Bubble Bursting as Phase Transition Phenomenon

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Fluctuations in real estate prices have substantial impacts on economic activities. For example, land prices in Japan exhibited a sharp rise in the latter half of the 1980s, and its rapid reversal in the early 1990s. This large swing had led to a significant deterioration of the balance sheets of firms, especially those of financial firms, thereby causing a decade-long stagnation of the Japanese economy, which is called Japan's "lost decade". A more recent example is the U.S. housing market bubble, which started somewhere around 2000 and is now in the middle of collapsing. This has already caused substantial damages to financial systems in the U.S. and the Euro area, and it is expected that it may spread worldwide as in the case of the Great Depression in the 1920s and 30s.

These recent episodes have rekindled researchers' interest on the issue of bubbles. Economists have been regarding this phenomenon as a disorder in prices. Specifically, they define bubbles as a temporary deviation of asset prices from the corresponding fundamental values, which are basically determined by investors' expectations about future dividend stream and appropriate discount rates. However, this research strategy has overlooked an important aspect of bubbles; namely, fluctuations in asset prices tend to be closely correlated with those in the volume of transactions.

Figure 1 depicts fluctuations in housing prices and the volume of house transactions in the U.S., which shows a positive correlation between the two variables over the business cycles. More importantly, it shows that a change in transaction volume tends to lead a change in prices by one year or two. It is reported that similar relationships were observed for other asset markets in other countries, including the land market in Japan. These evidences suggest that some sort of interaction between prices and the volume of transactions plays an important role in the process of bubble and its bursting, and that fluctuations in transaction volume, rather than those in prices, could be its driving force. Given this understanding, we focus more on transaction volume in this paper, and seek to propose a model which explains an emergence of temporary deviation of transaction volume from its appropriate level, as well as its reversal.

Consider an economy with symmetric N firms dealing with real estate, which are identified by i (i=1,...,N) and located along a circle. Firm i is allowed to purchases a piece of land from firm i-1, but not allowed to do so from any other firm. For simplicity, it is assumed that the amount of cash each firm owns before buying land is identical to the price of a piece of land, so that each firm has its entire asset either in the form of cash or in the form of land.

There are two rules governing transactions in this economy. First, all transactions must be in the form of an exchange of cash and land, and no barter transactions (i.e. transactions between land and land) are allowed. This implies that transaction between firms i and i-1 never takes place in period t unless firm i holds cash at the beginning of that period. This rule corresponds to what macroeconomists call "cash-in-advance" constraint. Second, firm i becomes timid if firm i fails to make a transaction with firm i+1 in period t. Specifically, firm i refuses to purchase land from firm i-1 in period t+2 even if firm i successfully has sold land to firm i+1 in period t+1, therefore holding cash at the beginning of period

t+2. This is because, *ceteris paribus*, firm i is able to increase the probability that firms behind him (firm i+1, i+2, i+3,…) hold cash, instead of land, thereby reducing the probability that he will be refused to sell land to firm i+1. This rule represents firms' preference to cash as a means to store value until the next period, because of its general acceptability.

Given the above rules, we conduct simulations. We assume that there exists no land in this market at the beginning of period 0, but in each period, firm i, which is randomly chosen, purchases new land from someone outside this market if (1) firm i does not hold land (and therefore owns cash), and (2) firms ahead and behind firm i (namely, firms i-1 and i+1) do not hold land either. In words, firm i wants to purchase land from firm i-1, but cannot do that because firm i-1 does not own land. At the same time, firm i expects that firm i+1 will be able to buy land from him because firm i owns cash. It is only in this situation that firm i brings in new land to the market from outside. We also assume that the probability of successful transaction between any two adjacent firms (the one with cash and the one ahead with land) is given by q.

Figure 2 shows fluctuations in transaction volume over time. An important thing to note is that transaction volume exhibits an abrupt and sharp decline in t=110 to 130 after a quiet period in which transaction volume is kept fairly stable. This abrupt decline is an endogenous event, and can be seen as phase transition phenomenon emerging from metastable state. Lots of similarities can be seen between this and an abrupt change from free to congested flow in highway traffic.

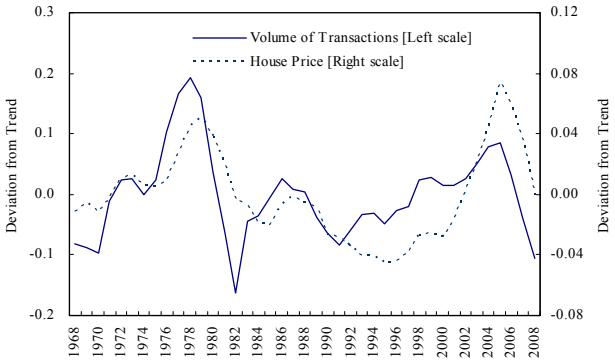

Figure 1: House price and transaction volume in the U.S.

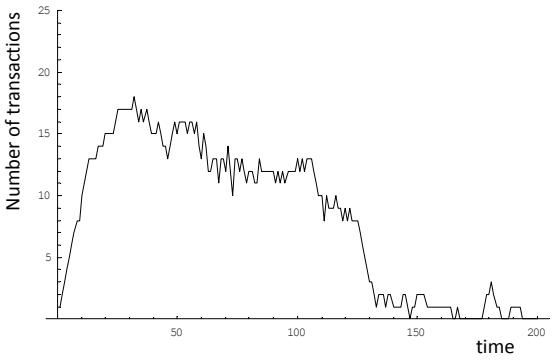

Figure 2 : Fluctuations in transaction volume over time Parameters N and q are set at N=50 and q=0.99.

Keywords

asset price bubbles; cash-in-advance constraint; metastable state; phase transition; traffic model

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