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Hedonic price–rent ratios, user cost, and departures from equilibrium in the housing market

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ABSTRACT

Departures from equilibrium in the housing market can be detected by comparing the actual price–rent ratio with the price–rent ratio derived from the user cost equilibrium condition. The equilibrium price–rent ratio, however, assumes that the sold and rented dwellings being compared are of equal quality, which is typically not the case. Using hedonic methods applied to prices and rents for 730,000 houses in Sydney, Australia, we find that quality-adjusting reduces the actual price–rent ratio by on average 18%. Failure to make such a correction therefore will seriously bias the results towards a finding that the price–rent ratio is above its equilibrium level. We also explore ways of imputing the expected capital gain – a key input into the equilibrium price–rent ratio formula, and show that price–rent ratios (both actual and equilibrium) vary in systematic ways over the housing distribution. This latter result implies that it is not enough to simply focus on the median, as different results may pertain for other quantiles.

1. Introduction

Recent events have shown how the housing market can impact on the rest of the economy, as a bust in the US housing market precipitated a global financial crisis. As housing markets are prone to booms and busts, it is particularly important that policy makers and other market participants can detect departures from equilibrium before they become too extreme.

One way of detecting such departures is to compare the user cost of owner-occupying with the cost of renting. In equilibrium, households should be indifferent between these alternatives. Departures from equilibrium therefore can be detected by comparing actual price–rent ratios with the price–rent ratio derived from the user-cost equilibrium condition.

Many applications of the user-cost equilibrium condition focus on changes in the price–rent ratio rather than its level. This is because price and rent indexes are easier to obtain than actual prices and rents measured in dollars. For example, Himmelberg, Mayer and Sinai (2005), compare a repeat-sales price index calculated for single-family houses obtained from the Office of Federal Housing Enterprise Oversight (OFHEO) – now replaced by the Federal Housing Finance Agency (FHFA) – with an index of annual average rents of two-bedroom apartments obtained from REIS (a real estate consulting firm). Gallin (2008) and Campbell, Davis, Gallin and Martin (2009) use the same FHFA repeat-sales price index as Himmelberg et al., and the tenant rent index (part of the rent of shelter index) from the CPI. Duca, Muellbauer and Murphy (2011) compare the FHFA repeat-sales index with the rental fixed dwelling index from the personal consumption expenditure (PCE) price index produced by the Bureau of Economic Analysis.

There are two serious problems in this context with using price and rent indexes. First, as Smith and Smith (2006) point out, there may be inconsistencies between the price and rent indexes:

> [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)

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Second, as noted in the final sentence of this quote, using price and rent indexes it is not possible to answer the most fundamental questions which are: (i) whether the price–rent ratio is above or below its equilibrium level and (ii) whether the price–rent ratio is moving towards or away from equilibrium.

To answer these questions we need to compute the actual price–rent ratio in each period, and not just changes in the price–rent ratio. One way of doing this is to compute the ratio of the median dwelling sold to the median dwelling rented. The equilibrium condition, however, assumes that a household is choosing between owner-occupying and renting dwellings of equal quality. In practice, the median sold dwelling tends to be of better quality than the median rented dwelling. Using a data set consisting of 730,000 price and rent observations for Sydney, Australia over the period 2001 to 2009, we find the difference is on average 18%.[1] The actual price–rent ratio, therefore, needs to be quality adjusted before it can be compared with its equilibrium counterpart (or the comparison will be biased towards finding that the price–rent ratio is above its equilibrium level). We show how this can be done using hedonic methods that impute prices for rented dwellings, and impute rents for sold dwellings.[2]

It should be noted that the quality difference between sold and rented dwellings in our data set is not stable over time. In the first half of our sample it is greater than 18%. By 2009 it had fallen to zero. It follows therefore that there is no simple rule of thumb that can be used to revise downward the actual price–rent ratio, and that the bias distorts changes over time in the quality-adjusted price–rent ratio as well as its level.

When imputing prices and rents, an important consideration in our data set is missing and omitted characteristics (where a missing characteristic is missing for a particular dwelling while an omitted characteristic is missing for all dwellings). We correct for missing characteristics by estimating multiple versions of our hedonic models, each with a different mix of characteristics, and then impute the price or rent of a dwelling from whichever model has exactly its mix of characteristics. We correct for omitted variables using a subsample of dwellings that both sell and rent during our sample period. These dwellings provide a a benchmark against which omitted variables bias can be measured.

We then consider two problems that arise when computing the equilibrium price–rent ratio. First, the expected capital gain on housing – a crucial input into the user-cost equilibrium condition – is not directly observed. While it can be imputed from the past performance of the housing market, we find that the resulting equilibrium price–rent ratio depends critically on the time horizon over which past performance is measured. In particular, when the time horizon is too short the equilibrium price–rent ratio is prone to become volatile and to rise in booms and fall in busts, both of which effects are liable to undermine the method's ability to detect departures from equilibrium. We therefore recommend a long time horizon of 30 years. When expectations are extrapolated over this horizon, we find that the price–rent ratio in Sydney was above its equilibrium level from 2001 to 2008, although not in 2009. In the absence of quality adjustment, the departure from equilibrium seems even larger than it actually was. Alternatively, the expected capital gain can be derived from the user cost equilibrium condition if we assume the market is in equilibrium. Using this approach we find that the expected real capital gain would need to be 4.0% per year, which rises to 4.6% in the absence of quality adjustment. Compared with other cities 4.0% seems too high, thus again leading to the conclusion that the price–rent ratio was above its equilibrium level in Sydney.

A second problem with the equilibrium price–rent ratio is that different conditions may apply in different segments of the market. For example, the depreciation rate may be lower at the high end (where the share of land in the total value of a dwelling tends to be higher). This acts to push up the equilibrium price–rent ratio at the high end. Also, households at the low end may be credit constrained, thus pushing down the equilibrium price–rent ratio at the low end. Empirically we find that the actual price–rent ratio is indeed higher at the high end. More generally, this type of cross-section analysis demonstrates that it is not enough to simply focus on the median. Even if the median price–rent ratio equals the equilibrium price–rent ratio (calculated at the median), this does not necessarily imply that either the high or low ends of the market are in equilibrium.

Our methodology and results also have applications that extend beyond the main issues addressed here. For example, failure to account for the quality difference between owner-occupied and rented dwellings and cross-section variation in the price–rent ratio may result in the flow of housing services in national accounts (and hence GDP) being mismeasured.

The remainder of this paper is structured as follows. Section 2 explains the user-cost equilibrium condition. Section 3 develops our hedonic approach for computing price–rent ratios at the level of individual dwellings. Section 4 describes our data set, and then explains our methods for correcting for missing characteristics and omitted variables. Our estimates of quality bias in actual price–rent ratios are presented in Section 5. Section 6 derives equilibrium price–rent ratios from the user-cost equilibrium condition and then checks for departures from equilibrium. Some implications of our findings for the measurement of GDP are considered in Section 7. Finally, our conclusions are discussed in Section 8.

2. The user-cost equilibrium condition

The user cost of a durable good is the present value of buying it, using it for one period and then selling it (see Hicks, 1946). In equilibrium this should equal the cost of renting the good for one period. Following Himmelberg et al. (2005) and Girouard, Kennedy, Noord and André (2006), the equilibrium condition can be written as follows:

$$R_t = u_t P_t, \tag{1}$$

where R_t is the period t rental price, P_t the purchase price, $u_t P_t$ is user cost, and u_t the per dollar user cost. In a housing context, per dollar user cost can be calculated as follows:

$$u_t = r_t + \omega_t + \delta_t + \gamma_t - g_t, \tag{2}$$

where r denotes an appropriate interest rate, w is running and average transaction costs, δ the depreciation rate for housing, γ the risk premium of owning as opposed to renting, and g the expected capital gain.[3] That is, an owner occupier foregoes interest on the market value of the dwelling, incurs property taxes and depreciation, incurs risk (mainly due to the inherent uncertainty of future price and rent movements in the housing market) and benefits from any capital gains on the dwelling.[4] If $R_t > u_t P_t$, owner-occupying becomes more attractive and hence this should exert upward pressure on P and downward pressure on R until equilibrium is restored. The converse argument applies when $R_t < u_t P_t$.

Rearranging (1), we obtain that in equilibrium the price–rent ratio should equal the reciprocal of per dollar user cost (i.e., $P_t/R_t = 1/u_t$). If the actual price–rent ratio exceeds, or is less than, our estimate of the reciprocal of per dollar user cost it follows that the housing market is not in equilibrium.

[1] This finding is consistent with the existing literature. For example, according to the American Housing Survey (2001), 82% of owner-occupied dwellings are detached single-family homes, while the corresponding figure for rental dwellings is only 23% (see also Gallin, 2008 and Heston and Nakamura, 2009). Given that most sold dwellings end up owner-occupied, a similar pattern should be observed for sold versus rented dwellings.

[2] Alternatively, a price and rent could be imputed from the hedonic models for an average house. Wu, Gyourko and Deng (2012) apply this approach to Chinese housing data.

[3] The computation of empirical values for these parameters is considered in Section 6.1.

[4] In some countries owner–occupiers can tax deduct mortgage interest payments (see Girouard et al., 2006 for a list of OECD countries providing such benefits). For these countries, r_t should be adjusted to include the offsetting tax benefit. However, no such benefit is provided to the owner occupiers in Australia.