



RESEARCH INSTITUTE FOR HOUSING AMERICA **SPECIAL REPORT**

The Affordability of Owner-Occupied Housing in the United States: Economic Perspectives

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Professor of Economics, Emeritus
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Executive Summary

There are many conceptualizations of how to measure housing affordability and there are many affordability indexes. All measures are based on judgments of which components of housing costs should be included and judgments about when these costs should be considered excessive. This study reviews existing theory and empirical work about the affordability of owner-occupied housing. It concludes that only a few affordability indexes are well grounded in economic theory, although all contain ad hoc assumptions. One commonly made judgment is that a household's housing cost should be compared with its income, although alternative comparisons such as with housing construction costs have been proposed. Another conclusion reached is that an affordability index should measure the full cost of housing faced by the homeowner.

Some of the problems with affordability measures are caused by lack of data; however, relevant data are increasingly available. For example, house price indexes are now available at a finely detailed geographic level. These data, combined with readily available information on mortgage interest and property tax rates and other housing costs allow for the development of new affordability indexes that better match theoretical ideals.

The study describes four major forms of affordability indexes. They include ones that: 1) measure out-of-pocket housing expenses compared to the amount of household income, 2) compare an arbitrarily chosen amount of income "needed" for non-housing expenses to a household's income after subtracting its housing expenses, 3) compare the cost of existing housing to the cost of producing new housing, and 4) measure the partial or the full economic cost of homeownership compared to household income.

This report concludes that the first two forms of affordability index are subject to multiple conceptual problems. The third measure, developed by Glaeser and Gyourko (2003) is well-grounded in economic theory, but is limited in that household income is not accounted for. There are multiple variants of the fourth type of measure. The link with economic theory is strongest for a form derived from the user cost theory of investment goods. This form has been difficult to measure in the past due to the lack of data on households' expectations of future house price



changes. However, that shortcoming has been addressed in the last decade as surveys have focused on this topic. This study describes a new index by Bourassa and Haurin (2015) designated the Dynamic Housing Affordability Index (DHAI) that incorporates the full cost of housing, including household expectations about house prices. The DHAI and the National Association of Realtor's Housing Affordability Index are similar in some ways. For example, the effect of changes in household income, interest rates, and the price of housing on the indexes is similar. However, they differ in that the DHAI accounts for expected house price changes, depreciation, property taxes, transaction costs,

the expected length of stay, and the federal tax treatment of housing, while the NAR measure is unaffected.

The validity of an affordability index is difficult to test, but index performance should be measured against specific criteria. This study establishes criteria that an affordability index should be able to predict current features of the housing market including sales of new and existing houses, housing starts, and the homeownership rate. The predictive ability of three indexes is compared for 2003–2014, where the indexes are the National Association of Realtors' Housing Affordability Index, the National Association of Home Builders' Housing Opportunity Index, and the new DHAI. The study finds that the DHAI is a better predictor of housing starts and sales of new and existing homes. However, none of these indexes correctly predict the steady decline in the homeownership rate after 2004, even when households' diminished access to the credit market is accounted for.

Because of the evidence that house price expectations are an important theoretical component of the cost of housing and because households' housing decisions are influenced by their expectations, the study analyzes changes in house price expectations over the last decade. Case et al. (2015) find that expectations peaked in 2004–2005. Since then, price expectations have fallen substantially, but they continue to lag observed changes in house prices. They

also are much less volatile than observed house prices. This finding is important because house price expectations influence the DHAI to an extent similar to that of the mortgage interest rate. Recently, the Survey of Consumers reported that U.S. households expect house prices to rise by about 2.5 percent annually over the next five years. Stronger performance of actual house prices would, with about a two year lag, increase price expectations, lower the user cost of housing, increase affordability, and add additional strength to housing demand.

The DHAI differs from the NAR and NAHB indexes over the full housing cycle; however, they are quite similar from 2008–2014. All have risen since 2008, the DHAI by 26 percent, the NAR index by 11 percent, and the NAHB index by 21 percent. Thus there is consensus that the affordability of owner-occupied housing is improving, but slowly. The relatively weak improvement of these indexes is consistent with the relatively weak recovery of the housing market. During the same period, existing home sales increased by 20 percent, housing starts by 11 percent, but new home sales fell by 10 percent.

For the interested reader, additional resources are provided in the form of an extensive review of affordability measures and their relationship to economic theory in Appendix I. In addition, a detailed discussion of data issues for affordability measures is found in Appendix III.

1. Introduction and Motivation

There is a continuing high level of interest in measuring the affordability of the stock of owner-occupied houses in the U.S. However, there are a number of conceptual issues with the measurement of affordability and there are additional problems with the implementation of empirical measures. The conceptual problems related to affordability result from the lack of theoretical underpinnings and from the multiple, sometimes conflicting, potential uses of affordability measures. Converting a conceptual measure to an observable indicator of affordability may encounter problems because of the lack of data, the difficulty of construction, or the difficulty of interpreting the measure. A number of measures of affordability have been created but there is little consensus about which one is optimal or appropriate. The confusion is increased because, at times, these competing measures result in conflicting conclusions regarding spatial differences or changes over time in housing affordability.

One goal of this study is to clarify the relationship between economic theory and housing affordability. A second goal is to identify the set of potential uses of a measure of the affordability of housing. For each use, the desirable attributes of an affordability measure is described. A third goal is to discuss the empirical counterpart to the conceptual measures and determine whether data are readily available to implement the measure. A fourth goal is to critically evaluate commonly used affordability measures as well as a new measure. A fifth goal is to describe housing affordability in the U.S. in recent years. A sixth specific goal is to investigate whether affordability indexes can predict contemporaneous changes in the housing market.

This study limits the discussion of affordability to owner-occupied housing. Many of the same conceptual and empirical issues are relevant when discussing the affordability of rental housing. The focus on owner-occupied housing is justified from its importance to the U.S. economy and culture. There is an extensive literature on the benefits and costs of owner-occupation.¹ Homeownership affects many household choices including savings, consumption, residential location, labor supply, fertility, child outcomes, and the residents' self-esteem. Achieving homeownership has been described as part of the "American Dream," and

thus is part of the U.S. culture. Arguably, homeownership is an important part of immigrants' cultural and economic assimilation. Finally, homeownership has been highlighted by U.S. presidents of both major political parties for at least 70 years.²

Solutions to affordability related issues have been proposed in many articles, with most focusing on government intervention such as supplements to household income or subsidies to reduce housing costs. In a similar vein, there have been many discussions of household access to affordable housing in specific locations and the companion topic of government regulations regarding the provision of affordable dwellings. However, this study does not discuss the history of federal, state, and local government policies related to the affordability of owner-occupied housing or the positions of housing related interest groups. Such descriptions are present in many articles (Wallace 1995; Quigley 2000; Caplin et al. 2007).

Section 2 of this paper discusses the definitions of affordability that are present in the literature and the set of potential uses of affordability indexes. Section 3 presents and compares the set of most commonly used measures of affordability. Section 4 presents data that describe affordability trends in the U.S. Section 5 evaluates whether the National Association of Realtors' Index, the National Association of Home Builders' Index, and a new user cost based index are able to predict the major characteristics of the housing market. Section 6 summarizes the results and concludes. Appendix I discusses the relationship between economic theory and affordability, and the factors that affect affordability. Appendix II compares the residual income affordability Index with the index based on the ratio of housing expenditures to income. Appendix III discusses data issues involved with creating affordability indexes.

1. This literature is summarized in Dietz and Haurin (2003).

2. Kiviat (2010) summarizes U.S. policy during the 20th century as follows: "Herbert Hoover argued that homeownership could 'change the very physical, mental and moral fiber of one's own children.' Franklin Roosevelt held that a country of homeowners was 'unconquerable.' Homeownership could even, in the words of George H.W. Bush's Secretary of Housing and Urban Development (HUD), Jack Kemp, 'save babies, save children, save families and save America.'"

2. Conceptual Issues Regarding the Affordability of Owner-Occupied Housing

DEFINITIONS OF HOUSING AFFORDABILITY

Bogdon and Can (1997) state that there are three major housing problems: affordability, overcrowding, and the physical condition of dwellings. They argue that in the U.S. the highest concern is with affordability, with as few households are subject to overcrowding or living in physically inadequate dwellings. Concerns with housing can be collected under the heading of “housing stress.” These concerns include overcrowding, quality of dwelling, security of tenure, price risk, and various aspects of affordability discussed below. New Zealand’s Productivity Commission (2012) argues that “housing is a fundamental determinant of well-being, central to health, family stability, and social cohesion.” They conclude that housing affordability is of high importance to the economy and society. However, Robinson, Scobie, and Hallinan (2006) note that “Affordability measures are not designed to measure well-being.”

It is reasonable to ask what “housing affordability” means. The literature on housing affordability provides multiple answers, with the level of consensus decreasing the greater the level of detail provided in the definition. Thalmann (2003) states that “Housing is not affordable for a household if it excessively crowds out other expenditure.” Hartman (2010) offers “Affordability is a relative concept, a relationship between what a consumer can afford and what the product or service costs” and thus he concludes that “affordable housing” is not a clearly defined term. Maclennan and Williams (1990) offer a more complete definition: “Affordability is concerned with securing some given standard of housing (or different standards) at a price or rent which does not impose, in the eye of some third party (usually government) an unreasonable burden on household incomes.” Here, multiple terms must be defined including the housing standard and the “burden”, which is often expressed as a percentage of income. When defining affordability the importance of consumer decisions regarding their expenditures on housing is noted by Whitehead (1991) who states that “only those households who given their income and the cost of their housing, could not potentially consume the required level of housing without breaking the affordability criteria are regarded as having a [affordability] problem.”

Utt (2010) makes a distinction between “affordable housing,” which he argues represents “a euphemism for government-subsidized housing or housing targeted to those whose incomes are too low to acquire safe and sanitary housing on the open market” and “housing affordability,” which focuses on “the difficulty confronting otherwise prosperous middle-class households in their attempt to become homeowners or to comfortably sustain that status once they achieve it.” The argument that affordable housing and housing that improves a household’s well-being are not the same thing is captured by Emrath and Taylor (2012) who note that “Affordability may be achieved by neglecting routine maintenance and allowing properties to deteriorate, or by failing to replace or renovate very old housing units to bring them more in line with modern building codes. Few people would consider these to be desirable outcomes.”³ Dokko et al. (2015) do not mention affordability, but they note that “expanded access” to housing “can generally be accomplished in three ways: a reduction in credit quality standards, lower down-payment requirements, or a reduction in the monthly payment.” Expanded access can be interpreted as increased affordability.

The policy aspects of the conceptualization of affordability are highlighted by Chaplin and Freeman (1999) who argue that an affordability index should produce “results that can be used as a robust allocative tool.” Thus, their implicit goal is to develop a measure that can be used to guide public policy.

Linneman and Megbolugbe (1992) argue that affordability measures should be limited to describe local markets given that housing markets are local.

In contrast to the mainstream set of affordability measures, Glaeser and Gyourko (2003) state “To us, a housing affordability crisis means that housing is expensive relative to its fundamental costs of production — not that people are poor.” This statement highlights an important aspect of

3. Gyourko and Linneman (1993) make a related point: most affordability measures do not account for the on-going costs of maintenance. Thus a dwelling that is affordable to a household at the time of purchase may not be affordable thereafter and the occupant’s solution may be to neglect maintenance.

most affordability measures: they combine characteristics of the housing market with characteristics of households including their participation in the labor market and receipt of transfer income.

One conclusion from this brief survey of definitions of affordability is that “housing affordability” is not a well-defined concept. Bourassa (1996) summarizes the problems with the multiple measures of affordability: “The implication of these problems is that affordability is a very slippery thing to try to grasp.” Quigley and Raphael (2004) provide more details: “But economists are wary, even uncomfortable, with the rhetoric of ‘affordability,’ which jumbles together in a single term a number of disparate issues: the distribution of housing prices, the distribution of housing quality, the distribution of income, the ability of households to borrow, public policies affecting housing markets, conditions affect the supply of new or refurbished housing, and the choices that people make about how much housing to consume relative to other goods.”

An extensive review of the literature on affordability measures and their relationship to economics is found in Appendix I. The first part of this appendix reviews the relationship of economic theory with affordability and the second part reviews the factors that the literature has identified as important when considering housing affordability.

POTENTIAL USES OF AN AFFORDABILITY MEASURE

An important question is the planned use of an affordability measure. One potential use is that it be a good predictor of the current level of homeownership or the direction of near future changes in the homeownership rate. This use is justified by noting that it is reasonable to define affordability as a measure of the ability to pay for owner-occupied housing. That is, when housing is highly (less) affordable, one would expect that the homeownership rate to be either high (low) or increasing (decreasing).⁴ Economic theory argues that homeownership rates are determined by a comparison of the cost of owner-occupation relative to renting the same dwelling. This theory relies heavily on the concept of the user cost of homeownership (Rosen and Rosen 1980).⁵ The argument that an affordability index should be related to the homeownership rate can be extended to other characteristics of the housing market

such as the number of housing starts, sales of new homes, and sales of existing homes.

The second potential use of an index of affordability is in public policy analysis. For example, if the homeownership rate is falling or is below a target level, then policy makers could use an affordability index as an input to evaluating this policy concern. There could be multiple reasons for a falling ownership rate including changes in the supply of mortgage funding, changes in the amount of government regulation, changes in household formation, or changes in the set of inputs to the level of affordability. The existence of a reliable affordability measure could thus help inform policy makers about the cause of the reduction in homeownership.

Another aspect of policy concerns could be about specific income groups not being able to afford to become a homeowner. For example, there may be public interest in whether households in the lower brackets of the income distribution can afford owner-occupied housing. While the housing demand of lower income households often is met in the rental market, given the sustained political and social interest in homeownership, it is reasonable to consider the affordability of owner-occupancy for various income levels.⁶ The social interest in the affordability of housing for low income households is linked with multiple arguments. The first potential argument is that owner-occupation is directly beneficial for lower income households.⁷ The second is that homeownership has external benefits in low income households’ neighborhoods and communities (Dietz and Haurin 2003). The third is that there is concern over low income households being “underserved” in the owner-occupied housing market due to some form of discrimination. Thus an affordability measure should be able to be applied to various tiers of income. However, as noted above, income is to some extent a choice variable; for example, some senior households voluntarily retire from the labor force and thus have low income (Quigley and Raphael, 2004).

4. This criterion could be used to determine the scale of the affordability measure. Specifically, when the homeownership rate is stable, then the affordability measure would be neutral and scaled to a value such as 0 or 100.

5. An alternative theory of homeownership was developed by Henderson and Ioannides (1983), who considered the investment and consumption motives for demanding dwelling space. They argued that if a household’s investment demand for housing exceeds its consumption demand, then the household would purchase and occupy the dwelling, otherwise they would rent. However, the Henderson-Ioannides theory has not yielded a simple measure of the demand for homeownership comparable to the user cost of owning and it has not been used in the discussion of housing affordability.

6. Consideration of owner-occupancy by low-income households is certainly not the same as advocating that all or most low-income households should be homeowners. Clearly, renting is the optimal tenancy for some households.

7. This argument is similar to the public policy case made for subsidies to lower income households for attaining a college degree. That argument rests on the estimated positive returns of attaining a college degree extending to the children of low income households. If the underlying assumption is false, then the argument for the policy is greatly weakened. Thus in the housing case, if owner-occupation is not beneficial to low income households, the justification for a concern with the affordability of owner-occupied housing for low income households is weakened.

3. Four Measures of Affordability

While there are many affordability measures in the literature, they are primarily variations on four themes.⁸ One measure is based on comparing housing expenditures to household income, usually as a ratio. Affordability is measured by comparing this ratio to an ad hoc standard such as 0.3. Haffner and Heylen (2011) argue that policy makers prefer easily measured affordability indexes, often the simple ratio of expenditures to income.⁹ A second measure is based on the residual income approach, where the amount of income left after paying for housing is compared to an ad hoc set of standards. The third affordability measure also is a ratio, comparing the amount of income required to purchase a specified level of housing to household income. The fourth measure of affordability is derived from the user cost formulation of housing costs.

AFFORDABILITY MEASURED BY THE RATIO OF HOUSING EXPENDITURES TO INCOME

The simplest affordability index is the ratio of an index of house prices to household disposable income. Some indexes are simple ratios of median house price to median income. An early measure was Weicher (1977) who computed the ratio of the median price of new homes to median family income. A variant of this approach is to measure the ratio of out-of-pocket housing expenditures to household income.

Chaplin and Freeman (1999) offer a set of criticisms of the expenditure to income ratio approach. First, it does not specify particular levels of housing and nonhousing consumption; second, a single maximal ratio is used for all income levels; and third, the target ratio does not vary spatially in a way that accounts for variations in housing costs. Another drawback of this measure is there is no consideration of price appreciation, which is a component of the cost of homeownership.

A significant problem with this approach is that a household's expenditure on housing is a choice variable: expenditures depend on the quantity and quality of the dwelling as well as price. Thus a household that voluntarily selects to consume a relatively large amount of housing could be defined as facing unaffordable housing. In contrast, households facing high housing prices could downsize housing consumption (quantity and quality) such that its

expenditures on housing are relatively low, thus it could be judged as an affordable expenditure. The basic problem is that this affordability measure is a function of expenditures on housing, which depends on the choices of the household; not on an exogenous set of criteria.

An aggregate measure of affordability is the ratio of median (mean) housing expenditures to median (mean) household income. This measure can be extended to a more comprehensive set of affordability indexes that better describe the full distribution of housing quality and household incomes. One simple alternative is to set income at a particular level, such as the median income, and separate the distribution of housing expenditures (or house values) in a market into deciles and then compute the affordability index at each decile of the distribution. A second alternative is to set housing expenditures (or house value) at a particular level, such as the median value, and separate the distribution of income in a market into deciles. Then compute the affordability index at each decile. Neither of these methods produces results that would be widely used in practice, although both are informative about the entire distribution of affordability instead of a single point in the distribution such as the median. The most sensible option would be to create a distribution of affordability measures.¹⁰ An example would be to compute the index for each decile using either the income and housing expenditure (or house value) of that decile. The widely reported U.S. National Association of Realtor's affordability measure is computed at the median for both income and house value; however, it would be more informative to report the index's value at each decile. Intertemporal changes or spatial difference in the value of the affordability index at the median may mask interesting variations in the distribution across the full distribution.

Versions of the housing expenditure-to-income ratio as a measure of affordability are often used by government agencies. Jewkes and Delgado (2010) note that the U.S. Department of Housing and Urban Development uses a simple percentage-of-income measure to define housing affordability. This index is based on identifying a "housing cost burden" whenever a household spending more than 30 percent of its gross annual income on total housing costs, including principal and interest payments on the mortgage, property taxes, utilities (which consist of electricity, gas,

8. The Glaeser and Gyourko (2003) measure is not included in this discussion as it has not been widely implemented.

9. More controversially and without evidence, Haffner and Heylen (2011) argue that simple affordability indexes are appropriate because households do not account for expectations of house prices or housing depreciation when making housing decisions.

10. For example, Law and Meehan (2012) report that 100% of current non-homeowning households in 2007-2008 in the top income quintile could afford a house priced equal to that of one in the lowest quartile of the price distribution.

water, and sewer), and insurance.”¹¹ The Massey Housing Affordability Index (New Zealand) is a ratio of housing expenses (derived from the median dwelling price and the mortgage interest rate) to median weekly earnings (New Zealand Productivity Commission, 2012).¹² The advantage of this approach is that housing costs are more fully specified than in the simple ratio approach.

AFFORDABILITY MEASURED BY THE RESIDUAL INCOME METHOD

Another measure of affordability is based on the residual income approach, this method used by the U.S. Veteran’s Administration in its home loan program.¹³ In general, there are three steps to the computation. First, measure a household’s after-tax flow of income, including the flow from the stock of assets. Second, measure the total cost of housing.¹⁴ Third, subtract housing expenses from income, yielding “residual income”. A household’s residual income is then compared with an administratively determined set of minimal residual incomes, which are judgments about the minimal amounts that can be devoted to non-housing expenses (the minimal amounts may vary depending on region and family size).¹⁵ If the household’s residual income falls below the specified level, then housing is unaffordable.

While this measure may be useful for financial planning at the household level, it is much less useful as an aggregate index of the affordability of housing in a locality. A major issue is the determination of the amount of housing expenditures that are used in the calculation. Expenditures are a function of the quantity of housing and if the quantity is not set, then the endogeneity of housing consumption is again an issue. However, once the quantity of housing is specified, constant-quality house price indexes can be applied to this quantity of housing and spatially and intertemporally varying values of the “appropriate” housing expenditures can be derived. Another issue is the arbitrariness of the specified minimal levels of residual income; however, this is no different than the arbitrariness of a 30 percent maximal expenditure on housing out of income used in other indexes.

Stone (2006a) suggests an extension of Lerman and Reeder’s (1987) method for calculating an affordability standard based on an exogenously determined quantity of housing and constant-quality price indexes. First, one must specify the composition of a dwelling that is minimally adequate, this being an ad hoc judgment. Next, estimate a hedonic price equation for all localities and apply the estimated implicit prices to this minimal bundle of characteristics (which includes lot size). The result is the minimally acceptable expenditure on the specified unit.¹⁶ Variations in family size can be addressed by varying the composition of the housing characteristic bundle. The calculated minimal housing expenditure can then be used in the residual income approach to measure affordability, or used in the ratio approach described above. The advantage of this approach is that the problematic endogeneity of housing expenditures is addressed. A criticism of this approach is that it assumes the supply of low quality units is adequate to house the number of low-income households in the locality. If supply is insufficient, perhaps due to government regulations, then even though a household has sufficient income to pay for the minimal dwelling, it may pay more than 30 percent of income for the available housing.

Bourassa (1996) argues that residual income affordability measures should depend on the age of the head of the household and the level of household wealth. For example, seniors may be “house rich but income poor.” Thus these households may have insufficient residual income and be deemed to not be able to afford a standard amount of housing while they simultaneously have a large amount of equity in their homes. On the other hand, a household may have sufficient residual income, making housing affordable as measured by this method; however, it may not have sufficient wealth to satisfy the down payment requirement to purchase a home, yielding a different type of limitation of this approach. In Appendix II, the residual income approach is compared with the housing expenditure-to-income ratio approach.

AFFORDABILITY MEASURED BY THE RATIO OF THE MEDIAN INCOME TO THE AMOUNT OF HOUSEHOLD INCOME REQUIRED TO PURCHASE THE MEDIAN PRICED HOUSE

In the U.S., the most well known example of an affordability index that measures the ratio of observed household income to the income “required” to buy the median priced house is that by the National Association of Realtors (2013). Jewkes and Delgadillo (2010, p. 47) interpret the National Association of Realtors (NAR) index as reporting “a number signifying what percentage of the needed income a family has in order to qualify for a mortgage on a median-priced home.” The NAR Housing Affordability Index (HAI) is defined, in principle, as the ratio of the observed median annual family income (y^m) to the amount of (qualifying)

11. The use of 30 percent is discussed in detail in Pelletiere (2008).

12. Accessed from <http://economics-finance.massey.ac.nz//publications/property/HomeAfford/HomeAffordabilitySEPT2013v2.pdf>

13. Lowry (1971) was among the first to propose this measure in the U.S. and Grigsby and Rosenberg (1975) were among the first to provide empirical details. An implementation of this approach in the U.K. was by Stone (2006b). A variant of this index was developed by Kutty (2005) who determines “the extent to which housing costs have led households that are not below the official poverty thresholds to have a poverty standard of living in terms of the nonhousing goods they can afford.”

14. Expected changes in the value of housing are ignored in the cost calculation.

15. Jewkes and Delgadillo (2010) recommend that the residual income approach consider variations in household size, geographic location, transportation and non-housing related expenses.

16. The estimated price of land should capture the value of local amenities.

annual income (y^a) needed to buy the median priced house, multiplied by 100. Thus, the index equals 100 when a family with the median income can just afford the median priced home, given the NAR's assumptions. These assumptions include the mortgage payment equaling 25 percent of a household's gross monthly income and the household making a 20 percent down payment. The NAR's Housing Affordability Index (HAI) is defined as:

$$\text{HAI} = 100 (y^m / y^a) = 100 (0.25 y^m / 12 p^m) \quad (1)$$

where p^m is the monthly payment on the median priced house (V^m) and the NAR defines r to be the interest rate for a 30 year fixed rate mortgage for a conventional loan.¹⁷ The monthly payment is:

$$p^m = (1 - 0.2) V^m (r/12) / [1 - (1/(1 + (r/12))^{360})] \quad (2)$$

Criticisms of the HAI are similar to those listed for the standard ratio approach and the residual income approach. The numerator of the HAI ratio is median income. It can be varied to any other percentile of the income distribution, although there may be data acquisition difficulties for values other than the mean or median in small geographies. The income measure can also be selected for specific groups such as potential young homeowners rather than the entire population. The endogeneity of income is an issue as households choose their labor supply. The denominator, called qualifying income, depends on assumptions about the down payment (20 percent) and that the appropriate amount spent on housing (25 percent of income). Of course, these assumptions are easily changed. The denominator also depends on the median house value, an issue for two reasons. One is that house size is not held constant over time or across space; the other is that other percentiles of the distribution of house values may be of more interest. Other concerns include the observation that mortgage interest rates vary among households based on the credit characteristics of the borrower and the type of the mortgage (fixed or adjustable rate, term, down payment) but the index uses a single average value. The index does not allow for different family types and their different housing demands. Compared with the user cost measure discussed below, the HAI does not account for the tax benefits of ownership of single-family housing. Further, there is no accounting for home depreciation, the expected duration of stay in the dwelling, transaction costs associated with purchase and sale of a property, or expected house price changes.¹⁸

An alternative measure is the National Association of Home Builders' (NAHB) Housing Opportunity Index (HOI) which

17. There is a variant that uses the prevailing adjustable interest rate.

18. Abelson (2009) argues that repayment of principal is a form of savings and should not be counted as a housing cost; however, the NAR's monthly payment includes repayment of principal.

measures affordability as the share of home sales "in a metropolitan area for which the monthly income available for housing is at or above the monthly cost for that unit."¹⁹ Monthly income is the median for a metropolitan area and households are assumed to spend 28 percent on housing. Monthly costs include repayment of principal and interest (with additional assumptions including a 10 percent down payment and 30 year fixed rate mortgage), property taxes and insurance. House price is derived from monthly records of sold properties in a locality. The inclusion of property taxes and insurance costs represents an improvement on the HAI.

AFFORDABILITY MEASURED BY THE USER COST OF HOUSING

The relative cost measure most often used in the prediction of whether households own or rent can be expressed as:

$$R = (p_h / p_r) u = (p_h u) / p_r \quad (2)$$

where R is the relative cost of owner-occupation compared with renting, p_h is the constant-quality price index of owner-occupation, p_r is the price of renting the same dwelling, and u is the user cost of owner-occupation. The numerator, $(p_h u)$, is a measure of the cost or affordability of owner-occupied housing. Many mathematical expressions have been used to express the user cost, some quite complicated (Hendershott and Shilling 1982). A commonly used simplified expression for the U.S. tax structure is:

$$u = (r + t_p) (1 - t_y) + d + T / t^e - \pi^* \quad (3)$$

where r is the mortgage interest rate, t_p is the property tax on housing, t_y is the appropriate income tax rate, d is depreciation and maintenance, T are the transactions costs of buying and selling dwellings, t^e is the expected duration of stay in the dwelling, and π^* is a measure of house price appreciation, discussed in detail below.²⁰ Quigley and Raphael (2004) describe the user cost measure of affordability noting that "tax and monetary policies can cause substantial changes in the costs of owner-occupied housing that are unrelated to the prices of house, per se."

19. Another alternative measure is the Goldman Sachs Marginal Buyers Index, which uses "expected future income of 30 to 40 year-olds, constant-quality seasonally-adjusted home prices for those purchased by 30 to 40 year-olds, a 5 percent down payment and FHA mortgage insurance premium." (Moto 2015)

20. See Hendershott and Slemrod (1982) for a discussion of how to calculate the income tax rate when mortgage interest and property taxes are deductible and the tax code allows a choice between a standard and an itemized deduction. The price expectations are evaluated at the time of decision of whether to purchase or rent a dwelling. The time period for the expected price change of housing should match that for the expected stay in the dwelling. There are multiple simplifications embodied in this specification of user costs including a static formulation and the assumption of intertemporal constancy of the various rates in the formula. Also, this form assumes that the household's loan-to-value ratio is one (or the opportunity cost of the down payment equals the mortgage interest rate); otherwise, there should be another term measuring the opportunity cost of the down payment.

Economic theory supplies backing for this form of an affordability measure.²¹ The term $(p_n u)$ measures housing costs more comprehensively than the other affordability measures as it includes the effects of taxes, depreciation, and house price inflation.²² The measure varies among households for multiple reasons including differences in income tax rates, differences in the cost of a mortgage due to variations in a household's quality of credit, variations in the expected length of stay in a dwelling, and spatial variations three components: property tax rates, the constant-quality price of housing, and the rate of house price inflation. One criticism of the user cost measure is that it assumes that the constant-quality price of housing is uniform within a locality. However, the literature on housing submarkets suggests that there are systematic long term variations in the price per unit of housing, even within a metro area (Bourassa et al. 1999).

The user cost expression in (3) includes π^* , which is a measure of house price inflation. Either an ex-ante (prospective) or ex-post (retrospective) measure of inflation can be used depending on the desired use of the user cost measure. An ex-ante measure is equivalent to using households' expected house price inflation, while an ex-post measure uses observed house price inflation data. Households' current decisions about whether to own or rent depend on their expectations of the future course of house prices, household income, length of stay in a dwelling, and demographic changes. Thus, theoretical models of tenure choice generally use expected house price inflation when measuring user costs. This assumption is similar to that made for any investment good; purchases depend not only on the current price but expected future prices. Manski (2004, Section 7) summarizes the use of expectations data to predict behavior, pointing out that there is supportive evidence that expectations matter (see also Kwan and Cotsomitis 2004). In contrast, a backwards looking measure of the actual cost of homeownership would use the observed time series of house price changes. Quigley and Raphael (2004) report the ex-post observed user cost of housing over a twenty year period using the history of observed house price changes as their measure of π^* .

Use of expected house prices in the user cost measure raises a number of theoretical concerns. Consider the tenure choice decision of an individual who is currently renting. If this person believes house prices will rise substantially relative to the cost of owning, then their user cost will be low, and all else equal, the relative price of owning compared with renting will be low. Thus the theory predicts that this individual will have a relatively high demand for homeownership.

21. See Jorgenson (1963).

22. Note that this expression measures the after-tax cost of housing, which is appropriate. Given that the U.S. tax structure results in deductions being itemized primarily by relatively high income households, lower income households will not benefit from the deductibility of mortgage interest or property taxes. The result is that owner-occupied housing is more costly; that is, less affordable.

Typically, a mortgage is required for the home purchase and there are a set of lender imposed constraints that must be met before the loan is granted. These constraints may not be met by the individual and homeownership may not be achieved. Thus, theory indicates that relatively high expected house price inflation results in relatively high demand for owner-occupation; however, it does not guarantee that homeownership will be achieved. If house price deflation is expected, theory suggests the person will likely desire to rent. A current renter can simply continue renting; however, a current homeowner has to incur nontrivial transaction costs in converting to renting. A conclusion from this discussion is that changes in expected house price inflation will change the demand for homeownership but the impact on the observed homeownership rate will be moderated by the supply of owner-occupied homes and the conditions in the mortgage market. Another issue is the measurement of the duration over which house price expectations should be measured. The time period should match the expected duration that the individual plans to reside in the dwelling, a value that varies over individuals. Empirically, the average time period would likely be in the five to ten year range.

COMPARISON OF THE NAR'S HAI INDEX WITH THE USER COST INDEX

One use of affordability indexes discussed earlier is to predict homeownership rates or changes in the current rate. The relationship of the HAI and user cost indexes with their component factors is displayed in Table 1; specifically, the signs of the derivatives of the two affordability measures with respect to the influential factors are listed. Note that increases in the HAI indicate housing is *more* affordable, while increases in relative costs indicate housing is *less* affordable; thus, if a variable has the same direction of influence on both indexes, it will have opposite signs in the table.

TABLE 1: COMPARISON OF THE COMPARATIVE STATICS OF TWO AFFORDABILITY INDEXES

	CHANGE IN HAI	CHANGE IN RELATIVE COST
Increased income ^a	+	-
Increased interest rate	-	+
Increased price of housing	-	+
Increased down payment % ^b	+	0
Increased depreciation rate	0	+
Increased expected house price appreciation	0	-
Increased property tax rate	0	+
Increased transaction cost	0	+
Increased expected length of stay	0	-

a. The income effect for the relative cost measure occurs because the tax rates in the U.S. are progressive, thus t_y rises as income increases.

b. The down payment percentage affects user costs in a more general specification where the opportunity cost of the down payment is included.

Inspection of Table 1 indicates that three important factors: income, mortgage interest rates and the price of owner-occupied housing, have the same direction of effect on the two affordability indexes, although not necessarily the same size of effect. Increased income raises the income tax rate, which increases the size of deduction for mortgage interest and property taxes, yielding a lower user cost, which raises affordability. Major differences between indexes occur because of the omission of factors in one index or the other. For example, the HAI is not affected by changes in depreciation or property tax rates, expected house price appreciation, the planned length of stay in the dwelling, or transaction costs. Among these variables, the one varying most over time and across geographies is the expected rate of house price appreciation. Thus, one might expect the two affordability measures to change in substantially different amounts or even directions if the expected house price appreciation rate changes. While the other factors vary some over time and across space, they are less likely to cause substantial differences in the two indexes.

The time period of the house price bubble and bust has been one of the most volatile periods of change for the U.S. homeownership rate. Thus it is of interest to compare the relationship between the HAI measure and the homeownership rate to the relationship between the relative cost measure and the homeownership rate. The time period used in this analysis is 2003–12 and two specific localities are used for this case study: the Los Angeles and San Francisco metro areas. Both the affordability index and the measure of relative cost changed substantially during this period in these localities as did the homeownership rates.

The National Association of Realtors metropolitan level house price indexes do not extend back to 2003. An alternative, but similar measure is the California Association of Realtors' (CAR) affordability index. It is constructed similarly to the HAI, except it reports the percentage of households with income above the qualifying income, which is computed the same as NAR's measure. Thus, the greater the CAR index, the more affordable is housing and one would expect the greater the homeownership rate.

The housing cost measure is the product of user cost and the constant-quality price of housing. In this example, the assumptions underlying the housing cost are: the mortgage interest rate is the average for a year for a 30 year fixed rate mortgage, the property tax rate is set at 1 percent, the depreciation rate equals 3 percent annually, the household income tax rate equals 20 percent (it is assumed to itemize deductions), and annualized transaction costs are set to 1 percent.²³ A key component of the user cost component

of costs is the expected rate of house price appreciation. Typically this rate is unobserved; however, Case, Shiller, and Thompson (2013) surveyed households in the Los Angeles and San Francisco areas each year during this study period.²⁴ They collected data on household's expected house price change for a one year period and the annualized rate for a ten year period. I create two user cost variables using these two measures of expected inflation, recognizing that the theoretical preference is for the longer term measure. Because the values of expected inflation are important and interesting they are reported in Table 2. As expected, the values are high during the boom, peaking in 2004, and as noted by Case et al., the 10 year measure is extraordinarily high. One-year price inflation expectations fall rapidly during the beginning of the bust, while the 10 year measure tapers off more slowly.

Table 2 also reports the values of the user cost of housing and house price index for the sampled areas. The user cost measure that is based on short horizon price expectations is low during the boom and much greater during the bust, positive in all years but one. The measure based on long horizon expectations is negative in 2003-05 and 2007. A negative user cost implies that a household should attempt to secure as much owner-occupied housing as possible at that time.²⁵ Local house prices rose rapidly through 2006 and then declined rapidly through 2011.

A comparison of the California Association of Realtor's housing affordability index (CAR-HAI), the two owner-occupied user cost measures, and homeownership rates is displayed in Table 3. The CAR index fell from 2003 to 2006 due to rising house prices, then rose dramatically from 2006 to 2009, and finally stabilized. Comparing the CAR-HAI and the owner-occupied housing affordability index yields quite different intertemporal patterns. The index based on 1 year forward expectations tends to rise from 2003 to 2008, and then it falls. The index based on 10 year forward expectations tends to rise throughout the entire period.

The relationships of the indexes and the homeownership rate are summarized by correlations of the time series. The theory underlying the CAR-HAI index suggests that it should be positively correlated with the homeownership rate. The correlation of these two data series in Table 3 is -0.91 , which is quite high and of the wrong sign. That is, when the CAR-HAI indicated greater affordability, the rate of homeownership is lower.

23. The assumed property tax rate of 1 percent is consistent with the assumption made by the CAR in their calculation of an affordability measure for California and with California's Proposition 13.

24. Their surveys are of recent home buyers in Orange County, CA (in the Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area) and Alameda County, CA (in the San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area).

25. The limitation on purchases of owner-occupied housing are due to various credit constraints (which were relaxed during this period) and the limitation of the tax benefit of mortgage interest and property tax payments to two homes.

TABLE 2: EXPECTED HOUSE PRICE INFLATION, USER COSTS, AND A LOCAL HOUSE PRICE INDEX

	1 YEAR EXPECTED PRICE CHANGE ¹	10 YEAR EXPECTED PRICE CHANGE ¹	USER COST: 1 YEAR EXPECTATION ²	USER COST: 10 YEAR EXPECTATION ²	LOCAL HOUSING PRICE INDEX ³
2003	8.5	11.90	0.010	-0.024	562,850
2004	11.2	15.75	-0.017	-0.063	695,946
2005	9.2	13.35	0.003	-0.039	849,286
2006	6.7	9.45	0.032	0.005	885,909
2007	2.4	11.45	0.075	-0.016	809,616
2008	-2.1	8.65	0.117	0.010	600,823
2009	1.6	7.70	0.073	0.011	523,124
2010	4.1	7.75	0.045	0.008	518,646
2011	1.3	7.35	0.071	0.010	483,100
2012	4.0	5.20	0.037	0.025	511,372

1. The values are the average of expected house price inflation in Orange and Alameda Counties derived from Case, Shiller, and Thompson (2013).

2. Author's calculation.

3. This house price index is derived by multiplying the 2003 median house price average of Alameda and Orange counties by the FHFA purchase-only repeat sales house price index for California. The median price of homes in California counties is derived from <http://www.car.org/marketdata/data/housingdata/>. The FHFA state price index was accessed at <http://www.fhfa.gov/Default.aspx?Page=215>.

TABLE 3: CAR AFFORDABILITY INDEX, COST OF OWNER-OCCUPIED HOUSING INDEXES, AND HOMEOWNERSHIP RATES IN CALIFORNIA

	CAR AFFORDABILITY INDEX ¹	OWNER COST INDEX: 1 YEAR PRICE EXPECTATIONS ²	OWNER COST INDEX:- 10 YEAR PRICE EXPECTATIONS ²	HOMEOWNERSHIP RATE
2003	26	5,426	-13,711	58.9
2004	20	-12,026	-43,692	59.7
2005	16	2,939	-32,732	59.7
2006	12	28,597	4,235	60.2
2007	13	60,495	-12,776	58.3
2008	33	70,441	5,852	57.5
2009	51	38,094	5,922	57.0
2010	48	23,090	4,160	56.1
2011	52	34,107	4,879	55.3
2012	51	19,064	12,927	54.5

1. These data were accessed at <http://www.car.org/marketdata/data/haitraditional/> and its links.

2. Author's calculation.

The theory underlying the user cost index suggests that it should be negatively correlated with the homeownership rate. The correlation of homeownership with the housing cost index based on 1 year price expectations is -0.29 and with the one based on 10 year price expectations is -0.69. Here, the correlation has the expected sign and is relatively large.

Figures 1 and 2 display these relationships. In Figure 1, the unexpected inverse relationship of the CAR-HAI affordability index and homeownership rates is shown, while in Figure 2, the expected inverse relationship of the 10-year

expectations based housing cost index and the homeownership rate is displayed.

This case study suggests that changes in the HAI or CAR affordability index are a poor predictor of changes in the homeownership rate, while changes in the user cost based housing cost index works well.²⁶

26. A NAR MSA level affordability index is available from 2009 on. In Los Angeles and San Francisco the index increased from 2009 while homeownership rates fell; again an unexpected relationship. These data were accessed at <http://www.realtor.org/topics/housing-affordability-index/data>.

FIGURE 1. CALIFORNIA'S HOMEOWNERSHIP RATE AND THE CAR AFFORDABILITY INDEX

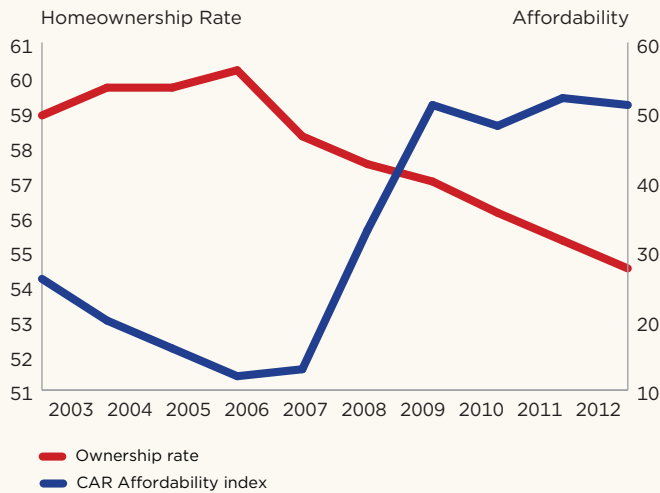


FIGURE 2. CALIFORNIA'S HOMEOWNERSHIP RATE AND THE RELATIVE COST INDEX (10 YEAR FORWARD EXPECTATIONS ABOUT HOUSE PRICE INFLATION)



COMPARISON OF HOUSE PRICE EXPECTATIONS AND OBSERVED INFLATION RATES²⁷

An important component of the net cost of owner-occupied housing is the rate of inflation or deflation of house prices. Prior to 2006 households' house price expectations were not measured in a recurrent survey with one exception, a series of surveys described in Case and Shiller (2003) and Case et al. (2012). Households located in Milwaukee

27. Other measurement and data availability issues are discussed in Appendix III.

County WI, Alameda County CA, Orange County CA, and Middlesex County MA (Boston area) were first surveyed in 1988, then annually beginning in 2003. Recognition of the important role of house price expectations during the housing boom led to multiple surveys beginning in 2007. Two are surveys of housing market experts' opinions about house price changes.²⁸ However, these expert opinions do not necessarily reflect households' opinions. The University of Michigan/Reuters Survey of Consumers started reporting house price change expectations in 2007.²⁹ Their results are based on a sample of 500 respondents per month (both renters and owners), with geographic detail limited to four regions. These expectations are compared with actual price changes below.

The second method of obtaining house price expectations is to make an assumption about how expectations are formed and then apply the assumption to observed data. For example, if perfect foresight is assumed, then expected house prices equal observed future prices. More often, either rational expectations or some form of adaptive expectations are assumed. In the latter case, the assumption is that current expected house price changes are a function of past changes. Which specific function should be used is unclear. A serious gap in the research literature is a comparison of expected house price changes from survey data with various analytical methods of predicting house price expectations using historical data.

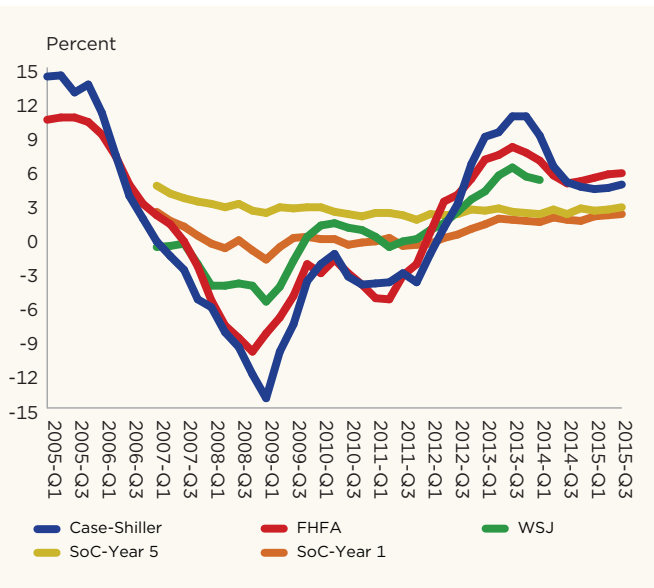
Given the importance of house price expectations to the user cost measure of affordability, an inspection of their time series of values and comparison to actual house price changes is presented in Figure 3. House price expectations data are derived from the *Wall Street Journal's* and *Pulsenomics's* surveys of housing experts and the *Reuters/University of Michigan Survey of Consumers*. In all cases, means of the survey results are reported. House price changes are from the Federal Housing Finance Agency (FHFA) repeat sales index and Case-Shiller repeat sales index. All series are for the U.S. national housing market.³⁰

28. One is the "House Price Expectations Survey" conducted by Pulsenomics, which surveys a panel of about 100 economists and industry professionals in the housing field beginning in 2010 (<https://pulsenomics.com/Home-Price-Expectations.html>). The other survey is by the Wall Street Journal, which surveys about 50 economists, beginning in 2007. The data can be found at <http://projects.wsj.com/econforecast>.

29. See <http://www.sca.isr.umich.edu> for the Survey of Consumers data.

30. The Case-Shiller national index is described as "a composite of single-family home price indices covering the nine U.S. Census divisions. As the broadest national measurement of home prices, the index captures approximately 75% of U.S. residential housing stock by value." (See <http://us.spindices.com/index-family/real-estate/sp-case-shiller>). The FHFA index is their "purchase only" index. *The Wall Street Journal index* is converted from monthly to quarterly and is a prediction of the 12 month rate of house price change in the FHFA index. The *Survey of Consumers* asks both one year and five year house price expectations.

FIGURE 3. HOUSE PRICE EXPECTATIONS AND OBSERVED PRICE CHANGES



The FHFA and Case-Shiller house price series are similar, but the Case-Shiller index is more volatile as a result of the different composition of surveyed properties (their correlation is 0.98).³¹ The Wall Street Journal price expectations series is less volatile than the observed price indexes and it appears to track their changes well (correlations with Case-Shiller (0.91) and FHFA (0.85)).³² However, recall that the WSJ expectations series predicts prices one year ahead, not contemporaneously. Thus, to a large extent, the WSJ panel of experts predicted house price change in the coming year equals the change in the current year.³³

The five-year-ahead *Survey of Consumers* price expectations index is the least volatile of all of the series.³⁴ In contrast to the observed pattern of house prices, the predicted average annual change for the coming five year period is always positive. This series is negatively correlated with contemporaneous house price changes (both FHFA and Case-Shiller). However, it is positively correlated with the observed price series lagged one year and highly positively correlated with observed prices lagged two years (0.71 with Case-Shiller and 0.67 with FHFA).³⁵

A number of conclusions can be drawn from the above observations. First, households' longer term house price expectations are relatively stable over time, which addresses one of the concerns of using a user cost type measure of housing affordability. Second, they track observed house price changes, but with about a two year lag. This suggests there will be a lag in demand for owner-occupied dwellings compared with a measure that uses contemporaneous house price changes. Third, U.S. households tended to be optimistic regarding long term changes in house price changes even when house prices are falling.

31. The standard deviations of the quarterly price changes are 7.5 for the Case-Shiller series and 6.1 for the FHFA series.
 32. The standard deviation of the WSJ series is 3.2.
 33. The correlation of the WSJ experts' predictions with the one-year-ahead Case-Shiller and FHFA house price indexes are lower, 0.66 and 0.65, respectively.

34. The standard deviation of the five-year-ahead Survey of Consumer series is 0.6 and it is 1.1 for the one-year-ahead series.
 35. The one-year-ahead Survey of Consumer series of price expectations is positively correlated with contemporaneous price changes (0.82 and 0.85). A regression analysis suggests households base their long term house price expectations on observed price changes 10 quarters prior. Observed price changes more recent than 10 quarters ago add little to the explanation of long term house price expectations.

4. Affordability in the United States

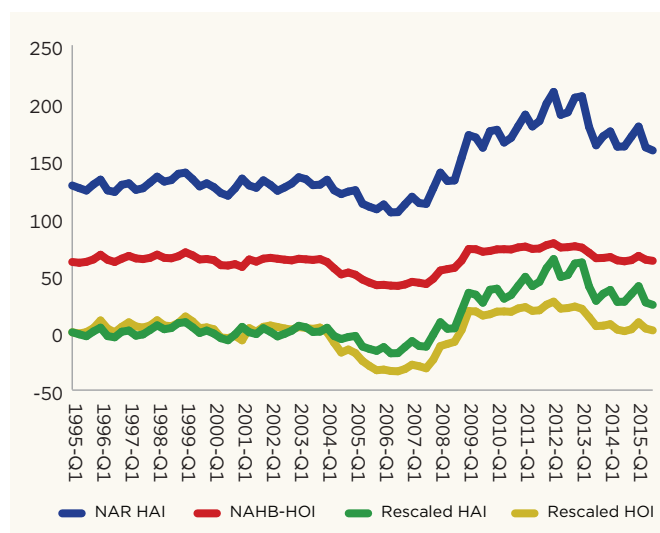
The history of housing affordability in the U.S. has been discussed in a series of articles.³⁶ Weicher (1977) used the ratio of the median price of new homes to median family income to measure the affordability of owner-occupancy and found that it was approximately stable from 1949 to 1975. Gyourko and Linneman (1993) study affordability over 1960 to 1989. They note that rising real household income from 1960 to 1974 (1.8% per year) helped to maintain affordability levels, but real income growth fell to only 0.2% per year from 1974 to 1989. Another strong trend during this period was improved quality of dwellings. They document that real house prices increased throughout the distribution of dwelling prices, but this increase reflected both quality and price changes. Using a hedonic price approach to hold quality at a constant level, they found that quality-adjusted house prices rose from 1974 to 1989, with the increase being the greatest in the lowest percentiles of the price distribution. Gyourko and Linneman next report the changes in real wages for workers with specific levels of educational attainment. While this analysis is not exactly for a constant-skilled household, it is informative and one of the better attempts to address income variations. They note that real incomes of workers with all levels of education fell from 1974 to 1989, more so for those with less education. However, overall household income increased due to the increase in the number of two-worker households. A demographic change also was occurring: an increase in single female headed households. Gyourko and Linneman (1993) draw a number of conclusions for the 1974 to 1989 period: 1) real wages fell, constant-quality house prices rose, and housing was less affordable, 2) this occurred throughout the distribution of workers' education and housing quality, but was most severe for lower skill workers, 3) at the household level, an offsetting factor was the growth of two worker households. Tong (2004) presents a history of affordability using a measure similar to the NAR index for 1990-2003. He notes that the index for first-time homebuyers improved from 1990 to 1993, then was essentially unchanged through 2003 although his results differ by metro area. While the level of the index for existing homeowners suggested hous-

36. Affordability has been measured in many countries. Examples include U.K. (Stone 2006), Russia (Kosareva and Tumanov 2007), Australia (Guest 2005; Marks and Sedgwick 2008; Abelson 2009), Canada (Hulchanski 1995; Bunting, Walks, and Fillion 2004; Skaburskis 2004), Hong Kong (Chiu 2007), Singapore (Ong 2000), China (Mengie, Reed, and Wu 2008), and the Netherlands (Milligan 2003). The history of public housing assistance programs, both rental and ownership, is discussed in Wallace (1995).

ing was more affordable for them than first-time buyers, the time trends and spatial patterns were similar. Glaeser and Gyourko (2003) find that in the U.S. there are areas, mostly in the Midwest, where current housing costs (as of the 2000 census) were below construction costs and thus housing was very affordable. There also are coastal areas where housing costs exceed construction costs.

The national NAR (HAI) and NAHB (HOI) measures of affordability are presented in Figure 4.³⁷ Given that the indexes are reporting different measures of affordability, direct comparison is questionable. To this end, both indexes are rescaled setting the initial year's value to 0 and subsequent values represent percentage changes in the index. The indexes were very similar from 1995 to 2004, then the HOI fell by a larger percentage during the height of the housing boom and it remained lower through 2015. Both indexes show affordability being unchanged from 1995 to the beginning of 2004, declining rapidly through the end of 2006, recovering and peaking in early 2012, then declining through 2014 and finally stabilizing. The HOI ends at nearly the identical level where it was in 1995, while the HAI is 24 percent higher.

FIGURE 4. NAR-HAI AND NAHB-HOI AFFORDABILITY INDEXES



37. A comparison of the HAI, HOI, and the California Realtors' affordability index for 2005-2015 is in Moto (2015).

Bourassa and Haurin (2015) developed an affordability index based on user cost theory, designated as the Dynamic Housing Affordability Index (DHAI). They describe their index as including “the price of housing and also related costs such as mortgage interest, property taxes, insurance, transactions costs, and depreciation and maintenance. It takes into account the tax benefits from the mortgage interest and property tax deductions and it considers the role of expected house price inflation in reducing the cost of housing.” The DHAI is described in two equations:

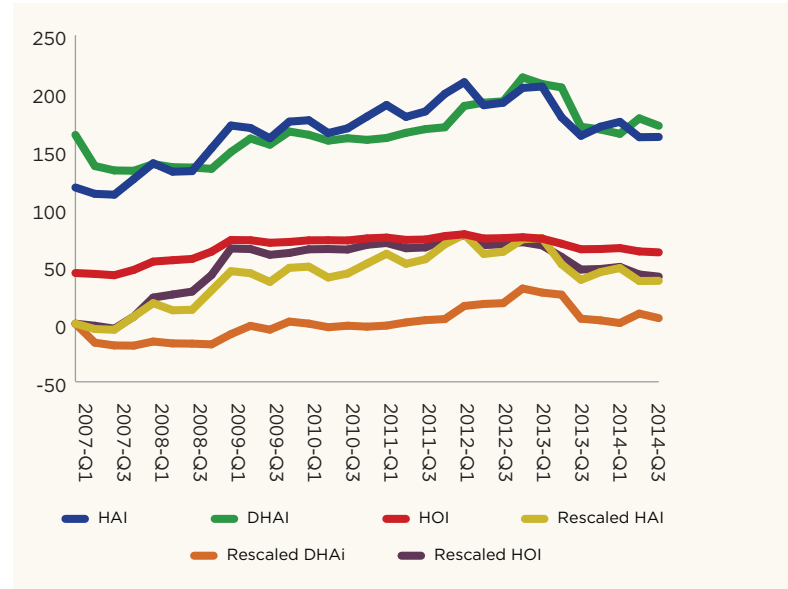
$$\text{DHAI} = 100(0.25y^m / \text{Owner Cost of Housing}) \quad (4)$$

$$\text{Owner Cost} = V ((r + t_p) (1 - t_y) + d + T/h_e - \pi_e) \quad (5)$$

where V is a measure of the constant-quality price of owner-occupied housing and y^m is the median household income.³⁸ The mortgage interest rate is r, t_p is the property tax rate on housing, d includes annual depreciation, maintenance and hazard insurance costs, T is the transactions cost of buying and selling a dwelling, h_e is the expected duration of stay (holding period) in the dwelling, and π_e is the expected rate of house price appreciation. This formulation assumes the affordable level of housing cost is 25 percent of income, the same assumption as used by the HAI.³⁹

The DHAI requires data reporting expected house price changes, limiting the index to after 2006. Figure 5 displays the U.S. DHAI, HAI, and HOI.⁴⁰ Although developed with different methodologies, the three indexes are positively correlated (DHAI and HAI = 0.84; DHAI and HOI = 0.67). This finding occurs because households’ long term house price expectations were relatively constant after 2008. However, the indexes differ as shown in the comparison of the rescaled indexes, these again reporting percentage changes. After the first quarter of 2007 the HAI and HOI rise substantially more than the DHAI and this difference persists throughout the period.

FIGURE 5. DHAI, HAI, AND HOI AFFORDABILITY INDEXES



Without national house price expectations data prior to 2007, the formal DHAI cannot be created. However, a rough approximation can be estimated by linking observed Survey of Consumers 5-year-ahead price expectations for 2007-2012 with the Case-Shiller 10-year-ahead price expectations data for metro areas.⁴¹ The result is a prediction that, nationally, household expectations of annual house price changes from 2003 to 2006 of 4.1, 4.8, 4.8, and 4.4 percent. The resulting DHAI values, using the Bourassa and Haurin (2016) methodology and data sources are quite different than the HAI or HOI values for 2003 to 2006 (see Table 4). Specifically, the DHAI values are greater during 2003 to 2005 relative to 2006 to 2008. This occurs, in part, because house price expectations were relatively high in 2003 to 2005 and house prices were pre-peak. By 2006, affordability began to fall rapidly because interest rose, house prices peaked, and households’ expected house price inflation decreased.

TABLE 4: DHAI, HAI, AND HOI AFFORDABILITY MEASURES FOR 2003 TO 2006

	DHAI	HAI	HOI
2003	171.5	131.2	63.6
2004	184.8	124.8	54.8
2005	170.8	113.0	45.0
2006	141.1	107.9	41.0

38. Similar to the HAI, income could be defined for any percentile of the income distribution.

39. The assumptions underlying the housing cost are: the mortgage interest rate is the average for a year for a 30 year fixed rate mortgage, the property tax rate is set at 1 percent, the depreciation rate equals 3 percent annually, the household income tax rate equals 20 percent (it is assumed to itemize deductions), and annualized transaction costs are set to 1 percent based on a 7 year length of stay and 8 percent one-time transaction cost at the end of the stay in the home. The expected rate of house price appreciation is the five-year-ahead data from the Survey of Consumers.

40. Affordability measures also exist for both indexes at the regional and MSA levels (see Bourassa and Haurin 2015).

41. The link is a regression with the Survey of Consumers data as the dependent variable and the Case-Shiller expectations series and its square as the dependent variables. Then the observed Case-Shiller expectations data for 2003-2006 are used to forecast the Survey of Consumers national data for those years. The Milwaukee Case-Shiller price expectations data was judged to best link with national Survey of Consumers data.

5. Evaluation of Affordability Indexes

Affordability indexes have different purposes thus there is no optimal index. However, indexes can be evaluated on their performance for specific criteria. Given that the NAR's HAI, the NAHB's HOI, and the Bourassa-Haurin DHAI are measures of the affordability of and demand for owner-occupied housing, the evaluation below tests the predictive ability of the indexes. The housing market characteristics included in this evaluation are the sales of new homes, sales of existing homes, number of housing starts, and homeownership rate.

As noted in the theoretical discussion, housing market outcomes are influenced by both demand and supply side factors. The evaluation of the affordability indexes thus should control for supply side factors, especially credit availability. Conceptually, credit availability can be viewed as an exogenous factor determined by government regulations and mortgage lenders' choices. The general perception is that credit availability was high during the housing boom, but later tightened during the housing bust.

Empirically, a choice must be made among competing measures of access to credit, none of which are fully exogenous. Zillow has developed a measure of access to mortgages and one of the components is selected as the control for credit availability. This measure is described as "Using Fannie Mae Loan Acquisition data, we tracked the lowest 10th percentile of borrower credit scores (CS10). CS10 gives a sense of which borrowers were on the cusp of denial in a given month. Rising CS10 values indicate tighter lending standards. For example, in late 2007 we see that borrowers in the bottom 10th percentile of credit scores had a score of approximately 630. By the end of 2008, CS10 would balloon to over 700. Essentially, an individual with a credit score of 630 would have had virtually no chance of being approved for a conforming mortgage at

that moment in time. According to CS10, credit remained tight until approximately 2013."⁴²

The evaluation strategy of the three affordability indexes is a simple ordinary least squares regression, with the dependent variable being one of the housing market outcomes listed above, and the explanatory variables being the measure of credit availability and one of the affordability indexes. The expected sign of the credit availability index is negative and that of the affordability indexes is positive. Results are listed in Table 5. The data are from 2003 to 2014 and are annual, thus there are relatively few observations.

A relatively clear pattern emerges in Table 5. The Credit Access variable performs as expected with a negative coefficient (tighter credit implies a lower value of the housing market outcome) with the results most often statistically significant. The DHAI measure of affordability has the expected positive coefficient in all cases and it is statistically significant when predicting housing starts, and new and existing home sales. It is not a significant predictor of the U.S. homeownership rate during 2003-2014. In contrast, the HOI measure of affordability is not statistically significant in any regression, although it has the expected positive sign for housing starts and sales. The HAI measure performs poorly in this evaluation, having the wrong sign in three of the four regressions.

42. See <http://www.zillow.com/research/zillow-mortgage-access-index-9099/>. Alternative measures of credit tightness are available including 1) "the proportion of loans with 20 percent or more down that are non-conforming (those that cannot be sold to a GSE, meaning the risk must remain on the lender's books)"; 2) a measure of "how many quotes a Zillow Mortgage inquirer with a credit score between 600 and 640 receives compared to an inquirer with a credit score of 760 or higher"; and 3) an overall index based on seven measures. These measures of credit tightness are highly correlated with the credit access variable in Table 5 (-0.94, -0.88, and -0.98 respectively). The estimation results using these alternative measures of credit tightness are similar in that DHAI performs better; however, these results have lower levels of statistical significance. An index of tightness created by the Mortgage Bankers Association begins only in 2011. CoreLogic's Housing Credit Index performs very similarly to Zillow's Credit Access variable listed in Table 5.

TABLE 5: COMPARISON OF PREDICTIVE ABILITY OF THE DHAI, HAI, AND HOI AFFORDABILITY INDEXES: 2003–2014

HOUSING MARKET	CONSTANT	CREDIT ACCESS	DHAI	HAI	HOI	ADJUSTED R ²
Housing Starts	10,781.6 (10.3)	-15.63 (9.4)	4.07 (1.5)			0.89
Housing Starts	8,707.1 (2.7)	-10.59 (1.8)		-4.22 (0.7)		0.87
Housing Starts	10,929.7 (4.8)	-14.88 (3.5)			0.34 (0.0)	0.86
Existing Home Sales	22,750.9 (7.2)	-33.1 (6.6)	28.67 (3.5)			0.80
Existing Home Sales	28,101.1 (2.0)	-36.10 (1.4)		9.29 (0.4)		0.52
Existing Home Sales	27,474.7 (2.9)	-35.13 (2.0)			22.57 (0.6)	0.53
New Home Sales	7,838.7 (8.5)	-12.18 (8.3)	6.16 (2.6)			0.86
New Home Sales	7,375.9 (2.1)	-9.72 (1.5)		-1.16 (0.2)		0.75
New Home Sales	9,782.7 (4.3)	-14.46 (3.4)			9.94 (0.9)	0.78
Homeownership Rate	93.4 (13.4)	-0.03 (3.2)	-0.02 (0.9)			0.54
Homeownership Rate	52.0 (3.6)	0.04 (1.5)		-0.08 (3.1)		0.75
Homeownership Rate	92.9 (14.1)	-0.04 (1.4)			-0.00 (0.0)	0.49

Notes: Annual observations. Numbers in parentheses are t-statistics. Coefficients that are statistically significant using the 0.05 criterion are shown in bold. Housing starts, new and existing home sales are measured in thousands.

The coefficients of DHAI in the various regressions have the following effects. A 10 point increase in the DHAI implies an annual increase of 41,000 housing starts, 287,000 sales of existing homes, and 62,000 sales of new homes. A 10 point increase could be caused by multiple factors. Examples, using 2014 values for variables in the DHAI formula and assuming a 15 percent tax bracket, include income rising by \$4,000, house prices falling by \$10,000, house price expectations rising by 0.33 percentage points, or mortgage interest rates falling by 40 basis points.

None of the affordability measures predict that increasing affordability will raise homeownership during 2003–2014. During this time, the ownership rate trended downwards, with little responsiveness to changes in affordability. This may be a reaction to the strong increase in homeownership rates from 1995 to 2003 and the large subsequent increase in the number of foreclosures. Arguably, the homeownership rate is slowly adjusting to the new equilibrium rate.

6. Summary and Conclusion

The literature contains many conceptualizations and definitions of housing affordability. There is general agreement that all measures contain ad hoc elements; however, some measures are better grounded in economic theory than others. An ideal affordability index would avoid multiple conceptual problems, the major ones including: 1) the failure to recognize that a household's observed level of housing consumption is a choice variable and thus a voluntarily high level of expenditures does not necessarily indicate a lack of affordability; 2) household income is a choice variable depending on the labor supply choices and thus may voluntarily be low; 3) many indexes omit important aspects of housing costs including depreciation and maintenance, transaction costs of buying and selling a home, property taxes, mortgage insurance, and the income tax consequences of homeownership; 4) failure to account for differences in the quantity and quality of housing when comparing housing expenditures over space or time, which includes failure to account for spatially or temporally differing values of local amenities; 5) failure to account for expected house price changes; 6) failure to account for household formation and the choice of household size; 7) overemphasis on measuring the affordability of the median income household and the median priced house rather than considering the full distribution of income and housing costs.

There are four major types of affordability indexes. They include indexes that: 1) measure housing price compared to the amount of household income; 2) compare a household's income after subtracting housing expenses to an arbitrary residual income standard; 3) compare the cost of existing housing to the cost of producing new housing; and 4) measure the partial or the full economic cost of homeownership and compare it to household income. This report concludes that the first two measures are subject to multiple conceptual problems and thus, while perhaps useful for policy analysis, they are less useful for economic analysis. The third measure, developed by Glaeser and Gyourko (2003) is well-grounded in economic theory, but somewhat limited in that it does not consider household income. Among the fourth type of measure, the link with economic theory is strongest for user cost based affordability indexes. This type of index has had data availability issues in the past, particularly due to the lack of data on

households' expectations of future house price changes, but these data are now available.

Indexes' values and trends can be compared, but this comparison is not a test of the validity of an index. This analysis concludes that a useful criterion for an index of the affordability of owner-occupied housing is its ability to predict characteristics of the housing market including homeownership, sales, and housing starts. Multiple tests of this predictive ability are conducted. In a case study, the California Realtors' Housing Affordability Index from 2003-2012 is compared with a new affordability index that uses Case-Shiller's (2012) measure of house price expectations for two California counties. During this period, the California HAI initially fell, then rose. However, contrary to expectations, the homeownership rate initially fell, then rose. In contrast, the data confirm that when the user cost measure of housing affordability rose, the homeownership

rate fell, as theory predicts. This case study suggests that further development of a national affordability index based on the user cost concept is appropriate.

A number of data issues exist for all affordability measures; however, the increase in availability of data such as house prices at very small geographies is addressing this concern. In contrast, measures of household income continue to be difficult to obtain at local levels. The greatest problem with implementing a user cost based measure of affordability has been the lack of data on households' house price expectations. House price expectations of both experts and households are now being collected, however, permitting the calculation of the user cost measure of affordability. This study found that experts' expectations tend to equal those observed in the housing market, lagged one year.⁴³ Households' expectations, as reported by the Survey of Consumers, tend to lag the market by two years and are substantially smoothed, lending stability to the user cost measure of affordability. This survey also reports price expectations for four regions and a relatively new survey from *Pulsenumics* reports price expectations for 20 MSAs.⁴⁴

Piecing together a series of affordability measures from various studies suggests that owner-occupied housing affordability was approximately constant from 1949 to 1975 (Weicher 1977), thereafter it fell somewhat through 1989 (Gyourko and Linneman 1993), but this conclusion was complicated by the emergence of two worker families. In the early 1990s affordability improved but then stabilized through 2003 (Tong 2004). The National Association of Realtors' Housing Affordability Index fell during the height of the housing boom and then improved from 2007 on. In contrast, a user cost measure of affordability developed by Bourassa and Haurin (2015) (DHAI) shows a different picture, indicating affordability was high in 2004, then it

fell dramatically and remained low during the Great Recession, but began a slow rise in 2009, with a smaller peak in 2013. This difference between the DHAI and the HAI or HOI is caused by the inclusion of house price expectations in the DHAI. Price expectations were high during the peak of the housing boom and then declined through 2011. Since then there has been a slight upwards trend.

As noted above, affordability measures have different goals. All goals are defensible, no single objective is overriding. That said, it is reasonable to test whether an index that indicates changing affordability of owner-occupied housing correctly predicts changes in the housing market conditions. This study considers four aspects of housing markets: sales of existing homes, sales of new homes, housing starts, and the homeownership rate. Three affordability indexes are compared, the NAR's HAI, the NAHB's HOI, and the Bourassa-Haurin DHAI. The finding is that the DHAI is the better predictor of housing starts and sales of new and existing homes during 2003–2014. None of these indexes correctly predict the steady decline in the homeownership rate after 2004. Using 2015 housing market conditions, a 40 basis point decrease in the mortgage interest rate or a 0.33 percentage point increase in house price expectations would increase the DHAI by 10 points. This change in the DHAI is associated with about 41,000 more housing starts, 287,000 more sales of existing homes, and 62,000 more sales of new homes.

43. See Jang (2006) for an analysis of the *Wall Street Journal's* experts' predictions of house price changes.

44. The data are reported in *Pulsenumics' "U.S. Housing Confidence Report"*, which started in 2014 and covers Atlanta, Boston, Chicago, Dallas, Denver, Detroit, Las Vegas, Los Angeles, Miami, Minneapolis, New York, Philadelphia, Phoenix, San Diego, San Jose, San Francisco, Seattle, St. Louis, Tampa, and Washington D.C.

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Appendix I: Review of the Literature

A basic problem is that the conceptualization of affordability is not derived from formal microeconomic theory and thus any index of affordability is ad hoc. A consequence is that the appropriateness of any index can be debated. For example, one question for many affordability indexes is what level of housing consumption should be set as a benchmark. Is it some minimal level of shelter, the average amount for a nation, or some arbitrary percentile of the distribution of housing quality?

ECONOMIC THEORY AND AFFORDABILITY CONCEPTS

Housing affordability indexes measure a set of market outcomes. However, unlike many market outcomes, housing affordability is not directly observed in the same way that prices or outputs are observed. Rather, it must be computed following a specific definition. An affordability index will typically have as components both aspects of the housing market (prices, annual expenditures, values) and aspects of the labor market (wages, incomes). Some of these aspects are the outcome of supply and demand interacting either in the labor market (wages) or the housing market (house prices). Other aspects depend on household decisions in either the labor market (the quantity of labor supplied and income earned) or the housing market (the quantity of housing consumed and housing expenditures). Depending on the specific affordability measure, the index also may include additional aspects of the economy (mortgage interest rates), household finances (asset levels), or the economic environment (the prevailing down payment requirement).

Housing affordability measures are at times interpreted as being closely related to the demand for housing but conceptually they are different. Housing demand is a formal theoretical concept. At the micro level it is the result of households maximizing utility subject to an income constraint. Similar to affordability, housing demand depends on house prices and household income. Housing demand also depends on a number of other factors such as the demographic characteristics of the household (age, number of children) and wealth, and aggregate housing demand

depends on the number of households and the distribution of household characteristics.⁴⁵

Similarly, the supply of housing is a formal theoretical concept, but again different than affordability. The supply of housing is derived from both the existing stock of dwellings and new construction. The stock of existing dwellings depends on past construction, and past and current maintenance and demolition decisions. The supply of new dwellings depends on the profit maximizing decisions of builders and on government regulations. Adding complexity to the supply side, a dwelling can be either rented or owner-occupied. Housing supply conditions affect affordability, but affordability is not measured by supply alone. In summary, housing affordability is ad hoc concept, and thus must be precisely defined. The justification for a particular definition should be made clear and its limitations noted.

When an affordability index is defined multiple decisions must be made with regard to its measurement. These decisions should be guided by the particular question that the index is designed to answer. For example, one might be interested in the affordability of new homes rather than the entire housing stock. Or the interest might be on the affordability of the existing housing stock to potential new homeowners. Different affordability measures would be appropriate for these different purposes. Housing affordability indexes can be created for various categories of housing. For example, dwellings may be separated by type: single family detached, multi-family attached (condominiums), and mobile homes, or by size of dwelling. The advantage of this separation is that it makes clear what the contribution is of each dwelling type to an overall index of affordability; otherwise, intertemporal changes in an aggregate index may be influenced by changes in the composition of dwelling types. However, if the purpose of the affordability index is to provide a measure for the entire housing market, then aggregation is appropriate.

45. The New Zealand Productivity Commission (2012) notes that housing demand is affected by population growth (natural and immigrant), the change in the number of households (which depends on the age structure and social factors such as marriage and divorce rates, and after-tax income).

The relationship between economic theory and affordability measures is highlighted in the analysis of Glaeser and Gyourko (2003). They contrast their measure of affordability with the class of “ratio” measures of affordability; typically, the ratio of a household’s housing expenditure to household income. They first argue that house prices are the appropriate measure, not housing expenditures. They next argue that affordability should not be measured by the ratio of house prices relative to income; rather, it should be measured as the ratio of house prices to housing construction costs. Their arguments are sound and well-grounded in economic theory. Focusing on the ratio of house prices to construction costs eliminates the dual role that other affordability measures have in that they are a function of both poverty (and thus the difficulty of paying for any good, including housing) and the cost of housing. Second, their index uses a measurable benchmark, the construction cost of dwellings.⁴⁶ Third, their index relies on measures of prices and costs, both being exogenous to household decisions. In contrast, the frequently used alternative components of affordability indexes, housing expenditures and household income, are both determined by household choices.

The endogeneity or exogeneity of the components of an affordability index is an important aspect of any definition of affordability. In general, one would prefer to measure affordability using criteria that cannot be influenced by a household’s decisions. For example, it is generally accepted that house prices are greater in New York City than in Columbus, OH. This statement holds no matter what decisions households in New York and Columbus make with regard to housing consumption. However, many affordability indexes are a function of choices made by households. The typical ratio of housing consumption to household income index depends on a household’s choice of both the amount of housing to consume and the amount of labor to supply. Holding income constant, whether the ratio of housing expenditures to income is greater in New York or Columbus is not theoretically predetermined; it depends on the price elasticity of demand for housing.⁴⁷ This occurs because housing expenditures depend on a household’s choice of housing quantity, given market prices, income,

and other household characteristics. If wages (rather than income) are held constant in the comparison of affordability in NYC and Columbus, then labor supply decisions also affect the values of the two affordability ratios. Most of the commonly cited measures of affordability use components that depend on households’ decisions, such as housing expenditures. One could specify an exogenous quantity of housing when creating an index, creating a measure of expenditures on housing by multiplying this quantity and the price level. However, an open question is what quantity of housing should be selected.⁴⁸

Housing costs include mortgage interest payments, maintenance costs, depreciation, property taxes, foregone earnings on the down payment, the transaction costs associated with buying and selling a property, and capital gains or losses.⁴⁹ Some of these costs are affected by federal, state, and local tax treatments of housing. Generally, the focus of the most used affordability indexes is on the mortgage payment, with the other costs being ignored. This exclusion is important as some of the non-mortgage costs vary over time and across space.

Although often ignored, the affordability of the down payment required for purchasing a house is relevant. This amount of the down payment depends on the level of house prices and on lender practices regarding the minimal or standard down payment percentage.⁵⁰ Gan and Hill (2009) define “purchase affordability”, this distinct from the standard concept which they designate “repayment affordability.” Purchase affordability measures whether a household is able to borrow “enough” funds to buy a home. Using data for Sydney, they find the two affordability measures substantially differed over the 1996–2006 period, with purchase affordability being greater during the housing boom. Purchase affordability should compare the minimal required down payment on an assumed house value (e.g. the median house price) with household wealth.⁵¹ Realistically, obtaining quarterly or annual household wealth data with spatial detail is difficult.

Another observation about some affordability measures is that most focus only on the initial cost of an owner-occupied dwelling or initial housing expenditure, ignoring

46. Their benchmark measure of construction costs excludes land costs. Housing prices differ from construction costs for multiple reasons. One is that housing’s price reflects the value of land and its attributes such as accessibility. Another reason for the difference between prices and construction costs is the overall state of the housing market such as the recent boom, which was generally considered to be a price bubble, and subsequent bust. For example, Wheaton and Nechayev (2008) argued that housing prices differed from their fundamental values during the housing boom of 1997-2006.

47. For example, if housing demand is very price elastic, households in Columbus could spend more on housing than comparable households in NYC. If median housing expenditures are used in an affordability measure then, counter intuitively, housing would be measured as more affordable in NYC.

48. Stone (2006a) discusses issues related to the measurement of “adequate” housing or a minimally acceptable level of housing.

49. A full specification of housing costs, appropriate for international comparisons, is in Bourassa et al. (2015).

50. Additional constraints on becoming a homeowner are discussed in Gabriel et al. (section 3.5, 2005).

51. Examples of studies that focus on the impact of down payment constraints include Linneman and Wachter (1989) and Haurin et al. (1997). Hendershott et al. (1997) show that there is a tradeoff between a larger down payment and smaller monthly mortgage payments and thus households can tradeoff these different types of affordability constraints.

the on-going flow of costs. The on-going costs include maintenance costs, utilities, and depreciation.⁵² Of note, there is a less recognition of the tradeoff between these two types of costs. For example, better insulation in a dwelling at the time of purchase would increase the purchase cost but reduce the flow of energy expenditures. Similarly, newer or higher quality appliances, roof, and exterior materials raise the initial price but reduce future maintenance costs. Standard affordability measures do not consider this tradeoff.

The New Zealand Productivity Commission (NZPC, 2012) notes that the rate of inflation has subtle effects on some of the affordability indexes. Coulson (2008) elaborates on this point by noting that fixed rate mortgages have level nominal payments for their term. Changes in the rate of expected inflation have two effects on affordability. One is that the nominal interest rate is directly related to the rate of inflation. Thus, increased expected inflation immediately increases the level of monthly payments while nominal income increases over an extended period of time. The result is that affordability indexes that measure only housing costs in the current time period will show reduced affordability. Another effect of inflation is due to the well-known effect that if inflation is expected then the stream of inflation adjusted mortgage payments “tilts,” resulting in declining real payments over the life of the loan. Thus, the greater the expected rate of inflation, the larger the tilt and the less affordable is housing at the initiation of the mortgage. However, over time the ratio of the fixed nominal payment to (presumably) increasing nominal income falls and thus affordability rises later in the mortgage term. Coulson argues that an inflation adjusted affordability index can be constructed using real instead of nominal interest rates. This version of an index would correct for the “overstatement” of mortgage payments; however, the usefulness of such an index would be limited.⁵³

FACTORS AFFECTING THE AFFORDABILITY OF OWNER-OCCUPIED HOUSING

Quality of Housing Stock

Linneman and Megbolugbe (1992) argue that unaffordable housing in the 1980s was caused, in part, by an improving quality of the stock of housing. The corresponding theoretical observation is that many affordability indexes do not control for housing quality. If the quality of housing improves and the price per unit of housing is relatively stable, the required expenditures for a dwelling rise. Affordability measures based on the ratio of median housing

expenditures to income will conclude that affordability has decreased, an incorrect conclusion.

Demographic Trends

Linneman and Megbolugbe (1992) also noted that demographic trends influence affordability. This is true in the aggregate as the rate of household formation influences the aggregate demand for dwellings and thus house prices. Household formation rates depend on society-wide factors such as immigration rates, the rates of marriage and divorce, birth rates, and households’ choices of living arrangements (youth home-leaving, doubling up of households, whether to live alone or in a group). Household formation also influences affordability at the household level; for example, consider two singles faced with the choice of whether to live together or separately. If they double up, household income is greater but housing cost likely does not rise proportionately, and thus the household is less likely to have an affordability problem as measured by most indexes. If they live separately, affordability measures also are affected because there are now two households rather than one, both more likely to have an affordability problem.

Mortgage Finance

Another factor affecting the affordability of owner-occupied dwellings is housing finance including issues such as underwriting standards, risk based pricing, down payment requirements, monthly payment options, the term of the mortgage, and whether the interest rate is fixed or adjustable. Linneman and Megbolugbe (1992) note that the structure of mortgages affects affordability. Examples include graduated payment mortgages, the amount of closing costs, and whether mortgage insurance is required. Caplin et al. (2007) note that in addition to government policies that attempt to address affordability issues, the private mortgage market was particularly innovative during the late 1990s through 2007 in terms of addressing affordability. Caplin et al.’s list of innovations included: 1) “Extending the loan term on fixed-rate mortgages from the traditional 30 years to 40;” 2) “Lowering early payment amounts by locking in teaser rates during the early years of the mortgage, with a later reset to a higher rate;” 3) “Allowing borrowers to pay just the interest (interest-only loans);” 4) “Allowing borrowers to pay even less than the interest (negatively amortizing or adjustable-rate option mortgages).” They assert that shared appreciation mortgages would address affordability issues if the tradeoff was a lowered interest rate in exchange for the allocation of expected house price appreciation to the lender.⁵⁴

52. Arguably, post-purchase house price changes are an on-going benefit or cost. This aspect of affordability is included in the user cost model.

53. One reason for the effect on affordability is that households cannot borrow against expected future increases in earnings.

54. However, given the history of house price changes after 2007, the likelihood of originating mortgages where house price changes are shared between borrower and lender appears to be relatively low.

Green and Shilling (1994) counter the above argument in one case — adjustable rate mortgages with teaser rates. They note that the typical partial equilibrium argument is that affordability is improved, at least in the short run, for those selecting this type of mortgage. But in a general equilibrium setting house prices likely increase, the extent of the increase depends on the elasticity of supply of housing in the locality. This increase in prices decreases affordability for all potential entrants to the ownership market.⁵⁵ In careful empirical work, using U.S. MSAs as the focus, they confirm their expectations. Teaser rates cause house prices to rise (presumably most in areas with an inelastic supply of housing) and higher house prices cause more borrowers to seek loans with teaser rates. They note that similar effects could occur for other government subsidies meant to increase affordability — they may have the opposite effect in localities with an inelastic supply of housing. Dokko et al. (2015) use county level data and compare the timing of house price increases with the use of alternative financing (such as loans rose increased early in the boom period, the first observed change was strong “fundamental” (such as income and population growth) causing house price to increase, followed by borrowers seeking alternative financing to make the more expensive houses affordable. In contrast, in counties that boomed later, the increase in prices and use of alternative mortgages was simultaneous. Bäckman and Lutz (2015) use data from Denmark and find there is a substantial positive impact of interest-only mortgages on house prices, this impact greater in supply inelastic housing markets.

Quercia, McCarthy, and Wachter’s (2003) list of “flexible underwriting guidelines” includes reduced down payments, and higher front-end and back-end ratios. They vary these constraints and determine the resulting variations in the percentage of constrained households, separating central city residents, low income households, and African American households from the full sample. They then combine these calculated changes in constraint variables with group-specific tenure choice estimations and predict the resulting change in ownership rates. As expected, in this partial equilibrium approach, reducing down payments from 20% to 5% combined with increasing the front end ratio from 28% to 33% is predicted to increase homeownership by about five percentage points for low income households and African Americans. Given that the experiment in this study is a nationwide change, general equilibrium effects would be expected; specifically, house prices would rise in areas where housing supply is inelastic. This change would offset, partly or fully, their predicted changes in ownership rates and thus the impact on increasing the affordability

55. Although not stated in the article, the price increase adds to the equity of current homeowners, relaxing the down payment constraint on the future purchase of homes (Stein 1995).

of owner-occupied housing is very likely overstated in this analysis.

The U.S. experience with this set of financial innovations that increased affordability is well-known, with the homeownership rate rising from 64.0% in 1994 to 69.0% in 2009. However, the subsequent negative consequences included the wave of foreclosures and other forms of early mortgage termination, costly governmental interventions, and the negative impact on the economy. The homeownership rate fell from its peak to 63.4 in 2015-Q2. The clear conclusion is that it is inappropriate to have a simple goal of increasing the affordability of owner-occupancy for all households when this increase is not sustainable.

McCord et al. (2011) study housing affordability in Northern Ireland pre and post housing boom. They argue that the deregulation of the mortgage market contributed to increased house prices and decreased affordability during the boom. Subsequently, house prices fell by 40 percent during 2008–2009. They argue that post boom, while falling house prices should have improved affordability, instead increased down payment requirements created a down payment (deposit) affordability problem; that is, many households aspiring to homeownership had insufficient wealth for a down payment. While they show that market LTVs decreased, they do not provide a measure of this type of affordability as it would require a measure of household wealth.

Government Regulation, the Supply of Housing, and Land Prices

In New Zealand, their Productivity Commission (2012) notes that land is a major component of housing costs in urban areas. Affordability will be negatively affected if land prices rise substantially. However, they argue that land is in relatively large supply in New Zealand relative to population, thus its price increases are due to supply side constraints, particularly in urban areas.⁵⁶ They identify one such constraint as being government targets to increase residential density. They also argue that a consequence of high land prices is that developers tend to build relatively large structures, and if the dwelling is designed as a detached single family residence, the result is relatively

56. The constraints in combination with geography influence the elasticity of supply of housing. Sanchez and Johansson (2011) present estimates of the supply elasticity in 21 developed countries. The most elastic supply is just above 2 (the average for the U.S.). It is at or below 0.5 in a dozen countries. In these countries, any substantial increase in demand for owner-occupancy results in notable increases in house prices and greater unaffordability according to most affordability indexes. Saiz (2010) presents estimates for locations within the U.S.

expensive package of structure and land.⁵⁷ Also affecting the supply side cost of residential dwellings is the level of technology in housing construction and regulations related to construction and materials used. NZPC argues that if land costs are high due to the regulation and limitation of the availability of land for new development, a solution is to change the policies that cause this limitation.⁵⁸ For example, they argue that regulation by New Zealand's major metropolitan areas councils desire to increase residential density "based on containment of the city, undermines the aspiration of affordable housing. An immediate release of land for residential development would ease supply constraints and reduce the pressure on prices."⁵⁹ They also note that these policies result in long development times for housing projects due to regulatory complexities.

Glaeser and Gyourko (2003) argue that their measure of housing affordability (house values divided by construction costs) is high in certain areas of the U.S. (mostly coastal areas) due to governmental regulation of land uses, such as zoning.⁶⁰ The price of a particular lot depends on the availability of substitute land and restrictions on the usage of the lot and its substitutes. Glaeser and Gyourko present evidence that supports their conclusion that the amount of regulation of land use is the key factor in the market valuation of a particular lot, especially in areas where house values are high. Substantial regulation of land results in higher land prices, a greater excess of house value over construction costs and thus less housing affordability.⁶¹ Hilber and Vermeulen (2010) similarly argue that restrictions on housing supply in the U.K. increase house prices and reduced housing affordability. Matlack and Vigdor (2008) consider the relationship of the distribution of income with housing affordability in both partial and general equilibrium models. Empirically, they find that recent gains in income at the high end of the distribution negatively impacts low income households through higher rents only in tight housing markets, ones with an inelastic housing supply.

Bogdon and Can (1997) suggest there are supply side measures of affordability; for example, the number of affordable housing units. However, units of all prices are affordable

given sufficient household income. One could create the distribution of housing size in a locality or of house values, but by itself this is not a measure of the affordability of housing. When combined with one of the criteria used in other affordability measures, such as the 25 or 30 percent metric for judging whether a household's income is sufficient to afford a particular dwelling, a distribution of house values in a locality can be converted into a distribution of resources needed by households that would result in the housing being affordable. This distribution could then be compared with the distribution of observed household incomes in the locality.⁶² There are multiple problems with this approach including the ad hoc nature of the 30 percent metric, the lack of consideration of the quality of housing in the stock, and the implicit assumptions that the housing stock is fixed and that households in this locality are geographically stable with no immigration or emigration.

Local Amenities

An important insight is by Fisher et al. (2010) who note that house prices reflect the market value of a bundle of characteristics of the dwelling, lot, and neighborhood. This conceptualization is the basis for hedonic price theory, which argues that a home's value is a function of the quantities of these characteristics and the implicit market prices of the characteristics. Thus, house values depend not only on dwelling characteristics, but also on the amount of capitalization of the value of local (dis)amenities. In particular, they note that accessibility to jobs, school quality, and local crime rates have often been found to have large effects on the valuation of dwellings. They raise the conceptual question of what should an affordability index measure: the affordability of the property including the value of the associated bundle of amenities or the affordability of the property stripped of amenity values. This question is similar to observations made above that the use of median house prices in affordability indexes does not hold the quantity of the property constant. For example, consider two identical properties in adjacent school jurisdictions, one with high quality schools compared to the other jurisdiction. In general, higher quality schools will be capitalized into higher house prices (Brasington and Haurin 2006), appearing to make that jurisdiction's housing less affordable. However, the complete bundle of characteristics of the two dwellings is not equivalent.

Fisher et al. (2010) first estimate the implicit prices of important amenities in the Boston metropolitan area using a hedonic price model. Next they multiply these prices by the quantities of amenities in each jurisdiction thus creating a measure of the value of the jurisdiction's amenities, and they then adjust their measure of house values to create a constant-amenity housing cost. This value is then used

57. Economic theory suggests that developers will substitute other inputs for expensive land, particularly capital. One outcome is multistory buildings with rental units or condominiums. If the dwelling is detached single family, the developer would reduce lot size relative to the amount of structure. A theory of house quality filtering dating back to Sweeney (1974) argues that new construction will occur primarily at the top of the house quality distribution because filtering is the most efficient way to "create" low quality housing, not new construction.

58. A similar argument is made by Abelson (2009) for Australia.

59. New Zealand Productivity Commission (2012), p. 10.

60. Linneman and Megbolugbe (1992) note that government regulations include levying impact fees on developers.

61. See also Glaeser, et al. 2008; Gyourko (2009), and Gyourko, et al. (2008).

62. Bogdon and Can (1997) call this approach the "Housing Affordability Mismatch".

in their affordability index, which is the percentage of dwellings in a jurisdiction that are structurally sound and affordable.⁶³ Empirically, they find that the unadjusted and adjusted affordability rankings of jurisdictions differ in meaningful ways. Conceptually, the authors make multiple points: 1) standard measures of affordability conflate the value of a property with the value of the associated locational amenities; 2) properties deemed to be affordable may be so due to high crime levels, poor quality schools and low access to employment; and 3) public policies that require the development of affordable dwellings should account for spatial differences in the values of amenities in setting their definitions of “affordable”. It should be noted that while conceptually well-founded, this type of adjustment to an affordability index would be difficult at a national level, primarily due to data limitations.

Tax Policies

The tax policies of a country affect the affordability of housing. The mechanisms are as numerous as the number of tax policies. Given that national tax policies affect the entire housing market, general equilibrium effects are expected. Bourassa et al. (2013) review the literature about the effects of the mortgage interest deduction, using an international perspective. One finding in this literature is that in supply inelastic localities a subsidy for homeownership, such as the mortgage interest deduction, may raise house prices substantially. Thus, although the direct effect of the mortgage interest subsidy is to increase the affordability of owner-occupation, the indirect effect on raising house prices reduces the affordability of homeownership.⁶⁴ Countless other national, regional, and local policies also affect house prices (and household income) and thus affect affordability. A full review of these policies is beyond the scope of this paper.

Aggregation

Once an affordability index is selected, an additional issue arises: how to measure the extent of aggregate affordability in the housing market. Chaplin and Freeman (1999) argue that two of the most used affordability measures are flawed in that they cannot be aggregated in a meaningful way. Consider the index that measures housing affordability based on the ratio of housing expenditures to household income with an ad hoc maximal ratio set at 0.3 as the measure of affordability. The two standard methods of describing the state of aggregate housing affordability are the headcount of households with a ratio greater than 0.3 and the average value of the ratio for the population. Chaplin and Freeman’s criticism is based on three normative properties they argue an aggregate measure should display. They first adopt Foster et al.’s (1984) three normative principles that should be met by an aggregate measure of poverty. In that application the properties are, *ceteris paribus*: 1) a reduction in the income of any poor household increases the poverty measure, 2) a transfer of income between two poor households, from a poorer to a richer one, increases the poverty measure, 3) a transfer of income between two poor households, from a poorer to a richer one, increases the poverty measure but the rate of increase is smaller the higher the initial incomes of the two households. They apply this framework to the ratio specification of the affordability index. They find that the ratio measure of affordability does not satisfy the three conditions. They then modify the poverty index proposed by Foster (1984) and define a new aggregate measure of affordability as $F(\alpha) = [\sum (g_i / z)^\alpha] / n$, where $\alpha > 2$. Here, the greater is α , the greater is the “concern for the depth” of a household’s affordability problem, z is the ad hoc affordability criterion such as 0.3, and n is the total number of households. The remaining term is g , which is defined as $|z - y_i|$ if $y_i > z$, else it is 0; where y_i is the housing expenditure to income ratio for the i -th household.⁶⁵ Of note, the previously mentioned flaws in the ratio index of affordability will carry over to this aggregate measure; however, the statement of normative criteria for aggregate index is interesting.

63. An affordable dwelling is defined as a housing-expenditure-to-income ratio of less than 30%.

64. See Hilber and Turner (2014) for a careful analysis of the general equilibrium effects of the U.S. mortgage interest deduction.

65. That is, the summation is over only those households with ratios above 0.3.

Appendix II: Comparison of the Residual Income Approach with the Housing Expenditure-to-Income Ratio Approach

Hancock (1993) was among the first to theoretically compare a variant of the residual income measures to housing expenditure ratio measures. He concludes that ratio measure is flawed, the reason being that it is possible for individuals to be “consuming less than the socially-acceptable minimum standards of consumption of both housing and other goods” and for their housing costs still to be considered affordable. Hancock also criticizes the residual income approach in that some households could have inadequate housing (externally defined), but they could afford an adequate amount and have sufficient residual income to purchase non-housing goods (“can pay, won’t pay”).⁶⁶

Thalmann (2003) presents a simple way to compare the housing cost to income ratio index and the residual income index.⁶⁷ A generalization is to first define observed housing expenditures for household i in location j as H_{ij} , income as Y_{ij} , and nonhousing expenditures as X_{ij} . Next define the minimum acceptable nonhousing expenditure as X_{ij}^* . The residual income index indicates housing is unaffordable if its residual income (income less housing expenses) is less than the ad hoc standard; that is, if $(Y_{ij} - H_{ij}) < X_{ij}^*$. Rearranging, housing is unaffordable if $H_{ij} > (Y_{ij} - X_{ij}^*)$. Alternatively, an affordability index based on income ratios assumes that the target nonhousing expenditure is a percentage α^* ($= X_{ij}^*/Y_{ij}$) of income and thus housing is unaffordable if $H_{ij} > (1 - \alpha^*) Y_{ij}$. Clearly these two concepts are related and are effectively the same if α^* is defined appropriately.

In these formulations, affordability is defined in terms of expenditures on housing and nonhousing goods. Greater precision and clarity can be attained if expenditures are stated in terms of prices and quantities. It is reasonable that the minimum nonhousing consumption is defined in terms of the **quantity** of nonhousing consumption, x_i^* .⁶⁸ Its price, p_{x_i} , varies across locations (the generalization to variations across time is straightforward). Similarly, the focal concern should be on the quantity of housing, h_{ij} , not expenditures, which depend on house price, p_{h_j} .⁶⁹ Define the minimal acceptable level of housing quantity as h_i^* . Then the residual income approach can be rewritten as identifying housing as unaffordable when

$$p_{h_j} (h_{ij} - h_i^*) > Y_{ij} - (p_{x_i} x_i^* + p_{h_j} h_i^*) = Y_{ij} - Z_{ij}$$

where $Z_{ij} = p_{x_i} x_i^* + p_{h_j} h_i^*$, which is a good representation of the poverty level for a household of type i in location j . Note that if a household’s income is above the poverty line, then it could still be judged by this criterion to be in unaffordable housing if it voluntarily selected a housing quantity that was sufficiently larger than the exogenously defined minimal standard quantity (h^*). If a household’s income is below the poverty line, then if it selected a sufficiently small housing quantity ($h_{ij} < h_i^*$), then it too could be judged to live in affordable housing. Both of these cases are misclassifications. Similarly, affordability indexes based on ratios of housing expenditures to income yield misclassifications.

66. A thorough descriptive comparison of the ratio and residual income methods is in Gabriel et al. (2005). See also Moto (2015) for their comparison of these indexes.

67. Thalmann (2003) also details the various misclassifications of households that occur when using the ratio form of affordability index, such as classifying a household that chooses to spend a very high percentage of income on housing as a result of choosing a very large quantity of housing as living in unaffordable housing.

68. Both x and h are allowed to vary with family size and other characteristics of a household.

69. A further generalization would allow house price to vary among households within a locality due to the same factors that cause the user cost of housing to vary over households.

The suggestion from the above analysis is that neither of these affordability measures is appropriate. What is required is recognition of which variables are subject to household choices, which ones must be exogenously defined, and what criteria are to be used to measure affordability. Household choices include the quantity of housing, the quantity of nonhousing goods, and the quantity of labor supplied to the market. All are determined by the same utility maximizing process, thus none has precedence over the others. That is, the residual income approach also should discuss whether nonhousing goods are affordable. Given that income plays an equal role in these affordability measures, it is equally sensible to be concerned with whether wages are sufficient to permit affordable housing consumption.

An ideal affordability measure should be independent of household choices; that is, it should depend only on exogenous prices and administratively specified amounts of consumption and labor supply. These administrative choices are ad hoc, but they are embedded in these forms of affordability measures. As noted above, x_i^* and h_i^* can be viewed as the key components of a definition of the poverty line, which is widely discussed. However, in the housing affordability literature there has been very little attention paid to the standards for labor supply. Rather, all of the above studies take household income as given even though it is recognized that household labor is supplied elastically to the market.

A recent empirical comparison of affordability using the expenditures ratio and residual income approaches is contained in Moto (2015). They show that for homeowners, the measures yield much different answers about the percentage of households who are “housing cost burdened” during the 2005–2014 period. Using the ratio method, the result is 25–30 percent of households are burdened, while using the residual income method, only 10 percent are, this difference due to the relatively small amount of residual income required in their measure.⁷⁰

70. They also present measures of affordability by income and household head’s age group in their appendix.

Appendix III: Data Issues

For an affordability index to be widely used, it should have particular attributes. An obvious key characteristic is that the required data must be readily available. A second characteristic is that the index should be relatively easy to compute and be replicable. A third characteristic is that the index should be easily interpreted and intuitive. Also, the index also should be available for an extended period of time and for various geographic areas.

In the U.S., house price information is readily available at many geographic levels. The frequently used price index developed by the Federal Housing Finance Authority (FHFA, 2013) has limitations (Leventis 2008) but is based on the well-known and generally accepted repeat sales price methodology. One major limitation of FHFA data is that the time series of prices for the nation, regions, states, and MSAs are not cross-sectionally comparable. However, this limitation can be addressed using the hedonic price method to establish constant-quality house price measures in various geographies.⁷¹ Then the FHFA time series can be applied to this cross-sectional price index.⁷² Alternative price indexes are available including the S&P/Case-Shiller index and many proprietary indexes.

Affordability indexes often use median price as an alternative to a constant-quality measure of house price. This measure is readily available, but differs from a constant-quality price measure. Specifically, what is referred to as the median house price is almost always measured as the median expenditure on a house. Expenditures equal the price per unit of housing multiplied by the quantity of housing. Thus changes in the median expenditure occur for two reasons: changes in the underlying price per unit of housing and changes in the quantity of housing. As a consequence the frequently reported time series of median house “prices” reflects both changes in house prices and changes in quantity. It is well-known that in the U.S. house

sizes increased from the 1960s at least through 2006. The result is that the time series of the reported median price of owner-occupied housing overstated the change in the median price for a constant amount of housing, and it is the latter that is conceptually more desirable. Hendershott and Thibodeau (1990) found that the National Association of Realtors’ median house price measure overstated the increase in constant-quality house prices by about two percent per year over 1976–1985. Placed on top of this long term trend of increased dwelling sizes (through 2006) is the housing cycle where house sizes expand during a boom and thus push the median house price up and they shrink during a bust, pushing median sizes down.⁷³ This same defect in median prices applies to cross-sectional comparisons, as differences in the benchmark quantity of housing across geographies are not controlled.⁷⁴

Another important component of most affordability indexes is a measure of household income. Gyourko and Linneman (1993) note that housing can remain affordable if real house prices rise if real incomes rise proportionately.⁷⁵ There has been less concern in the literature with the use of median household income than median house prices, although its use has similar problems. One is that the skill set of households change over time, but there has been no interest in measuring income for a “constant-skill level” household. Second, income is the product of a wage rate and hours worked, the later a household choice variable. As an alternative to income, one could use the wage rate, but this approach has been used rarely in the literature. Third, household size has changed over time and varies across space, but there has been little interest in developing a housing affordability measure based on per capita income. Fourth, there are differences between family income and household income (both are based on census definitions), but most frequently household income is used in constructing affordability indexes.

71. A constant-quality index tracks the price of a property or set of properties with the same characteristics over time or across space. Quality could be set at any level, but often it is set at the median or mean values of house characteristics (for example, a three bedroom, 2,000 square foot dwelling). The hedonic price method is a well-known method for estimating the implicit prices of house and neighborhood characteristics. These prices can then be applied to the selected set of constant-quality attributes to obtain an estimated valuation of the asset price of an owner-occupied dwelling.

72. Various data sources could be used for the cross-sectional analysis such as American Community Survey PUMs data or American Housing Survey data.

73. Another caveat is that the observed median price of recently sold housing (new and/or existing) is not necessarily the same as the median price of the stock of housing. The reason is that which houses are selected to be sold varies across time and the housing cycle (see Gatzlaff and Haurin 1997, 1998).

74. The use of the median rather than the mean is not necessarily a problem; the problem is the contamination of the measure of price with changes in the quantity of housing consumed.

75. Measurement issues related to house prices, household income, interest rates and other inputs to affordability measures are discussed in Linneman and Megbolugbe (1992).

Constructing an index of affordability related to the down payment constraint requires that the down payment requirement be a well-defined percentage of the loan amount; however, this has not been fulfilled in recent U.S. history. Instead, the down payment requirement has varied over time and across lenders and programs.⁷⁶ This variation poses a significant issue for developing the so-called home purchase affordability index (Gan and Hill, 2009) and it is an issue for the NAR HAI. One option is to specify a fixed and time invariant down payment requirement. Another option is to report a set of measures, each based on a specific down payment percentage. A final option is an affordability index with a time varying down payment requirement. Examples include an index based on either the average down payment made at that time, or one based on the minimal down payment available from a federal program or Government Sponsored Enterprise (GSE).

Measuring affordability related to the down payment constraint also requires data on household asset levels. Asset data are difficult to obtain, especially if the data must be frequently updated over time and are required for small geographies. The Survey of Consumer Finances is administered too infrequently and reports only at regional geographies. National surveys of households such as the Panel Study of Income Dynamics (PSID) and National Longitudinal Study of Youth (NLSY) are made public with relatively long lags of over a year, and while detailed asset information is available, the sample sizes are relatively small. Overall, the use of household net wealth in a timely affordability index is of doubtful feasibility at this time. However, household net asset levels are clearly an important variable in the tenure choice decisions of households and a broad conceptualization of the affordability of owner-occupancy should not ignore the importance of asset levels.

Regarding the variables measuring the flow costs of housing, data availability is not an issue for mortgage interest rates. Rather, the issue is that there is substantial heterogeneity in mortgage types and household risk characteristics. Given that the interest rates vary among mortgage types (e.g., adjustable versus fixed rates), a choice must be made of which one is used for the affordability index or multiple indexes can be created. At the household level, mortgage interest rates vary because differences in household credit histories. Typically an average interest rate is used; however, the credit characteristics of borrowers may change over time or differ across space and thus the average interest rate may not be relevant for a “constant-risk” borrower. It is feasible to consider specifying a simple summary of riskiness, such as the household’s credit score, and measuring the interest rate for that level of credit quality. And similar to the issue of considering affordability for low-income households, it is reasonable to consider measuring the affordability of housing for households anywhere in the distribution of credit quality.

Data availability is an issue for some of the components of user costs such as maintenance, depreciation, property taxes, and transaction costs. As a result, they are sometimes assumed constant over time and space or measured crudely. While they theoretically affect the affordability of owner-occupancy, in practice they impact affordability measures only slightly. The exception is the tax treatment of housing, a topic that has been the focus of many studies.⁷⁷ Intertemporal variations in federal income tax codes have clearly had an impact on the cost of homeownership (Folain and Ling 1991; Bourassa and Grigsby 2000), but these variations are ignored in most measures of affordability.

76. See Haurin et al. (2007) for a review of changes in required down payments and Federal programs.

77. For a summary of papers analyzing the tax treatment of owner-occupied housing see Bourassa et al. (2013), where the focus is on the mortgage interest deduction.

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