Analysis of the phenomenon of speculative trading in one of its basic manifestations: postage stamp bubbles

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(July 9, 2021)

We document and analyze the empirical facts concerning one of the clearest evidence of speculation in financial trading as observed in the postage collection stamp market. We unravel some of the mechanisms of speculative behavior which emphasize the role of fancy and collective behavior. In our conclusion, we propose a classification of speculative markets based on two parameters, namely the amplitude of the price peak and a second parameter that measures its “sharpness”. This study is offered to anchor modeling efforts to realistic market constraints and observations.

Keywords: speculative bubble, stock market, collective behavior

I. INTRODUCTION

In his “Treatise on general sociology” [1], Vilfredo Pareto pointed out that the construction of celestial mechanics has been favoured by the fact that the mass of the sun is many times larger than the masses of the largest planets. In other circumstances, for instance with a double star in place of the sun or with a sun’s mass only a few times larger than the mass of the largest planets, the movements of the planets would be considerably more complicated. As a result, the three Kepler’s laws would no longer hold; instead of a 2-body problem, one would have to tackle a 3-or 4-body problem, which cannot be done without a thorough understanding of non-integrable hamiltonian dynamics and computer-assisted numerical computations. Under such conditions, the understanding of the laws of gravitation might have been delayed by at least two centuries.

In some respects, one is facing a similar difficulty in the analysis of financial markets as one has to deal with a many-body problem. First, many investors are active in a typical trading day and their market impact drives constantly the prices up and down. The difficulty is increased by the recent suggestion that the effective number \( N \) of traders who count on the market is not very large in the sense of the usual “thermodynamical limit” in physical systems (which usually provide important simplification for modeling), probably of the order of hundreds, as all models of market microstructure lead to trivial deterministic dynamics when the limit of large \( N \) is taken [2]. Secondly, the many-body nature of the problem is further complicated by the interconnection between the equity, bond, commodity and real estate markets. This is shown by the following examples.

- In Vigreux et al. [3], one can find a spectacular example of the influence of new bond emissions on the price level in the equity market: between 1954 and 1962, several large bonds have been issued at the Paris Stock Exchange which, by absorbing a substantial part of available funds, brought down the equity market by as much as 20% for the largest emissions.

- The connection between the real estate market and the equity market has been illustrated in the early 1990s when the burst of the speculative bubble in Japan provoked a parallel fall (of as much as 50 percent) in both markets [4–6]. The recent financial crises in Malaysia and Thailand also seem to have been triggered by a fall in property prices [7]. The role of intermediaries and of herding has also been pointed out [8].

- It can be remembered that the Great Depression of 1929-1933 was, apart from the Stock market crash of Oct. 1929, marked by a sharp decline in wheat prices which in fact already started in 1925.

- These last years, one has witnessed that the US stock exchange is very sensitive to rumors concerning interest rates. Pushing the illustration, a sybillin remark from the president of the Federal Reserve suggesting a drop of the short-term rate is enough to trigger important sell-out of bonds, with investment reported to stocks, leading to a surge of the Dow Jones lasting typically a full week. Conversely, when the Dow Jones drops, the long-term interest rates fall down, which is a proof that the cash taken out of the stock market has been carried over to the bond market. In a nutshell, there is...
a kind of pendulum dynamics of the cash between the two markets.

To deal jointly with stocks, commodities and property is an awesome perspective for this involves almost the whole economy either directly or indirectly.

Simpler phenomenologies appear when analyzing stock market price fluctuations at short-time scales, from the tick scale (trade to trade transaction time) to scales of about one month, for which the coupling between different markets is less overwhelming, at least in normal circumstances, and for which the structure may be argued to be controlled in large part by simple market rules. Exponentially truncated Lévy laws [9–11] with exponent around \( \alpha \approx 1.5 \) for the 6-year period 1984-1989 and power laws with exponents \( \alpha \approx 3 \) for the 2-year period 1994-1995 [12], superposition of Gaussian motivated by an analogy with turbulence [13,14] or stretched exponentials [15] have been proposed to describe the empirical distribution of price returns in organized markets.

Another strategy to simplify the problem is to study periods when financial markets were still embryonic. This was the case before 1850; since in addition wheat was before the 20th century by far the most important commodity in Western Europe, wheat price patterns can be expected to constitute a fairly isolated phenomenon (with the obvious qualification that they are influenced by meteorological factors). This approach has been explored by Roehner [16] and Roehner and Sornette [17].

In the present paper, we present an alternative empirical investigation which exemplifies one single factor underlying market dynamics, namely “speculation”. In recent years, many groups have come up with interesting microscopic models of stock market price dynamics that put emphasis on such an endogenous speculative origin for the observed complexity of market prices [18–21]. Here, we present what we consider to be probably the purest case illustrating speculation in a market, as it occurs in the collector’s stamp market, just like the motion of planets was for Kepler and Newton the purest case of frictionless motion. This market has a number of definite advantages in terms of simplicity.

1. It is relatively isolated from other speculative markets because the proportion of the collectors is by far larger than that of the investors.

2. “Production” and “consumption” take on particularly simple forms: production is restricted to a short time span and the production figures are statistically well known; since most collectors’ stamps are not actually used on letters, consumption is basically non-existent; it only occurs by wear and tear or by accident at a small and probably fairly constant rate.

3. In contrast to gold, silver or copper coins, stamps cannot be melted. A few decades after they have been issued, they can no longer be used and have therefore no intrinsic value; in other words, their prices are solely determined by the judgment of the collectors.

4. In contrast to other collectibles such as paintings or furniture, stamps are fairly liquid assets. Any valuable stamp can be sold to a trader at a price given in the current catalogue (a discount might be applied which takes into account the state of conservation of the stamp).

5. Stamp markets display huge price bubbles. Multiplication of the current price by a factor of about 10 within a decade is not uncommon.

6. Stamp prices range from a fraction of a dollar to several thousand dollars. This gives the opportunity to observe the speculative behavior of collectors when they are confronted with stakes of different magnitudes.

7. The identification of what is a speculative bubble in the stamp market does not suffer from the same uncertainties as in other markets. Indeed, in recent years, an active debate between economists has been aimed at the problem of an unambiguous and rigorous definition of speculative bubbles, by trying to distinguish those price increases due to changes in fundamentals from those resulting from pure speculation [22]. The challenge stems from the fact that this question is rather ill-posed in general because one does not know and does not have access to all relevant fundamentals. For instance, should the construction of the Opera-Bastille theatre be incorporated in the list of fundamentals defining the real-estate market in the 11th Paris district? In the stamp market, there are very few fundamentals and they are well-known. The definition of a speculative bubble is thus much clearer.

To be fair, one has to recognize that, as far as its statistical analysis is concerned, the stamp market also has a number of drawbacks. First, stamp catalogues are published only every year (sometimes even every two or three years). As the catalogues are the only practical mean for knowing the prices of stamps in a fairly systematic way, this precludes any investigation of short term fluctuations. The bulk of stamp transactions takes place between private individuals; as a result it is almost impossible to estimate the volume of the transactions.

Let us now explain how an exploration of the stamp market may provide clues for a better understanding of the mechanisms and patterns of speculation. Generally speaking, it may be argued that several kinds of agents participate in a given market. For instance, the operators in real estate markets can be divided into two subgroups.

(i) Residents who buy and sell for their personal use and
II. THE STAMP MARKET

A. Turn over

Compared to stock or real estate markets, the markets of stamps for collection are small. The French market can serve to illustrate this point. Approximately 40 stamps for collection are issued every year. Sales of these newly issued stamps for collection can be estimated (for 1984) to be of the order of 400 million francs (less than US$80 millions). Of this, about no more than 5% are used for mailing. This results from two factors: (i) the issued stamps for collection have facial values that very rarely correspond to mailing values; (ii) the state of conservation of a stamp for collection is so determinant for its value (discount for less than perfect conservation can reach 50% or more), that few collectors take the risk to use these stamps for mailing. The 400 million francs issue of stamps for collection for 1984 has only very slowly varied over the years, being 420 million francs for 1993. This must be compared to the total value of 5.5 billions francs in 1993 of stamps issued for mailing.

As we already noted, it is more difficult to estimate the other transactions. The turn over of the five main traders was of the order of 300 million francs. If the total transaction figure is assumed (somewhat arbitrarily) to be four times larger, one obtains an overall figure of less than 2 billion francs. This is larger than 400 million francs because it comprises trading of all previously issued stamps. Let us compare this figure to the transactions on stocks, on real estates or on works of art.

- By 1984, the annual transactions on the Paris Stock Exchange were of the order of 100 billions francs.
- In 1984, 35000 appartments have been sold in Paris (figure given by the Chambre des Notaires, i.e. the Lawyers Association); at an average price of one million francs per appartement, this represented an amount of 35 billions francs.
- The turnover of public auctions in works of art was in 1975 of the order of one billion francs, while private transactions were estimated at about 1.5 billion francs.

The French stamp market thus represented in the 1980s about 2% of the transactions on the stock market, about 6% of the real estate sales in the city of Paris, (i.e. excluding the suburbs); they were approximately of the same magnitude as those of works of art.

B. Estimating the price of stamps

The stamp catalogues provide the prices of all existing stamps. In countries such as Britain, France, Germany and the United States, such catalogues have been
published annually for more than a century. They thus constitute a valuable source of information for anyone who wants to study either price bubbles or the long term trend of stamp prices. However, the question arises as to whether the prices given in the catalogues truly reflect the prices in actual transactions. From a collector’s perspective, this is a complex question; yet from a statistical point of view, it will be seen to have a simple answer.

The prices listed in a catalogue are for stamps in a perfect state of conservation. It is however obvious that a stamp that has been bought several decades ago can hardly be in a perfect state. In other words, its price will always be less than listed in the catalogue. Statistically however, there is a close connection between negotiated prices and the prices listed in the catalogue. This has been proved by Feuilloley [36] using a sample of 300 stamps; the correlation was about 0.90, while the regression coefficient was about 0.5 which means that on average the real prices were only half the prices listed in the Yvert and Tellier catalogue. In the following, we are interested in the evolution of relative prices rather than in their absolute magnitude. The catalogues can thus be considered as a reliable source.

C. Long-term trend of French stamp prices

Fig.1 shows the long term price trend of (i) Nineteenth century stamps (ii) All stamps listed in the Yvert & Tellier catalogue. The deflated price of 19th century stamps has increased at an average rate $r_{19} = 5.2\%$, while the average price of all stamps has grown at a rate $r_{\text{all}} = 2.1\%$.

The rate for 19th century stamps is easier to rationalize than the second one for all stamps, since it concerns the evolution of a sample of stamps which remained unchanged in the course of time. During the same time span, the net national income (at constant prices) has increased at an annual rate of $r_0 = 3.1\%$. The difference $r_{19} - r_0 = 2.1\%$ can be interpreted with the following simple model.

- In the course of time, the offer, i.e. the number of 19th century stamps, has decreased at a constant rate of $d\%$. Thus, the residual number of stamps after a time $t$ is $N_0e^{-dt}$, starting from an initial number $N_0$. One can advance the following rational for this decrease. There are two types collectors:
  1. the ‘amateurs’, those who have just a small collection. At some point in time they stop collecting, and as their collection’s worth is low, the stamps will be thrown away.
  2. The ‘professionals’: they collect ‘seriously’, and their collection has a certain value, and even when they die their relatives will be aware of the collection’s value and sell it. Thus, the stamps re-enter the market.

What makes things difficult is that the amateurs will normally not have the rare stamps. Thus, the rare stamps’depreciation rate is much flatter than that of the everyday stamps. For the rare stamps, the depreciation rate is probably rather close to zero.

- On the demand side, one must consider the total amount of money $M$ that the total number of collectors $C$ are willing to devote to purchasing 19th century stamps. Let us denote by $c$ the proportion of collectors in the total population $N$, and by $f$ the fraction of his/her revenue $R$ that a collector is willing to spend on 19th century stamps. One has:

$$C = cN, \quad M = fRC = (NR)c = fcI , \quad (1)$$

where $I$ denotes the national income.

Within this simple framework, the difference $r_{19} - r_0 = 2.1\%$ can be attributed to the following factors.

- The proportion $c$ of collectors in the total population has increased.
- The number of 19th stamps has slightly decreased.
- The proportion $f$ of a typical collector’s revenue spent on 19th century stamps has increased. This conjecture seems quite reasonable in the light of Engel’s law which states that, as per capita income increases, the percentage spent on items other than food, clothing or housing increases too.
- The number of stamps decrease because of their finite “half-time”.

Equating (1) to $N_0e^{-dt}p(t)$ and using $I = I_0e^{\gamma t}$ gives the estimation

$$r_{19} = r_0 + d . \quad (2)$$

Actually, the equality should be replaced by the inequality $\geq$, to take into account that the fraction $f$ of the revenue and the proportion $c$ of collectors may have also increased. This gives a lower bound for the half-time $(\ln 2/d)$ of about thirty years. If in addition, we incorporate a risk factor, requiring that the rate $r_{19}$ of stamp price appreciation should include the price of risk of the stamp destruction, typically proportional to the standard deviation of the Poisson process of stamp destruction, this doubles the lower bound of the expected half-time for 19th century stamps to sixty years. Indeed, including the price of risk means that there must be a remuneration resulting from the fact that the process is not certain and exhibits fluctuations. In this framework, the interest rate $r_{19}$ must incorporate a remuneration which is typically proportional to the risk, measured usually by the
standard deviation of the uncertain process. For a Poisson process, the standard deviation is $1/d$. Adding this contribution, $d$ is replaced by $2d$ in (2) and the corresponding estimation for $d$ is halved, hence the doubling of the half-time.

If the interpretation provided by this model is correct, one would expect the price of 19th century stamps to continue to increase at a faster rate than the net national income. Since in addition, there are no taxes on stamp sales, stamps are likely to constitute a good investment for the foreseeable future. Notice that the difference $r_{19} - r_0 = 2.1\%$ between the rate of return of 19th stamps and the net national income does not reflect the influence of a risk factor but rather that of a shift on the supply-demand curve towards increasing scarcity of supply and increasing demand for old and rare stamps.

III. SPECULATIVE BUBBLES

In this section, we address the following questions:

1. Has the price of an item a determining influence on the way a speculative bubble unfolds?
2. Are there different speculative patterns?
3. Is it possible to predict at least the upper bounds for the amplitude of the price peaks?
4. Why does a specific stamp become the target of a speculative process?

A. How versus why

The first three questions have to do with how the speculative process develops. In other words, given that a speculative process has taken place, one tries to analyse its characteristics; in contrast, the fourth question refers to the why’s. In a previous paper [17], we have already emphasized that this latter question is very difficult to address specifically and this difficulty is a clue for the origin of bubbles. As an illustration, consider the two stamps that have been issued the same day (27 Oct. 1979) with the same number of copies (6 millions) and with the same face value (2 francs). They only differed by their themes: one (No 2059 in the Cérès catalogue) represented an ancient painting of “Diane at the bath”, while the other (No 2060) represented a painting by Van Gogh. As can be seen in Fig.2, only the second stamp experienced a speculative process which multiplied its price by 10 in less than six years.

When invited to comment on that enigma, a stamp expert explained that the speculation probably started when a big collector (or trader) happened by chance to come in possession of a substantial proportion of the total number of stamps that had been issued. In fact, many different rumours circulated in philatelic circles as to how this happened. One possible explanation is that speculation seemed, at least in that case, to be triggered by purely subjective factors. Another scenario explored by Roehner and Sornette [17] (see also [39]) is that chance plays a crucial role in nucleating the bubble which is then amplified by multiplicative effects [39] and/or path dependent positive feedback effects [40]. In this last scenario, the initial price inflation of the “Van Gogh” stamp was a “lucky” event, or maybe even the act of speculation by a big collector, which was afterwards amplified by the action of positive feedbacks as described for instance in the Polya Urn model (see [41] for a modern extension to describe self-organization): the bubble fed on itself, reinforcing itself by the increasing attraction presented by the “Van Gogh” stamp. A similar scenario has been documented for the real estate bubble that culminated in 1991 in France [42]: a booming real-estate market is attracting to everybody but the poor who cannot enter the market: sellers cash in a substantial profit; buyers are not frightened by the astronomical price and buy confidently with the expectation that they will also cash a profit when they sell in the future. This is sustainable only as long as there is liquidity, i.e. a reservoir of potential buyers is continuously replenishing.

B. Impact of initial price levels

We now turn to the first question, namely what is the influence of the price level. To a large extent, we find that the price is irrelevant. In other words, an expensive stamp and a cheap stamp, which both became the targets of a speculative process, experience parallel price trajectories. However, there is a low but statistically significant correlation between the price level and the price amplification factor. This fact is illustrated by Fig.3 for French stamps and by Fig.4 for British stamps. Fig.3 shows the evolutions of a very rare stamp and of a fairly common stamp. In 1904, the price of stamp No 2 was 200 francs while the price of stamp No 16 was 0.05 francs. In spite of such a large price gap, the price evolutions are fairly similar. It is true that the timing was not the same, with the bubble for the cheap stamp beginning to build up about 10 years earlier; but the overall increase was of the same order as well as the subsequent decrease. Fig.4 provides a similar example. In 1965, stamp No 90 was worth 4000 francs against 60 francs for stamp No 155. Yet, the price evolutions are very similar. In fact, almost all British stamps issued before World War II and having a face value of a pound or more followed a similar evolution. Stamp No 106 provides an example of a stamp issued in 1902-1910 but having a face value of only half a penny; in this case, the speculative increase is very small in comparison.
We now examine if there is a correlation between the initial price of a stamp and its price amplification factor. The results are presented in table 1a. In this table and the others below, the coefficient of amplification are given in current value, following the habit of professionals. The coefficient of linear correlation between the logarithms of the 1965 prices and the price amplification factor is equal to 0.55; in other words, the higher the initial price the stronger the speculation seems to be. A similar observation was made for the district-level prices during the Paris real estate bubble \[3\]. When the bubble started in 1984, the price in the most expensive district (6th) was twice as high as the price in the cheapest one (10th). The bubble first began to build up in the most expensive districts (6th, 7th, 16th, 17th) and then spread to cheaper districts with a delay of about 6 to 12 months. Furthermore there was a low (but nevertheless significant) correlation of 0.49 between the 1984 prices and the price amplification factors as shown in table 1b.

### C. Speculative patterns

#### 1. Corners

We now turn to the second question, namely whether different speculation patterns can be identified. Table 2 shows that there is a marked difference in terms of price increase rate between the first and the second half of the table. Let us for instance consider more closely one of the episodes in the second group, namely the bubble which concerned a few French stamps in the mid 1980s. Owing to its short duration and to its high increase rate, one may wonder whether this was not a deliberate attempt to corner the market, i.e. to take the control of the market by buying all available stamps. This question clearly raises two other ones: what is the percentage of the total “production” of a stamp that it is necessary to buy in order to control the market and create such a “squeeze”. Is it within the financial capability of big operators? Let us consider the Van Gogh stamp (Cérès No 2060); its face value is 2 francs and 6 millions copies have been issued representing a total amount of 12 million francs, that is to say about 3 percent of the total annual value of newly issued stamps or 4 percent of the annual turnover of the five major French traders. There should therefore be no problem for a trader or an important collector to buy at least 75 percent of the 6 million stamps. Once the bubble has reached its peak-level however, it becomes much more difficult to keep the market under control for the 6 million stamps now represent $60 \times 6 = 360$ millions francs, an amount which is of the same magnitude as the global turnover of the five major traders. This has two consequences:

1. There is obviously an upper bound to the price level that can be reached during a speculative bubble; this ceiling price is determined both by the ability of the main operators to control the market and by the subsequent ability of the market to absorb the offer. It seems that 60 francs for the Van Gogh stamp was either close to or even beyond this upper bound.

2. The 360 millions francs represent about 20 percent of our estimate for annual transactions; clearly the market is not going to devote 20 percent of its purchasing power to just one stamp among several thousand other French stamps. In other words, the market will obviously be unwilling to absorb the 6 million stamps (or even a substantial fraction of them) at such a high price. The price is therefore bound to decrease before large stocks of stamps can be absorbed by the market.

#### 2. Shape of the price peak

In order to characterize the shape of the bubble peaks, we use the quantification defined by Roehner and Sornette \[17\] describing the price $p(t)$ as a function of time according to:

$$p(t) = a \exp \left[ \frac{t - t_0}{\tau} \right]^{\alpha} ,$$  \hspace{1cm} (3)

where $t_0$ denotes the turning point of the peak and $\tau$ is a characteristic time scale for the maturation of the bubble. The key parameter that quantifies the shape of the peak is the exponent $\alpha$.

- If $\alpha$ is equal to 1, one retrieves an exponential growth up to the turning point followed by an exponential decay. $x = \ln(p)$ is thus linear up to the maximum, with a tent-like structure.

- If $\alpha < 1$ and $\tau > 0$, the function describes a sharp peak (accelerating rise before the peak and decelerating drop after the peak).

- If $\alpha > 1$ and $\tau < 0$, the function describes a flat trough (decelerating drop followed by an accelerating rise).

- If $\alpha > 1$ and $\tau > 0$, the function describes a “flat peak” (decelerating rise followed by an accelerating drop).

- If $\alpha < 1$ and $\tau < 0$, the function describes a sharp trough (accelerating drop followed by a decelerating rise).
Table 2 shows that almost all price peaks that we examined have a peak exponent $\alpha > 1$. This corresponds to a flat peak pattern. This must be contrasted to the situations found for most commodity price peaks for which a sharp peak-flat through pattern holds \cite{2}. The only stamp bubble which clearly displays a sharp peak pattern is the one that occurred in France during World War II. The “causes” of this peak are relatively easy to enumerate, namely

1. the need to sweep black market profits under the carpet,
2. the demand generated by a number of passionate collectors belonging to the German occupation troops,
3. the fact that during the war, savings accumulated as a result of consumption restrictions.

Yet, none of these reasons explains why the shape of these peaks was so much different.

IV. CONCLUSION

By analysing the stamp market, we have tried to document a vivid demonstration of speculation and of its main characteristics in a one of its most basic manifestation. Our observations emphasize the role of fancy and collective behavior. With J.M. Keynes and his parallel between the stock market and newspapers’ beauty contests (see section 12 of the General Theory \cite{13}), one could argue that the main characteristic of the successful speculator is his/her ability to predict what the (average) behavior of the rest of the public will be. However, such a model probably underestimates the importance of social interaction and mimetic contagion. For instance, one can hardly expect an isolated collector to be capable of predicting that, among hundreds of other stamps, the Van Gogh stamp will become the target of an important speculative movement. Such a behavior is more likely to be propagated by the interactions between collectors and by philatelic publications. Unfortunately, lack of data prevents us from statistically estimating the strength and frequency of those social interactions.

In order to provide a unified overview of some of the results presented in this paper and in \cite{17} and to compare the shape of bubbles found in commodities and in collecting items, Fig.5 shows comparison between different types of speculative movements.

A question left open by our present study is the possible correlation between the structure and shape of the speculative bubble and the degree of market liquidity. By this, we mean the following. Speculators are very useful to provide “liquidity” in the market. Otherwise, in the stamp or real-estate markets, exchanges would occur only between collectors or residents and would be very scarce since the purpose of a collector is to collect and that of a resident is to reside! The task of collecting and changing living place would thus be proportionally more difficult. This positive role of speculation is classical and is often advanced to defenders of free capitalistic markets. On the other hand, a larger proportion of speculators imply that traders are more in phase, there is less friction and the speculative bubbles should develop faster. This could be tested empirically by correlating the exponent $\alpha$ to the ratio of residents to speculators in the 20 Parisian districts.

Our results on the independence of the shape of the speculative peaks with respect to the price of the stamps suggest that risk aversion (related to the amount of money involved in a transaction) does not play an important role in the speculative bubbles observed in the stamp market. This is a very interesting information, whose validity should be investigated for other markets, including financial markets. Theoretical models of financial crashes using rational expectation theory coupled to herding behavior of a fraction of the traders suggest also that risk aversion is not a determining factor \cite{44}. It is thus reassuring that a similar conclusion is obtained on two very different markets and by very different approaches.

Acknowledgements: We would like to express our gratitude to Mrs. Paganini and Luppi (Céres-Philatélie) and to the librarians of the Documentation Center for Collectors Stamps (Musée de la Poste-France Telecom).

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Figure Captions:

Figure 1: Long-term evolution of stamp prices: the upper curve corresponds to 19th century non-used French stamps; the lower curve corresponds to all French stamps including newly issued ones. Prices are based on the Yvert & Tellier catalogues [37,38,36].

Figure 2: Speculative bubble for two French stamps. In contrast to the “Van Gogh” stamp, “the Diane au bain” stamp which has been issued in similar conditions and on the same day was not a speculation target. The range of the horizontal scale has been selected so as to facilitate the comparison with Figs. 3 and 4. Sources: Cérès catalogues (1980-1998).

Figure 3: Speculative bubble for two stamps during World War II [43]. The price of stamp No 2 is more than one thousand times the price of stamp No 16. The range of the horizontal scale has been selected so as to facilitate the comparison with Figs. 2 and 4.

Figure 4: Speculative bubble for two British stamps. Stamp No 106 experienced only a small price increase; it is shown for the purpose of comparison with the bubble experienced by the two other stamps. The price of stamp No90 is about 70 times the price of stamp No155. Source: Yvert & Tellier catalogues (1965-1998).

Figure 5: Classification of speculative movements in terms of peak amplitudes and peak exponents. The peak amplitude is defined as the ratio of the price at the maximum of the peak divided by the price at the beginning of the bubble. The exponent $\alpha$ is defined by eq. (3) as in Ref. [17]. A small exponent (less than one) corresponds to a sharp peak. An exponent larger than one corresponds to a smooth maximum.
Deflated price index for French stamps (1905=100)

Nineteenth century stamps

All stamps
Deflated prices of some British stamps

- No 155
- No 90
- No 106
### Table 1a  Price bubble for British stamps (1967-1998): correlation between initial price levels and price amplification factors

| Stamp number | 46 | 89 | 90 | 105 | 106 | 155 | 156 | 183 | 238 | 286 |
|--------------|----|----|----|-----|-----|-----|-----|-----|-----|-----|
| Price (1965) [francs] | 1600 | 2250 | 4000 | 325 | 0.40 | 65 | 500 | 250 | 30 | 40 |
| Price amplification factor (current prices) | 28 | 44 | 44 | 55 | 15 | 42 | 24 | 24 | 12 | 35 |

Notes: The stamp numbers refer to the Yvert and Tellier catalogue. The coefficient of linear correlation between the logarithms of 1965 prices and the price amplification factors is equal to 0.55. *Source: Yvert & Tellier catalogues (1965-1998).*

### Table 1b  Real estate bubble in Paris (1984-1998): correlation between initial price levels and price amplification factors.

| District number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------------|---|---|---|---|---|---|---|---|---|---|
| Price (1984) [1000francs/sqm] | 8.03 | 7.37 | 6.99 | 9.45 | 9.71 | 11.6 | 10.3 | 10.1 | 6.35 | 5.51 |
| Price amplification factor (current prices) | 3.50 | 2.83 | 3.39 | 3.14 | 3.07 | 3.18 | 3.65 | 3.59 | 3.04 | 2.93 |

| District number | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|-----------------|----|----|----|----|----|----|----|----|----|----|
| Price (1984) [1000francs/sqm] | 6.45 | 7.85 | 7.19 | 8.81 | 9.60 | 11.1 | 7.91 | 5.90 | 6.49 | 6.11 |
| Price amplification factor (current prices) | 2.79 | 2.53 | 2.81 | 2.62 | 2.61 | 3.24 | 2.98 | 2.64 | 2.52 | 2.65 |

Notes: The coefficient of linear correlation between the 1984 prices and the price amplification factors is equal to 0.49. *Source: Roehner (1998).*
|   | Characteristics of the ascending phase of the bubble: duration, deflated price increase, shape of the peak |
|---|-----------------------------------------------------------------------------------------------------|
|   | Duration | Annual price increase rate | Shape of the peak |
|---|----------|---------------------------|--------------------|
|   | [year]   | [1/year, %]                | (α)               |
| 1) | Hong Kong (1970-, no225) | >26 | 3 | peak year yet unknown |
| 2) | Britain (1965-1981, no90,155) | 16 | 10 | 1.32 |
| 3) | France (1930-1943, no16) | 14 | 14 | 0.73 |
| 4) | Hong Kong (1970-, no226) | >26 | 25 | peak year yet unknown |
| 5) | France (1980-1987, no 2060, 2391) | 7 | 32 | 1.13 |
| 6) | France (1941-1944, no2) | 3 | 48 | 0.46 |