Consumption and House Prices in South Africa

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Abstract:

Many countries such as Australia, Ireland, Netherlands, United Kingdom (UK), Spain, United States of America (USA) and South Africa (SA) among others have experienced an increase in housing prices, since the late 1990s. In SA, the abrupt increase in residential property prices, particularly during the period 1999 to 2007, resulted in an improvement in the level of households' net wealth position. Empirical investigations, mainly from developed countries, provide evidence indicating that a house price increase has a significant impact on the households' wealth, and thus house price gains increase housing collateral for homeowners which make it possible for them to take out equity in the form of refinancing or selling of the house to finance consumption.

With the above in mind, this study investigates the relationship between aggregate expenditure on consumption by households and residential house prices in South Africa. Following the permanent-income/lifecycle hypothesis (PI-LCH), this study applies the vector error model (VECM) into the 1980:Q1 to 2007:Q4 quarterly data sample. The overall finding of the study indicates there is indeed a long-run positive relationship between housing prices and consumption in South Africa.

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1. Introduction

Internationally, there exists immense literature on a relationship between housing prices and private consumption by households. The core aim of these studies had been the establishment of the relationship between aggregate consumption and the change in house prices. Amongst others, countries like Australia, Ireland, Netherlands, United Kingdom (UK), Spain, United States of America (US), South Africa (SA) etc. have experienced an increase in housing prices, since the late 1990s. The booming property market, house prices have received a great deal of attention from policy-makers and economic commentators. Hence, as correctly pointed out by Ahearne, Ammer, Doyle, Kole and Martin, (2005), it therefore becomes necessary to examine the effects of changes in residential house prices on consumption expenditure by households.

A sizeable body of theoretical literature indicates that consumption is the most crucial component which contributes the largest proportion of more than 50 percent of the total aggregate demand (Eliot, 1979). In SA, final expenditure on consumption by households constituted about 63 percent of the gross domestic product (GDP) in 2005 (SARB, 2006). Given the contribution of this high consumption towards GDP, it is therefore not surprising that, there is a significant amount of studies, particularly in the first world countries that have been undertaken to investigate factors influencing consumption (Griffiths & Wall, 1993).

As explained by Elliot (1979), the general consensus of the growing body of empirical evidence suggests that liquid assets contribute extensively towards the explanation of fluctuations in consumer spending. The life-cycle/permanent-income hypothesis (LC-PIH) amplifies the argument that consumer spending is mainly influenced by both permanent income and wealth over lifetime (Dornbusch et al, 2004). In their respective studies, Iacoviello (2004) and Carroll (2004) found that housing prices are one of the key drivers of changes in consumption, a conclusion which was further confirmed by Rapach and Straus (2006). Guided by the permanent income hypothesis; Bostic, Gabriel and Painter (2005)[2] also concluded that wealth effect is most significant to consumption among homeowners.

The most commonly celebrated view[3] on the relationship between housing prices and consumption maintains that, consumption might be directly influenced by housing prices through credit market effects (Campbell & Cocco, 2004)[4]. Unlike borrowing on unsecured but punitive facilities such as credit cards or personal loans, houses generally provide sufficient and cheaper collateral security for home owning borrowers (Aoki et al. 2002). Following the life-cycle theory, Attanasio et al. (2005)[5] provide evidence suggesting that homeowners are likely to use housing wealth as a form of collateral security for borrowing purposes. Following the PI-LCH,

[2] Also see Thomson &Tang (2002), Sousa (2008) and Dvornak & Kohler (2003).
[3] Due to its practicality, data issues and popularity, this view is closely followed in this study.
[4] Amongst others, also see Attannasio and Wakefield (2008) as well as Thomson and Tang (2004).
[5] Also see Cutler (2004).

Aron and Muellbauer (2000) present a model suggesting an indirect but positive relationship between household consumption and financial liberalisation. Their model shows a correlation between financial liberalisation and credit constraints on house-owning households who anticipate future income growth. For those households owning houses, financial liberalisation increases the availability of collaterally secured loans while at the same time reducing deposit requirements for first-time buyers of residential properties.

Thus an increase in house prices makes more collateral available to homeowners, which in turn may encourage them to borrow more, in the form of mortgage equity withdrawal (MEW)[6], to finance desired levels of consumption and housing investment (Ahearne et al, 2005). For borrowing-constrained homeowners, an increase in housing prices relaxes borrowing constraints, even if there is no wealth effect associated with the house price increase. As a result, increase in house prices may lead to an increase in consumption not because of a wealth effect, but because it allows borrowing-constrained homeowners to smooth consumption over the life cycle (Attannasio & Wakefield, 2008)[7].

Girouard and Blondal (2001**),** show that the relaxation of regulation in the home loan market in most OECD countries which started around the 1970s has ameliorated households to borrow and finance current consumption using their housing wealth as collateral. This borrowing was calibrated to be coherent with the withdrawal of housing equity. Like many world-renowned permanent income hypotheses, Girouard and Blondal also concluded that increase in house prices contribute significantly to consumption by household through wealth effects. They further maintain that housing prices can be used as one of the economic indicators exerting pressures on demand for goods and services.

Similar to Campbell and Cocco (2005), Aron and Muellbauer (2006) use empirical data from UK and SA to show that financial liberalisation increases borrowing capacity which in turn leads to financial assets booming and hence accelerating further borrowing and higher spending behaviour. Since financial liberalisation is an unobservable variable, Aron and Muellbauer use linear spline function[8] as a proxy to estimate its parameters using cross-equation restrictions. Their findings provide empirical evidence indicating that the failure to allow for financial liberalisation[9] for both the consumption function and debt equation results in the inability

[6] MEW is a type of loan in which the borrower uses the equity in their home as collateral. These loans are sometimes useful to help finance major home repairs, medical bills or tertiary education. A home equity loan creates a security against the borrower's house, and reduces actual home equity. This type of a loan is only applicable when there is sufficient security value in the property to cover the amount.

[7] Also see Nieuwerburgh (2004).

[8] Aron and Muellbauer (2000) treated financial liberalisation as an unobservable indicator entering both household debt and consumption equations. The financial liberalisation credit conditions index indicator, CCI, is proxied by a linear spline function, and the parameters of this function are estimated jointly with the consumption and debt equations.

[9] The process of liberalizing financial market in SA started as early as in the mid 80s following the de Kock Commission reports (1978, 1985) advocating a more market-oriented monetary policy. In the 1990s pensions were

account for structural breaks in the equation. Nevertheless, their results provide evidence indicating that in the long-run, the estimated South African marginal propensity to consume arising from housing wealth ranges between seven percent and fourteen percent.

In this paper I follow the economic model of consumption function using the vector error correction model (VECM) representation of Engle and Granger (1987). I apply the VECM with the insight that even if it could be found that consumption, disposable income and housing prices are non-stationary they might be cointegrated. I use VECM with a view of determining whether an increase in residential property prices has an impact on consumption expenditure by private households. In an attempt to make a contribution towards consumption function analysis, this paper provides an empirical investigation on the relationship between housing prices and private household consumption in South Africa (SA) during the period 1980:Q1 to 2007:Q4.

Section 2 of this paper provides a brief overview of the trends in the South African housing prices, disposable income of households and households' expenditure on consumption. In section 3, I present the econometric model upon which the relationship between house prices and consumption is based. Section 4 focuses on data and the variables chosen. Results showing empirical evidence on the relationship between housing prices and consumption and the discussion of findings are presented in section 5. The last section presents summary, policy and recommendations, limitations as well as the need for further research.

2. Trends in Macroeconomic Variables in South Africa

Though there is a range of macroeconomic variables affecting the entire economic performance of a country, for the purpose of this study[10], however, this subsection only focuses on the housing prices, households' disposable income and expenditure on consumption by households

2.1 Trends in Housing Prices in SA

Using ABSA's calculations, the housing prices[11] recorded positive year-on-year percentage changes all the way through to 1983 in real terms, with the largest negative downturn of 20.6 percent recorded in 1985. Between 2000 and 2005, the South African residential property market recorded a robust average annual price growth rate of approximately 15.1 percent in real terms. During this period the market was driven by a wide range of factors, including the lowest

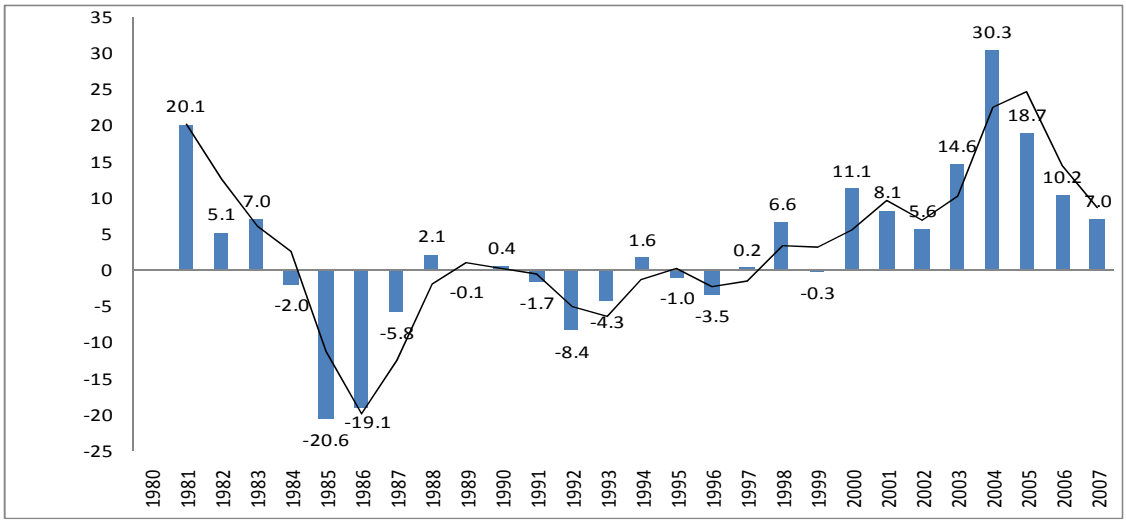
increasingly used to provide additional collateral for housing loans; while from 1995, special mortgage accounts (access bond accounts.) allowed households to borrow and pay back flexibly from these accounts up to an agreed limit set by the value of their housing collateral (Aron & Muellbauer, 2000).

[10] As evident in the model specified in section 5, the study focuses on the relationship between expenditure on consumption, disposable income and changes in housing prices.

[11] Amalgamation of Banks in South Africa (ABSA) uses average real housing prices, calculated at 2000 prices, for all middle class (80 square meters to 400 square meters) new and old houses.

inflation rates since the 1960s and the lowest interest rates in more than 20 years, causing real house prices to increase to all-time highs in 2005 (ABSA, 2006). The South African housing prices recorded the highest annualised real growth rate of 30.3 percent in 2004 before slowing down to an annualised real growth rate of 7 percent in 2007 (figure 1) [12].

Figure 1: South African Annual Percentage Change in Real Housing Prices (2000 Prices), 1980 to 2007



Source: Own calculations using data obtained from ABSA (2009)

Due to the abrupt increase in residential property prices, particularly, during the period 1999 to 2007, the level of households' net wealth position was improved (ABSA, 2007). The anecdotal booming of the residential property market further augmented the level of mortgage advances by households which increased immensely between 2000 and 2005 (ABSA, 2007). The main factors agitated to have influenced the property prices are among others, historically low interest rates, ensuing from lower inflation and the strong performance of the property market because of the underperformance of other asset classes such as equities. As a result, new home-buyers have increasingly taken out larger loans as property prices have increased, while existing homeowners increased their mortgage loans to turn their massive appreciation on their properties into cash for consumption purposes. This has caused ratios of households and mortgage debt-to-disposable income in countries such as SA, Australia, Ireland, Netherlands, Spain, UK and the US to increase to levels never seen before (ABSA, 2006).

In addition to the economic growth, households' disposable income and adjustments to personal and property tax rates are quoted as having positively influenced the residential market in SA. Other economic factors such as residential fixed capital formation, the construction sector,

[12] Own calculations based on the 1960 to 2008 monthly data obtained from ABSA (see appendix A for more details on the data utilized).

building material, household wealth, household consumption expenditure, net household saving, mortgage debt, credit extension by the financial sector, government revenue etc. are also cited to have contributed towards the sky-rocketing prices of the residential property market (ABSA, 2007). The question is, therefore, raised as to how this rise in net wealth has influenced aggregate consumer expenditure.

In 2007 the property prices were still increasing, however, according to ABSA House Price Indices the trend in house price growth indicated that, in real terms, the year-on-year house price was declining. This decline was mainly driven by the stringent increase in households' real disposable income and the full implementation of the National Credit Act (NCA)[13] in June 2007, which saw a tightening of lending requirements applicable to consumers and financial institutions (ABSA, 2008).

2.2 Disposable Income of Households

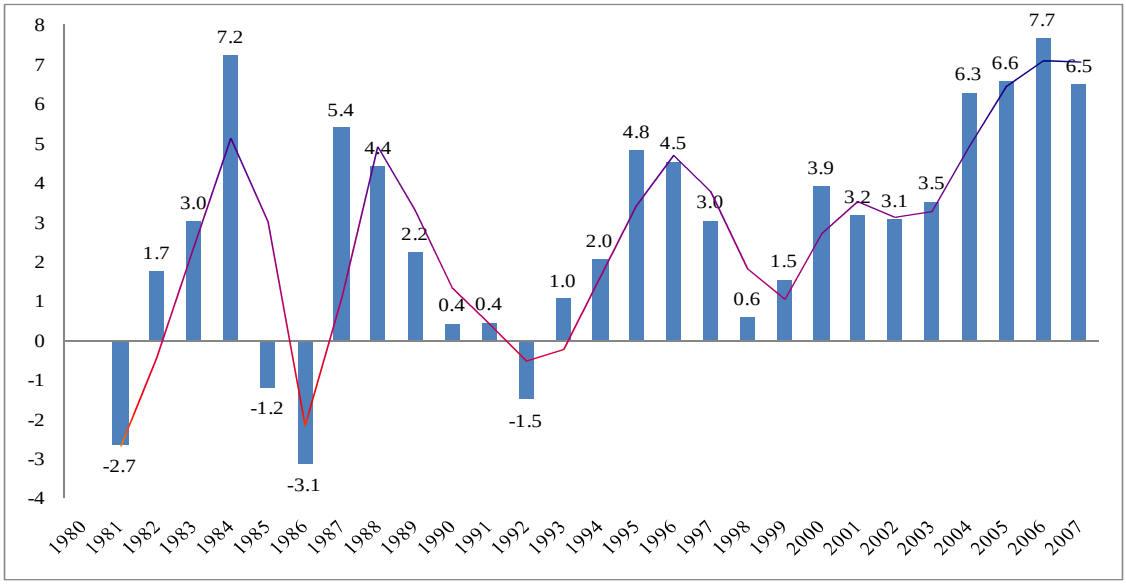
Despite the negative annualised percentage change recorded in the years 1981 (-2.7 percent), 1985 (-1.2 percent), 1986 (-3.1 percent) and 1992 (-1.5 percent), real disposable income of households recovered in 1993 and recorded an annualised growth rate of 1 percent. Households' real disposable income uninterruptedly increased from an annual increase of 1 percent in 1993, peaked at 7.7 percent in 2006 and settled at around 6.5 percent[14] in 2007 (Figure 2). Such an increase in disposable income for a country with a high marginal propensity to consume inevitably leads to a strong response in consumer spending (SARB, 2007).

Amongst other factors, improvement in employment opportunities as well as higher wage settlements between trade union and employers are cited to have influenced growth in real disposable income of households (SARB, 2008). This abrupt increase in real disposable income was further augmented by the "personal tax relief measures as well as increases in the thresholds for tax exemption which were introduced by the South African government over the years" (SARB, 2006:1). In addition, government transfers to households in the form of disability, child and pension grants gained momentum. Over and above the general increase in disposable income, consumers further supported their consumption spending through borrowing. This, as a result, led to the rise in the ratio of household debt to disposable income from 53 percent in 1993 (SARB, 1996) to 77.5 percent in 2007 (SARB, 2007).

[13] NCA is the South African law that came into effect on the 1st of June 2007. NCA was created with an intention of regulating the credit industry in South Africa in order to protect consumers from poor credit practices. The Act aims at reducing reckless credit behavior by both the credit providers and consumers. Basically, the Act places a greater responsibility on credit providers to ensure that a consumer can afford the credit before any credit advancement is committed (www.nca.co.za).

[14] Own calculations based on the seasonally adjusted disposable income of households data, constant at 2000 prices obtained from the SARB.

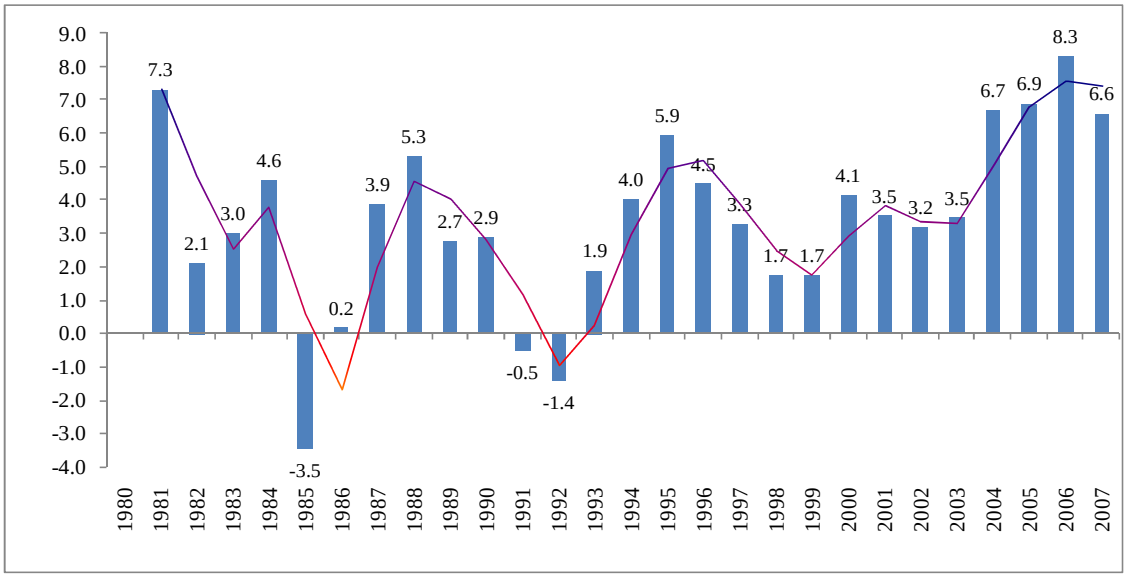
Figure 2: South African Annual Percentage Change in Real Disposable Income of Households (2000 Prices), 1980 to 2007



Source: Own calculations using Disposable Income of Households (Seasonally Adjusted at Constant 2000 Prices) data obtained from SARB (2009)

2.3 Private Households Expenditure on Consumption

Figure 3: South African Annual Percentage Change in Real Households' Expenditure on Consumption (2000 Prices), 1980 to 2007



Source: Own calculations using Final Consumption Expenditure by Households (Total Seasonally Adjusted at Constant 2000 Prices) data obtained from SARB (2009)

Figure 3 shows that though private household consumption had been robustly increasing from 1980 to 2007, it however dropped in 1985, 1991 and 1992 whereby the negative annual percentage changes of -3.5 percent, -0.5 percent and -1.4 percent were recorded respectively. After having turned positive with an annualised percentage change of 1.9 percent in 1993, real private consumption expenditure strengthened progressively to the highest annual percentage increase of 8.3 percent in 2006 before settling to 6.6 percentage change [15] in 2007. One of the key drivers of household consumption during early 2000 to 2006 relates to the availability of easily accessible mortgage facilities which allowed for the financing of recurrent household spending against the surety of real estate (SARB, 2006 & 2007).

The fall in private consumption expenditure particularly during the late 90's was mainly attributed to factors such as weak consumer confidence which could have been influenced by (among others): higher interest rates, lesser job opportunities in the formal sector leading to a fall in employment, marginal growth rate in real income, falling share prices in the Johannesburg Stock Exchange (JSE) etc. (SARB, 2000). The steep rise in interest rates in 1998 led to the dramatic increase in the costs of servicing debts. As a result, "…households had much less capacity to spend, while at the same time the savings ratio came under pressure as households attempted to maintain past spending habits" (SARB, 1999:9).

3. Econometric Model

The basic principle in the permanent-income/life-cycle hypothesis (PI-LCH) is that consumption decision is made to optimise utility over the life time (Thomson & Tang, 2004). However, the level of consumption will only be affected by permanent changes in income or wealth[16] (Chen, 2006). Phang (2003) and Souca (2008)[17] provide extensive literature on the empirical test of the PI-LCH.

The methodology adopted in this paper is similar to the one applied by Chen (2006) in his analysis of housing wealth and expenditure on consumption in Sweden. The multivariate conventional model specification is chosen as the cointegrating relationship between expenditure on consumption, disposable income and housing wealth particularly housing prices. For the purpose of this study, housing prices are used as a proxy for households' wealth resulting from changes in housing prices. The randomly selected sample period for the study starts from the quarter one of 1980 to quarter four of 2007 (i.e. 1980:Q1 to 2007:Q4).

The appropriate model is therefore specified as:

[15] Own calculations based on the 1980 to 2007 monthly data obtained from ABSA (See Section 4.3.1 for more details on the data utilized).

[16] Wealth is made up of two components: financial and human wealth *(See Section 2.5 in Chapter Two).*

[17] Also see Ludwig and Slok (2002), Campbell and Cocco (2004) and Girouard and Blondal (2001).

$$LogC_t = \alpha_0 + Log\alpha_1 Y_t^d + Log\alpha_2 Y_t^{hp} + \varepsilon_t. \qquad (1)$$

Where t refers to time, while C_t, Y_t^d, Y_t^{hp} and ε_t denote households' expenditure on consumption, households' disposable income at a time, housing prices and the error term respectively. All the variables are stated in logarithmic form so that the estimated coefficients could be treated as elasticities.

3.1 Vector Error Correctional Model

It is evident in equation *(1)* that X_{it} influences Y_t, however, due to an endogeinity problem at the same time, Y_t might also influence X_{it}, implying that there is a two way movement between the variable under consideration (Koop, 2005). As results, all the variables included in the model should be treated as endogenous. Failure to do so will result into simultaneity biased estimation. Given this difficulty, it is therefore safer to "estimate a system of equations using the VECM", (Chen, 2006).

VECM emanates from the restricted non-stationary but cointegrated vector autoregression (VAR) series. VECM does not require the weak endogeinity condition of independent variables. Most importantly, VECM provides both the coefficients of the short-run adjustments as well as the coefficients of the cointegration in the long-run. The short-run deviations from the long-run relationship are corrected back into the cointegration through the error correction term.

$$Z_t = A_1 Z_{t-1} + ... + A_k Z_{t-k} + u, \qquad (2)$$

Variable Z_t represents *(n* x *1)* and each of the A_i is an *(n* x *n)* matrix of parameters. Johnston & Dinardo (1997) argues that, "this type of VAR-model is advocated as a way to estimate dynamic relationships among jointly endogenous variables without imposing restrictions such as structural relationships or the endogeinity of some of the variables". It is a reduced system with each variable in Z_t regressed on only lagged values of both itself and all other variables in the system. The extension of equation *(2)* leads to the formulation of a VECM model which is stated as:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-k} + u_t, \qquad (3)$$

where $\Gamma_i = -(\mathrm{I} - A_i - ... - A_i), (i = 1,..., k-1),$ and $(\mathrm{I} - A_1 - ... - A_k)$. The main advantage about equation *(3)* is that it is expressed in such a way that the system produces result estimates on both the short-run and long-run adjustment to changes in Z_t, via the estimates of $\hat{\Gamma}_i$ and $\hat{\Pi}$

respectively. A closer analysis of *(3)* reveals that $\Pi = \alpha\beta'$, where α represents the speed of adjustment to the equilibrium, while β is a matrix of long-run coefficient such that the term $\beta' Z_{t-k}$ embedded in *(3)* represents up to *(n-1)* cointegration relationships in the multivariate model which ensure that Z_t converge to their long-run steady-state solutions (Harries, 1995) [18].

4. Data and Variable Description

Data used in this study is quarterly and seasonally adjusted, measured at 2000 prices; quoted in million rand; and expressed in the logarithmic form. The sample period chosen is 1980: Q1 to 2007: Q4. In an attempt to estimate the effect of housing wealth on consumption in South Africa, data on housing prices is used as a proxy for housing wealth. The variables used in pursuance of the study are final expenditure on consumption by households, households' disposable income and housing prices. Details on sources of data and variable description are outlined in Appendix A, while variables names used in the regression models are described in table 1 below.

Table 1: List of Variable Names and Description

Variable Name	Description
Log_cons	Log of Households' Total Expenditure on Consumption
Trend Cons	Trend variable for Households' Total Expenditure on Consumption
C Log_Cons	Constant for Households' Total Expenditure on Consumption
D(Dlog_Cons)	Differenced Log per Capita Households' Expenditure on Consumption
Log_inc	Log of per Capita Households' Disposable Income
Trend Inc	Trend variable for Disposable Income
C Log_inc	Constant for Households' Total Disposable Income
D(Dlog_Inc)	Differenced Log per Capita Households' Disposable Income
LOG_HP	Log of House Price
Trend HP	Trend variable for Log Hosing Prices
C Log_HP	Constant for Log Housing Prices
D(Log_HP)	Differenced Log of H

5. Empirical Results

5.1 Unit Root Test

The standard econometric theory cautions that any regression run on time series data should be stationary, unless they are co-integrated (Harris, 1995). It is, however, common that time series variables can influence another with a time lag. Thus if the variables are non-stationary, this could lead to the problem of spurious regression (Koop, 2005).

[18] Also see Watson (1994) and Johnston and Dinardo (1997).

Thus, in an attempt to test whether the series has a unit root, I employ the formidable Augmented Dickey-Fuller (ADF) method. Estimated results of the unit root test depend on whether the selected equation includes the intercept, time trend or none of them (Johnston & Dinardo, 1997). Thus, following the Augmented Dicky-Fuller (ADF) unit root test procedures in each of the series, the study therefore specifically simulates the general principle applied by Kuo, Tsai, and Chen (2003: 496) of fitting "a specification that is a plausible description of the data under both the null hypothesis and the alternative".

The empirical evidence in table *B1 (Appendix B)*, which is based on the step by step unit root test procedure, clearly indicates that the three variables - consumption, disposable income and housing prices are individually non stationary[19]. The conclusion that these series are individually integrated into order one *I(1)* is also confirmed by the *DF's* procedure of testing the null hypothesis that the data generated by the restricted regression without intercept and/or trend against the alternative unrestricted model. All the series become stationary if differenced once. The table shows that both consumption and housing prices series are without the trend and drift, while disposable income series contains a deterministic trend. Furthermore, as Enders (2004) maintains, consumption and permanent income are reasonably integrated into order one *I(1)*.

5.2 Testing for Cointegration

Cointegration is said to exist if the series under investigation are moving together and thus converge to form a long-term equilibrium position. Even though the series themselves may be non-stationary, they may nevertheless move together over time and the difference between them be stationary (Dougherty, 2002). In testing for cointegration, I apply both the Augmented Engle-Granger and Johansen methods as outlined in Enders (2004)[20]. In this test I adopt the null hypothesis that variables Y_t and X_{it} are not cointegrated.

Following the Johansen's cointegration testing procedure, the first step ***(step one)*** is to determine the number of lags *(k)* in the vector autoregression (VAR). *Table C1 (Appendix C)* presents the results of the number of lags selection method using the optimum number of 6 lags in the VAR model. With 106 observations, based on the AIC statistics, the results show that at *5 percent* level of significant, *k* equals to *2*, indicating that the lags order of *two* are sufficient for the VAR model. The lag selection of $k = 2$ is further confirmed by the statistical results from the Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ).

[19] These estimates were obtained using the E Views computer software package. EViews is one of the statistical computer software used for the analysis economic data, with particular emphasis on time series data.
[20] For the purpose of this paper I only report on Johansen Cointegration method. Results on the Engle-Granger method are available on request.

Now that the *k* is confirmed to be equals to *two*, the ***next step (step two)*** is to estimate the model and determine *r* that is the number of cointegrating relationships among the *three* variables in the VAR. Tables 2 and 3 report on the Johansen's cointegration rank test among the three variables under investigation. Report in table 2 is based on the Trace analysis while table 3 provides statistical results using Maximum Eigenvalue.

Table 2: Cointegration Test Using Trace (λ_{Trace}), 1980: Q1 to 2007: Q4

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
r=0	0.211489	37.71491	42.91525	0.1504
r=1	0.078099	11.81556	25.87211	0.8246
r= 2	0.026718	2.951921	12.51798	0.8822

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Starting with trace (λ_{trace}), which is usually the less preferred method of testing the null that number of cointegrating vector *r* is less than or equal to some number against the alternative that it is one larger than that number (Enders, 2004). The first line in the *t*-statistics tests that *r = 0* against *r > 0*. As the critical values of *42.9152* exceeds the statistic value of *37.7149*, the test fails to reject the null *r = 0* at the *5 percent* level of significance. The test for the null that $r \leq 1$ against $r > 1$ indicates that at the *5 percent* level, the *t*-statistics of *11.8156* is insignificant, meaning that the null cannot be rejected. Trace, therefore, concludes that there is no evidence suggesting a cointegration relationship between the variables in the VAR model.

Table 3: Cointegration Test Using Maximum Eigenvalue (λ_{Max}), 1980:Q1 to 2007:Q4

Unrestricted Cointegration Rank Test (Maximum Eigenvalue), 106 observations with 4 Lags				
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	5 % Critical Value	Probability Value
r=0*	0.2115	25.8994	25.8232	0.0489
r=1	0.0781	8.8636	19.3870	0.7384
r=2	0.0267	2.9519	12.5180	0.8822

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Contrary to the trace test, results from the maximum eigenvalue reject the null hypothesis of *r = 0* at the *5 percent* level of significance against the alternative that *r = 1*. The rejection of the null is informed by the *t*-statistics of 25.8994 which exceeds the *5 percent* critical value of *25.8232*. Regarding the null hypothesis of *r = 1* against *r = 2*, the statistics of *8.8636* is insignificant at the *5 percent* level of significance, suggesting that the null cannot be rejected. Thus, the maximum

eigenvalue cointegration rank test concludes that *r;* the number of cointegrating vectors at the *5 percent* level of significance is *one.*

The finding that the model contains at least one cointegrating vector warrants progression to ***step three*** of Johansen methodology of testing for cointegration in a VAR. As pointed out in Enders (2004), step three requires an analysis of the normalised cointegrating vectors and speed of adjustment coefficients. Under this procedure, a reduced rank regression in which α and β are each restricted to be *(n x r)* is estimated. Since the model contains three variables that is *n = 3* and *r =1*, the vector is stated as *(3 x 1).* The estimated value of the single *β* vector becomes the estimates of the parameters of the single cointegrating relationship. The normalised cointegrating vector is presented as:

$$\beta_1 Log\_Cons_t + \beta_2 Log\_HP_t + \beta_3 LogLog\_inc + \beta_4 t_t = 0 \qquad (4)$$

Since it is concluded that that *r = 1*, thus from equation *(4),* the estimated cointegrating vector is *β,* hence the model has parameters β_1, β_2, β_3 and β_4. The values of the parameters of β are -64.012, -1.03, 65.57 and 0.04 respectively. After normalisation with respect to β_1, the parameters of the normalised vector become *1.00, 0.02, -1.02* and *-0.0007* respectively.

The substitution in *equation (4)* results to:

$$1.0 Log\_Cons_t + 0.02 Log\_HP_t - 1.02 Log\_inc - 0.0007 t_t = 0.$$

Thus:

$$Log\_Cons_t = -0.02 Log\_HP_t + 1.02 Log\_inc + 0.0007 t_t. \qquad (5)$$
$$(0.021820) \qquad (0.12326) \qquad (0.00074)$$

Equation *(5)* indicates that the long-run consumption elasticity with respect to housing prices is 0.02 and 1.02 with respect to disposable income. Following the analysis from *table 3* above, the study therefore accepts the hypothesis of one cointegration relationship at *5 percent* level of significance. Hence, the cointegration test based on Johansen's procedure provides empirical support (as does the Engle-Granger procedure) for a long-run relationship between consumption, disposable income and housing prices. Since the vector error correction model (VECM) has a (i) "cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variable to converge to their cointegration relationships while allowing for short-run adjustment dynamics"; and (ii) "cointegration error correction term deviating from the long-run, equilibrium is gradually corrected through a series of partial short-run adjustments" (Philips,

1991: 968); thus, in order to get the true long-run and short-run coefficients of the full model, the study therefore opted to estimate a VECM.

5.3 The Vector Error Correction Model Results

The model is estimated using the log of housing prices and log of income to capture the persistence in the adjustment of consumption to change in income and housing prices.

5.3.1 Long-Run Relationship

Table 4: Long-Run Equilibrium Estimation Results, 1980: Q1 to 2007: Q4

Cointegrating Eq:	CointEq1
LOG_CONS(-1)	1.000000
LOG_HP(-1)	0.016091
	(0.02182)
	[0.73733]
LOG_INC(-1)	-1.024408
	(0.12326)
	[-8.31119]
@TREND(80M01)	-0.000698
	(0.00074)
	[-0.94760]
C	0.195580

The results of the long-run relationship between the three endogenous variables are reported in table 4 above. Ensuing from *table 5* long- run relation is presented as:

$$\Delta LogC_t = 0.196 + 0.016\log\_HP_{t-1} - 1.024\log\_inc_{t-1} - 0.0007t + \varepsilon$$
$$\textit{(0.73733)} \qquad \textit{(-8.31119)} \qquad \textit{(-0.94760)} \qquad (6)$$

In equation *(6)*, the *0.016* coefficient for *Log_HP i*s treated as the elasticity of the housing wealth arising from increase in housing prices. This is, therefore, interpreted as the long-run relation between consumption and housing prices, meaning that everything else held constant, a *1 percent* increase in housing prices will result to a *0.02 percent* increase in consumption in the long-run. The *t*-statistics of *0.73733*, however, suggests that the long-run relation between housing prices and consumption is statistically insignificant.

Though the estimated results are statistically insignificant, they are however consistent with Prinsloo's (2002) argument that due to the changes in the South African retail credit markets the retail finance sector has seen new developments, particularly in private-label credit cards and unsecured loans. Subsequent to these developments, households entered into mortgage loans to acquire funds for purposes other than the purchase of fixed property. In such a case the fixed properties owned by households are pledged as security for the loan. The key competition among the various financial institutions in South Africa since the first half of the 1980s has caused mortgage advances to be promoted increasingly for purposes other than the financing of transactions in fixed property.

Startlingly, the model shows a negative long-run relationship between the expenditure on consumption and the disposable income. However, as indicated by Romer (1996), consumption is a function of a permanent income. Hence, an increase in current income is associated with an increase in consumption only to a degree that reflects an increase in permanent income. Consequently, when consumers' increased income is expected to be transitory, it is unlikely that such income would induce an increase in consumption. Thus, instead of increasing consumption, a transitory income might encourage savings. Alternatively, when a change in the permanent income is small relative to the change in transitory income, little of the change in income comes from the change in permanent income and so consumption increases little with the increase in income (Griffiths & Wall, 1993).

Furthermore, as demonstrated in Romer (1996), the random walk hypothesis postulates the argument that regression results from lagged income not having strong predictive power for consumption could arise because lagged values of income are of little use in predicting income movements and not because predictable changes in income do not produce predictable changes in consumption. Hence, the change in consumption is unpredictable, implying that no information available at time $t-1$ can be used to forecast the change in consumption from the previous to the current period.

From equation *(6)*, the coefficient of log_inc is -1.02 implying that for homeowners' households, a one percent increase in the transitory income in the last quarter, will lead to a decrease of approximately 1.02 percent in the expenditure on consumption, ceteris paribus.

5.3.2 Short-Run Relationship

Table 5 below reports on the speed at which an out-of-equilibrium system adjusts back to the long-run equilibrium. From Table *5*, despite being statistically insignificant, approximately *5.2 percent* of disequilibrium is corrected each quarter by changes in the housing prices. Meanwhile, changes in disposable income correct about *44 percent* of disequilibrium in each quarter. In addition, the model specification which is well supported by the *F-statistic* explains

approximately *28 percent* of the variation in the log of consumption. Since the coefficient of the second lagged housing prices is also statistically insignificant, it thus becomes evident that in South Africa, it takes more than two quarters or six months before consumption could respond to changes in housing prices.

Table 5: Short-Run Error Correction Equilibrium Estimation Results, 1980: Q1 to 2007: Q4

Error Correction:	D(LOG_CONS)	D(LOG_HP)	D(LOG_INC)
CointEq1	0.051419	0.052196	0.440261
	(0.05901)	(0.10029)	(0.09011)
	[0.87142]	[0.52047]	[4.88578]
D(LOG_HP(-1)	0.184316	0.906822	0.002086
	(0.05776)	(0.09817)	(0.08821)
	[3.19089]	[9.23682]	[0.02365]
D(LOG_HP(-2)	-0.040448	-0.135798	-0.036629
	(0.06303)	(0.10713)	(0.09626)
	[-0.64169]	[-1.26758]	[-0.38052]
R-squared	0.284280	0.725263	0.329484
Adj. R-squared	0.234676	0.706222	0.283013
F-statistic	5.730960	38.08913	7.090034

5.4 Discussion of Findings and Conclusion

The first critical issue about the estimated results relates to the constraint that due to the limited access to the relevant literature on the relationship between consumption and housing prices in South Africa, the estimated coefficients are to a large extent compared to the studies conducted in developed countries. Hence, the vast amount of international literature[21] reviewed indicates that the marginal propensity to consume (MPC) accruing from housing prices ranges between *0.03* and *0.10*, interestingly most of the studies referred to have been conducted in countries[22] that have also experienced a strong upswing in housing prices over the years.

Secondly, as observed in section 3 of this paper, the important component linking housing prices and consumption is the "credit channel". In addition to the treatment of being consumption good, a house can also be used as collateral security in advancing a consumption credit loan. Emanating from this argument, Hogan and O'Sullivan (2003) have correctly pointed out that under the central tenant of the LC-PIH, the level of consumption will only be affected by the permanent component of changes in wealth. In this paper, however, income accruing from

[21] See Cutler (2004), Girouard and Blondel (2001), Attanasio et al (2005) and Ludwig and Slok (2002).
[22] Amongst others the countries referred to are the US, the UK, Australia etc.

housing wealth is treated as one basket without separating the transitory income from the permanent income.

Thirdly, the estimated coefficient shows that, in South Africa, *ceteris paribus,* it takes on average more than *two quarters* before home owning consumers increase consumption in respond to increase in housing prices. A question is then posed as to why it takes longer in South Africa for consumer expenditure to increase in response to an increase in housing prices, while empirical evidence (as discussed section 1) from US, UK, Australia etc. has indicated that homeowners respond to changes in housing prices as early as in the first quarter after prices have increased.

Thus, following Hogan and O'Sullivan's (2003) argument, MPC resulting from housing wealth could be different from other forms of wealth due to: (i) where an accumulation of housing wealth is deemed to be temporary, then rational consumers would refrain from consuming it. This could be the case in SA whereby consumers might be applying a "wait and see approach" until they are certain that an increase in housing prices has indeed increased their net wealth; (ii) it might take some time for a household to be aware that their house is now worth more than the initial price paid to purchase the house. Even after the information about the new value of the house has been obtained, it might still take some time before it could be decided to take an advance loan in a form of mortgage equity withdrawal (MEW).

In tandem to this argument, once a decision is taken to apply for a MEW with a respective financial institution, the process of applying for the second bond could be very lengthy. The application needs to be approved and it comes with a number of delays and costs such as fees relating to bond initiation, administration that is charged by the financial institution, bond registration and payments to the conveyancing attorneys who usually charge a percentage of the registered home loan amount, valuation fee payable to the assessor who valuates the property, etc. The process is further delayed by some of the following: personal information not provided by the applicant, the local authority receiving the rates clearance certificates late, delay in the provision of guarantees, the applicant not paying the transfer costs on time or delays in forwarding personal income and expenditure documents which are required by the lending financial institution, etc[23].

The fourth argument in support of the results could be linked to the concept of households' savings ratio[24]. South Africa has experienced a steady decline in its national saving rate[25] over the past several decades; this decline has been accompanied by a fall in domestic investment. The national saving rate remained well above 20 percent in the 1970s and 1980s, however, both corporate and personal saving fell throughout most of the 1990s (Harjes & Ricci, 2006)[26]. The

[23] http://www.secu-bond.co.za/index.htm accessed on the 16th of October 2009.
[24] The saving ratio is generally defined as the unconsumed fraction of income (Harjes & Ricci, 2006).
[25] The national saving rate is defined as the ratio of national saving to gross national disposable income (GNDI).
[26] Also see Prinsloo, J. W. (2000), Bonga-Bonga, (2008), and Aron and Muellbauer (2000_a and 2000_b).

authors further link this low poor saving rate into some instances whereby households are willing to save, but most of them are caught in debt trap hence it becomes extremely difficult to escape from the cycle of overspending and debt accumulation.

As a result, the ratio of households' saving in SA has dropped from around 3.5 percent in the early 90s to around 1.5 percent in 2007 (SARB, 1996 and 2007). The declining saving ratio is primarily explained, amongst other factors, by the easy access to credit until 2007 encouraging people to take out loans which included mortgage loans[27], cultural or social trends encouraging an attitude of borrowing and spending, low interest rates etc. Meanwhile, the ratio of total household debt as a percentage of disposable income had been increasing from as low as 53 percent in 1992 to approximately 76.5 percent in 2007.

The fifth critical issue which could have an impact on the estimated results is the change in monetary policy stance which was not incorporated in this paper. During the 1980s, the South African momentary policy was mainly focused on the so called liquid asset ratio-based system with quantitative controls on interest rates and credit (Aron & Muellbauer, 2007b)[28]. The second set of monetary regime adopted by mid 1985 was more about the pre-announced monetary target ranges, which were about a broad definition of money (M3)[29]. With effect from the early 90s, sound fiscal stance supported by a set of economic indicators such as asset prices output-gap, balance of payments etc. were used a substitutes for the monetary targets. Eventually, as mandated by the South African Government, the SARB switched to inflation targeting monetary policy stance which is aimed at price stability while at the same time maintaining the enhancement of policy transparency, accountability and predictability (Aron & Muellbauer, 2007b).

Finally, as suggested by Dvornak and Kohler (2003:5), the longer than *two lags* delays for house-owners to increase consumption when housing prices increase could also be attributed to various other factors such as "differences in liquidity, other utility associated with owning an asset (housing services, bequest motives), income distribution across racial groups, expected permanency of changes, and psychological factors". Hence, it becomes difficult to liquidate within a shorter period and the transaction costs of "trading up" seem to be high.

6 Summary

This paper attempted to estimate a relationship between housing wealth and consumption for South Africa using the permanent-income/life-cycle hypothesis. However, constrained by the non-availability of the official balance sheet estimates for the household sector in South Africa

[27] After the introduction of the National Credit Act in 2007, access to credit started to decline.
[28] For more details on a range of reforms enacted from the early 1980s , see de Kock Commission Reports (1978 and 1985)
[29] For more details see Gidlow (1995).

(Aron et al, 2007a), housing prices were used as a proxy for housing wealth. The data utilised indicates that in SA, both housing prices and consumption expenditure by households have increased considerably in real terms over the period under investigation.

Empirical investigations mainly from developed countries provide evidence indicating that an increase in housing prices generally results in a higher household's wealth which is in turn used as collateral in borrowing for consumption purposes (Attanasio et. al 2005). Hence, empirical evidence suggests that in the developed countries, MPC arising from a one dollar increase in housing prices ranges bet**w**een *0.03* and *0.10.* In the case of South Africa, Aron and Muellbauer (2006), found the same to be ranging between 0.07 and 0.14.

Following the specified VECM, the paper used data from the first quarter of 1980 to the last quarter of 2007 and found that there is indeed a long-run relation between the expenditure on consumption by households and the changes in housing prices. Ceteris paribus, in the long-run, a *1 percent* increase in housing prices will result to a *0.02 percent* increase in consumption. This estimate is consistent with the findings by Aron and Muellbauer (2000). Their estimates were, however, higher than those in the UK, a discrepancy which was attributed to the likelihood of underestimating the household net wealth in SA, particularly given the fact that there is no official recording of the systematic household balance sheet in SA.

The findings of the study further suggest that there is no relationship between housing prices and consumption over a short-run *(one quarter)* period. I however, made no attempt to account for financial liberalisation. Meanwhile Aron and Muellbauer (2006:1) argue that in most countries the relaxation of regulations controlling credit supply is often followed by a boom in the prices of residential properties. Hence, as argued by Aron and Muellbauer, "failure to control for the direct effect of such easing on consumption can have an impact on the effect of housing wealth or collateral on consumption". This is indeed evident in this paper, particularly given the fact that estimated results by Aron and Muellbauer (2007a) suggest that in SA, the coefficient of housing wealth on consumption ranges between *7 percent and 14 percent.*

6.1 Policy and Recommendations

The South African credit markets developed markedly during the 1980s and 1990s. As indicated in Aron et al. (2007b), access to second bond mortgage loans gained momentum in SA. As a result it became cheaper for home-owning households to borrow and finance consumption. Aoke et al. (2002:8), referred to this as a "positive shock to economic activity which causes a rise in housing demand leading to a rise in house prices and so an increase in homeowners' net worth". Consequently, the drop in the costs of borrowing, leads to a further increase in demand for residential properties and thus indirectly stimulates consumption.

Given this analysis, it thus becomes important for policymakers to closely monitor any arrangements by financial institutions that make it easy for households to access housing equity withdrawals that are aimed at financing consumption (Girouard & Blondal 2005). In order to fulfill this obligation, SA via Stats SA, South African Revenue Services (SARS) or SARB needs to consider compiling official household balance sheets in order to be able to carefully monitor the direct effect of housing wealth into consumption. This in turn will assist in developing the appropriate policy in monitoring the relationship between housing wealth and consumption.

In addition, as argued by Nickel (2004:7), though the relation between housing price and consumption is complex, it is however crucial "for monetary policy because house price inflation, being positively related to household consumption, is therefore positively related to aggregate demand and hence future inflation". So even though house prices are not included in the Consumer Price Index, monetary policy must carefully consider their potential impact. This argument is also raised by Baker (2005) who cautioned that if the housing bubble is not carefully monitored, it will collapse, thus leading to mortgage defaults which will put major strains on the financial system and eventually lead the economy into recession. This was clearly evident in the recent financial collapse of 2008 and its impact on the real economy worldwide.

Lenhert (2004), however, argues that since the dynamics of the a bubble are not known for sure, while at the same time, monetary policy's lags are generally long, monetary policy authorities would find it difficult to formulate appropriate policies during bubble. Hence, central banks need to consider any potential effects that might arise as a result of changes on asset prices on inflation and the national output measured in real gross domestic product.

Meanwhile, Ludwig and Stock (2002) warned policy makers that increase in both stock prices and housing prices generally lead towards a downward trend in savings. This conclusion is based on the empirical evidence indicating a strong significance of both stock prices and house price wealth in explaining consumption. A final caution relates to the argument by Nickel (2004:10) who maintains that since monetary policy is governed by the inflation target, the extent of household debt accumulation is "unlikely to have much of a direct impact on monetary policy", but the existing and future expected level of house price inflation will have a "direct impact on monetary policy" because of the effect on general inflation via household consumption growth.

6.2 Limitations of the Study and Further Research

The following are noted as major limitations of the study which warrant further investigation:

Firstly, due to the inaccessibility of empirical review in studies conducted in developing countries (e.g. other African countries, Brazil, Argentina etc.), evidence considered in this study is therefore mainly obtained from studies conducted in developed countries. Given the economic

structures, development stages, income distribution, economic performance etc. between the developed and developing nations, this therefore makes it difficult to compare South African results with those from developed countries.

Secondly, as argued by Hogan and O'Sullivan (2003) that under the central tenant of the PI-LCH, the level of consumption will only be affected by the permanent component of changes in wealth. In this study, however, income accruing from housing wealth is treated as one basket without separating the transitory income from the permanent income. Thus, even though the results seem plausible, the study provides a general overview of the households' reaction to changes in housing prices without a reaction specifying their behavior as a result of temporary changes to their net wealth. This, therefore, creates an opportunity for further investigation towards the relationship between consumption and housing prices.

Finally, though South Africa, particularly after 1994 has experienced extensive economic policy changes which could have influenced the outcomes of the estimated results; effects of such policy changes are not captured in this study. This, therefore, opens an opportunity for further investigation which should take into account variables such as race, level of education, level of income, house ownership versus household renting houses, structural changes etc, particularly in a country like SA where inequality is still prevalent.

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8. Appendix

8.1 Appendix A: Data Sources and Variable Description

Data on households' expenditure on consumption and households' disposable income was sourced from the Policy and Research Unit of the South African Reserve Bank (SARB). "As the South African Central Bank, SARB collects, processes, interprets and publishes economic statistics and other information". To this end, the Bank publishes, amongst others, Quarterly Bulletins, Annual Economic Reports[30] etc.

[30] See the SARB website at www.resbank.co.za.

However, unlike developed countries such as UK, US, Australia etc. and some emerging economies such as Hungary, Mexico and Poland, SA has no records of any wealth estimates balance sheets. The wealth estimates that exist in SA were compiled by Aron et. al (2007a) and are not published using a market-value basis. Data on these balance sheet estimates published by the South African Reserve Bank (SARB) are on a book value and not on a market-value basis; hence require revaluation adjustments using appropriate asset price indices. In addition, some asset classes, e.g. official pensions and directly-held bonds, are published only as flow-of-funds data with no benchmarks.

Meanwhile, data on housing prices, which were already extrapolated and readily available, were sourced from the Amalgamated Banks of South Africa (ABSA) Group Limited (henceforth referred to as ABSA)[31]. In SA, there are only a few large financial institutions providing for personal and business clients of which ABSA is one. Amongst others, the ABSA Economic Research unit provides regular, well-researched support, advice and information regarding global and domestic economic trends and properties[32].

8.1.1 Variables

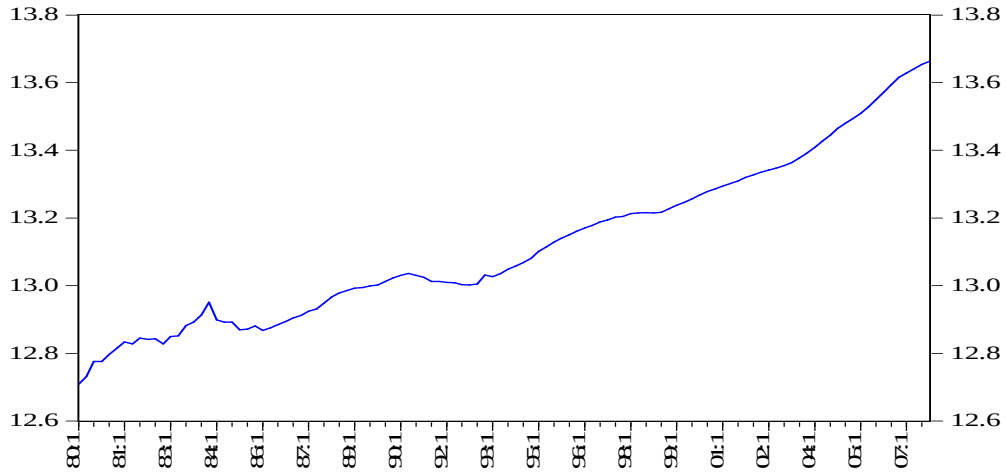
Consumption

The real expenditure on consumption by households' data obtained is transformed into log terms. As in the case of Thomson and Tang (2004), this study broadly defines consumption in such a way that both durable and non-durable goods are treated as one basket. The rationale for the inclusion of both types of goods is based on the argument that firstly, in some instances, it becomes practically impossible for consumers en-masse to treat some durable goods such as clothing, footwear and households appliances as forming part of wealth. Secondly, there is a high level of inaccuracy associated with reliability of the depreciation rate of durable goods. Thirdly and most importantly, the objective of this study is to measure the overall relationship between residential property prices and consumption.

Figure *(A1)* above illustrates that households' expenditure on consumption increases over time. Though the series is trending upward, the trend is however not deterministic, particularly during the periods 1983 to 1986 and 1991 to 1993. An upward trending series is the first indication that the series per se is non-stationary hence warranting a unit root test.

[31] Data is from Absa Home Loans, a division of ABSA Group. The Absa House Price Indices are based on the total purchase price of houses in the $80m^2$ to $400m^2$ category. Prices are smoothed in an attempt to exclude the distorting effect of seasonal factors and outliers in the data. ABSA Group maintains that its data is derived from sources which are regarded as accurate and reliable and is general in nature.
[32] For more details see ABSA Group website, http://www.absa.co.za.

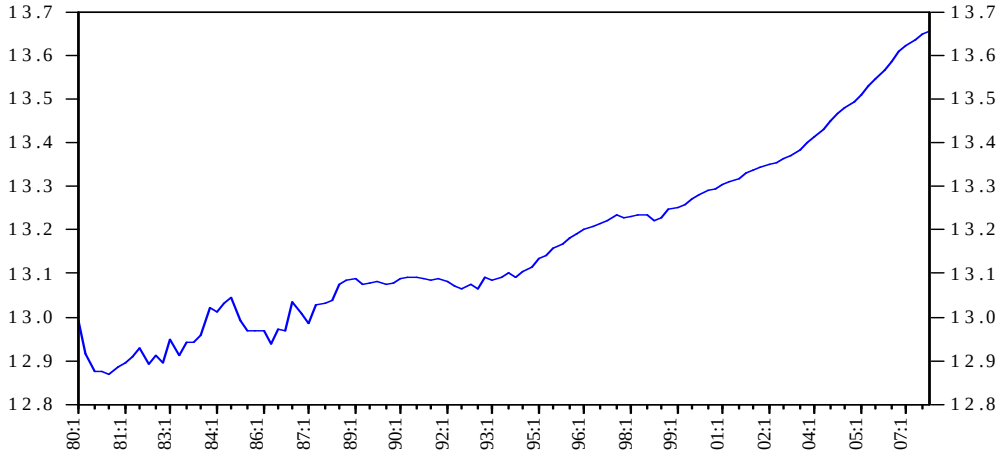
Figure A1: Log of Expenditure on Consumption, 1980: Q1 to 2007: Q4



Source: Own Calculations using Total and Seasonally Adjusted Final Expenditure by Households at Constant 2000 Prices in R Millions Obtained from SARB (2009).

Disposable Income

Figure A2: Log of Disposable Income, 1980: Q1 to 2007: Q4



Source: Own Calculations using Seasonally Adjusted data on Disposable Income at 2000 Constant Price (in R Millions), Obtained from SARB (2009)

The log disposable income in figure A2 exhibits a stochastic random walk non-stationary time series indicating the presence of a unit root in the disposable income series. Households' total disposable income (Y_d)[33] which is quarterly, real and seasonally adjusted is the sum of both

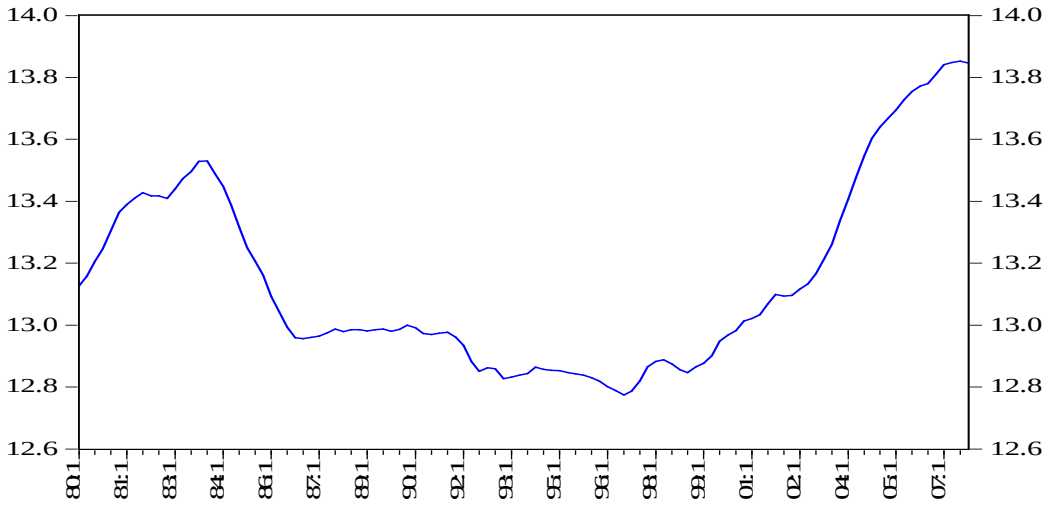
[33] Y_d is the level of income available to consumers to spend on consumption or save after having paid the direct tax and the transfer payments.

primary and secondary income. Primary income is mainly the labour income which constitutes more than 70 percent of the total household income. The remaining balance of plus or minus 30 percent is secondary income which comprises transfers from other households in the form of remittances, social grant benefits and workers' compensation and the transfers from the rest of the world (Aron et al, 2007a).

Housing Prices

The South African big four commercial banks[34], compile data on Housing Price Indices (HPI)[35]. Though data provided by these banks is compatible with minimum variant, for the purpose of this study, data from ABSA was randomly selected. Housing prices data from ABSA is calculated based on the total purchase price of all new and old middle class houses in the 80 square metres to 400 square metres size category. Prices are smoothed so as to exclude any distorting effects arising from the seasonal factors as well as the outliers that might be contained in the data[36]. For the purpose of this study, the monthly series data was transformed into quarterly by calculating the average values of each quarter. Figure A3 shows that housing price series is more like a random walk.

Figure A3: Log of House Prices, 1980: Q1 to 2007: Q4



Source: Own Calculations Using Housing Prices Data obtained from ABSA (2009)

[34] The four big commercial banks in SA are ABSA, First National Bank (FNB), Standard Bank and Nedbank (Nedcor Group).
[35] HPI is the index of the market price of transacted private residential properties.
[36] See ABSA website at www.absa.co.za.

8.2 Appendix B: Unit Root Tests

Table B1: Standard ADF Test Statistics (N = 107, AIC Lag Selection)

Series	Model	ADF		
	Deterministic Trend	Lags	τ_μ, τ_π, τ	ϕ_3, ϕ_1
Log_Cons	None	4	2.732***	4.298***
D(Dlog_Cons)	None	1	-13.929***	-
Log_Inc	Time Trend	3	-0.738***	7.311***
D(log_Inc)	Time Trend	12	-3.487***	
Log_HP	None	5	0.187***	0.846***
D(Dlog_HP)	None	3	6.291***	-

*Reject H_0: Non-stationarity at 10% level
**Reject H_0: Non-stationarity at 5% level
***Reject H_0: Non-stationarity at 1% level

The study employs the ADF's procedure to investigate the statistical evidence for stationarity. Since the lag length selection affects the power performance of ADF tests, lag length selection is therefore fundamental. The inclusion of additional lagged dependent variables has a tendency of reducing the power of the ADF to detect a unit root (Chen, 2006)[37]. "In fact ADF may indicate a unit root for some lag lengths but not for others" (Enders, 2004:192). For the purpose of this study, the maximum number of lags is determined using the Akaike Information Criteria (AIC).

8.3 Appendix C: Cointegration Test Results

Table C1: Statistical Values of the VAR Lag Order Selection Criteria for Logs of Consumption, Housing Prices and Disposable Income, 1980: Q1 to 2007: Q4

Lag	LogL	LR	FPE	AIC	SC	HQ
0	264.6715	NA	1.44e-06	-4.937197	-4.861817	-4.906645
1	899.4167	1221.585	1.07e-11	-16.74371	-16.44219	-16.62150
2	952.3886	98.94754	4.69e-12*	-17.57337*	-17.04571*	-17.35951*
3	955.1860	5.067059	5.27e-12	-17.45634	-16.70254	-17.15082
4	969.3276	24.81443*	4.80e-12	-17.55335	-16.57341	-17.15617
5	978.6593	15.84624	4.78e-12	-17.55961	-16.35352	-17.07078
6	984.8344	10.13647	5.07e-12	-17.50631	-16.07408	-16.92582

[37] Also see Enders (2004)