Department of Land Economy

Environment, Law & Economics

UNIVERSITY OF CAMBRIDGE
Real Estate Research Centre

Working Paper Series
No. 2015-12

Title: The Dynamics of House Prices in Israel

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The Dynamics of House Prices in Israel

Abstract

This paper investigates the macroeconomic drivers of house prices in Israel, the OECD country with the highest growth rate in recent years, and tests for divergence of observed prices from underlying fundamentals using cointegration analysis and error-correction models for the 1998 to 2013 time period. While the recent surge in house prices is partially explained by fundamentals such as population growth, low unemployment and interest rates along with supply constraints, the results suggest that prices have deviated from fundamental values by approximately 20 percent from 2009 onwards. Stock market volatility is found to be a key predictor of house prices in the short run, indicating a shift towards increased investment in the housing market when other asset classes, notably the stock market, are perceived as very risky.

Keywords: Housing market, Macroeconomic Drivers, Asset Pricing, Volatility, Cointegration, Error Correction Model

JEL Classification: C22, R21, R31

House prices in Israel have attracted considerable public attention in recent years. Israel, a developed economy and member of the OECD, has witnessed a protracted period of price appreciation since 2007. Despite the Global Financial Crisis (GFC), house prices have risen by roughly 62 percent in real terms, a sharp increase compared to the average growth rate of OECD countries over the same period (IMF, 2014). At the same time, there is a marked paucity of research on the underlying reasons for this price increase and the policy options for restoring affordability in the housing market. This study seeks to elucidate the drivers of the observed rapid price increase, and to identify whether this price movement is justified by

macroeconomic fundamentals or whether it is driven by investors' expectations of future price increase and capital gains, which might suggest the development of a housing market bubble.

In general, housing markets have been identified as the key sector to lead economic cycles by influencing financial stability and the monetary policy mechanism (Mishkin, 2007). Housing represents a large share of household wealth, savings and investments and has a significant effect on consumer spending and output growth (Case et al., 2005), especially in Israel with its 70% home ownership rate and high percentage of income spent on housing, (Kahn and Ribon, 2013).

Research on the determinants of house prices has demonstrated that government policies and regulations can improve housing affordability and prevent market distortions (Malpezzi, 1996). On the other hand, more recent evidence suggests that monetary policies such as quantitative easing (QE) may have fuelled asset price bubbles and lead to house prices diverging from fundamentals (Tsai, 2014). The present study offers an empirical investigation of the Israel housing market based on quarterly data over the 1998 to 2013 period to identify the underlying drivers and test for significant deviation of house prices from fundamentals. Following Adams and Füss (2010) and Nagar and Segal (2011), we draw on the stock-flow and asset pricing approach, primarily the equilibrium relationship between interest rates, rents and prices and factors that drive existing housing supply and demand-shifting variables, and study the contribution of such factors to prices. This study extends the analysis performed by Nagar and Segal (2011) by expanding both the length of the time series and the set of explanatory variables and by further investigating the period 2009 to 2013, when prices surged by 42 percent in real terms. In particular, we include the stock

market volatility index (VIX) to gain a better understanding of the linkages and substitution effects between asset classes, particularly the impact of stock market risk and volatility on house price appreciation.

PREVIOUS RESEARCH

One of the earliest attempts to develop a complete housing market model is the study by Smith (1969) who confirmed that house prices vary directly with permanent disposable income and housing-starts. The crucial role of long-term household income in price formation is also supported by Quigley (1999), Case and Shiller (2003), McCarthy and Peach (2004) and Arestis and González (2013), who all find that both income and employment levels explain real-estate cycles of housing demand, mainly since permanent employment leads to increase in wealth which in turn increases the fundamental demand for housing.

Monetary policy and the cost of external financing are two further key determinants for housing demand. A low interest-rate environment and relaxation of credit standards allow more marginal households to switch from renting to owning a property and enable existing property owners to afford a more expensive property. More specifically, the role of credit markets in relation to the housing market has been discussed by Kearl (1979) who found that constant payment mortgages led to distortions in the market in the face of anticipated inflation. Reichert (1990) found that US house prices are sensitive to changes in mortgage interest rates. Baffoe-Bonnie (1998) study of the US further suggested that real-estate cycles are primarily affected by shocks in the form of fiscal and monetary policy. More recently, Miles (2014) found that both mortgage rates and the central bank interest-rate independently determine house prices, and mortgage rates do not simply act as a proxy for monetary policy, i.e. the impact of central bank interest-rate on long-term rates decreases over time.

Demographic factors are a further essential demand shifter. Case and Shiller (1990), Bar-Nathan et al. (1998) Jud and Winkler (2002), Mikhed and Zemčík (2009) and Arestis and González (2013) all demonstrate empirically that a positive correlation between population growth and house prices exists, albeit with a relatively slow response of prices to changing demographic forces. Arbel et al (2012) and Mesch & Mano (2010) demonstrate the link between immigration to Israel and home ownership in a micro-economic framework.

By contrast, empirical studies of the link between the stock market and the housing market arrive at more mixed conclusions. While some report that the wealth effect in the stock market can cause a concomitant rise in real estate prices, others conclude that there is a substitution effect marked by a negative correlation between equity and real estate prices. For example, Jud and Winkler (2002) find a significant wealth effect transmitting stock market appreciation to a growth of housing prices via growing household net wealth. Green (2002) reports for Northern California that stock values influence housing consumption with a stronger correlation in high income areas where households are more likely to invest in stocks. Conversely, Case and Shiller (2003) purport that the appearance of a real estate bubble immediately after a stock market crash supports the notion of a substitution effect. A stock market crash and high volatility leads to a flight to quality which increases the demand for housing investments as housing is perceived to be a safer investment than other liquid financial assets during this phase. Pashardes and Savva (2009) find for Cyprus that the real estate investment decisions are influenced by competing returns achievable in the stock market. During periods of equity high returns relative to rental income there was a lower demand for housing investments, consequently, a lower increase in house prices. Since the prior literature has generated mixed results, we leave the relationship between stock markets and house prices open for empirical examination in this paper.

The evidence on supply, both in terms of the existing housing inventory and new construction activity, in determining house prices is also contradictory. Basic economic theory suggests that increasing demand and rising prices should induce a positive supply response, resulting in a subsequent price adjustment. However, empirical studies do not always confirm this relationship and in some cases even report a positive association between new supply and house prices (e.g. Ooi and Le, 2012). The extent to which prices will adjust depends on the price elasticity of supply, which in turn depends upon factors such as: expectations of demand and the size and structure of the house-building industry. If supply is inelastic, the required price adjustment period may be so long that supply never responds adequately from a market equilibrium perspective, resulting in largely demand driven market (Pryce, 1999). Cameron et al. (2006) report that inelastic supply, i.e. a lack of house building in conjunction with strong demand is a major driver of price appreciation. For Israel, Bar-Nathan et al. (1998) find the supply elasticity to be very low in the long-run (0.35), suggesting that price shocks have a long-run influence on future prices with supply responding inadequately. A more recent study by Caldera and Johansson (2013) finds large variation in the responsiveness of housing supply to prices driven by spatial characteristics, land use and planning regulations. The study confirms the relatively low supply elasticity of the Israeli housing market.

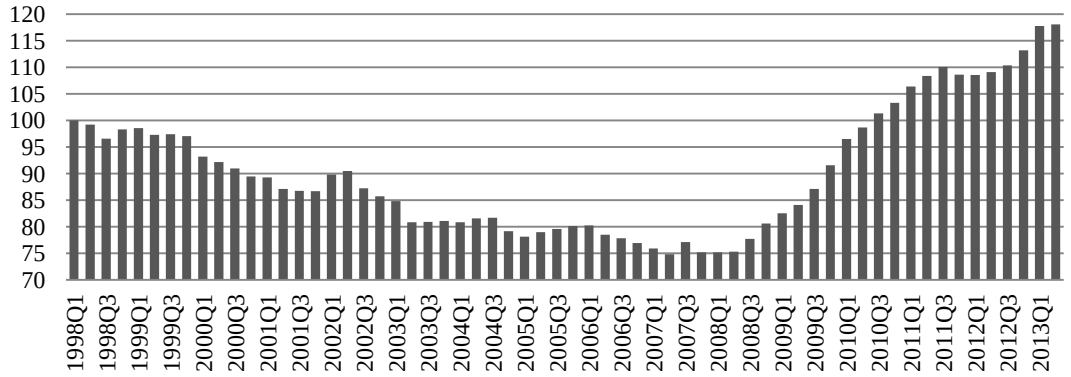
SOME BACKGROUND ON THE ISRAELI HOUSING MARKET

Several recent studies of the Israeli housing market appear to support the notion of a moderate deviation from house price fundamentals in the more recent past. However, these studies do not take into account the period of exceptionally strong price growth after 2010. Dovman et al. (2012) find that in the period up to 2010 actual prices were between 3 percent below and 10 percent above the fundamental price and conclude that there is no evidence of a

significant price misalignment. In a similar vein, Nagar and Segal (2011) find that observed house prices were 8 percent to 16 percent above their fundamental value which again provides no evidence of a significant price misalignment.

Despite possessing a number of unique features, the Israeli housing market may be seen as representative of developed countries with strong immigration patterns. An analysis of the house price index reveals a cyclical movement of prices; a long cycle of bust and boom is distinguishable. From 1998Q1 to 2007Q1, prices declined consistently, with an aggregate fall of 24 percent in real terms, while in the following period 2007Q2 to 2013Q4, prices have surged with an upward adjustment of 62 percent in real terms. This price growth rate, which is almost unparalleled among developed countries in recent years, with approximately double the growth rate of the second ranked country Turkey (OECD, 2014), has significantly impeded households' ability to purchase a property.

Figure 1: Real House Price Index (1998Q1-2013Q4)

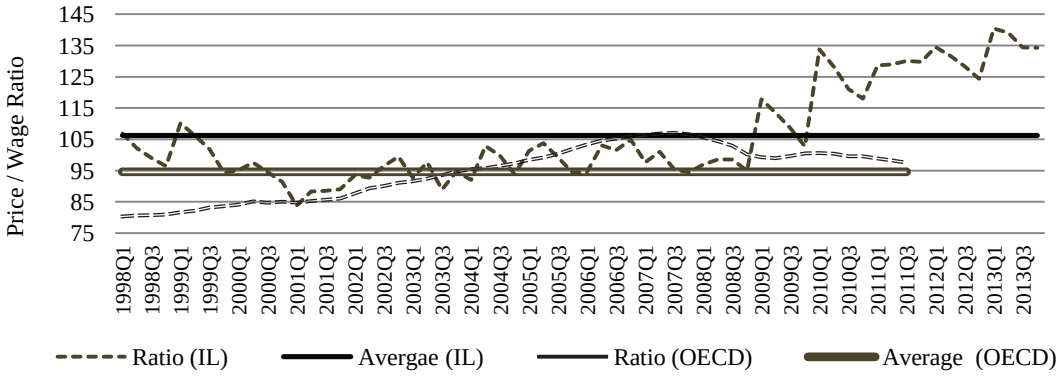


Source: *Central Bureau of Statistics*, *authors*

House prices to average wage

One of the key metrics of affordability are earnings multiples of house prices. Figure 2 shows the evolution of the monthly earnings ratio in Israel and in the OECD countries. From 2009Q4 onwards, we witness a significant deviation from both the long-term Israeli average and from the contemporaneous development of all other OECD countries, from 106 months of work to 140 months at 2013Q1, at the same period house prices rose by a cumulative 26 percent beyond the rise in real wage. These numbers signal a sharp drop in the purchasing power of households with regard to housing and may even amount to an affordability crisis for some cities and income groups.

Figure 2: Prices to Average Wage Ratio (1998Q1-2013Q4)



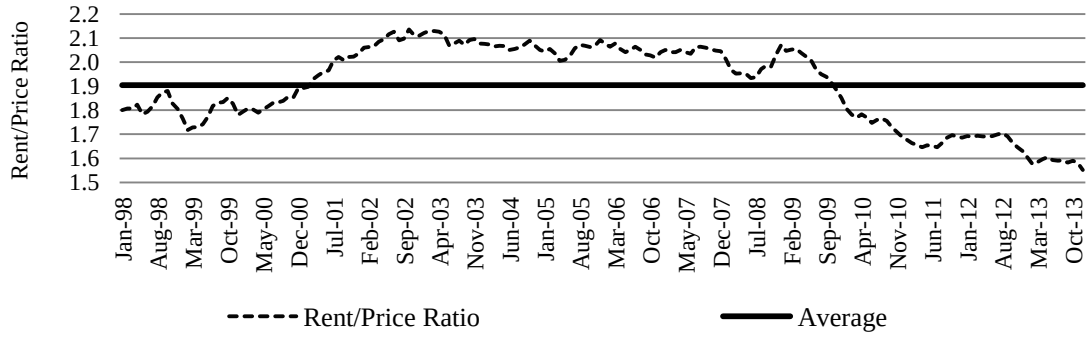
Source: *Bank of Israel, OECD, authors*

Rent to house prices ratio

A further key stability metric is the rent-to-price ratio which is essentially a profitability measure. It is assumed that households will switch from renting to owning a property (and vice versa) when conditions are favorable. This mechanism ensures that prices readjust to equilibrium whenever there is an imbalance and a departure of prices from the fundamental investment value represented by rents. In the long-run, this ratio should remain relatively stable in a market economy such as Israel. Figure 3 shows that since January 2010, there is a

deviation from the sample mean. Prices have risen more steeply than rents, resulting in lower return on investment. Moreover, from 2007Q2 to 2013Q4, rents have only grown by 19 percent in real terms, while house prices grow by 62 percent. We acknowledge that to some extent this is a result of low interest rates but the implication for such deviation might also represent a formation of a significant price misalignment. McCarthy and Peach (2004) report that in the US, the last time the ratio fell below its long-run average, the late 1980s, house prices subsequently declined significantly.

Figure 3: Rent to House prices Ratio (1998Q1-2013Q4)



Source: *Bank of Israel, authors*

Economic activity / Business cycle:

Since 2004 income tax reforms and a constant growth in terms of labour force participation contributed to increased purchasing power in Israel. Notwithstanding, from 2004Q1 to 2007Q2, while economic activity exhibited constant growth house prices decreased by 8 percent in real terms. In the following period, 2007Q3 to 2013Q4, the steep increase in real house prices (62 percent) appears to be unrelated to the real GDP growth of only 8 percent and an average wage increase of only 2 percent, suggesting that economic activity indicators and house prices are not contemporaneously correlated in Israel.

Monetary Policy

Since February 2009, in response to the GFC, the appreciation of the New Israeli Shekel (NIS) and in order to prevent an economic recession, the Bank of Israel (BoI) initiated two rounds of monetary easing, which supported economic growth but also boosted demand in the housing market. Since then, the BoI has introduced various macroprudential measures to address the risk of a house price bubble such as capital surcharges aimed at reducing banks' incentives to extend mortgage. Also, the variable component of mortgages was limited to one-third of the principal amount of the loan. To date, these measures have not been effective in containing house prices inflation but the recent direct regulations regarding loan-to-value limits and the second-home extended purchasing tax seem to have contained, to some extent, the speculative investment element in the housing market.

The housing investment market

Investment activity in the housing market by non-owner occupiers has a considerable impact on house prices. In the 2003-2013 period, this market segment represented roughly 26 percent of the total national transactions on average and overseas investors' activity represented an additional 3.5 percent of total transactions (Ben-Naim, 2010; BoI, 2014). Figure 2 shows the investors involvement in the market. The Dot.com bust resulted in a flight to quality as liquid assets became riskier and more volatile, driving investors toward housing investments. The 2003 introduction of a capital markets capital gain tax increased the attractiveness of housing as well. In late 2008, the GFC caused a continuous decrease in the value of financial assets and interest rates while strengthening the attractiveness of housing as an alternative investment asset. By 2009, investors' activity accounted for one-third of the total transaction volume in the national residential market.

Figure 4: Investor Activity in the Housing Market (2003Q1-2012Q4)

Source: *adopted from the Bank of Israel*

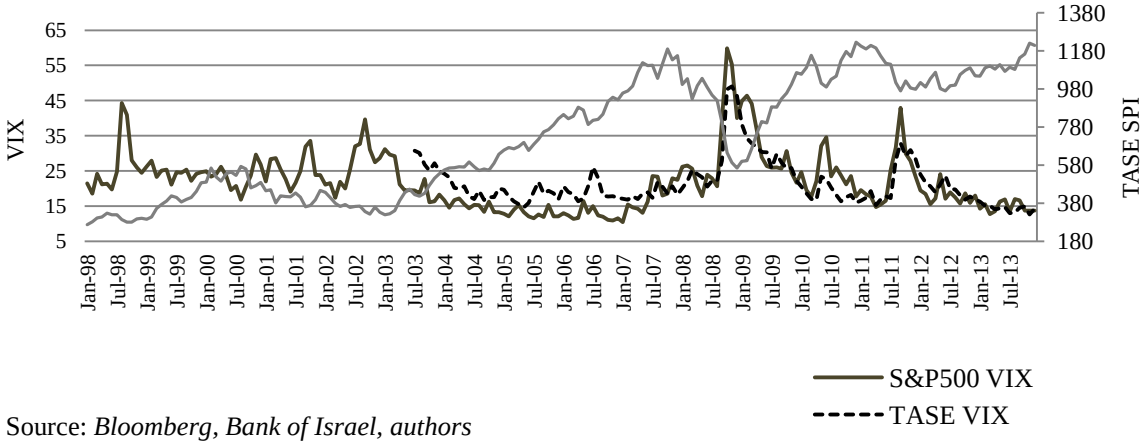
Stock markets and volatility

While a number of studies have investigated the link between stock markets and housing markets, the role of stock market *volatility* has been largely neglected in this context. A suitable indicator for measuring volatility is the VIX index which is sometimes referred to as the investors' fear gauge since it is set by investors and expresses their consensus view about expected future stock market volatility and risk (Whaley, 2000). The literature examined the to predict the expected volatility and stock market returns and found that a high level of VIX typically indicatesmarket turmoil. Banerjee et al. (2007) found that implied volatilities measured by VIX hold meaningful economic information and strong predictive ability with regards to risk and returns. Connors (2002) reported that traders use the VIX as a market timing tool since VIX indicates when market top or bottom. Furthermore, since the long-term volatility is mean-reverting; when VIX begins its mean reversion it is accompanied by a market rally, either bullish or bearish. Along with the finding of Chadwick (2006) that VIX is a good signal of 5-month rallies of market returns, we infer that when VIX is low, investors expect future strong market returns, thus low VIX should ignite a substitution effect. In a

similar vein, Eldor et al. (2008) finds that the TASE VIX is a significant predictor of the expected volatility of share prices in Israel, especially in time of high volatility, and when VIX increases, investors expect the market to fall. Lastly, Poon and Granger (2003) reviewed 26 papers which compared the volatility forecasting performance of historical volatility models and volatility implied from options. They found that 76 percent of the studies found ISD (option-implied-standard-deviation) to provide the best forecasting for the future volatility of stock prices. Thus, confirming the rationale for using a forward-looking volatility measure rather than using the past Stock-Price-Index volatility.

In line with the extant literature, VIX represents a risk management and information tool with which investors assess the capital market risks. Thus, risk-averse investors will translate high levels of VIX to high risk premiums and since the TASE100 index and VIX were found to be negatively correlated, high VIX should ignite a 'substitution effect'. Furthermore, Figure 3 shows how the violent stock market crash in late 2008 can be seen in the VIX graph as record peaking levels and the 2005-2007 stock market boom can be seen as the VIX record low level.

Figure 5: TASE100, TASE VIX, S&P500 VIX



Source: *Bloomberg, Bank of Israel, authors*

Apart from these cyclical developments, there is also a structural characteristic that is important for understanding the workings of the Israeli housing market. 93 percent of the land is owned by the Israeli Land Authority (ILA) which determines the land availability for housing construction. The ILA releases land, with detailed plans, and determines the price (by bids with a reserve price) as well as when and how developments will be executed. Therefore, the price of land depends, *inter alia*, on the rate at which the ILA releases land. Somkin and Gayer's (2013) research shows that during the last decade, the ILA was consistently under-supplying the market, thus contradicting expressed government policy to increase land supply. The authors further argue that the monopolistic nature of the ILA land marketing activity led to a distortion in the market, reflected in a total surplus of NIS 356 billion (USD 91.17 billion) paid by households, and if the ILA release of land for development had been in line with demand, prices today would be 35 percent lower.

DATA

The econometric model is estimated on a dataset covering the 1998Q1 to 2013Q4 period and includes 64 observations. The following variables are used in the estimation:

Variable	Symbol	Source
Real house prices index	*Hp*	Central Bureau of Statistics
Real rent index	*rent*	Central Bureau of Statistics
Real stock-price-index	*SPI*	Bloomberg
Market volatility index	*VIX*	Bloomberg
Unemployment rate	*uemp*	Bank of Israel
Real mortgage interest rate	*long*	Bank of Israel
Short-term interest-rate	*ir*	Bank of Israel
Housing-inventory-to-population	*hipop*	Central Bureau of Statistics
Average real wage per-capita	*wage*	Bank of Israel

The housing market is characterized by great heterogeneity of characteristics that affect prices, thus estimating price trends by comparing the average or the median price of houses sold will affect the results of the estimation and yield index bias. Therefore the Central Bureau of Statistics (CBS) uses the hedonic pricing method to calculate the house prices index (the dependent variable). The method assumes that prices are set by the aggregative effect of quality parameters, therefore the ability to measure their different effect on prices allows a more accurate estimation of the index. The CBS house prices index used in this study is calculated on the basis of the Carman database which covers approximately 85 percent of the total housing transactions reported to the tax authority and includes over 40 house specific and regional parameters, such as size, type, age and location.

Data for the owner occupied housing services (rent index) is retrieved from the CBS. Since 1999, the index is measured according to rental-equivalent methodology, which recognizes the rent in new and renewable contracts as a proxy for housing services costs, or equivalently the return to investor from owning her home. Indisputably, measuring new leases is a more accurate indicator, since it reflects the user costs of housing in current values, and therefore represents a better comparison with house prices. For the period of 1998, we use rental values according to existing leases. Our analysis reveals a very low correlation (0.13) between prices and rents for the entire sample period. Moreover, rents have grown only by 3.74 percent in real terms, while house price grow by 20.81 percent.

Data for the unemployment rate is retrieved from the BoI and along with average wage represent the economic activity. Data for real disposable income does not exist for Israel, therefore we include the quarterly average wage per employee from BoI Statistics. Housing-inventory-to-population ratio is created from the quarterly population growth data and the

quarterly housing inventory, which is a synthetic variable based on the CBS housing inventory survey (1995), to which we added the quarterly construction completions.

A growing literature has reported evidence of a relation between changes in underwriting standards, the supply of mortgage credit, securitization and subsequent house price movement (Anderson, Capozza and Van Order, 2011; Mayer and Sinai, 2009; Mian and Sufi 2009). Since data series for these variable does not exist for Israel and since there is no mortgages securitization activity in the Israeli financial market in this study we employ the data for the quarterly real long-term mortgage interest rates is retrieved from the BoI. Data exist for periods of up to five years, 5-10 years, 10-15 years, 15-20 years, 20-25 years, and over 25 years. Following Nagar and Segal (2011) and the fact that lending rates change from period to period, and households might base their expectations concerning the future rates, not only on current rates but also on rates in the preceding periods, we include the long-term average of index-linked morgages. Furthermore, we use the central bank (BoI) interest-rate which mailny affects the ARMs that represent apporixamtly 58 percent of the total market credit.

Data for the TASE100 index and for the VIX index is retrieved from Bloomberg. The VIX time-series for Israel exists only from 2003; therefore the highly correlated (+0.869) S&P500 VIX is used in this study. The CBOE Volatility Index was introduced in 1993 and since then is a key measure of market expectations of near-term volatility conveyed by S&P500 stock index option prices. The VIX was originally designed to measure the market's expectation of 30-days volatility implied by at-the-money S&P100. But since 2003 VIX is calculated by using real-time S&P500 Index (SPX) option bid/ask quotes. VIX uses near-term and next-

term out-of-the money SPX options and then weights them to yield a constant, 30-day measure of the expected volatility of the S&P500 Index (CBOE, 2014).

EMPRICAL ANALYSIS

The empirical analysis for the estimated period of 1998Q1 to 2013Q4 is conducted in three steps: First, we test the variables for stationarity using unit root tests. Next, we apply a cointegration test to detect the long-run equilibrium relationships and the variables long-run elasticities and finally estimate an error-correction model for the short-run dynamics by employing ordinary least squares (OLS) method to estimate the variables in stationary form.

Unit root tests

The standard Augmented Dicky-Fuller (ADF) test is used for testing whether the time-series data are stationary and follow a unit root process. The ADF test statistics are reported in Table 1 and indicate that all the series, except *wage* and VIX are non-stationary. The finding of wage to be stationary is remarkable since wages are expected to increase over time, roughly in line with economic and productivity growth. For further analysis, we use the error-correction model and first-difference the non-stationary series. As expected, first-differencing renders all the time series stationary.

Table 1: Augmented Dickey-Fuller Test

Variable	Level	Difference
$log\ hp$	0.697	-4.253 ***
$log\ rent$	-0.311	-5.804 ***
$log\ spi$	0.99	-5.993 ***
$uemp$	-1.298	-5.886 ***
$long$	-1.539	-5.925 ***
ir	-1.925	-5.673 ***

$log\ hipop$	3.588	-5.914 *** c
$log\ const$	-1.89	-12.623 ***
$log\ wage$	-4.748 *** c	
$log\ vix$	-2.748 * c	

Note: *, and *** indicate statistical significance and rejection of the null at the 10 percent and 1 percent significance levels, respectively. c indicates a constant has been used.

Causality tests

The result of Granger causality tests of the variables is given in table 2. We only present the estimation results of the stock-price-index and the VIX, since we focus on how capitals flow from the stock market to the housing market. As shown in Table 2, results of Granger causality test reveal a strong channel of one-sided directional causality and confirms that changes in the stock-price-index and VIX may lead to the housing price changes. We find no reverse causation from house prices to the stock market or the VIX.

Table 2 - Granger Causality Test

Variable	Lags	F-statistic	Prob.
Stock-price-index > house-price-index	3	2.3122	0.0866*
	4	2.9951	0.0271**
	5	2.7044	0.0315**
	6	3.4128	0.0085***
VIX > house-price-index	*5*	3.7213	0.0064***
	6	3.1657	0.0114**
	7	2.8649	0.0157**

Note: *, ** and *** indicate statistical significance and rejection of the null at the 10%, 5% and 1% significance levels, respectively.

Long-run relationships

Economic theory suggests that a short-run deviation from equilibrium prices should be corrected in the long run. Several specifications of potential long-run equilibrium relations to which house prices adjust were estimated using cointegration analysis for the period 1998Q1-2013Q4. All the individual variables are I(1). The results of the Engle-Granger cointegration test indicate that for; log house prices, log rent, log stock-price-index, unemployment, long-interest rates, interest rates and house-prices-to-population-ratio the estimated p-value is found to be less than ten percent (Engle-Granger cointegration test Prob.0.0739). Thus, the null hypothesis of no cointegration is rejected at a significance level higher than 7.39 percent. To derive the long-run coefficients we estimate an OLS regression. We test the residual series from the estimated equation and find it to be stationary with a t-statistic of 4.4379, therefore, the estimated relations can be regarded as a long-run equilibrium relationship and can be used to estimate the error-correction model.

Table 3 shows the estimated long-run elasticities of the variables effect with regard to house prices. Since all the variables are in logarithms or percentages, the elements of the coefficient show the average long-run percentage change of the dependent variable for a one-percentage change in the independent variable, *ceteris paribus*. In cointegration analysis, statistical inference is not possible on parameters in a cointegration equation which includes I(1) variables but the long-run elasticities can obtained after making all included time-series I(0) stationary (Brooks, 2008).

Table 3: Cointegration Estimation

Dependent Variable: HP

Variable	Coefficient	Std. Error
Constant	-9.3945	2.2594
log Rent	1.4102	0.1861
log SPI	-0.0106	0.0325
uemp	-2.6556	0.7848
long	-1.6802	1.1773
ir	2.4212	0.3853
log hipop	-8.3019	1.7826
Included Observations:	64	
Adjusted R-squared	0.8812	
F-statistic	78.8766	
ADF t-value	4.4379	

The estimated relationships point to the supply variable (housing-inventory-to-population ratio) as the most important variable in explaining house prices in the long-run. The long-run elasticity of house prices with respect to housing-inventory-to-population ratio is -8.3019. The strong elasticity is the result of the housing stock and adult population growing at different rates during the sample period (some due to rapid population growth on account of immigration). A decrease in the value of the housing-inventory-to-population ratio indicates that the market suffers from under supply; therefore, a one percentage-point decrease in the ratio today would lead to 8.30 percent increase in prices in the long-run equilibrium level. This result is largely in line with previous research on the housing market in Israel. For example, Bar-Nathan et al.(1998) documented the long-run elasticity of house prices with respect to housing stock to be -11.7.

The second strongest elasticity was found for unemployment, which varies inversely to prices. The coefficient estimate indicates that a one percentage-point increase in unemployment rate today would lead to 2.65 percent decrease in prices in the long-run.

Furthermore, in-line with the asset-pricing theory, rent was found to have a strong effect on prices. The coefficient estimate indicates that a one percentage-point increase in rental values today would lead to 1.41 percent increase in prices in the long-run equilibrium.

The construction industry in Israel requires considerable financing, mainly due to the need to acquire land and the length of time planning and construction takes (25 - 35 months). In addition, under the terms of the "Assurance of Investments of Purchasers of Apartments Law – 1973" developers are obliged to provide a financial guarantee that secures completion of the dwelling in the event of bankruptcy or liquidation of the business or failure to complete, all of which increases the cost of financing. In terms of the effect of monetary policy has on prices, we find that short-term interest rates exhibit strong and positive elasticity with respect to prices, which means that in the long-run the increase in financing costs contributes to house prices appreciation. The coefficient estimate indicates that a one percentage-point increase in the BoI interest-rate leads on average to 2.42 percent increase in house prices. In terms of long-term mortgage interest rates, the strong negative elasticity, -1.6802, reflects both capital switching due to higher interest rates and lower demand for home ownership due to higher mortgage costs.

The present study confirms for the first time a significantly long-run inverse relationship between the stock-price-index and house prices which supports a ‘substitution effect’. Previous studies of Israel did not find the stock-price-index to explain the variation in house prices but the result of the present analysis suggests a link between the housing market and other asset classes, notably the stock market. Consider a model in which a household attempts to maximize an investment portfolio. When stock markets crash, the ‘substitution effect’ will cause households to reduce their liquid assets investment activity and increase the demand for

long-term stable housing investments. This scenario reflects the economics of asset substitution: the household can now achieve a portfolio diversification and higher returns from investing in less volatile asset, the effect of an increase in demand is that of house prices increase. The results support the theory suggested by Case and Shiller (2003) that a stock market crash leads to a flight to quality which increases the demand for housing investments.

An important conclusion from the long-run analysis is the fact that efforts to alleviate supply-side constraints, specifically housing inventory, could be a more effective approach to constraining house price appreciation in the long-run than monetary authorities influencing the housing market.

Short-Run Dynamics

The error-correction model captures the short-run dynamics and the correction of prices deviation from the long-run equilibrium post an exogenous shock (Engle and Granger, 1987). We proceed to measure how long it would take for the Israeli housing market to return to equilibrium after an exogenous shock to the market. The estimated error-correction model presented in Table 4 is relatively strong and the coefficients and significances were found to be robust and consistent for different period estimations.

Table 4: Error-Correction Estimation

Dependent Variable: HP

Variable	Coefficient	t-Statistic
Constant	**-0.0074*** **	(-4.1652)
$\Delta log\ hp(-1)$	**0.3632*** **	(3.3347)
$\Delta log\ hp\ (-3)$	**0.3173*** **	(3.4812)
$\Delta log\ rent(-1)$	**-0.6138*** **	(-6.1435)
$\Delta log\ spi(-4)$	**-0.0274** **	(-2.0494)
$\Delta\ uemp(-4)$	**-1.0372*** **	(-3.0498)
$\Delta\ uemp(-5)$	**-0.9446*** **	(-2.7399)
$\Delta\ long(-2)$	**-1.5283*** **	(-2.7229)
$\Delta\ long(-3)$	**-1.3631** **	(-2.6438)
$\Delta log\ hipop(-4)$	**-3.4222** **	(-2.1164)
$\Delta\ ir(-1)$	**-0.7038*** **	(-3.6224)
$log\ wage\ (-2)$	**0.1420** **	(2.3867)
$log\ vix(-5)$	**0.0293*** **	(4.9015)
ECT (-1)	**-0.1332*** **	(-3.0945)

Adjusted R-squared	0.739114	Centered VIFs (all variables)	< 5
F-statistic	13.42202	Breusch-Pagan-Godfrey	0.6685
Prob (F-statistic)	0.000000	Ramsey RESET	0.8911
Durbin Watson stat	2.156228	Lagrange-multiplier-statistic	0.4650
Observations after adjustments	58		

Note: **, and *** indicate statistical significance and rejection of the null at the 5%, and 1% significance levels, respectively. Numbers in parentheses, show the lag(s) of the variable and t statistics.

A considerable debate in recent years has proven the effect of psychology and behavioral factors influence on market behavior. In behavioral finance models, investor sentiment and assumptions play a role in determining asset prices. Perhaps, the most popular model in finance and housing markets is extrapolation, occasionally called momentum trading, or backwards-looking investors. In the housing economics context expectations concerning future prices play a behavioral role in explaining the movement of prices in the short-run. Investors use the recent growth rate in past prices to infer the growth rate in fundamentals (Glaeser and Nathanson, 2014). In-line with the ideas presented in Glaeser (2013) and Piazzesi and Scheider (2009) we assume in the empirical analysis that the expectations concerning future housing price movements are backward-looking expectations and are explained by lagged house prices which take the role of sentiment in house price dynamics.

Hence, lagged house prices change take the effect of expected appreciation of price movement into account and a specific expectations variable is not needed. Moreover, lagged house prices are influenced by the moving average of all the lagged explanatory variables and therefore amplify their influence on future prices.

We find evidence in favor of behavioral explanations based on recent data of lagged house prices. The backward-looking expectation based on the one and three quarters lagged house price growth rate were found to be significant in determining the positive price appreciation. This finding appears plausible and is supported by the fact that during 2009Q1-2013Q4 lagged house prices explained 40 percent of the price appreciation at that period. These results highlight the role of expectations and inertia in the formation of prices and the fact that during periods of booms investors' and households' assume that past price increases reflect expectations about future price increases and this speculative behavior contribute to further price hikes. An increase of one percentage-point change in house prices rate results in an increase of 0.363 percent in prices after one quarter and 0.317 percent after three quarters (the short-run cumulative effect was found to be 0.68 percent). These results are supported by Nagar and Segal (2011) who found the lagged house prices elasticities to be 0.394 after one quarter and 0.316 after four quarters.

Backward-looking expectations may also assist in explaining why homebuyers often miss the signals new construction and supply should have on prices and typically lead to buyers failing to predict that supply will eventually cause prices to converge (Glaeser and Nathanson, 2014). While throughout the entire sample period the supply variable (housing-inventory-to-population ratio) seems to be the strongest and most stable contributor to the positive price appreciation, we suspect the reason behind the lesser contribution of supply in

the short-run is that the backward-looking expectations cause buyers to miss the signals new construction and supply should have on prices. We found that in the short-term, for the period 2009Q1-2013Q4, housing-inventory-to-population ratio was only the third most important contributor to price appreciation, explaining only 11 percent of the price increase at that period.

The ECT (error-correction term) demonstrates how long it would take for the housing market to return to equilibrium after an exogenous shock. The ECT coefficient, -0.1332, suggests 13.32 percent of adjustment towards equilibrium following a shock to the model, one quarter later. These results are similar to the finding of Nagar and Segal (2011) who found the adjustment rate to be 20.6 percent per-quarter although their model specification and dataset differed from the present study. According to the IMF (2014), the adjustment rate has significant macroeconomic effects, notably a slow adjustment rate may allow the economy to avoid a recession while a rapid correction may lead the economy into a recessionary episode, with economic activity recovering as late as two years after a temporary shock.

The housing equilibrium value (hp^f) is derived from the long-run equation. Misalignment in house prices is given by: $M_t = hp_t - hp^f$. If $M_t > 0$, then house prices are above their equilibrium value. Further analysis of the cointegration relationship reveals that the positive accumulative price deviation from equilibrium, in the period 2009Q3 to 2013Q4, is $M_t = 19.5$ percent. These results are similar to the finding of the IMF (2014) suggesting that prices are 26 percent above their fundamental value.

We find interest rates to be significant in explaining and influencing house prices movement, but as suggested by Glaeser (2013), interest rates play a supporting role and provide only partial explanation of the great shift in prices between 2009 and 2013. The predicted impact of interest rates on prices is in line with the empirical results presented by Glaeser, Gottlieb and Gyourko (2013) and suggests that lower interest rates can explain only one-sixth of the rise in prices. We found that an increase of one percentage-point change in long-term interest rates results in a decrease of 1.53 percent in prices after two quarters and 1.37 percent after three quarters, explaining only 7% of the 2009 to 2013 price inflation. The BoI interest-rate effect was found to be somewhat smaller, an increase of one percentage-point change to the BoI interest-rate results in a decrease of 0.70 percent in prices after one quarter, explain only 3% of the 2009 to 2013 price inflation. We find these results to be consistent with Miles (2014) who found the long-term rates to have an independent and sometimes greater effect on house prices than the central bank interest-rate.

The economic activity represented by unemployment and wage was found to be significant and with expected sign and as expected the contribution of wage to price appreciation was found to be very low and amounted to only 1.20 percent of the price appreciation in the 2009Q1-2013Q4 period.

Regarding rental rates, contrary to the long-run positive elasticity, the short-run result seems implausible from an economic perspective. The coefficient is significant but negative (-0.6137), which implies that in the short-run, an increase in rental values reduces house prices after one quarter. Nagar and Segal (2011) documented similar results, and suggested that the negative coefficient might be explained by the interaction between lagged house prices, rent and the ECT. An economic explanation might be that, in the short-run, house

prices increase results in affordability issues leading to stronger demand for renting, leaving less potential buyers in the market, thus reducing the short-term demand for homeownership.

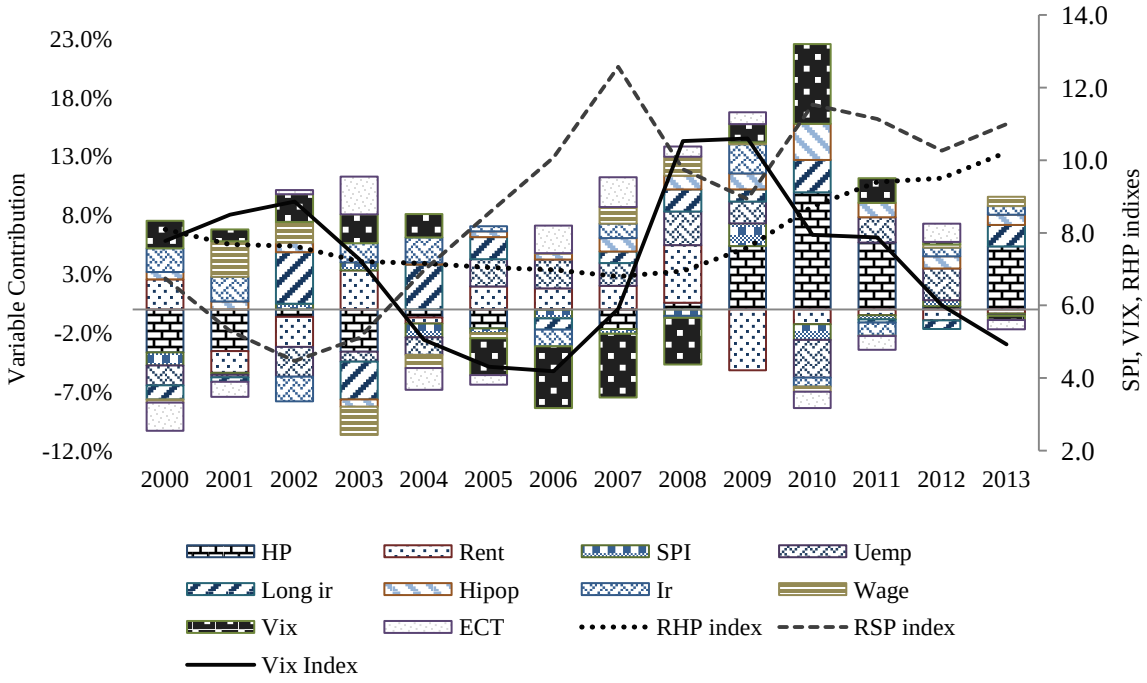
An important contribution of the present study is to show empirically the important inverse relationship between house prices and both the Stock-Price-Index and the market-volatility-index. The short-run relationship of the Stock-Price-Index with regards to prices confirms the existence of a negative lagged 'substitution effect' of stock market performance on house prices. The lagged effect of VIX on prices was also found to be highly significant and robust, further strengthening the 'substitution effect' theory and as previously discussed our expectations in relation to the meaningful effect investor's activity has on prices. The lagged effect of both Stock-Price-Index and VIX on prices is explained by the period of time it takes from the moment a potential investor decides on a housing investment to the time the purchase is executed and registered in the house prices index (3-5 quarters later).

Figure 6 examines the contribution of all the variables to house prices misalignment. In contrast to Nagar and Segal (2011) who found the main contributors to prices misalignment, for the period 2009Q1-2010Q4, to be lagged house prices, population-to-housing-inventory, monetary policy and mortgage-rates (in order of importance), we find that lagged house prices and the VIX are the two most dominant explanatory variables, explaining 60 percent of the price appreciation during that period. Furthermore, for the extended period of 2009Q1-2013Q4 lagged house prices explain 40 percent and VIX explains 15 percent of the positive prices misalignment, while interest rates and supply constraints explain the rest. In the 2005-2007 period, while the Stock-Price-Index peaked, VIX, which was at its all-time low, had a strongly negative effect on prices, explaining 44 percent of the negative prices misalignment in the period prior to the GFC. This negative contribution to prices is the result of investors'

expectations of future strong stock market returns which ignited the 'substitution effect', shifting investors' investment portfolio composition away from real-estate towards financial assets, thus reducing the demand for housing investments by 15 percent (compared to the previous period). Inversely, since 2008Q4 when the Stock-Price-Index was at its lowest point and VIX reached its all-time peak, signaling investors' expectation for future negative market returns, investors' activity in the housing market increased by 19 percent and house prices increased by 22 percent five quarters later. Furthermore, it is also evident that the introduction of macroprudential measures, in 2011, aimed to reduce investors' involvement in the market resulted in 26 percent decrease in investors' activity during 2011/12, which significantly reduced the effect of both lagged house prices and VIX on prices during 2012.

These findings persuasively support our hypothesis that investors' activity, pursuing 'safe and higher returns' accompanied by expectations of further price appreciation are the main explanations to the prices misalignment in the sample period. Furthermore, our analysis demonstrates the critical role of housing investment activity (rather than purchases by owner occupiers) and the magnitude by which the interaction of high demand for investments, insufficient supply and monetary easing result in of short-run house price misalignment. Lastly, these results support the earlier study by Bar-Nathan et al. (1998) who argue that house prices in Israel respond sharply to demand shocks and that the subsequent prices misalignment displays considerable persistence.

Figure 6: Variables Estimated Contributions to House Prices (2000Q1-2013Q4)



CONCLUSIONS

This study was prompted by the rapid surge in Israeli house prices during 2007Q2 to 2013Q4 along with speculations about a potential housing bubble. Using quarterly data from 1998Q1 to 2013Q2 we employed a cointegration technique to model the long-run equilibrium relationship between house prices and the macroeconomic factors driving them and found that the positive accumulative price deviation from the fundamental value is roughly 20 percent over the last four years of the study period.

However, the results suggest that in the long-run the lack of sufficient supply of housing along with population growth justify most of the increase in house prices. The demand factors, namely the decline in interest rates together with a lower unemployment rate and the growth in rents were also found to explain the price increase. We identified that efforts to

alleviate supply-side constraints, specifically housing inventory, could be a more effective approach to constrain house price appreciation in the long-run than other macro-financial factors influencing the housing market. The most interesting finding for the long-run relationship involves the stock market-price-index movement. We found empirical evidence for a 'substitution effect' in which the stock market and the housing market act as an independent alternative investment market for households and investors.

The study also examined the short-run dynamics of house prices and the correction of price deviation from the long-run equilibrium level. The estimated error-correction model results imply that, following an exogenous shock, house prices adjust around 13 percent per quarter towards their long-run equilibrium. We find that prices respond sharply to demand shocks and the deviation from equilibrium displays considerable persistence. Furthermore, at present, the housing market appears vulnerable to interest-rate fluctuation.

One of the key contributions of this study is the inclusion of the market volatility index, VIX, i.e. the predicted risk of investing in the stock market, as an explanatory variable aimed to represent the driving force behind the 'substitution effect'. The results indicate that along with the inertia in house prices, VIX is the second most dominant explanatory variable to the short-term prices misalignment, followed by supply constraints and interest rates. We found that long-term investment decisions such as housing were significantly influenced by the expected stock market instability represented by long periods of low or high VIX, confirming that households' investment decisions are driven by the perception of 'safe and higher returns' with little tolerance for episodes of volatility in stock markets.

The empirical results also suggest that in contrast to the long-run dynamics, in the short-run, the boom and bust cycles in Israel are mainly affected by the expectations of future price appreciation and investors' activity. Therefore the model implies that in the short-run demand-side policies would work faster on prices than will supply-side policies.

In terms of policy recommendations aimed to stabilise the housing market, in the long run it is evident that concerted efforts to alleviate supply-side constraints mainly by the government intervening with the ILA supply policy, making sure sufficient land is being planned and marketed for housing construction may improve housing affordability. In the short-run, empirical evidence shows that macroprudential measures aimed at limiting non owner-occupier investment activity were effective in reducing some of the speculative investment element in the market during 2011/12. But since the price increase was not halted completely, our study suggests that additional macroprudential policies in the form of further tax restrictions on investors may be necessary to stabilize house prices.

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