Does an Oligopolistic Primary Market Matter? The Case of an Asian Housing Market

Tang, Edward Chi Ho and Leung, Charles Ka Yui and Ng, Joe Cho Yiu

Hong Kong Shue Yan University, City University of Hong Kong, City University of Hong Kong

June 2018

Does an Oligopolistic Primary Market Matter? The Case of an Asian Housing Market[1]

Edward C. H. Tang[2]
Assistant Professor, Department of Economics and Finance, Hong Kong Shue Yan University, North Point, Hong Kong, email: chtang@hksyu.edu

Charles K. Y. Leung
Associate Professor, Department of Economics and Finance, City University of Hong Kong, Kowloon Tong, Hong Kong, email: kycleung@cityu.edu.hk

Joe C. Y. Ng
PhD candidate, Department of Economics and Finance, City University of Hong Kong, Kowloon Tong, email: joecyng-c@my.cityu.edu.hk

This version: June 2018

Abstract

This paper takes advantage of the oligopolistic structure of the Hong Kong primary housing market and examines whether the time-variations of the market concentration are caused by or cause the variations of the local economic factors. The analysis also takes into consideration of the changes of the U.S. variables and commodity prices, which arguably may represent changes in the construction cost. We find clear evidence of time-varying responses of housing market variables to macroeconomic variables. Policy implications and directions for future research are also discussed.

Keywords
Oligopoly, market share, Herfindahl index, macroeconomic variables, dynamic factor model, Time-Varying Bayesian Factor Augmented VAR

JEL Classification
E30, L13, L85, R31

[1] Acknowledgement: We thank Pohan Fong, Steve Malpezzi, Tim Riddiough, Abdullah Yavas, seminar participants of the North American Regional Science Council (NARSC) for helpful comments. Part of this research was conducted when Leung visited University of Wisconsin-Madison, whose hospitality is gratefully acknowledged. The usual disclaimer applies.
[2] Corresponding author

…The extremely large number of homebuilders nationwide certainly makes the construction industry look competitive. The 1997 Economic Census reports almost 140,000 firms in the single-family construction business. There is concentration in the industry, but it is not dominated by only a handful of companies, as there were over seventeen hundred firms with revenues in excess of $10 million annually. There are many fewer builders of apartment complexes, but the same data source indicates over seventy-five hundred firms in the sector. At least for big cities such as New York, there is no evidence of control by a few firms….

Edward Glaeser and Joseph Gyourko, Rethinking Federal Housing Policy, 2008, p.52

…In particular, to the extent that construction firms have some degree of monopoly power, we will mistake monopolistic price setting for government-created barriers to entry. However, all the available evidence suggests that the housing production industry is highly competitive… The multifamily housing industry is only slightly less concentrated. In 1997, there were 7,544 establishments in this industry and more than 1,000 in New York State alone. According to County Business Patterns, over 100 such establishments were headquartered in Manhattan, with another 329 elsewhere in New York City. Nearly two-thirds of the multi-family builders in Manhattan were relatively small enterprises with fewer than 10 employees; nearly three-quarters of all such enterprises in New York City have fewer than 10 employees. Because this is not an industry controlled by a few large firms, it is highly unlikely that there is any monopoly power with which to set prices….

Edward Glaeser, Joseph Gyourko and Raven Saks, Why is Manhattan so Expensive, 2005, p.337.

Introduction

Does an oligopolistic market matter? For non-durable goods, the Economics literatures have provided much theoretical works and evidence that it does (for instance, Tirole, 1988; Waldman and Jensen, 2012). In the case of durable goods, the situation may be different. As goods are durable, we need to separate the primary from the secondary market. Once we make such distinction, we also recognize that the primary market buyers could re-sell their goods in the secondary market in the future. In other words, *from the perspective of a primary market seller, customers today could become competitors tomorrow*. Would the potential "threats" of the secondary market constrain the pricing, and potentially other behaviors, of the primary market producers? In a seminal paper, Coase (1972) argues that it is the case and that leads to a large theoretical literature on the topic.

Clearly, to empirically test the importance of an oligopolistic primary market, we need to address several questions. First, we need to identify goods with an oligopolistic primary market. Second, we would ask why the primary market is oligopolistic in the first place. Third, we would like to take into account the factors that both drive the primary market to be oligopolistic and affect the price in the whole market. Therefore, to evaluate whether the "concentration" of the primary market has an effect on the price, we would need to "separate" the effect of the market structure from other "exogenous factors". Recently, Chen et al (2013) calibrate a structural model of US automobile market, which is clearly oligopolistic in the primary market, and find that the net effect of opening the secondary market would suppress the profit of new car manufacturers as much as 35 percent. It is then natural to ask whether the same is true for housing, which is also a durable consumption goods and arguably being at least as important as automobile, and has an important secondary market as automobile.[3] Unfortunately, the importance of an oligopolistic primary market may not be easily tested with the U.S. housing data. As reflected by the quotations, Glaeser and Gyourko (2008), Glaeser et al (2005), among others, it is not easy to find a city in which a few developers dominate the primary market. In addition, Somerville (1999) suggests that homebuilders in United States should be treated as monopolistically competitive suppliers of differentiated products, where the builder size and concentration vary across different MSA. Thus, it may be controversial to identify a housing market in U.S. whose primary market is oligopolistic in the first place.

This paper attempts to address the importance of an oligopolistic housing market in an Asian city, namely Hong Kong. In 2013, there are 34 major private developers listed in Hong Kong. In addition, the Urban Renewal Authority, which is a quasi-government

[3] Among others, Stein (1995) argues that secondary market transactions typically dominate the primary ones in the housing market.

profit making body, is also active in the market [Table 1]. In this paper, we define the developers' market share as the percentage of total gross floor area completed, and we find that these 35 developers could take more than 90% of the total [Figure 1a].[4] More importantly, the market share of top 10 developers can be as high as 80% [Figure 1b]. Thus, the housing market of Hong Kong provides us a natural platform to study the effect of an oligopoly structure of primary market.

Other features of the Hong Kong economy may provide further justifications for the study. For instance, there is neither capital control nor capital gains tax in the Hong Kong housing market. During our sampling period, the nominal exchange rate between the U.S. dollar and Hong Kong dollar has remains fixed, and foreign investors receive equal treatment as domestic ones. All these features facilitate the possibility of arbitrage by domestic and foreign investors. In addition, Hong Kong does not practice fiscal federalism. Public goods provision (such as public schools, police, etc.) is financed by the overall budget of the Hong Kong government rather than local property tax. Most residents in Hong Kong are broadly-defined Chinese. All these factors mitigate certain incentives behind segregation and hence simplify the analysis.[5]

Traditionally, the existence of an oligopolistic primary housing market in Hong Kong is attributed to the land scarcity of Hong Kong. According to the CIA World Factbook (2012), for each square kilometers of land in Hong Kong, it hosts 6,480 people, which is the second densest country in the world [Figure 2]. On top of that, only 7% of land is used for residential purposes, hence actually the living environment is even more crowded [Figure 3]. To host such an amount of population, an obvious solution is to build high-rise buildings[6]. Unlike detached houses in United States, which may take several months to complete, it is normal to spend more than three years to complete a residential project in Hong Kong. Starting from land auction[7], to site investigation and foundation, and finally superstructure and completion[8], it requires huge amount of human resources and capital. That may create an implicit barrier for other firms to enter the market. Table 1 shows that the market capitalization of the top four developers, including SHK, CKH, HEN and NWD, ranges from HK$79 billion to HK$329 billion.

[4] Clearly, there are other alternative measurements. Unfortunately, total gross floor area is the only variable commonly reported in all listed developer annual reports. Hence, we recognize the limitation and restrict our attention to this measure.

[5] Among others, see Hanushek and Yilmaz (2007) show how fiscal federalism would change the locational choices of economic agents and hence the equilibrium rent gradient.

[6] In United States, condominium developers compete with multifamily counterparts for a piece of land [Cypher and Hayunga (2010)]. However, it usually occurs in Hong Kong that the developers compete a piece of land through an auction, and then build condominiums on it.

[7] Ching and Fu (2003) show that the Hong Kong land market is imperfectly contestable.

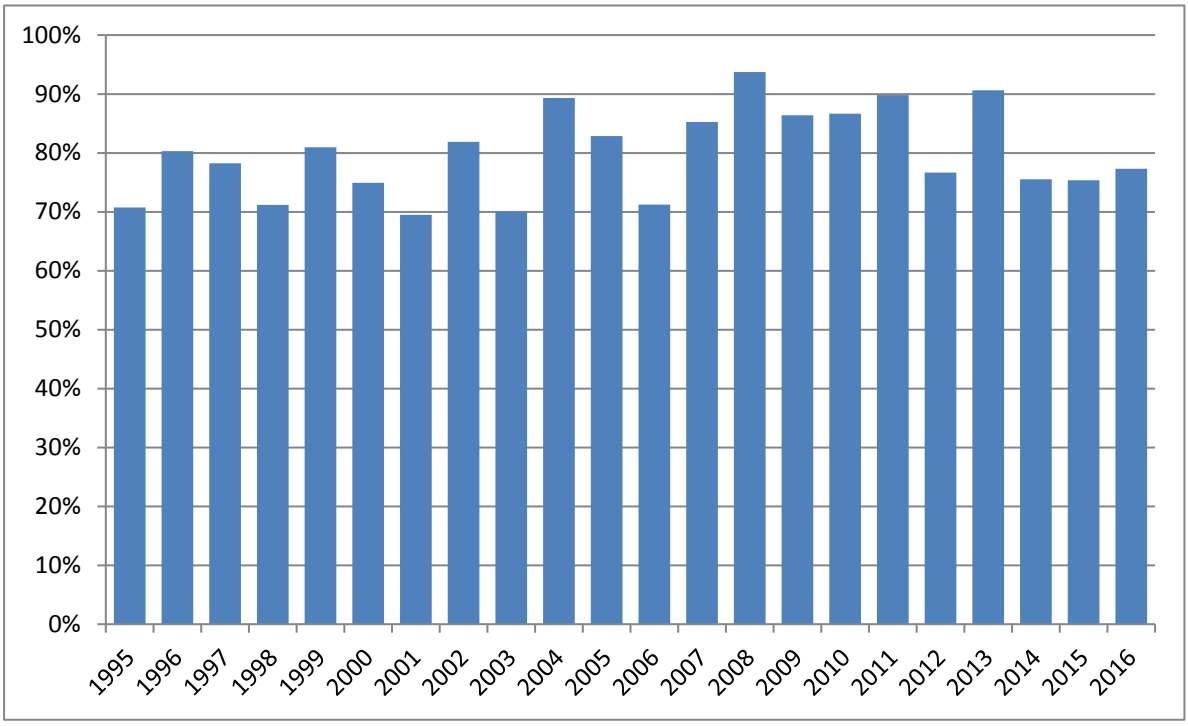
[8] In the multi-stage construction process, Spiegel (2001) shows that developers acquire land when expected housing returns lie above the rate of interest, and develop when housing returns lie below.

Table 1 Major Property Developers in Hong Kong

Property Developers (Top 10 developers are marked with *)	Abbreviations	Stock Code	Market Capitalization as at 7 Jan 2015 (HKD)
Hutchison Whampoa Property *	HUT	0013	368,994,741,009
CITIC	CITIC	0267	338,187,134,895
Sun Hung Kai Properties Limited *	SHK	0016	329,159,467,650
Cheung Kong (Holdings) Limited *	CKH	0001	294,152,870,926
China Overseas Land and Investment Ltd.	COL	0688	203,531,990,099
MTR Corporation	MTR	0066	183,478,517,681
Wharf Holdings Limited *	WH	0004	172,717,257,639
Henderson Land Development Co Ltd *	HEN	0012	160,368,130,240
Hang Lung Properties Limited *	HL	0101	95,312,575,488
Swire Pacific A	SW	0019	89,290,040,100
New World Development *	NWD	0017	79,151,411,398
Wheelock Properties	WHEEL	0020	74,467,276,369
Sino Land *	SINO	0083	74,466,645,920
Chinese Estates Holdings Limited	CEH	0127	48,835,048,422
Hang Lung Group	HLG	0010	46,880,171,173
New World China Land Limited	NWCL	0917	42,644,340,367
Kerry Properties Limited	KP	0683	40,592,507,707
China Resources	CR	0291	39,371,400,819
PCCW	PCCW	0008	38,831,055,614
Hysan Development Company Limited *	HYS	0014	37,288,702,805
Hopewell Holdings Limited *	HOPE	0054	25,309,964,170
K. Wah International	KW	0173	11,873,106,790
Shun Tak Holdings Limited	STH	0242	11,013,726,142
Kowloon Development Company Limited	KDC	0034	10,632,294,981
Emperor International	EMP	0163	6,388,890,574
Hong Kong International Limited	HKR	0480	5,266,070,031
Tai Cheung Holdings Limited	TCH	0088	3,933,675,177
Lai Sun Development	LSD	0488	3,631,383,685
SEA Holdings	SEA	0251	3,606,888,987
Hong Kong Ferry (Holdings) Co Ltd	HKF	0050	2,985,575,140
Asia Standard International	ASI	0129	2,237,373,982
Y. T. Realty	YTR	0075	1,886,955,499
Chuang's Consortium International Ltd.	CCI	0367	1,623,274,633
Tai Sang Land Development	TSLD	0089	1,098,898,162
Urban Renewal Authority (quasi-government profit making statutory body)	URA	---	---

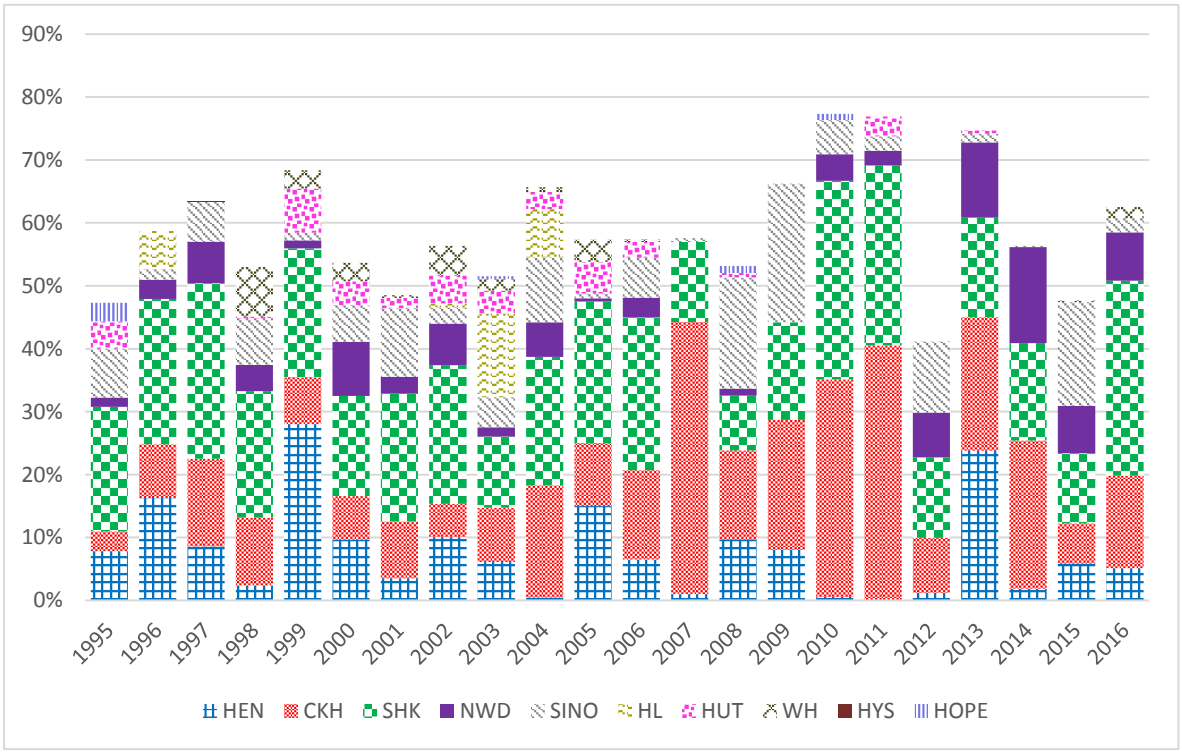
Source: Hong Kong Stock Exchanges and Clearing Limited

Figure 1a Market Share of the Major Real Estate Developers in Hong Kong



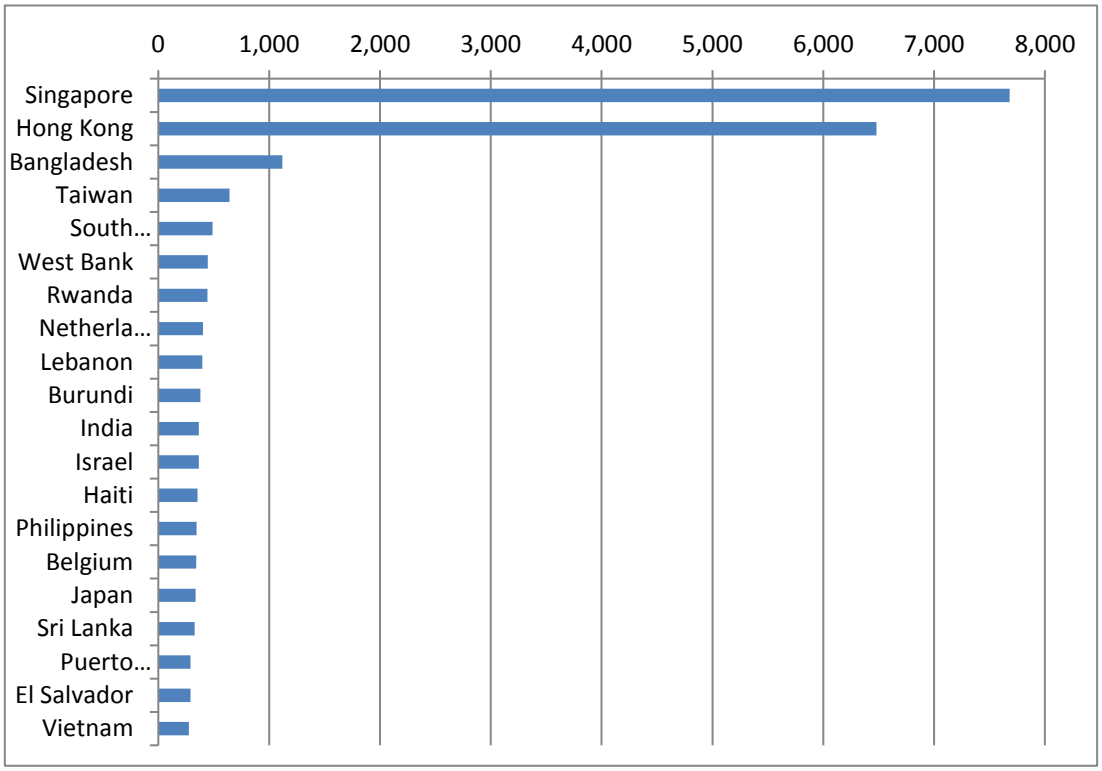
Source: Authors' calculations

Figure 1b Market Share of the Top 10 Developers in Hong Kong



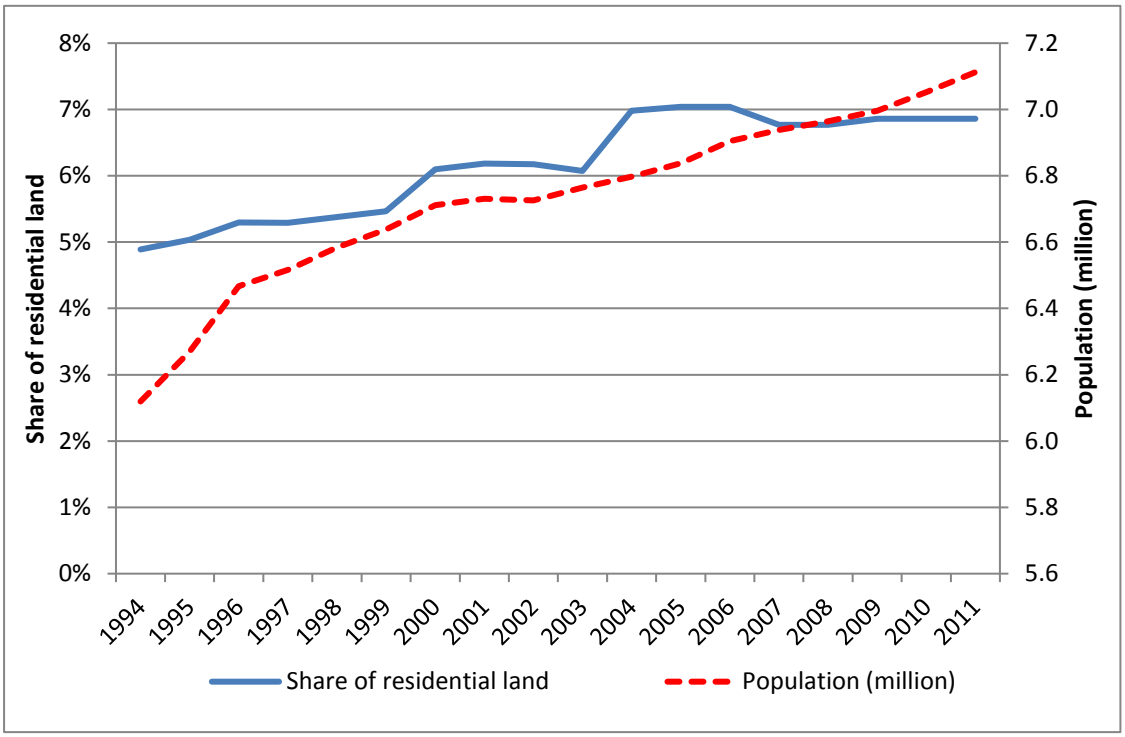
Source: Authors' calculations

Figure 2 Densities of the Countries (People per Square Kilometers of Land)



Source: CIA World Factbook (2012)

Figure 3 Share of Land Used for Residential Purpose and Population

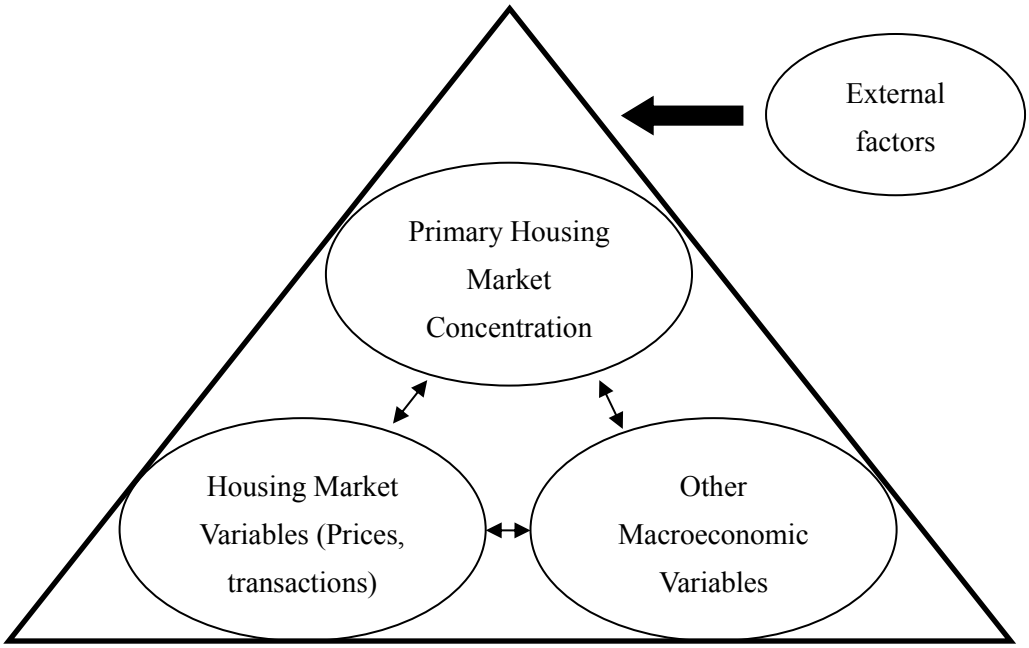


Source: Census and Statistics Department

The analytical part of the paper is conducted in two steps. First, we need to measure the "market concentration" of the primary housing market. Following the literature on Industrial Organization, a simple measure is the Herfindahl Index (HI),[9] which is widely used in the literature. For examples, Ye et. al (2009) synthesizes four concentration methods (including HI as one of them) and proposes a model for measuring the intensity of competition in the international construction market; and Beck et al (2012) uses the HI to measure the degree of concentration in the real estate brokerage industry across different cities in the US. Compiling the data from Buildings Department as well as developers' annual reports, we can compute the quarterly HI from 1995 – 2013.

Second, we examine the *dynamic interactions* among the Herfindahl Index, other indicators of the housing market (e.g. housing price index and housing supply), macroeconomic variables of Hong Kong (e.g. GDP and stock price), and other variables that are exogenous to Hong Kong (e.g. US factors and international commodity prices) [Figure 4]. As there are a large number of time series, we follow Bernanke et al (2005) to use Factor-Augmented Vector Autoregressive Models (FAVAR), which combines the standard VAR with factor analysis. It allows us to summarize the large amounts of information about the economy by a relatively small set of estimated factors. In addition, due to the large dimensionality of the VAR, Bayesian approach is preferred [Banbura et al. (2010)]. As a whole, we employ a Time-Varying Bayesian FAVAR model, which allows the parameters to change over time.

Figure 4 Mechanism



The rest of the paper is organized as follows. It first provides a general picture of the

[9] Clearly, it is beyond the scope of this paper to review the literature. Among others, see Djolov (2013) and the reference therein.

major real estate developers in Hong Kong. Next, it highlights the changes in concentration of developers' market through constructing the Herfindahl Index. Then, it studies the dynamic interactions by applying FAVAR model. Implications will be made at the end of the paper.

Data

We employ data from 1996Q3 to 2016Q2 in quarterly frequency. The details about the raw data and their short forms are provided in the Appendix. All data employed in the VAR model are seasonally adjusted. Except for those in percentage or contain zero/negative value, all data are transferred into log scale. Also, they are normalized to zero mean and unit variance which is necessary for the principal component analysis decriable in the next section.

Methodology

To study the dynamic interactions between housing variables in Hong Kong, we employ a two-step FAVAR model (Stock and Waston, 2002a b). Figure 5 summarizes the structure of the FAVAR model. First, we extract 2-32 frequency cycles from housing variables, GDP and other macro-variables in Hong Kong by using band-pass filter developed by Christiano and Fitzgerald (2003). In order to capture the idea that housing variables can be induced by internal as well as external factors, we then extract 2-32 frequency cycles from macro-variables in the U.S. and commodity prices.

We envision a world that Hong Kong is affected by external factors which are represented by macro-variables in the U.S. and commodity prices but *not* vice versa. Therefore, there is a one-way causality from macro-variables in the U.S. and commodity prices to variables in Hong Kong. However, there are too many macros and commodity prices variables. Including all of them in the VAR system is not feasible. We, therefore, conduct principal component analysis on those variables and include only the important components (PCs) in the VAR system.

Formally, the "structural form" of the FAVAR model is:

$$B_0 X_t = \sum_{j=1}^{p} B_j X_{t-j} + \sum_{i=1}^{p} \gamma_i PC_{US_{t-i}} + \sum_{i=1}^{p} \mu_i PC_{HK_{t-i}} + w_t \qquad (1)$$

The vectors $PC_{US_t} = \left[PC_{US_{1,t}}\, PC_{US_{2,t}} \ldots PC_{US_{n,t}}\right]'$ and $PC_{COM_t} = \left[PC_{COM_{1,t}}\, PC_{COM_{2,t}} \ldots PC_{COM_{m,t}}\right]'$, where n and m are the numbers of principal

components extracted from macro-variables in the U.S. and commodity prices, respectively. $X_t = \left[RHI_t\ RHPI_t\ RHSI_t\ RGDP_t\ VA_t\ RI_t\ MR_t\ PC_{HK_{1,t}} \ldots PC_{HK_{s,t}}\right]'$, where s is the number of principal components extracted from other macro-variables in Hong Kong. B_0 has a unit diagonal, and w_t is the residual term, while the reduced form of the FAVAR model is then modeled as:

$$X_t = \sum_{j=1}^{p} \varphi_j X_{t-j} + \sum_{i=1}^{p} \theta_i PPC_{US_{t-i}} + \sum_{i=1}^{p} \tau_i PC_{COM_{t-i}} + \in_t \qquad (2)$$

where $\in_t \sim i.i.d.N(0, \Sigma_\in)$ is $k \times 1$ vectors, $\{\varphi_j\}$ are $k \times k$ matrices, $\{\theta_i\}$ and $\{\tau_i\}$ are $k \times n$ and $k \times m$ matrices, X_t is a $k \times 1$ vectors of endogenous variables, $\in_t$ and $\Sigma_\in$ are the innovation of reduced form VAR and variance-covariance matrix, respectively. p is the maximum number of lags which is equal to one.

The interactions among X_t and PC_t depend on B_0 in equation (1). Unfortunately, we can only estimate equation (2) and hence are unable to recover B_0 with traditional econometric methods. The conventional approach is to assume some form of block-recursive structure in B_0.[10] However, as explained in Leeper et al. (1996) and others, some of those assumptions might have economic interpretations and hence an assumed block-recursive structure might have precluded certain types of economic dynamics that are of interest. Instead, we follow the sign restriction approach proposed by Ouliaris and Pagan (2016), known as SRC approach (sign restriction with generated coefficients).[11] Here we provide a brief description of the SRC approach. Based on equation (1) and (2), it can be shown that $\Sigma_\in = B_0^{-1}\Sigma_w B_0^{-1'}$, where Σ_w is the variance-covariance matrix of w_t. Based on this simple equation, the SRC approach would first draw above-diagonal elements of B_0 at random such that sign restrictions on B_0 are satisfied. Then we solve for remaining elements of B_0 and diagonal elements of Σ_w and retain the resulting candidate solution for B_0 if all sign restrictions on B_0 are satisfied. The procedure for drawing the above-diagonal elements of B_0 is as follows. First, for each of the $b_{ij,0}$ element in B_0, where $i < j$, we draw a random variable φ from the uniform distribution $U(-1,1)$. Then $b_{ij,0}$ is set to be $\varphi/(1 - |\varphi|)$. Given the above-diagonal elements of B_0 and the innovation of reduced form VAR $\Sigma_\in$, the below-diagonal elements of B_0 can be solved by using a nonlinear equation solver or the instrumental variable method as discussed in Ouliaris and Pagan (2016).

[10] Among others, see Christiano et al. (1999).

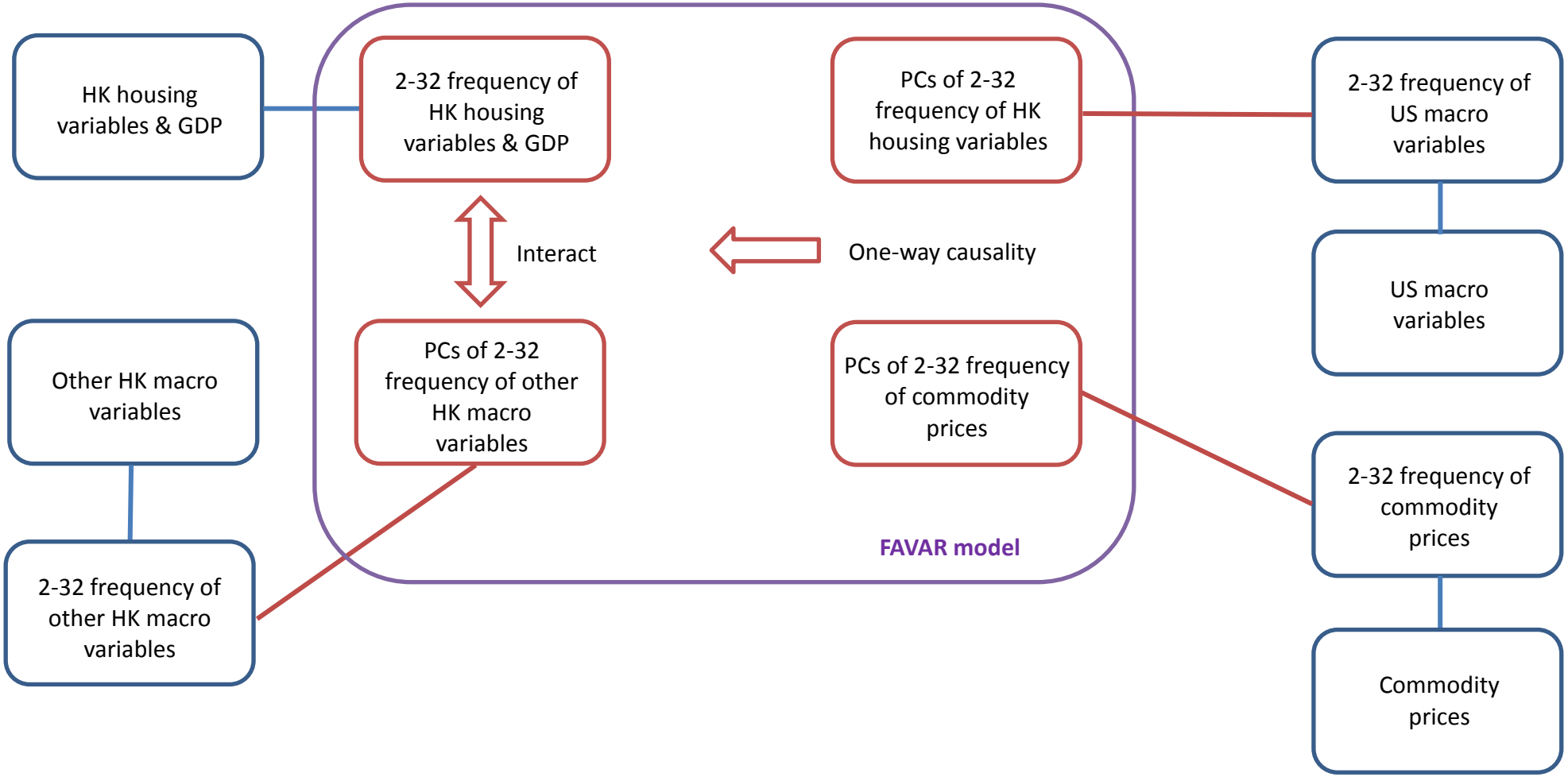
[11] Ouliaris and Pagan use simulation data to compare the performance of SRC and the traditional SRR approach (sign restriction recombination). Experiments show that there seems to be a slightly better fit to the true values by SRC, although both methods work well. They conclude that SRC has some advantages over SRR: it applies to any simultaneous equations system and can incorporate a wider range of information e.g. on both the parameters and impulse responses.

We follow Towbin and Weber (2015) to identify the signs of a housing demand, housing supply, mortgage rate and price expectation shock. In addition, we identify a market structure shock by placing positive signs on the responses of NHI and RHPI. The reason is simple. When the market structure becomes more concentrate, the market power of developers increases. Other things being equal, they would set a higher price to gain more profits. We restrict only the first period after the shock. Table 3 provides the details of the sign restriction. As we are interested in some structural shocks only, our model is referred as a partially identified VAR model in literature. Our approach is that we impose the sign pattern of each of the unidentified shock is different from that of the identified shock. We retain 1000 draws for the impulse response analysis.

Tables 3 Sign Restricition

Shock	Housing supply	Housing demand	Mortgage rate	Price expectation	Market structure
NHI					+
RHPI	+	+	+	+	+
VA	-	-		+	
RI	-	+	+	+	
MR		+	-	+	

Figure 5 Structure of the FAVAR Model



Results

We first present the results of the principal component analysis. Table 4 shows the summary statistic of the principal component analysis. Taking in mind the trade-off between explanation power of the PCs and the degree of freedom in the VAR system, we retain the first 4 PCs of other macro-variables in Hong Kong as they explain two third of the variations. Similarly, we retain 2 and 4 PCs of macro-variables in the U.S. and commodity prices as they explain more than 60% of the variations.

Second, we discuss some interesting results from the impulse response functions of different shocks (Figure 6 - 10). It is interesting to see that RGDP response negatively to housing demand, mortgage rate and price expectation shocks but positively to housing supply and market structure shocks. The sign of RHPI in the former shocks are identified due to an upward shift of the housing demand curve (i.e. a positive housing demand shock increase demand for housing; a negative mortgage rate shock stimulates demand for housing due to a decrease in mortgage rate; a positive price expectation shock stimulates current demand for housing since people tend to buy housing units now rather than later when the price goes up). The results suggest that when the economy is hit by these "demand-side shocks", households may tend to reduce consumption and increase saving in order to fulfill the need for housing. This, in turn, lowers the RGDP. On the other hand, housing supply and market structure shocks are "supply-side shocks" and they lead to positive responses of RGDP. This may be related to wealth effect of housing. In sum, our results suggest that whether the wealth effect of housing exists depends on the sources of shocks which lead to an increase in housing prices. The "supply-side shocks" tend to produce a wealth effect of housing.

Furthermore, it is clear that the responses of NHI also depend on whether the shocks are "demand side" or "supply side" shocks. NHI responses negatively to "demand side" shocks but positively to "supply-side shocks". This is readily comprehensible. The market power of developers increases when the "supply side" shocks reduce the supply of housing, and hence, a positive response of NHI. On the other hand, the "demand side shocks" lead to an increase in residential investment (see Table 3). When the future supply of housing increases, the market power of developers tends to fall.

Finally, since the signs of RPHI in all the shocks are restricted to be positive, we are able to compare the magnitude of the responses of RHPI across difference shocks. The

peak responses of RHPI to a housing demand, housing supply, mortgage rate, price expectation and market structure shock are 5.7%, 11.8%, 15.3%, 6.7% and 8.4%, respectively. This suggests that mortgage rate and housing supply are important drivers of changes in RPHI. The market structure shock identified in this paper, which is peculiar to similar studies, is ranked at third. This implies changes in market structure could also lead to substantial changes in RHPI.

Conclusion

(to be added)

Table 4 Principal Component Analysis Summary Statistic

Other macro-variables in Hong Kong

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	**4.09**	**1.24**	**0.27**	**0.27**
Comp2	**2.86**	**1.3**	**0.19**	**0.46**
Comp3	**1.55**	**0.2**	**0.1**	**0.57**
Comp4	**1.36**	**0.12**	**0.09**	**0.66**
Comp5	1.24	0.41	0.08	0.74
Comp6	0.82	0.07	0.05	0.79
Comp7	0.75	0.15	0.05	0.84
Comp8	0.61	0.14	0.04	0.89
Comp9	0.46	0.14	0.03	0.92
Comp10	0.32	0.06	0.02	0.94

Macro-variables in the U.S.

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	**50.32**	**34.2**	**0.46**	**0.46**
Comp2	**16.12**	**5.56**	**0.15**	**0.61**
Comp3	10.56	6.35	0.1	0.71
Comp4	4.2	0.45	0.04	0.75
Comp5	3.75	0.43	0.03	0.78
Comp6	3.32	0.4	0.03	0.81
Comp7	2.93	0.55	0.03	0.84

Comp8	2.38	0.39	0.02	0.86
Comp9	1.99	0.61	0.02	0.88
Comp10	1.38	0.16	0.01	0.89

Commodity prices

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	**8.13**	**4.86**	**0.3**	**0.3**
Comp2	**3.27**	**0.56**	**0.12**	**0.42**
Comp3	**2.7**	**0.72**	**0.1**	**0.52**
Comp4	**1.98**	**0.13**	**0.07**	**0.60**
Comp5	1.85	0.36	0.07	0.66
Comp6	1.49	0.18	0.06	0.72
Comp7	1.31	0.15	0.05	0.77
Comp8	1.17	0.23	0.04	0.81
Comp9	0.94	0.26	0.03	0.85
Comp10	0.67	0.13	0.03	0.87

Figure 6 Housing Demand Shock

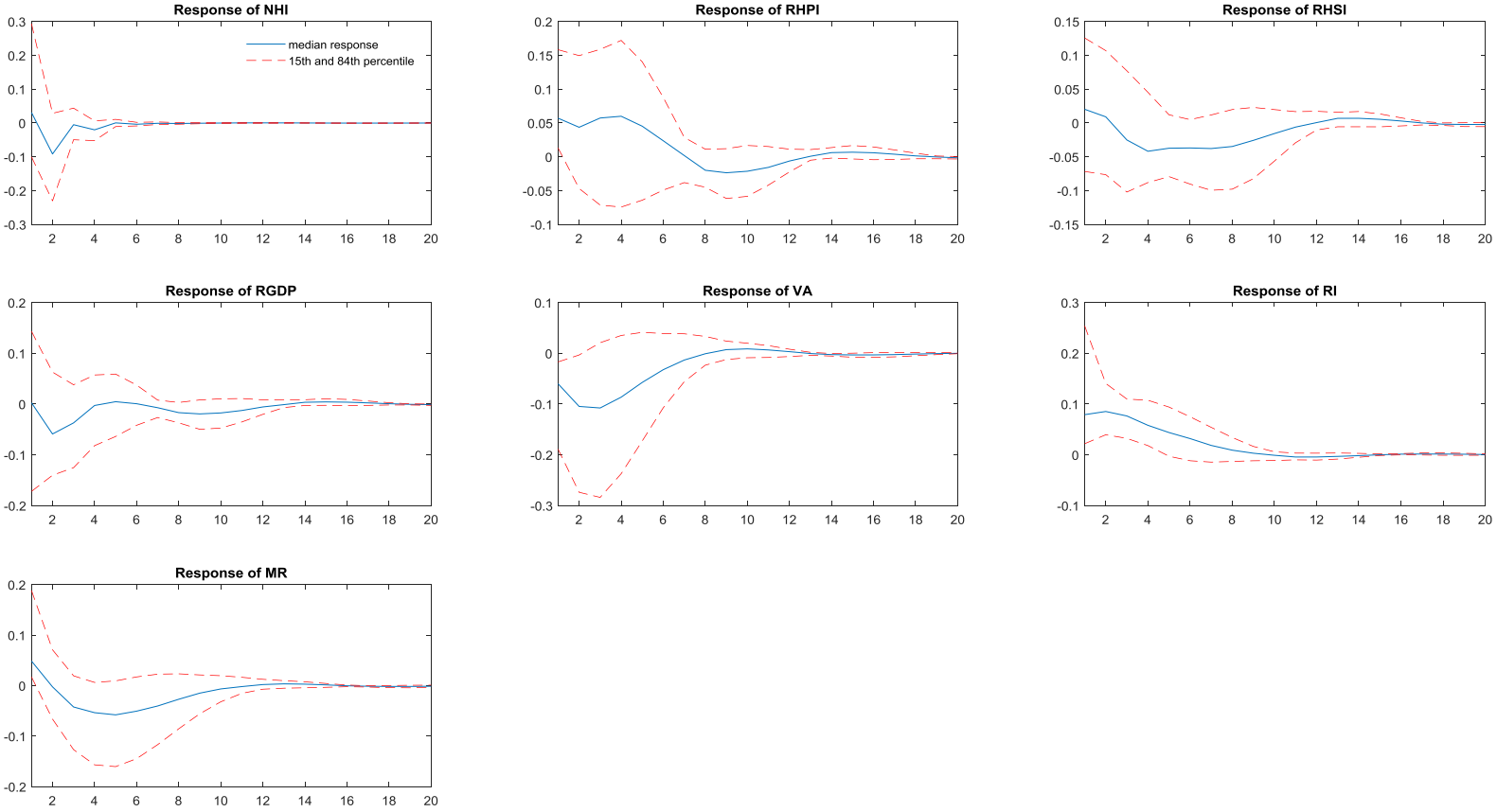


Figure 7 Housing Supply Shock

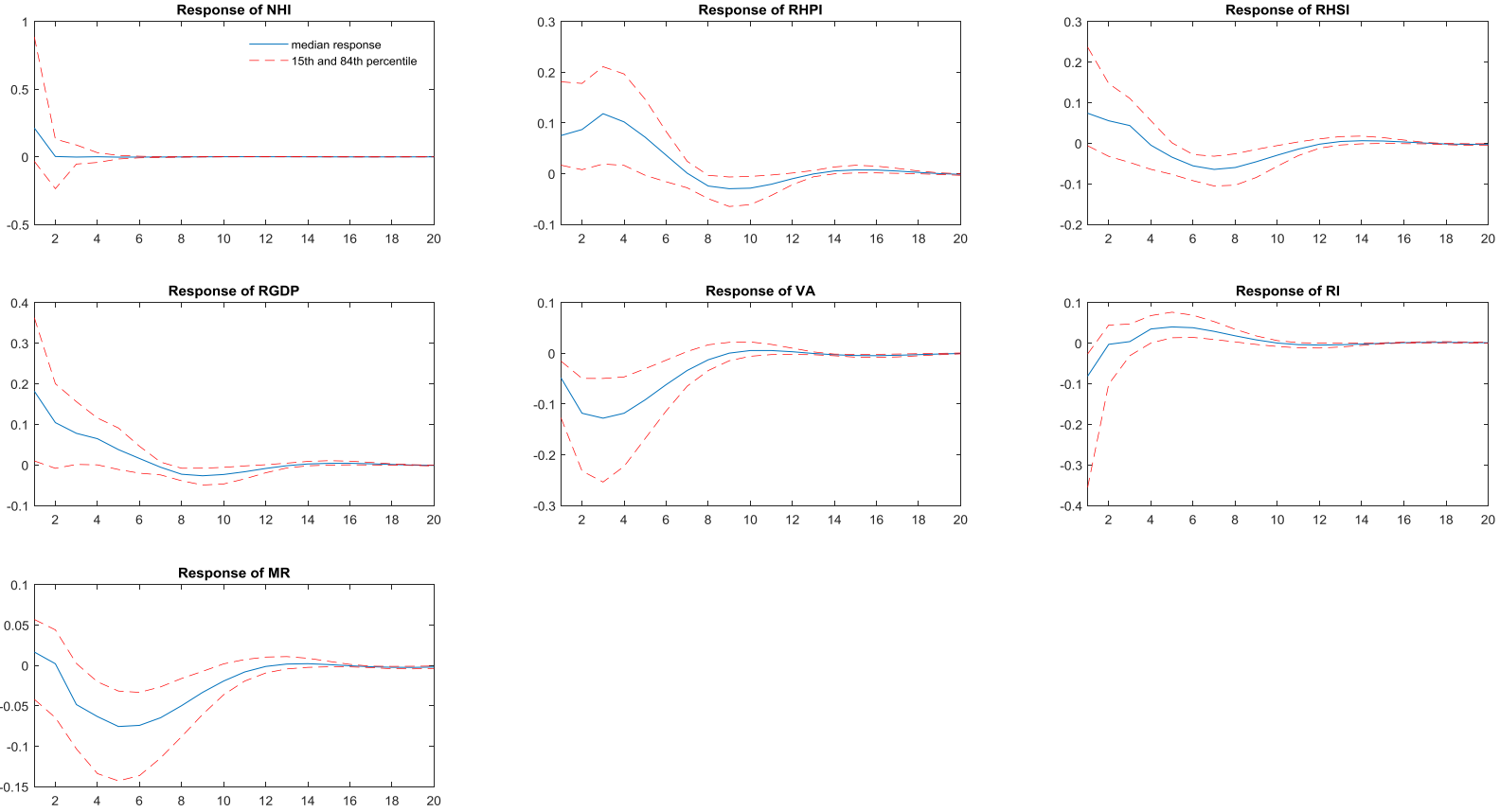


Figure 8 Mortgage Rate Shock

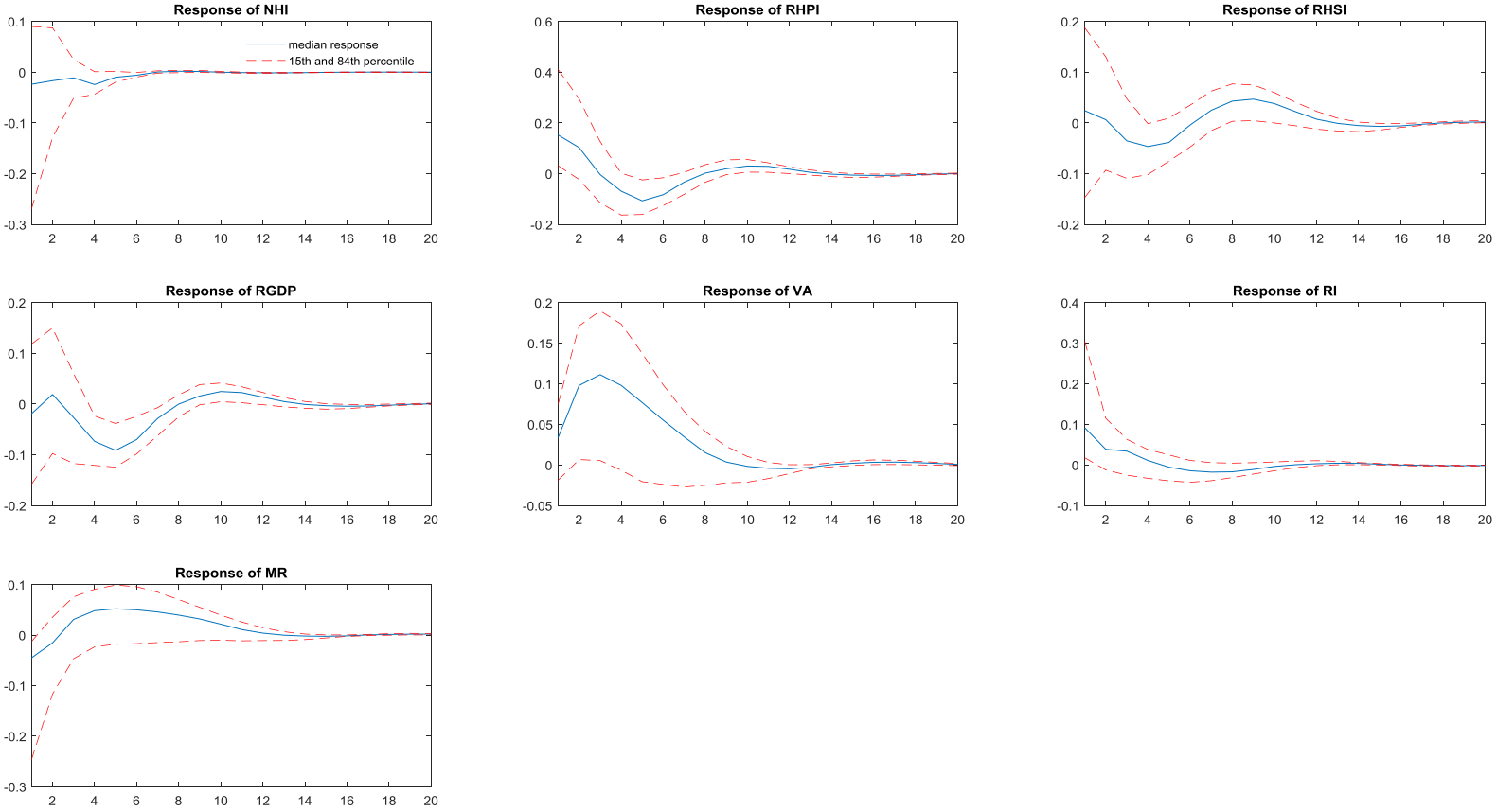


Figure 9 Price Expectation Shock

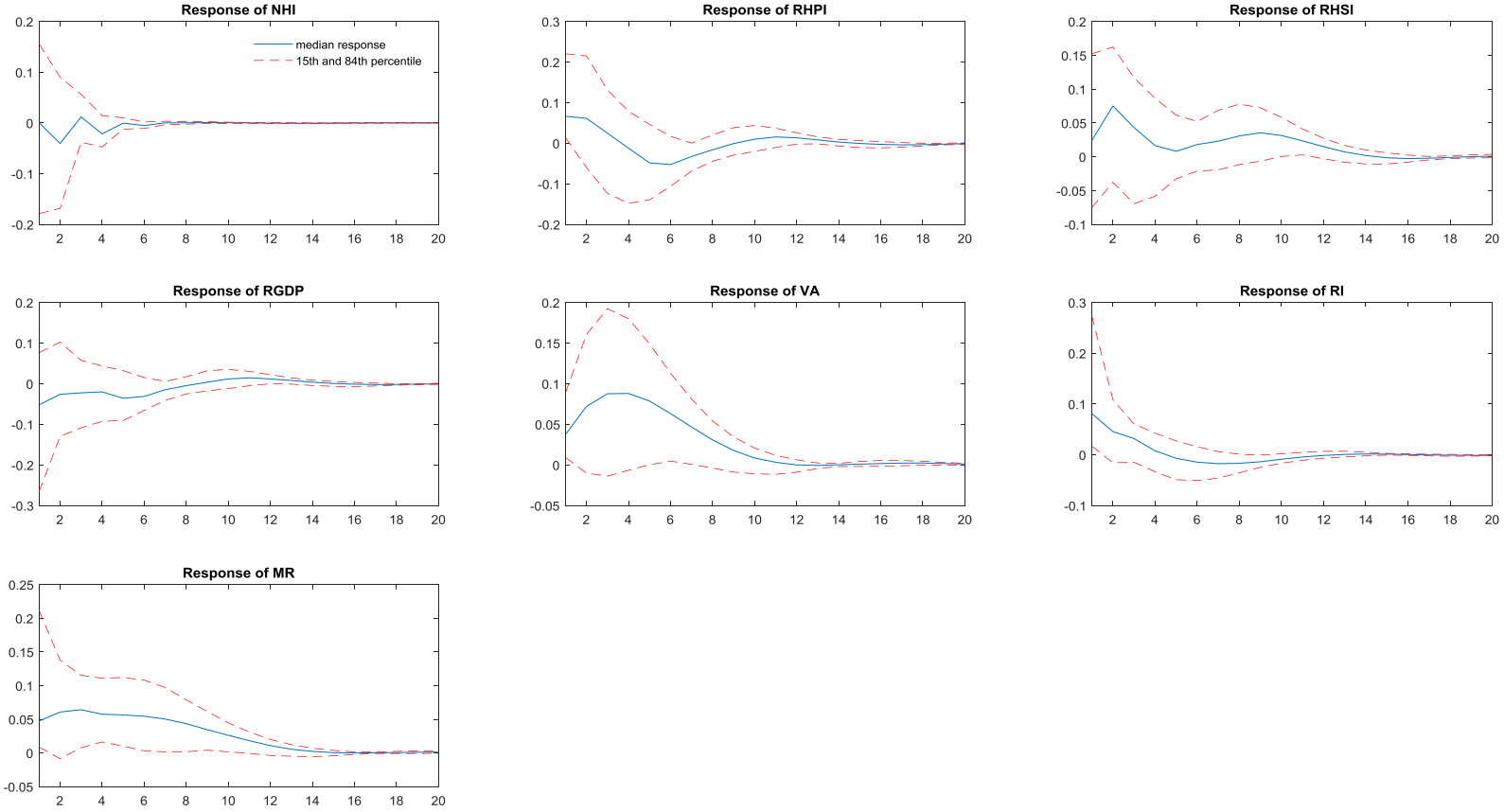
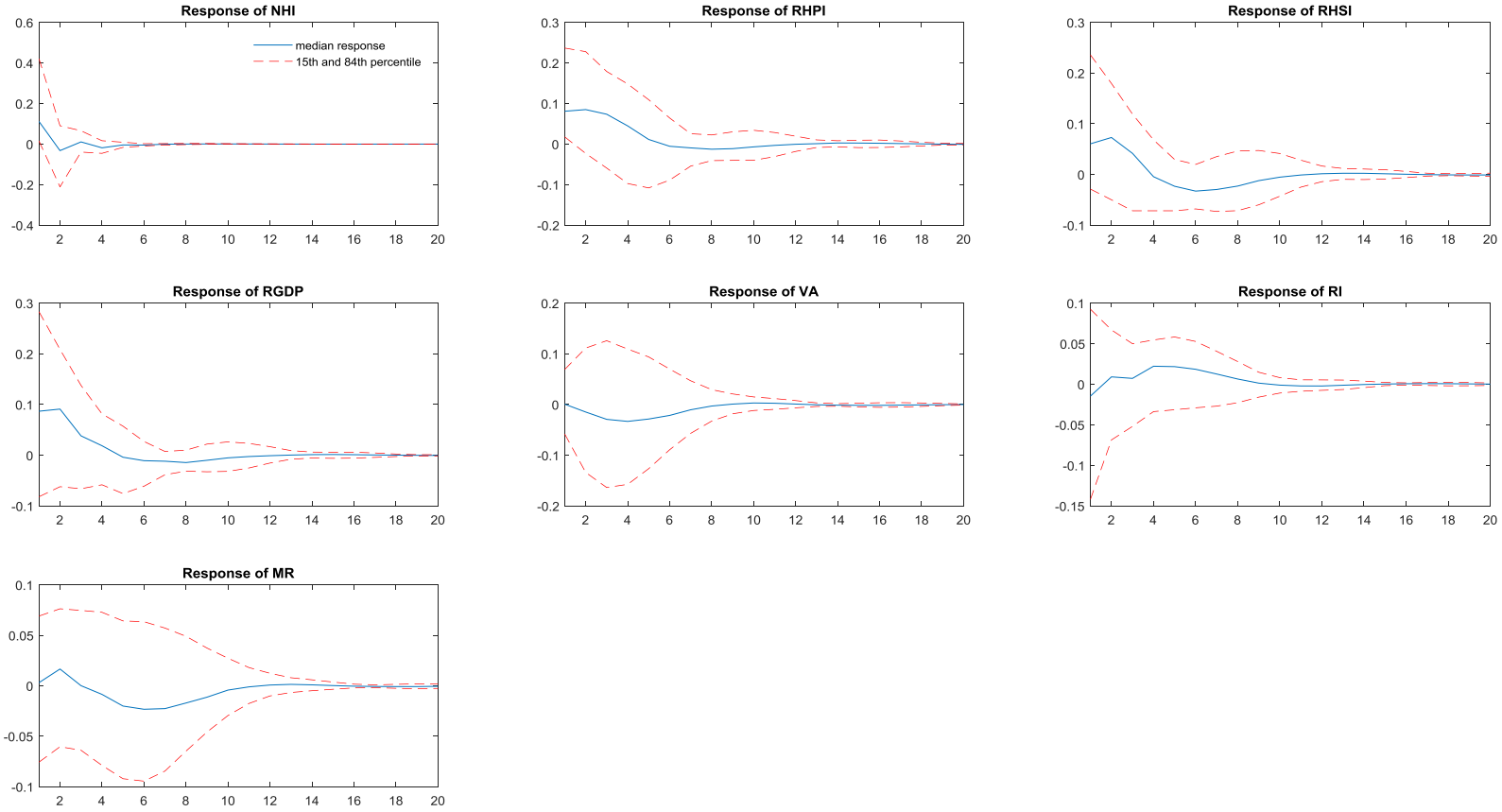


Figure 10 Market Structure Shock



References

Banbura, T., R. Giannone and C. Reichlin (2010). Large Bayesian Vector Auto Regressions. Journal of Applied Econometrics, 25(1), 71-92.

Beck, J., F. Scott and A. Yelowitz (2012). Concentration and Market Structure in Local Real Estate Markets. Real Estate Economics, 40(3), 422-460.

Bernanke, B. S., J. Boivin and P. Eliasz (2005). Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach. Quarterly Journal of Economics, 120(1), 387-422.

Chen, J., S. Esteban and M. Shum (2013). When Do Secondary Markets Harm Firms? American Economic Review, 103(7), 2911-2934.

Ching, S. and Y. Fu (2003). Contestability of the Urban Land Market: An Event Study of Hong Kong Land Auctions. Regional Science and Urban Economics, 33(6), 695-720.

Coase, R. (1972). Durability and Monopoly. Journal of Law and Economics, 15(1), 143–49.

Cypher, M. L., and D. K. Hayunga (2010). Market Competition for High-Density Residential Land. International Journal of Strategic Property Management, 14(1), 19-34.

Djolov, G. (2013). The Herfindahl-Hirschman Index as a Decision Guide to Business Concentration: A Statistical Exploration. Journal of Economic & Social Measurement, 38(3), 201-227.

Glaeser, E. and J. Gyourko (2008). Rethinking Federal Housing Policy: How to Make Housing Plentiful and Affordable. Washington, D.C.: American Enterprise Institute.

Glaeser, E., J. Gyourko and R. Saks (2005). Why is Manhattan so Expensive? Regulation and the Rise in Housing Prices. Journal of Law and Economics, 48(2), 331-369.

Hanushek, E. and K. Yilmaz, (2007). The Complementarity of Tiebout and Alonso. Journal of Housing Economics, 16(2), 243-261.

Somerville, C. T. (1999). The Industrial Organization of Housing Supply: Market Activity, Land Supply and the Size of Homebuilder Firms. Real Estate Economics, 27(4), 669-694.

Spiegel, M. (2001). Housing Return and Construction Cycles. Real Estate Economics, 29(4), 521-551.

Stein, J. (1995). Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects, Quarterly Journal of Economics, 110, 379-406.

Tirole, J. (1988). The Theory of Industrial Organization. Cambridge: MIT Press.

Waldman, D. and E. J. Jensen (2012). Industrial Organization: Theory and Practice, 4th ed., New York: Prentice Hall.

Ye, K., W. Lu and W. Jiang (2009). Concentration in the International Construction Market. Construction Management and Economics, 27, 1197-1207.

Appendix

Hong Kong data (1996 Q3 – 2016 Q2)

Variable	Abbreviation	Source
Normalized Herfindahl Index	NHI	Authors' calculation
Market share of all listed developers	MSALL	Authors' calculation
Market share of top 4 developers	MS4	Authors' calculation
Real housing price index	RHPI	RVD
Real money supply – M0	MS0	HKMA
Real money supply – M1	MS1	HKMA
Real money supply – M2	MS2	HKMA
Real building works tender price index	RBWTPI	ASD
Unemployment rate	UR	CSD
Real Hang Seng Index	RHSI	HKEX
Real stock market trading value	RSMTV	HKEX
Real wage index	RW	IMF
Real GDP	RGDP	CSD
Trade ratio	TR	CSD
Real retail sales	RSALES	CSD
Tourist arrival	TOUR	CSD
Number of IPO	NO_IPO	HKEX
Real dollar value of IPO	RD_IPO	HKEX
Volatility of HSI daily return	VTY	HKEX
Vacancy rate	VA	RVD
Residential new loan approved	NL	HKMA
Real prime rate	RPR	HKMA
Real 1-month HIBOR	RHIBOR	HKMA
CPI	CPI	CSD
Residential investment	RI	Authors' calculation

Key:
ASD = Architectural Services Department
CSD = Census and Statistics Department
HKEX = Hong Kong Exchanges and Clearing Limited
IMF = International Monetary Fund
RVD = Rating and Valuation Department

US Data description (1996 Q3 – 2016 Q2)

Variable	Abbreviation	Source
Personal income (USD bn, saar)	PI	BEA
Personal current transfer receipts (USD bn, saar)	PCTR	BEA
Retail sales (USD mn, sa)	RS	USCB
Industrial production index – Total index (2007 = 100)	IPI	FRB
Industrial production index – Final Product & Nonindustrial Supplies (2007 = 100)	IPIFPNS	FRB
Industrial production index – Final Product (2007 = 100)	IPIFP	FRB
Industrial production index – Consumer Goods (2007 = 100)	IPICG	FRB
Industrial production index – Durable consumer goods (2007 = 100)	IPIDCG	FRB
Industrial production index – Non-Durable consumer goods (2007 = 100)	IPINDCG	FRB
Industrial production index – Fuels (2007 = 100)	IPIF	FRB
Industrial production index – Residential Utilities (2007 = 100)	IPIRU	FRB
Industrial production index – Equipment (2007 = 100)	IPIE	FRB
Industrial production index – Materials (2007 = 100)	IPIM	FRB
Industrial production index – Durable goods materials (2007 = 100)	IPIDGM	FRB

Industrial production index – Non-durable goods materials (2007 = 100)	IPINDGM	FRB
Industrial production index – Manufacturing (SIC) (2007 = 100)	IPIMFG	FRB
NAPM production Index	NAPMPI	ISM
Capacity utilization (%, sa)	CU	FRB
Civilian Labor Force: Employed, Total (thousand, sa)	CLFT	BLS
Civilian Labor Force: Employed, Nonagricultural Industries (thousand, sa)	CLFNI	BLS
Unemployment rate (sa)	UR	BLS
Unemployment: average duration (weeks, sa)	UD	BLS
Unemployment: by duration: persons unemployed for less than 5 weeks (thousand, sa)	UP5	BLS
Unemployment: by duration: persons unemployed for 5 to 14 weeks (thousand, sa)	UP14	BLS
Unemployment: by duration: persons unemployed for more than 15 weeks (thousand, sa)	UP15	BLS
Unemployment: by duration: persons unemployed for 15 to 26 weeks (thousand, sa)	UP26	BLS
Unemployment: by duration: persons unemployed for more than 27 weeks (thousand, sa)	UP27	BLS
Average weekly initial claims of unemployment insurance (thousand, sa)	UI	USDL
Employees on nonfarm payrolls: Total private (sa)	EP	BLS
Employees on nonfarm payrolls: Goods producing (sa)	EGP	BLS
Employees on nonfarm payrolls: Mining (sa)	EM	BLS
Employees on nonfarm payrolls: Construction (sa)	EC	BLS
Employees on nonfarm payrolls: Manufacturing (sa)	EMFG	BLS
Employees on nonfarm payrolls: Durable goods (sa)	EDG	BLS
Employees on nonfarm payrolls: Non-durable goods (sa)	ENDG	BLS
Employees on nonfarm payrolls: Service providing (sa)	ESP	BLS

Employees on nonfarm payrolls: Trade, transportation and utilities (sa)	ETTU	BLS
Employees of nonfarm payrolls: Wholesale trade (sa)	EWT	BLS
Employees of nonfarm payrolls: Retail trade (sa)	ERT	BLS
Employees of nonfarm payrolls: Financial activities (sa)	EFA	BLS
Employees of nonfarm payrolls: Government (sa)	EG	BLS
Average weekly hours: Goods producing (sa)	AWHGP	BLS
Average weekly hours: Manufacturing overtime hours (sa)	AWHMOH	BLS
Average weekly hours: Manufacturing	AWHM	BLS
NAPM employment index	NAPMEI	ISM
Private housing units started (thousand, saar)	HS	USCB
Private housing units started: Northeast (thousand, saar)	HSNE	USCB
Private housing units started: Midwest (thousand, saar)	HSMW	USCB
Private housing units started: South (thousand, saar)	HSS	USCB
Private housing units started: West (thousand, saar)	HSW	USCB
Private housing units authorized (thousand, saar)	HA	USCB
Private housing units authorized: Northeast (thousand, saar)	HANE	USCB
Private housing units authorized: Midwest (thousand, saar)	HAMW	USCB
Private housing units authorized: South (thousand, saar)	HAS	USCB
Private housing units authorized: West (thousand, saar)	HAW	USCB
Purchasing managers' index	PMI	ISM
New orders index	NOI	ISM
Supplier deliveries index	SDI	ISM
Inventories index	INI	ISM
Manufacturers' new order: Consumer goods (USD mn)	MNOCG	USCB
Manufacturers' new order: Durable goods industries (USD mn)	MNODGI	USCB
Manufacturers' new order: Nondefense capital goods (USD mn)	MNONCG	USCB
Manufacturers' unfilled orders: Durable goods industries (USD mn)	MUODGI	USCB

Money supply: M1 (USD bn, sa)	MONE	FRB
Money supply: M2 (USD bn, sa)	MTWO	FRB
Money supply: Base money (USD bn)	MBM	IMF
Depository institutions reserves: Total (USD mn)	DIRT	FRB
Depository institutions reserves: Non-borrowed (USD mn)	DIRNB	FRB
Consumer credit outstanding: Non-revolving (USD bn, sa)	CCO	FRB
S&P 500: Composite (1941-43 = 100)	SP	RS
S&P 500: Industrial (1941-43 = 100)	SPI	S&P
S&P 500: Dividend yield	SIDY	RS
Federal funds rate (% pa)	FFR	FRB
Commercial paper rate (% pa)	CPR	FRB
US Treasury Bills: 3 months (% pa)	TBTHREE	FRB
US Treasury Bills: 6 months (% pa)	TBSIX	FRB
US Treasury constant maturities: 1 year	TCMONE	FRB
US Treasury constant maturities: 5 years	TCMFIVE	FRB
US Treasury constant maturities: 10 years	TCMTEN	FRB
Corporate bond yield: Aaa (% pa)	CBYAAA	FRB
Corporate bond yield: Baa (% pa)	CBYBAA	FRB
Spread: CPR - FFR	SCPR	FRB
Spread: TBTHREE – FFR	STBTHREE	FRB
Spread: TBSIX – FFR	STBSIX	FRB
Spread: TCMONE – FFR	STCMONE	FRB
Spread: TCMFIVE – FFR	STCMFIVE	FRB
Spread: TCMTEN – FFR	STCMTEN	FRB
Spread: CBYAAA – FFR	SCBYAAA	FRB
Spread: CBYBAA – FFR	SCBYBAA	FRB
Real effective exchange rate index (2010 = 100)	REERI	BIS
Real exchange rate: Switzerland (US$ per Swiss Franc)	FXSWISS	FRB
Real exchange rate: Japan (US$ per Yen)	FXJAPAN	FRB
Real exchange rate: United Kingdom (US$ per pound)	FXUK	FRB
Real exchange rate: Canada (US$ per Canadian $)	FXCAN	FRB

Inflation rate: All items (1982 – 1984 = 100, sa)	CPI	BLS
Inflation rate: Apparel (1982 – 1984 = 100, sa)	CPIA	BLS
Inflation rate: Transport (1982 – 1984 = 100, sa)	CPIT	BLS
Inflation rate: Medical care (1982 – 1984 = 100, sa)	CPIMC	BLS
Inflation rate: Commodities (1982 – 1984 = 100, sa)	CPIC	BLS
Inflation rate: Durables (1982 – 1984 = 100, sa)	CPID	BLS
Inflation rate: Services (1982 – 1984 = 100, sa)	CPIS	BLS
Inflation rate: All items less food (1982 – 1984 = 100, sa)	CPILF	BLS
Inflation rate: All items less shelter (1982 – 1984 = 100, sa)	CPILS	BLS
Inflation rate: All items less medical care (1982 – 1984 = 100, sa)	CPILMC	BLS
Average hourly earnings: Good producing (USD, sa)	AHEGP	BLS
Average hourly earnings: Construction (USD, sa)	AHEC	BLS
Average hourly earnings: Manufacturing (USD, sa)	AHEM	BLS
Consumer confidence index: Expectations (1985 = 100)	CCIE	CB
CBOE volatility index	VIX	CBOE

Key:
BEA = Bureau of Economic Analysis
USCB = US Census Bureau
FRB = Federal Reserve Board
ISM = Institute of Supply Management
BLS = Bureau of Labor Statistics
USDL = US Department of Labor
S&P = Standard & Poor's
RS = Online data provided by Robert Shiller (http://www.econ.yale.edu/~shiller/data.htm)
BIS = Bank of International Settlements
DAT = Datastream
CB = Conference Board
CBOE = Chicago Board Options Exchange

Commodities data (1996 Q3 – 2016 Q2)

Variable	Abbreviation	Source
Aluminum	ALU	Datastream
Beef	BEEF	IMF
Copper	COP	Datastream
Cotton	COT	Datastream
Gold	GOLD	Datastream
Iron	IRON	Datastream
Lead	LEAD	IMF
Nickel	NICKEL	IMF
Rice	RICE	Datastream
Sugar	SUGAR	Datastream
Wheat	WHEAT	Datastream
Wool	WOOL	IMF
Zinc	ZINC	Datastream
Crude oil	COIL	Datastream
Natural gas	NGAS	Datastream
Coal	COAL	Datastream
Cement	CEM	Datastream
Corn	CORN	Datastream
Pulp	PULP	Datastream
Silver	SILVER	Datastream
Lamb	LAMB	IMF
Soft Logs	SLOGS	IMF
Hard logs	HLOGS	IMF
Fish	FISH	IMF
Hard Sawnwood	HWOOD	IMF

Soft Sawnwood	SWOOD	IMF
Potash	POT	IFS