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An assessment of relationships between key economic indicators and the South African residential property market

by

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degree of Master of Business Administration**

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ABSTRACT

The phenomenal growth of residential property prices when compared to other asset classes has resulted in property prices being the subject of significant debate in South Africa in the recent past. The reasons for the price increases are the subject of as much debate and uncertainty.

This research attempts to determine whether there is a statistically significant relationship between the economic indicators selected and residential property prices, which could provide some indication of the factors influencing residential property prices in South Africa.

The economic indicators selected were interest rates, real gross domestic product, average income, bond affordability levels, rand to US dollar exchange rates and inflation. Residential property prices in South Africa were measured using two data bases, the ABSA database, which comprised average residential property prices split into affordable, middle and luxury segments, as well as the Standard Bank database comprising median residential property prices in South Africa.

The sample period was determined by reference to the period when data in respect of all the variables was available. Autocorrelation was removed from the data and thereafter a stepwise regression was performed to determine which economic indicators had a statistically significant relationship to each category of residential property price.

It was found that quarterly lagged disposable income per capita (average income) had a statistically significant relationship to affordable and luxury property segments, as well as the median property prices. No economic indicator was found to have a statistically significant relationship to middle segment property prices.

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfillment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University.

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Spiros Tyranes

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Date

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LIST OF ABBREVIATIONS

CPI	Consumer Price Index
CPIX	Consumer Price Index excluding interest rates on mortgage bonds
GDP	Gross Domestic Product
SARB	South African Reserve Bank
US	United States of America
USD	United States Dollar
UK	United Kingdom
VS	Versus
ZAR	South African Rand

CHAPTER 1: INTRODUCTION TO THE RESEARCH PROBLEM

1.1 DESCRIPTION OF THE PROBLEM AND BACKGROUND

In the last few years South Africa has seen phenomenal growth in residential property prices. As explained by ABSA (2006a) the average price of houses in the so-called middle segment of the residential property market (houses of 80m² - 400m² and priced up to R2 600 000) increased in 2005 by 21.9% year on year (2004: 32.2%). In real terms (after adjusting for inflation), the increase was 17.9% for 2005 (2004: 30.4%).

This high growth situation has led to extensive discussion regarding whether the residential property market is currently in a bubble situation or possibly fast approaching this situation. As noted in an article by Clayton and du Preez (2005, p.1), “after a decade of under-performance, the recent out-performance of property has restored the value of property relative to other asset classes”. The article further stated that if appreciation in property prices in South Africa continues at its current rate, property prices will rapidly enter bubble territory. The divergence in opinion on the subject of property prices in South Africa is evident from a quote by Michael Power, an asset manager from Investec Asset Management, in Clayton and du Preez (2005, p.1) who says that, “there is little risk of a South African-led property meltdown”.

This highlights two potential property prices in South Africa:

1. Is there indeed a bubble situation in the South African residential property market? and
2. Is there an objective method to assess the situation without relying on the prediction or comments of interested parties, such as estate agents, bankers or developers?

Although this research will not address property bubbles in detail, the relationship of property prices to the economic indicators selected, if found to be statistically significant, may be useful in determining bubble situations.

The problem that this research document sets out to examine is whether the key economic indicators selected have a statistically significant relationship to residential property prices in South Africa.

1.2 PURPOSE OF THE STUDY

The property boom is not only being felt in South Africa, as noted by Pickard (2006), where it was stated that the volume of property deals and the prices fetched, are at record highs across Europe and this is partly due to the low global interest rates. The article further questions when the property boom will end and predicts that this may come with some sort of event or crisis. This illustrates the fact that around the world the question remains unanswered.

When is the property market overvalued? How are the prices simply following the market forces of supply and demand?

It can be expected that the views of industry experts could be biased, due to the inherent interest in the market by these parties. This therefore necessitates an objective assessment of the property market without the influence of biased opinions which could conceal clear market indicators, regarding the state of the property market.

The objective of this study will be to determine if the economic indicators selected are statistically significant drivers of residential property prices. This should allow the reader to decide whether these factors are relevant in considering whether the property market in South Africa is over or under valued.

The key economic indicators selected are:

- interest rates,
- gross domestic product (GDP),
- average income,
- bond affordability levels,
- rand to US dollar exchange rates, and
- inflation.

1.3 SCOPE OF T



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This research focuses on residential property in South Africa, as well as the economic indicators selected. The research does not take into account all possible economic indicators which could be applicable to residential property prices in South Africa.

It should be noted that this research report considers selected demand side factors of residential property prices. This report does not consider supply side factors, such as labour, building costs or land availability. These factors may well have an affect on residential property prices in South Africa and could affect the model which is developed by this research.

This research does not provide a forecasting model of residential property prices but rather an indication of the current level of residential property prices, relative to the economic indicators found to be statistically significant.

1.4 RELEVANCE OF THE STUDY

ABSA (2006c) states that South Africa has seen phenomenal growth in the housing sector as shown in Table 1. The percentage change in nominal house prices from 1997 to 2006 in South Africa was calculated at 322%, higher than any other country shown in Table 1. It is also evident from table 1 that the year on year, quarterly percentage change of house prices in South Africa is decreasing.

Table 1: Nominal house prices % change

Nominal house prices Year-on-year % change										
Country	2004				2005				2006	Total % change 1997-2006
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1 ¹	
Australia	17,9	12,7	8,2	0,2	0,1	-0,1	1,0	2,3	3,6	119
Britain	16,9	19,4	19,3	14,3	10,1	2,3	2,4	3,7	4,6	176
Canada	5,7	7,0	6,9	6,2	5,7	4,3	4,4	5,7	7,7	57
China	7,7	10,4	9,9	10,8	9,8	8,0	6,6	5,1	5,6	-
Denmark	6,0	7,9	9,7	11,8	13,2	12,2	14,3	17,7	21,3	92
France	14,7	14,9	15,5	15,9	15,7	14,5	14,2	14,7	14,2	115
Hong Kong	17,4	29,1	31,2	29,5	22,1	22,1	14,1	5,8	-3,2	-43
Ireland	13,2	11,9	11,5	9,7	7,9	6,2	7,2	10,2	13,2	231
Italy	10,8	10,8	9,7	9,7	8,5	8,5	7,3	7,3	7,3	81
Japan	-6,4	-6,4	-6,0	-6,0	-5,4	-5,4	-4,7	-4,7	-3,9	-31
Netherlands	5,5	3,9	2,9	2,4	1,6	4,2	5,6	6,0	5,4	86
New Zealand	21,3	22,3	16,4	12,2	13,4	14,2	14,5	16,8	14,8	93
Singapore	-1,5	-0,8	0,0	0,9	2,0	2,4	3,3	3,9	4,7	-
South Africa	28,2	31,2	34,7	34,3	29,3	25,2	20,7	17,8	16,4	322
Spain	17,2	17,4	16,8	17,2	15,7	13,7	13,4	12,8	12,0	165
Sweden	7,7	9,7	9,8	10,0	10,0	8,3	9,5	10,5	13,5	109
Switzerland	3,4	2,1	2,2	2,2	1,4	0,5	1,3	1,6	2,4	16
United States	8,2	9,9	12,9	12,0	13,2	14,1	12,7	13,3	12,5	95

The effect of increased house prices has implications for both business and individuals in South Africa. As stated in ABSA (2006c, p.9) “the cost of building a new house increased by a nominal 10,3% year on year in the second quarter of 2006”. This above inflation increase in building costs reflected an active building and construction sector over the last 12 months. ABSA (2006c) further detailed how factors such as a strong demand for new housing and increased housing prices have contributed to a strong demand for building materials and skilled labour. It is clear therefore that the residential property demand and price increases have noticeable implications for businesses within this sector.

For individuals living in South Africa residential property prices are of major importance, as this will directly influence the affordability of housing and will determine whether individuals live in formal housing structures or not, as well as

whether the housing market can afford the needs of its occupants. Moolman and Schoeman (2006a) show per Table 2, the number of individuals that can afford different percentiles of house prices (8 being the lowest percentile and 80 being the upper percentile house prices) for 2005, 2003 and 2000. From Table 2 it appears that 4 870 000 more individuals were able to afford houses in the 8th percentile in 2005, when compared to 2000. In the other percentile of house prices, such as the 80th, fewer individuals (330 000) were able to afford houses in 2005 when compared to 2000.

Table 2: Number of individuals that can afford different percentiles of house prices

Percentile	2005	2003	Change: 2003 to 2005	2000	Change: 2000 to 2005
8	13.35m	8.71m	4.6m	8.48m	4.87m
30	4.43m	4.17m	0.3m	4.81m	-0.39m
50	1.10m	1.39m	-0.29m	2.52m	-1.42m
80	0.49m	1.15m	-0.21m	0.82m	-0.33m

According to these results it appears that more people are able to afford housing in the lower priced houses, while fewer people are able to afford houses in the middle to higher priced houses. The position of the residential property prices relative to other economic indicators such as disposable income, is therefore of great importance to anyone considering purchasing residential property in South Africa and deserves further attention.

Other interested parties in the residential property sector in South Africa include banking institutions which grant mortgage loans in order to finance residential

property purchases. eman (2006c) the growth in house prices at the lower end of the house price spectrum in recent years was indicated by the year on year growth in mortgage advances made; however the imminent slowdown in housing prices and transactions was already reflected in the month on month growth rates. Clearly factors which influence residential property prices and the relative importance of those factors is of great interest to banks and other financing institutions, which earn their revenue based on property transactions which are financed.

This research report is set out as follows:

Chapter 2 - describes through a literature review, the relevant theory base,

Chapter 3 - sets out the research hypotheses,

Chapter 4 - describes the research methodology that was used,

Chapter 5 - presents the results of the research and discusses the research findings, and

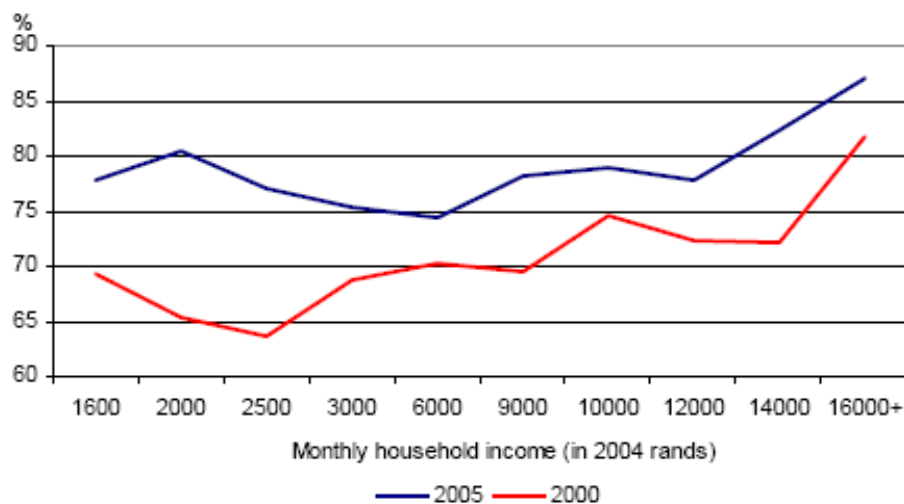
Chapter 6 - presents the conclusions.

CHAPTER 2: LITERATURE REVIEW

2.1 RESIDENTIAL PROPERTY INDUSTRY IN SOUTH AFRICA

The state of the residential property industry in South Africa remains an area for significant debate, with wide divergences of views commonly found. Moolman and Schoeman (2006a) show that per Figure 1 there has been a strong rise in home ownership in recent years and this rise has occurred across most income groups. This increased home ownership has resulted in increased activity in the property market and increased property prices.

Figure 1: Percentage of population owning their dwelling

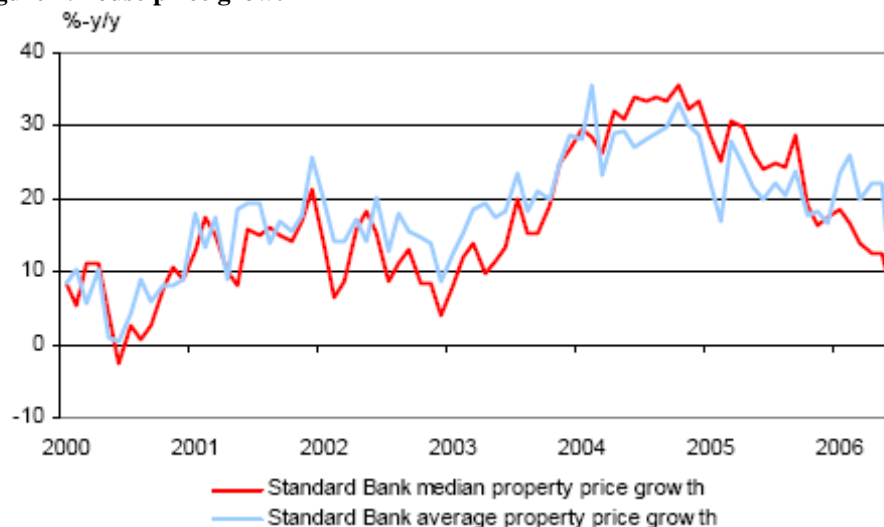


Other industry experts (van Eyk, 2006) have noted that the growth being felt in the South African residential property market is healthy and they expect the fears of a property bubble in South Africa to dissipate.

These views are held by analysts, such as Saville (2004), who comments on the over-inflated residential property market and the expectation that sooner or later the bubble will burst. Saville (2004) further states that there are at least five factors necessary for a financial bubble to exist and these are: ample liquidity (such as growth in mortgage advances), increased use of leverage, increased turnover (activity) in the market, democratisation of the market (belief that prices will increase indefinitely) and new supply (such as new homes and buildings). Saville (2004) warns that these factors all appear to be present in the South African residential property market.

Moolman and Schoeman (2006c) show that per Figure 2 the growth in house prices has decreased from above 30% in 2004 to 6,5% in June 2006 partly due to the decrease in consumer activity and partly due to the increased number of affordable houses being sold. This reflects the fact that house prices are impacted by the demand of consumers and their level of activity in respect of purchases of housing.

Figure 2: House price growth



2.2 KEY ECONOMIC INDICATORS

The key economic indicators selected for this study are discussed below and includes fundamental principles regarding what the economic indicators are and what they typically indicate. Where applicable, the economic indicators used relate to real data i.e. the economic indicators have been adjusted for the effects of inflation.

2.2.1. INTEREST RATES

Interest is effectively the cost of using borrowed funds over a period of time. McAleese (2004, p.306) defines interest rates as “the amount of interest paid per unit of time as a fraction of the balance outstanding”.

According to the South African Reserve Bank (SARB) (2006), the repo rate or repurchase rate is the rate at which the private (sector) banks borrow rands from SARB, while the prime overdraft rate is the rate at which private banks lend out to the public. Mortgage bonds used for the acquisition of property will bear interest at some ratio to the prime interest rate. The ratio such as a certain % below the prime rate will vary depending on certain criteria, such as the bank’s specific lending policy, the applicant’s credit rating and income levels, to name a few.

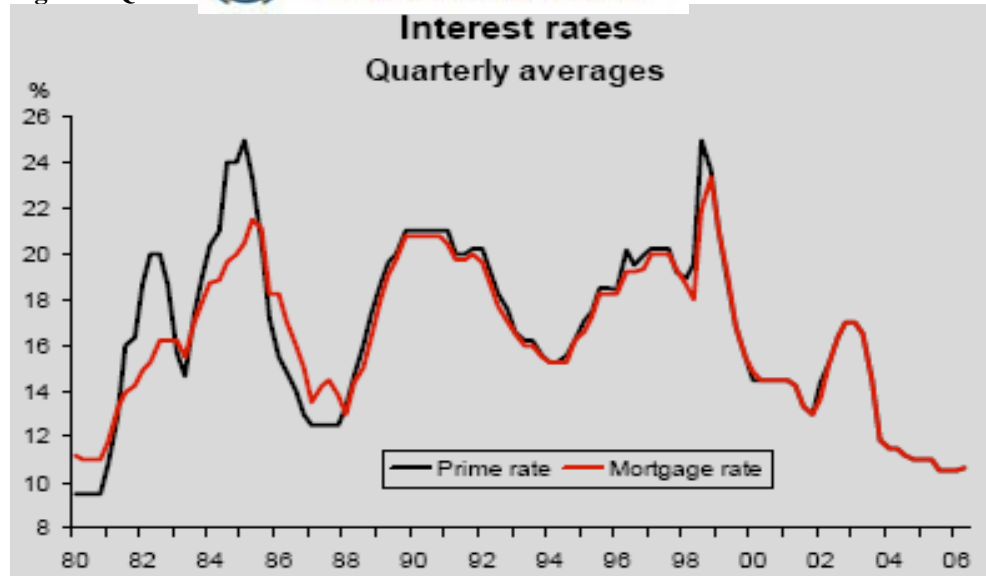
Residential property prices are affected by interest rates where the residential property purchase is financed by a mortgage bond. This has been suggested in some international research (Meen, 1999) where it was found that the most important factor affecting residential house prices in the UK was interest rates.

Research by Yun, Wong, Man, Hui and Seabrooke (2003), indicates that the effect of interest rates on housing prices is dependent on whether the country is in an inflationary or deflationary period. Their study on housing prices in Hong Kong, spanning 1981 to 2001, found that in times of inflation (pre 1997) there was an inverse relationship between housing prices and nominal interest rates, while in periods of deflation (1998-2001) there was a positive relationship between interest rates and property prices. This illustrated that a decline in interest rates did not increase property prices in that period.

As shown by ABSA (2006c) in Figure 3 below, interest rates have shown some fluctuations in the past. Prime interest rates currently at 12%, reached record highs of 25,5% in 1998. As noted previously, due to the fact that mortgage bonds interest rates are linked to the prime interest rate (evident from figure 3) it is reasonable to assume that prime interest rates could affect property prices.



Figure 3:Quarte



2.2.2. GROSS DOMESTIC PRODUCT

GDP is defined by McAleese (2004, p.247) as “the output of goods and services produced in an economy during a specified period of time”. This is possibly the best indicator of the economic health of a country as it measures the economic performance of that country. Real GDP i.e. adjusted for the effects of inflation, measures the real growth in an economy. Nominal GDP (not adjusted for the effects of inflation) combines and measures the effects of real economic growth and price inflation.

As explained by Muradzikwa, Smith and de Villiers (2004), there are two sides to GDP - what is spent on a product to purchase it and what is earned as income from the product by those who produced it. GDP can therefore be calculated either by adding up all amounts spent on output



(expenditure on the incomes derived from producing the output (incomes approach). These measures should equal each other, due to the impact of profit (or loss) which remains for the producer after paying for all components necessary to make the product. Where reference is made above to products, it should be noted that services apply as well.

Muradzikwa *et al.* (2004) further state that GDP can therefore be measured as the sum of consumption expenditure of households (C), expenditure by general government (G), gross capital formation or investments (I), and exports (X) minus imports (Z).

$$GDP = C + I + G + X - Z$$

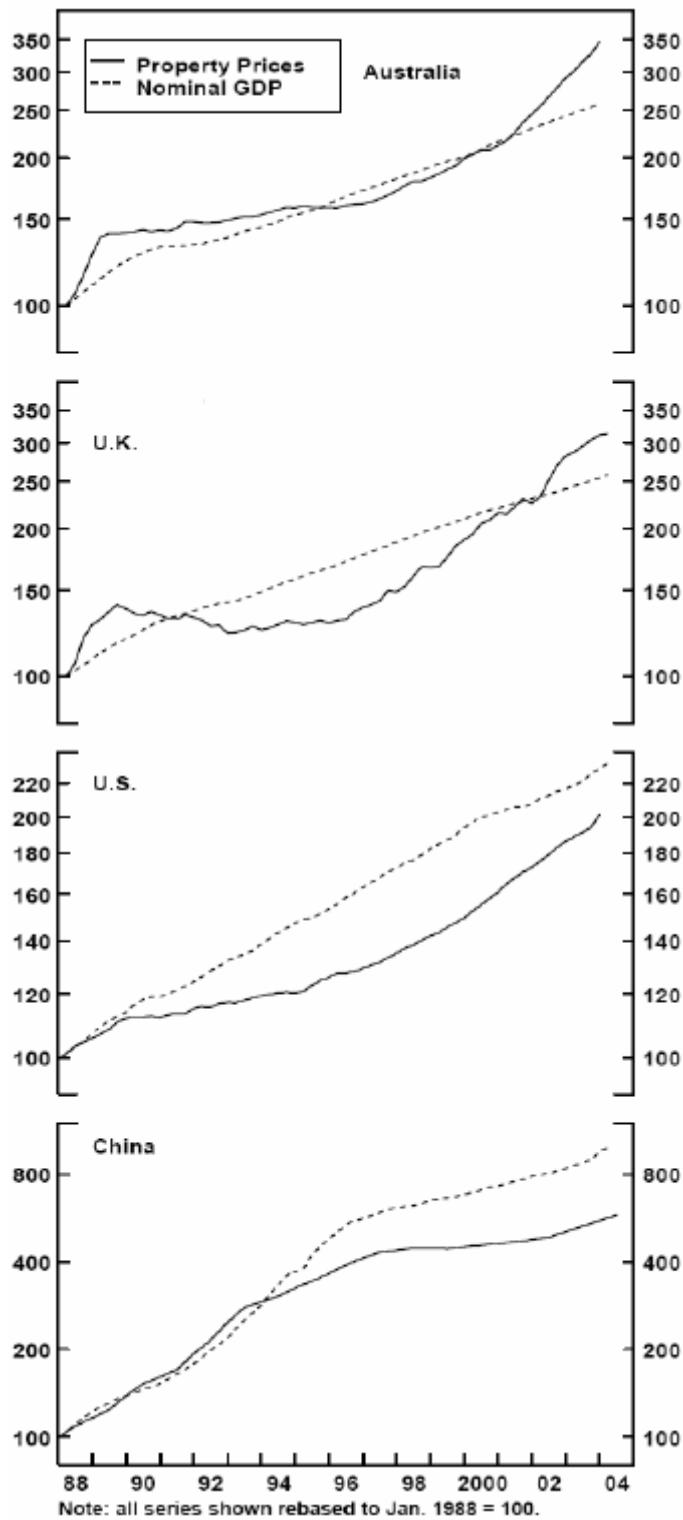
GDP is an important economic indicator in a country and it is believed (Muradzikwa *et al.* 2004) that GDP is the best available means of measuring economic progress in a country.

Saville (2004) states that one of the most widely accepted and broadly used valuation tools in the case of the property market is a model based on nominal GDP. He further states that the use of the nominal GDP model is fairly clear, for example if a country's nominal GDP increases by 50% over a period of 10 years, allowing for modest deviations, we would expect the value of property to rise by an equivalent amount over the same period. Saville (2004) shows, refer Figure 4 below, that by using

this model for the United Kingdom, United States and China, a change in nominal GDP had strong explanatory power with regard to property prices in that country. Saville (2004) illustrates, as shown in Figure 4, that in Britain in the late 1980's and early 1990's a substantial overvaluation of the property market occurred, and the nominal GDP tool shows that the property price index exceeded the GDP index in that period by approximately 25%. The property price index then declined until 1994, where the indexes meet, after which the property price index re-inflates to catch up to growing nominal GDP.

This lends support to the expectation that GDP could be a key driver of residential property prices in South Africa.

Figure 4: Nominal GDP and property prices (1988-2004)



2.2.3. AVERAGE INCOME

Some research suggests that the level of income in a population will have a noticeable effect on the liquidity of the residential property market in that country. In a study by Jud and Winkler (2002) in the United States, it was found that real house price increases were significantly related to changes in income, among other factors. It is reasonable to believe that the level of income will affect not only the number of transactions, but the level of house prices where the majority of the activity is experienced, such as low, middle or high priced housing.

In contrast to this, a study performed by Gallin (2003) on property in the United States, found that based on quarterly data from 1975 to 2002 the level of house prices did not appear to be tied in to the level of market fundamentals, which included per capita income. This study concluded that any relationship at the national level, between the level of house prices and the fundamentals is more than likely spurious.

In a report performed by Standard Bank (Moolman and Schoeman, 2006a) it was noted that the 121% cumulative rise in house prices in South Africa over the last five years, gave rise to some concerns that houses are less affordable than in previous years and this could have implications for future house price growth. The report illustrated however that the change in mortgage installments (which combines the effect of

interest rates by the growth in income for the same period. So while the growth in house prices did not seem to race ahead of income, it is clear that the average income was a factor considered by this institution in assessing the future prospects of residential property prices in South Africa.

2.2.4. BOND AFFORDABILITY LEVELS

As stated in ABSA (2005), the affordability of housing has become an increasingly important issue. The ratio of house prices to household income in South Africa was 4,5 in 2000; this increased to 7,2 in 2004 and rose to significantly higher levels in certain provinces.

It was found in a study performed in the United States (Fratantoni, 2005) that while income was used to assess the qualification of a family for an 80% - mortgage loan to house price ratio, in the months prior to the study, house affordability had decreased due to rising house prices not matched by rising income levels or decreasing interest rates. This supports the view that affordability levels, relative to the mortgage bond taken to purchase residential property, could influence the property price.

Du Toit (2005) states that in the five years to 2005, South Africa experienced residential property price increases of 20% in nominal terms, 13,6% in real terms. As a result of these price increases, an important indicator, being the ratio of house prices to the level of

remuneration 2000. An increase in this ratio implies that house prices are increasing at a faster rate than remuneration. He further stated that the residential price growth had begun to taper off in 2005. According to Du Toit (2005) the nominal growth in the fourth quarter of 2004 was 34,2%, while in the second quarter of 2005 the nominal growth was 25%. He ascribes the declining trend in house price growth to the fact that in general, housing has become less affordable, taking into account the above trend in the ratio of house prices to remuneration.

In an interview with Schoeman (2006), it was stated that banks in South Africa use the Installment to Income (ITI) ratio, as one of the most important criteria, in order to assess the eligibility of an individual to be granted a mortgage bond. It is therefore logical to expect that if house prices grow at a higher rate than average income the ITI ratio will increase, which could decrease the prospects of mortgage bonds being granted by the financing institution.

2.2.5. RAND TO US DOLLAR EXCHANGE RATES

McAleese (2004, p.530) defines an exchange rate as “the price of a unit of foreign currency in terms of domestic currency”.

Although it may appear strange that this economic indicator should have an effect on residential property prices in a particular country, as noted



by Standish, Jick (2005) in their study, there was a negative relationship between the rand to US dollar exchange rate and residential property prices in South Africa. As the rand lost value against the dollar, their study found that residential property prices increased. This was largely attributed to people attempting to hedge the inflationary consequences of the exchange rate movement by investing in residential property.

One of the factors identified by Luus (2003) to have influenced, or which is expected to influence, residential property trends in South Africa, is foreign buying of South African properties. The occurrence of foreign buying of South African properties was largely attributed to: the undervalued currency (particularly in 2002), heightened global political risks and the beauty and climate of South Africa. He stated that foreign buying of property was further fuelled by the relatively low property prices in South Africa in previous years. This foreign buying had a noticeable impact on prices in some regions, such as property found in coastal areas.

2.2.6. INFLATION

A common economic indicator used today to explain at least partly some increase in prices, is inflation. Inflation is defined (McAleese, 2004) as the persistent rise in the general level of money prices. The Consumer Price Index (CPI) is used as a measure of inflation in a particular country.

CPI is defined as the average price level or the average cost of a basket of consumer goods and services. As described by McAleese (2004) the components of the basket and the weights attached to each item are designed to reflect the type of goods and services consumed by the average individual or household in the country. Typically the basket of goods and services includes items such as food products, electronic equipment, cleaning material and transport costs, to name a few.

The measure of inflation, using CPI is affected by three main sources of bias as described by McAleese (2004); these are:

1. Composition bias, which results from the delay in including new goods into the basket of goods and services.
2. Quality bias, which occurs due to insufficient adjustment of price increases to recognise improvements in quality.
3. Substitution bias which results from the fact that as goods and services become more expensive, people shift their spending to cheaper items or outlets (outlet bias).

Another economic indicator commonly used in assessing inflation in South Africa is the CPIX. The CPIX is CPI excluding interest rates on mortgage bonds (SARB, 2006).

Luus (2003) states that in the past the persistently higher inflation rates of South Africa have necessitated fairly restrictive monetary policies by South Africa's central bank. This resulted in higher interest rates which

made it difficult for interest payments. In recent years however, due to the inflation targeting policy by SARB of between 3% to 6%, this has resulted in lower inflation rates and relaxed monetary policies which have given rise to lower interest rates. This could affect the appetite for buyers in the residential property market, as more disposable income is available for consumers as a result of the lower interest rates payable.

Yun *et al.* (2003) found that price changes in Hong Kong could be explained by the interaction of nominal interest rates and price expectations of potential buyers. They found however that the effects were significantly different in times of inflation and deflation.

2.3 OTHER ECONOMIC INDICATORS

Research by Standish *et al.* (2005) in South Africa on the relationship between key factors and the residential property market, found that only three independent variables were determinants of residential property in South Africa. These variables were the ratio of household debt to disposable income, foreign direct investment and the real rand gold price.

Luus (2003) found a non-exhaustive list of factors that have influenced or are expected to influence residential property trends in South Africa: migration trends, black economic empowerment, security/crime issues, economic growth, disposable income, employment levels, foreign purchases of South African

properties, monetary investment returns from property.

The extent of factors noted above illustrates that the factors selected for this study are not necessarily the only factors that could be considered and other factors may well have a bearing on residential property prices in South Africa.

2.4 CONCLUSION

As can be seen from the above literature review, experts differ on the state of the residential property market i.e. is it in a bubble situation or simply correcting previously undervalued assets? In addition there is some discrepancy as to which indicators influence or drive the residential property market and which indicators do not.

In essence this study will analyse whether the key economic indicators selected, either in isolation or in combination, have a statistically significant relationship to residential property prices in South Africa.

If the key economic indicators are found to have a statistically significant relationship with residential property prices, this study will attempt to provide some insight into what the relationship is and the implications of the relationship.

CHAPTER 3: HYPOTHESIS

This research report seeks to identify whether the independent variables are statistically significant drivers of the dependent variables.

The dependent variables were defined as residential property prices in South Africa. Four sets of data will be used for the dependent variable.

ABSA (2006c), divide the residential property market into three segments, namely:

- affordable segment (houses between 40m² – 79m² priced up to R226 000),
- middle segment (houses between 80m² – 400m² priced up to R2 600 000),
and
- luxury segment (no size limits, but priced from R2 600 000 up to R9 500 000).

Average prices for each of the above segments were obtained from ABSA in order to conduct the study and make up three of the data sets in respect of the dependent variables.

Standard Bank provided the fourth data set in respect of the dependent variable being the median (or middle) residential property prices in South Africa.

The independent variables are the key economic indicators selected for this study, and consist of:

1. interest rates,
2. GDP,
3. average disposable income,
4. bond affordability levels,
5. rand (ZAR) to US Dollar (USD) exchange rates, and
6. inflation.

Prime interest rates will be used as the measure of interest rates in South Africa.

Real GDP will be used for variable 2 due to the fact that the effects of inflation, which are included in nominal GDP, will be addressed through variable 6. The use of real GDP will avoid relationships between the dependent and independent variable being identified, but which could occur only due to the effects of inflation.

The ITI ratio will be used to assess the bond affordability levels of variable 4 above, as this is the key ratio used by banks in assessing mortgage bond applications. Due to the fact that this variable is a constant percentage of the disposable income variable, it will be excluded from the statistical analysis, as this would result in autocorrelation of the data.

In assessing the relationship of inflation (variable 6 above) to residential property prices, CPIX will be used. As noted previously, CPIX excludes the effects of interest on mortgage bond repayments. This study will therefore use

CPIX as the indicator of multicollinearity of CPI with property values due to the fact that mortgage bond repayments are primarily affected by property prices, which constitute the subject of this study.

The hypothesis can be described as follows; however this will be expanded later for each property category used as the dependent variable in this study:

$$Y = f(I; G; A; X; T)$$

Where:

Y = Residential property prices

I = Prime interest rates

G = Real GDP

A = Disposable income per capita

X = Rand to US dollar exchange rates

T = Inflation

Hypothesis 1: Affordable segment

The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: affordable segment property prices), either in combination or individually. The alternative hypothesis states that there is a statistically significant relationship between I, G, A, X, T and Y, either in combination or individually.

$H_0: Y \neq \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e$ (null hypothesis)

$H_A: Y = \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e$ (alternative hypothesis)

Where Y represents property prices in the affordable segment and e is an error term, in acknowledgement of the fact that the equation does not predict Y with complete accuracy and β represents the regression coefficient.

Hypothesis 2: Middle segment

The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: middle segment property prices), either in combination or individually. The alternative hypothesis states that there is a statistically significant relationship between I, G, A, X, T and Y, either in combination or individually.

$H_0: Y \neq \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e$ (null hypothesis)

$H_A: Y = \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e$ (alternative hypothesis)

Where Y represents property prices in the middle segment.

Hypothesis 3: Luxur

The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: luxury segment property prices), either in combination or individually. The alternative hypothesis states that there is a statistically significant relationship between I, G, A, X, T and Y, either in combination or individually.

$$H_0: Y \neq \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e \text{ (null hypothesis)}$$

$$H_A: Y = \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e \text{ (alternative hypothesis)}$$

Where Y represents property prices in the luxury segment.

Hypothesis 4: Median property prices

The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: median property prices), either in combination or individually. The alternative hypothesis states that there is a statistically significant relationship between I, G, A, X, T and Y, either in combination or individually.

$$H_0: Y \neq \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e \text{ (null hypothesis)}$$

$$H_A: Y = \beta_0 + \beta_1 I + \beta_2 G + \beta_3 A + \beta_4 X + \beta_5 T + e \text{ (alternative hypothesis)}$$

Where Y represents median property prices.

CHAPTER 4: RESEARCH METHODOLOGY

This chapter describes the research methodology used in this research. The primary purpose of this research is to assess whether the key economic indicators selected are statistically significant drivers of the residential property prices in South Africa, with a view to allowing an investor or another interested party to understand the relationship, if any; and the implications thereof. Data regarding the key economic indicators was gathered and plotted against the residential property prices in South Africa for the same period.

4.1. RESEARCH METHOD

A quantitative study as described by Creswell (1994, p.2) is “based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures, in order to determine whether the predictive generalisations of the theory hold true”.

This research will primarily use a quantitative research methodology in order to determine if there is a statistically significant relationship between the dependent variables and the independent variables, either in isolation or in combination.

The population of relevance will be the affordable, middle and luxury property price segments as defined by ABSA, as well as the median residential property prices in South Africa as defined by Standard Bank, for all years available. The property prices provided by both ABSA and Standard Bank refer only to the property prices based on mortgage bonds granted by each institution in the relevant period.

4.1.1.1 ABSA DATABASE

The average property price per segment (affordable, middle and luxury) as supplied by ABSA was used to determine if their relationships to the independent variables revealed different relationships. This average price per segment was not available from Standard Bank.

4.1.1.2 STANDARD BANK DATABASE

As noted by Moolman and Schoeman (2006b), measuring house prices is complicated by the fact that the data used is usually sourced from the properties sold during a particular period. Changes in prices, therefore, could be as a result of: changes in general price levels; changes in the types of houses sold, for example more sales of luxury houses could increase the measured house price, even though

general house prices are not stable over time; or the changes may be random. Moolman and Schoeman (2006b) further state that, due to these challenges, the international practice is to use the median or middle price, rather than the average house price. The median will allow that half of all houses are more expensive and half are less expensive than the median price. This allows the data to be less volatile and less sensitive to the problems usually encountered with housing price data. Median house prices were therefore supplied by Standard Bank regarding the mortgage bonds granted by Standard Bank in South Africa. Median prices were not available from ABSA.

Residential property refers to all types of residential property, such as flats, townhouses and houses, unless indicated otherwise. All economic indicators for South Africa relating to all years for which they can be obtained also constitute the population of relevance. Due to the fact that this research will attempt to explain if there is a statistically significant relationship between the key economic indicators selected and the residential property prices, an analysis will be performed for the full period where the data is available for all sets of variables.

The population of relevance also includes all economic indicators which have an impact on residential property prices in South Africa. As described in Chapter 2, there are a number of economic indicators which could be considered to have an impact on residential property

prices, su dex, rand gold price, net migration and foreign direct investment.

4.1.2. UNIT OF ANALYSIS

Welman and Kruger (2001) define the units of analysis as the members or elements of the population. This study has been performed using the independent and dependent variables in a quarterly time series for the full period for which all data sets are available.

Dependent variables – the unit of analysis is the quarterly median and quarterly average (per segment) residential property price.

Independent variables – the unit of analysis is the quarterly prime lending rates, real GDP, average income, the ITI ratio, rand to US dollar exchange rates and CPIX.

The data was converted to real values using the March 1995 values as the index, which was the first data point in the time series for which data on all the variables was available.

Welman and Kruger (2001) state that, non-probability sampling is used when the probability that any element or unit will be included in the sample, cannot be specified. Non-probability judgmental sampling was used in this study for the years 1995 to 2005. Non-probability sampling was applicable in this case as the years were specified as well as the key economic factors that were assessed. The years were selected primarily based on the availability of all necessary data. Some data was available for more years than selected for this study, however this would not allow the analysis of the relationships for all the variables for those years where the data could not be obtained. The key economic indicators were selected from all economic indicators; this was based on the researcher's expectations and previous studies which have been conducted in this field of research such as those discussed in Chapter 2.

4.1.4. DATA COLLECTION

Data for the research was obtained from various sources as shown in Table 3 below.



Table 3: Economic indicators

<u>Variable type</u>	<u>Economic indicator</u>	<u>Measurement basis used</u>	<u>Source</u>
Dependent	Residential property prices in SA	Affordable, middle & luxury property segment prices in SA	ABSA Bank house price database
Dependent	Residential property prices in SA	Median residential property prices in SA	Standard Bank house price database
Independent	Interest rates	Prime bank lending rates	Standard Bank database
Independent	Economic growth of SA	Real GDP	Standard Bank database
Independent	Average income in SA	Disposable income per capita in SA	Statistics South Africa
Independent	Bond affordability levels	ITI ratio	Leading banks in SA mortgage bond application criteria
Independent	Exchange rate	Rand : US\$ exchange rate	Standard Bank database
Independent	Inflation	CPIX	Statistics South Africa

The data obtained was found to be recorded by the various institutions in different time series. For instance real GDP was recorded quarterly while prime lending rates were recorded monthly. The data was refined into quarterly periods, in order to obtain a consistent time series across the various variables and was recorded in an electronic (Microsoft Excel) template. The following adjustments/assumptions were made:

- Median residential property prices were based on the mortgage bonds granted by Standard Bank for that period. Per discussion with an economist working for Standard Bank, Standard Bank have approximately a 30% market share of the residential property market mortgage bonds granted in South Africa (similar to other leading banks). Likewise, per discussion with a senior economist from ABSA, they hold approximately 33% of the total residential mortgage bond market in South Africa. The data provided by the banks noted above were

therefore assumed that the average residential median and average property mortgage bonds registered in South Africa.

- Prime lending rates are consistent for all banks in South Africa.
- Real GDP data is reported quarterly and a seasonally adjusted real GDP data set was used.
- The rand:US dollar exchange rate was based on the monthly average exchange rate as obtained from Standard Bank. It was assumed that this rate would not differ significantly from other banks' quoted exchange rates.
- Quarterly disposable income per capita was obtained from SARB; this income was seasonally adjusted.
- Seasonally adjusted data was obtained for all variables where seasonality affected the data. Per discussion with a senior economist at Standard Bank, variables such as property prices did not require seasonality adjustments as they did not find that this affected the data to any significant extent.

4.1.5. DATA ANALYSIS

The data analysis was approached in two phases, being a preliminary analysis and a final analysis as described below. This was found to be necessary due to the high correlation results found in the preliminary analysis.

4.1.5.1.

A preliminary assessment was performed in order to understand the data that was used and identify any errors or unusual relationships.

Welman and Kruger (2001) explain that correlations are used to describe relationships between variables. Correlations measure the extent to which changes in one variable are associated with changes in another variable.

Scatter plots were compiled for each property price category against the independent variables, and a linear equation ($Y = a + bX$) as well as the coefficient of determination (R^2) value was obtained. This was performed in order to determine the correlations of the property prices against the independent variable. As described by Albright, Winston and Zappe (2003) in the linear equation, a is the Y-intercept of the line when $X = 0$, while b is the slope of the line, i.e. the change in Y when X increases by 1 unit. Albright *et al.* (2003) also explain that the R^2 is the percentage of variation of the response (dependent) variable explained by the regression. It was considered in this research that an R^2 of greater than 0.5 would require further investigation in order to assess whether the data displayed signs of autocorrelation. Values other than this indicated that the variables may not be statistically relevant in isolation but this would be assessed through the stepwise regression analysis explained below. The scatter plots were compiled using Microsoft Excel.

4.1.5.2. FINAL ANALYSIS

Based on the findings in the initial analysis, it was considered that autocorrelation or serial correlation existed in some of the dependent and independent variables.

Gujarati (2003, p.442) defines autocorrelation as “correlation between members of a series of observations ordered in time (as in time series data) or space (as in cross-sectional data)”. As noted by Gujarati (2003) it is now common to refer to the terms autocorrelation and serial correlation synonymously, although some authors do make a distinction. Gujarati (2003, p.443), notes that some authors define autocorrelation as “lag correlation of a given series with itself”, while serial correlation could be defined as “lag correlation between two different series”. Similar to the use made by Gujarati (2003) this research will use the two terms synonymously.

Gujarati (2003) further explains that there are a number of reasons why autocorrelation may occur and some of the more important reasons are due to inertia in the time series (sluggishness in the data), excluded variables bias (incorrect variables used) or incorrect functional form (incorrect model). This study did not attempt to address all the possible reasons for autocorrelation, but rather focused on those reasons of autocorrelation which were more applicable. As noted in section 4.2

below, one could argue that some variables may have been excluded from the study, which may be relevant in determining residential property prices. This can only be overcome through further research incorporating further independent variables. The effects of inertia in the data were considered important and were addressed as described below.

A. PARTIAL AUTOCORRELATION

Black (2004) explains that time series data which contains no trend or cyclical effects are said to be stationary, while time series data which display a trend or cyclical effects over time are considered non-stationary. Due to the trends in non-stationary data, autocorrelation usually results from regression analysis on the data. This study used time series data, therefore the initial assessment was used in order to identify any indication of autocorrelation.

In an interview with Moolman (2006), it was noted that there is often autocorrelation in property price data, especially in South Africa due to the continued trend in one direction of property prices, in particular over the last 5 to 10 years. It was therefore expected that autocorrelation could exist in the data.

Gujarati (2003) explains that if autocorrelation is found in the data, this may be overcome by using an appropriate transformation of the data.

One such transformation is differencing the data from one period to the next, otherwise known as introducing a lag into the data. This lagged data is then used as the data set, rather than the original values.

Partial autocorrelation was performed on both the independent and dependent variables to identify whether there was autocorrelation in the data. The partial autocorrelation tests performed not only showed the effect of introducing a lag into the data, it also illustrated at what lag period the autocorrelations would be within the confidence (acceptable) limits.

B. STEPWISE REGRESSION

A stepwise regression analysis was thereafter used to determine the set of lagged independent variables that would explain the most variance (R^2) in the lagged dependent variable.

As described by Gujarati (2003, p.479) “when the first-difference model is used, there is no intercept in it”. Hence in using first-differences (one lag) to overcome autocorrelation and measuring the Durbin-Watson, you have to use the regression through the origin and effectively set the intercept to 0. This was done in running the stepwise regression model.

The Durbin-V (2004), was then used to ensure there was no autocorrelation in the regression.

A stepwise regression was used by Standish *et al.* (2005) in their research to isolate the determinants of residential property prices and to build forecasting models to provide predictions for future developments in the property market.

As defined by Black (2004, p.583) multicollinearity is “when two or more of the independent variables of a multiple regression model are highly correlated”. It was expected that multicollinearity may occur in the data used for this study; the use of stepwise regression assisted in eliminating multicollinearity.

An analysis technique which combined multiple variables was necessary for this study. The stepwise regression allowed this study to determine which independent variables, either in combination or individually, displayed a statistically significant relationship to the dependent variables. The regression analysis was performed using Statistica. In performing this research probability values (p) of less than 0.05 (5%) were considered statistically significant.


As explained by Gujarati (2003, p.462) “the importance of analyzing residuals as a part of the statistical analysis cannot be overemphasized”. For the independent variable which was found to have a statistically

significant regression, an analysis of the residuals was performed in order to determine if the residuals were nonrandom or displayed any other patterns or signs of correlation.

4.2. LIMITATIONS OF THE RESEARCH

The research conducted in this study had certain limitations, which included the following:

- Other indicators, economic or otherwise which could affect the residential property market were not considered. Factors could include rental income, foreign direct investment or emotional factors such as individuals who consider property to be a “safe” investment and an investment which directly translates into wealth.
- As noted previously, this study did not consider supply side factors which could affect residential property prices, such as building costs, land availability or supply of housing.
- This study did not assess residential property split according to province or regions within South Africa. It is quite possible, for instance, that prices of holiday property in Cape Town or other popular vacation destinations could react differently to the economic indicators selected, when compared with property in other areas.
- The analysis in this study only covered the period for which all variables, both independent and dependent were available. A different result may have been obtained if a longer period was used. It is possible that the property market operates in long-term cycles spanning time-periods greater than

11 years (the pe  a larger number of data points could result in different findings.

- Although this study revealed some correlation between the independent and dependent variables, this does not automatically indicate that there is a causation relationship between the variables; causation may be due to other factors.

CHAPTER 5: RESULTS AND DISCUSSION OF RESULTS

According to Welman and Kruger (2001) it is permissible in some cases to combine the results and their discussion in the same section if it is considered more appropriate to do so. The results of the research performed and the discussion of the results are presented in Chapter 5. This was done primarily due to the findings in the initial analysis impacting on the procedures performed in the final analysis. The discussion regarding both the preliminary and final results was considered to be clearer if the discussion was presented simultaneously with the results.

The results and discussion of the results are presented in two sections namely the preliminary analysis and the final analysis. Within each section there are four sub-sections, which correspond to the four dependent variable categories, being average affordable, middle and luxury property segment prices as well as the median property prices. The data was analysed in the two sections (preliminary and final analysis), due to the high correlations found in the preliminary analysis.

The data that was analysed covered the period March 1995 to December 2005. This is the period for which all variables could be gathered. The data was formatted into a quarterly time series. A quarterly time series was used due to the fact that certain data such as GDP is only available in a quarterly format, as well as the fact that this interval allowed enough detail to identify any significant relationships.

Results and the discussion of the preliminary and final analysis performed on the independent and dependent variables are shown below and are presented per hypothesis.

5.1 PRELIMINARY ANALYSIS

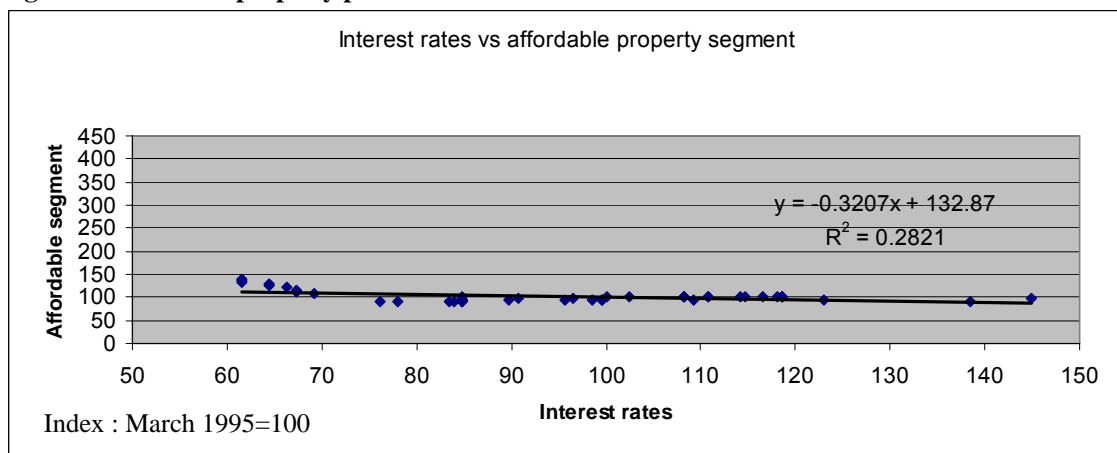
The preliminary results show the scatter plots, regression equation and R^2 value, per hypothesis and according to each dependent variable. Due to the varying units of measurement such as rands and percentages of the variables, the axes on the scatter plots below, relate to indexed values of 100 at March 1995.

5.1.1. HYPOTHESIS 1: AFFORDABLE PROPERTY SEGMENT

The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: affordable segment property prices), either in combination or individually. The alternative hypothesis states that there is a statistically significant relationship between I, G, A, X, T and Y, either in combination or individually.

Figure 5 shows the scatter plot of the affordable property segment vs prime interest rates for the full sample period. This shows a linear regression formula of $Y = -0.3207x + 132.87$ and an R^2 of 0.2821. Although the R^2 value was not considered high the correlation would be investigated further in the final analysis. The scatter plot and regression line relationship between affordable property and prime interest rates appears to be negative.

Figure 5: Affordable property prices vs interest rates

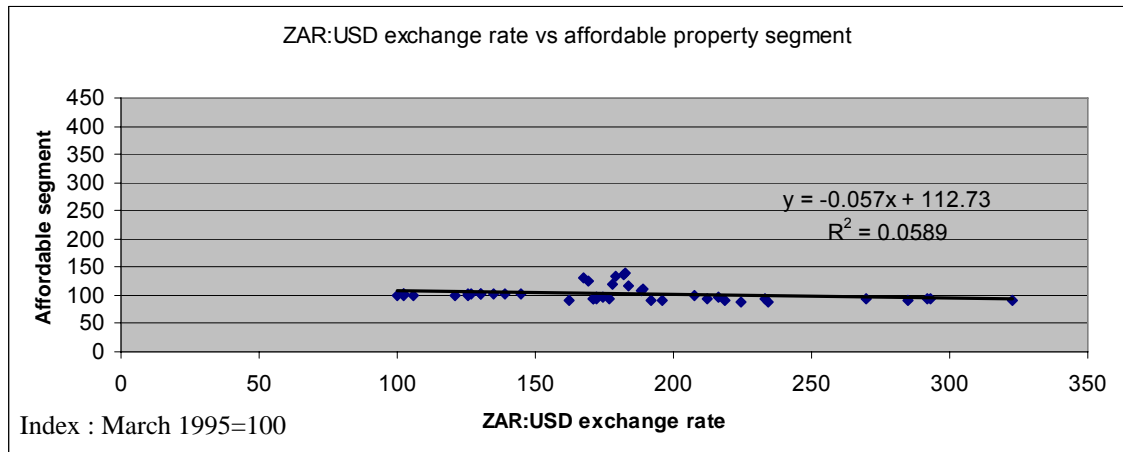


5.1.1.2 ZAR:USD EXCHANGE RATE

Figure 6 shows the scatter plot of the affordable property segment vs ZAR:USD exchange rates for the full sample period. This shows a linear regression formula of $Y = -0.057x + 112.73$ and an R^2 of 0.0589. This R^2 appears low and is

a clear relationship.

Figure 6: Affordable property prices vs ZAR:USD exchange rates

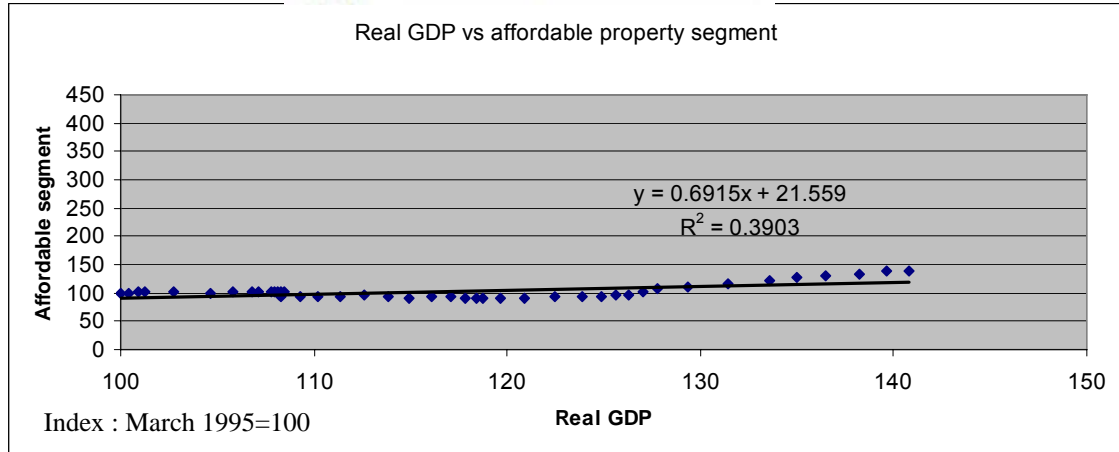


5.1.1.3 REAL GDP

Figure 7 shows the scatter plot of the affordable property segment vs real GDP for the full sample period. This shows a linear regression formula of $Y = 0.6915x + 21.559$ and an R^2 of 0.3903. The dependent and independent variables appeared to be positively related based on the slope of the regression line. The R^2 appeared high which necessitated further investigation.



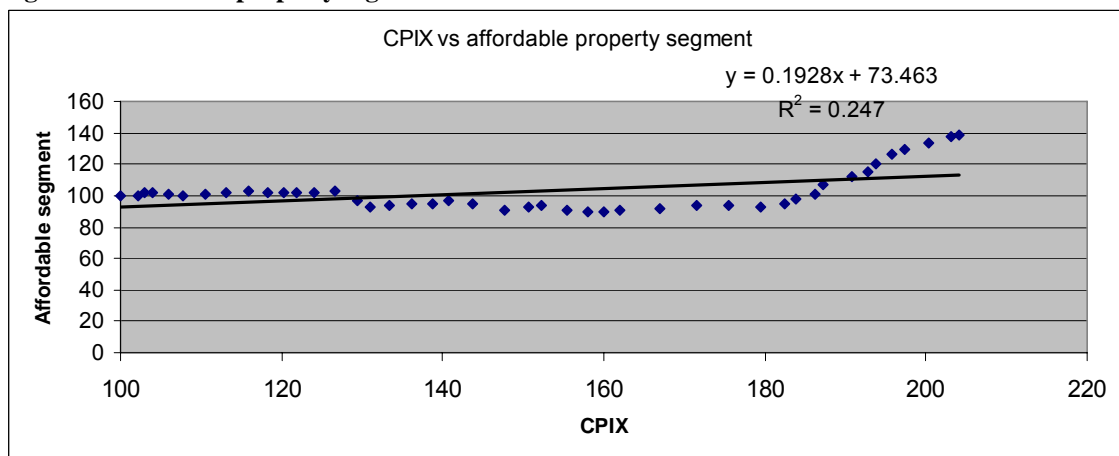
Figure 7: Affordable prop



5.1.1.4 INFLATION

Figure 8 shows the correlation graph of the affordable property segment vs CPIX for the full sample period. This shows a linear regression formula of $Y = 0.1928x + 73.463$ and an R^2 of 0.247. This regression line slope showed a positive relationship between the two variables. The value of the R^2 did not appear excessively high.

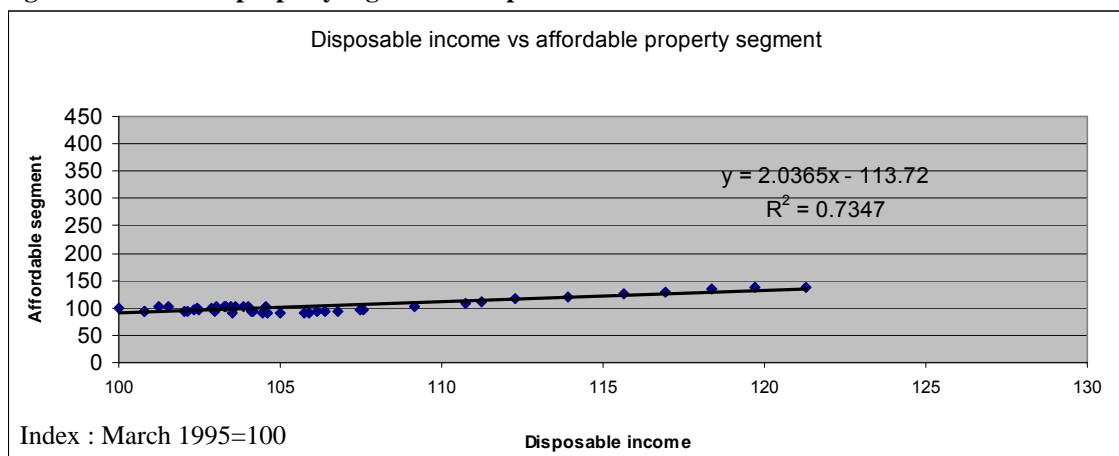
Figure 8: Affordable property segment vs CPIX



5.1.1.5 DISPOSABLE INCOME

Figure 9 shows the correlation graph of the affordable property segment vs disposable income for the full sample period. This shows a linear regression formula of $Y = 2.0365x - 113.72$ and an R^2 of 0.7347. The R^2 value in respect of the relationship between affordable property segment prices and disposable income appeared high and required further investigation.

Figure 9: Affordable property segment vs disposable income



5.1.2. HYPOTHESIS 2: MIDDLE PROPERTY SEGMENT

The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: middle segment property prices), either in combination or individually. The alternative hypothesis states that there is

5.1.2.1 INTEREST RATES

Figure 10 shows the correlation graph of the middle property segment vs interest rates for the full sample period. This shows a linear regression formula of $Y = -1.6179x + 283.45$ and an R^2 of 0.6527. The R^2 value of 0.6542 was considered high and required further investigation. The scatter plot and regression line for the middle property segment and prime interest rates also appears to indicate that the relationship is negative.

Figure 10: Middle property segment vs prime interest rates

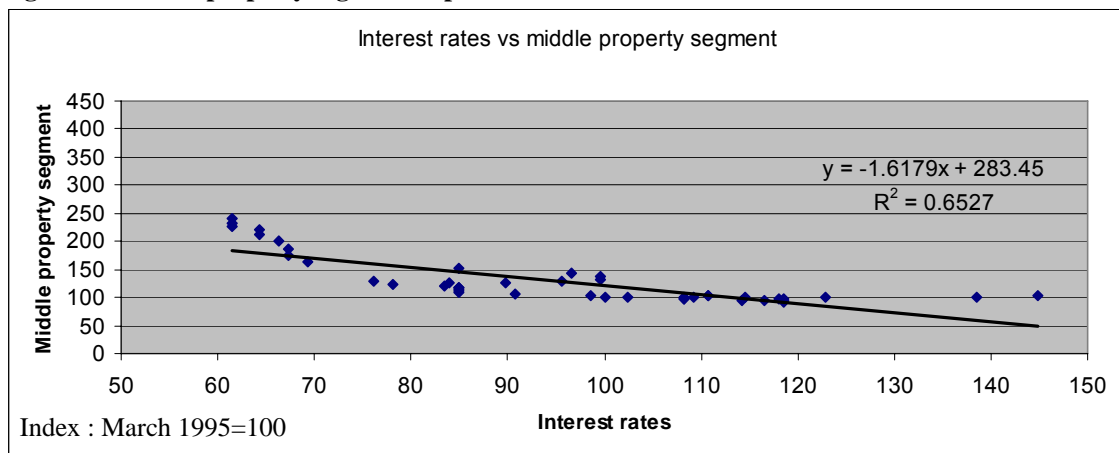
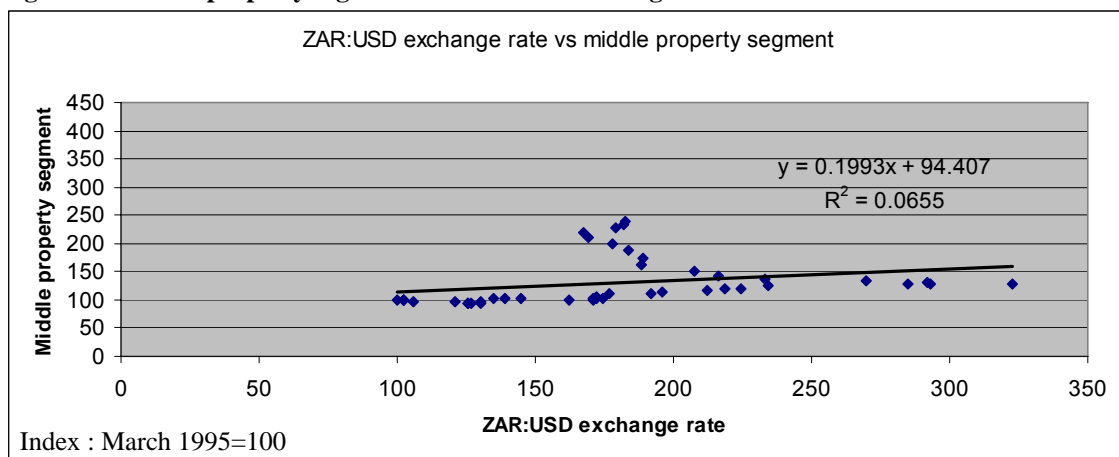


Figure 11 shows the correlation graph of the middle property segment vs ZAR:USD exchange rates for the full sample period. This shows a linear regression formula of $Y = 0.1993x + 94.407$ and an R^2 of 0.0655. The relationship between these variables appears positive, the R^2 value however, appears low, indicating that the relationship may be weak or there may be no autocorrelation in the data.

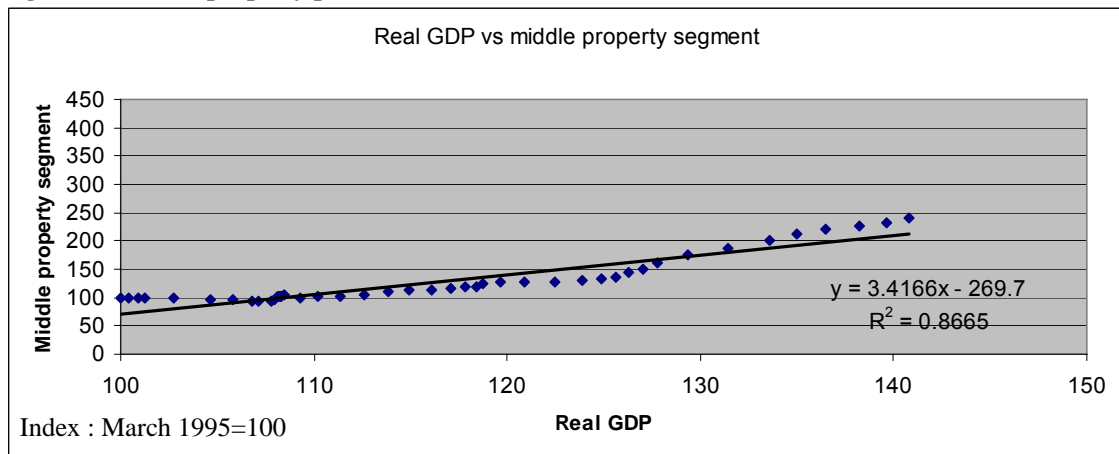
Figure 11: Middle property segment vs ZAR:USD exchange rates



5.1.2.3 REAL GDP

Figure 12 shows the correlation graph of the middle property segment vs real GDP for the full sample period. This shows a linear regression formula of $Y = 3.4166x - 269.7$ and an R^2 of 0.8665. This regression line is positive and the R^2 value, extremely high; this required further investigation.

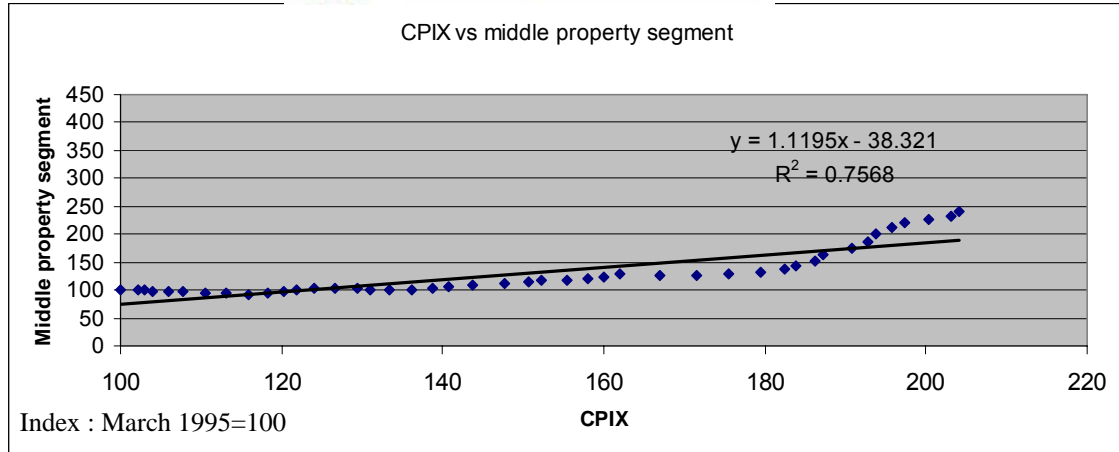
Figure 12: Middle property prices vs real GDP



5.1.2.4 INFLATION

Figure 13 shows the correlation graph of the middle property segment vs CPIX for the full sample period. This shows a linear regression formula of $Y = 1.1195x - 38.321$ and an R^2 of 0.7568. The relationship between the middle property segment prices and inflation appears positive, based on the scatter plot and regression line. The high value of the R^2 in this relationship required further investigation for possible autocorrelation in the data.

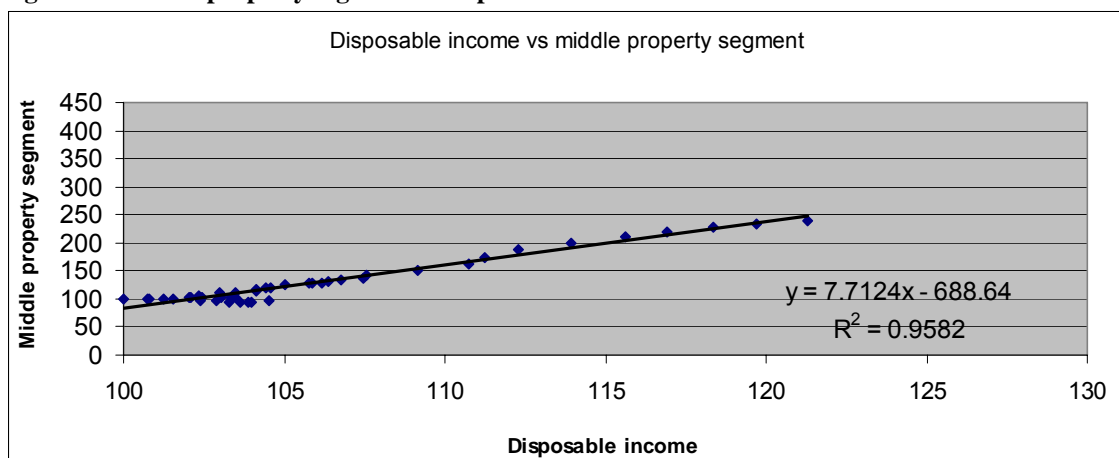
Figure 13: Middle proper



5.1.2.5 DISPOSABLE INCOME

Figure 14 shows the correlation graph of the middle property segment vs disposable income for the full sample period. This shows a linear regression formula of $Y = 7.7124x - 688.64$ and an R^2 of 0.9582. The R^2 value in respect of the relationship between the middle property segment prices and disposable income appeared high and required further investigation.

Figure 14: Middle property segment vs disposable income



5.1.3. HYPOTHESIS 3: LUXURY PROPERTY SEGMENT

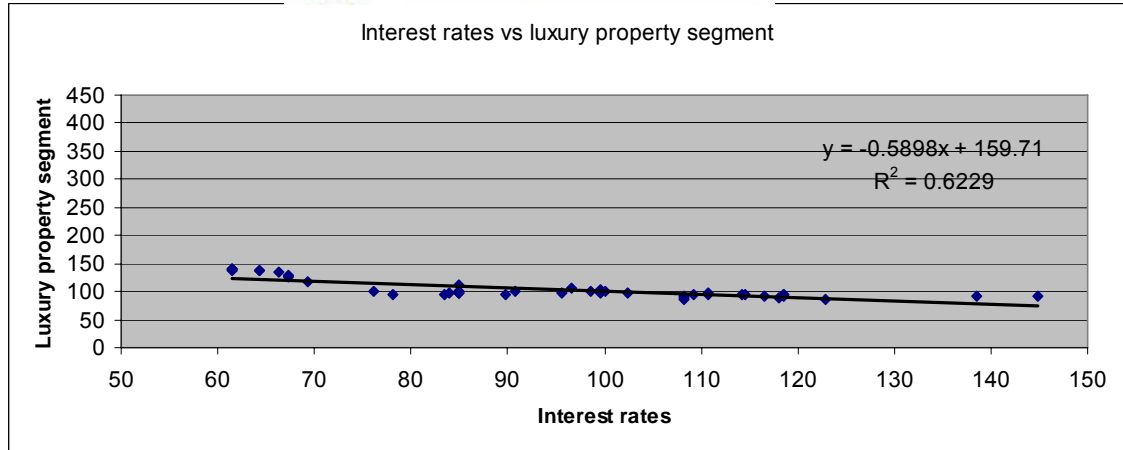
The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: luxury segment property prices), either in combination or individually. The alternative hypothesis states that there is a statistically significant relationship between I, G, A, X, T and Y, either in combination or individually.

5.1.3.1 INTEREST RATES

Figure 15 shows the correlation graph of the luxury property segment vs interest rates for the full sample period. This shows a linear regression formula of $Y = -0.5898x + 159.7$ and an R^2 of 0.6229. An R^2 value of 0.6229 is considered high and required further investigation. The relationship between luxury property and prime interest rates appears to be negatively related from this scatter plot and regression line.



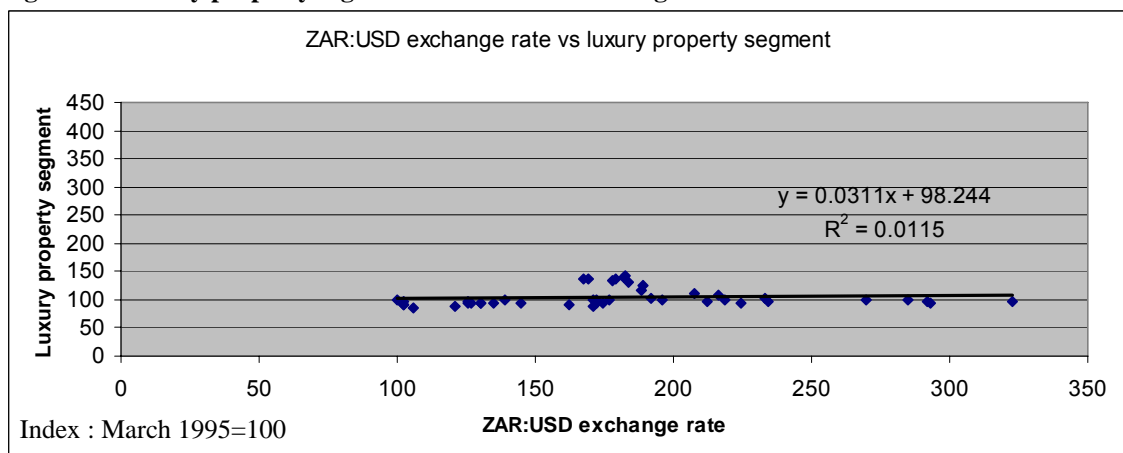
Figure 15: Luxury proper



5.1.3.2 ZAR:USD EXCHANGE RATE

Figure 16 shows the correlation graph of the luxury property segment vs ZAR:USD exchange rates for the full sample period. This shows a linear regression formula of $Y = 0.0311x + 98.244$ and an R^2 of 0.0115. This R^2 below in Figure 16 appears low and does not indicate autocorrelation in the data. This will however be tested in the final analysis.

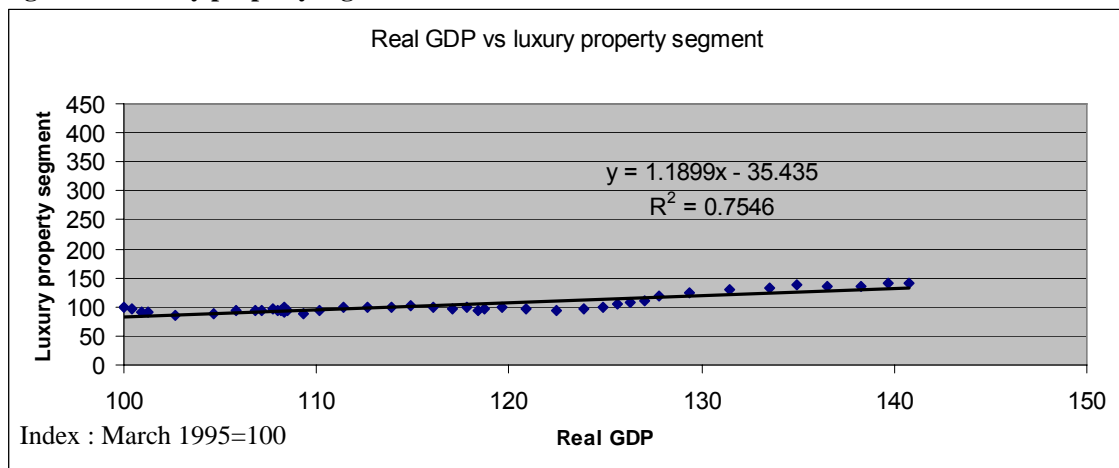
Figure 16: Luxury property segment vs ZAR:USD exchange rates



5.1.3.3 REAL GDP

The scatter plot shown in figure 17, shows the correlation of the luxury property segment vs real GDP for the full sample period. This shows a linear regression formula of $Y = 1.1899x - 35.435$ and an R^2 of 0.7546. The R^2 value in this regression appears extremely high and required further investigation.

Figure 17: Luxury property segment vs real GDP

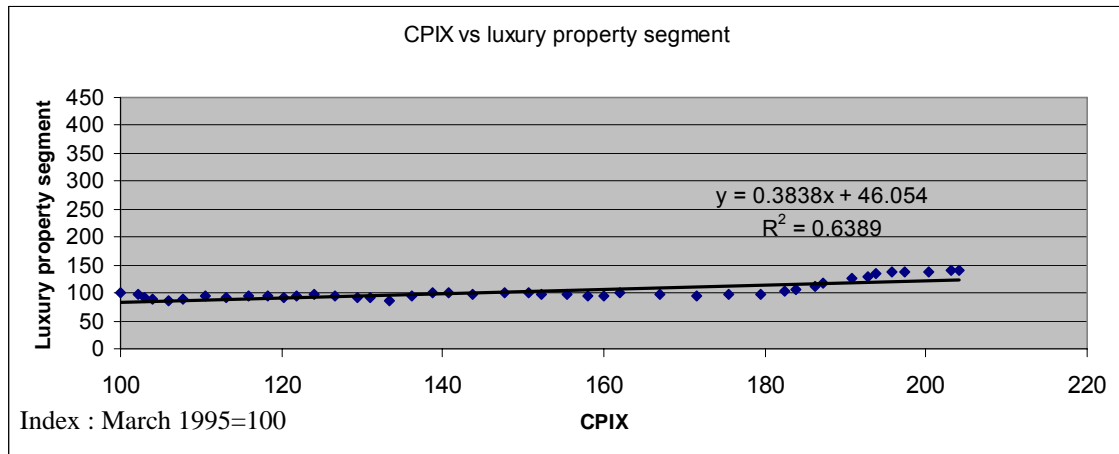


5.1.3.4 INFLATION

Figure 18 below shows the correlation graph of the luxury property segment vs CPIX for the full sample period. This shows a linear regression formula of $Y = 0.3838x + 46.054$ and an R^2 of 0.6389. This scatter plot shows a positive relationship

bet the high value of the R^2
 this relationship needed to be investigated further.

Figure 18: Luxury property segment vs CPIX

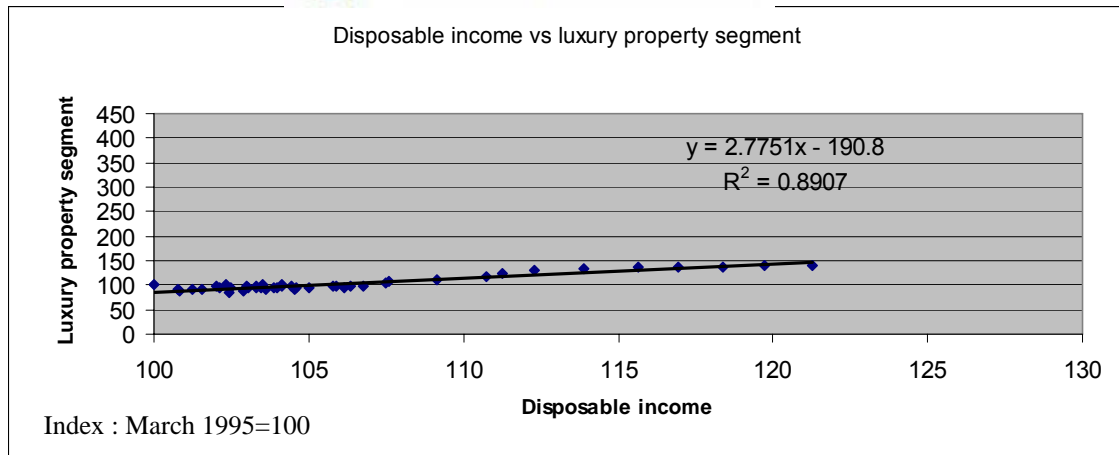


5.1.3.5 DISPOSABLE INCOME

The relationship between the luxury property segment and disposable income for the full sample period is shown below in figure 19. This shows a linear regression formula of $Y = 2.7751x - 190.8$ and an R^2 of 0.8907. The R^2 value in respect of the relationship between the luxury property segment prices and disposable income appeared high and required further investigation.



Figure 19: Luxury property



5.1.4. HYPOTHESIS 4: MEDIAN PROPERTY PRICES

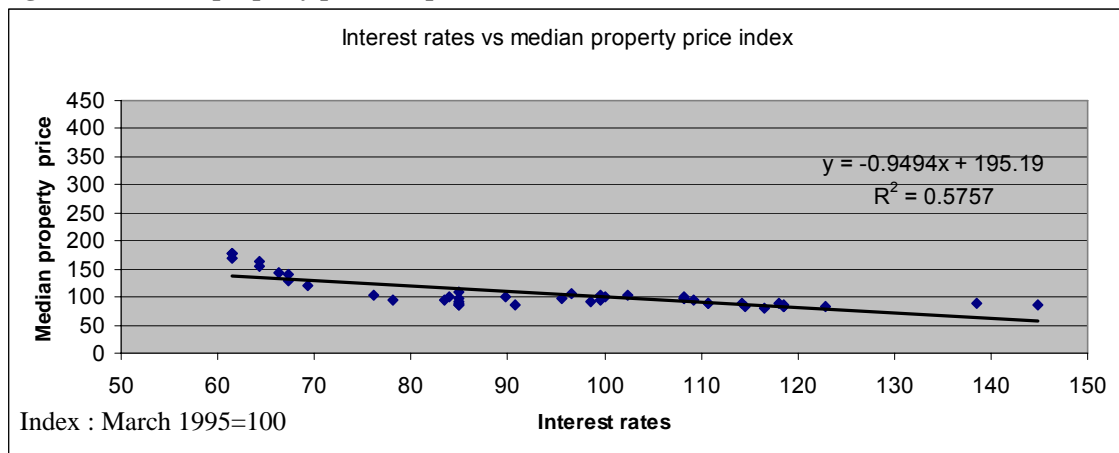
The null hypothesis states that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: median property prices), either in combination or individually. The alternative hypothesis states that there is a statistically significant relationship between I, G, A, X, T and Y, either in combination or individually.

5.1.4.1 INTEREST RATES

When median property prices were plotted against interest rates for the full sample period, the scatter plot as shown in figure 20 below was obtained. This shows a linear regression formula of $Y = -0.9494x + 195.19$ and an R^2 of 0.5757. An R^2 value of 0.5757 is considered high and required further

also appears to highlight that the relationship between median property prices and prime interest rates is negative.

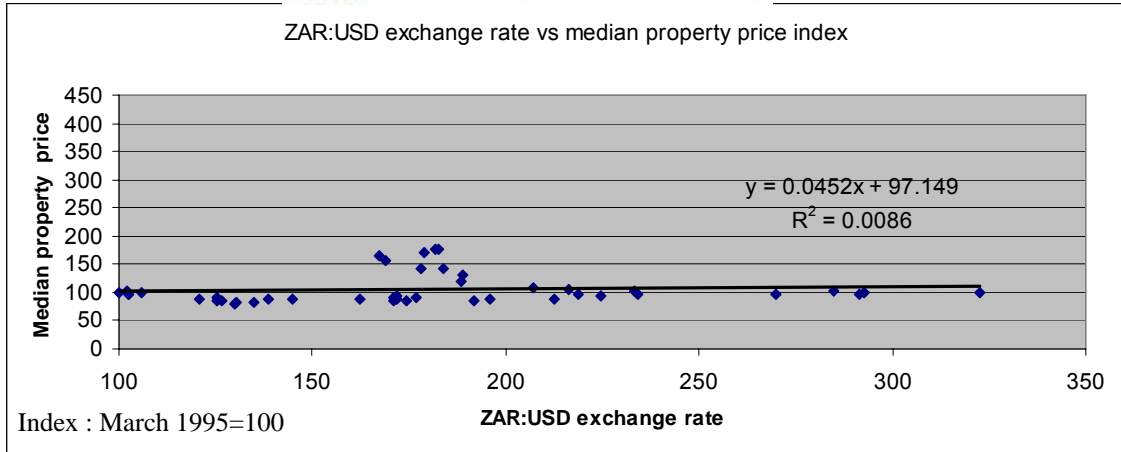
Figure 20: Median property prices vs prime interest rates



5.1.4.2 ZAR:USD EXCHANGE RATE

Figure 21 shows the scatter plot of the median property prices and ZAR:USD exchange rates for the full sample period. This shows a linear regression formula of $Y = 0.0452x + 97.149$ and an R^2 of 0.0086. The relationship between median property prices and ZAR:USD appears positive as evidenced by the upward sloping regression line; the R^2 however appears low.

Figure 21: Median property

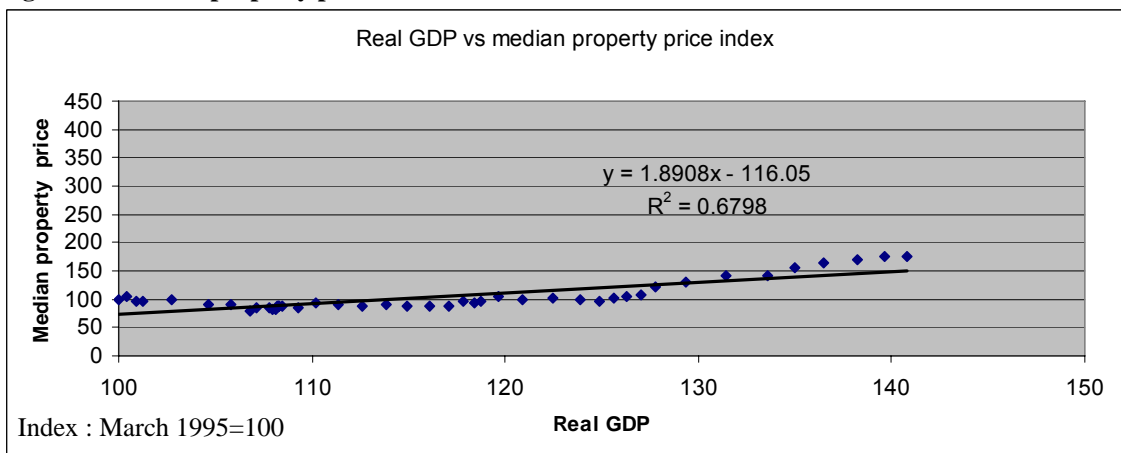


5.1.4.3 REAL GDP

The scatter plot (Figure 22), shows the relationship of the median property prices vs real GDP for the full sample period.

This shows a linear regression formula of $Y = 1.8908x - 116.05$ and an R^2 of 0.6798. The R^2 value in this relationship was considered to be extremely high and required further investigation.

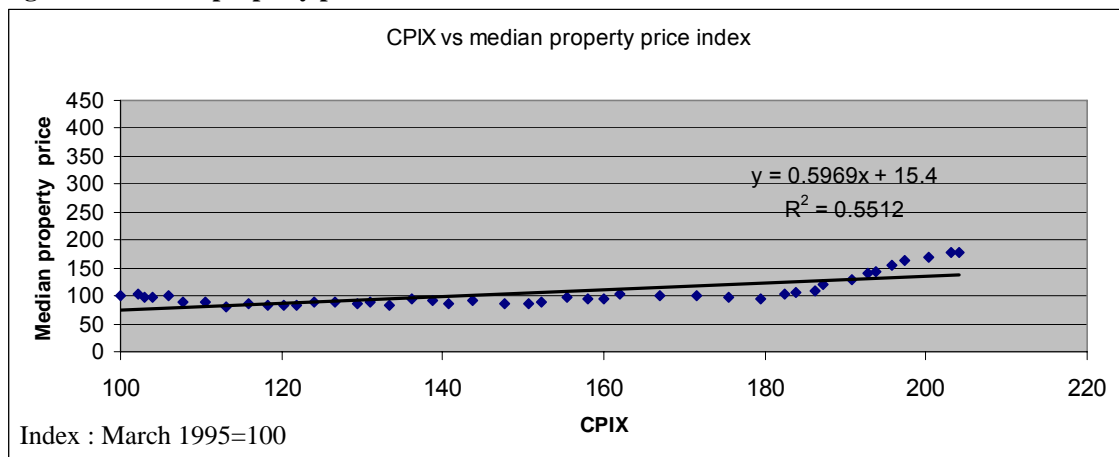
Figure 22: Median property prices vs real GDP



5.1.4.4 INFLATION

Figure 23 shows the scatter plot and regression line of the median property prices vs CPIX for the full sample period. This shows a linear regression formula of $Y = 0.5969x + 15.4$ and an R^2 of 0.5512. The high value of the R^2 in this relationship required further investigation.

Figure 23: Median property prices vs CPIX

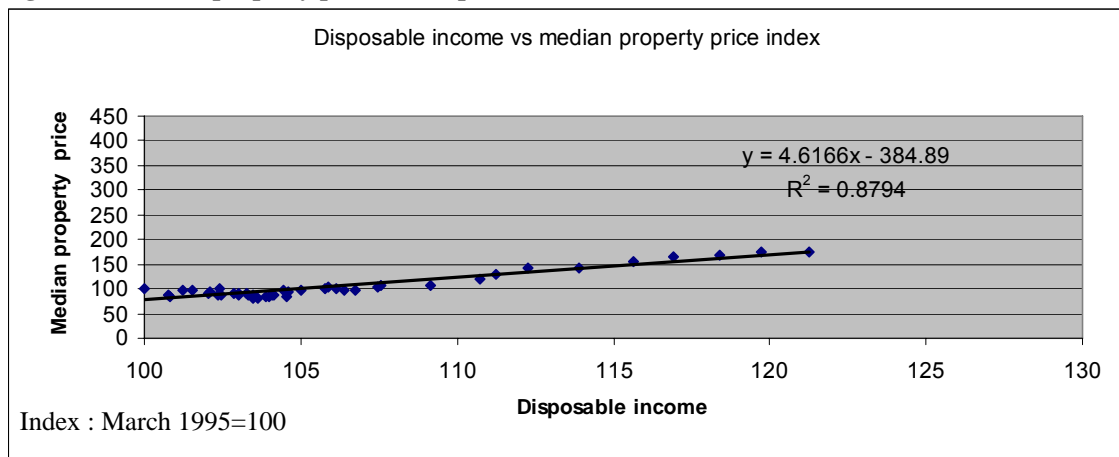


5.1.4.5 DISPOSABLE INCOME

When the median property prices were plotted against disposable income for the full sample period the scatter plot as shown in figure 24 was obtained. This shows a linear regression formula of $Y = 4.6166x - 384.89$ and an R^2 of 0.8794. The R^2 value in respect of the relationship between the

and required further investigation before any conclusions could be drawn from it.


Figure 24: Median property prices vs disposable income



The preliminary analysis revealed a wide range of R^2 values. Those relationships which showed high R^2 (greater than 0.5) required specific testing for autocorrelation in the data. The relationship with a low R^2 (less than 0.5) appeared to indicate no or less autocorrelation. In either instance it was determined appropriate to test the data specifically for autocorrelation as part of the final analysis.

5.2 FINAL ANALYSIS

Based on the findings in the initial analysis, it was suspected that autocorrelation or serial correlation existed in some of the dependent and independent variables. The final analysis firstly assessed whether there was

autocorrelation in  UNIVERSITY OF PRETORIA
UNIVERSITEIT VAN PRETORIA
YUNIBESITHI YA PRETORIA dependent variables. Where autocorrelation was found to exist, an appropriate transformation in the data was performed, in order to allow the stepwise regression to be performed.

The second part of the final analysis entailed performing the stepwise regression, considering the results thereof and performing the Durbin-Watson test in order to determine if there was any remaining autocorrelation in the regression model.

5.2.1. PARTIAL AUTOCORRELATION

The data giving rise to the high R^2 values shown in the initial analysis above was tested using partial autocorrelation; these results are shown in appendix A to I. These graphs show the effect on the autocorrelation of that particular variable, if lags are introduced. It is evident from appendix A to I that if no lag is introduced there are high autocorrelations in the variables. The lowest of these is disposable income per capita with a correlation of 0.461 as shown on appendix I. When a lag is introduced the correlations on all the graphs (appendix A to I) reduce, illustrating that the effects of autocorrelation have been reduced. The implications of any remaining autocorrelation were tested by using the Durbin-Watson test per hypothesis as noted in section 5.2.2. It was therefore decided to introduce a lag of one period (quarter) into all the variables, in order to reduce the autocorrelation in the data.

Prior to performing a correlation matrix was run for all the independent variables, as shown in Table 4 below. This highlighted which variables appeared to have high correlations with each other. As shown in Table 4, most variables showed some correlation with each other, only those highlighted showed correlations of less than 0.5 either positive or negative. It was therefore expected that through the stepwise regression few variables (possibly two), would ultimately remain as significant; this however was tested using a stepwise regression.

Table 4: Correlation matrix of independent variables
Correlations of independent variables, marked correlations are significant at $p < .05000$
N=44

	<u>CPIX</u>	<u>Prime</u> <u>interest rate</u>	<u>ZAR:USD</u>	<u>Real GDP</u>	<u>Disposable</u> <u>income per</u> <u>capita</u>
CPIX		-0.80	0.64	0.98	0.85
Prime interest rate	-0.80		-0.41	-0.82	-0.77
ZAR:USD	0.64	-0.41		0.54	0.25
Real GDP	0.98	-0.82	0.54		0.93
Disposable income per capita	0.85	-0.77	0.25	0.93	

5.2.2. STEPWISE REGRESSION

Based on the findings in 5.2.1 above, data with a lag of 1 was used in running the stepwise regression for each property category. The regression was stopped when adding another variable did not contribute to the correlation equation. The Durbin-Watson test was then run to ensure that autocorrelation was not present. A Durbin-Watson value of close to 2 is required and Durbin-Watson decision rules as described by

Gujarati (2000)   ibles, were used to determine if the Durbin-Watson value was acceptable.

5.2.2.1 HYPOTHESIS 1: AFFORDABLE SEGMENT

As shown by the results in Table 5 below, when the regression analysis was performed on the affordable segment, property prices lagged for 1 period; only disposable income was found to contribute significantly to the regression. This is evidenced by the significance of the R^2 of 0.47, meaning that the quarterly disposable income, lagged for one quarter, explains 47% of the variation in the quarterly median property prices lagged for one quarter.

The p value is very small (<0.001) and shows high significance, thus the null hypothesis is rejected at the 0.1% level of significance.

Based on the fact that there is only one independent variable in this regression, the p value is applicable to both the variable and the regression equation in total; the t value is therefore significant at the 0.1% level.

The Durbin- Watson shows a value of 1.56.

The | ujarati (2003) explains that if the Durban-Watson value (d) has the following value:

$$d_u < d < 4 - d_u$$

where: d_u is the upper limit as shown on the Durbin-Watson level of significance tables; then the null hypothesis is accepted, being that there is no autocorrelation, either positive or negative. In this case the null hypothesis of the Durbin-Watson test is accepted.

Table 5: Regression analysis results - Affordable segment

Summary Statistics: DV: Real Affordable property prices						
	Value					
Multiple R	0.69					
Multiple R ²	0.47					
Adjusted R ²	0.46					
F(1,42)	37.28					
p	0.00					
Std.Err. of Estimate	1625.6					
Regression Summary for Dependent Variable: Real Affordable segment						
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(42)	p-level
Disposable inc per capita lag 1	0.69	0.11	13.36	2.19	6.11	0.00
Durbin-Watson and serial correlation of residuals						
	Durbin- Watson d	Serial Corr.				
Estimate	1.56	0.21				

Looking at the partial autocorrelation graph per appendix A, there is some debate that a lag of 3 or even 4 is necessary to remove further autocorrelation in the data. When the regression was re-run on the affordable prices lagged by 3 quarters, the value of the Durbin-Watson test was lower at 0.98 and a significant serial correlation of 0.5%. When a further lag of 1

quarter, this yielded an even lower Durbin-Watson statistic of 0.89 with a serial correlation of 0.54. Lagged by 6 quarters, the Durbin-Watson value was even worse at 0.80 and a serial correlation of 0.60. The lag of 1 quarter was thus retained.

Conclusion:

Taken together, the acceptable Durbin-Watson statistic and significant regression model at the 1% level are sufficient evidence to reject the null hypothesis of no relation between the independent variable (disposable income) and the dependent variable (median property prices).

The null hypothesis is rejected in favour of the alternative hypothesis that lagged affordable segment property prices are a function of lagged disposable income, and can be stated as follows:

$$H_A: Y = 0.69A$$

Where:

Y = Lagged affordable segment property prices; and

A = Lagged disposable income per capita.

As shown by the results in table 6, of the regression analysis performed on the lagged middle segment prices, only lagged disposable income was found to contribute significantly to the regression. This is evidenced by the significance of the R^2 of 0.54, meaning that the lagged quarterly disposable income, explains 54% of the variation in the quarterly differences in median segment prices lagged for one quarter.

For the regression model, the p value (0.01) shows that the regression is significant at the 0.1% level of significance. As there is only one independent variable in this regression, the p value of 0.01 is the same for both the coefficient of disposable income and the regression model ($t(42)=7.03$; $p<0.01$).

The Durbin- Watson shows a value of 0.92. This value (d) is, $0 < d < d_L$. Per the Durbin-Watson decision rule shown by Gujarati (2003), the null hypothesis of the Durbin-Watson rule that there is no positive autocorrelation, is rejected.



Table 6: Regression anal

Summary Statistics; DV: Real Middle property prices						
	Value					
Multiple R	0.74					
Multiple R ²	0.54					
Adjusted R ²	0.53					
F(1,42)	49.44					
p	0.00					
Std.Err. of Estimate	8776					
Regression Summary for Dependent Variable: Real Middle segment						
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(42)	p-level
Disposable inc per capita lag 1	0.74	0.10	83.06	11.81	7.03	0.00
Durbin-Watson and serial correlation of residuals						
	Durbin- Watson d	Serial Corr.				
Estimate	0.92	0.54				

A plot of the residuals, refer appendix K, in respect of the middle segment reveals a downward sloping trend line, which confirms the result given by the Durbin-Watson test. The residuals therefore appear to be displaying a trend.

Conclusion:

The unacceptable Durbin-Watson statistic and trend of residuals are sufficient evidence to accept the null hypothesis that there is no statistically significant relationship between the independent variables (I, G, A, X, T) and the dependent variable (Y: middle segment property prices), either in combination or individually. This can be stated as follows:

$H_0: Y \neq b_0 + b_1I + b_2G + b_3A + b_4X + b_5T + e$ (either in combination or individually)

Where

Y = Residential property prices

I = Prime interest rates

G = Real GDP

A = Disposable income per capita

X = Rand to US dollar exchange rates

T = Inflation

e = Error term

5.2.2.3 HYPOTHESIS 3: LUXURY SEGMENT

As shown by the results in Table 7, of the regression analysis performed on the lagged luxury segment prices, only lagged disposable income was found to contribute significantly to the regression. This is evidenced by the significance of the R^2 of 0.17, meaning that the lagged quarterly disposable income, explains 17% of the variation in the quarterly luxury segment prices lagged for one quarter.

For the regression model, the p value (0.01) shows that the regression is significant at the 5% significance level. As there is only one independent variable in this regression, the p value of 0.01 is the same for both the coefficient of disposable income and the regression model ($t(42)=2.92$; $p<0.1$).



The .65. Due to the fact that this value (d) falls within the range, $d_u < d < 4 - d_u$; the null hypothesis is accepted, being that there is no autocorrelation, either positive or negative.

Table 7: Regression analysis results – Luxury segment

Summary Statistics; DV: Real Luxury property prices						
	Value					
Multiple R	0.41					
Multiple R ²	0.17					
Adjusted R ²	0.15					
F(1,42)	8.53					
p	0.01					
Std.Err. of Estimate	62819.0					
Regression Summary for Dependent Variable: Real Luxury segment						
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(42)	p-level
Disposable inc per capita lag 1	0.41	0.14	246.92	84.56	2.92	0.01
Durbin-Watson and serial correlation of residuals						
	Durbin- Watson d	Serial Corr.				
Estimate	1.65	0.17				

As lagged disposable income was found to be relevant for lagged luxury segment prices, a plot of the residuals was performed, refer appendix L. This appendix shows the plot of the raw residuals vs lagged disposable income per capita. From the plot there does not appear to be any bunching of the residuals in any particular area, nor is there a particular trend or pattern of the residuals. The residuals therefore appear to be random.

A histogram of the distribution of the raw residuals (appendix L) shows that the pattern is approximately normally distributed,

Conclusion:

Taken together, the acceptable Durbin-Watson statistic and significant regression model at the 5% level are sufficient evidence to reject the null hypothesis of no relation between the independent variable (disposable income) and the dependent variable (luxury segment prices).

The null hypothesis is rejected in favour of the alternative hypothesis that lagged luxury segment property prices are a function of lagged disposable income, and can be stated as follows:

$$H_A: Y = 0.41A$$

Where:

Y = Lagged luxury segment property prices; and

A = Lagged disposable income per capita.

As shown by the results in table 8, of the regression analysis performed on the lagged median property prices, only lagged disposable income was found to contribute significantly to the regression. This is evidenced by the significance of the R^2 of 0.22, meaning that the lagged quarterly disposable income, explains 22% of the variation in the lagged quarterly median property prices.

For the regression model, the p value (0.0014) shows that the regression is significant at the 1% significance level. As there is only one independent variable in this regression, the p value of 0.0014 is the same for both the coefficient of disposable income and the regression model ($t(42)=3.42$; $p<0.01$).

The Durbin- Watson shows a value of 2.07. Due to the fact that this value (d) falls within the range, $d_u < d < 4 - d_u$; the null hypothesis is accepted, being that there is no autocorrelation, either positive or negative.



Table 8: Regression anal

Summary Statistics; Real Median property prices						
	Value					
Multiple R	0.47					
Multiple R ²	0.22					
Adjusted R ²	0.20					
F(1,42)	11.70					
p	0.00					
Std.Err. of Estimate	11763.76					
Regression Summary for Dependent Variable: Real Median property price						
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(42)	p-level
Disposable inc per capita lag 1	0.47	0.14	54.17	15.83	3.42	0.00140
Durbin-Watson and serial correlation of residuals						
	Durbin- Watson	Serial Corr.				
Estimate	2.07	-0.05				

As lagged disposable income was found to be relevant for lagged median property prices, a plot of the residuals was performed, refer appendix M. This appendix shows the plot of the raw residuals vs lagged disposable income per capita. From the plot there does not appear to be any bunching of the residuals in any particular area, nor is there a particular trend or pattern of the residuals. The residuals therefore appear to be random.

A histogram of the distribution of the raw residuals (appendix M), shows that the pattern is approximately normally distributed, thus satisfying another underlying assumption of regression analysis.

Taken together, the acceptable Durbin-Watson statistic and significant regression model at the 1% level are sufficient evidence to reject the null hypothesis of no relation between the independent variable (disposable income) and the dependent variable (median property prices).

The null hypothesis is rejected in favour of the alternative hypothesis that lagged median property prices are a function of lagged disposable income, and can be stated as follows:

$$H_A: Y = 0.47A$$

Where:

Y = Lagged median property prices; and

A = Lagged disposable income per capita.

5.3 SUMMARY OF FINDINGS

Based on the analysis of the research performed above, lagged disposable income per capita was found to be statistically significant to lagged affordable segment property prices, luxury segment property prices and median property prices.



These findings support (2002) who found that real house price increases were significantly related to changes in income among other factors. These findings oppose the study of Gallin (2003) who found that the level of house prices did not appear to be tied to the level of market fundamentals, including per capita income.

Lagged disposable income per capita was not found to be statistically significant to lagged middle segment property prices. As stated in chapter 3, middle segment property is categorised by ABSA (2006c) as houses between 80m² – 400m² and priced from R226 000 up to R2 600 000.

Due to the fact that as interest rates increase so do mortgage repayments, this results in the affordability of property decreasing, which exerts downward pressure on property prices. Instinctively one would therefore expect that interest rates would be negatively related to residential property prices. This research did not find any indication that interest rates had any explanatory power with regard to residential property prices. These findings are contrary to a study by Meen (1999) in the UK, where it was found that interest rates had a statistically significant relationship to residential property prices.

Some international research (Yun *et al.* 2003) has found that residential property prices could be explained by nominal interest rates and price expectations of potential buyers, depending on whether it was an inflationary or deflationary period. This research did not find any statistically significant relationship between inflation and residential property prices.

Saville (2004) states that nominal GDP can be used as a calculation tool for residential property; this research did not use nominal GDP, but it did use real GDP and real residential property prices. The effects of inflation were therefore removed from both variables (GDP and residential property prices). This study did not find any statistically significant relationship between these two inflation adjusted variables.

Standish *et al.* (2005), developed two models in their research regarding determinants of residential property prices in South Africa. Firstly a long term model was developed (1974-2003) and secondly a short term model (1994-2003). The long term model retained net migration, real capitalisation on the JSE, foreign direct investment, log of the real rand gold price and the log of the rand:US dollar exchange rate, as significant in determining residential property price in South Africa. The short term model retained only three independent variables, being the ratio of household debt to disposable income, foreign direct investment and the log of the real rand gold price. Contrary to the findings of Standish *et al.* (2005), who found that there was a negative relationship between the rand to US dollar exchange rate and residential property prices, this research did not find any statistically significant relationship between these two factors, either positive or negative.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

This chapter revisits the objectives of this research and the results of the research. This chapter also includes recommendations to stakeholders in the residential property market, as well as recommendations for future research on this topic.

6.2 RESEARCH OBJECTIVE AND RESEARCH RESULTS

The objective of this research report was to determine if the economic indicators selected, are statistically significant drivers of residential property prices in South Africa. Residential property prices have been separated into four categories, being average affordable, middle and luxury segment property prices, as well as median property prices.

This research found that the lagged disposable income per capita had a statistically significant relationship to the lagged affordable and luxury property prices, as well as the lagged median property prices in South Africa. Importantly the property prices and disposable income in this relationship refer to quarterly lagged data.

Due to the fact that found (Table 4) between many of the independent variables (economic indicators) used for this research, it appears reasonable that only one variable was retained in the regression analysis model.

No economic indicator selected was found to be statistically significant to the middle segment property category, even the lagged disposable income per capita variable, which was retained as significant for the other property categories.

It appears appropriate that the independent variable retained was that of disposable income, as the affordability of property is directly related to the amount of income available to pay for the property. Notwithstanding this, it is interesting to note that the coefficient (Beta) varied per property segment. In the affordable property segment the Beta of disposable income was 0.69, for the luxury segment the Beta was 0.41, while for median property prices it was 0.47. This could indicate that in the luxury and median property categories, there are more factors influencing the property price over and above disposable income, which are not as important in the affordable property segment. This could also lead to an indication as to why none of the economic indicators selected, showed a statistically significant relationship to the middle segment property prices. That is, there may be numerous other factors affecting the middle property segment which all impact on the property prices in this segment, therefore eliminating any significant effect from one indicator alone.

6.3 RECOMMENDATIONS TO STAKEHOLDERS

6.3.1. RECOMMENDATIONS TO BUSINESSES

As stated previously in section 1.4, the construction industry has seen above inflation increases in building costs primarily fuelled by demand for new housing. This has allowed businesses supplying building materials and other construction products and services to realise above inflation returns. Based on the fact that this research finds a statistically significant relationship between average affordable, average luxury and median property prices with disposable income, these businesses should monitor the movement in disposable income to determine when the housing market is likely to slow down from its recent increasing price trends. As detailed in section 2.1, Moolman and Schoeman (2006c) emphasise that the growth in house prices has already decreased to 6.5% and there is some indication that this fall will continue due to the increased demand on households' discretionary spending. By concentrating on indicators that show a slowdown in housing price increases, this will allow businesses to re-assess their cost structures, efficiencies and pricing policy to ensure there is no sudden unexpected decrease in profitability.

It appears from the results of this study, as shown in Chapter 5, that disposable income has a greater effect on the affordable property segment, when compared to the luxury or median property.

It is recommended therefore that financial institutions should focus more of their attention on the demands on the disposable income of households buying residential property in this segment (affordable) when compared to the other segments. This could be achieved through detailed income and expense bond application forms, for applicants purchasing property in this segment, followed by the financial institution's representative discussing the application form with the applicant. For other categories such as the luxury property segment applications, the combined effects of the income and expense bond application form together with other factors, such as other assets held by the applicant, could be considered in to a greater extent.

Financial institutions should also be cautious in continuous extension of credit to investor applicants where it is apparent that the repayment of the debt would be difficult given the applicant's present income levels; that is, the effect of rental income from the property should be carefully assessed to consider the effects on repayment of the mortgage bond if no tenant could be found for the property.

This study shows that primarily disposable income is a significant factor driving residential property prices in South Africa. The individual should therefore consider not only their current income levels but their disposable income, thus allowing for the effects of taxation. In addition it is recommended that individuals allow for other demands on their income such as living expenses, motor vehicle financing repayments, entertainment and other commitments. This will allow the individual to make a reasonable estimate of the price of residential housing most suited to their financial position.

Individuals are encouraged to review economic reports such as those from SARB or financial institutions such as Standard Bank and ABSA, where disposable income per capita, as well as other factors which affect disposable income per capita and residential property prices are discussed. This will allow the individual to assess, based on the demands on disposable income per capita, what the effects on residential property prices could be. It should be noted that sellers and buyers of residential property need to consider these factors carefully as they could have different implications for each group. The seller may find signs that their property should be sold sooner rather than later, while the buyer may be encouraged to delay their purchase for a certain period of time. This will allow both the sellers and buyers to make informed decisions regarding potential purchases or sales of residential property.

6.4 FURTHER RESEARCH IDEAS

Further research on this topic could include the following:

- Other economic indicators could be analysed to determine if they have a statistically significant relationship to residential property prices in South Africa. Based on a review of the literature for this topic, important indicators could be the ratio of debt to household income, the business confidence index, population growth and migration trends.
- The impacts of supply side factors, such as building and labour costs, could be researched further, in order to determine if this provides additional information regarding the factors which influence residential property prices.
- There is no central database of residential property prices for South Africa. The deeds office records only total property transactions which have taken place over a period of time. The deeds office registry does not distinguish between residential, commercial and industrial property. The lack of this information makes migration and pricing trends more difficult to analyse in South Africa. A future study could assess the feasibility and benefits of such a central database.
- Due to the fact that the middle property segment did not reveal any statistically significant relationships with the indicators selected in this study, an analysis of this property segment (middle), could be performed in order to understand the composition of the segment e.g. number of transactions, demographics of buyers and sellers and what factors are influencing

property prices i  n compared to the other property segments.

6.5 CONCLUSION

It is evident from Chapter 1 that there is a significant degree of debate regarding the residential property market in South Africa and the price increases that have been experienced. This research has shown that some factors such as interest rates, which are considered to be highly significant to residential property prices, have not shown a statistically significant relationship, while disposable income per capita has shown a statistically significant relationship to residential property prices in the affordable, luxury segment as well as median property prices. It is also apparent that the extent of the effect of disposable income per capita on residential property prices differs for each property category.

This research has contributed to understanding whether the factors selected show a statistically significant relationship to residential property prices in South Africa. This should assist in gaining a better understanding of the dynamics of the residential property market in South Africa and will allow for further research on the relationships of other factors with residential property prices. In addition I hope this research has assisted individuals in considering factors that could impact a purchase or sale of residential property which they are considering.

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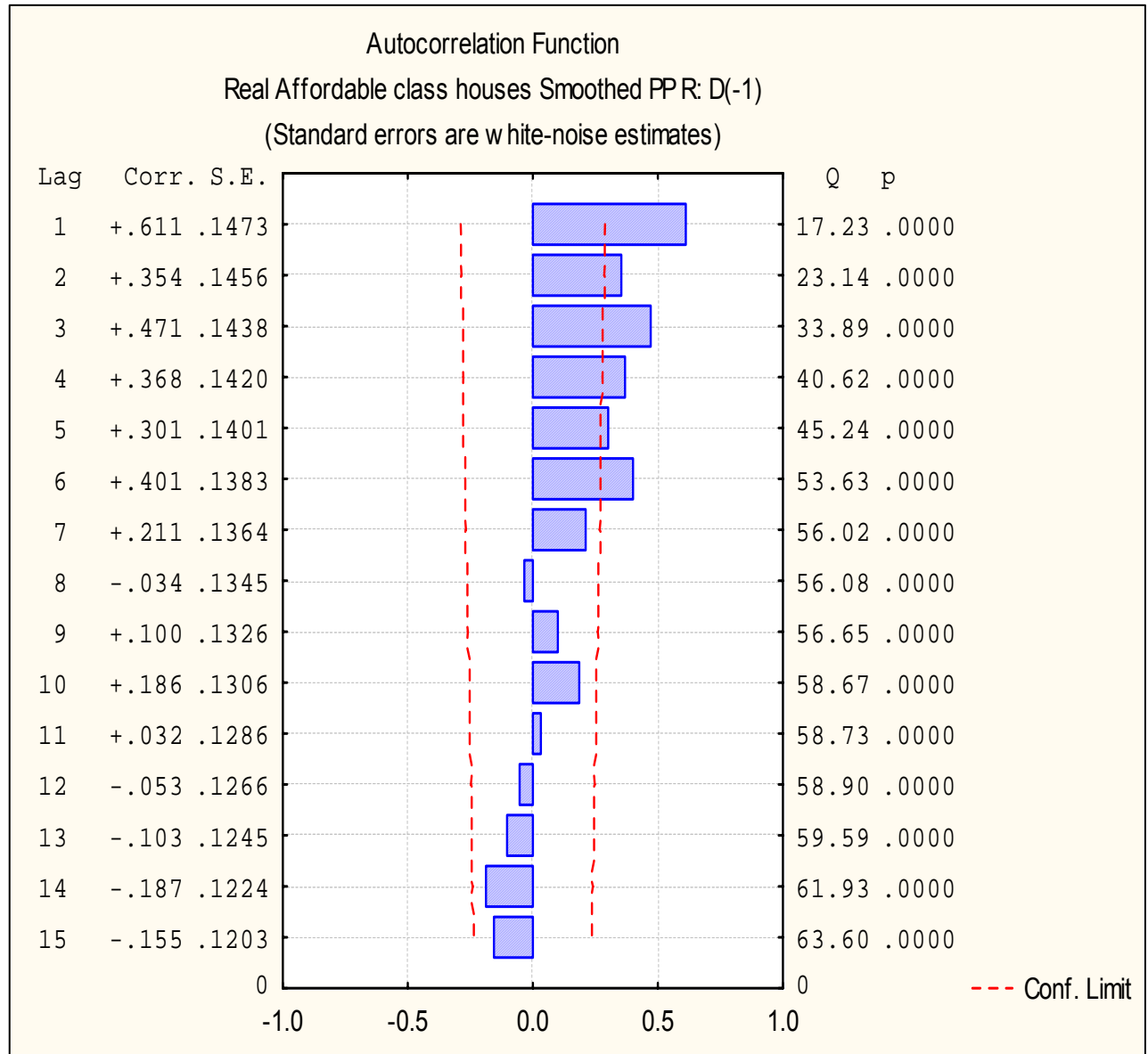
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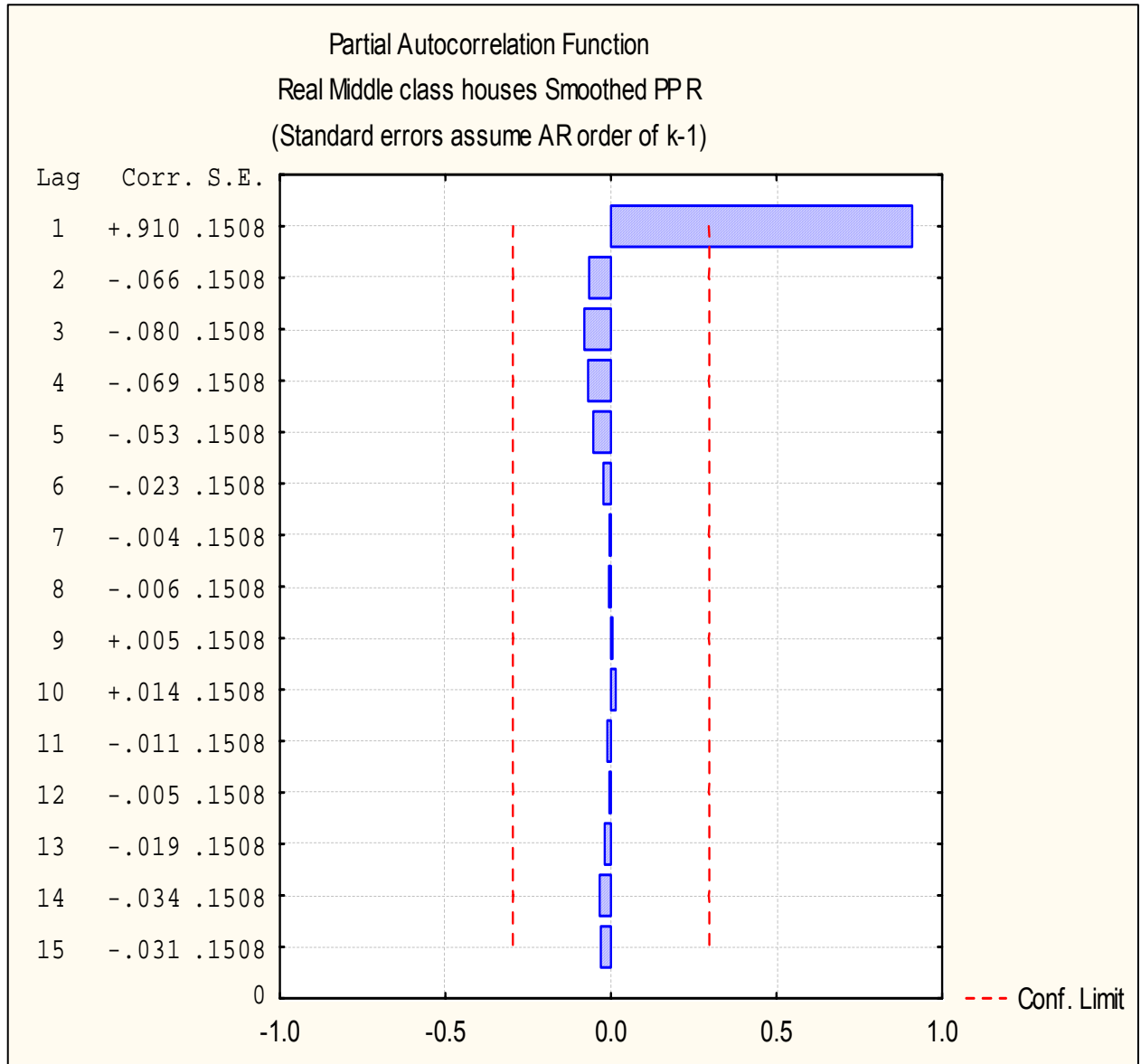
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APPENDICES

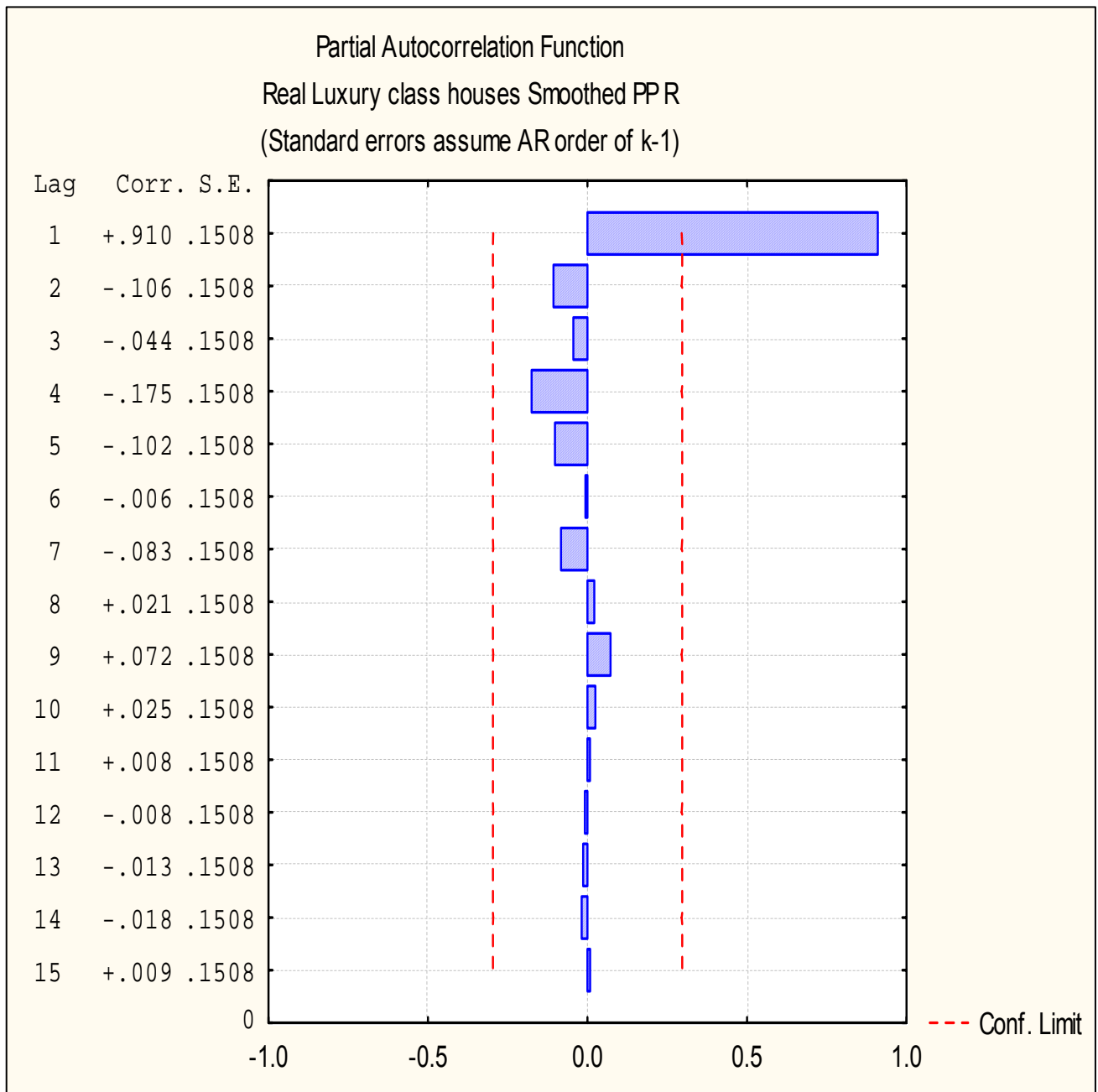
APPENDIX A: PARTIAL AUTOCORRELATION GRAPH – AFFORDABLE PROPERTY SEGMENT



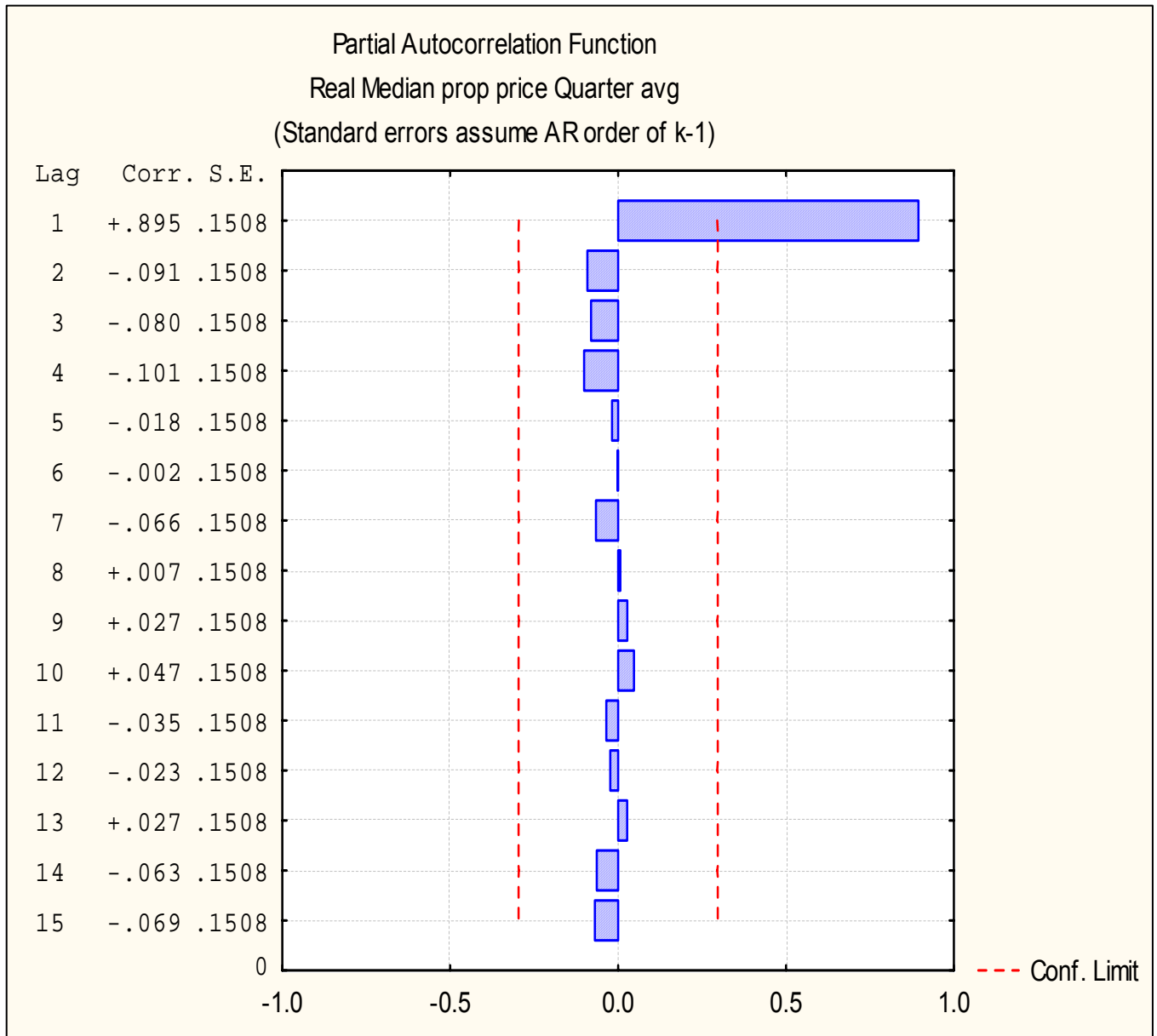
APPENDIX B: PARTIAL AUTOCORRELATION GRAPH – MIDDLE PROPERTY SEGMENT



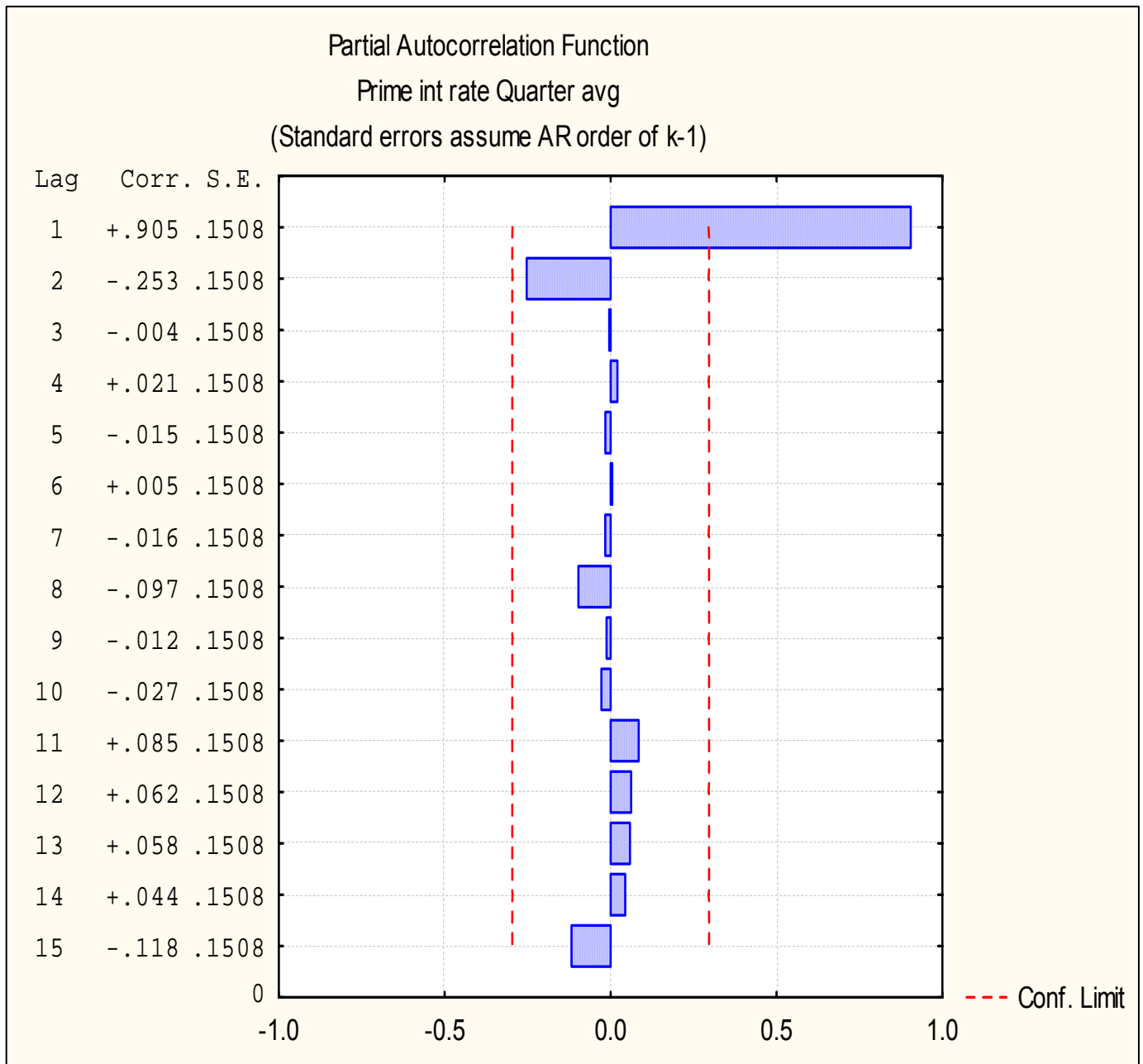
APPENDIX C: PARTIAL AUTOCORRELATION GRAPH – LUXURY PROPERTY SEGMENT



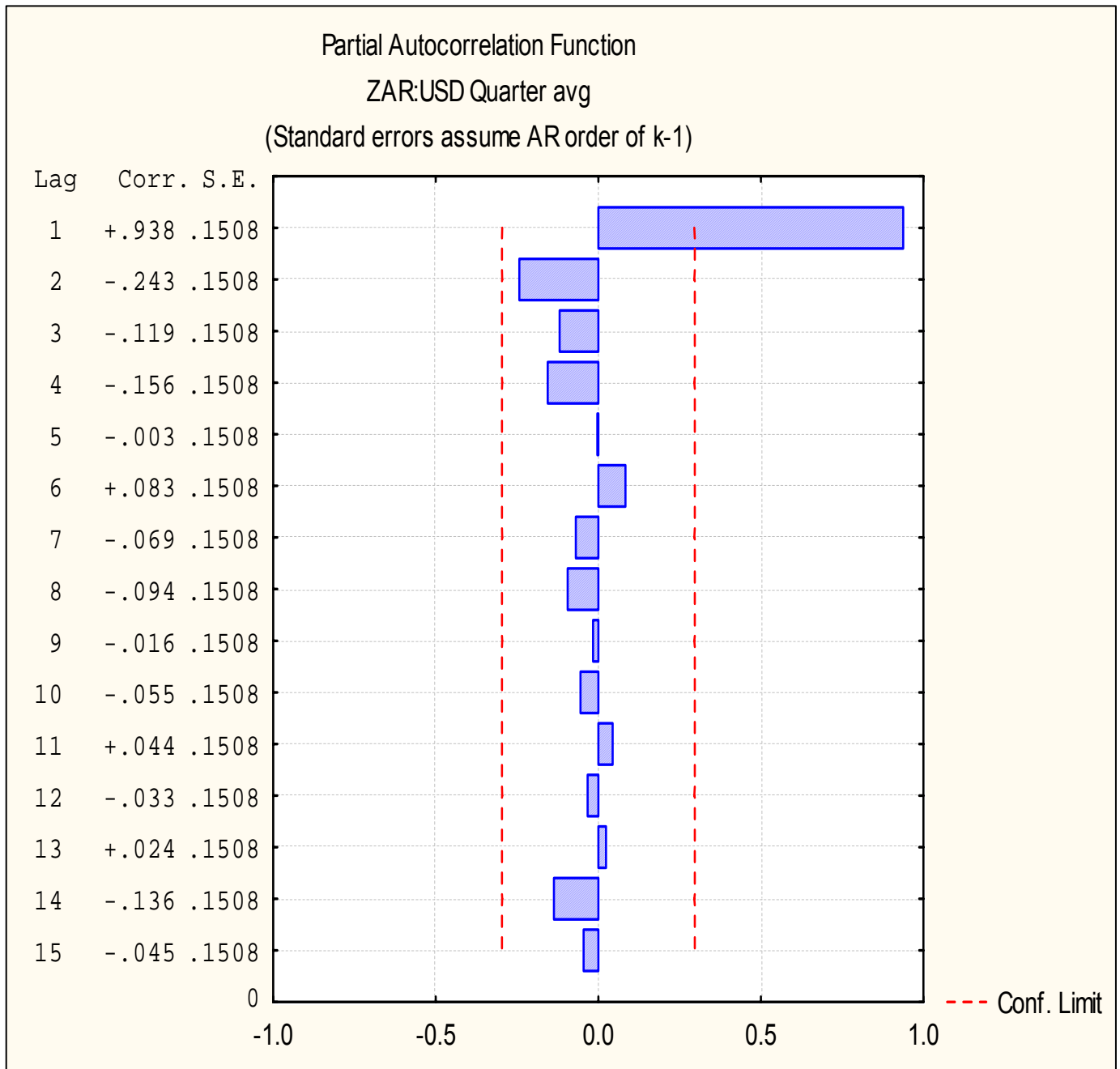
APPENDIX D: PARTIAL AUTOCORRELATION GRAPH – MEDIAN PROPERTY PRICES



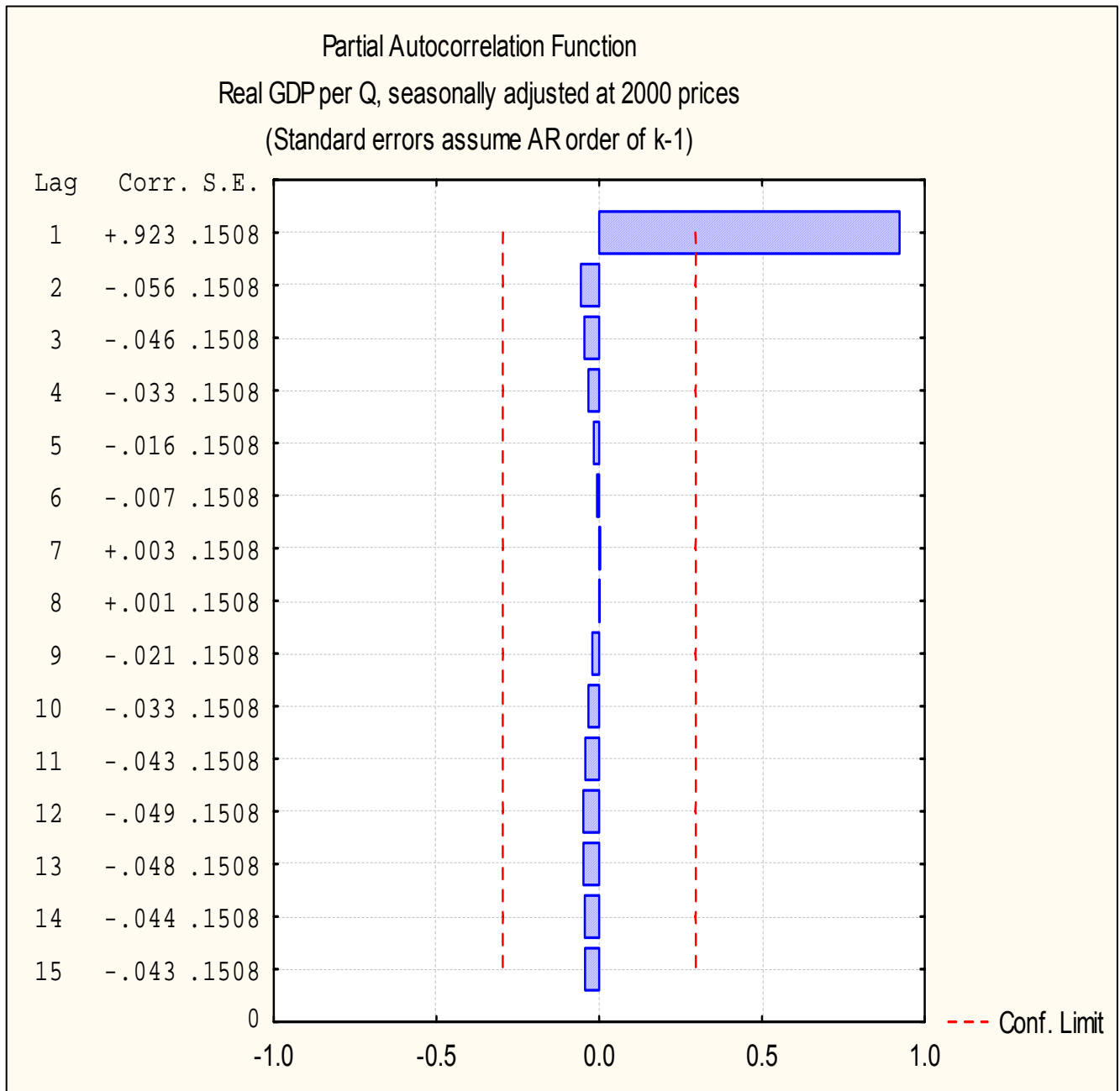
APPENDIX E: PARTIAL AUTOCORRELATION GRAPH – PRIME INTEREST RATES



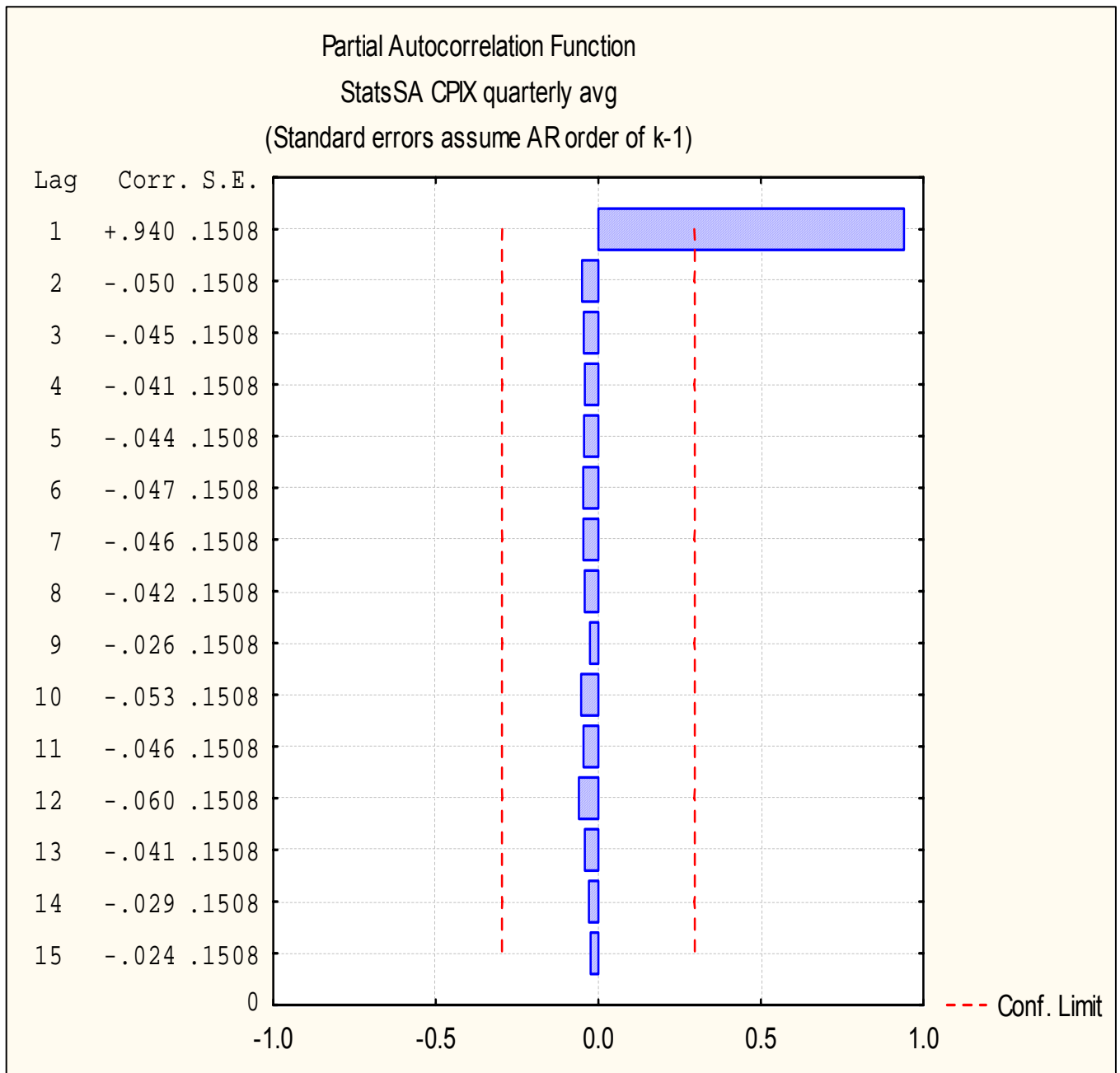
APPENDIX F: PARTIAL AUTOCORRELATION GRAPH – ZAR:USD EXCHANGE RATES



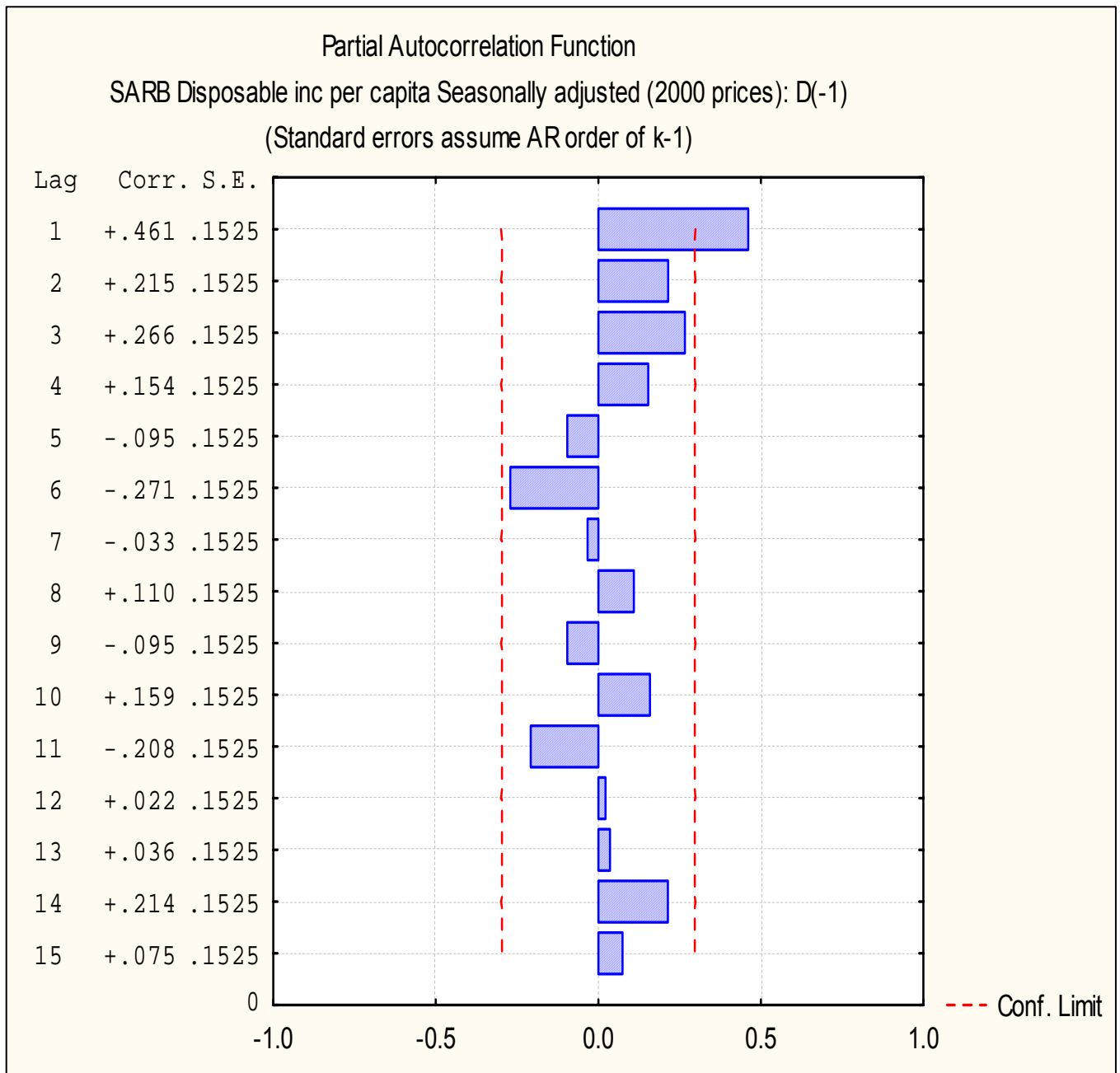
APPENDIX G: PARTIAL AUTOCORRELATION GRAPH – REAL GDP



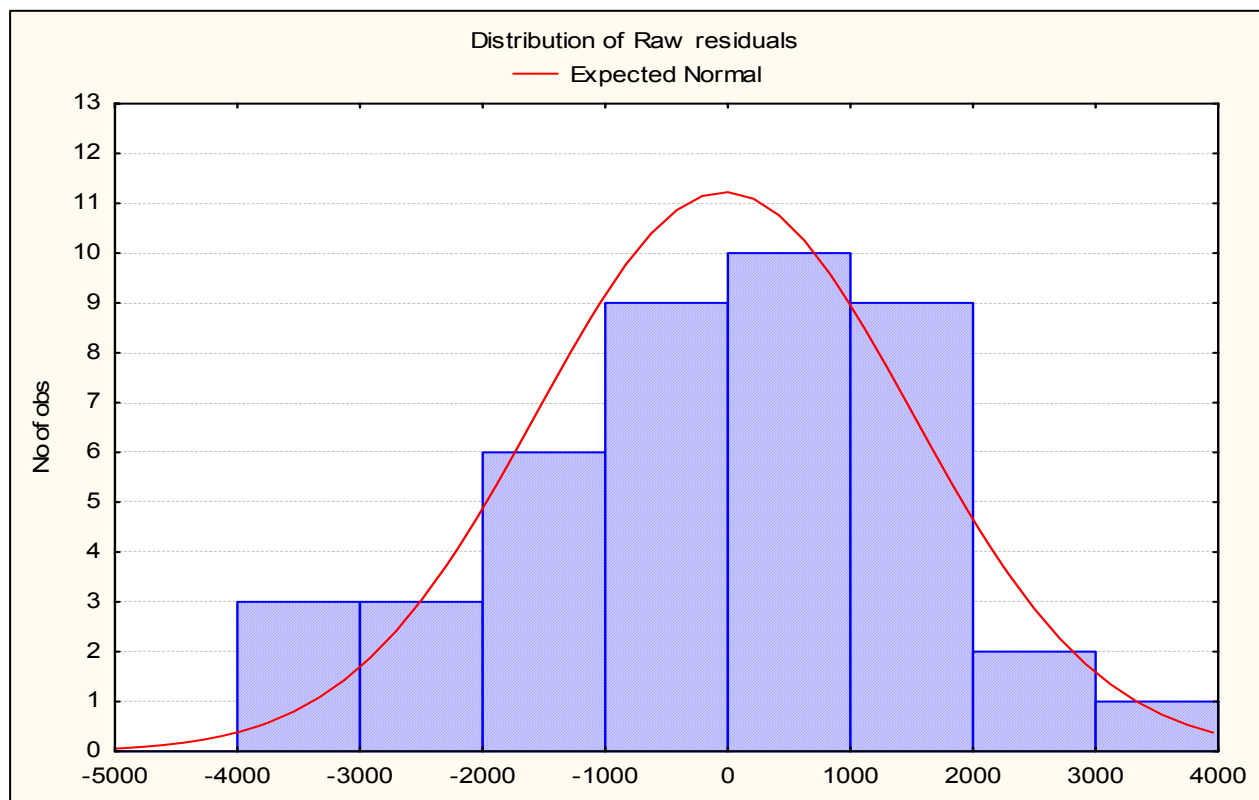
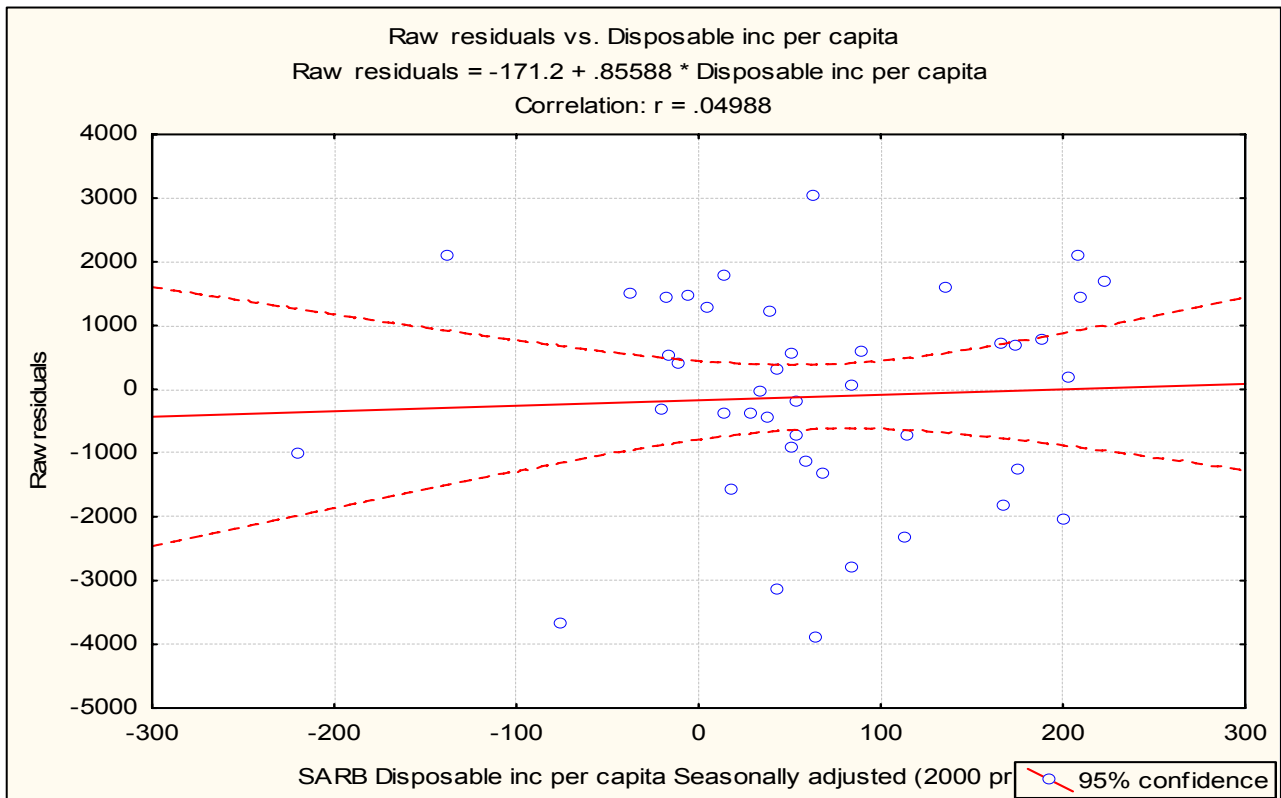
APPENDIX H: PARTIAL AUTOCORRELATION GRAPH – CPIX (INFLATION)



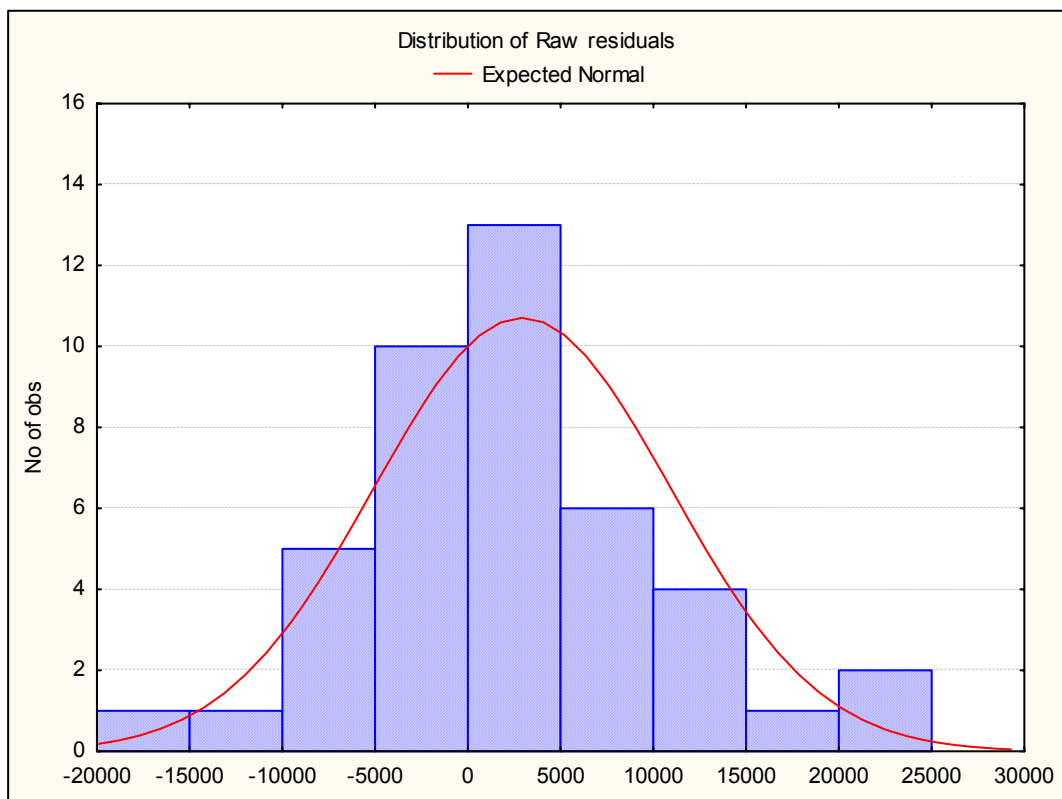
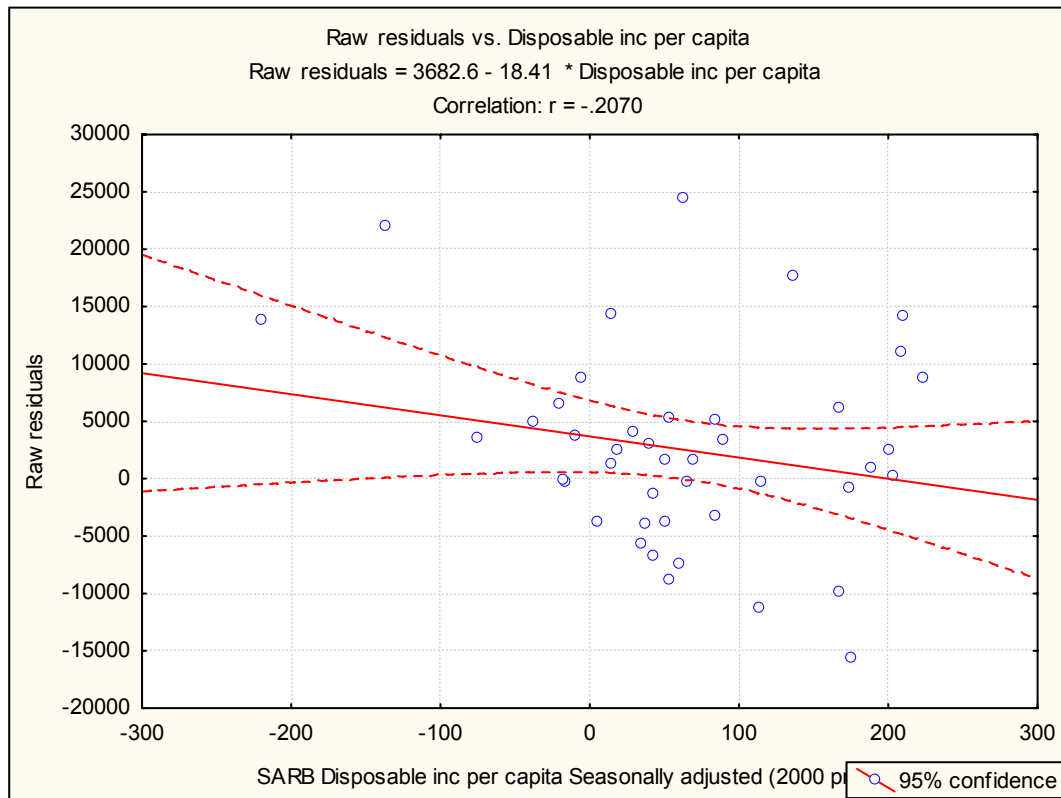
APPENDIX I: PARTIAL AUTOCORRELATION GRAPH – DISPOSABLE INCOME



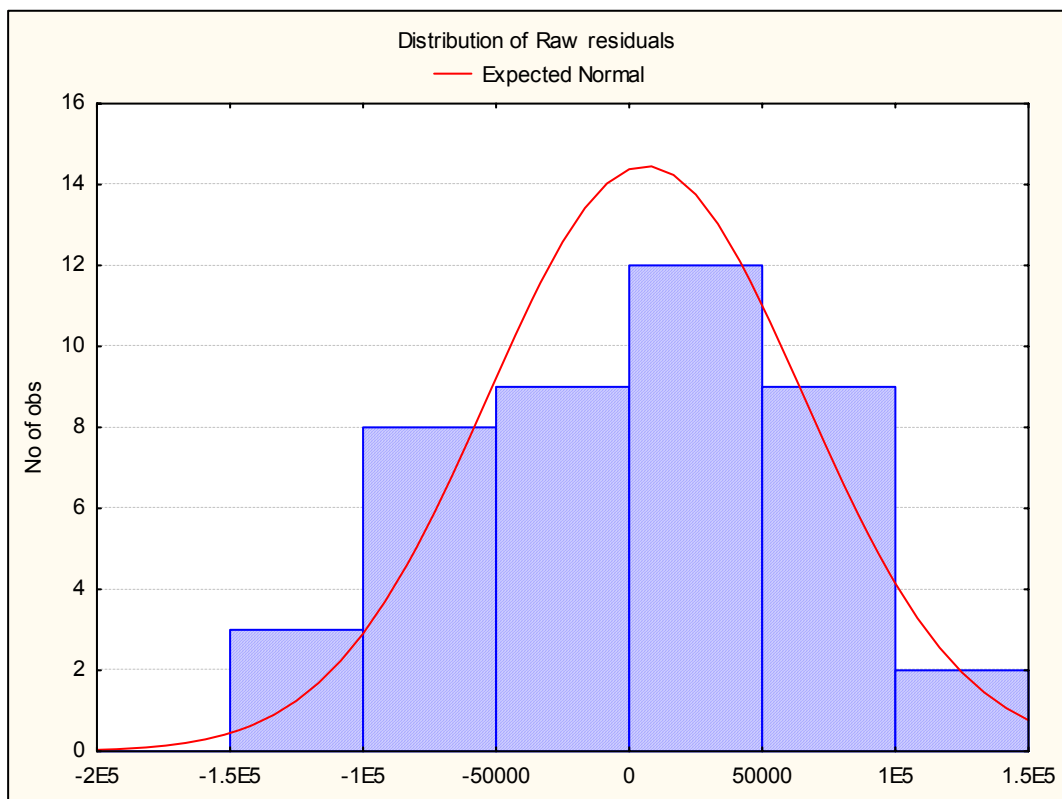
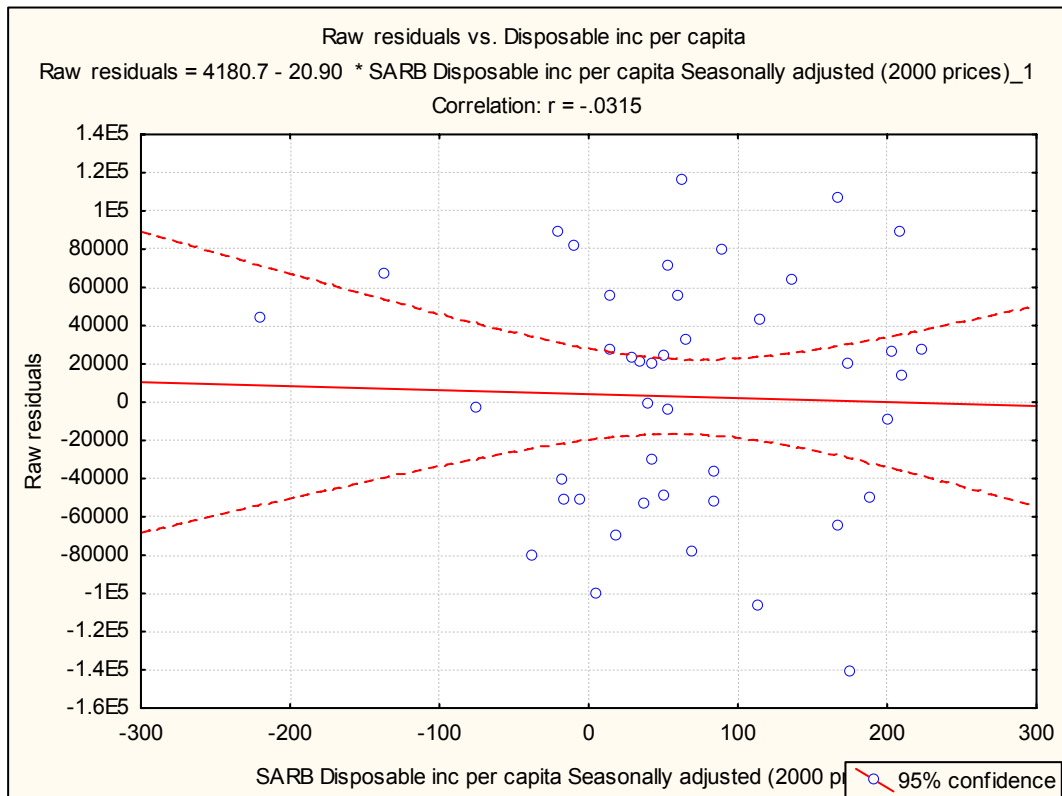
APPENDIX J: PLOT & HISTOGRAM OF RAW RESIDUALS – AFFORDABLE PROPERTY SEGMENT



APPENDIX K: PLOT & HISTOGRAM OF RAW RESIDUALS – MIDDLE PROPERTY SEGMENT



APPENDIX L: PLOT & HISTOGRAM OF RAW RESIDUALS – LUXURY PROPERTY SEGMENT



APPENDIX M: PLOT & HISTOGRAM OF RAW RESIDUALS – MEDIAN PROPERTY PRICES

