Anticipated vs. Unanticipated House Price Movements and Transaction Volume

Arslan, Yavuz and Kanik, Birol and Köksal, Bülent

March 2014

Anticipated vs. Unanticipated House Price Movements and Transaction Volume*

Yavuz Arslan
Central Bank of Turkey

Birol Kanık
Central Bank of Turkey

Bülent Köksal
Ipek University

March 2014

Abstract

Using data from England and Wales, we analyze the relationship between house prices and transaction volume (number of houses sold) and find that there is a negative relationship. When we decompose price changes into anticipated and unanticipated components we find that while anticipated house price changes positively affect transaction volume, unanticipated price changes have a negative effect. These findings give insights for the theories which try to explain the relationship between house prices and transaction volume. Our findings are inconsistent with the down-payment effect approach developed by Stein (1995) and with the loss aversion behavior approach discussed by Genesove and Mayer (2001). However, our results support the evidence of asymmetric decisions on the buyer and seller side documented in Case and Shiller (1988).

JEL classification: D8;G1;R3.

Keywords: Expectations; Transaction volume; House prices.

*We would like to thank to Timur Hulagu and Istanbul School of Central Banking Brownbag Seminar participants for valuable comments and Royal Institute of Chartered Surveyors for providing data. The views expressed are those of the authors and should not be attributed to the Central Bank of Turkey.

E-mails: yavuz.arslan@tcmb.gov.tr, birol.kanik@tcmb.gov.tr and bkoksal@ipek.edu.tr

1 Introduction

In this paper we analyze the relationship between house prices and transaction volume by using a novel panel data set of ten regions from England including Wales. We have three contributions. First we show that, there is a negative relationship between house prices and transaction volume. Second, we decompose house price changes into anticipated and unanticipated (shock) components and show that while anticipated movements in house prices are positively related with transaction volume, unanticipated movements in house prices are negatively related. To our knowledge, this paper is the first attempt to analyze price-transaction volume relationship by separating the anticipated price movements from unanticipated part. Our third contribution builds on our second contribution. We argue that some of the explanations offered in the literature to explain the relationship between house prices and transaction volume are inconsistent with the finding that unexpected housing price movements are negatively related to the transaction volume.

Any relationship between prices and transaction volume (either positive or negative) is inconsistent with the standard frictionless rational expectations asset market models. In a frictionless market, any demand or supply shock should immediately be reflected in the prices without any effect on transaction volume. There are numerous articles in the literature that study the relationship between housing prices and transaction volume (see next section for a brief literature review). Looking at an overview of the findings, one can say that the results emerging from those researches are mixed. Our findings provide evidence in favor of a negative correlation.

Our second contribution stems from the theoretical implication that the response of individuals to unexpected and expected movements can be quite different –in fact, most of the theoretical models predict "no response" to anticipated movements. To explore implications in the housing market, we decompose house price changes into anticipated and unanticipated (shock) components. We show that while a rise in unexpected movements in house prices causes a decline in transactions, a rise in expectations about the house prices causes an increase. Therefore we find that, as implied by the theory, individuals react differently, i.e., in opposing directions, to anticipated and unanticipated prices changes in the housing market.

While the empirical literature gives a blurry view of house prices-transaction volume relationship, most of the influential articles are written to explain a positive correlation, e.g., Stein (1995), Oratalo Magne Rady(2006), Genesove and Mayer (1997), Wheaton(1990) and Ngai and Tenrayro (2010). Each explanation introduces a relevant friction in the housing market to standard models. In all of the explanations offered, the mechanism works when there is an unexpected shock to the model which causes a movement in house prices. Hence these models assume that the source of positive comovement in the data is coming from the unanticipated part. On the contrary, our results show that there is a negative relationship between the unanticipated part of the house price movements and transaction volume.[1] This implies that the quantitative importance of the proposed mechanisms are small and there should be some other mechanisms at play.

This paper is not the first paper that provides evidence against the theories offered to explain the comovements. Recently, Akkoyun, Arslan and Kanik (2013) use dynamic correlations analysis and show that the positive comovement in house prices and transaction volume mainly comes from the low frequency component. At the high frequency the correlation is very close to zero. However the theories discussed above predict the opposite. This paper can be seen as another attempt to reconsider the existing theories.

The remainder of the paper is organized as follows. Section 2 briefly reviews the related literature. Section 3, describes our data and provides the relationship between house prices and transactions for the 10 regions of England and Wales. Section 4 presents the model specification and results. Section 5 concludes.

2 Related Literature

The relationship between price change and transaction volume in housing market is widely studied on the empirical front. Miller and Sklarz (1986) shows with Hawaii data that the rate of sale is positively related to price change of next quarter. Stein (1995) provides

[1]In Wheaton (1990) the shock to the model is an unanticipated movement in time needed to sell a house. Hence, our paper is silent about the mechanism in Wheaton (1990).

results for the regressions of housing transactions against last year's price change and a linear time trend for the US. The coefficient for the price change is found to be positive and highly significant. Berkovec and Goodman (1996) report regression results of price changes on simultaneous change in turnover with significantly positive coefficients. Contrary to these results, Follain an Velz (1995) depicts a negative correlation between price level and transaction volume. While this branch of literature looks at the simple correlation between price change and the number of transactions, another branch of the literature focuses on the joint dynamics of the two variables. Hort (2000) with Swedish data, Andrew and Meen (2003) with UK data, and Wit et al. (2013) with Dutch data show that shocks to the fundamentals have immediate effect on sales but a gradual one on prices. On the other hand, Clayton et al. (2010) using US data shows that both prices and transactions are affected by a fundamental shock to housing market in a similar temporal trend. While Hort (2000) finds no consistent correlation between price changes and transactions, the other three papers find strong relationship between the two variables. To sum up, empirical literature partially supports a positive relationship between house prices and transaction volume.

On the other hand, as we mentioned earlier, any relationship between prices and transaction volume (either positive or negative) is inconsistent with the standard frictionless rational expectations asset market models. Several influential articles have been written to reconcile the theory with the data. Stein(1995) provides a simple model of house trade in which homeowners have downpayment constraints and moving decision of sellers depends on their home equity which they use as downpayment for their new homes. A similar mechanism is employed in Ortalo-Magne and Rady (2006). In both Stein and Ortalo-Magne and Rady, an unexpected decrease in house prices cause a fraction of sellers not to move due to their reduced capability of paying the downpayment of new homes. Genesove and Mayer (2001) argue that if households have loss aversion preferences then the positive comovement can be explained. By using the Boston condominium market data, they show that homeowners with high loan-to-value ratio set higher asking prices and have higher expected time on the market that reduces the trading activity. They also find empirical evidence for loss aversion behavior of sellers that homeowners are less willing to sell their homes in a falling market to avoid losses. Hence, transaction volume decreases.

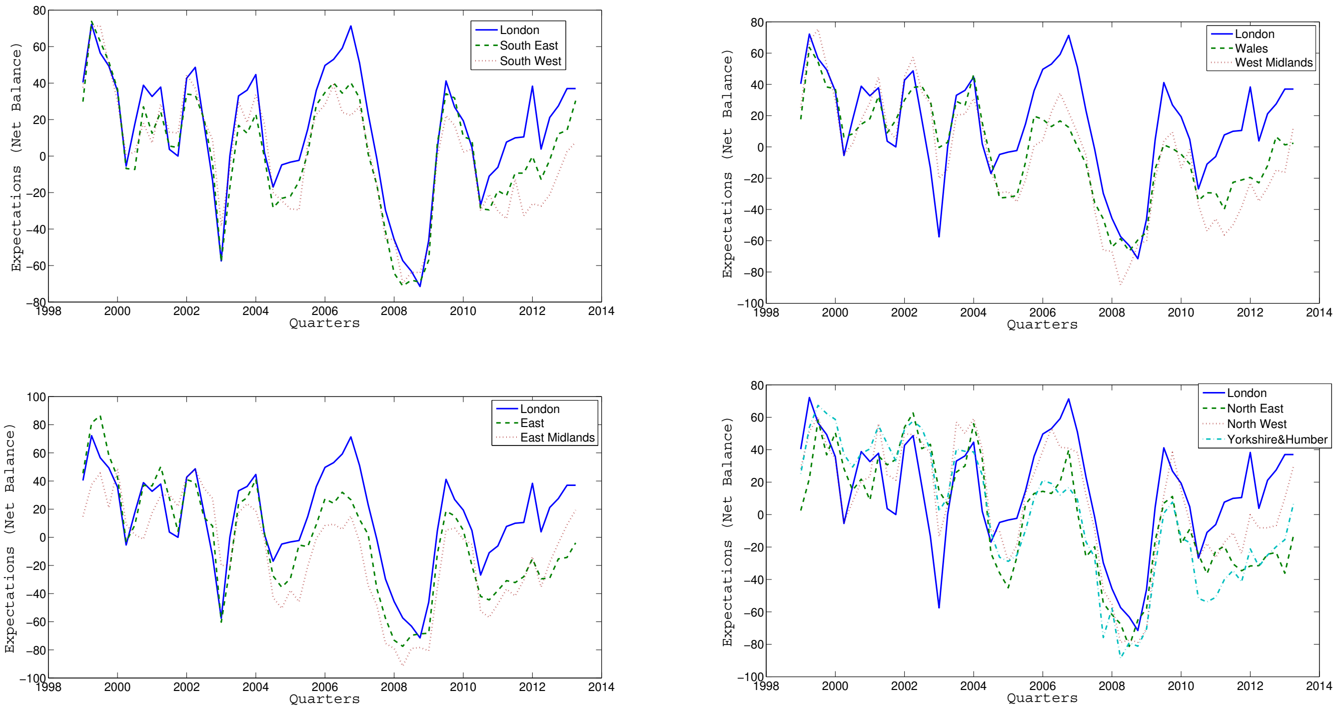
There is another strand of literature which employs search and matching frictions to model the housing market. Berkovec and Goodman (1996) and Wheaton (1990) show that with search and matching frictions their model can generate a positive comovement in house prices and transaction volume. Recently, Ngai and Tenreyro (2010) use a similar model to explain the seasonality in house prices and transaction volume that they document in the US and the UK data.

In all of the explanations discussed above the mechanism works when there is an unexpected shock in the model. In these models, when there is an unanticipated increase in prices, then transaction volume increases. Our finding that unanticipated movements in prices negatively move with transaction volume challenges the mechanisms of these studies. In addition, all the models except Wheaton (1990) are silent about the implications of change in expectations. In case of Wheton (1990), when there is an expectation of a price increase in the future transaction volume increases. According to Stein (1995) and Ortalo-Magne and Rady (2006) an expectation change would immediately affect the prices hence the effects of an expectation would not be different from an unexpected shock.

3 Data

We use quarterly data for 10 regions of England and Wales for the period 1999-2013. Data consists of housing price expectations, transaction volume, house prices, number of employed people, and homeownership rate. In addition to these publicly available data, we compose a shock series for house prices by using house price expectations and price data (the procedure is explained below). Expectations data is provided by Royal Institution of Chartered Surveyors (RICS). Every month chartered surveyors respond to the question whether they expect the house prices to rise, fall or stay the same for the next three months. For instance, if someone is asked in January, she gives opinion for the period till the end of April. The difference between the percentages of “rise” and “fall” answers gives the net balance for the price expectations. For example, when 70 percent of the surveyors reply as “rise”, 20 percent of the them say to “fall” and 10 percent reply as “stay the same” then

Figure 1: Net Balance of Expectations by Regions of England



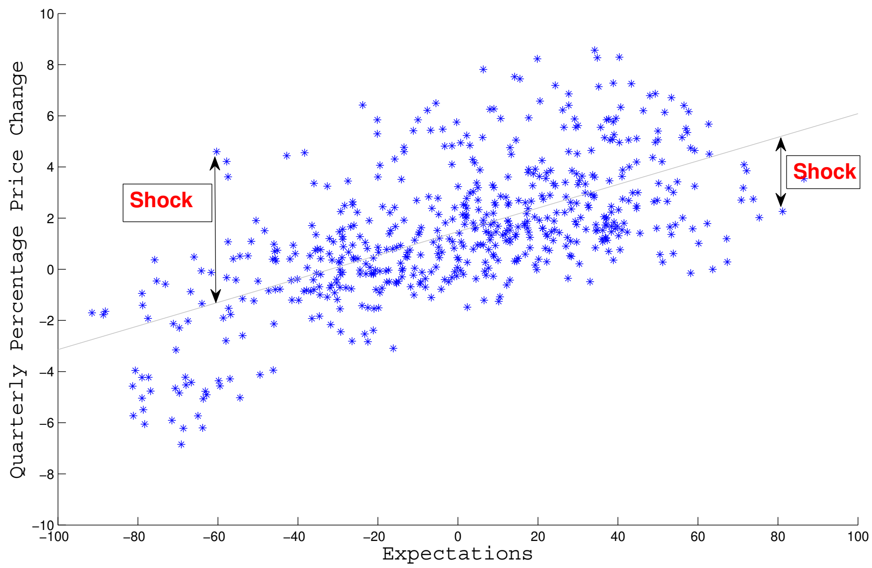
the net balance is 50. RICS does not provide the "rise" and the "fall" answers but only the net balance.

The transaction volume data is from Land Registry including all home sales in the British electronic register. The original data is monthly and shows high seasonality for each 10 regions. We construct quarterly and seasonally adjusted data by summing up the monthly seasonally adjusted values of the quarter. Housing prices are Land Registry House Price Index (LR-HPI) and Department for Communities and Local Goverment's Mixed Adjusted House Price Index (DCLG-MAHPI). Employment and homeownership data is from the UK Office for National Statistics. We provide the explanation of the derivation of the shock series in the next section.

Expectations and Derivation of the shock component

In this paper, as our second contribution mentioned above, we analyze price-volume relationship in a different perspective than previous studies. Decomposing percentage price

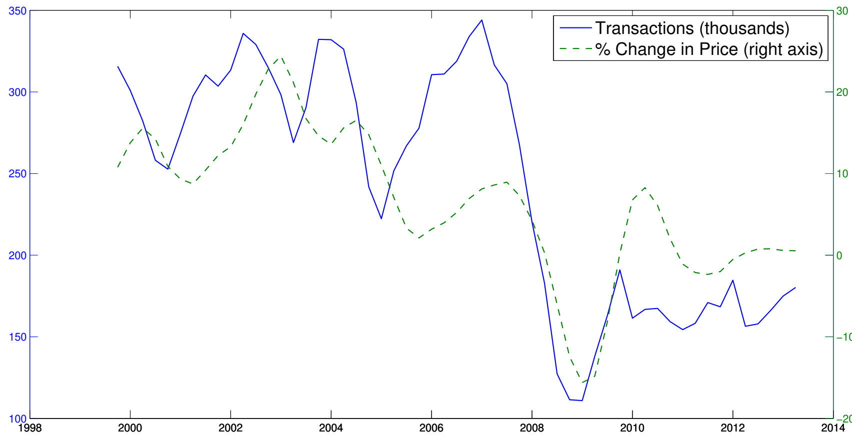
Figure 2: The Shock Component



change into two parts as expectations and shock component allows us to distinguish the effects of anticipated and unanticipated changes in price. Expectations component refers to the anticipated and shock component refers to the unanticipated change. We use price and price expectations data to derive these two components. Figure 1 shows the net balance of expectations for 10 regions with the comparison of all regions with London. The figure shows that the net balance of expectations for each region, in general, follows a similar pattern but at the same time there are significant differences between them in levels.

We plot the expectations and quarterly percentage price changes of all regions in Figure 2. The horizontal axis represents net balance of price expectations of the previous quarter about the current quarter's prices and vertical axis shows quarterly percentage change in prices. It shows a clear positive relationship between expectations and price changes. We assume that house price expectations and the realized price changes have a linear relationship. To obtain the shock component, we utilize a panel regression of quarterly price change on a constant and price expectations as follows

Figure 3: House Prices and Transactions



$$\%\Delta Price_{i,t} = \beta_0 + \beta_1 * Expectations_{i,t-1} + u_i + \varepsilon_{i,t}, \quad (1)$$

where u_i is the fixed effects for region i and standard errors are adjusted for heteroskedasticity and serial correlation. We take the predicted value of price changes as expected quarterly price growth (anticipated component)

$$E_{t-1}\%\Delta Price_{i,t} = \beta_0 + \beta_1 * Expectations_{i,t-1} + u_i, \quad (2)$$

and take the residual of regression in Equation 1, $\varepsilon_{i,t}$, as our shock (unanticipated) component. By construction, our shock component is uncorrelated with the expectations.

The Correlation Between Housing Prices and Transactions

In the literature of housing market while empirical works find mix results about the relationship there is no disagreement that simple correlation is positive. In Figure 3, we plot house price changes of LR-HPI and transaction volume of England and Wales for the period 1999-2013. The simple correlation of the two series is 0.77. Once we use the methods of the papers in the literature (i.e. time series regressions of transactions on last period price change and a linear time trend for quarterly data as in Stein) we find a positive and significant coefficient for the price change for each region of England and Wales. However, if we

Table 1: Correlation Coefficients

Region	Sales-price growth	Sales growth-price growth
East	0.77	0.16
East Midlands	0.76	0.20
London	0.71	0.27
Northeast	0.74	0.18
Nothwest	0.80	0.26
Southeast	0.75	0.18
Southwest	0.78	0.14
Wales	0.79	0.16
West Midlands	0.76	0.24
Yorkshire and Humber	0.79	0.20

use panel data estimation techniques and use the extra information embedded in the panel structure of our data set, the results change and we find a negative relationship. Correlation coefficients continue to be positive (Table 1). Decomposing anticipated and unanticipated components allows us to refer to theories that explain the price-volume relationship. We use sales growth rather than sales in our estimations because of the unit root problem. The model specification is explained in the next section in detail.

4 Empirical Model Specification

For the panel data analysis, we choose a dynamic specification to capture the dynamic behavior of sales growth. Because of the empirical problems introduced by the inclusion of the lagged dependent variable in the model, we consider several estimators that are proposed in the literature.

Nickell (1981) shows that when the lagged dependent variable is included in the model, the fixed effects estimator (within estimator) is biased of $O(T^{-1})$. This bias is called the dynamic panel bias and it does not approach to zero as the N increases implying that the fixed effects estimator is inconsistent for large N and small T. As T increases, however, the fixed effects estimator becomes consistent. Since we have a relatively long panel (N=10, T=57), least square dummy variable (LSDV) estimator will be one of the estimators that we consider.

Anderson and Hsiao (1982) suggest first differencing the model to eliminate the fixed effect, and then using second lag of the dependent variable either differenced or in levels as an instrument for the differenced and one-time lagged dependent variable. We consider Anderson-Hsiao estimator by using the second lag of the dependent variable as an instrument since this approach saves one observation for each group.

Kiviet (1995, 1999) calculates an approximation for the bias of the fixed effects estimator in a dynamic panel data model and proposes a bias corrected estimator. Bruno (2005) describes a Stata routine that implements this bias corrected estimator for approximations up to $O(T^{-1})$, $O(N^{-1}T^{-1})$, and $O(N^{-1}T^{-2})$. He shows by using a Monte Carlo analysis that the finite sample performance of the bias corrected LSDV (LSDVC) performs better than original LSDV, Arellano-Bond, Anderson-Hsiao, and Blundell-Bond estimators when the number of groups is small. We use LSDVC estimators for the approximations mentioned above, but report the results only for the $O(N^{-1}T^{-1})$ case since they are qualitatively and quantitatively similar.

Our basic specifications are[2]

$$salesgr_{i,t} = \beta_0 + \beta_1 * salesgr_{i,t-1} + \beta_2 * pricegrowth_{i,t} + D_{time} + D_{region} + \varepsilon_{i,t} \quad (3)$$

and

$$salesgr_{i,t} = \gamma_0 + \gamma_1 * salesgr_{i,t-1} + \gamma_2 * Anticipated_{i,t} + \gamma_3 * Unanticipated_{i,t} + D_{region} + D_{time} + \varepsilon_{i,t}. \quad (4)$$

where "salesgr" is sales growth and "D" represents dummy variables.

[2]We take the employment and homeownership data out of specification because they are insignificant in all estimations.

5 Results

Estimation results for quarterly Land Registry data are shown in Table 2 and results for DCLG data are shown in Table 3. The dependent variable is the sales growth. Second column provides us how the quarterly rate of change in prices affects the quarterly sales growth. In both of the tables second, third and fourth columns present LSDV model estimation results. In the second column one lag of the price growth is used as an instrument for the price. In the fourth column first lag of anticipated price change is used as an instrument for the anticipated price change.[3] Fifth column reports the results from using Anderson-Hsiao estimator, and the results in the last two columns are from LSDV estimation corrected for biasedness as in Bruno.

The striking feature of the results are the negative coefficient of price growth. This is contradictory to the plot we have in Figure 3 at first glance and to many studies in the literature, including Stein (1995) and Berkovec and Goodman (1996), who argue positive price-volume relationship. However, results are in line with Follain and Velz (1995) who find a negative coefficient. In the paper, one possible explanation for their result is the reduced importance of the down-payment constraints since mid-80's. When they rerun the Stein's regressions with the data since 1986 they obtain negative coefficients. Moreover, Berkovec and Goodman also get a negative coefficient with same regressions when they use data since 1986.

A second important result is the positive effect of anticipated but negative effect of unanticipated increase in prices on transactions. In columns 3, 4, 5 and 7 "Anticipated" variable is the expectations of the last quarter on today's price changes and "Unanticipated" variable represents the shock component which is the unanticipated changes in price explained in detail above. These results are important in two sense. First, no other paper has decomposed price changes into components and investigated the effects of anticipated and unanticipated price changes on transaction volume seperately. Second, these results lead us to question the empirical implications of the theories on price-volume relationship

[3]Agents do not see the sales figures until after they form expectations. Therefore, anticipated component is exogoneous. Nevertheless, we use an instrument for anticipated changes in one of the specifications.

Table 2: Estimation Results for Land Registry Data

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	LSDV-1	LSDV-2	LSDV-3	A.Hsiao	LSDV-Corrected	LSDV-Corrected
PriceGr_t	-1.019^{***}				-0.291^{**}	
	(0.166)				(0.116)	
SalesGr_{t-1}	0.152^{***}	0.112^{**}	0.104^{**}		0.149^{***}	0.134^{**}
	(0.077)	(0.068)	(0.068)		(0.062)	(0.060)
Anticipated_t		0.808^{***}	1.164^{***}			0.795^{***}
		(0.250)	(0.331)			(0.245)
Unanticipated_t		-0.309^{*}	-0.269^{*}			-0.331^{**}
		(0.163)	(0.152)			(0.121)
$\Delta\text{SalesGr}_{t-1}$				-0.004		
				(0.085)		
$\Delta\text{Anticipated}_t$				0.814		
				(0.521)		
$\Delta\text{Unanticipated}_t$				-0.124		
				(0.187)		
Constant	3.543^{***}		0.247	-2.471^{***}		
	(0.777)		(0.963)	(0.929)		
Observations	560	560	560	550	560	560
R^2	0.928	0.937	0.936	0.885		

Robust Standard errors in parantheses.

*** for p<0.01, ** for p<0.05, * for p<0.1

SalesGr(SalesGrowth): Quarterly percentage changes in number of houses sold. PriceGr(PriceGrowth): Quarterly percentage price change.

Anticipated: Anticipated component of price changes calculated by authors.

Unanticipated: Shock component of price changes calculated by the authors.

All specifications include time dummies, LSDV-1 and LDV-3 also include regional dummies, coefficients are not reported.

LSDV-1, LSDV-2 and LSDV-3: Least squares dummy variable estimation,

Lag of price change is used as an instrument for price change in LSDV-1, Lag of expectations is used as an instrument in LSDV-3.

LSDV-Corrected: Bias corrected Least squares dummy variable estimation as in Bruno.

Table 3: Estimation Results for Dep. of Communities and Local Gov. Data

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	LSDV-1	LSDV-2	LSDV-3	A.Hsiao	LSDV-Corrected	LSDV-Corrected
PriceGr_t	-0.935^{**}				-0.141	
	(0.443)				(0.115)	
SalesGr_{t-1}	0.087	0.047	0.040		0.087	0.071
	(0.0588)	(0.053)	(0.053)		(0.045)	(0.042)
Anticipated_t		0.723^{***}	1.099^{***}			0.698^{***}
		(0.198)	(0.263)			(0.227)
Unanticipated_t		-0.436^{***}	-0.373^{***}			-0.440^{***}
		(0.123)	(0.117)			(0.121)
$\Delta\text{SalesGr}_{t-1}$				0.127		
				(0.078)		
$\Delta\text{Anticipated}_t$				1.345^{***}		
				(0.495)		
$\Delta\text{Unanticipated}_t$				-0.062		
				(0.246)		
Constant	2.687^{***}		-0.455	-2.715^{***}		
	(0.690)		(0.903)	(0.999)		
Observations	430	430	430	420	430	430
R^2	0.928	0.937	0.936	0.885		

Robust Standard errors in parantheses.

*** for p<0.01, ** for p<0.05, * for p<0.1

SalesGr(SalesGrowth): Quarterly percentage changes in number of houses sold. PriceGr(PriceGrowth): Quarterly percentage price change.

Anticipated: Anticipated component of price changes calculated by authors.

Unanticipated: Shock component of price changes calculated by the authors.

All specifications include time dummies, LSDV-1 and LDV-3 also include regional dummies, coefficients are not reported.

LSDV-1, LSDV-2 and LSDV-3: Least squares dummy variable estimation,

Lag of price change is used as an instrument for price change in LSDV-1, Lag of expectations is used as an instrument in LSDV-3.

LSDV-Corrected: Bias corrected Least squares dummy variable estimation as in Bruno.

we discuss in the first section.

The positive coefficient of anticipated price change in our results supports price rigidity arguments on sellers' side. If buyers adjust their price ranges faster than the sellers' asking prices based on market conditions, then with good price prospects, buyers will be able to find the houses in their price range easier and buy a house faster, which causes an increase in transactions. On the other hand, with bad price prospects, buyers will not be able to find the houses in their reduced price ranges easier and can't finish a transaction, resulting in a decrease in transaction volume. Case and Shiller survey results show evidence on both up and downturns of housing markets. In excess demand, sellers' fairness or soliciting calls from real estate agents play a role for quick sales and in excess supply, sellers' belief on the rigth decision to hold on until getting the price they want is the source of slowing sales. The positive coefficient of anticipated price change in our estimations is consistent with the evidence on this asymmetry between seller and buyer decision.

The negative coefficient of unanticipated price change is another prominent observation in the results. This is contradictory to theories explaining the positive price-volume relationship. For instance, in the theoretical explanation of Stein (1995) with an unanticipated shock to the housing market which reduces the prices also reduces the transaction volume. Our results show that this is not the case. The data does not support Stein's explanation. Moreover, negative coefficient of unanticipated component does not conform to the explanation of Genesove and Mayer (2001) for the price-volume correlation. They show evidence and bring explanation to the prospect theory that loss aversion behaviour is responsible for an individual's value function to be concave in gains and convex in losses. That is, when there is a negative shock to the market, transactions also fall under the circumstances of reduced prices. However, our results imply the opposite sign for the transactions. According to our findings, the direction of movement of transactions depends on how prices change. Anticipated price falls are followed by a decrease in transactions but unanticipated price falls are followed by an increase which is not consistent with Genesove and Mayer's explanation.

6 Conclusion

In this paper, we analyze the house price-volume relation by using panel data from England and Wales and find that transacions are negatively affected by positive price changes. We, then, investigate the effect of anticipated and unanticipated price changes on transactions. When we decompose price changes into anticipated and unanticipated components, we observe that price expectations positively affect housing transactions but the shocks which cause prices to deviate from expectations have a negative effect on the transactions. The statistically significant negative coefficient for the unanticipated component contradicts with the theory of down-payment developed by Stein (1995) and "loss aversion behavior" approach. On the other hand, positive coefficient for anticipated component is consistent with the Case and Shiller (1988) survey evidence where buyers' and sellers' decisions are found to be asymetric.

References

[1] Akkoyun, H. C., Arslan, Y. and B. Kanik, 2013, Housing Prices and Transaction Volume, Journal of housing Economics, 22(2), 119-134.

[2] Andrew, M. and G. Meen, 2003, House Price Appreciation, Transactions and Structural Change in the British Housing Market: A Macroeconomic Perspective.

[3] Anderson, T. W. and C. Hsaio, 1982. Formulation and Estimation of Dynamic Models Using Panel Data, Journal of Econometrics 18: 570-606.

[4] Berkovec, J. and J. Goodman, 1996, Turnover as a Measure of Demand for Existing Homes, Real Estate Economics, 24, 421–40.

[5] Bruno, G.S.F.,2005, Estimation and Inference in Dynamic Unbalanced Panel-data Models with Small Number of Individuals, The Stata Journal 5 (4), 473-500.

[6] Case, K. E. and R. J. Shiller, 1988, The Behavior of Home Buyers in Boom and Post Boom Markets, NBER No.2748.

[7] Clayton, J., Miller, N. and L. Peng, 2010, Price-volume Correlation in the Housing Market: Causality and Co-movements, Journal of Real Estate Finance and Economics, 40(1), 14-40.

[8] de Wit, E. R., Englund, P. and M. K. Francke, 2013, Price and Transaction Volume in the Dutch Housing Market, Regional Science and Urban Economics, 43 (2), 220-241.

[9] Follain, J. and O. Velz, 1995, Incorporating the Number of Existing Home Sales into a Structural Model of the Market for Owner-Occupied Housing, Journal of Housing Economics, 4, 93-117.

[10] Genesove, D. and C. Mayer, 2001, Loss Aversion and Seller Behavior: Evidence From the Housing Market, The Quarterly Journal of Economics, November

[11] Green R. K. and S. M. Wachter, 2005, The American Mortgage in Historical and International Context, Journal of Economic Perspectives, 19(4) 93-114.

[12] Hort, K., 2000, Prices and Turnover in the Market for Owner-Occupied Homes, Regional Science and Urban Economics, 30, 99-119.

[13] Kiviet, J.F.,1995, On Bias, Inconsistency, and Efficiency of Various Estimators in Dynamic Panel Data Models, journal of Econometrics 68, 53-78.

[14] Kiviet, J.F.,1999, Expectations of Expansions for Estimators in a Dynamic Panel Data Model: Some Results for Weakly Exogenous Regressors, Cambridge University Press, 199-225.

[15] Leung, Charles K. Y., Garion C. K Lau and Youngman C. F. Leong, 2002, Testing Alternative Theories of the Property Price-Trading Volume Correlation, Journal of Real Estate Research.

[16] Lau, G. C. K., 2000, Hong Kong Property Market: The Correlation between the Trading Volume and the Rate of Return, Unpublished Master Thesis, Chinese University of Hong Kong.

[17] Lucas, R., 1978, Asset Prices in an Exchange Economy, Econometrica, 46, 1426–45.

[18] Miller, N. and M. Sklarz, 1986, A Note on Leading Indicators of Housing Market Price Trends, The Journal of Real Estate Research, Fall, 1(1), 115-124.

[19] Ngai, R. and S. Tenreyro, 2009, Hot and Cold Seasons in the Housing Market, London School of Economics Working Paper.

[20] Nickell, S. J., 1981, Biases in Dynamic Models with Fixed Effects, Econometrica, 49, 1417-1426.

[21] Ortalo-Magne, F. and Rady, S., 2006, Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints, Review of Economic Studies, 73, 459-485.

[22] Stein, J., 1995,Prices and Trading Volume in the Housing Market: A Model with Downpayment Effects, Quarterly Journal of Economics, 110, 379–405.

[23] Wheaton, W., 1990, Vacancy, Search, and Prices in a Housing Market Matching Model, Journal of Political Economy, 98, 1270–92.