

This PDF is a selection from a published volume from the National Bureau of Economic Research

Volume Title: NBER Macroeconomics Annual 2015, Volume 30

Volume Author/Editor: Martin Eichenbaum and Jonathan A. Parker, editors

Volume Publisher: University of Chicago Press

Volume ISBNs: 978-0-226-39560-9 (cloth); 978-0-226-39574-6 (e-ISBN)

Volume URL: <http://www.nber.org/books/eich15-1>

Conference Date: April 17–18, 2015

Publication Date: June 2016

Chapter Title: Comment on "Demystifying the Chinese Housing Boom"

Chapter Author(s): Martin Schneider

Chapter URL: <http://www.nber.org/chapters/c13596>

Chapter pages in book: (p. 167 – 175)

Comment

Martin Schneider, Stanford University and NBER

Introduction

What drives the spectacular recent movements in Chinese house prices is an important and challenging question. This paper makes progress by providing very interesting new data: it develops new city-level price indices. The key stylized facts that emerge are that (i) in large (“first-tier”) cities, house price growth outpaces income growth, whereas (ii) in smaller cities house prices and income grow together. The paper also provides novel facts on mortgage borrowing by income group. This discussion first comments on the construction and interpretation of the price index and makes some suggestions for future research with transactions data from China. It then considers what relationship between house prices and income we might expect from theory. Finally, it sketches a mechanism for why emerging, urbanizing economies might see particularly dramatic movements in house price-rent ratios.

Measuring City-Level House Price Changes

A major contribution of the paper is to present a novel data set on housing transactions. The data come from mortgage records of a large commercial bank. The authors can see the transaction price, details of the mortgage, characteristics of the house, as well as some demographics. The sample of transactions has two special properties. First, it contains only mortgage purchases (as opposed to cash purchases). Even with this specific focus, the new data represent tremendous progress given the overall lack of microdata on housing in China. Future research could further clarify the relative importance of mortgage borrowers in

China and connect to facts on leverage. In particular, aggregate data show that leverage during the Chinese housing boom was substantially lower than in other countries that recently experienced boom-bust episodes. For example, the ratio of outstanding mortgage debt to GDP in China in 2012 was 15%, whereas the same ratio in the United States in 2006 was 80% (Barth, Lea, and Li 2012). A second feature of the sample is that the data contain relatively few repeat sales of the same property. This is because many transactions are recent sales of new dwellings that were not yet resold within the sample period. Lack of repeat sales generally makes it tricky to control for house quality when developing price indices. However, the structure of urban Chinese housing markets allows the authors to address this issue. Indeed, most sales are apartments in developments that consist of many similar units. It is thus reasonable that we can learn about price movements for a given dwelling by looking at sales prices of very close comparables in the same development. To implement this idea, the authors write down a statistical model of transactions prices in a city. The log price of dwelling i located in development $\delta(i)$ that sells at date t is given by

$$p_t^i = p_t + \beta'X_t^i + q^{\delta(i)} + \varepsilon_t^i \quad (1)$$

where the vector X_t^i consists of a set of property characteristics, $q^{\delta(i)}$ is a development fixed effect, and p_t is a city-time fixed effect. The latter serves as the authors' price index for the city, after appropriate normalization. One way to interpret (1) is that the value of a dwelling reflects both a property-level and a city-level component. The former is described by the characteristics X and the development effect, which, for example, captures the location of the dwelling. The regression removes property-level heterogeneity in prices and what is left is the city-level component, a common force that affects all properties equally. The key assumptions underlying this interpretation are that (i) the relative contribution to dwelling value of living in a particular development is fixed over time, and that (ii) the effects of the individual characteristics are also constant. If these two assumptions do not hold, then the interpretation of the price index becomes more difficult. For example, suppose that the relative contribution to apartment value of living in a particular development increases over time. The measured price index can then grow because more apartments located in that development are traded. Similarly, if both prices and quantities of characteristics like square footage change over time, the index will partly reflect composition effects and not simply a common force that affects all properties equally. The

following subsection illustrates these arguments. Future research could show whether they are in fact quantitatively important.

What Does the Price Index Capture?

In order to think about forces that affect the price index p_t , it is helpful to consider a stylized model of housing technology. Suppose that utility from housing is given by an aggregator over attributes that is homogeneous of degree one:

$$F(X_t^1 \dots X_t^{N_x}, Y_t^1 \dots Y_t^{N_y}, Z_t^1 \dots Z_t^{N_z}).$$

Here the X s are property-level characteristics as above, the Y s are development-level characteristics, and the Z s are city-level characteristics. Under a benchmark assumption of competitive markets for both dwellings and attributes, the value of a dwelling is then a linear combination of the prices of its attributes

$$P_t = \sum_j p_t^{x,j} X_t^j + \sum_j p_t^{y,j} Y_t^j + \sum_j p_t^{z,j} Z_t^j.$$

A first-order approximation can now deliver the model for log prices (1). For example, assume that the expenditure shares on each property-level characteristic X as well as the overall expenditure share on the development-level characteristics are constant over time, and moreover, that the prices of each property-level characteristic are constant over time. The regression then picks up the relative contribution of each characteristic to dwelling values, as well as the relative contribution of each development. It is not a priori obvious, however, why the relative contributions of attributes X should be constant over time. Suppose the aggregate F is Cobb-Douglas, so expenditure shares on attributes are indeed constant over time. We could now imagine that scarcity of space implies that the characteristic "square footage" becomes relatively more expensive. If, moreover, in response to the shortage of space the average apartment becomes smaller, then this will affect the interpretation of the price index. Indeed, consider an econometrician who estimates the model (1) with a constant coefficient on square footage. Since square footage declines, the econometrician infers a decline in the contribution of square footage to dwelling value. At the same time, transactions prices reflect constant expenditure on square footage. The econometrician will thus further infer an increase in the city-wide price component. The price index he constructs then reflects in part the composition of dwellings that were

traded, as opposed to simply a common driver of the prices of all dwellings in the city. The model (1) also imposes a constant value of living in a particular development. To illustrate the implication of this assumption, take differences of equation to represent capital gains on dwellings as

$$\Delta p_{t+1}^i = \beta' \Delta X_{t+1}^i + \varepsilon_{t+1}^i - \varepsilon_t^i.$$

The statistical model thus assumes that differences in capital gains within a city can be explained by changes in dwelling-level characteristics (or noise). In particular, the location of the property does not matter for the capital gain. This implication is in contrast to recent evidence from the US housing boom. For example, Landvoigt, Piazzesi, and Schneider (2015) show that 2000–2005 capital gains were much larger in those census tracts of San Diego County where median house prices were initially low. Moreover, the cross-sectional differences were so large that they cannot plausibly be explained by home improvements (which generate changes in the X s). There is also evidence for several theoretical mechanisms that generate changes in house prices by location. For example, Guerrieri, Hartley, and Hurst (2013) study a model of gentrification where utility from a dwelling comes in part from the income level of the neighbors. In another example, Landvoigt et al. (2015) study an assignment model in which the quality distribution of houses for sale changes so that richer movers have to be induced to move into lower-quality houses. In both cases, the change in the income of movers into a neighborhood generates a location-specific factor in house prices. Of course, we do not know whether similar patterns are present in the Chinese data. Future research could show, however, whether the location of a development has a systematic impact on capital gains there. This would again help with the interpretation of the price index. If more suburban developments typically grow less in price, then an increase in the share of suburban apartments traded could lower the growth rate of the price index. Thus, the price index would again reflect, in part, the composition of sales.

House Prices and Income

Given the authors' results on house price increases in China, it is interesting to ask whether prices are "too high" or grow "too fast" relative to benchmarks provided by theory. The authors focus on a comparison of price growth and income growth. This section uses a standard neo-classical growth model with a housing sector to provide a benchmark for the relationship of price growth, income growth, and the level of

prices. Consider a small open economy with two goods, housing services and an “other” good. Preferences of an infinitely lived representative agent are assumed to be consistent with balanced growth. For the purposes of this section, it is enough to specify date t felicity from H_t units of housing services and C_t units of the other good as $U(C_t^\alpha H_t^{1-\alpha})$. Population M_t grows at the constant rate g_M . The world interest rate is constant at r . Housing services are produced one-for-one from housing capital, which in turn is produced from land and depreciable structures. While there is a constant supply of land L , structures can be made from the other good. Housing technology is thus summarized by a production function and a capital accumulation equation. Assuming that all land is used in housing production they can be written as

$$H_t = L^\lambda (K_t^h)^{1-\lambda},$$

$$K_{t+1}^h = (1 - \delta_h)K_t^h + I_{h,t}$$

where H is housing capital, K^h is structures and I^h is investment in structures.

The other good is produced from fixed capital and labor. There is exogenous labor augmenting technical progress A_t that grows at the rate g_A . With full employment, the production and capital accumulation imply

$$Y_t = (A_t M_t)^\nu (K_t^y)^{1-\nu},$$

$$K_{t+1}^y = (1 - \delta_y)K_t^y + I_t^y$$

where Y_t is production of other goods, K_t^y is fixed capital, and I_t^y is investment. Consider competitive equilibria in which all variables grow at a constant rate. Production of the other goods grows at the rate $g_Y = g_M + g_A$. Consumption of the other good, investment in either technology, as well as structures and fixed capital, must also grow at g_Y . Housing capital and housing services require the fixed factor land and therefore grow at the slower rate $(1 - \lambda) g_Y$. With Cobb-Douglas felicity, expenditure on housing is constant. Rents (the price of housing services) thus grow at the rate λg_Y , as does the house price per unit of quality H .

The balanced growth model provides a simple benchmark for the relationship between income and house prices. Indeed, controlling for house quality captured by H , house prices grow at $\lambda (g_M + g_A)$, whereas income per capita grows at g_A . It follows that the growth rate of income matters for prices only if there is a fixed-factor land. Prices grow faster relative to income if the land share λ is higher or population growth is

higher. It would be interesting to relate this benchmark to the differences between first- and lower-tier cities reported in the paper. It is possible, for example, that prices grow quickly relative to income in first-tier cities in China because those cities experience faster population growth. The balanced growth model also provides a benchmark to judge whether the level of prices at a given point in time is “too high.” The price-rent ratio, that is, the value of housing capital divided by the expenditure on housing services, can be written as

$$\text{price rent ratio} = \lambda \frac{1}{r - (g_M + g_A)} + (1 - \lambda) \frac{1}{r + \delta_h}. \quad (2)$$

The price-rent ratio is a weighted average of the present value of rents from land and structures. Both satisfy versions of the Gordon growth formula that relates the price-dividend ratio of an asset to the discount rate and expected dividend growth. For land, dividends (that is, land rents) grow at $g_M + g_A$ and are discounted at r . For structures, rents are constant but are discounted at the higher rate $r + \delta_h$ to account for depreciation. Formula (2) illustrates two familiar points that are useful for thinking about house prices by city. First, to assess whether the level of prices is “too high” requires comparing prices to rents as well as expectations of future rent growth. There is some evidence that Chinese price rent ratios have increased in recent years (Barth et al. 2012). It is interesting to ask whether those numbers can be reconciled with reasonable expectations of population and technology growth. Second, the price-rent ratio depends on growth only through the effect on the fixed-factor land. This generates further cross-sectional predictions on land shares, growth, and prices. The previous calculations consider only the balanced growth path of the model and in a strict sense speak only to long-run trends. It is likely, however, that prices in China respond in part to the ongoing process of urbanization, which is inherently a transition phenomenon. A serious quantitative study of prices and rents thus requires studying transition dynamics. Garriga, Tang, and Wang (2014) take on this task and investigate the impact of urbanization in a multisector growth model with endogenous migration choice. They find that urbanization can account for about two-thirds of recent house price movements.

A Learning Model of Housing Bubbles

The previous section considered house price determination in a perfect foresight setup with constant price-rent ratios. This approach ignores

the fact that urbanization involves structural change with an uncertain outcome. How fast can cities in China grow and for how long? Which cities will end up growing more? This section uses a learning model of housing bubbles, based on the classic paper by Zeira (1999), to show how growth with an uncertain ending can lead to booms in price-rent ratios. The model describes valuation of houses given subjective expectations about future rent growth. It thus develops a counterpart of (2) with $\lambda = 1$, but with the growth path initially unknown. The rent and learning dynamics are kept simple so as to zero in on the key mechanism. At date 1, rent is equal to one. Thereafter, it increases by one unit every period, until at some date $T \in [2, 10]$ it does not grow anymore and then remains constant forever. At the stopping date, all uncertainty is resolved. Intuitively, as the city grows there is uncertain potential of further growth until convergence occurs. Consider risk-neutral agents who discount the future with factor β and who learn over time about the unknown parameter T . At date 1, they start with a prior probability $\Pr(T = t)$ assumed to be (i) decreasing in t and (ii) convex. The idea here is that (i) converging to very high levels is a priori less likely but also that (ii) once the city has grown for a while, it becomes harder to know what its true potential is. The specific prior used in the calculations below is plotted in the upper panel of figure 1. While it is unlikely that a city manages to grow beyond date 3, once it has done so, “all bets are off” and the posterior over when it will stop becomes much flatter.

Let π_t denote the probability that growth stops at the next date $t + 1$ given agents’ knowledge that growth has not stopped by date t . It follows from Bayes’ rule starting from the prior probability $\pi_1 = \Pr(T = 2)$. If growth stops at date $t + 1$, the house price settles at the constant level $t / (1 - \beta)$. Let p_t denote the price at date t conditional on growth not having stopped yet. It reflects the current rent t as well as the discounted expected price next period and thus satisfies the recursion

$$p_t = t + \beta \left(\pi_t \frac{\beta t}{1 - \beta} + (1 - \pi_t)p_{t+1} \right). \tag{3}$$

If growth has not stopped by date 9, it is sure to stop at date 10 so that $\pi_9 = 1$ and $p_9 = 9 / (1 - \beta)$. Given the sequence of posteriors and the terminal condition for p_9 , the recursion (3) delivers the entire path of p_t s. The bottom panel of figure 1 shows the resulting price dynamics. The solid dark line is the present value of rents $t\beta / (1 - \beta)$ and thus also marks the price that will realize at the next date in case growth stops. The solid light line is the price path p_t that realizes while growth has not

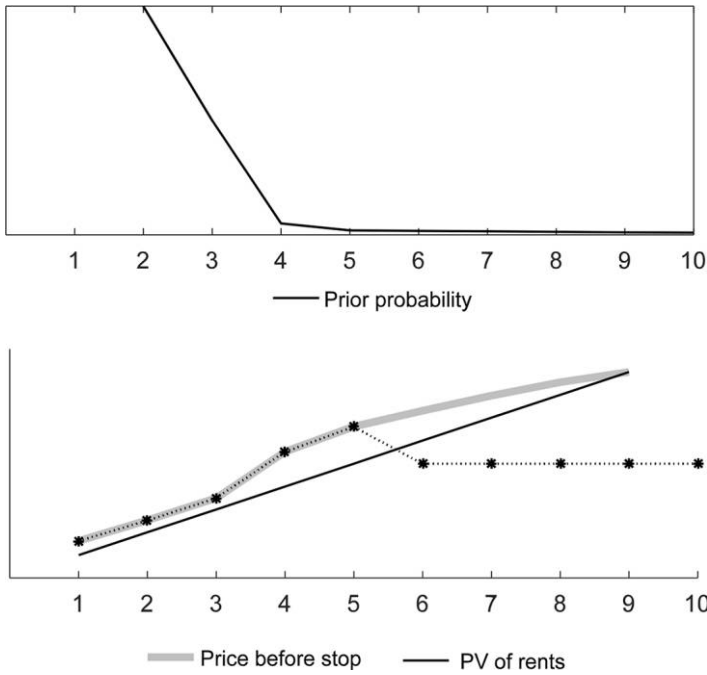


Fig. 1.

stopped. The dotted dark line represents a particular sample path, realized when growth stops at date 6 so the price settles at $5 / (1 - \beta)$. Since the dark solid line is proportional to rent, the ratio of the light to dark lines also represents (up to a constant) movements in the price-rent ratio before growth stops. Once growth stops, the price-rent ratio is constant at $1 / (1 - \beta)$. The model has several properties that help one think about house prices in emerging urbanizing economies. First, as long as learning is ongoing, the potential of future growth naturally generates prices that are higher than the present value of rents. Second, once growth stops and the true potential of the city is realized, there will typically be a downward price correction. In the example, a “soft landing” where house prices settle at a new plateau without ever falling occurs only along the sample path where the a priori maximum potential of the city is realized (that is, $T = 10$). A final feature of the example is that learning generates increases in the price-rent ratio even as the potential of the city becomes more uncertain. Indeed, along sample paths that reach date 4, the posterior flattens and all bets are off. The

increase in expected potential drives up prices relative to rents. This mechanism may be contributing to elevated price-rent ratios in China, as the structural change implied by urbanization forces market participants to assess scenarios for which there is no obvious precedent.

Endnote

Prepared for the NBER *Macroeconomics Annual*. I thank Sean Myers and Monika Piazzesi for helpful comments. For acknowledgments, sources of research support, and disclosure of the author's material financial relationships, if any, please see <http://www.nber.org/chapters/c13596.ack>.

References

- Barth, James, Michael Lea, and Tong Li. 2012. "China's Housing Market: Is a Bubble about to Burst?" Report, Milken Institute, December.
- Garriga, Carlos, Yang Tang, and Ping Wang. 2014. "Rural-Urban Migration, Structural Transformation, and Housing Markets in China." Working paper, Federal Reserve Bank of St. Louis.
- Guerrieri, Veronica, Daniel Hartley, and Erik Hurst. 2013. "Endogenous Gentrification and Housing Price Dynamics." *Journal of Public Economics* 100:45–60.
- Landvoigt, Tim, Monika Piazzesi, and Martin Schneider. 2015. "The Housing Market(s) of San Diego." *American Economic Review* 105 (4): 1371–1407.
- Zeira, Joseph. 1999. "Informational Overshooting, Booms and Crashes." *Journal of Monetary Economics* 43:237–57.