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PRICES AND TRADING VOLUME IN THE HOUSING MARKET: A MODEL WITH DOWNPAYMENT EFFECTS

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ABSTRACT

This paper presents a simple model of trade in the housing market. The crucial feature is that a minimum downpayment is required for the purchase of a new home. The model has direct implications for the volatility of house prices, as well as for the correlation between prices and trading volume. The model can also be extended to address the correlation between prices and time-to-sale, as well as certain aspects of the cyclical behavior of housing starts.

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1. Introduction

This paper seeks to address two fundamental and related questions about the housing market: 1) What accounts for fluctuations in house prices? and 2) Why is it that there appears to be more intense trading activity (i.e, a higher volume of sales; and a shorter average waiting time from listing to sale) in rising markets than in falling markets?

The standard theoretical approach to the first question (as exemplified by Poterba (1984)) treats the housing market much like any other asset market. In this framework, house prices are forward looking and depend solely on such current and future "fundamentals" as user costs of capital, rents, and construction costs.

However, this "efficient markets" approach to house price determination has encountered empirical difficulties. Case and Shiller (1989, 1990) present evidence that changes in house prices are forecastable, based on both past price changes and on such fundamental-based measures as rent-to-price and construction-cost-to-price ratios.[1] Furthermore, there have been a number of dramatic boom-to-bust episodes at both the country and regional levels that appear to be difficult to explain--even retrospectively--with the standard model.[2] Many observers have concluded from these sorts of data that house prices are in part driven by non-fundamental speculative phenomena such as fads or bubbles.

While the issue of house pricing has at least had the benefit of a well-accepted benchmark model to guide inquiry, the same cannot be said for questions surrounding the level

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[1]See also Cutler, Poterba and Summers (1991), and Meese and Wallace (1991).

[2]Poterba (1991) gives a number of examples (at both the city and national level) of dramatic price swings. Case (1986) argues that the run-up in home prices in Boston in the mid-1980's cannot be explained based solely on changes in fundamentals.

of trading activity. Of the informal stories that are used to explain trading activity, many appear to involve less-than-fully rational behavior. For example, the observed correlation between the level of house prices and trading volume is often attributed to sellers who have slowly-adapting expectations or who simply refuse to "recognize reality" in depressed markets and therefore do not cut prices to appropriate levels. A similar line of reasoning is also advanced to explain why houses tend to stay on the market longer in times of falling prices.

The theory of the housing market that is developed in this paper can help to explain both large price swings as well as a correlation between prices and trading activity. The theory is predicated on rational behavior and does not rely on fads or bubbles. It takes as its starting point two sets of observations:

1) The purchase of a house typically requires a significant downpayment. This implies that the demand for houses will be affected by buyer liquidity.[3] Moreover, in order to support strong housing demand, it is necessary that the liquidity be broad-based. One buyer with ten units of liquidity will probably not demand as much housing as ten buyers with one unit each, since there is diminishing marginal utility from owning houses. Thus a few "deep pockets" in the economy cannot counteract a widespread liquidity shortage. This stands in contrast to other asset markets (e.g., equities) where diminishing returns to ownership are not as pronounced, and where a few deep-pocket arbitrageurs can thus absorb large supplies with relatively small price concessions.

2) Houses represent a substantial fraction of household net worth. According to the Federal Reserve, owner-occupied homes had a value of $4.6 trillion in 1990, or roughly 27%

[3] Using micro data, Linneman and Wachter (1989) present direct evidence that downpayment requirements can act as a substantial constraint to the purchase of a home. See also Zorn (1989) and Jones (1989).

of household net worth. Furthermore, approximately two-thirds of all American households own their own houses.[4] This means that an exogenous shock to house prices can have a large and broad-based impact on household liquidity.

Taken together, these two sets of observations would seem to imply that there can be self-reinforcing effects from shocks to house prices: Suppose an initial shock knocks prices down. The ensuing loss on their existing homes compromises the ability of would-be movers to make downpayments on new homes. This in turn leads to a lack of demand that further depresses prices, and so on.

A couple of further pieces of data strengthen the presumption that these self-reinforcing effects could be quantitatively important. First, for repeat buyers, the average percentage of their downpayment coming from the proceeds on the sale of their old home has ranged from 38% to 57% over the years 1987-1990. In other words, the value of their old home is likely to have a critical impact on the ability of a repeat buyer family to make a downpayment. Second, roughly 60% of all home sales are to repeat buyers.[5]

The model that is presented below captures in a simple fashion the potential for self-reinforcing effects that run from house prices to downpayments to housing demand back to house prices. In some cases, it turns out that these effects do indeed have significant consequences for house price behavior. First of all, they can lead to within-equilibrium multiplier effects from changes in fundamentals. Second, they can create the potential for multiple equilibria--i.e., for a given level of fundamentals, there may be more than one price level that equates supply and

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[4]See Smith, Rosen and Fallis (1988).

[5]The sources for these facts are Chicago Title and Trust Company's Annual Surveys of Recent Home Buyers.

demand.

The existence of multipliers and multiple equilibria suggest that the model can rationalize house price volatility that might appear excessive relative to the standard efficient markets framework. The multiple equilibria seem to fit especially well with the notion of dramatic boom-to-bust movements in prices. Somewhat surprisingly, however, these conclusions about price volatility appear to be sensitive to parameter values. For certain distributions of initial liquidity in the population, downpayment effects have very little effect on house prices.

The model also provides a simple (and much more robust) explanation for the observed positive correlation between the level of house prices and trading volume: As house prices fall, some potential movers find their liquidity so impaired that they are better off staying in their old house rather than attempting to move. To take a concrete example: Imagine a family with a house initially worth \$100,000, an outstanding mortgage of \$85,000, and no other assets. Suppose further that the family would like to move to the next town, say because the public schools are better. The purchase of a new house requires a minimum downpayment of 10%. If house prices stay where they are, the family can sell its old house, pay off the mortgage and still have more than enough (\$15,000) to make a downpayment on a new house of comparable size.

But if house prices fall by 10%, the family will only have enough to make a downpayment of \$5,000. Rather than moving to a much smaller house, they may rationally choose to stay where they are. Or, they may try "fishing"--listing their current house at an above-market price in the (low probability) hopes of getting lucky and raising enough money to make a reasonable downpayment. Given that the alternative to fishing in this low-liquidity scenario is not moving at all, fishing will have very little opportunity cost. In contrast, when prices are higher, the alternative to fishing is moving to the desired location more promptly and with certainty. Thus fishing will be much less attractive. These arguments suggest that both the volume of trade and the length of time on the market will be related to the level of prices.

One reason that it is particularly important to understand the determinants of prices and trading behavior in the housing market is because of the implications of these variables for housing starts, and by extension, for construction and related industries. Housing starts are extremely volatile, with average peak-to-trough declines of 45 percent in eight postwar housing cycles.[6] Topel and Rosen (1988) find that starts are very sensitive to the level of house prices. This is not surprising from a theoretical point of view--it can simply be interpreted as evidence of an upwards-sloping supply curve for new construction--but it underscores the economic significance of house-price volatility.

Perhaps more surprising is Topel and Rosen's finding that a measure of trading intensity--specifically, the median time that it takes for a new house to be sold--also has a strong, independent effect on housing starts. As these authors emphasize, this independent effect of waiting times is hard to explain, even if one appeals to a number of well-known housing market imperfections. For example, factors such as high nominal interest rates and the attendant disintermediation may well have been responsible for large declines in housing demand during the period they analyze. But these factors should only affect housing starts to the extent they affect the level of house prices, and no more. Or said differentially, the level of prices should be a sufficient statistic for any demand-side effects on housing starts.

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[6]See Smith, Rosen and Fallis (1988).

However, it turns out that the theory developed here can be adapted to address the independent correlation between waiting times and housing starts. This point is discussed in detail later in the paper.

The remainder of the paper is organized as follows. Section 2 briefly reviews some related work. Section 3 presents and analyzes a simple model of the housing market that captures the importance of downpayment effects. For the purposes of this section, it is just assumed that there is an exogenous downpayment requirement that new homebuyers must satisfy. In Section 4, however, it is briefly sketched how such a downpayment requirement might arise endogenously from adverse selection problems in the loan market. Section 5 discusses the model's empirical implications. Section 6 concludes.

2. Related Work

There are a number of papers in the real estate and public finance literatures that emphasize the importance of downpayment requirements in the housing market. Unlike in this paper, however, the focus is not typically on the implications of such requirements for variables like trading volume and price volatility. Instead, earlier work has explored the interaction between downpayment requirements and consumption-savings decisions, the rent vs. buy choice, and the tax code.

Slemrod (1982) is a noteworthy example. In his paper, much as in this one, families seeking to buy a house must put up a fixed fraction of the purchase price as a downpayment. Among other things, Slemrod shows that this can lead families to distort consumption downwards early on in the life cycle, in an effort to save enough to be able to buy a house.[7] However, his model has the feature that once a family buys a first house, they never have the opportunity to trade it--in other words, all sales are to first-time buyers. By definition, this rules out the sort of issues that are of central concern here, since these issues only arise when prospective buyers already own another home.

On the empirical front, work by Linneman and Wachter (1989), Zorn (1989) and Jones (1989) all provide support for one of the key premises of the model in this paper--the notion that downpayment requirements can significantly constrain households in their purchase of a home. However, given that their primary interest is in individual household behavior, none of these papers go on to consider the impact of downpayment requirements on market equilibrium prices.

In terms of its focus on market-wide equilibrium, and on the positive feedback from house prices to buyer liquidity to housing demand, this paper is more closely related to recent work by Shleifer and Vishny (1992), who study the market for corporate asset sales. They begin with the assumptions that: 1) many corporate assets have a higher operating value when resold to buyers in the same industry; and 2) capital market imperfections make it necessary for such buyers to put up some of the purchase price themselves. The interaction of these two factors can lead asset values to be very sensitive to certain sorts of shocks. For example, an initial shock to the price of oil will not only make the fundamental value of oil-producing properties fall, but it will also impair the ability of others in the oil industry to bid for these properties, thereby further depressing the price at which the assets can be sold.

In a somewhat similar spirit is work by Kashyap, Scharfstein and Weil (1990) on land

[7]See Engelhardt (1991) for evidence supporting this hypothesis.

prices and corporate investment. In their model, corporations own land and use this as collateral when borrowing, say to finance investment in physical capital. Here too, there can be multiplier effects from exogenous shocks to land values, although the mechanism is somewhat less direct: an initial exogenous decline in land values makes it harder for companies to finance investment; the ensuing drop in output and corporate profitability reduces the marginal product of land, leading to further land price drops.

3. The Model

3.1 Assumptions

The model has three time periods, 0, 1 and 2, and a continuum of families, indexed by i. At time 0, each family is endowed with 1 unit of housing stock, as well as with some outstanding mortgage debt secured against the house. There is heterogeneity across families in the amount of debt outstanding--in particular, family i owes an amount K_i, and the K_i's are distributed on an interval $[K^L, K^H]$ according to the cumulative distribution function G(K). The debt is denominated in units of the numeraire good, "food". I allow for the possibility of negative values of K_i--i.e., it is possible that $K^L < 0$. This can be interpreted as some families having liquid assets at time 0 above and beyond their houses.

At time 1, families can trade houses with each other. The housing stock is assumed to be divisible, so it is possible for any family to own more or less than one unit after moving. It is also assumed that the housing stock is fixed at its time 0 level--no new houses are built at time 1. The per unit price of housing at time 1 is P, so the cost of buying a house of size H is PH.

I make two crucial assumptions about the trading process. First, when a family sells their old house, they must repay the outstanding debt immediately, leaving them with net liquid assets of $P-K_i$. Second, a minimum downpayment is required on the new house. In particular, if the new house costs PH, the downpayment must be at least γPH, with $0<\gamma<1$. Once this minimum downpayment requirement is met, a buyer is able to borrow the rest of the purchase price at the riskless rate of interest, which for simplicity is normalized to zero.

A downpayment requirement of some sort is essential to the model's results. However, the particularly simple formulation adopted here--with the proportion γ independent of all other variables in the model, and with no interaction between interest rates and the size of the downpayment--is not essential, but rather is chosen to make the analysis more tractable. Loosely speaking, all that is really necessary for the results to go through is that the maximum loan size be an increasing function of the market value of the house. (Here, the maximum loan size is simply $(1-\gamma)$ times the market value of the house.)

For the moment, the downpayment requirement is taken as exogenous to the model. However, in Section 4 below, I briefly illustrate how such a requirement might arise endogenously in response to adverse selection problems in the lending market. The basic idea is that, in addition to the families discussed above, there is also a set of "defaulters" who would not repay any loans taken out at time 1. By requiring enough of a downpayment, lenders can make it unattractive for the defaulters to borrow, thereby screening them out of the market.

Given the downpayment requirement, there will be a limit to the size of the house that any family i can buy at time 1. The constraint is given by:

$$(1)\ PH_i \leq (P-K_i)/\gamma$$

At time 2, families get labor income (in units of food), settle all their outstanding debts, and enjoy utility from their consumption of both food and housing services. Family i's labor income L_i is equal to $1+K_i$. This implies that each family's total net income (including the initial time 0 endowment and the time 2 labor income) is the same, and is equal to one unit of housing plus one unit of food. The only difference across families is that those with higher values of K_i are effectively more liquidity-constrained, since their income is more back-loaded.

A family's utility is a function of three things: 1) the amount of food they consume; 2) the size of the house they live in; and 3) whether they were able to move to a new house. In particular, utility is given by:

$$(2)\ U_i = \alpha \ln H_i + (1-\alpha)\ln F_i + \theta M_i$$

where F_i is i's food consumption and M_i is an indicator variable that takes on the value one if family i moves at time 1, and zero otherwise. The last term in the utility function is meant to capture in a simple fashion the notion that there are gains from trading in the housing market at time 1. As suggested earlier, one way to motivate this assumption is to imagine that houses have different attributes, and that families' preferences across these attributes shift at time 1. For example, families that have recently had children will wish to move to houses that are closer to good schools, playgrounds, etc.

3.2 Benchmark Case: $\gamma = 0$

In order to have a benchmark against which to compare the results, it is useful to first work through the "perfect capital markets" case where there is no downpayment requirement--i.e, where $\gamma = 0$. In this case, the constraint in (1) is never binding. It follows immediately from (2) that everybody will trade on the housing market at time 1, since this increases utility by θ.

Since the liquidity constraint is never binding, each family's demand for housing is independent of their initial debt K_i, and depends only on their total lifetime wealth. In units of food, this lifetime wealth has value $1+P$. By virtue of the Cobb-Douglas form of the preferences, families will wish to spend a fraction α of their wealth on housing. This implies that the per-capita demand for housing is given by:

(3) $H_i = \alpha(1+P)/P$

The per-capita supply of housing is one unit. Equating supply and demand gives us the price of houses:

(4) $P = \alpha/(1-\alpha)$

Thus in the benchmark case, prices are given by (4), and 100 percent of the population is involved in trading at time 1. In what follows, the parameter α will be interpreted as a measure of housing market "fundamentals". This will allow us to ask two related sorts of questions: 1) Do downpayment effects cause prices to be "excessively" sensitive to changes in fundamentals--i.e., is $dP/d\alpha$ larger in the case where $\gamma > 0$ than it is in the benchmark case?; and 2) Can there be movements in prices that are completely unrelated to changes in fundamentals?

3.3 Excess Demand Schedules with Downpayment Effects

We now turn to the case in which $\gamma > 0$. The method of analysis will be as follows. For any given value of α, and any candidate price P, we can calculate the net excess demand for houses. By varying P, we can then generate an excess demand schedule as a function of price. A necessary condition for equilibrium is that the price be such that net excess demand is zero. As will become clear shortly, there may be more than one price that satisfies this condition. In any case, however, the first task is to derive the excess demand schedule.

To do so, note that at any price P, we can divide the population into three groups, according to the amount of outstanding debt K_i that each family owes. The first group will be called the "unconstrained movers". This group consists of those families whose debt is so low that the downpayment requirement does not affect their behavior. The unconstrained movers have K_i in the interval $[K^L, K^*]$. The breakpoint K^* is determined by equating the unconstrained demand in equation (3) to the constrained demand that obtains when (1) holds with equality. In other words, K^* is given by:

$$(5)\ \alpha(1+P)/P = (P - K^*)/\gamma P, \quad \text{or}$$

$$(5')\ K^* = P - \alpha\gamma(1+P)$$

The unconstrained movers each unload one unit of housing (i.e., they sell their old house) and demand $\alpha(1+P)/P$ new units. Therefore, the total population-weighted net excess demand from this group, denoted by $D^1(P)$, is:

$$(6)\ D^1(P) = G(K^*)\{\alpha(1+P)/P - 1\}$$

where K^* is defined in (5′) above.

The second group is the "constrained movers". This group has an intermediate level of debt. On the one hand, the debt level is so high that the constraint in (1) is binding. On the other hand, the debt is still low enough that families in this group prefer to move (to a smaller house) so as to be able to capture the gains from trade, θ, rather than remaining in their current house. The constrained movers have debt K_i in the interval $[K^*, K^{**}]$, and the breakpoint K^{**} is determined by equating the utility from moving to the utility from not moving.

The utility from not moving is simple to calculate. If a family does not move, they simply consume their initial endowment of one unit of food and one unit of housing. By (2), this gives a utility level of zero. Therefore, we can think of K^{**} as the level of debt for which moving yields utility of exactly zero.

To economize on notation, let us define H_i^c as the size of the new house bought by a family i subject to the constraint in (1):

(7) $H_i^c = (P - K_i)/\gamma P$.

The cost of this house will be PH_i^c, leaving family i with an endowment of $(1+P-PH_i^c)$ that can be spent on food. Thus the utility of this family, U_i^c, is given by:

(8) $U_i^c = \alpha\ln(H_i^c) + (1-\alpha)\ln(1+P-PH_i^c) + \theta$

We can now use equations (7) and (8) to implicitly define K^{**}: K^{**} is that value of K_i for which the utility level U_i^c in (8) is exactly equal to zero. Note that K^{**} is a function of P.

Each constrained mover unloads one unit of housing, and demands H_i^c new units. Therefore, the total population-weighted net excess demand from this group, denoted by $D^2(P)$ is given by:

(9) $$D^2(P) = \int_{K_i=K^*}^{K^{**}} (H_i^c - 1)\, G'(K_i)\, dK_i$$

The final group is the "non-movers". This group has the highest level of debt, in the interval $[K^{**}, K^H]$. Their debt is so high that they find it optimal to remain in their old house (thereby forsaking any gains from trade) rather than having to move to a much smaller new house. Thus the non-movers contribute nothing to net excess demand.

We are now ready to look for equilibria of the model. A necessary condition for equilibrium is that the price P be such that the total economy-wide excess demand for houses, $D(P) = D^1(P) + D^2(P)$, equals zero. In any such equilibrium, the aggregate trading volume can be measured by the combined size of the unconstrained mover and constrained mover groups--i.e., by $G(K^{**})$.

3.4 Multipliers and Multiple Equilibria

In order to gain further intuition for the forces that generate multipliers (i.e., higher values of $dP/d\alpha$ than in the benchmark perfect capital markets case) and multiple equilibria, it is useful to examine the formula for the derivative of excess demand with respect to price, dD/dP. With regard to multiple equilibria, note that if D(P) is monotonically decreasing--i.e., $dD/dP < 0$ everywhere--then the model can have at most one equilibrium. In contrast, if D(P) is not monotonic, it is possible that there are several values of P that satisfy $D(P) = 0$.

Even in the neighborhood of any single equilibrium, there can be multiplier effects if dD/dP is sufficiently small in absolute magnitude compared to the value that prevails in the benchmark case--in other words, if excess demand is relatively insensitive to changes in prices. More precisely, it can be shown that there will be a local multiplier effect if and only if the following inequality is satisfied in equilibrium:

$$(10) \quad -(1/G(K^*))(dD/dP) < \alpha/P^2,$$

where the quantity on the right hand side of (10) is the absolute value of the dD/dP that obtains in the benchmark case.

Thus downpayment effects can only lead to multipliers or multiple equilibria to the extent that they exert a sufficiently positive influence on dD/dP. This derivative can be written in simplified form as:

$$(11)\quad \frac{dD}{dP} = \frac{-\alpha}{P^2} G(K^*) + G'(K^{**})\frac{dK^{**}}{dP}\,[H_i^c(K^{**}) - 1] + \frac{\{G(K^{**}) - G(K^*)\}}{\gamma P^2}\,\{E(K \mid K^* \leq K \leq K^{**})\}$$

The derivative has three terms. The first term represents the change in demand due to the unconstrained mover group; its sign is negative. Were it just for this term, the two sides of (10) would be identically equal, and hence there would be no multipliers. Intuitively, if there are only unconstrained movers active in the market, prices are determined in exactly the same way as in the benchmark case. This is true even if the aggregate trading volume associated with the unconstrained movers, $G(K^*)$, is small relative to that in the benchmark case--fewer families may trade, but pricing is unaffected.

The second term represents the change in demand that arises from families that switch from being non-movers to constrained movers as P rises. Before the rise in P, these families contributed nothing to excess demand. Now, as they move into the housing market, they each sell their old houses, and buy $H_i^c(K^{**})$ units of new housing. This term will also be negative in the neighborhood of any candidate equilibrium, since in any equilibrium it must be that $H_i^c < 1$. Thus the second term does not help to generate multipliers--indeed, it tends to offset them.

The third term is positive, and hence is the one that creates the tendency for multipliers and multiple equilibria. Indeed, for either to exist, the third term must be larger in absolute magnitude than the second term. The third term represents the change in demand of the constrained mover group. Their demand actually increases as prices rise, because higher prices relax their liquidity constraints. Naturally, this third term will be relatively more important in regions where there are a large number of constrained movers relative to unconstrained movers.

Figures 1 through 7 illustrate the effects at work in the model. Figures 1 and 2 begin by investigating the potential for multiple equilibria, plotting excess demand as a function of price, for the case where $\alpha = .5$, $\gamma = \theta = .1$. In Figure 1, the distribution of initial debt levels in the population is quite disperse--in particular, K_i is uniform on the interval [-0.2, 1]. In Figure 2, there is a greater concentration of debt at higher levels--99% of the population has K_i uniform on [0.6, 1], while 1% of the population has no liquidity constraint whatsoever.[8] In both figures, the excess demand function corresponding to the benchmark case of no downpayment requirement is also included as a point of reference.

In Figure 1, with widely dispersed initial debt levels, the effect of downpayment requirements on the excess demand schedule is modest. The schedule is flatter than in the benchmark case, but not remarkably so. Moreover, the schedule is monotonically decreasing. Thus there is no possibility of multiple equilibria. The consequences of a downpayment requirement are not very pronounced in this example because of the dispersion of debt levels--at no point is the ratio of constrained movers to unconstrained movers ever very high.

[8]This unconstrained 1% is just a device for avoiding an even greater multiplicity of equilibria. Without it, excess demand would be exactly equal to zero for <u>all</u> prices below a certain threshold level.

Figure 2 provides a sharp contrast. Here the schedule is not only much flatter in the neighborhood of the benchmark equilibrium, it actually changes slope and crosses the axis where $D(P) = 0$ more than once. Both the right and left-most crossing points would seem to be stable equilibria, since they occur on downward-sloping portions of the schedule. Intuitively, what makes Figure 2 different is that, as prices fall towards 0.6, the relative concentration of constrained movers in the population becomes very high. This tends to impart a strong upward tilt to the excess demand schedule.

One interpretation of the multiple equilibria displayed in Figure 2 is that they create the potential for "catastrophes"--i.e., situations in which small changes in fundamentals can lead to large, discontinuous jumps in prices. This is illustrated graphically in Figure 3. This figure begins with the same excess demand schedule shown in Figure 2. It then demonstrates that when the fundamental α is reduced slightly, from .50 to .455, the higher-price equilibrium (point A) suddenly ceases to exist. The only possible outcome is now the new lower-price equilibrium, given by point B in the figure. Thus if the housing market was initially in the higher-price equilibrium, the necessary consequence of the small change in fundamentals is a dramatic fall in prices.

Even when the market is not in a region of the parameter space where such catastrophic events can occur, there can nonetheless be more modest multiplier effects from changes in fundamentals. Figures 4 and 5 examine this possibility. The figures use the same parameter values as Figures 1 and 2, respectively, but instead plot equilibrium prices as a function of α.[9]

[9]Since there can be two equilibria for the parameters in Figure 5, the figure only focuses on what happens in a neighborhood around the higher-price equilibrium, and restricts attention to values of α for which this equilibrium continues to exist.

In Figure 4, there is hardly any perceptible difference between the benchmark case and the downpayment effects case. Evidently, for this set of parameter values, the inequality in (10) is barely satisfied. Thus these parameters give little support to the notion that downpayment effects can generate additional price volatility--there is a unique equilibrium, and its price behavior is almost identical to that in the benchmark case.

In Figure 5, however, there are noteworthy multiplier effects. That is, even if we restrict ourselves solely to the higher-price equilibrium, prices are significantly more sensitive to changes in α than in the benchmark case. Thus for this set of parameter values, there are two senses in which one can think of downpayment effects as generating a higher degree of volatility--they lead to both multiple equilibria (and the accompanying potential for catastrophic price movements) <u>and</u> within-equilibrium multipliers.

Finally, Figures 6 and 7 illustrate the correlation between prices and trading volume. Again, the parameter values are the same as in Figures 1 and 2, but now the trading volume measure, $G(K^{**})$, is plotted as a function of price. The striking conclusion that emerges from these two figures is that there is a very pronounced correlation for <u>both</u> sets of parameter values, although that in Figure 7 is stronger than that in Figure 6.

Overall, the figures suggest that the model's implications for the price-volume correlation are somewhat more robust than its implications for volatility. Indeed, it is precisely <u>because</u> of the strong price-volume correlation that the volatility results are not always so striking. The intuition that was given in the Introduction--that prices declines lead to reduced liquidity and reduced demand, and thereby feed on themselves--is actually incomplete. As prices fall, those families with the most impaired liquidity drop out of the market completely. Thus they <u>do not</u>

contribute in a negative way to excess demand. For some parameter values, the ability of low-liquidity families to opt out of the market acts as a safety valve that tends to cut off downward price spirals.

4. Endogenizing the Downpayment Requirement

Thus far, the downpayment requirement has been taken as exogenous to the model. Although such a requirement (or something quite like it) certainly seems to fit with what is observed in reality, the question arises of whether it can be explained in the context of a model with rational participants.

Suppose that, in addition to the families described above, there are a large number of "defaulters" in the economy. Defaulters differ from other families in a number of ways. First, and most importantly, they have no observable income at time 2. Thus they can never be made to repay any loan that is extended to them at time 1. (Implicitly, the model above has assumed that all the time 2 income of the other families is publicly observed, so that they can always be held to their debts.)

Defaulters also own one unit each of housing stock at time 0, and have no outstanding debts at this time. They can either consume their "old" house at time 1, or they can attempt to move to a new house. The utility of a representative defaulter, U_d, is given by:

(12) $U_d = H^{old} + \beta H^{new}$

where $0<\beta<1$. Thus defaulters have linear utility, and would prefer to stay in their old houses if the shadow price of new and old houses were the same.

However, defaulters may view new houses as effectively cheaper, if they can borrow to buy them and then default on the loan. For example, suppose $\beta = .5$, $P = 1$, and the downpayment requirement γ is only .2. In this case, a defaulter can sell the old one-unit house for 1, take the proceeds and make a downpayment on a new five-unit house, and then not repay the loan. This will yield a utility of $.5 \times 5 = 2.5$, which exceeds the utility of 1 that the defaulter gets from staying in the old house.

This suggests that if lenders cannot distinguish defaulters from other families ex-ante, and they wish to screen out defaulters, they must set $\gamma > \beta$. This will deter defaulters from attempting to pool with other families by buying a new home and taking out a loan.

The required downpayment can be made smaller if it is possible to punish defaulters in some way ex-post. Following Diamond (1984), one might imagine that a non-pecuniary penalty (time spent in court, social stigma, etc.) is imposed on those who do not repay their loans. If the utility value of this cost is given by z, then the minimum downpayment that deters defaulters from borrowing need only satisfy $\gamma > \beta/(1+z)$.

Although the above example is highly stylized, it does seem to capture the basic economic intuition behind a downpayment requirement. If a potential homebuyer does not have to put up any money at the time of purchase, there is nothing to prevent him from buying a very large house, living in it (and thereby depreciating it) and then walking away, leaving the lender holding the bag. A downpayment that is proportional to the purchase price of the house can effectively make the prospective homebuyer internalize some of the lender's losses, thereby deterring the "walk away" strategy. When combined with ex-post sanctions, the downpayment requirement becomes more potent in this regard, and hence can safely be reduced.

5. Implications of the Model

5.1 The Behavior of House Prices

The fact that the model can generate both multiple equilibria as well as within-equilibrium multipliers suggests that downpayment effects may cause house prices to be more volatile than in a standard efficient markets setting. However, some care must be taken when interpreting the model in light of the empirical literature on the time series behavior of house prices, as the model is essentially a static one. Thus it would be something of a stretch to claim that the model in its current form can help explain, say, the Case and Shiller (1989, 1990) finding that house price changes are positively correlated at short horizons but negatively correlated at longer horizons.

In order to obtain more precise predictions about such time series behavior, the model would have to be extended to explicitly incorporate intertemporal considerations. This may be quite difficult to do, particularly if one wants to still be able to derive the form of the mortgage contract endogenously. In an intertemporal setting, the size of the downpayment lenders require today will presumably depend on the collateral value of the house--i.e, how much it will be worth if it is repossessed and sold on the open market tomorrow. The price tomorrow in turn depends on the downpayment requirement that prevails tomorrow, and so on. Thus the problem quickly becomes very complicated.[10]

[10]In the static model presented above, houses have no collateral value--they are implicitly assumed to be worthless after they are lived in for one period. As we have seen, in this case, a downpayment protects the lender not by ensuring that he will have adequate collateral underlying his loan, but only by screening out default-prone borrowers.

The model may also be able to shed some light on cross-sectional variations in house prices. This point is most easily understood in the context of an extreme example. Suppose there are two distinct types of houses: 1) "starter" houses, which are only ever purchased by first-time buyers; and 2) "repeat" houses, which are only ever purchased by buyers who are also selling an existing home. The logic developed above applies only to the repeat market, and not to the starter market, since in the starter market there is no feedback from house prices to buyer liquidity. Thus one should expect the prices of repeat houses to be more sensitive to changes in fundamentals than the prices of starter houses.

In practice, testing this hypothesis is likely to be tricky, since the empirical distinction between starter and repeat houses is not totally clear-cut--while larger houses are probably more likely to be purchased by repeat buyers, the two markets are certainly not completely segmented. Moreover, there are a number of other factors that could cause larger-house prices to be more sensitive to fundamentals than smaller-house prices; for example, higher-income families could also have more volatile incomes.

These caveats notwithstanding, it is still interesting to note some recent empirical results. Smith and Tesarek (1991) find that during the housing boom that occured in Houston from the 1970's through 1983, the prices of larger, more expensive homes rose significantly faster than the median price. This pattern was then reversed in the housing bust that followed, with large home prices falling faster through 1987.

As noted in the Introduction, the account of house price volatility given here probably does not carry over well to many other asset markets where downpayment effects are likely to be far less important, e.g., the equity market. One might argue that this specificity makes the theory less attractive, particularly in view of the fact that prices in many other asset markets share some of the time-series characteristics of house prices.[11] Indeed, Cutler, Poterba and Summers (1991) have suggested that these common time-series properties--a tendency toward positive correlation at short horizons, negative correlation at longer horizons, and fundamental reversion--can be explained in terms of "speculative dynamics" that operate similarly across all asset markets.

The counter to this view is that it may make little theoretical sense to expect the same speculative dynamics to arise in markets as diverse as those for equities and houses. The models that generate the sort of speculative dynamics which Cutler et al have in mind--e.g., the bubble model of Blanchard and Watson (1986) and the noise trader/positive feedback trader models of DeLong et al (1990a, 1990b) rely critically on agents having short holding periods. Traders in these models behave the way they do only because they anticipate reselling the asset soon after they buy it. This short-horizon assumption may make some sense in the context of the stock market, where trading costs are low and turnover is greater than 50% per year, but it is much less clear that it fits the housing market. Therefore, it may be an unnatural and inappropriate goal to have a single unified theory of the time-series properties of all asset prices. If the housing market is distinct in certain important ways, it makes sense to have a model that captures these distinctions.

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[11]Some other asset markets also share the tendency to exhibit a correlation between prices and trading volumes, although it is not clear that the correlation is as pronounced as in the housing market. See, e.g., Lakonishok and Smidt (1986) for some evidence from the stock market and a discussion of competing hypotheses.

5.2 Trading Volume

The most robust prediction of the model is that trading volume will be correlated with prices. The only practical issue that the static model fails to address in this regard is whether it is some measure of the change in prices, rather than the level, that has the most explanatory power for trading volume. The answer to this question probably depends on the distribution of lengths of time that would-be movers own their old homes before seeking to trade. For example, if all would-be movers bought their old homes exactly one year ago, then the change in prices over the last year would be a good measure of the state of their liquidity. In contrast, if would-be movers bought their homes at different times over the last twenty years, the level of prices, rather than the recent change, may be a better indicator of the state of the typical mover's liquidity.

Figure 8 provides some data on the price-volume relationship, plotting the monthly U.S.-wide volume and median real sales price for existing single-family homes between 1968 and 1992. This is a somwehat crude approach--one might expect the correlation between these two variables to be most pronounced at the level of a single city or regional market, so that aggregating over the entire country would blur the relationship somewhat. Nonetheless, the correlation at the national level is visually striking, and some simple statistical exercises confirm the visual impression. I ran a regression of volume against: i) the last year's percentage change in prices; and ii) a linear time trend. The regression produces a coefficient on the former variable that is highly statistically significant, with a t-stat of 4.9. Moreover, the point estimate suggests that a 10% drop in prices reduces volume by over 1.6 million units. Given that total volume has been in the range of 3 to 4 million units in the last several years, this effect is clearly of major economic importance.[12]

While these sorts of correlations are certainly consistent with the model's predictions, they do not constitute a very sharp test. That is, they do not clearly differentiate between the downpayment effects hypothesis and other alternative hypotheses--e.g., the behavioral explanation that sellers refuse to "recognize reality" and accept low prices in depressed markets. In order to be able to distinguish these two types of stories, it would be useful to have transaction-level data with information on seller characteristics. Then one could check to see if, for example, those families that did sell their houses in bad times had on average lower outstanding mortgages (or equivalently, larger holdings of liquid assets such as cash and securities) than those that sold in good times. Such a finding would cut quite decisively in favor of the downpayment effects hypothesis.

5.3 Waiting Times

Taken literally, the model has nothing to say about the length of time a house sits on the market before it is sold, or about why this waiting time might be correlated with price movements. However, such predictions can be generated by appending a simple search technology to the current model. Rather than presenting such an extension of the model formally, I will just lay out the basic intuition.

The search technology works as follows. A seller can either 1) sell with certainty at the current "auction market" price; or 2) "fish" for a better price. Fishing involves listing the house at an above-auction-market price; the tradeoff is that there is a significant probability that the

[12] I also ran separate regressions for four regions of the country: Northeast, Midwest, South and West. In each case, the percentage change in price continued to be very significantly related to volume.

house will not be sold immediately, if ever.

The important insight is that the opportunity cost of fishing is zero for families that would otherwise be non-movers--if these families do not fish, it is certain that they will have to remain in their old homes. At the same time, fishing holds some potential upside for these families. If they get lucky and sell their house for an above-market price, they may have sufficient cash to make moving worthwhile. Thus fishing is a no-lose proposition for families that are in the non-mover group.

In contrast, fishing has a positive opportunity cost for families that are in the other two groups--if they fish and are unsuccessful, they give up their opportunity to move to a new house and thereby enjoy the gains from trade. Thus there should be more fishing when there are more families in the non-mover range--i.e., when prices and trading volume are low. Empirically, the greater concentration of the fishing strategy in the population will show up as more houses sitting on the market for a significant period of time before they are sold. Hence the prediction of this extended version of the model is that waiting times will be negatively correlated with prices and trading volume.

In this simple version of the story, the search technology is invariant to the other parameters of the model. However, one can strengthen the argument for a correlation between prices and waiting times by noting that the search technology itself may work differently in high and low markets. In particular, it seems plausible that matching will be easier in markets with higher trading volume; this "thick markets" effect has been noted by a number of authors. (See, e.g., Diamond 1982).

If it is indeed the case that matches are easier to find in high volume markets, then it is likely that the average waiting time associated with a search strategy is shorter. That is, if a seller lists a house at a given percentage above the auction market price, he will on average have a shorter wait if there are more potential buyers in the market.

Now there is a second channel through which house prices can be correlated to waiting times: as house prices fall, trading volume drops for the reasons outlined above. With lower trading volume, those who choose to pursue a search strategy have to make do with a less efficient matching technology, and thus typically must wait longer to sell their houses.

To summarize, there are two distinct links between house prices and waiting times. The first is the "fishing for liquidity" link: lower prices lead to less liquid families and hence to a greater concentration in the population of the fishing strategy. The second is the "thick markets" link: lower prices lead to less trading volume, which in turn forces those sellers who do search to wait longer for a good buyer.

In principle, it should be possible to distinguish these two channels empirically. Again, the key to doing so would be transaction-level data of the sort discussed above, that includes information on seller characteristics. If the "fishing for liquidity" story is correct, one should observe a cross-sectional correlation between a house's time-to-sale and the size of the seller's mortgage. That is, there should be longer waiting times for houses that are being offered by sellers who are more deeply in debt.[13]

5.4 Housing Starts

The model of this paper may also be able to shed some light on the cyclical behavior of

[13]I thank Chris Mayer for pointing out this implication of the theory to me.

housing starts. As noted earlier, Topel and Rosen (1988) find that housing starts are sensitive not only to house prices, but to waiting times as well.

The correlation between housing starts and waiting times can be explained using a logic very similar to that developed in Section 5.3 to explain the correlation between trading volume and waiting times. Indeed, the story is essentially the same one, with would-be mover families replaced by capital-constrained builders.

Suppose that when a builder starts a new project, he needs to put up some of his own money as a downpayment on the land, materials, etc. His ability to make such a downpayment will depend on the prices he is able to realize on the houses he is just completing. If house prices fall, the builder will do worse than expected on the sale of his current inventory of houses, and will have a more difficult time coming up with the funds to move on to the next construction project.

When liquidity constraints are not very binding, the builder should move from one project to the next without undue delay--that is, he should sell houses promptly as he finishes them, take the proceeds, and use them to move on to the next job. However, if liquidity constraints become very severe, the builder is in a position exactly analogous to the non-mover families in the model above. There would be gains from trade if he could move on to the next project, but if he sells his current house (or houses) at the prevailing market price, he will have insufficient cash to move on. Thus at some point it will become optimal for the builder to shift to the "fishing for liquidity" strategy.

Until the builder's fishing strategy pays off, (i.e, while his finished house sits on the market) he cannot move on to the next project. Thus one will observe a correlation between waiting times and housing starts. To the extent that the level of house prices is not a perfect summary statistic for the state of builder liquidity--e.g., builder liquidity may also be influenced by recent changes in prices--this correlation will show up in a regression even when the level of house prices is added as an additional explanatory variable.

As in the previous section, one can augment this "fishing for liquidity" story with a second "thick markets" channel. Even if builders themselves are not capital-constrained, they may face a time-varying search technology due to liquidity constraints on the part of prospective homebuyers. During periods when homebuyer liquidity is reduced--due, say to a sudden drop in house prices--there will be less trading volume for the reasons identified earlier. This lower trading volume makes it harder for builders to find a good match for the houses they are completing, and all else equal, will cause them to search longer and build less.

As before, it should again be possible to separate these two channels empirically. The key to doing so would be data on time-to-sale and housing starts that is at least partially disaggregated by builder. If builders' capital constraints are a central part of the phenomenon, then we should expect to see a more pronounced correlation between waiting times and housing starts for those builders who are most capital-constrained. Thus the correlation should be strongest for small, heavily indebted builders; larger construction companies with a greater degree of access to external finance should have behavior that is less sensitive to waiting times.

If, on the other hand, the phenomenon is due mainly to homebuyers' liquidity constraints and the accompanying time-variation in trading volume and matching technology, then there is no reason to expect systematic differences across types of builders.

6. Conclusions

The model of the housing market developed above is extremely simple and stylized, yet it yields a variety of implications. Several of these appear to be broadly consistent with existing empirical evidence, but a number of the model's most distinguishing predictions have not yet been carefully tested.

In brief, the key conclusions of the paper are:

1) In some cases, downpayment effects can dramatically increase the volatility of house prices--they can lead to multiple equilibria and/or within-equilibrium multiplier effects. Somewhat surprisingly however, these results are sensitive to parameter values. Loosely speaking, the excess volatility results hinge on there being a relatively large proportion of the homeowner population concentrated in a narrow range of high loan-to-value ratios.

2) Downpayment effects provide a robust explanation for the correlation between house prices and trading volume. They also provide a natural rationale for the correlation between house prices and time-to-sale.

3) Finally, one can use a similar sort of logic to think about the relationship between time-to-sale and housing starts.

There are a number of directions in which the basic model might be extended. First, as noted above, it would be desirable (albeit difficult) to make the model an explicitly intertemporal one, in order to generate sharper predictions about the time series behavior of house prices. Second, it might be interesting to append a rental sector to the model. In the current version, the only option a family has besides buying a new home is to stay in their old one. In reality, it might instead make sense for a liquidity-constrained family that needs to move to rent a new place, at least temporarily. The ability of families to avail themselves of this third option might well alter the response of prices to changes in fundamentals.

Finally, if one is interested in pursuing the model's implications for time-to-sale in more detail, it could be useful to make the search technology described above more explicit. Presumably, this would involve adding some degree of heterogeneity to the housing stock, so that not all houses are equally well-suited to all buyers, and there is a substantive matching problem.

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Figure 1

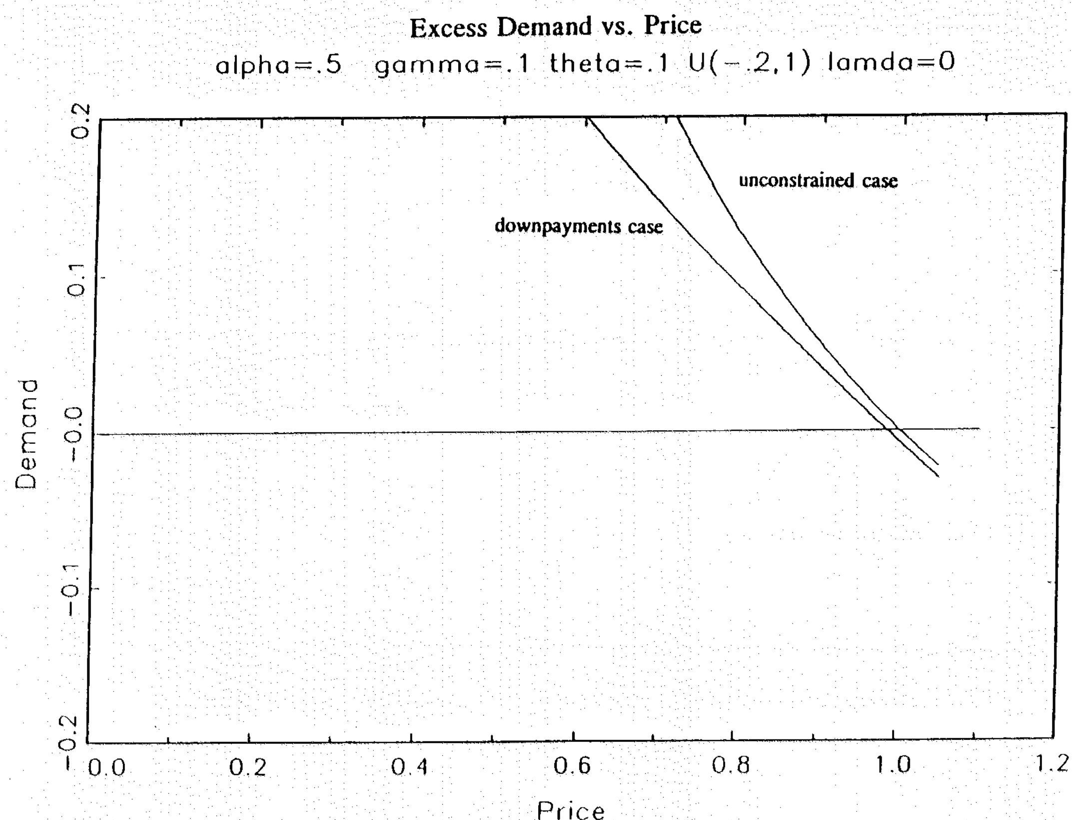
Excess Demand vs. Price
alpha=.5 gamma=.1 theta=.1 U(-.2,1) lamda=0
unconstrained case
downpayments case
0.2
0.1
-0.0
-0.1
-0.2
Demand
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Price

Figure 2

Excess Demand vs. Price

alpha=.5 gamma=.1 theta=.1 U(.6,1) lamda=.01

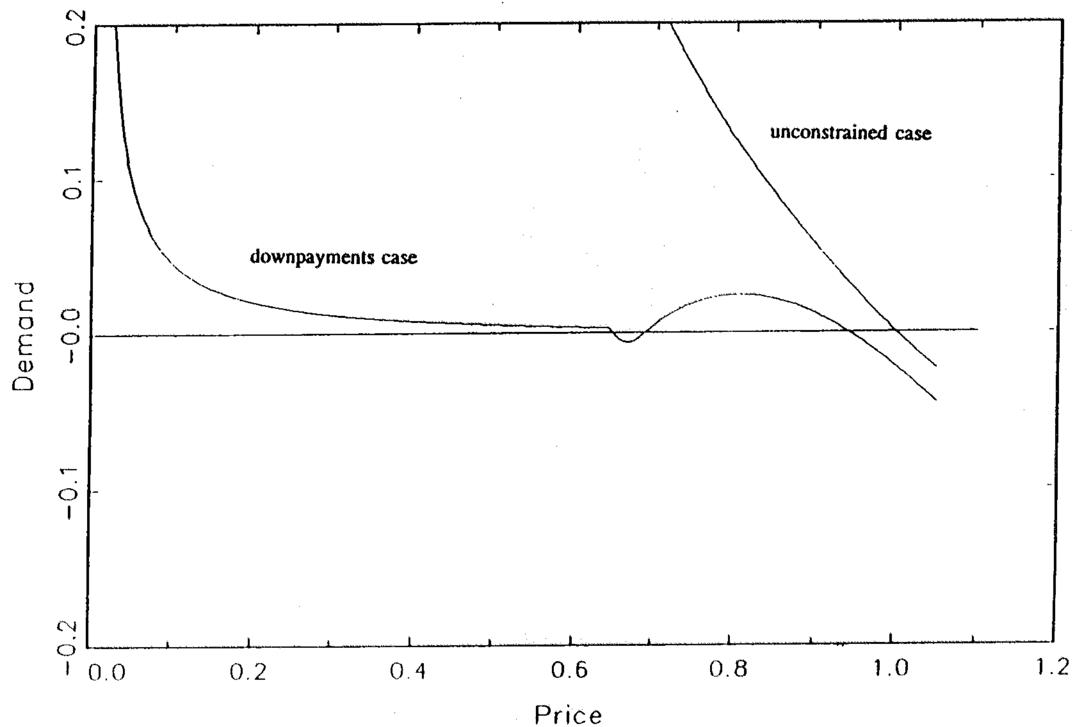

Figure 3

Excess Demand vs. Price
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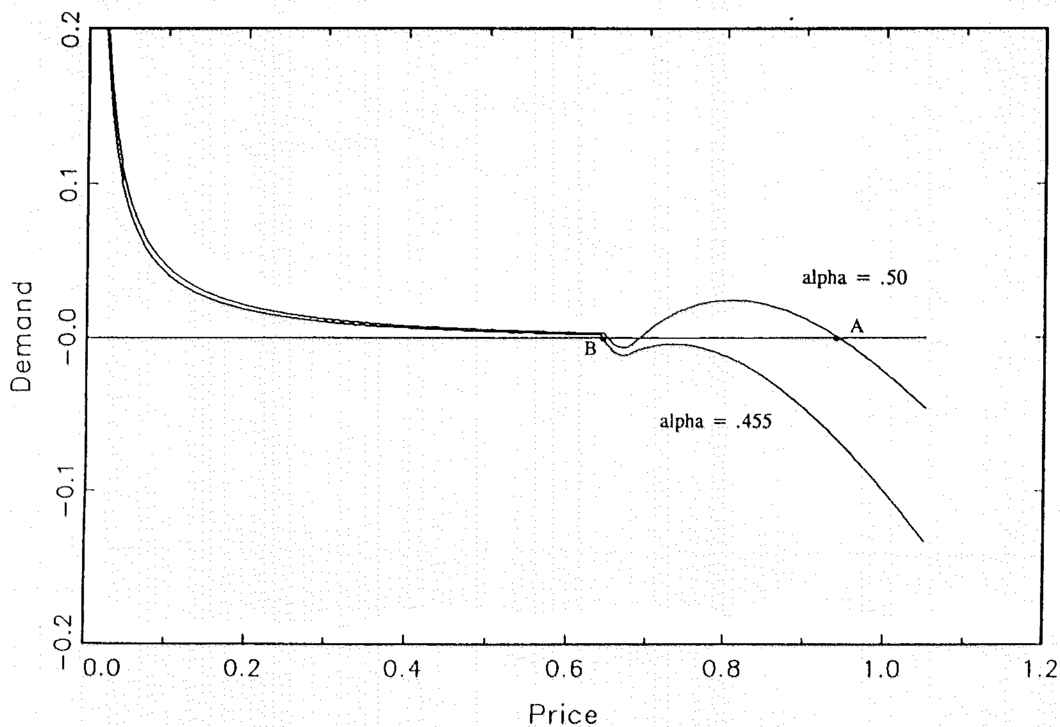


Figure 4

Price vs. alpha

gamma=.1 theta=.1 U(−.2,1) lambda=0

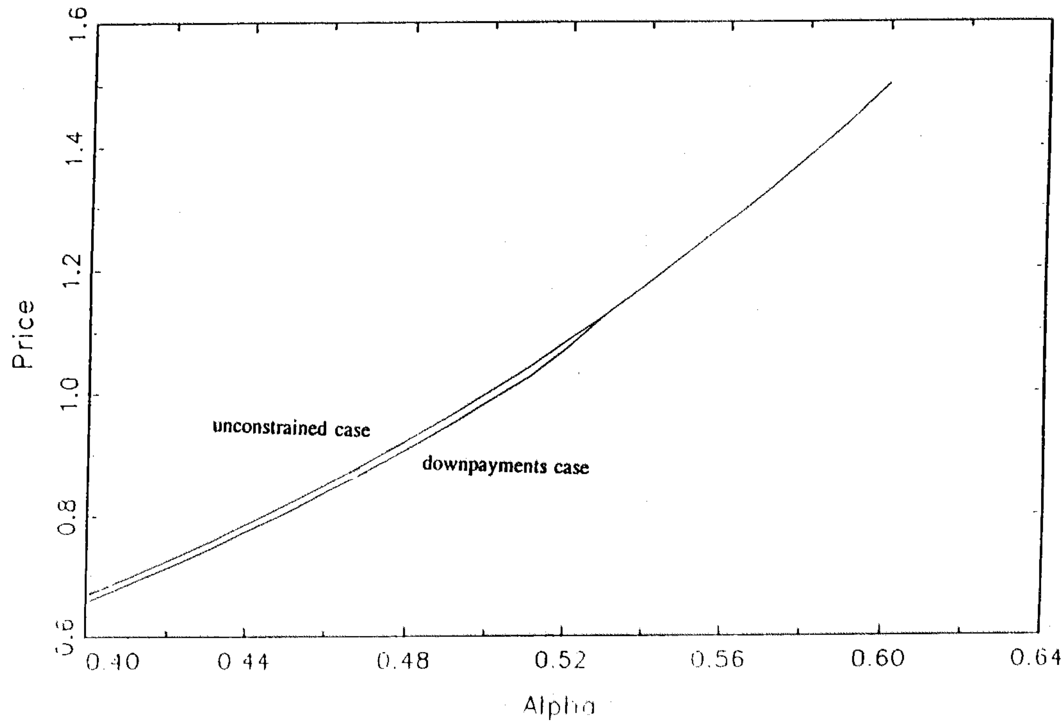


Figure 5

Price vs. alpha

gamma=.1 theta=.1 U(.6,1) lambda=.01

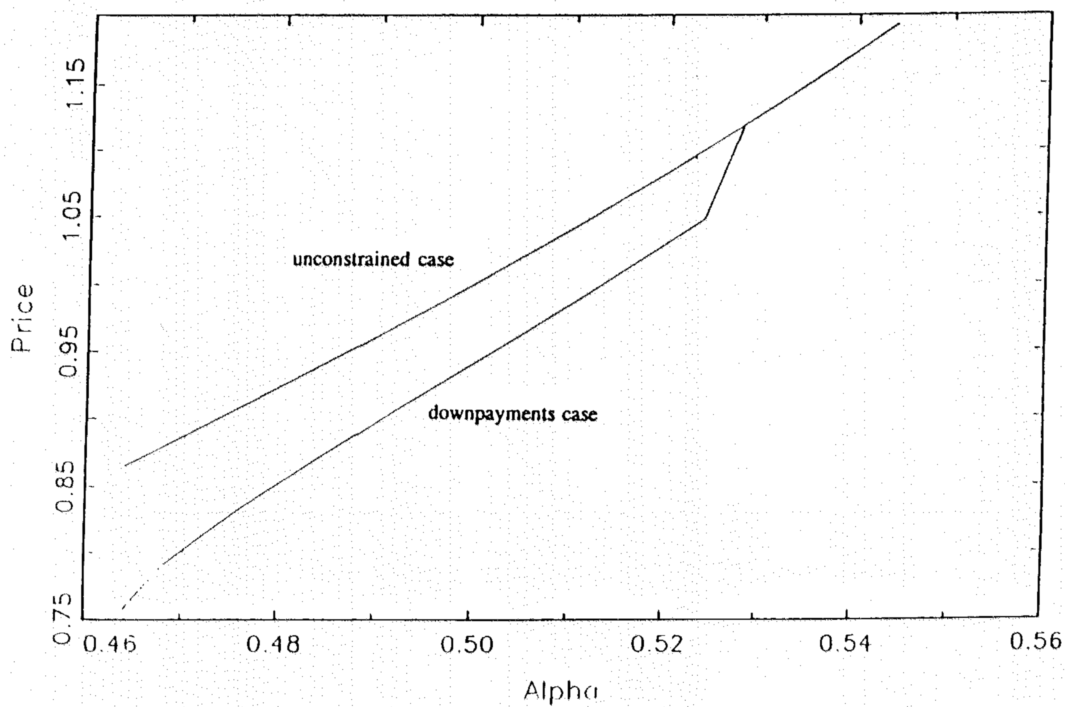


Figure 6

Trading volume vs. price

gamma=.1 theta=.1 U(−.2,1) lambda=0

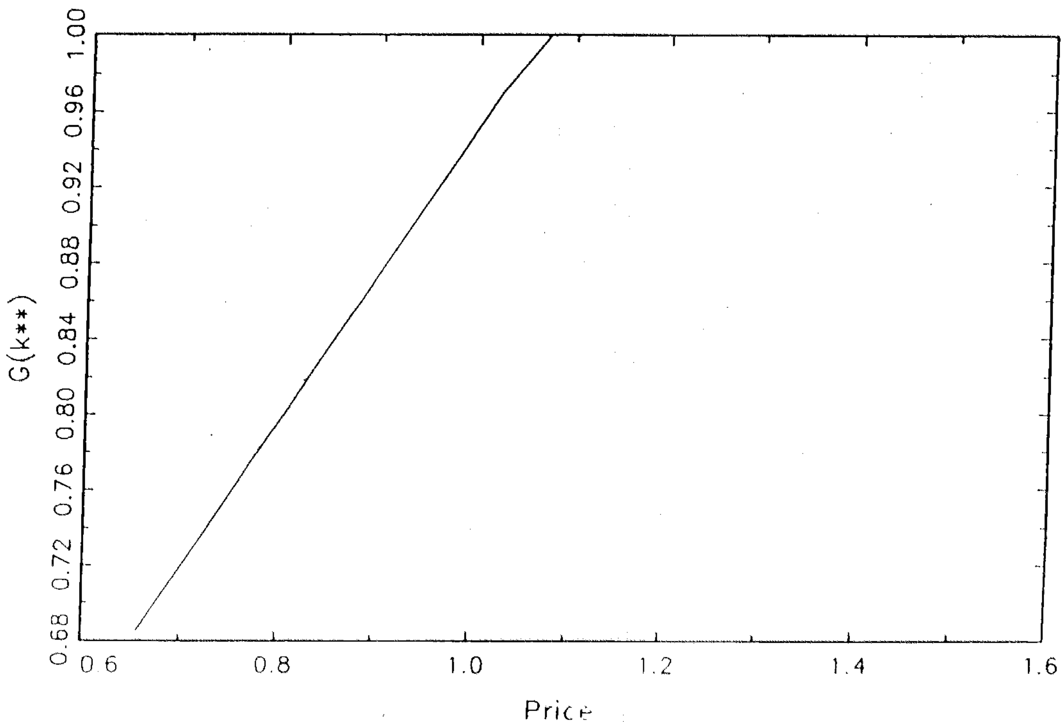


Figure 7

Trading volume vs. price

gamma=.1 theta=.1 U(.6,1) lambda=.01

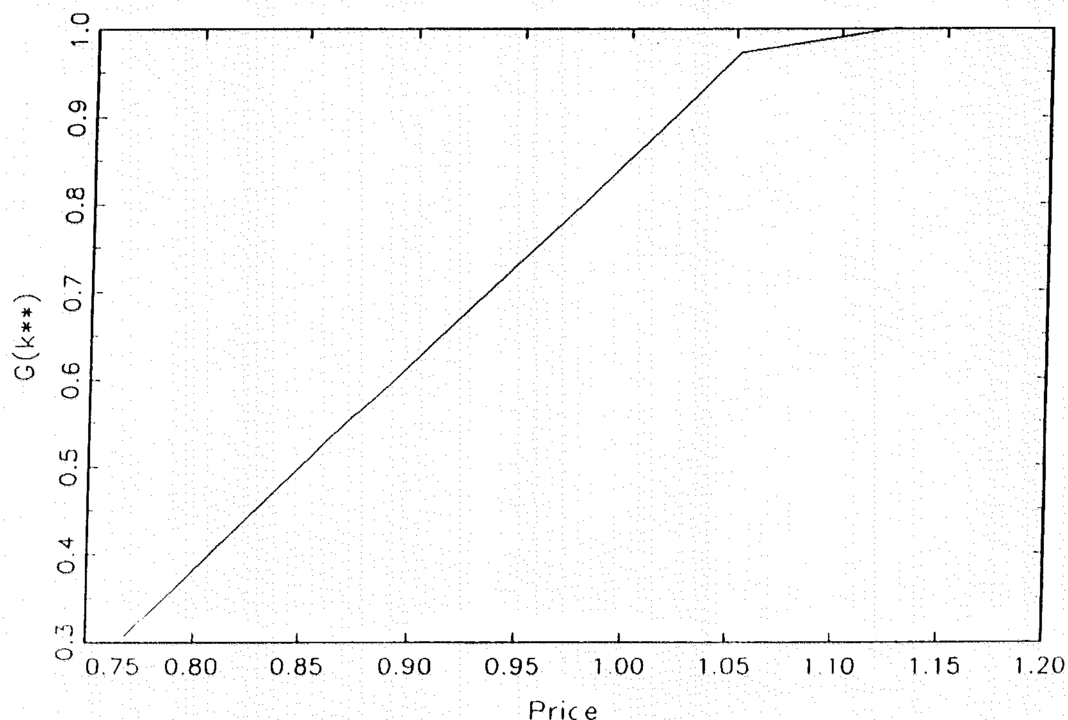
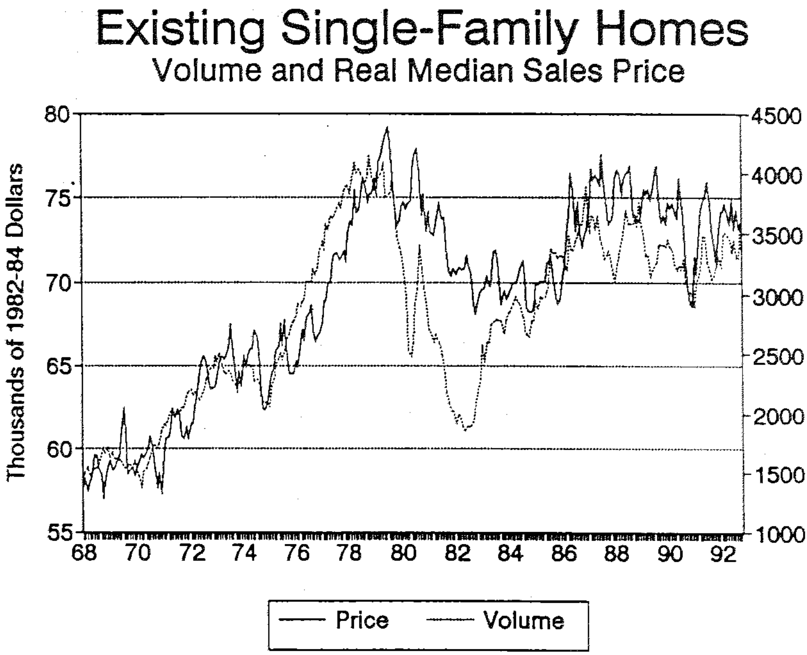


Figure 8


Existing Single-Family Homes
Volume and Real Median Sales Price
Thousands of 1982-84 Dollars
Thousands
80
75
70
65
60
55
4500
4000
3500
3000
2500
2000
1500
1000
68
70
72
74
76
78
80
82
84
86
88
90
92
Price
Volume