Time Varying Trading Volume and the Economic Impact of the Housing Market

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Abstract

This paper empirically analyzes if trading volume in the housing market, particularly existing single family home sales, helps explain economic growth. Using a large panel data set that covers all 379 MSAs in the U.S. from 1983:1 to 2005:4, we find strong evidence that changes in home sales are significantly and positively correlated with the growth of Gross Metropolitan Product, with house prices, some local variables, as well as fixed effects and unobserved common factors controlled. Moreover, we find that the explanatory power of home sales seems to mainly come from decrease in home sales in "cold" housing markets. In a panel VAR setting, we find no evidence for home sales to be a leading indicator of GMP growth: GMP growth Granger causes home sales but home sales do not Granger cause GMP growth.

JEL classification: E23, E24, R11

Key words: home sales, housing market, common correlated effects estimators, CD test, Granger causality.

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I. Introduction

This paper empirically analyzes if trading volume in the housing market, particularly existing single family home sales, helps explain economic growth. The important role of the housing market in the economy has been a central research question since the crash of the U.S. stock market in 2001 if not earlier. The booming housing market in 2001, the recent declining house prices, as well as the ongoing subprime mortgage market crisis, have been believed by many, including the media and the FED, to significantly affect the economy. This belief has a solid theoretic foundation. A well known theory that implies the economic impact of the housing market is the wealth effect - Friedman's permanent income hypothesis suggests that people would change their consumption if house price changes affect their estimates of their permanent wealth. A more recently proposed theory is the collateral effect - house price increases may help relax borrowing constraints and thus increase consumption (see e.g. Aoki, Proudman and Vlieghe (2004), Lustig and Nieuwerburg (2004), and Ortalo-Magné and Rady (2004), among others).

On the empirical side, the literature provides plenty of evidence for the economic impact of the housing market, particularly the effects of house prices. For example, a fast growing literature suggests that the wealth effect of housing is not only statistically significant, but probably larger than the wealth effect on consumption induced from stock market appreciation (see Benjamin, Chinloy and Jud (2004), Case, Quigley and Shiller (2005), Kishor (2006), and Lettau and Ludvigson (2003), Bostic, Gabriel and Painter (2006), Carroll, Otsuka and Slacalek (2006), Slacalek (2006), among others). Furthermore, Campbell and Cocco (2005) show that the aggregate effect on consumption varies across different age groups and there is evidence supporting both the wealth effect and the collateral effect. Evidence of strong effects of house price changes on the growth of Gross Metropolitan Product (GMP) is provided by Miller and Peng (2007), using panel data from all 379 MSAs in USA. Up to now, the only evidence we know that shows no aggregate effect from house price changes on the economy is Phang (2004).

While the above theoretic and empirical work provide invaluable insights regarding the effects of the housing market on the economy, almost all of them exclusively focus on the effect of house prices. Another important aspect of the housing market, trading volume, is largely ignored. Economists, policy makers, and real estate professional have long realized the importance of the information content of trading volume in the housing market. For example, Stein (1995) and Ortlo-Magne and Rady (2004) develop models in which housing sales volume is cyclical due to liquidity constraints of sellers and the market interaction between young credit-constrained households with older unconstrained households. Empirically, Lamont and Stein (1999) show that price indices might be impacted by changes in overall loan-to-value ratios across cities. Genesove and Mayer (1997) use sales data to show that seller reservation prices are affected by the loan-to-value ratio. Engelhardt (2003) and Genesove and Mayer (2001) show that loss aversion directly affects housing mobility and transaction prices.

Motivated by the above theories and empirical evidence, economists argue that transaction prices in the housing market are biased measure of market valuations, and thus provide incomplete information regarding market conditions, unless time varying trading volume or time on market is controlled. In this literature, Gatzlaff and Haurin (1997), Gatzlaff and Haurin (1998), Fisher, Gartzlaff, Geltner and Haurin (2003), Goetzmann and Peng (2006), Lin and Vandell (2007), among others, propose a variety of methods to amend transaction prices to incorporate information contained by trading volume. This paper tries to bring together the literature of the wealth effect of housing and the literature of the information content of trading volume in the housing market, and empirically studies the economic effects of home sales, given the fact that time varying trading volume contains information regarding market conditions that is not necessarily fully represented by transaction prices.

This analysis uses a large panel data set that comprises 379 metropolitan statistic areas (MSAs) in U.S. in a sample period from the first quarter of 1983 to the fourth quarter of 2005. Using a multifactor error structure panel regression model, which allows us to control for unobserved common factors that affect both the housing market and the economic growth, we investigate whether existing single family home sales help explain the growth in Gross Metropolitan Product (GMP) at the MSA level, with house prices and other local variables controlled. We find statistically significant coefficients of home sales, which appear to indicate that trading volume in the housing market does provide extra information beyond what is reflected by house prices. Since the theories by Stein (1995) and others imply that, in "cold" markets, prices might be sticky while trading volume would be easier to adjust (decrease), we conjecture that decreases in trading volume would be more informative than increases. Empirically, we separate the increases and decreases in trading volume, and find that the explanatory power of trading volume mainly comes from decreases while increases in home sales are not statistically significant in explaining GMP growth.

We also investigate if trading volume in the housing market helps predict future GMP growth. In a panel vector autoregression setting, we formally test the Granger causality between home sales and GMP growth. We find that GMP growth Granger causes home sales, but home sales do not Granger cause GMP growth. We also find that house prices and home sales Granger cause each other, which is consistent with the literature.

This paper makes some novel contributions to the literature regarding the economic impact of the housing market. First, to our knowledge, this paper seems the first to analyze and verify the effects of trading volume in the housing market on economic growth. Second, this paper seems the first to find the asymmetric impact of trading volume – decreases in home sales seem to contain more information than increases. Third, this paper uses an unusually large data set and some recent econometric advances for the control of unobserved common factors, which may help improve the reliability of the results.

This rest of this paper is organized as follows. Section 2 describes the data. Section 3 tests the cross-section dependence among MSAs, and justifies the importance of controlling unobserved common factors. Section 4 reports the results in multifactor error structure panel regressions and finds evidence for the impact of home sales on GMP. Section 5 analyzes if trading volume in the housing market is a leading indicator for economic growth, and finds no evidence of that. Section 6 concludes.

II. Data

Our data set covers 379 MSAs (2006 definition) in the U.S. from 1983:1 to 2005:4. We have six quarterly time series for each MSA: per capita GMP, existing single family home sales, the single family house price index, average household income, population, and the unemployment rate. Series of per capita GMP are estimated by Moody's economy.com using information of the productivity of NAICS Supersector industries and industry employments in MSAs. Moody's economy.com also estimates quarterly population series using census data and migration flows among MSAs (data sources are Census Bureau and IRS respectively), compiles unemployment rates using BLS data, and estimates average household income using BEA data. The Office of Federal Housing Enterprise Oversight (OFHEO) provides transaction-based quarterly home price indices. OFEHO constructs house price indices using repeat sale regressions. Such indices control for time invariant attributes of houses that enter into the sample at least twice, and thus appear to be superior to median or mean sale prices.

In additional to MSA level variables, the data set also includes two national level time series in the same sample period, which are the national average 30-year fixed-rate mortgage rate and the SP500 index. Interest rates and stock market performance are key economic variables, which would affect both economic growth and the housing market. However, we show that these two variables are not sufficient to control for unobserved macro variables that affect all MSAs; therefore, it is crucial for our analysis to utilize the linear model of heterogeneous panel with multifactor error structure, which is developed by Pesaran (2006).

While our research focuses on per capita GMP, existing single family home sales, and house prices (as a major control variable), we include average household income, population, and the unemployment rate as important MSA level control variables. Ignoring these control variables would bias the estimation of the coefficients of house prices and trading volume, for these control variables are likely correlated with both economic growth and movements in prices and trading volume in housing markets. For example, Ortalo-Magné and Rady (2004) suggest that changes in household income affect not only the economy but also the housing market. In addition, changes in population often concur with changes in the industrial structure in a MSA, which may indicate changes in productivity and economic growth. Changes in population also often concur with migrations, which may affect the dynamics of house prices (see, e.g. Gabriel, Mattey and Wascher (1999) for direct evidence). Finally, changes in the unemployment rate may capture changes in the magnitude of frictions in the labor market or transitions of the economy, which relates to relocation of labor force and affects both the economy and the housing market.

The large panel data set we use significantly benefits our research. First, it is well known that panel data allow researchers to control individual heterogeneity and help increase the power of tests due to a large number of observations. Second, our panel data is a large N (cross-section) and small T (time periods) data set, which is an appropriate setting for the novel approach by Pesaran (2006). Consequently, we are able to control for unobserved macro economic variables that affect all MSAs. Third, all MSAs are in the United Sates, and are homogenous in the sense that they are subject to similar if not identical monetary policies, political environment, legal context, tax codes, and financial market conditions. Results obtained from more homogenous samples would be more reliable since some heterogeneity is difficult to address statistically. Finally, the sample period in this paper covers both economic expansions and recessions so it does not seem to be biased.

Readers should be cautious that our results should be interpreted as the effects of single family home sales on the growth of an *open* economy. The reason is that changes in trading volume and prices in the housing market in a MSA may affect not only local economy but also the economy in other MSAs, for MSA economies are integrated. This research focuses on the *local* economic effects of trading volume in the housing market, while econometrically model the effects on other MSAs using cross sectional dependence in idiosyncratic errors in the framework of Pesaran (2006).

We prepare the variables for our analysis by first converting nominal terms into real terms, and then calculating the first order differences of log values of the variables. We use CPI to adjust for inflation and obtain real terms for per capita GMP, the house price index, average household income, the 30 year fixed rate conventional mortgage interest rate, and the SP500 index. We choose to work on log differences instead of the original variables or their logs (level) because all OFHEO house price indices are set to be 100 in 1995:1, and thus house price levels are not comparable across MSAs. To illustrate the temporal behavior of per capita GMP and existing single family home sales, figures 1 and 2 plot the 25%, 50%, and 75% percentiles of across MSA distributions of per capita GMP (in thousand dollars) and the existing single family home sales (in 1,000 sales) in the sample period.

Since our analysis uses log differences instead of levels, we report some important statistics on the log differences of the six MSA level variables in table 1. Note that existing home sales significantly correlate with per capita GMP, which is consistent with a positive effect of trading volume in the housing market on economic growth. However, both GMP and home sales significantly correlate with many of other variables, such as house prices, average household income, and unemployment rates. This justifies the importance of including the control variables in our analysis.

III. Cross-section Dependence Tests

We us the following linear multifactor error structure panel model to analyze if changes in trading volume in the housing market helps explain the growth of per capita GMP.

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + u_{i,t}, \text{ in which } x_{i,t} = \left(po_{i,t}, hi_{i,t}, ur_{i,t}\right)' \quad (1)$$

In equation (1), for MSA i, α_i is a MSA specific intercept term that captures all variables that might differ across MSAs but remain time invariant for each MSA; $gmp_{i,t}$, $hp_{i,t}$, and $sl_{i,t}$ are respectively the log differences of GMP, the house price index, and existing single family home sales from quarter t to $t+1$; $x_{i,t}$ is a vector of MSA level variables that may help determine $gmp_{i,t}$, including log differences of population, average household income, and the unemployment rate; and $u_{i,t}$ is the error term. We assume that the error term captures the common unobserved factors as well as possible spatial effects.

$$u_{i,t} = \gamma_i' f_t + \varepsilon_{i,t} \tag{2}$$

In equation (2), f_t is a vector of unobserved common factors, which includes macro economic variables that are the same across all MSAs in a given time period but vary across time, such as interest rates, performance of the stock market, etc. $\varepsilon_{i,t}$ is a idiosyncratic error, which is assumed to be distributed independently of $x_{i,t}$ and f_t and across MSAs.

The model in equations (1) and (2) is reasonably general and flexible. First, the model uses MSA specific intercept terms (MSA fixed effects) to capture unobserved heterogeneity in $gmp_{i,t}$ that remains constant over time. Second, in addition to controlling house prices, the model controls for local variables that change both across MSAs and time periods that may affect $gmp_{i,t}$, including changes in population, average household income, and the unemployment rate. Third, the model controls for macro economic variables, even if they are unobserved, that affect the economic growth in all MSAs. Moreover, the model is flexible enough to allow each MSA to respond to the unobserved macro variables differently. As a result, factors that affect some but not all MSAs are also controlled since the MSAs that are not affected by these factors simply have zero coefficients. This is the major difference between the multifactor error structure model and a model with time period fixed effects.

A particularly attractive feature of the model in equations (1) and (2) is that it controls for unobserved common macro economic variables. Well some macro variables may be observed, including the observed variables only may not effectively eliminate the bias in coefficient estimation due to the correlation between unobserved variables and the dependent and explanatory variables. To illustrate the importance of controlling unobserved macro variables, we use the CD (Cross-section Dependence) test of Pesaran (2004) to identify the existence of cross section dependence of error terms, which is a symptom of unobserved common macro variables. We first test for cross-section dependence without including any observed macro economic variables, and then repeat the tests by including some observed macro variables, specifically the 30-year fixed rate conventional mortgage interest rate and the SP500 index. In both cases, we find strong evidence of cross-section dependence.

We conduct the CD test under three specifications of equation (1). Under each specification, we first run a regression for each MSA separately, and obtain the OLS residuals. After that, for each variation/specification, we calculate the CD statistic using residuals for all MSAs. We use the following notations. For MSA i, denote by T_i the set of time periods over which data are available, and by $\#T_i$ the number of the elements in the set. Denote the residuals by $e_{i,t}$ for $t \in T_i$, we compute the pair-wise correlations of $e_{i,t}$ and $e_{j,t}$ using the common set of observations in $T_i \cap T_j$, and have

$$\hat{\rho}_{i,j} = \frac{\sum_{t \in T_i \cap T_j}(e_{i,t} - \bar{e}_i)(e_{j,t} - \bar{e}_j)}{\left[\sum_{t \in T_i \cap T_j}(e_{i,t} - \bar{e}_i)^2\right]^{1/2}\left[\sum_{t \in T_i \cap T_j}(e_{j,t} - \bar{e}_j)^2\right]^{1/2}}, \tag{3}$$

where

$$\bar{e}_i = \frac{\sum_{t \in T_i \cap T_j} e_{i,t}}{\#(T_i \cap T_j)}. \tag{4}$$

The CD statistic is

$$CD = \sqrt{\frac{2}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\sqrt{\#(T_i \cap T_j)}\,\hat{\rho}_{i,j}\right). \tag{5}$$

Under the null hypothesis that $\gamma' = 0$, Pesaran (2004) proves that $cov(u_{i,t}, u_{j,t}) = 0$ and $CD \sim N(0,1)$.

We conduct the CD tests under the following three specifications:

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + u_{i,t}, \quad (6)$$

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + u_{i,t},, \quad (7)$$

and

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + \beta_i^3 mr_t + \beta_i^4 sp_t + u_{i,t}. \quad (8)$$

In above equations, $x_{i,t} = (po_{i,t}, hi_{i,t}, ur_{i,t})'$, mr_t and sp_t are log differences of the 30-year fixed rate mortgage rate and the SP500 index respectively. Note that specification in **Error! Reference source not found.** does not include any control variables; **Error! Reference source not found.** includes MSA level control variables; and **Error! Reference source not found.** includes both MSA level variables and two national level variables.

Table 2 reports the CD statistics for the three specifications, which are 667.17, 382.56, and 377.30 respectively. The test statistics significantly reject the null hypothesis that $\gamma' = 0$ at 1% level, and thus provide strong evidence of the existence of cross section dependence of error terms. Furthermore, the tests show that the 30-year mortgage rate and the S&P500 index are not sufficient in capturing all factors that affect MSAs. As a result, it is important to use the multifactor error structure of equations (1) and (2) to control for unobserved common factors that affect all MSAs.

IV. Panel Regressions

After testing the cross-section dependence, we estimate four different specifications of the multifactor error structure linear panel model in equations (1) and (2), which helps us check the robustness of the results. In all specifications, we include house prices as a control variable. The first specification is

$$gmp_{i,t} = \alpha + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + u_{i,t}, \tag{9}$$

which does not include MSA fixed effects or local control variables. The second specification is

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + u_{i,t}, \tag{10}$$

which includes MSA fixed effects but not local control variables. The third specification is

$$gmp_{i,t} = \alpha + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + u_{i,t}, \tag{11}$$

which includes local control variables but not fixed effects. The fourth specification is

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + u_{i,t}, \tag{12}$$

which includes both fixed effects and local control variables.

For the above specifications, we provide the Common Correlated Effects estimators (CCE estimators) proposed by Pesaran (2006), which controls for unobserved macro economic factors. This estimator is constructed using regressions augmented with cross-sectional averages of all dependent and independent variables. Pesaran (2006) proves that the CCE estimators can use cross-sectional averages of all dependant and independent variables to capture the unobserved variables, for the unobserved variables converge to a linear combination of the cross-sectional averages. To illustrate this, following Pesaran (2006), consider a simple but generic model

$$y_{i,t} = a_i + \beta_i' x_{i,t} + u_{i,t}, \tag{13}$$

where $u_{i,t} = \gamma_i' f_t + \varepsilon_{i,t}$ and f_t is a vector of unobserved variables that help determine $y_{i,t}$ Suppose f_t also help determine the k by 1 vector $x_{i,t}$:

$$x_{i,t} = b_i + \tau_i' f_t + v_{i,t}, \tag{14}$$

Where b_i is a vector of individual effects, τ_i' is a factor loading matrix with fixed components, and $v_{i,t}$ is the specific component of $x_{i,t}$ that is distributed independently of f_t and across i but follows general covariance stationary processes. Pesaran (2006) shows that

$$f_t - (CC')C(\bar{Z}_t - \bar{d}) \xrightarrow{p} 0, \text{ as } N \to \infty, \tag{15}$$

where $Z_t = \binom{y_{i,t}}{x_{i,t}}$, d_t and C are functions of parameters. Equation **Error! Reference source not found.** indicates that the cross-sectional averages of all dependent and independent variables span the same space that the unobserved common factors span.

Table 3 reports the estimation results. First, the coefficient of existing single family home sales is significant at 1% level across all four specifications. Note that the regressions already control the effects of house prices on GMP. Therefore, the results in table 3 seem to indicate that single family home sales contain extra information that helps explain economic growth beyond the information content of house prices. Second, the coefficients of single family home sales are always positive. This indicates that economic growth is associated with the “expansion” of the housing market, which is characterized with increasing home sales. Third, while the coefficients of single family home sales are positive and statistically significant, they are much smaller than the coefficients of house prices. For example, in the fourth specification, which includes MSA fixed effects and local control variables, the coefficient for single family home sales is 0.002, while the coefficient for house prices is 0.049. This appears to indicate that home sales have weaker explanatory power than house prices.

To investigate the sources of the explanatory power of home sales, we analyze the possible asymmetric effects of home sales on GMP. Economists have noticed that house prices can by sticky in and trading volume decreases at the same time in “cold” markets. Theories and empirical evidence are provided from different perspectives. First, since house sellers have the option to walk away from their mortgages if the sale prices are lower than their mortgage balance, house sellers typically would not accept offers that are lower than their mortgage balance. As a result, prices are sticky and trading volume decreases. Empirically, Lamont and Stein (1999) show that price indices might be impacted by changes in overall loan-to-value ratios across cities. Genesove and Mayer (1997) use sales data in Boston to show that seller reservation prices are affected by the loan-to-value ratio. Second, house sellers may be loss averse and thus do not adjust ask prices down in “cold” markets. Consequently, house prices are sticky and trading volume goes down. Engelhardt (2003) and Genesove and Mayer (2001) show that loss aversion directly affects housing mobility and transaction prices.

The above theories and evidence help us form the conjecture that trading volume contains more information in “cold” markets, for house prices are sticky under such market conditions. To test this conjecture, we separate positive changes from negative changes for both home sales and house prices, and analyze if the negative changes in trading volume would contain more information. Specifically, we replace house prices in equation (1) with $hp.positive_{i,t}$ and $hp.negative_{i,t}$, and replace home sales with $sl.positive_{i,t}$ and $sl.negative_{i,t}$. $hp.positive_{i,t}$ ($hp.negative_{i,t}$) equals the log difference of house price index if it is positive (negative) or 0 otherwise, and $sl.positive_{i,t}$ ($sl.negative_{i,t}$) equals the log difference of the single family home sales if it is positive (negative) or 0 otherwise. We expect to see larger coefficients of home sales when sales decrease.

Table 4 reports the CCE estimators for positive and negative changes in trading volume. In all four specifications, decreases in home sales have larger and more significant coefficients than increases in home sales. For example, in the fourth specification, which includes MSA fixed effects and local control variables, the coefficient for decreases in home sales is 0.003 and significant at 1% level, while the coefficient for increases in home sales is 0.001 and not significant. This seems to indicate that the explanatory power of trading volume in the housing market mainly comes from decreases in home sales in “cold” markets. Note that both increases and decreases in home prices have statistically significant and positive coefficients, which seems to suggest that home prices are information in both “cold” and “hot” markets.

V. Trading Volume as a Leading Indicator

This section investigates if trading volume in the housing market helps predict future GMP growth in the sense of Granger causality. We treat GMP, house prices, and home sales are endogenous variables, and estimate the following panel vector autoregression model:

$$y_{i,t} = \alpha_i + \alpha_t + \sum_{k=1}^{K} \beta_k L_k(y_{i,t}) + \rho x_{i,t} + u_{i,t}, \tag{16}$$

where $y_{i,t} = (gmp_{i,t}, hp_{t,t}, sl_{i,t})'$, $x_{i,t} = (po_{i,t}, hi_{i,t}, ur_{i,t})'$, L_k is a lagging operator that lags a variable for k periods, β_k is a three by three matrix of coefficients, and so is ρ. The lag order K is chosen by running a preliminary VAR for each MSA separately, and about 91% of the MSAs have optimal (in the sense of AIC) lag order that is equal to or shorter than 4[2]. This model in (16) includes two way fixed effects: MSA fixed effects and time period fixed effects. They control for two kinds of unobserved heterogeneity – variables that differ across MSAs but remain constant across time and variables that vary across time but affect all MSAs in each time period. We are not using the multifactor error structure setting here, for theories have not yet validated this method in dynamic settings.

[2] Granger Causality tests have similar results with different lag orders such as 3 and 5.

To obtain consistent estimators, in each period, we first subtract cross sectional averages for each variable to eliminate the time dummy. After that, we take first order difference on both sides of equation (16) to eliminate the MSA dummies. After this differencing, all dummies disappear, and variables are differences of differences. It is well known that the differenced model can not be directly estimated, for the correlation between independent variables and the error term is not zero (see, e.g. Nickell (1981)). To overcome this problem, we follow the instrumental variable approach of Holtz-Eakin, Newey and Rosen (1988), for this approach is appropriate for panels with large N and short T, which is our case. This approach is valid even if there are unit roots and nonstationary variables (as a result of large N). Therefore, we do not conduct any unit root or cointegration tests. We use $t-2$ to $t-6$ lagged endogenous variables as instrumental variables. According to Holtz-Eakin, Newey and Rosen (1988), the coefficients of lagged endogenous variables are identified, for we have 12 coefficients for endogenous variables but 15 instrumental variables.

Table 5 reports the regression results for the equation in **Error! Reference source not found.** with $gmp_{i,t}$ being the dependent variable. First, all lagged home sales and house prices are not statistically significant in explaining the GMP growth. Second, control variables, such as population, average household income, and the unemployment rate, are all significant. Third, lagged GMP growth rates are significant and positive. In short, the estimated coefficients do not provide any evidence that trading volume in the housing market serves as a leading indicator for GMP growth.

We formally test the Granger causality among the three endogenous variables using the conventional F tests, and report the results in table 6. The results indicate that GMP growth Granger causes changes in home sales (at 1% level), but changes in home sales do not Granger cause GMP growth. Therefore, the Granger causality tests do not provide evidence that trading volume in the housing market helps predict future economic growth. It is worth noting that, in table 6, both house prices and trading volume Granger cause each other. The Granger causality from house prices to trading volume is consistent with Stein (1995). In Stein (1995), falling prices reduce homeowners' home equity values. Therefore, when homeowners want to sell their houses, to make sure that the proceeds from selling their homes would be sufficient to repay their mortgages, they need to ask for higher prices, which increase the time on the market and reduce the trading volume. The Granger causality from trading volume to house prices is consistent with conventional wisdom in the real estate literature (e.g. Berkovec and Goodman, 1996) that trading volume reacts more quickly to economic shocks than house prices.

VI. Conclusion

This paper empirically analyzes if trading volume in the housing market, particularly existing single family home sales, helps explain the growth of GMP. Using an unusually large panel data set that covers 379 MSAs from 1983:1 to 2005:4, we find strong evidence that trading volume is significantly and positively correlated with GMP growth, with house prices, some local variables, as well as fixed effects and unobserved common factors controlled. Moreover, we find that the explanatory power of trading volume seems to mainly come from decreases in home sales in "cold" housing markets – decreases in home sales have strong explanatory power while increases do not. In a panel VAR setting, we find no evidence for the home sales to be a leading indicator of GMP growth: GMP growth Granger causes home sales but home sales do not Granger cause GMP growth.

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Table 1 Data Summary

Panel A summarizes the respective mean, median, standard deviation for the time series of log differences of per capita GMP (GMP), single family home sales (SL), home price index (HP), population (PO), average household income (HI), and the unemployment rate (UR). Panel B reports their 1 to 4-quarter autocorrelations. Panel C reports correlations among the variables. All reported numbers are across MSA averages. For the reported statistics, we also report the t-statistics with the null hypotheses being that the distributions of the statistics have zero means. * denotes significance at the 5% level and ** at the 1% level.

	GMP	SL	HP	PO	HI	UR
Panel A: Means, medians, and standard deviations						
Mean	**0.447%	**1.177%	**0.461%	**0.281%	**0.305%	**-0.092%
Median	**0.452%	**1.151%	**0.470%	**0.282%	**0.321%	**-0.476%
Standard deviation	**1.26%	**11.265%	**2.131%	**0.194%	**1.288%	**7.382%
Panel B: Autocorrelations						
1 quarter	**0.292	**-0.269	*-0.043	**0.955	**-0.058	**0.230
2 quarter	**0.247	**-0.061	**0.182	**0.837	**0.123	**0.118
3 quarter	**0.082	**0.034	**0.220	**0.678	**-0.121	**0.067
4 quarter	**0.066	**-0.066	**0.204	**0.532	**0.205	*-0.019
Panel C: Correlations						
GMP	1	**0.041	**0.211	**-0.060	**0.418	**-0.229
SL		1	**0.048	-0.002	**0.043	**-0.031
HP			1	**0.102	**0.168	**-0.029
PO				1	**-0.049	0.016
HI					1	**-0.112
UR						1

Table 2 Cross Section Dependence Tests

This table reports the cross section dependence tests for three different specifications of a linear model in which the log difference of GMP ($gmp_{i,t}$) is regressed on the log difference of the house price index ($hp_{i,t}$) and the log difference of single family home sales ($sl_{i,t}$). The specification 2 includes control variables $x_{i,t} = (po_{i,t}, hi_{i,t}, ur_{i,t})$, which are the log difference of population ($po_{i,t}$), the log difference of average household income ($hi_{i,t}$), and the log difference of the unemployment rate ($ur_{i,t}$). The specification 3 includes the above control variables as well as the log differences of the 30-year fixed rate conventional mortgage interest rate (mr_t) and the SP500 index (sp_t).

Specification 1 $gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + u_{i,t}$ CD test value: 667.17
Specification 2: $gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + u_{i,t}$ CD test value = 382.56
Specification 3: $gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + \beta_i^3 mr_t + \beta_i^4 sp_t + u_{i,t}$ CD test value = 377.30

Table 3 Housing Prices, Volume and Economic Growth

This table reports the Common Correlated Effects (Pesaran 2006) estimation results for four different specifications of the following linear model:

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp_{i,t} + \beta_i^2 sl_{i,t} + \rho' x_{i,t} + u_{i,t}$$

$$x_{i,t} = \left(po_{i,t}, hi_{i,t}, ur_{i,t}\right)$$

$$u_{i,t} = \gamma_i' f_t + \varepsilon_{i,t}$$

where $gmp_{i,t}$, $hp_{i,t}$, and $sl_{i,t}$ are the log differences of the GMP, the house price index, and the single family home sales from quarter t to $t+1$ for MSA i; $x_{i,t}$ is a vector of MSA level variables, including log differences of population, average household income, and unemployment rate; f_t is a vector of unknown common effects; and $\varepsilon_{i,t}$ is the idiosyncratic error. The first specification does not include the MSA fixed effect or local control variables; the second specification includes the MSA fixed effect but not local control variables, the third specification includes local control variables but not the MSA fixed effect; and the fourth specification includes both the MSA fixed effect and the local control variables. * denotes significance at the 5% level and ** at the 1% level.

Variables	Regression I	Regression II	Regression III	Regression IV
$sl_{i,t}$	**0.003	**0.003	**0.002	*0.002
	[0.001]	[0.001]	[0.001]	[0.001]
$hp_{i,t}$	**0.042	**0.039	**0.040	**0.049
	[0.004]	[0.004]	[0.004]	[0.005]
$po_{i,t}$			**-0.145	*-0.336
			[0.021]	[0.130]
$hi_{i,t}$			**0.145	**0.144
			[0.006]	[0.009]
$ur_{i,t}$			**-0.027	**-0.027
			[0.001]	[0.001]
Fixed Effects	No	Yes	No	Yes
R2	0.27	0.27	0.35	0.36

Table 4 Housing Prices, Volume and Economic Growth: Asymmetric Patterns

This table reports the Common Correlated Effects (Pesaran 2006) estimation results for four different specifications of the following linear model:

$$gmp_{i,t} = \alpha_i + \beta_i^1 hp.positive_{i,t} + \beta_i^2 hp.negative_{i,t} + \beta_i^3 sl.positive_{i,t} + \beta_i^4 sl.negative_{i,t} + \rho' x_{i,t} + u_{i,t}$$

$$x_{i,t} = (po_{i,t}, hi_{i,t}, ur_{i,t})$$

$$u_{i,t} = \gamma_i' f_t + \varepsilon_{i,t}.$$

From quarter t to $t+1$ for MSA i, $gmp_{i,t}$ *is* the log difference of the GMP; $hp.positive_{i,t}$ ($hp.negative_{i,t}$) equals the log difference of house price index if it is positive (negative) or 0 otherwise; $sl.positive_{i,t}$ ($sl.negative_{i,t}$) equals the log difference of the single family home sales if it is positive (negative) or 0 otherwise; $x_{i,t}$ is a vector of MSA level variables, including log differences of population, average household income, and unemployment rate; f_t is a vector of unknown common effects; and $\varepsilon_{i,t}$ is the idiosyncratic error. The first specification does not include the MSA fixed effect or control variables; the second specification includes the MSA fixed effect but not control variables, the third specification includes control variables but not the MSA fixed effect; and the fourth specification includes both the MSA fixed effects and control variables. * denotes significance at the 5% level and ** at the 1% level.

Variables	Regression I	Regression II	Regression III	Regression IV
$sl.positive_{i,t}$	*0.002	**0.003	0.001	0.001
	[0.001]	[0.001]	[0.001]	[0.001]
$sl.negative_{i,t}$	**0.005	**0.004	**0.003	*0.003
	[0.001]	[0.001]	[0.001]	[0.001]
$hp.positive_{i,t}$	**0.040	**0.042	**0.039	**0.044
	[0.005]	[0.005]	[0.005]	[0.006]
$hp.negative_{i,t}$	**0.042	**0.033	**0.041	**0.060
	[0.005]	[0.005]	[0.008]	[0.008]
$po_{i,t}$			**-0.173	**-0.372
			[0.020]	[0.030]
$hi_{i,t}$			**0.143	**0.142
			[0.006]	[0.006]
$ur_{i,t}$			**-0.027	**-0.027
			[0.001]	[0.001]
Fixed Effects	No	Yes	No	Yes
R2	0.25	0.26	0.35	0.36

Table 5 Transaction Volume as a Leading Indicator

This table reports the estimation of the following dynamic regression, which is one of the three equations in a panel VAR model

$$gmp_{i,t} = \alpha_i + \alpha_t + \sum_{s=1}^{4} \gamma_s gmp_{i,t-s} + \sum_{s=1}^{4} \beta_s hp_{i,t-s} + \sum_{s=1}^{4} \rho_s sl_{i,t-s} + \theta' x_{i,t} + u_{i,t},$$

$$x_{i,t} = (po_{i,t}, hi_{i,t}, ur_{i,t})'$$

We eliminate the time period fixed effects by subtracting cross sectional means for each variable, and then eliminate the MSA fixed effects by taking differences on both sides. The model is then estimated with instrumental variable regression to overcome the correlation between independent variables and the error term. * denotes significance at the 5% level and ** at the 1% level.

Variables	Coefficients	Standard deviations	T statistics
SL lag1	0.000	0.001	0.51
SL lag2	-0.000	0.001	-0.33
SL lag3	-0.001	0.001	-1.52
SL lag4	-0.001	0.001	-1.54
HP lag1	-0.006	0.005	-1.15
HP lag2	-0.011	0.007	-1.63
HP lag3	-0.012	0.007	-1.79
HP lag4	-0.008	0.005	-1.88
GMP lag1	**0.293	0.002	19.32
GMP lag2	**0.118	0.009	12.17
GMP lag3	-0.003	0.008	-0.45
GMP lag4	**-0.178	0.007	-26.31
PO	**-0.949	0.043	-22.31
HI	**0.039	0.005	8.41
UR	**-0.021	0.001	-26.93
R2		0.10	

Table 6 Granger Causality Tests

This table reports the Granger Causality tests in the panel VAR model with the three endogenous variables being the log differences of per capita GMP, home price index, and single family home sales. The test for variable x Granger causes variable y is a F test with the null hypothesis being that all coefficients of the lagged x are 0 in the equation with y being the dependant variable.

	Transaction volume Granger causes GMP
F static	1.612
P value	0.17
	GMP Granger causes transaction volume
F static	3.178
P value	0.01
	Transaction volume Granger causes house prices
F static	2.239
P value	0.06
	House prices Granger cause transaction volume
F static	9.24
P value	0.00

Figure 1. Per Capita GMP

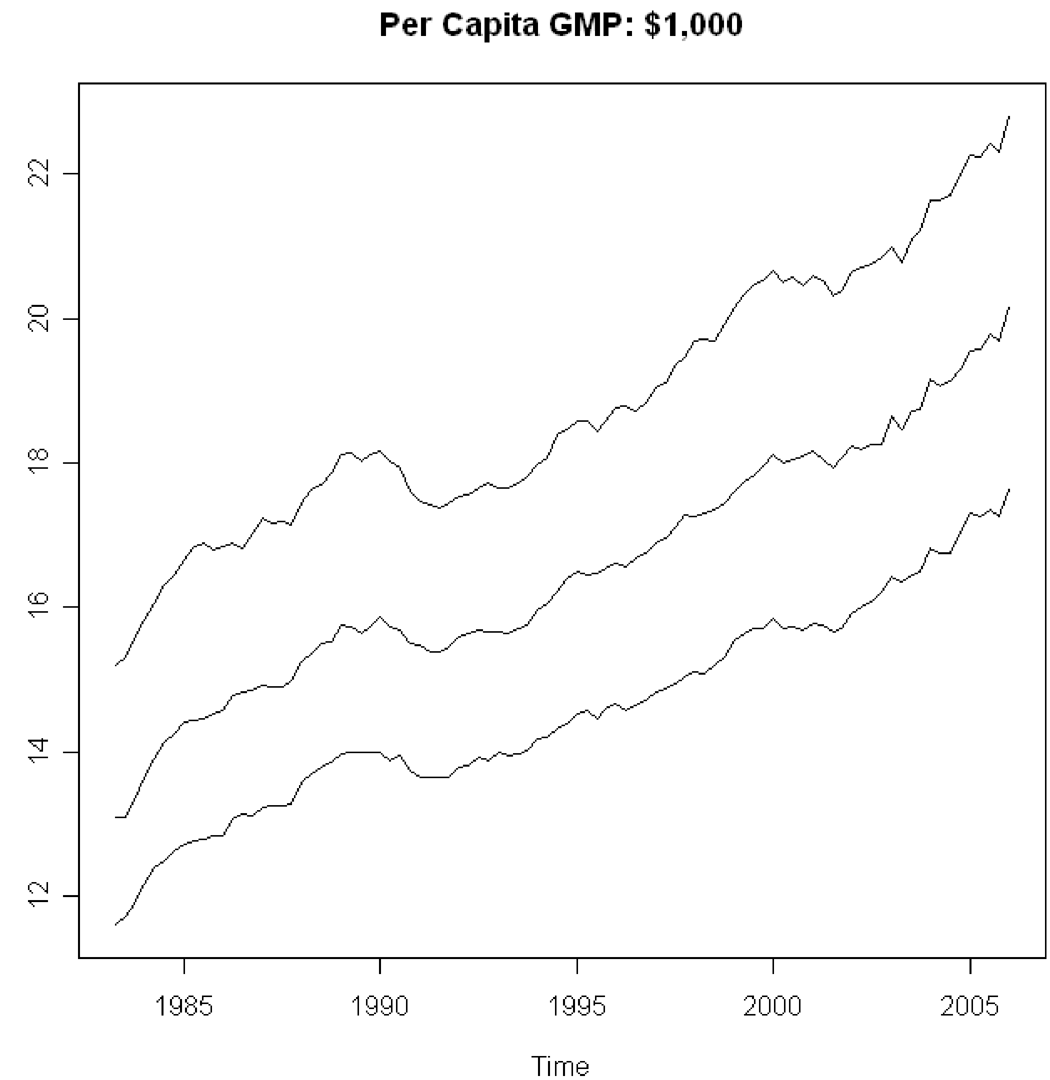

Figure 2. Single Family Home Sales