How can one tell when the housing market is out of equilibrium?

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Abstract

Purpose - One way of detecting departures from equilibrium is by comparing house prices and rents. Here I assess the viability of this approach.

Design/methodology - Error-correction models (ECMs) based on price and rent indexes can be used to forecast movements in house prices. The short-term forecasting ability of ECMs is limited though due to the long persistence of departures from equilibrium. ECMs also suffer from the limitation that they do not tell us whether the price-rent ratio is above or below its equilibrium level at any given point in time. To answer this question it is necessary to make cross-section comparisons of prices, rents and user cost (i.e., the cost incurred by owning a house).

Findings - A meaningful cross-section comparison requires that prices and rents are quality adjusted. This may require the use of hedonic methods. The equilibrium price-rent ratio (which is derived from the user cost) is difficult to compute since it depends on the expected capital gain. Also, both the actual and equilibrium price-rent ratios differ depending on which segment of the housing market is considered.

Originality/value - The housing market, which is prone to booms and busts, can very significantly affect the rest of the economy. Hence it is important that central banks and governments can detect when the housing market is out of equilibrium. I show here how difficult it is to detect such departures.

Keywords Housing market, Booms and busts, Price-rent ratio, Error-correction model, User cost, Quality mismatches, Hedonic price index, Expected capital gain

1.   Introduction

The housing market seems to be prone to booms and busts. For example, Ireland, Spain, the UK and the US all experienced booms over the 10 year period prior to 2007, which then turned to busts. In Ireland prices rose by a factor of four, before then halving again between 2007 and 2012 (according to the Economist's interactive guide to the world's housing market).

The boom-bust cycle of the housing market (and other asset markets) can be attributed to the important role played by expected capital gains in determining the expected rate of return. When calculating the expected capital gain, participants tend to focus on past performance as a measure of expected future performance. This tendency to extrapolate price trends naturally leads to overshooting (i.e., prices rise too much in a boom). When the sentiment shifts and participants start expecting price declines, the market again overshoots (i.e., prices fall too much in a bust). Three special features of the housing market make it particularly prone to booms and busts. First, it is hard to determine the fundamental value of houses, since each house is different, both in terms of its physical characteristics (such as land area and number of

bedrooms) and its location. When it is hard to measure fundamental value, market participants are more likely to focus on extrapolating price trends. Second, supply of housing is fixed in the short run. Hence any changes in demand can translate into large price movements, which then build their own momentum as market participants then start extrapolating the trend. Third, mortgage lending standards become laxer during a boom since banks have more deposits to invest and are less concerned about defaults. This process reverses in a bust. To the extent that home buyers feel credit constrained (particularly first home buyers), these procyclical fluctuations in lending standards act to accentuate the boom-bust cycle.

This inherent instability in the housing market has important implications for the rest of the economy, as has been demonstrated by the recent financial crisis. The housing market affects the economy in a number of ways. (i) Wealth effects: A change in house prices changes measured wealth which then affects consumption. Case, Quigley and Shiller (2005) find that consumption is more sensitive to changes in house prices than to changes in stock prices. (ii) Income effects: events in the housing market affect the construction sector, mortgage brokers, building inspectors, appraisers, mortgage lenders, home appliance firms, and real estate agents. For example, at the peak of the boom in the US in 2006, new construction of residential structures accounted for 5.5 percent of GDP (see Case and Quigley 2008). (iii) Banking sector effects: feedback effects exist between the housing and banking sectors. Booms in the housing market tend to go hand in hand with an expansion in the banking sector, as rising house prices stimulate bank mortgage lending which in turn causes higher house prices. In a bust, this feedback cycle goes into reverse, potentially endangering the financial system if banks are left holding too many bad loans. (iv) Fiscal effects: a banking crisis may turn into a government debt crisis if the government is forced to bail out banks, as happened in Ireland and Spain starting in 2009. Taxes on house sales are also an important source of revenue during a boom, which then largely dissipates during the subsequent bust.

Given its importance to the rest of the economy, central banks and governments may wish to intervene to try and stabilize the housing market. Prior to the current crisis, the conventional wisdom among central bankers (known as the Greenspan doctrine), however, was that it is better to focus on cleaning up after an asset bubble rather than trying to deflate it while it is happening (see Mishkin 2010). Since the crisis, a new consensus seems to be emerging that booms that are financed by credit (housing booms are almost inevitably of this type) are potentially extremely dangerous for the economy. This is because when boom turns to bust, leveraged borrows may default on their debts. This may then start a domino effect as defaults spread through the financial system. It is still an open question as to how central banks can best lean on credit driven booms. Raising interest rates and stricter prudential regulation are the two main candidates.

Before central banks can consider intervening in the housing market, however, it is first necessary to know where house prices currently stand relative to their equilibrium level. My focus here is on considering how one should go about trying to answer this question.

2. The user cost equilibrium condition

One way of detecting departures from equilibrium in the housing market is by comparing house prices with rents. The equilibrium price-rent ratio can be determined from the user cost equilibrium condition. The user cost of a house is the present value of buying it, living in it for one period and then selling it. In equilibrium this should equal the cost of renting the house for one period. We abstract from transaction costs (which for housing are high) in this discussion. The per dollar user cost in period t denoted by u_t can be written as follows:

$$u_t = r_t + m_t + d_t + w_t - g_t, \tag{1}$$

where r_t is the risk-free interest rate, m_t is the property tax rate, d_t the depreciation rate for housing, w_t the risk premium of owning as opposed to renting (which could be positive or negative), and g_t the expected capital gain. Equation (1) is a simplified version of a more general user cost formula proposed by Poterba (1984) – see also Himmelberg et al. (2005). For example, it is assumed in (1) that mortgage interest payments are not tax deductable. This is true in many countries, a notable exception being the US. The expected capital gain g_t in (1) is probably the most problematic to compute. I discuss the estimation of g_t in section 5.1.

The overall user cost is obtained by multiplying per dollar user cost u_t by the cost of buying a house P_t. In equilibrium,

$$u_t P_t = R_t, \tag{2}$$

where R_t is the cost of renting. If user cost $u_t P_t$ is higher than the rental cost R_t, then renting is more attractive. Some households therefore should switch from owning to renting. This will act to reduce P_t and increase R_t, until equilibrium is restored. Conversely, if user cost $u_t P_t$ is lower than the rental cost R_t, then owner-occupying is more attractive. Some households switch from renting to owning, thus causing P_t to rise and R_t to fall until equilibrium is restored.

Rearranging (2), the following expression is obtained:

$$P_t/R_t = 1/u_t. \tag{3}$$

Equation (3) states that the equilibrium price-rent ratio is equal to the reciprocal of the per dollar user cost of owner occupying. For example, suppose each time period is a year, and the annual risk-free interest rate is 3 percent, the property tax is 1 percent, the depreciation rate is 2 percent, the risk premium of owner-occupying is 1 percent, and the expect capital gain is 2 percent. These parameter values yield a per dollar user cost of 5 percent (i.e., $u_t = 0.05$). Taking the reciprocal yields an equilibrium price-rent ratio of 20. In other words, the price of a house should be 20 times larger than its annual rent.

3.   Cointegration and error correction models

How well does the user cost equilibrium condition actually describe reality? Empirical studies (e.g., Hill and Syed 2013) have shown that departures from equilibrium in any given period can be large. The question is whether the equilibrium condition holds in the long run, and if so how useful is the condition for forecasting future movements in house prices.

According to the user cost equilibrium condition, departures from equilibrium should be self correcting. If prices are too high relative to rents, some households should switch from owner-occupying to renting, thus acting to reduce the price-rent ratio. This process should continue until the price-rent ratio returns to its equilibrium level.
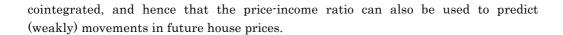
Cointegration tests usually do not reject the null hypothesis that $\ln P_t$ and $\ln R_t$ are cointegrated (i.e., $\ln P_t - \ln R_t$ is I(0)). When two series are cointegrated, they tend to rise and fall together, and when the gap between them gets larger there are forces that act to reduce the size of the gap. This perspective is consistent with the user cost equilibrium condition in (2) as long as the per dollar user cost u_t is mean reverting, which seems plausible. In cases where the null hypothesis of cointegration is rejected, this is often interpreted as evidence of a bubble in the housing market. Alternatively, data problems as discussed in section 4 below could also be responsible for rejections of the cointegration hypothesis.

Assuming prices and rents are cointegrated, the speed at which prices return to their equilibrium level can be measured using error-correction models (ECMs). A simple ECM is the following:

$$\Delta \ln P_t = b_0 + b_1 \Delta(\ln R_t - \ln u_t) - b_2 (\ln P_{t-1} - \ln R_{t-1} + \ln u_{t-1}) + \varepsilon_t, \tag{4}$$

where P_t and R_t in (4) are real price and rent indexes (i.e., adjusted for inflation). The ECM assumes that changes in house prices depend on changes in rents and user cost, as well as the deviation from equilibrium in the previous period. The parameter b_2 should be positive. This implies that when $P_t > R_t/u_t$, this pushes $\Delta \ln P_t$ towards being negative, although this tendency can be outweighed by $\Delta(\ln R_t - \ln u_t) > 0$. Gallin (2008), using a slightly more complicated ECM and a slightly different definition of per dollar user cost u_t, finds that the parameter b_2 is indeed positive and statistically significant. He also estimates an equivalent ECM for rents, and finds that the reversion to equilibrium is driven more by price adjustments than rent adjustments. Even for prices, the predictive power of ECMs in this context is generally quite weak. To put it another way, the adjustment back to equilibrium is typically quite slow.

Is there also a link between house prices and income? An important difference in this case is that there is no simple equivalent of the user cost equilibrium condition to link house prices to income. An equilibrium condition can be derived by modelling the demand and supply of housing. A rise in income acts to increase the demand for housing, which in turn acts to increase the equilibrium house price. Malpezzi (1999) for example develops a model along these lines, and then estimates an ECM linking house prices and income. The general conclusion is that prices and income are likewise

cointegrated, and hence that the price-income ratio can also be used to predict (weakly) movements in future house prices.

4. Some data problems

4.1 Constructing house price and rent indexes

Constructing a house price (or rent) index is potentially problematic since every house is different both in terms of its physical characteristics and location. These measurement problems are important since such indexes form the building blocks used by cointegration tests and ECMs.

Three main types of house price and rent indexes exist in the literature (see Hill 2013). These are median, repeat-sales and hedonic indexes. Median indexes are the easiest to compute but are unreliable, since the quality of the median sold house may vary quite a bit from one period to the next. This means that movements of the index from one period to the next confound changes in price with changes in quality. Repeat-sales methods try to control for quality change by focusing only on repeat sales. Probably the best known repeat-sales index is the Standard and Poor's/Case-Shiller (SPCS) Home Price Indexes (see Standard and Poor's 2008). Repeat-sales indexes, however, have three weaknesses. First, the same house at two different points in time is not necessarily the same. For example, the house may have been renovated between sales. Second, the repeat-sales approach also throws away all houses that sell only once in the data set, which is wasteful. Third, throwing away data can cause sample selection bias which may in turn cause bias in the index. Clapp and Giaccotto (1992) argue that a repeat-sales sample has a "lemons" bias, since starter homes sell more frequently as a result of people upgrading as their wealth rises. This lemons bias has also been documented by amongst others Gatzlaff and Haurin (1997), and Meese and Wallace (1997). Suppose further that better quality dwellings rise in price on average at a differing rate than worse quality dwellings. In this case, a repeat-sales index may be biased. This seems to be the situation observed by Hill, Melser and Syed (2009) in their data set for Sydney, and by Shimizu, Nishimura and Watanabe (2010) for Tokyo.

A hedonic model regresses the price of a product on a vector of characteristics (such as land area, number of bedrooms and postcode). The hedonic equation is a reduced form equation that is determined by the interaction between supply and demand. The hedonic method can be implemented in different ways. One approach includes dummy variables for each time period. The house price index is then obtained directly from the estimated coefficients on these dummy variables. An alternative approach uses the hedonic model to impute prices for an average house in each period. A third approach takes all the houses sold say in period t and then uses the hedonic model to impute prices for them in period t+1. Then it takes all the houses sold in period t+1 and uses the hedonic model to impute prices for them in period t. A price index is then computed from these imputed prices using a standard price index formula (see Hill 2013 for further details).

The hedonic approach generally produces the most reliable price (and rent) indexes. However, it also requires the most information (i.e., prices and characteristics on each house sold or rented).

As noted above, cointegration tests and ECMs require price and rent indexes as inputs. Poor quality indexes will generate poor quality results (i.e., garbage in-garbage out). Where possible, therefore, hedonic indexes should be used.

4.2 Mismatched indexes

In practice, researchers often do not have much choice over which price and rent indexes they use in a cointegration test or ECM. As a result incompatibility issues can arise between the indexes. Smith and Smith (2006) make this point as follows:

> [T]he dwellings included in price indexes do not match the dwellings in rent indexes, so that the resulting comparison is of apples to oranges. The ratio of a home sale price index to a rent index can rise because the prices of homes in desirable neighborhoods increased more than did the rents of apartment buildings in less desirable neighborhoods. Or perhaps the quality of the average home in the price index has increased relative to the quality of the average property in the rent index. In any case, gauging fundamental value requires actual rent and sale price data, not indexes with arbitrary scales. (p. 7)

At the very least, this type of apples and oranges mismatch problem will introduce noise into cointegration tests and into the estimated parameters of ECMs. It remains to be seen whether it also causes bias. Gallin (2008) considers this issue. He makes ad hoc adjustments to his rent indexes to try to correct for mismatches with the price index, and finds that these adjustments increase the magnitude of the b_2 parameter in (4). In other words, mismatches between the price and rent indexes may cause the speed with which prices adjust to departures from equilibrium to be underestimated in an ECM. Clearly though, this is an issue that warrants further investigation.

4.3 Indexes do not tell us whether the market is out of equilibrium in any given period

When all we have are price and rent indexes we cannot say in any given period whether P_t is bigger or smaller than R_t/u_t. We cannot answer the most fundamental question which is whether the price-rent ratio is above or below its equilibrium level or whether it is moving towards or away from equilibrium. To answer this question we need price-rent ratios that are directly calculated for each period, rather than separate price and rent indexes. The calculation of price-rent ratios for each period, however, is also a process fraught with difficulties. We turn to these problems now.

4.4 Quality-adjusting price-rent ratios

A price-rent ratio for a given period can be calculated by dividing the median price by the median rent (see for example Hatzvi and Otto 2008). By comparing this ratio with

the reciprocal of the per dollar user cost (which can be calculated independently from estimates of r_t, m_t, d_t, w_t and g_t) it is possible to say whether the price-rent ratio in period t is above or below its equilibrium value.

One problem with this approach is that the user cost equilibrium condition implicitly assumes that P_t and R_t refer to houses of equal quality. In practice, Hill and Syed (2013) show that the median sold house tends to be of better quality than the median rented house. It follows that a comparison of the median price-rent ratio with the reciprocal of per dollar user cost will be biased towards finding that the price-rent ratio is above its equilibrium level. Hill and Syed propose a hedonic method that can be used to compute quality-adjusted price-rent ratios. Making this adjustment they find that in addition to being lower than its unadjusted counterpart, the difference between the quality adjusted and median price-rent ratio also varies quite significantly over time. This means that the distortion introduced by using a quality unadjusted price-rent ratios varies from one period to the next, thus making it harder to correct for using ad hoc methods.

5.   A closer look at the user cost equilibrium condition

5.1   Expected capital gains

From (1) we know that estimates of r_t, m_t, d_t, w_t and g_t are required to calculate the per dollar user cost u_t. Probably the most problematic of these terms is the expected capital gain g_t. This cannot be observed directly. It is usually calculated by assuming market participants form their expectations by extrapolating from past performance. This raises the question of what is the appropriate extrapolation time horizon. If it is too short, during a boom g_t may be so large as to make u_t turn negative. In this case the equilibrium price-rent ratio effectively becomes infinite. Hill and Syed (2013) find that a long time horizon such as 30 years may be needed to generate plausible results during booms.

5.2   Depreciation

Suppose all houses are now ordered from cheapest to most expensive. The share of land in the total value of a house is likely to rise as one moves up the house price distribution. Given that the structure of a house depreciates over time while the land does not, it therefore follows that the depreciation rate should be lower for more expensive houses than for cheaper houses (see Hill and Syed 2013). It follows that the per dollar user cost (and hence the equilibrium price-rent ratio) also differs at different points in the housing distribution.

This observation has important implications. It implies that there exists a whole continuum of user cost equilibrium conditions. If an empirical comparison finds for example that the price-rent ratio is above its equilibrium level for the median house, we cannot be sure that the same is true for other points in the distribution. Both the

 actual and equilibrium price-rent ratios at other points in the distribution may be different.

5.3   Changing credit constraints

A further concern with the user cost equilibrium condition is that it assumes households are not credit constrained. This assumption may be particularly unrealistic for first home buyers. In the presence of credit constraints, we should generally find that in equilibrium $u_t P_t < R_t$. That is, some households that would like to buy are unable to do so since they are unable to borrow as much as they want. As a result they are forced to rent, thus pushing up rents and lowering house prices. This constraint is more likely to be binding at the lower end of the market. Again therefore this finding reinforces the point made in section 5.2. Different things may be going on at different points in the housing distribution. This is true both for comparisons between actual and equilibrium price-rent ratios and for cointegration tests and ECMs.

Duca et al. (2011) consider how the credit constraint varies over time. In booms, the credit constraint becomes weaker, which in turn helps further stimulate the boom. Duca et al. then include variations in the credit constraint as an explanatory variable in an ECM and show how this can increase the model's predictive power.

6.   Conclusion

The housing market can have a very significant effect on the rest of the economy. Given that it is prone to booms and busts it is therefore important that policy makers (especially central banks) are able to follow trends in the housing market, and in particular are able to detect departures from equilibrium.

The user cost condition provides an equilibrium price-rent ratio against which actual price-rent ratios can be compared. If over time the actual price-rent ratio tends to converge towards the reciprocal of the per dollar user cost, as predicted by the user cost condition, this should imply that prices and rents are cointegrated. Cointegration tests are generally supportive of this conclusion. It follows that ECMs may prove useful for forecasting changes in house prices. ECMs, however, do not tell us whether the market is out of equilibrium in a particular period. To detect departures from equilibrium one must compare the price-rent ratio in a period directly with the reciprocal of per dollar user cost.

Cointegration tests, ECMs and direct comparisons of price-rent ratios with their equilibrium counterparts are all problematic in practice. I have considered here some of the problems that can arise in such empirical comparisons. In particular, cointegration tests and ECMs should use compatible price and rent indexes. Where possible these indexes should be constructed using hedonic methods. Likewise, actual price-rent ratios in a given period need to be quality adjusted before they are compared with their equilibrium counterparts.

Also different things could be happening in different segments of the housing market. For example, the top end of the market may have different coefficients in an

ECM than the middle or bottom end, and one segment may be in equilibrium in a given period while others are not.

The detection of departures from equilibrium therefore is a complicated process that requires care and attention to detail. Nevertheless price-rent ratios are a useful tool that central bankers in particular should probably make greater use of in future.

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