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Australian Household Debt

- an empirical investigation into the determinants of the rise in the debt-to-income ratio

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Abstract

Australia's household debt to disposable income ratio has increased substantially over the last 30 years. While there has been much theoretical discussion into what has caused this development, the empirical research into the field is limited. In this essay we analyse the determinants of the household debt-to-income ratio, using both long-run cointegration analysis and a short-run error-correction model. We find that in the long run the change in the debt ratio depends positively on house prices and negatively on interest rates. In the short run it depends positively on the change in house prices and the consumer sentiment index and negatively on inflation and long-run equilibrium error term. It is also evident that there is a high degree of inertia in the debt-to-income ratio indicating that it takes a long time for households to adjust their debt levels to current economic conditions.

Keywords: Household debt, Life cycle hypothesis, Cointegration, Johansen approach, Error-correction model, Australia

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1. Introduction

Household debt levels in Australia and much of the developed world have soared in recent years. Currently the average Australian household has debt levels at 156% of their disposable income, a level four and half times higher than in 1977. The collapse of the housing market in the United States and the subsequent global economic crisis has been a firm reminder of the possible far reaching consequences of an economy that is too reliant on private debt. Despite having debt levels comparable to the United States, Australia has weathered the storm of the financial crisis better than most, emerging with the real estate market intact, and having technically avoided a recession, albeit with the help of a substantial stimulus package and sustained demand from China. The favorable borrowing conditions that have prevailed as a result of the crises have however recently reignited speculation that once interest rates inevitably return to a more normal level, high interest burdens will induce significant financial distress for some Australian households.

The available research into the development of debt is largely theoretical in character, and we have not been able to locate any econometric studies on the determinants of household debt levels in Australia.[1] The theoretical work is mainly based on life cycle models, in which households take on debt to smooth their life time consumption path, and for the acquisition of durable goods. The determinants of household debt positions within this framework include, although not exclusively, interest rates, expected future income and wealth, income volatility and the time preferences of households.

The main purpose of this essay is to empirically study the determinants of the growth in Australia's debt-to-income ratio, both in the long run, through cointegration analysis and the short run, through an error-correction model. Although we will not be able to make any firm conclusions on whether the household debt-to-income ratio is unsustainably high, we do hope that through gaining some insights into its determinants, we will be able to say something about its future development. It is our intention to put this discussion into the perspective of the available theoretical work on the macroeconomic consequences of increasing debt.

[1] Even for other countries the econometric research is very scarce; the only study we have been able to find is one of the U.S household debt to disposable income ratio.

The main finding of the econometric study undertaken in this essay is that in the long run, the increase in the household debt-to-income ratio has been caused by increased house prices and decreased borrowing costs, i.e. lowered borrowing rates. In the short run, changes in the debt ratio were found to be determined positively by: its own lagged value, changes in house prices, and the expectations of future economic conditions as measured by the Westpac-Melbourne Institute consumer sentiment index and negatively by the inflation rate and equilibrium error term of the error-correction model.

This thesis is arranged as follows: section 2 provides background information, discussing how debt and its determinants have progressed over time in Australia, as well as possible macroeconomic implications of high household debt burdens, section 3 is a review of prior research, section 4 is an overview of the theoretical explanations for the growth in household debt, in section 5 the relevant econometric theory is discussed and our econometric method is put forward, in section 6 the data used in the econometric analysis is discussed, section 7 presents the results, we discuss these results in section 8, potential further research is presented in section 9, and finally, section 10 contains the conclusion.

2. Background Information

In this section different measures relevant for discussing household debt levels and sustainability will be introduced, followed by an overview of the development of household debt and related variables in the Australian economy. The final part of this section provides some background information into why debt levels are important for the development of the economy.

2.1 Measures of Household Debt

There are a number of complementary measures used to assess a country's aggregate household debt position. Three very commonly used measures are the debt to disposable income ratio, the debt to asset ratio and the interest payment to disposable income ratio.

The debt to disposable income ratio is calculated by dividing gross household debt by household disposable income. There is a debate going on among some economists over whether this variable is in fact a reasonable measure of a country's debt position, since it compares a stock variable (debt) to a flow variable (disposable income) (Debelle, 2004).

Others such as Keen (2009a) point out that in dynamic systems (such as the economy) "stock to flow comparisons matter because they tell you the capacity of your system to maintain a flow". In the case of the debt to disposable income ratio, it gives a measure of how many years it takes to reduce debt to zero, if all disposable income was used for its repayment. This is comparable to the much discussed public debt to GDP ratio, commonly used by economists to assess the sustainability of government debt (see for example Obstfeld & Rogoff, 1996, pp. 66-70).

The debt to asset ratio (or gearing/leverage ratio) is calculated by dividing aggregate household debt in the economy by aggregate household assets. This measure is sensitive to changes in asset prices such as house prices. If house prices fall or jump suddenly then this ratio would change significantly even if the stock of debt remained unchanged.

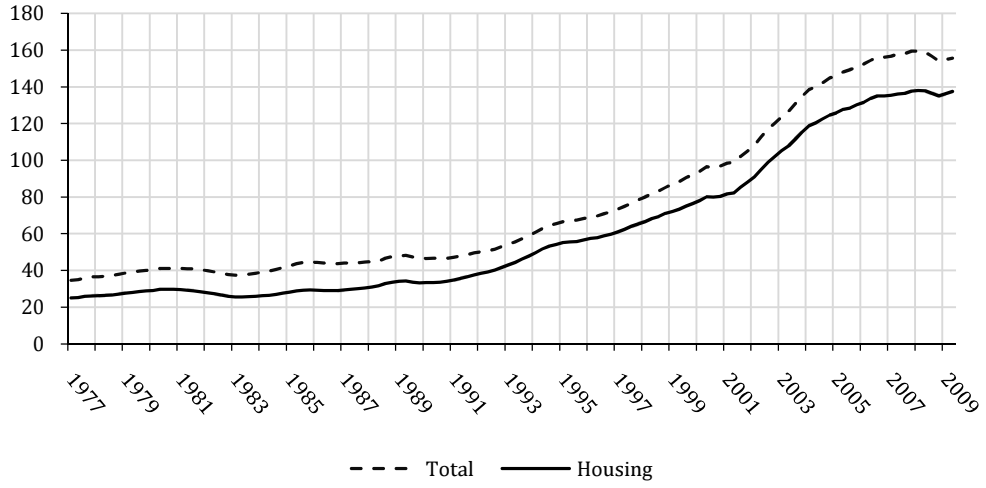
The interest payment to disposable income ratio (or debt service ratio) is calculated by dividing debt repayments (including interest payments and compulsory principal repayments) by disposable income (Debelle, 2004). When using this variable to assess a country's household debt position it should be kept in mind that changes in interest rates can have very significant effects on the level of this ratio, so the state of the current interest rate should also be considered.

2.2 Household Debt in the Australian Economy

In the last three decades, Australia, along with many other developed countries, has seen an unprecedented increase in the amount of debt held by households. As can be seen in graph 2.1, since the late 1980's the household debt to disposable personal income ratio has increased in what seems like an exponential fashion, until the recent financial and economic crisis during which this ratio has decreased slightly. In 1977 debt was around 40 percent of disposable income whereas in late 2007 it peaked at just below 160 percent. Today, the average household has debt equivalent to more than 19 months of disposable income.

It can also be seen from graph 2.1 that housing debt makes up the majority of total debt and that the growth in debt is largely driven by a growth in housing debt, although the gap between housing debt and total debt has increased slightly since around 2003, indicating that other types of debt have also increased recently.

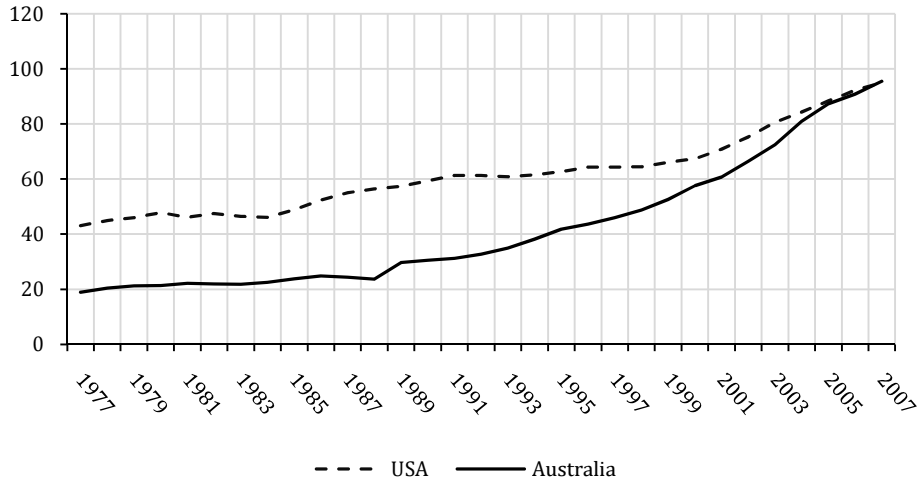
Graph 2.1: Household debt to disposable income (percentage)



Source: RBA table B21

Graph 2.2 shows the progression of Australia's household debt to GDP ratio in comparison to the United States from 1977-2007. The debt to GDP ratio has increased much more dramatically in Australia than it has in the US and in 2007 the two countries debt ratios were at a similar level. While the inability of many households in the US to repay their debt has been widely cited as the cause of the recent economic crisis, Australia has maintained household debt levels at a similarly high level, without major problem, even throughout the crisis.

Graph 2.2: Household debt to GDP - Aus and US (percentage)

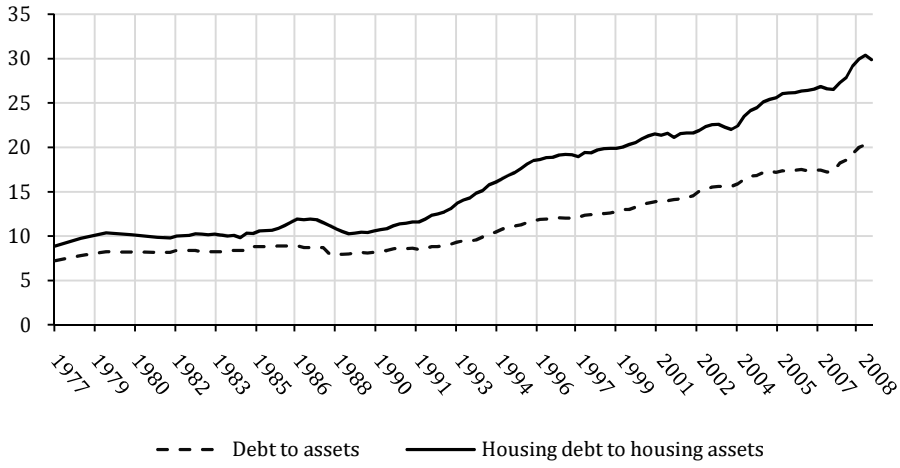


Source: Keen, 2009b

Graph 2.3 shows that the debt to asset ratio for Australian households has also increased significantly over time although less exponentially than the debt-to-income ratio. This ratio remained steady at around 7 percent until the late 1980s and has almost tripled to over 20

percent in 2008. It can also be noted from the graph that the housing asset to housing debt ratio is higher, and has increased more significantly than the total household debt to asset ratio, indicating that increases in housing debt has played an important role in the total increase in the gearing ratio.

Graph 2.3: Debt to assets (percentage)



Source: RBA table B21

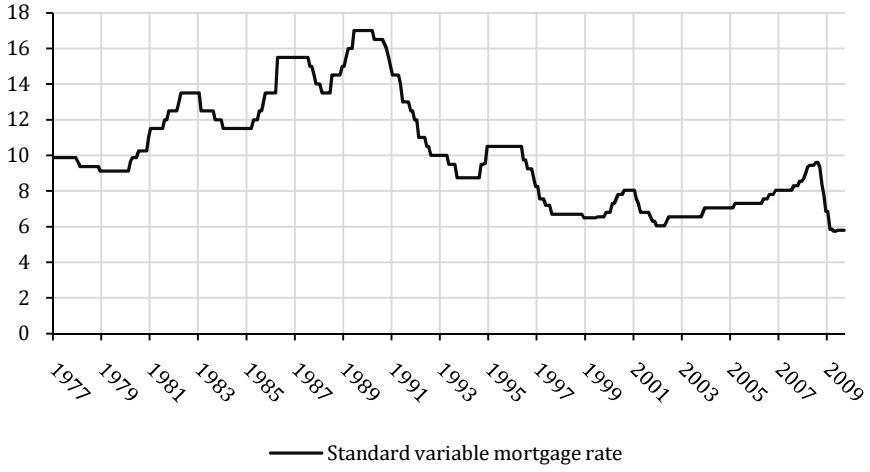
Graph 2.4: Interest payments to disposable income (percentage)

Source: RBA table B21

The interest payments to disposable income ratio has also increased over time, from around 6 percent in 1977 up to over 15 percent in late 2007 (see graph 2.4). It has since dropped down to around 10 percent as a result of the drop in interest rates during the recent economic crises. The interest payment burden began increasing much later than the debt-to-income ratio, but has increased rapidly since the year 2000. This can be explained by looking at the

development of interest rates over this period (graph 2.5). From the late 1980s until the late 1990s interest rates decreased significantly, such that the increase in debt over this time was offset by the decreased cost of borrowing, and so the interest rate to income ratio was able to remain somewhat steady. Since this time the interest rate has only increased marginally (compared to previous changes), while the interest payment to disposable income level has increased very markedly. The reason is that the interest payment to income ratio has become much more sensitive to changes in interest rates, due to the increasing debt-to-income ratio.

Graph 2.5: Mortgage interest rate (percentage)



Source: RBA table F05

2.2.1 Distribution and type of debt in the Australian economy

In order to get an overall picture of household debt in Australia it is important to understand not only how the debt level has changed over time, but also to understand what type of debt is held and how the debt is distributed throughout the population, both in terms age groups and income quintiles.

A breakdown of the type of debt held by Australian households in 2005 is given in table 2.1. This table indicates that the vast majority of household debt is property debt, mostly owner-occupied housing, with 44.9 percent of all households owing money on the house they live in, with the median amount owing being $130 800. A further 9.8 and 6.8 percent respectively have debt related to rental and other properties, with median amounts owed of $202 000 and $138 000. Credit card debt, held by 76.6 percent of households is the most prevalent form of

debt, however the median amount held is comparatively small ($2300). Debt from vehicle purchase (held by 23 percent) and student loans (16.3 percent) are also reasonably common, but the amounts owed are also small compared to housing debt.

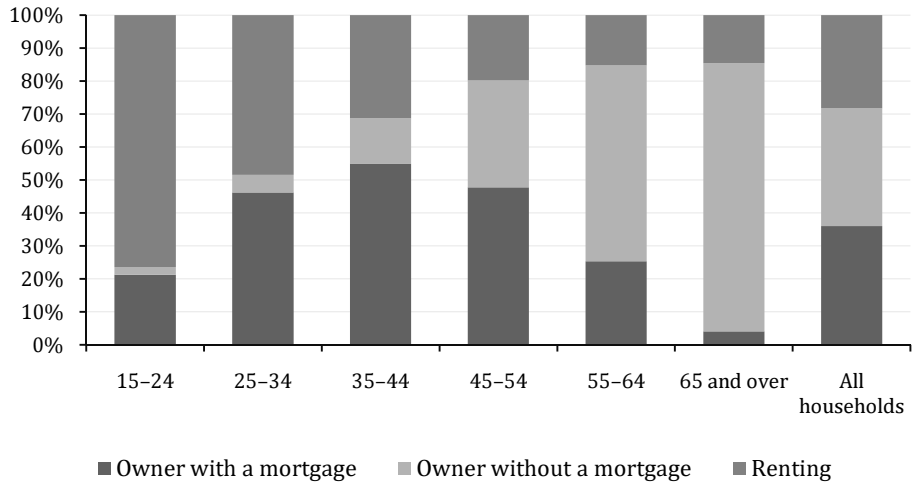
Table 2.1: Types of household debt

Type of Debt	% of households with debt	Median debt*
Owner-occupied property	44.9	$130 800
Rental property	9.8	$202 000
Other property	6.8	$138 000
Investment	4.1	$79 600
Credit card	76.6	$2 300
Vehicle purchase	23	$14 000
Other	13.8	$7 000
Student	16.3	$9 000

* **For households with debt, in Australian dollars**
Data source: ABS 2005-06 Survey of income and housing (table recreated from Household debt: ABS Australian Social Trends 4102, 2009)

Finding data on the distribution of debt throughout the population has proved a difficult task, however it was possible to find data on the percentage of households in different age and income groups who live in owner-occupied housing, with and without a mortgage, and those who live in rental properties. Since the majority of household debt in the Australian economy is owner-occupied housing debt, looking at the percentage of households with a mortgage, is at least able to give some idea as to how debt is distributed throughout the population.

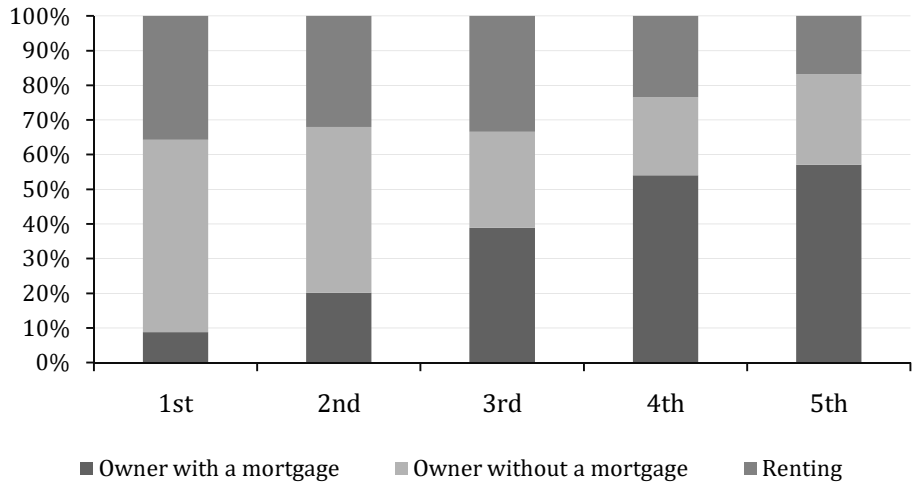
Graph 2.6: Tenure and landlord type by age



Source: ABS Household expenditure survey 2003-2004, Cat. No. 6535.0.55.001

Looking at graph 2.6 it can be seen that the percentage of people holding a mortgage on their home is hump shaped over the life cycle, peaking in the age group 35-44 where nearly 55% of households have a mortgage. The graph also shows the expected result that the percentage of households renting decreases over the life cycle, while the percentage of households that own their homes outright increases. This indicates that generally young households rent until they have a high enough income to get a mortgage, which they then slowly pay off before retirement.

Graph 2.7: Tenure and landlord type by income quintiles



Source: ABS Household expenditure survey 2003-2004, Cat. No. 6530.0

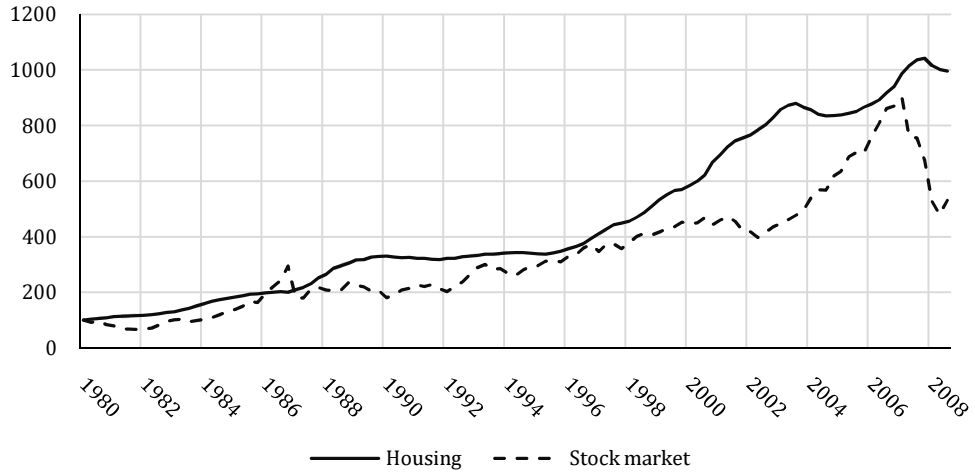
Graph 2.7 shows how owner-occupied housing debt is spread throughout the income quintiles. The percentage of households with a mortgage increases as income goes up. Approximately 8 percent of households in the lowest income quintile and 20 percent in the second lowest quintile have a mortgage, while over 50 percent of households in the top two quintiles owe money on their mortgages. The finding that the percentage of households in the lower income quintiles with mortgages is quite low is not an unexpected result, since most of these households will not satisfy the banks' lending criteria. Graph 2.7 also shows outright home ownership rates actually decrease as income increases (except in the 5th income quintile), this is likely to be largely as a result of the fact that many older people, who have already paid off their homes generally have quite low incomes.

2.3 Housing and Mortgage Market

As we have seen, the main driver of household debt in Australia has been the increase in housing related debt, both for owner-occupied housing and investment housing. To

understand households' decisions on debt levels, it is thus essential to understand the determinants of house prices and expectations about future house prices. Graph 2.8 shows an index for quarterly data of the median price of houses sold in Melbourne from 1980 and onwards, together with a price index for the stock market.[2]

Graph 2.8: Nominal house and stock price indices(1980Q4=100)



Source: Stock price data from OECD, House price data from Real Estate Institute of Australia

The data in this graph should be able to explain much of the willingness to invest in housing in Australia. For most of the time since 1980 house prices increased at the same rate, or faster the price of shares. If risk is measured as price volatility it is also obvious that the return on housing comes at a significantly lower level of risk. This is of course not a complete picture of the different returns from housing and stock market investments. For housing the net income from rent must be included, and the dividends paid to share owners must be added to the increase in the prices on the stock market.

However, just looking at the outcome of the prices on the housing market does not necessarily tell us what caused this outcome. A common explanation for the increase in house prices is that of population growth and scarcity of land. The argument is that house prices must basically keep increasing indefinitely, because a larger number of people will compete for a fixed amount of land. In the short run changes in demand will increase the price because the stock of houses (supply) is fixed, due to the time it takes to construct new dwellings (Sørensen & Whitta-Jacobsen, 2005, p. 454)

[2] Data for Melbourne is used because of availability issues. See the data section of this essay for a further discussion on this.

For the Australian housing market a number of important government policies can be identified to have caused house prices to increase. An obvious one is the fact that the Australian government is subsidizing first-time home buyers. In 2000 the national government introduced the "First Home Owners Scheme", giving newcomers in the housing market a grant of $7 000 (First Home Owners Scheme, 2009). One justification for the grant was the introduction of a value added tax (called GST in Australia) on new houses (ibid). However, the grant was also given to those who purchased an already established home, even though these purchases did not attract any extra tax. Since the amount of money a household can borrow is related to the upfront payment they can make, this could actually have shifted the demand curve by more than the size of the grant (assuming that many first home buyers are credit constrained). Thus, both the debt levels and house prices should have increased as an effect of the grant. In 2008 the Australian government temporarily increased the grant in an effort to stimulate the housing market in the wake of the financial crisis (First Home Owners Boost, 2009).

A second government policy that has influenced the Australian housing is what is called *negative gearing.* Negative gearing means that a property investor can make a tax deduction for any net rental losses (Hanegbi, 2002). If the rental income is lower than expenses such as interest payments, maintenance etc, the owner of the investment property can deduct this from other kinds of income, for example labor income. If the investor is subject to the highest marginal income tax rate of 45% (Australian Tax Office, 2009), the after-tax losses from the investment property are nearly halved. The available research suggests that the effect of negative gearing has been to increase house prices (Hanegbi, 2002).[3] Negative gearing for property investment has been allowed for the whole period we study in this essay, except for between July 1985 and July 1987 (ibid).

2.4 Financial Market Deregulation and Innovation

Since the early 1970s financial regulation in Australia has undergone a series of reforms, aimed at increasing efficiency, competition and innovation in the financial sector, as well as adapting to global changes such as the collapse of the Bretton Woods system. Deregulation of the financial sector in Australia has been a gradual process, beginning in the early 1970s with the removal of interest rate controls on banks, and was largely over in the mid 1980s

[3] There are a number of other effects, such as increased construction and availability of rental accommodation. We will not go into more detail of this here though since our main interest is the effects relevant to debt levels.

when barriers restricting both foreign and new domestic banks entering the Australian market were eased (Battelino, 2007). Table 2.2 outlines the major financial reforms undertaken in Australia.

Table 2.2: Major financial market reforms undertaken in Australia

Reform	Year introduced
Removal of interest rate controls on banks	1973
Introduction of competitive pricing of government securities	1979 for Treasury notes 1982 for Treasury bonds
Exchange rate floated	1983
Reform to allow foreign banks to enter Australian financial system, as well as the easing of regulation for establishing new domestic banks	1985

Source: RBA, 2007

While the deregulation was largely complete by the mid 1980s, the full effects were not felt immediately. Even though new banks were free to enter the market, they found it difficult to compete with the established banks because they lacked the branch infrastructure. However the development of financial innovations such as securitization markets, internet and telephone banking and mortgage brokers, decreased the importance of this infrastructure, allowing new financial institutions to compete with existing banks (ibid).

In terms of the household sector the effect of these financial deregulations was to increase the available supply of credit. This eased households' credit constraints, allowing them greater possibilities to fulfill their desire to borrow in order to purchase large durable goods, most notably housing, as well as to smooth consumption over their lifetime (Green et al, 2009).

The introduction and expansion of home equity loans in particular, have had big effects on the way households accumulated debt. Previously it was standard that when households purchased a property they would steadily pay this loan off until it was owned outright. Home equity loans have allowed households to top up their debt a number of times over the lifetime of the loan, so that many households remain in higher levels of debt for a longer period of time than was previously the case (Macfarlane, 2003).

2.5 The Macroeconomic Consequences of Increasing Household Debt

The discussion on the macroeconomic consequences of high household debt can roughly be divided into three different topics: a) is the current level of debt sustainable given current conditions b) can the debt levels increase further and c) has the increase in debt caused the households to become more sensitive to shocks such as interest rate changes, unemployment and asset price changes. The topic of sustainability will not be discussed here; this section instead focuses on households' sensitivity to shocks, and macroeconomic theories of the role of debt in business cycles.

2.5.1 The sensitivity of households to shocks

Higher debt-to-income ratios leave households and the economy more exposed to shocks such as changes in interest rates, unemployment, and house prices. Below we discuss the effects of shocks to these variables separately; however it is important to consider that they are intimately related. For example an exogenous drop in house prices may cause a decrease in consumer sentiment and therefore decreased consumption, which can in turn increase unemployment. This can have the effect of further decreasing house prices, since it will lead to a decrease in the number of households who can afford home ownership. Although this chain of events is only one of many possible, it is important to emphasize that the overall sensitivity of households is dependent on a large number of interdependent factors.

The increase in the household debt-to-income ratio directly results in increasing the sensitivity of households to changes in interest rates. Eq.2.1 shows the relationship between a change in the interest burden, the debt-to-income ratio and a change in the interest rate. According to this equation, the debt ratio is a measure of the impact on the household interest burden from a change in interest rates.

$$\Delta \frac{interest\ payments}{income} = \frac{debt}{income} * \Delta interest\ rate \qquad \textbf{(Eq 2.1)}$$

The aggregate effect of changing interest rates is however also dependent on the share of households that have variable rate loans. In Australia it is most common for households to have variable rate mortgages (Debelle, 2004), and thus the effects of changing interest rates should be more or less immediate. The capacity of the household sector to handle an increase in the interest burden is also a function of the distribution of debt among households. High-

income households should be less liquidity constrained than low-income, and it is thus the accumulation of debt by low-income households that could be a cause for concern.[4]

A negative income shock, such as unemployment will affect a much smaller portion of the population than interest rate shocks, although the effect is likely to be much more sizable for the small number of households that are affected. If an increase in unemployment has a significant effect on the number of households defaulting on their debt, depends on whether those affected by unemployment have sizable amounts of debt (Debelle, 2004), and also on the generosity of a country's unemployment insurance system. However, apart from unemployment having a limiting effect on households' abilities to meet their debt commitments, it is also possible that mortgage debt can impede chances of reentering the work force, since having a mortgage limits an individuals' ability to move to a place where they are more likely to find work (Rosholm et al, 2006).

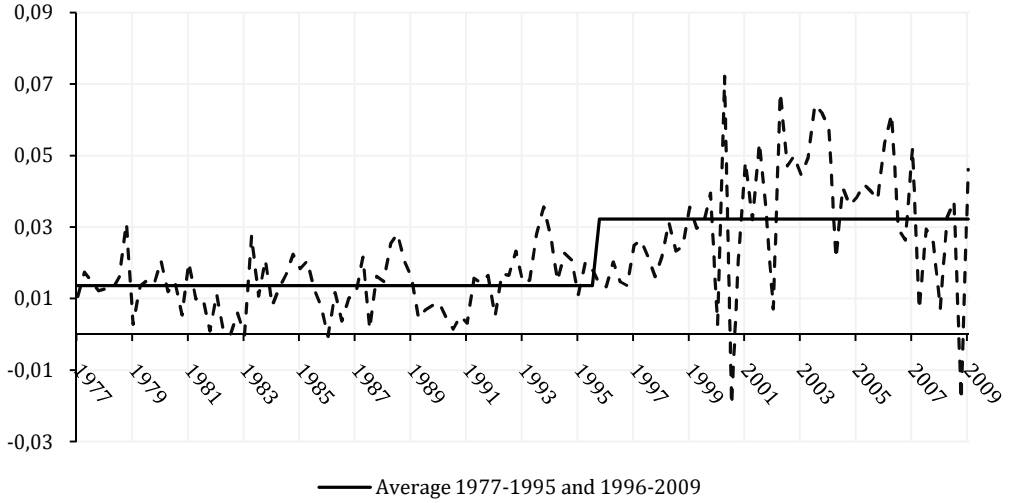
The risk with house price drops is that they decrease households' net asset position. Although this alone has no affect on households' ability to maintain their monthly repayments, the drop in wealth can cause a decrease in consumption, which will quite likely have significant affects on the wider economy. Furthermore, as the financial crisis in the US has shown, an increase in households with negative equity can have very severe consequences for both the financial sector and the wider economy.

2.5.2 Debt and growth

The normal way to analyze debt is as an intertemporal reallocation of resources, i.e. borrowing means using future income for current consumption. Since the resources that are borrowed from the future are spent today, they can contribute significantly to the current aggregate demand, depending on their size relative to disposable income. This point has been emphasized by economists within the post-Keynesian school, and the importance of debt for the concept of *effective demand* has been pointed out by Lavoie (2009, pp.150-152), among others. One important explanation for why this school of economic thought has shown significant interest in debt is that they consider the economy to be driven by demand, both in the short and the long run.

[4] For a detailed discussion on the impact of interest rates see Debelle (2004).

Graph : Change in debt as share of total disposable amount (ratio)



Source: Own calculations from RBA table B21 (total disposable amount = disposable income + change in debt

Graph 2.9 shows the quarterly change in total household debt as share of the total amount households can spend (disposable income plus amount borrowed). From the above perspective it would be argued that the higher level of this ratio has been one of the important factors driving the Australian economy in the last 15 years. Keen (2009c) has argued that the debt levels in the Australian economy have reached levels so high that they cannot increase any further, and thus it cannot be expected to be a significant contribution to demand in the future. Barba and Pivetti (2008) have however argued that from a neo-classical growth theory perspective, the changing debt levels should have a negative impact on growth since it reduces the savings rate, and thus the resources available for investment in capital accumulation.

2.5.3 Debt and stability

An early, and perhaps the most famous, theory of the importance of debt for macroeconomic stability is Irving Fishers' theory of debt-deflation (Fisher, 1933). In short, Fisher envisioned a situation where an economic event, such as an increase in interest rates or a decline in stock market prices initiates what is called the debt-deflation spiral. Without focusing too much on the specifics of his argument, the debt-deflation process can be described as a situation where lowered economic activity causes lowered prices, which in turn causes the nominal debt burden to exceed expectations and the confidence in the economy to fall. During the process firms and households will try to reduce the debt burden, and thus contribute to lowering the economic activity even more. A famous conclusion from this is that the attempt to lower the

debt burden can actually increase the real debt burden through the process of deflation (Wolfson, 1996).

Another influential model that incorporates the possibility of a debt-deflation process is the Financial Instability Hypothesis by Hyman Minsky. The model is one of endogenous business cycles, in which prolonged periods of beneficial economic conditions cause expectations to improve, and the actors of the financial system to move from a hedging position to speculative and Ponzi positions, and thus the dynamics of the financial system has itself created the pre-conditions for a period of financial instability. One of the conclusions is that the Ponzi financing position of many actors in the financial system, will eventually lead to a situation where it is no longer sustainable, and thus investors will engage in a deleveraging position that is likely to cause declining asset prices and possibly also a Fisher-type debt-deflation (Minsky, 1992).

3. Prior Research

Although the development of household debt has been given significantly more attention during the last decade, the empirical research into the causes of changes in gross debt levels has been very limited. From a review of the available literature we have only been able to find one econometric study, by Christen & Morgan (2005). Although they estimate a quite general model for the US economy, their main interest is how the changes in income distribution have affected the debt levels of US households. They do however indentify a number of other contributing factors (such as interest rates and asset accumulation). Perhaps the most comprehensive empirical study is that by Kent et al (2007). They have studied cross-country correlations, for a group of 18 countries, between average annual growth rates of debt ratios and average annual changes in variables commonly believed to have caused the increase in debt ratios. They identify positive correlations for real house price growth, and negative for changes in real mortgage rates, inflation rates, macroeconomic volatility and the unemployment rate.

The theoretical research into household debt is somewhat more comprehensive. Most commonly household debt is studied within some variety of a life cycle or permanent income hypothesis, sometimes within an overlapping-generations framework. The main two causes of increases in debt levels in these kinds of models are increased income volatility and easing of

credit constraints. One example is Krueger and Perri (2005), who have tried to model the fact that increasing income inequality in the US has not been accompanied by increasing consumption inequality. They construct a model in which an increase in idiosyncratic income volatility does not lead to consumption inequality because individuals extend their use of credit markets in order to smooth their consumption over time.[5] There is however one important aspect of households' debt decisions missing from many of these models, that of taking on debt in order to invest or acquire housing.

The most comprehensive review of literature on household debt is probably a Bank for International Settlements working paper by Debelle (2004). Using a life cycle framework as a starting point, he examines the effects on debt levels from a number of macroeconomic variables, as well as the macroeconomic implications of the increase in household debt.

Recently a number of studies have discussed the growth of debt in relationship to the development of other variables such as disposable income, house prices, asset prices and interest payment burdens, without explicitly using actual economic models or econometric methods. These studies often include some variety of stress testing of households with respect to changes in house prices, interest rates and financial asset prices etc. Internationally these studies have become more common after the crash in the US mortgage market in 2007, and the financial and economic crisis that followed. In a report by the Reserve Bank of Australia (2003) it is argued that the increase in household debt ratios can mostly be explained by the shift to a low interest and low inflation regime.

4. Theory

From a theoretical point of view there are two reasons for why households take on debt; to smooth consumption and to finance the acquisition of assets. The smoothing of consumption can take place both in the short and long run. In the short run households take on debt to smooth consumption in the face of negative income shocks, for example unemployment. In the long run debt is used to smooth consumption in the presence of an upward sloping life-time income schedule. But debt can also be used to acquire durable goods such as houses and cars and also to finance investment in stocks and other financial assets.

[5] Other examples include Iacoviello (2007) and Kent et al (2007).

In the following discussion on consumption smoothing we will use a life cycle hypothesis framework. Within this framework a number of different variables will be discussed that can potentially affect households' decisions on their desired level of net assets. While this essay is primarily concerned with gross household debt, it is necessary to discuss what influences net assets, since changes in net assets should generally lead to similar changes in gross debt, as long as we assume that a change in net assets to some extent is caused by a change in debt and not just a change in the volume or value of the assets held by households. For the life cycle framework to be useful we must thus assume that households do not always smooth their consumption by selling assets (reducing their net assets), but instead by taking on some form of debt (increasing gross debt levels).

In the data it is obvious that the increase in gross household debt to disposable income is largely associated with an increase in the accumulation of housing assets. In the following theoretical overview a number of variables will thus also be discussed in terms of how they affect households' willingness to take on debt for this purpose.

4.1 Life Cycle Hypothesis

The dominant explanation as to why households go into debt is provided by the life cycle hypothesis of Modigliani and Ando (1957). According to this hypothesis households maximize their utility by smoothing their consumption over time, such that their consumption today is determined by their entire lifetime wealth (initial wealth plus current and expected future income), the interest rate and their rate of time preference (the discount rate). The model is presented mathematically below.

The individual wants to choose a level of current consumption in order to maximize the following expected lifetime utility function:

$$E_t[U] = E_t[\sum_{\tau=0}^{T-t}(1+\theta)^{-t}u(c_{t+\tau})] \qquad \textbf{(Eq. 4.1)}$$

Where $E_t[.]$ is the expectations operator, U is lifetime utility, θ is the discount rate, $u(\cdot)$ is the instantaneous utility function and c_t is the consumption level in time t. This equation says that total lifetime utility is equal to the discounted sum of utility of current consumption in each period.

This is subject to the individual's budget constraint which can be written as:

$$\sum_{\tau=0}^{\tau-t}(1+r)^{-\tau}(c_{t-\tau}-y_{t-\tau})=A_t \qquad \textbf{(Eq. 4.2)}$$

Where A_t is assets in period t, r is the interest rate (return on assets) and $y_t$is income in period t. This equation is the constraint that lifetime consumption is equal to lifetime income, plus initial assets.

Solving this maximization problem gives the optimal condition below, known as the Euler equation:

$$\frac{E_t u'(c_{t+1})}{u'(c_t)}=\frac{1+\theta}{1+r} \qquad \textbf{(Eq. 4.3)}$$

The Euler equation states that the relationship between current and future consumption depends on the relationship between the interest rate and the discount factor. Where the interest rate is higher than the discount factor, the returns on savings outweigh the effect of discounting future consumption, and individuals will maximize their utility by consuming more tomorrow than today.

Using the simplifying assumption that the discount rate is equal to the interest rate gives that consumption in the current period is equal to the expected consumption in all future periods, i.e. that the individual will maximize their utility by having constant expected consumption over their lifetime:

$$E_t u'(c_{t+1})=u'(c_t) \rightarrow\ E_t[c_{t+1}]=c_t=\bar{c} \qquad \textbf{(Eq. 4.4)}$$

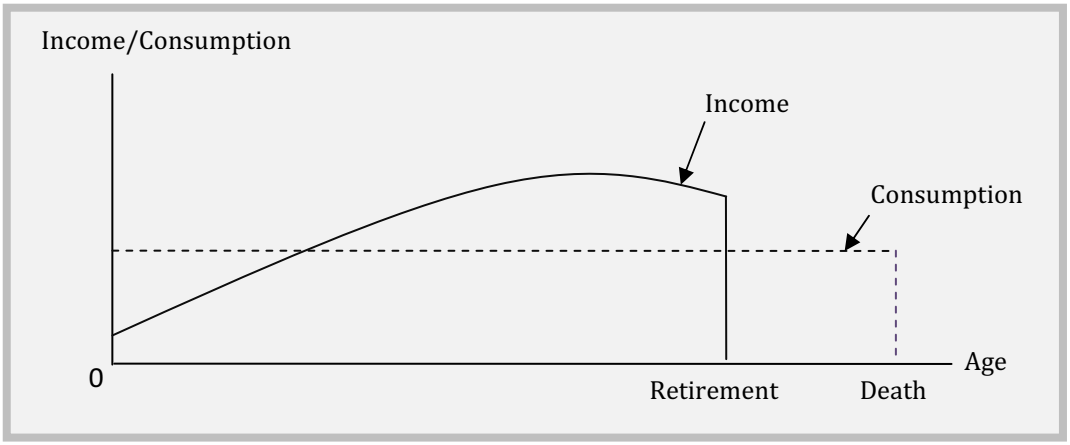


Figure 4.1: Life cycle income and consumption schedule

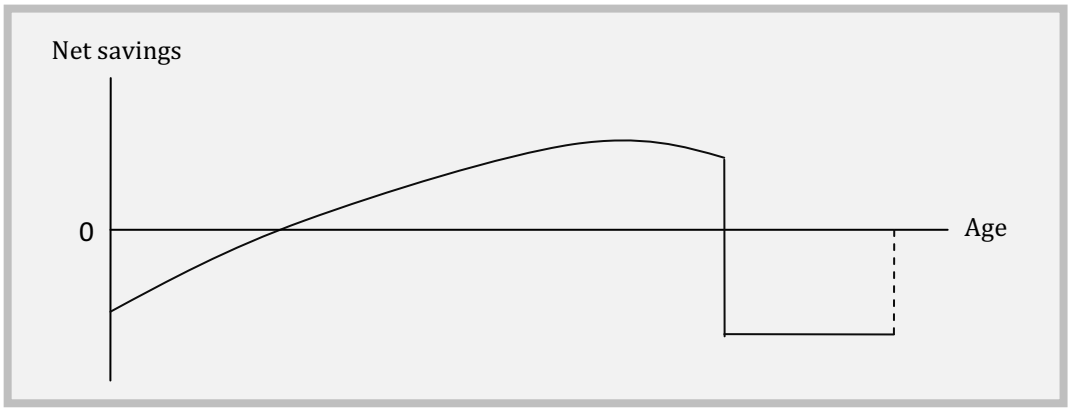


Figure 4.2: Life cycle net savings schedule

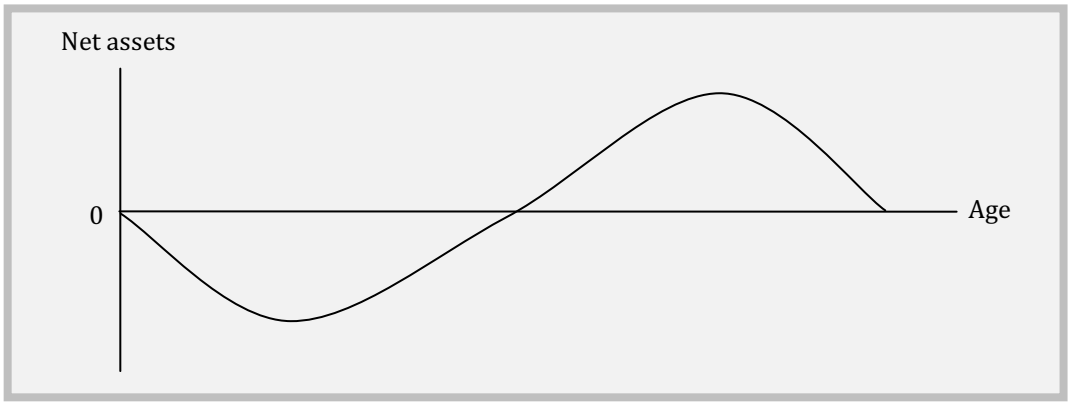


Figure 4.3: Life cycle net assets schedule

The conclusion that individuals will seek to smooth their consumption has important implications for the net asset levels they will choose to hold over their lifetime. Assuming no credit constraints and an upward sloping income profile, you would expect individuals in early adulthood to have negative net asset holdings, as they borrow from their higher future incomes to fund increased consumption today. As individuals incomes rise over their lifetimes, they should begin to save money, both to pay back their earlier debt and also in

order to fund consumption in their retirement, and finally in retirement individuals should dis-save from their stock of assets, as they have very little or no income, and will want to maintain their previous consumption levels. A graphical representation of income, consumption, net savings levels and gross debt levels over the life time is shown below in figure 4.1, 4.2 & 4.3, for the generalized case where the discount rate is equal to the interest rate.

A further result of the lifecycle hypothesis is that consumption will not only be smoothed over the lifecycle, but also where there are temporary shocks to current income (for example through temporary unemployment). An unexpected negative shock to current income will only cause total lifetime income to decrease by a small amount and therefore current consumption will also only decrease marginally, even though current income has decreased substantially. In order to maintain a smooth level of consumption through an adverse income shock, households will need to either borrow or take money from their savings, thus decreasing their net assets.

While the lifecycle hypothesis is a very useful tool in examining households' consumption and savings decisions, it is important to keep in mind that in reality it does not hold perfectly. An important reason for this is that many households are subject to some degree of credit constraint. These constraints, caused by financial regulation and incomplete information in the lender borrower relationship, cause many households to be unable to borrow in order to smooth their consumption to the degree desired. A relaxation of financial regulation has taken place in most developed countries in recent decades. These deregulations have reduced the degree to which many households are credit constrained. Given this, it is reasonable to assume that at least some of the increase in household debt levels observed over time is caused not by an increase in demand for debt, but instead by previously credit constrained households being given greater access to their desired credit levels.

A further reason that consumption and debt levels are empirically not perfectly explained by the lifecycle hypothesis is that a part of households' consumption is spent on durable goods such as housing (Obstfeld & Rogoff, 1996, pp. 96-99). Housing in particular is often very expensive relative to current income and so when purchasing housing assets, households will often have to take on very large amounts of debt. However, this does not imply that the consumer does not smooth consumption over the lifecycle. Instead of smoothing consumption

expenditure, households smooth the sum of current consumption and the stream of consumption from durables. Since most households purchase housing quite early on in their income earning years, the gross debt levels will be more hump-shaped than predicted by a lifecycle model without durables.

Below we discuss the effect of changes in the variables that we have indentified from the life cycle hypothesis as affecting current consumption levels and thus net savings rates, namely the interest rate, the discount rate, ,income volatility, as well changes in the demographic structure of the economy. We also discuss these and other variables that affect households' willingness to take on debt for the purpose of accumulating assets.

4.1.1 Interest rate changes

Economic theory does not provide any conclusive result regarding the expected effect of a change in real interest rates on savings and consumption. There are two main effects that have to be considered; the income effect and the substitution effect (Debelle, 2004). On the one hand a decrease in the real interest rate will decrease the cost of borrowing, effectively making shifting from future to current consumption relatively less costly and thus causing the savings rate to drop (the substitution effect). On the other hand a decrease in real interest rates will cause households' income to decrease through decreasing the real return on assets, causing consumption to decrease and thus net savings to increase (the income effect) (Mankiw, 1998, p. 460). The net effect of a decrease in interest rates depends on the relative sizes of these two effects.

The relative magnitudes of these income and substitution effects would likely depend on the financial situation and stage in the lifecycle of households. For those that are young with relatively few assets the decreased cost of borrowing caused by an interest rate decrease is likely to outweigh the effect of the decreased return on assets, whereas for those that are older and have large asset holdings the opposite is likely true (Debelle 2004).

Empirical results on the effect of changes in interest rates are mixed, however it seems widely accepted that decreased borrowing costs have played a major role in the increased debt levels in Australia (Reserve Bank of Australia, 2003).

4.1.2 Demographics

In the lifecycle hypothesis framework it follows that the age structure of the population will have an impact on the level of aggregate debt in the economy. Where there is a high proportion of younger households in the economy it would be expected that the aggregate net debt levels would be higher than the case where there is a higher proportion of older households, since these households have to borrow from their future income to maintain a smooth consumption path over their life cycles.

Perhaps another demographic explanation to increasing household debt levels is how the proportion of individuals who undertake tertiary education has changed over time. Since undertaking tertiary education generally involves deferring earnings and borrowing to fund current consumption and tuition fees, it would be expected that where the proportion of students increase over time, aggregate debt levels in the economy will increase (Dynan & Kohn, 2007). The same would be true where the average number of years of tertiary education undertaken increase.

4.1.3 Discount rates

According to life cycle theory, if discount rates increase households will maximize their utility by consuming relatively more of their lifetime income today, instead of in the future. This will mean a lower net savings rate and thus lower net asset levels. Evidence that such a change has taken place is very scarce.

4.1.4 House prices and home ownership levels

As we have discussed in the previous section house prices have increased significantly in Australia in recent years. This will have a range of effects on households' debt accumulation decisions and the effects are quite different for those who have entered the housing market before the price rises and those that enter after.

For households that own a house an obvious effect of increased house prices is that their wealth increases, which in the framework of the lifecycle hypothesis will lead to increased current and future consumption and higher current debt levels. This result is however dependent on a number of factors. Firstly, in order to increase current consumption households must have a means of gaining access to a liquid form of their newly increased

wealth. Financial tools such as home equity loans are a common means through which this is achieved. Secondly, this result is dependent on there not being perfect altruistic links between generations (Dynan & Kohn, 2007). Where current home owners consider that house prices have risen to the extent that their children will have trouble entering the housing market, increases in housing wealth through price increases may not be consumed, but instead saved and passed on to their children. Finally when considering whether consumption should increase from an increase in housing wealth it is also important to consider changes in housing user costs. This concept can be thought of as the cost of a flow of housing services over a particular time (Podenza, 1988, p.85) or more specifically it is equal $(r + \delta)p^H$, where r is the interest rate, δ is the cost of housing maintenance (the depreciation rate for housing capital) and p^H is house prices (Sørensen & Whitta-Jacobsen, 2005, p. 454). As can be seen by the user cost equation an increase in house prices, interest rates (this is included even when the house in owned outright since it reflects the opportunity cost of the money invested in housing) and the housing depreciation rate all increase the user cost of housing. So when house prices increase the extra consumption caused by the wealth effect should be somewhat diminished by the user cost of housing also increasing from the house price rise.

For households that have not yet entered the housing market, increases in house prices could have two opposing effects. The first is that some households might be turned off by the higher prices and instead opt to settle for rental accommodation. These households will not accumulate as much gross debt as they would have without the increase in prices. The second effect is that for households that still decide to enter the housing market despite the house price increases, higher prices will mean that they have to assume more debt in order to purchase housing. In Australia the owner occupier rate has barely changed over time despite the significant rise in house prices (Kryger, 2009), suggesting that the second effect outweighs the first.

4.1.5 Income volatility

Iacoviello (2007) and Krueger and Perri (2005) have constructed models that have incorporated income inequality as an explanatory factor for changes in the ratio of household debt to disposable income. The main assumption of these models is that an increase in income inequality is, at least to some extent, equivalent to an increase in the volatility of individuals' income profiles. The prediction is that even if the permanent levels of income remain

unchanged for all households, the increased volatility in the individual income patterns will have the effect that at any period in time a larger number of individuals will need to turn to the credit markets to smooth their consumption, and thus the level of gross household debt to disposable income will increase. One study by Barret et al (2000) have found that income inequality does not lead to consumption inequality, suggesting that the increase in inequality is at least to some extent caused by increased individual income volatility.

4.2 Hyperbolic Preferences

An important note with discount rates is that much experimental evidence suggests that some individuals have hyperbolic preferences, i.e. they have a much higher discount rate in the short run than in the long run (Harris & Laibson, 1999). Households with such preferences may have a long-run desire to smooth their consumption over time, but in the short run they lack the self control to enact these long-run desires.

Households with these hyperbolic preferences have been found to have relatively more illiquid assets (presumably to lock themselves into some kind of saving plan), as well more credit card debt, resulting in less ability to smooth their consumption in the face of income shocks (Angeletos et al, 2000). However while the existence of these time inconsistent discount rates may explain why in some cases households' consumption are not smoothed over time (ibid), it is unclear that this will have any implications for the increase in aggregate household debt over time (Barnes & Young 2003). A possible explanation though for why hyperbolic preferences are relevant for the changes in debt levels could be that households exhibiting these kinds of preferences were previously not able to consume as much as they wanted in the short term, due to credit constraints. If this is the case the existence of hyperbolic preferences could have amplified the increase in borrowing caused by a relaxation of credit constraints.

4.3 The Inflation Rate

Modern monetary policy has been very successful in recent years at stabilizing inflation rates at historically low levels. The low inflation environment has likely contributed to rising debt-to-income levels for two reasons (Reserve Bank of Australia, 2003).

Firstly, lowered inflation rates can have the effect of decreasing households' credit constraints. The reason for this is that it is common for lending institutions to set the

maximum amount a household can borrow such that initial repayments are no higher than some portion of the household's income. A decrease in inflation which reduces nominal interest rates increases the amount that households can borrow without going over this bound (Kent et al, 2007).

The second effect of decreased inflation rates is that the debt-to-income ratio will erode more slowly over time (Debelle, 2004). The debt-to-income ratio is eroded by two factors; principal repayments and nominal income growth. Decreased inflation leads to decreased nominal income growth and so the power of this second factor to decrease the debt-to-income ratio over time is decreased when inflation is lowered (Reserve Bank of Australia, 2003)[6].

4.4 Conspicuous Consumption and Income Inequality

Previously income inequality was discussed as having an effect on debt levels through individual income volatility; however it has also been argued that income inequality in itself affects the consumption decisions of households. This notion is supported by a different interpretation of empirical research that concludes that changes in income inequality do not lead to changes in consumption inequality to the same extent.[7] If the increased income inequality is not explained by an increase in individual income volatility, the fact that consumption inequality has not developed as expected must be explained by either a) increased borrowing (or reduced savings) by the those who have fallen behind in the income distribution or b) or by an increase in savings by those whose relative income has increased, beyond their relative gain.

One of the arguments for why people would consume beyond their means is concerned with what is called conspicuous consumption. The idea is that the utility an individual gets from consumption is dependent not only on the level of consumption, but also on how this level compares to the level of the surrounding society. One justification for this assumption is that individuals consume not only to satisfy their direct needs, but also as a way of obtaining status in a community. This is relevant to this essay because as some parts of society see their income decline relative to others they will try to retain their position in society by maintaining

[6] For a more detailed analysis of this effect see the appendix of 'Household Debt: What the Data show', Reserve Bank of Australia (2003)
[7] See section 3.1.5 in this essay

their consumption of what has been called positional goods[8]. However, since their current income is decreasing or constant they will be forced to increase their indebtedness. It should be noted though, that with this simple theory of conspicuous consumption there is no actual argument for why households would engage in conspicuous consumption today, since doing so diminishes their possible future consumption.

A refinement of this line of reasoning is offered by Frank (1985). His argument starts with the assumption that it is known that individuals in the labor force have different abilities, but that these abilities cannot be directly observed. He then adds that consumption of what is called positional goods can act as a signal of ability, i.e. individuals with a high level of consumption of these goods are also assumed to have a high income, and thus high level of abilities. Increasing the consumption of positional goods could therefore improve an individual's rank in the labor force, and assuming that this would increase the chance of getting a higher paid job, the increase in current consumption could very well be the result of a rational individual's maximization of life-time utility, and therefore it does not necessarily have the same problem as the simple theory of conspicuous consumption discussed above. Even though this kind of "signaling competition" could very well increase with increased inequality, we do not see that the magnitude could be large enough for the this factor to be able to explain significant changes in debt levels.

4.5 The Irrationality of Household Financial Behavior

From empirical work it is well known that the standard life cycle hypothesis presented above cannot explain a number of characteristics of actual household saving rates. In a recent book within the field of behavioral economics, by Akerlof and Shiller (2009), it is argued that households' decisions to save are often arbitrary and to a large extent dependent what they call "psychological framing". This can be thought of as the behavioral background surrounding savings, something which varies across individuals, groups and countries. Akerlof and Shiller thus argue that even though standard economic theory is able to predict the savings behavior over the life cycle of an individual, it cannot explain the actual variability of saving rates across individuals or countries. This conclusion might seem trivial, but it is actually very important for the conclusions drawn from the previous discussion on the life cycle hypothesis. Consider for example the case of a demographic change; above we

[8] Positional goods are goods that can be observed by others and therefore they signal something about the owner. Examples could be cars, houses and mobile phones. See Frank (1985).

concluded that an aging population should lead to an increase in net assets (which we have assumed will also decrease gross debt). However, this conclusion is highly dependent on the assumption that the "psychological framing" has not changed between generations. If young people are becoming less willing to save, and more willing to take on debt, this will counteract the effects of the change in the demographic structure. This discussion does not give any clear predictions that can be incorporated into the empirical analysis of debt levels; however it does imply that an econometric analysis could fail to adequately explain changes in debt levels, simply because of the fact that it depends on behavioral changes that are not easily captured by available economic data.

4.6 Expectations, Rational Bubbles and the Confidence of Storytelling

Within the life cycle framework the effects of expected future income and wealth are quite obvious; a positive shock to either will increase life-time income, and therefore also current, consumption and thus increase current debt. The effects of an increase in expected capital gains will increase investment, for example in housing, and therefore increase the amount of current debt used to finance investment. A more thorough discussion on how expectations are formed are thus of crucial importance for understanding the development of household debt.

There are a number of different forms of expectations that households could have with respect to their future income, for example static backward-looking, adjustable or rational expectations. In our econometric study in this essay we assume rational expectations in the long run, such that on average expected future income is equal to the actual average future income. In the short run however, we will not make any theoretical assumptions on the type of expectations that characterize the Australian households, instead we will use a consumer sentiment index to reflect actual expectations.

Since house prices are assumed to be one of the main explanatory variables for future household wealth, a good understanding of what determines expected future house prices is necessary. Within standard economic theory it is assumed that asset prices reflect fundamentals, so that changes in prices can be explained by factors influencing demand and supply. The expected future price would thus be based on the forecasts of these factors. There have been a number of econometric studies on what determines house prices in Australia and the variables found to be significant are income growth, population growth, construction costs, mortgage rates and consumer prices (Hatzvi & Otto, 2008).

It is often argued that different asset prices are not based on fundamentals, but instead are the result of speculative bubbles. Broadly, two forms of bubbles can be distinguished: a) rational bubbles in which the participants are aware of the speculative nature of prices and are hoping to get out before the bubble bursts and b) irrational bubbles where participants are not aware of the deviation from prices stipulated by fundamentals. One of the first to propose the existence of rational speculative bubbles was Blanchard (1979). The key characteristics of this concept are that a bubble exists and that there is a positive probability that it will not burst in the near future. Irrational housing market bubbles have recently been analyzed from a behavioral economics perspective by Akerlof and Shiller (2009). In their analysis they apply the two concepts of *confidence multipliers* and *stories.* For the housing market the arguments goes as follows: as house prices increase and the economy grows, confidence increases, this increase in confidence then causes further economic expansion and house price increases. There is thus a positive feedback loop between confidence and the economy. However, this process is also dependent on what information is available to the agents of the economy. This is where *stories* come into play. In the presence of a housing market bubble the dominant story could be that of ever-increasing house prices, big investment returns and constant supply shortages. This story can be retold through the media, by experts or from friend to friend or colleague to colleague. The implication is that human behavior is not based on all the available facts, but on these dominant stories. In this sense an irrational bubble could appear. It should be noted though that expected future house prices can still be considered to be based on fundamentals, the problem being that the processes of storytelling and confidence multipliers have distorted and exaggerated the forecasts of these fundamentals. In practice it is probably hard to characterize a bubble (if the existence of a bubble can ever be agreed upon) as rational or irrational. It is probably the case that the different participants of a bubble choose to participate on different grounds. Some might think there is a rational bubble (or at least that they act like the agents of a rational speculative bubble), while others are not aware of the bubble. A bubble is therefore most likely not exclusively rational or irrational, instead it could have elements of rationality, irrationality, storytelling and positive confidence feedback loops – all at the same time.

5. Model and Econometric Method

This section first contains a discussion on the variables that will be included in our specification, based on the previous theoretical discussion and the available data. Following this is a discussion on relevant econometric theory and method.

5.1 Choice of Variables

The theoretical discussion in the previous section suggests a number of possible variables to include in the econometric analysis of the determinants of the debt-to-income ratio. The following is a short discussion of the variables we choose to include in our model.

A real house price index (RHPI) is included to capture both the wealth effect, from a change in asset prices, and also the fact that when house prices increase households must take on more debt in order to purchase housing. The standard variable mortgage rate (SVMR) is included to capture how interest rate changes (the substitution and income effect) affect the household debt decision. We include the interest rate spread (IRS), i.e. the gap between lending and deposit rates, to capture the effect of changes in financial regulations and innovations. The inflation rate (INF) is included to capture its affect of the speed at which the debt-to-income ratio erodes. Expectations of future income and wealth changes are captured by including the consumer sentiment index (CSI) jointly compiled by the Westpac Bank and the Melbourne Institute. Finally, we include a measure of GDP variance in order to capture the effect of output volatility (OUTV). A discussion on the exact nature of these variables and where they are sourced from is included in the next section.

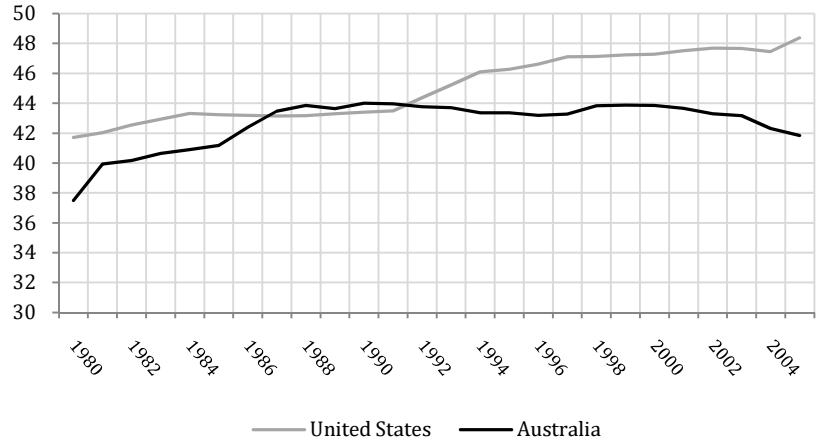
As we have discussed in the theory section, the expected signs of the variables we plan to include in the model determining the household debt to disposable income ratio (DTDPI) are as follows:

$$DTDPI = f(RHPI, SMVR, IRS, INF, CSI, OUTV)$$
$$(\ +\quad -\quad -\quad -\quad +\quad -\ )$$

Variables representing changes in the demographic structure of the population and income inequality over time are not included, even though as we have discussed previously, there are theoretical reasons why that they may affect aggregate household debt levels. The reason that we do not include an income inequality measure such as the Gini coefficient in the model is

that we were unable to find suitable data spanning the time frame of our study. Yearly Gini data up until 2005 is shown in graph 5.1. This graph shows that income inequality has progressed quite differently in Australia compared to the United States. Inequality increased in Australia from 1980-1987 and has since gradually declined aside from a small increase around 1997, whereas in the US it has increased steadily since 1980. Comparing income inequality in Australia to the debt-to-income ratio (see graph 2.1) it appears that the major increase in household debt has occurred while inequality has been decreasing or constant. The theoretical literature and the somewhat limited empirical findings[9] (for the United States) suggest that the opposite should be the case, i.e. increasing income inequality contributes to increases in aggregate household debt. A simple visual analysis of the data for Australia therefore indicates that changes in income inequality are unlikely to have been a major cause of the increase in the debt-to-income ratio over time, at least not in the way we expect from the theoretical discussion.

Graph 5.1: Gini coefficients - Australia and USA



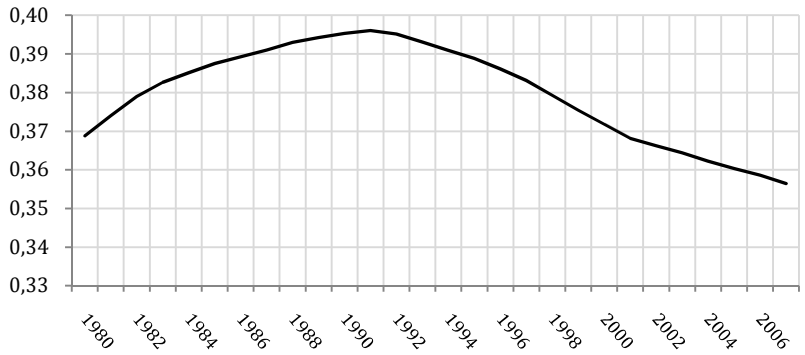
Source: Standardized World Income Inequality Database (net income Gini)

Looking at data for the age structure of the population with respect to the increasing household debt levels in the economy is somewhat puzzling. Graph 5.2 shows how the number of 20-45 year olds as a share of total population has changed since the 1980s. As we have discussed previously, those in this age group are generally expected to have relatively more debt than other age cohorts and so it would be expected that a decrease in 20-45 year olds as a share of total population would lead to a decrease in aggregate debt levels. However analyzing graph 7.2 shows that this age cohort has been decreasing in share since 1991, while

[9] See Keeping Up With the Joneses: Analysing the Effects of Income Inequality on Consumer Borrowing (Christen & Morgan, 2005)

debt levels have increased substantially during this time (see graph 2.1). The conclusion that we draw from this is that including this variable in the regression will give misleading results and for this reason it is excluded.

Graph 5.2: 20-45 Cohort as share of total population



Source: ABS Population data

5.2 Non-Stationarity and Cointegration

An important assumption in using time-series data in regression analysis is that of stationarity. Stationary variables are those that have a time-invariant mean, variance and autocovariance (Harris & Sollis, 2005, p. 27). Time series can also be trend stationary if they are stationary around a deterministic trend. If a series is stationary after first differencing it is said to be integrated of order one (I(1)). A series is said to be integrated of order *n* (I(n)) if it requires differencing n times in order to be stationary.

Running OLS regressions on non-stationary series can be very problematic for econometric (and economic) inference. The reason for this is that in such regressions the residuals are serially correlated, which leads to an underestimation of the residual variance and also standard errors for the coefficients in the regression and an overestimated R^2 (Granger & Newbold, 1974). Since the standard errors of the coefficients are unreliable, hypothesis testing on whether they are significant will be meaningless. This type of regression is called a spurious regression.

The first solution to the problem of running regressions with I(1) variables was to estimate a regression in first differences. However, using such an approach is not ideal for those interested in long-run relationships between the variables, because first differencing removes this information (Davidson et al, 1978). Fortunately there is a special case where regressions containing non-stationary variables can have a meaningful interpretation. This is when these

variables are cointegrated. A set of non-stationary I(1) variables are said to be cointegrated when a combination of them exists, such that in the long run they do not drift apart (Enders, 2005 p. 320). Consider the following simple model, where y_t is the non-stationary dependent variable, and x_t is the n-dimensional vector of non-stationary independent variables:

$$y_t = \beta' x_t + u_t \quad \textbf{(Eq. 5.1)}$$

$$y_t - \beta' x_t = u_t \sim I(0) \quad \textbf{(Eq. 5.2)}$$

Cointegration then implies that there is a vector β such that the residuals u_t, are stationary and integrated of order zero. If this is the case $(1 - \beta_1 \ldots - \beta_n)'$ is said to be the cointegrating vector. This is the condition stated in eq. 5.2.

5.3 Error-Correction Model

Engle and Granger (1987) have shown that the existence of a cointegrating relationship is equivalent to the existence of a short-run specification called an *error-correction model, ECM*. The ECM of the model above can be expressed as follows

$$\Delta y_t = \Delta y_{t-1} + \alpha' \Delta x_t + \gamma (y_{t-1} - \beta' x_{t-1}) + v_t \quad \textbf{(Eq. 5.3)}$$

$$\Delta y_t = \Delta y_{t-1} + \alpha' \Delta x_t + \gamma u_{t-1} + v_t \quad \textbf{(Eq. 5.4)}$$

The lagged value of the residual from the long-run cointegrating relationship here takes the form of a disequilibrium term. The economic interpretation of γ is the speed of adjustment towards the long-run equilibrium. The connection to the concept of cointegration can best be understood by examining what happens when $\gamma \geq 0$. If this is the case y_t does not react in an equilibrium reverting way to deviations from the equilibrium (as represented by the lagged residuals from eq. 5.2), and thus there is no tendency for it to return to this equilibrium in the long run. This is equivalent to saying that there is no meaningful long-run relationship between y_t and the variables in x_t, i.e. no cointegration.

If one wants a more complete model, the ECM above can be augmented with other I(0) variables that are thought to be a significant part of the short-run dynamics. Later we will estimate a model like this, within a general-to-specific framework.

5.4 Testing for Unit Roots

In order to test for the presence of unit roots in the series we mainly use the Augmented Dickey-Fuller (ADF) test. This test is an extension of the Dickey-Fuller test, modified to account for higher order autoregressive processes, by including more lags of the first difference of the variable. The test regressions used are given below. Equation 5.5 has no deterministic components and equation 5.6 includes a constant, while equation 5.7 includes both a constant and a linear trend.

$$\Delta y_t = \varphi^* y_{t-1} + \varphi_1 \Delta y_{t-1} + \varphi_2 \Delta y_{t-2} + \cdots + \varphi_{p-1} \Delta y_{t-p+1} + u_t \quad \textbf{(Eq. 5.5)}$$

$$\Delta y_t = \beta_0 + \varphi^* y_{t-1} + \varphi_1 \Delta y_{t-1} + \varphi_2 \Delta y_{t-2} + \cdots + \varphi_{p-1} \Delta y_{t-p+1} + u_t \quad \textbf{(Eq. 5.6)}$$

$$\Delta y_t = \beta_0 + \beta_1 t + \varphi^* y_{t-1} + \varphi_1 \Delta y_{t-1} + \varphi_2 \Delta y_{t-2} + \cdots + \varphi_{p-1} \Delta y_{t-p+1} + u_t \quad \textbf{(Eq. 5.7)}$$

The null hypothesis of the ADF test is that $\varphi^* = 0$, i.e. that the series contains a unit root and is therefore non-stationary. The alternative hypothesis is that $\varphi^* < 0$, in which case we cannot reject the null of a unit root (Harris, 1995, pp. 32-34).

5.5 Testing for Cointegration

One of the most common ways to test for cointegration is to use Engle-Granger approach (Engel & Granger, 1987). This is a two-step procedure to test for a cointegrating relationship in a single-equation system. The first step is to run an OLS regression of the form in eq. 5.1. The second step is then simply to test if the residuals from this regression are stationary, using the Augmented Dickey-Fuller test discussed previously.

A serious problem can however be present in the case when we are interested in cointegrating relationships between more than two variables. In the case where there are n variables it is possible that $n - 1$ unique cointegrating vectors can exist (Harris, 1995, p.21). Since the Engel-Granger procedure provides no way to isolate these multiple cointegrating vectors this presents a problem where more than 2 variables are being examined (Enders 2004, p. 347). The most commonly used approach to get around this problem is that developed by Johansen (1988).

5.5.1 The Johansen approach

The Johansen test can be intuitively thought of as a vector auto-regressive (VAR) form of the Engel-Granger procedure:

$$z_t = A_1 z_{t-1} + \cdots + A_k z_{t-k} + u_t \qquad \textbf{(Eq. 5.8)}$$

Where $\boldsymbol{z_t}$ is an $(n \times 1)$ matrix, each $\boldsymbol{A}$ matrix is an $(n \times n)$ matrix of parameters, $\boldsymbol{u_t}$ is an $(n \times 1)$ matrix of residuals (Harris, 1995, p. 77).

In the same way that the single-equation specification can be reformulated into the ECM, the multivariate system can also be expressed in vector error-correction (VECM) form (Harris & Sollis, 2005, p. 110):

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \cdots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + u_t \qquad \textbf{(Eq. 5.9)}$$

This model is comparable to the single-equation error-correction model in that $\boldsymbol{\Pi = \gamma\beta}$, where $\boldsymbol{\beta}$ is equivalent to the single-equation cointegrating vector, and $\boldsymbol{\gamma}$ contains the speed-of-adjustment coefficients. Testing the number of cointegrating relationships that exist is done by testing the number of linearly independent rows (called matrix rank) in the $\boldsymbol{\Pi}$ matrix. For each linearly independent row in the $\boldsymbol{\Pi}$ matrix there is one corresponding cointegrating relationship, and also one significantly non-zero eigenvalue (λ). In order to test the rank of the $\boldsymbol{\Pi}$ matrix Johansen proposes the trace test and the max test statistics.

The trace test tests the null that r or less cointegrating relationships exist, against the alternative that there exists more than r cointegrating relationships. The trace test statistic is as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{k} \ln(1 - \hat{\lambda}_i), \quad r = 1,2, \ldots, n-1 \qquad \textbf{(Eq. 5.10)}$$

where T is the sample size and $\hat{\lambda}_i$ are the estimated eigenvalues.
The max test has the more specific null that there exists r cointegrating relationships against the null of $r + 1$. The max test statistic is:

$$\lambda_{max}\,(r, r+1) = -T\ln(1-\hat{\lambda}_i)\,,\;\; r = 1,2,\ldots,n-1 \qquad \textbf{(Eq. 5.11)}$$

In EViews (which is the econometrics software used in this essay) the critical values for these tests are those from Osterwald-Lenum (1992).

5.6 Estimation of Cointegrating Relationships

In the special case where only one unique cointegrating vector is found using the Johansen approach, it can be appropriate to proceed with the estimation of a single-equation cointegrating relationship.[10] However, it is not straightforward to use ordinary least squares in this case. The two main reasons are that all the independent variables might not be weakly exogenous and that the error terms from the cointegrating relationship might be serially correlated. Phillips and Hansen (1990) developed the Fully Modified-OLS (FM-OLS) estimator for the purpose of efficient and unbiased estimation of single-equation cointegrating relationships.

The FM-OLS estimator corrects for both endogeneity and serial correlation with the aid of estimates of the long-run covariance within the system. The gains in efficiency and reduced bias from using FM-OLS have been discussed in a number of papers. Inder (1993) examined the properties of a number of estimators used in cointegration analysis through Monte Carlo simulations. The results indicated that the gain from using FM-OLS over OLS is not very significant, and instead it is recommended that an unrestricted ECM estimator is used, in which the short run and long run is estimated simultaneously. However, Hargreaves (1994) has argued the Monte Carlo simulations like the ones performed by Inder (1993) have some shortcomings, in that they usually only examine cointegrating relationships between two variables. He then performs a large number of simulations on a system where four variables are cointegrated, and finds that there are quite significant gains to be made in terms of both efficiency and bias by using the FM-OLS. He also argues in favor of the FM-OLS on the grounds that it is a lot less sensitive to miss-specification, such as the choice of wrong set of deterministic components or lag length, than for example the Johansen ML estimator.

[10] The reason this discussion is limited to single-equation estimators, is that our econometric investigation found that there is one unique cointegrating relationship in our data.

6. Data

A list of the data used in our model is provided in table 6.1. All this data is freely available with the exception being the real house price data, which is available for purchase from the Real Estate Institute of Australia. All the data is quarterly and spans the period March 1980 to June 2009.

Table 6.1: Data sources

Variable	Measure	Source
Household debt to disposable income	Percent, reported in annualised terms	Reserve Bank of Australia, table B21
Real median house prices index	Index (1997Q2=100)	Real Estate Institute of Australia, data cube REMF1
Standard variable mortgage interest rate	Rate per annum	Reserve Bank of Australia, table F5
Interest rate spread	Rate per annum	Reserve Bank of Australia, tables F5 & F4
Consumer sentiment index	Index	Reserve Bank of Australia, table G08
Inflation	Per annum, measured as the rate of change in the CPI from the same quarter of the previous year	Australian Bureau of Statistics, Series ID 2325847F
Output growth volatility	Variance of GDP growth during the previous five years.	Own calculations from Reserve Bank of Australia, table G11

Reserve Bank of Australia data tables are available at **www.rba.gov.au**
Australian Bureau of Statistics data is available at **www.abs.gov.au**
Real Estate Institute of Australia can be purchased from **www.reia.com.au**

6.1 Household Debt to Disposable Income

The data for household debt to disposable income was obtained from the Reserve Bank of Australia's statistical database and is seasonally adjusted. This data refers to housing and other personal debt, and does not include that of unincorporated enterprises. The data for disposable income came from the quarterly national accounts and is reported in annual terms.

6.2 Consumer Sentiment Index

We use a consumer sentiment index, jointly compiled by the Westpac bank and the Melbourne institute, as a proxy for expectations about future economic conditions. This index has a base of 1 and assesses five different aspects of consumer confidence; evaluations of their household financial situation over the past and coming year, anticipated economic

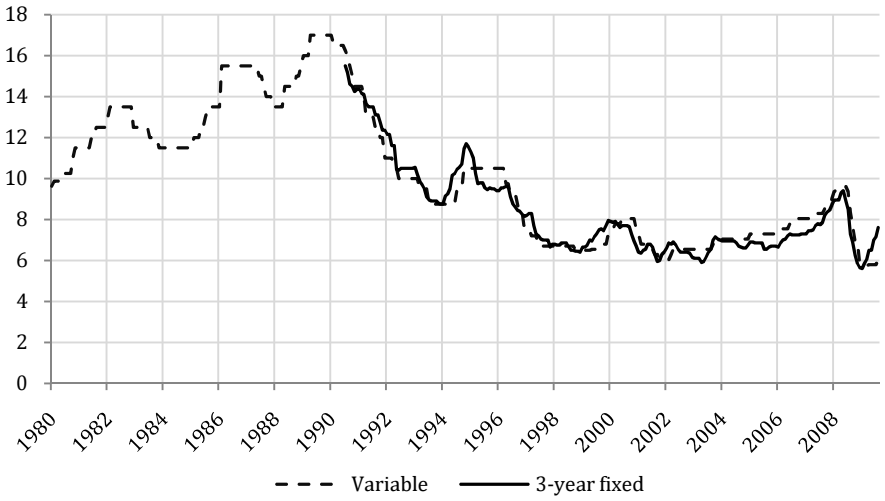
conditions over the coming year and next five years, buying conditions for major household items as well as assessments about future unemployment rates (Melbourne Institute, 2009).

This variable is included to capture expectations of future wealth and income growth. Others doing similar studies have used past income growth (Christen & Morgan, 2005), however we prefer to use a consumer confidence index because of its forward looking character.

6.3 Mortgage Standard Variable Interest Rate

We have chosen to use the mortgage standard variable interest rate to represent the cost of borrowing. Despite the fact that the majority of home loans in Australia are variable loans (Debelle, 2004), it would have been somewhat preferable to use a fixed mortgage interest rate. The reason for this is that the fixed mortgage rates show the expected average interest rate over the time of the loan, and as such are much more indicative of the cost of borrowing than the variable interest rate, which only reflect the current cost of borrowing. The data for fixed interest rates was however only available after 1990 and so would have cut short our data set by 10 years. Graph 6.1 shows the mortgage standard variable rate and the 3-year fixed mortgage interest rate. Visual analysis of this graph shows that the two interest rates are very similar, so the choice of using a variable or fixed interest rate should not make a major difference for our analysis.

Graph 6.1: Mortgage interest rates (percentage)



Source: RBA table F05

Mortgage debt is not the only form of debt that households accumulate, and so it could be argued that we should consider changes in other lending rates in our analysis such as credit

card and personal loan rates. However given that all lending rates are highly correlated, and furthermore that housing debt not only makes up the biggest share of total debt, but also that it has increased much more dramatically over time than other forms of debt, we consider use of the mortgage rate sufficient.

6.4 Interest Rate Spread

The interest rate spread is used as a measure of credit constraint and credit supply, and is calculated as the difference between the standard variable mortgage interest rate and the interest earned on 3-month term deposits. It would have been preferable to have used the interest rate on a non-fixed term savings accounts rather than 3-month term deposits since this is more directly comparable with the variable mortgage rate; however this data is not available for a significant period of our study.

Although this measure is not perfect it should capture a number of credit supply and constraint developments. Firstly, the spread will reflect the level of competition in the banking sector. If more banks are competing for the same customers they will push the lending rate down, and potentially also push the saving interest rate upwards. The spread should also take into account the recent significant developments in the use of credit derivatives for risk management.

6.5 Inflation

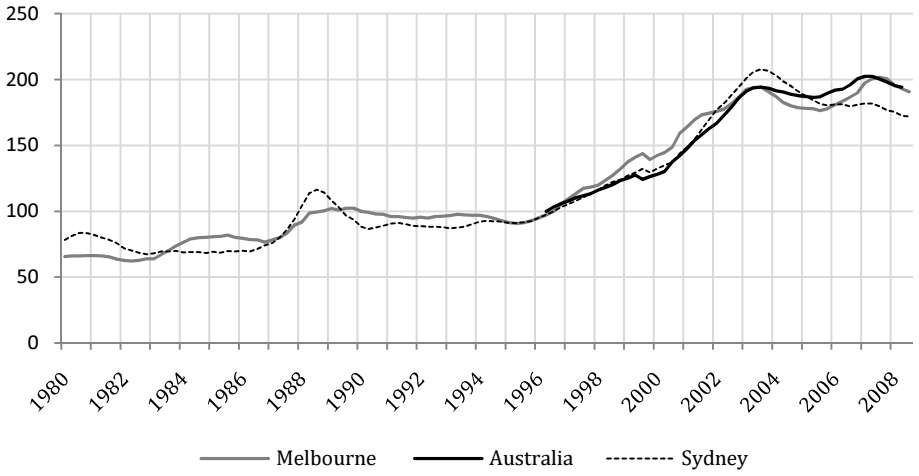
We use inflation data calculated from consumer price index data collected by the Australian Bureau of Statistics. The inflation data is calculated as the percentage change from the corresponding quarter of the previous year. We choose to use this form of inflation since it accounts for any seasonality in the data.

6.6 House Price Data

In order to calculate median house price data, we use nominal data collated by the Real Estate Institute of Australia (REAI) and deflate it with the CPI. The data is then transformed into an index with 1997Q2=100. The data for median house prices for the whole of Australia is only available from 1997, so in order to allow us to study a much longer time frame we use Melbourne house price data as a proxy. Graph 6.2 shows median house price data for Melbourne, Sydney and Australia, for the period for which the data is available. From this

graph it can be seen that the three series are highly correlated, and that the Melbourne data seems to represent Australia's median house prices somewhat better than the data for Sydney.

Graph 6.2:Median real house price indices (1997Q2=100)



Source: Real Estate Institute of Australia, data cube REMF1

This house price data is for the median sale price of established homes and should not be thought of as house price inflation since it does not take into account improvements to the quality of housing stock, which have been quite substantial over the time period analysed (Department of Parliamentary Services, 2006).

A further issue with this data is that it is sensitive to the type of houses sold in each quarter. Where the mix of houses sold changes significantly between the periods the median house price data will be affected, even if prices of similar houses have not actually changed at all. In order to overcome this problem we use moving annual medians, which are calculated as the average of four consecutive quarterly medians. Using this moving annual median series also has the advantage of removing any seasonality present in the data.

6.7 Output Growth Volatility

As an aggregate measure of income volatility a series of the variance of output growth has been calculated. The method used for this has been to first calculate the quarterly growth rate of gross domestic product, and then for each quarter the variance for the previous five years has been calculated. Thus, it is assumed that households base their expectations of the volatility of future income on the volatility of past income.

7. Estimation

In this section we estimate both the long-run and short-run model for the debt-to-income ratio in Australia. Before doing this unit root tests are performed on all the included variables, and a Johansen cointegration test is undertaken on the variables determined to be I(1).

7.1 Testing for Order of Integration

The first step in the estimation of our model is to test all the variables for their order of integration. Table 7.1 contains the Augmented Dickey-Fuller test results for all variables. The set of deterministic components for each test has been selected on basis of significance in the test regression and/or a visual inspection of the data. The lag structure has been determined during estimation, using the Schwartz Information Criterion.[11]

Table 7.1: Unit root resting
H_0: variable has a unit root

Variable	Ho	Deter.comp	# of lags	DF-statistic	Critical value 5 %	Critical value 10 %	Order of integration
Debt to DPI	I(1)	$\beta_0 + \beta_1 t$	5	-1.98	-3.45	-3.16	
	I(2)	β_0	4	-2.13	-2.89	-2.58	I(1)[12]
Inflation	I(1)	β_0	4	-2.56	-2.89	-2.58	I(1)
Real House Price Index	I(1)	$\beta_0 + \beta_1 t$	5	-1.87	-3.45	-3.16	
	I(2)	β_0	1	-3.50*	-2.89	-2.58	I(1)
Standard Variable Mortgage Rate	I(1)	$\beta_0 + \beta_1 t$	1	-2.59	-3.45	-3.16	
	I(2)	...	0	-5.53*	-1.94	-1.61	I(1)
Interest Rate Spread	I(1)	β_0	0	-2.33	-2.89	-2.58	
	I(2)	...	0	-10.13*	-1.94	-1.61	I(1)
Consumer Sentiment Index	I(1)	β_0	0	-2.76	-2.89	-2.58	I(0)
	I(2)	...	0	-8.93*	-2.89	-2.58	
Output volatility	I(1)	β_0	1	-3.70*	-2.89	-2.58	I(0)

*** significant at 5% level, ** significant at 10% level**

[11] For robustness we have also tested using the Aikake Information Criterion. In this case the lag structure for some of the tests changed, but it did not affect any of the results.
[12] Even though the ADF-test does not reject the null of this variable being I(2) we have chosen to proceed as if it is I(1), since the ADF test is known to have low power to reject the null when it is indeed false. Other unit root tests support this conclusion.

The results are close to what could be expected for most of the variables. Debt to Disposable Income and the Real House Prices Index are both non-stationary. The Augmented Dickey-Fuller test fails to reject non-stationarity in the first differences of Debt to DPI, however since we find this quite unlikely we have tested this with both KPSS and Phillips-Perron unit root tests, and they both support that this variable is integrated of order one. Inflation is not found to be stationary, however for three reasons we will not include it in our cointegrating relationship. Firstly, the ADF test is very close to rejecting non-stationarity and is known to have low power to reject the null when it is in fact false (Harris & Sollis, 2003, p. 54), secondly a number of econometric studies using higher power panel unit root tests find that inflation is stationary[13], and finally, there is limited theoretical support for a unit root in inflation. The Standard Variable Mortgage Rate, the Interest Rate Spread and the consumer sentiment index are found to be integrated of order one.

The variables that we will include when testing for cointegration are thus Debt to Disposable Personal Income (DTDPI), Melbourne Real House Price Index (RPHI), Standard Variable Mortgage Rate (SVMR) and the Interest Rate Spread (IRS).

7.2 Cointegration Testing

From the discussion previously on cointegration testing in a multivariate system we have chosen to use the approach proposed by Johansen (1988) as our testing procedure. For this test to give accurate results it is important that the VAR specification used in the test has the appropriate lag structure and set of deterministic components. It is quite straightforward to select these on the basis of some information criteria, but this can give misleading results since the accuracy of the test is sensitive to the errors being non-normally distributed and serially correlated (Johansen & Juselius, 1990) The first step in our cointegrating test is thus to come up with a well specified VAR model.

7.2.1 VAR Model Specification

We have used two criteria for choosing the deterministic components to include in the unrestricted VAR. The first is to look at what deterministic components were significant in the unit root tests and the second it to choose it based on significance in the estimated VAR. Both these criteria support the inclusion of a constant and a linear trend in the VAR.

[13] See for example Basher & Westerlund (2006)

In determining an appropriate lag structure for the VAR model, we initially look at a number of different information criteria. In table 7.2 this is shown for the VAR including our variables, and a constant and trend. Choosing the specification with the lowest information criteria gives two lags for SIC and HQ and six for AIC. A first conclusion would thus be that a lag length of two is appropriate.

Table 7.2: Lag length selection

Lags	AIC	SC	HQ
0	-2.228	-2.126	-2.187
1	-17.77	-17.25	-17.60
2	-18.98	-18.06*	-18.60*
3	-19.03	-17.70	-18.49
4	-18.90	-17.16	-18.19
5	-18.98	-16.83	-18.11
6	-19.15*	-16.60	-18.12
7	-19.07	-16.11	-17.87
8	-19.09	-15.71	-17.72

*** indicates optimal lag length selected by criteria**

However, as mentioned above it is important at this stage to test for normality and serial correlation in our chosen VAR specification. A serial correlation LM test clearly rejects the null of no serial correlation in this specification. The residuals also exhibit strong forms of non-normality, with high levels of both kurtosis and skewness[14]. Even though the information criteria procedure suggested that two lags is enough, we need to consider the inclusion of more lags to overcome the problems with the Johansen test when the errors are non-normal and serially correlated. Further testing indicates that at 7 lags the problem of skewness and serial correlation is gone. However, there is still some kurtosis but this will be ignored since the Johansen approach is not particularly sensitive to this form of non-normality (Johansen & Juselius, 1990).

7.2.2 Johansen procedure: test for the number of cointegrating relationships

From table 3.3 we see that both the trace test and the max test indicate that there is one unique cointegration relationship between our variables. Using the trace test we reject the null of zero cointegrating relationships, in favor of the alternative of one or more cointegrating

[14] The results of these normality and autocorrelation tests can be found appendix A.

relationships. Since we cannot reject the null of one cointegrating relationship we conclude that the trace test indicates that there is one unique cointegrating relationship. From the max test we reject the null of zero cointegrating relationships, thus accepting the alternative of one. The null of one, against the alternative of two, cannot be rejected however, thus the max test also indicates one cointegrating relationship. We have also performed the test with different sets of deterministic components and lag lengths, and found the results to be reasonably robust.

Table 7.3: Johansen cointegration test

$H_{0,trace}$: $\#\ coint.rel. = r$ $H_{1,trace}$: $\#\ coint.rel\ \geq r$ **+1**

$H_{0,max}$: $\#\ coint.rel. = r$ $H_{1,max}$: $\#\ coint.rel. = r + 1$

Trace test			Max test	
R	**Trace statistic**	**Critical value 5%**	**Max statistic**	**Critical value 5%**
0	52.57*	47.85	32.78*	27.58
1	19.79	29.80	12.61	21.13
2	7.18	15.49	6.20	3.85

*** significant at 5% level, ** significant at 10% level**

7.3 Estimating the Single-Equation Cointegrating Relationship

As has been discussed in the method section it is appropriate to proceed with estimating a single-equation cointegration relationship, when the conclusion from the Johansen approach is that there is one unique cointegrating relationship. However, OLS will give biased and inefficient estimates of the cointegrating relationship in the presence of endogeneity and serial correlation in the residuals (Hargreaves, 2003).

The most straightforward procedure for testing if variables are weakly exogenous with respect to the cointegrating relationship is to impose restrictions on the adjustment coefficients from the VECM used in the Johansen approach.[15] The results, shown in table 4, show that house prices and the mortgage interest rate are not weakly exogenous, and thus it is not advisable to use OLS for estimation of the single-equation cointegrating relationship.

[15] See Eviews 5 Users Guide pp. 746-747 for details.

Table 7.4: Testing for weak exogeneity
H_0: variable is weakly exogenous w.r.t cointegrating relationship

Variable	**P-value**	**Weakly exogenous**
RPHI	0.100	No
SVMR	0.608	No
IRS	0.0378	Yes

The next step is to test for serial correlation in the residuals. The procedure adopted is to estimate the cointegration relationship using OLS, and then use the Breusch-Godfrey serial correlation test. The results clearly show that the residuals are serially correlated, with a P-value of 0.000 for the null of no serial correlation.

Because we have found evidence that not all independent variables are weakly exogenous and that the residuals from the OLS estimate of the cointegrating relationship exhibit serial correlation we have decided to proceed with the Fully Modified-OLS estimator discussed in the method section.

7.3.1 Fully Modified OLS estimation of cointegrating relationship

Our main problem with using FM-OLS has been to find suitable econometrics software that implements this estimator. In the recently released version 7 of EViews, the FM-OLS and a number of other estimators for single-equation cointegrating relationships have been implemented; however we do not have access to this. Instead we have decided to use is an EViews program written by an employee at QMS, the company producing Eviews.[16] This program allows FM-OLS estimation using the Bartlett kernel, with a user selected bandwidth, and a constant, but no deterministic trend, in the cointegrating relationship.

Table 7.5 contains the results from estimation of the cointegrating relationship using both the Fully Modified-OLS and OLS. When using OLS to estimate the cointegrating relationship the only variable that is significant at the 5 percent level is the Melbourne real house price index, and as expected the sign of the coefficient is positive. The other estimates have the expected sign; however they are not statistically significant. Because of the bias caused by endogeneity and serial correlation these results are however not particularly interesting. When using FM-

[16] The program can be downloaded from the Program Repository at http://forums.eviews.com.

OLS the house price index is still significant and has the expected positive sign. The only significant change is that the standard variable mortgage rate is also now significant. For now we only conclude that the variables we have found to be significant in explaining the long-run development of household debt are house prices and the interest rate. A further analysis on the relative importance of these, and a discussion on interpretation will follow in the next section. Graph 7.1 shows the fitted and actual values as well as the residuals from the FM-OLS estimation of the long-run relationship.

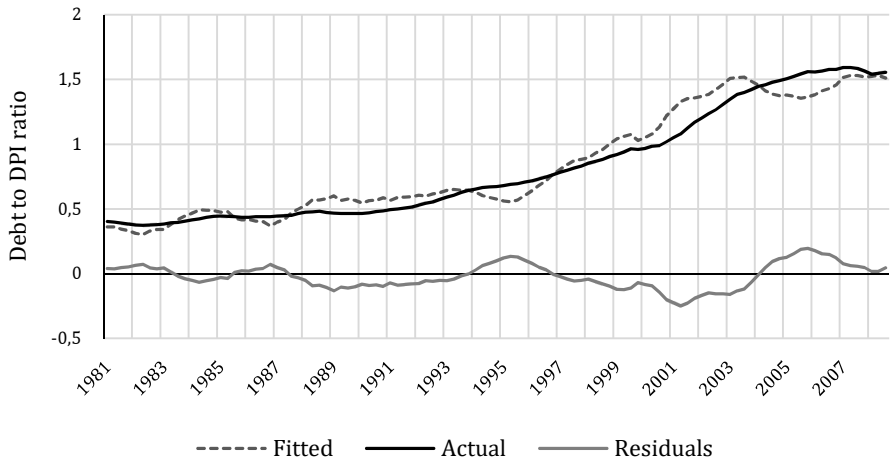
Table 7.5: Single-equation cointegration estimation
$H_0: \hat{\beta} = 0$

Dependent variable: Debt to disposable income
T-statistics within brackets, bandwidth = 6

Variable	FM-OLS	OLS
Constant	0.0325	-0.021
	(0.201)	(-0.271)
RHPI	0.00855*	0.008439*
	(13.980)	(29.189)
SVMR	-1.807*	-3.80
	(-2.087)	(-1.5578)
IRS	-1.380	-0.653
	(-0.7809)	(-0.784)

*** significant at 5% level**

Graph 7.1: Series from FM-OLS estimate of CE



7.4 Error-Correction Model

The cointegration analysis above seems to be able to explain the long-run development of household indebtedness reasonably well, however the short and medium run deviations from equilibrium are quite significant. We have thus decided to estimate an error-correction model in order to examine if we can also say something about the short-run movements in the debt-to-income ratio. We will start with a general specification derived from the discussion in the model section. The general specification thus contains the variables from the cointegrating relationship, the interest rate spread (IRS), and a number of I(0) variables, all of which we tested for unit roots previously. We include a constant so that the intercept is not forced through the origin. This specification is shown below:

$$\Delta DTDPI_t = \alpha_0 + \alpha_1 \Delta DTPI_{t-1} + \alpha_2 \Delta SVMR_t + \alpha_3 \Delta IRS_t + \alpha_4 \Delta RHPI_t + \gamma(DTDPI_{t-1} - \beta_0 - \beta_1 SVMR_{t-1} - \beta_2 RHPI_{t-1}) + \alpha_6 CSI_t + \alpha_7 \Delta OUTV_t + \alpha_8 INF_t + e_t \quad \textbf{(Eq. 7.1)}$$

The ECM specification thus allows the short-run changes in the debt to disposable income to depend on the lagged change of itself, the first differences of the variables in the cointegrating relationship, the interest rate spread, an adjustment towards the equilibrium, the consumer sentiment index (CSI), the variance of the output growth rate (OUTV) and the inflation rate (INF).

The consumer sentiment index enters in levels, because we assume that households who are continuously confident will keep increasing their debt, even if the confidence level does not change. Our interpretation is that households who are confident will keep increasing their debt levels, through acquisition of housing and durable goods. If this index would enter in first differences it would on the other hand require a change in the index to cause a change debt levels. Another interpretation of this is that confident households do not engage in precautionary savings to same degree as non-confident households. Inflation also enters the short-run model in levels. The justification for this is that the debt-to-income ratio is eroded through the effect of the inflation rate. The debt-to-income ratio will change, ceteris paribus, for any inflation rate different from zero.

7.4.1 General to specific estimation

Table 7.6 gives the results of the general to specific estimation of the ECM model. The initial model contains all the variables mentioned above as well as two lags of the change in the mortgage rate, the interest rate spread and the house price index. In this model the lagged dependent variable, the change in the real house price index and its second lag, the consumer sentiment index and the error-correction term are all significant at the 5% level. In the second model we remove the output volatility and the second lag of the mortgage rate and interest rate spread since they are all highly insignificant. In this model inflation is significant at the 5% level and all the variables significant in model 1 remain so. In Model 3 we remove the first lags of the change in the mortgage rate and the interest rate spread without any significant change in results. Since the change in the mortgage rate and the interest rate spread are still insignificant they are removed in model 4. In this final model the lagged dependent variable, the change in the house price index and its second lag, the consumer sentiment index, inflation and the speed of adjustment term are all significant at the 5% level while the constant and first lag of the house price index are significant at the 10% level. In this final model the sign on all the coefficients are as expected except for the negative sign on the lagged change in the house price index. Graph 7.2 shows the fitted and actual values and residuals for the final ECM model.

Graph 7.2: Error-correction model estimate

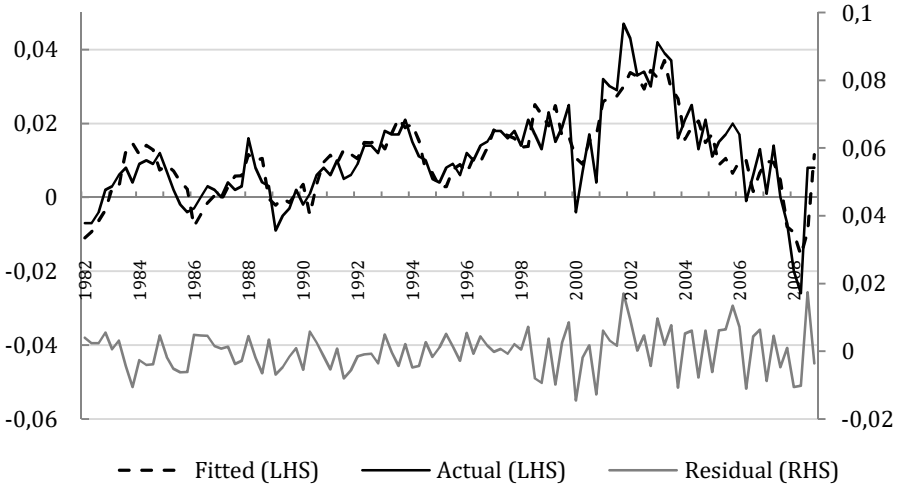


Table 7.6: General to specific modeling of ECM
Dependent variable: $\Delta DTDPI_t$

Variable/Model	1	2	3	4	(NW HAC)
$Constant$	-0.0142	-0.0132	-0.0129	-0.0118**	-0.0118**
	(-1.90)	(-1.87)	(-1.86)	(-1.79)	(-1.75)
$\Delta DTDPI_{t-1}$	0.493*	0.497*	0.487*	0.478*	0.478*
	(5.74)	(5.95)	(6.11)	(6.22)	(5.25)
$\Delta SVMR_t$	0.0154	-0.00214	-0.0688	….	….
	(0.09)	(-0.01)	(-0.49)		
$\Delta SVMR_{t-1}$	-0.221	-0.145	…..	….	….
	(-1.05)	(-0.83)			
$\Delta SVMR_{t-2}$	-0.0475	….	….	….	….
	(-0.27)				
ΔIRS_t	0.0373	0.0474	0.0599	….	….
	(0.28)	(0.37)	(0.47)		
ΔIRS_{t-1}	0.0219	0.0161	…..	….	….
	(0.16)	(0.12)			
ΔIRS_{t-2}	-0.127	….	……	…	…
	(-0.89)				
$\Delta RHPI_t$	0.00131*	0.00133*	0.00143*	0.00142*	0.00142*
	(3.74)	(3.86)	(4.48)	(4.49)	(4.22)
$\Delta RHPI_{t-1}$	-0.000552	-0.000531	-0.000584	-0.000590**	-0.000590**
	(-1.42)	(-1.43)	(-1.62)	(-1.65)	(-1.72)
$\Delta RHPI_{t-2}$	-0.000777*	-0.000798*	-0.000878*	-0.000926*	-0.000926*
	(-2.10)	(-2.27)	(-2.62)	(-2.86)	(-2.91)
CE_{t-1}	-0.0394*	-0.0398*	-0.0414*	-0.0423*	-0.0423*
	(-4.47)	(-4.56)	(-4.95)	(-5.17)	(-3.85)
CSI_t	0.0210*	0.0201*	0.0203*	0.0195*	0.0195*
	(2.80)	(2.86)	(2.97)	(2.93)	(2.74)
$\Delta OUTV_t$	-7.19	…..	…..	….	….
	(-0.78)				
INF_t	-0.0438	-0.0570*	-0.0651*	-0.0695*	-0.0695*
	(-1.38)	(-1.98)	(-2.46)	(-2.87)	(-3.00)
Adjusted R^2	0.7325	0.7371	0.7406	0.7448	0.7448
Standard error	0.00637	0.00632	0.00627	0.00622	0.00622
AIC	-7.146	-7.187	-7.217	-7.250	-7.250

* significant at 5%, ** significant at 10% level

Note: Since higher order autocorrelation and heteroskedasticity also exist in models 1-3, we repeated these estimations using Newey-West standard errors. The t-statistics are not included here, although it should be noted that there was no changes in the significant variables at the 5% or 10% level.

7.4.2 Diagnostic testing

A range of diagnostic tests are run on the final specification to ensure the results are meaningful. The normality of the residuals is tested using the Jarque-Bera test. This gives a p-value of 0.86 which indicates that the null of normality cannot be rejected. Testing for heteroskedasticity using the White's test gives a p-value of 0.0034 ($H_0 = \text{No heteroskedasticity}$) indicating that a heteroskedasticity problem exists. The Breusch-Godfrey Lagrange-Multiplier (LM) test does not find autocorrelation at the 5% level with three lags or less but does find autocorrelation with four and five lags included, indicating that higher order autocorrelation may be present. The ARCH-LM test for autoregressive conditional heteroskedasticity (ARCH) finds that no ARCH effects exist in the data.[17]

7.4.3 Correcting for heteroskedasticity and autocorrelation in the ECM

Since the diagnostic tests indicated that the residuals of the estimated ECM are heteroskedastic and contain some autocorrelation, we cannot use the ordinary standard errors and thus t-statistics for statistical inference. In order to correct for this we use heteroskadasticity-and-autocorrelation-consistent (HAC)/Newey-West standard errors[18]. The final column of table 7.6 gives the final ECM specification with HAC adjusted t-statistics. Using the HAC t-statistics does not give any significantly different results to the standard OLS results.

8. Discussion

The purpose of this essay, set out in the introduction, was to study the determinants of the changing household debt to disposable income ratio in Australia. In this section we discuss the findings and implications of the econometric analysis both in terms of the long-run cointegration study and the short-run error-correction model.

The results of the cointegration analysis show that for Australia the long-run increase in the debt ratio can be largely explained by the increasing house prices and the shift to a low nominal interest rate regime. The estimated coefficient for the real house price index

[17] The result for the ARCH-LM and Breusch-Godfrey tests are in appendix B
[18] For more information on HAC standard errors see Verbeek, (2004 pp 110-111)

(1990Q4=100) is 0.00855 and the coefficient for the standard variable interest rate is -1.807. In order to get a better idea of the scale of each variables' contribution to the change in the debt ratio, we have multiplied each coefficient by the total change in the variable during the period studied. This gives a total *size effect* for each variable. Household debt to disposable income changed from 40.2 to 155.6 percent, and the size effect of house prices is 106.5 percentage points, while interest rates contributed with 12.18 percentage points. So, by far the greatest contributor to the change in the debt ratio has been the significant increase in house prices.

Although this result was expected, there are problems with the interpretation. The first being that falling interest rates likely have a positive effect on house prices, and thus the total effect from interest rates is actually higher than our estimate indicates. On the other hand, the fact that interest rates are significant implies that it has an effect on the debt ratio, beyond its effect on house prices. Within the life cycle hypothesis this would imply that the substitution effect dominates the income effect, i.e. the effect of the decreased cost of borrowing outweighs the decreased future return on assets.

A further complication with interpretation is the question of causality between household debt and house prices. The house price data used in this study is for sold houses. But for houses to be sold households must take on debt. Thus it could be argued that both these variables are determined simultaneously, and the causality could go in both directions. For this reason the estimated house price coefficient should not be directly interpreted as the effect of house prices on debt, but as the share of the change in debt related to households buying houses. However, this reasoning neglects the possible wealth effect on current consumption from increasing housing wealth.

It is somewhat surprising that the interest rate spread (IRS) is not significant in the cointegrating relationship. This suggests that the easing of credit constraints and increase in credit supply have not been a major factor for the increase in household debt. However, we see two arguments for why this might not be the case; the first being that the interest rate spread may not capture all the effects of changes in credit supply and constraints, and secondly that the effects could already have been captured in the house price data.

A final remark on the long-run analysis is that the debt ratio is quite slow in adapting towards the long-run relationship (see graph 7.1). This leads to periods of quite significant deviations from the debt levels suggested by the cointegration analysis. This conclusion is not unexpected, since it takes time for households to adjust their debt position, especially downwards, where the only way to reduce debt levels is to increase principal payments. One reason for why the upward adjustment is slow could be that the current house prices will only determine the debt level of households that are in the process of buying a house.

The result of the error-correction analysis gives some insight into the deviations from the long-run relationship described above. The factors found to be statistically significant in explaining the first difference of the debt ratio are the lagged value of the dependent variable, the contemporary and two lags of the first difference of the house price index, the levels of the consumer sentiment index the inflation rate and the error-correction term. The large positive coefficient of the lagged debt ratio shows the considerable inertia in household debt behavior. The first difference of the house price index has a positive effect on the change in the debt ratio. As in the long run this is most likely the result of both a wealth effect and the effect on households acquiring a house in the current period. The consumer sentiment index was included as a proxy for expectations of future income and wealth. As expected the coefficient is positive, indicating that expectations are important for the short-run change in household debt. However, it would seem unlikely that the short-run expectations measured by the consumer sentiment index would affect housing debt to the same degree as other forms of debt, such as personal loans and credit card debt. A rough way to see if this is the case is to examine the correlation between the consumer sentiment index and the changes in housing and other forms of debt as share of income.[19] The correlation between housing debt and the consumer sentiment index is 0.47, and for other forms of debt the correlation is 0.55, indicating that the expectations captured by the consumer sentiment index have a larger effect on the other forms of debt. The fact that consumer sentiment has a positive effect on other forms of debt can probably be explained by the pro-cyclical behavior of consumption of durables such as cars. Further the level of inflation has a negative effect on the change in the debt ratio. This supports the proposition that the level of inflation affects the debt ratio through its effect on nominal wages. Changes in interest rates, the interest rate spread and the change in output volatility were not significant in the short run.

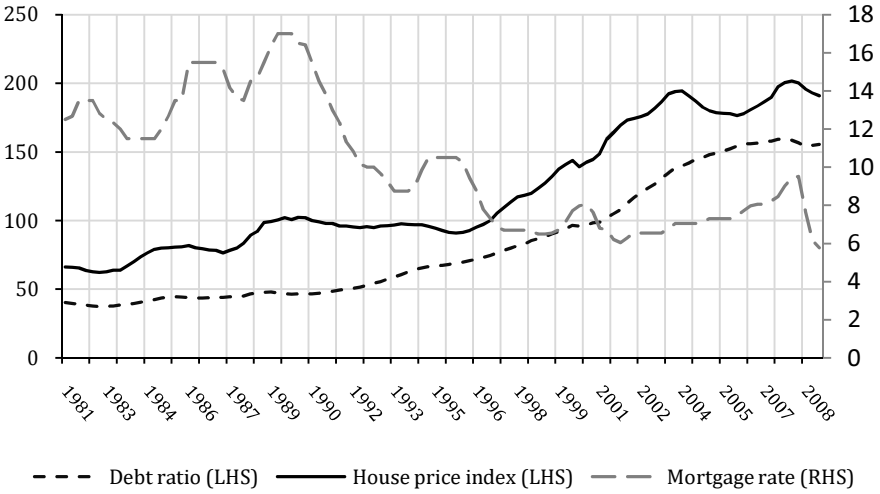
[19] "Other forms of debt" is calculated by subtracting housing debt from total debt. The source for the data is RBA table B21.

The estimated speed of adjustment coefficient is -0.0423. The negative sign shows that the debt ratio is reverting towards the long-run relationship. The small absolute value of the coefficient confirms the conclusion from the analysis of the output from the cointegration analysis, that the debt ratio is slow to adjust towards the level suggested by the long-run analysis. To get an idea of how slow the adjustment is, we calculated the time it takes for a deviation from the cointegration relationship to be halved, which was 17 quarters.

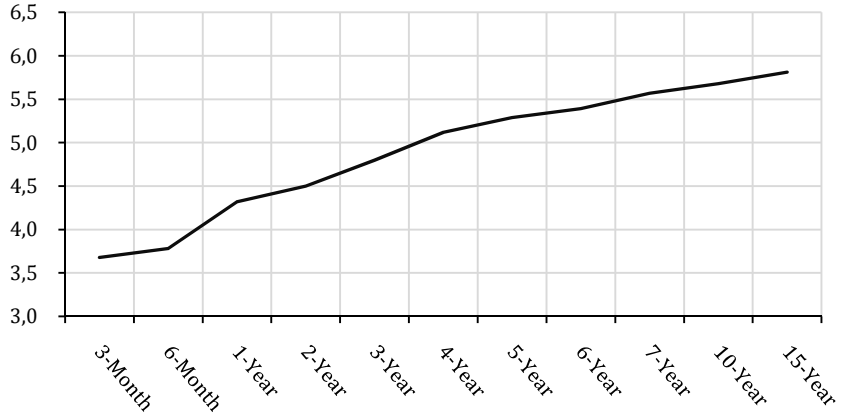
One of the most striking results from the error-correction model is that it explains the short-run behavior of the debt ratio significantly better up until the year 1997, than for the period 1997-2009 where, as can be seen by graph 7.2, the variance of the residuals increases significantly. It is noteworthy that during the first half of this period that the housing prices increased at its highest pace, and that house prices had a U-shaped development during the second half of this period. The cause of the increased variance is that the actual series is a lot more volatile than the fitted series, i.e. households behavior are more erratic than suggested by the estimated error-correction model. Our interpretation of this is that in times of significant house prices changes, it is more difficult for households to decide on their debt position. Large changes in house prices are likely to have large effects on the households' confidence in the economy. If there is a speculative bubble in the economy it is not hard to imagine a situation where the feedback from prices to expectations are non-linear, such that the marginal effect of house prices on expectations are increasing with the size of house price changes. However, if the expectations are not fulfilled, households will adjust their debt positions downward. A process like this could be the explanation for why the variance of the ECM error term has increased.

The above discussion should have given some insight into both the long-run and short-run development of the household debt-to-income ratio. However, the ambition of this essay is not only to understand the past, but also to be able to say something about the development of household debt in the future. We think that this can be achieved by discussing both the future development of the variables found to affect debt in the long run, and the development from the perspective of the behavioral and macroeconomic theories presented in the theory and background sections of this essay.

Graph 8.1: Cointegrating variables



Graph 8.2: Government bond yield curve (percentage)



Source: http://www.bloomberg.com/markets/rates/australia.html [Accessed 8 January 2010]

In graph 8.1 we can see the long-run development of the variables in the cointegration analysis. The development of the interest rate over time is important since it determines not only the cost of borrowing but also has some affect on house price developments. In the short run the interest rates can be expected to rise, as the economy recovers from the effects of the recent financial crisis. This should dampen the demand for debt, and put downward pressure on house prices. Forecasting interest rates in the medium and long run is a lot harder. However, one indicator of the future interest rate is the yield curve for Australian government bonds. As can be seen in graph 8.2 this yield curve is upward-sloping. The slope of the yield curve is commonly thought to be determined by expectations of future short-run interest rates as well as an increasing risk premium for long-term investment[20]. Research by Finlay &

[20] The assumptions vary depending on what theory is used. The explanation used here can be derived using the liquidity preference theory. See Asgharian & Nordén (2007, p. 62)

Chambers (2009) implies that the required risk premium for 5-year government bonds is not large enough (in fact they suggest that it could even be negative) to account for the upward-sloping yield curve. It is thus expected that in the medium-run interest rates will increase and therefore dampen or reduce the debt ratio, and put downward pressure on house prices.

The remaining factor that could cause the debt level to change significantly in the coming years is house prices. The main question is then what, if not interest rates, could cause significant changes in house prices. One explanation could be construction of new dwellings not keeping up with the rate of population growth, which is expected to remain high in the coming decades (Australian Bureau of Statistics, 2008), and thus it can be assumed that demand will keep putting upward pressure on prices. A restraining factor on this demand could be the interest payment burden. Even if individual households can afford to allocate more of their resources to interest payments, this could have negative effects on household demand for other goods. It could be the case that the increase in demand for housing could be counteracted by the effects this will have on other sectors of the economy, and house prices might not be able to increase further.

A second reason for why house prices could keep increasing is the possible existence of a speculative bubble. Although most economists in Australia seem to argue that there is no proof of a debt-fueled bubble in the Australian economy[21], there are those who oppose this view. The most prominent is perhaps Steve Keen who recently published an article where he models Hyman Minsky's financial instability hypothesis. He argues that the recent development in Australia is in accordance with his model. If this model is a good description of the Australian economy, the prolonged boom, during which private debt levels have increased sharply, should be followed by a period during which households and firms deleverage (Keen, 2009d). Deleveraging can be achieved either through inflation or by households trying to sell assets. At the moment we do not see any signs of households trying to deleverage, however this could be because of the Australian government's stimulus package, and the continuously high demand from China, where the government stimulus has been even larger.

[21] See for example Richards (2009) for a discussion on house prices and Wilkins & Wooden (2009) for a discussion on household debt sustainability.

9. Further Research

Even though we feel that we have contributed to the understanding of Australian household debt, there are many ways in which our empirical study could be improved. One important improvement would be to include an econometric model of the housing market in the cointegration analysis. That way a number of limitations with the current study could be overcome. First the issue of the direction of causality between debt and house prices would be less of a constraint on the interpretation of the determinants of households' debt levels. While the direction of causality in this study is a real limitation, it is not obvious that for example population growth and other determinants of housing demand are affected by the amount of debt households take on. A second benefit of this approach could be that the effect of interest rates could be isolated, since it would no longer be a part of house prices.

A further direction of research is to study less aggregated data. The understanding of debt could be improved by studying housing debt separately from different kinds of consumption debt. Individual household data could also improve understanding; however studies of this nature are limited by the available data and the fact that all households face similar macro conditions.

One of the major problems we faced when we began writing this essay was the lack of comparable studies. As with other research it is easier to discuss the results, when the results can be compared to those of other studies. Performing similar studies for other countries is therefore an important way forward. Such studies would also be a good way to develop and extend both the model and the method used in this essay.

10. Conclusion

The econometric analysis undertaken in this essay has shown that the long-run increase in household debt can be attributed to lowered interest rates and increasing house prices. We can only speculate on the future development of the debt ratio in the Australian economy, but predictions of future interest rates and the dynamic process suggested by Keen point in the direction of stabilizing or falling debt levels. In the end the only conclusion we can make is that the future development will depend on the expectations of households. Is it, as Shiller and Akerlof (2009) argue, the 'animal spirits' that determines the outcome? The concepts of *confidence* and *storytelling* might be the best tools we have for discussing the future.

However, at the moment we do not know if the economy will enter a period of self-reinforcing confidence, accompanied by the return of the positive stories of rising house prices, or if the confidence multiplier will set of a process like the ones described by Minsky and Fisher. There is however one further clue to the future – the past. If there is something the past can teach us, it is that quickly increasing debt levels tend to be followed by significant downward adjustments[22]. Of course, there is the possibility that, this time it is actually different.

[22] After the boom in late 19th century the debt level in the economy decreased from approximately 100 percent down to the pre-boom level of 40 percent. Prior to the Great Depression the debt level had surged to 80 percent, but during the depression it fell below 40 percent (Keen, 2009d).

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Appendix A: VAR residual diagnostic testing

The graphs in this appendix contain the results of the diagnostic testing of the VAR specification. The tests have been performed for a number of different lag specifications, until a satisfactory result with respect to normality and autocorrelation was achieved. The VAR specification used includes a constant, but no trend.

Table A.1: VAR residual autocorrelation test

H_0: no serial correlation at lag order h

	Lags in VAR					
h	**1-2**	**1-3**	**1-4**	**1-5**	**1-6**	**1-7**
1	0.0128	0.6473	0.0546	0.0024	0.0955	0.3244
2	0.0185	0.0223	0.0087	0.0074	0.6993	0.3305
3	0.0077	0.6012	0.5133	0.0494	0.0366	0.1972
4	0.0007	0.0004	0.0002	0.0007	0.3336	0.3489
5	0.0231	0.1376	0.0959	0.3595	0.7175	0.8979
6	0.1121	0.2088	0.1122	0.4109	0.2377	0.0133
7	0.2060	0.1279	0.1898	0.0789	0.1393	0.0761
8	0.2442	0.2280	0.3080	0.2479	0.0582	0.0488
9	0.5925	0.4807	0.4529	0.7336	0.9883	0.9988
10	0.6790	0.3157	0.1129	0.2899	0.1221	0.0560
11	0.4430	0.5620	0.6777	0.4447	0.2472	0.5124
12	0.8031	0.3186	0.3795	0.0953	0.0140	0.0467

Table A.2: VAR residual normality test

H_0: residuals are multivariate normal

	Joint p-value		
Lags	**Skewness**	**Kurtosis**	**Jarque-Bera**
1-2	0.0004	0.0000	0.0000
1-3	0.0120	0.0000	0.0000
1-4	0.0253	0.0000	0.0000
1-5	0.0391	0.0000	0.0000
1-6	0.0258	0.0002	0.0001
1-7	0.0503	0.0001	0.0001

Appendix B: Error-correction Model diagnostic testing

Table B.1: Autocorrelation and ARCH LM testing

	Test	
Lags	**Breusch-Godfrey**	**ARCH LM**
1	0.228411	0.174604
2	0.429301	0.364826
3	0.062089	0.334523
4	0.018466	0.106925
5	0.031797	0.144329