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# RELATIONSHIP BETWEEN RESIDENTIAL PROPERTY PRICE INDEX AND MACROECONOMIC INDICATORS IN DUBAI HOUSING MARKET

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**ABSTRACT.** The main purpose of this study is to investigate whether there is a long-run relationship between macroeconomic indicators and property price index in Dubai. This paper uses the monthly data for the eight year period from January 2003 to December 2010. In order to identify long term equilibrium between property price index and macroeconomic indicators, cointegration analyses are utilized for the study. The results of the empirical analyses show that there is a long term positive equilibrium relationship not only between REIDIN.com Dubai Residential Property Price Index (DRPPI) and gold prices; but also between DRPPI and volume of total direct foreign trade. On the other hand, there is a negative long-run relationship between DRPPI and the number of completed residential units. In addition, there is a significant positive relation between DRPPI and the first lag of DRPPI and also the first lag of error term. Our paper is the first academic study that identifies this relationship in Dubai.

**KEYWORDS:** Dubai; Real estate; Residential Property Price Index; Macroeconomic indicators; Cointegration

## 1. INTRODUCTION

Over a period of half a century the city state of Dubai has progressed from pre-industrial to industrial to post-industrial status. Change is evident in the economic, social and cultural characteristics of the city and, most visibly, in the scale, pace and nature of real estate development. Dubai has also changed from an economy based on oil and trade to a centre for the service industries of tourism, trade, professional and financial services. This transition has included a rise in property construction and a massive proliferation of large-scale residential building developments in the past years. Dubai has recreated itself in the image of the cutting edge financial sector, creating buildings appealing to wealthy indigenous habitants as well as the wealthy expatriate, and offshore population. Development of the city has been energized by a synergistic relationship between global and local forces embedded within a particular historical and geographical context. Central to the planned urban growth, and as part of the city's strategy to establish itself as the region's hub for commerce, services and leisure, is the construction of a series of, cities within the city, mega-projects.

Principal among these are Burj Al Arab, Burj Khalifa (the world's tallest building), Dubai Mall (the largest shopping mall in the world), Dubai Marina, Palm Jumeirah, Dubai International Financial Center, Internet City, Festival City, Media City and International City. As seen real estate has been a key driver of growth and has been a steady and robust performer over the years. For instance, the real estate sector contributed 14.73% of Dubai's total Gross Domestic Product (GDP) in 2008 (Dubai Statistics Center, 2010). Legal factors that have been also critical to the strong development of this sector including property rights, transaction costs and capital gains taxes. With the opening up of the market to allow freehold ownership of properties to foreigners in Dubai in May 2002, international investors have driven a huge demand for properties. At that point, monitoring the evolution of property prices and the market trend over time is obviously a necessary requirement in Dubai. The REIDIN.com Dubai Residential Property Price Index (DRPPI) comes out of this necessity.

Statistics on residential property prices have a number of important uses. They are used as a macro-economic indicator of inflation, as a measurement of wealth, as a deflator for national accounts, as an input into an individual citizen's decision making on whether to invest a residential property and as an input into other price indices, most particularly the Consumer Price Index for use, amongst other things for wage bargaining or indexation (Fenwick, 2009). Additionally, as the International Monetary Fund mentioned, property price indices are direct input into an analysis of exposure to risk of default (International Monetary Fund, 2006): *"During an upswing in real estate prices, real estate may be used as collateral for extensions of credit for further purchases. But once conditions begin to reverse, such exposure can cause the downturns in economic activity, credit, and real estate prices to become mutually reinforcing."*

The main purpose of this study is to investigate whether there is a long-run relationship between Dubai's property market and macroeconomic factors. The rest of this article is organized in four sections. The next section gives brief information for the REIDIN.com Dubai residential property price index methodology. Section 3 begins by reviewing some of the existing studies on dynamic interaction between property prices and macroeconomic indicators. Section 4 explains the data and theoretical framework adopted in this study, and section 5 describes the empirical results. Finally, section 6 offers concluding comments.

## 2. BRIEF INFORMATION FOR THE REIDIN.COM DUBAI RESIDENTIAL PROPERTY PRICE INDEX METHODOLOGY

The objective of the residential property price index (RPPI) is to provide an accurate measure of the contemporary rate of change in the prices of the properties. The methods used to compile residential property price indices vary considerably both between countries and between alternative sources within individual countries. The differences between the available property price indices cover almost every aspect of price index construction: the conceptual basis of index; data sources (land registry transactions, tax records, mortgage applications and completions, estate agents, newspaper advertisements); market coverage (geographical coverage, type of property, mortgage/cash transactions); weighting (stock or transaction weighted). The problems caused by these different factors can be exacerbated by the fact that housing markets can be highly heterogeneous.

There are also four distinct approaches for constructing property price indices. The first and the easiest approach to construct indexes is the unit method. That is taking an average of all property prices observed in a period-usually

a mean or median. In general, given the heterogeneity of properties, the median is preferred to the mean. The mean method considers the values of all sales activities regardless of extremely high or low values, whereas median series considers all sales activities but is not affected by extremely high or low values. The benefit of this method is median house prices have been used by several researchers (i.e., Mark and Goldberg, 1984; Crone and Voith, 1992; Gatzlaff and Ling, 1994; Wang and Zorn, 1997; Prasad and Richards, 2006; Hoffmann and Lorenz, 2006; Olczyk and Neideck, 2007; Prasad and Richards, 2008; McDonald and Smith, 2009); however, medians also form the basis of publicly available house price indexes (Bourassa et al., 2006). Most major property price indices (including those of The U.S. National Association of Realtors, the U.S. Census Bureau, the Real Estate Institute of Australia, the Real Estate Institute of New Zealand, and the Standard Bank in South Africa) all publish house price data based on median measures (Prasad and Richards, 2006; Nhleko and Tlatsana, 2009). A second approach-the repeat sales methodology-originally developed by Bailey et al. (1963), and focuses on houses that have sold more than one. The straightforward idea motivating the repeat sales methodology is that a property's quality approximately the same over time; hence there is no need to include the properties' attributes in the model. A third approach-the hedonic regression approach-uses regression techniques to control for compositional and quality change. It treats a property as a bundle of attributes, each with its own price that changes over time. However it is a widely used technique, it requires a tremendous amount of data on property attributes (Rappaport, 2007). The final approach is the appraisal-based indexes-the Sales Price Appraisal Ratio (SPAR) approach. The method combines sale prices and valuations or appraisals from an earlier period to compute price relatives or sale price appraisal ratio's and thus controls for quality mix changes (Bourassa et al., 2006). Property price indices for a number of cities in New Zealand based on the SPAR method are published by Quotable Value, a property valuation company. The SPAR method is also being used by the statistical agencies of Sweden and the Netherlands. The method can of course only be used in countries where appraisals of sufficient quality are available (de Vries et al., 2009).

The REIDIN.com DRPPI employs the unit method-the median approach and uses sales transaction data made available exclusively through "the Government of Dubai Land Department [1]". The main advantages of that approach are the simplicity of their methodology and the data compiling stage is low cost. Another advantage is to include the new period data to the model instantly and the application methods are relatively easy to understand by the users. On the other hand, property price indices that are based on median measures can be constructed for different types and locations of housing (Diewert, 2006). But city-wide median price measures do not control for the location of houses. Cities have areas where houses tend to be more expensive and other areas where they tend to be less expensive. If the mix of houses between these groups varies significantly, it would have negative effect on median price measures. As a result, changes in median prices may contain substantial noise from regional composition change and provide poor estimates of true price changes. To control

[1] The Government of Dubai Land Department is the real estate registry for the Emirate. It is responsible for registering built and unbuilt land, villas, apartments, commercial and residential buildings, leases and mortgages throughout Dubai including the designated freehold areas. The Department records and officially authorizes as legitimate transactions involving Dubai real estate and transfers of ownership, whether these are between buyer and seller, donations, gifts or inheritance. It is Dubai's official registry, valuer, auctioneer, regulator, information provider and property overseer (http://www.dubailand.gov.ae).

for compositional change, the REIDIN.com DRPPI employs arithmetic average of the median prices of districts for constructing index series. All indices are also calculated by using a moving average algorithm. A moving average is commonly used with time series data to smooth out short-term fluctuations and highlight longer-term trends or cycles. Outliers and extreme values (as a result of incomplete, inconsistent or erroneous data) are excluded by the outlier detection procedure of the interquartile range (IQR) based on the calculated price per square meter of each property. This commonly used methodology considers any data that is more than 1.5 times the IQR from the upper or lower quartile to be an outlier (Tukey, 1977). The REIDIN.com DRPPIs are calculated by using the Dutot price index formula. The formula can be written as:

$$I_{DUTOT} = \frac{\frac{1}{n} \times \sum p_t}{\frac{1}{n} \times \sum p_0} \times 100 = \frac{\sum p_t}{\sum p_0} \times 100, \quad (1)$$

where: $p_t$ is the median of price/sqm, t months after the base period; $p_0$ is the median of price/sqm during the base period; n is the number of districts.

Dutot price index formula defined as the ratio of the unweighted arithmetic average of the prices in the current period to the unweighted arithmetic average of the prices in the base period 0. The following table shows the name of indices and their features.

The Figure 1 shows the time series of REIDIN.com Dubai Residential Property Price Index (DRPPI) for the period January 2003-December 2010.

**Table 1.** The REIDIN.com Dubai Residential Property Price Index series and prices*

| Index name | Property type | USD/SQM prices | Index start date | Update interval |
|---|---|---|---|---|
| Dubai – Residential | Residential | 2,193 | Jan 2003=100 | Monthly |
| Dubai – Apartment | Apartment | 2,400 | Jan 2003=100 | Monthly |
| Dubai – Villa | Villa | 2,018 | Jan 2003=100 | Monthly |
| Dubai (51SQM and Less) | Apartment | 2,724 | Jan 2006=100 | Monthly |
| Dubai (51SQM-100SQM) | Apartment | 2,214 | Jan 2006=100 | Monthly |
| Dubai (101SQM-150SQM) | Apartment | 2,549 | Jan 2006=100 | Monthly |
| Dubai (151SQM and More) | Apartment | 2,572 | Jan 2006=100 | Monthly |
| Arabian Ranches | Villa | 1,478 | 2005Q1=100 | Quarterly |
| Business Bay | Apartment | 3,886 | 2006Q1=100 | Quarterly |
| Discovery Gardens | Apartment | 2,076 | 2006Q2=100 | Quarterly |
| Downtown Dubai | Apartment | 3,995 | 2006Q1=100 | Quarterly |
| Dubai Marina | Apartment | 2,654 | 2003Q1=100 | Quarterly |
| Dubai Sports City | Apartment | 2,372 | 2007Q1=100 | Quarterly |
| Emirates Hills First | Apartment | 2,231 | 2004Q1=100 | Quarterly |
| International City | Apartment | 1,413 | 2005Q2=100 | Quarterly |
| Jumeirah Beach Residences | Apartment | 3,029 | 2007Q1=100 | Quarterly |
| Jumeirah Lake Towers | Apartment | 2,225 | 2004Q1=100 | Quarterly |
| Mirdiff | Villa | 1,136 | 2005Q1=100 | Quarterly |
| Old Town | Apartment | 4,019 | 2006Q1=100 | Quarterly |
| Palm Jumeirah | Apartment | 3,005 | 2007Q1=100 | Quarterly |
| Palm Fronds | Villa | 2,502 | 2007Q1=100 | Quarterly |
| The Greens | Apartment | 2,620 | 2003Q1=100 | Quarterly |
| The Springs&The Meadows | Villa | 1,684 | 2003Q1=100 | Quarterly |

*USD/SQM values as of December 2010 and 4th Quarter of 2010.

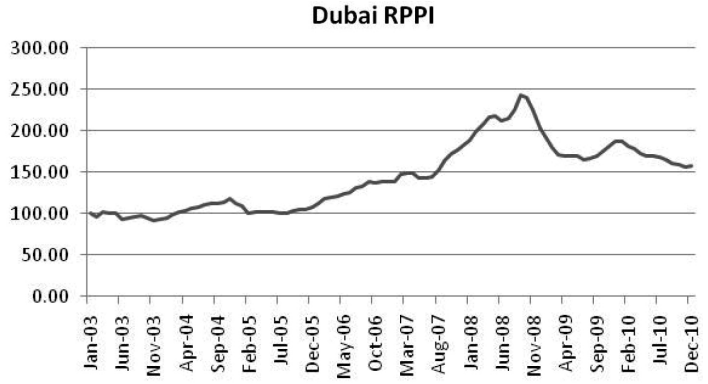


**Figure 1.** REIDIN.com Dubai Residential Property Price Index (DRPPI) (January 2003=100)

## 3. LITERATURE REVIEW

In the context of real estate research, the academic studies primarily focus on the relationship between the housing sector and a common set of macroeconomic variables. Nellis and Longbottom (1981) find that the determinants of housing price in the United Kingdom are real disposable income, loan interest rates, and total loans. Reichert (1990) identifies that regional housing prices react uniformly to certain national economic factors, such as mortgage rates.

On the other hand, local factors such as population shifts, employment, and income trends often have a unique impact on housing prices. Clapp and Giaccotto (1994) study the influence of economic variables on local house price dynamics and find that some variables (including population, employment and income) have considerable forecasting ability for housing price. To identify the factors influencing yearly urban housing prices, Potepan (1996) uses a number of indicators including the privately owned dwelling price index, monthly rent based on the Hedonic Model, land price, medium income, population, quality of public services, crime rate, air pollution, non-dwelling consumable price, mortgage rate, construction cost, farm land price, land restriction and so on. Baffoe-Bonnie (1998) uses a nonstructural estimation technique (a vector autoregression (VAR) model) to analyze the dynamic effects of four key macroeconomic variables on housing prices and the stock of houses sold in US sub regions. The impulse response functions derived from the VAR suggest that the housing market is very sensitive to shocks in the employment growth and mortgage rate at both national and regional levels. Case (2000) discusses global macroeconomic effects on US house prices. He notes that the impact of fundamentals depends on the openness of the different states.

By applying the vector error correction model (VECM), Kasparova and White (2001) examine the housing markets in selected European countries, including Germany and the UK. Granger tests reveal that the effect of house prices on GDP is significantly greater than the effect of GDP on house prices. Tsatsaronis and Zhu (2004) look at the importance of a number of macroeconomic factors affecting the dynamics of residential property prices. The authors examine the determinants of house prices for 17 industrialized economies between 1970 and 2003 by employing a vector autoregression (VAR) model. The model includes five endogenous variables besides house price growth: the growth rate of GDP, the rate of inflation in consumer prices, the real short-term interest rate, the term spread, and the growth rate in inflation adjusted bank credit. The main finding of their study is that economic growth, inflation and interest rates, bank lending, and equity prices have significant explanatory power on

house price movements. Hofmann (2004) analyses the patterns of dynamic interaction between bank lending and property prices based on a sample of 20 developed countries using both time series and panel data techniques. The main finding of his study is that long-run causality appears to go from property prices to bank lending. This finding suggests that property price cycles, reflecting changing beliefs about future economic prospects, drive credit cycles, rather than excessive bank lending being the cause of property price bubbles.

McGibany and Nourzad (2004) use Granger non-causality tests, impulse response functions and variance decompositions to analyze the long- and short-run relationships between housing prices and mortgage rates, and identify that there is virtually no short-run influence from mortgage rates to housing prices. Fraser et al. (2008) analyze New Zealand's actual (real) house prices relative to fundamental (real) house values for the period 1970-2005 in order to ascertain whether increases in house prices are justified by changes in expectations about fundamentals. Using a dynamic present value model, the authors detect disparities between actual and fundamental house prices in the early 1970s and 1980s and from 2000 to 2005. Accordingly, a significant proportion of the overvaluation results from price dynamics rather than from fundamentals.

The previous studies focus on industrialized economies, whereas Yang and Lu (2003), Shen and Liu (2004), and Zhu (2006) provide complementary insights for emerging market economies. Yang and Lu (2003) classify the factors which influence the housing prices into three areas: population (including urban population and family population), economic factors (including income of urban residents, CPI, interest rate, housing rent and development cost) and factors used for forecasts. Using the panel data of housing prices and economic fundamentals (including disposable income, population, unemployment rate, vacancy rate and construction cost) for 14 Chinese cities 1995–2002. Shen and Liu (2004) investigate the city level interactions of housing prices and economic fundamentals in China with the Pooled Least Squares and Dummy Variable Regression Model. Zhu (2006) examines the long run relationship between macroeconomic variables and house price dynamics (including GDP, bank credit, equity prices, short term rate, CPI and exchange rate) in six Asia-Pacific (China, Hong Kong SAR, Indonesia, South Korea, Singapore and Thailand) economies by applying the two-step error correction method (ECM). He suggests that the driving factors behind house prices tend to be country-specific. For instance, bank credit has an important impact on house prices in all the economies except the one with the least developed banking sector (Indonesia). In addition, GDP and house prices are negatively related in South Korea and Singapore and unrelated in Hong Kong, and short-term interest rates are positively related to house prices in China, Korea and Singapore. On the other hand, there is no any previous study analyzing property price movements and macroeconomic indicators in Dubai, an emerging market. At this point, our paper is the first attempt that identifies this relationship.

## 4. DATA AND THE THEORETICAL FRAMEWORK

The main purpose of this study is to investigate whether there is a long-run relationship between macroeconomic indicators and property price index in Dubai during the period from January 2003 to December 2010. Monthly time series of REIDIN.com Dubai Residential Property Price Index (DRPPI) data is used as the substitution variable for property price index. Gold price (USD/Ons); Dubai's volume of total direct foreign trade and number of completed residential units; the United Arab Emirates (UAE) interest rate on personal loan, consumer price index, total population, monetary aggregate and gross domestic product are considered into the model as the macroeconomic in-

dicators. The Standard & Poor's Case-Shiller Composite-20 house price index is also included into the model for determining the affects of non-Dubai factors. Data sets are compiled from Dubai Statistics Centre, Dubai Department of Economic Development, Central Bank of the UAE and the Standard & Poor's. Since the data on total direct foreign trade, number of completed residential units, interest rate on personal loan, consumer price index, total population and monetary aggregate and gross domestic product are not available monthly, the annual and quarterly series on these data are converted into monthly data by constant conversion technique so as to make use of them together with monthly data on residential property prices.

In order to identify long term equilibrium between property price index and macroeconomic indicators, cointegration analyses are utilized in this study. The concept of cointegration and the implications of cointegrating relationships are very relevant in the real estate market. Real estate economic and investment theory often suggests that two or more variables would be expected to hold some long-run relationship with one another. Therefore, cointegration analysis is a crucial tool for the existence of such a long-run relationship (Brooks and Tsolacos, 2010). There are a number of methods for testing cointegration in the literature. This article considers two most commonly used tests of cointegration; namely Engle-Granger (EG) or Augmented Engle-Granger (AEG) test and Cointegrating Regression Durbin Watson (CRDW) test (Gujurati, 2004).

## 5. EMPIRICAL RESULTS

### 5.1. Development of the model

Our aim is to investigate whether there is a long-term relationship between macroeconomic indicators (gold price index, total direct foreign trade, number of completed residential units, interest rate on personal loan, consumer price index, total population, monetary aggregate, gross domestic product, the Standard & Poor's Case-Shiller Composite-20 house price index) and property price index in Dubai. To find the relationship between them, Dubai Residential Property Price Index (DRPPI) are regressed on the macroeconomic indicators.

The simplest regression model can be written as

$$DRPPI_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon_t, \quad (2)$$

where: *DRPPI* is Dubai Residential Property Price Index; $X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8$ and $X_9$ are gold price index, total direct foreign trade, number of completed residential units, interest rate on personal loan, consumer price index, total population, monetary aggregate, gross domestic product and the Standard & Poor's Case-Shiller Composite-20 house price index respectively; $\varepsilon_t$ is the error term and the subscript t represents time; $\beta_0$ is intercept term; and finally $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$, $\beta_6$, $\beta_7$, $\beta_8$ and $\beta_9$ are the estimators of gold price index, total direct foreign trade, number of completed residential units, interest rate on personal loan, consumer price index, total population, monetary aggregate, gross domestic product, the Standard & Poor's Case-Shiller Composite-20 house price index respectively.

By using Eviews 5.0 statistical package, we obtain the following estimated ordinary least square results for equation 2:

$$\widehat{DRPPI_t} = -155.41 + 0.235X_1 + 0.316X_2 + 1.614X_4 + 1.81X_5 - 2.447X_6 - 0.165X_7 + 021X_8 - 0.609X_9. \quad (3)$$

In this model, p-values of $\beta_0$, $\beta_1$, $\beta_2$ and $\beta_3$ are all within acceptable range and they are significance at 5% significance level. On the other hand $\beta_4$, $\beta_5$, $\beta_6$, $\beta_7$, $\beta_8$ and $\beta_9$ are not significance at 5% significance level. So $X_4$, $X_5$, $X_6$, $X_7$, $X_8$ and $X_9$ are ignored in this model.

By ignoring $X_4$, $X_5$, $X_6$, $X_7$, $X_8$ and $X_9$ we obtain the following estimated ordinary least square results:

$$\widehat{DRPPI_t} = 46.081 + 0.156X_1 + 0.433X_2 - 0.147X_3. \quad (4)$$

P-values of $\beta_0$, $\beta_1$, $\beta_2$ and $\beta_3$ are all within acceptable range and they are significance at 5% significance level in the model. Finally, p-values of the F-statistics are zero.

There is, however, a possibility that the ordinary least square results may be misleading due to inappropriate standard errors because of the presence of heteroskedasticity. In order to test whether error terms are heteroskedastic or not, White heteroskedasticity test (cross terms) is carried out (White, 1980). The probability value of 0.000029 in this test indicates that error terms are jointly significant even at 5% significance level, meaning that they are heteroskedastic in our model.

We need also to test for serial correlation. Breusch – Godfrey Serial Correlation LM test is applied. The (effectively) zero probability value in this test strongly indicates the presence of serial correlation in the residuals. In the presence of serial correlation, the ordinary least square estimators are still unbiased as well as consistent and asymptotically normally distributed, but they are no longer efficient, meaning that standard errors are estimated in the wrong way and, therefore, usual confidence intervals and hypothesestests are unreliable. Moreover, usually, the finding of autocorrelation is also an indication that the model is misspecified. Newey and West (1987) proposed a general covariance estimator. The covariance estimator is used to try to overcome autocorrelation and heteroskedasticity in the error terms in the model. In order to correct the standard errors for autocorrelation and heteroskedasticity, the model is re-estimated by ordinary least square with Newey-West procedure[3] and then $X_1$ became insignificant at 5% significance level. Based on these results, the model is misspecified.

Since it is obvious that the conventional econometric model is not the appropriate one in our case, we have estimated more models in order to determine the right specification, by choosing from the different models estimated on R-Squared, Adjusted R-Squared, the Akaike, Schwarz's Bayesian information criteria. After experimenting with various functional forms, from R-Squared, Adjusted RSquared, the Akaike and Schwarz criterias' point of view, the proper model to best adjust the data below is specified and estimated.

$$DRPPI_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 DRPPI_{t-1} + \beta_5 \varepsilon_{t-1} + \varepsilon_t, \quad (5)$$

where: $DRPPI_{t-1}$ is the first lag of the Dubai RPPI; $\varepsilon_{t-1}$ is the first lag of error term; and t is a trend that increases by one for each observation.

By using Eviews 5.0 statistical package, we obtain the following estimated ordinary least square results for equation 5:

$$\widehat{DRPPI_t} = 7.924 + 0.085X_1 + 0.066X_2 - 0.046X_3 + 0.809DRPPI_{t-1} + 0.405\varepsilon_{t-1}. \quad (6)$$

This last model is obviously the best one. p-values of $\beta_0$, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$ and $\beta_5$ are all within acceptable range and they are significance at 5% significance level. As for "goodness-of" measures "$R^2$" and "Adjusted $R^2$" values are about 0.99 and 0.99 respectively, which indicate the regression fits almost perfectly. Finally, p-values of the F-statistics are zero.

[3] Newey and West procedure may not appropriate in small samples. Since we have 96 obsarvation, our samples may be regarded as reasonable large.

The Akaike, Schwarz's Bayesian information criteria are 6.098 and 6.273 respectively which are minimum values in experimenting with various functional forms. It obviously shows that the first lag of the Dubai RPPI and the first lag of error term have significant and important effect on our model.

White heteroskedasticity test (cross terms) and Breusch–Godfrey Serial Correlation LM test are carried out once more for the new model. The results indicate that we have heteroskedasticity and serial correlation in our model. In order to correct the standard errors for autocorrelation and heteroskedasticity, the model is re-estimated by ordinary least square with Newey-West procedure and it is seen that all coefficients are significant at 5% significance level. Although all econometric indicators support the appropriateness of this model, a formal test for functional form namely Ramsey's RESET test, is also carried out to make sure that our specification is correct. This test does not indicate a specification problem in our model at the 5% level of significance. That is, the model appears to be free from misspecification.

### 5.2. Cointegration analysis

As indicated before, since it is critical to find out whether the results obtained from our model are meaningful (i.e., not spurious) or not, let we apply formal unit root tests in each series to test the reliability of our estimates.

#### 5.2.1. The Augmented Dickey-Fuller (ADF) test

The established standard procedure for cointegration analysis is to start with unit root tests on the time series data being analyzed. The ADF test is used to test for the presence of unit roots and establish the order of integration of the variables in the model.

Table 2 shows the results of the ADF unit root tests [4]. The null hypothesis of the test is that there is a unit root against the alternative one that there is no unit root in the variables.

The ADF statistics for DRPPI, gold price index, total direct foreign trade and number of completed residential units are all insignificant at 5% level of significance, which leads to nonrejection of the null hypothesis that there is a unit root problem in the variables. Based on ADF test, it is obvious that the variables are nonstationary.

As mentioned previously, differencing has the effect of making the variable stationary.

[4] Two lags have been used in ADF unit root tests.

**Table 2.** Summary of ADF tests for unit roots in the variables (in level from with a trend and intercept)

| Variable | ADF Test | Probability | Results |
|---|---|---|---|
| DRPPI | –2.803 | 0.200 | Fail to reject the null |
| Gold Price Index | –2.385 | 0.384 | Fail to reject the null |
| Total Direct Foreign Trade | –1.959 | 0.614 | Fail to reject the null |
| No. of Completed Residential Units | –2.568 | 0.296 | Fail to reject the null |

**Table 3.** Summary of ADF tests for unit roots in the variables (in 1st difference from with a trend and intercept)

| Variable | ADF Test | Probability | Results |
|---|---|---|---|
| Δ DRPPI | –5.318 | 0.0002 | Reject the null |
| Δ Gold Price Index | –4.935 | 0.0007 | Reject the null |
| Δ Total Direct Foreign Trade | –5.251 | 0.0002 | Reject the null |
| Δ No. of Completed Residential Units | –5.324 | 0.0002 | Reject the null |

Table 3 summarizes the results of unit root tests for first difference variables.

The ADF test statistics for the first difference variables are all significant at 5% level of significance, which leads to rejection of the null hypothesis that there is a unit root problem in the variables. Based on ADF test, it is apparent that the first difference variables are stationary, which implies that the variables are integrated of order one, I(1).

### 5.2.2. Augmented Engle-Granger (AEG) test

The residuals from the estimation of equation 5 are used to test for the existence of cointegrating relationship between the variables. The null hypothesis is that the residuals have a unit root problem against the alternative that the variables cointegrate.

AEG test statistics and the probability of the test are -5.59 and 0.0001, respectively. This test indicates that residuals are significant at 5% significance level, meaning that that the null hypothesis is rejected. To reject the null hypothesis implies that the residuals have not a unit root problem, i.e., they are stationary. It can therefore be concluded that, based on the AEG method, the variables are cointegrated.

### 5.2.3. Cointegrating Regression Durbin–Watson test

Since cointegration is very crucial to the reliability of estimated parameters, a second test, namely CRDW test, was carried out to make sure that the variables in this study are definitely cointegrated. The Durbin–Watson statistic for the regression represented by equation (5) is 1.68, which is above the 1% critical value of 0.511. Therefore, we fail to reject the null hypothesis of cointegration at the 1% level.

To sum up, our conclusion is based on both the AEG and CRDW tests giving the variables that DRPPI, gold price index, total direct foreign trade and number of completed residential units are cointegrated. Depending on these results, we may infer that the appropriate model for DRPPI is the one represented in equation (5) and determines that our estimations are reliable, i.e., not spurious.

Equation 6 reflects that there is not only a positive long-run relationship between DRPPI and gold prices (USD/Ons); but also a positive relationship between DRPPI and volume of total direct foreign trade. Both increased in gold prices and volume of total direct foreign trade increased property price index in Dubai from January 2003 to December 2010. In figures, when the gold prices (USD/Ons) increased by 1 point then DRPPI increased by 0.085 point and when volume of total direct foreign trade increased by 1 point then DRPPI increased by 0.066 point.

On the other hand, equation 6 also reflects that there is a negative long-run relationship between DRPPI and the number of completed residential units which is the result of the oversupply of real estate puts downward pressure on property prices. In figures, when the number of completed residential units increased by 1 point then DRPPI decreased by 0.046 point.

In addition, equation 6 reveals that there is a significant positive relation between *DRPPI* and the first lag of *DRPPI* and also the first lag of error term. In figures, when $DRPPI_{t-1}$ and $\varepsilon_{t-1}$ increased by 1 point, the *DRPPI* increased by 0.809 and 0.405 point respectively.

## 6. CONCLUSION

Dubai has developed into a city of regional importance, with a planned objective of becoming a city of significance within the global urban economic system. This development has included a rise in property construction and a massive proliferation of large-scale residential building developments in the past years. At that point, monitoring the evolution of property

prices and the market trend over time is obviously a necessary requirement. Changes in housing prices are of interest to households, policy-makers and those involved in the housing industry. This has been the case both in Dubai and in other cities or countries where house price developments are having significant macroeconomic impacts.

In this paper, we firstly give brief information about the construction of REIDIN.com Dubai Residential Property Price Index (DRPPI), which employs the unit method-the median approach and uses sales transaction data made available exclusively through "the Government of Dubai Land Department". Within this paper we want to highlight the empirical relevance of the interplay between macroeconomic indicators and property price index in Dubai. In order to identify this relationship, this paper uses the REIDIN.com DRPPI as the substitution variable for property price index and macroeconomic indicators including gold price, total direct foreign trade, number of completed residential units, interest rate on personal loan, consumer price index, total population, monetary aggregate, gross domestic product, the Standard & Poor's Case-Shiller Composite-20 house price index.

This study implements a cointegration analysis from January 2003 to December 2010, and its results show a long term positive equilibrium relationship not only between REIDIN.com DRPPI and gold prices; but also between DRPPI and volume of total direct foreign trade. Firstly Dubai is known as the "City of Gold" and for good reason. On an annual basis, Dubai imports 300 tons of gold for retail and wholesale; much of this is routed through Dubai to other GCC countries, as Dubai has become a regional hub for gold and jewellery trading. Secondly Dubai is also well known for the success of its foreign trade strategy. It boasts of modern ports and efficient support services and facilities; making Dubai not only a gateway of products from Europe, America, Oceania and Asian to the Middle East and North Africa, but as port of transshipment, comparable to the port of Singapore and Hong Kong. Those are the factors that lead to increase both national and household income, and put upward pressure on property prices. On the other hand, we find a negative long-run relationship between DRPPI and the number of completed residential units. That is excess supply puts downward pressure on property prices. In addition, there is a significant positive relation between DRPPI and the first lag of DRPPI and also the first lag of error term.

Consequently, our findings underline the imperative for long-run real estate policy targets by taking into account the long-run macroeconomic indicators such as gold price, total direct foreign trade and number of completed residential units. Additionally, given these findings, various agencies and private concerns may consider using, or feel more confident in using, real estate investment as an indicator in their activities. The results may provide insight into real estate investment-macroeconomic relationships in other emerging markets but for which data may not yet be readily available. Moreover, it will also contribute for improving the accuracy of property value forecasting and for stabilizing property values on the Dubai housing market. On the other hand, for the government side, in addition to macroeconomic indicators future rises, falls, and turning points of the property prices puts into perspective the effects of government policy created to deal with them. Revealing the duration and magnitude of cycles allow for better understanding of the course of property prices, which, in turn, helps government policy-makers take the best stance in reaction to the price changes. Further researches might also use this information for building models that connect real estate market and the macroeconomic indicators.

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REIDIN.com is the world's first global business information service, that is designed to meet the unique requirements of real estate market professionals who are interested in the emerging countries, develops residential property price indices for number of countries including Dubai. We would like to thank REIDIN.com as their index plays an essential role on this study.

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**SANTRAUKA**

**SANTYKIS TARP GYVENAMOJO NT INDEKSO IR MAKROEKONOMINIŲ RODIKLIŲ DUBAJAUS BŪSTO RINKOJE**

**Ali HEPŞEN, Metin VATANSEVER**

Pagrindinis tyrimo tikslas – išnagrinėti, ar makroekonominius rodiklius ir NT kainų indeksą Dubajuje sieja ilgalaikis santykis. Darbe naudojami aštuonerių metų (nuo 2003 m. sausio iki 2010 m. gruodžio) mėnesiniai duomenys. Siekiant nustatyti ilgalaikę pusiausvyrą tarp NT kainų indekso ir makroekonominių rodiklių, tyrimui naudojamos kointegracijos analizės. Empirinių analizių rezultatai rodo ilgalaikį teigiamą pusiausvyros santykį ne tik tarp REIDIN.com skelbiamo Dubajaus gyvenamojo NT kainų indekso (DRPPI) ir aukso kainų, bet ir tarp DRPPI ir bendros tiesioginės užsienio prekybos apimčių. Kita vertus, nustatytas ilgalaikis neigiamas santykis tarp DRPPI ir pastatytų būstų skaičiaus. Be to, nustatytas reikšmingas teigiamas santykis tarp DRPPI ir jo pirmojo vėlavimo (angl. *first lag*) bei paklaidos pirmojo vėlavimo. Šis darbas – pirmas mokslinis tyrimas, kuriame nustatomas šis santykis Dubajaus atveju.