Is there an equilibrating relationship between house prices and replacement cost? Empirical evidence from Berlin

Rainer Schulz [a,*], Axel Werwatz [b]

[a] University of Aberdeen Business School, Edward Wright Building, Dunbar Street, Aberdeen, AB24 3QY, United Kingdom
[b] Technische Universität Berlin, Institut für Volkswirtschaftslehre und Wirtschaftsrecht, Straße des 17. Juni 135, 10623 Berlin and SFB 649, Humboldt-Universität zu Berlin, Germany

ARTICLE INFO

ABSTRACT

It is a feature of competitive markets with forward-looking participants that a good's benefit and its production cost are equalized in equilibrium and that no resources are wasted during the adjustment process. For housing markets, there is mixed evidence whether they meet this standard of allocative efficiency. Based on a unique data set with rich information on prices and cost, we examine the market for single-family houses in Germany's capital Berlin. At the aggregate market level, we find that prices and cost tend to equalize in the long run. Short-run adjustment appears to be sufficiently fast and properly anticipated to prevent systematic excess profit opportunities. At the cross sectional level of individual houses, we find support that resources are allocated efficiently between different market segments. Taken together, our results provide sufficient evidence that the market in Berlin is efficient.

1. Introduction

The allocative efficiency of competitive markets implies that in equilibrium the benefit to the marginal buyer from buying a good equals the marginal cost of producing it. In the single-family house market, the benefit of house ownership to the marginal buyer is the present value of future imputed rents, which should equal the price paid. The cost of producing a house is the sum of building and land cost (replacement cost). Only an efficient allocation ensures that social welfare is maximized. It is therefore an important economic question if existing house markets are efficient.

Most previous studies on the efficiency of house markets have focussed on whether house prices are, on average, equal to present values of future imputed rents.[1] This question is usually approached either directly by comparing prices with present values or indirectly via the implication that if prices reflect present values, then excess return rates should be unforecastable given current information.[2]

In this paper, we take a different stance and focus on replacement cost to investigate the efficiency of the single-family house market in Germany's capital Berlin. Even though prices in an efficient market cannot be expected to equal replacement cost at all times, competitive forces should restore the equality in the long run. Because rational market participants foresee the adjustment process, no systematic excess profit opportunities should exist in the short run. This reasoning suggests a natural test of house market efficiency: Investigate whether prices and replacement cost show a close statistical relationship with a tendency to move towards equality in the long run, providing no excess profit opportunities in the short run.

The results of studies using prices and present values to test for the efficiency of house markets are mixed. Case and Shiller (1989, 1990) use the indirect test approach and find for their sample of four regional US house markets that excess return rates are predictable by their own lagged values and other predetermined market variables. Moreover, they find that this predictability can be profitably exploited even after accounting for transactions cost. Larsen and Weum (2008) obtain similar results for Oslo, Norway. This indicates that prices do not fully reflect available information in these markets. Meese and Wallace (1994) apply both the direct and the indirect test to data from Californian municipalities. They detect predictability in excess return rates of house prices using the indirect test. By applying the direct test, however, they also find that house prices revert to present values in the long run. Meese and Wallace reconcile their finding of efficiency in the long

---

* Corresponding author. Fax: + 44 (0) 1224 272214.
E-mail addresses: r.schulz@abdn.ac.uk (R. Schulz), axel.werwatz@tu-berlin.de (A. Werwatz).

[1] If prices equal present values, they will reflect available information fully and "provide accurate signals for resource allocation" (Fama, 1970, p. 383). Such (informational) efficiency of prices is a necessary condition for allocative efficiency. Allocation effects of inaccurate price signals in housing markets are discussed in Glaeser et al. (2008).

[2] The indirect test may have low power against the null of efficiency and its outcome might be difficult to interpret, see Campbell and Shiller (1988, p. 206) and Summers (1986).

run but inefficiency in the short run with the existence of transactions cost. The cost prevents that mispricing can be exploited and corrected in the short run.[3]

A common criticism of market efficiency tests based on present values is that they are, in effect, joint tests of the efficiency of the market under examination and the validity of auxiliary assumptions made by the researcher (Fama, 1970, p. 384). The tests require assumptions on the required return rate in order to discount rents and compute excess return rates. They also require information on market rents and tax advantages from home ownership, which are often difficult to obtain.[4] Case and Shiller (1989, p. 135) go so far to say that because of such definitional and data problems, there "is little hope of proving definitely whether the housing market is not efficient".

Testing for market efficiency by focussing on the relationship between prices and cost is less prone to such problems. Rosenthal (1999) stresses that this focus utilizes only data on current and past variables and does not—unlike present value studies—require forecasts of future rents and required return rates. The focus is not without problems, however, because it requires house builder activity. It therefore cannot be applied to a permanently shrinking market.[5] In his study on Vancouver's expanding house market, Rosenthal finds that deviations between constant-quality building prices and construction cost are stationary and disappear faster than construction lags, implying that there are no excess profit opportunities for house builders.[6] Rosenthal concludes that the Vancouver market is efficient.

Our paper shares the modeling advantage that comes from focussing on prices and cost. We have a unique data set that contains rich information on the prices, replacement cost, and characteristics for all transacted single-family houses in the city of Berlin. These data allow us to test the implications of an efficient market for the relationship between house prices and cost components not only on the aggregate constant-quality level, but also at the level of individual houses.

Guided by Tobin's Q-theory of investment, we test the following three implications of an efficient market for the relationship between prices and cost: (i) prices and replacement cost should exhibit a close, stationary relationship with a tendency to move towards equality in the long run; (ii) imbalances between prices and replacement cost may occur at any time, but should trigger an adjustment process. Builders should increase house construction whenever prices exceed cost or should reduce construction activities whenever prices are lower than cost. Rational market participants, foreseeing this adjustment process, will immediately adjust prices down (up). In the short run, therefore, price-cost imbalances should disappear in such a way that systematic excess profit opportunities are prevented; (iii) in market segments where prices greatly exceed cost, new construction offers the largest rewards for builders and the greatest benefits to buyers. Efficient allocation of resources thus requires that builders focus their activities on these segments first, leading to accelerated price adjustment for houses in such segments.

To test the first two implications, we construct constant-quality price and cost series from our data and examine their dynamic behavior, particularly that of their ratio Q. The long-run equilibrating relationship between prices and cost implies that the time series of Q must be stationary. Regarding the short-run adjustment, we cannot test directly if systematic excess profit opportunities are prevented, as we neither observe house builders' supply nor their profits. We can, however, focus on the consequences of an efficient short-run adjustment for our observed variables, which are prices, cost, and Q. In particular, we are able to study the nature and speed of the adjustment process of these variables towards their equilibrium equality. This allows us to gauge indirectly if the implied reactions of prices and builders' possible profits are in line with an efficient market. To test the third implication, we use our individual level data. In an efficient market, prices for houses in segments that currently have large price-cost imbalances should show a stronger subsequent price adjustment than houses in segments with small imbalances.

The following results emerge from our empirical analysis. First, while we find that real prices and replacement cost are nonstationary time series, their ratio Q appears to be stationary, supporting the notion that prices and cost have a long-run equilibrating relationship. Second, the magnitude of the deviations of Q from its long-run equilibrium level gives no indication for excess profit opportunities once time of construction and land assembly is taken into account. Adjustment towards equilibrium appears to be sufficiently fast. We estimate that it takes about 2 years from a shock to the house market until prices and replacement cost are aligned again.[7] The adjustment process involves both components of Q, prices and replacement cost, where adjustment of replacement cost is driven by land rather than building cost. The latter appear to be exogenous to the market for single-family houses, which suggests that construction services are competitively and elastically supplied.

Finally, we find that equilibrating adjustment occurs not only at the aggregate market level, but also among the many segments and heterogenous houses of which the market is comprised. Specifically, price adjustment is more pronounced for those single-family house types that currently have large imbalances between price and replacement cost. This indicates that house builders focus their activities on segments where prices are above cost. The eventual change in the composition of the stock appears to be swiftly incorporated into prices. This finding has practical relevance: Real estate assessors often view replacement cost as a last resort for the valuation of single-family houses when sales comparison values cannot be computed. This view underrates the role replacement cost can play in the valuation process. We show that replacement cost improve the accuracy of single-family house valuations.

In summary, our analysis of a large metropolitan market provides reassuring empirical evidence on the efficiency of markets for single-family houses. Based on both aggregate time series and cross sectional data, prices and replacement cost appear to exhibit the equilibrating relationship expected from an efficient market.

The rest of the paper is organized as follows. Section 2 details the testable implications motivated by Tobin's Q-theory of investment. Section 3 presents the data. The behavior of constant-quality time series for prices, cost, and Q is examined in Section 4. Section 5 examines the behavior of prices and replacement cost in the cross section of individual houses. Section 6 concludes. Details of the analysis, particularly regarding data preparation, have been relegated to the Appendix.

---

[3] Himmelberg et al. (2005) compare imputed rents for owner-occupied houses with market rents in 46 US markets and inspect the deviations of the series. They, too, do not detect large and persistent mispricing, providing informal support for efficiency at least in the long run.

[4] Meese and Wallace (1994), for instance, are unable to obtain rental series at the municipal level and have to settle for county level series corresponding to rents for two-bedroom apartments.

[5] Some cities in the East of Germany or the US (Glaeser and Gyourko, 2005) are such markets. We are grateful to an anonymous referee for pointing us to this problem.

[6] Rosenthal uses hedonic regression to split house prices into a building and a land component. The building price series is then computed for constant building characteristics.

[7] This is comparable to the adjustment period in the US (Topel and Rosen, 1988).