Further Evidence on Real Estate Market Efficiency

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Abstract. **This article investigates the extent to which condominium apartment prices in Vancouver, British Columbia are set in an efficient asset market. The empirical results provide strong evidence against market efficiency. A number of instruments, including lagged annual returns and a measure of the deviation of price from fundamental or intrinsic value, to some extent predict future returns. This suggests that a sharp run-up in house prices is due in part to irrational expectations, and thus signals a future correction as prices ultimately reflect market fundamentals. These findings have important implications for appraisals and the mortgage underwriting process. In a booming market, property may be overvalued and hence market value appraisals may exceed intrinsic or fundamental values. Given the inevitability of a market correction in the near term, a potentially useful complement to the standard valuation process would be an assessment of the likelihood of a market correction.**

Introduction

In recent years many local housing markets in North America have undergone boom and bust cycles. A number of academics and housing market commentators claim that housing markets are characterized by excess speculation during real estate market upswings. That is, intangible expectations lead prices to race ahead of fundamental or intrinsic values, and thus, housing price booms are driven primarily by irrational house price expectations and investor psychology, rather than wide swings in housing market fundamentals.[1]

The question of whether homebuyers are significantly influenced by psychology during housing price booms has important implications for residential appraisals and the mortgage underwriting process. Most housing purchases involve mortgage financing. A house's market value forms the basis for the lending decision. Appraisers generally use the sales comparison approach to value residential dwelling units. If local housing price cycles are driven in part by irrational expectations or psychology, rather than changes in market fundamentals, and thus house prices exceed intrinsic values in market upswings, a market correction is inevitable; the irrational bubble will collapse. The resulting sharp reductions in house values may put a significant strain on the financial system. Thus, the sales or market comparison approach, by itself, may not be appropriate at all times in local markets characterized by wide swings in house prices.

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This article provides further evidence on the rationality of house price expectations and the informational efficiency of residential housing markets. It extends the work of Case and Shiller (1989, 1990) and others to a new data set and new sector of the housing market. More precisely, this study tests for predictability in excess returns in the condominium apartment prices in Vancouver, British Columbia, using a time series of cross-section data on eight municipalities within the Vancouver metropolitan area, over the 1982–94 time period. That is, it investigates the extent to which condominium prices are set in an efficient market. Vancouver saw dramatic house price movements over this period, and thus provides an ideal testing ground.

This article is unique in its focus on the condominium apartment market sector. Most previous studies focus on the efficiency of the market for single-family homes. It is often argued that real estate markets are inefficient ''based on a perceived set of market imperfections,'' (Gau, 1985). The indivisibility or lumpiness of real estate assets and capital constraints faced by investors due to the expensive nature of the asset, are often cited forms of market imperfection, which may limit information capitalization into real estate values (Gau, 1984, 1985; and Case and Shiller, 1989). Condominium apartments are generally smaller and significantly less expensive than single-family homes.[2] This suggests that the potential lack of arbitrage due to indivisibility and capital constraints is reduced in the condominium apartment market. Thus, if indivisibility and high asset value are more than just perceived market imperfections, we might expect to find that the condominium market is in some sense more efficient than the market for single-family homes. Moreover, the analysis here provides an additional test of the robustness of previously reported results.

The results of this study provide strong evidence to suggest that residential real estate returns are partly predictable. Current annual excess returns are found to be negatively correlated with returns two years previous. Moreover, a measure of deviation of price from fundamental value is shown to be a powerful predictor of future returns. These results indicate that the Vancouver condominium market is subject to mean reversion, which is consistent with the bursting of an irrational bubble. From a lenders perspective, these findings indicate that appraisers' market value estimates derived from the sales comparison approach may not always reflect fundamental or intrinsic value, and therefore standard appraisal techniques should be used in conjunction with an assessment of the likelihood of major price movements in the near term, when undertaking a market value estimate for a lender client.

The remainder of this article is organized as follows. The second section presents an asset-based model of house price dynamics and describes the tests for predictability of condominium returns. The third section describes, and assesses the accuracy of, the data. The fourth section reports the empirical results. The final section summarizes the findings and presents concluding comments.

Theoretical Framework and Test Design

The housing market is comprised of two separate but interrelated markets: one for the flow of housing services and another for the stock of housing capital. If the market for the stock of housing is an efficient asset market, then the expected rate of return to housing investment equals the rate of return available on alternative investments. The return to housing investment equals rental income net of operating expenses plus expected property price appreciation. Denote the nominal return available on alternative investments by i, and then, under the efficient markets hypothesis,[3]

$$\frac{E_t[P_{t+1}|I_t]-P_t+R_t}{P_t}-pt_t-d_t=i_t, \tag{1}$$

where E is the expectation operator, P denotes house price, R is rental income, either actual if the unit is rented or imputed if owner-occupied, pt and d are the property tax and operating (maintenance and depreciation) costs expressed as a percentage of house value, respectively, and I is the information set available to agents at the time expectations of future house prices are formed.

Equation (1) implies that the expected excess rate of return to housing, conditional on information in the current information set, is zero. That is,

$$E_t[r_{t+1}|I_t]=0, \tag{2}$$

where $r_{t+1}=(P_{t+1}-P_t+R_t)/P_t-pt_t-d_t-i_t$ denotes excess returns.

If agents efficiently use all the relevant information available at the time expectations of future house prices are formed then, on average, these forecasts are correct (or unbiased). That is, the time series of excess returns, r_t, is a mean zero, serially uncorrelated random variable. This in turn implies that future excess returns are uncorrelated with variables in the current information set in an efficient market. That is, current information cannot be used to predict future excess returns. If this condition is satisfied and the information set is assumed to contain only past excess returns, then the market is said to exhibit weak form efficiency. When I_t contains all publicly available information, including excess returns, the condition in Equation (2) describes the semi-strong form of market efficiency.[4]

If on the other hand, housing markets are not efficient then it may be possible to find variables in the current information set that predict future returns. That is, in regressions of the form:

$$r_{t+1}=\gamma_0+\gamma_1 Z_t+e_{t+1}, \tag{3}$$

where e_{t+1} is a serially uncorrelated, mean zero disturbance term, we should reject the null hypothesis that $\gamma_i=0$ for some set of variables, Z_t, whose values are known at time t. Equation (3) forms the basis for the tests of return predictability. The next section discusses the relevant variables to include in the information set.

Choice of Forecasting Variables

If the housing market is inefficient then it may be subject to ‘‘fads,’’ or driven by ‘‘noise traders,’’ who are market participants with irrational expectations. In such a world, the asset demand for housing responds not only to news about current and future market fundamentals, but also to information completely unrelated to these variables, termed investor sentiment or noise.[5] Homebuyers may follow technical trading rules and base future price projections on past returns or price changes, and thereby ‘‘jump on the bandwagon’’ and purchase homes when prices are rising.[6]

In a market where trend chasing by uninformed traders plays an important role in house price dynamics, short-run house prices are too persistent and exhibit excess volatility, because market participants overreact to news or information on market fundamentals. In periods of rapidly rising house prices, trend chasing forces short-run house prices above fundamental value. Eventually, however, the irrational bubble collapses and prices return to their fundamental value; house prices are mean-reverting. As a consequence, while house price changes exhibit excess volatility over short horizons, they do not over the long term.

Econometric tests to support the fads hypothesis should detect positive serial correlation in high frequency returns and negative correlation in long-horizon returns. Investor overreaction or trend chasing drives price from fundamental value in the short run, but eventually there is a correction and prices return to fundamental value. To test for return predictability, therefore, the ability of past excess returns (weak form efficiency), both quarterly and annual, and a measure of deviation of current house price from intrinsic value (semi-strong form efficiency) to forecast future excess returns, is evaluated.

Data

Rent, Value and Property Tax Data

The data for this study comes from a regular survey of Canadian housing markets undertaken by Royal Lepage Real Estate Services, Ltd., a large Canadian real estate brokerage company. The *Royal Lepage Survey of Canadian House Prices* provides quarterly data on prices, monthly rents and annual property tax payments for seven types of dwelling units in a large number of cities across Canada. The Survey reports data for four categories of single-family housing: bungalow, detached two-story, standard townhouse and senior executive; as well as a standard condominium apartment and luxury condominium apartment. Royal Lepage reports data for a range of neighborhoods within major urban centers.

This study examines the efficiency of the ‘‘standard condominium apartment’’ market, as defined in the Royal Lepage Survey, in the Vancouver metropolitan area, over the 1982–94 sample period. Condominiums represented 13% of the stock of occupied private dwelling units in the Vancouver CMA in 1986.[7] A standard condominium apartment is a two-bedroom carpeted unit of 900 square feet in a multi-story building with one and one-half bathrooms, two appliances, a small balcony and one underground parking space. The sample chosen consists of condominiums in the following eight locations within the Vancouver area: Burnaby, East Vancouver, Vancouver Westside, North Vancouver, West Vancouver, Richmond, Surrey and

Tsawassen. Exhibit 1 reports summary statistics for annual percentage changes in prices and rents. While house price levels in all eight areas exhibit the same general pattern (not shown), Exhibit 1 shows that price and rent fluctuations do differ significantly by area.

The data set is unique in that it provides time series of prices, rents and property taxes for a single housing type. Thus, it offers a significant advantage over previous studies, which have had to rely on various proxies to derive rental series.[8]

At the same time, it is important to recognize a potentially significant limitation of the data. The price data are not market-transaction based, but are estimates or appraisals. The validity of the results in this article therefore depends crucially on the accuracy of the data. In order to shed some light on the extent of potential measurement error in the Royal Lepage price data, below it is compared with a constant quality (hedonic) transaction-based price series that is available for one of the housing submarkets.

An Assessment of Data Accuracy

The Royal Lepage data are estimates. The survey reflects Royal Lepage's estimate of ''Fair Market Value'' of certain housing types in each location for the value date indicated and based on both data and opinion supplied by Royal Lepage personnel across Canada. A comparable sales appraisal method, based on recent similar transactions, is combined with an analysis of current market conditions to derive the published figures. Estimated monthly rents are derived using the same procedure plus local investors and property managers are contacted and asked to provide rents by dwelling type in their local area.

The data, therefore, are based on appraisals rather than market transactions. One potential concern is the accuracy of the estimated series. It is well known that

Exhibit 1
Summary Statistics for Royal Lepage Condominium Data 1982:2–1995:1

	Capital Gains				Rental Inflation			
Area	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
Burnaby	8.34	16.98	−21.51	49.90	3.76	11.65	−18.23	30.01
E. Vancouver	1.87	13.70	−28.77	49.00	2.13	13.77	−18.22	32.74
Westside	5.35	13.57	−31.34	36.69	4.65	10.51	−10.54	28.77
N. Vancouver	6.40	11.64	−14.31	36.24	3.24	11.90	−33.65	23.84
Richmond	6.93	10.69	−12.14	30.22	5.12	9.42	−34.48	19.42
Surrey	7.53	14.06	−15.03	51.08	4.23	10.77	−15.42	31.85
Tsawassen	6.13	10.72	−13.98	30.22	3.67	5.59	0.0	19.24
W. Vancouver	4.95	9.39	−15.21	28.03	4.75	16.98	−55.01	61.90

Note: All values are expressed as year-to-year percentage change. There were forty-seven observations.

appraisal-based commercial real estate return series are plagued by an appraisal-smoothing problem.[9] More specifically, appraisal-based returns tend to lag actual market conditions and, as a result, systematically underestimate the variance of true real estate returns. This literature argues that appraisers use both current and past data on real estate values to arrive at their 'best guess' of current value, and thereby smooth the estimated price series over time. The explanation for why appraisers incorporate past information into current value estimates relies on both the heterogeneity and infrequent trading of commercial real estate assets. Together, these two factors imply that the appraiser has very little, or no, recent transaction data with which to construct an estimate of current value. As a consequence, the appraiser relies partly on the most recent 'similar' transactions, which likely took place some time ago. Thus the appraiser relies on lagged market data. Taking individual property appraisals and aggregating them into a return index exacerbates the smoothing effect because of the well documented seasonality of appraisals in benchmark return series such as the Russell-NCREIF Index.

The presence of smoothing in Royal Lepage housing price estimates may induce measurement error, which could bias the test results. Is there a smoothing problem with the residential price data? There is good reason to believe the appraisal-induced smoothing that affects commercial returns should not severely bias return series derived from Royal Lepage price data. Residential property is much more homogenous, more liquid and the turnover rate higher relative to commercial properties, and hence appraisers have more continuous and timely information to work with. In addition, there is no systematic fourth quarter seasonality effect as with benchmark commercial property returns.

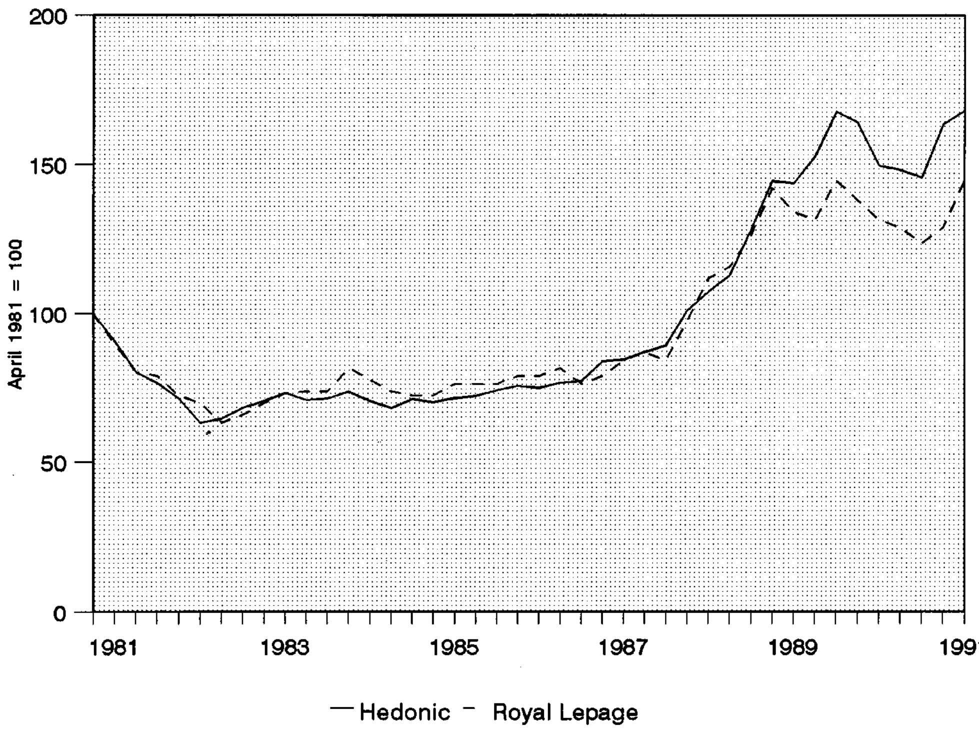
To help evaluate the potential for measurement problems with the Royal Lepage price data, I compare a transactions-based house price series that is available for one of the municipalities, with Royal Lepage price data for that municipality. Hamilton and Hobden (1992) derive a constant quality time series of single-detached house prices for the westside of the city of Vancouver, over the 1981–91 sample period.[10] This is compared with Royal Lepage price estimates for a "detached two-story" home in Kerrisdale. Kerrisdale is a westside neighborhood. Thus, while the two data series do not provide value estimates for exactly the same house, they both provide estimates of the price of single-detached housing on the westide of the city of Vancouver. A comparison should therefore help us to evaluate the extent of the measurement error in the Royal Lepage data.

Exhibit 2 plots both Hamilton and Hobden's (1992) hedonic price data and Royal Lepage price estimates. Panel A shows the levels data. Both series are divided by their respective first observations and multiplied by 100 to set them equal to 100 in April 1981. The two price series move closely together over most of the sample period. The correlation coefficient is 0.98. There is some divergence starting in late 1988, but the pattern of price movements remains closely aligned.

Panel B shows the first differences of the logarithm of each house price series. Exhibit 3 provides summary statistics. Quarterly house price appreciation, based on Royal

Exhibit 2
A Comparison of Royal Lepage Single-Detached House Price Estimates with a Transaction-Based Quality Adjusted House Price Series, 1981–1991

Panel A: Price Levels



Panel B: Quarterly Appreciation

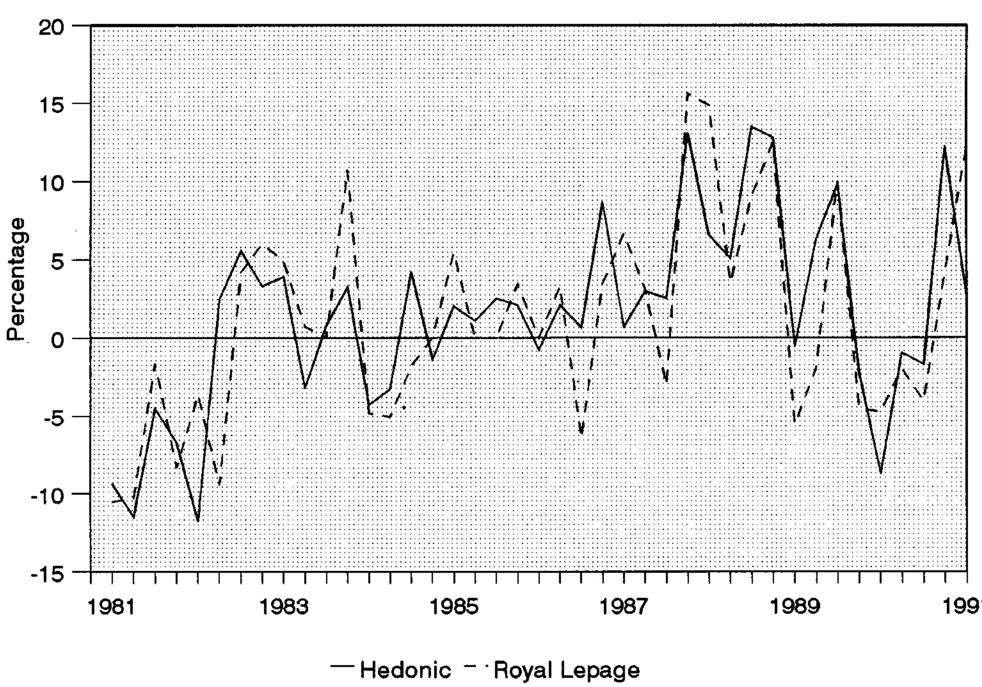


Exhibit 3
Summary Statistics for Royal Lepage Single-Detached House Price Estimates and a Transactions-Based, Quality-Adjusted House Price Series, Westside of Vancouver, 1982:2–1991:2

Series	Mean	Std. Dev.	Min.	Max.
Royal Lepage	0.90	6.66	−11.12	12.66
Hedonic	1.26	6.17	−12.49	12.66

Note: All values are expressed as percentages; $\rho = .75$. Hamilton and Hobden (1992) is the source of the hedonic series.

Lepage estimates, does not diverge significantly from market-based estimates. The correlation coefficient is 0.75. Moreover, the Royal Lepage house price data exhibits greater volatility than the hedonic price series. We would expect the opposite result if the Royal Lepage data systematically underestimated the variance of house price changes. Thus, while this analysis by itself certainly does not prove the absence of smoothing, it does suggest that there does not appear to be any strong evidence of appraisal-based smoothing in the Royal Lepage single-detached house price data. Since Royal Lepage derives condominium price and rent estimates using the same procedure, it seems reasonable to assume that this result carries over to the condominium data.

Unlike the price data, there is no market-based series of rents with which to compare Royal Lepage rent data. However, available data indicates that a significant proportion of condominiums in the Vancouver CMA are rental units. Hamilton (1989) reports that more than one-third of the condominium units the Vancouver CMA are rental units. The relatively large rental component of the Vancouver condominium housing stock implies that market rents are observable. This factor should help to minimize the noise in the estimated monthly rental series.

Interest Rate Data

Equilibrium in the market for existing housing units requires that investors expect to earn a rate of return on housing investment equal to that available on alternative assets. Since investors are assumed to be risk neutral, I use the risk-free rate of return on government bonds to measure the opportunity cost of money.[11]

Results

Weak Form Efficiency Tests

This section evaluates the ability of past excess housing returns to predict future housing returns. It first examines the autocorrelation structure of quarterly excess returns and then the relationship between longer horizon, annual excess returns.

Quarterly Returns. Ex-post quarterly excess returns are calculated as rent plus capital gain divided by initial price, minus property taxes and the three month risk-free rate of interest.[12] Exhibit 4 shows the autocorrelations over a two-year period. In general, the hypothesis of random series cannot be rejected. While there is a weak tendency for returns to be positively correlated over the first year and negatively correlated over the next four quarters, which is consistent with a housing market subject to fads, the values are not statistically significant in a number of the municipalities. Short-term returns essentially appear to follow a random walk.

Even though the autocorrelation properties indicate that excess quarterly returns are unpredictable from past quarterly excess returns, this is not necessarily inconsistent with irrational expectations. It may be a consequence of the low power of high frequency autocorrelation-based tests. As emphasized by Shiller (1989) and Summers (1986), tests for autocorrelation in short-horizon returns have little power to detect temporary deviations of market price from fundamental value.[13] They derive simple fads models of stock price determination in which prices deviate from fundamental value by a slowly moving mean-reverting fad. They show that, even though the market is inefficient, short-horizon returns exhibit little autocorrelation.[14] Tests for short-term autocorrelation incorrectly accept the random walk hypothesis. Hence, absence of statistically significant correlation in quarterly returns is not necessarily inconsistent with market inefficiency.

Exhibit 4
Autocorrelations in Excess Quarterly Condominium Returns, 1981:3–1995:1

	Autocorrelation at Lag							
Area	1	2	3	4	5	6	7	8
Burnaby	0.370	0.150	0.220	0.130	−0.070	−0.040	−0.110	−0.010
	(0.017)	(0.034)	(0.028)	(0.042)	(0.071)	(0.115)	(0.143)	(0.207)
E. Vancouver	0.140	0.100	0.090	−0.330	−0.150	−0.030	−0.080	0.070
	(0.358)	(0.529)	(0.654)	(0.132)	(0.141)	(0.215)	(0.274)	(0.341)
Westside	0.000	−0.21	−0.060	0.030	0.020	−0.080	−0.170	−0.030
	(0.983)	(0.365)	(0.536)	(0.695)	(0.815)	(0.855)	(0.763)	(0.840)
N. Vancouver	−0.01	0.140	−0.110	0.160	0.220	0.110	0.190	0.010
	(0.973)	(0.637)	(0.691)	(0.597)	(0.396)	(0.444)	(0.360)	(0.463)
Richmond	−0.040	0.240	−0.100	−0.090	0.100	−0.090	0.270	−0.070
	(0.809)	(0.260)	(0.362)	(0.458)	(0.530)	(0.599)	(0.287)	(0.355)
Surrey	0.390	−0.060	−0.200	−0.160	0.130	0.110	−0.060	−0.170
	(0.008)	(0.028)	(0.028)	(0.034)	(0.045)	(0.063)	(0.095)	(0.089)
Tsawassen	0.20	0.010	0.020	0.020	−0.010	0.020	−0.030	−0.140
	(0.184)	(0.323)	(0.517)	(0.681)	(0.805)	(0.888)	(0.936)	(0.900)
W. Vancouver	0.014	0.090	0.010	0.140	0.040	−0.110	−0.040	0.110
	(0.359)	(0.551)	(0.754)	(0.700)	(0.807)	(0.822)	(0.887)	(0.892)
Average	0.131	0.069	−0.016	−0.013	0.049	−0.014	−0.004	−0.029

Note: Figures in parentheses are the marginal significance levels (*p*-values) associated with the *Q*-Statistics for tests of joint significance in the autocorrelations up to and including that lag. Data based on fifty observations.

Although inefficiency may not be detectable in short-term correlations, the presence of temporary or fad components in asset prices imply that longer-horizon returns are negatively correlated. If condominium prices race ahead of fundamental value, then over the long-term they are mean-reverting, and thus negatively correlated.[15]

Annual Returns. To test for dependence in annual returns, ex-post annual excess condominium returns for each municipality are regressed on their respective lagged values over the past two years. The model is given by:

$$r_{j,t+4} = \gamma_{j,0} + \gamma_{j,1} r_{j,t} + \gamma_{j,2}\, r_{j,t-4} + u_{j,t+4} \tag{4}$$

where $r_{j,t+4} = (P_{j,t+4} - P_{j,t} + R_{j,t})/P_{j,t} - pt_{j,t} - i_t$ is the excess return earned over the four quarters from period t to $(t+4)$ in municipality j, and $r_{j,t}$ and $r_{j,t-4}$, the excess returns during each of the past two years in that area, respectively, are defined analogously. Both Case and Shiller (1989, 1990) and Hosios and Pesando (1991) find statistically significant positive estimates of γ_1 in their tests of single-family housing market efficiency. If mean reversion is present, over a two-year period, then γ_2 should be negative. Case and Shiller (1990) regress annual price changes on lags over the past four years. In addition to their well-documented finding of persistence at the one-year horizon, they report weak evidence of long-horizon price reversals. However, the negative coefficient estimates are small in magnitude and not statistically different from zero.

Exhibit 5 reports the estimation results.[16] Panel A of the exhibit constrains the coefficients to be the same in all eight areas, while Panels B and C relax this restriction. In Panel A there is no significant relationship between current and past returns. Allowing for location-specific intercepts in Panel B, however, reveals that current excess annual returns are negatively related to annual excess returns in the two years previous; returns to condominiums appear to be mean-reverting. Positive excess returns in one year predict a fall in excess annual returns, of about one fifth in magnitude, two years later. Interestingly, in contrast to earlier findings, there is little evidence of positive serial correlation at the one-year horizon. In fact, the one year point estimate is negative, and statistically different from zero.

Panel C indicates that the conclusions are much weaker with unrestricted parameters across municipalities, especially the sign of the coefficient on excess returns lagged one year, which is positive in some areas and negative in others. The parameter estimates on returns lagged two years, however, are all negative, although only about one-half are statistically different from zero. There appears to be a lot of noise in the disaggregated data. In addition, given the small sample size, these results must be viewed with caution, and are at best suggestive of return predictability with lagged returns.

Semi-Strong Form Efficiency Tests

The autocorrelation-based tests of return predictability, above, are tests of weak-form efficiency. The information set contains only current and past returns. This section

Exhibit 5
Regressions of Excess Annual Returns on Lagged Excess Returns
1983:2–1995:1

Coefficient	Area	Estimate	*t*-Stat
Panel A: Pooled Results	$r_{j,t+4}=\gamma_0+\gamma_1 r_{j,t}+\gamma_2 r_{j,t-4}+v_{j,t+4}$		
γ_0		0.028	0.9
γ_1		0.033	0.4
γ_2		−0.069	−0.9
LLF		275.80	
Panel B: Location-Specific Intercepts	$r_{j,t+4}=\gamma_{j,0}+\gamma_1 r_{j,t}+\gamma_2 r_{j,t-4}+v_{j,t+4}$		
γ_0	Burnaby	0.202	5.6
	E. Vancouver	0.048	1.8
	Westside	0.051	2.3
	N. Vancouver	0.116	5.3
	Richmond	0.097	4.5
	Surrey	0.190	5.3
	Tsawassen	0.113	5.1
	W. Vancouver	0.044	2.3
γ_1		−0.153	−2.0
γ_2		−0.250	−3.7
LLF		315.49	
Panel C: Location-Specific Parameters	$r_{j,t+4}=\gamma_{j,0}+\gamma_{j,1} r_{j,t}+\gamma_{j,2} r_{j,t-4}+v_{j,t+4}$		
γ_0	Burnaby	0.180	4.4
	E. Vancouver	0.045	1.6
	Westside	0.063	2.7
	N. Vancouver	0.097	4.4
	Richmond	0.086	3.4
	Surrey	0.272	7.2
	Tsawassen	0.076	3.4
	W. Vancouver	0.038	1.9
γ_1	Burnaby	−0.154	−1.3
	E. Vancouver	−0.204	−1.8
	Westside	−0.386	−3.8
	N. Vancouver	0.030	0.3
	Richmond	0.059	0.5
	Surrey	−0.473	−3.4
	Tsawassen	0.222	2.4
	W. Vancouver	−0.035	−0.2
γ_2	Burnaby	−0.044	−0.5
	E. Vancouver	−0.066	−0.7
	Westside	−0.328	−4.3
	N. Vancouver	−0.155	−1.5
	Richmond	−0.323	−2.7
	Surrey	−0.591	−5.2
	Tsawassen	−0.076	−0.6
	W. Vancouver	−0.039	−0.3
LLF		344.62	

Note: The models are estimated with iterative seemingly unrelated regression techniques. *t*-Stats are constructed using standard errors that have been adjusted to account for third-order autocorrelation using the Newey-West (1987) covariance matrix, with lag length set to four. *LLF* is the maximized value of the log-likelihood function. Data based on forty-three observations.

tests the semi-strong form variant of market efficiency in which the information set is expanded to contain additional information. More specifically, I examine the ability of a proxy for the deviation of price from fundamental value to forecast future returns.

If the Vancouver condominium market is subject to fads or investor overreaction, then during housing market upswings, price is higher than is justified by market fundamentals. Similarly price may be less than fundamental value in periods immediately following large price declines. Hence, the difference between fundamental value and observed price can be used to forecast future returns. To test the power of a measure of deviation from fundamental value to predict future returns, I estimate the following model:

$$r_{j,t+4} = \lambda_j + \beta_j \log\left(\frac{R_{j,t}}{P_{j,t}}\right) + \nu_{j,t+4}. \quad (5)$$

Ex-post annual excess returns are regressed on a constant and the logarithm of the rent-price ratio one year previous. Under the null hypothesis of market efficiency, $\beta=0$ in each municipality. I use the rent-to-price ratio to proxy the difference between fundamental or intrinsic value and the observed house price. If prices deviate from intrinsic value in real estate booms then this is reflected in a low rent-to-price ratio. Notice that the rent-to-price ratio is actually the inverse of the gross rent multiplier.[17] Thus, relatively high gross rent multipliers may be indicative of an overheated housing market and hence signal a future correction in house values. The logarithm of the rent-to-price ratio is used so that β estimates the fraction of the deviation of actual price from fundamental price that is eliminated over a one-year period.

Exhibit 6 presents the results. The logarithm of the ratio of condominium rents and prices are statistically significant predictors of future excess returns. This finding is more robust across the eight municipalities than the weak-form efficient tests. Panel C shows that in six of the eight municipalities, the measure of deviation from fundamental value is quite large in magnitude and precisely estimated. The statistical significance of the beta estimates provides strong evidence of return predictability. The results are consistent with a market that overreacts to changes in fundamentals and pushes house prices above fundamental value in market upswings.

It is important to note that, while these findings are consistent with market inefficiency, they do not necessarily imply that housing markets are informationally inefficient. Tests of market efficiency evaluate a joint hypothesis that includes rational house price expectations, risk neutral housing investors and a frictionless asset-based model of equilibrium housing returns. Predictable components in housing returns may represent irrational expectations, or time-varying risk considerations, or model misspecification due to neglect of transactions costs and other market frictions that drive a wedge between observed house price dynamics and those predicted by the frictionless asset-based, rational expectations model.

From appraisers' perspective, however, it does not really matter whether predictable components in housing returns reflect inefficiency or time-varying risk considerations

Exhibit 6
Regressions of Annual Returns on Lagged Rent-to-Price Ratios 1982:2–1995:1

Coefficient	Area	Estimate	*t*-Stat
Panel A: Pooled Results	$r_{j,t+4}=\lambda+\beta_j \log(R_{j,t}/P_{j,t})+\upsilon_{j,t+4}$		
λ		0.806	9.3
β		0.274	9.7
LLF		309.94	
Panel B: Location-Specific Intercepts	$r_{j,t+4}=\lambda_j+\beta_j \log(R_{j,t}/P_{j,t})+\upsilon_{j,t+4}$		
λ	Burnaby	0.988	7.8
	E. Vancouver	0.897	6.9
	Westside	1.029	7.0
	N. Vancouver	1.003	7.4
	Richmond	0.998	7.3
	Surrey	0.926	7.8
	Tsawassen	0.939	7.3
	W. Vancouver	1.060	6.9
β		0.359	6.8
LLF		332.66	
Panel C: Location-Specific Parameters	$r_{j,t+4}=\lambda_j+\beta_j \log(R_{j,t}/P_{j,t})+\upsilon_{j,t+4}$		
λ	Burnaby	1.132	6.7
	E. Vancouver	1.190	2.9
	Westside	1.895	6.5
	N. Vancouver	0.421	1.9
	Richmond	0.625	2.1
	Surrey	0.887	6.2
	Tsawassen	−0.074	−0.4
	W. Vancouver	0.787	3.5
β	Burnaby	0.421	5.9
	E. Vancouver	0.482	2.8
	Westside	0.673	6.4
	N. Vancouver	0.130	1.5
	Richmond	0.214	1.9
	Surrey	0.341	5.3
	Tsawassen	−0.070	−0.9
	W. Vancouver	0.263	3.4
LLF		356.09	

Note: The models are estimated with iterative seemingly unrelated regression techniques. *t*-Stats are constructed using standard errors that have been adjusted to account for third-order autocorrelation using the Newey-West (1987) covariance matrix, with lag length set to four. Data based on forty-seven observations.

or market frictions, only that future house price movements are partly predictable, based on currently available information.

Conclusion

This article provides additional evidence to suggest that housing markets are inefficient. Future excess returns to housing are partly predictable based on currently available information. Both past price movements and the ratio of current rents to house prices have some power to forecast future price movements. One way to interpret these findings is that a sharp run-up in house prices is partly due to irrational expectations (fads, noise traders, trend chasing) and thus signals a future correction, as prices are ultimately anchored by market fundamentals.

These findings have important implications for appraisers and their lender clients. First, they suggest that, at times, the prices paid for residential properties do not reflect underlying market fundamentals. In a booming market it is likely that homes are overpriced, and hence lenders should exercise extreme caution in viewing appraisals using comparables to value a subject property. A useful complement to the standard sales comparison method would be an assessment of the likelihood of a market correction. One way to approach this might be to track gross income multipliers over time and look for large deviations from historical averages and examine how they relate to house price cycles. If rental data is not available, then market indicators such as the Multiple Listing Service sales to listings ratio and/or an affordability index could be used.

Notes

[1]Hamilton and Schwab (1985), Case and Shiller (1989, 1990), Hosios and Pesando (1991), Poterba (1991) and Meese and Wallace (1994) all report that house price changes are positively correlated over time and that information on past housing market fundamentals can be employed to forecast future excess returns. Hamilton and Schwab (1985), Capozza and Seguin (1996), and Clayton (1997), all provide significant evidence against the hypothesis of rational house price expectations. Abraham and Hendershott (1996), Meese and Wallace (1994) and Clayton (1996) report that supply and demand fundamentals explain relatively little of the variation in short-run price fluctuations in markets experiencing wide swings in house prices.

[2]For example, consider the following price estimates by Royal Lepage for different sized homes in the same neighborhood on the westside of the city of Vancouver on January 1, 1995: $232,000 for a standard two-bedroom condominium (900 square feet) versus $530,000 for a standard two-story (three bedroom, 1500 square feet, single-car garage) and $670,000 for an executive detached two-story (four bedroom, 2000 square feet, two-car garage.

[3]Poterba (1991) develops this theoretical framework for house price dynamics.

[4]The semi-strong form of market efficiency is equivalent to rational expectations.

[5]Shiller (1984, 1989), Poterba and Summers (1988), Mussa (1990), and Cutler, Poterba and Summers (1990, 1991) discuss the potential role of noise or uninformed traders in explaining asset price movements. Scheifer and Summers (1990) review the noise trader approach to asset pricing.

[6]Case and Shiller (1988) and Collins, Lipman and Groeneman (1992) present survey evidence that indicates homebuyers may indeed follow such extrapolative behaviour.

[7]Source: 1986 Census of Canada. The figure is likely higher now since condominiums have accounted for approximately 40% of all housing starts in Vancouver since 1986 (Source: Canada Mortgage and Housing Corporation).

[8]Previous studies all investigate the efficiency of the single-family housing market, but most single-family homes are owner-occupied, and hence rents on these homes are not observed. For example, 90% of the existing stock of 5.7 million occupied single-family dwelling units in Canada are owner-occupied. This figure drops slightly to 86% for the Vancouver Census Metropolitan Area (Source: Dwellings: The Nation, 1991 Census of Canada). Federal government statistical agencies in both Canada and the United States publish indices of rents on rental dwellings, as part of their Consumer Price Indexes. Most researchers proxy single-family rents with these published rent series.

[9]See Geltner (1989).

[10]The authors employ hedonic price methods to arrive at a quality adjusted house price series for a home with the mean attributes of all homes in the sample.

[11]The nominal yields on three month and one to three year Government of Canada Bonds are used to test for short-run and longer term predictable components in excess condominium returns, respectively. These series are available on CANSIM, in matrices B14009 and B14007 (source: Bank of Canada).

[12]Since I do not have data on depreciation and maintenance costs they are not included in the calculation of excess returns. This should not be a major concern as the contribution of these two variables to short-run house price movements should be minimal.

[13]See also Poterba and Summers (1988).

[14]The intuition behind this result is as follows: Assume that the fad or temporary deviation follows an AR(1) process with slope parameter near to, but less than one. This process looks a lot like a (nonstationary) random walk, even though it is a stationary series. This is the same problem that plagues the power of unit root tests.

[15]Recent work on stock market efficiency examine the predictability of long-horizon returns and finds stronger evidence of return predictability than in short-horizon returns. See Poterba and Summers (1988), Fama and French (1988a), De Bondt and Thaler (1989) and Engel and Morris (1991) summarize the empirical work on mean reversion in the stock market.

[16]To account for the autocorrelation induced by the annual forecast horizon with quarterly data points, the standard errors on the coefficient estimates are calculated using the Newey-West (1987) variance-covariance matrix. In addition, since all eight municipal housing submarkets are part of the same larger metropolitan market seemingly unrelated system techniques (SURE) are employed to account for the correlation across the residuals in the regressions for each municipality.

[17]This is analogous to the use of the dividend-to-price ratio and price-earnings multiple used in tests of stock return predictability. Recent work by Fama and French (1988b) and Cutler, Poterba and Summers (1988) documents econometric predictability of stock returns using lagged dividend/price ratios.

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