Banks and Real Estate Prices

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Draft Version

Abstract

The willingness of banks to provide funding for real estate purchases depends on the creditworthiness of their borrowers. Beside other factors, the creditworthiness of the borrowers depends on the development of real estate prices. Real estate prices, in turn, depend on the demand for houses which is influenced by the willingness of the banks to provide funding for real estate purchases. In this paper, I develop a theoretical model which shows how this circular relationship can lead to a cyclical behavior of real estate prices. Furthermore, I show that banks make above average profits in the upswing phase of the real estate cycle but suffer high losses when the market turns.

Keywords: Credit Cycle, Real Estate Prices, Bubbles.

JEL-Classifications: E51, G12, G21.

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1 Introduction

The recent crisis in the US sub-prime mortgage market has illustrated that problems in the housing market can have a pronounced impact on the banking sector. Default rates in the sub-prime sector have always been rather high and borrowers had to pay comparable high risk premiums. However, when house prices in the US started to rise substantially in the late 1990's the wealth of sub-prime borrowers increased also and, as an effect of the increasing wealth, default rates decreased. This development made it increasingly profitable to invest in sub-prime mortgages and banks and other financial institutions put more and more money into the housing market. In doing so they were fuelling the bubble and created a positive feedback effect between house prices, default rates and mortgages.

Increasing house prices have a positive effect on the wealth of borrowers, however, on the other hand they also lead to a higher mortgage burden for the borrowers. In 2006 the house price increase slowed down and suddenly the wealth effect of increasing house prices was not strong enough anymore to compensate for the high mortgage burden and default rates among sub-prime borrowers started to increase again. This led to losses for sub-prime lenders and investors and lending standards were tightened. The tighter lending standards together with the high mortgage burden let to a situation where many borrowers were forced to sell their houses or got insolvent. In this new phase declining house prices lead to increasing default rates, increasing default rates lead to losses at banks and to tighter lending standards and tighter lending standards, in turn, lead to decreasing house prices.

The described cyclical relationship between house prices, default rates, bank profits and mortgage lending is not a new development. Real estate crises have led to problems in the banking sector already in the past. In countries such as Japan, Norway, Switzerland, the UK and the US, for example, bank lending grew substantially in the mid/late 1980's. This development was accompanied by a strong increase in house prices. Around 1990 in all of these countries the housing bubbles burst. In reaction to this, default rates among borrowers and loan losses at banks increased and some banks got into server problems.[1] Correspondingly, Herring and Wachter (1999, 2) write:

> "Real estate cycles may occur without banking crises. And banking crises may occur without real estate cycles. But the two phenomena are correlated

[1]BIS (2004) describes the development of the banking crises in all of these countries.

> in a remarkable number of instances ranging over a wide variety of institutional arrangements, in both advanced industrial nations and emerging economies."

The relationship between real estate cycles and bank exposures is examined in a number of studies. Gerlach and Peng (2005), for example, examine the relationship between property prices and bank lending in Hong Kong. Their results suggest that the development of property prices influences bank lending rather than vice versa. Collyns and Senhadji (2002), on the other hand, look at some Asian countries during the Asian Crisis and find evidence that lending influences property prices. Following Hofmann (2004) the development of property prices helps to explain long-run movements of credit in a sample of 16 industrialized countries.

In general one can say that the relationship works in both ways, meaning that there is a positive feedback effect between real estate prices, mortgage loans and bank profits. Collyns and Senhadji (2002, 6) provide a motivation for this feedback effect:

> "Increases in the price of real estate may increase both the value of bank capital, to the extent that banks own real estate, and increase the value of real estate collateral, leading to a downward revision of the perceived risk of real estate lending. Consequently, an increase in real estate prices may increase the supply of credit to the real estate industry, which in turn, is likely to lead to further increases in the price of real estate. These feedback effects go into reverse when real estate prices start to decline."

These factors are also mentioned by Herring and Wachter (1999, 3). In addition they point out that the development of real estate prices might also influence the perceived risk in real estate lending.

There are different models which aim to formalize these basic effects. Kiyotaki and Moore (1997) develop a model where a fixed stock of land is used for production. At the same time credit constraint firms use their land as collateral to borrow money. Now suppose that there is a temporary productivity shock. Firms earn less and, therefore, can invest less in the factor land. This reduces their output further and, since the supply of land is fix, lowers the value of their land. Because of this reduced value of their collateral firms can borrow less. This reduces their demand for land further and so on.

Bernanke and Gertler (1989) describe a very similar process. However, they consider a general capital good as an input factor for production rather than explicitly real estate. In both models the feedback effect is kept alive because of the link to productivity.

In this paper I will show that credit cycles can also be produced solely by the behavior of banks. In a first approach I show how mood swings can generate cycles. If the default rate of mortgage loans gets lower, the bank gets more optimistic about the creditworthiness of its costumers. This leads to higher mortgage loans, higher house prices and lower default rates. When the price increase gets too low to justify the high house prices, default rates increase again. Now the process is reversed and banks get more and more pessimistic.

In a second approach I show how momentum forecasts can produce property price cycles. If the forecast of house prices is influenced by their momentum, a house price increase has a positive effect on the forecast for future house prices. This has, in turn a positive effect on the actual house price. Therefore, forecasts become self-fulfilling and banks have no incentive to change their forecasting model. The process is reversed after a while because forecasts rely not only on the momentum of the prices but also on fundamentals.

Herring and Wachter (1999, 15) name another possible reason for the pronounced pro cyclical behavior of mortgages: disaster myopia. Following this idea there is a:

> "... tendency over time to underestimate the probability of low-frequency shocks. To the extent that subjective probabilities (π_t) decline even though actual probabilities remain constant or increase, banks take on greater exposures relative to their capital positions and the banking system becomes more vulnerable to a disaster."

Real estate markets are very vulnerable to this kind of disaster myopia because cycles are usually rather long and shocks or crises occur correspondingly seldom. In my third approach I show how this disaster myopia can lead to house price fluctuations. For all three model variations I also show that price fluctuations lead to high profits in upswing phases and to high losses when the bubbles burst.

The paper is organized as follows: In the next section I develop the basic model of banks, households, mortgages and house prices. In the third section I present the three model variations to examine the occurrence of price bubbles. In the last section I offer some concluding remarks.

2 The Basic Model

To analyze the interaction between house prices, mortgages, household defaults and bank profits I keep the basic model as simple as possible. In the following I present the assumptions about these four elements of my model.

I start with the assumptions about houses: There is a constant supply S of identical houses. In Period t the price of each house is P_t. Hence, the total stock of houses is worth SP_t. For simplicity and without loss of generality, I assume that $S = 1$.

The second element is the mortgage market: I assume a constant mortgage rate m. The maturity of each mortgage is one period and the Loan-to-Value (LTV) is 100%. Therefore, the amount of the sum of all mortgages is equal to the value of the entire housing stock (P_t).

The third element is the household sector: I assume that there are N households. In period t each household buys the same fraction $1/N$ of the housing stock by taking a mortgage loan in the amount of P_t/N. The labor income Y^i of the households ($i = 1, .., N$) is equally distributed between 0 and $\bar{Y}$. In addition to the labor income they have an income form capital gains: $(P_t - P_{t-1})/N$. Households use their entire income for paying their mortgage rates (mP_t/N) and for consumption.[2] If the mortgage duties of a household exceed its income the household becomes insolvent. In period t the household i is insolvent if:

$$Y^i < \frac{(1+m)P_{t-1} - P_t}{N}. \tag{1}$$

Since households have different labor income, the assumption that they all buy identical fractions of the housing stock seems to be rather unrealistic. However, the focus of this paper is not the behavior of households but the behavior of banks in house price circles. Therefore, I describe the behavior of households very mechanical: All households have a very high preference for housing, they discount the future with a high rate and they do not know how high their individual income will be in the future. Under these

[2] I assume that they do not have or use the possibility to save money or to invest it in houses directly.

assumptions it is plausible that households borrow as much as they can to purchase houses and prefer a LTV of 100%. In the following I will assume that banks can not distinguish between the households. Hence, every household gets the same loan and purchases the same fraction of the housing stock.

The fourth element is the banking sector: I assume that banks are identical, risk neutral and, as already mentioned, can not distinguish between the different households. Further, I assume that there is perfect competition in the banking sector. They provide mortgages to households at the constant rate m and refinance themselves at the constant rate r. Since banks can not distinguish between "good" and "bad" households, they also give a mortgage to households that cannot afford it and most likely will default in the next period. Because of the defaults, in period t the earnings of the banks are reduced by the fraction ρ_t of their mortgage exposure P_{t-1}. Therefore, in period t the profit (π_t) of the entire banking sector is given by:

$$\pi_t = P_{t-1}(m - r - \rho_t). \tag{2}$$

Since I have assumed that there is perfect competition in the banking sector, competition leads to zero expected profits and to:

$$E(\rho_{t+1}) = m - r. \tag{3}$$

In other words, the competition leads to a mortgage rate which is equal to the (save) financing rate r plus the risk premium $E(\rho_{t+1})$. However, in my model banks do not chose a mortgage rate that covers the risk premium. Instead they consider the amount of the mortgage loans that households can afford at a given mortgage rate. Accordingly, the banks provide mortgages as long as the expected writedowns can be covered by the mortgage rate.[3] Therefore, my model is a simple example for credit rationing under imperfect information à la Stiglitz and Weiss (1981).

Beside the labor income, expected defaults mainly depend on the development of house prices (P_t). As illustrated in Figure 1, one can think of three different cases: First, the development of the house price leads to a situation where some households get insolvent and some stay solvent. Second, a huge price increase leads to a situation where all households stay solvent. Third, a strong decrease in house prices leads to a situation where all households get insolvent.

[3] Lown and Morgan (2006) emphasis the the importance of credit standards compared to the role of loan rates for bank loans.

[Insert Figure 1 about here]

In Figure 1, the vertical lined area represent the interest margin income of the banks ($P_t(m-r)$). The horizontal lined area represents the expected writedowns ($P_tE(\rho_{t+1})$). In equilibrium, under perfect competition among banks and zero expected profits, the two areas have to be identical in size.[4] The expected writedowns can be calculated for the three different cases as follows:

$$P_tE(\rho_{t+1}) = \frac{1}{2}\frac{[(1+m)P_t - E(P_{t+1}]^2}{N\bar{Y}} \quad \text{if} \quad (1+m)P_t \geq E(P_{t+1} \geq (1+m)P_t - N\bar{Y} \quad (4)$$

$$P_tE(\rho_{t+1}) = 0 \quad \text{if} \quad E(P_{t+1}) > (1+m)P_t \quad (5)$$

$$P_tE(\rho_{t+1}) = \left(\frac{3}{2} + m\right)P_t - \frac{3}{2}E(P_{t+1}) - \frac{1}{2}N\bar{Y} \quad \text{if} \quad E(P_{t+1}) < (1+m)P_t - N\bar{Y} \quad (6)$$

Since in my model the underlying fundamentals of house prices (number of households, income, mortgage rate) stay constant, in equilibrium, house prices have to be constant as well. I define $\bar{P} = P_t = P_{t-1}$ as the equilibrium (benchmark) house price. Together with equation (4) I can now rewrite equation (2) to:

$$\pi = \bar{P}\left(m - r - \frac{1}{2}\frac{m^2\bar{P}}{N\bar{Y}}\right). \quad (7)$$

Following the assumption that banks are under perfect competition and that they expect to make zero profits, the equilibrium house price (and therefore the equilibrium amount of mortgage loans) is given by:

$$\bar{P} = 2\frac{(m-r)N\bar{Y}}{m^2}. \quad (8)$$

Hence, the equilibrium house price depends positively on the interest margin (or risk premium of banks), the number of households and the income and negatively on the mortgage rate. These findings are in line with the results of many studies on house prices.[5]

[4]Therefore, with "normal" interest margins, in equilibrium, only the intermediate case is possible.

[5]In Hott and Monnin (2008), the fundamental value of houses depends on aggregated income, housing supply and mortgage rates. Case and Shiller (2003) and Holly and Jones (1997) point out that income is most important factor. Beside other factors, Himmelberg et al. consider a mortgage interest rate and an expected capital gain.

3 The Behavior of Banks

3.1 Mood Swings

The basic idea of this paper is that there is a feedback effect between default rates, mortgage loans and house prices. Lower default rates lead to higher mortgage loans, increasing house prices and, again, lower default rates. It is easy to see that higher mortgage loans have an impact on house prices and that increasing house prices lower default rates.[6] However, the important missing link is the link between default rates and the supply of mortgage loans.

In my first approach to explain and motivate this link I assume that bank managers are subject to mood swings. Notice that even if banks know the income distribution of households as a group, since they can not distinguish between households, they do not know the income distribution of their own customers. If a bank is optimistic, it might assume that its screening process was very successful and that its customers have an above average income. On the other hand, if the bank is pessimistic it beliefs that its customers' income is below average. A consequence of this assumption is that if banks become more optimistic they are willing to provide higher mortgage loans and house prices increase. This leads to lower default rates and, hence, to higher profits for banks.

I further assume that the sentiment of banks is positively influenced by their profits. If banks have an excess (positive) return they become more optimistic and if they have a lower (negative) return they become more pessimistic. Now assume that an external unexpected shock leads to a temporary increase in labor income. This increase in income lowers the default rate among households and increases the profits of banks. Therefore, banks become more optimistic, the price of houses increases, default rates become low and banks make high profits. This process pushes the house price higher and higher. However, if the house price and therefore the mortgage burden for households becomes too high to be compensated by the price increase, the process is reversed.

A very similar process is described by Lux (1995). He provides a theoretical explanation for herding behavior by introducing a positive feedback between the development of asset prices and investors' sentiment. To formalize this idea, I assume that an

[6] These effects are made explicit in the basic model.

optimistic bank beliefs that the writedown rate (ρ_t^o) in its loan portfolio will be:

$$E(\rho_{t+1}^o) = (1-\delta)\frac{1}{2}\frac{[(1+m)P_t - E(P_{t+1})]^2}{P_t N\bar{Y}}, \tag{9}$$

where δ is the degree of optimism. For a pessimistic bank the assumed writedown rate (ρ_t^p) is:

$$E(\rho_{t+1}^p) = (1+\delta)\frac{1}{2}\frac{[(1+m)P_t - E(P_{t+1})]^2}{P_t N\bar{Y}}. \tag{10}$$

Banks are not necessarily entirely optimistic or pessimistic. I assume that in period t all banks put the weight ν_t on the optimistic view and the weight $(1-\nu_t)$ on the pessimistic view. Therefore, in t all banks expect that the writedown rate (ρ_{t+1}^r) will be:

$$E(\rho_{t+1}^r = \nu_{t+1}E(\rho_{t+1}^o) + (1-\nu_{t+1})E(\rho_{t+1}^p). \tag{11}$$

Under perfect competition profits are expected to be zero. Hence, there is an excess return if profits are positive: $\rho_t < m-r$. If the excess return is positive, banks become more optimistic and if it is negative they become more pessimistic:[7]

$$\nu_{t+1} = \nu_t + \tau(m-r-\rho_t)(1-\nu_t) \quad \text{if} \quad \rho_t \leq m-r \quad \text{and} \tag{12}$$

$$\nu_{t+1} = \nu_t + \tau(m-r-\rho_t)\nu_t \quad \text{if} \quad \rho_t > m-r, \tag{13}$$

where τ reflects the speed of mood adjustment. The dynamic effects of the assumptions are illustrated in Figure 2. Here, it is assumed that $E(P_{t+1}) = P_t$ and that:

- number of households: $N = 10$,
- maximum income: $\bar{Y} = 100$,
- temporary income shock in t=5: $Y_t = 90$,
- mortgage rate: $m = 0.05$,
- financing rate: $r = 0.04$ and

[7]Hott (2007) uses a very similar definition.

- degree of optimism: $\delta = 0.25$.

For the parameter τ (speed of mood adjustment) I consider different values. As we can see in Figure 2, the initial income shock in $t = 5$ leads to house prices fluctuations in the following periods. In the first example ($\tau = 9.75$) the shock leads to uniform sinus shaped price cycles. In the second example the speed of mood adjustment is higher ($\tau = 10$) and the reaction to changes in profits is much stronger. This leads not only to higher amplitudes of the house price fluctuations but also to increasing amplitudes. In the third example the opposite is the case: The slower mood adjustment ($\tau = 9.5$) leads to smaller and decreasing price fluctuations. In all three examples the peaks and troughs of the cycle are not entirely symmetrical. The reason for this is that the development of the writedown rates is not linear.

[Insert Figure 2 about here]

The house price fluctuations in Figure 2 are generated by the mood swings of banks. These mood swings are, in turn, triggered by the house price fluctuations. Note that, even though banks are willing to provide higher mortgage loans in upswing phases, the LTV is unchanged over the entire cycle. It is always 100%.[8] However, the affordability of houses changes over time. This has, of course, an effect on default rates among households and, hence, on the profits of banks. Figure 3 displays the development of the profits of the entire banking sector. As we can see, house price fluctuations lead to positive profits in upswing phases and losses in downswing phases. However, profits and losses are not symmetrical: Losses are higher than profits. This has two reasons: Firstly, the house price cycles are not completely symmetrical themselves and, secondly, the exposure of banks is higher in downswing phases than in upswing phases. The reason for this is that the high exposure at the house price peak belongs to the downswing (loss) phase and the low exposure at the trough of the cycle belongs to the upswing phase.

[Insert Figure 3 about here]

[8] To be more correctly, what is really unchanged is the Loan-to-Price ratio. From a theoretical point of view the fundamental value of houses should be constant over time. Hence, the real LTV is fluctuating with the house price cycles. However, banks can not observe the fundamental value and assume that the LTV is constant.

The greater the influence of the banks' mood (high τ) the higher the fluctuations of house prices and banks' profits. This emphasizes that it is important that banks base their risk assessment on objective indicators rather than a subjective assessment of the creditworthiness of their costumers. This is increasingly important since the distance between borrowers and the ultimate holder of the risk seems to increase (e.g. via securitization).

3.2 Momentum Forecasts

In section 2 I have assumed that banks act under perfect competition. This means that they do not consider the impact of their own decisions on the market, they only react to the different market variables. Variables banks can not observe are the house price and the income in the next period. Both variables have a large effect on default rates and, therefore, on the banks' profits. Expected house prices ($E(P_{t+1})$) and expected income ($E(Y_{t+1})$) for the next period are given by:

$$E(P_{t+1}) = (1 + w_t^{Pe})^2 P_{t-1} \quad \text{and} \tag{14}$$

$$E(Y_{t+1}) = (1 + w_t^{Ye})^2 Y_{t-1}, \tag{15}$$

where w_t^{Pe} and w_t^{Ye} are the expected growth rates of house prices and income, respectively. In this section I assume that banks forecast the growth rates of income and house prices by using a very simple VAR model:

$$1 + w_t^{Pe} = \left(\frac{P_{t-1}}{P_{t-k}}\right)^{\frac{\alpha}{k-1}} \left(\frac{Y_{t-1}}{Y_{t-k}}\right)^{\frac{1-\alpha}{k-1}} \tag{16}$$

$$1 + w_t^{Ye} = \left(\frac{Y_{t-1}}{Y_{t-k}}\right)^{\frac{1}{k-1}} \tag{17}$$

or, in logs:

$$w_t^{Pe} = \frac{\alpha}{k-1} p_{t-1} - \frac{\alpha}{k-1} p_{t-k} + \frac{1-\alpha}{k-1} y_{t-1} - \frac{1-\alpha}{k-1} y_{t-k} \tag{18}$$

$$w_t^{Ye} = \frac{1}{k-1} y_{t-1} - \frac{1}{k-1} y_{t-k}, \tag{19}$$

where k is the number of lags, $0 \leq \alpha \leq 1$ is a parameter of the VAR and p_t and y_t are the logs of house prices and the income, respectively.

This setup has an important consequence: If an exogenous shock leads to an increasing house price in $t-1$, the period t expectation for the house price in $t+1$ gets higher. Following equation (4) this has a positive effect on the house price in t. A higher price in t has a positive effect on the period $t+1$ expectations of the price in $t+2$. This has, in turn, a positive effect on the price in $t+1$, and so on. This positive feedback effect is slowed down, however, by the consideration of a fundamental factor: income. As long as the house price increase is not accompanied by an appropriate increase in income and the consideration of the income development is strong enough (low α) the price increase is reversed at some point and the house price is going back to its "fundamental" value.

This mechanism is very similar to Hong and Stein (1999). They develop a model of "news-watchers" and "momentum traders". Momentum traders can amplify the effects of shocks. News-watchers link the price development to fundamentals. In my model agents (banks) base their forecasts on the momentum of the price as well as on fundamentals. To illustrate the impact of my assumptions I simulate the model for different sets of parameters. In all examples I use the following parameter values:

- number of households: $N = 10$,
- maximum income: $\bar{Y} = 100$,
- temporary income shock in t=5: $Y_t = 105$,
- mortgage rate: $m = 0.05$ and
- financing rate: $r = 0.04$.

For the parameter α and the number of lags k I consider different values. For the first two diagrams in Figure 4 $k = 2$. As we can see in the first diagram, very high and very low levels of α are not very interesting cases. With $\alpha = 0.1$, the price forecasts react mainly on changes in income. Since income stays constant after the shock in period 5 the house price goes back to its fundamental value very quickly. If, on the other hand, $\alpha = 0.9$, the positive feedback effect is dominant and the house price keeps on growing exponentially and is never going back.

More interesting are intermediate levels of α. As shown in the second diagram of Figure 4, $\alpha = 0.5$ leads house price fluctuations with a decreasing amplitude and

$\alpha = 0.52$ leads to price fluctuations with increasing amplitudes. Beside the house prices their expected values are displayed as well. As we can see, in both cases the forecasts are very accurate. The reason for this is that the forecasts are self-fulfilling. Hence, banks feel no need to change their VAR model.[9]

One reason for the price bubbles created by the VAR forecast is that it uses very short lags ($k = 2$). As shown in the third diagram of Figure 4, the amplitudes and the frequency of the house price fluctuations can be reduced by using longer lags ($k = 5, 10$). In this diagram $\alpha = 0.52$.

[Insert Figure 4 about here]

The results of the simulation are very similar to the results in section 3.1. Only now its not the changing mood of banks that creates fluctuations but their momentum forecasts. However, in both models the positive feedback effect emerges because the behavior of banks has an influence on the house price. This creates self-fulfilling prophesies.

House price fluctuations created by the momentum forecasts of banks lead, of course, also to fluctuations of their profits. These fluctuations are displayed in Figure 5.

[Insert Figure 5 about here]

As we have seen there are two elements that increase the adverse effects of the momentum forecasts: a high weight (high α) on the price development rather than fundamentals and short time lags (small k). Therefore, it is important that banks base their forecasts on fundamentals and that they consider long time horizons.

3.3 Disaster Myopia

From time to time it is a widespread opinion that houses are very safe investments and that house prices are always going up. In many cases, however, such a phase is ended abruptly by a real estate crisis. The question is: Why do people (and banks) sometimes neglect or underestimate the possibility of declining house prices? Herring

[9] Hirshleifer et al. (2006) also point out that irrational trading positively affects asset prices and thereby the profits of the irrational investors.

and Wachter (1999) see a reason for this in a "disaster myopia". Following this idea agents underestimate the probability for a shock if previous shocks were long ago. This idea relies on Tversky and Kahneman's (1982) availability heuristic. The authors write (1982, 164):

> "The availability heuristic ... uses strength of association as a basis for the judgment of frequency... Availability is an ecologically valid clue for the judgment of frequency because, in general, frequent events are easier to recall or imagine than infrequent ones. However, availability is affected by various factors which are unrelated to actual frequency."

One of the factors that affects availability is time. If an event occurred only recently it might be more available than an event that is long ago. To illustrate the effect of this heuristic on house prices, I make some small changes to my basic model.

First, I assume that in each period there is an income shock ($Y^S < \bar{Y}$) with probability β. Banks do not know, however, if this probability is high (β^h) or low ($\beta^l < \beta^h$). They assess the probability for a high β by looking at past shocks. The a priori probability for a high β is assumed to be $P(h) = 0.5$. Following Bayes' rule, under the condition that a shock (S) occurred, the probability for β^h ($P(h \mid S)$) is:

$$P(h|S) = \frac{P(S|h)P(h)}{P(S|h)P(h) + P(S|l)(1 - P(h))} = \frac{\beta^h}{\beta^h + \beta^l} \tag{20}$$

and under the condition that no shock (NS) occurred, it is:

$$P(h|NS) = \frac{P(NS|h)P(h)}{P(NS|h)P(h) + P(NS|l)(1 - P(h))} = \frac{1 - \beta^h}{1 - \beta^h + 1 - \beta^l}. \tag{21}$$

Agents do not look at just a single signal, however. In each period there is either a shock or not and these events provide a useful information. If banks do not consider just one signal but a hole history of signals (H), the probability for a high β is for example:

$$P(h|H) = \frac{\beta^h\beta^h(1 - \beta^h)(1 - \beta^h)\beta^h}{\beta^h\beta^h(1 - \beta^h)(1 - \beta^h)\beta^h + \beta^l\beta^l(1 - \beta^l)(1 - \beta^l)\beta^l} \tag{22}$$

In this case we have three shocks and two periods without a shock. As we can see, the sequence of the events is irrelevant for the probability. If we consider availability, however, the sequence suddenly becomes relevant. To introduce this effect, I assume that the parameter v (with $0 \leq v \leq 1$) represents how good past events can be recalled. If $v = 1$ agents perfectly remember all past events and if $v = 0$ they only look at the current event. To formalize this, I assume that a shock in $t - x$ leads to a probability assessment of:

$$P(h|S) = \frac{(\beta^h)^{v^x}}{(\beta^h)^{v^x} + (\beta^l)^{v^x}} \tag{23}$$

Now the sequence of events becomes very relevant. For the above example we get:

$$P(h|H) = \frac{\beta^h(\beta^h)^v(1-\beta^h)^{v^2}(1-\beta^h)^{v^3}(\beta^h)^{v^4}}{\beta^h(\beta^h)^v(1-\beta^h)^{v^2}(1-\beta^h)^{v^3}(\beta^h)^{v^4} + \beta^l(\beta^l)^v(1-\beta^l)^{v^2}(1-\beta^l)^{v^3}(\beta^l)^{v^4}} \tag{24}$$

To illustrate the effect of these assumptions, I simulate the model for the following parameter values:

- number of households: $N = 10$,
- maximum income: $\bar{Y} = 100$,
- income shock: $Y^S = 80$,
- high shock probability: $\beta^h = 0.2$,
- low shock probability: $\beta^l = 0.01$,
- true shock probability: $\beta = 0.2$,
- mortgage rate: $m = 0.05$ and
- financing rate: $r = 0.04$.

For the parameter v I consider different values. Shocks occur randomly with the probability $\beta = 0.2$. The first diagram of Figure 6 shows the development of the probability assessment for different values of v. As we can see, if banks do not forget previous events ($v = 1$), they learn quickly that the true shock probability is $\beta = 0.2$ and $P(h|H)$ gets close to 100%. On the other hand, if banks only consider the current period ($v = 0$) their probability assessment jumps between the result of equation (20) and the result of equation (21). Each time a shock occurs the probability for a high shock probability jumps up and it is low when there is no shock.

More interesting are the cases of intermediate values of v. With $v = 0.95$ banks learn quite good as well. However, if there are longer episodes with no shocks, the probability for a high shock probability can decline substantially and can even get smaller then with $v = 0$. It is important to note that this effect works in the other direction as well: If the true β is 0.01, banks overestimate the risk whenever a shock occurs. However, I only look at the case where banks underestimate the risk ($\beta = 0.2$).

The changing risk assessment of the banks has of course an effect on house prices. If banks believe that the shock probability is low, they are willing to provide higher mortgage loans. The second diagram of Figure 6 shows the development of house prices for $v = 0.75$ and $v = 0.95$. As we can see, with $v = 0.75$ house price bubbles are more frequent. If the episode of no shocks is very long, however, the bubble can get bigger if $v = 0.95$. The corresponding development of the profits is displayed in the third diagram. As we can see, banks make positive profits in the upswing phases and they suffer very high losses when the bubbles burst.

[Insert Figure 6 about here]

These results have two implications: First, they show that it is important that banks consider long time series (long memory or high v) for their risk assessment. However, the results also show that is important that past event have to be considered in the same objective way as recent events.

4 Conclusions

Banks are often among the victims of real estate crises. On the other hand, there is some evidence that banks do also contribute to create the problems. They provide more and more financial recourses for the real estate market and, thereby, help to create a price bubble. When the bubble bursts they are heavily exposed and suffer high losses.

In this paper I have shown how banks can create real estate cycles by providing higher or lower loans. They make high profits in upswing phases but suffer high(er) losses when the market turns. In my first approach banks become over- or under-confident because of the good or bad performance of their mortgage loans. The higher or lower confidence lead to higher or lower loans and, therefore, to higher or lower house prices. In a second approach I have shown how momentum forecasts can lead to overreactions and persistent fluctuations. Finally, I have shown that disaster myopia can lead to an underestimation of risks. This creates house price bubbles which burst if a shock occurs.

These findings have several implications: Firstly, they show that it is important that banks base their risk assessment on objective indicators. This is increasingly important since the distance between borrowers and the ultimate holder of the risk seems to increase (e.g. via securitization). Secondly, it is important that banks base their forecasts on fundamentals and that they apply long time horizons. It is, for example, insufficient to use house prices of the previous five years to predict future prices and at the same time a typical real estate cycle lasts for about 15 years. These points are not only relevant for banks, they are also important for rating agencies, supervisors and central banks.

References

[1] **Bernanke, Ben and Mark Gertler (1989)** Agency Costs, Net Worth, and Business Fluctuations. *The American Economic Review,* Vol. 79, No. 1, 14-31.

[2] **BIS (2004)** Bank Failures in Mature Economies. *Basel Committee on Banking Supervison, Working Paper* No. 13.

[3] **Case, Karl E. and Robert J. Shiller (2003)** Is There a Bubble in the Housing Market? *Brookings Papers on Economic Activity,* 2, 299-362.

[4] **Collyns, Charles and Abdelhak Senhadji (2002)** Lending Booms, Real Estate Bubbles and the Asian Crisis. *IMF Working Paper,* WP/02/20.

[5] **Gerlach, Stefan and Wensheng Peng (2005)** Bank Lending and Property Prices in Hong Kong. *Journal of Banking and Finance,* 29, 461-481.

[6] **Herring, Richard J. and Susan Wachter (1999)** Real Estate Booms and Banking Busts: An International Perspective. *Wharton Financial Institutions Center,* Wokring Paper 99-27.

[7] **Himmelberg, Charles, Christoph Mayer and Todd Sinai (2005)** Assessing High House Prices: Bubbles, Fundamentals, and Misperceptions. *Journal of Economic Perspectives,* Vol. 19, No. 4, 67-92.

[8] **Hirshleifer, David, Avanidhar Subrahmanyam and Sheridan Titman (2006)** Feedback and the Success of Irrational Investors. *Journal of Financial Economics,* 81, 311-338.

[9] **Holly, Sean and Natasha Jones (1997)** House Prices Since the 1940s: Cointegration, Demography and Asymmetries. *Economic Modelling,* 14, 549-565.

[10] **Hong, Harrison and Jeremy C. Stein (1999)** A Unified Theory of Underreaction, Momentum Trading, and Overreaction in Asset Markets. *The Journal of Finance,* Vol. 54, No. 6, 2143-2184.

[11] **Hofmann, Boris (2004)** The Determinants of Bank Credit in Industrialized Countries: Do Property Prices Matter? *International Finance,* 7:2, 203-234.

[12] **Hott, Christian (2007)** Explaining House Price Fluctuations. In: The Federal Reserve Bank of Chicago *"The Mixing of Banking and Commerce - The 43rd Annual Conference on Bank structure and Competition"* 304-325.

[13] **Hott, Christian and Pierre Monnin (2008)** Fundamental Real Estate Prices: An Empirical Estimation with International Data. *Journal of Real Estate Finance and Economics,* Vol. 36, No. 4, 427-450.

[14] **Kiyotaki, Nobuhiro and John Moore (1997)** Credit Cycles. *The Journal of Political Economy,* Vol. 105, No. 2, 211-248.

[15] **Lown, Cara and Donald P. Morgan (2006)** The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey. *Journal of Money, Credit, and Banking,* Vol. 38, No. 6, 1575-1597.

[16] **Lux, Thomas (1995)** Herd Behaviour, Bubbles and Crashes. *The Economic Journal,* Vol. 105, No. 431, 881-896.

[17] **Stiglitz, Joseph E. and Andrew Weiss (1981)** Credit Rationing in Markets with Imperfect Information. *The American Economic Review,* Vol. 71, No. 3, 393-410.

[18] **Tversky, Amos and Daniel Kahneman (1982)** Availability: A Heuristic fo Judging Frequency and Probability. *In: Daniel Kahneman, Paul Slovic and Amos Tversky "Judgment Under Uncertainty: Heuristics and Biases"* , Cambridge University Press, 163-178.

FIGURE 1: THREE CASES OF DEFAULT RATES AND PROFITS.

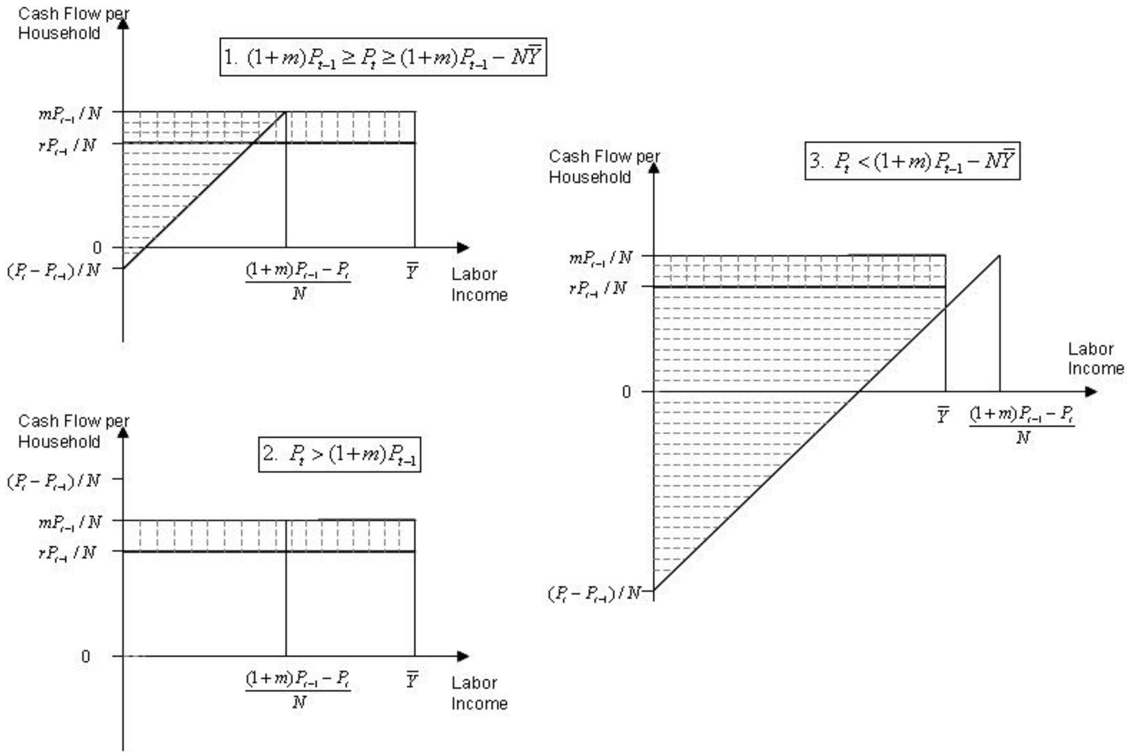

Figure 2: Three cases of house price fluctuations under mood swings.

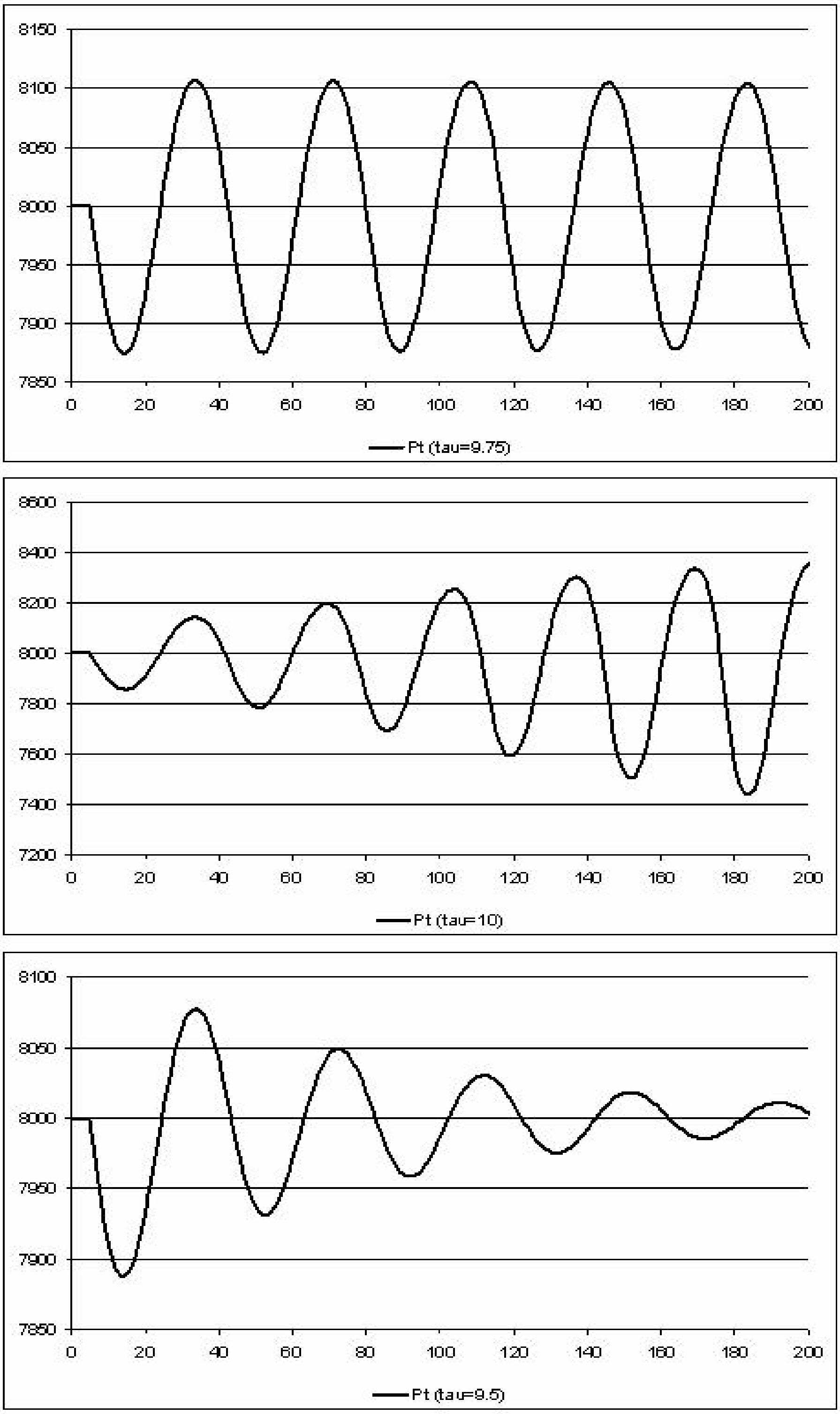

Figure 3: Three cases of bank profits under mood swings.

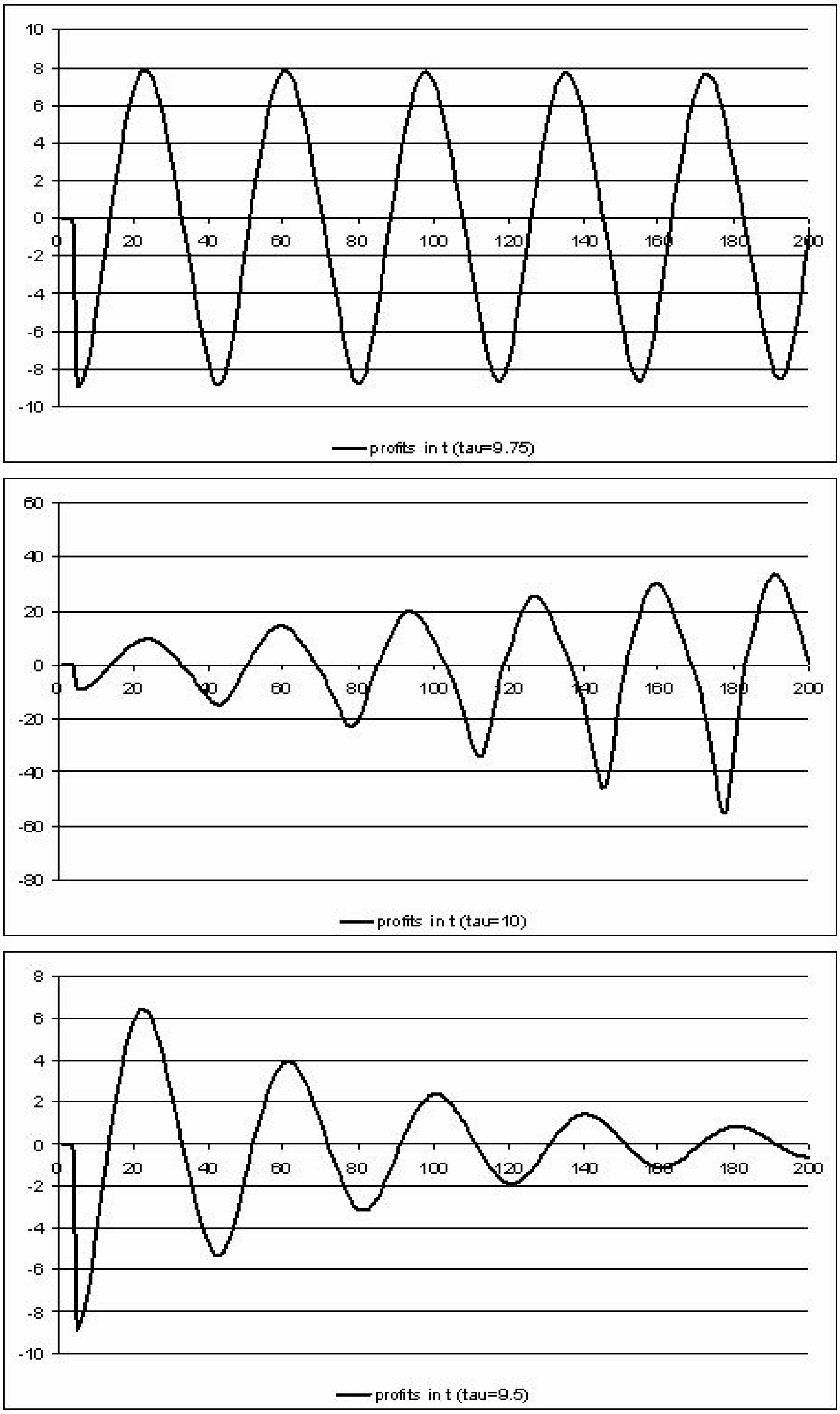

Figure 4: House price fluctuations with momentum forecasts.

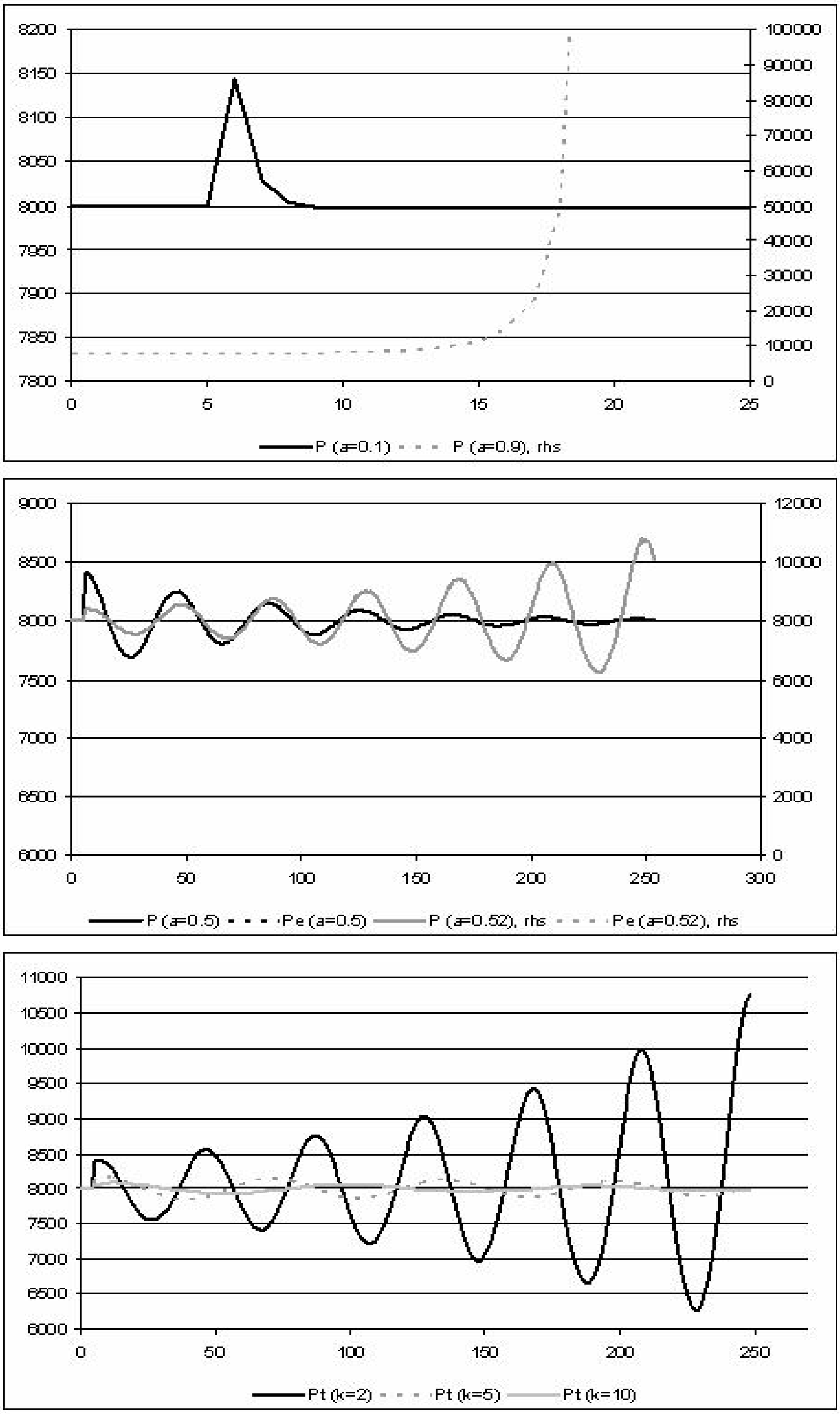

Figure 5: Bank profits with momentum forecasts.

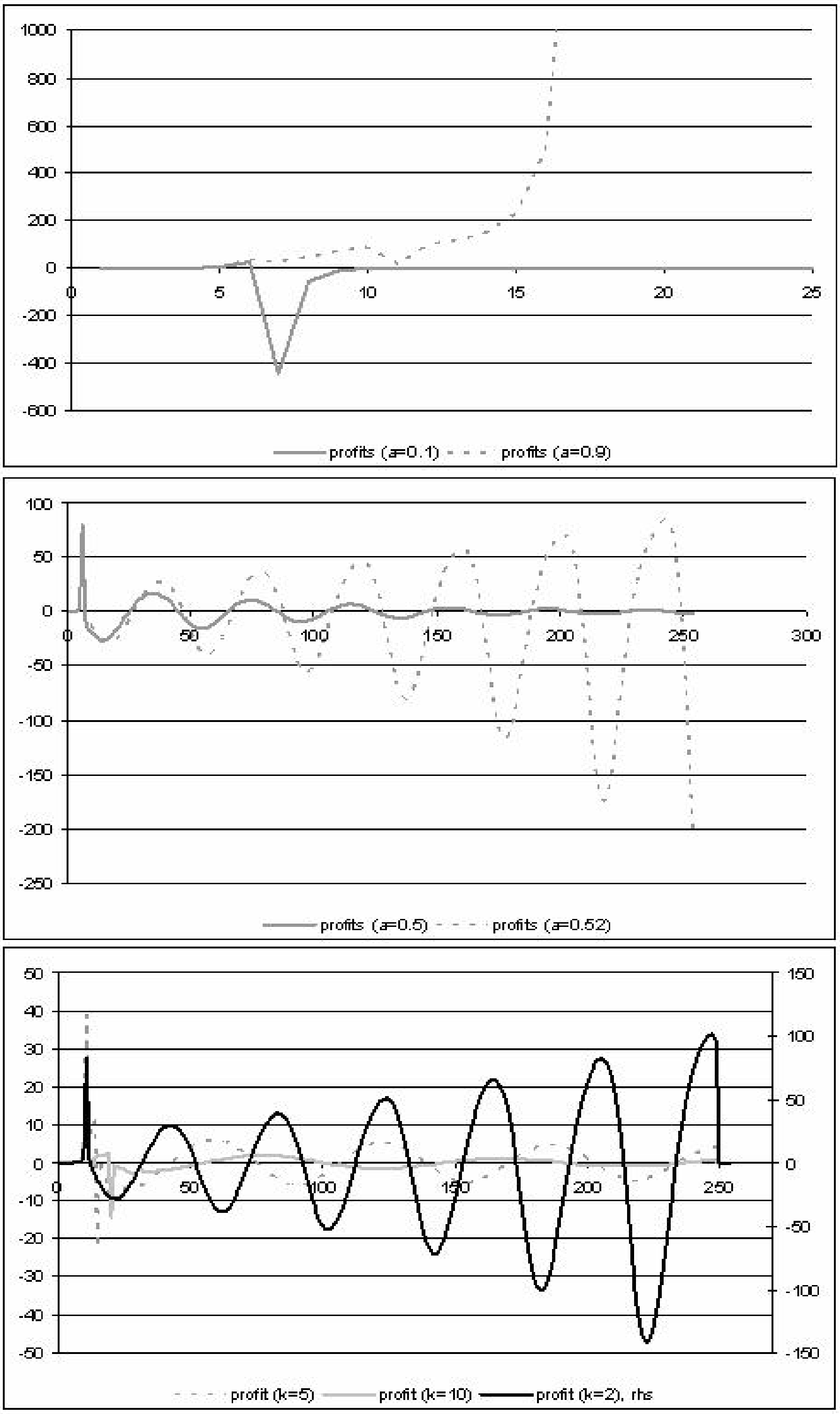

Figure 6: Probability assessment, house prices and profits with availability heuristic.