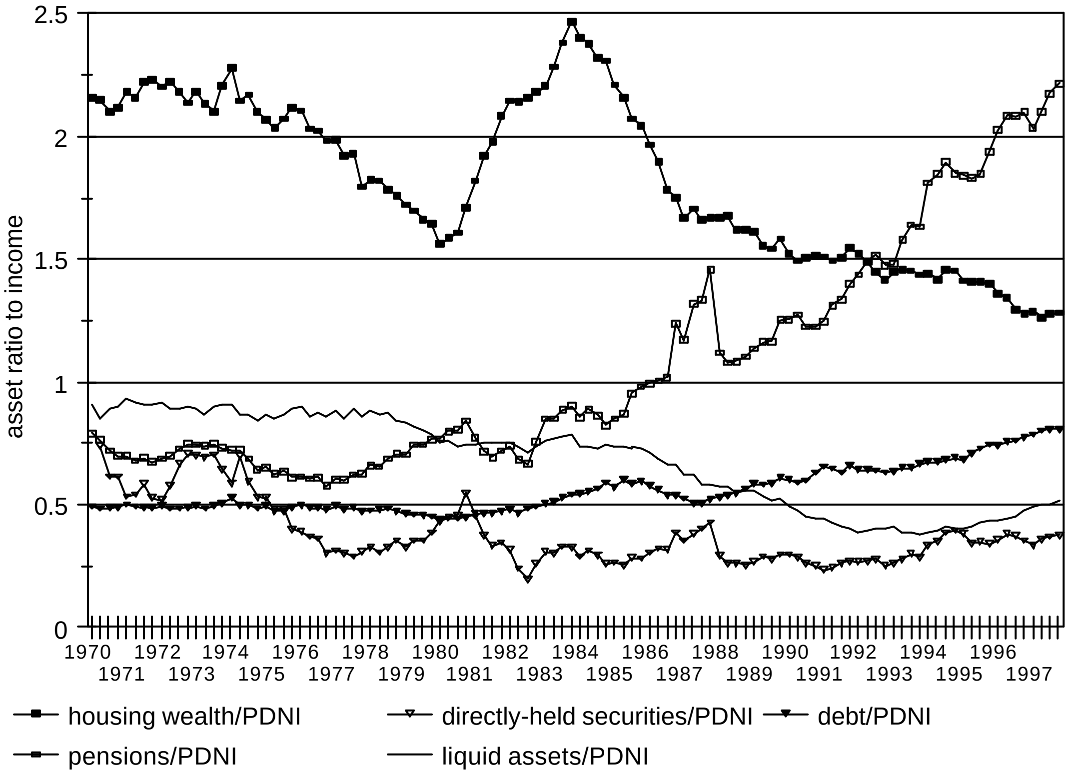


Figure 3 : Household debt relative to personal disposable non-property income, and financial liberalization

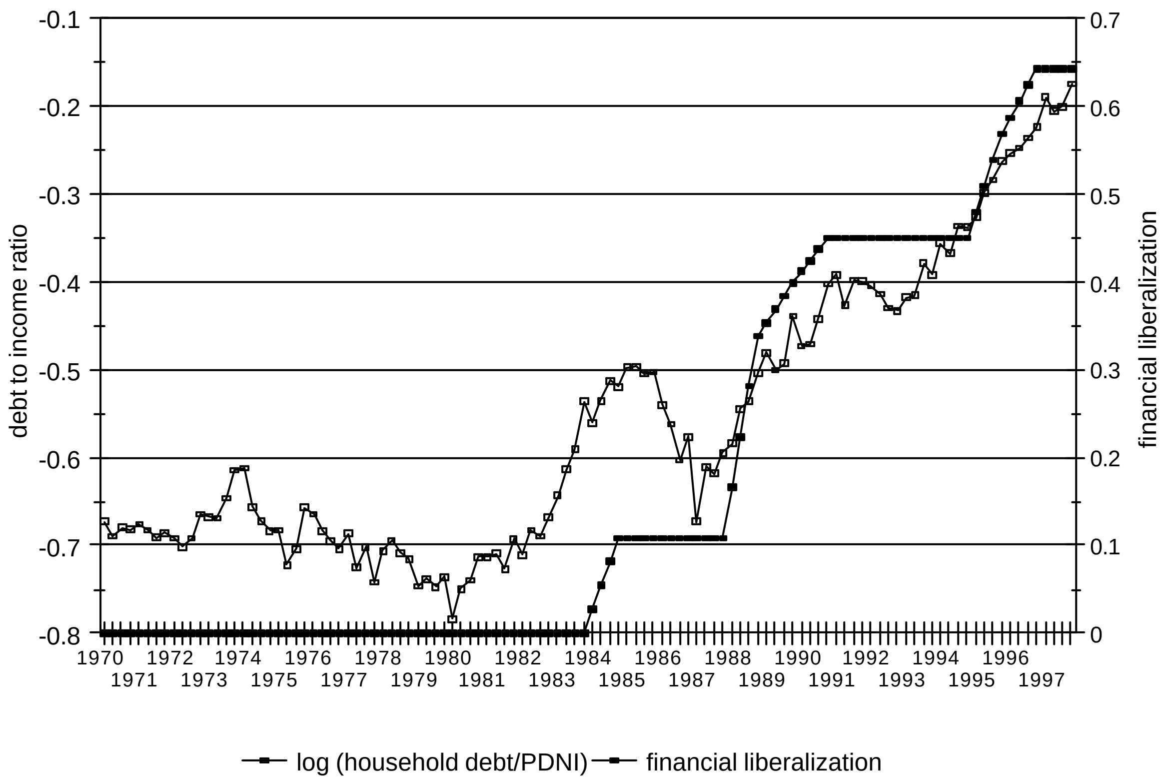
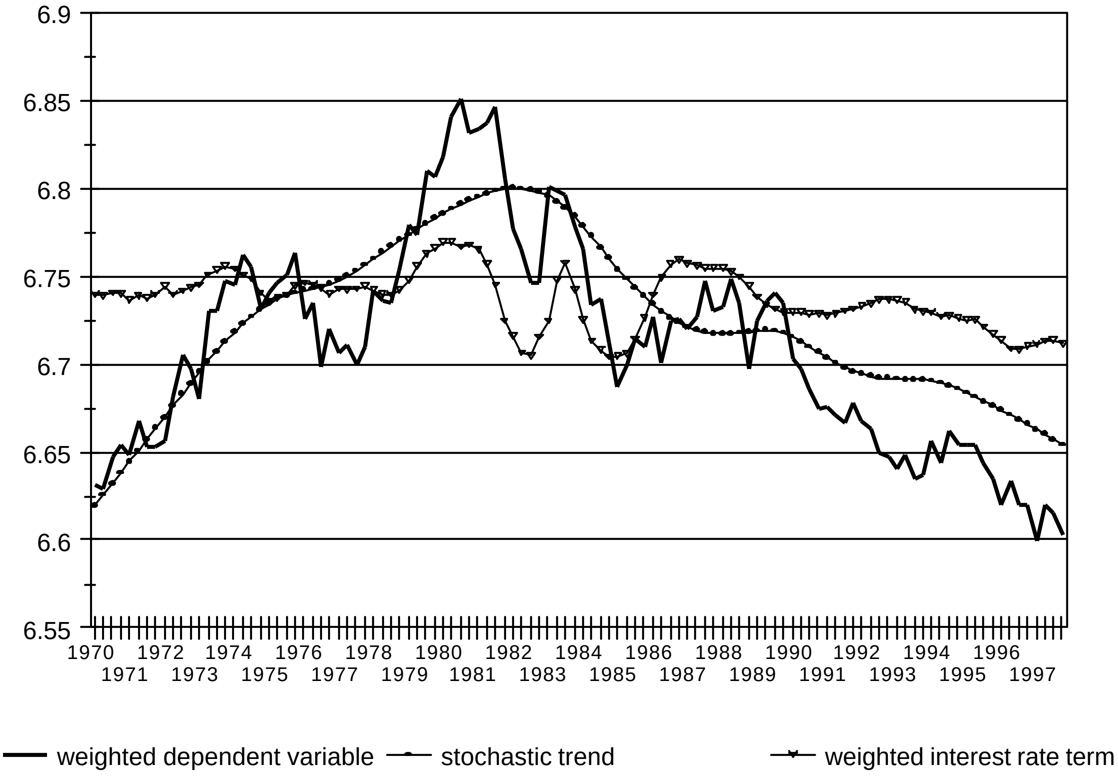


Figure 4 : The contribution to the income forecast of the stochastic trend and the composite interest rate effect



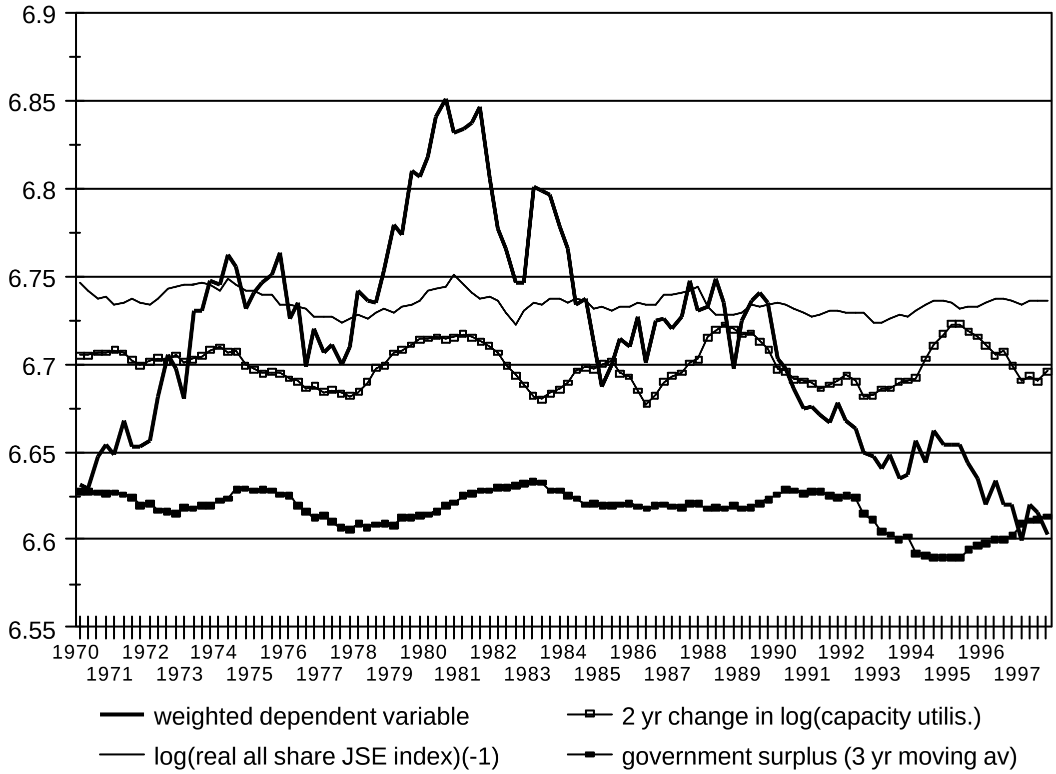
Note 1. The weighted dependent variable term is defined as Δ_4 log (RYN (+4)) +0.8211 log (RYN) .

Note 2. The stochastic trend is from the equation in column 1, Table 2.

Note 3. The weighted composite interest rate term is defined as -0.327422 *RPRIMEma + 0.00355294*NΔ_4PRIME(-1)-0.396631*Δ_4PRIME(-1) .

Note 4. The right-hand side variables are shown weighted by their regression coefficients (Table 2, column 1), and are levels-adjusted relative to the dependent variable.

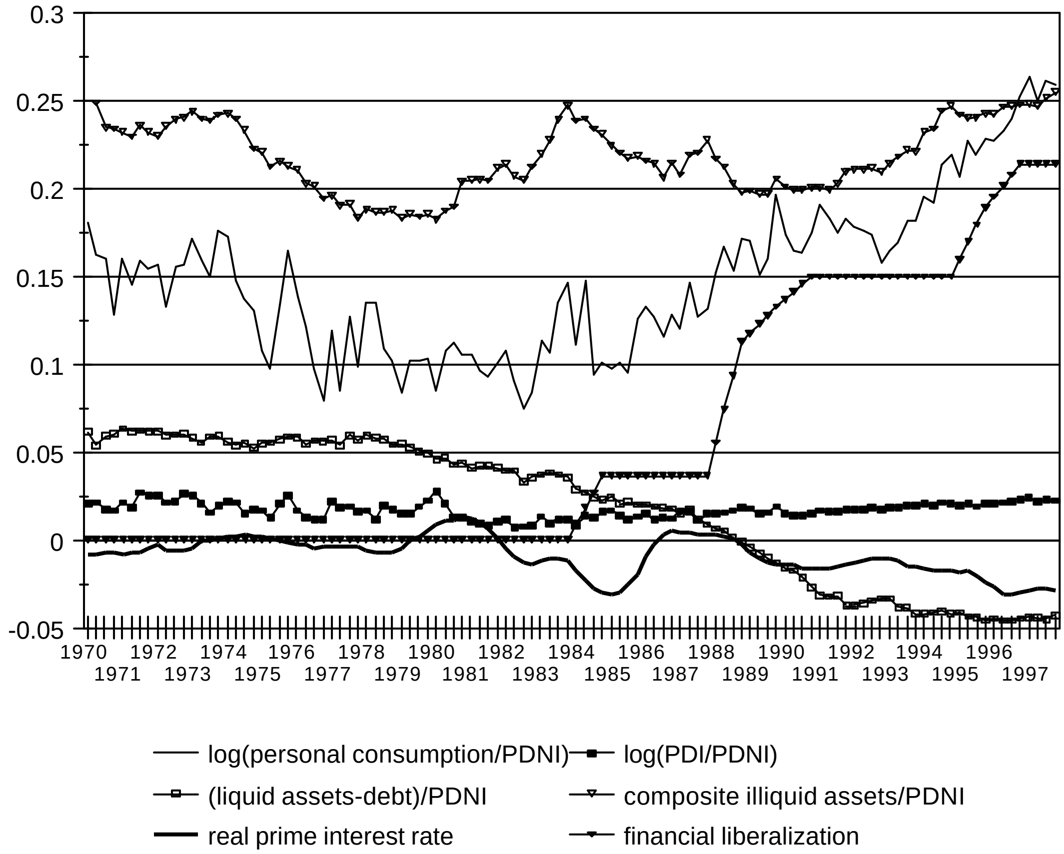
Figure 5 : The contribution to the income forecast of other variables



Note 1. The weighted dependent variable term is defined as Δ_4 log (RYN (+4)) +0.8211 log (RYN).

Note 2. The right-hand side variables are shown weighted by their regression coefficients (Table 2, column 1), and are levels-adjusted relative to the dependent variable.

Figure 6 : Decomposition of the consumption to personal income ratio into asset to income and relative income effects, financial liberalization and real interest rate effects



Note 1. The right-hand side variables from equation (3.7) are shown weighted by their regression coefficients (Table 4, column 1).