Economic impacts of the housing market: a panel data approach

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Abstract

Usually housing is viewed in the context of consumption resulting from other economic drivers such as income and employment. Here, we study how two key local economic measures, the gross metropolitan product (GMP) and unemployment rate, respond to shocks in home value appreciation, home sales, and new construction, respectively. Our analysis relies upon a large panel of 158 metropolitan statistical areas (MSAs) in the United States from 1983 to 2002. Location-related MSA characteristics and time-specific macro economic variables are both controlled. We find a statistically significant impact of home appreciation and home sales on these economic measures with home appreciation having a stronger impact than home sales. However, the magnitude of the impact of housing shocks is modest, at least when we compare it to the impact of a shock in the population growth rate.

*JEL classification: E23, E24, E32, R11

Key words: housing market, economic impact, panel VAR

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Abstract

Usually housing is viewed in the context of consumption resulting from other economic drivers such as income and employment. Here, we study how two key local economic measures, the gross metropolitan product (GMP) and unemployment rate, respond to shocks in home value appreciation, home sales, and new construction, respectively. Our analysis relies upon a large panel of 158 metropolitan statistical areas (MSAs) in the United States from 1983 to 2002. Location-related MSA characteristics and time-specific macro economic variables are both controlled. We find a statistically significant impact of home appreciation and home sales on these economic measures with home appreciation having a stronger impact than home sales. However, the magnitude of the impact of housing shocks is modest, at least when we compare it to the impact of a shock in the population growth rate.

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I. Introduction

Typically housing is viewed in a consumption framework driven by other economic variables such as income, employment and interest rates. In recent years, with fears of a housing bubble in parts of the USA, housing has been viewed in more of an investment and speculative context. Here we presume the possibility of a larger role for housing as a driver of dynamic economic responses. In this paper we focus on the economic impact of housing shocks. We investigate how shocks in single-family home appreciation, home sales, and new construction affect the local economy. We analyze the dynamic patterns and magnitude of the impact of the housing shocks, and compare these with that of the economic effect of a population growth shock.

The economic impact of the housing market has important policy implications. For instance, while the stock market and the labor market may be characterized as soft or weak from 2001 through mid 2004, the housing market has experienced a strong uptrend in mortgage refinancing, home values, and home sales. In 2002, close to 10 million home owners refinanced their mortgages, and households “cashed out” almost $200 billion of accumulated home equity. The contrast of the weak economy and the strong housing market leads to a few important questions. Is the strong housing market merely a symptom of the lowest mortgage interest rate in the past three decades, or does the housing market and perceived equity reserves have a real impact on the economy, helping

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1 According to the National Association of Realtors average home prices from 2001 through 2004 have increased almost 21% while sales increased by 8% in 2004 over 2001 levels.

2 Remarks by Alan Greenspan at the annual convention of the Independent Community Bankers of America, Orlando, Florida on March 4, 2003
recovery? If it has real economic effects, what are the possible mechanisms and for how long? Does the housing market affect the economy via the well known wealth effect associated with higher home values and refinancing, or realized capital gain associated with home sales, or through the more direct effect of new construction? What is the relative magnitude of these different effects?

Despite the theoretical work by Aoki et al. (2002), which suggests that the housing market may amplify and propagate the effect of monetary policy shocks on the economy since houses serve as collateral of borrowing, there is very limited empirical evidence that provides answers to these questions. Most empirical papers studying the economic effects of housing focus on the consumption effect of housing wealth. These papers provide mixed evidence. Among others, Benjamin et al. (2004), Case (1992), Case et al. (2001), Engelhardt (1996), Kishor (2004), and Skinner (1989) find a strong effect of housing wealth on consumption. Some of the research (e.g. Case et al, 2001) finds a stronger effect of housing wealth on consumption than from the effect of financial wealth. On the other hand, earlier research by Elliott (1980) based on aggregate data finds housing wealth has no effect on consumption. Levin (1998) finds essentially no effect of housing wealth on consumption using the Retirement History Survey. Phang (2002) uses aggregate consumption data from Singapore and finds a negative effect of home price increases on consumption. In contrast to the wealth effect, the economic effects from home sales and new construction are largely ignored.

Our paper differs from the previous research in four important aspects. First, we allow home values, sales and new development to have separate effects. In previous research on the wealth effect, the consumption changes are assumed or implied to be
caused by changing home values. Such an assumption is not justified by empirical evidence and may lead to an upward-biased estimation of the wealth effect and a false understanding of the economic effects of the complete housing market.

Second, we take into account the endogeneity of housing market. Home prices and sales change for reasons. For example, a decrease in the interest rate may increase both the consumption of durable goods and also home prices. Consequently, a direct regression of consumption changes on home price changes may suggest a false causal relation.

Third, we try to disentangle the economic effects of housing and the effects of macro economic variables. We use a panel of 158 metropolitan statistical areas (MSAs) so that unobserved macro economic variables affecting all MSAs can be easily controlled. For example, a decrease in the mortgage interest rate affects all MSAs, but changes of home values may vary across MSAs. The cross-sectional variations of home values effectively help us disentangle the economic effects of housing from the national effects of mortgage rate changes.

Finally, we investigate not only the contemporaneous effects but also the dynamic impact of housing shocks. This provides us a more complete picture of the role of housing market in the economy as there is no reason to believe the effects of housing are simply transient.

We find that shocks in home value appreciation and home sales have statistically significant positive effects on the GMP and metropolitan unemployment rates. New construction, which is measured by new single-family house permits, seems to be a symptom of economic growth and does not have significant economic driving effects.
itself. In terms of magnitude, shocks in home value appreciation have stronger effects than shocks in home sales. However, the magnitude of the effect is modest compared with the magnitude of the economic effects of exogenous shocks such as a shock in population growth rate. In short, we find evidence of a housing wealth effect, consistent with past literature. However, we also find evidence of the effects of home sales, which indicates that the literature may have measured the wealth effect of housing with an upward bias since the effects of home sales were not controlled. Furthermore, we find that the economic effects of housing shocks are relatively modest.

The paper proceeds as follows. In the next section data is presented. Section 3 discusses research design. Empirical evidence is presented in section 4. Section 5 provides conclusions.

II. Data

We use a large panel data set that comprises 6 variables observed quarterly from 1983:2 to 2002:2 in 158 MSAs. The variables are: Gross Metropolitan Product (GMP), the unemployment rate, population, the transaction-based home price index, existing single-family home sales, and total single-family home permits. We use single-family permits as a proxy for new construction. There is empirical evidence that single-family permits accurately capture starts for new construction of single-family homes. For example, Somerville (2001) finds that current and previous quarter permits forecast current construction starts, and 95% of single-family permits are exercised within 3 months after the month of issue.

The GMP and the unemployment rate are provided by the Bureau of Labor Statistics (BLS); the population data are provided by the Bureau of the Census (BOC);
home price indices are provided by the Office of Federal Housing Enterprise Oversight (OFEHO); existing single family sales and total single-family permits are also provided by BOC. To summarize and characterize the data, we plot in figure 1 the scatter points of MSAs according to their means and standard deviations of their GMP growth rates, home appreciation rates, population growth rates, total single-family permit growth rates, existing home sale growth rates, and unemployment rates, respectively.

Our data set has a few important merits. First, it is large. It provides 12,008 (158 MSAs in 76 quarters) observations of the local economy and each observation measures the economy from 6 different perspectives. To our knowledge, our data set is the largest among all data sets that have been used to study the consumption effect of housing wealth. Second, all MSAs are in the United States and thus subject to exactly the same monetary policy, political environment, legal context, tax code, and financial market and practice at the national level. All MSAs, therefore, provide homogenous observations for our analysis, in the sense that the economic influences between housing and the macro economy are similar across MSAs. We believe MSA-level data are superior to international data because housing effects may differ with a different legal and tax environment, and such an environment is difficult to control for international data. Third, MSAs differ from each other at the local-level, which drastically helps us disentangle the economic effects of housing from the effects of common macro economic variables such as the mortgage interest rate. Finally, the sample period covers both a boom and recession so our analysis is less likely to be biased. On the other hand, our data also has limitations. We wish to have but do not have metro level consumption data which would
more directly capture the wealth effect of housing shocks and more accurately track how housing shocks affect the economy via the effects on consumption.

To illustrate the economic and housing variations across MSAs, figure 2 plots the GMP, home price index, population, number of total single-family permits, number of home sales, and unemployment rates in Detroit, New York, and San Jose, respectively. We choose these 3 MSAs because of their distinct economic characteristics. Detroit may be a good example of a “rustbelt” city, which is characterized with stable or declining population, lack of a productive or technology edge and a stable housing market. New York, on the other hand, has long been an international financial center with its large population but very limited supply of land and housing. San Jose represents a “new” economy driven by innovative technologies and high productivity and with a strong but more volatile housing market. It is straightforward to see that the home price index varies significantly across the three MSAs; the home price has increased the most in San Jose and is much more volatile in San Jose and New York than in Detroit. Such housing market variations by size and supply constraint as well as economic growth rate shown in figure 2 certainly help increase the power of our analysis.

Figure 2 also indicates that our sample period is long enough to cover at least one complete housing cycle. For example, San Jose experienced a booming housing market from 1987 to 1990, and then a decline of home prices until 1995. The home prices started to increase again around 1995, and maintained a good momentum until the end of the sample period when softening appeared. The long sample period is certainly beneficial to our analysis because it mitigates possible biases due to sampling from unusual periods in economic cycles. In addition, the time variation of these housing markets also increases
the power of our analysis by providing more opportunities to study possible effects from housing shocks, under the assumption that some variations are unexpected.

III. Model and Estimation

We use a 6-equation VAR model to describe the interactions between the housing market and the economy. For MSA $i$ in time period $t$, the 6 dependent variables are the logged growth rates of GMP, home price index, population, total single-family permits, home sales, and unemployment rate. We denote the 6 logged growth rates by $gmp_{i,t}$, $hp_{i,t}$, $po_{i,t}$, $pt_{i,t}$, $hs_{i,t}$, and $ur_{i,t}$, respectively. We model growth rates instead of levels because levels are almost surely not stationary while growth rates are likely to have steady states in the long run. We use growth rates of aggregate variables instead of per capita variables because population is already at the right side of the equation so the log-linear effect of population on the variables is already captured.

The VAR model can be written as follows.

$$
\begin{bmatrix}
gmp_{i,t} \\
hp_{i,t} \\
po_{i,t} \\
pt_{i,t} \\
hs_{i,t} \\
ur_{i,t}
\end{bmatrix}
= \begin{bmatrix}
\alpha_{gmp}^{gmp} \\
\alpha_{hp}^{hp} \\
\alpha_{po}^{po} \\
\alpha_{pt}^{pt} \\
\alpha_{hs}^{hs} \\
\alpha_{ur}^{ur}
\end{bmatrix}
\begin{bmatrix}
gmp_{i,t-1} \\
hp_{i,t-1} \\
po_{i,t-1} \\
pt_{i,t-1} \\
hs_{i,t-1} \\
ur_{i,t-1}
\end{bmatrix}
+ AX_{t-1} + BX_{t-2} + CX_{t-3} + DX_{t-4} + U_t
$$

In (1), $X_{t-1}, X_{t-2}, X_{t-3},$ and $X_{t-4}$ are 12 by 1 matrices that correspond to 1 to 4-quarter lags. We use 4 lags to capture possible seasonality and annual cycles. The 12 elements in each matrix are the positive (or 0) and negative values (or 0) of the lagged $gmp_{i,t}$, $hp_{i,t}$, $po_{i,t}$, $pt_{i,t}$, $hs_{i,t}$, and $ur_{i,t}$, respectively. We separate positive and negative values to accommodate possible asymmetry in the economy. For example, it is much easier to add
housing supply when demand increases than to reduce the supply when demand falls.\(^3\) \(U_i\) is a vector of i.i.d. error terms. \(A, B, C,\) and \(D\) are 6 by 12 matrices of coefficients.

The model in (1) includes two types of intercept terms. The first type is time invariant MSA-specific intercepts (MSA dummies). We include them to control for unobserved location-related variables that may affect metropolitan economy and remain constant over time. These variables include special geographic features, unique natural resources, etc. It is important to control for location-related constant variables because they certainly affect the performance of economy and might correlate with some of the endogenous variables in our model, and thus may bias the estimation. The second type is time-specific MSA-invariant intercepts (time dummies). We use them to capture macro economic, legal, and political variables and events that affect all MSAs, such as changes of the oil price, changes of the mortgage interest rate, wars, stock market crashes, and changes of regulations and/or tax codes, etc. We use time dummies instead of including as many such variables as possible for two reasons. First, time dummies essentially capture all of common macro variables including for example inflation, so it is unlikely for us to miss some variables. Second, bundling these variables into dummies helps conserve degrees of freedom, which is particularly valuable since our model includes a fairly large number of explanatory variables. Note also that since the national average inflation rate is absorbed by the time dummies, our results could be interpreted as relations among real terms.

Our VAR approach has merits and limitations. The main merit is that it is theory-free in the sense that we are able to investigate the economic effects of housing without

\(^3\) For example, Glaeser and Gyourko (2001) model a kinked housing supply curve which is highly elastic with respect to positive demand shocks and almost completely inelastic with respect to negative shocks in the medium run.
assuming a particular data generating process that is dictated by a particular theory. This feature may also be a limitation though, for our empirical results may not directly support or reject a theory. Nonetheless, our results provide important insights regarding the mechanism of how the housing market affects the economy.

We estimate model (1) row by row. When estimating each row, we conduct two within transformations, within each MSA and each time period respectively, to eliminate the MSA and time dummies. The transformation is equivalent to pre-multiplying the row using the following transformation matrix,

\[ Q = I_{NT} - I_N \otimes \frac{1}{T} ee' - \frac{1}{N} e_N e_N' \otimes I_T + \frac{1}{NT} J \]  

(2)

where \( N \) is the number of MSAs, \( T \) denotes the total periods in our sample, \( I_{NT} \) denotes the \( NT \) by \( NT \) identity matrix, \( e \) is a \( T \times 1 \) matrix of ones, \( e_N \) is a \( N \times 1 \) matrix of ones, and \( J \) is a \( NT \times NT \) matrix of ones, and \( \otimes \) denotes the Kronecker product. We estimate each row of with OLS. The OLS coefficient estimators are consistent when both \( N \to \infty \) and \( T \to \infty \) (e.g., see Hsiao, 1986) despite the dynamic nature of the equation. However, the standard deviation and t-statistic need to be adjusted due to the within transformations.

Our empirical results shall be interpreted as relations among real terms instead of nominal terms. Note that a log nominal growth rate equals a log of real growth rate plus a log of the inflation rate. Since we use the within transformation across MSAs to eliminate the time dummies, the de-meaned log nominal growth rates equal the de-meaned log real growth rates. Intuitively, the inflation rate, at least the national average, is constant across MSAs; therefore, it is controlled by the time dummies in the model.
To illustrate the estimation results, we report the estimated coefficients and their adjusted t-statistics for the first row of model (1) in table 1. The first row contains 48 coefficients, and 19 of them are significantly different from 0 at 5% level. Out of the 19 coefficients, 2 lagged home appreciation rates and 2 lagged home sale growth rates are significant. None of the lagged single-family permit growth rates is significant. We do not report all estimated coefficients because our model has 288 coefficients in total and tabulating them is not an efficient way to present the results. In addition, due to the existence of 4 lags and 6 interacting variables, the coefficients per se do not provide a clear picture regarding the economic relations between the variable.

IV. Economic Effects of Housing Shocks

We use a variety of impulse response functions to analyze the economic effects of housing shocks. To construct the impulse response functions, we follow the convention (e.g., Hamilton, 1994) and let all lagged variables and intercepts be 0, and introduce a transitory shock (an exogenous change) on a particular noise term but not others. Since the VAR system is a log linear system, a noise that equals log(1.1) implies that the corresponding variable has an exogenous increase of 10%. A noise that equals log(0.9) implies that the variable has an exogenous decrease of 10%. We let all noise terms be 0 in the period following the shock, so the shock is transitory. The values of the six endogenous variables in the period following the shock calculated by plugging into the VAR system the estimated coefficients, the shock, the noise terms, and the initial values of the lagged variables, which are all 0. We then plot the dynamic response of the variable that is of interest to us to the transitory shock. The starting value of the variable
is 1. Values greater than 1 suggest positive deviations from the normal equilibrium level. For example, 1.02 means the variable is 2% higher than the equilibrium level.

Figure 3 manifests a few relations about the dynamic response of the GMP to a transitory 10% increase in the GMP growth rate, home price appreciation rate, population growth rate, single-family permit growth rate, home sale growth rate, and unemployment growth rate, respectively. First, all shocks affect the future GMP growth rate, and the direction of the effects are sensible. The future GMP growth rate would increase if currently the GMP growth rate increases, the home price appreciation rate increases, population growth rate increases, single-family permit growth rate increases, and unemployment rate decreases. Second, the GMP growth rate responds differently to different shocks. The most significant impact is made by the shock in population growth rate. A 10% increase in the population growth rate increases the GMP growth rate up to 30% (3 quarters after the shock), and the impact lasts for a long time. About 12 quarters after the shock, the GMP growth rate can be still about 10% higher than the equilibrium level. The impact also seems cyclical. Among the housing shocks, the shock in home appreciation rate has the most significant effect. The GMP growth rate increases by up to about 0.5%, which is trivial compared with the effect of population shock. The shocks in home sales and single-family permits have even weaker effects. However, the effect of the home appreciation rate shock is much stronger than the effect of the unemployment rate shock. This seems to imply that housing provides somewhat of an economic shock absorber effect on the local economy.

To further study the mechanism of the interaction between the housing market and the growth rates of GMP and unemployment rate, we plot the economic effects of
housing shocks in figures 4 to 8. Figure 4 plots the effects of a transitory home appreciation shock. It is clear that the shock immediately increases new construction growth rate up to about 8%, and then slowly and modestly increases the GMP growth rate. We also observe an overshooting of new construction. When the effect on permit growth rate decays, the permit growth rate drops below the equilibrium level significantly. This is consistent with an overreaction of new construction to positive home appreciation shocks. At the same time, the shock decreases the unemployment rate and the home sales growth rate.

The decrease of home sales is interesting. It may indicate that our model effectively disentangles the effects of mortgage interest rate from the effects of home appreciation shocks, because if the mortgage interest rate is not controlled, home appreciation shocks may coincide with an increase of home sales. The decrease of home sales may also be caused by magnified discrepancies on the valuation of homes due to the noise introduced by the shock. The more noise the market contains, the less likely buyers and sellers agree on home values or even know what the homes are worth. In such a market fewer transactions are observed, once we control for interest rates. Overall, figure 4 shows that the home appreciation shock increases new construction and GMP growth rate, reduces unemployment rate and home sales.

In the real world, housing shocks can be persistent and their total effects may be much stronger. We analyze the effects of a long-lived home appreciation shock by plotting the effects of an 8-quarter persistent 10% shock in the home appreciation rate. We observe similar patterns of the impact with a transitory shock, but the magnitude and the length of elapsed time is different. Nor surprisingly, the effects are much stronger
and last for a longer period of time. The GMP growth rate can be increased by up to about 5%, and the growth rates of home sales and unemployment rate are reduced by about 6% and 9% respectively.

Figure 6 shows the effects of a transitory 10% exogenous increase in the home sale growth rate. The effects are much weaker compared with the effects of a home appreciation shock. In addition, it seems that the increase in home sales growth rate reduces the new construction growth rate. This may indicate that an exogenous home sale increase often coincides with a relative increase of new housing supply: the new construction becomes less profitable and slows down due to the increased supply. Figure 7 plots the effects of an 8-quarter persistent shock in home sales. The basic patterns are similar and the effects are still weak compared with the effects of the home appreciation shocks.

Figure 8 and figure 9 plot the effects of a transitory and a persistent shock in new construction. The effects of the transitory shock are very weak, while the effects of the persistent shock are stronger and seem to provide more insights. First, figure 9 shows an exogenous of new construction increases the future home appreciation rate. This may indicate that new construction may have positive externalities on the housing market, due to the creation of area amenities or the promotion made by developers. For example, several thousand new condominiums in Chicago in the 2000-2004 period has clearly led to significant local investment in retail and restaurants and other amenities which in turn has increased home values. The growth rate of the unemployment rate is reduced up to 0.5% by the shock, and the GMP growth rate increases slightly. Overall, the effects of new construction are weak.
V. Conclusions

We use a 6-equation VAR model to study the economic effects of housing shocks. Specifically, we study the patterns and magnitude of shocks in home appreciation rate, home sale growth rate, and new construction growth rate on the GMP growth rate and unemployment growth rate. Our analysis relies on a large panel of 158 MSAs in a sample period from 1983 to 2002. The rich cross-sectional and cross-time variations of variables in our data dramatically increase the power of our analysis. We also use dummies to control for time-related common variables and location-related MSA attributes, so our model more accurately capture the interactions between the housing market and the economy.

We find that the effects of home appreciation rate and home sale growth rate are statistically significant, but the effects of new construction are not. The shock in home appreciation has stronger effects than the shock in home sales. However, the magnitude of the economic impact of housing shocks seems modest when compared with the effects of a shock in population growth rate. Our results are consistent with the existence of a wealth effect of home value appreciation on the local economy. It seems that housing wealth does provide some stabilization in this regard. However, our results also indicate that home sale changes also affect the economy; therefore, measurements of the wealth effect can be upward biased if home sales are not properly controlled. Last, we find that more noise in the value of homes decreases the level of transactions or sales, once interest rates are controlled, possibly indicating greater homeownership risk if not difficulty in simply judging home values on the part of buyers and sellers. If buyers and sellers do not know the value of their homes they may be more hesitant to buy or sell.
References


Kishor, Kundan N., 2004, “Does consumption respond more to housing wealth than to financial market wealth?” University of Washington working paper.


Table 1
This table reports the estimated coefficients and their t-statistics for the first row of the 6-equation VAR model, which is a regression of the log GMP growth rate upon 1 to 4-quarter lags of the log growth rates of GMP, home values, population, single-family permits, home sales, and unemployment rate. In the regressions, positive values and negative values of the regressors are separated to accommodate possible asymmetric effects. We report 100 times of the estimated coefficients for single-family permits, home sales, and the unemployment rate because the coefficients are small numbers.

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<th>Negative values or 0</th>
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<tr>
<td></td>
<td>(2.6)</td>
<td>(1.4)</td>
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<tr>
<td>100*UR</td>
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<td>-0.35</td>
</tr>
<tr>
<td></td>
<td>(-1.7)</td>
<td>(-1.4)</td>
</tr>
</tbody>
</table>
Figure 1
This figure plots the scatter points of MSAs according to their means and standard deviations of GMP growth rate, home appreciation rate, population growth rate, single-family permit growth rate, home sale growth rate, and unemployment rate, respectively.
Figure 2
This figure plots the time series of GMP, home prices, population, single-family permits, home sales, and unemployment rate for Detroit, New York, and San Jose.
Figure 3
This figure plots the dynamic response of the GMP growth rate to a 10% transitory positive (negative) shock in the growth rates of GMP, population, unemployment rate, home price appreciation, single-family permits, and home sales.
Figure 4
This figure plots the dynamic impact of a transitory 10% increase in the home appreciation rate on the growth rates of GMP, single-family permits, home sales, and unemployment rate.

The Economic Impact of A Transitory Home Appreciation Shock
Figure 5
This figure plots the dynamic impact of a persistent (8-quarter long) 10% exogenous increase in the home appreciation rate on the growth rates of GMP, single-family permits, home sales, and unemployment rate.

The Economic Impact of A 2 Year Long Home Appreciation Shock
Figure 6
This figure plots the dynamic impact of a transitory 10% increase in the growth rate of home sales on the growth rates of GMP, home appreciation rate, single-family permits, and unemployment rate.
Figure 7
This figure plots the dynamic impact of a persistent (8-quarter long) 10% exogenous increase in the growth rate of home sales on the growth rates of GMP, home appreciation rate, single-family permits, and unemployment rate.
Figure 8
This figure plots the dynamic impact of a transitory 10% exogenous increase in the growth rate of single-family permits on the growth rates of GMP, home appreciation rate, home sales, and unemployment rate.
Figure 9
This figure plots the dynamic impact of a persistent (8-quarter long) 10% exogenous increase in the growth rate of single-family permits on the growth rates of GMP, home appreciation rate, home sales, and unemployment rate.