INTERNATIONAL REAL ESTATE INVESTMENTS:

AN ANALYSIS OF THE PUBLIC AND PRIVATE MARKETS IN
SINGAPORE, THAILAND, CHINA AND INDONESIA

by

Alfonzo Leon

Bachelor in Science in Architecture, University of Virginia, 1997

Submitted to the Department of Urban Studies and Planning in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE IN REAL ESTATE DEVELOPMENT

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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Signature of Author _____

Alfonzo Leon
Department of Urban Studies and Planning
August 2, 1999

Certified by _____

William C. Wheaton
Professor of Economics
Thesis Supervisor

Accepted by _____

William C. Wheaton
Chairman, Interdisciplinary Degree Program in Real Estate

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ABSTRACT

In the past, international real estate investment has consisted of direct equity investment in foreign countries. Such investments have traditionally been considered to provide diversification benefits given that it was assumed that such properties were affected predominately by their respective domestic economies. Of course another benefit of international investment is the ability to seek out the best risk adjusted returns, wherever they may be.

Due to the recent globalization and securitization trends, today investors are finding that they have another investment option, international real estate public markets. This thesis addresses several of the issues related to the emergence of these markets in four countries: Singapore, Thailand, China and Indonesia. For each of these countries extensive data was obtained for both the private and public markets in order to statistically examine various related relationships. Specifically, this thesis attempts to find answers to the three following questions:
Are GDP, rents, private, and public prices following a random walk or a trend-reverting pattern?
How does the local economy affect the real estate markets?
How do the public and private real estate markets relate with each other?
It is important to note that the purpose of this thesis was to systematically examine the data, and then to present the results. An in-depth analysis of the results was not the intent.

For Question one it was found that the majority of the public prices were random whereas the results for rents and private prices were mixed. Also, an absence of any significant trends was found for the real estate data. These results would tend to indicate that for all of the countries studied the public market was much more volatile, and presumably efficient, than the private market.

Question two related directly to the issue of diversification. A significant contemporaneous relationship was found to exist between GDP and the private market. And an even stronger contemporaneous linkage between GDP and public prices was also found. It was thus concluded that shifting from direct investment to public market investment would not likely increase diversification benefits.

The results for Question three indicated a strong contemporaneous relationship between rents and private prices. The lagged relationships for the rents-public was found to be stronger than the contemporaneous in all the cases. The results for the private-public relationship were not consistent. For all the countries, except China public prices were found to lead private prices.

Thesis Supervisor: William C. Wheaton
Title: Professor of Economics

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CHAPTER 1: INTRODUCTION

1.1 PUBLIC MARKET RELEVANCE

The recent emergence of the public real estate markets in many countries has effectively changed the nature of real estate investment worldwide. Real estate investors can now either directly purchase properties, or buy public securities with claims on these underlying properties. Obviously a major consequence of a developed, efficient public market is the dramatic increase in the ease with which investors can add international real estate to their portfolios. Foreign investors will no longer have to buy properties outright, and subsequently be subjected to all of the associated cross-cultural difficulties of direct equity investment. Thus, as a direct consequence of the emergence of the public markets, investors will enjoy increased real estate liquidity in these foreign markets.

Furthermore, unlike buying stock in other industries where the intangible component is greater, buying stock in publicly traded real estate in essences just a claim in the underlying buildings. Therefore an investor can essentially acquire comparable real estate assets through either the private or the public markets. This unique ability poses several important issues concerning the relationship between the public and private markets that are important to real estate investors as they evaluate their options. One of the most obvious issues is the exact relationship between the private and public markets. Since public and private prices are valued in large part by discounting future rent income, it stands to reason that there should be a large degree of correlation between public, private, and rent prices. However, the extent to which this is the case is unclear. Some economists even argue that it is theoretically possible for the public and private markets to be grossly out of line, possibly to the point where there is no correlation at all between them at all.

Another key concern is the time relationship between the public and private markets. Those that argue that public markets are more efficient that private markets believe that the public markets should lead the private markets. That is, that the public market should react quicker to changes in real estate

fundamentals, which affect the rent cash flows or discount rates used as determinants of private prices, than even the private prices themselves. If this is the case, then public markets are said to be "forward looking" since they are predicting asset price changes before they actually occur. Such scenario indicates the inability of private prices to fully reflect the same level information incorporated by the public prices which are priced daily. But if there is no lead, indicating that the public markets mirror current asset prices, then the public markets are said to be myopic, or "backwards looking". In that case investors are simply extending the previous rent cash flows into the future to forecast future asset prices.

The implications of a forward looking, efficient public real estate market are profound. The existence of such a market would enforce investment discipline. Some economists and industry experts believe that this discipline may actually put an end to the vicious boom/bust cycles that have traditionally characterized the real estate industry of most countries, or at least lessen their severity. It stands to reason that as the public real estate markets grow in size, particularly in North America, Europe, and the Far East, this increased market discipline should create a more stable supply and demand balance.

The extent to which GDP affects both the public and private markets is also an interesting question to address. One would expect rents to be highly correlated with GDP since it follows that space demand increases more in good economic times than in bad. And since public prices and private prices are a function of rent prices, then all three variables should be highly correlated. However, again, the exact nature of these relationships is not clear. An increase in demand might very well cause an increase in development leading to overbuilding. In such a case rents might actually fall in good economic times. Also, firms may be inclined to "stockpile" space in economic downturns because rent prices are low, which may result in rents being bid up. And like the public-private relationship, the issue of time complicates matters even further. If public prices react more quickly to external influences like changes in GDP, then a predominately contemporaneous relationship should be found. And following the same logic, if private prices react more slowly to changes in GDP, either via rent price fluctuations or otherwise, then GDP should lead private prices.

The exact relationship that GDP has on rent, public, and private prices has direct consequences on the diversification benefits of international investment. Properties whose returns are highly correlated with their associated domestic economy, but not greatly affected by the global economy, produce the greatest diversification benefits for the international investor. To be more precise, the country specific influences can be labeled as non-systematic, idiosyncratic risks and the global economy as systematic risks. Modern portfolio theory states that investing in several different assets of varying volatility and return diversified away the non-systemic risks in a portfolio[1] and produces the optimal risk-reward trade-off. The reason being that the positive influences of one economy on a portfolio would offset the negative influences of another. Removing the country specific risk from a portfolio leaves the systematic risk which can not be diversified away. The portfolio as a whole is then less volatile which translates into less risk. However, if public markets are affected more by global economic fluctuations than by the local economy, then investing in public securities would tend to increase the systematic risks, and thus reduce the benefits of diversification.

In addition to analyzing the intra-market and GDP relationships, it is also important to ascertain whether or not any predictability in the economic data is present. If historical trend patterns can be identified and modeled to forecast public or private price levels, for example, then investors could conceivably profit by investing in depressed markets and selling in inflated markets. However, if the data follows a random walk then no investor using a trend-reverting forecast could ever produce abnormal positive results.

Determining whether the real estate markets follow random walks or not would also allow for a better understanding of the relationship between markets. Real estate economic theory indicates that in the long run the price of a real estate asset should be a function of its replacement cost[2], and thus should revert back to a "normal" level based on cost regardless of short-run fluctuations. If private prices reflect

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[1] Harry Markowitz, "Portfolio Selection", Journal of Finance, March 1952
[2] D. DiPasquale, W. Wheaton, "Urban Economics and Real Estate Markets" 1996

this replacement cost, private prices should show some level of persistence. Another reason to believe prices should show some level of persistence is the effect of rent leases on building value. A building's value depends on its rent cash flows, which change rather slowly given the existence of long-term leases. Overlapping lease terms with relatively stable rents would tend to smooth a building's value as it moves through periods of economic expansion and contraction and as a result should create a private price series with some level of persistence. The public price series, on the other hand, should tend to be uncorrelated across time as it reflects the latest available information on projected returns and thus allow for no arbitrage across time. If so, then the most recent quoted price is the best estimate for tomorrow's price and one would expect any difference between them to be purely random.

1.2 THESIS OBJECTIVE

This thesis attempts to take a look at several of the previously described issues relating to the emergence of international public markets. Specifically, three questions will be addressed for four different countries and the United States (included for reference). They are listed below.

1) Are GDP, rents, private, and public prices following a random walk or a trend-reverting pattern?

2) How does the local economy affect the real estate markets?

3) How do the public and private real estate markets relate with each other?

All of these questions address issues that international real estate investors need to gain a better understanding of these markets before they invest in them. In question three, if persistence can be found in the data, then investors can create econometric models to predict future returns. In question two, by measuring the extent that GDP affects both the public and private markets, investors can access the diversification benefits of their international real estate investments. In question three, by addressing the relationship between private and public markets we can determine whether or not these markets are efficient.

1.3 PREVIOUS RESEARCH

Given that the interest and development in international public real estate markets is a relatively recent event, there has been practically no research done on the subject. The main reason is that there simply has not been enough data for comprehensive statistical analysis. Global Property Research (GPR) only began collecting data around the mid-1980's. In fact, though they have 15 years of data, they only use 1990 as the base year of their GPR 250 index citing that "before this time the breadth and liquidity of the market was not sufficient to provide a well-balanced index"[3].

On the other hand, available international private data dates back much further, usually to the early 1970s. Not surprisingly, there have been several papers written addressing private market issues. The most relevant for this thesis is a preliminarily paper being prepared by Yale professors Bradford Case, William Goetzmann, and K. Geert Rouwenhorst. Their paper, "Global Real Estate Markets--Cycles and Fundamentals", looks at the issue of the influence of global GDP on the private real estate values in different international countries[4]. They attempt to separate the domestic GDP into two components; that effected by global economic events and that exclusively related to domestic economic conditions for 22 markets in 21 countries. As previously discussed, this has direct implications relating to the ability of investors to diversify away country specific, non-systematic risk.

By using an equal-weighted GDP index to represent the global GDP, Case et. al. discovered that "removing the effects of global GDP from returns significantly decreased global real estate market correlations"[5], even more so than when local GDP effects were removed. They concluded that 1) private property returns fluctuate with changes in the domestic GDP, 2) the relationship between domestic GDP and returns is contemporaneous, and 3) global influences have a large effect on domestic GDP. Based on

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[3] P. Eichholtz, N. De Graaf, W. Kastrop, H. Op't Veld, "Introducing the GPR 250 Property Share Index", Real Estate Finance, Spring 1998, p.55

[4] B. Case, W. Goetzmann, K. Geert Rouwenhorst, "Global Real Estate Markets, Cycles and Fundamentals", 1999.

[5] Op. Cit., B. Case, W. Goetzmann, K. Geert Rouwenhorst, p. 3

these conclusions, they proposed that international diversification is effective only when investing in industrial properties since it has been shown that such properties tend to be less correlated with GDP in general.

The implications of the Yale paper for this thesis are sizable with respect to the ability of international real estate investment to diversify a given portfolio. If the paper's conclusions are correct, there should be a high degree of contemporaneous correlation between a given country's GDP and that country's private asset prices. In view of this, this thesis seeks to answer the following: How does GDP affect the public prices, and subsequently what is the relationship between the public market prices and the private prices? If there is a large contemporaneous correlation between domestic GDP and public prices, then there is effectively no "escape" from the effects of global economic fluctuations. This would mean that investors could not decrease their systematic risk by shifting from direct private investment to public real estate securities.

If it is found that there is a strong correlation between GDP and the public prices, then the relationship between the public prices and private prices becomes even more important. A large and contemporaneous link would indicate that GDP would immediately effect private prices both directly and via the public market. If the effect is lagged however, then prudent private investors could conceivable use the public markets to influence their buy/sell decision so as to catch/avoid the private market lag effect. Of course, they would still be affected by any contemporaneous GDP/private prices relationship.

In another paper published in 1995, Richard Barkham and David Geltner[6] examined the public and private commercial property markets in the United States and in the United Kingdom for evidence of price discovery. They defined price discovery as the process by which asset market prices are formed, or more formally, as the statistical significance of past returns in one market in the forecasting of future

[6] R. Barkham and D. Geltner, "Price Discovery in American and British Property Markets", Real Estate Economics, V23, 1995, pp.21-44

returns in the other market. Their goal was to see if price discovery may occur in either the private or pubic markets, and then be transmitted to the other.

Barkham and Geltner discovered that price discovery occurs first in the securities markets in both countries, and does not completely transmit to the unsecuritized property markets for about a year, perhaps even longer in the United States. These findings suggest that public markets are more efficient than private markets in the US and UK because they reflect all available information faster, and since private prices follow only after a lag. The results of this paper tend to add weight to the possibility of finding pubic markets leading the private markets in other countries as well.

In another article published in 1996, Chiong-Long Kuo studied the behavior of residential related data series for several cities in the United State[7]. He tested the common belief that the private real estate market may be less efficient than the markets of more liquid financial assets, and may not follow a random walk like stocks or bonds. In his article he proposed a two-step, two-sample method and a Bayesian method to estimate the serial correlation and test the price behavior in the residential markets of Atlanta, Dallas, Chicago and San Francisco. Kuo's results supported the rejection of the random walk hypothesis, indicating strong persistence in residential house price in three of the four analyzed cities. These findings are of enormous importance because they suggest that investors could potentially create trend-reverting models to predict future residential real estate returns. If this is the case, then the same might be true for the office markets addressed in this study.

[7] Chiong-Long Kuo, "Serial Correlation and Seasonality in real estate market", Journal of Real Estate Finance and Economics, 12, 1996, pp.139-162

1.4 GENERAL FINDINGS

1.4.1 Question 1: Are GDP, rents, private, and public prices following a random walk or a trend - reverting pattern?

- The presence of a constant time-related trend was consistently found in the GDP time series. All the other variables proved to be time independent.
- When the behavior of the series were analyzed, the results for GDP, rents and private prices indicated a trend-reverting pattern in almost all of the cases. On the other hand, the results for the public prices analysis unequivocally showed that public markets in all countries were following a random walk.

These results confirm the findings presented in Kuo's paper. Only in one out of the four European cities private property markets followed a random walk. The consistent results across countries regarding the randomness of the public markets support the hypothesis of an efficient highly liquid spot market. The fact that only GDP data was trending during the period suggests some inability in the real estate market to incorporate the growth in the overall economy into real economic growth for the sector.

1.4.2 Question 2: HOW does the local economy affect the real estate markets?

- Both private and public prices have significant correlations with GDP in all of the analyzed countries. When relationships between random variables were tested strong evidence of co-integration, on average, was found. The link between GDP and rents was found to be weaker though significant in three out of the four European countries.
- The relationship between the local economies and the real estate market was found to be essentially contemporaneous.

The results for this question are not surprising. The general economy has a strong influence on the contemporaneous performance of the real estate markets. These results agree with the results Professor Goetzmann et. al. found in the countries they analyzed. Based on their conclusions, international investments in real estate would not provide huge diversification benefits. Furthermore,

investing in the real estate markets of the analyzed European countries is essentially a bet on the local economy which fluctuates with the whole region's economy. Thus, the diversification benefits of the international real estate investor are limited.

1.4.3 Question 3: HOW do the public and private real estate markets relate with each other?

- A very strong contemporaneous correlation between rents and private prices was found.
- The correlations between rents and public prices were not as strong as those for private prices. However the co-integration test showed that the variables were moving together. Public prices were found to lead rents in all of the countries analyzed.
- The results for the public and private relationships leaned toward public market leading private market.

The results for this question, for the most part, provide few surprises. Given that rent income is a major function of private prices, there should be a strong correlation between the two variables. The fact that public prices were found to lead rent prices could also be expected due to the fact that public prices are better able to adjust to new information than is the case with rents due to extended lease contracts. Except in one out of the four European countries public markets were found to lead the private markets supporting Barkham and Geltner's findings in the US and in the UK.

CHAPTER 2: DATA

2.1 REAL ESTATE DATA

Finding enough quality data to do a proper study of the relationships between private, public, property markets, and GDP in foreign countries was of primary importance. As was mentioned in the previous section, the lack of available data has been a major impediment to the completion of any thorough research on international real estate markets. We used data provided by CB Richard Ellis to analyze the private real estate market in each of the selected countries and data from Global Property Research (GPR), located in the Netherlands, to analyze the public real estate market. GPR utilizes this data in the construction of its GPR 250 public market index. The GDP, CPI and exchange rate information for the foreign countries was provided by the World Tables of the International Monetary Fund. The source for the GDP data for the United States was the U.S. Department of Commerce; Bureau of Economic Analysis; and for the CPI data was the U.S. Bureau of labor Statistics.

2.1.1 PRIVATE DATA: CB RICHARD ELLIS DATA

The data from CB Richard Ellis contains information about the annual level of rents, yields, and values for prime office property in 27 cities of 21 countries around the world. The information about values is appraisal-based as opposed to transaction-based. Each of the yearly values was obtained by estimating the price that relevant buildings may sell for. There were a significant number of observations for most countries. Several of the European and Asian countries had data that went back as far as 1970, which provided almost 30 years of data for the analysis. In almost all of the cases, rents and prices were measured in local nominal currency. CB Richard Ellis calculated the required yield by real estate investors by dividing the annual rent level by the appraised value.

2.1.2 PUBLIC DATA: GLOBAL PROPERTY RESEARCH DATA

The data provided by Global Property Research consisted of monthly price appreciation returns and dividend yields for an index composed of publicly traded real estate companies. The majority of the companies in the index invest primarily in office buildings. This is a key issue given that the CB Richard Ellis data is also for the office sector. Values were provided for 28 different countries. The indices for 14 of the countries began in January of 1984. Data for the other 14 countries began on various dates after January 1984[8].

The GPR indices include all publicly traded property companies which have had a freely available market capitalization exceeding $50 million for at least twelve months, and that have also demonstrated high liquidity in terms of average trading volume. Also, only property investment and investment/development companies are included in the index. Thus the data excluded pure development orientated companies[9].

2.2 DATA LIMITATIONS

Although we felt that these were the best data sets available for use in our research, the data inherently contains certain limitations that must be noted.

1.) In general, data on historical private real estate returns and prices is less available, and thus less accurate, than that for other investment assets. The reason being that the appreciation component for real estate is largely unknown. Stocks, for example, are traded heavily daily, thus the appreciation component of their return is readily observed. So the total return for stocks, dividend yield plus appreciation, is easily ascertained. Given that direct observation is not possible with real estate, other methods are utilized to determine the private property values. The most common being the method of "capping" the

[8] Op. Cit., P. Eichholtz, N. De Graaf, W. Kastrop, H. Op't Veld.
[9] Ibid.

final period's, or subsequent period's, cash flow. That is, treat that cash flow as a perpetuity that is discounted at the property yield rate. As was previously noted, this was the method employed by CB Richard Ellis.

The yields for the CB Richard Ellis data were calculated dividing the level of rents by the appraised value. There are two potential problems with this methodology. The first is that rent values do not represent the income for the building. Therefore yields computed using rents values would tend to be inaccurate. The second problem is that appraised values may lag the constant-liquidity market values. The lag is due to property owners trading liquidity for reduced volatility. In other words, a typical property owner might very well choose to hold properties during down markets and sell during up markets.

This effect would tend to offset the increased volatility inherent in using transaction prices to compute property values. The smoothing effect is also prevalent in the public data values. The yearly public data was calculated by averaging monthly values to produce comparable results. As a result, the standard deviation of the public data would be greatly reduced. This is an important consideration considering that the public data should in fact be more efficient, thus more volatile, than private property prices in the short term.

2.) Some of the publicly traded companies included in the GPR indexes tend to make substantial international investments. For example, German investment funds invest heavily in Europe, as well as in the United States; however, their prices are included in the public prices for Germany only. Thus the German public prices might be heavily influenced by the state of the real estate markets in other countries as well. Obviously the more investments these companies make in foreign markets, the more that country's public prices will reflect changes in other countries. This effect would cause a decrease in the correlation between public prices and the other data series since public prices would be more heavily affected by factors outside a particular country.

3.) There were a relatively small number of observations available for much of the data. The inability to use lengthy time series data constrained the statistical tests that were performed. Specifically, it had a major impact on the t-statistics. Given the small number of degrees of freedom, the critical values were inflated making it difficult to obtain significant results in general. The logic being that as the sample size gets smaller, the magnitude by which a variable could be overestimated gets larger, so the confidence interval is necessarily increased. The public data would have been the only data series with a significant number of observations had we used monthly returns.

2.3 SELECTION OF COUNTRIES

Countries were selected based on their representation in the two data sources. Some countries were immediately eliminated because they were included in one set of data but not in the other. For the remaining countries attention was focused on those that had the most amount of public data available in order to make the statistical analysis as reliable as possible. Only countries that had at least a decade of public information available and 14 years of private real estate returns were included in the study. Given that several of the Asian countries did not meet this criteria due to a lack of public data, this requirement was generally relaxed for those countries in order to include them..

The final selection of countries and cities in Europe were: United Kingdom (London), France (Paris), Spain (Madrid), Germany (Frankfurt), The Netherlands (Amsterdam) and Belgium (Brussels). For Asia the countries were: Australia (Sidney), China (Hong Kong), Singapore (Singapore), Indonesia (Jakarta) and Thailand (Bangkok). This thesis analyzes Singapore, Thailand, China, and Indonesia. The other countries were analyzed in additional theses by Martin M. Loketek and C. Randall Speck. The United States was included in the analysis to serve as a reference. Both the NCREIF office data and the GPR data were used to construct the real private and GDP price series.

CHAPTER 3: METHODOLOGY

3.1 DATA PREPARATION

The nominal GDP, rent, and yield data provided by CB Richard Ellis was used in order to derive the private market data that was used in the study. The majority of the rent data was provided in yearly increments that were expressed in local currency denominations. Some of the rent data was given as the average rent per month for a given year. These values were multiplied by twelve in order to get the average rent per year values. The GDP and rent series were then deflated using the CPI index of each country, also provided by CB Richard Ellis, to arrive at real series values. In the few cases where the rent values were expressed in US dollars, the appropriate exchange rates were used to compute the equivalent local currency values. A real private price series was then computed by dividing the real rent series by the corresponding yield data.

A similar set of indices were created using the GPR data. Again, the nominal public values were converted into real series by dividing by the CPI index. But unlike the private data, the GPR data was provided in monthly increments. In order to be consistent with the private data the average of the twelve months was taken. All of the GPR data was in local currency denominations, so no exchange rates were needed.

After similar private and public data series were computed, they were then included in a single table for each country. The tables consisted of data series for annual real GDP, real rents, real private prices and real public prices. These tables formed the basis of the statistical analysis and are presented in Exhibits 1 through 5.

EXHIBIT 1
National, USA

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	561.01			
1961	574.59			
1962	610.42			
1963	636.25			
1964	674.44			
1965	719.13			
1966	765.92			
1967	787.75			
1968	825.81			
1969	845.31			
1970	841.50			
1971	876.75			
1972	933.16			
1973	981.67			
1974	957.72			
1975	955.92			
1976	1008.17			
1977	1055.30			
1978	1108.16	53.07	50.04	
1979	1111.70	49.06	51.36	
1980	1066.08	47.30	52.76	
1981	1080.97	46.22	53.49	
1982	1059.77	46.61	53.78	
1983	1113.01	46.98	53.33	
1984	1185.40	45.64	54.48	30.68
1985	1226.18	46.60	53.98	37.79
1986	1272.53	44.03	53.29	50.66
1987	1302.66	41.18	49.93	53.86
1988	1346.85	36.75	47.25	47.26
1989	1384.20	33.35	44.58	49.15
1990	1386.79	29.98	40.65	34.52
1991	1370.41	26.37	34.28	33.15
1992	1404.00	24.78	27.69	33.99
1993	1432.26	22.90	23.21	42.07
1994	1478.58	22.36	20.69	43.05
1995	1504.88	21.73	19.47	40.49
1996	1540.79	19.91	19.01	43.83
1997	1594.18	21.44	19.66	52.58
1998	1647.12	21.82	21.55	53.81

EXHIBIT 2
Singapore, Singapore

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	2.05			
1961	2.33			
1962	2.37			
1963	2.57			
1964	2.46			
1965	2.67			
1966	2.95			
1967	3.21			
1968	3.68			
1969	4.29			
1970	4.94			
1971	5.55	14.89		
1972	6.31	17.07		
1973	7.03	16.35		
1974	7.48	14.99		
1975	7.79	16.27		
1976	8.44	16.57		
1977	9.10	19.27	170.19	
1978	9.65	17.20	178.51	
1979	10.67	16.15	265.08	
1980	12.02	22.87	593.86	
1981	12.99	34.66	752.58	
1982	13.92	46.70	634.76	
1983	15.46	37.21	530.43	
1984	16.43	27.57	389.79	30.30
1985	15.89	25.11	306.26	21.18
1986	16.26	18.16	244.31	28.31
1987	17.95	20.09	308.94	58.05
1988	20.95	24.37	446.32	51.81
1989	23.53	37.99	594.67	82.27
1990	26.01	53.94	613.10	73.34
1991	27.98	51.48	555.74	68.23
1992	29.32	32.58	543.44	64.79
1993	33.41	24.74	495.86	87.44
1994	37.18	28.44	601.19	135.15
1995	40.02	38.26	668.02	144.76
1996	42.96	39.52	759.84	172.41
1997	46.13	37.52	694.63	146.08
1998	45.30	27.33	505.44	82.83

EXHIBIT 3
Bangkok, Thailand

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	53.98			
1961	54.91			
1962	57.28			
1963	61.14			
1964	67.59			
1965	76.18			
1966	88.06			
1967	90.18			
1968	95.53			
1969	102.67			
1970	117.81			
1971	122.03			
1972	129.04			
1973	145.88			
1974	147.52			
1975	152.15			
1976	166.89			
1977	180.62			
1978	202.49			
1979	210.91			
1980	208.86			
1981	212.77	570.86		
1982	223.73	542.34		
1983	236.05	584.37		
1984	251.07	632.72		
1985	262.09	632.58		
1986	276.08	657.68		
1987	308.92	684.42		
1988	357.09	741.75	6181.21	
1989	403.51	1108.20	8270.11	
1990	447.71	1291.74	8175.58	
1991	486.08	1396.21	8726.30	15.44
1992	527.51	1118.03	10257.13	11.52
1993	573.17	1081.62	10604.13	7.84
1994	623.79	1029.70	10297.03	6.84
1995	680.40	1021.92	10535.23	3.89
1996	718.91	977.28	9307.38	2.88
1997	700.67	838.25	9313.87	0.64
1998	649.25	659.97	6572.95	0.29

EXHIBIT 4
Hongkong, China

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960				
1961				
1962	8.85			
1963	9.88			
1964	10.68			
1965	12.59			
1966	13.50			
1967	13.69			
1968	14.09			
1969	15.61			
1970	16.80	14.93		
1971	17.17	20.61		
1972	18.29	20.72		
1973	20.54	27.08		
1974	21.15	26.12		
1975	20.71	21.94		
1976	22.58	24.84		
1977	25.92	23.30		
1978	28.17	26.20		
1979	30.01	35.11		
1980	32.10	38.68	459.83	
1981	34.37	47.53	493.90	
1982	34.84	42.56	453.57	
1983	36.89	33.26	335.69	
1984	39.68	22.76	225.39	18.69
1985	39.62	22.75	236.21	32.13
1986	43.78	27.61	244.45	37.37
1987	48.43	33.35	292.17	53.93
1988	51.37	44.53	400.56	46.46
1989	51.71	63.42	440.85	48.73
1990	53.02	51.55	404.06	42.87
1991	55.46	37.08	359.99	47.42
1992	58.61	33.36	380.70	64.61
1993	61.91	37.13	545.21	82.64
1994	65.03	52.10	800.66	101.82
1995	67.49	44.92	499.23	83.65
1996	70.37	36.62	552.74	108.19
1997	74.15	36.54	628.27	98.70
1998	69.07	28.90	265.85	54.61

EXHIBIT 5
Jakarta, Indonesia

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	1623.20			
1961	1720.06			
1962	2111.10			
1963	2063.29			
1964	2194.75			
1965	1793.38			
1966	1932.78			
1967	2518.02			
1968	2721.22			
1969	3053.98			
1970	3340.20			
1971	3518.64			
1972	4105.97			
1973	4636.55			
1974	5228.65			
1975	5185.25			
1976	5292.53			
1977	5858.65			
1978	6483.98			
1979	7852.33			
1980	9441.74	2032.77	18571.25	
1981	10759.06	2219.86	20280.52	
1982	10562.47	2749.69	25120.99	
1983	11739.57	3907.33	35697.19	
1984	12307.27	2192.01	20026.10	
1985	12865.52	1618.57	14787.12	
1986	13675.53	1203.47	10994.87	
1987	14542.13	1346.68	12303.22	
1988	15632.36	2359.28	14990.26	
1989	17660.39	2910.64	33070.71	
1990	19231.42	4313.28	50465.32	9.53
1991	20836.75			5.71
1992	21891.03			3.75
1993	23307.34			5.24
1994	24892.90			5.06
1995	27049.38			2.24
1996	29354.97			2.74
1997	32303.57			2.99
1998	29437.01			1.09

3.2 DATA ANALYSIS

As was described in Chapter 1, there were three general questions to be answered for each country that was analyzed. Accordingly, the data was divided up into 3 separate sections as well. The equations and methodology used in each section in an attempt to answer the questions are described next in detail.

3.2.1 Question #1 Analysis: Are GDP, rents, private, and public prices following a random or trend-reverting pattern?

One of the most fundamental properties of any data set is the determination of whether or not there are any recurrent patterns in the data. As was shown previously, the existence of persistency means that, among other things, future values can be predicted. However, if no trend- reverting behavior can be identified, then there is no way to predict future values. The differences are said to be random in such a case. In the United States it is widely believed that many key economic variables, including GDP and public prices, follow a random walk pattern[10].

The identification of a random walk also means that the effects of a temporary "shock", i.e. outlying data points will not tend to dissipate after several years, but will instead permanently alter the series[11]. However, in the case of a recurrent trend, the data will tend to revert back towards the equilibrium level following such a shock. Again, the implications of this analysis for real estate investors are far reaching. A trend-reverting property market suggesting the existence of persistency in the cycle could conceivably be forecasted by looking at its past performance. Under this scenario a prudent investor could identify the market's peaks and troughs and buy or sell accordingly to make abnormal profits. Exhibits 6A and 6B shows the level and percentage differences series for real GDP in the United

[10] C.R. Nelson, C. I. Plosser, "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications", Journal of Monetary Economics, Vol. 10, 1982, p. 139-162

[11] R. Pindyck, D. Rubinfeld, "Econometric Models & Economic Forecasts", 1991, p.460

States. The graphs illustrate an example of a drifting economic variable that appears to demonstrate a random walk pattern after the differences are taken.

To test for the hypothesis of random walks in the analyzed data the following two step statistical process was performed.

1) Identifying the existence of a constant time related trend using an auto-regression equation of percentage differences, i.e. a 1st order auto-regression equation (ARI).
2) Based on the results of Step 1, two different Dickey-Fuller tests were used to determine randomness[12].

   Case I: If no trend was identified a Dickey-Fuller equation that does not have a time variable was used.

   Case II: If a trend was identified a Dickey-Fuller equation with a time variable was used.

Finally, it is important to note that even though the Dickey-Fuller test is widely used, its power is somewhat limited. It only allows one to reject, or fail to reject, the hypothesis that a variable is not a random walk. And failure to reject, especially at a high significance level, is only weak evidence in favor of the random walk hypothesis[13]. What is more, its power is even more limited in situations where there are low degrees of freedom. In such a situation, most researchers rely more on the results, the 1st order auto-regression equation (ARI).

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[12] D. A. Dickey and W. A. Fuller, "Distribution of the Estimators for Autoregressive Time-Series: with a Unit Root", Journal of the American Statistical Association, Vol. 74, 1979 p. 427-431; D. A. Dickey and W. A. Fuller, "Likehood Ratio Statistics for Autoregressive Time Series with Unit Root", Econometrica, Vol. 49, 1981, p 1057-1072; And W. A. Fuller, ""Introduction to Statistical Time Series, 1976.

[13] Op. Cit., Pindyck, D. Rubinfeld, p. 462

EXHIBIT 6A

Levels - GDP - USA

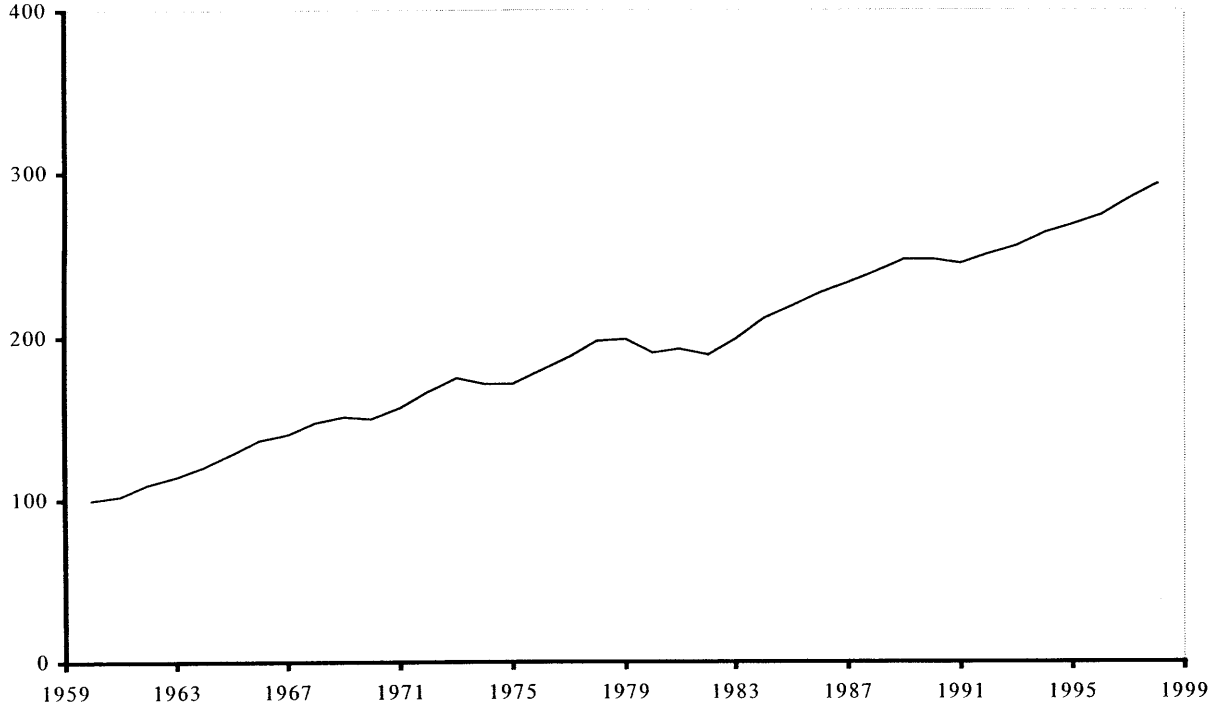
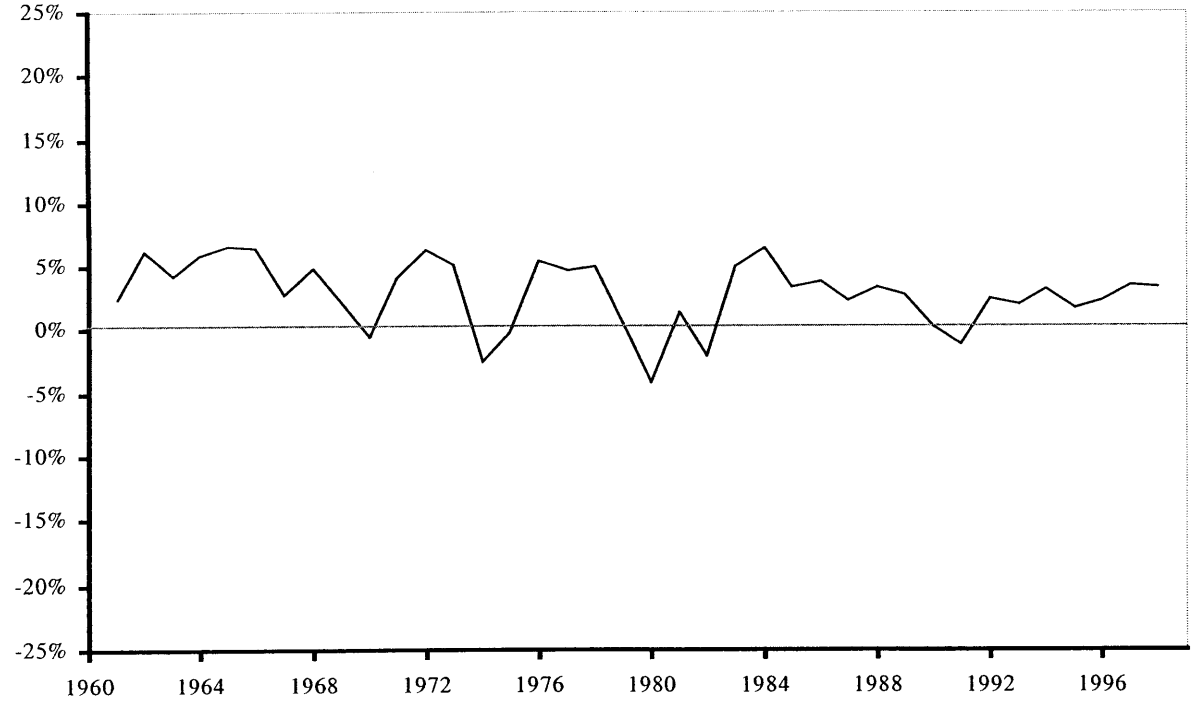


EXHIBIT 6B

Differences - GDP - USA



Step 1: The auto-regression equation

The following auto-regression equation for the differences, given as percentages, was estimated:

$$\Delta Y_t = \alpha + \beta \Delta Y_{t-1} + \varepsilon_t \qquad \text{(Eq. 1)}$$

$$\text{Where } \Delta Y_t = (Y_t - Y_{t-1}) / Y_{t-1} \text{ ; and } \Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}) / Y_{t-2}$$

If the coefficient for α in the above equation passed the student t-test, i.e. was significantly different from zero at the 5% significance level, the null hypothesis of no trend in the series was rejected. It was then concluded that the level of the variable changes because of the passage of time. The existence of an upward trend in the series, i.e. a positive and significant α, indicated that the variable had been on average growing over time, so the mean of the series was time dependent. If a negative and significant α was found, then it indicated that the variable had been decreasing with time. If the α coefficient failed the t-test, then it was concluded that the data series was not time dependent. The β values for Equation 1 indicated the reliance on the previous data point. For a 1st order equation, a β of 0 indicates a random walk. And a β value different from zero indicates persistence. That is, the current change on Y_t is to a large degree a function previous changes.

Therefore Equation 1 can lead to four separate conclusions:

1) $\alpha \neq 0$ and $\beta \neq 0$: This would indicate persistence with a trend.

2) $\alpha = 0$ and $\beta \neq 0$: This would indicate persistence with no trend.

3) $\alpha \neq 0$ and $\beta = 0$: This would indicate a random walk with drift.

4) $\alpha = 0$ and $\beta = 0$: This would indicate a random walk with no drift.

Step 2: The Dickey-Fuller unit root test

For those variables where the trend term was not significantly different from zero, i.e. failed the t-test and thus was assumed to be independent of time, the Dickey-Fuller equation without a variable for time was used. For data sets that passed the t-test, i.e. were assumed to have a constant trend and were

thus said to have a correlation with time, the Dickey-Fuller equation with a variable in the equation for time was used[14].

Case I: No Trend

In general if a series is flat, as opposed to trending, the auto-regression for levels is used given that the levels are independent of time. If there is a trend then differences must be used.

The following equation was estimated for the Dickey-Fuller test in the case of no trend:

$$Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t \qquad \text{(Eq. 2)}$$

A random walk here is identified by a lagged coefficient close to one. In that case, $Y_t - Y_{t-1} = \alpha + \varepsilon_t \equiv \Delta Y_t = \alpha + \varepsilon_t$. Where ε_t is an independently distributed random variable with a zero mean. So there is no model that can provide a forecast any better than $Y_T = Y_{T-1}$[15]. When this coefficient tends to differ from one, the series was considered to show some level of persistency across time. Therefore, the relevant hypothesis to be tested with the t-test was whether or not the computed lagged coefficient was significantly different from 1. The pertinent statistical test is:

$$T_{N-K} = (\beta - 1) / s_\beta \qquad \text{(Eq. 3)}$$

Where $s_{\beta t}$ is the standard error of the β coefficient in the auto-regression equation.

If the computed value was higher than the critical value of the t distribution at the 5 percent level of significance, then the null hypothesis that $\beta = 1$ could not have been rejected. In such a case it was concluded that the true process that describes the behavior of the series was a random walk without a trend. Again, this conclusion meant that no predictions were possible. So, as in the case of the US stock market, the best prediction for any variable would be the previous value since the series is just as likely to go up as it is to go down.

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[14] J. D. Hamilton, "Time Series Analysis", 1994p. 502
[15] Op. Cit.,Pindyck, D. Rubinfeld, p.446-447

If the computed value was lower than the critical value at the 5% level, then the null hypothesis was rejected and it was then concluded that the series demonstrated a persistent behavior around a flat steady state or equilibrium level. In this case, the level of Y_{t-1} could be used to predict the level of Y_t.

Case II: Constant Time Related Trend

If a trend was identified in Step 1, then a variable was inserted into the equation to account for the effects of time. Also, differences had to be used, as opposed to levels, if a trend was found to exist in the data. The equation used is given below:

$$Y_t - Y_{t-1} = \alpha + \delta t + (1 - \rho)\, Y_{t-1} + \varepsilon_t \qquad \text{(Eq. 4)}$$

The proper statistical test to use in this case is the F-test, which tests the joint significance of all of the variables in the equation. In order to use the F-test an additional equation, that is assumed to describe the true process, is needed. This equation is:

$$Y_t - Y_{t-1} = \alpha + \varepsilon_t \qquad \text{(Eq. 5)}$$

This equation is usually referred to as the restricted equation. And consequently, the Dickey-Fuller equation is labeled as the unrestricted equation.

Next the F ratio was computed to test whether or not the restriction held. The equation used is the following.

$$F = (N - k)(ESS_R - ESS_{UR}) / q\,(ESS_{UR}) \qquad \text{(Eq. 6)}$$

ESS_R is the sum of the squared residuals in the restricted equation

ESS_{UR} is the sum of the squared residuals in the unrestricted equation

N is the number of observations

k is the number of estimated parameters in the unrestricted regression

q is the number of parameter restrictions

Since this ratio is not distributed as a standard F distribution the critical values for this statistic are much larger than those found in the standard F table. Thus to test the null hypothesis that $\delta = 0$ and ρ

= 1, i.e. a random walk with trend, we had to refer to the distributions tabulated by Dickey and Fuller themselves[16]. If the calculated F value is less than the 5% critical value, the joint null hypothesis of a random walk with positive drift trend could not be rejected. Otherwise it was rejected and we concluded that the data series was not a random walk. In that case the series was trend-reverting around an upward or downward trend, which of course depended on the sign of the α coefficient in the auto-regression equation for percentage changes. The same conclusions regarding the forecast power of the Y_{t-1} variable mentioned for Case I also apply here. In addition to the joint F-test, a T-test on Rho was used to determine if the coefficient for the lagged variable was significantly different than one. This is another test to determine randomness in the series.

3.2.2 Question #2 Analysis: How does the local economy affect the real estate markets?

Real estate economists have long believed that there is a strong correlation between real estate investment performance and the state of the economy. They reason that recession years should lead to a soft real estate market due to a decrease in the demand for space, while boom years should lead to a high real estate market given the increase in demand. However, over the longer term this relationship becomes less stable. The increase in rents and prices will almost certainly promote new construction as asset prices rise above replacement costs. If the amount of new development "overshoots" the new equilibrium, rents will in turn eventually fall[17]. This scenario is the basic premise underlying the infamous real estate boom/bust cycle. However, as was mentioned in the beginning of Chapter 1, the advent of the public markets should serve to reduce these extreme cycles.

As was also described in Chapter 1, the relationship between GDP and the private/public markets has tremendous implications as to the diversification benefits of international real estate investment. The conclusions of the Yale paper indicate that not only is there is a strong correlation between private

[16] Op. Cit., D. A. Dickey and W. A. Fuller
[17] Op. Cit., D. DiPasquale, W. Wheaton.

property values, but that global economic effects have a major influence on a given country's domestic GDP fluctuations as well. So it is clear that correctly accessing the link between GDP and the public markets, and for the other data series, is of great importance to real estate investors. This was the intent of attempting to answer Question #2 which is detailed below.

We began the analysis by using the base data (in levels) for real GDP, real rents, real private prices, and real public prices to construct four corresponding data series that gave the annual percentage changes in each variable. Then two separate statistical tests were performed for each country using the charts.

1) The correlation values of the differences were computed between GDP and the other data series.
2) The Durbin-Watson values of the levels were computed between all data series.

Correlation Test

The correlation values for GDP with real rents, real private prices, and real public prices were all computed. Specifically, the ratio between the covariance of the two studied variables and the product of their standard deviations was calculated to arrive at the correlation coefficient value. The equation is given below:

$$\rho = \sigma_{xy} / (\sigma_x \sigma_y) \quad \text{(Eq. 6)}$$

In addition, because it is also believed that property markets may react slowly to changes in the GDP, in effect creating a lag, the same correlation values were computed between the changes in the property market variable in a given year and the GDP changes in the previous year.

In order to examine the significance of the correlation parameters the standard F-test was computed by running a regression on the two series being analyzed. The R^2 value given in the regression equation is equivalent to the ρ value given above. These values were computed for both the contemporaneous and lagged cases. If the computed F value was greater than the critical F value, then

the overall equation was deemed to be significant at the 5% level. If the computed F value failed the significance test, then the correlation was deemed to be unreliable.

Durbin-Watson Co-Integration Test

If two data series follow a random walk pattern, it is still possible for them to be highly correlated. This occurs if the series tend to move together in a random fashion. In this case, the variables are said to be co-integrated[18]. Given that a large number of variables in the study were shown to be random as per the Dickey-Fuller analysis, and that there were so few observations in that determination, a co-integration test was run for all of the series--regardless of whether or not the Dickey-Fuller test indicated persistence.

The Durbin-Watson statistic was calculated from the co-integrating regression ($X_t = \alpha + \beta Y_t + \varepsilon_t$), and tested the hypothesis that DW = 0. The actual Durbin-Watson statistic used is given below:

$$DW = \Sigma(\varepsilon_t - \varepsilon_{t-1})^2 / \Sigma(\varepsilon_t)^2 \qquad \text{(Eq. 7)}$$

Obtaining critical values of the Durbin-Watson (DW) value to test for co-integration proved to be a difficult task. The only values available were given in the paper by economists Robert Engle and C.W. Granger for 100 observations[19]. Those values were .386 for a 5% level of significance, and .322 for a 10% level. It was decided that higher values would be used since there were far fewer observations in this study. Those values were .4 and .35 respectively. If the computed DW value exceeded the critical value of .4, the hypothesis of no co-integration could be rejected at the 5% significance level. Thus it was concluded that the data series were indeed co-integrated. In addition, to study the reaction of the real estate market to changes in economic production, the same co-integration tests were performed between the changes in the property market variable in a given year and the GDP changes in the previous year.

[18] R. F. Engle, C. W. J. Wranger, "Co-integration and Error Correction: Representation, Estimation and Testing" Econometrica, Vol. 55, 1987, p.251-276.

3.2.3 Question #3 Analysis: How do the public and private real estate markets relate with each other?

Three different relationships were analyzed: rents & private values, rents & public values, and private values & public values. In general, the analysis for this question was similar to that for Question #2 in that correlations and Durbin-Watson statistics were computed for each combination of series.

In addition to the analysis of the contemporaneous relationships, the correlations for each series lagged against one another were also examined. Using rents & private prices as an example, the rent series lagged one period was analyzed with the contemporaneous private price series. Then the private price series lagged one period was analyzed with the contemporaneous rent series. This allowed us to ascertain whether or not one series lead the other. If the correlation of one of the lagged series combinations was greater than the dual contemporaneous correlation, then it was concluded that the lagged series did in fact lead the contemporaneous series over the study period.

Relationship: Rents & Private Prices

Under the rational expectations hypothesis changes in private prices should anticipate changes in rents[20]. This is the case if it is assumed that the market participants are perfectly informed about predicted movements of the private market. If so, then investors should be able to correctly anticipate how the private market will respond to a shock. In the statistical analysis this would be indicated if the correlation between the lagged values for private prices and for contemporaneous rent values are higher than that for the dual contemporaneous correlation.

Under the myopic price expectation hypothesis, real estate investors use only current rents to form their price expectation for the following period[21]. That is, they are incapable of predicting future

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[19] Op. Cit.,R. F. Engle, C. W. J. Wranger, p.269
[20] Op. Cit., D. DiPasquale, W. Wheaton, p. 254-256.
[21] Ibid., p. 251-254.

rent values. In this scheme of price formation the contemporaneous correlation between private prices and rents will be greater than either of the lagged correlation combinations.

Relationship: Rents & Public Prices

The same analysis was performed for rents & public prices. In this case one would expect the public markets to be more rational given their increased liquidity and analyst scrutiny. If so, the correlation of the lagged public prices and contemporaneous rent prices should be greater than any of the other correlation values. If this is not the case, then the dual contemporaneous correlation calculation will be the greatest. This indicates no evidence of presumably greater public market efficiency.

Relationship: Private Prices & Public Prices

Once again correlation and DW statistical tests were run for the contemporaneous and lagged values of the private & public price combinations. As was mentioned in the first chapter, there has not been any extensive research conducted on this topic outside the US markets. This relationship is much more complex than the previous two that were analyzed. It stands to reason that given an efficient publicly traded market for securities, representing claims on real estate investment companies, an investor would be able to obtain a similar performance as if he/she had invested directly in the real estate assets themselves. If this was the case, then a high level of contemporaneous correlation between the public and private returns should be indicated by the statistical analysis.

However, it must be noted that the value of public real estate companies is affected by more than the value of the underlying assets. Management's contribution is also a key valuation input. If analysts feel that management can consistently add value to the company, then it is likely that the market value of the public company will in fact trade at a higher value than the private market value of the underlying assets. And as has been demonstrated recently, the reverse situation may occur as well. That is, if analysts feel that management is not able to maintain the asset's value, then the market value of the

public company may actually be less than that of the underlying assets. It should be clear that it is very unlikely that there would be a perfect correlation between public and private prices.

In addition to determining the direct correlation values for each country, the lagged correlation values provides crucial information as to the efficiency of the public markets. Previous studies in the US have focused on the lead/lag relationship between public and private returns. There is some evidence to indicate that the public market in the US tends to anticipate the private market movements. One would expect this to be the case given the US's relatively well developed public real estate market. Again, the idea is that if a public market is an efficient one, i.e. with high liquidity and heavy analyst and investor scrutiny, prices will adjust very quickly to all available information. Private prices on the other hand are typically very sticky, reflecting a small number of transactions and low degree of investor scrutiny.

In order to address this tremendously important question in our study, the relevant correlation values were compared to see if public prices did in fact lead private privates. The specific analysis followed that which was done for the other two data combinations. If the correlation between the lagged public series and the contemporaneous private series was greater than the dual contemporaneous correlation value, then it was concluded that the public market lead the private market. If the lagged correlations were not greater than the dual contemporaneous correlation, then it was concluded that the public markets did not lead the private markets. This might that either public markets are inefficient and underdeveloped or that the private market is adjusting instantaneously to news, which given the stickiness of private prices, should rarely be the case. Furthermore, there is a transaction cost tied into the private prices which would create a gap between private and public prices.

As a final observation the limitations of the lead/lag analysis should be noted. Any non-contemporaneous relationships could not be tested in depth since only yearly data was used. Shorter lagged periods would have had to be used for a more precise determination of the lead/lag relationships if it were available. It is quite possible that monthly data would have yielded different conclusions.

EXHIBIT 7A
Levels - USA

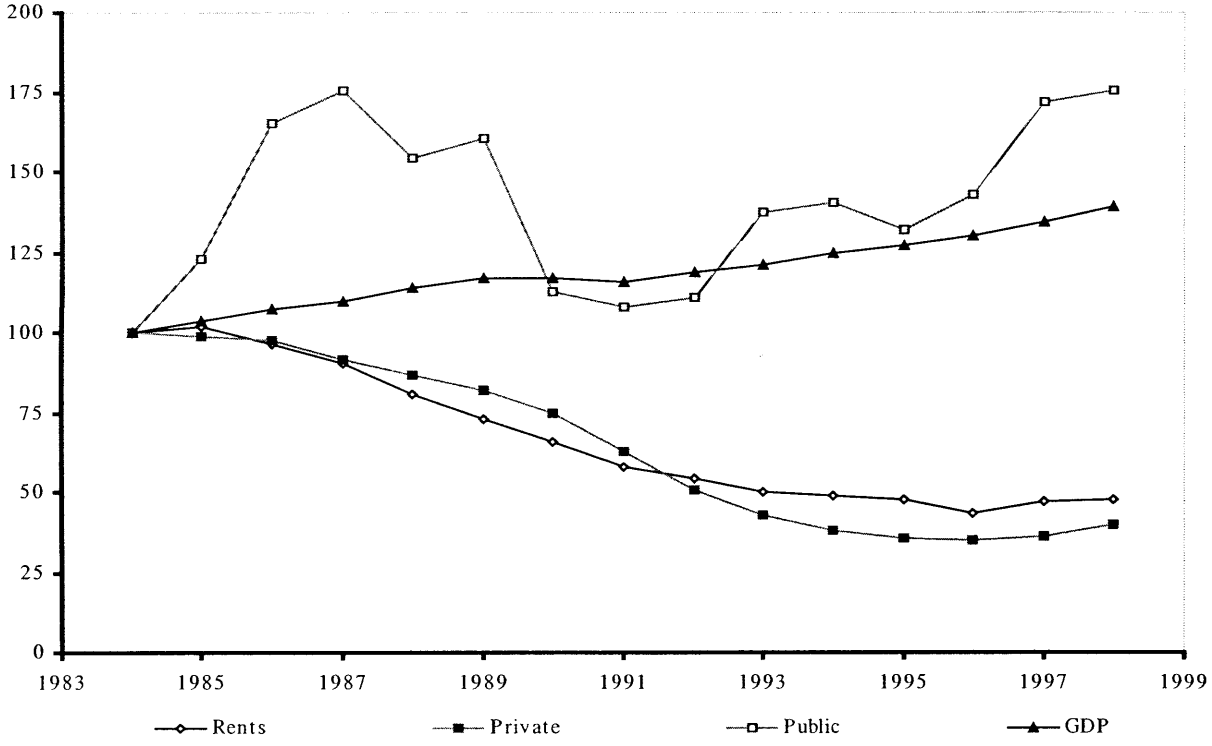


EXHIBIT 7B
Differences - USA

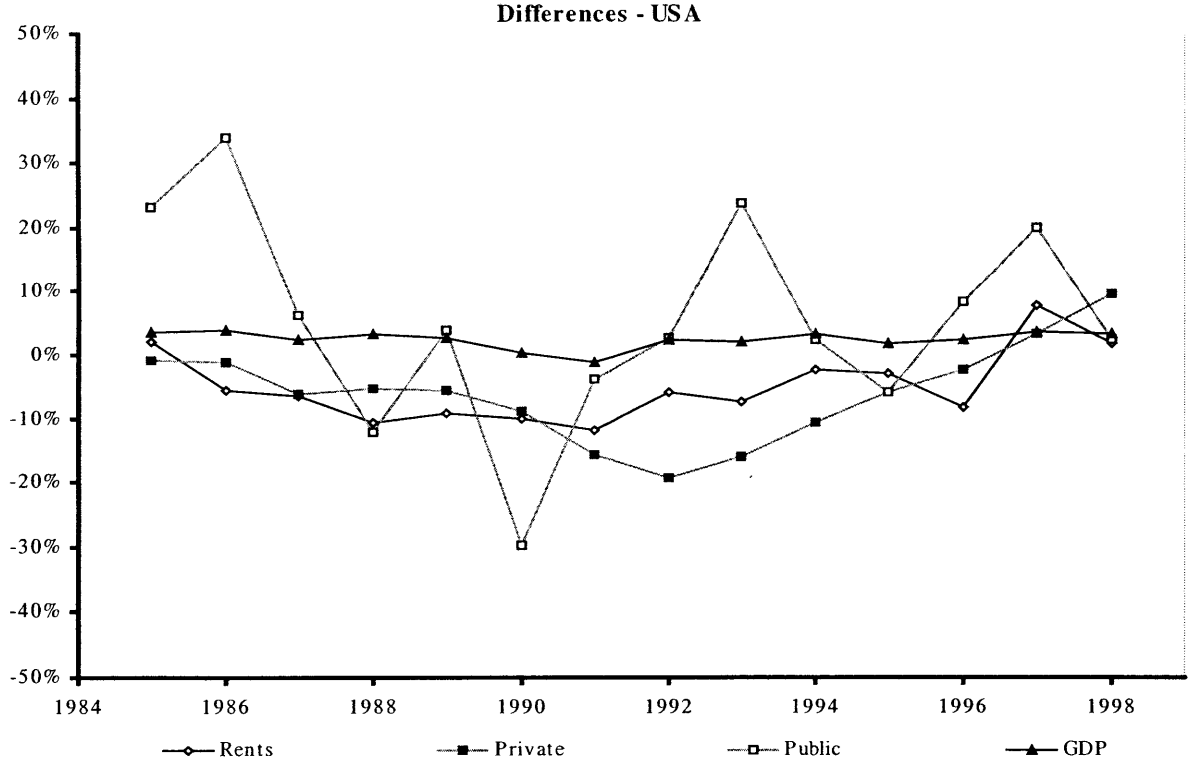


EXHIBIT 8A

Levels - Singapore

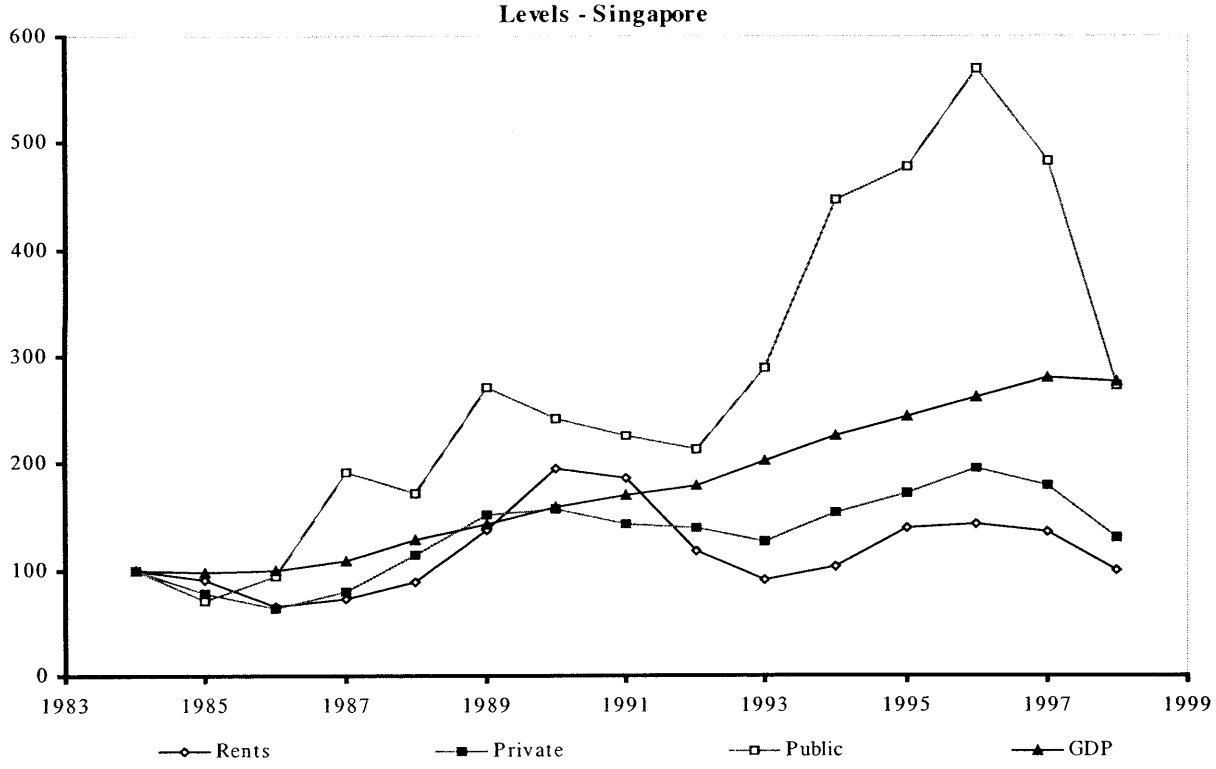


EXHIBIT 8B

Differences - Singapore

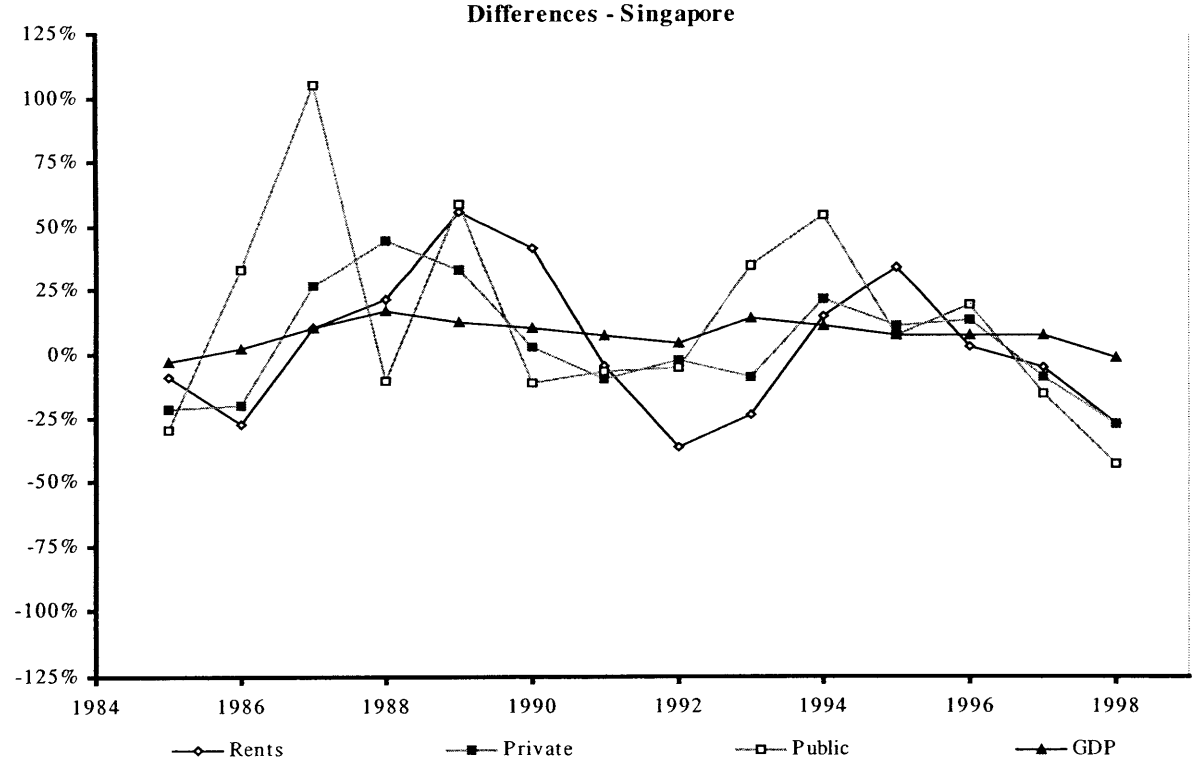


EXHIBIT 9A
Levels - Thailand

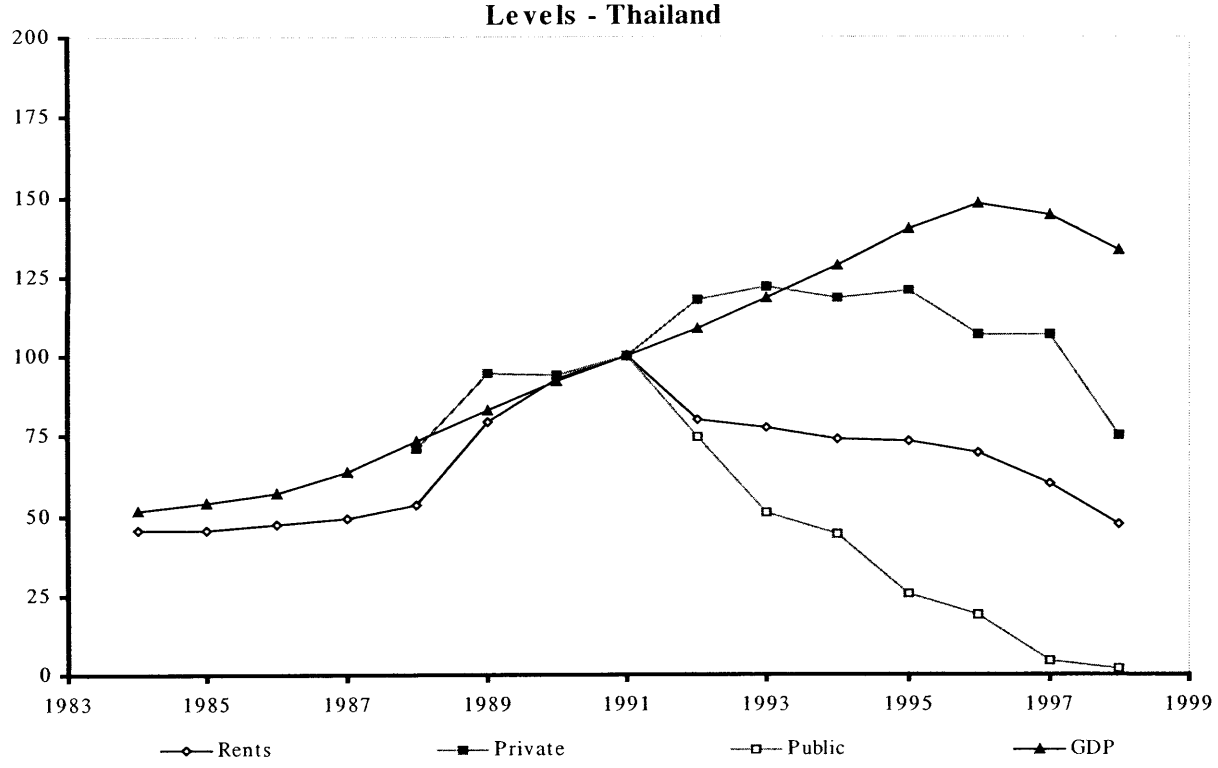


EXHIBIT 9B
Differences - Thailand

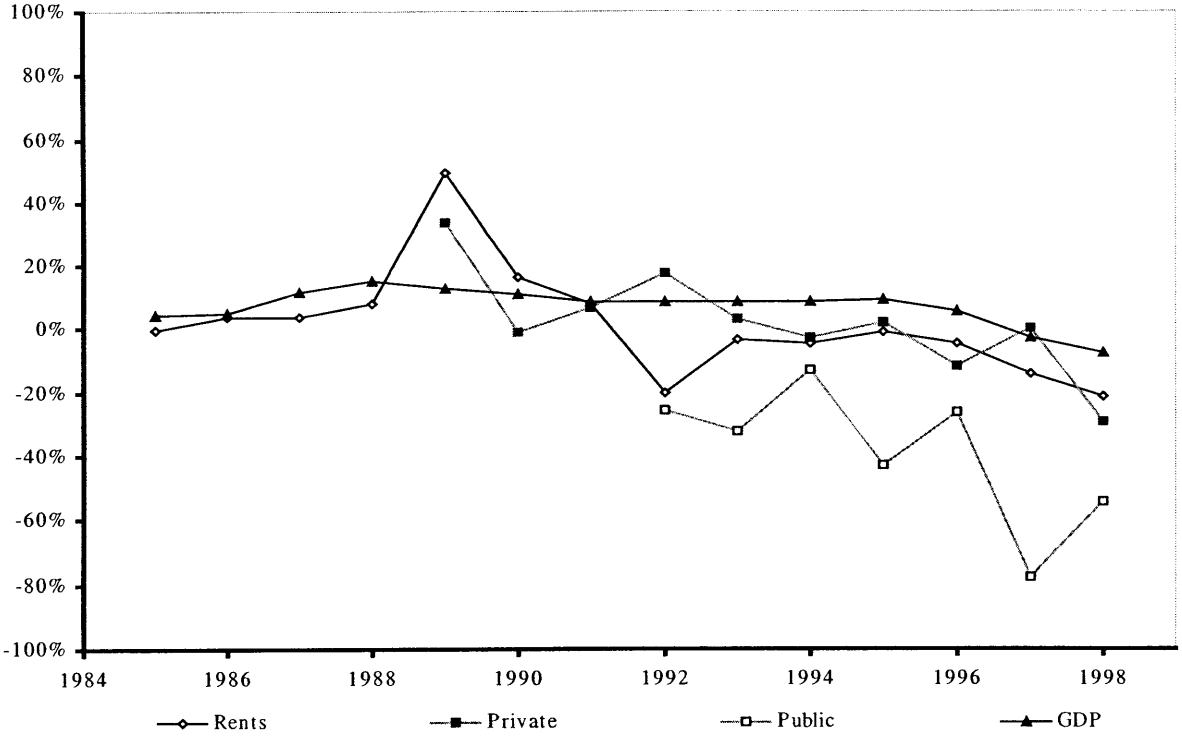


EXHIBIT 10A
Levels - China

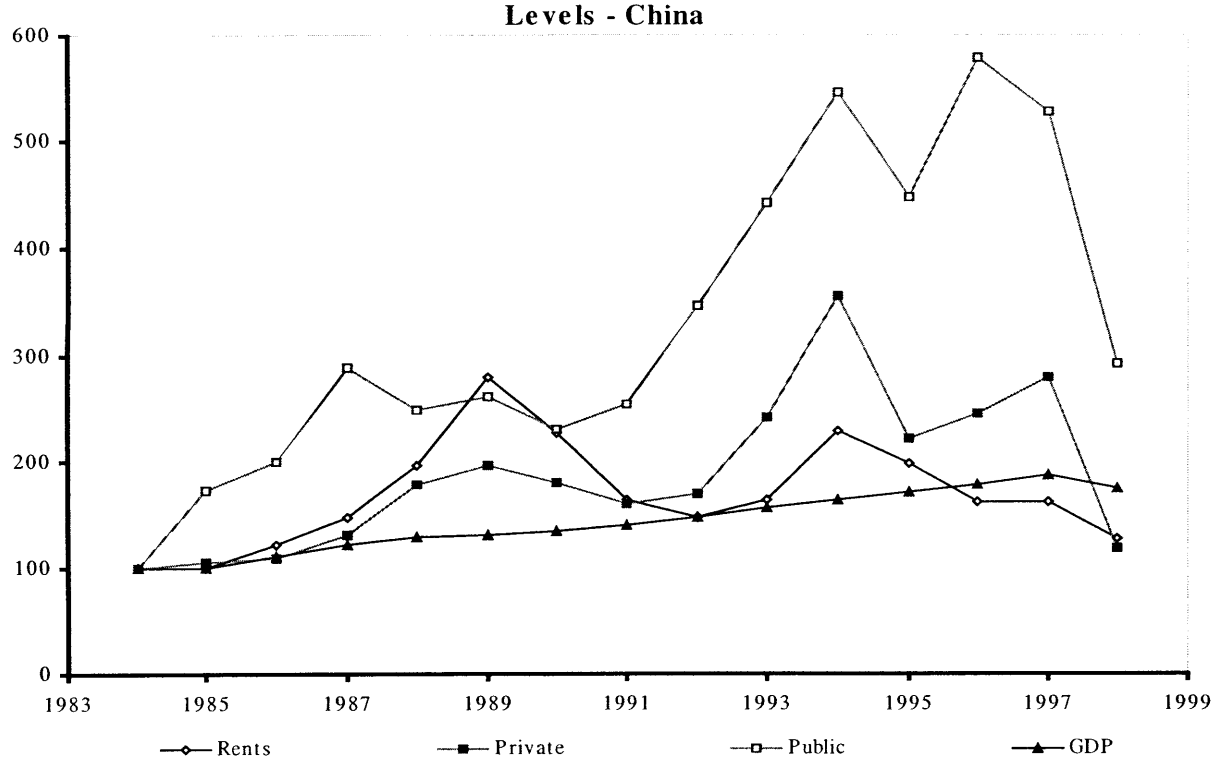


EXHIBIT 10B
Differences - China

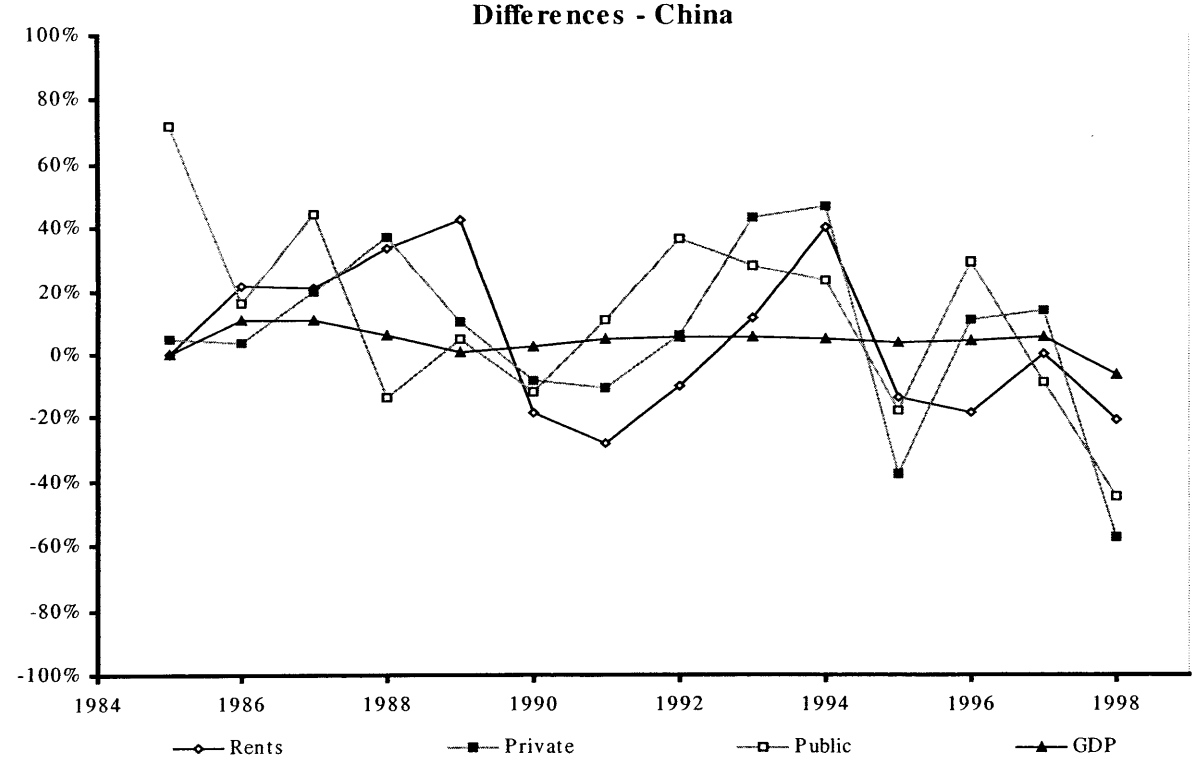


EXHIBIT 11A
Levels - Indonesia

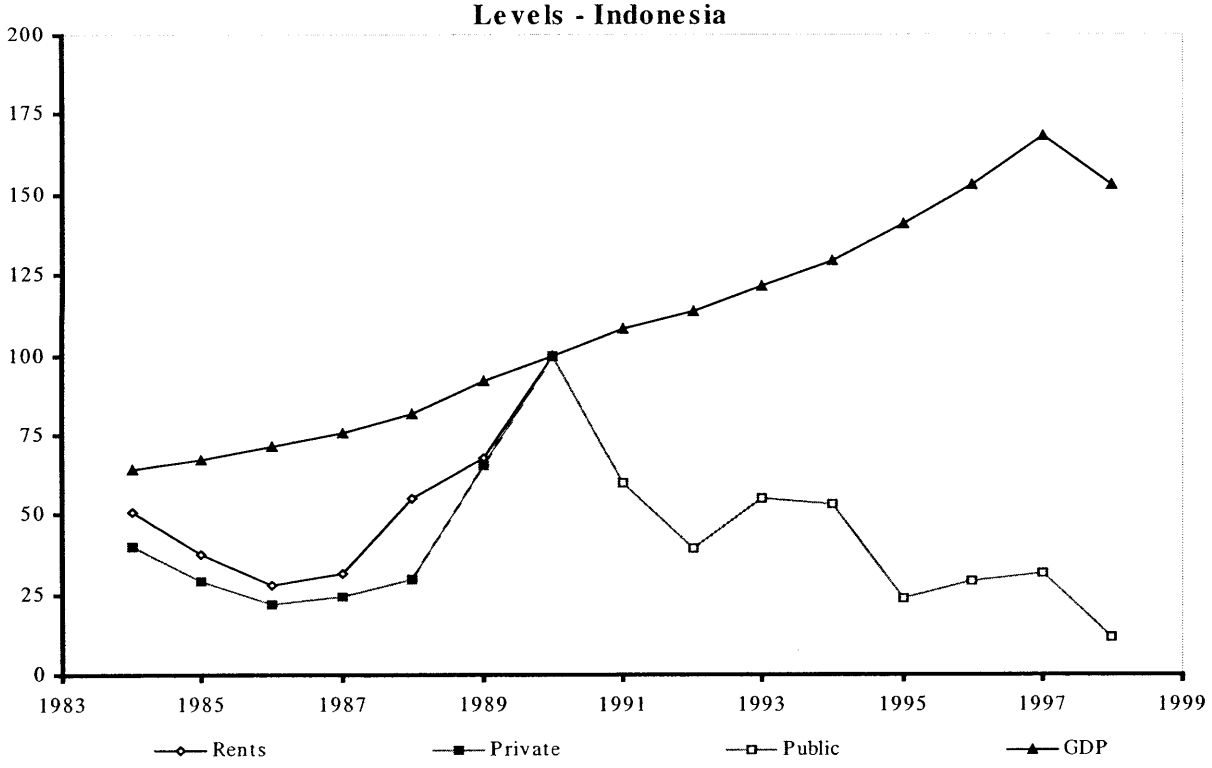
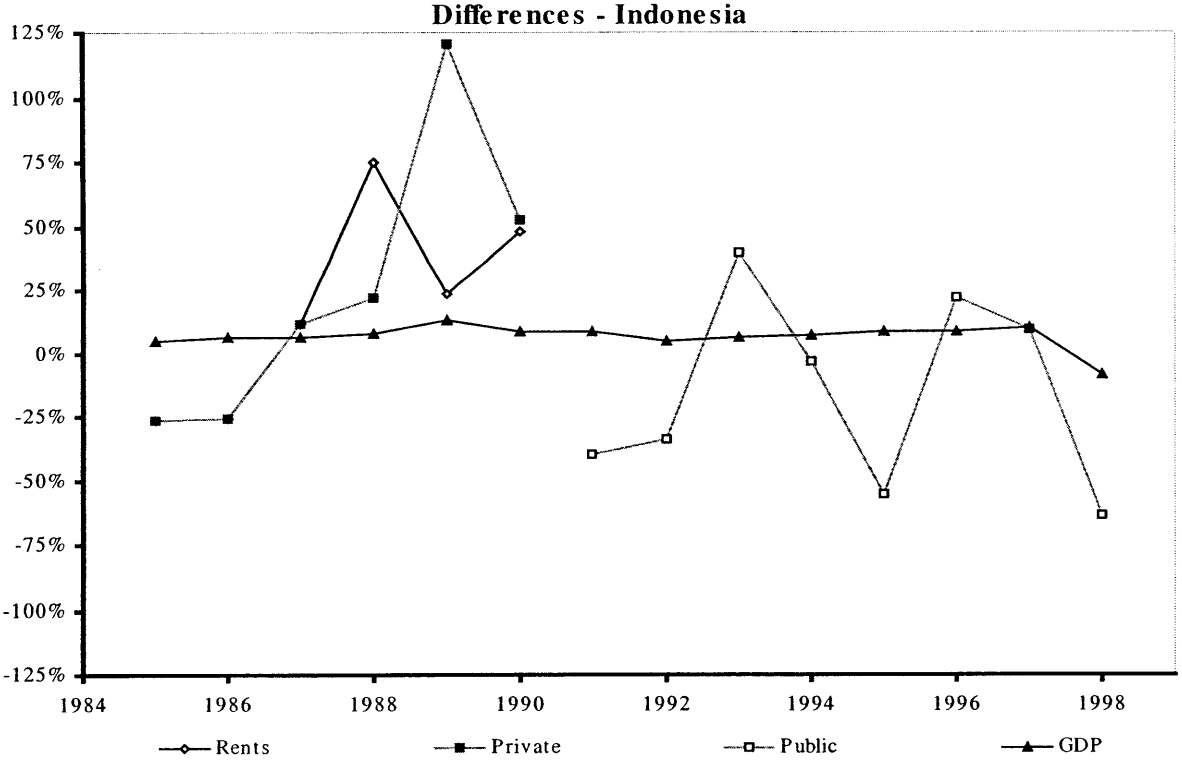


EXHIBIT 11B
Differences - Indonesia



CHAPTER 4

QUESTION 1: ARE GDP, RENTS, PRIVATE AND PUBLIC PRICES FOLLOWING A RANDOM WALK OR A TREND-REVERTING PATTERN?

4.1 CHAPTER OBJECTIVE

The overall objectives of this chapter are twofold. The first is to identify, using the auto-regression equation, any constant trends in the time series for each country. The second is to determine whether or not this data is trend-reverting or random based on the results of the first order auto-regression equation (ARI) and the Dickey-Fuller unit root tests. The time series for each country is presented in graphical form in Exhibit 7 through 11. Both levels and differences for DGP, private prices, rents, and public prices are shown for the years 1984 to 1998. The results of the statistical analysis performed for the answer of these questions are presented in the following section.

4.2 QUESTION 1 SUMMARY CHART

Summary chart A gives the results for this question.

4.2.1 GDP Results

39 yearly observations beginning in 1960 were used to examine the GDP data for all of the countries in the study except for Hong Kong for which the CPI data for the first two years was missing from the data set. The t-statistics on the alphas were significant for all of the analyzed countries and the coefficients were outstanding, reflecting the economic miracle of the Asian region where the real GDP grew at impressive rates during the studied period. Indonesia's real economy grew at about 8.0% per year followed by Singapore and Hong Kong with approximately 5.0% real growth per year.

Summary Chart A BEHAVIOR OF ANALYZED VARIABLES	**USA** National	**Singapore** Singapore	**Indonesia** Jakarta	**China** Hong Kong	**Thailand** Bangkok
GDP - Lagged Regression Statistics	*1961* *1998*	*1961* *1998*	*1961* *1998*	*1963* *1998*	*1961* *1998*
Autoregressive Formula: Is there a trend?	**Trend**	**Trend**	**Trend**	**Trend**	**Trend**
Alpha of Differences	0.020	0.055	0.080	0.047	0.036
T-statistic	3.111	3.245	3.791	3.286	2.458
Beta of Differences	0.334	0.335	0.036	0.168	0.474
T-statistic	2.099	1.990	0.200	0.883	2.775
Behavior of the Market:	**Persistant**	**Persistant**	**Random**	**Random**	**Persistant**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Random
Beta of Auto-Regression	1.003	1.058	1.038	1.013	1.029
T-test (single test for beta significant from one)	0.238	4.732	2.230	0.865	1.709
Dickey-Fuller Case 2 (Trend)	Random	Persistant	Random	Random	Random
Rho of Unrestricted Regression	0.749	1.002	0.934	0.852	0.947
F-test (OLS joint test for Rho=1 & Gamma=0)	2.222	13.787	5.297	2.927	3.732
T-test (single test for Rho significant from one)	-2.051	0.055	-1.346	-2.025	-1.233
GDP - Lagged Regression Statistics (Rent time frame)	*1979* *1998*	*1972* *1998*	*1981* *1990*	*1971* *1998*	*1982* *1998*
Autoregressive Formula: Is there a trend?	**Trend**	**Trend**	**Trend**	**Trend**	**No Trend**
Alpha of Differences	0.015	0.046	0.100	0.046	-0.014
T-statistic	2.119	2.374	4.067	2.909	-0.740
Beta of Differences	0.311	0.390	-0.445	0.131	1.079
T-statistic	1.356	1.892	-1.564	0.560	5.023
Behavior of the Market:	**Random**	**Random**	**Random**	**Random**	**Persistant**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Random
Beta of Auto-Regression	1.049	1.051	1.129	1.002	0.979
T-test (single test for beta significant from one)	1.264	2.823	1.776	0.112	-0.527
Dickey-Fuller Case 2 (Trend)	Random	Random	Random	Random	Random
Rho of Unrestricted Regression	0.644	0.952	0.933	0.605	0.747
F-test (OLS joint test for Rho=1 & Gamma=0)	5.035	6.102	1.586	4.096	0.765
T-test (single test for Rho significant from one)	-2.403	-0.854	-0.182	-2.819	-1.197
Rents - Lagged Regression Statistics	*1979* *1998*	*1972* *1998*	*1981* *1990*	*1971* *1998*	*1982* *1998*
Autoregressive Formula: Is there a trend?	**No Trend**	**No Trend**	**No Trend**	**No Trend**	**No Trend**
Alpha of Differences	-0.020	0.018	0.113	0.020	0.008
T-statistic	-1.356	0.371	0.807	0.465	0.208
Beta of Differences	0.442	0.480	0.303	0.263	0.458
T-statistic	1.965	2.577	0.794	1.393	1.767
Behavior of the Market:	**Persistant**	**Persistant**	**Random**	**Random**	**Random**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Random
Beta of Auto-Regression	0.965	0.739	0.636	0.698	0.841
T-test (single test for beta significant from one)	-1.016	-2.047	-0.929	-2.381	-1.225
Dickey-Fuller Case 2 (Trend)	Random	Random	Random	Random	Random
Rho of Unrestricted Regression	0.895	0.629	0.686	0.629	0.967
F-test (OLS joint test for Rho=1 & Gamma=0)	0.623	2.581	0.718	2.972	1.288
T-test (single test for Rho significant from one)	-0.739	-2.190	-0.773	-2.206	-0.185
Private - Lagged Regression Statistics	*1979* *1998*	*1978* *1998*	*1981* *1990*	*1981* *1998*	*1989* *1998*
Autoregressive Formula: Is there a trend?	**No Trend**	**No Trend**	**No Trend**	**No Trend**	**No Trend**
Alpha of Differences	0.001	0.042	0.138	0.001	-0.023
T-statistic	0.053	0.554	0.796	0.017	-0.460
Beta of Differences	0.932	0.490	0.397	0.146	0.118
T-statistic	6.982	2.296	1.104	0.485	0.320
Behavior of the Market:	**Persistant**	**Persistant**	**Random**	**Random**	**Random**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Random
Beta of Auto-Regression	1.019	0.696	0.862	0.529	0.467
T-test (single test for beta significant from one)	0.442	-2.222	-0.319	-2.126	-1.863
Dickey-Fuller Case 2 (Trend)	Random	Random	Random	Random	Random
Rho of Unrestricted Regression	0.820	0.672	0.920	0.401	0.962
F-test (OLS joint test for Rho=1 & Gamma=0)	3.524	2.374	0.853	2.632	4.992
T-test (single test for Rho significant from one)	-2.125	-1.902	-0.191	-2.263	-0.116
Public - Lagged Regression Statistics	*1985* *1998*	*1985* *1998*	*1991* *1998*	*1985* *1998*	*1992* *1998*
Autoregressive Formula: Is there a trend?	**No Trend**	**No Trend**	**No Trend**	**No Trend**	**No Trend**
Alpha of Differences	0.026	0.182	-0.151	0.060	-0.376
T-statistic	0.546	1.421	-0.921	0.678	-1.788
Beta of Differences	0.243	-0.064	-0.310	0.085	0.093
T-statistic	0.876	-0.206	-0.642	0.290	0.185
Behavior of the Market:	**Random**	**Random**	**Random**	**Random**	**Random**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Persistant
Beta of Auto-Regression	0.565	0.782	0.435	0.694	0.778
T-test (single test for beta significant from one)	-1.910	-1.402	-2.549	-1.832	-3.078
Dickey-Fuller Case 2 (Trend)	Random	Random	Persistant	Random	Random
Rho of Unrestricted Regression	0.561	0.444	-0.106	0.398	0.373
F-test (OLS joint test for Rho=1 & Gamma=0)	1.680	1.337	8.116	1.838	5.547
T-test (single test for Rho significant from one)	-1.828	-1.320	-3.786	-1.294	-1.674

Thailand's economy grew a little slower at the still amazing real rate of 3.6%. The results can be compared with the growth of the United States which had a much slower positive trend of about 2% per year when analyzed GDP values since the 1960.

The beta coefficients in the first order auto-regression equation gave mixed results. A weak relationship between successive GDP changes, which suggests a random walk was found in Indonesia and Hong Kong, China. However, for Thailand, Singapore and the United States the coefficients were statistically significant evidencing a trend-reverting pattern.

Given that the data for all of the countries was shown to demonstrate a trend Case II of the Dickey-Fuller test was used. The calculated F values were below the critical value of 7.00 in all the cases except Singapore, indicating that the hypothesis of a random walk could not be rejected. In Thailand and the United States a low F value contradicts the results of the auto-regression equation that indicates a strong trend reverting pattern. In all of the countries, the t-statistics for the rho coefficients were above the -3.5 critical values, supporting the conclusion of a random walk with trend for all countries.

We should keep in mind the limitations of the Dickey-Fuller test explained in chapter 3 of this thesis when analyzing the sometimes conflicting results of the different tests and consequently put more emphasis in the findings of the first order auto-regression equation when forming conclusions. This applies for the GDP analysis and for the analysis of all the other variables as well.

4.2.2 GDP (Rent Time Frame) Results

Given that for all of the countries the GDP data series pre-dated the other data series by at least 10 years, a shorter GDP series was also analyzed. In this case the time period was restricted to the same interval as the rent data of each country. When only data for the years 1982 through 1998 were used, Thailand did not show the presence of the trend observed using data for the years 1961 through 1998. The remaining countries continued to exhibit a time-related trend, though with slightly less significant t-

stats (due to the increase in the critical values) for the alpha coefficients. The only exception was for Indonesia which showed a strong and more significant trend. The range of real economic growth for this period was between 4.6% and 10.0% for the Asian countries excluding Thailand, which are much higher than the 1.5% rate for the United States.

Using this time frame the only case of a trend reverting behavior was found again in Thailand. The beta coefficients for the countries other than Thailand were insignificant. The results of the Dickey-Fuller test failed to reject the null hypothesis of a random walk in all of the countries for GDP.

4.2.3 Rents Results

There were no trends found in rents of any country. The very small t-statistic values for the alphas seemed to indicate this rather conclusively. Interesting to note that in the case of the United States the coefficient was negative, suggesting the existence of a downward trend. However, the t-statistic was not significant to confirm the validity of this result.

The beta coefficients in the auto-regression equation for United States and Singapore were significantly different from zero, suggesting that the level of rents this year can be used to forecast the level of the next one. This persistence in the rent series was not found in the rest of the countries, where rents described a random pattern.

Since there was not trend in any of the series, case I of the Dickey Fuller test, for flat series, was used. The T-statistics on the coefficient of the lagged variable were greater than the critical value in all cases. Thus, the null hypothesis that true coefficient is 1 and the series are following a random walk process could not be rejected. The -2.05 t-statistic for Singapore, the country with the highest beta coefficients in the auto-regression equation, came close to the critical value of –3.00. With a few more observations the Dickey-Fuller test could very well determine that Singapore's rents had been persistent over the test period, supporting the initial conclusion of the auto-regression equation.

4.2.4 Private Prices Results

The Private price data begins around 1980 for all the countries except for Thailand where the first observation is from 1988. In Indonesia the data stops in 1990. Using the auto-regression equation on differences, private prices were found to exhibit no trend at all for any of the countries. All of the alpha values were very small and t-statistics were insignificant. This indicated a weak influence of the associated GDP growth on the private price series.

Interestingly, the same countries that showed some persistence in rents, United States and Singapore, showed persistence in the private prices series as well. The results of the auto-regression test showed that private prices in Indonesia, Hong Kong, and Thailand followed a random walk.

Case I of the Dickey-Fuller test showed that in all of the cases the series were random. The highest t-statistic was obtained for Singapore. Private prices in this country were found to be persistent under the previous test. However, given the small number of degrees of freedom, the critical values were inflated making it difficult to reject the random walk hypothesis.

4.2.5 Public Prices Results

Less than 15 data points were available for analyzing the behavior of the public market. For Thailand as well as for Indonesia data begins around 1990which gives less than 10 observations.

Similar to private prices, public prices were found to demonstrate no trends. In the public series the alphas and the t-statistics for the public prices were much higher than for rents and private prices, however still well below critical value. In the cases of Thailand and Indonesia the results were interesting; the alpha coefficients were highly negative, suggesting the existence of a downward trend, even though the t-statistics were not significant enough to confirm this result. These findings are not totally unexpected given the brevity of the series that might not capture a full economic cycle and the turmoil that affected the region's capital markets in recent years.

Examining the beta coefficients in the first order auto-regression equation we find that they were all close to zero and the t-statistics were insignificant, suggesting that historic returns are useless to forecast future performance. Thus, the level of public prices this year is the best forecast for the level of the next one, being the variation pure white noise or random

Again, Case I of the Dickey-Fuller test indicated that all of the countries had random public price movements supporting the conclusion of the first order auto-regression test. This confirms the common belief that public markets are predominantly efficient.

CHAPTER 5:

QUESTION 2: HOW DOES THE LOCAL ECONOMY AFFECT THE REAL ESTATE MARKET?

5.1 CHAPTER OBJECTIVE

The goal of this chapter is to examine the relationships between GDP and other key real estate market variables. The analysis consisted of determining GDP's contemporaneous correlations with rents, private prices, and public prices. Then correlations using a one period lagged data series were used to determine whether or not these relationships were more strongly contemporaneous or lagged. In order to more accurately compare data series in which one (or both) followed a random walk, the Durbin-Watson co-integration test was used to determine if the random variables were moving together. This chapter will examine the results of these tests in an attempt to answer Question 2.

5.2 QUESTION 2 SUMMARY CHART

Summary chart B gives the results for this question.

5.2.1 GDP-Rents Results

The correlations between contemporaneous GDP and rent values in the US, China, and Indonesia were statistically insignificant. However, in both Thailand and Singapore, both the correlation coefficients are high and the F statistics are significant. In Indonesia and China, where the rents and GDP follow random walks, the contemporaneous and lagged Durbin-Watson results are very significant (greater than 0.4) indicating co-integration. However, neither the correlation nor the Durbin-Watson results in any of the five countries make it clear whether or not GDP leads rents.

Summary Chart B THE ECONOMY & THE REAL ESTATE MARKET	USA National	Singapore Singapore	Indonesia Jakarta	China Hong Kong	Thailand Bangkok
GDP -RENTS					
Durbin Watson					
Contemporaneous Rents - GDP	0.426	0.669	0.899	0.744	0.355
GDP Leading Rents	0.507	0.660	0.919	0.727	0.333
Are GDP(t) and Rents (t) Co-integrated?	**Yes**	**Yes**	**Yes**	**Yes**	**No**
Correlation					
Correlation GDP (t) - Rents (t)	**23.47%**	**42.43%**	**25.94%**	**26.98%**	**61.23%**
F-stat	1.049	5.488	0.577	2.041	8.998
Significance F	0.319	0.027	0.469	0.165	0.009
Correlation GDP (t-1) - Rents (t)	**0.56%**	**54.32%**	**-6.09%**	**31.13%**	**66.56%**
F-stat	0.001	10.466	0.030	2.790	11.930
Significance F	0.981	0.003	0.867	0.107	0.004
Are GDP changes leading Rents?	**No**	**Yes**	**No**	**Yes**	**Yes**
GDP-PRIVATE					
Durbin Watson					
Contemporaneous Private Prices - GDP	0.267	0.635	0.767	1.122	0.757
GDP Leading Private Prices	0.341	0.640	0.805	1.149	0.731
Are GDP(t) and Private (t) Co-integrated?	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Correlation					
Correlation GDP (t) - Private Prices (t)	**8.49%**	**57.86%**	**47.82%**	**43.84%**	**72.81%**
F-stat	0.131	9.563	2.372	3.808	9.026
Significance F	0.722	0.006	0.162	0.069	0.017
Correlation GDP (t-1) - Private Prices (t)	**19.81%**	**29.86%**	**-3.54%**	**32.88%**	**79.21%**
F-stat	0.735	1.859	0.010	1.940	13.471
Significance F	0.402	0.189	0.923	0.183	0.006
Are GDP changes leading Private?	**Yes**	**No**	**No**	**No**	**Yes**
GDP-PUBLIC					
Durbin Watson					
Contemporaneous Public Prices - GDP	0.796	1.124	1.927	1.281	1.038
GDP Leading Public Prices	0.794	1.064	1.652	1.196	1.472
Are GDP(t) and Public (t) Co-integrated?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Correlation					
Correlation GDP (t) - Public Prices (t)	**54.55%**	**47.91%**	**49.49%**	**39.51%**	**74.72%**
F-stat	5.085	3.575	1.947	2.220	6.321
Significance F	0.044	0.083	0.212	0.162	0.054
Correlation GDP (t-1) - Public Prices (t)	**28.92%**	**-10.68%**	**-51.85%**	**20.14%**	**53.09%**
F-stat	1.095	0.139	2.207	0.507	1.962
Significance F	0.316	0.716	0.188	0.490	0.220
Are GDP changes leading Public?	**No**	**No**	**No**	**No**	**No**

There is only weak evidence in favor of GDP leading rents in Singapore, China, and Thailand. For the US and Indonesia, the state of the domestic GDP was found to play a relatively small contemporaneous role in determining current rent prices.

5.2.2 GDP-Private Prices Results

With the exception of the US, all of the countries showed high correlation values and significant F statistics with contemporaneous GDP. Thailand had the highest correlation values both for GDP contemporaneous with 72% and GDP leading with 79%. Average correlation among the Asia countries is about 50%. The Durbin-Watson results were also significant for all of the countries. With the exception of the US, the average Durbin-Watson result exceeded 0.6, well above the critical value of 0.4. Given that in Indonesia and China, the countries with the highest Durbin-Watson coefficients, private and GDP

follow random walks adds evidence in support of the hypothesis that these two variables are related across time. Interesting to note that countries with the highest Durbin-Watson coefficients and where GDP and private followed random walks are also the countries with the lowest correlation values. The inverse is also true. Countries with persistent GDP and private price have higher correlations and lower Durbin-Watson coefficients. These results are not unexpected given that the correlation of two random variable could produce spurious results. Only the US has inconclusive results for Question 2.

5.2.3 GDP-Public Prices Results

In general, the contemporaneous correlations between the GDP and public prices were found to be larger and significant for most of the countries in the selection. The US, Singapore, and Thailand have significant correlations which range from 50% to 75%. This makes sense given that public prices should be more volatile and liquid, and thus subject to more influence by immediate local economic considerations. Once again, the same inverse relationship between the Durbin-Watson results and the correlations values was found depending on whether the variables were random or persistent, though the relationship was not as strong.

CHAPTER 6:

QUESTION 3: HOW DO PUBLIC AND PRIVATE REAL ESTATE RELATES WITH EACH OTHER?

6.1 CHAPTER OBJECTIVE

The objectives of this chapter are similar to those of the previous one for the various relationships being addressed. The correlations between rents & private prices, rents & public prices, and public & private prices were calculated in order to better understand these inter-market relationships. It was also determined whether these relationships were lagged or contemporaneous, as in the previous chapter. The Durbin-Watson test for co-integration was used as well. This chapter will attempt to analyze the implications of the results with the intent of answering the third and final question.

6.2 QUESTION 3 SUMMARY CHART

Summary chart C gives the results for this question.

6.2.1 Rents-Private Prices Results

Given that rental income is such a key component of a building's value, one would expect to find a very high correlation between rent levels and private prices. This was indeed found to be the case. For the four countries for which the relevant data was available, the contemporaneous correlations were approximately 60%. All of the F values were overwhelmingly significant for these correlations. The only exception was Singapore, where private prices were found to lead rents. This may be a direct result of the persistence found in Singapore's rent prices, as was shown in Chapter 4. The correlation results for Indonesia, China, and Thailand indicate that the current rent level levels played a large role in determining contemporaneous private prices over the study period similar to what was found in the United States.

Summary Chart C RELATIONSHIPS WITHIN THE REAL ESTATE SECTOR	**USA** National	**Singapore** Singapore	**Indonesia** Jakarta	**China** Hong Kong	**Thailand** Bangkok
RENTS - PRIVATE					
Durbin Watson					
Contemporaneous Private Prices - Rents	0.305	0.807	1.864	0.934	0.710
Rents Leading Private Prices	0.507	0.657	1.016	1.174	1.243
Private Prices Leading Rents	0.187	0.462	1.556	0.641	0.769
Are Rents(t) and Private (t) Co-integrated?	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Correlation					
Correlation Rents (t) - Private Prices (t)	**57.55%**	**56.88%**	**64.76%**	**73.05%**	**65.06%**
F-stat	8.913	9.088	5.777	18.311	5.872
Significance F	0.008	0.007	0.043	0.001	0.042
Correlation Rents (t-1) - Private Prices (t)	**68.22%**	**-4.58%**	**64.75%**	**0.65%**	**26.63%**
F-stat	14.800	0.040	5.054	0.001	0.611
Significance F	0.001	0.844	0.059	0.980	0.457
Are changes in Rents leading Private?	**Yes**	**No**	**No**	**No**	**No**
Correlation Private Prices (t-1) - Rents (t)	**44.13%**	**77.08%**	**40.42%**	**54.05%**	**55.97%**
F-stat	4.110	26.343	1.367	6.190	3.192
Significance F	0.059	0.000	0.281	0.025	0.117
Are changes in Private leading Rents?	**No**	**Yes**	**No**	**No**	**No**
RENTS - PUBLIC					
Durbin Watson					
Contemporaneous Public Prices - Rents	0.750	0.376		0.459	1.309
Rents Leading Public Prices	0.752	0.380		0.574	2.268
Public Prices Leading Rents	0.862	0.184		0.231	0.821
Are Rents(t) and Public (t) Co-integrated?	**Yes**	**No**		**Yes**	**Yes**
Correlation					
Correlation Rents (t) - Public Prices (t)	**44.81%**	**28.30%**		**18.64%**	**37.83%**
F-stat	3.015	1.044		0.432	0.835
Significance F	0.108	0.327		0.524	0.403
Correlation Rents (t-1) - Public Prices (t)	**32.31%**	**-30.86%**		**-48.30%**	**24.47%**
F-stat	1.399	1.263		3.651	0.318
Significance F	0.260	0.283		0.080	0.597
Are changes in Rents leading Public?	**No**	**No**		**No**	**No**
Correlation Public Prices (t-1) - Rents (t)	**45.05%**	**55.98%**		**46.40%**	**77.82%**
F-stat	2.800	5.021		3.018	6.143
Significance F	0.122	0.047		0.110	0.068
Are changes in Public leading Rents?	**Yes**	**Yes**		**Yes**	**Yes**
PRIVATE - PUBLIC					
Durbin Watson					
Contemporaneous Private Prices - Public Prices	0.065	0.768		1.639	1.115
Private Prices Leading Public Prices	0.075	0.718		1.668	0.937
Public Prices Leading Private Prices	0.062	0.751		1.513	1.280
Are Public and Private (t) Co-integrated?	**No**	**Yes**		**Yes**	**Yes**
Correlation					
Correlation Private Prices (t) - Public Prices (t)	**21.97%**	**52.78%**		**51.29%**	**25.06%**
F-stat	0.609	4.633		4.283	0.335
Significance F	0.450	0.052		0.061	0.588
Correlation Private Prices (t-1) - Public Prices (t)	**14.24%**	**-7.50%**		**-56.77%**	**67.83%**
F-stat	0.248	0.068		5.707	4.261
Significance F	0.627	0.799		0.034	0.094
Are changes in Private leading Public?	**No**	**No**		**No**	**Yes**
Correlation Public Prices (t-1) - Private Prices (t)	**42.32%**	**66.03%**		**39.19%**	**97.68%**
F-stat	2.399	8.505		1.997	83.163
Significance F	0.150	0.014		0.185	0.001
Are changes in Public leading Private?	**Yes**	**Yes**		**No**	**Yes**

Since both rents and private prices were found to follow random walks, except in Singapore and the United States, one would expect to find significant Durbin-Watson statistics if there is a strong relationship between the variables in the other countries. The results confirmed this hypothesis. The Durbin-Watson values for Thailand, China and Indonesia for all of the relationships, both contemporaneous and lagged, were very significant. The co-integration test reveals evidence of rents leading private prices in Thailand, China as was the case in the United States using the correlation test.

Some of these results contradict the findings of the correlation tests that indicated strong contemporaneous relationships.

6.2.2 Rents-Public Prices Results

The contemporaneous correlations between public prices and rents were smaller than those for the rents-private prices relationship, but still very marked. Thailand's 39% value was the highest correlation, while China's 18% was the lowest. However China's F value was below the critical value indicating that the results for that country were spurious.

The correlation results for the public prices leading rents were much higher than the contemporaneous correlation values for all the countries analyzed. For Thailand the correlation jumped by approximately 40%. Most of the F values were above or near the critical values as well. This provides evidence that public prices lead rent prices in Singapore, China, and Thailand.
The results for the Durbin-Watson test were not reliable for the United States and Singapore given that persistence was found in the series. In Thailand and China the results showed a strong contemporaneous relationship.

6.2.3 Private Prices-Public Prices Results

If the public markets are efficient, then evidence that the public market prices lead the private market values should be found. This was the case for two of the three Asian countries analyzed, Singapore and Thailand, confirming the findings for the United States. China, however, did not have clear results. Though some correlation was found for the lagged relationship, the contemporaneous values were found to be the highest in addition this relationship had the highest signifcance. For Thailand the lagged effect was quite pronounced. The correlation rose an incredible 70% with the lag to 98%. For Singapore the correlation rose only 13%.

The Durbin-Watson results were significant for all of the relationships. They showed that there was in fact a high degree of co-integration for the public prices-private prices relationship for all of the countries. But once again, the results for the United States and Singapore were not reliable given that persistence was found in the series. For Thailand the Durbin-Watson values of the lagged relationship proved to be the highest suggesting that the public market were leading private market over the study period. However, no clear lead-lag relationship was shown for China.

CHAPTER 7: FINAL SUMMARY

7.1 COUNTRY SUMMARY GRAPHS

The results of the three question analyzed in this thesis are presented in graphical form in Exhibits 12 through 15.

7.2 QUESTION 1 SUMMARY

Of all the tested variables, public prices was the only one that remained completely consistet among the selected countries. In all cases this variable was found to be random. For all the other series the results were mixed. Surprisingly, given that that the private real estate market has historically been viewed as somewhat inefficient, private market indicators showed a random walk pattern in three out of the four Asian countries included in this study. These results lead to the final conclusion that private and public markets in the analyzed countries are more efficient than was previously thought. Another interesting result is the lack of trends in the real estate data. Given that there were trends found in the GDPs, the relationship between the variables and time suggests that the real estate market may sometimes get disconnected from the path of the local economy. Therefore, there could be situations where the real estate markets would not benefit from periods of great economic expansion as the ones exhibited by these Asian nations.

7.3 QUESTION 2 SUMMARY

Chapter 1 indicated that Professor's Goetzmann et. al. had found a strong correlation between GDP and the private real estate markets in may international countries. They also found that a large portion of the changes in GDP was caused by global economic influences. Therefore it was concluded that international diversification was of little help in such a scenario.

Exhibit 12

National, USA

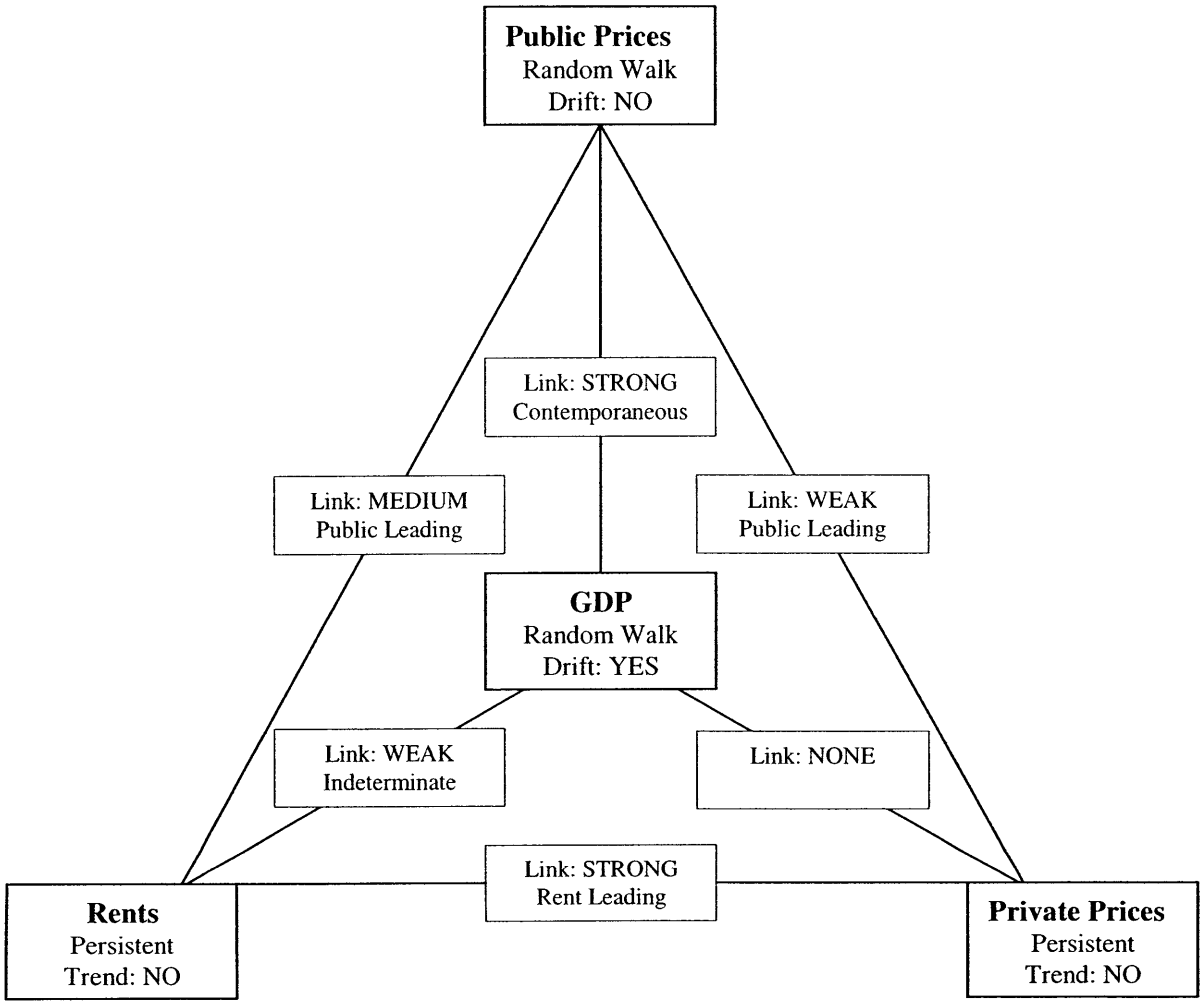


EXHIBIT 13

Singapore, Singapore

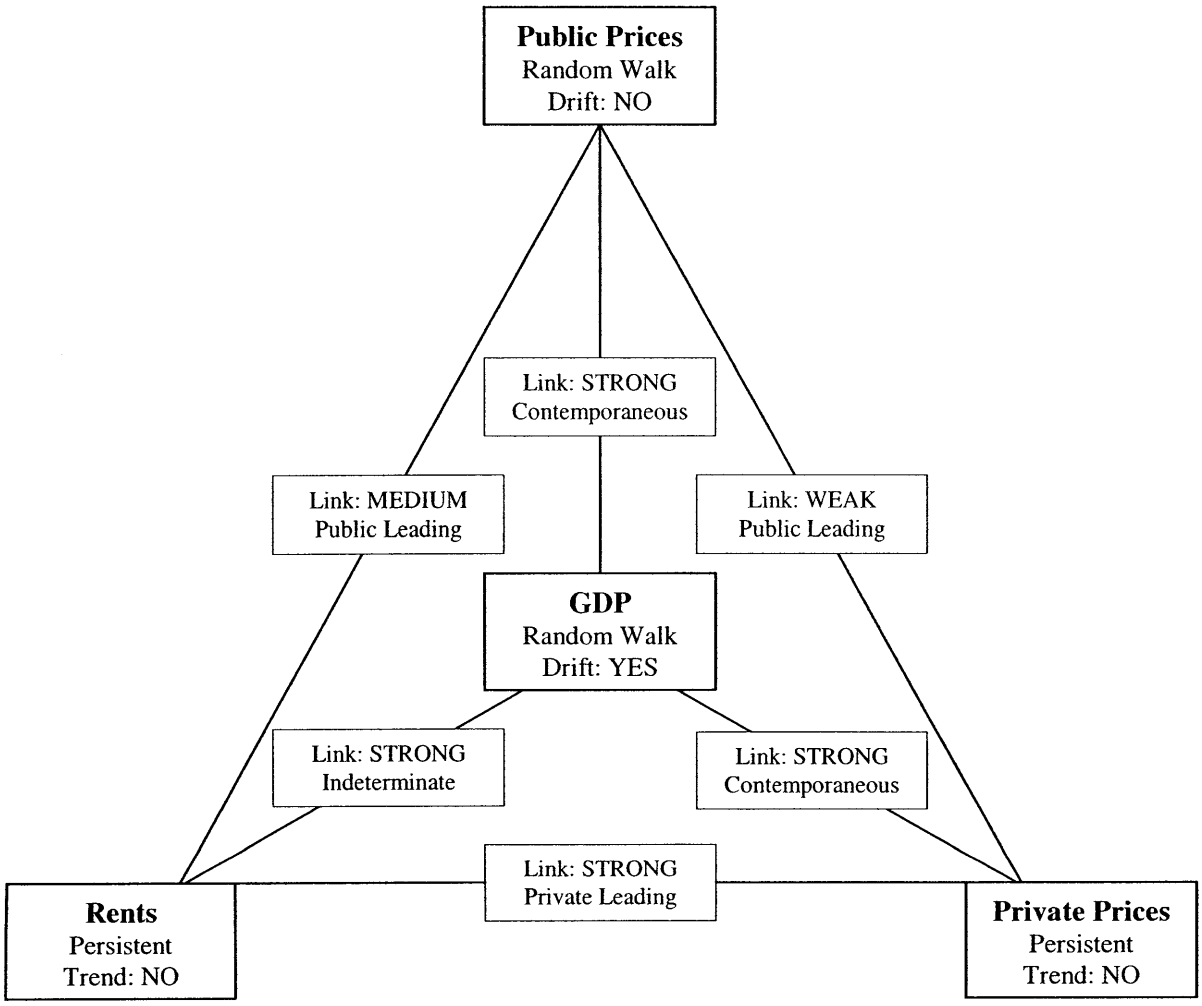


EXHIBIT 14

Jakarta, Indonesia

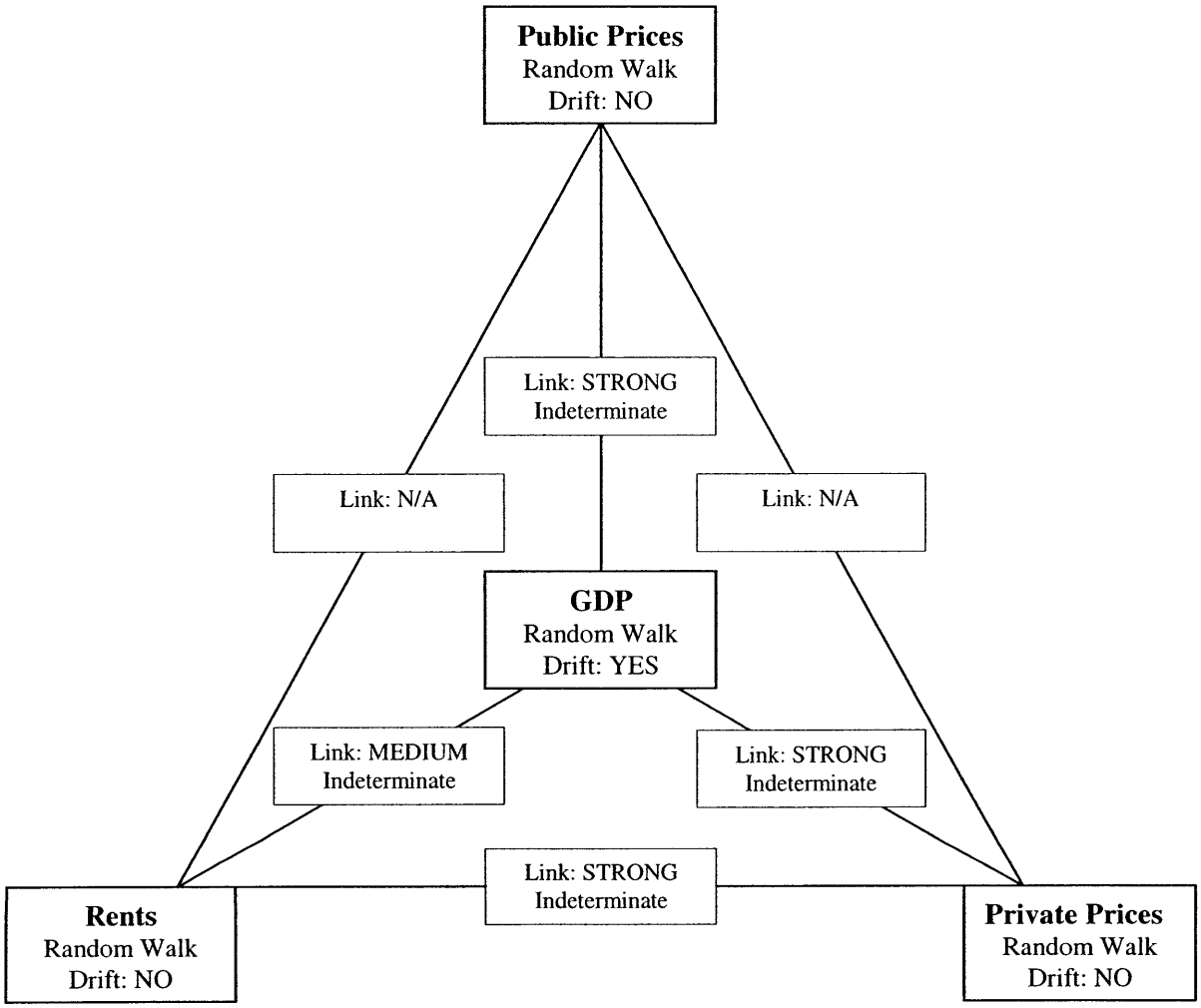


EXHIBIT 15

Hong Kong, China

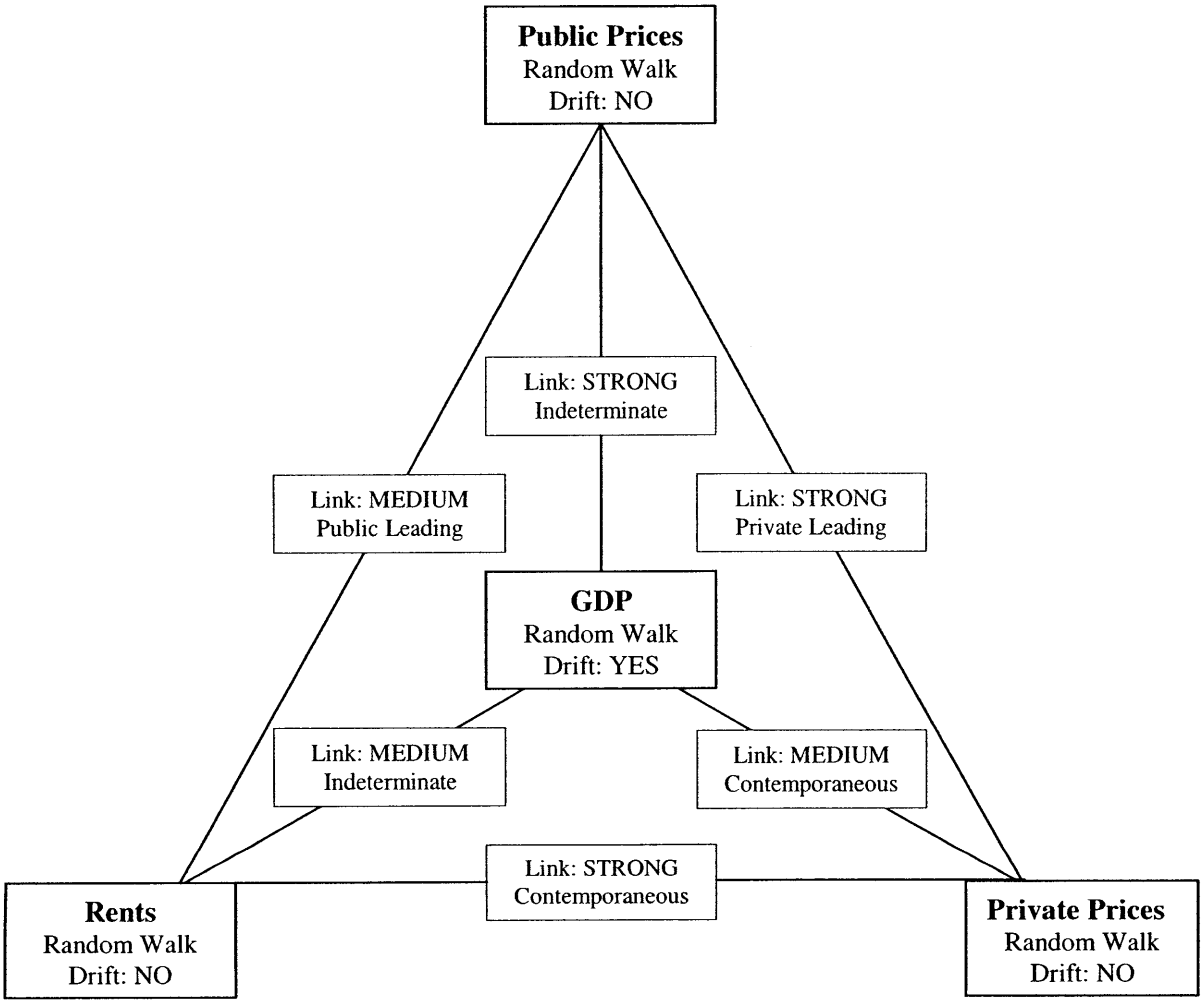
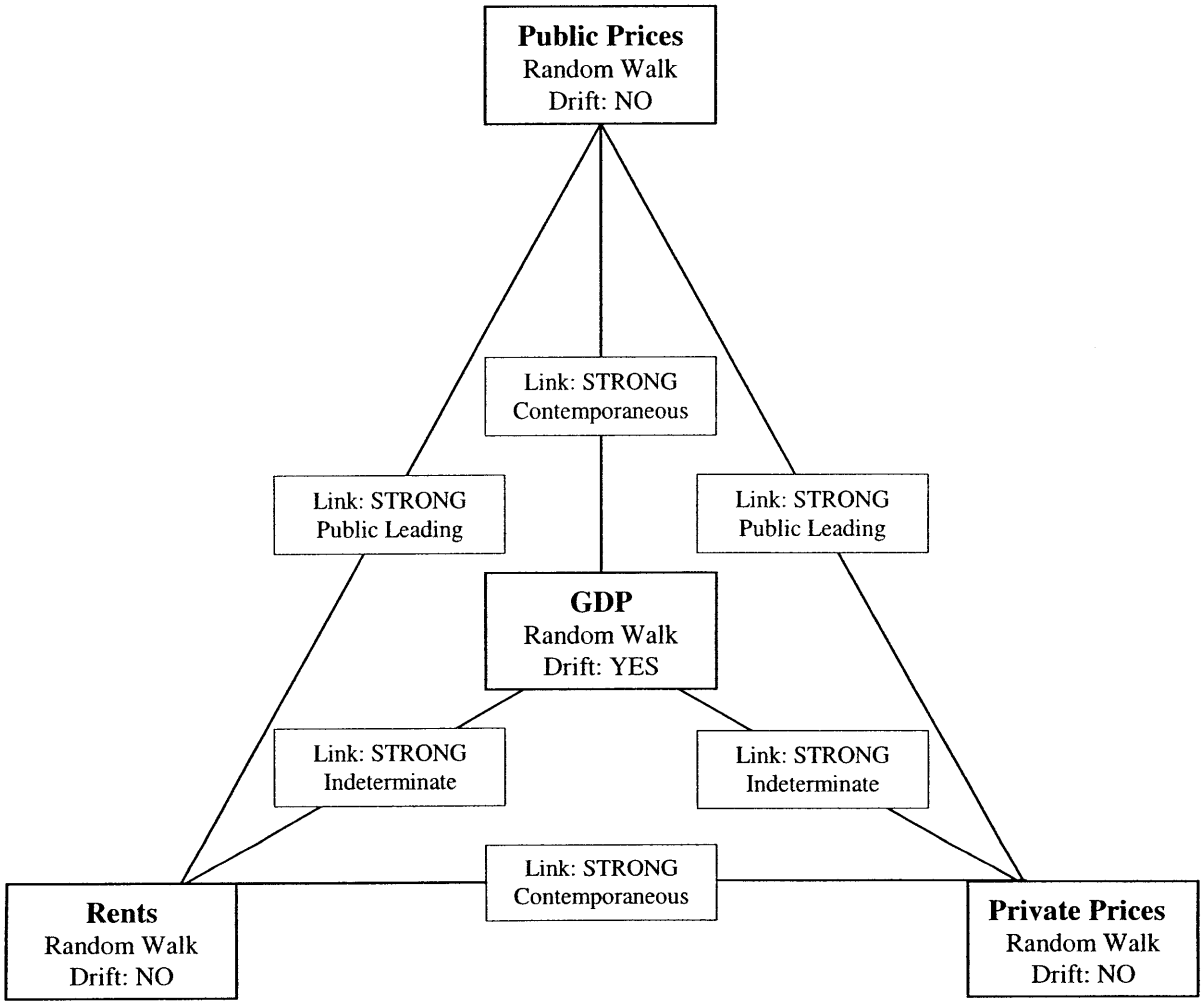


EXHIBIT 16

Bangkok, Thailand



The results found in this thesis also indicated a strong contemporaneous correlation between GDP and private prices. It was also found that GDP, on average, had an even higher correlation with the public prices. As was stated previously, this is not surprising given that public prices are able to adjust much more quickly to new economic data than private prices. Countries with random private and public series showed stronger evidence of Durbin-Watson co-integration than countries with persistent series. The results for rents and GDP are mixed. Only two of the four Asian countries exhibited significant correlations. However, both contemporaneous and lagged correlations in these two countries produced similar results. As such, the evidence could not determine whether to accept or reject the hypothesis that GDP was leading rents.

Assuming that Goetzmann et. al.'s hypothesis that a large portion of the changes in GDP is due to international influences is correct, and given that GDP effects both public and private prices, the overall conclusion must be that international investment in office properties will not produce substantial diversification benefits. More specifically, switching from direct equity investments to public securities will not reduce the non-systematic risk that investors face. However, it must be emphasized that investors will still enjoy greater investment liquidity, that may very well overshadow the diversification issues since the investment options available to them are dramatically increased.

7.4 QUESTION 3 SUMMARY

Overall, a high degree of correlation and even higher degree of co-integration was found for rent prices, private prices, and for public prices. These results make sense given that the data analysis of Chapter 4 indicated a high degree of randomness in the data. The relatively high co-integration values indicates that the data series consisted of random variables moving together over the study period.

There was a very strong contemporaneous link shown for the private prices-rents relationship for all of the countries. This is not surprising given that private prices are a function of rent values. The lagged correlations were all lower, except for Singapore where it was shown that the private prices lead

changes in rents. The results for the public prices-rents relationship indicated that a definite relationship existed, but less so than for rents-private prices. On the other hand public prices were found to lead rents in all three countries analyzed. The public-private results were leaning towards a public leading private relationship, but this was not consistent. The public markets of Singapore and Thailand were found to lead the private markets, as we find in the United States, but this was not the case in China.

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