



Price Bubbles on the Housing Market: Concept, theory and indicators

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Abstract

Purpose: The purpose is to clarify the concept of bubble, what it means to explain a bubble and propose a list of bubble indicators.

Method: The article is based on a literature review and then uses some philosophical ideas to derive conclusions for the problems studied.

Findings: A price bubble should be defined only in relation to the development of prices: A dramatic increase immediately followed by a dramatic fall. The traditional definition in terms of prices not determined by fundamentals is problematic primarily because the concept "fundamentals" is vague. A bubble can never be explained by a single factor, but is the result of a complex of factors. The explanatory factors proposed are used to derive a set of indicators that work as warning signals whether a dramatic increase in prices will be followed by a dramatic fall. The list developed covers e.g. interest costs in relation to household incomes, the elasticity of supply, price expectations and credit conditions.

Research limitations/implications: Both the explanatory framework and the list of indicators should be seen as preliminary and the starting point for further development through empirical testing.

Practical implications: A developed list of bubble indicators could be useful for a number of actors, e.g. banks and authorities responsible for monitoring financial stability.

Originality/value: The contribution is a clearer and more useful concept of bubble, a clearer separation of the question whether bubbles exist and how they should be explained. The proposed list of indicators goes far beyond earlier indicators.

1. Introduction

In the last five years there has been a discussion in many countries about whether there was a bubble on the housing market¹. An interesting feature of this debate is the large disagreements between different participants, both among scientists and in the more general debate. In the scientific debate, Case and Shiller (2003) and Shiller (2007a and b) argue that there were clear indicators of a bubble in the USA. This conclusion was questioned by e.g. Quigley (2003), Himmelberg et. al. (2005) and Smith & Smith (2006). In the more popular debate The Economist in 2005 argued that the largest bubble in history could be observed on the housing market. But it is also easy to find popular articles arguing against this view, e.g. Krainer (2003).

Disagreements about price bubbles are not new. Garber (1990), e.g., argues that even in the classical bubbles - the Dutch tulipmania (1634-37), the Mississippi Bubble (1719-20), and the South Sea Bubble (1720) - were there perceived changes in fundamental factors that could explain the increase in asset prices.

The first thesis in this article, argued for in section 2 below, is that these problems are related to an unsatisfactory definition of "bubble" that mixes a descriptive component (price increases) with a (vague) explanatory component (not caused by "fundamentals"). The conclusion is that "bubble" should be defined only in terms of how prices behave.

The second thesis argued for below is related to the debate about explanations of bubbles (focusing on why prices increase dramatically). One common argument is that the interesting type of dramatic price increase is one that is related to expectations about further price increases. In section 3 below it is argued that this type of explanation that focuses on a single factor is unsatisfactory. Bubbles must be seen as the result of the interaction of a set of factors. A framework for such an explanation will be presented

The third issue that is in focus here is the possibility to predict whether a dramatic price increase will be followed by a fall in prices. Much of the recent "bubble" debate is actually about whether it is likely that the dramatic price increases that have been observed will be followed by a serious fall in prices. In section 4 this is discussed explicitly in terms of what a system of "bubble indicators" could look like. Given the conclusion that a complex of interacting factors causes bubbles, it is logical to try to develop a larger set of indicators, not just one or two as the price/income ratio or the price/rent ratio.

2. The definition of a price bubble: Anti-Stiglitz

2.1 Why we need the concept "bubble", but not Stiglitz' definition

When there is much controversy around a concept, and when there are several somewhat different interpretations, one possible solution is simply to discard the concept. An example is the concept of "the natural rate of unemployment" that were introduced in macroeconomics in

¹ In this article, "bubble" and "price bubble" or more specifically "asset price bubble" will be used as synonyms.

the 1970s, only to be replaced in the 1980s with the clearer and less ideological term "non-accelerating rate of inflation unemployment" (NAIRU).

There are, however, strong reasons for keeping the term bubble and that is that asset prices develop very differently in different time periods. It is possible to observe periods with an extreme pattern of asset price behaviour - first a sudden dramatic increase in the asset price and then almost immediately a fall back to a level close to the original one. These periods are *so dramatic that it seems rational to have a specific term that refers to them*, and it is also rather clear that these events are the historical origin of the term.

Most recent discussions about bubbles start from Stiglitz' definition reproduced below²:

"the basic intuition is straightforward: if the reason that the price is high today is *only* because investors believe that the selling price will be high tomorrow-when "fundamental" factors do not seem to justify such a price-then a bubble exists."
. (Stiglitz 1990, p 13)

There are several problematic features of this definition. The first is that it does not refer to a bubble episode as a whole - both a price increase and a price decrease - but only discusses the increase in prices. The implicit assumption is that if the price increase is not based on fundamentals, then it will not last. As has been showed in a number of theoretical articles (see Stiglitz 1990, p 14), it is possible to construct models where a price increase not based on fundamentals continues. From an historical perspective it is clear that the interesting thing to understand are complete episodes where prices first increase and then decrease.

The second problem is, as suggested above, that the definition includes reference to what can *explain* the price increase, and especially that it does this in two different but not identical ways. The first part of the definition says that there is a bubble if the price is high today only because investors think that it will be high tomorrow. The second explanatory part says that the price increase cannot be justified by fundamentals. The first part of the definition is however narrower than the second, as price increases not possible to explain by fundamentals, could be explained by other things than expectations of high prices tomorrow, e.g. unrealistic expectations about incomes or interest rates. The final problem is that the central term "fundamentals" is vague. As will be discussed below it is e.g. controversial whether real or nominal interest rates belong to the fundamental, and whether current and/or future expected rates should be included.

With hindsight it is clear that introducing several rather vague explanatory factors in the definition of a bubble was bound to lead to major disagreements about almost every episode in history.

The simplest solution seems to be define a bubble in such a way *that it focus only on the specific development of prices and not on why the price has developed in this way*. The general definition of a bubble would then simply be:

"There is a bubble if the price of an asset first increase dramatically and then almost immediately falls dramatically."

² There are other definitions of bubbles, e.g. in Kindleberger (1978) where a "bubble" is defined as "a non-sustainable pattern of price changes or cash-flows" (p 25) but these will not be discussed here as Stiglitz definition is so dominating. Smith & Smith (2006) also present an alternative definition in terms of the relation between price and net present value of revenue from the asset.

2.2 Making the alternative definition more precise

A *first necessary feature* of a bubble is then that there has been a "*dramatic price increase*". But what does "dramatic" mean here? In the most famous episodes that has been called bubbles in the literature (see e.g. Garber 1990), price increases of an asset have been more than 10-fold within a period of less than a year. The increase in the Nasdaq stock market in the late 1990s is another example of what must be classified as a very dramatic price increase.

Looking at house prices, such large price increases have not occurred and are not very likely, and a dramatic price increase on the housing market could be defined as e.g. that:

- real prices have at least doubled during a five year period.
- real prices have increased with at least 50% during a three-year period.

The second and third necessary condition for a price bubble according to the definition above are that prices *fall back* to something like the original level, *shortly after* the prices have peaked. This raises the questions; "How short must the time period be between the peak of the prices and when prices start to fall?" and "How quick and how much must prices fall?"

In the historical episodes described as bubbles there were no stable period with high prices after the dramatic price increase. The prices started to fall immediately after the peak. This might however be too restrictive, but I think it is *not* reasonable to see something as a bubble if the prices have stabilized on a high level, for example during a 3-year period. Exactly where to draw the line is not important - but if we want to have a rather narrow concept of bubble maybe a 1-2 year period is the longest acceptable period between the time when the prices peaked and the time when they start to fall. Otherwise the price increase and the price decrease would be seen as two separate events.

Finally we have to make a decision about how much prices have to fall. In many of the classical bubbles prices fell back to (at least) the level before the price increase started. This might also be too restrictive. Suppose for example that house prices triple from 100 to 300, and then directly after fall with 50% to 150. Even if the price does not fall back to the initial level, it seems reasonable to see such a period as a bubble period as a 50% fall must be seen as a dramatic fall in property prices.

There is no point in making an exact definition of a bubble, as one has to take into account the relation between the factors. An example is that the bigger the increase in prices, the larger deviation might be acceptable between the initial price and the price at the bottom after the downturn. Any definition has borderline cases.

3. The explanation of a bubble - A general framework

3.1 What is an explanation?

In the philosophical literature a number of models of explanations can be found. The covering-law model is perhaps the most well known (see Hempel 1965). A more complex

model was formulated by Mackie (1974) in an attempt to explicate what is meant by a cause, and that model will be used here. Mackie summarizes the model by saying that for something to be a cause it has to fulfil the so called INUS-condition. The ideas behind these letters are the following.

First, an event occurs because there is a *set of conditions that is Sufficient*. This is the "S" at the end of the INUS. For a fire to occur, the combination of a dropped burning match and a carpet that easily burns, might be such a set of sufficient conditions. A single factor is seldom sufficient to lead to a specific event. This means that if we want to understand an event like a bubble we should look for a *combination of a number of factors* in order to find sufficient conditions for the bubble.

This set of sufficient factors is not necessary. An event can usually occur because of somewhat different sets of sufficient factors. In the bubble context this means that one should not expect that the complete set of factors that was sufficient for one bubble also will be found in other cases. The set of Sufficient factors is *Unnecessary* (this is the U in the INUS-condition). There might be a large overlap between the sufficient factors for two bubble episodes, but there can also be expected to be some important unique events in each case.

When we talk about a cause of an event we usually pick *one factor or a small number of factors as explanations*, e.g that a bubble was caused by unrealistic expectations about future prices. The single factor that is focused on is an *Insufficient but Necessary part of the Unnecessary but Sufficient complex*.

From this perspective explaining a bubble would be the same as to investigate the whole set of factors that was sufficient for the bubble to occur. In the next section an attempt will be made to create a structure for such an explanation, based on the factors often mentioned in the literature.

3.2 The explanatory framework

The hypothesis here is that by looking at the following dimensions it should be possible to present a set of sufficient conditions for a specific bubble episode.

1. The macroeconomic situation and macroeconomic policies

Bubbles typically start in a rather extreme boom period that has lasted for a comparative long period. It can also be hypothesized that it is a period where the macroeconomic policies have been rather lax.

2. Structural changes in the economy

A theme that comes up in a number of studies of bubbles is that the period when the bubble starts is a period where it is more difficult than usual to evaluate what is "normal". An example is the discussion in White (1990) about the boom on the stock market in the late 1920s where he concludes: "Fundamentals became difficult to judge because of major changes in industry." The wave of deregulations in the 1980s has e.g. been mentioned as an

example of such structural changes behind the real estate bubble in a number of countries around 1990. The IT-boom 10 years later also falls into this pattern. There is at least some basis for the "New era theories" that Shiller (2000) criticizes.

3. The capital and credit market

When prices for assets increase dramatically, the actors must of course be able to pay these prices and then credit usually is necessary. Kindleberger (2003) underlines the role of the credit market for asset price bubbles:

"The thesis in this book is that the cycle of manias and panics results from the pro-cyclical changes in the supply of credit." (p 10)

The real estate bubble around 1990 in Sweden, one of the "Top 5 bubbles" in recent years according to Reinhart & Rogoff (2008), is in most analyses related to generous lending policies by the banks (see e.g. Lind 1998).

4. The beliefs, expectations and plans of the actors

An important aspect of understanding the changes in the asset price is to know how the people who bought the asset at the high price argued and thought. It should be expected that people who buy an asset during a boom period have rather heterogeneous beliefs, expectations and plans, and the question is then the distribution between different groups in a specific period. Below is a number of interdependent aspects mentioned in various bubble debates:

- *Holding period*: How many were buying but planning only to hold the asset for a short period of time? We should expect that during a dramatic period with price increases, a larger share plan to sell shortly after they had bought the property.

- *Beliefs about the future development of the asset price*: How many actors on the market think that prices will continue to increase, and for how long? This is the aspect focused on in the Stiglitz definition, and it is also in focus in Case & Shiller (2003): People are paying a high price because they believe that the price will be higher in the future. A home-buyer might think that if they do not enter the market now it will be even more expensive in the future.

A further example of the role of expectations is an hypothesis presented in Pastor & Veronesi (2006). They question whether there really was a bubble (in Stiglitz sense) on Nasdaq around the year 2000. They argue that high uncertainty, because of the new technology, meant that there was a (small) chance that at least some firms were a new Microsoft. If the degree of risk-averseness is low, then it can be rational to pay very much for such a stock today even if current profits are low. It is like buying a lottery ticket.

- *The rationality of the actors*: Do people have rational expectations about the future? The title of Shiller's famous book - "Irrational exuberance" - indicates that this an important aspect to study when understanding bubble periods. This also needs clarification and Nozick (1993) points to some important aspects:

"Two themes permeate the philosophical literature. First that rationality is a matter of reasons. A belief's rationality depends upon the reasons for holding that belief

[...] Second, that rationality is a matter of reliability. Does the process or procedure that produces (and maintains) the belief lead to a high percentage of true beliefs?" (Nozick 1993)

The hypothesis here is then that a larger share of actors, during the period with rising prices during a bubble, are not acting rationally in this sense. The behaviours of the banks in Sweden during the boom in the late 1980s are analysed from this perspective in Lind (1998).

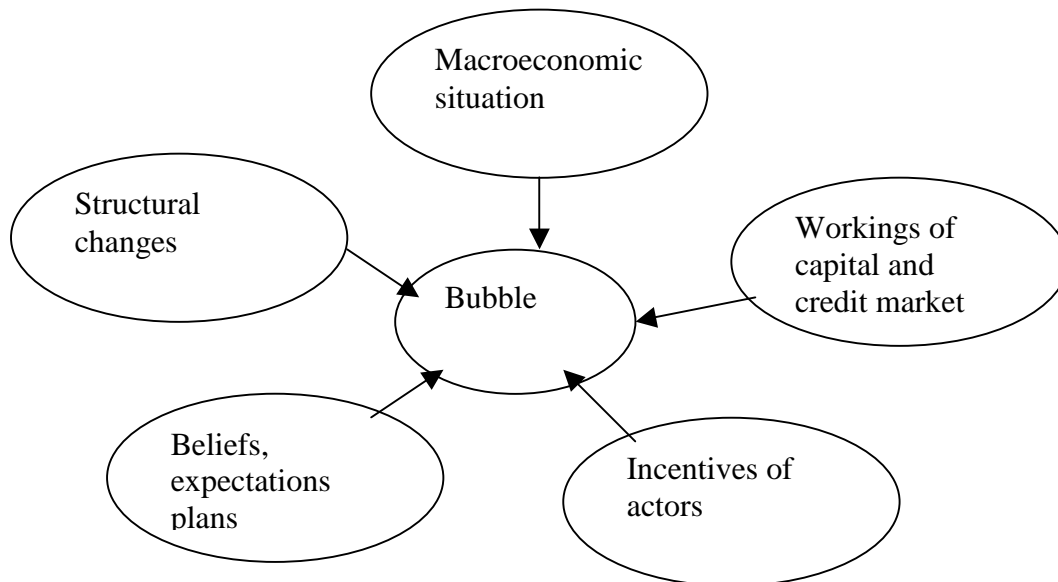
5. The incentive of the individuals

A theme in a number of studies about bubble episodes is that the incentive system made it rational for individuals to make decisions that from outside looks irrational. Garber (2000) e.g. mentions that during the Tulipmania period many buyers "knew" that they would not be forced to pay the price that were agreed in the contracts. Cole & Eisenbeis (1996) points out that there were a number of principal-agent problems during the US Savings- and loans scandal, and in the current sub-prime crisis similar aspects can be found.

Summing up

The diagram below gives an overview of the different dimensions that need to be analysed in order to find a sufficient condition for a specific bubble. In each dimensions there could be necessary conditions for the bubble, e.g. if there were no boom in the economy there would not have been any bubble, if incentives had been different then there might not have been a bubble, etc.

Diagram 1 Theoretical framework for explaining bubbles



3.3 Bubbles: three ideal types

Explaining a bubble is, according to the arguments above, a type of historical explanation, focusing on the interaction of a number of factors and the interaction of individuals with different degrees of knowledge, different beliefs and plans - and with various incentives to take certain things into account. Even if each bubble episode has unique features it might be possible to construct a smaller number of “ideal types” of bubbles, where some specific mechanism dominates. Here are three such types.

Ideal type 1. A pure speculative bubble.

In this case buyers believe that the price of the asset today is too high and that the price eventually will fall, but believe that the price will continue to rise for some time, and that it will be possible to sell with a profit before the price falls. Bubbles of this type have for example been observed in some laboratory experiments where the price of the asset at the end of the experiment is known (see Smith et al 1988). As the transaction cost is rather high on the housing market, it should not be expected that this kind of mechanism would dominate periods of rapidly rising prices on the housing market.

Ideal type 2. An irrational expectations bubble.

In this case actors on the market become overoptimistic and think that asset price will grow rapidly over a longer period of time. The growth is expected to be considerably higher than historical averages. Therefore it seems rational to pay a high price today. In this case the buyer plans to stay in the house or apartment for a longer period (keep the asset), but thinks that it is reasonable to pay the high price because of a combination of assumptions that is not supported by historical patterns or other strong evidence, e.g. about incomes and interest rates.

Ideal type 3. The irrational institutions bubble.

In this case the main mechanism behind the bubble is principal-agent problems, where actors have incentives to pay higher prices than what is supported by historical patterns or strong evidence. There are several ways that a principal-agent mechanism can push house prices above what is justified. The core of the mechanism is however, by definition that the buyer of the house/apartment does not expect to take the losses that occur when prices fall dramatically. The person who lends to money also expects to be able to shift the losses to someone else, maybe the government in the end. The sub-prime lending is the latest example of this (see Wheaton & Nechayev 2008).

4. A system of bubble indicators

4.1 What is an indicator?

From a policy point of view the most important aspect of bubble theories is their predictive ability. Can they be used to indicate the probability that a period with a dramatic price increase quickly will be followed by a dramatic fall in prices? An *indicator system* would be a set of characteristics that are such that if they are at hand during a period of quickly rising prices, then it increases the probability that prices will fall dramatically soon.³

“Probability” can be given both more “objective” and more “subjective” interpretations. The objective interpretation would focus on characteristics that have been observed in early phases of earlier bubbles, and draw the conclusion that if such characteristics are observed now then the likelihood of a downturn is higher. The more subjective, or theoretical interpretation, would go something like the following. In the long run, the market is determined by rational factors, by factors that a knowledgeable actor would take into account, and by the weight that the knowledgeable actor would give them. If during a certain period with increasing prices it is observed that other factors are affecting the behaviour of the actors, then the probability that prices will fall soon is higher. The “irrational” factors that affect the price would then indicate that there is a bubble.⁴

Before presenting the list of indicators it must be underlined that if asset prices follow a random walk driven by new information only - if the efficient market hypothesis is correct - *then there could not be any bubble indicators*. The development in behavioral finance (see e.g. Shiller 2001, 2002) show, however, that it should not be taken for granted that markets are efficient in this sense. In the end it is an empirical question whether it is possible to find any interesting empirical regularities on which indicators can be based, and if it is possible to predict whether the market is in a first stage of a bubble.

The only more systematic list of indicators that I have seen is one developed in a report from China Academy of Social Science (described in Xiaoling 2007, p 27). This is presented in the table below, and it is based on price to income ratios, the price increase rate, rent to price ratios and investor psychology.

³ There is an interesting parallel that will not be developed further here to the much criticised German concept “Mortgage lending value”. An attempt to defend this concept in terms of risk for falling prices can be found in Bienert & Brunauer (2007).

⁴ This idea might be behind Stiglitz definition of bubble.

Table 1 Example of bubble indicators

Table 1 Housing price index

Type	Specific index	Bubble reference standard		China current situation
		Little bubble	Serious bubble	
Price index	Selling price	Housing price to income ratio < 1:6	Housing price to income ratio > 1:10	Almost 1:8
	Price increase rate	Housing price increase rate/average income increase rate per capita > 1	Housing price increase rate > 30%	Housing price increase rate/average income increase rate per capita > 1
	Increase range	All kinds of property price increased nationally	All kinds of property price increased nationally	All kinds of property price increased nationally
	Rent level	Rent level index/CPI index < 1	Rent level index < 100	Rent level index/CPI index < 1
	Investors' psychology	Quite optimistic	Very optimistic	Quite optimistic

The indicators presented below are based on factors discussed in the literature. The list presented below should however be seen more as an hypothesis than as something rather final.

4.2 Prices and incomes

One common indicator is the price/income ratio. One argument for using this indicator can be found in the empirical material presented in Case & Shiller (2003) where it is shown that this relation has been very stable over time in a number of regions (p. 308). It is also shown that in a number of states where the relation increased it later fell back towards an historical average (p 311).

There are several arguments against using the price/income ratio as a bubble indicator (see e.g. McCarthy & Peach 2004 and Himmelberg et al 2005). The first is that households care about the relation between housing expenditure and incomes, not the relation between price and income. Another, and according to my view, stronger argument against using the price/income ratio is that even in the fastest growing countries or regions, incomes do not grow more than around 10% per year. This means that *any* period with a dramatic rise in prices would be characterized by an increased price to income ratio, and the ratio would therefore not make it possible to distinguish periods where prices increase because of a structural shift or by factors that will not last.

4.3 Housing expenditure

When constructing a bubble indicator related to housing expenditure it does not seem reasonable to focus on the standard user cost concept (as is done in e.g. Himmelberg et al 2005) as the user cost includes changes in the value of the property. During a period with rapidly increasing prices this user cost will seem to be rather low as there are dramatic increases in the wealth of the home owning households.

This means that the direct expenditure should be in focus instead. Interest costs are a large part of the housing expenditure and a possible indicator is the *relation between the nominal interest payments of the average buyer and their income*. If this is significantly higher than in earlier periods, it would indicate that the buyers are acting in a non-sustainable way.

Several economists have argued that falling nominal interest rates is a fundamental that can explain the observed price increases (see e.g. McCarthy & Peach 2004), but there have been several criticisms of the use of nominal interest rates in this type of calculation (see e.g. Economist 2005, Shiller 2007a,b). The core of their argument is that if nominal interest rates fall because of lower inflation, then this would not motivate paying more for a house. Shiller (2007a) argues that the weight given to nominal interest rates should be seen as a change in “popular models” and reflects money illusion.⁵ This argument would then instead lead to a focus on *the real (after tax) interest payments for buyers*.

It is also necessary to clarify *which* nominal and real interest rate that should be used. The background to this question is the argument that homebuyers are thinking too much about the current interest rate and that they (irrationally?) think that a current (low) nominal interest rate will last.

As both these issues are controversial, the proposal here is to include four different subindicators related to interest payments; see Box 1.

Box 1: Indicator group 1 - Interest payments in relation to income for homebuyers

- a) Nominal interest payments in relation to income have been increasing.
- b) Nominal interest payment in relation to income would have been increasing if historical interest rate levels were applied
- c) Real interest payments in relation to income have been increasing
- d) Real interest payments in relation to income would have been increasing if historical interest rate levels were applied

4.4 Housing supply

If, for example, falling interest rates were analysed from the perspective of a standard stock flow model, the argument would go like the following:

1. Falling interest rates would lead to increasing demand for housing.
2. In the short run with given supply, this leads to higher prices.
3. The higher prices lead to increased profitability in housing construction and increased supply.
4. The prices fall to a level that is determined by the level of construction costs.

It is also possible to argue, using the so called Coase conjecture for durable goods, that there will be no dramatic increase in prices in step 2, as the buyers will realize that cheaper houses soon will come on the market. Explaining increased house prices with a falling interest rates would then presuppose myopic actors.

⁵ Égert & Dubravko (2007) e.g. see the real interest rate as the fundamental.

The supply side has been mentioned in the recent debates about bubbles, by e.g. Quigley (2003) and Goodman & Thibodeau (2008). They argue that a price increase caused by e.g. falling interest rates and increasing GDP is not a bubble, if it is very difficult to increase supply. The logic of this reasoning is clear from the stock-flow model. These arguments indicate that a *bubble sub-indicator should focus on how difficult it is to increase supply in the areas where prices increase much*: See Box 2 below.

Box 2: Indicator group 2 - Housing supply

The easier it is to increase supply, the more likely is it that the price increase is part of a bubble.

4.5 Buyer expectations about prices

One central idea in e.g. Case and Shiller (2003) is that a sign of a bubble is that people expect increasing house prices even though prices already have increased a lot. This is related to the classical Stiglitz definition discussed above. Schiller (2007a, p 8) says:

“I will argue that a significant factor in this boom was a widespread perception that houses are a great investment, and the boom psychology that helped spread such thinking.”

Expectations about future prices can be formed in a number of ways. Beside the efficient market assumptions, people might build their expectations on longer or shorter historical trends, or on assumptions about mean reversion: that the probability of falling prices increases when prices have gone up a number of years. The hypothesis here is then that the typical situation during a bubble period is that people have adaptive expectations based on a rather short period. Many actors on the market believe that prices will continue to increase as they did in recent years, and when prices has increased a lot people still do not believe that they will fall, but will stabilize on a level that is very high from an historical perspective (see Wong & Hui (2006) for some evidence that support this). The households underestimate the risk from housing investment. The indicators in this group are summarized in Box 3.

Box 3: Indicator group 3- Buyer expectations about prices

- a) Buyers expect that prices will continue to rise or stabilize on a level that is much higher than historical trends.
- b) Buyers believe that even in a median term perspective (3-5 years) investing in housing is almost risk-free.

4.6 Buyer impatience and financial risk taking

The first idea here is that the probability of falling prices would be higher if, during a period with rising prices, households become more impatient: The cost of waiting is felt to be high, which might be related to herd behaviour, if it is felt that many others have "realized their dreams" and e.g bought a house or apartment that is expensive in relation to their income.

The second aspect of this is that the risk for falling prices would be higher if households choose more risky financing alternatives. An extreme case is the kind of loan that led to the sub-prime crises in the USA, where interest payments and amortization were reduced the first years. A less extreme case is where a large part of the loan has interest rates that follow the current market rent and that these loans are taken during a period where the short run interest is low.

A third aspect of increased risk taking would be if the rate of amortization is low for home buyers compared to historical averages. As amortization is a way to build up reserves, a low rate of amortization means increased risk taking.

The indicators in this group are summarized in Box 4.

Box 4: Indicator group 4 - Buyers risk-taking and impatience

- a) People are entering the ownership earlier or at a higher quality level.
- b) Buyers tend to choose riskier financing alternatives than earlier.
- c) Buyers are amortizing less than earlier.

4.7 The credit market

More risky financing choices by the households presuppose that there is a supply of such lending. Kindleberger (2003) underlines that bubbles on the asset markets are "fuelled by" easy credit:

“The thesis in this book is that the cycle of manias and panics results from the pro-cyclical changes in the supply of credit.” (p 10)

When the focus is on the housing market, easy lending should firstly be reflected in the loan-to-value ratios. From a mean-reversion perspective, loan to value ratios should be reduced during an extreme boom, but if loan-to-value ratios even increase (everything else equal) then that should be an indicator of too easy lending. Another aspect is how the banks evaluate the borrowers' credit worthiness and whether there is a change in a more liberal direction.

Box 5: Indicator group 5 - Bank behaviour

- a) Banks are increasing or at least not decreasing loan to value ratios for buyers on the housing market when prices increase.
- b) Banks become more liberal when judging the credit worthiness of households.

4.8 Speculative behaviour

The final bubble indicator concerns short run speculative behaviour. When housing prices are increasing rather quickly and if there are strong expectations of future price increases, then some people might see an opportunity for quick profits by buying an apartment or house and selling it again rather soon. This speculative behaviour might then further increase demand and prices. In many historical asset market bubbles this type of behaviour has been observed,

even if it can not be expected to be central on the housing market where transaction costs are high.

Box 6: Indicator group 6 - Speculative behavior

A larger share of home-buyers than usual are planning to sell rather quickly again.

4.9 Final comments on indicators

The list of indicators presented above needs to be tested and developed in a number of ways. The first question is whether it is the right list. Besides leaving out the price/income ratio, the list also leaves out the relation between the rent level and the price level. Several authors have focused on this relation as a central bubble indicator (e.g. Taipalus 2006), but it was not included above because many European countries have rent regulations that make the interpretation of the rent/price ratio difficult.

A second question is how the indicators can be made more operational. It is probably not possible to find a general scale for measuring the indicators as e.g. financing structures differs between countries. The next step would however be to look at least at a number of countries and then try develop a measuring scale for each of the indicators..

5. Conclusions

Three main theses have been developed in this article.

The definition of bubble: Through history there have been periods where asset prices rose dramatically and then fell back to roughly the original level. These periods need a specific label that does not assume anything about why such a period occurs. The proposal here is to use the term bubble for these periods. The definition should then not include conditions like "price increases not determined by fundamentals".

The theory of bubbles. The framework proposed here is based on the idea that such dramatic developments of asset prices depend on the interaction between different factors. It is necessary to look at a whole complex of factors covering macroeconomic factors, structural changes, credit conditions, expectations among the actors in the market and principal-agent problems.

Bubble indicators: From a policy perspective the most important and most controversial thing is to try to develop warning signals that function as indicators as to whether it is likely that a dramatic increase in house prices will be followed by a dramatic fall. If bubbles result from different sets of sufficient conditions, and the interaction of several factors, then the focus should be on a broad set of indicators. The list developed here covers e.g. interest costs in relation to household incomes, the elasticity of supply, price expectations and credit conditions.

This way of structuring the problem of bubbles also points to a number of areas for future research, e.g. investigating a number of historical episodes with the theoretical framework described above. The list of indicators also need to be tested and made more operational.

The recent events (september 2008) where the sub-prime crisis have developed into a full-scale financial crisis, clearly underline the importance of trying to develop indicator systems like the one sketched above.

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