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The Liberalization Of Shibor And The Economic Fundamentals Of House Price Growth In China

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SUBMITTED TO

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Abstract

This paper uses data collected from the National Interbank Funding Center of China, the People's Bank of China, the National Bureau of Statistics, and Bloomberg starting in October 2006 through 2013 to test the economic fundamental's affecting the housing market in Shanghai, particularly interest rates. This study finds that the 6-month duration Shibor has a negative and significant correlation with house price growth in Shanghai when lagged 4 months. The analysis continues by examining other economic fundamentals affecting house price growth, finding growth in inflation, the money supply and Shanghai real estate investment to have significant, positive relationships with the housing market in China. GDP and the national state balance, on the other hand, have negative and significant relationships with house price growth. The Shanghai stock exchange was found to have no significant impact on the housing market over the time period. The sample period is limited to 87 observations due to the relatively recent development of Shibor for a benchmark interest rate.

I. Introduction

Historically, the reputation of the Chinese government's control over the economy has only been surpassed by its control over the Internet. In the years following the nation's acceptance into the World Trade Organization in 2001, the government has made a slow but steady move for financial reform, particularly with regards to the nation's real estate market. In 2001, the government continued the privatization of the country's housing market, allowing real estate companies to go public. As the provincial governments became increasingly significant in the real estate supply chain, the significant increases in house prices that accompanied investment from local government has been met with substantial, but not necessarily effective regulation.

China's housing market is currently separated into three distinct categories; commodity houses, rental properties, and economically affordable properties. Economically affordable houses have strict requirements for applicants, and once purchased cannot be sold for five years[1]. The latter has made these properties particularly uneconomical for investors as speculators of the housing market, causing economical properties to only account for 3% of all homes built in 2010, a figure far from its height of 25% in the late 90s when the government exercised more control over the market. Speculation on the country's housing market has led to drastic increases in commodity houses and rental properties prices; however rental prices have not exhibited the same growth as the properties themselves. In attempts to deflate a possible bubble in the housing market, the government has been trying to restrict real estate investor's access to funds from banks and State- Owned Enterprises (SOEs). While this has

[1] https://www.milkeninstitute.org/pdf/China-HousingMarket.pdf

decreased the amount of direct funding from SOEs into the real estate market, it is unclear how effective these regulations have been as SOEs have been lending to an increasing amount of trusts and wealth management products, which tend to invest in the speculative housing market.

After a governmental tightening of their control over interest rates failed to curb house price growth, the government has taken steps towards a more free economy, which is most apparent in the country's attempts to liberalize interest rates. This freeing of interest rates began in 2006 with the creation of a benchmark interest rate, the Shanghai Interbank Offered Rate (Shibor). This was an extremely important step for the government in adjusting from a highly controlled economy to a more laissez faire economy run by economic fundamentals rather than national policy. While short-term interest rates experienced extreme spikes over the summer, the long-term rates have been much smoother, giving the government confidence in rate liberalization. The HSBC believes this confidence will soon manifest in the final liberalization of interest rates with the freeing of deposit rates within the next year or two[2].

With the liberalization of interest rates and the amount of wealth concentrated in China's real estate market, the economic fundamentals affecting house price growth has been widely investigated. The goal of this paper is to econometrically determine the economic fundamentals that affect the housing market in China, especially if interest rates have influence on house price growth since the inception of Shibor. Previous research into this subject has determined that the main influences on the housing market are inflation, the money supply, GDP and growth in Chinese equity prices. Studies that

[2] http://www.nytimes.com/2014/03/12/business/international/china-details-plans-to-liberalize-interest-rates-and-encourage-private-banks.html?_r=0

have investigates the effects interest rates have on the nation's real estate market concluded they have no impact on house price growth.

This study will proceed as follows. Section II is a review of academic literature on the fundamental factors of China's housing market. Section III describes the data analyzed and models used to investigate the determinants of house price growth. Section IV goes on to discuss the results of the tests conducted. Section V will conclude the study and provide suggestions for further study.

II. Literature Review

The economic fundamental determinants of housing prices in China has been previously looked at but the conventional wisdom on the subject is in a state of constant change as the Chinese government continues to liberalize their economy. Burdekin and Tao (2013) investigate the relationships between the nation's housing prices and liquidity, lending activity, stock prices, and inflation, using monthly data from 1999-2000. Liquidity is measured as the ratio of monthly new M2 to monthly new industrial production and lending activity is calculated as the ratio of monthly new loans to monthly new industrial production[3]. Industrial production is chosen instead of GDP because GDP is reported quarterly while industrial production, a figure that tends to track GDP with less smoothing, ensures monthly observations and possibly more accurate figures. They use the national consumer price index (CPI) to account for inflation, the Shanghai A-shares index as a proxy for stock prices, and include the five-year lending rate to

[3] "Industrial production is seasonally adjusted based upon a seasonality index (S.I.) comprised of each month's gross output divided by the one-year moving average of gross output. Each month's index is the average of that month's indices throughout the sample. After normalizing the S.I. to a sum of 12, each month's gross output is then divided by that month's S.I. to obtain the series used in the empirical work" Burdekin and Tao (2013).

represent interest rates. Burdekin and Tao reference previous studies (Guo and Li (2011), Wang and Han (2011), and Zhang, Hua and Zhao (2012)) and states their results might be negligible as the government-provided national housing price series seems unusually flat, implying government smoothing of the data series. Shanghai is one of China's largest, most mature housing markets, leading them to use Shanghai housing price data to show the effects on housing markets in China's major cities. They conduct a Granger causality test between Shanghai housing prices and each of the other variables, finding that there is significant bi-directional causality between housing price growth and stock price growth. The test results also showed that the M2/industrial production and the new loans/industrial production ratios have significant causality on house price growth but not the other way around. The lack of reverse causality implies that house price appreciation in China is not solely caused by aggregate price pressure but instead might have been the preferential investment channel for the excess liquidity. Housing prices and interest rates showed no causality either way, and housing prices showed slight causality on inflation.

Burdekin and Tao (2013) went on to conduct a vector autoregressive (VAR) test to further examine the connections between housing prices, stock prices and the other macroeconomic variables. The VAR model confirms that stock market growth has a significant effect on the Shanghai housing market growth, and also shows significant negative effects of lagged inflation on share price growth, the liquidity ratio, and the new loan ratio. It is possible that these negative effects are caused by "countercyclical monetary policy whereby the People's Bank attempts to tighten money and credit growth when inflation is on the rise" (Burdekin and Tao (2010), 9). The VAR model also suggests that the lending rate significantly affects the liquidity ratio, the new loan ratio

and the national inflation rate while lagged share price growth and its own lagged values have significant effects on the lending rate. Burdekin and Tao rerun these tests using a national housing price data series; however, unlike Guo and Li (2011), Burdekin and Tao (2013) utilize a national data series provided by a private institution[4] rather than using the government-provided national real estate data set as they share Leung's (2010) distrust of the Chinese official nationwide house price data. The Granger test results mimicked the results of the Shanghai housing data series with the exception that there was not a significant effect of house price growth on either share price growth nor the new loan ratio. The VAR model similarly paralleled the Shanghai housing data set results, confirming the earlier test result and adding that the lagged M2 ratio positively and significantly affects house price growth while the lagged loan ratio negatively and significantly affects house price growth. This liquidity effect is consistent with Guo and Li (2011), Wang and Han (2011), Xu and Chen (2012) and Zhang, Hua and Zhao (2012).

Guo and Li (2011) look at excess liquidity and policy changes in China with respect to housing price booms. They measure excess liquidity as the gap between excess money growth, represented by M2, and nominal GDP growth ($LIQ = \Delta M2 - \Delta NGDP$). Rather than purely looking at housing prices they assess the effects of excess liquidity on housing price booms, which is measured as the difference between the growth of the real estate price index and the rental price index ($HPB = \Delta REPI - \Delta RPI$). They look at quarterly data from the first quarter of 1998 to the second quarter of 2010, utilizing national real estate and rental price indices. They conduct a Granger causality test, which showed that excess liquidity causes housing price booms, but not the other

[4] China International Capital Corporation Limited [http://www.cicc.com.cn/CICC/english/index.htm]. The index includes Beijing, Chendu, Hangzhou, Hefei, Shanghai, Shenzen, Tianjin, Wuhan and Xian

way around. They are also able to show this through a VAR model, looking at the effects of a positive shock in excess liquidity on real estate price booms and inflation represented by the national CPI. The VAR model suggests a positive shock to excess liquidity leads to a significant rise in housing price booms, even more so than consumer prices as the effect on CPI was insignificant.

Wang and Wang (2013) focus on the effects that the money supply, interest rate, RMB exchange rate and GDP have on housing price growth. Unlike previous studies (Burdekin and Tao (2013), Guo and Li (2011)), this study uses M1 to represent the money supply instead of M2 but offers no explanation as to why they feel M1 is a more accurate representation. They use the real effective RMB exchange rate, the 7-day Shibor as the interest rate, and a combination of quarterly GDP data using industrial added value growth year-over-year (YoY) as a proxy for GDP growth in the intermittent monthly periods. Industrial growth as a GDP proxy to ensure monthly data is consistent with Burdekin and Tao (2013). All data is monthly from December 2005 through August 2012 and are taken the logarithm to avoid a unit root error. Wang and Wang (2013) first run a regression to confirm these four macroeconomic variables are significant, and the regression suggests the 7-day Shibor is an insignificant factor in determining housing prices, leading them to drop interest rates as a variable in their further tests. They go on to conduct a Granger causality test revealing a negative and significant relationship between GDP and housing prices, that real estate prices negatively and significantly impact the real effective RMB exchange rate and that M1 and real estate prices have a positive and significant correlation. While the relationship between GDP and housing prices seems counterintuitive, they offer the explanation that rising house prices will increase

homeowners wealth, causing them to increase spending thereby increasing GDP, but this is offset by the increase in people's desires to own real estate (housing market demand), furthering savings and decreasing GDP.

Marie-Theres Stohldreier (2012) examines the macroeconomic determinants of housing prices in Chinese cities, looking specifically at the population growth rate, stock market growth rate, inflation, GDP, geographical locations, savings, investment in fixed assets, construction activity, and the unemployment rate. All data was collected from the government-provided national data on an annual basis starting in 1998 through 2011. The national CPI represents inflation, the share price growth is reflected through a Shanghai Stock Exchange (SSE) index and construction activity growth is captured by the growth in the amount of total completed floor space of 10,000 square meters. She conducts an ordinary least squares (OLS) regression in which all macroeconomic variables were regressed individually against housing price growth. The results of all the variables were significant over the series with the exception of savings, possibly refuting Wang and Wang's (2013) notions that house price growth would have a positive correlation with savings and the reason for the negative relationship between GDP and the housing market. The population growth rate and stock market growth rate were shown to have significantly negative impacts on real estate market growth rate, the latter confirming Burdekin and Tao (2013) that the Chinese real estate and stock markets are competing investment channels. The national CPI, GDP, geographical location, investment in fixed assets, construction activity growth, and the unemployment rate all showed positive significant effects on house price growth. Stohldreier (2012) acknowledges that the positive correlations seen in construction activity and investments

in fixed assets intuitively would be negative as they would increase supply in the housing market and speculation may have been the driving factor in house price growth overshadowing the increase in supply.

Contrary to the studies above, Yu (2010) found that there is no consistent relationship between housing prices and economic fundamentals because of the Chinese government exercising direct influence on the housing market. Yu in particular points to the "*Provision for the Transferring State-owned Land by Bids, Auction or Listing*"[5], which prohibited the sale of land through closed-door negotiations as well as the transfer of land-use rights. This leaves landowners with the option of either selling land-use rights through public bids, auction or listing, or by allowing the Chinese government to repurchase the land at a relatively low price. Yu believes this policy causes housing prices to be inflated as it greatly restricts the land supply. Yu analyzes the relationship of economic fundamentals and China's housing prices by regressing population, real interest rate, per capita disposable income, and housing density as economic factors on real estate over three time periods 1998-2001, 2002-2006, and the all encompassing 1998-2006. Yu chooses to break the data series into the periods before and after the Chinese government instituted their land-use policy in 2002 to see if the policy changed the real estate market in China and determines this macro-control has created a new real estate market. Over the entire time period the regression found that population growth, per capita disposable income, and the real interest rate positively and significantly affects housing prices. However, this significance is not reflected through the sub-periods as variables that weren't significant in the complete sample were very significant in a sub-period and

[5] Yu (2010)

variables that were significant in the complete sample did not show significance in the sub-periods. One of these variables is the interest rate, which was significant in the first sub-period and over the total data set, but not in the second sub-period leading Yu to state the real interest rate has been rendered insignificant in the current housing market by the land-use policy.

III. Data Section

Shibor

The Shanghai Interbank Offered Rate represents the wholesale interest rates calculated by averaging all interbank RMB lending rates as quoted by 18 banks at 11:30 A.M. each business day, excluding the 4 highest and 4 lowest quotations[6]. Shibor durations consist of the overnight, 1-week, 1-month, 3-month, 6-month, 9-month and 1 year. The National Interbank Funding Center is responsible for calculating and publishing Shibor (current quotes available at www.shibor.org). The Shibor Working Group is in charge of adjusting the panel banks, supervising and administering Shibor, and regulating the behavior of the quoted banks in accordance with the Implementation Rules of Shibor[7]. As Shibor was originally incepted to provide a benchmark for derivative products as China pushed for more interest rate liberalization, banks are not required to trade at their reported rates possibly offering an opportunity for interest rate manipulation[8][9]. To avoid issues experienced with the manipulation of Libor (which the

[6] Report both borrowing and lending rates www.shibor.org
[7] Shibor.org
[8] Reforming China's Monetary Policy Framework to Meet Domestic Objectives (Conway, Herd, Chalaux)
[9] In January 2008, an interest rate swap market based off of SHIBOR was introduced; "However, turnover in this market has remained very limited and by September 2010 transactions in the interbank swap market

model for Shibor was based off of) the PBoC has increased rewards for banks that offer more reliable quotes and instituted harsher penalties for those that do not, while requiring all price quotes to be evaluated by a third party. This regulation has led Shibor to become one of the premiere benchmark rates in China (Wen Bin, 2004), and is used as a reference for setting interest rates on financial products, including interbank deposits, bonds, wealth management products and derivatives[10]. Shibor was first calculated October 8, 2006, making my first monthly data point October 31, 2006 for all variables and extending through 2013. Shibor data for all maturities was collected from Bloomberg, which sourced the National Interbank Funding Center.

Kuang (2010) looked at interest rates from 1996-2007, ending right around the inception of Shibor, and discovered they have a positive effect on the housing market while the analysis of Yu and Chen (2009) suggested a negative correlation between the real interest rate and housing prices. Kuang and Yu were unable to utilize Shibor for their interest rates, so Wang and Wang (2013) decided to use the 1-week Shibor monthly data series. They used a Grainger test and determined that the 1-week Shibor was not a significant factor on real estate prices. This study will look into the other Shibor durations for significance as well as a lag between interest rates and housing prices, offering greater insight into interest rates' effects on housing prices as the government continues to liberalize rates. The study expects to find a negative relationship between house price growth and interest rates if any significant correlation is found over the time period. The basic regression to determine which Shibor maturity has the greatest effect on the Shanghai housing market is as follows:

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were only 1.4% of the transactions in the cash and secured interbank bank market" (Conway, Herd, Chalaux).

[10] http://english.caixin.com/2012-10-15/100447412.html

$$Ln(Growth\_of\_Shanghai\_Second\_Hand\_Housing\_PI = \alpha i + \beta_1 Ln(Shibor\_duration(i)) \quad \text{for } 0 < i < 7$$

Housing Market

The Second-Hand Housing Sales Price Index of Shanghai was used since variables effecting Shanghai's housing market are likely to affect China's other major cities' housing markets. The use of Shanghai's housing data is consistent with previous studies (Burdekin and Tao (2013)) as the national housing price series provided by the government is dubiously flat, possibly implying some manipulation of the data by the government. Shanghai is "the largest and most important housing market in China" (Burdekin and Tao (2013), 3). I used the Second-Hand Housing PI for Shanghai rather than the New-Housing PI as the Shanghai housing market is a mature market with most activity being in the Second-Hand market rather than being fueled by the construction of new homes and buildings and more accurately reflects what the population is paying. All housing market data was collected from the Chinese National Bureau of Statistics off of their website (data.stats.gov.cn) from their 70 cities housing sales price index. The National Bureau of Statistics used to publish only 35 housing price indices along with a national composite but discontinued this in 2011. When they switched to using 70 cities, they stopped publishing a national composite as well as used a different methodology for data collection, which unfortunately might cause some discrepancy within the Shanghai Second-Hand Housing PI even though Shanghai was one of the original 35 cities surveyed[11]. Contrary to the housing price data series in this study, Wang and Wang

[11] https://www.milkeninstitute.org/pdf/China-HousingMarket.pdf

(2013) used the national composite up until 2011 then switched to an average of all 70 cities' real estate price indices.

All data was collected monthly starting October 31, 2006 extending through December 31, 2013, and was either downloaded as or converted to a growth rate then taken the natural logarithm. This is done in order to rid the data series of a unit root error, and the use of the natural log of all variables is consistent with Wang and Wang (2013). The study then used the following basic regression:

$$\begin{aligned}\text{Ln(Growth\_of\_Second\_Hand\_Housing\_PI)} = {} & \alpha i + \beta_1 \text{Ln(SHCOMP\_Return)} + \\ & \beta_2 \text{Ln(Growth\_of\_CPI\_YoY)} + \beta_3 \text{Ln(Growth\_of\_M2\_YoY)} + \\ & \beta_4 \text{Ln(Growth\_of\_State\_Balance)} + \\ & \beta_5 \text{Ln(Growth\_of\_Shanghai\_Real\_Estate\_Investment)} + \beta_6 \text{Ln(Growth\_Shibor)} + \\ & \beta_7 \text{Ln(Cumulative\_Growth\_of\_Industrial\_Added\_Value)}\end{aligned}$$

This basic regression is then run at lagged time intervals, looking at the independent variables from time T-i for i=0 through i=6 to see if there is a delay in the effects of these macroeconomic fundamentals on the Shanghai housing market.

The Shanghai Composite (SHCOMP), developed in December 1990, is a capitalization-weighted index that tracks the performance of all A-shares and B-shares[12] listed on the Shanghai Stock Exchange[13]. This was used as a benchmark for the performance of Chinese equities, and is consistent with previous studies (Burdekin 2013, Xu and Chen 2012). Burdekin (2013) is able to confirm the findings of Xu and Chen (2012) that there exists a positive correlation between Chinese stock market gains and home prices. Zhang and Fung (2006, pp. 31-32) instead discovered that there is a negative correlation between the Chinese housing and equity markets, theorizing, "that

[12] Contains 1000 securities
[13] Bloomberg

stocks and real estate are competing investment channels."[14] It is possible that the opposing findings of these studies are due to a change in the economic environment where households move funds from savings into real estate and equities. Burdekin and Redfern (2009) suggest this might be the case as they looked at participation rates in the nation's stock markets and saw a great increase in 2007. This study should be able to offer more insight into whether or not this is the case as the earliest data point is October 31, 2006, and the study expects to yield similar results to these previous studies.

The national CPI YoY growth is used as a proxy for inflation. The study uses the YoY growth rate to account for seasonality in price changes. The use of CPI YoY as an inflation proxy is consistent with Burdekin and Tao (2013) where they find a causal effect of growth in housing prices on overall consumer price inflation. The M2 YoY growth rate is used as a proxy for changes in the overall money supply, and use YoY in order to account for seasonality experienced with M2. The use of M2 is consistent with Li and Wang (2011) in which they showed the M2 money supply to be a major factor affecting housing prices and was reconfirmed by Gao and Wang (2009), which looked from 2000-2007 and findings suggested the money supply had an impact on real estate price. Han and Wang (2011), in contrast, found there to be little or no effect of changes in the money supply on housing prices, while Wang and Wang (2013) used M1 for their money supply. This study expects to confirm the previous results that inflation and money supply have positive correlations with house price growth.

The growth of the state balance is the growth of the national state revenues minus the state financial expenditures. Central government state-owned enterprises (SOEs)

[14] Zhang and Fung (2006) used data from 1997-2005 and were able to confirm their results with both the Shanghai housing price index and national housing price index

invest primarily in real estate and have possibly been overbidding in land auctions contributing to a real estate bubble in China[15]; therefore, the state's liquidity may be an important factor on housing prices. The data was collected from the Chinese National Bureau of Statistics.

Shanghai real estate investment growth is the cumulative growth rate of the amount of money being invested in real estate in Shanghai as reported by the National Bureau of Statistics. The cumulative growth of industrial added value is the national increase in industrial production adjusted for seasonality, which serves as a proxy for GDP since national GDP data is reported quarterly instead of monthly and is consistent with Burdekin and Tao (2013). Luo and Hong (2012) are able to show bi-directional Granger causality between real estate prices and GDP, while Hu, Jin, and Chen (2011) suggest a negative relationship between GDP and real estate prices.

IV. Results and Analysis

The study begins by looking at how different Shibor maturities impact the Chinese housing market and attempts to determine which duration most significantly affects house price growth. Table 2 shows the regression outputs of each duration of Shibor on house price growth, revealing none to be statistically significant. The more unexpected revelation from the regressions was the positive coefficients for all Shibor maturities with the exception of the overnight rate. This lack of a significant correlation between interest rates is consistent with both Burdekin and Tao (2013) and Wang and Wang (2013)[16]; however, with the 3-month and 6-month Shibor durations yielding the

[15] Burdekin 13, 3
[16] The 7-day SHIBOR maturity yielded a p-value of .7013

only positive adjusted R-squareds and the 6-month maturity having the most significant coefficient[17], it seemed that the 6-month maturity required further analysis.

The study goes on to regress the macroeconomic variables on the Shanghai housing market, shown in Table 3. The national CPI and M2 money supply YoY growth both positively and significantly affect house price growth, with M2 having the coefficient with the greatest magnitude and significance, confirming previous studies Burdekin and Tao (2013), Wang and Wang (2013) and Stohldreier (2012). The national state balance has a negative and significant relationship with the house price growth, which is in accordance with this study's view that an increase in the state balance would increase the housing supply as SOEs continue to be a main investment channel for the housing market, lowering house prices. Another unexpected result was the positive and significant correlation between Shanghai real estate investment and Shanghai house price growth, paralleling Stohldreier's (2012) discovery of a positive correlation between the housing market and investment in fixed assets as well as construction activity. This reaffirms her notion that speculation on the Chinese housing market might be driving price more than fundamentals as house prices show to grow with supply.

The stock market, industrial growth and the interest rate were shown to be insignificant. The extreme insignificance of the stock market and GDP[18] on the housing market is particularly shocking given the previous significant findings from Burdekin and Tao (2013), Wang and Wang (2013) and Stohldreier (2012). This is more in line with Yu's (2010) hypothesis that macroeconomic fundamentals do not have consistent relationships with house price growth but rather have are effective only in certain periods,

[17] P-value = 0.1994
[18] SHCOMP p-value = .8441 and Industrial Added Value p-value = .4815

suggesting these factors are not relevant given the macroeconomic environment observed from 2007 through 2013. Although the 6-month Shibor maturity was insignificant, the negative impact agrees with the initial hypothesis and since it was substantially more significant than GDP and the Shanghai Composite Index I reran the regression leaving out the latter two variables. This new regression (Table 3: II) confirmed the results of the first regression, both in sign of the coefficients and level of significance, including the insignificance of the 6-month duration Shibor. The study goes on to test the regression with only the significant variables, confirming the two previous regression results with Shanghai real estate investment jumping into the 95% level of significance from the 90% level. Unexpectedly, the R-squared is less so in the third regression than the second regression suggesting that interest rates may in fact influence the housing market. The study then runs an auto-regression of the Shanghai housing price index on itself, revealing that the previously announced housing prices[19] are extremely significant and positively effect the house price growth, which is consistent with Wang and Wang (2013) and might be further evidence of Stohldreier's (2012) assumption that speculation is currently playing a major role in the Chinese housing market.

Real estate, by nature, is a relatively illiquid market with a long-term[20] investment horizon making it important to consider that these macroeconomic variables might have a lagged impact on house price growth. Since the initial Shibor regression results suggest the 6-month duration Shibor is the most relevant interest rate, this study chooses to look at lags up to 6 months to look at the complete credit cycle to maturity. The initial 3 months of lags already showed a lag effect within a few variables as seen in Table 4. The

[19] Independent variable SHPI (T-1)
[20] US capital gains tax law defines long-term as a holding period greater than one year

initial lag (T-1) showed that lagged CPI and M2 growths have positive and significant impacts on house price growth in Shanghai. Moving through the table to lags T-2 and T-3, the national CPI continues to get more and more significant, increasing from the 95% level of significance up to the 99% level, peaking at lag T-3. Cumulative industrial growth experiences a similar trend, going from an extremely insignificant relationship at time T to significance at the 90% level showing a negative correlation between the GDP proxy and the housing market[21]. This negative relationship agrees with Wang and Wang's (2013) results, and while house price appreciation might lead people to increase savings and reduce GDP but rather an effect of China's economic shift from a production-based economy to a consumption-based economy, thereby reducing industrial growth. The money supply proves to have a highly positive relationship that is consistent through almost every lag period, maximizing significance in the first lag period with a p-value of 3.36E-5. The money supply having a positive correlation is in agreement with the study's hypothesis that the money supply would mimic the results of previous studies (Burdekin and Tao (2013), Guo and Li (2011), Wang and Wang (2013) and Stohldreier (2012)).

Shanghai real estate investment growth seems to share these positive lagged effects; however, upon further examination this is revealed to not be the case once one removes the insignificant variables from the regression[22]. Shanghai real estate is one of only two variables to consistently exhibit no significant lagged effects on the housing

[21] p-value = .4815 at time T compared to p = .0801 at time T-3

[22] The first 2 regressions at LAG T-1 showed a positive and significant correlation between Shanghai real estate investment and house price growth, once all variables were removed in the third regression it pushed the variable to insignificance (p-value = .1035).

market within 6 months[23]. The other of these variables, much to the study's surprise, is the SHCOMP, making it the only variable insignificant throughout all the regressions run in this study. Given Burdekin and Tao's (2013) confirmation of Stohldreir's (2012) finding that the stock market negatively and significantly influences housing prices, this study expected the index to yield similar results. Instead this study's results of the stock market over the 2007-2013 period to have no significant real-time nor lagged impact on the Chinese housing market is more consistent with Yu's (2012) hypothesis that fundamentals have periodic effects on the housing market suggesting current macroeconomic conditions or government policy may have caused this.

The national state balance yielded unusual results throughout the lagged effects. The state balance continues to have a negative and significant relationship with house price growth at the 95% significance level in the lag series T-1. The variable loses all significance with its p-value soaring to 0.9889 by lag T-4 before it swiftly returns to the 95% level of significance at T-6[24]. The relationship at the 6-month lag is now significantly positive contrary to the results at time T, which agrees with the earlier notion that these excess funds flow back into the real estate market through SOEs and take 6-months to create value.

The most interesting finding from the lagged series is the newfound significance of interest rates, which is not seen in any of the previous studies (Burdekin and Tao (2013) and Wang and Wang (2013)). The 6-month duration Shibor first proclaims significance at lag T-1, where the interest rate imposes a negative influence on house

[23] Lag T-4 through T-6 results available in Table 5
[24] p-value = .03

price growth right at the 95% significance level[25]. This is the first significant correlation between interest rates and the housing market, showing interest rates are a fundamental factor of house price growth at least in the observed time period. The negative relationship between interest rates and the housing market is in line with the study's hypothesis that increasing interest rates should increase one's cost of capital, making it harder to obtain and therefore driving down house price growth. The 6-month Shibor maturity continues to increase in significance as the time lag gets closer to the duration date, peaking at lag T-4 within the 99% confidence level as seen in Table 5[26].

The study conducts its final regressions, first using a combined regression of the most significant coefficient of each variable based on its lag period then continuing to run each variable individually against house price growth. The combined regression yielded the greatest adjusted R-squared within this study[27], suggesting its model and variables best explain changes in house prices. The Shanghai Composite Index did not yield any significant coefficients and was therefore excluded from these regressions. Table 6 uses the state balance with no lag; the Shanghai real estate investment with no lag; the M2 with the 1-month lag; the CPI with the 3-month lag; the industrial growth with the 3-month lag and the 6-month duration Shibor at the 4-month lag. The 3-month lagged national CPI positively and significantly affected the housing market at the 95% significance level, consistent with the study's earlier expectations and results, but when it was then individually regressed against house price growth the CPI dropped out of significance with the p-value increasing to 0.3495 and the adjusted R-squared yields -

[25] p-value = .0507
[26] p-value = .0007 at T-4 versus p-value = .0009 at T-6
[27] not including the auto-regression of house price growth at a lag of 1-month to current house price growth, which yielded an adjusted R-squared of .77

0.0009. The industrial added value growth follows a similar trend, having a negative impact on the housing market at a significance level within 95% as was the case in earlier regressions. When the GDP proxy is then individually regressed against house price growth, however, its p-value substantially rises to 0.4672 from the 0.03 value experienced in the combined regression as well as exhibiting a negative adjusted R-squared in the individual regression. The negative adjusted R-squared resulting from both the national CPI and industrial growth regressions suggest that these variables themselves may not have significant relationships with the housing market but instead these variables might be capturing some other factor of house price growth.

The 1-month lagged money supply continues to have an extremely positive impact on the housing market[28] and is significant within the 99%, consistent with the study's expectations and findings in previous regressions. M2 is then regressed individually against house price growth, raising its p-value substantially but still shows a positive relationship with the housing market and remains significant at the 90% level[29]. The national state balance shows to have a negative correlation with house price growth at the 95% significance level, and this relationship is confirmed by its individual regression results of a nearly identical coefficient with greater significance[30]. Shanghai real estate investment continues its counterintuitive positive relationship with the housing market and is reaffirmed by its individual regression having nearly identical coefficients and p-values. The 4-month lagged 6-month Shibor maturity again showed a negative correlation with the Shanghai housing market that is significant within the 95% level,

[28] Coefficient = 3.02
[29] P-value = 1.43E-5 combined, p-value = .0585 individually
[30] P-value = 0.022 combined, p-value = .0035 individually

confirming the study's earlier intuition that interest rates are fundamental to the housing market. This relationship is supported by the individual regression of the 6-month duration Shibor on house price growth, with the coefficient and p-value essentially equaling the values from the combined regression[31][32].

V. Conclusion

The results of this study confirm the original hypothesis that interest rates are a significant economic factor in determining housing prices in China, exhibiting a negative correlation between the two. While more immediate interest rate durations have proven to have insignificant impacts on the housing market, the 6-month Shibor maturity shows to be highly significant when lagged 4 months behind housing prices. This lagged affect confirms the study's suspicion that since the real estate market is generally an illiquid and a long-term investment, immediate changes in short duration interest rates shouldn't have any affect on house prices while long duration rates will. Inflation growth in China continued to have a positive and significant impact over multiple lag durations but is most effective when lagged 3 months behind housing prices. Again, the study expected that it would take time for these economic fundamentals to trickle through the Chinese economy into housing prices, with the only variables showing greater significance are the national state balance and the government-reported Shanghai real estate investment. As SOEs are major players in the Chinese real estate market, increases in the national balance could signal to investors an increase in investment and therefore supply to the housing market, causing investors to bid down prices in anticipation of the supply

[31] Coefficient combined = -0.1497, individual = -0.1452
[32] P-value combined = 0.013, individual = 0.016

increase. Contrarily, increases in Shanghai real estate investment are related to increases in housing prices, but housing prices might be the cause for increases in investment as higher housing prices increases speculation on the market leading to more investments in the Chinese housing market. While the Shanghai stock market showed to have no significant influence on the housing market, further study is needed to show if this is a result of the specific sample period or if the two truly are competing investment channels.

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Table 1: Summary Statistics

SHCOMP	
Mean	0.006693278
Standard Error	0.010150537
Median	0.007937205
Mode	#N/A
Standard Deviation	0.094677904
Sample Variance	0.008963906
Kurtosis	0.695297974
Skewness	-0.223429678
Range	0.520783739
Minimum	-0.246317003
Maximum	0.274466736
Sum	0.582315223
Count	87

CPI YoY	
Mean	0.033816092
Standard Error	0.002619123
Median	0.031
Mode	0.027
Standard Deviation	0.024429552
Sample Variance	0.000596803
Kurtosis	-0.130936996
Skewness	-0.086516004
Range	0.105
Minimum	-0.018
Maximum	0.087
Sum	2.942
Count	87

Shanghai Real Estate Investment	
Mean	0.117982759
Standard Error	0.011620182
Median	0.093
Mode	0.077
Standard Deviation	0.108385843
Sample Variance	0.011747491
Kurtosis	-0.163150048
Skewness	0.82133683
Range	0.452
Minimum	-0.063
Maximum	0.389
Sum	10.2645
Count	87

National Real Estate Sales Growth %	
Mean	0.1315
Standard Error	0.019233232
Median	0.122
Mode	0.371
Standard Deviation	0.179395642
Sample Variance	0.032182797
Kurtosis	-0.719671995
Skewness	0.154607288
Range	0.727
Minimum	-0.197
Maximum	0.53
Sum	11.4405
Count	87

M2 YoY	
Mean	0.178005747
Standard Error	0.004910847
Median	0.1674
Mode	0.185
Standard Deviation	0.04580533
Sample Variance	0.002098128
Kurtosis	0.952379362
Skewness	1.341674601
Range	0.1734
Minimum	0.124
Maximum	0.2974
Sum	15.4865
Count	87

State Balance	
Mean	-0.020264368
Standard Error	0.019311438
Median	0.003
Mode	-0.008
Standard Deviation	0.180125099
Sample Variance	0.032445051
Kurtosis	2.171634841
Skewness	-0.267520351
Range	1.065
Minimum	-0.521
Maximum	0.544
Sum	-1.763
Count	87

Second-Hand Housing Sales PI YoY	
Mean	0.042206897
Standard Error	0.005117782
Median	0.033
Mode	-0.015
Standard Deviation	0.047735497
Sample Variance	0.002278678
Kurtosis	- 1.157668587
Skewness	0.468769714
Range	0.161
Minimum	-0.022
Maximum	0.139
Sum	3.672
Count	87

6M	
Mean	0.009717512
Standard Error	0.007732429
Median	0.005472996
Mode	0
Standard Deviation	0.072123295
Sample Variance	0.00520177
Kurtosis	8.487556178
Skewness	-1.737590155
Range	0.482001999
Minimum	-0.309136939
Maximum	0.17286506
Sum	0.845423518
Count	87

Table 2: SHIBOR Durations Regressed on Shanghai House Price Growth

VAR	I	II	III	IV	V	VI
	(0.02072)					
O/N	(0.8629)					
		0.042202				
1 W		(0.701342)				
			0.03059			
1 M			(0.750227)			
				(.07265)		
3 M				(0.295741)		
					.0.0725	
6 M					(0.199476)	
						(.02876)
1 Y						(0.545764)
Observations	87	87	87	87	87	87
Adjusted R-squared	-0.01141	-0.01001	-0.01055	0.001241	0.007755	-0.0074

**P-value in Parentheses*

Table 3: Macroeconomic Fundamentals on Shanghai House Price Growth

	No Lag			
VAR	I	II	III	IV
SHCOMP	0.024124 (.844145)			
CPI YoY	0.797514** (.010076)	0.676144** (0.007821)	0.602465** (0.016085)	
M2 YoY	2.75423*** (7.67E-5)	2.72519*** (7.28E-5)	2.55007*** (0.000169)	
State Balance	-0.287559** (0.012888)	-0.303008** (0.007046)	-0.338292** (0.002403)	
Shanghai Real Estate Investment	0.251112* (0.051828)	0.22382* (0.054301)	0.24421** (0.036336)	
6M	-0.080604 (0.15242)	-0.084093 (0.130617)		
Industrial Added Value	-0.077467 (0.481495)			
SHPI Lag T-1				0.869122*** (6.49E-29)
Observations	87	87	87	87
Adjusted R-squared	0.233219	0.24711	0.234878	0.77197204

*Note: P-value in Parentheses. * Denotes 90% confidence, ** denotes 95% confidence, ***denotes 99% confidence*

Table 4: Lagged Effects of Macroeconomic Fundamentals on Shanghai House Price Growth

	LAG T-1			LAG T-2			
VAR	I	II	III	I	II	III	IV
	0.042943			0.025822			
SHCOMP	(0.726404)			(0.83266)			
	0.868182**	0.872514**	0.665689**	0.884505**	1.04997***	0.985241***	0.766798**
CPI YoY	(0.006093)	(0.00507)	(0.009843)	(0.005298)	(0.000213)	(0.000454)	(0.00144)
	2.926694***	2.91389***	2.850909***	2.88543***	2.70942***	2.57552***	2.46982***
M2 YoY	(3.36E-5)	(2.74E-5)	(3.87E-5)	(4.01E-5)	(5.98E-5)	(0.000123)	(0.000228)
	-0.202083*	-0.20729*	-0.236138**	-0.123606			
State Balance	(0.087269)	(0.072125)	(0.037449)	(0.296761)			
Shanghai Real Estate	0.236018*	0.219338*	0.188558	0.179356	0.178159		
Investment	(0.068466)	(0.064274)	(0.103502)	(0.162851)	(0.129297)		
	-0.120374**	-0.10682*	-0.11196**	-0.162152**	-0.159596**	-0.173399**	-0.181945**
6M	(0.044531)	(0.062019)	(0.050749)	(0.007564)	(0.005154)	(0.002353)	(0.00153)
	-0.130643	-0.13189		-0.170849	0.195015*	-0.162943	
Industrial Added Value	(0.237832)	(0.225116)		(0.122775)	(0.067993)	(0.121683)	
Observations	86	86	86	85	85	85	85
Adjusted R-squared	0.213498	0.23186	0.227109	0.202406	0.216732	0.203516	0.189286

*Note: P-value in Parentheses. * denotes 90% confidence, ** denotes 95% confidence, ***denotes 99% confidence*

Table 5: Lagged Effects of Macroeconomic Fundamentals on Shanghai House Price Growth (Continued)

	LAG T-3		LAG T-4	
VAR	I	II	I	II
	0.081516		0.111356	
SHCOMP	(0.499726)		(.347729)	
	0.877872**	0.913139***	0.660792**	0.43962*
CPI YoY	(0.004832)	(0.000833)	(0.030299)	(0.050661)
	2.76419***	2.6498***	2.44478***	2.3507***
M2 YoY	(6.09E-5)	(5.6E-5)	(0.000262)	(0.000239)
	-0.062631		-0.001618	
State Balance	(0.587491)		(0.988987)	
Shanghai Real Estate	0.109482		0.083142	
Investment	(0.383077)		(0.499004)	
	-0.177833**	-0.192245**	-0.186592**	-0.199608***
6M	(0.003593)	(0.001039)	(0.002227)	(0.000763)
	-0.185394*	-0.18022*	-0.156202	
Industrial Added Value	(0.088091)	(0.080093)	(0.142515)	
Observations	84	84	83	83
Adjusted R-squared	0.205852	0.223363	0.176896	0.186018

*Note: P-value in Parentheses. * Denotes 90% confidence, ** denotes 95% confidence, ***denotes 99% confidence*

Table 6: Lagged Effects of Macroeconomic Fundamentals on Shanghai House Price Growth (Continued)

	LAG T-5		LAG T-6			
VAR	I	II	I	II	III	IV
	0.029842		0.101143			
SHCOMP	(0.797277)		(0.352894)			
	0.464453		0.537844*	0.48924*	0.239718	
CPI YoY	(.121754)		(.05635)	(0.077497)	(0.302115)	
	2.04803**	1.80701***	1.78542**	1.74675	1.69158**	1.49479**
M2 YoY	(0.001616)	(0.000804)	(0.002896)	(0.003255)	(0.004661)	(0.007965)
	0.090884		0.302313**	0.299754**	0.258372 **	0.206238**
State Balance	(0.441951)		(0.00796)	(0.008168)	(0.019948)	(0.03566)
Shanghai Real Estate	0.075946		0.134306			
Investment	(0.529298)		(0.230737)			
	-0.166208**	-0.167672**	-0.183856**	-0.18993***	-0.197607***	-0.188375***
6M	(0.006815)	(0.004645)	(0.001364)	(0.000884)	(.000611)	(.000907)
	-0.146785		-0.175385*	-0.155302		
Industrial Added Value	(0.160952)		(0.071526)	(0.101633)		
Observations	82	82	81	81	81	81
Adjusted R-squared	0.137153	0.159247	0.253541	0.256038	0.238939	0.238154

*Note: P-value in Parentheses. * Denotes 90% confidence, ** denotes 95% confidence, ***denotes 99% confidence*

Table 7: Mixed Lagged Effects Regression Results

	Combined	Individual					
VAR	I	II	III	IV	V	VI	VII
	0.803014**	0.213314					
CPI YoY	(0.008947)	(0.340463)					
	3.020202***		0.915296*				
M2 YoY	(1.43E-5)		(0.058591)				
	-0.238928**			-0.287843**			
State Balance	(0.02212)			(0.003512)			
Shanghai Real Estate	0.210609*				0.216474*		
Investment	(0.061456)				(0.091955)		
	-0.149759**					-0.145185**	
6M	(0.013601)					(0.016732)	
	-0.208518**						-0.070495
Industrial Added Value	(0.038167)						(0.467196)
Observations	83	84	86	87	87	83	84
Adjusted R-squared	0.268376	-0.000972	0.0142467	0.085268	0.021671	0.057136	-0.005651

*Note: P-value in Parentheses. * Denotes 90% confidence, ** denotes 95% confidence, ***denotes 99% confidence*