

The Economic Impact of House Price Changes: A Panel VAR Approach

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Presentation Outline

- Motivation
- Data
- Linear regressions vs. panel VARs
- Parameter stability tests
- Granger Causality and financial markets
- Conclusions

Research Question

- Do real house price changes Granger cause real output growth?

Theories

- Wealth effect
 - Friedman's permanent income hypothesis
- Collateral effect
 - Aoki, Proudman and Vlieghe (2002), Lustig and Nieuwerburg (2004), and Ortalo-Magné and Rady (2004)

Empirical Evidence

- Supporting
 - On consumption
 - Bhatia (1987)
 - Benjamin, Chinloy and Jud (2004), Case, Quigley and Shiller (2001), Kishor (2004)
 - On saving
 - Engelhardt (1994), Engelhardt (1996), and Sheiner (1995)
- Not supporting
 - Phang (2004)

Possible Problems of Existing Empirical Studies

- Simultaneity
 - Most empirical papers rely on linear regressions
 - House price as a independent variable may not be “independent”
 - Unobserved variables may affect both house prices and consumption/saving
- Parameter stability
 - Collateral effect relates to cost of refinance and home equity loan, which varies over time
 - Economic structure varies over time
- Literature
 - Either relies on linear regressions
 - Or use simple VAR without controlling any macro variables or nonstationary parameters

Intended Contributions

- Understand whether house price changes affect output of the economy
 - Treating both output and house prices as endogenous
 - Controlling macro economic variables
 - Allowing non-stationary parameters

Data

- A large panel data
 - 127 Metropolitan statistical areas
 - From 1990:1 to 2002:2
 - 5 MSA level time series for each MSA
 - Per capita GMP
 - Single family home price index
 - Average household income
 - Population
 - Unemployment rate
 - 2 national level time series
 - SP500 index
 - National average 30 year fixed rate mortgage

Data Summary

Table 1 Data Summary

Panel A summarizes the respective mean, median, standard deviation for the time series of first order differences of the log values of per capita GMP (GMP), home price index (HP), population (PO), average household income (HI), unemployment rate (UR), 30-year fixed rate mortgage rate, and the SP500 index. Panel B reports their 1 to 4-quarter autocorrelations. Panel C reports correlations among the variables. For statistics involving MSA level variables (GMP, HP, PO, HI, UR), the reported numbers are across MSA averages. For these variables, we also report the t statistics with the null hypotheses being that the distributions of the variables have zero means. * denotes significance at the 5% level and ** at the 1% level.

	GMP	HP	PO	HI	UR	MR	SP
Panel A. Mean, median, and standard deviation							
Mean	**0.245%	**0.273%	**0.301%	**0.204%	-0.047%	-0.876%	1.185%
Median	**0.280%	**0.275%	**0.298%	**0.218%	**0.373%	-1.196%	2.339%
Sta. Dev.	**1.184%	**1.417%	**0.153%	**1.041%	7.647%	5.068%	7.900%
Panel B. Autocorrelation							
1 quarter	**0.285	**0.084	**0.947	**0.141	**0.255	0.135	-0.081
2 quarter	**0.160	**0.084	**0.820	**0.284	**0.113	0.078	0.125
3 quarter	-0.027	**0.101	**0.665	**0.172	0.007	-0.049	0.219
4 quarter	0.017	**0.089	**0.522	**0.127	**0.067	-0.252	0.045
Panel C. Correlation							
GMP	1	**0.162	*-0.039	**0.405	**0.229	**0.068	**0.224
HP		1	*0.041	**0.161	0.027	**0.067	**0.045
PO			1	**0.038	-0.020	**0.031	**0.100
HI				1	**0.132	**0.194	**0.099
UR					1	**0.063	**0.126
MR						1	0.038
SP							1

Linear Regressions

- 9 different specifications

$$gmp_{i,t} = \alpha_0 + \alpha_1 quarter1_{i,t} + \alpha_2 quarter2_{i,t} + \alpha_3 quarter3_{i,t} + \beta hp_{i,t} + \varepsilon_{i,t}$$

Linear Regressions

Table 2 Contemporaneous Panel Regressions

This table reports the results of nine different specifications of the regression of growth rates of per capita GMP on contemporaneous appreciation rates of house price index (HP) and a variety of control variables. Control variables include growth rates of population (PO), growth rates of average household income (HI), change rates of unemployment rates (UR), growth rates of the 30-year fixed rate mortgage rate (MR) and their differences (MR²), and appreciation rates of the SP500 index (SP) and their differences (SP²). All growth and appreciation rates are in log terms (i.e. differences of log values). For each specification, results include estimated coefficients and their standard deviations (in brackets), whether the specification includes quarter dummies, MSA fixed effects, or time fixed effects, and the multiple R square. For estimated coefficients, * denotes significance at the 5% level and ** at the 1% level.

	1	2	3	4	5	6	7	8	9
HP	**0.070 [0.014]	**0.050 [0.014]	**0.067 [0.014]	**0.067 [0.014]	**0.050 [0.014]	**0.068 [0.014]	*0.037 [0.016]	*0.026 [0.012]	*0.026 [0.012]
PO		-0.111 [0.062]	*-0.123 [0.062]		**0.291 [0.096]	**0.322 [0.097]		-0.044 [0.062]	-0.155 [0.106]
HI		**0.339 [0.022]	**0.348 [0.022]		**0.326 [0.022]	**0.334 [0.023]		**0.340 [0.028]	**0.320 [0.002]
UR		**0.029 [0.002]	**0.025 [0.002]		**0.030 [0.002]	**0.026 [0.002]		**0.026 [0.002]	**0.026 [0.002]
MR			**0.034 [0.005]			**0.034 [0.005]			
MR ²			**0.030 [0.003]			**0.029 [0.003]			
SP			**0.013 [0.003]			**0.014 [0.003]			
SP ²			0.003 [0.003]			0.002 [0.003]			
Quarter dummy	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
MSA fixed effect	No	No	No	Yes	Yes	Yes	No	No	Yes
Time fixed effect	No	No	No	No	No	No	Yes	Yes	Yes
R ²	0.06	0.16	0.17	0.11	0.20	0.22	0.18	0.24	0.26

Panel VARs

- 9 different specifications

$$gmp_{i,t} = \alpha_0 + \alpha_1 quarter1_{i,t} + \alpha_2 quarter2_{i,t} + \alpha_3 quarter3_{i,t} + \sum_{s=1}^3 \gamma_s gmp_{i,t-s} + \sum_{s=1}^3 \beta_s hp_{i,t-s} + \varepsilon_{i,t}$$

$$hp_{i,t} = \alpha_0 + \alpha_1 quarter1_{i,t} + \alpha_2 quarter2_{i,t} + \alpha_3 quarter3_{i,t} + \sum_{s=1}^3 \gamma_s gmp_{i,t-s} + \sum_{s=1}^3 \beta_s hp_{i,t-s} + v_{i,t}$$

Panel VAR Results

Table 3 Panel VAR Regressions

This table reports the results of the GMP equation in nine different specifications of a conditioning bivariate VAR model with the growth rate of per capita GMP and the appreciation rate of house price index (HP) as the two endogenous variables. Conditioning variables include contemporaneous growth rates of population (PO), household income (HI), unemployment rates (UR), as well as the growth rate of the 30-year fixed rate mortgage rate (MR) and its difference (MR2), and the appreciation rate of the SP500 index (SP) and its difference (SP2). All growth and appreciation rates are in log terms (i.e. differences of log values). For each specification, results include estimated coefficients and their standard deviations (in brackets), whether the specification includes quarter dummies, MSA fixed effects, or Time fixed effects, the F value of a Granger causality test (the null hypothesis being that all coefficients of lagged HP are zero), and the multiple R square. For estimated coefficients and F values of the Granger causality test, * denotes significance at the 5% level and ** at the 1% level.

	1	2	3	4	5	6	7	8	9
IIP lag 1	-0.002 [0.012]	0.002 [0.013]	0.009 [0.013]	-0.007 [0.014]	0.001 [0.014]	0.003 [0.012]	0.016 [0.013]	0.020 [0.013]	0.019 [0.013]
HP lag 2	0.013 [0.011]	0.015 [0.013]	0.014 [0.013]	0.009 [0.014]	0.013 [0.014]	0.012 [0.012]	0.019 [0.013]	0.019 [0.012]	0.018 [0.013]
IIP lag 3	0.014 [0.011]	0.017 [0.015]	0.015 [0.015]	0.011 [0.016]	0.016 [0.015]	0.008 [0.011]	0.006 [0.012]	0.007 [0.011]	0.006 [0.012]
GMP lag 1	**0.354 [0.013]	**0.311 [0.065]	**0.308 [0.067]	**0.337 [0.068]	**0.295 [0.067]	**0.284 [0.013]	**0.346 [0.013]	**0.310 [0.013]	**0.293 [0.013]
GMP lag 2	** -0.045 [0.014]	-0.061 [0.067]	-0.067 [0.066]	-0.054 [0.072]	-0.070 [0.068]	** -0.062 [0.013]	** -0.045 [0.013]	** -0.054 [0.013]	** -0.064 [0.013]
GMP lag 3	** -0.048 [0.013]	-0.060 [0.043]	-0.048 [0.041]	-0.064 [0.044]	-0.075 [0.044]	** -0.082 [0.012]	** -0.068 [0.013]	** -0.072 [0.013]	** -0.089 [0.013]
PO		-0.050 [0.058]	*0.132 [0.057]		-0.162 [0.096]	-0.123 [0.098]		-0.036 [0.063]	-0.135 [0.111]
HI		**0.263 [0.024]	**0.280 [0.025]		**0.257 [0.024]	**0.269 [0.017]		**0.261 [0.019]	**0.251 [0.020]
UR		** -0.025 [0.002]	** -0.022 [0.002]		** -0.025 [0.003]	** -0.023 [0.002]		** -0.024 [0.002]	** -0.024 [0.002]
MR			**0.022 [0.005]			**0.026 [0.004]			
MR2			** -0.022 [0.004]			** -0.020 [0.003]			
SP			-0.001 [0.004]			-0.001 [0.004]			
SP2			*0.005 [0.003]			*0.008 [0.003]			
Quarter dummy	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
MSA fixed effect	No	No	No	Yes	Yes	Yes	No	No	Yes
Time fixed effect	No	No	No	No	No	No	Yes	Yes	Yes
Granger F values	0.92	1.32	1.21	0.56	1.05	0.49	1.19	1.61	1.13
R2	0.18	0.23	0.27	0.22	0.28	0.29	0.29	0.31	0.33

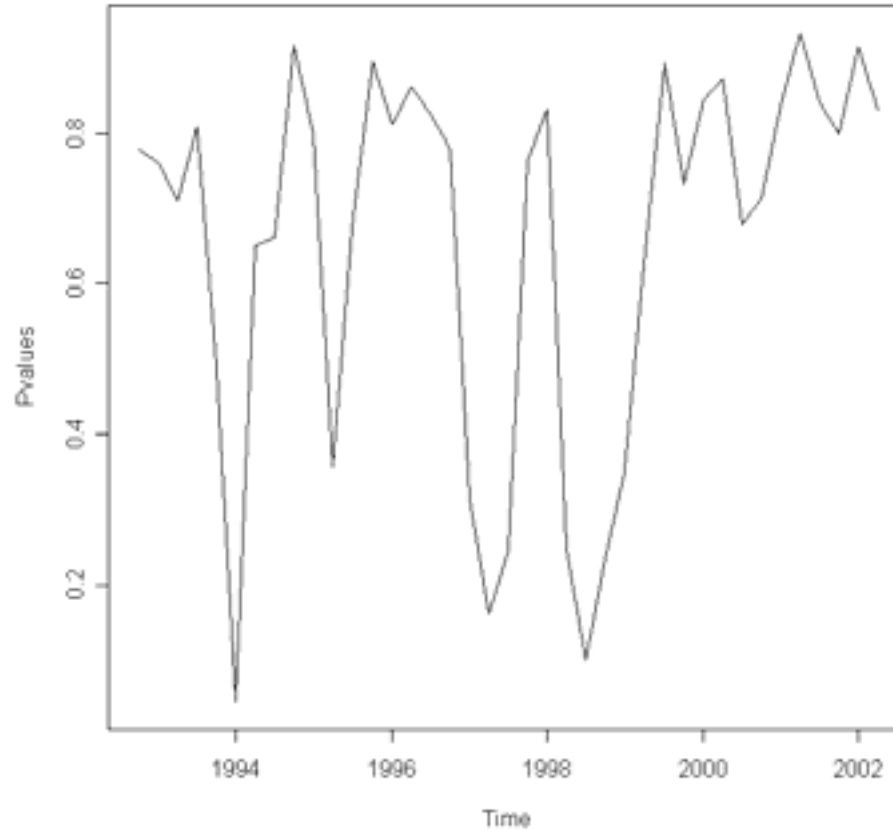
Parameter Stability

Table 4 Stability Tests for the GMP Equation in the VAR Model

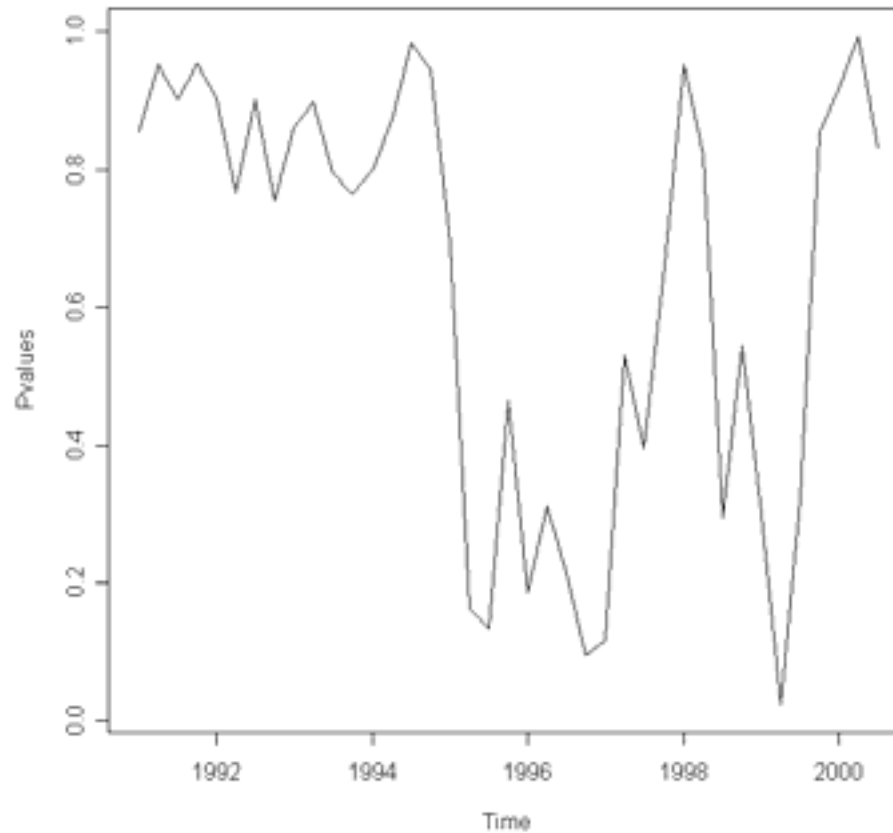
This table summarizes results of parameter stability tests for the GMP equation in the sixth specification of the bivariate VAR model. Tests are conducted for each MSA separately, and three test statistics, Sup F, Ave F, and Exp F, are calculated for each MSA. Across MSA minimum, median, mean, maximum, and standard deviation of each test statistics are reported. This table also reports the number and percentage of MSAs with each test statistic being significant at 1%, 5%, and 10% levels respectively.

	Sup F	Ave F	Exp F
Minimum	9.35	6.80	3.78
Median	31.23	20.30	13.78
Mean	38.98	22.77	17.61
Maximum	162.13	84.62	78.67
Std. Dev.	25.94	12.75	12.73
# of MSAs at 1%	36 (28.35%)	19 (14.96%)	37 (29.13%)
# of MSAs at 5%	48 (37.80%)	25 (19.68%)	55 (43.31%)
# of MSAs at 10%	66 (51.97%)	36 (28.34%)	70 (55.12%)

Granger Causality Tests in Rolling Windows



Granger Causality Tests in Increasing Size Windows



Granger Causality and Financial Market Conditions

Table 5 Granger Causality P Values and Financial Markets

This table reports the result of the regression of the P values of the Granger causality tests in fixed size (eight quarters) rolling windows on five measures of financial market conditions in corresponding windows. The five measures are: the average level of the 30-year fixed rate mortgage rate (MR level), the average change rate of the mortgage rate (MR change), the standard deviation of the mortgage rate (MR sd), the average appreciation rate of the SP500 index (SP change), and the standard deviation of the SP500 index (SP sd). * denotes significance at the 5% level and ** at the 1% level.

	MR level	MR change	MR sd	SP change	SP sd
Coefficient	12.94	0.50	2.62	** -0.41	1.33
Std. Dev.	10.92	0.34	2.76	0.14	1.46
t-statistic	1.18	0.52	0.94	-2.89	0.91
R2	0.04	0.06	0.02	0.18	0.02

Conclusions

- A puzzle
 - Significant correlation
 - Insignificant Granger Causality
- Unstable parameters
 - Not a good idea to assume stationary parameters
 - Structural breaks or changes
- In short
 - Call for more theories and empirical analysis