High and Low Activity in Housing and Labor

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PRELIMMINARY

1 Introduction

Housing, labor and other markets with trading frictions often appear to experience prolonged spells of high and low turnover.[1] Although specifics vary across particular markets and over time, the general impression is that during very active periods, prices are high. Prices are low when turnover becomes slack, if trade occurs at all. This paper demonstrates the way in which such distinct hot and cold trading episodes can arise given a stock-flow matching process.

Stock-flow matching (see Taylor, 1995; Coles and Smith, 1998; Coles and Muthoo, 1998; Coles, 1999; Gregg and Petrongolo, 2005; Lagos, 2000) assumes that buyers and sellers do not search randomly. Instead, market participants have a good idea about where to look for suitable partners. They check public and private intermediaries such as real estate or employment agencies, ads in newspapers and in websites, or ask friends and relatives. As in the directed search literature (e.g. Montgomery, 1991; Acemoglu and Shimer, 1999; Burdett et al, 2001), the stock-flow literature assumes the

[1]Stein (1995) and Muelbauer and Murphy (1997) document this behavior for the housing market.

polar case that traders are fully informed about all opportunities currently on the market.

Unlike in the directed search literature, buyers and sellers in a stock-flow matching economy are heterogeneous. Markets consist of distinct submarkets, differentiated by location and other characteristics,[2] in which there are no trading frictions. Submarkets are, however, self-contained such that agents can only trade within their assigned submarket. For example, the labor market for construction workers in an urban area might be made up of plumbers, electricians, carpenters, bricklayers, roofers and so on who possess skills suitable for jobs only in their designated specialization and location. Likewise, in the housing market, buyers look exclusively for a precise combination of rooms, acreage, local amenities and so on in a limited area.

As buyers and sellers independently come and go in each submarket, the population fluctuates stochastically so that traders can be on either the long or the short side of their submarket. If lucky, an entrant is on the short side and finds one or more options immediately available in their submarket. If the entrant is unlucky and on the long side, there are no potential partners immediately at hand. In the event that no partners currently exist in the submarket, the entrant becomes a part the stock or queue of traders on their side of the market and must wait to match from the flow of new entrants on the other side.[3]

The innovation introduced here is to allow endogenous seller entry. To maintain a balanced market over time, the stock-flow literature typically assumes that buyers and sellers independently enter the market at the same exogenous Poisson rate. In this paper, sellers have a higher potential arrival rate than buyers but they have the option to decline the opportunity to enter the market and its associated cost. To illustrate, consider a housing submarket in which buyers bid for available homes in a public, complete information auction. Suppose a developer receives the opportunity to build a new home. If the developer knows that two or more biders are willing to make offers, it will pay the cost of building the house knowing that Bertrand bidding by the buyers will result in the seller obtaining the gains to trade. On the other hand, with one or zero bidders present, the seller will face a

[2]Stock-flow also allows traders to submit multiple job applications as in Albrecht et al, (2003) who consider a directed search model with multiple applications by job seekers.

[3]Coles and Smith (1998) obtain compelling evidence in favor of this matching behavior. See also Gregg and Petrongolo, 2005; Andrews, Bradley and Upward, 2001; Coles and Petrongolo, 2008; Kuo and Smith, 2009.

monopolistic buyer (either immediately or in the future) who captures the gains to trade. Entry does not occur in this case.

Sellers know the number of bidders, to some extent, from the previous auction. If the were N bidders in the last auction, there must be at least $N-1$ for the next. As such, developers will enter until only one known bidder remains. The market then goes quiet and developers reject the opportunity to enter the market. Buyer entry will gradually replenish the market. Assuming buyer entry is not revealed until the auction is held, the market remains dormant or fallow until sellers think enough time has passed to make it profitable to enter the market. When the market reopens, if new buyer entry has not occurred, the lone old bidder pays a low price and the market becomes dormant again. If entry was high, the bidders offer high prices and entry remains active until the queue of buyers dwindles down again.

This pattern of trade is inefficient. When entry gets turned off with one bidder known to be waiting, gains to trade are passed over. A monopoly bidder exists but prospective sellers do not respond. In the housing market, a developer first pays an entry cost which may be thought of as the cost of building the home. If entry were to occur, the monopoly bidder would not compensate the seller for this sunk cost. The outcome of this fallow period is therefore inefficient.

Several factors - the rate of buyer entry, housing costs - naturally determine the duration of these active and inactive spells and hence the efficiency of the market. Perhaps more interestingly, resale of existing houses or worker turnover in established positions will also shape the pattern of entry and the duration of these fallow and fertile spells. More specifically, housing, labor and similar markets share the feature that matched pairs of traders can involve either new entrants or previous participants. New houses sell along side already occupied housing. Job creation and job turnover potentially offer employment to workers. As markets can vary in their composition of new and returning traders, the paper assesses the effect that resale or mobility has on this type of market.

2 THE MODEL

Individual buyers enter a continuous time market for an indivisible good at the constant Poisson rate β. There are two potential types of sellers. New sellers have the option to create a new good and enter the market. Old sellers have an existing good ready for market and automatically enter. Buyers and old sellers always participate whereas new sellers can choose to take advantage of their opportunity or not. New sellers receive the opportunity to participate in the market at the rate $\sigma > \beta$. If a new seller enters the market, the cost of entry is F. Old sellers enter at rate $\alpha < \beta$.

In the housing market new sellers might be thought of as developers who observe a potential site to build on whereas old sellers already own a house and are compelled to move for some reason. Alternatively, new sellers might be current owners who are less motivated to relocate than old sellers.[4] In the labor market context, new sellers represent job creation whereas old jobs correspond to job turnover. In these leading examples, old sellers act like recyclers or re-sellers. However, no formal link of this sort is made. In particular, buyers will not take into account the future value of resale in making their decisions.

In the resale context, not all goods make it back on to the market and hence the entry rate of old sellers, α is less than the entry rate of buyers, β. Old sellers do not pay entry or any other type of cost. Since the old sellers are compelled to entered the market, it is immaterial whether they pay the entry cost F. All agents are risk neutral - they maximize expected receipts - and discount at rate r. Idle agents receive and make no payments.

Any seller, old or new, who enters the market holds an auction for their good. An accepted bid at price p yields a payoff $x-p$ to the buyer and revenue p to the seller. After a trade takes place both the consummating buyer and seller leave the market. Unsatisfied buyers and sellers remain behind to wait for the next trading opportunity.

Once entry occurs, there are no impediments to trade. Agents are perfectly informed about market conditions. Before entry occurs, a new seller who receives an opportunity to trade knows the outcome of the previous auction, including the number of bidders and the date of the auction. This seller, however, does not know the outcome of buyer entry over the period since the last auction. On the other hand, the new seller contemplating entry knows if there are any unsatisfied sellers existing in the market.

ASSERTION: Immediate trade occurs so that the market never simultaneously has unsatisfied buyers and unsatisfied sellers.

See Coles and Muthoo (1999) for a discussion of this assertion.

[4]Albrecht et. al. (2007) analyze a search theoretic model of the housing market with motivated and relaxed traders on both sides who always enter the market.

2.1 HOT AND COLD MARKETS

At any given point in time, new sellers who obtain an opportunity to enter the market decide whether to accept or decline this opportunity. In hot or active markets, given the known number of bidders remaining from the last auction as well as the duration since that event, new buyers decide to enter. In cold or dormant markets, given this information new buyers decline the opportunity to participate thereby saving the fee F.

In a cold market, new sellers are waiting for buyer entry to replenish the market. Since buyer entry follows a known underlying process that is unobserved by sellers, the transition can come in one of two ways. An old seller can enter automatically and trigger an auction. The outcome of this auction reveals the number of buyers who have entered during the cold phase of the market and hence resets the entry decision of potential new sellers. If a sufficient number of bidders appear in the auction, the market becomes active. If not, the waiting decision resets itself to the beginning of the cold phase.

The cold phase may also end after a period of complete market inactivity, that is after a sufficiently long period without any old seller entry. After some length of time, seller expectations of (unobserved) buyer entry eventually improve enough to induce entry. These expectations and hence the potential duration of inactivity depend on the outcome of the previous auction.

Hot markets, on the other hand, turn fallow once entry becomes no longer profitable. Expected profits from an auction depend on the expected number of bidders found in the market. Since buyers exit only after consummating a trade, the expected number of buyers depends on both the known number remaining from the previous auction and subsequent entry since that auction.

Assuming that the market becomes less profitable as the number of bidders decline, a hot market becomes dormant immediately following an auction with some threshold number of buyers. Directly after an auction, the number of potential bidders is known with certainty. The market will resume activity after a sufficient time elapses for expected turnover to revitalize the market or for the entry of an old seller to reveal sufficient buyer demand.

The previous auction may have any number of excess bidders from zero, one, or more. Monopolistic bidding markets - those with one or zero bidders left over from the last auction - allow buyers to capture the entire trade surplus. Since market power in these cases rests with buyers, these markets are assumed for now to be cold. On the other hand, suppose that if there are two or more bidders left over. These Bertrand competitors are on the short side of their market once entry occurs and thus market power resides with the seller. In this case, immediate entry (if available) is assumed to be profitable, the market is hot. Conditions on entry fee levels will be derived below that deliver these outcomes.

2.2 MARKETS WITH EXCESS BUYERS

Assuming that a sufficiently strong expectation of monopolistic bidding deters entry, a market becomes cold and dormant if the previous entrant found zero, one or two bidders available for the auction. A prospective seller knows that there exists one buyer right after an auction with two bidders and that there are no bidders immediately following an auction with only one or zero bidders. Auctions without any bidders imply (a weak) excess supply of sellers which is discussed below. This section discusses the market following an auction with single seller and at least one bidder.

Buyer payoffs

Let $H(N)$ represent the payoff to a buyer from being in a hot, active market where $N \geq 1$ denotes the number of bidders (including the buyer) in the market waiting for the arrival of a seller. If $N = 1$ and entry occurs, the single bidder has monopoly power. For $N \geq 2$, bidding is competitive. Similarly, let $C(N, T)$ represented the expected payoff to a buyer in a cold market with N bidders who must wait a duration T before entry of new sellers becomes viable again, i.e. the remaining duration without any old seller entry before new sellers with the option of entry become willing to pay F to visit the market.

Let $P(N)$ represent the price resulting from an auction with $N \geq 1$ bidders. In the Bertrand pricing game with more than one buyer, buyers bid prices up until the gains to trade from purchasing the currently available good equal the payoff of staying in the market and waiting for the next auction. For $N \geq 2$, the buyer is indifferent between paying $P(N)$ and waiting for the next entrant, whether in a hot or cold market :

$$\begin{aligned} P(N) &= x - H(N-1) \qquad N \geq 3 \\ &= x - C(1, T_1) \qquad N = 2 \end{aligned}$$

where T_1 represents the duration new sellers will wait before entering given there was one buyer in the market at the last auction when the market became cold. $P(1)$, the price paid when the market is balanced with one buyer and one seller, is discussed below. With zero production costs after the entry fee, the seller accepts the highest non-negative bid.

With probability $\alpha e^{-\alpha t}dt$, an old seller enters the market during the cold period after a duration t and triggers an auction with the existing bidders and any other buyers who might have entered during the cold period up to time t. In this environment, the buyer's expected payoff in a cold market can be written as

$$\begin{aligned} C(N,T) &= \int_0^T \alpha e^{-(r+\alpha)t}\sum_{i=0}^{\infty}\pi_i(t)[x-P(i+N)]dt \\ &\quad + e^{-(r+\alpha)T}\sum_{i=0}^{\infty}\pi_i(T)H(i+N) \end{aligned} \tag{1}$$

where $\pi_i(t)$ denotes the probability that i buyers enter the market after a duration t in which case $N+i$ bidders await an incoming seller. Since buyers enter at Poisson rate β, the probability of i entrants after duration t is given by

$$\pi_i(t) = \frac{e^{-\beta t}(\beta t)^i}{i!}$$

Now consider the bidder payoff in a hot market. Suppose the buyer is alone in the market. With a monopoly position $(N=1)$[5], the buyer receives $x-P(1)$ if seller entry occurs and $H(2)$ if buyer entry occurs. Accounting for arrival rates, this expected payoff can be written as the linear difference equation:

$$H(1) = \frac{1}{1+rdt}\left[(\alpha+\sigma)dt(x-P(1)) + \beta dt\, H(2) + (1-(\alpha+\sigma+\beta)dt)H(1)\right].$$

With one other bidder $(N=2)$, seller entry results in an auction that will leave one known, unsatisfied bidder remaining for the next auction. This outcome stops entry of new sellers and leaves the unsatisfied bidder in a cold market with expected payoff $C(1,T_1)$. Since the successful bid with two bidders leaves them indifferent between buying and remaining, the payoff to a buyer in an active market with two bidders is given by

$$H(2) = \frac{1}{1+rdt}\left[(\alpha+\sigma)dt\, C(1,T_1) + \beta dt\, H(3) + (1-(\alpha+\sigma+\beta)dt)H(2)\right]$$

[5]With one bidder remaing from the previous auction $(N=1)$, a one bidder auction can arise after entry of an old seller (and no buyer entry) or after entry of a new seller following a cold period in which no buyer entry occurred.

For $N \geq 3$, competitive bidding makes buyers indifferent between purchasing and waiting for the next auction with one less competitor. Hence,

$$H(N) = \frac{1}{1 + rdt} [(\alpha + \sigma)dt\, H(N-1) + \beta dt\, H(N+1) + (1 - (\alpha + \sigma + \beta)dt)H(N)]$$

For $N > 1$, the solution to these difference equations is given by

$$H(N) = C(1, T_1)\eta^{N-1}$$

where

$$\eta = \frac{r + \alpha + \sigma + \beta - [(r + \alpha + \sigma + \beta)^2 - 4(\alpha + \sigma)\beta]^{1/2}}{2\beta}$$

After substituting for $H(2)$ in $H(1)$, the payoff to a lone monopolistic buyer in an active markets becomes

$$H(1) = \frac{(\alpha + \sigma)(x - P(1)) + \beta\eta C(1, T_1)}{r + \alpha + \sigma + \beta}$$

New Seller Entry

Following a spell of duration t without seller entry, expected revenue less entry fee to a new seller contemplating entry into the market with $N \geq 1$ bidders remaining from the last auction is given by

$$R(N, t) = \sum_{i=0}^{\infty} \pi_i(t)P(i + N) - F$$

Consider the monopolistic bidding cases. If one bidder remains from the previous auction, then the expected revenue from entry is the expected sales less the cost of entry. If no new buyers have entered since the previous auction, the monopolistic buyer bids the monopolistic price $P(1)$. With two bidders, the seller receives $x - C(1, T_1)$. With three or more bidders two bidders, the price is $P(i) = x - H(i - 1)$. Since $\pi_i(t)$ gives the probability of observing $i + 1$ bidders, expected profit is given by

$$R(1, t) = \pi_0(t)P(1) + \pi_1(t)[x - C(1, T_1)] + \sum_{i=2}^{\infty} \pi_i(t)[x - H(i)] - F$$

Substitution and manipulation yields

$$R(1, t) = e^{-\beta t}P(1) + (1 - e^{-\beta t})x + e^{-\beta(1-\eta)t}[1 - e^{-\beta\eta t}]C(1, T_1)/\eta - F$$

Entry occurs if and only if $R(1,t) \geq 0$ hence the critical duration of entry, T_1, for new sellers aware of only one known bidder satisfies

$$x - e^{-\beta T_1}(x - P(1)) + e^{-\beta(1-\eta)T_1}[1 - e^{-\beta\eta T_1}]C(1,T_1)/\eta - F = 0 \qquad (2)$$

A similar procedure reveals that revenue after a duration T_0 following an auction with zero bidders left over is given by

$$\begin{aligned} &\beta e^{-\beta T_0}\left[t + 1/(r + \alpha + \beta - \alpha\lambda)\right] P(1) \\ &+(1 - e^{-\beta T_0} - \beta T_0 e^{-\beta T_0})x \\ &-e^{-\beta(1-\eta)T_0}[1 - e^{-\beta\eta T_0} - \beta\eta T_0 e^{-\beta\eta T_0}]C(1,T_1)/\eta^2 - F = 0 \end{aligned} \qquad (3)$$

Firm entry is assumed for $N \geq 2$. If entry occurs immediately after an auction with $N = 3$ bidders, the entering sellers receives $x - P(2) = C(1,T_1)$. The entry assumption thus holds provided entry cost is sufficiently small: $x - C(1,T_1) \geq F$

2.3 MARKETS WITH EXCESS SELLERS AND WITH BALANCED TRADE

Entry of old sellers occurs during both active and dormant markets. Even though old sellers enter at a slower rate than buyers, from time to time the realization of the entry processes will be such that more old sellers enter than buyers and cold markets experience having excess sellers. In addition, the entry of new buyers can cause an excess supply of one seller. If the previous auction had a single bidder and no entry of buyers or sellers occurs, eventually the market becomes active and a new seller will enter and not find a bidder.

New sellers will not enter markets with excess supply until all of the previous entrants consummate trades. They observe all unsatisfied trade and hence do not enter if another seller already exists in the market. Old sellers, however, may enter to cause excess supply. Really cold markets, those with excess sellers, remain cold until balance is restored.

Like buyers in markets with excess bidders, sellers in markets with excess goods accept bids that make them indifferent between taking the bid and waiting for the next auction. Since the arrival rate of sellers is governed by α alone, the payoff to a lone seller in the market ($M = 1$) awaiting for the arrival of buyer is given by

$$Z(1) = \frac{1}{1 + rdt} \left[\alpha dt\, Z(2) + \beta dt\, P(1) + (1 - \alpha dt - \beta dt) Z(1)\right].$$

With other sellers waiting the arrival of a buyer ($M = 2$), sellers are willing to accept a bid that makes them indifferent between selling and waiting in the market, the payoff to $Z(M)$ is given by

$$Z(M) = \frac{1}{1 + rdt} \left[\alpha dt\, Z(M+1) + \beta dt\, Z(M-1) + (1 - \alpha dt - \beta dt) Z(M)\right].$$

The solution to these difference equations is given by

$$Z(M) = Z(1)\lambda^{M-1}$$

for $M > 1$, and

$$Z(1) = \frac{\beta P(1)}{r + \alpha + \beta - \alpha\lambda}$$

where

$$\lambda = \frac{r + \alpha + \beta - [(r + \alpha + \beta)^2 - 4\alpha\beta]^{1/2}}{2\alpha}$$

From time to time, entry from one side or the other of the market will occur such that the auction has one bidder and one seller. In this auction, the buyer's offer again makes the seller indifferent between waiting and accepting. Given that buyer entry or seller entry will unbalance the market, the equilibrium bid can be written as

$$P(1) = \frac{1}{1 + rdt} \left[\alpha dt\, Z(1) + \beta dt\, [x - C(1, T_1)] + (1 - \alpha dt - \beta dt) P(1)\right]$$

Substitution for $Z(1)$ gives

$$P(1) = \frac{\beta(r + \alpha + \beta - \alpha\lambda)[x - C(1, T_1)]}{(r + \alpha + \beta)^2 - \alpha\lambda(r + \alpha + \beta) - \alpha\beta} \tag{4}$$

3 EQUILIBRIUM

An equilibrium is a set of prices $P(N)$ and accompanying entry decisions that terminate cold markets, T_0 and T_1 such that buyers and sellers willingly trade whenever possible and new sellers entry is profitable. If a buyer and a seller are simultaneously present in the market, trade takes place immediately at a price that makes the short side of the market indifferent between buying and waiting. Two sets of difference equations emerge, $H(N)$ for buyers and $Z(N)$ for sellers $N = 1, 2, 3...,$. Given the payoff to waiting at the onset of a cold market $C(1, T_1)$, these equations can be recursively solved. Prices $P(N)$ follow accordingly. Thus, equation (1) reduces to an implicit equation in $C(1, T_1)$ and T :

$$\begin{aligned} C(1,T) \quad = \quad & \left[\frac{\alpha(1-e^{-(r+\alpha+\beta)T_1})}{r+\alpha+\beta} + \frac{(\alpha+\sigma)e^{-(r+\alpha+\beta)T_1}}{r+\alpha+\sigma+\beta}\right](x - P(1)) \\ & + \frac{\alpha}{\eta}\left[\frac{1-e^{-(r+\alpha+\beta(1-\eta))T_1}}{r+\alpha+\beta(1-\eta)} + \frac{1-e^{-(r+\alpha+\beta)T_1}}{r+\alpha+\beta}\right] C(1,T_1) \\ & \frac{e^{-(r+\alpha+\beta(1-\eta))T_1}}{r+\alpha+\sigma+\beta}\left[r+\alpha+\sigma+\beta-(r+\alpha+\sigma+\beta(1-\eta))e^{-\beta\eta T_1}\right] C(1,T_1) \end{aligned} \tag{5}$$

where (4) reveals that $X - P(1)$ is a linear function of $C(1, T_1)$

The entry decisions of new sellers, captured through T_1 and T_2 and encapsulated in (2) and (3) depend on expected revenue from these prices and buyer entry. Since equation(2) contains only $C(1, T_1)$ and T_1 (along with exogenous parameters) an equilibrium follows from a positive solution of equations (2) and (5) in these two unknowns. Equation (3) then gives T_0. The payoffs and prices follow accordingly.

It is possible to establish that an equilibrium exists with $T_0 > T_1 > 0$. The market exhibits hot and cold cycles. The cumbersome algebra involved with characterizing the two equations in two unknowns is unexceptional and omitted here.

This equilibrium is inefficient. With one buyer is known to exist in the market ($N = 1$), a social planner would want entry. There are gains to trade not being exploited otherwise. The existence of decline entry with new sellers during a T_1 is thus suboptimal and occurs due to the inability of new sellers to recoup the sunk costs of entry, however, small.

Entry when there are no known buyers may or may not be efficient. If no known buyers exist ($N = 0$) entry has positive return if and only if

$$\sum_{i=1}^{\infty} \pi_i(t)x > F$$

which simplifies to

$$t > \frac{\ln[1 - F/x]}{\beta}$$

Since analytic solutions are difficult to derive, it is hard to compare this figure to T_0. However, simulations reveal the unsurprising result that T_0 is greater than this planner's solution.

4 Simulations

Although some results for this equilibrium can be established - e.g. higher prices lead to longer search duration for buyers - analytic solutions for many variables and comparative statics are in general unavailable. Simulations are therefore calculated by embedding the above framework into an economy similar to the one analyzed by Shimer (2007).

Suppose N distinct islands represent individual, isolated markets. The initial population on each island is a random draw from a Poisson distribution with parameter β. The number of matched pairs is given by the short side of the market on each island, i.e. for island i at date t there are $M_{i,t} = \min\{buyers, sellers\}$ coupled agents. Poisson processes also determine when a separation shock hits a pair randomly chosen on one of the islands. When a separation occurs (the β shock described above), a new buyer is randomly assigned to one of the islands. Either trade occurs immediately after entry or the new island's queue of potential buyers increases by one. The buyer population thus remains undisturbed. At the same time with some probability strictly less than one, an old seller also arrives at one of the islands, again chosen randomly, and if feasible trade takes place at that time. These movements are the α shocks. If not the seller queue increases. This re-allocation shock thus decreases the seller population over time.

A second Poisson shock replenishes the seller populations. New sellers arrive via σ shocks. The acceptance or rejection of the opportunity by the new seller adjusts the seller population. Given a large number of islands, individual decisions and economic outcomes follow from the above market decisions.

In this economy agents arrive according to continuous time processes. Since the associated waiting times of arrivals of buyers and sellers are distributed exponentially, simulations are able to avoid having more than one arrival at a time. However, the organization of simulated data reflects actual data in that the recording of events involves discrete intervals in which more than one sale can occur. In particular, the model is simulated for $T = 240$ intervals or discrete periods of time with $N = 100$ islands. The

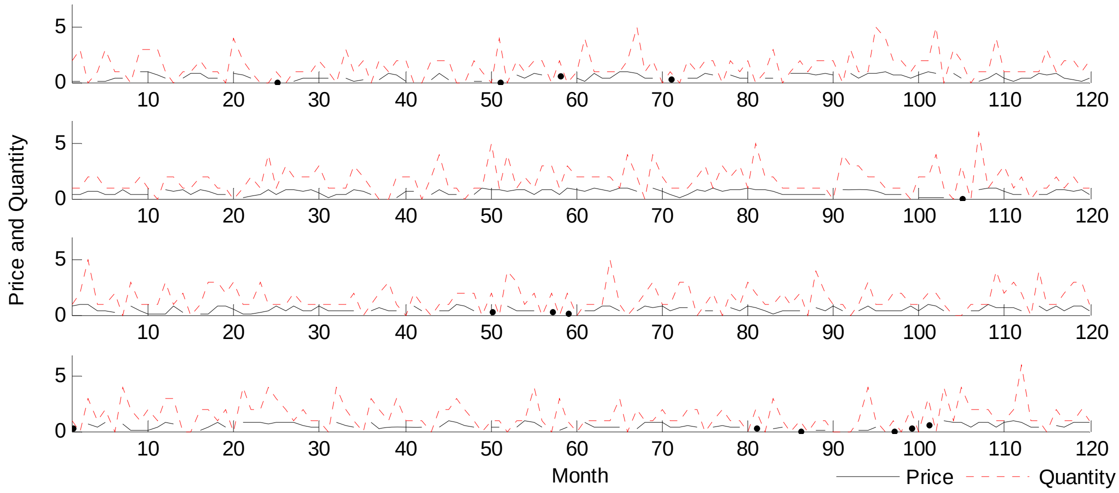

Figure 1: Price and Sales in Four Markets

first 100 periods are dropped. As an island will often experience multiple sales during the discrete time interval, the reported prices in a given market are the average price of sales on the island during the period. Although the simulations are not computed to match particular observations, in what follows, the data are presented for a period which the reader might consider think of as roughly a month. The parameters are set such that $x = 1$; $F = .75$; $r = 0.05$; $\beta = 0.05$; $\sigma = k\beta - \alpha$, where $k = 4$.

Figure 1 presents prices and quantities for four different islands given a moderate rate of resales by old sellers entering the market. Old sellers arrive at half the rate as new buyers, $\alpha = \beta/2$. In some periods, no sales occur in which case there is no price to report. The breaks in the price series can be seen in Figure 1 when quantity equals zero. Prices and quantities exhibit considerable variability with a high degree of positive co-movement. In addition, these islands experience fallow periods in which trade is low and prices are depressed even though the explicit fallow periods last $T_1 = 0.40$ and $T_0 = 1.13$ proportions of an interval of time. If the interval is a month, the fallow period given one known bidder is approximately 12 days.

Figure 2 presents price and quantity movements aggregated over the islands. The average market price and average quantity sold on one island

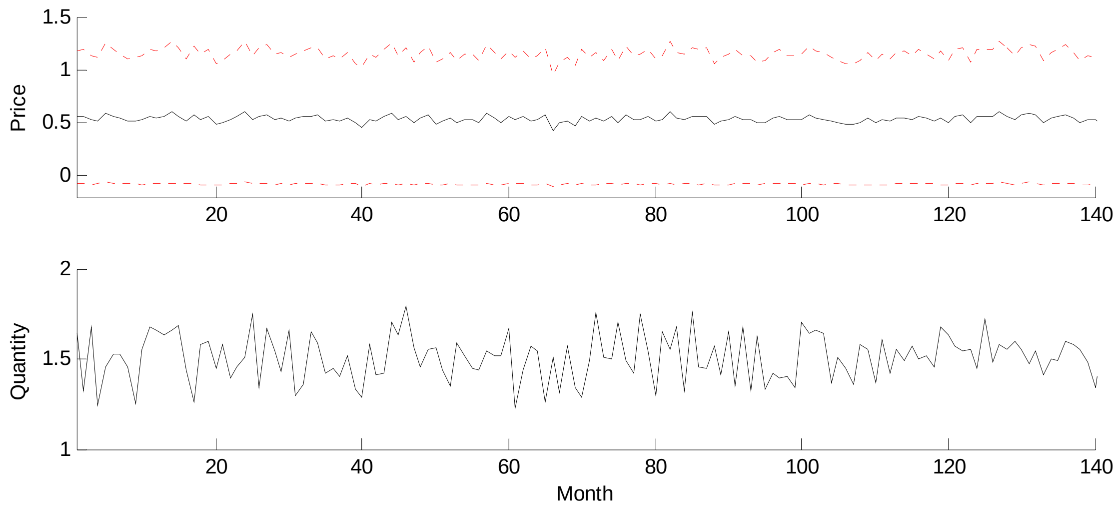

Figure 2: Average Prices and Average Sales in the Economy

continue to vary but the co-movement declines considerably. The correlation coefficient for price and quantity equals 0.17. As one would expect given a large number of islands, sales occur in all periods. Figure 2 also presents the standard deviation of prices around the mean. In order to provide a measure of the way in which the number of sales affects price dispersion, the mean price at date t is bracketed by plus and minus the standard deviation across islands of date t prices. As can be seen by the flatness of the lower bound, the correlation between price and standard deviation is high. The correlation of price and standard deviation is 0.98.

Figure 3 depicts price dispersion across markets. The three panels present the cross section histogram of average island prices for the highest, lowest and an intermediate turnover months.[6] All three panels display a mode slightly less than midrange of all prices. All three also have a significant proportion of extreme observations with high prices more frequent than lower ones. More significantly, as turnover rises, these extremes become more prevalent. The price variance rises with trading volume. The basic shape of these distri-

[6]Prices are grouped into intervals of length 0.05. Islands without any observed sales are omitted. During the low turnover period there were 25 such islands; 18 during the medium turnover; and 14 during the high turnover period.

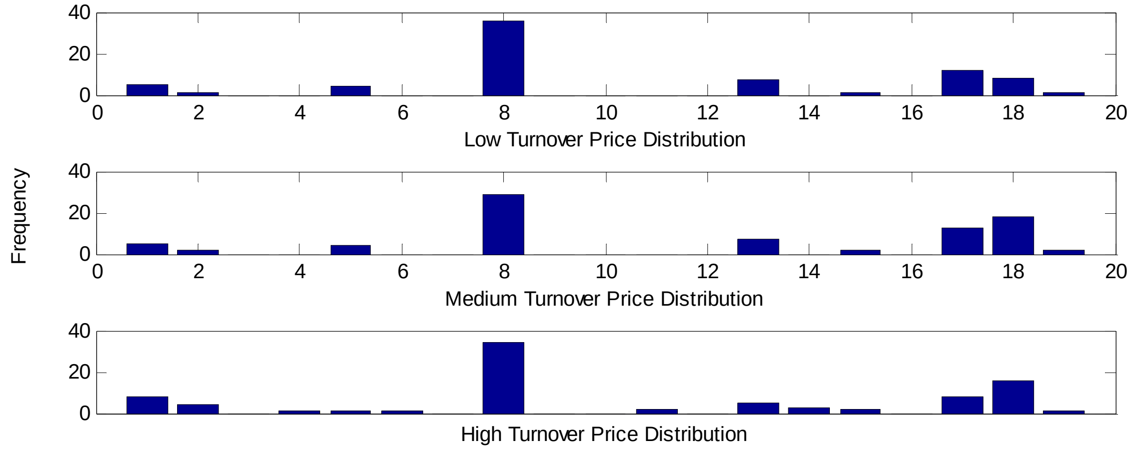

Figure 3: Price Distributions in Low, Medium and High Turnover Periods

butions differs from the leading examples of endogenous price distributions found in the literature. More specifically the Burdett-Judd (1985) price distribution has an upward sloping distribution so that higher prices are more likely.

Turnover comes from the pairing of an entrant on one side of the market with a trader in the stock on the other side of the stock. To gauge the queue of traders waiting for such trades to take place, Figure 4 graphs the evolution of unsatisfied buyers and sellers in the market. Both exhibit roughly the similar degrees of variation. This variation is uncorrelated with a coefficient equal to -0.04.

The queues in each market wax and wane with arrival of sellers and buyers. Trade involves either new goods that entered the market voluntarily or recycled goods that entered automatically. The composition of sellers, either new or old, will have considerable affect on the queue of sellers and more generally on economic outcomes, both across goods and over time. Moreover, the extent of resale will vary with the good under consideration. For example, the housing market in Manhattan is likely to contain fewer opportunities to build (high α) whereas growing cities such as Las Vegas will consist mostly of new homes (low α). Likewise, vacancies in emerging job

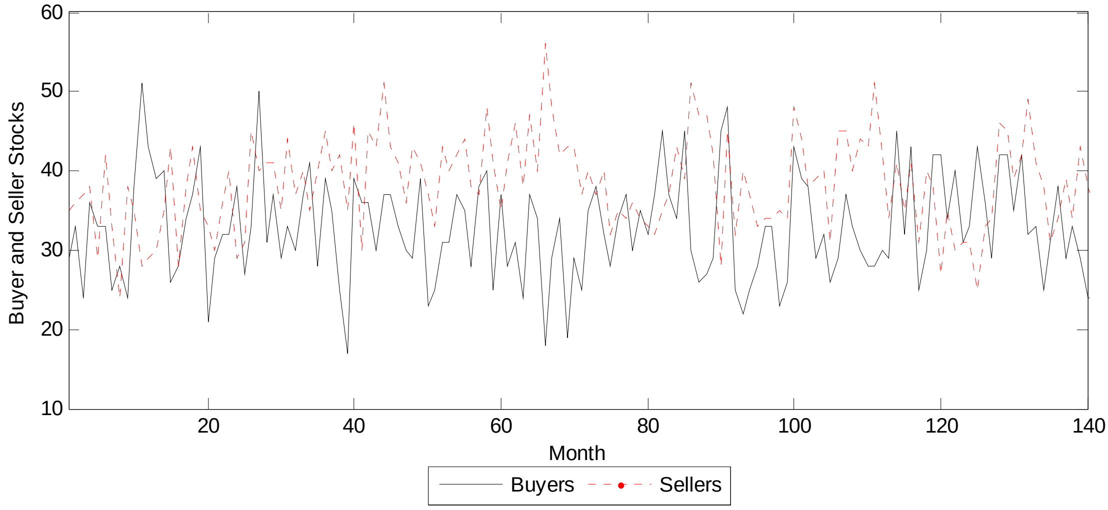

Figure 4: Queues of Waiting Buyers and Sellers

markets might consist of more newly created positions (as opposed to job turnover) than job opportunities in established occupations in with lower growth areas.

To assess the impact of resale on the pattern of trade, Table 1 characterizes the fallow periods for different values of α.[7] The length of these cold spells, measured by T_1 and T_0, increase with α. A lower expected utility $C(1, T)$ of a buyer waiting in the market at the start of this period accompanies these increased durations.

[7]One interpretation of α is as the proportion of sellers who are reselling. To keep the economies comparable, the simulations keep the sum of $\alpha + \sigma$ constant.

Table 1. Fallow Intervals

α	T_1	T_0	$C(1, T_1)$
0.0	11.68	33.47	0.218
0.1	11.72	33.58	0.213
0.2	11.76	33.68	0.209
0.3	11.80	33.79	0.204
0.4	11.86	33.90	0.202
0.5	11.88	34.01	0.194
0.6	11.92	34.12	0.188
0.7	11.96	34.24	0.183
0.8	12.00	34.36	0.178
0.9	12.05	34.48	0.173

As automatic entry of recycled goods increases, the contribution of T_1 and T_0 to the actual duration of cold spells and the pattern of trade changes. Realized periods without new entry also depend on the outcome following automatic entry. When resale reveals a buyer queue, entry is turned on. A resale attempt that reveals a dearth of buyers resets and prolongs new entry. As a first pass on gauging the impact of resale on new entry, Table 2 presents the means of observed price ($P_{i,t}$) and quantities ($Q_{i,t}$) as a function of α. Average prices decline considerably and quantities for the most part do not vary substantially. These figures together suggest that the net effect of slower new entry and higher resale will result in more advantageous trade for the buyers. Without further analysis on the distribution across islands, however, it is inconclusive whether these markets necessarily experience smoother trading and shorter dormant periods.

Automatic entry alters the queues of buyers (B_t) and sellers (S_t). As sellers are less likely to be able to decline entry, it is not surprising that more sellers wind up on the long side of trades. Entry of new goods continues to occur on some islands with potential buyer queues. Over time these goods get shifted around with the result that some islands become full of seemingly abandon old goods. Similarly, less buyers appear in queues as resale becomes more prevalent. Indeed, as resale becomes highly likely, many of these goods appear to wind up in long queues.

Table 2. Means of Price and Quantities

α	P_{it}	Q_{it}	B_t	S_t
0.0	0.693	1.51	53.1	16.6
0.1	0.676	1.51	48.9	17.9
0.2	0.655	1.50	45.9	19.1
0.3	0.622	1.49	40.2	22.6
0.4	0.588	1.52	37.1	27.6
0.5	0.535	1.50	32.1	41.3
0.6	0.474	1.51	27.0	59.8
0.7	0.390	1.53	21.2	106.1
0.8	0.291	1.53	14.7	226.7
0.9	0.168	1.50	8.39	493.9

Table 3 illustrates the way in which resale alters the relationship among these variables. The correlation of prices with the number of trades as well as with the number of buyers deteriorates as automatic entry becomes more common. As resale becomes the norm (high α with long seller queues on some islands), the average price is very low and displays virtually no connection with quantity sold across all islands. Likewise, the correlations of price with the stock of buyers becomes weaker as resale rises.

The search literature often posits a matching function to describe realized matches as a function of traders. The correlations between Q_t and B_t fits this proposed relationship at least for low α. The correlation between Q_t and S_t does not. The correlation between queues is negative (and consistent with a Beveridge curve) but this correlation too fades with the extent of resale.

Table 3. Correlations

α	$P_t,\ Q_t$	$P_t,\ B_t$	$P_t,\ S_t$	$Q_t,\ B_t$	$Q_t,\ S_t$	$B_t,\ S_t$
0.0	0.73	0.73	-0.25	0.42	-0.65	-0.38
0.1	0.51	0.69	0.03	0.43	-0.67	-0.26
0.2	0.51	0.77	-0.06	0.36	-0.47	-0.21
0.3	0.41	0.60	0.09	0.38	-0.31	-0.20
0.4	0.25	0.59	-0.18	0.25	-0.37	-0.17
0.5	0.17	0.49	-0.18	0.28	-0.17	-0.15
0.6	0.22	0.45	-0.21	0.21	-0.03	-0.06
0.7	0.10	0.53	-0.18	0.07	0.09	0.09
0.8	0.03	0.48	-0.14	0.03	0.22	0.04
0.9	0.04	0.43	-0.33	0.02	0.29	-0.08

Tables 2 and 3 present a limited picture that omits many important and salient features of particular markets. Housing economists and labor economists often address a number of other stylized facts, some but not all in common. For example, some analyses look at transitions from one match to another. Others explore price changes and serial correlation.

Presenting these simulation results (or Phillips and Beveridge curves) in a meaningful way requires a richer and more sophisticated approach. The bare bones simulation results given here fail to capture a number of important market features. The message from the simulations is straightforward. The model can generate substantial variation in prices that not only correlates to some extent with turnover and pent up traders but also reflects the source of the goods for sale, either resale or entry.

5 Conclusion

Profit attracts entry. In perfectly competitive markets with full information, instantaneous erosion pins down the timing and number of entrants as well as the price and quantity sold. In markets with frictions, entry and the subsequent pattern of trade may not be as straightforward. Depending on market structure, it may take time to uncover profitable opportunities which in turn affects the ability and willingness of agents to exchange goods and services.

This paper investigates the way in which entry of this sort affects trade in stock-flow matching markets such as housing or labor. Buyers compete in complete information auctions for indivisible goods brought to market one by one. To attract seller production and entry, there must be sufficient competition among these bidders. Bertrand-like offers from two bidders are sufficient to induce entry. One monopolistic buyer is not.

Given that sellers can find and produce the opportunity of making a new good faster than new buyers appear ready to purchase the goods, markets will alternate between periods of inactive and active entry. In cold markets, prospective sellers pass up production opportunities as they wait for the (unobserved) arrival of buyers to replenish the market. Once they think enough time has passed, entry resumes and reveals the profits to be made in the market. New production continues until it exhausts the existing demand.

The periods of inactivity with one willing but monopolistic bidder are inefficient. Gains to trade exist but are passed over because sellers do not obtain a sufficient share of this payoff. In particular, production requires an upfront sunk cost which a monopolistic bidder cannot commit to paying before production takes place but Bertrand buyers are compelled to bid above.

Houses and jobs are durable and often resold. The decision to resell differs from the original decision to go to market. Since no production costs are incurred in reselling, recycled entry is taken to be the extreme case of automatic entry of sellers. Because resale reveals the same information about the profit conditions as new goods sales, the re-appearance of the goods on the market has profound effects on the entry decision of new goods. The exogenous entry of pre-owned goods can either restart markets or prolong the delay before the restart new production. Resale thus alters the nature of competition and the evolution of trade. Simulations suggest that prices fall but turnover remains constant as resale becomes more prevalent.

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