

# The Relationships Between the Real Estate and Stock Markets in Poland

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## INTRODUCTION

POLAND'S ECONOMY HAS BEEN ONE OF THE MOST successful in Europe, and the world, since the early 1990s. In 2009, during the Great Recession, Poland actually had a positive (albeit small) increase in GDP. In light of the success of Poland's economy, it is noteworthy that no widely circulating research examines the relationship between its real estate and stock markets. This is likely because Poland has been a free market for a relatively short time and usable data, particularly on the real estate market, is limited.

Given this limitation, the authors assembled a proprietary real estate data set covering Warsaw residential property values between 1995 and 2009. Using that data to examine the relationships between the real estate and stock markets in Poland, they discovered a small positive correlation between those markets. The data shows that positive stock market returns anticipate increases in real estate values. These findings contrast with the results of similar studies of relationships in more developed countries; those tend to show a low or negative relationship between these markets.

The results of our study of Polish real and capital markets are similar to the findings of earlier research on developing markets around the world; Poland's economy actually seems to emulate behavior that can be described as being between a developing and a fully developed nation. As it emerged from behind the Iron Curtain, starting its exit earlier than many with social upheaval such as at the Gdańsk shipyard in the early 1980s, Poland moved more quickly than most, if not all, Soviet-era countries to join the community of nations.

## About the Authors



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received a master's degree in Business Administration from the University of North Florida in 1979. At the University of North Carolina/Wilmington, he teaches Corporate, International and Real Estate Finance at the graduate and undergraduate levels. Graham's research has been published in a number of journals, covering real estate, investments and other financial and educational topics. Prior to earning his doctorate, he founded a small investment firm in Jacksonville, Florida. He retains interests there in residential and commercial real estate. Graham also is a founding member of the Wilmington Investor's Network, an officer of the Academy of Economics and Finance, and an advisor to a number of non-profits.

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This article provides a brief historical background on Poland's exit from Soviet rule and entry to the free world. This is followed by a review of extant literature on relationships between the real estate and capital markets. Following the literature review, the authors describe the data collection, methodology, and report the findings.

## SOME HISTORICAL BACKGROUND

The aftermath of World War II led to decades of Communist rule in Poland and a centrally planned economy. The country's exit from this dogma brought about rapid change, with shockwaves felt across the country; real estate markets in particular were affected.<sup>1</sup>

In 1990 a new political environment, including the election of Solidarity candidate Lech Walesa to the re-established office of president, served as a catalyst for economic change. Walesa's election was preceded by the adoption of the Balcerowicz Plan in December 1989; that edict aimed to rapidly transform the centrally planned economy to a market system.

In relation to other countries in the region that did not introduce reforms—such as the Ukraine, Slovakia, Romania and Bulgaria—Poland's economy is a clear success. Over the past couple of decades, Poland has been able to lower inflation, lower interest rates, stabilize its currency (the zloty) and privatize state-owned enterprises. A more stable legal infrastructure has likewise contributed to private sector growth.<sup>2</sup>

Poland became a full member of the European Union in May 2004. And, depending on the period examined since 1995, the International Monetary Fund<sup>3</sup> reports that the economic growth in Poland is among the highest, if not the highest, of all the nations in Europe. More recently, Poland has considered adopting the euro, but the current euro zone crisis will likely delay that adoption.<sup>4</sup>

## LITERATURE REVIEW

Various authors have examined the relationship between real estate and stock returns in the United States. In early work, they find a small negative correlation between U.S. real estate and the S&P 500.<sup>5</sup> This inverse relationship is confirmed in later research using different real estate data.<sup>6</sup>

While the authors found no widely circulating study considering the relationships between the real estate and stock markets in Poland, this relationship in other countries has been examined by many authors. The evidence regarding the relationships between real estate and stock returns varies across countries.

## About the Authors



**Jacek Markowski**, earned a master's degree in Business Administration from the University of North Carolina/Wilmington (UNCW), and a master of science degree in Computer Engineering from Warsaw University of Technology. His studies at UNCW focused on international finance and his thesis was presented at the American Real Estate Society's meeting in 2011. He is currently working for one of the largest investment banks in the FX markets.



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The Asia-Pacific region, along with a few European countries, has a significant positive relationship.<sup>7</sup> Accordingly, diversification across asset classes in these countries may be less beneficial than would be the case with assets more poorly correlated.<sup>8</sup>

Several methodologies have been used to examine the relationship between real estate and stock returns in the U. S. Studies reveal that U.S. commercial real estate and stock returns are significantly integrated. A similar and expansive research examines relationships between international real estate and financial markets.<sup>9</sup>

Numerous studies illustrate the benefits of including real estate as an investment.<sup>10</sup> In general, the results show that investors would benefit by adding real estate to their portfolios. However, the extent of the benefit varies across countries.

The authors' study extends the existing literature in several areas. Using a proprietary Polish real estate data set covering a fifteen-year period, the study explores the correlation between real estate and stock returns in Poland, and tests whether stock returns have an impact on changes in real estate prices and rentals. In addition, the

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study measures Polish residential real estate and capital market changes, and contrasts those changes to movements in U.S. markets. This article considers the implications of the findings for varied stakeholders.

## DATA AND METHODOLOGY

Data for this study were compiled by estimating the average monthly asking price in the Polish currency (PLN or zloty) per square meter based on real estate listings in *The Gazeta-Wyborcza*, the largest newspaper in Warsaw. The estimate of the average monthly asking price is calculated using ten listings per month from January 1995 through December 2009. To account for variation in prices across different regions, listings were randomly selected from each of the five geographic regions in Warsaw. A total of ten listings were selected from those regions each month.

The study begins with samples from 1995 because it took several years for Poland's economy to stabilize after the transition to a market-based system. Property availabilities and real estate listings were far more sporadic prior to 1995. Advertised real estate prices and monthly rentals in Warsaw were used as proxies for changing home prices and rents across Poland, although it should be noted that Warsaw is among the most attractive real estate markets in all of Northern Europe, and values there are likely higher than in most of Poland.

According to the National Bank of Poland, about 30 percent of the real estate in Poland is rented, but average rental rates are not widely available. Given this, the study follows the same methodology as for selling prices—using advertisements in *The Gazeta-Wyborcza* to collect data on average monthly rents per square meter.

Polish stock market data was more easily accessible. The return on stocks in Poland is published by the Warsaw Stock Exchange (WSE). Of the various WSE indexes, WIG was the first exchange index and has been calculated since April of 1991. The value of it was obtained from *Trading Economics*. The WIG is based on all companies listed on the WSE that meet base eligibility criteria. The WIG is a total return index; thus it accounts for price changes, dividends and subscription rights income.

The S&P 500 represents U.S. stocks. The S&P/Case-Shiller Home Price Index Series is the leading measure for the U.S. residential housing market, and the study employed the 10-City Composite Home Price Index as the U.S. real estate proxy. As Warsaw is far and away the largest real

estate market in Poland, the purpose was to contrast it with the ten largest (but not the single largest) markets in the U.S.

Figure 1 provides a summary of the annual returns on the WIG and the S&P 500 from 1995 to 2009. The higher returns and greater risk (standard deviation) of the Polish stock market, relative to the U. S., is observed. Data in Figure 1 may help explain why private equity firms and investors are attracted to opportunities in Poland.

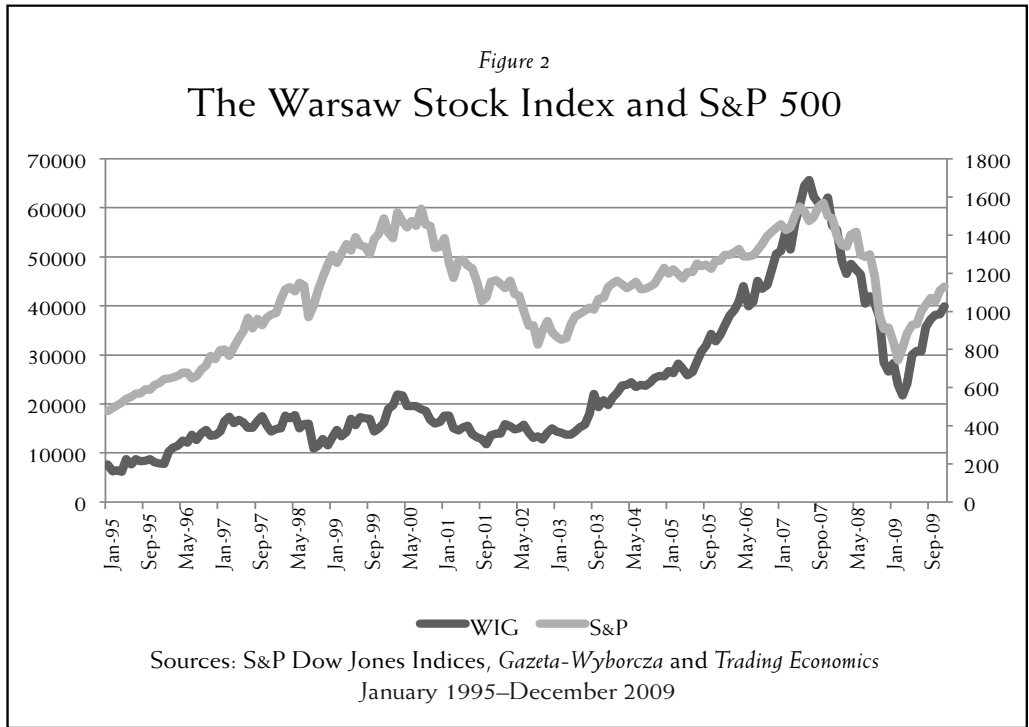
*Figure 1*  
Annual Return on the S&P 500, and the Warsaw Stock Index (WIG)

| Year               | S&P 500 Annual Return (in \$) | WIG Annual Return (in zł) | WIG Annual Return (in \$) |
|--------------------|-------------------------------|---------------------------|---------------------------|
| 1995               | 35.20%                        | -2.42%                    | 0.66%                     |
| 1996               | 23.61%                        | 60.16%                    | 86.71%                    |
| 1997               | 24.69%                        | -14.45%                   | 3.21%                     |
| 1998               | 30.54%                        | -11.46%                   | -11.21%                   |
| 1999               | 8.97%                         | 23.94%                    | 43.60%                    |
| 2000               | -2.04%                        | -7.06%                    | -6.90%                    |
| 2001               | -17.26%                       | -19.92%                   | -20.81%                   |
| 2002               | -24.29%                       | 8.98%                     | 2.74%                     |
| 2003               | 32.19%                        | 51.99%                    | 48.14%                    |
| 2004               | 4.43%                         | 50.92%                    | 25.40%                    |
| 2005               | 8.36%                         | 32.54%                    | 34.96%                    |
| 2006               | 12.36%                        | 50.44%                    | 42.05%                    |
| 2007               | -4.15%                        | 31.86%                    | 8.43%                     |
| 2008               | -40.09%                       | -60.52%                   | -48.97%                   |
| 2009               | 35.02%                        | 61.00%                    | 43.92%                    |
| Arithmetic Average | 8.50%                         | 17.07%                    | 16.80%                    |
| Geometric Average  | 5.92%                         | 10.65%                    | 11.78%                    |
| Standard Deviation | 22.14%                        | 34.64%                    | 32.82%                    |

Sources: S & P Dow Jones Indices and *Trading Economics*  
January 1995–December 2009

Like Figure 1, Figure 2 reveals that the WIG outperformed the S&P 500 over the fifteen-year period ending in December of 2009. That figure provides a graph of the WIG index and S&P 500 from 1995 to 2009, in local currencies. The WIG is plotted on the left axis and the S&P 500 is plotted on the right axis. The WIG index ended with a value of 39,906 in December 2009, evidence of a 419 percent increase from January of 1995 to December

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*Figure 3*  
**Annual Changes: Case-Shiller Index, Polish Real Estate Values and Rentals in Poland**

| Year               | S&P/Case-Shiller 10-City Composite Home Price Index (U.S. index, in \$) | Polish Real Estate Values Annual Change (in zł) | Polish Real Estate Rentals Annual Change |
|--------------------|---|---|--|
| 1995               | -0.34%  | 20.68%  | 25.23%                                   |
| 1996               | 1.99%   | 28.27%  | 12.72%                                   |
| 1997               | 5.92%   | 21.08%  | -1.62%                                   |
| 1998               | 8.90%   | 4.75%   | 10.78%                                   |
| 1999               | 11.04%  | 15.33%  | -2.46%                                   |
| 2000               | 14.58%  | 2.38%   | -11.97%                                  |
| 2001               | 8.16%   | -17.27%   | -4.25%                                   |
| 2002               | 15.27%  | 9.34%   | -16.03%                                  |
| 2003               | 14.03%  | 2.46%   | -1.60%                                   |
| 2004               | 18.69%  | 11.64%  | 4.62%                                    |
| 2005               | 15.06%  | 55.22%  | 11.64%                                   |
| 2006               | -0.52%  | 53.78%  | 63.98%                                   |
| 2007               | -11.40%   | 10.51%  | 2.77%                                    |
| 2008               | -19.44%   | -4.41%  | -4.13%                                   |
| 2009               | -0.06%  | -0.90%  | 14.80%                                   |
| Arithmetic Average | 5.46%   | 14.86%  | 6.97%                                    |
| Geometric Average  | 4.92%   | 13.38%  | 5.6%                                     |
| Standard Deviation | 10.28%  | 18.92%  | 18.46%                                   |

Sources: S & P Dow Jones Indices, *Gazeta-Wyborcza* and *Trading Economics*  
January 1995–December 2009

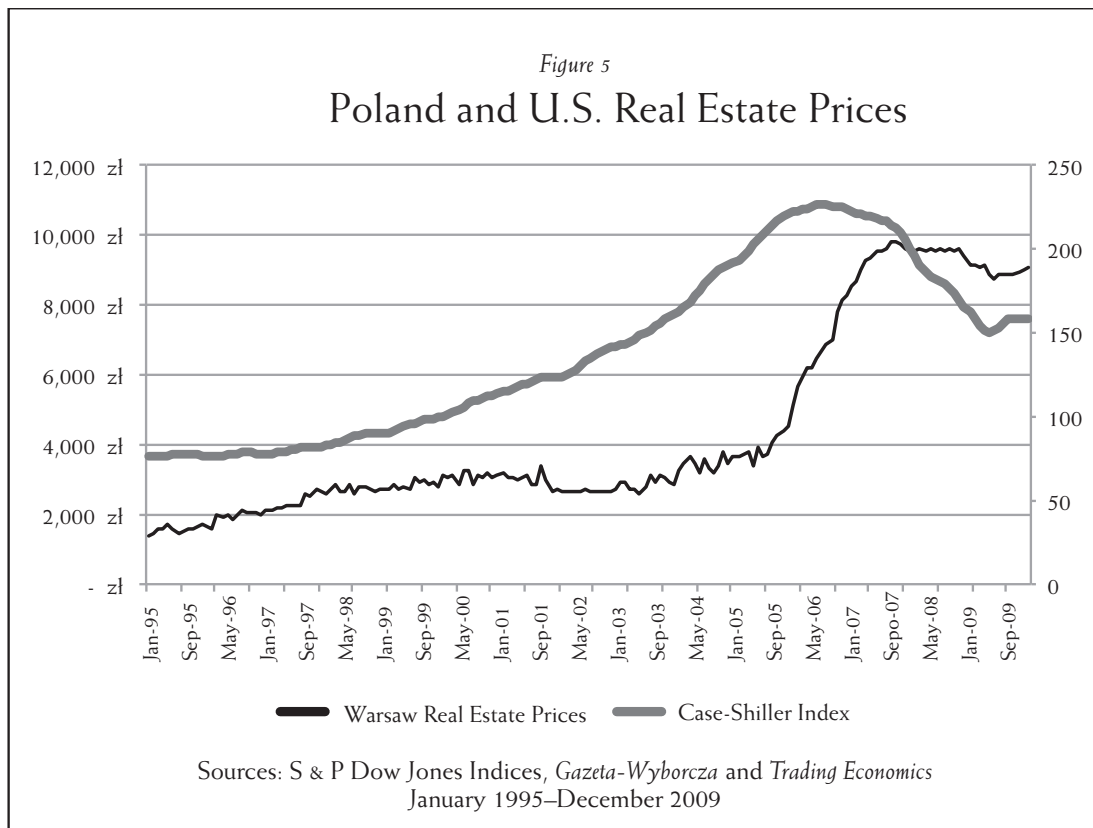
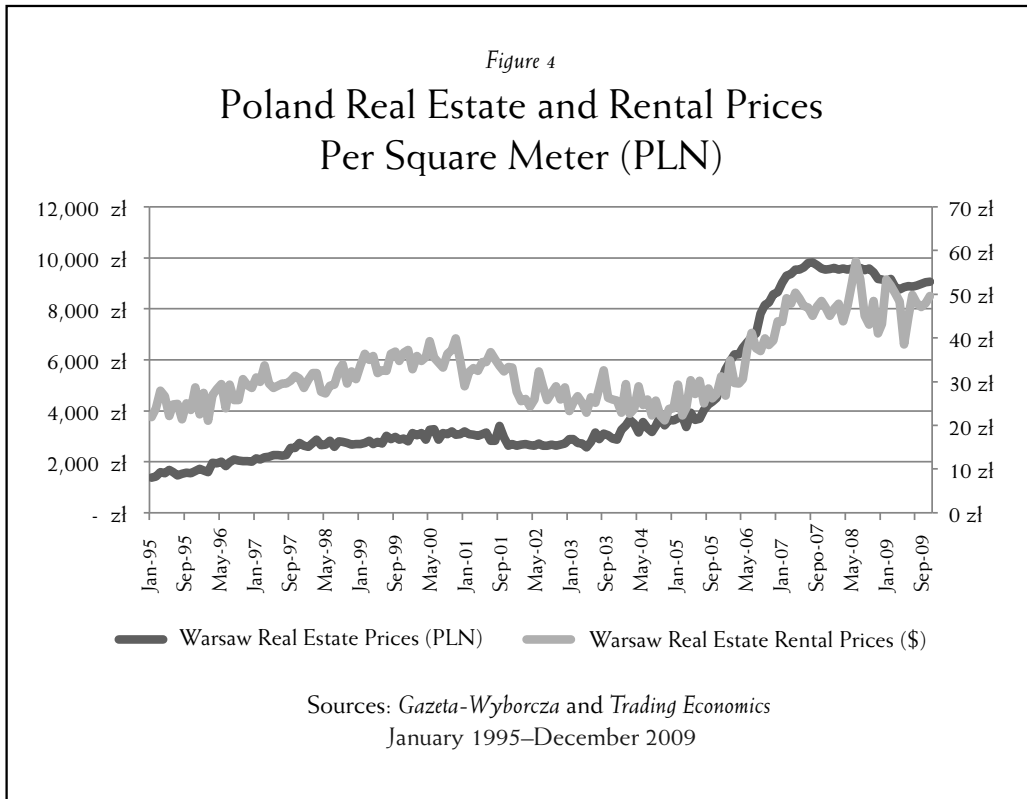
of 2009. The S&P 500 closed at 1,115 in December 2009, representing a 137 percent increase since January of 1995, far less than the non-risk-adjusted return of the WIG.

Figure 3 provides a summary of the annual changes in the property values and rental rates in Poland and property values in the U.S. The data are expressed in local currencies. An initial review of the table suggests greater returns and greater risk in Warsaw, but the data need to be employed with care. They do not reflect actual annual returns and are not directly comparable to stock returns or each other. The U.S. figure is an index of home values and the Polish data represent changes in asking prices. For Poland’s figures, if the relative difference between the asking price and selling price remains constant over the period then this would be a measure of annual return. However, this relationship likely varies over time; the “bid-ask spread” certainly varies.

The data in Figure 3 support the idea that the real estate downturn did not impact Poland as severely as in the U.S. in 2007 and 2008. The difference between the U.S. and Polish real estate markets is stark. U.S. home values, on average, decreased by 11.4 percent and 19.4 percent during those years, while Poland’s real estate increased by 10.5 percent in 2007 and decreased by only 4.4 percent in 2008.

The annual data do not reveal the extent of the volatility occurring during the sample period. Figure 4 illustrates

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average monthly measures of the asking purchase prices of real estate in Poland (per square meter) on the left axis and the asking rental price (per square meter per month) on the right axis. The values are expressed in zloty. Over the same period, the asking price of rental property in Warsaw, Poland, increased by 126 percent.

Figure 5 shows the S&P/Case-Shiller 10-City Composite Home Price Index and the monthly data for property values in Poland from January 1995 to December 2009. The 10-City index reached its high in June 2006 at 226.29; this represented a 195 percent increase since January of 1995 when the index was at 76.82. The index was “pegged” at around 100 in January of 2000, the base year. It was at 158.16 in December 2009, representing a 106 percent increase since January of 1995. Average real estate prices in Poland had a significantly larger increase over this period (558 percent) than was the case in the U.S. And prices in Poland did not drop as significantly from their highs as did prices in the U.S. The relationship between Poland’s real estate and stock markets is framed by these outsized returns.

Figure 6 shows monthly data for Poland’s real estate and stock markets from January 1995 to December 2009. The

asking price of real estate per square meter in Poland is on the left axis and the WIG is on the right axis. These variables generally move in concert until the beginning of 2007, when the stock market spikes and then plummets, divorcing itself from the closer relationship with housing prices that existed until up to 2007. At its peak, the WIG increased by 755 percent and at the end of the period still had a 419 percent total return. This compares to real estate prices which at their peak had a 612 percent increase and closed with a 558 percent increase over the period. The graver correction and pronounced recovery of the WIG between 2007 and 2009 is noteworthy. Overall, real estate outperformed stocks in Poland from 1995 to 2009; annual returns for real estate were about 13.4 percent, and stock returns in the same period were less than 11.8 percent. Even given that these results derive from advertised asking prices for Polish real estate, and not closed sales or rental data (which was unavailable in Poland over the period examined), the findings are significant, and are borne out with the study’s last sets of tests.

Figure 7 shows the relationship between monthly real estate *rental* prices and stocks in Poland over the sample period. Results similar to those for (sales) asking prices

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in Figure 6 are observed. Rental rates are far more stable since 2007 than is the case for the Polish stock market. This is especially true since 2005 or 2006.

The study employs simple linear regression analyses to discover relationships between stock prices and residential property values and rents in Poland. This approach is appealing in its ease of interpretation and has precedence in the literature.<sup>11</sup> The dependent variables are real estate prices and rents in Poland, and the independent variables are current and lagged stock returns in Poland. The lagged specification allows for the slow adjustment that may occur in the less efficient real estate market. The basic models are:

$$D RE Price_t = \beta_0 + \beta_1 \%DWIG_t + \beta_2 \%DWIG_{t-1}$$

$$D RE Rent_t = \beta_0 + \beta_1 \%DWIG_t + \beta_2 \%DWIG_{t-1}$$

where  $t = \text{Jan 1995-Dec 2009}$

The dependent variables are the change in Polish real estate prices in month  $i$  ( $\Delta RE Price_i$ ) and the change in monthly rentals in month  $i$  ( $\Delta RE Rent_i$ ). The independent variables are the stock return ( $\% \Delta WIG_i$ ) and lagged stock return in Poland ( $\% \Delta WIG_{i-1}$ ). A priori, one expects the coefficient on WIG to be positive. It is reasonable to

assume that an increase in stock values would be driven by the same economic factors that influence real estate prices. Those factors might also be expected to increase the amount of capital flowing into Poland from foreign investors. This would increase wealth and personal income, lower unemployment, and increase residential real estate asking prices. The correlation coefficients between the variables were also calculated.

### RESULTS

Correlation coefficients between these variables are reported in Figures 8 and 9. Figure 10 provides a summary of the models used to measure the strength and direction of the relationships between the WIG and real estate asking prices and rental rates.

In Figure 8, real estate prices in Poland are found to be significantly correlated with rental costs (0.64) and Polish stock prices (0.55); a weaker correlation with U.S. stock prices (0.326) and U.S. real estate (0.126) is observed. The lower correlation with U.S. stock prices suggests some diversification benefit for the U.S. investor buying Polish real estate, or the Polish investor buying U.S. stocks. Advertised rental rates in Warsaw are not significantly correlated with Polish or U.S. stock indexes, or the U.S.

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*Figure 8*

Correlation Coefficient for the Annual Percentage Change in each Variable

| Variable                            | Poland Real Estate Values | Poland Real Estate Rentals | U.S. Real Estate Values (C-S index) | Poland Stock Price (WIG) |
|-------------------------------------|---------------------------|----------------------------|-------------------------------------|--------------------------|
| Poland Real Estate Rentals          | 0.640***                  |                            |                                     |                          |
| U.S. Real Estate Values (C-S index) | 0.126                     | -0.244                     |                                     |                          |
| Poland Stock Price (WIG)            | 0.550**                   | 0.360                      | 0.291                               |                          |
| U.S. Stock Prices (S&P 500)         | 0.326                     | 0.421                      | 0.232                               | 0.578**                  |

A \*\*\*, and \*\* indicate significance at the 1%, and 5% levels, respectively.

Sources: S & P Dow Jones Indices, *Gazeta-Wyborcza* and *Trading Economics* January 1995–December 2009

*Figure 9*

Correlation Coefficient for the Monthly Percentage Change in each Variable

| Variable                            | Poland Real Estate Values | Poland Real Estate Rentals | U.S. Real Estate Values (C-S index) | Poland Stock Price (WIG) |
|-------------------------------------|---------------------------|----------------------------|-------------------------------------|--------------------------|
| Poland Real Estate Rentals          | 0.096                     |                            |                                     |                          |
| U.S. Real Estate Values (C-S index) | 0.021                     | -0.004                     |                                     |                          |
| Poland Stock Price (WIG)            | 0.114                     | -0.085                     | 0.138*                              |                          |
| U.S. Stock Prices (S&P 500)         | 0.032                     | -0.091                     | 0.128*                              | 0.079                    |

A \*\*\*, and \*\* indicate significance at the 1%, and 5% levels, respectively.

Sources: S & P Dow Jones Indices, *Gazeta-Wyborcza* and *Trading Economics* January 1995–December 2009

housing index. Polish and U.S. stock markets are highly and positively correlated (0.578), suggesting only modest diversification benefits to the investor spreading his or her portfolio over those two stock markets.

Because annual returns do not capture the true volatility in the underlying data, Figure 9 examines the correlations between the monthly percentage changes in the variables. All of the correlations are significantly lower using monthly returns. Polish real estate prices have relatively low correlation with Polish stocks (0.114), Polish rental values (0.096), U.S. real estate prices (0.021) and U.S. stocks (-0.032). Polish rents are negatively correlated with Polish stocks (-0.085), U.S. stocks (-0.091) and U.S. property values (-0.004). The correlation between the two countries' stock indexes is 0.079. The lower correlation measures in Figure 9, versus Figure 8, imply potentially greater diversification benefits for the investor crossing the Polish or U.S. border assembling a portfolio for the U.S. or Polish investor, respectively.

Figure 10 provides the results from the time series regression models. In Panel A, the dependent variable is the change in real estate prices. The coefficient for stock returns is not significant, indicating the stock market does not immediately impact real estate prices. Real estate prices may be slow to adjust to stock returns so a one-

*Figure 10*

Time Series Regression Results

| Panel A: Dependent Variable: $\Delta RE Price_t$ |                     |                     |
|--|---------------------|---------------------|
|  | Model 1             | Model 2             |
| Intercept  | 40.18<br>(0.005)*** | 35.87<br>(0.015)*** |
| % $\Delta WIG_i$                                 | 210.27<br>(0.178)   | 233.53<br>(0.079)*  |
| % $\Delta WIG_{t-1}$                             |                     | 274.71<br>(0.079)*  |
| R <sup>2</sup>                                   | 0.01                | 0.03                |

| Panel B: Dependent Variable: $\Delta RE Rent_t$ |                   |                  |
|---|-------------------|------------------|
|   | Model 1           | Model 2          |
| Intercept                                       | 0.210<br>(0.803)  | 0.165<br>(0.618) |
| % $\Delta WIG_i$                                | -4.12<br>(0.1478) | -3.81<br>(0.186) |
| % $\Delta WIG_{t-1}$                            |                   | 2.65<br>(0.934)  |
| R <sup>2</sup>                                  | 0.01              | 0.02             |

A \*\*\*, and \* indicate significance at the 1%, and 10% level, respectively.

Sources: S & P Dow Jones Indices, *Gazeta-Wyborcza* and *Trading Economics* January 1995–December 2009

period lagged variable is examined in Model 2. The lagged variable is significant at the 10 percent level, indicating that real estate prices react slowly to movements in stock



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prices. The R-squared in both models is low, indicating that stock returns are not the primary factors driving real estate prices. Panel B shows the results from the same two models using the change in rents as the dependent variable. The stock return variable and the lagged stock return variable are not significant in either model. These results indicate that the changes in rents in Poland are not significantly influenced by stock returns. These findings drive the concluding remarks below.

### CONCLUSION

No circulating study considers the relationships between Polish real estate and stock returns in the manner conducted here, as no data platform such as the one offered in this article has been available. The data presented here, prosaically assembled using advertisements in the local newspaper, leads to several discoveries: first, alongside Poland's robust economy, real estate values in Warsaw increased dramatically in the fifteen years ending in 2009. Second, stock returns appear to have a positive impact on real estate prices but stock returns do not seem to directly impact rents. Third, the correlation between real estate and stocks in Poland is low and provides evidence in favor of diversification opportunities for investors. The data also provide evidence illustrating the high returns in Poland's real estate and stock markets over the period examined.

These findings are important to the international investor contemplating opportunities in Poland, in both the real and capital markets. The discoveries reported here are also clearly important to the Polish investor placing funds domestically. Like many markets, real estate in Poland, as measured by advertised asking prices on residential rentals and sales in Warsaw, can serve as an important diversification objective for the Polish investor. Likewise, U.S. or other foreign investors can use this data, and discoveries, in refining their own international and real estate investment strategies. Additionally, the policymaker, across Europe and in other countries, might wish to discover and emulate those Polish protocols that influenced that country's favorable macro-economic environment; this is particularly meaningful in the midst of the economic malaise that populates much of the policymaker discussions at present across Southern Europe. And finally, the results are important to the academic in the U.S. and Poland, as that Eastern European country enters the Western fold, and measures develop to gauge the behavior of Polish markets within the realm of traditional financial and economic theory.

Later work will build on this study's preliminary findings. As real estate transaction recordation at the local level becomes more standardized in Poland, opportunities will develop for more exacting research—with more thorough and accurate real estate transaction data. ■

### ENDNOTES

1. See Kaliński, J., *Zarys historii gospodarczej XIX i XX w.* Efekt, 2000. Kaliński reports that a shortage of homes developed in the 1980s; in 1988 there were more than 30 percent fewer homes completed than ten years earlier. Nearly 600,000 married couples were waiting at that time for their own homes. See also Czarnecka, K., "Real Estate Market Trends in Poland," *Integrating Generations FIG Working Week*, Stockholm, Sweden, 2008. He reported on macroeconomic matters plaguing Poland as it transitioned to a market economy.
2. Private equity firms have recognized the success of Poland and have increased investments there. For some recent comments on this, see Klonowski, D., "The Evolution of Private Equity in Emerging Markets: The Case of Poland," *Journal of Applied Corporate Finance*, Vol. 23, No. 4, 2011, pp. 60–69. And, according to the European Private Equity and Venture Capital Association, as of 2011, there were 40 private equity firms that had invested in Poland.
3. See International Monetary Fund: Dissemination Standards Bulletin Board: <http://dsbb.imf.org/Pages/SDDS/CtyCtgList.aspx?ctycode=POL>.
4. Sobczyk, Marcin, "Euro's Popularity Hits Record Low in Poland," *The Wall Street Journal*, June 5, 2012. Sobczyk notes that Poland has met two of the "convergence criteria" that would allow it to adopt the euro.
5. Ibbotson, R., and L. Siegel, "Real Estate Returns: A Comparison with Other Investments," *AREUEA Journal*, Vol. 12, No. 3, pp. 219–241, 1984. They use annual data from 1947 to 1982 and construct a market-value weighted index based on commercial, residential and rural real estate values.
6. Diversification benefits of real estate are considered by Hartzell, D., "Real Estate in the Portfolio," *The Institutional Investor: Focus on Investment Management*, edited by F.J. Fabozzi, Cambridge, Ma., Ballinger, 1986. He uses quarterly data from 1977 to 1986 and finds a -0.25 correlation between U.S. real estate and the S&P 500.
7. See, for example, Barkham, R., and D. Geltner, "Unsmoothing British Valuation-Based Returns without Assuming an Efficient Market," *Journal of Property Research*, Vol. 11, No. 2, pp. 81–95, 1994. They correct for serial correlation and find a correlation of 0.38 between real estate and stock returns in the UK. A study of the relationships between real estate and stock returns in the international markets is provided by Quan, D. and S. Titman, "Commercial Real Estate Prices and Stock Market Returns: An International Analysis," *Financial Analyst Journal*, Vol. 53, No. 3, pp. 21–34, 1997. They find that the correlation between real estate and stocks varies across countries. In the aggregate, they find the relationship between real estate and stock markets to be statistically significant and positive.
8. Quan, D. and S. Titman, "Do Real Estate Prices and Stock Prices Move Together? An International Analysis," *Real Estate Economics*,

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Vol. 27, No. 2, pp. 183–207, 1999. They use data from 17 countries and find that over long periods, changes in GDP and stock prices are positively associated with real estate prices.

9. An extensive literature on the international real estate markets is represented first by Liu and Mei in three articles: Liu, C. and J. Mei, 1992, “The predictability of Returns on Equity REITS and their Co-Movements with Other Assets,” *Journal of Real Estate Finance and Economics*, Vol. 5, No. 4, pp. 401–418; Liu, C. and J. Mei, 1994, “An Analysis of Real Estate Risk Using the Present Value Model,” *Journal of Real Estate Finance and Economics*, Vol. 8, No. 1, pp. 5–20; and in 1998, “The Predictability of International Real Estate Markets, Exchange Risks and Diversification Consequences,” *Real Estate Economics*, Vol. 26, No. 1, pp. 3–40. Successively, the authors report that T-bills and long-term yield spreads impact stock and real estate markets and these markets tend to move together. In the 1998 study they examine international real estate and stock markets and find that short-term interest rates, maturity spreads and dividend yields are relevant in some countries but not others. Two articles by Ling and Naranjo pursue similar international real estate objectives: See Ling, D. and A Naranjo, 1997, “Economic Risk Factors and Commercial Real Estate Returns,” *Journal of Real Estate Finance and Economics*, Vol. 14, No. 3, pp. 283–307; see also their 1999 study “The Integration of Commercial Real Estate Markets and Stock Markets,” *Real Estate Economics*, Vol. 27, No. 3, pp. 483–516. In those two papers, the authors employ non-linear estimation techniques and securitized real estate data and find that common factors impact commercial real estate and stock market returns. The key factors were T-bill rates and per capita consumption. Their results support the hypothesis that the market for exchange-traded real estate companies (including REITs) is integrated with the market for exchange-traded non-real estate stocks. Their results show that the degree of integration increased significantly during the 1990s.
10. Worzala, E. and C. F. Sirmans, “Investing in International Real Estate Stocks: A Review of the Literature,” *Urban Studies*, Vol. 40, Nos. 5–6, 2003, pp. 1115–1149.
11. Op. cit. at 7.