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Markets where buyers also are sellers

How realized home equity may work as an accelerator of house prices

Abstract:
The house price level is a function of buyers' realized home equity, and buyers' realized home equity is a function of the house price level. This interdependence follows from the fact that buyers are sellers in the same market. This article examines under what conditions this leads to a possible upward-sloping demand curve with a potentially unstable equilibrium. I employ a parsimonious model with two kinds of buyers, and utilize an augmented Slusky-equation that decomposes Walrasian demand into a substitution, an income, and an endowment income effect. The model demonstrates that instability may occur if first-time buyers' demand is sufficiently inelastic, leverage is stretched, debt-financing is common, and nth-time buyers are relatively more frequent than first-time buyers. Regulation on leverage and a capital gains tax reduce the likelihood of upward-sloping demand. The article utilizes new data from Norway to examine an empirical indicator of an equity accelerator of house prices and finds that over the period 2000-2008 the value of all housing transactions exceeded the aggregate net growth of mortgages by 50%, indicating substantial equity financing. In one year, 2008, the value of aggregate housing transactions was double the growth in net mortgages.

Keywords: capital gains, consumer behavior, endowment income, feedback system, financial acceleration, home equity, housing, instability, interdependence

JEL classification: D03, D10, D53, E21, E44, G12, R21, R31

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Introduction

In the housing market, a buyer typically finances a part of the new purchase with the realized equity from the sale of the old house. This makes his bid function dependent on the house price level since a higher price level gives him more equity. But higher bids tend to increase the price level, so the price level is also dependent upon buyers' bid functions. In short, the house price level is a function of realized home equity and realized home equity is a function of the house price level. When this is the case, the market clearing condition becomes inter-dependent, so that demand is a function of supply. This makes house markets where buyers simultaneously are sellers different from good markets where buyers and sellers are different agents; a point Sinai and Souleles (2009) note in their analysis of house hedging and a market feature central to Wheaton's (1990) model of vacancy rates in the housing market. In fact, markets where buyers also are sellers may encounter that strange phenomenon known as an upward-sloping demand curve. Dusansky and Koc (2007) construct a model where upward-sloping demand curve results from price expectations. Stein (1995) examines a model with down payment requirements and show that this generates self-reinforcing effects, where house prices affect down payments, which in turn affect housing demand and then subsequently house prices again. This article uses a different approach and focuses attention on the role played by realized home equity and explores whether a model without price expectations and with no down payment requirements, but with two types of agents where one type leverage home equity, still can generate an upward-sloping demand curve and self-reinforcing house price spirals. In short, I ask whether realized home equity may play a role in creating an unstable house price equilibrium.

It turns out that the upward-sloping demand and unstable equilibrium may occur under certain conditions which can be derived from a parsimonious model using first-principles that start with an augmented Slutsky equation. The intuition is that the bid a given buyer is willing to make is higher (lower) the larger (smaller) his realized home equity is, and realized home equity is higher (lower) the higher (lower) other buyers' bids are. Thus, bids are interdependent through realized equity and this article examines the instability it may generate. The model demonstrates that it is possible that realized home equity can function as an accelerator, a consumer variety of the accelerator mechanism Bernanke et al. (1998) described early; a system that involved endogenous developments in credit markets that amplified shocks. Recently, Krugman (2008) has studied another accelerator effect, which he called a multiplier effect, on asset prices of leveraged investors with preferences over the degree of leverage, using ideas floated by Calvo (1998) and Kaminsky et al. (2003). This article studies a similar mechanism in the housing market; where one type of buyer only buys and another type both sells and buys, and the latter may demand more housing when house prices increase.

The model shows that unstable conditions are more likely to occur when demand from the first-time buyer is highly inelastic, when leverage is stretched, debt-financing is common, and nth time buyers are relatively more frequent than first-time buyers. At first blush, such findings are not easily reconciled with classical consumer theory since higher prices usually decrease demand. However, the apparent contradiction between consumer theory and upward-sloping demand occurs because housing is both a consumption good and an investment asset; i.e. buyers are also sellers, which is not the case for standard consumption goods. The augmented Slutsky-equation contains a third term, realized equity arising from owning an object, i.e. an endowment, and the effect of the third term may bridge consumer theory with observations of increasing demand from increasing prices.

Economists have known for some time that markets where buyers also are sellers are different from markets where demand and supply are separated and consist of different agents. Inter-dependent aggregate demand and supply lie at the core for Keynes' rejection of Say's Law, the dictum that supply would create its own market. In labor research, many studies have examined how workers respond to a change in the hourly wage; an increase makes leisure more expensive but also income higher. The traditional income and substitution effect is supplemented by an endowment income effect. In the housing market, similar mechanisms are at work since rising prices makes it more expensive to acquire a house but increases the equity of home-owners. But the analysis of demand for leisure from a given time endowment of 24 hours per day that can only be divided into labor or leisure does not obviously cover all aspects of the somewhat different situation in the housing market. First, leverage does not play the same role. Granted, in the housing market, consumers may be thought of as buying their own house in every period similar to how laborers buy leisure time from themselves in every period. But in the housing market, consumers can also sell an object to another party, realize equity, leverage, and purchase another object. Second, in the labor market one obtains a new set of 24 hours per day in every period, so the sum total of time sold to an employer and time sold to oneself as leisure sum to 24 hours. In each period, the agent is a net seller of hours. In the housing market, there is no such constraint and the agent may demand more than the initial endowment. Third, a house is a bundled good since it is both a consumption good and an investment asset, and this is a challenge for constructing the relevant price concept. The price of leisure is transparent, namely the hourly wage. But the price of housing is non-trivial, since the user price comprises both capital gains, i.e. returns to an investment, and consumption cost, i.e. maintenance cost and interest payments. This user price of housing may even become negative, and entail infinite demand, where theory is incomplete and unexplored, see Deaton and Muellbauer (1980, p. 349). In short, there is a need to examine the market conditions of demand and supply in the housing market when sellers are buyers.

It is, at least theoretically, possible that the substitution and income effect are dominated by an endowment income effect. If so, the demand curve for nth time buyers would be up-ward sloping, a point Krugman (2008) makes in an analysis of how leveraged investors who own a given asset may demand *more* of the asset when the asset price rises. Similarly, it is fathomable that an initial increase in the house price level may propagate with momentum through many rounds since the initial rise leaves some sellers with more equity, which in turn makes it possible for them to increase their bids when they purchase, which again leaves other sellers with more equity – and the rounds may continue, as Akerlof and Shiller (2009, p. 136 and 154) suggest. Sommervoll et al. (2009) demonstrate how house prices may fluctuate endogenously, given unchanged labor income and interest levels, in a simulation with plausible assumptions. Dusansky and Koc turn to data and find that in Florida increases in housing prices actually increased the demand for owner-occupied housing services.

My contribution contains four new elements. First, I use a simple housing market model to demonstrate at equilibrium instability does not necessarily depend upon price expectations; it is sufficient that buyers who also are sellers use realized home equity towards the new purchase. This model differs from others in simplicity and transparency since Dusansky and Koc constructs a more elaborate model with expectations and Stein uses a more detailed model without renters but with loan limits. Second, I show that for important short-term analysis of the aggregate market effects it may be sufficient to use demand and supply schedules derived from an augmented Slutsky equation without explicit utility function specification and closed-form solutions to inter-temporal optimization programs. Third, I find that market instability depends upon home equity usage, leverage, debt levels, absence of taxation, and relative frequency of first-time and nth-time buyers. Fourth, I identify empirical data consistent with the model and establish an equity effect statistic that consists of the ratio of total value of transactions to growth in new mortgages. For one year, 2008, the total value of transactions was double the growth in mortgages, while over the period 2000-2008 the ratio was 1.5, indicative of home equity financing of housing transactions.

This article, then, attempts to bridge the short-fall in the literature on the interaction between two types of agents, one with and one without home equity. The analysis shows that the importance of an assumption made early by Hildenbrand (1983, pp 998-999): “The distribution of individual expenditure of a group of individuals, is assumed to be independent of the price system…" This article shows that for housing the use of equity *is* dependent on the price system. There are similarities between this under-communicated endowment income effect in housing and the well-known endowment income effect in labor. Notice the motivation Becker (1965, p. 496) gives in his seminal article on time allocation: "The integration of production and consumption is at odds with the tendency for economists to separate them sharply, production occurring in firms and consumption in households." This article inspects exactly such an interaction between supply and demand and derives the general conditions that allow the possibility Dusansky and Koc (op.cit., p. 291) mention: "…it is entirely possible that the housing demand curve can be upward sloping."

In the next section, I present the underlying theory and the model. The subsequent section presents the resulting comparative statics of the housing market. In section four, I substantiate the existence of an equity accelerator by inspecting aggregate mortgage generation and sales data on consumer behavior. The fifth section discusses the absence of expectations. The final section concludes and discusses the political implications. In the appendix, I demonstrate how the budget line, well-known from textbooks, after a price change need not pivot around the initial bundle, but may change position also. The appendix also contains a description of my data sources.

Theory

In order obtain the broadest range of results, I make a minimum of assumptions on preferences and inter-temporal behavior. This is achieved by constructing a parsimonious model of demand and supply schedules that allow comparative statics around the short-term equilibrium of price and quantity in the housing market. I focus attention on analyzing the relative slopes of supply and demand in order to derive the conditions for equilibrium instability: an upward-sloping demand schedule where the supply curve is steeper. I do this to examine the conditions for destabilizing price spirals and it is sufficient for this purpose to derive Taylor approximations of housing demand from two types of agents using a fully specified augmented Slutsky equation, which is an extension of the Slutsky-equation suggested in Dusansky and Koc (op.cit., p. 291). They choose, in stead of an explicit utility-function specification, to describe general features of the underlying preference structure. This approach is less restrictive than Stein (op.cit., p. 386) who employs a utility function of Cobb-Douglas form where utility is additive in the logarithm of food and the logarithm of housing size and a binary variable describing ability to move.

Starting from a Slutsky-equation allows us to construct a simple model from first-principles yet retain a flexible form which is consistent with a set-up where agents are utility optimizers who optimize utility streams over the life-cycle given subjective discount factors and inter-temporal budget constraints. Still, in this model, consumer behavior need not be constrained full-information, complete-computation optimization as it may be compatible with behavioral rules-of-thumb. Nevertheless, underlying my model and the Slutsky-equation is consumer theory's basic idea that utility is extracted from time pairs of housing consumption and other consumption with a degree of smoothing.

Assume there are two types of consumers, a first-time home buyer and an nth-time buyer, who is also a seller. The important dichotomy is between buyers who do not own a home and buyers who do, so the essence of the term "nth-time buyer" is that the agent owns a home. There exists a rental market from and to which agents may exit and enter. The agents buy and hold one object at the time, so they experience the conventional substitution and income effect from price increases, but the model could easily be extended to cover also a third type who makes investment-purchases. Assume there are a number α of type *A* and a number *β* of type *B*. In the short-run supply is given, although the assumption will be relaxed in a refinement below. The Walrasian demand function, *Wa*, for a first-time buyer can be derived, as is convention in consumer theory, from the duality observation that Walrasian demand equals Hicksian demand, *Hi*, when the income level, I, in the former is equal to the solution to the cost-minimization problem for a given utility level, *U*: $Wa_h\left(p,h,I=c\left(p,h,U\right)\right)=Hi_h\left(p,h,U\right)$, where *p* is the price of other consumption, *h* is the price of housing, *U* is the utility level, and *c* is the solution function of cost-minimization. By partial differentiation with respect to the unit price of housing, *h*, and rearranging, we obtain the housing Slutsky-equation for first-time buyers:

(1) $$\frac{\partial Wa_h^A}{\partial h}=\frac{\partial Hi_h^A}{\partial h}-\frac{\partial Wa_h^A}{\partial I}\frac{\partial c}{\partial h},$$

where *Wa* is Walrasian demand, *Hi* Hicksian demand, the subscript h denotes housing, and the superscript *A* refers to the first-time buyer type. The first component on the right hand side is the substitution effect and the second the income effect from a partial house price change. Both components of this direct Cournot derivative are negative for housing, so the sum of the right-hand side is negative and Walrasian demand for a first-time buyer slopes downwards. Nth time buyers, who also are sellers, have a different structure in their demand due to the endowment income effect. For these agents, realized equity *E*(*h*), which is a function of the house price, adds to income and extends the budget. Thus, an increase of one monetary unit of realized equity allows a decrease of one monetary unit from income such that it is still possible to satisfy maintenance of a given utility level.[1] In other words, $Wa_h^B\left(p,h,I+E(h)=c\left(p,h,U\right)\right)=Hi_h^B\left(p,h,U\right)$. Implicitly, $I=c\left(p,h,U\right)-E(h)$. Partial differentiation with respect to house price, h, yields

(2) $$\frac{\partial Wa_h^B}{\partial h}+\frac{\partial Wa_h^B}{\partial I}\frac{\partial I}{\partial c}\frac{\partial c}{\partial h}+\frac{\partial Wa_h^B}{\partial I}\frac{\partial I}{\partial E}\frac{\partial E}{\partial h}=\frac{\partial Hi_h^B}{\partial h},$$

which, when re-arranged, becomes:

(3) $$\frac{\partial Wa_h^B}{\partial h}=\frac{\partial Hi_h^B}{\partial h}-\frac{\partial Wa_h^B}{\partial I}\frac{\partial c}{\partial h}+\frac{\partial Wa_h^B}{\partial I}\frac{\partial E}{\partial h},$$

where the subscript *B* indicates that the agent is both a seller and a buyer. The first and second components on the right-hand side are the substitution and income effect and the third component is the endowment income effect from realized home equity. The first two are negative, but the third is positive when housing is a normal good. I show in an appendix how the budget line in a 2-good 2-period set-up may both pivot around the initial endowment or be repositioned. For the purpose of this article it suffices to note that the third effect is key and that; depending on preferences, leverage possibilities, and credit constraints; it may be larger in absolute value than the combined first and second effect. Notice how this realized home equity effect differs crucially from expectations effects in other models, e.g. in the Dusansky and Koc model. If expectations of future price increases are sufficiently strong, the expected user price becomes negative, demand infinite, and only credit constraints limit demand. My model utilizes only the endowment income effect from realized equity and does not rely on expectations for results to go through.

In order to establish a demand schedule, I use a first-order Taylor approximation of the Walrasian demand of the first-time buyer implicitly defined by its derivative from equation (1), and so it is given by:

(4) $$n^A(h)=a-bh,$$

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[1] Too see this, keep in mind that while the first-time buyer's utility maximization constraint is $pO+hH=I$, the nth time buyer's constraint is $pO+hH=I+E(h)$, where the new right-side income equals ordinary income, *I*, plus realized home equity, *E*(*h*). The ordinary income necessary to keep utility level *U* will be reduced unit by unit by increased equity.

where $n^A(h)$ is a first-time buyer's demand for a number of square meters of housing. Equation (4) is the inverse of a standard price-quantity relationship, and may be written $h = (a/b) - (1/b)n^A$. Equation (4) could be made more realistic by including shift parameters. This would allow examination of interesting shocks to demand by changes in income, employment, or demographic composition. However, to keep the model parsimonious, I suppress shifters. Aggregation over α first-time buyer yields an aggregate demand curve for first-time buyers:

$$(5) \qquad N^A(h) = \alpha a - \alpha bh,$$

where capital letters indicate aggregate demand. If written with price as the dependent variable, demand becomes $h = a/b - (1/\alpha b)N^A$. The key ingredient in the model is the *n*th-time buyer, who also sells, and obtains realized home equity given by equation (6):

$$(6) \qquad E = hn^{B0} - D^B,$$

in which the variable n^{B0} is the original number of square meters purchased by the *n*th-time buyer in the earlier period, $n-1$, and D^B is the current debt, which may be smaller (after partial amortization) than, or equal to (if no amortization), the original debt, D^{B0}, that originated upon acquisition. Agents of type B use a proportion of realized home equity towards purchase of a new home. This proportion may be smaller than, equal to, or greater than unity. Ultimately, it is an empirical question what consumers do. The latter would be possible if a bank allows more absolute debt given the increase in equity (e.g. in order to maintain the leverage ratio of debt to equity). Thus, the difference between current value of the home and the rest of the principal of the debt is realized home equity, i.e. different from capital gains by the amount of amortization of the mortgage. Then, the number of square meters demanded by the nth-time buyer is given by equation (7):

$$(7) \qquad n^B = c - dh + \lambda\left[\frac{hn^{B0} - D^B}{h}\right],$$

where the λ is the proportion of home equity used in the demand for a new home. If λ is larger than unity the conventional term is leverage. I allow nth-time buyers to respond to prices by computing the augmented Slusky-equation, for which equation (7) is a first-order Taylor approximation, cast as a function of price h. *N*th-time buyers may experience substitution and income effects equal to those of first-time buyers $((a,b) = (c,d))$ or different from those of first-time buyers $((a,b) \neq (c,d))$. The last component of equation (7) is the essential difference between demand from first-time buyers and *n*th-time buyers, and comprises how many square meters the realized home equity can purchase, arising with the appreciation of the initial housing endowment through prices *h*. That the nth-time buyer uses a factor, λ, of realized home equity, is a model feature that is shared with the accelerator effect suggested by Krugman (2008). When $\lambda = 1$ then all the realized home equity, $hn^{B0} - D^{B}$ is used to purchase a new home with no additional debt. When $\lambda < 1$ the nth-time buyer only uses a part of his realized home equity to purchase more housing. The market clearing condition is given in equation (8) by aggregating demand from α first-time buyers and β nth time buyers.

(8) $$N^{*} = \alpha n^{A} + \beta n^{B},$$

in which total available supply of housing area, N^{*}, is for now assumed given in the short-run and where aggregate demand from β nth time buyers follows from equation (7). This assumption will be relaxed below. Equations (4), (7), and (8) are three equations in three endogenous variables, n^{A}, n^{B}, and *h*. However, the capital gains effect in the last term of equation (7) involves the inverse of variable *h*, 1/*h*, and so the system is non-linear. For our purpose, however, the algebraic closed-form solution of price-quantity equilibrium is non-essential. What this article seeks is the conditions describing the short-term comparative statics around equilibrium, i.e. whether the demand curve may be upward-sloping. In other words, we seek to establish the derivatives of the demand and supply schedules. To that end, let us re-write equation (8), and note that the difference $N^{*} - N^{A} = N^{*} - \alpha n^{A}$ is the supply available for *n*th-time buyers. Keep in mind that the system, however, is not recursive, so both N^{A} and $N - N^{A}$ are determined simultaneously with demand from nth time buyers $N^{B}\left(= \beta n^{B}\right)$. We do it as an illustrative heuristic, and it does not prevent us from reaching the solution. The supply consistent with nth-time buyers' demand is then given by equation (9):

(9) $$N^{S}(h) = N^{*} - \alpha n^{A} = N^{*} - \alpha a + \alpha b h,$$

which when markets clear must be consistent with the aggregate of equation (7), $N^{S} = \beta n^{B}$. Solving equation (9) with respect to the price, *h*, and partially differentiating with respect to the residual supply, N^{S}, yields the slope of the supply curve in a standard price-quantity diagram (with price on the vertical axis):

(10) $$\frac{\partial h}{\partial N^{S}} = \frac{1}{\alpha b} > 0,$$

which is positive, and so the supply curve slopes upward. The supply available for *n*th-time buyers depends upon the price elasticity and frequency of first-time buyers. From rearrangement and partial differentiation of equation (7), adjusting for the frequency of *n*th-time buyers, we obtain the slope of the demand curve of nth-time buyers as:

(11) $$\frac{\partial h}{\partial N^B} = \frac{h^2}{\beta\left(\lambda D^B - dh^2\right)},$$

which may be positive or negative depending on whether the remaining debt multiplied by the leverage factor (or the proportion of equity spent on new purchase, if below unity) is larger than or smaller than the factor dh^2, which depends upon the price sensitivity of nth-time buyers and the price level. From this follows that there exist three cases of price dynamics in this model.

Case 1. Downward-sloping demand curve for *n*th-time buyers

To test for equilibrium stability, we employ a conventional comparative static market condition: a stable equilibrium occurs when the demand and supply schedules are such that for prices above the equilibrium price, supply exceeds demand, and for prices below equilibrium price, demand exceeds supply.

When $\lambda D^B < dh^2$ the demand curve for nth-time buyers is downward-sloping. In other words, when leverage is low and debt is small, demand is more likely to be downward-sloping. The result is a standard market-cross situation with upward-sloping supply and downward-sloping demand. The equilibrium is stable, since a price larger than equilibrium price h^*, makes supply larger than demand, which in turn induces falling prices. Should the price temporarily fall below equilibrium price h^*, demand would be larger than supply, which imply rising prices. The result is convergence to equilibrium.

Case 2. A steep, upward-sloping demand curve for *n*th-time buyers

When $\lambda D^B < dh^2$, the demand curve for *n*th-time buyers is upward-sloping. And if, in addition, the following inequality holds,

(12) $$\frac{\partial h}{\partial N^B} = \frac{h^2}{\beta\left(\lambda D^B - dh^2\right)} > \frac{1}{\alpha b},$$

then the demand curve is steeper than the supply curve. Thus, should price h become larger than the equilibrium price h^*, supply would be larger than demand, and prices fall. When h is below the equilibrium price h^*, demand is larger than supply, and prices rise. This implies price convergence towards h^* and entails a stable equilibrium.

Case 3. A less steep upward-sloping demand curve for nth-time buyers

When $\lambda D^B < dh^2$, and in addition,

(13) $$\frac{\partial h}{\partial N^B} = \frac{h^2}{\beta\left(\lambda D^B - dh^2\right)} < \frac{1}{\alpha b},$$

then the demand curve of nth-time buyers slopes upwards and the supply curve is steeper than the demand curve. When h is larger than the equilibrium price h^*, demand is larger than supply, and so prices *increase*. When h is smaller than the equilibrium price h^*, supply is larger than demand, so prices decrease. This equilibrium is *unstable* and there exists a feedback mechanism that reinforces divergence away from equilibrium once a price deviates from it. Put differently, the realized home equity effect may imply self-reinforcing price spirals away from equilibrium. This inequality is more likely to hold when $(1/\alpha b)$ is large, e.g. when the product αb is small, which it is when the number of first-time buyers is small or the demand curve of first-time buyers is steeply downward sloping and reveals inelastic demand. The inequality is more likely to hold when the leverage factor is large, debt is large, or when second-time buyers are frequent relative to first-time buyers.

This is a highly stylized model of a more complex reality, but the model illuminates how markets where buyers also are sellers are different in structure from other markets. It begs the question of what actually ends a divergent process, given that something actually does. One trivial possibility is the multiple-equilibria scenario where non-linear demand curve crosses the supply curve twice, above which the situation is a case 2 stable equilibrium. Another possibility is that exogenous shocks to the economy change the parameters. The third, however, and most likely explanation is that these short-term dynamics are different from the long-term development. The obvious reason is the emergence of supply of *new* housing, i.e. construction of more square meters of housing, which in the long-term makes N^* not a given, but a function of price h, $N^*(h)$. However, the recent financial episodes have demonstrated the need to understand also short-term price deviations from long-term equilibria. A few applications and refinements follow now.

Application 1: Taxes on capital gains reduce the financial acceleration

If capital gains are taxed as other capital gains, the disposable realized equity, given in equation (6) would be reduced for each nth-time buyer and so demand would become:

$$N^B = c - dp + \beta\lambda\left[\frac{\left(hn^{B0} - D^B\right) - \tau n^{B0}\left(h - h^0\right)}{h}\right], \tag{14}$$

where the tax rate is denoted by *τ*. From this we obtain a modified demand derivative given in equation (15):

$$\frac{\partial h}{\partial N^B} = \frac{h^2}{\beta\left(\lambda\left\{D^B - \tau n^{B0}h^0\right\} - dh^2\right)}, \tag{15}$$

which makes it clear that the presence of capital gains taxation reduces the likelihood of the supply curve being steeper than the demand curve (when the demand curve slopes upward), which is the characteristic of the unstable equilibrium. This follows from the observation that taxation of capital gains reduces home equity available for a new purchase and thus affects the nth time buyers demand curve. From equation (15) we observe that a properly chosen tax level, *τ*, can decrease a positive denominator, and thus increase the ratio and make it larger than $1/\alpha b$. In fact, if the tax rate is sufficiently large, nth time buyers will have downward-sloping demand curves, $\lambda D^B - \tau n^{B0}h^0 < dh^2$, eliminating the possibility of financial acceleration.

Application 2: Regulations on the magnitude of leverage

The situation that $h^2 / \left(\beta\left(\lambda D^B - dh^2\right)\right) < \left(1/\alpha b\right)$, which creates an unstable equilibrium and feedback mechanisms, and the existence of an upward-sloping demand curve for nth-time buyers, may be influenced by regulation that states a maximum level of leverage *λ*. *N*th-time byuers' demand curves can be forced to be downward-sloping if the rule ensure that $\lambda^{\max} D^B < dh^2$. Thus, as long as:

$$\lambda^{\max} < \frac{dh^2}{D^B}, \tag{16}$$

nth-time buyers' demand curves will slope down. In other words, even if lawmakers cannot tax capital gains (so that $\tau = 0$), they may still be able to regulate leverage by imposing requirements on down-payments and maximum leverage and make sure that $\lambda^{\max} D^B < dh^2$.

Refinement A: Non-constant supply as a function of price

The model assumes short-term supply is given at N^* and it is the presence or absence of first-time buyers that determines the supply available for nth-time buyers. This is a core modeling feature, and it involves the possibility that prices escalate to a level at which first-time buyers are priced out. The simple assumption helps the model uncover the potential price-spiral mechanism and illustrate the function first-time buyers play in a market where many agents are both sellers and buyers, but it may be too simple on two grounds. First, even in the very short-run there will be some destruction of old homes and some influx of new homes. Second, supply given at N^* implicitly assumes that the volume sellers put on the market keeps a constant rate. In practice, transaction volumes vary and the supply N^* in the short-run, with no construction, consists of the objects the β nth time buyers sell. This may be important because it may affect the conditions for unstable equilibria, even if it makes the model less transparent. If there is no construction, the only supply comes from nth time buyers. N^* is sum total area supplied for sale, and so if nth time buyers scale down or if n-1th time-buyers become tenants, as often is the case with older households that retire, there is room available for first-time buyers. In the extreme case, only *n*th-time buyers can afford to purchase and so the supply they purchase comes from other nth-time buyers who sell. In essence, they swap houses. This extreme case may actually make the model more intuitive as readers appreciate the possibility that if $\beta = 2$, then John and Joe buy from and sell to each other. The only factor that matters is the difference in price between the two objects, and there is no nominal price anchor. John and Joe may agree that John's house is worth 0.2 million dollars more than Joe's, but then it does not matter whether they anchor John's house at half a million and Joe's at 300,000 or John's house at 1,200,000 and Joe's at 1 million. This illustrates neatly the inherent accelerator mechanism when first-time buyers are priced out and construction is not speedy enough to dampen the effects. Interestingly, this analysis may be especially pertinent to what is truly scarce and given, namely geometric positions of land around a given origin, say in San Francisco or Manhattan.

Markets where sellers are buyers involve simultaneity between the decision to sell and the decision to buy. Sellers buy and buyers sell, and both sequences apply (even if some sellers exit the market and rent). Thus, an initial Taylor approximation of the behavior of a representative is given in equation (17):

(17) $$n^{SB} = e + fh + g\left(hn^{B0} - D^{B}\right),$$

where the superscript s indicates supply from the only suppliers, i.e. agents of type *B*, *e* and *f* are parameters governing the upward-sloping supply curve and where *g*(.) is an unspecified function of realized home equity. Assuming that $g(\cdot) = \theta\left(hn^{B0} - D^{B}\right)$, so that *g*(.) is a multiple of realized home equity, we may compute the conditions for instability by assuming that $\delta\beta$ sellers do not exit the market, while the remaining $(1-\delta)\beta$ sellers exit and become tenants. This yields the stability condition, given in equation (18):

$$(18) \qquad \frac{\partial h}{\partial N^{B}} = \frac{h^{2}}{\beta\left(\lambda D^{B} - dh^{2}\right)} < \frac{1}{\alpha b + \delta\beta f + \delta\beta\theta n^{B0}},$$

where the denominator of the right-hand-side increases and made the ratio smaller (for non-zero *f*) and thus the condition stronger.

Refinement B: A leverage function

In microeconomic theory, consumers have preferences over goods and services and extract utility from consumption. They have no preferences over degrees of leverage nor do they extract utility from leverage. Leverage is a means not an end. Thus, while a desire for constant leverage may be a key insight in why leverage may accelerate asset prices in Krugman's (2008) model, it may not be applicable or realistic in modeling consumer behavior, unless it turns out to be a rule-of-thumb consumers employ in approximating optimization solutions or banks use in extending credit and making mortgages. In other words, a refined model would make leverage a function of prices, equity, interest rates, and household income. Making the model more realistic in this fashion, one could introduce model features such that first-time buyers would have some equity from savings and were able to leverage savings at a multiple of λ^{A}, say e.g. 20, given that such leverage not exceed income by a multiple of more than a given threshold t^{A}, say e.g. 3. Nth-time buyers could be able to leverage equity at a multiple of $\lambda^{B} = 4$ given that such leverage not exceed income by a multiple of more than $t^{B} = 4$. Such refinements would add realism to the model and modify relative importance of parameters, but they would *not* change the underlying mechanism that use of realized home equity can lead to an upward-sloping demand curve for nth time buyers.

Empirical Evidence

The pivotal point in the mechanism described above is the *n*th-time buyer's use of realized home equity. If most nth-time buyers respond to a price change by downscaling his housing consumption, the demand curve slopes downward and equilibrium is stable. If, however, a sufficiently large number of nth-time buyers decide to use their realized equity, with or without leverage, towards a new purchase, there may exist an upward-sloping demand curve which may create an accelerator effect away from equilibrium. Admittedly, it is a formidable challenge to document the equity effect since the estimation of a price-quantity demand curve in a given annual cross-section is very difficult, especially when we would have to control for price expectations. This article cannot claim to prove the existence of an equity effect, but I offer a few indicators that are consistent with it and that illustrate the potential magnitude of it.

If an equity effect is present it should manifest itself through the aggregate value of all transactions exceeding new mortgages. Thus, the most intuitive empirical evidence of the described process lies with the time development of mortgage growth compared to total transaction value in the housing market. If new mortgages in a given year are smaller in total value than total transaction value in the same year, then most likely a substantial part is financed through realized home equity and the latter thus accounts for the difference. Below, I examine the evidence for a presence of an equity effect.

In addition, I put forward two supporting exhibits of the presence of an equity effect: the ratio of mean house prices to mean income and the time development of (unrealized) home equity levels in Norway. The former is an indicator of the degree of home equity in purchase finance since income can only service a certain level of mortgage. The second is an indicator of the rising value of the home endowment income. None of these supporting exhibits prove the existence of an equity effect, because they are also consistent with credit creation and price expectations. But looked at in tandem with the main evidence they may substantiate the claim that an equity effect exists.

Indicative evidence

I estimate the total value of all housing transactions and compare this estimate with the growth in new mortgages for each year. A difference indicates use of equity in purchases. Table 1 lists house transaction values from several sources and combines them to an overall measure of total transaction values in the housing (including leisure homes) market.

Table 1. Transaction Values of Homes, Leisure Homes, and Coop Residence Rights. Norway. 2000-2008

Year	No. Housing Trans.	Total Trans. Value (mill NOK)[1]	No. Leisure Home Trans.	Total Value Leisure Home Trans.[1] (mill NOK)	No. of Trans. of Res. Rights[2]	Total Value of Coop Res. Rights Trans.[3] (mill NOK)	Total Trans. Value, Homes and Leisure Homes (mill NOK)
2000	55,900	71,373	6,306	3,251	N/A	21,537[4]	96,161
2001	60,169	83,586	6,456	3,713	24,177	23,476	110,775
2002	63,353	93,462	6,789	4,364	23,278	25,350	123,176
2003	66,726	100,151	7,003	4,514	23,016	25,087	129,752
2004	69,107	113,649	8,175	6,597	N/A	28,884[5]	149,130
2005	74,435	135,239	8,889	7,369	24,924	33,274	175,882
2006	77,160	153,915	9,260	9,067	25,617	39,450	202,432
2007	81,075	184,007	10,340	12,690	25,987	45,373	242,070
2008	73,321	174,591	8,910	11,663	23,284	39,303	225,557

Source: Statistics Norway. [1]Registered change of land and property title. [2]Source: NBBL, a large Norwegian association of co-operatives. Legally, residence rights within a housing co-operative may be sold without being registered as change title to land and property (since the co-op possess that). [3]Source: NBBL. Multiplication of no. of transactions and average value of transaction. [4]NBBL informs us that the average transaction price in 2001 was 9% higher than in 2000; thus, we can infer the 2000-price. To estimate total transaction value, I impute transaction volume of 2001. [5]NBBL informs us that average transaction value was NOK 1,090,000, but since the no. of transactions are unavailable, I imputed the average transaction no. of 2003 and 2005.

Table 2 demonstrates that the total transaction values exceed the increase in aggregate household mortgage growth every year since year 2000, and by as much as 99 percent in the most recent year recorded, 2008. For the period 2000-2008 the total transaction values were 50% larger than the growth of new mortgages, which yield an "equity accelerator" (transaction value over mortgage growth) of 1.50. These transactions have had to be financed, and the excess value of transactions indicates that these house purchases were financed with realized home equity.

Table 2. Mortgage Growth and Total Transaction Value. Norway. 2000-2008

Year	Aggregate Net Growth in Mortgage Value (mill NOK)*	Total House Transaction Value (mill NOK)	Equity Accelerator (Transaction Value/Mortgage Growth)
2000	60,070	96,161	1.60
2001	71,423	110,775	1.55
2002	76,856	123,176	1.60
2003	92,916	129,752	1.40
2004	98,689	149,130	1.51
2005	139,064	175,882	1.26
2006	155,648	202,432	1.30
2007	164,264	242,070	1.47
2008	113,616	225,557	1.99
2009	110,282	N/A	N/A
Aggregate over period 2000-2008		1,454,935	1.50

Source: Statistics Norway and NBBL; see Table 3. Note: *Measured in December each year.

Supporting evidence

Exhibit A: The ratio of mean house prices to mean income

If house purchases were financed by mortgages, and mortgage interest was paid for by income, there exists a level above which mortgages will become difficult to service because of the budget share interest payments constitute. Thus, first-time buyers with no equity will find themselves in a position where rising house prices may prohibit entry with rising probability. Conversely, two agents who swap houses (with or without a compensation due to price difference) are both buyers off and sellers to each other. They may be able to agree on any nominal house price level as long as the *difference* between the two levels is the same. As seen above, there may emerge longer transaction sequences where the value difference in swaps is the key ingredient of an unstable equilibrium and where the nominal price level is inessential. Put differently, when equity is used in the transaction rounds, higher and rising nominal house price levels may be sustained. This means that house price levels measured against household income is an indicator of transaction spirals where equity plays a financing role (but also consistent with credit extension and price expectations). This article's supporting evidence is Table 3 where the ratio of average house prices to average salary of industrial worker and mean household income are tabulated. From column 5 we observe that while house prices in 1998 were a multiple of 4 times the average manufacturing salary they were 6 times the average manufacturing salary in 2008, indirect evidence that equity plays a role in financing. This is no final proof of an equity effect since reduced interest levels potentially could explain the higher ratio since most Norwegian households finance their home purchases using variable interest rate mortgages. However, the burden of interest payments as measured as a budget share of income *increased* within the period. I have computed this interest burden in order to substantiate the claim of a presence of an equity effect.[2] This computation yields an average budget share of interest payments in 2000 of 28%. By 2007, this burden *increased* to 30%.

Table 3. The ratio of mean transaction price to mean income before taxes and fraction of interest payments out of income before taxes

År	Av. House Price	Average Salary, Manufacturing	Average Total Income, Households	House Price on Manufacture Salary	House Price on Total Income
1998	1,000,000	252,200	357,500	3.97	2.80
1999	1,119,000	265,900	381,400	4.21	2.93
2000	1,277,000	277,000	405,100	4.61	3.15
2001	1,389,000	289,400	415,500	4.80	3.34
2002	1,475,000	306,200	444,700	4.82	3.32
2003	1,501,000	319,900	457,500	4.69	3.28
2004	1,645,000	331,300	487,800	4.97	3.37
2005	1,817,000	343,100	535,100	5.30	3.40
2006	1,995,000	356,600	509,300	5.59	3.92
2007	2,270,000	374,700	556,800	6.06	4.08
2008	2,383,000	399,400	N/A	5.97	N/A

Exhibit B: Time Development of (Unrealized) Home Equity

Table 4 tabulates the estimates of the development of (unrealized) home equity in Norway for the three years 2004-2006 for households participating in the Consumer Expenditure Survey; see the appendix. Figure 1 shows how equity is distributed over the income spectrum for the three years. House values for owner-occupiers are estimated by capitalization of imputed rent[3]; see the appendix for a detailed description of the estimation procedure behind rent imputation. Debt levels are acquired

[2] To do this, I use mean house prices for the years 2000 and 2007 and the interest levels (computed as the NIBOR interest level (7.49% and 5.86%, respectively) plus a premium of 1.5 percentage point for mortgages.

[3] Capitalization factor 20.

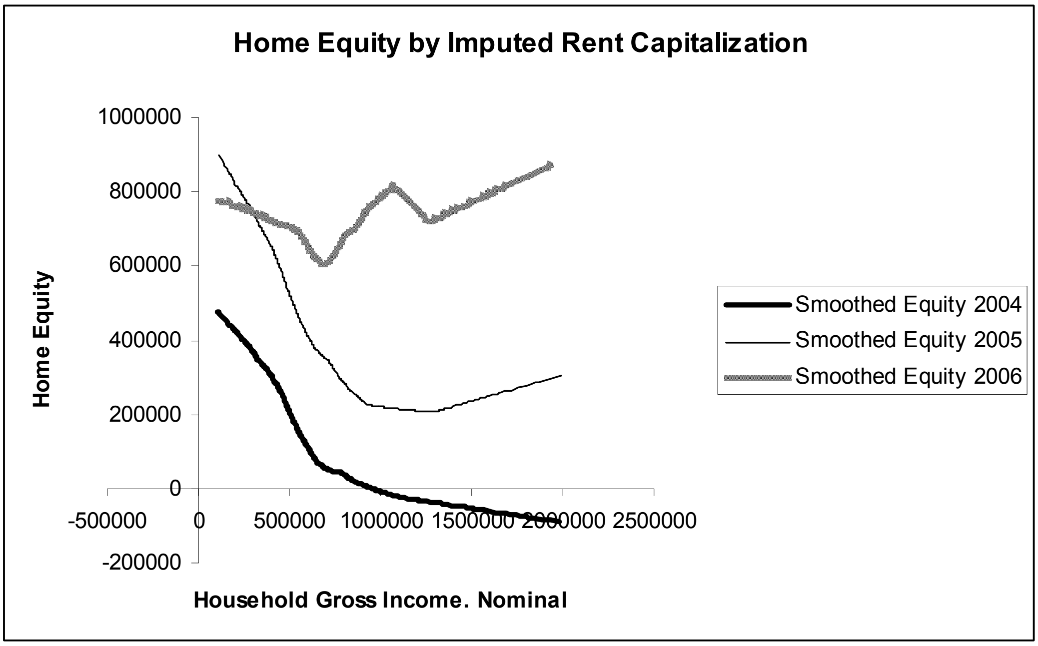
from the registry of the Norwegian IRS. We observe in Table 4 that median home equity increased from NOK 186,900 in 2004 to NOK 762,450; a substantial increase amounting to more than half again median gross income. Figure 4 clearly demonstrates that all households observe a rapid increase in their home equity. This article's idea is that Table 4 and Figure 1 together show that home equity rises rapidly and makes it plausible that it serves as an important vehicle in financing new purchases (for the households that actually moves) and potentially allow a substantial endowment income effect from equity.

Table 4. Estimated Home Equity Levels in Norwegian Kroner (NOK). Some Characteristics of the Distribution. Capitalization of Imputed Rent as House Value Estimator. From Consumer Expenditure Surveys (CES). Norway. 2004-2006

Statistic	2004	2005	2006
N	762	708	715
95th Percentile	1,085,240	1,467,500	2,009,578
75th Percentile	608,700	935,640	1,185,738
Median	186,900	522,270	762,450
Mean	137,942	429,824	700,361
25th Percentile	-233,320	12,230	191,998
5th Percentile	-915,520	-748,840	-495,336

Source: Statistics Norway, Consumer Expenditure Surveys; see the Appendix for details. Home equity is defined as the difference between estimated house value and house mortgage. House value is estimated as estimated imputed rent (see appendix) multiplied by a capitalization factor of 20. 2004: 1149 observations. 52 lost in data trimming by truncation upper and lower level of gross income (NOK 100,000 and 2,000,000). 835 were owner-occupiers and 762 with identifiable imputed rent. 2005: 1096. 1049 after trimming. 778 are owner-occupiers and 708 allowed imputed rent computation. 2006: 993. 955 after trimming. 743 owner-occupiers. 715 allowed imputed rent computation.

Figure 1. Estimated Home Equity from Imputed Rent Capitalization on Household Gross Income. Consumer Expenditure Survey Data. Norway. 2004-2006



Source: Statistics Norway. Home equity is defined as the difference between estimated house value and house mortgage. House value is estimated as estimated imputed rent (see appendix) multiplied by a capitalization factor of 20. Imputation procedure identical in 2004 and 2005, improved in 2006; see Appendix. Non-parametric Local Regression Smoothing. 2004. No. of obs.: 762. Fitting points: 17. Residual Sum of Squares: 2.803. Equivalent No. of Parameters: 4.057. 2005: No. of obs. 708. Fitting points: 17. Residual Sum of Squares: 3.466. Equivalent No. of Parameters: 3.983. 2006: No. of obs. 715. Fitting points: 17. Residual Sum of Squares: 4.546. Equivalent No. of Parameters. 3.969.

Discussion

The mechanism described above revolves around the use of realized home equity. If households use much of it, and even leverage it, towards new purchases, it will strongly affect house prices, which again will affect realized equity, and in turn affect house prices again. Households may understand this mechanism and employ models of their own for how house prices will develop given that others behave in the same manner they do themselves. If so, they may contemplate another feedback mechanism, one involving realized prices and price expectations.

Expectations of increasing house prices imply expectations of decreasing user costs of housing. This would not be limited to nth-time buyers, but apply to both types. In fact, if house price increases are sufficiently large, the user cost becomes negative, and only credit constraints will prevent households from ever-increasing demand. In other words, while this article models the leverage factor, λ, as exogenous, it may be endogenously determined by a complex web of expectations among households and financial institutions. Moreover, augmenting my model with price expectations would also imply the possibility of increasing demand curves for first-time buyers, which would require a much richer modeling apparatus and a careful mapping of what price expectations would be consistent with economic theory and what would have to be modeled as behavioral assumptions. Put differently, it would lead to an article with *two* interesting mechanisms, an equity effect mechanism and an expectations mechanism. For tractability, I study only the former in this article.

Concluding Remarks and Policy Implications

When the acquisition price of a square meter of housing increases three effects occur. First, the substitution effect signals that housing has become relatively more expensive. Second, the income effect involves reduced purchasing power for given income. Third, the endowment income effect equips owners with more equity. The first-time buyer experiences only the first two effects, while the nth-time buyer experiences all three. It is plausible that the total effect for the latter, the nth-time buyer, is negative such that a price increase entails a decrease in demand. If so, all agents experience a partial effect that leads to down-scaling of their housing consumption when prices increase. This is at odds with recent empirical evidence since some households do purchase more housing when house prices increase.

It is fathomable that the total effect for the nth-time buyer is positive such that a price increase entails an increase in demand. This article shows that a home equity effect may, if not in full so at least, partly explain the existence of an upward-sloping demand schedule for equity-rich households since early entrants have equity that long appreciate with house prices. But when equity depends on house prices and house prices depend on equity, endogeneity emerges and this article examines under what conditions this creates a short-term feed-back loop that could imply an up-ward sloping demand curve and under which conditions up-ward sloping demand entails unstable equilibria.

The results show algebraically, from a first-order Taylor approximation of demand schedules, that an unstable equilibrium is more likely to occur when i) the demand of first-time buyers is inelastic, ii) when the leverage factor is large, iii) debt is substantial, or iv) when second-time buyers are many relative to first-time buyers. In the limiting case, where no first-time buyers buy, all transactions take place by using equity, and each round may entail increased prices and increased equity. However, the effect could also work in the reverse so that falling prices entail decreasing price levels and reductions in equity.

I put forward two pieces of evidence that is consistent with an equity effect. First, the value of house transactions in Norway in the period 2000-2008 exceeded the increase of household credit for every year. Over the period, the value of transactions was 50% larger than the value of new mortgages. In one year, 2008, the value of transactions was double the value of new mortgages. Thus, in aggregate, equity must have played a role in realizing the over-all house price level. Second, house prices rose much more than income in the period, so the ability to finance a mortgage must have come from somewhere else, equity.

The policy implications that follow are that limitations on and regulations of leverage dampen the effect and may decrease the probability of unstable equilibrium. Moreover, a capital gains tax on capital gains also dampens the effect.

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The two-good, two-period budget line

Consider the simplest example, a two-period two-good system. Assume that households buy two goods, housing and other goods, in the beginning of a period, consumes the non-durable (other goods) during the period, and sells the durable (housing) at the end of the period, at a new house price. In the next period, housing is re-bought, using equity from the first period's endowment, at the new relative price level. This means the first period budget-constraint is $p_O^0 O^0 + p_H^0 H^0 = Y + W$, where Y is income in each period (identical in both periods for simplicity) and W is initial wealth. If W is smaller than $p_H^0 H^0$, then the residual is covered by using parts of income Y for the first-period housing consumption. In the second period, the budget-constraint is: $p_O^1 O^1 + p_H^1 H^1 = Y + p_H^1 H^0$, where the last term indicates the equity gains on the acquired stock, H^0, valued at the new price, p_H^1. Assume, for simplicity, that house prices rise between periods 0 and 1, so $p_H^1 > p_H^0$.

Then, when comparing the position of these two budget lines, we observe that the second period line crosses the housing good axis inside the first, but outside on the other (good) axis. The budget line may be re-positioned, and not only pivot around the initial consumption bundle O^0, H^0. To see this, compare the budget line at the level where $H^1 = H^0$. Assume the price of other goods is nominally unchanged (but has become relatively cheaper), $p_O^0 = p_O^1$, and income identical in both periods, Y. By subtracting the former budget line from the latter, we obtain:
$O^1 = \left(1/p_O^1\right)\left(p_O^0 O^0 + p_H^0 H^0 - W\right) = O^0 + \left(p_H^0/p_O^1\right)H^0 - W/p_O^0$ by recalling that H^1 is equal to H^0 at that geometrical point so that $p_H^1 H^0$ cancels with $p_H^1 H^1$. If $W = 0$, then, since $p_O^0 = p_O^1$, $O^1 = O^0 + \left(p_H^0 H^0/p_O^1\right)$, clearly *larger* than O^0. If W is positive, then $O^1 > O^0$ if $p_H^0 H^0 > W$ and $O^1 < O^0$ when $p_H^0 H^0 > W$. By comparing budget lines at the initial level of consumption of other goods, $O^1 = O^0$, we obtain by subtracting the first-period budget line from the second-period one $H^1 = H^0 + \left(p_H^0 H^0 - W\right)/p_H^1$, where $H^1 > H^0$ if $p_H^0 H^0 > W$.

This simple algebraic exercise demonstrates the possibility of a re-positioning of the budget line, which is useful because otherwise price increases should lead to, in the simple 2-good 2-period set-up, decreased demand regardless of the magnitude of the endowment income effect. Nevertheless, we should be careful in interpreting such simple algebraic results because of the difficulty in capturing the features of housing consumption in a standard two-good diagram. Keep in mind that the price of other consumption is a standard consumption price while the price of housing here is acquisition price, *not* user cost. Housing is a bundled good, both offering consumption services and functioning as a saving vehicle, thus separating the price of the former from the returns to the latter is quite involved, but crucial, and may be outside the scope of a two-good, two-period budget line diagram.

Appendix B

Data

B1. Consumer Expenditure Survey (CES) and Income Data

Table 4 and Figure 1 offer estimated levels of home equity for Norwegian households based on a combination of Consumer Expenditure Surveys, Rental Surveys, and Income data. Below follows a brief description of these data sources.

Statistics Norway contact 1/26 of their household sample every two weeks and ask households to keep a diary of all expenditures over a fortnight. These households are subsequently interviewed for demographic variables, housing arrangements and attributes, and other variables of interest. The CES data set includes household size and composition, age of household members, region of residence, vocation of main income earner, number of hours worked for main income earner, and ownership of a number of household durables such as cars, boats, refrigerators, washing machines, cooking stoves, television sets, video recorders, and microwave ovens. Sample sizes are typically around 1,000–1,200 households per year. The sampling scheme is a two-stage stratified random sample of the universe of Norwegian households. Response rates typically lie around 60 percent. The expenditures are classified into a large array of different items. Official data managers code from the entries in the households' accounting books and slot them into pre-assigned groups. Expenditures are annualized (by multiplying by 26). Standard aggregation levels are 9, 37, 150 and 488 commodity groups. The demographic data include variables on number of children below 7, 16, and 20 years of age. My variable "No. of Children in household" denotes number of children below 16 years of age. I truncate the data in order to minimize outlier influence.

Statistics Norway may, given the authorization, link Consumer Expenditure Survey datasets with datasets from income registers. These income registers are not surveys, but complete and exhaustive full-count registers compiled by the Norwegian Tax Administration (*Skattedirektoratet*, the Norwegian equivalent of the IRS) and National Insurance Administration (*Rikstrygdeverket*) and contain records of all Norwegian residents. I was able to access several income variables in these merged datasets, e.g. income before taxes and income after taxes. So insofar as the reported data do not rely on individual memory or individual discretion, but are transmitted to the income registers directly by the employers, they maintain a very high standard.

B2. Imputed Rent and Owner-Occupier's Housing Attributes

In order to compute equity, this article calculates the home value and subtracts mortgages. The estimation of home value is done by multiplication of imputed annual rent by a capitalization factor of 20. Below follows a brief discussion of the imputation technique and the rental survey it is based on.

For every CES survey household, an imputed rent is assigned on the basis of observable attributes of the household's home. For the years 2004 and 2005, the sample was divided into strata of geographical location, size of home, and home type, yielding 24 strata in all. Every household in a given stratum is assigned an imputed rent derived from the average rent retrieved by a rental survey. In 2006, the imputation method included an algorithm that computes imputed rent as an explicit function of size and spatial residence. It was specifically designed to account for the non-linearity in imputed rent for different sizes. The parameters derive from estimates based on collected monthly rents in the Norwegian Rental Survey of 2006; see Røed Larsen and Sommervoll (2009) for the use of the first vintage of data from the Norwegian Rental Survey, 2005.

As the population of rental objects in Norway is not known it is impossible to draw a simple random sample, thus, a number of techniques was used in order to acquire a workable data set, see Røed Larsen and Sommervoll (2009). From a set of addresses, 15,818 interviews (postal and telephonic) were performed; of these 5,169 interviewees were identified as tenants.

There are differences in size and spatial attributes between rental objects and owner-occupied objects, but the differences are not completely documented. The Rental Survey is, to the best of my knowledge, unique in its range and detail. It documents physical attributes of the rental object, types of renting agreement, characteristics of tenant, landlord, and their interaction, length of rental period, and types of contract.