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Land leverage and house prices ☆

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ABSTRACT

A house is a bundle of land and improvements, with the weights of the two components varying both over time and across locations. We capture the land intensity or "leverage" of a property by measuring the ratio of land to total value. This is accomplished using transactions data for single-family homes in Switzerland over the period 1978 to 2008. We show how to use hedonic models to develop time series of land prices and land leverage. Then we estimate error correction models for both house prices and land leverage. We show the importance of interacting land leverage with fundamentals when assessing the determinants of house prices. House price changes are shown to be affected by changes in real construction costs, in real GDP per capita, and in the growth of the population aged 30 to 49, while land leverage changes are a function of changes in real construction costs and in real GDP per capita.

1. Introduction

Housing represents a large fraction of wealth in household portfolios and in national economies. A good understanding of housing dynamics and of the determinants of house price changes is thus essential. Assessment of the impacts of changes in the economy on house prices could potentially benefit by recognizing that a house is a combination of a lot and a structure (Bostic et al., 2007; Davis and Heathcote, 2007). Indeed, fundamentals affecting the prices of the two components are not the same, with changes in interest rates, income, population, and land use constraints driving land values, while building values are related primarily to construction costs. In fact, a large fraction of house price changes is typically related to land price changes rather than changes in construction costs.

If the relative value of land and structures was constant over time and locations, disentangling the two components would be of little or no importance. However, land leverage (that is, the ratio of land value to total property value) will be greater in more highly populated areas than in rural regions and also greater at the peak than at the trough of a housing cycle. Davis and Palumbo (2008), for instance, report a land leverage of 88.5% for the San Francisco metropolitan area for 2004, but only 23.3% for Oklahoma City. Davis and Heathcote (2007) report swings in land leverage in the US as a whole from less than 30% to above 45%. Moreover, there was an upward trend in leverage between 1975 and 2006.

It thus seems important to take into account land leverage in analyses of house price determinants. One approach to this is to consider both components of a property separately and to analyze the determining factors for each component (Davis and Heathcote, 2007). Research in this area, however, is hampered by the lack of reliable land price indexes. There are some land price indexes, such as for Japan and some Swiss regions (including Zurich), but these indexes do not control for the "quality" of the land; that is, they rely on mean or median prices.[1] There have also been some efforts to develop land value indexes for the United States. Such studies include Case (2007), Davis and Palumbo (2008), and Davis and Heathcote (2007). At a regional level, Been et al. (2009) use teardown values (prices paid for properties purchased for demolition and redevelopment) as a proxy

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[1] For details on the Japanese and Zurich regional indexes, see http://www.stat.go.jp/english/data/nenkan/1431-17.htm and http://www.statistik.zh.ch/bodenpreise/boe.php, respectively.

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for land values to measure land price changes in New York, following an approach suggested by Rosenthal and Helsley (1994) and extended by Dye and McMillen (2007).

This paper makes use of a rich database of house prices for Switzerland covering the period 1978 through 2008. The database contains a large number of attributes, which enable us to calculate the implied land value for each sale using the depreciated cost appraisal method. Those values are in turn used to construct a hedonic index of land prices for Switzerland. We also estimate house price and land leverage hedonic models.

We use those inputs to analyze house price dynamics with error correction models. We show the importance of interacting land leverage with fundamentals in a house price equation. Changes in real house prices are driven by changes in real construction costs, in real GDP per capita, and in the growth of the population aged 30 to 49. Changes in land leverage are shown to be affected by changes in real construction costs and in real GDP per capita.

The structure of the paper is as follows. The next section reviews the literature on land leverage. In Section 3, we discuss the calculation of land leverage and the construction of house and land price indexes and a land leverage time series. The following section contains the time series error correction modeling of house prices and land leverage, while a final section summarizes our conclusions.

2. Recent research on land leverage

Bostic et al. (2007) introduced the term "land leverage" to refer to the ratio of land value to total property value. Although they do not use the term, Davis and Heathcote (2007) published a paper on land leverage at about the same time. Both sets of authors emphasize the relationship between land leverage and house price appreciation, a focus that was apparently motivated by a desire to explain the disparities in house price appreciation rates in different parts of the US during the late 1990s and early 2000s. Bostic et al.'s empirical study of Wichita, Kansas, demonstrates that land leverage is positively associated with house price inflation in that city. These authors estimate land leverage in two ways. The first involves comparing the prices of vacant lots with the prices of the same properties after houses are constructed on them. The second method simply uses the assessed values for land and improvements determined by the local property tax assessment office. The two samples yield similar conclusions about the role of land leverage in house price inflation.

Davis and Heathcote (2007) produce quarterly constant-quality price indexes for residential land in the US from 1975 through 2006. During this period, the real price of residential land nearly quadrupled, while the price of structures grew by only one-third. By 2006, land accounted for 46% of aggregate residential property value, compared with 35% in 1975. To construct their land price indexes, a benchmark market value of housing is calculated for 2000 based on the decennial census and other data. Various data sources, including Office of Federal Housing Enterprise Oversight (now the Federal Housing Finance Agency) price indexes and information about investment in new residential structures and the replacement cost of residential structures produced by the Bureau of Economic Analysis (BEA), are used to develop land price estimates for the benchmark date and to extend the series forwards and backwards from the benchmark date. A somewhat different technique is used to extend the analysis back to 1930. According to that series, land leverage was about 15% in 1930 and remained as low as about 20% in 1970.

Davis and Heathcote also show how taking land leverage into account is important when modeling house price dynamics. Their strategy is to regress real house, land, and structure prices on a set of fundamentals that includes real per capita income, the nominal 3-month Treasury Bill rate, and the inflation rate. A second set of regressions adds three additional variables: population, the percentage of the population aged 35 to 54 (the primary home-buying category), and the spread between 30-year fixed mortgage rates and the 3-month Treasury Bill rate. The land price regressions in particular perform better than house price regressions, and the estimates for the house price regressions appear to be a weighted average of the estimates for the land and structure price regressions.

In a related paper, Davis and Palumbo (2008) focus on 46 large metropolitan areas in the US from 1984 to 2004. For these areas, land leverage for single-family owner-occupied homes increased from an average of 32% in 1984 to 51% in 2004. In this study, the authors use RS Means construction cost data to price the housing stock in each area using property characteristics contained in the American Housing Survey (AHS) for a benchmark year. The structures are then depreciated at a rate of 1.5% per year of age. Land value is the total property value reported in the AHS less the depreciated value of the structure. The Freddie Mac Conventional Mortgage House Price Index and other data are then used to develop a time series for each metropolitan area backwards and forwards from the benchmark date.

Case (2007) estimates land leverage for residential property in the US from 1975 through 2005.[2] Using data similar to those employed by Davis and Heathcote (2007), he produces quite different estimates of land leverage: about 14% in 1975 and 38% on 2005. For the 3 years for which these authors provide comparable data (1980, 1990, and 2000), Case's estimates of both total residential property values and structure values are higher and his estimates of land values are lower than those of Davis and Heathcote, meaning that his estimates of land leverage are consistently lower. Among other differences in methods, Davis and Heathcote exclude farmhouses and remove sales commissions from the BEA data, which should account for some of the discrepancy between Case's and their results.[3]

Bourassa et al. (2009) incorporate a measure of land leverage in models that seek to explain how individual house prices move relative to the market as a whole in three New Zealand cities. They measure land leverage using values determined by property tax assessors. Although the focus of their paper is on the role of atypical house characteristics, they also find that houses with greater land leverage are more volatile over the course of the property cycle.

The biggest challenge in studies of land leverage is accurately measuring the ratio of land to total property value. One solution, as in Bostic et al. (2007) or Bourassa et al. (2009), is to rely on separate land and improvement values as assessed for property tax purposes. This is probably fine for their purposes, which involve the use of individual transactions data to test hypotheses about the role of land leverage. It is generally not suitable for developing indexes of land prices or land leverage over time.[4] As Bell et al. (2009) point out, separate land and improvement assessed values are likely to be less accurate than the combined assessments. One reason for this is that assessors typically have no incentive to make the allocation between the two components of property value accurate. In most jurisdictions, property tax rates are the same for land and improvements and property owners can challenge the total assessment but not the individual components. Moreover, assessing land and improvement values is difficult. The sales comparison approach is hampered by the fact that there are typically few vacant land sales in developed areas. The replacement cost approach to measuring structure values depends on what are usually quite rough estimates of depreciation. Other assessment

[2] Malpezzi's (2007) commentary on Case's paper provides a useful short review of the empirical literature on land prices; the most remarkable study is Hoyt's analysis of land values in Chicago from 1830 to 1933 (Hoyt, 1933).

[3] Both Case (2007) and Davis and Palumbo (2008) provide estimates of land leverage for owner-occupied properties for the US, although Davis and Palumbo's sample is limited to 46 large metropolitan areas. Case's estimate of 33% for 1985 is quite close to Davis and Palumbo's estimate of 32% for 1984; however, Case's estimate of 38% for 2005 is much lower than Davis and Palumbo's 51% for 2004. It is likely, however, that land leverage in large cities grew at a much faster rate than in the US as a whole during this period.

[4] However, Clapp (1990) provides a method for using assessed values to construct vacant land price indexes.