INTERNATIONAL REAL ESTATE INVESTMENTS:
An Analysis of the Public and Private Markets in
Germany, Australia, France, and Japan.

By

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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: Germany, Australia, France, and Japan. 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:

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?

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 predominately persistent. 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 Germany public prices were found to lead private prices.

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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 by investing in several different assets the non-systemic risks could be diversified away[1]. 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. But 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 in each market. 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. Real estate would in effect be a money machine. However, if the price data follows a random walk, investor wouldn't be able to use trend-reverting forecasts to 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 this replacement cost, private prices should show some level of persistence. Another reason to believe

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

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 pure 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. 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?

As was previously discussed, all of these questions relate to issues that are directly relevant to international real estate investors. If persistence can be found in the data, then investors can create econometric models to predict future returns. Measuring the extent that GDP affects both the public and private markets would help investors access the diversification benefits of their international real estate investments. 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 development of the 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, international private data on average dates back much further, usually to the early 1970s. As a result 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 was discussed in the first section, 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 1) that private property returns fluctuate with changes in the domestic GDP, 2) the relationship between domestic GDP and returns is contemporaneous, and 3) that global influences have a large effect on domestic GDP. As a

[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

result, 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 tremendous with respect to the ability of international real estate investment to diversify a given portfolio. If the paper's conclusions are correct, a high degree of contemporaneous correlation between a given country's GDP and that country's private asset prices should be found. The unknown question then is: 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 also a large contemporaneous correlation between domestic GDP and public prices, then there effectively is no "escape" from the effects of the global GDP. 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 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.

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

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.

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 found in the GDP time series for Germany and France only. No GDP trends were found in Australia or Japan.

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

- Rents and private prices were found to show some degree of persistence, while all of the public markets analyzed were found to be random in nature.

The fact that the trending GDP prices for Germany and France did not result in other trends, given the high degree of overall correlation that GDP has with the other data series, suggests an inability for real GDP growth to translate into real sector growth. This result is very surprising. Also, the high degree of persistence found all of the data, except the public prices, supports the findings presented in Kuo's paper. The fact that the public markets were the exception provides support for the hypothesis that public real estate markets are indeed more efficient than the private markets.

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

- A high degree of contemporaneous correlation was found between rents and GDP for all of the countries.
- Both private and public prices were also found to a have a significant contemporaneous correlation with GDP.

The results for this question are not surprising. Most economists believe that the state of the general economy has a strong influence on the contemporaneous performance of the real estate markets. These results agree with Professor Goetzmann et. al.'s findings. They also found a high level of contemporaneous correlation. And based on their work, which shows global GDP to be a significant influence on local GDP, it must then be concluded that investing in international public real estate securities would probably not provide significant diversification benefits.

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, but they were still very significant. Public prices were found to lead rents in all of the countries analyzed.
- The results for the public and private relationships leaned toward the public market leading the private market. Germany, somewhat surprisingly, was the only exception.

Again, the results for this question provided few surprises for the most part. Given that rental income is a major function of private prices, a strong correlation between the two variables should have been found. The fact that public prices were found to lead rent prices could also be predicted 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. These findings, with the glaring exception of Germany, support 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 the 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 observable. 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 United States was also included in the analysis in order to compare it with the other markets. Both the NCREIF office data and the GPR data were used to obtain the all of the necessary information for the study.

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 Germany, Australia, France, and Japan. The other countries were analyzed in additional theses by Alfonzo Leon and Martin M. Loketek.

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	526.58			
1961	539.33			
1962	572.95			
1963	597.20			
1964	633.05			
1965	674.99			
1966	718.91			
1967	739.40			
1968	775.12			
1969	793.43			
1970	789.85			
1971	822.94			
1972	875.89			
1973	921.42			
1974	898.94			
1975	897.25			
1976	946.29			
1977	990.53			
1978	1040.15	4.15	46.96	
1979	1043.47	3.84	48.21	
1980	1000.65	3.70	49.52	
1981	1014.62	3.62	50.21	
1982	994.72	3.65	50.48	
1983	1044.70	3.67	50.06	
1984	1112.65	3.57	51.14	28.80
1985	1150.92	3.65	50.67	35.47
1986	1194.42	3.44	50.02	47.55
1987	1222.71	3.22	46.86	50.55
1988	1264.18	2.87	44.35	44.36
1989	1299.25	2.61	41.84	46.13
1990	1301.68	2.34	38.16	32.40
1991	1286.30	2.06	32.18	31.11
1992	1317.83	1.94	25.99	31.91
1993	1344.36	1.79	21.79	39.49
1994	1387.83	1.75	19.42	40.41
1995	1412.52	1.70	18.28	38.00
1996	1446.23	1.56	17.84	41.14
1997	1496.34	1.68	18.45	49.36
1998	1546.02	1.71	20.22	50.50

EXHIBIT 2
Frankfort, Germany

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	302.70			
1961	324.32			
1962	342.89			
1963	352.88			
1964	378.88			
1965	401.08			
1966	411.51			
1967	410.14			
1968	435.34			
1969	478.38			
1970	523.14			
1971	551.91			
1972	574.36	209.33		
1973	598.20	195.65	3726.65	
1974	599.91	197.54	3591.72	
1975	590.85	172.66	3002.72	
1976	618.30	145.68	2533.53	
1977	636.10	159.65	2776.53	
1978	665.20	167.91	2920.21	
1979	691.11	170.23	2895.66	
1980	695.05	169.98	3245.07	
1981	681.65	159.87	2843.51	
1982	669.95	161.99	3239.88	
1983	681.56	156.86	3219.67	
1984	698.38	153.17	3224.58	39.93
1985	711.69	149.90	3155.71	39.71
1986	752.49	178.22	3564.49	40.49
1987	776.09	204.70	4093.95	40.95
1988	806.94	219.45	4388.96	40.52
1989	833.25	258.47	5743.71	41.10
1990	884.89	328.28	7724.20	41.48
1991	1004.34	374.83	8584.24	41.52
1992	1031.37	321.61	6637.42	41.34
1993	1014.65	262.19	5070.81	41.02
1994	1039.01	242.72	4623.27	40.16
1995	1055.36	222.24	4217.92	39.65
1996	1064.26	199.35	3624.56	38.73
1997	1075.77	195.92	3562.16	38.12
1998	1104.91	199.94	3713.11	37.60

EXHIBIT 3
Sydney, Australia

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	14.98			
1961	14.85			
1962	15.10			
1963	15.22			
1964	15.63			
1965	15.12			
1966	14.95			
1967	15.43			
1968	16.11			
1969	17.52			
1970	18.29	70.89	787.71	
1971	19.00	65.51	770.70	
1972	19.62	50.66	596.04	
1973	20.76	38.31	510.74	
1974	21.66	33.32	416.46	
1975	21.95	30.18	355.08	
1976	21.92	26.98	337.25	
1977	19.39	22.94	295.97	
1978	17.94	21.28	283.72	
1979	17.88	21.08	295.87	
1980	17.57	27.53	423.54	
1981	17.40	33.30	532.78	
1982	16.83	32.90	470.00	
1983	16.41	29.78	441.19	
1984	16.86	29.60	438.52	8.20
1985	17.13	29.07	430.60	7.82
1986	17.18	31.58	485.84	8.35
1987	18.41	32.87	571.63	10.08
1988	19.82	36.47	694.75	9.73
1989	20.81	39.24	730.07	8.80
1990	20.63	38.81	633.67	8.18
1991	19.67	36.38	549.14	7.92
1992	19.33	31.55	435.26	7.82
1993	19.49	27.74	369.85	8.58
1994	19.82	26.16	373.69	8.37
1995	20.20	25.41	376.47	8.19
1996	20.65	25.15	402.44	8.56
1997	21.23	25.70	428.36	9.80
1998	22.00	26.08	453.51	11.20

EXHIBIT 4
Paris, France

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	296.50			
1961	315.87			
1962	335.10			
1963	357.96			
1964	384.70			
1965	403.13			
1966	425.46			
1967	447.01			
1968	464.67			
1969	499.68			
1970	534.60	606.36		
1971	565.20	639.23		
1972	595.39	662.96		
1973	634.11	645.45	6794.23	
1974	643.49	444.47	4678.62	
1975	649.08	397.96	4081.67	
1976	685.95	363.02	4033.56	
1977	706.48	368.38	4333.89	
1978	735.95	370.91	4636.34	
1979	756.10	380.93	5781.41	
1980	753.76	369.06	6287.07	
1981	749.51	367.08	7161.19	
1982	766.87	359.54	6395.15	
1983	774.12	357.45	5719.19	
1984	782.72	367.86	5885.81	18.74
1985	796.94	423.90	6782.34	23.40
1986	838.26	479.55	7992.43	33.21
1987	854.36	496.30	9023.55	29.84
1988	894.02	565.08	11301.67	24.76
1989	927.75	610.00	12902.78	27.57
1990	948.38	670.18	16754.54	28.27
1991	956.47	656.35	13476.20	23.71
1992	965.17	586.03	10326.45	20.15
1993	955.73	489.54	8158.95	22.15
1994	981.64	451.65	7607.73	22.32
1995	1000.08	405.65	7054.77	16.83
1996	1007.17	379.62	6580.48	16.70
1997	1028.78	368.80	6146.63	17.74
1998	1054.78	387.29	6671.25	19.30

EXHIBIT 5
Tokyo, Japan

Year	Real GDP (Base 1960)	Real Rents (Base 1960)	Real Private Prices (Base 1960)	Real Public Prices Ave (Base1960)
1960	16009.70			
1961	18345.00			
1962	19497.00			
1963	20726.21			
1964	23479.58			
1965	24506.27			
1966	27085.31			
1967	30526.32			
1968	34310.35			
1969	38296.19			
1970	41920.40			
1971	43363.74			
1972	47338.96			
1973	51623.07	4270.18		
1974	50033.23	5780.44		
1975	49462.96	6723.57		
1976	50781.04	7186.82		
1977	52302.00	6992.07		
1978	55299.34	7133.06		
1979	57767.24	7130.79		
1980	58104.51	7557.70		
1981	59480.65	7611.63		
1982	60734.03	7821.19		
1983	62064.55	7978.11		
1984	64743.89	8348.82		21.51
1985	67648.01	8367.99		32.88
1986	70384.00	9150.01		70.17
1987	73300.61	11637.73		94.90
1988	77844.91	13310.61		94.93
1989	81410.00	14362.29		111.47
1990	84927.56	15104.35		72.96
1991	87645.05	16499.44		61.08
1992	88556.80	14470.00		41.12
1993	88255.11	9762.66		44.67
1994	88359.15	7559.00		46.06
1995	89170.89	6274.18		40.81
1996	92118.92	5897.25		51.39
1997	91916.49	6070.13		49.68
1998	89627.73	6136.19		42.46

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 future values can be predicted among other things. 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).

[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

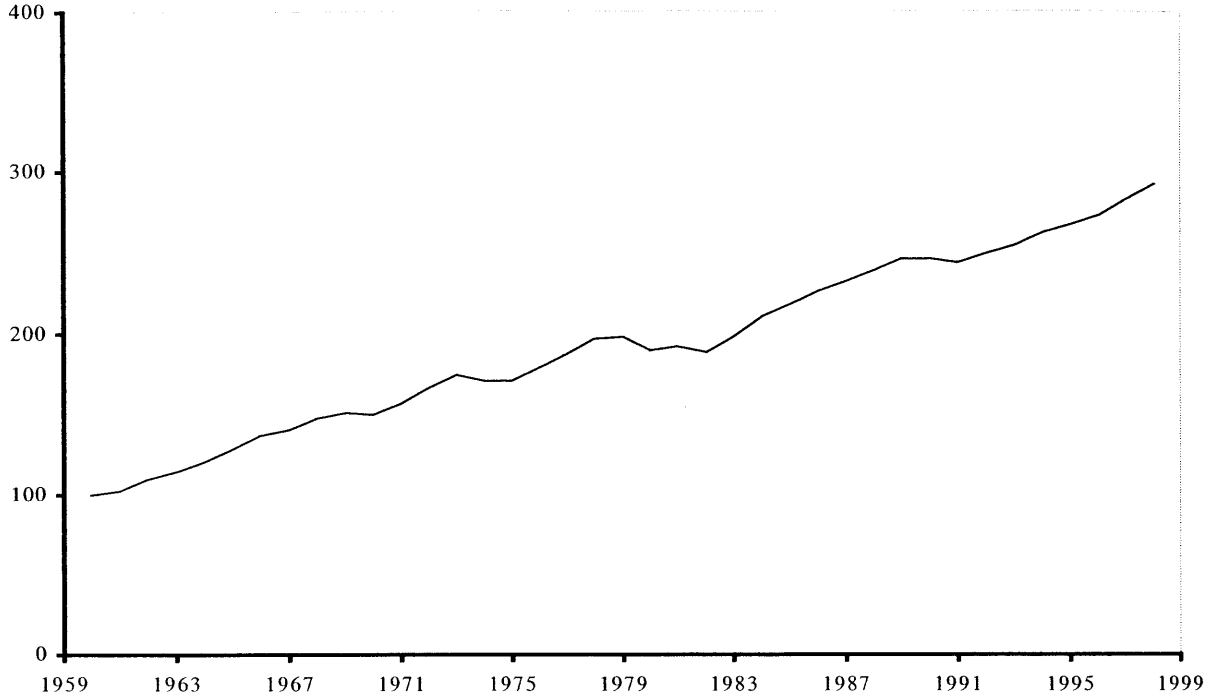
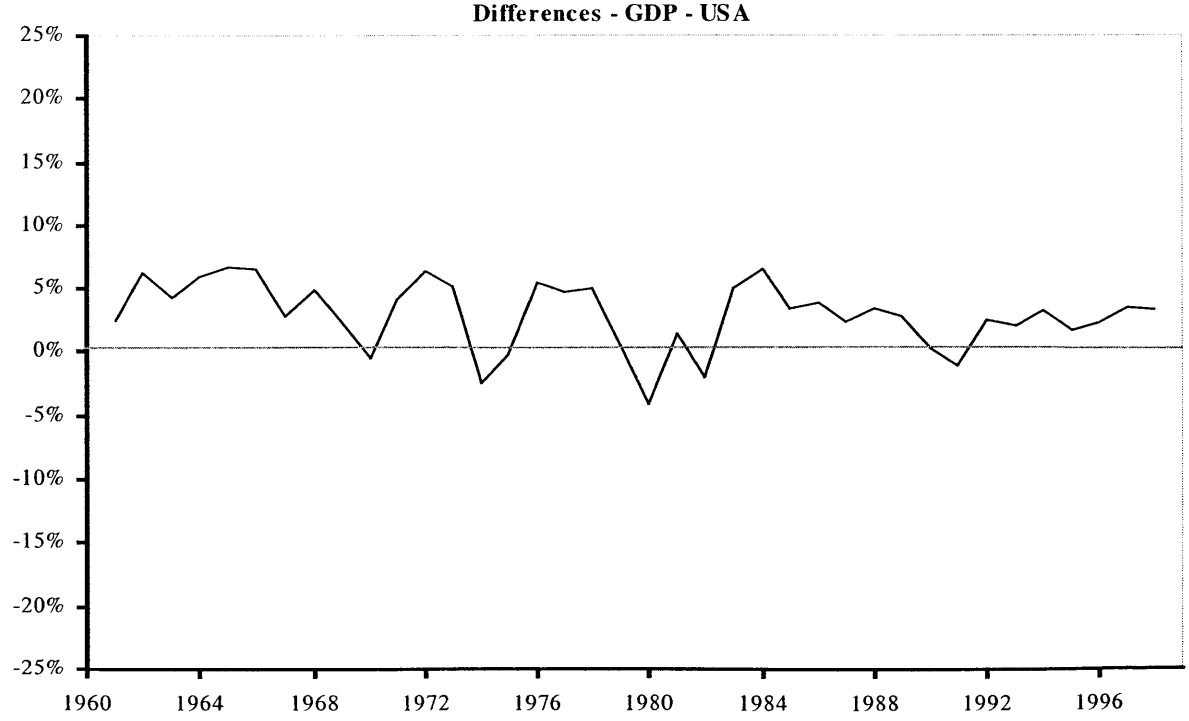


EXHIBIT 6B

Differences - GDP - USA



Step 1: The auto-regression equation

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

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

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

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 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 Dicky-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

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

conclusions of the Yale paper indicate that not only is there is a strong correlation between private 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 next.

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

1) The correlation values were computed between GDP and the other data series.

2) The Durbin-Watson values were computed for the 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.

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

[19] Op. Cit.,R. F. Engle, C. W. J. Wranger, p.269

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 data using the previously derived percentage difference tables.

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

[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 figure that is higher than the market value of the underlying assets. And 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 indicate inefficient, underdeveloped public markets. Another possible interpretation of this result would be that the private market is also adjusting instantaneously to news, which given the stickiness of private prices, should rarely be the case.

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 extermination of the lead/lag relationships. It is quite possible that monthly data would have yielded different conclusions.

EXHIBIT 7A
Levels - USA

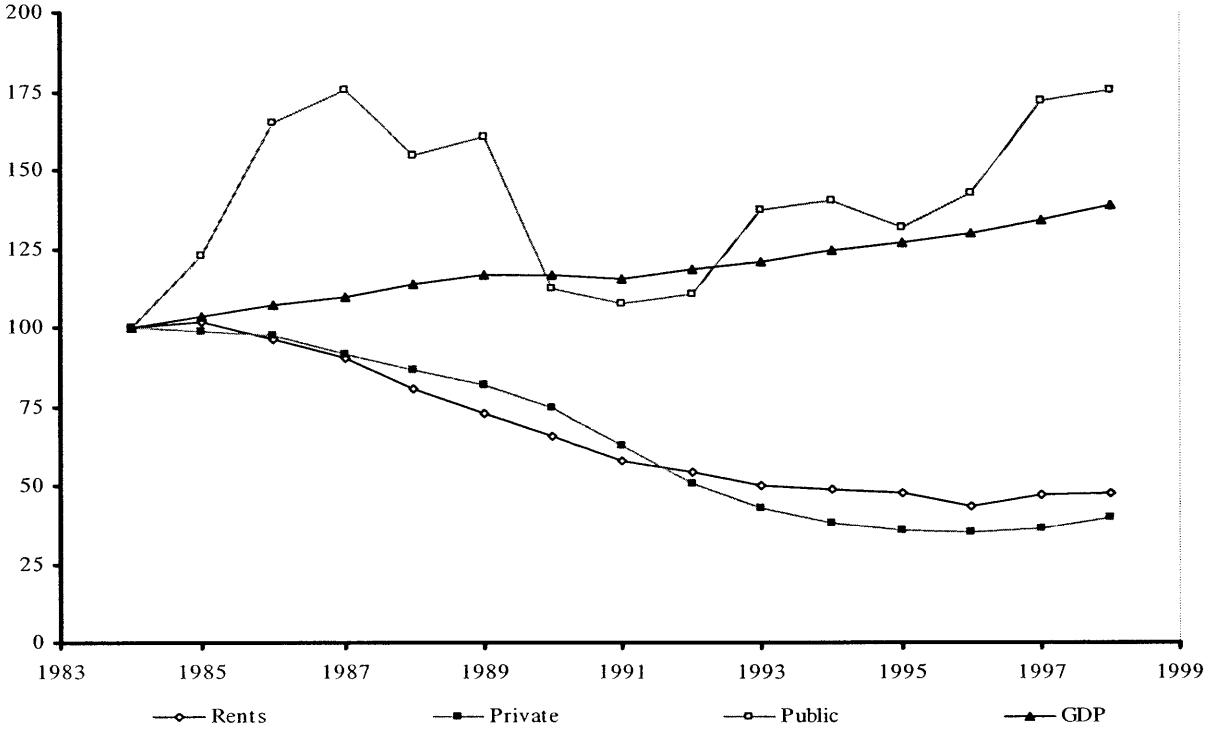


EXHIBIT 7B
Differences - USA

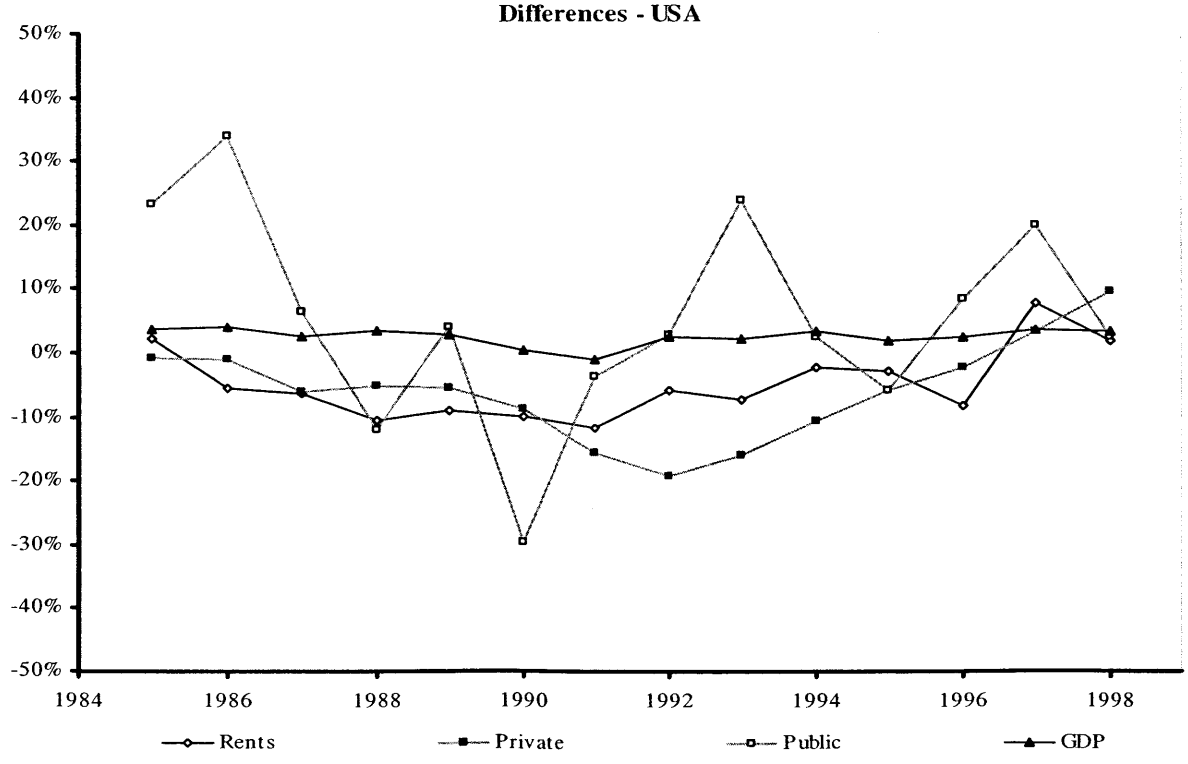


EXHIBIT 8A
Levels - Germany

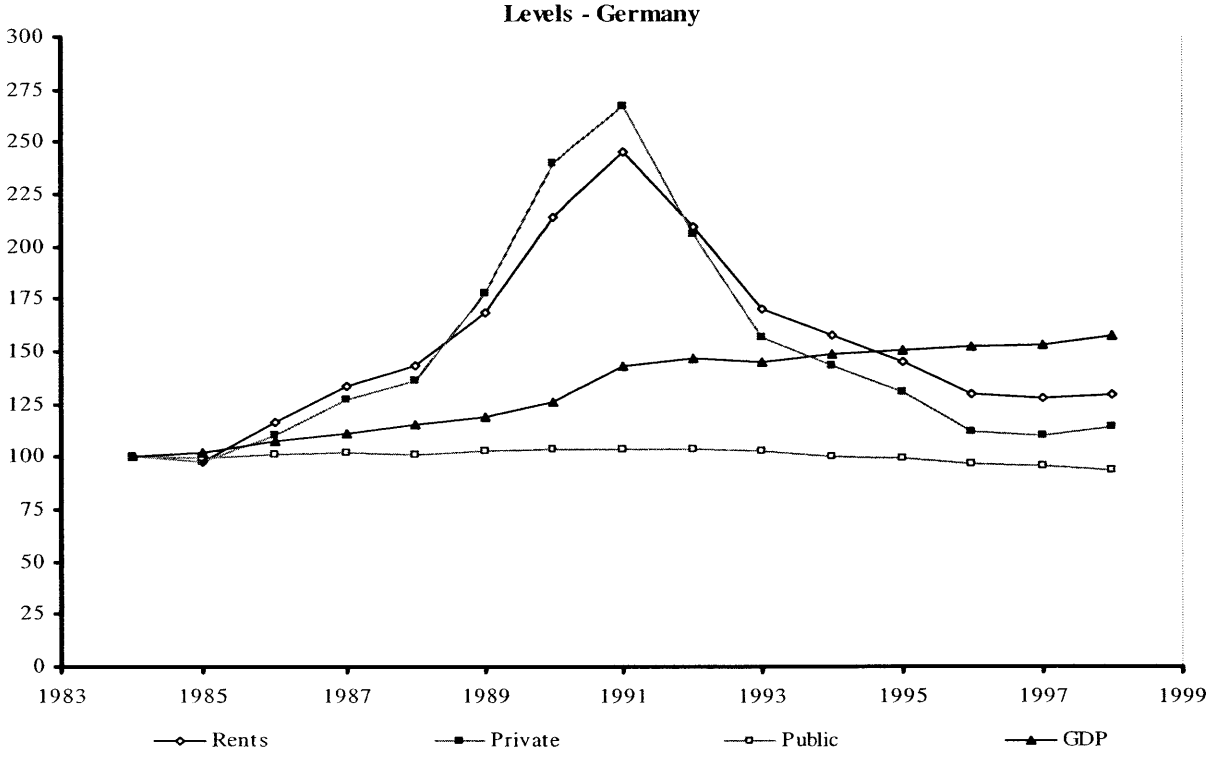


EXHIBIT 8B
Differences - Germany

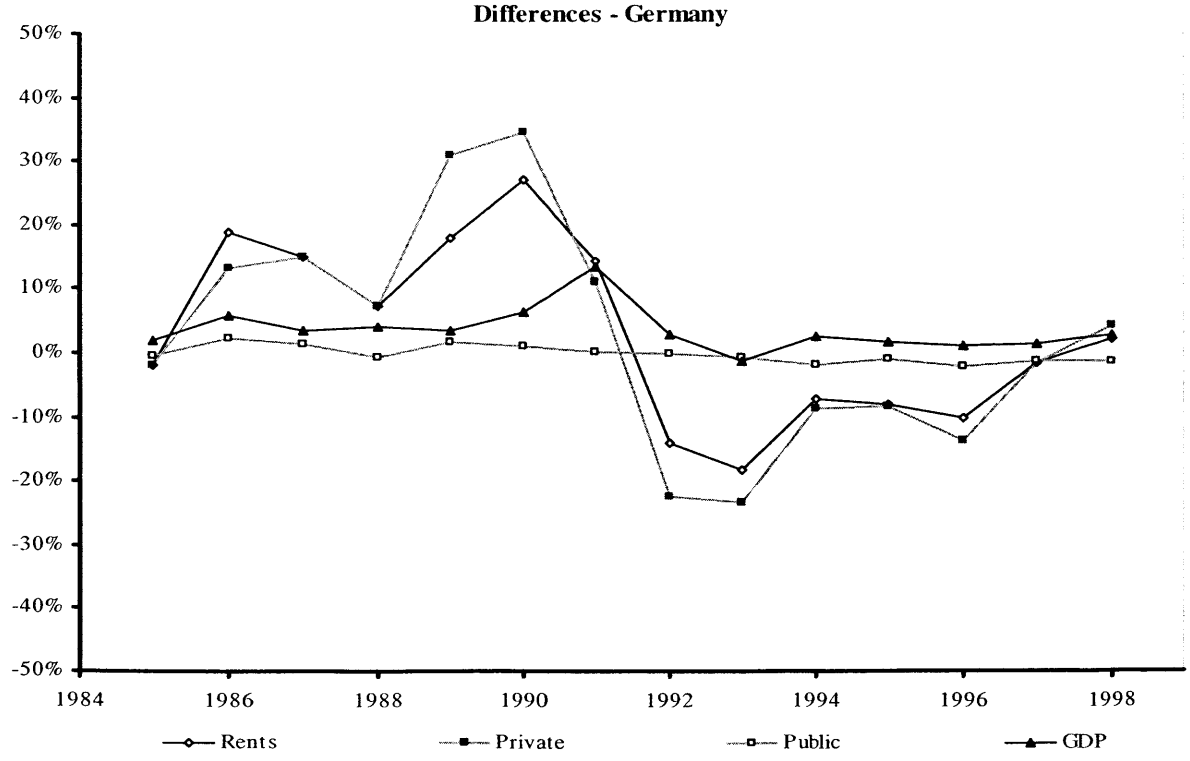


EXHIBIT 9A
Levels - Australia

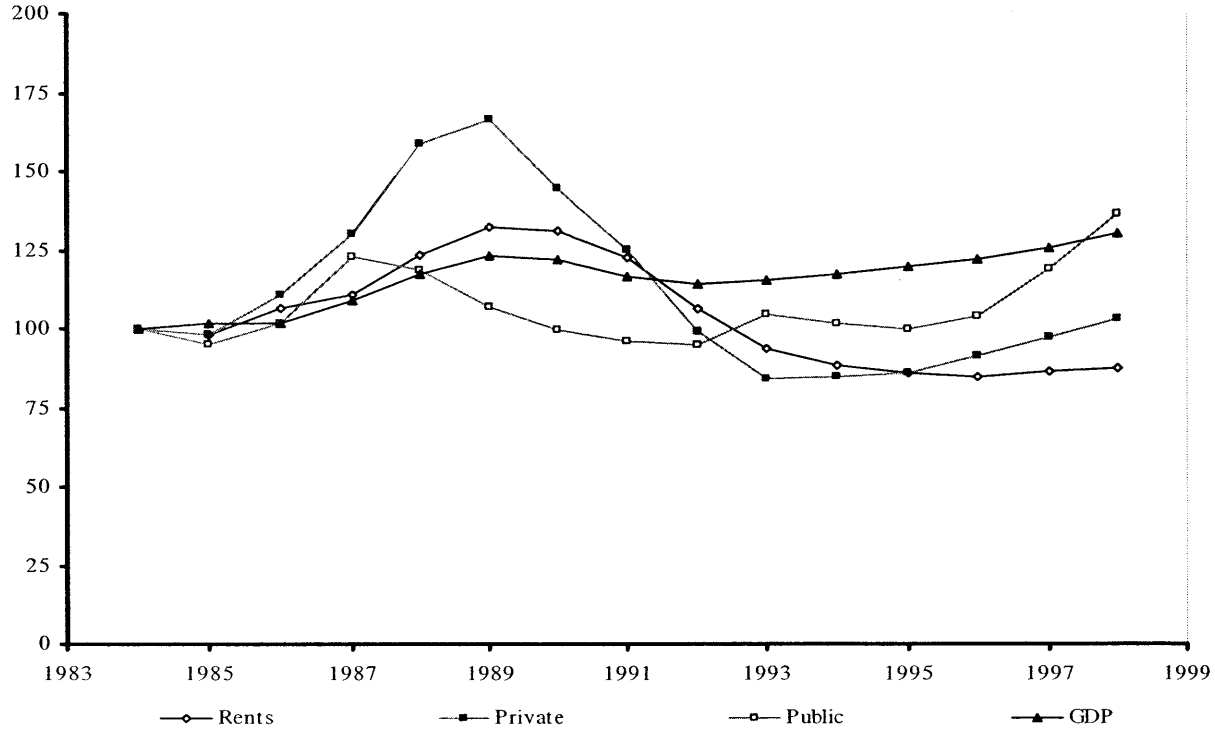


EXHIBIT 9B
Differences - Australia

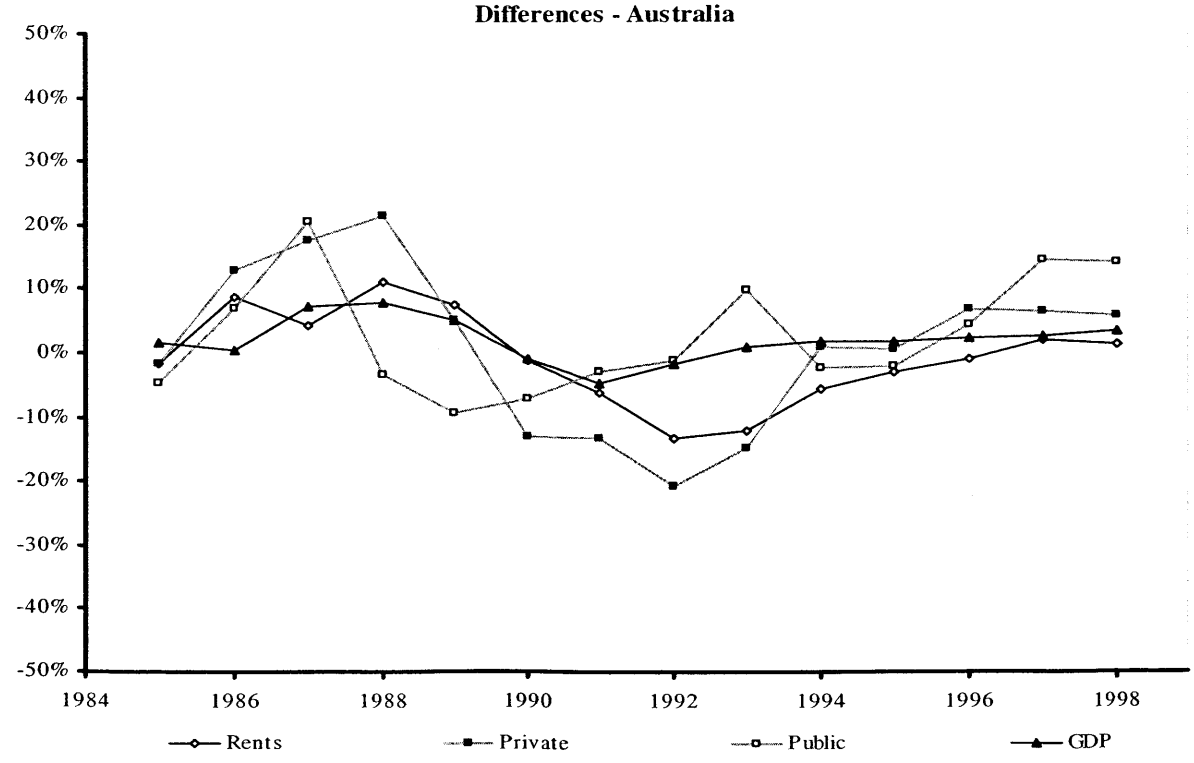


EXHIBIT 10A
Levels - France

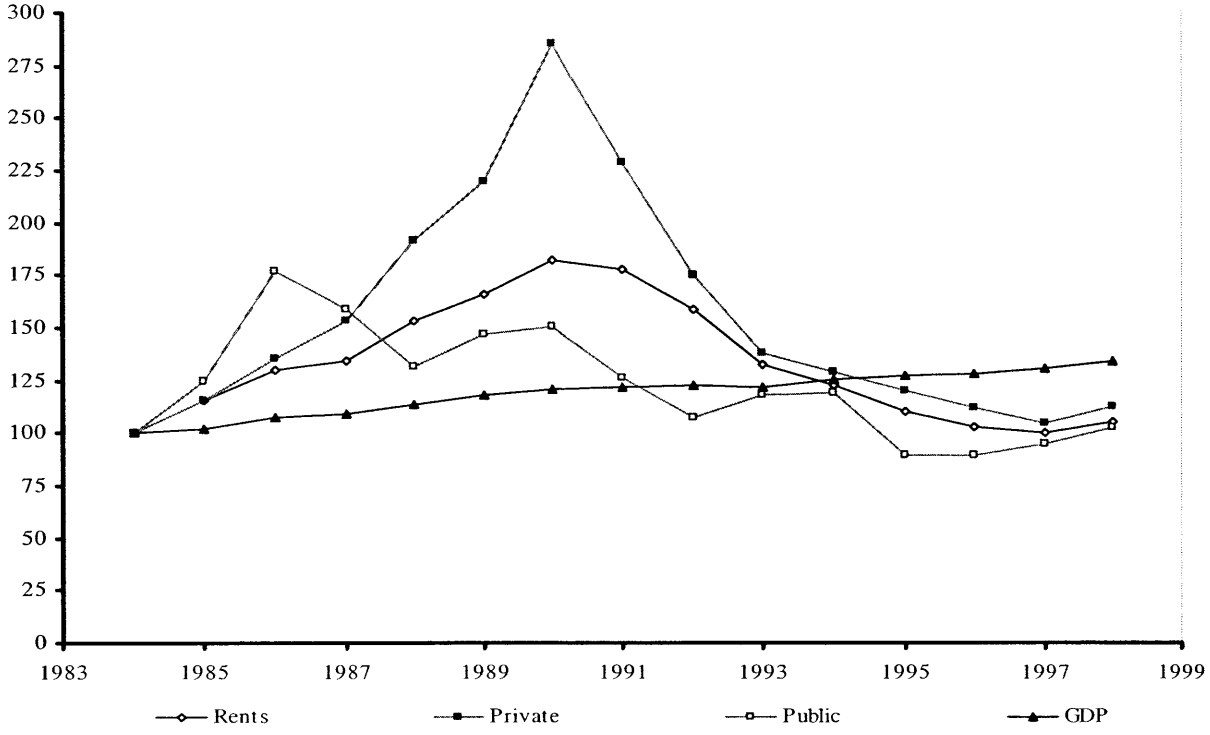


EXHIBIT 10B
Differences - France

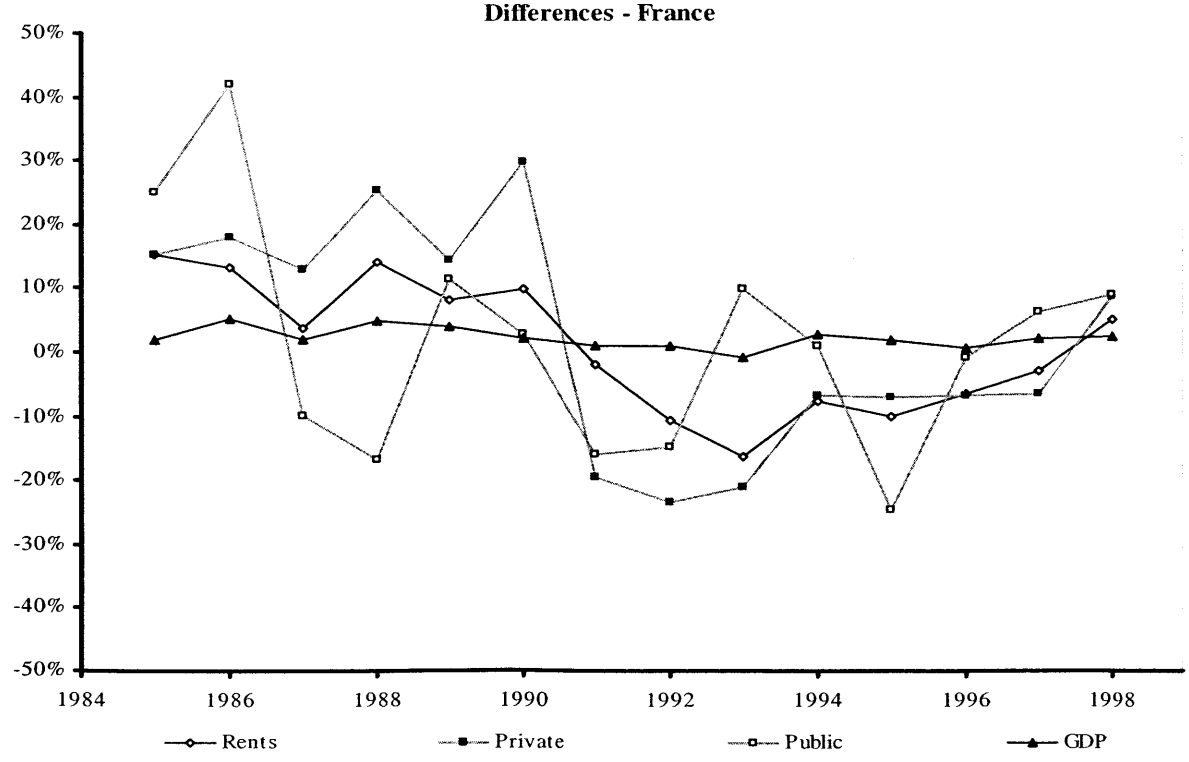


EXHIBIT 11A
Levels - Japan

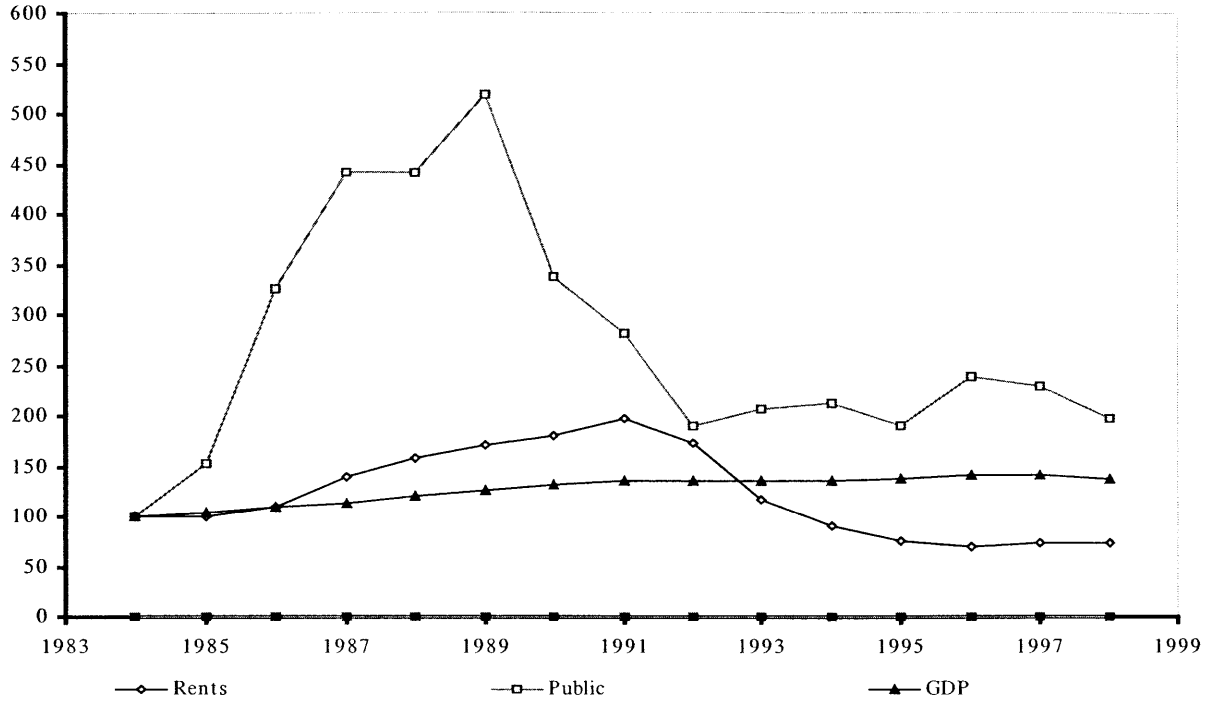
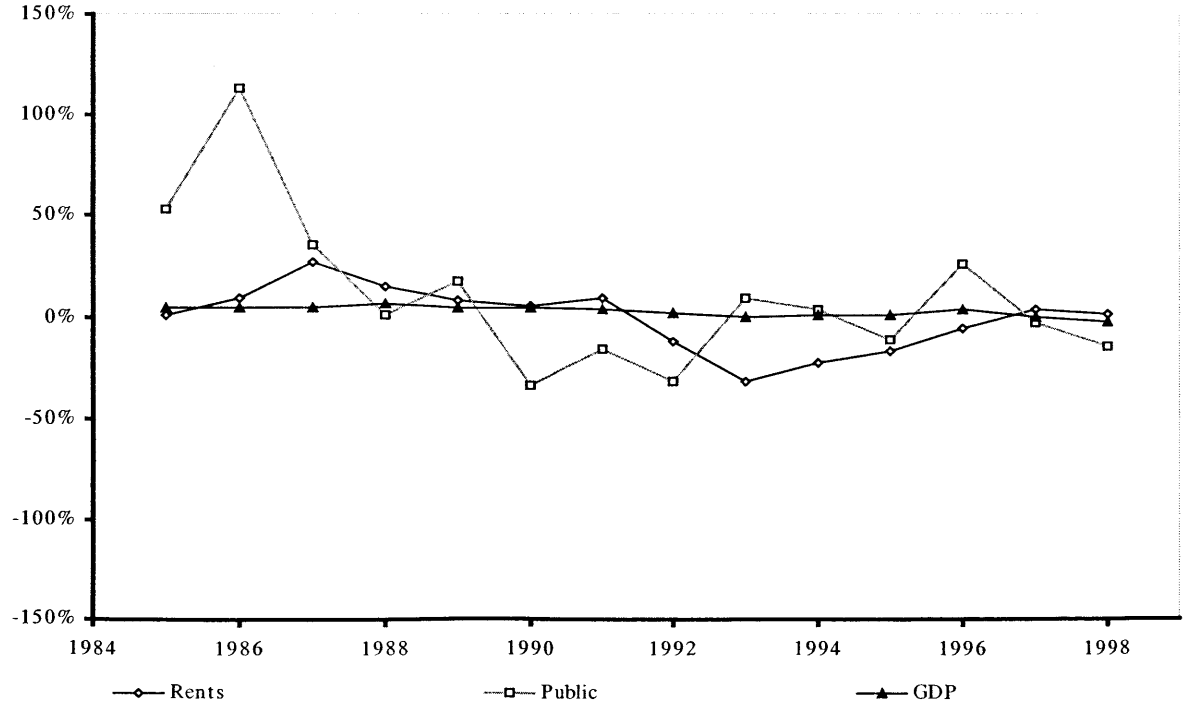


EXHIBIT 11B
Differences - Japan



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 1st order auto-regression equation (ARI), 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 ARI and the Dickey-Fuller unit root tests. The time series data for each country is presented in graphical form in Exhibit 7 through 11. Both levels and differences for GDP, private prices, rents, and public prices are shown. The results of the statistical analysis performed to answer these questions are presented in the following sections.

4.2 QUESTION 1 SUMMARY CHART

Summary chart A gives the results for this question.

4.2.1 GDP RESULTS

39 yearly observations were used to examine the GDP data for each of the countries in the study, beginning in 1960. The alpha coefficients were significant for two of the four countries, which indicated a positive trend. Germany's real economy grew at about 2% per year, while France's economy grew by approximately 1.3% per year over the study period. Both Australia and Japan, somewhat surprisingly, did not seem to show positive trends. A possible reason why Japan did not show a trend may be that the GDP data for Japan was actually MSA data for Tokyo only, not for all of Japan. Japan's previous recession would have had a major impact on the data.

Summary Chart A BEHAVIOR OF ANALYZED VARIABLES	**USA** National	**Germany** Frankfort	**Australia** Sydney	**France** Paris	**Japan** Tokyo
GDP - Lagged Regression Statistics	*1961* *1998*	*1961* *1998*	*1961* *1998*	*1961* *1998*	*1961* *1998*
Autoregressive Formula: Is there a trend?	**Trend**	**Trend**	**No Trend**	**Trend**	**No Trend**
Alpha of Differences	0.020	0.019	0.005	0.013	0.016
T-statistic	3.111	2.624	0.959	2.286	1.915
Beta of Differences	0.334	0.426	0.590	0.606	0.571
T-statistic	2.099	2.844	4.305	4.662	4.341
Behavior of the Market:	**Persistant**	**Persistant**	**Persistant**	**Persistant**	**Persistant**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Random
Beta of Auto-Regression	1.003	1.006	0.946	0.986	0.982
T-test (single test for beta significant from one)	0.238	0.346	-0.944	-1.530	-1.616
Dickey-Fuller Case 2 (Trend)	Random	Random	Random	Random	Random
Rho of Unrestricted Regression	0.749	0.881	0.905	0.902	0.940
F-test (OLS joint test for Rho=1 & Gamma=0)	2.222	1.251	0.853	1.897	1.370
T-test (single test for Rho significant from one)	-2.051	-1.445	-1.301	-1.375	-0.616
GDP - Lagged Regression Statistics (Rent time frame)	*1979* *1998*	*1973* *1998*	*1971* *1998*	*1971* *1998*	*1974* *1998*
Autoregressive Formula: Is there a trend?	**Trend**	**Trend**	**No Trend**	**Trend**	**No Trend**
Alpha of Differences	0.015	0.017	0.003	0.016	0.010
T-statistic	2.119	2.120	0.371	2.751	1.807
Beta of Differences	0.311	0.323	0.595	0.320	0.613
T-statistic	1.356	1.646	3.708	1.794	3.793
Behavior of the Market:	**Random**	**Random**	**Persistant**	**Random**	**Persistant**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Random
Beta of Auto-Regression	1.049	1.019	0.916	0.979	0.992
T-test (single test for beta significant from one)	1.264	0.618	-0.861	-1.142	-0.350
Dickey-Fuller Case 2 (Trend)	Random	Random	Random	Random	Random
Rho of Unrestricted Regression	0.644	0.853	0.909	0.698	0.839
F-test (OLS joint test for Rho=1 & Gamma=0)	5.035	1.798	0.646	3.288	0.851
T-test (single test for Rho significant from one)	-2.403	-1.508	-0.917	-2.394	-1.299
Rents - Lagged Regression Statistics	*1979* *1998*	*1973* *1998*	*1971* *1998*	*1971* *1998*	*1974* *1998*
Autoregressive Formula: Is there a trend?	**No Trend**	**No Trend**	**No Trend**	**No Trend**	**No Trend**
Alpha of Differences	-0.020	0.005	-0.007	-0.006	-0.005
T-statistic	-1.356	0.259	-0.393	-0.365	-0.262
Beta of Differences	0.442	0.543	0.647	0.557	0.623
T-statistic	1.965	3.137	4.248	3.356	4.778
Behavior of the Market:	**Persistant**	**Persistant**	**Persistant**	**Persistant**	**Persistant**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Persistant	Random	Random
Beta of Auto-Regression	0.965	0.888	0.732	0.872	0.880
T-test (single test for beta significant from one)	-1.016	-1.192	-4.833	-1.433	-1.386
Dickey-Fuller Case 2 (Trend)	Random	Random	Persistant	Random	Random
Rho of Unrestricted Regression	0.895	0.849	0.758	0.873	0.934
F-test (OLS joint test for Rho=1 & Gamma=0)	0.623	0.915	11.965	1.007	2.020
T-test (single test for Rho significant from one)	-0.739	-1.352	-3.823	-1.384	-0.708
Private - Lagged Regression Statistics	*1979* *1998*	*1974* *1998*	*1971* *1998*	*1974* *1998*	
Autoregressive Formula: Is there a trend?	**No Trend**	**No Trend**	**No Trend**	**No Trend**	
Alpha of Differences	0.0006	0.0079	-0.0019	0.0213	
T-statistic	0.0528	0.2844	-0.0752	0.7931	
Beta of Differences	0.9319	0.4746	0.5757	0.4871	
T-statistic	6.9820	2.5327	3.5010	2.9518	
Behavior of the Market:	**Persistant**	**Persistant**	**Persistant**	**Persistant**	
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	
Beta of Auto-Regression	1.0187	0.8710	0.7761	0.8739	
T-test (single test for beta significant from one)	0.4417	-1.2586	-2.4520	-1.2417	
Dickey-Fuller Case 2 (Trend)	Random	Random	Random	Random	
Rho of Unrestricted Regression	0.8204	0.8445	0.7912	0.8548	
F-test (OLS joint test for Rho=1 & Gamma=0)	3.5244	0.8440	3.5960	0.7868	
T-test (single test for Rho significant from one)	-2.1252	-1.2594	-2.2666	-1.1983	
Public - Lagged Regression Statistics	*1985* *1998*	*1985* *1998*	*1985* *1998*	*1985* *1998*	*1985* *1998*
Autoregressive Formula: Is there a trend?	**No Trend**	**No Trend**	**No Trend**	**No Trend**	**No Trend**
Alpha of Differences	0.0262	-0.0023	0.0260	-0.0036	0.0130
T-statistic	0.5460	-0.6440	0.9953	-0.0728	0.1279
Beta of Differences	0.2428	0.5028	0.3393	0.1792	0.4682
T-statistic	0.8759	1.8780	1.1386	0.6483	1.8407
Behavior of the Market:	**Random**	**Random**	**Random**	**Random**	**Random**
Dickey-Fuller Case 1 (No Trend)	Random	Random	Random	Random	Random
Beta of Auto-Regression	0.5649	1.1152	0.8237	0.6433	0.6750
T-test (single test for beta significant from one)	-1.9096	0.7814	-0.5720	-1.6338	-1.7556
Dickey-Fuller Case 2 (Trend)	Random	Random	Random	Persistant	Random
Rho of Unrestricted Regression	0.5613	0.9622	0.7944	0.2562	0.6126
F-test (OLS joint test for Rho=1 & Gamma=0)	1.6795	5.7341	0.8601	7.6143	4.1646
T-test (single test for Rho significant from one)	-1.8278	-0.3142	-0.6754	-3.6737	-2.3306

All of the t-statistics for the beta coefficients were easily significant. This fact, and given that the beta values themselves were all quite high, indicated a strong relationship between successive GDP data points. This behavior is consistent with trend-reverting data series.

To formally test the data for a random walk, both Case I and II of the dickey-Fuller test were used. If the data was shown to be level, then Case I was used. If the data was shown to demonstrate a trend, then Case II was used. For Australia and Japan the resulting t-statistics from Case I were well above the -3.5 critical value. This indicates a random walk without a drift. For Germany and France the calculated F values for Case II were below the critical value of 7.00, indicating a random walk with a positive drift.

So it seems that the results of the Dickey-Fully test contradicted those produced with the 1st order ARI equation. It should be noted that, as was explained in Chapter 3, the limitations of the Dickey-Fuller test with a low number of degrees of freedom. As a result more emphasis was placed on the ARI results, and it was concluded that GDP data series were predominantly persistent with trends for Germany and France, and persistent without trends for Australia and Japan.

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 approximately 10 years, a shorter GDP series was also analyzed. For these computations the time period was restricted to the same interval as the rent data for each country. This analysis produced very interesting results. The trend conclusions reached in the previous section were identical. That is, Australia and Japan were not shown to demonstrate any trends, while Germany and France did. However, the beta values for the ARI equation were not significant for both Germany and France. This indicated a random movement over the study period. The Case II Dickey-Fuller test results supported these findings since both F values were below the critical value. The t-statistics for the beta values for Australia and Japan actually increased, indicating persistence.

Therefore the results for the shorter time period seemed to indicate that Germany and France demonstrated random walks with drift, while Australia and Japan showed some degree of persistence with no trends evident. These findings could be due to the fact that the economies of both Australia and Japan were somewhat stagnate over the majority of the latter portion of the study period.

4.2.3 RENTS RESULTS

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

The beta coefficients from the auto-regression equation were significantly different from zero for all of the countries, suggesting that the level of rents this year can be used to forecast the level of the next one. Since there were no trends in any of the series, Case I of the Dickey Fuller test, for flat series, was used. The t-statistics for the lagged scenarios for this test were greater than the critical values in all cases except Australia. Thus, the null hypothesis that the true beta coefficient is one, indicating that the series are following a random walk process, could not be rejected for those countries. The -4.83 t-statistic for Australia, in contrast, was well below the critical value of –3.00. This indicated that rent levels for Australia clearly persistent over the study period.

So once again, the results of the ARI equation contradict those of the Dickey-Fuller test. And gain, since more weight should be given the ARI results, it was determined that rents were indeed persistent over the study period with no trends present.

4.2.4 PRIVATE PRICES RESULTS

Private prices were found to exhibit no trend for any of the countries, which mirrored the results for the United States. Germany and France's alpha values and t-statistics were the highest. This

indicated a weak influence of the associated GDP trends on the private price series. However, not enough to cause a trend in the private prices themselves.

The beta coefficients for the ARI equation were all significantly from zero, indicating persistence. But Case I of the Dickey-Fuller test showed that all of the values were random. All of the beta t-statistics were very low however. The -2.45 t-statistic for Australia came very close to the -3.00 critical value. The beta coefficient of its level regression was also the lowest at .7761. This seems to be a very marginal value. With a few more observations the Dickey-Fuller test could have very well determined that Australia's private prices had been persistent over the test period. This may have been the case for several of the other countries as well. There was no private price data available for Japan. Again, the results of the ARI were given more weight and private prices were therefore assumed to be persistent with no trends.

4.2.5 PUBLIC PRICES RESULTS

Similar to the private prices results, public prices were found to demonstrate no trends. All of the t-statistics for the beta coefficients were insignificant as well. Which indicates a high degree of randomness. Case I of the Dickey-Fuller test was used. This time, however, none of the t-statistics for the public prices came close to the –3 critical value. Therefore it was concluded that the public markets were moving very randomly with no drift. These results provided evidence that the public markets were very efficient for all of the countries over the study period.

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 varied considerably among the countries studied. Overall they were somewhat lower than what might be expected. Germany's 55% correlation was by far the largest. Australia's correlation of 8.55%, and Japan's value of 9.23% were the lowest, however the F statistics for both those countries indicated that those correlations were not significant, and thus unreliable. The F statistics for Germany and France were well above their respective critical values.

Summary Chart B THE ECONOMY & THE REAL ESTATE MARKET	**USA** National	**Germany** Frankfort	**Australia** Sydney	**France** Paris	**Japan** Tokyo
GDP -RENTS					
Durbin Watson					
Contemporaneous Rents - GDP	0.426	0.290	0.168	0.229	0.210
GDP Leading Rents	0.507	0.322	0.180	0.227	0.202
Are GDP(t) and Rents (t) Co-integrated?	Yes	No	No	No	No
Correlation					
Correlation GDP (t) - Rents (t)	**23.47%**	**55.12%**	**8.55%**	**38.15%**	**9.23%**
F-stat	1.049	10.475	0.192	4.429	0.198
Significance F	0.319	0.004	0.665	0.045	0.661
Correlation GDP (t-1) - Rents (t)	**0.56%**	**16.37%**	**2.74%**	**3.93%**	**45.58%**
F-stat	0.001	0.661	0.019	0.040	6.032
Significance F	0.981	0.424	0.890	0.842	0.022
Are GDP changes leading Rents?	No	No	No	No	Yes
GDP-PRIVATE					
Durbin Watson					
Contemporaneous Private Prices - GDP	0.267	0.325	0.276	0.327	
GDP Leading Private Prices	0.341	0.352	0.312	0.335	
Are GDP(t) and Private (t) Co-integrated?	No	No	No	No	
Correlation					
Correlation GDP (t) - Private Prices (t)	**8.49%**	**43.22%**	**20.22%**	**42.74%**	
F-stat	0.131	5.284	1.108	5.141	
Significance F	0.722	0.031	0.302	0.033	
Correlation GDP (t-1) - Private Prices (t)	**19.81%**	**3.86%**	**0.91%**	**16.99%**	
F-stat	0.735	0.034	0.002	0.683	
Significance F	0.402	0.854	0.963	0.417	
Are GDP changes leading Private?	Yes	No	No	No	
GDP-PUBLIC					
Durbin Watson					
Contemporaneous Public Prices - GDP	0.796	0.248	0.760	0.964	0.514
GDP Leading Public Prices	0.794	0.261	0.730	0.976	0.527
Are GDP(t) and Public (t) Co-integrated?	Yes	No	Yes	Yes	Yes
Correlation					
Correlation GDP (t) - Public Prices (t)	**54.55%**	**44.01%**	**30.70%**	**31.18%**	**36.02%**
F-stat	5.085	2.883	1.249	1.292	1.789
Significance F	0.044	0.115	0.286	0.278	0.206
Correlation GDP (t-1) - Public Prices (t)	**28.92%**	**33.90%**	**-33.67%**	**-13.48%**	**24.84%**
F-stat	1.095	1.558	1.534	0.222	0.789
Significance F	0.316	0.236	0.239	0.646	0.392
Are GDP changes leading Public?	No	No	No	No	No

The lagged correlation analysis indicated that only Japan's GDP lead the rent series over the study period. However, this is most likely do to the fact the GDP data for Japan was really that for the city studied as well, Tokyo. So it stands to reason that there should be a very strong relationship between GDP and rents in this case, which was found to be 46%. For the rest of the countries the lagged state of the domestic GDP was found to play a relatively small role in determining current rent prices.

A Durbin-Watson value of .4, corresponding to a 5% level of significance, was used as the critical value. None of the Durbin-Watson values for the countries in the study, except for the United States, exceeded this value. This indicated that GDP and rents were not co-integrated for any of the countries over the test period. It must be emphasized, however, that the Durbin-Watson statistical test in only valid for two random variables. Chapter 4 showed that both GDP and rent values were

predominately persistent. Therefore the Durbin-Watson results are probably not reliable for this relationship for the four countries analyzed. The significant value for the United States would tend to indicate that the GDP and rent values for the US are more random than for the other countries. This makes sense given that the beta values for the ARI equation for both those variables were only marginally significant, whereas for the other countries they were markedly so.

5.2.2 GDP-PRIVATE PRICES RESULTS

The t-statistics in Section 4.3.4 indicated that a strong correlation between GDP and private prices might be found, as was described in that section. The correlations did show this to be the case with Germany and France. Their contemporaneous correlation values were quite high. On the other hand, Australia's correlation was somewhat low at 20.22%. Again, there was no private data available for Japan, so this relationship could not be examined. All of the F values were strongly significant. Also, given that the lagged correlations are less than the contemporaneous values, the relationship between GDP and private prices was assumed to be contemporaneous in nature for all of the countries but the US, where it was found that GDP lead private prices over the study period.

None of the Durbin-Watson parameters were greater than the critical value for the relationship of GDP and private prices. But again, it must be noted that the Durbin-Watson results for the GDP-public prices relationship should be given little weight since both of these variables were concluded to be persistent in the previous chapter.

5.2.3 GDP-PUBLIC PRICES RESULTS

In general, the contemporaneous correlations between the GDP and public prices were found to be larger than those for GDP and private prices. This makes sense given that public prices should be more volatile, and thus subject to more influence by external economic considerations. All of the F values were easily significant as well, indicating great consistency in the findings. The GDP-Public price

relationship was also found to be contemporaneous in nature. One would assume this to be the case given the ability of the public markets to quickly assimilate new information.

Most of the computed Durbin-Watson statistics were above the .4 critical value for the GDP-public prices relationship, indicating a high degree of co-integration. Germany was the only country were this was not the case. It was shown in the previous chapter that the public prices move in a random fashion for all of the countries, but GDP was found to be predominately persistent. Technically there should be no co-integration between a random variable and a persistent variable, so these results, although reflecting the high degree of randomness found the public markets, should once again be cautiously interpreted.

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, which supports the results found in the United States. For the three countries for which the relevant data was available, the correlation was approximately 90%. All of the F values were overwhelmingly significant as well. In addition, all of the relationships were found to be contemporaneous. The results indicate that the current level of rents played a large role in determining contemporaneous private prices over the study period.

Summary Chart C RELATIONSHIPS WITHIN THE REAL ESTATE SECTOR	**USA** National	**Germany** Frankfort	**Australia** Sydney	**France** Paris	**Japan** Tokyo
RENTS - PRIVATE					
Durbin Watson					
Contemporaneous Private Prices - Rents	0.305	0.532	0.336	0.419	
Rents Leading Private Prices	0.507	0.726	0.418	0.385	
Private Prices Leading Rents	0.187	1.067	0.764	0.706	
Are Rents(t) and Private (t) Co-integrated?	**No**	**Yes**	**No**	**Yes**	
Correlation					
Correlation Rents (t) - Private Prices (t)	**57.55%**	**93.42%**	**90.97%**	**84.00%**	
F-stat	8.913	157.732	124.760	55.122	
Significance F	0.008	0.000	0.000	0.000	
Correlation Rents (t-1) - Private Prices (t)	**68.22%**	**45.66%**	**47.22%**	**46.53%**	
F-stat	14.800	6.059	7.173	6.356	
Significance F	0.001	0.022	0.013	0.019	
Are changes in Rents leading Private?	**Yes**	**No**	**No**	**No**	
Correlation Private Prices (t-1) - Rents (t)	**44.13%**	**58.11%**	**69.21%**	**61.06%**	
F-stat	4.110	11.219	22.989	13.077	
Significance F	0.059	0.003	0.000	0.002	
Are changes in Private leading Rents?	**No**	**No**	**No**	**No**	
RENTS - PUBLIC					
Durbin Watson					
Contemporaneous Public Prices - Rents	0.750	0.235	0.693	0.879	0.735
Rents Leading Public Prices	0.752	0.199	0.776	0.720	0.596
Public Prices Leading Rents	0.862	0.533	1.021	1.292	0.913
Are Rents(t) and Public (t) Co-integrated?	**Yes**	**No**	**Yes**	**Yes**	**Yes**
Correlation					
Correlation Rents (t) - Public Prices (t)	**44.81%**	**76.07%**	**7.00%**	**44.06%**	**25.67%**
F-stat	3.015	16.486	0.059	2.891	0.847
Significance F	0.108	0.002	0.812	0.115	0.376
Correlation Rents (t-1) - Public Prices (t)	**32.31%**	**56.29%**	**-5.39%**	**23.64%**	**-1.55%**
F-stat	1.399	5.566	0.035	0.710	0.003
Significance F	0.260	0.036	0.855	0.416	0.958
Are changes in Rents leading Public?	**No**	**No**	**No**	**No**	**No**
Correlation Public Prices (t-1) - Rents (t)	**45.05%**	**49.41%**	**36.96%**	**38.07%**	**66.38%**
F-stat	2.800	3.553	1.741	1.864	8.664
Significance F	0.122	0.086	0.214	0.199	0.013
Are changes in Public leading Rents?	**Yes**	**No**	**Yes**	**No**	**Yes**
PRIVATE - PUBLIC					
Durbin Watson					
Contemporaneous Private Prices - Public Prices	0.065	0.497	0.307	0.539	
Private Prices Leading Public Prices	0.075	0.410	0.331	0.409	
Public Prices Leading Private Prices	0.062	0.720	0.410	0.888	
Are Public and Private (t) Co-integrated?	**No**	**Yes**	**No**	**Yes**	
Correlation					
Correlation Private Prices (t) - Public Prices (t)	**21.97%**	**69.26%**	**34.36%**	**34.78%**	
F-stat	0.609	11.065	1.606	1.651	
Significance F	0.450	0.006	0.229	0.223	
Correlation Private Prices (t-1) - Public Prices (t)	**14.24%**	**54.42%**	**1.31%**	**5.55%**	
F-stat	0.248	5.050	0.002	0.037	
Significance F	0.627	0.044	0.964	0.851	
Are changes in Private leading Public?	**No**	**No**	**No**	**No**	
Correlation Public Prices (t-1) - Private Prices (t)	**42.32%**	**39.06%**	**61.95%**	**40.36%**	
F-stat	2.399	1.980	6.852	2.141	
Significance F	0.150	0.187	0.024	0.171	
Are changes in Public leading Private?	**Yes**	**No**	**Yes**	**Yes**	

Since both rents and private prices were deemed to be mostly persistent, one would expect to find low Durbin-Watson statistics. Overall, this was the case. But some values were at or above the .4 critical value. However, as was described in the last section, this is because the Durbin-Watson test is considered to provide accurate results for random variables only. It is not considered reliable for persistent variables.

6.2.2 RENTS-PUBLIC PRICES RESULTS

The contemporaneous correlations between public prices and rents were also found to be fairly large. Germany's 76% value was the highest correlation, while Australia's was the lowest. However Australia's F value was below the critical value indicating that the results were spurious. France's correlation of 44% was also quite high.

The results of the lagged correlations were mixed. In Australia and Japan public prices seemed to lead rent values. However in Germany and France this was not found to be so. These results indicated that the state of the economy might affect the relationship between public prices and rents. Specifically, if the economy is sluggish, then the public prices may tend to lead the private prices. But if the economy is relatively healthy, then the relationship could be more contemporaneous. One possible explanation is that property owners wait longer to evaluate economic changes when the economy is good when a change takes place, but react much more quickly if the economy is poor.

The results of the Durbin-Watson test were mixed. Overall France and Japan's rent series and public prices seemed to be co-integrated for both the contemporaneous and lagged states. There were no other signs of contemporaneous co-integration except for Australia's public prices-rents relationship. Also, the only other significant lagged value was that for the
public prices-rents correlation for Germany.

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, which was found to be the situation for the United States. This was also the case for two of the three countries analyzed, Australia and France. Germany, however, did not demonstrate this. For Australia the lagged effect was quite pronounced. The correlation rose approximately 30% with the lag. For France the correlation rose only 6%. Interestingly, the correlation

for Germany actually dropped by about 30%. These results are somewhat surprising. One would have thought that Germany's public markets would have demonstrated a significant lagged effect as well.

The Durbin-Watson results were consistent. They showed that there was in fact a high degree of co-integration for the private prices-public prices relationship for all the countries. These results are similar to those found for the GDP-public prices relationship analyzed in the last chapter. Again, this makes sense given the high degree of randomness found in the public prices. But given that private prices were shown to be predominately persistent, these Durbin-Watson results should be considered spurious.

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 variables tested, only the public prices for all of the countries were consistently random. The only other random variables were rent levels for Germany and France when the shorter time series was used. These findings indicate that the public markets for all of the countries studied do in fact follow the random pattern that would be predicted under the efficient markets hypothesis. It also indicates that GDP, rents, and private prices all demonstrated an inability to adjust quickly. None of these conclusions are very surprising. However, one finding that was surprising was the lack of trends in the data. There were only trends found in the GDP data for Germany and France. All of the other variables did not exhibit any significant trends.

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 many 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.

The results of this study also indicated a strong contemporaneous correlation between GDP and private prices. In addition, 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 since public prices are able to adjust much more quickly to new economic data than private prices.

Exhibit 12

National, USA

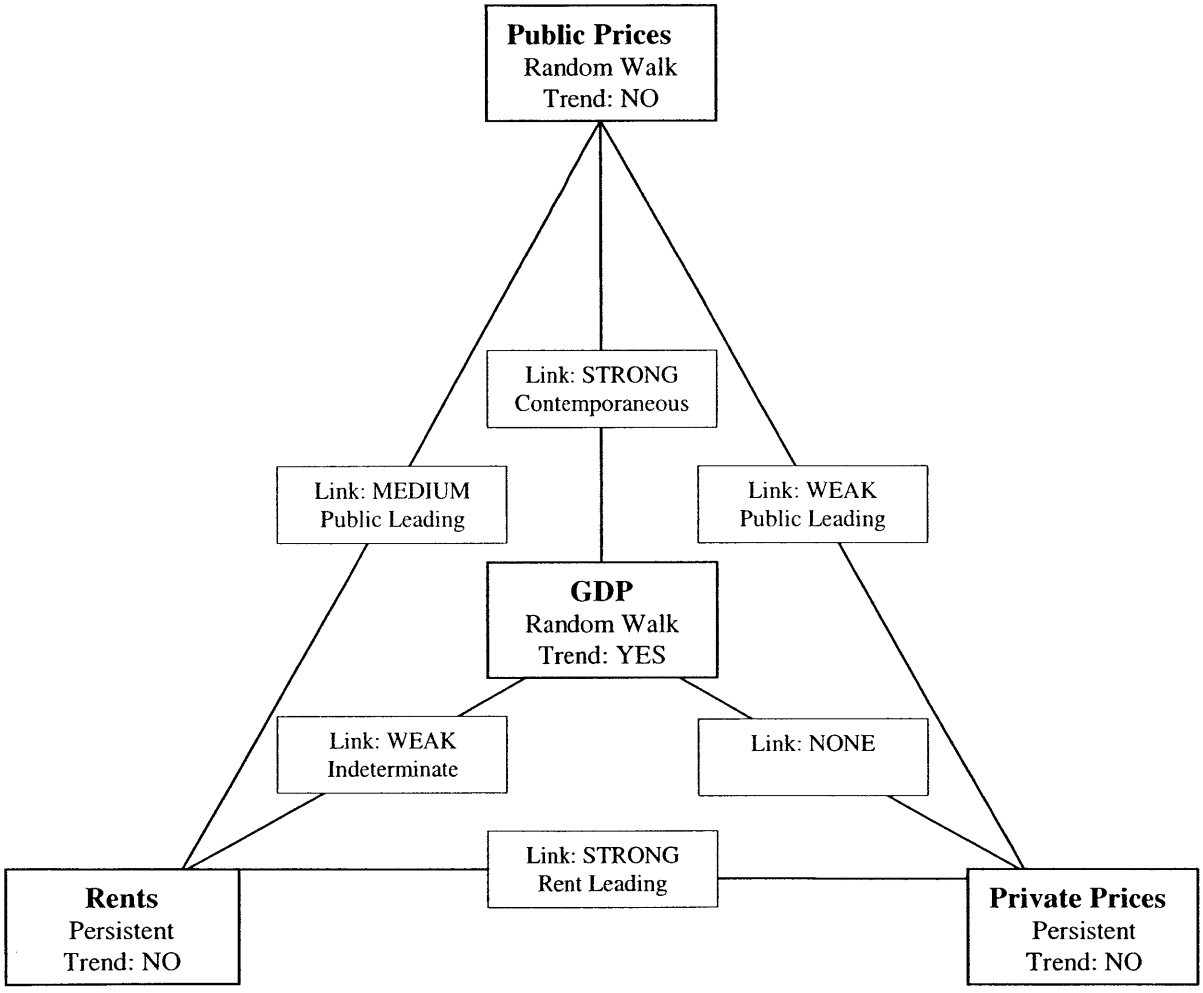


EXHIBIT 13

Germany, Frankfort

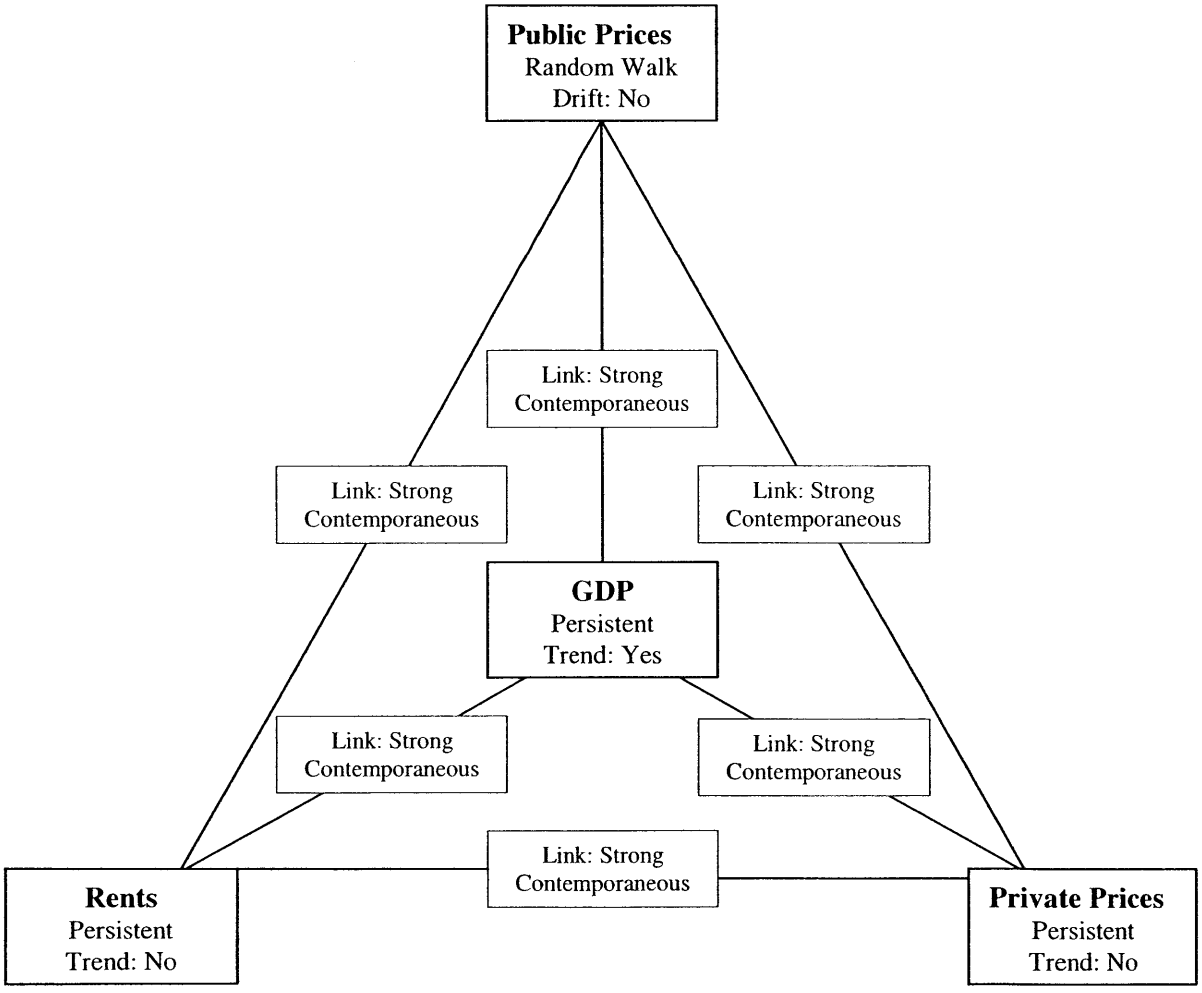


EXHIBIT 14

Australia, Sydney

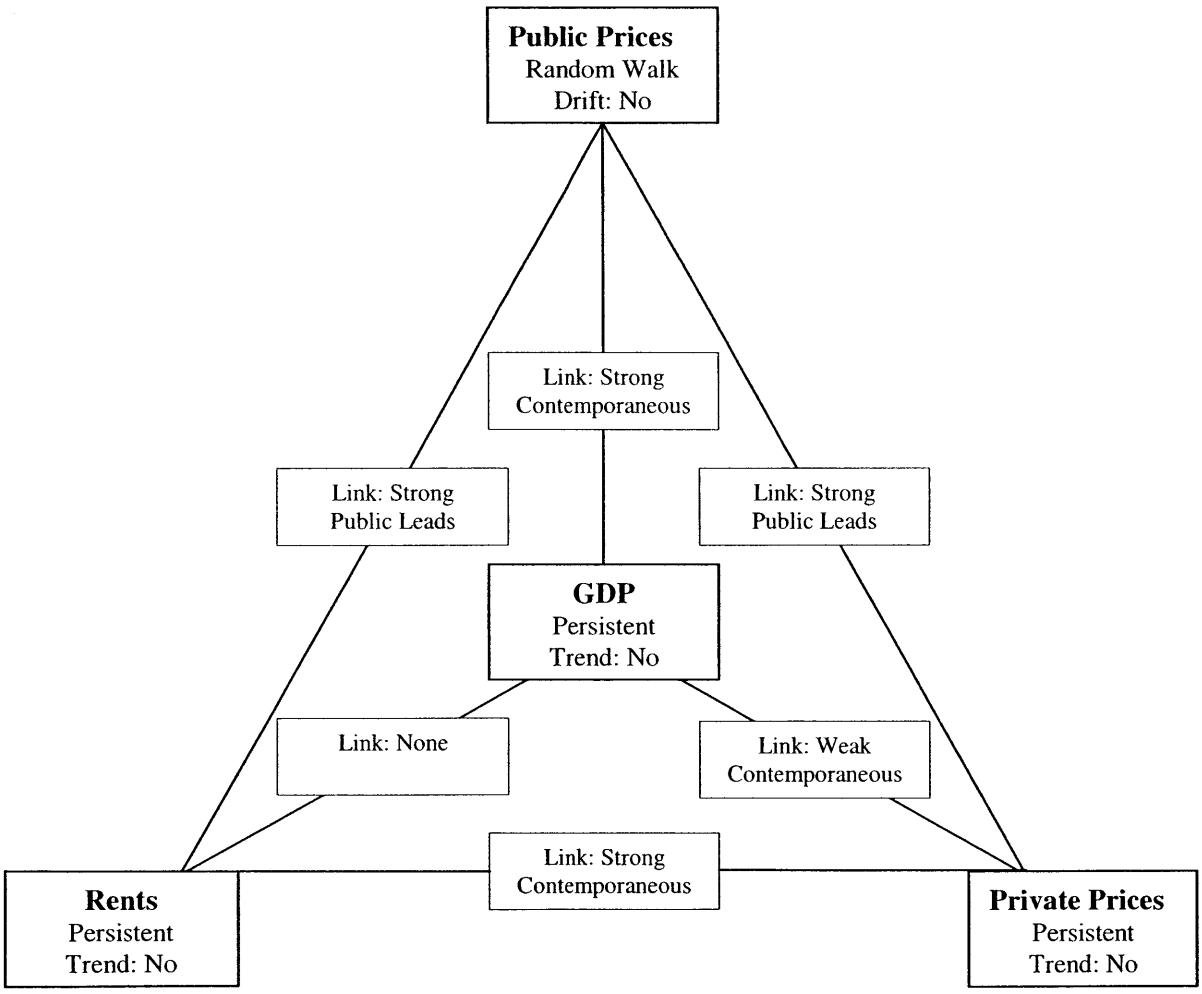


EXHIBIT 15

France, Paris

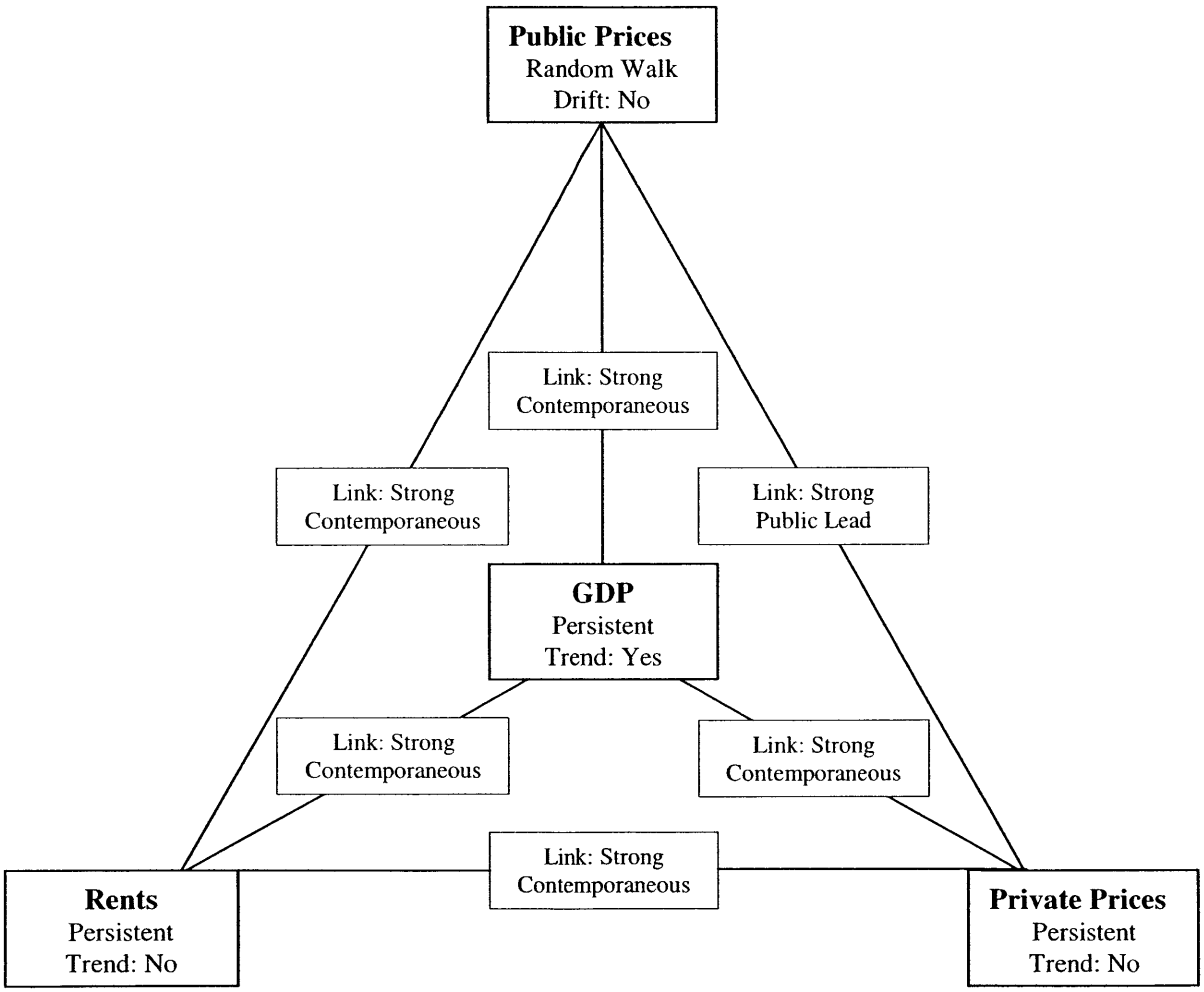
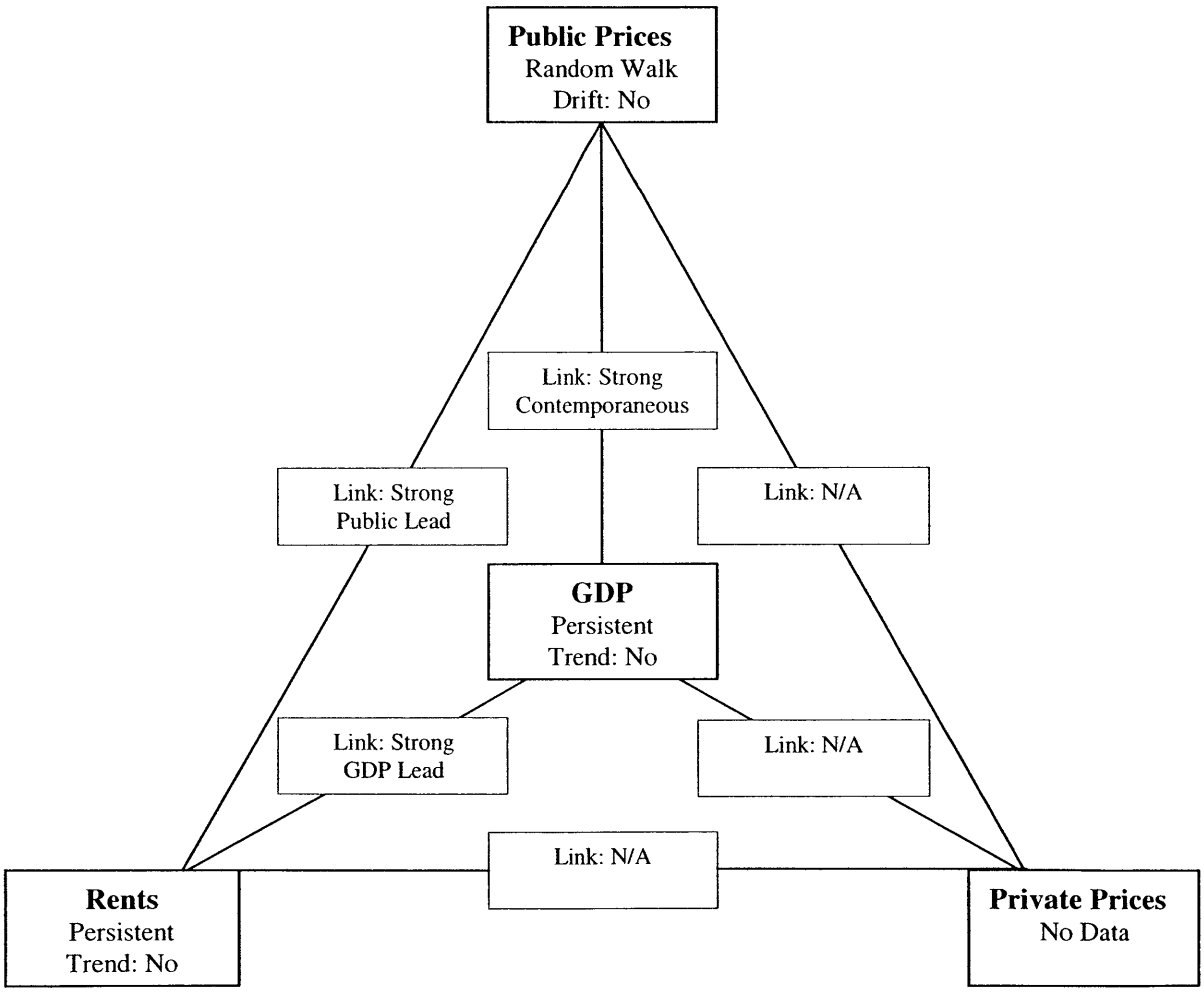


EXHIBIT 16

Japan, Tokyo



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 greatly, 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

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 results for the public prices-rents relationship were not so conclusive. For Australia and Japan GDP was found to lead rents, but for Germany and France this was not the case. A possible reason for this is that owners may adjust rents quicker to changes in public prices in bad markets than in good markets. The private-public results were not consistent either. The public markets of Australia and France were found to lead the private markets, but not in Germany. This would tend to indicated that Australia and France's public markets are probably more efficient.

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