

METROPOLITAN HOUSE PRICES IN SOUTH AFRICA: DO THEY CONVERGE?

PHILIPPE BURGER AND LIZELLE JANSE VAN RENSBURG¹

Abstract: Considering disparities in development and income between South African cities, significant differences exist between average house prices in different metropolitan areas. The question this paper investigates is whether or not these differences cause the different metropolitan areas to each constitute a separate housing market or whether or not, in spite of the differences, there still is a single South African housing market. Theory on the law of one price suggests that if products or geographic areas belong in the same market, their absolute prices must converge, so that their relative prices are stationary. By using cross-sectional time series data of five metropolitan areas, the paper tests for the law of one price by applying the Levin, Lin and Chu pooled cross-sectional unit root test, the Im, Pesaran and Shin panel unit root test and the ADF-Fisher Chi-square test. The paper finds strong evidence of convergence in large middle-segment house prices and weaker support for convergence in medium middle-segment house prices. In addition, the paper finds no evidence for convergence in small middle-segment house prices. This suggests the existence of a national market for large and possibly middle-segment houses in metropolitan, but separate metropolitan markets for small middle-segment houses. In addition, the paper estimates the speed of convergence and finds that large middle-segment house prices converge within two to seven quarters, while the speed of convergence for medium middle-segment house prices in three of the five areas is five to eight quarters.

JEL codes: D40; L85

1. INTRODUCTION

Is there such a thing as *the* South African housing market? Or are there segmented, regional markets in which property price movements are mutually independent? These are the central questions that this paper addresses. It is common knowledge that there are significant disparities in development, income and urbanisation among South African provinces and regions. Given that these disparities to a large extent occur on household level, it would not be unreasonable to expect that they might translate into differences in regional house prices as well as differences in the dynamics of house price determination. For instance, average house prices in the poorer provinces are below the national average for the past number of years. In addition, illegal immigration of foreigners, especially from Zimbabwe and Mozambique, as well as pressures on the agricultural sector and the subsequent urbanisation of ex-farm workers, resulted in an escalation of squatting in and around cities and might have caused downward pressure on formal property prices in some areas, notably certain suburbs of cities in Gauteng and KwaZulu-Natal (Luüs, 2003: 157). In contrast, a province such as the Western Cape has benefited from tourism and foreign buying power, including foreigners buying relatively cheap South African property. Bruggemans (2006) estimates that the influx of foreign investors constitutes approximately 6% to 10% of the total purchases of coastal property.

¹ Department of Economics, University of the Free State. The authors wish to thank Rangan Gupta for valuable comments and help. It goes without saying that the usual disclaimers apply.

Though data is available for both metropolitan and non-metropolitan areas, the data for the latter is only available for a more limited period. In addition, one might also expect a higher degree of homogeneity in the determinants of metropolitan areas compared to a combination of metropolitan and non-metropolitan areas. Hence, this paper focuses on residential property prices in metropolitan areas. More specifically, it covers prices in Cape Town, Durban, Port Elizabeth/Uitenhage, Pretoria and Greater Johannesburg. Given the regional disparities highlighted above, the question arises whether or not these five metropolitan areas function as a single market, or alternatively as segmented, independent metropolitan markets.

2. THEORY AND METHOD

Usually, whether or not goods that are similar or close substitutes display the same price movements and move within the same price range when sold at different locations, signify whether or not those goods are sold in the same market (Lipczynski *et al*, 2005:207; Shepherd, 1997:288-9). However, to compare products sold at different locations requires from the outset a clear definition of the product. This explains why this paper does not only consider residential property in general, but subdivides residential property in terms of their size and price. To do this, it uses the ABSA house price indices that first distinguish between three price categories and secondly subdivides the middle price category into three further size categories. The prices in the size categories are calculated for different geographical area, including the five metropolitan areas that the paper considers, thereby allowing testing for whether or not the different metropolitan areas for each size category of houses constitute a single market.

To establish whether or not each size category of houses constitute a single geographical market depends on whether or not house prices in one location exercise a competitive constraint on house prices in other locations (cf. Carlton and Perloff, 2005:648; Motta 2004:107 who discuss the theory in general). For example, if a home owner of a small middle-segment house in Cape Town computes the selling price of his residential property, the question is whether or not residential prices in the same category in Pretoria constrain his ability to set a competitive price relative to other properties in Cape Town. If this is the case, the properties in Pretoria and Cape Town are viewed as in the same market and it can be expected that their prices will not indefinitely move far from each other in the long run. If two products do not compete in the same product market their prices will not influence each other and their prices might diverge.

Products are classified as being sold in one market if consumers and firms can arbitrage away temporary price differentials and eliminate price misalignments. The Law of One Price (LOOP) states that if same-category product prices across geographical areas converge to one price the different geographical markets function as a single market. If not, the different geographical markets operate as independent local markets (Stigler and Sherwin, 1985:555-562). Although the products that the literature covers include *inter alia* fuel, automobiles and primary commodities, the general literature on the LOOP primarily focuses on cross-country, aggregate level price differentials (Cecchetti *et al*, 2002: 1081-1098; Fan and Wei, 2005:1-53; Goldberg and Verboven, 2005: 49-73; Dreher and Krieger, 2005:1-30; Isard, 1977:942; Parsley and Wei, 1996:1214 and 1220). These studies show that for the LOOP to hold, tradable products should be homogenous or near-perfect substitutes. Yet, Parsley and Wei (1996:1214 and 1220) also considered the

validity of the LOOP for non-tradables such as services. They analysed the rate of convergence to purchasing power parity of prices of goods and services from a number of cities within the USA. They found evidence of convergence of the prices of these non-tradables.

The requirements of homogeneity, near-perfect substitutability as well as tradability, may seem difficult to satisfy in the case of houses. Typically residential property is heterogeneous in nature and its spatial fixity implies immobility and thus non-tradability. The lack of homogeneity and tradability may seem to undermine opportunities for arbitrage between different geographical areas. If prices in different locations change relative to each other and buyers and sellers are unable to eliminate the price misalignment between geographical areas, then arbitrage is ineffective. Absence of arbitrage leads to different geographical areas being separate markets, and thus, the absence of a single market. However, even though houses themselves might be heterogeneous in nature, they all provide the same type of service. As such, researchers can ignore the physical heterogeneity of houses and assume the existence of an unobservable homogenous commodity called housing services (Smith, Rosen and Fallis, 1988:33). This allows researchers to classify housing services as non-tradable services. The remaining question, though, is why one would expect the prices of these non-tradable services to converge across geographical areas.

A possible answer to this question is the presence of institutional and large individual investors (and speculators) whose portfolios may contain outlays in more than one property. These investors might not themselves live in these properties, but acquire the properties to earn rental income and capital appreciation. Because they may want to diversify their portfolios to reduce risk and to balance risk and return, they may decide to acquire property in various locations. Should property prices in one location diverge too much from that in another location, an arbitrage opportunity exists. As such, an investor might decide to substitute the lower-priced property for the higher-priced one in her portfolio. In addition, Goetzmann (1993:201) showed that for investors property ownership reduces overall portfolio risk and serves as a comparatively stable investment. Montezuma (2004:268) argues that a large housing portfolio reduces the exposure to any specific risk created by any single house or group of houses in a single area. Therefore, geographically diversification improves investor welfare.

Thus, to conclude, houses yield a homogenous service, called housing services, which even though it is non-tradable, may constitute assets in a geographically diversified portfolio. Homogeneity permits one to ask whether or not house prices in the different metropolitan areas in South Africa obey the LOOP. Should they obey the LOOP, they constitute a single metropolitan residential property market for each of the different size categories.

3. AN OVERVIEW OF THE DATA: SOURCES AND DESCRIPTION

This section first provides a description of the data sources on house prices that the paper uses. This is followed by a brief description of the data for the different metropolitan areas of South Africa.

(a) *The source of data*

Currently, there are only two sources of systematic residential property market data in South Africa that covers an extensive period of time that also includes the pre-1990s. These are data from the deeds office, where all ownership and changes in ownership of fixed property need to be registered² and the ABSA residential property market database (Luüs, 2003:153). The ABSA database categorises the South African residential property market into three major segments: luxury houses, middle-segment houses and affordable houses. The luxury segment refers to houses that are priced between R2.6 million and R9.5 million followed by the middle-segment housing that include houses priced between R226 000 and R2.6 million. The middle-segment housing category is further divided into three sub-segments according to their size. Small houses cover an area of 80m² to 140m², medium houses an area of 141m² to 220m² and large houses an area of 221m² to 400m². The affordable housing segment consists of houses sized 40m² to 79m² and priced at R226 000 or less. House price data for different geographical areas is only available for the middle-segment category. For the luxury house category and some geographical areas in the middle-segment category observations date back as far as 1966, while data for the five largest metropolitan areas (Cape Town, Durban, Port Elizabeth/Uitenhage, Pretoria and Greater Johannesburg) date back to 1967.³ Hence this paper covers the period 1967Q1-2007Q2.

Table 1 – Categories of houses in ABSA residential property market data base

Categories	Price	Area (m²)
Luxury housing	R2.6 million < P _H > R9.5 million	
Middle-segment housing	R226 000 < P _H > R2.6 million	
<i>Small</i>		80 – 140
<i>Medium</i>		141 – 220
<i>Large</i>		221 – 400
Affordable housing	P _H < 226 000	40 – 79

To explore the existence of a single national residential property market for metropolitan areas against the alternative of multiple metropolitan residential property markets, the paper employs large, medium and small house prices from the middle-segment category of the ABSA residential property market database. The data covers the five large metropolitan areas in South Africa. These areas are Cape Town, Durban, Port Elizabeth/Uitenhage, Pretoria and Greater Johannesburg. Unfortunately, because price data of residential property that are classified as affordable houses and luxury houses are not available for different geographical areas, they are excluded from the analysis below.

(b) *A general description of the data*

According to the ABSA residential property market database from 1967 to 2006, large middle-segment house prices for the five metropolitan areas were on average only 92%

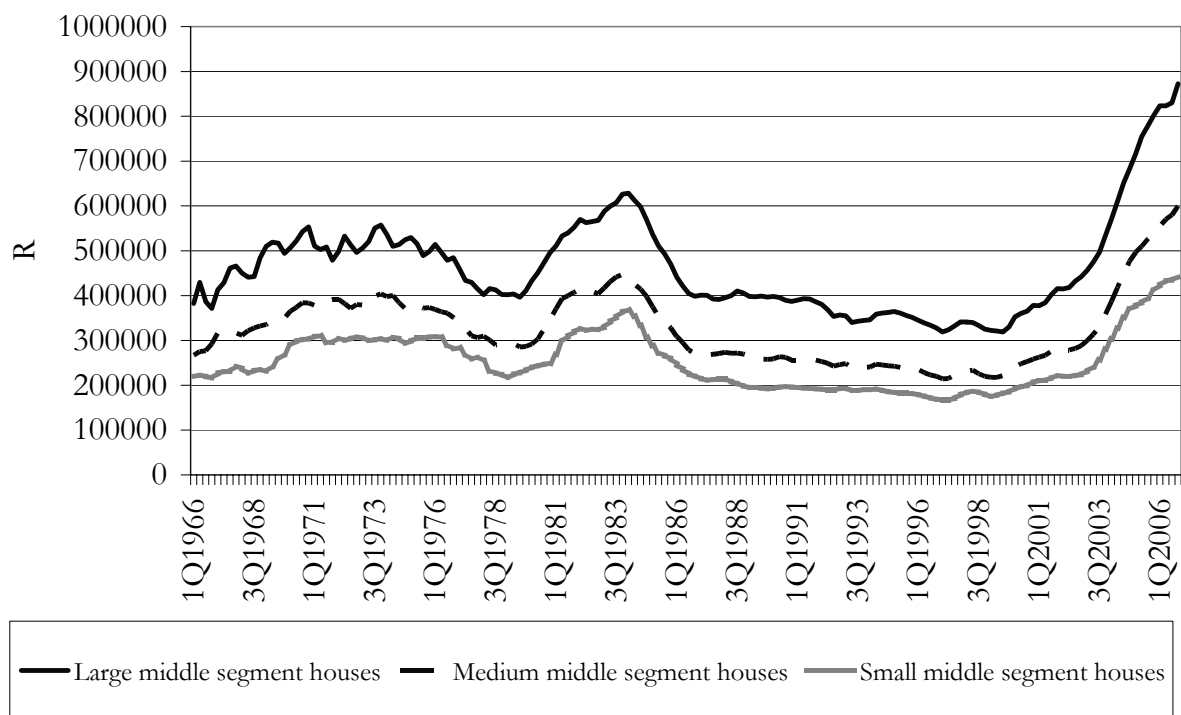
² Data from the deeds office suffer from two important deficiencies. Firstly, the data only becomes available after a lag of about six months and secondly no area size variable for properties is available. The latter may make comparisons between periods difficult since it is not possible to ascertain the extent of a shifting of weights from smaller to larger properties or *vice versa* (Luüs, 2003:153).

³ Data for these five metropolitan areas is just partially available for 1966.

higher in 2006 than 39 years earlier (1967). Compared to 1967, medium and small middle-segment houses in the five metropolitan areas were on average respectively 142% and 84% higher in 2006. This means that, for instance, large middle-segment metropolitan house prices showed a real average annual increase of only 1.6%, while medium and small middle-segment house prices in metropolitan areas increased by only 2.4% and 1.5% *per annum*. Notable is the peak and steep downturn in real house prices during the early 1980s.

Figure 1 provides a graphical depiction of overall house prices (and thus include metropolitan and other house prices in each of the size categories). Middle-segment houses in all three size categories lost between 34.5% and 36.1% of their real value between the third quarter of 1984 and the end of 1987. From 1987 until 1998 the real price growth in all three size categories was largely negative. Consequently middle-segment houses were, on average, priced almost 16% lower in real terms in 1998 than in 1987. However, from 1999 the residential property market entered a boom phase and middle-segment house prices rapidly recovered to reach the same real price level in 2004 as that reached in 1984. Between 2000 and 2006 real middle-segment houses on average increased with roughly 17% annually.

Figure 1 - Real house prices: Middle-segment houses



A comparison of the standard deviation in the growth of real house prices of the three residential property size categories reveals that, except for the price peak during the early 1980s, house prices were more volatile during the late 1960s and 1970s as compared to the late 1980s and 1990s. The standard deviation in the real growth of middle-segment house prices from 1966 until 1979 is roughly between 7.2% and 8.6% for the three size categories. The period covering the peak (1980 to 1987) displayed an increase in the standard deviation of the real price growth for the three size categories to between 12.6%

and 14.4%. This contrasts sharply with the standard deviation of approximately 4% for all three categories for the period 1988 to 1999.

The higher degree of volatility in real middle-segment house prices during the late 1960s throughout the 1970s can possibly be explained by monetary policy and international political events during the period. The 1960s and 1970s is characterised by financial market interventions such as credit ceilings and interest rate caps that inhibited the smooth functioning of financial markets (Gidlow, 1995:4-8). In addition to the instability caused by monetary policy during the 1970s the period also saw high oil prices that perpetuated inflationary problems, while political turmoil such as the Soweto student uprising (1976) adversely affected economic performance. Furthermore, South Africa ceased to peg the rand at a fixed rate against the American dollar in January 1979 in favour of a managed float. Thus, in general there was a need for a more stable financial environment that would be conducive to economic growth in the longer term. During the 1980s the South African Reserve Bank moved towards a more market-oriented approach to enhance financial and monetary stability.

Another possible reason for higher house price volatility during the late 1960s and 1970s is that home ownership in South Africa was financed mainly through building societies. Building societies enjoyed certain privileges over commercial banks such as special tax treatment that enabled them to offer mortgage loans below market rates (Luüs, 2003:152). As a result of a more market-oriented monetary approach the De Kock Commission (1982 to 1985) ended the special privileges for building societies and levelled the playing field between banks and building societies (Gidlow, 1995:15).

(c) *Relative house prices*

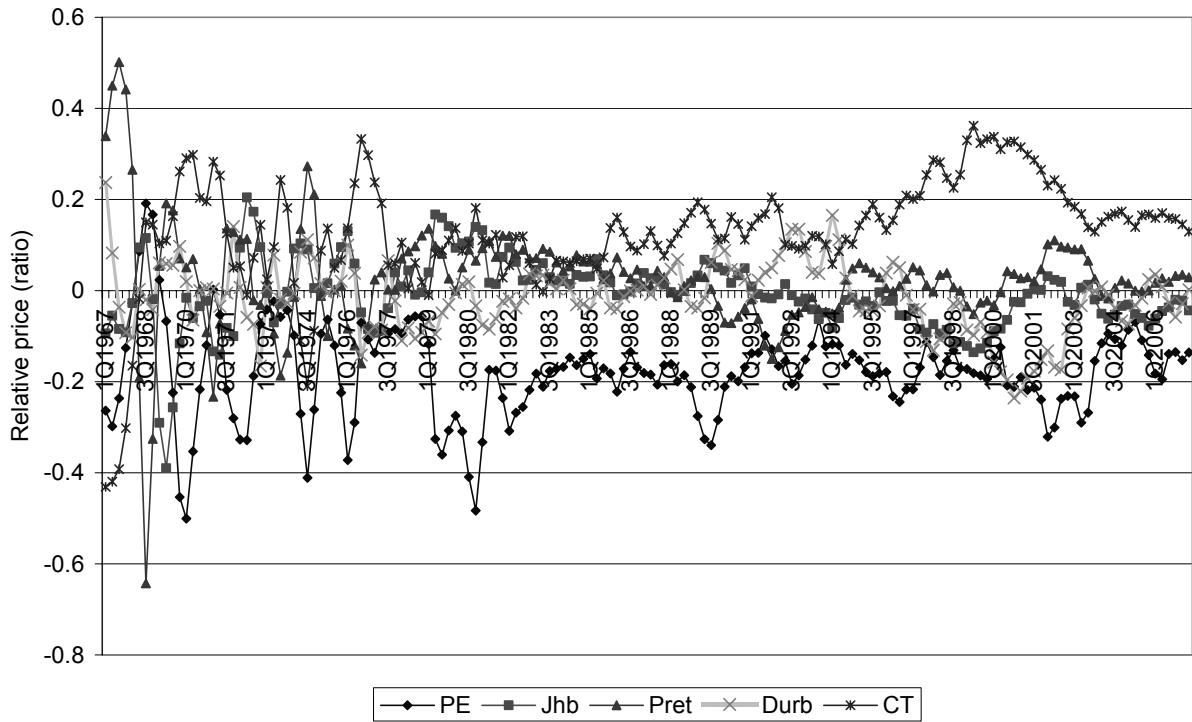
Although real residential property price movements (across the metropolitan area) are seemingly similar (the graph is not shown to save space), a comparison of these prices relative to the cross-sectional mean depicts a different picture (see Figure 2). The relative real price differential is defined in Equation (1) as the log-difference between each of the actual price levels of the five metropolitan areas and the cross-sectional mean (Ratfai, 2006:2).⁴

$$y = \ln(\hat{p}_i / \bar{p}_i) \quad (1)$$

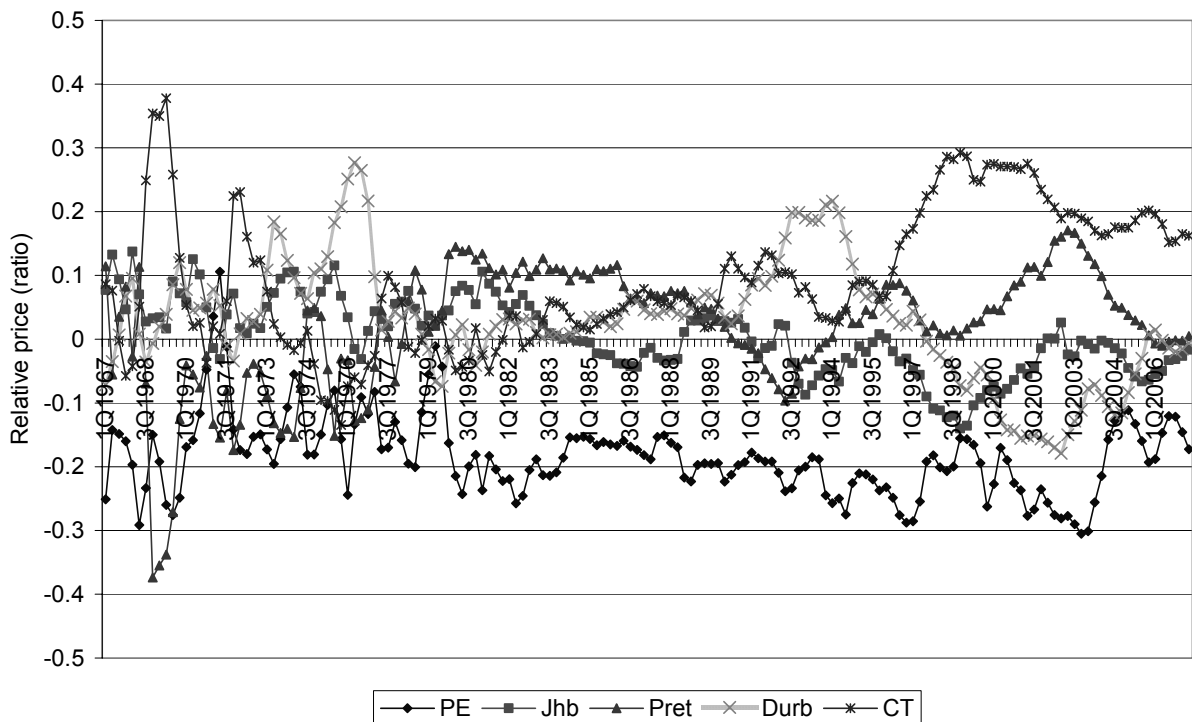
Figure 2 shows the relative price differentials of large, medium and small middle-segment houses in the various metropolitan areas. Figure 2 suggests that significant deviations in the relative price differentials of the various metropolitan areas persist for all house sizes. In addition, Cape Town house prices, especially since the late 1990s, consistently exceed the cross-sectional mean, while Port Elizabeth/Uitenhage throughout the entire sample period consistently falls short of the cross-sectional mean. Given that these relative price movements might on first sight suggest that relative convergence to the cross-sectional mean is not present, the next section considers the convergence of prices among metropolitan areas.

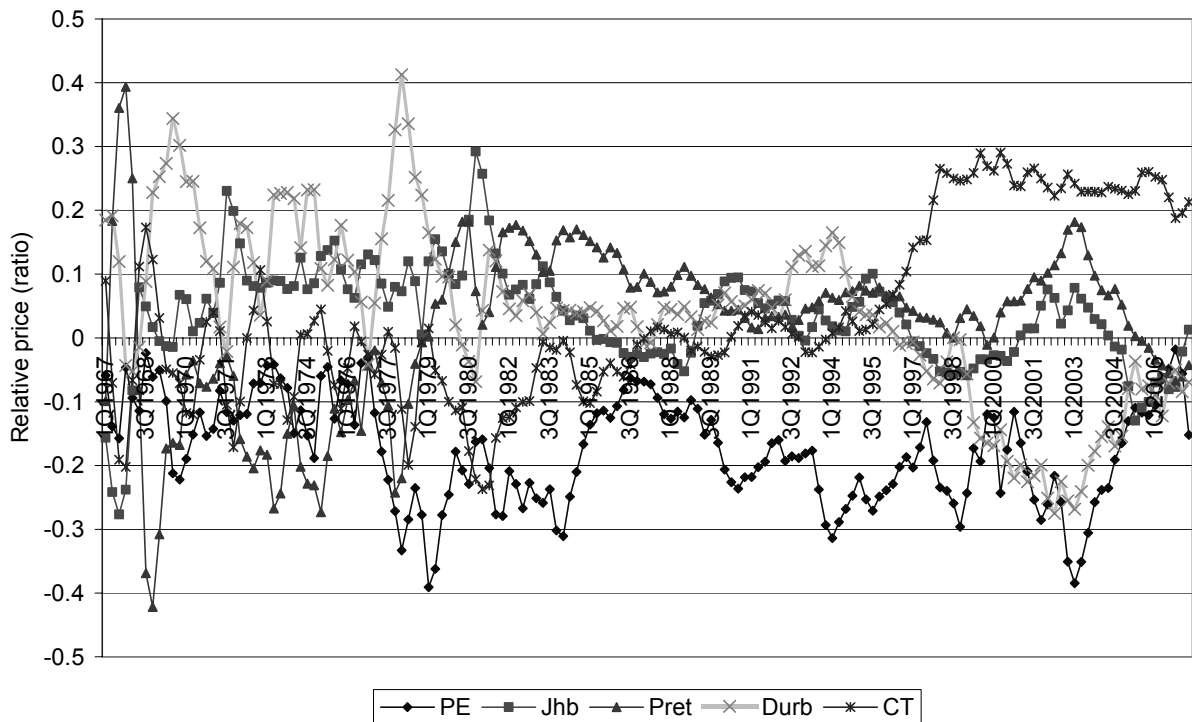
⁴ Since inflation appears both in the numerator and denominator of the ratio, there is no difference between using nominal or real house price data.

Figure 2 - Relative house prices
Large middle-segment houses



Medium middle-segment houses





4. EMPIRICAL ANALYSIS

If the prices of houses in two different locations do not diverge in the longer run, it may be concluded that they are in the same market. As a result, the log of their price ratio must then also be stationary (Forni, 2004:443). Stated differently, convergence to the LOOP for a product means that its time series of relative prices is mean reverting or stationary (Dreher and Krieger, 2005:10). The common approach to examine price convergence is to apply a unit root test to examine the stationarity of the price differential series. The rejection of the null hypothesis of a unit root implies that the time series of relative prices are stationary, also meaning that relative prices will converge in the long run. If the stationarity tests fail to reject the null hypotheses, then the relative prices follow a random walk. Hence, any deviation from the ‘one price’ becomes permanent (Fan & Wei, 2005:3-5), which also means that the houses in the different geographical locations constitute separate markets.

Unfortunately, the Augmented Dickey-Fuller (ADF) test, which is the commonly used unit root test for a single time series, has low power, causing it to overly reject the stationarity hypothesis of a time series (Dreher and Krieger, 2005:12; Fan and Wei, 2005:21; Dreger et al, 2006:12; Cecchetti et al, 2002:1087). To address this problem, Levin, Lin and Chu (2002)(LLC) have shown that the use of a panel unit root test, such as the one that they propose in Equation (2) below, can significantly increase the power of a unit root test. Since including the data of several series implies that the cross-section dimension enhances the time-series dimension, the results rely on a broader information set. The test procedure is designed to evaluate the null hypothesis that the time series in the panel are stationary. Compared to performing a separate unit root test for each individual relative price time series, the panel unit root test approach yields higher test power. However, the LLC test has two limitations: it assumes independence across

individual time series and homogeneity regarding the presence or absence of a unit root among the series. To address these restrictions, Im, Pesaran and Shin (2003: 53-75)(IPS) put forward a panel unit root test that allows for residual serial correlation and heterogeneity of the dynamics and error variances across groups, as denoted by the subscript of ρ in Equation (3) (Im *et al*, 2003:53). An alternative approach to the panel unit roots tests is the ADF-Fischer Chi-square test (see Equation 4) (Baltagi 2001:240-1; Fisher, 1932). The ADF-Fischer Chi-square test combines the ρ -values from the individual unit root tests. Both the IPS and the ADF-Fischer Chi-square test allow for individual unit root processes so that ρ may vary across cross-sections. In Equations (2) and (3) y represents the relative house prices for i cross-sections, while p in Equation (4) represents the probability of the individual ADF test.

$$\Delta y_{it} = \alpha_i + \rho y_{it-1} + \sum_{j=1}^q \lambda_{i,j} \Delta y_{it-j} + \varepsilon_{it}, i = 1, 2, \dots, n \quad (2)$$

$$\Delta y_{it} = \alpha_i + \rho_i y_{it-1} + \sum_{j=1}^q \lambda_{ij} \Delta y_{it-j} + \varepsilon_{it}, i = 1, 2, \dots, n \quad (3)$$

$$P = -2 \sum_{i=1}^N \ln p_i \quad (4)$$

Although the paper reports the results for the LLC, IPS and ADF-Fischer Chi-square tests, the limitations of the LLC test discussed above means that the conclusions of this paper rests on the results of the IPS and the ADF-Fischer Chi-square tests. Table 2 reports the results. The number of lags to be included in the LLC, IPS and ADF-Fischer Chi-square for each house size and metropolitan area is determined throughout by using the Modified Akaike Information Criterion (MAIC) and Modified Schwarz Information Criterion (MSIC).

Table 2 – Panel unit root test results (1967q1-2007q2)

	Large	Medium	Small
Levin, Lin and Chu t*			
MSIC	0.8342	0.2732	0.3859
MAIC	0.9782	0.1882	0.8879
Im, Pesaran and Shin W-stat			
MSIC	0.0003***	0.0229**	0.0353**
MAIC	0.0005***	0.0132**	0.3194
ADF-Fischer Chi-square			
MSIC	0.0003***	0.0360**	0.0045***
MAIC	0.0009***	0.0279**	0.4548

Note: *, **, *** indicates statistical significance at the 10%, 5% and 1% levels respectively

The stationarity results of the IPS and ADF-Fisher Chi-square test consistently support convergence to a cross sectional mean for large and medium size houses in the five

metropolitan areas. The result for small houses is ambiguous, with the MSIC indicating stationarity and the MAIC indicating non-stationarity of relative small house prices. Non-stationarity would imply that small middle-segment house prices follow a random walk, thus meaning that small house prices in different geographical locations do not converge. Following these results the obvious conclusion is that the different metropolitan areas constitute a single market in the case of large and medium size houses, with some ambiguity in the case of small houses.

To confirm the consistency of the results, recursive probabilities of the IPS test were calculated. First the probability of the IPS test is calculated for the period 1967Q1-1982Q4. Thereafter the probability of the IPS is recalculated for the periods 1967Q1-1987Q1, 1967Q1-1992Q1, 1967Q1-1997Q1 and 1967Q1-2002Q1. This is done for small, medium and large houses. In all cases the paper uses both MAIC and MSIC (see Table 3). This expression of the IPS test results is particularly useful since the sensitivity of the results to the number of observations and the period covered is easily identifiable.

The consistently low probability values of the IPS test for the real large middle-segment house prices indicate that the series is consistently stationary throughout the time series. However, the stationarity of relative middle and small house prices appear sensitive to the number of observations and the information criteria used. Thus, Table 3 supports the initial IPS test result above that indicated that large middle-segment house prices converge to the cross-sectional mean. However, the recursive probabilities suggest weaker support for convergence of the relative prices of medium middle-segment houses. In particular, the IPS test using MSIC indicates that medium middle-segment houses are consistently stationary, with little evidence that the results are sensitive to the number of observations and the period covered (the one exception being the period 1967Q1-2002Q4). However, the MAIC yields mixed results, with the results being very sensitive to the period covered. With regard to small middle-segment house prices, there is little to no evidence of convergence. MAIC indicates no convergence, while the results for MSIC indicate ambiguity with the results being sensitive to the period covered. Therefore, the results suggest that the separate metropolitan areas constitute a single market in the case of large and possibly medium middle-segment houses, while separate metropolitan areas function as separate markets in the case of small houses.

Table 3 - IPS recursive probabilities of relative house prices

	Small		Medium		Large	
	MAIC	MSIC	MAIC	MSIC	MAIC	MSIC
1967-1982	0.3267	0.1389	0.0095***	0.0138***	0.0103***	0.0178**
1967-1987	0.2357	0.0445**	0.1658	0.0037***	0.0008***	0.0009***
1967-1992	0.1745	0.0602*	0.0286**	0.0011***	0.0005***	0.0036***
1967-1997	0.7253	0.1954	0.1347	0.0446**	0.0006***	0.0003***
1967-2002	0.9073	0.5026	0.1359	0.205	0.0120**	0.0026***
1967-2007	0.3194	0.0353**	0.0132**	0.0229**	0.0005***	0.0003***

Note: *, **, *** indicates statistical significance at the 10%, 5% and 1% levels respectively

Table 4 – IPS recursive probabilities with different metropolitan areas as denominator

Port Elizabeth/Uitenhage	Small		Medium		Large	
	MAIC	MSIC	MAIC	MSIC	MAIC	MSIC
1982	0.0718*	0.0139**	0.0769*	0.0769*	0.0367**	0.0092***
1987	0.0561*	0.0098***	0.0096***	0.0046***	0.0032***	0.0002***
1992	0.1048	0.0177**	0.0820*	0.0033***	0.0008***	0.0002***
1997	0.3974	0.1565	0.1162	0.0390**	0.0001***	0.0000***
2002	0.7838	0.8287	0.1437	0.1254	0.0321**	0.0321**
2007	0.3230	0.3112	0.0130**	0.0131**	0.0037***	0.0037***
Greater Johannesburg	Small		Medium		Large	
	MAIC	MSIC	MAIC	MSIC	MAIC	MSIC
1982	0.1303	0.0029***	0.0728*	0.0755*	0.0027***	0.0013***
1987	0.0991*	0.0189**	0.0115**	0.0244**	0.0012***	0.0002***
1992	0.0312**	0.0034***	0.0075***	0.0071***	0.0082***	0.0000***
1997	0.0500**	0.0058***	0.0256**	0.0050***	0.0061***	0.0000***
2002	0.5453	0.1884	0.0105**	0.0055***	0.0430**	0.0091***
2007	0.1962	0.0400**	0.0005***	0.0002***	0.0115**	0.0002***
Durban	Small		Medium		Large	
	MAIC	MSIC	MAIC	MSIC	MAIC	MSIC
1982	0.0392**	0.0392**	0.1298	0.0642*	0.0204**	0.0052***
1987	0.0224**	0.0061***	0.0480**	0.0166**	0.0031***	0.0011**
1992	0.1075	0.0407**	0.1731	0.0403**	0.0233**	0.0007***
1997	0.2061	0.0588*	0.0636*	0.0636*	0.0021***	0.0003***
2002	0.9894	0.9729	0.4205	0.5248	0.1597	0.2342
2007	0.3970	0.4696	0.0185**	0.1029	0.0134**	0.0078***
Pretoria	Small		Medium		Large	
	MAIC	MSIC	MAIC	MSIC	MAIC	MSIC
1982	0.9819	0.8705	0.9163	0.9489	0.0028***	0.0274**
1987	0.8402	0.4826	0.2835	0.3998	0.0074***	0.0008***
1992	0.7368	0.4589	0.0891*	0.3541	0.2565	0.0468**
1997	0.7281	0.4541	0.0470**	0.0841*	0.0588*	0.0017***
2002	0.8902	0.5571	0.1305	0.1391	0.0853*	0.1817
2007	0.5134	0.2741	0.003***	0.0127**	0.0101**	0.0205**
Cape Town	Small		Medium		Large	
	MAIC	MSIC	MAIC	MSIC	MAIC	MSIC
1982	0.0951*	0.0048***	0.072*	0.0576*	0.0001***	0.0001***
1987	0.1315	0.0045***	0.0042***	0.0019**	0.0000***	0.0000***
1992	0.3974	0.2618	0.0465**	0.0176**	0.0000***	0.0000***
1997	0.9909	0.9517	0.3384	0.0304**	0.0000***	0.0000***
2002	0.9950	0.9934	0.3622	0.3397	0.1719	0.0382**
2007	0.8900	0.8764	0.0294**	0.2166	0.0277**	0.0032***

Note: *, **, *** indicates statistical significance at the 10%, 5% and 1% levels respectively

To test the robustness of the conclusion reached regarding the price behaviour of small, medium and large middle-segment houses and because stationarity tests may sometimes

overly reject the null hypothesis of stationarity due to their lack of power, the paper also tests for convergence to specific metropolitan house-price time series. Thus, instead of using the cross-sectional mean as denominator in the calculation of the relative house price, the paper uses in turn each metropolitan house price series as denominator. With five metropolitan areas, this yielded four series each for the large, medium and small house price categories. The recursive probabilities of the results appear in Table 4.

The results confirm the robustness of the finding that large middle-segment house prices are stationary and thus, constitute a single geographical market. In the case where Greater Johannesburg serves as denominator, IPS tests using MAIC and MSIC all indicate that medium middle-segment house prices in general tend to converge to those of Greater Johannesburg. As with the case where the cross-sectional mean is used as denominator, the results for the medium middle-segment category are rather mixed. In the case of small middle-segment houses, some evidence exist that house prices converged up to the mid-1990s, but not there after.

Forni (2004:448) states that if stationarity is accepted, in this case for relative prices of large and possibly medium middle-segment houses, it still does not imply a definite conclusion. This is a consequence of the arbitrage argument, which is inherently asymmetric. In other words, while non-stationarity implies different markets, stationarity could in principle be observed even if markets are separate. This would happen, for instance, when prices themselves are stationary, or are affected only by common sources of non-stationary variation during the sample period. However, if (log) prices are non-stationary in levels and they have been affected by several non-common sources of variation, a consistent conclusion of stationarity can be interpreted as an indication in favour of a single market. The South African middle-segment house price time series for large, medium and small houses are non-stationary in levels. Thus, the finding of stationarity for large and possibly medium middle-segment house prices across geographical areas can be accepted as an indication that this category of houses constitutes a single market.

Following a result of stationarity, and given that stationarity implies convergence towards the cross-sectional mean, allows one to raise the question of how fast this convergence will be. This requires the estimation of the speed of convergence. Given that only large and possibly middle-segment house prices display convergence, means that these are the only categories of houses for which the speed of convergence can be calculated. An indicator of the speed of convergence is the calculated half life of convergence, in this case that of large and medium middle-segment houses. The half life is calculated with Equation (5):

$$\text{Half life} = \ln(0.5)/\ln(1 + \rho). \quad (5)$$

The half lives for large and medium middle-segment houses are shown in Table 5 for the period 1967:1 to 2007:2. These results show that for large middle-segment houses the half lives of price adjustment range from two to seven quarters. In the case of medium middle-segment houses the results for Port-Elizabeth/Uitenhage, Greater Johannesburg and Cape Town indicate half lives ranging between five to eight quarters. However, Durban and Cape Town have half lives of 16 to 23 quarters. The extraordinary low adjustment speeds of Durban and Cape Town coincide with the ambiguous findings regarding the stationarity of medium middle-segment house prices.

Table 5 - Half lives of house price adjustments (measured in quarters)

	Large				Medium			
	MAIC		MSIC		MAIC		MSIC	
	ρ	Half live	ρ	Half live	ρ	Half live	ρ	Half live
Port Elizabeth/Uitenhage	-0.31	1.87	-0.28	2.11	-0.12	5.42	-0.12	5.42
Greater Johannesburg	-0.16	3.98	-0.14	4.60	-0.09	7.35	-0.09	7.35
Durban	-0.1	6.58	-0.1	6.58	-0.03	22.76	-0.03	22.76
Pretoria	-0.16	3.98	-0.15	4.27	-0.09	7.35	-0.09	7.35
Cape Town	-0.13	4.98	-0.13	4.98	-0.04	16.98	-0.03	22.76

5. CONCLUSION

This paper set out to investigate whether or not the South African middle-segment residential property market functions as a single market. The economic intuition is that if houses in two or more geographical areas belong to the same market their prices will not move far from each other in the long run. Thus, convergence to the LOOP implies that relative house prices in different geographical areas are stationary.

Based on the criterion of price convergence that is commonly used in the existing literature, the results in this paper show that large and possibly medium middle-segment house prices in the five metropolitan areas converge to the LOOP. This implies that the market for large and possibly medium middle-segment houses constitute a single market. Though the evidence for medium middle-segment houses is mixed, the strongest evidence of convergence is found in the case where Greater Johannesburg serves as denominator. Lastly, small middle-segment house prices in different metropolitan areas do not converge, at least not since the mid-1990s. This serves as evidence that the different metropolitan areas function as separate geographical markets for small middle-segment house.

BIBLIOGRAPHY

- ABSA. (2007) House price indices. *Quantec*. www.quantec.co.za
- BALTAGI, B.H. (2001) *Econometric Analysis of Panel Data*, 2nd ed. Chichester, John Wiley and Sons, Ltd.
- BRUGGERMANS, C. (2006) South Africa's Housing Boom. *Weekly Comment*. First National Bank. [Online] Available: <http://www.finb.co.za/economics/subscriptions/images/logo.gif> [08 March 2006].
- CARLTON, D. W. & PERLOFF, J. M. (2005) *Modern Industrial Organization*, 4th ed. New York, Pearson Addison Wesley.
- CECCHETTI, S., NELSON, M. & SONORA, R. (2002) Price level convergence among United States cities: Lessons for the European Central Bank. *International Economic Review*, 43(4): 1081-1099.
- DREHER, A. & KRIEGER, T. (2005) Do Gasoline Prices Converge in a Unified Europe with Non-harmonized Tax Rates? *Swiss Institute for Business Cycle Research*, (114): 1-30.

- FAN, C. S. & WEI, X. (2005) The Law of One Price: Evidence from the Transitional Economy of China. [Online] Available: <http://www.ln.edu.hk/econ/staff/xdwei/docs/fan-wei-price.pdf> [03 August 2007].
- FISHER, R. A. (1932) *Statistical methods for research workers*, Edinburgh, Oliver and Boyd.
- FORNI, M. (2004) Using Stationarity Tests in Antitrust Market Definition. *American Law and Economics*, 6(2): 441-464.
- GIDLOW, R. M. (1995) *South African Reserve Bank Monetary Policies under Dr Gerhard De Kock 1981-1989*, Pretoria, South African Reserve Bank.
- GOETZMANN, W. N. (1993) The Single Family Home in the Investment Portfolio. *Journal of Real Estate Finance and Economics*, 6: 201-222.
- GOLDBERG, P. K. & VERBOVEN, F. (2005) Market integration and convergence to the Law of One Price: evidence from the European car market. *Journal of International Economics*, 65: 49-73.
- IM, K. S., PESARAN, M. H. & SHIN, Y. (2003) Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics*: 53-75.
- ISARD, P. (1977) How Far Can We Push the "Law of One Price". *The American Economic Review*, 67(5): 942-948.
- LEVIN, A., LIN, C.-F. & CHU, S.-S. J. (2002) Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics*, 108: 1-24.
- LIPCZYNSKI, J., WILSON, J. & GODDARD, J. (2005) *Industrial Organization, Competition, Strategy, Policy*, 2nd ed. London, Pearson Education Limited.
- LUÜS, C. (2003) The ABSA residential Property market database for South Africa - key data trends and implications. *BIS Papers*, (21): 149-170.
- MONTEZUMA, J. (2004) Owner-Occupied housing and household asset allocation: A review of the issues. *Property Management*, 22(4): 267-275.
- MOTTA, M. & (2004) *Competition Policy Theory and Practice*, New York, Cambridge University Press.
- PARSLEY, D. C. & WEI, S.-J. (1996) Convergence to the Law of One Price Without Trade Barriers or Currency Fluctuations. *The Quarterly Journal of Economics*, 111(4): 1211-1236.
- SHEPHERD, W. G. (1997) *The Economic of Industrial Organization*, 4th ed. New Jersey, Prentice-Hall International, Inc.
- SMITH, L. B., ROSEN, K. T. & FALLIS, G. (1988) Recent Developments in Economic Models of housing Markets. *Journal of Economic Literature*, XXVI: 29-64.
- STIGLER, G. J. & SHERWIN, R. A. (1985) The Extent of the Market. *Journal of Law and Economics*, 28(3): 555-585.