La transmission des mouvements spéculatifs entre places boursières :

Une étude des causalités entre les composantes non fondamentales des cours boursiers européens, américain et japonais

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Résumé

Première partie (réalisée ci jointe) : tester l'existence de bulles spéculatives

Les théories des bulles spéculatives connaissent un renouveau, non seulement comme moyen d'évaluation de la nature des dernières crises financières mais aussi en tant que méthodes de détection de signes avant coureurs de krachs boursiers. Les tests de bulles et plus largement la mise en évidence statistique et l'évaluation des composantes non fondamentales des cours boursiers sont susceptibles de jouer ainsi un rôle dans la prévention des crises financières. Une correction des tests de co-intégration tenant compte du biais et du kurtosis engendrés par des bulles permet d'améliorer la détection des bulles par ces tests. L'application d'un tel test sur des données boursières pour l'Allemagne, la France, les Etats-Unis, le Japon, et le Royaume-Uni ne nous permet pas de rejeter l'existence de bulles spéculatives pour chacun de ces marchés. Des tests similaires avaient été utilisés pour l'étude de marchés financiers asiatiques, mais jamais appliqués, à notre connaissance, aux marchés financiers des grandes puissances industrielles. La question qui se pose est alors celle de l'existence d'une forme de contagion internationale spécifique qui - en amont du déclenchement et de la diffusion des crises – porterait sur la transmission de bulles spéculatives entre places financières.

Deuxième partie (en cours) : mesurer l'évolution des composantes non fondamentales des cours boursiers et tester leurs liens de causalités entre les cinq pays considérés

La deuxième étape de notre travail sera donc d'évaluer les composantes non fondamentales des cours boursiers des cinq pays considérés. Pour ce faire, nous utiliserons deux méthodes qui ont l'avantage de ne pas placer d'hypothèses trop restrictives sur le processus suivi par les dividendes. La première méthode a été proposée et appliquée par Chung et Lee (1998) à l'étude des marchés financiers asiatiques. Il s'agit d'estimer un VAR pour les cours boursiers et les dividendes et d'utiliser la restriction selon laquelle les chocs non fondamentaux –à l'inverse des chocs fondamentaux- affectent les cours boursiers mais pas les dividendes, pour isoler ces chocs et calculer l'évolution de la composante non fondamentale. La deuxième méthode a été élaborée par Wu (1995) et appliquée aux taux de change du dollar avec la livre anglaise, le yen et le deutsche mark. Il s'agit d'utiliser le filtre de Kalman pour estimer la bulle spéculative, traitée comme une variable d'état inobservable.

L'originalité de notre approche par rapport à ces deux études réside non seulement dans l'application (pays, période), mais surtout dans l'utilisation novatrice des mesures des composantes non fondamentales de cours boursiers ainsi obtenues pour tester les causalités internationales entre ces composantes. Enfin, nous utiliserons non seulement des tests de causalités linéaires, mais aussi des tests de causalités non linéaires.

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Part I: Testing for bubbles in Stock Prices

Abstract:
Speculative finance has played a major part in the recent crises of emerging countries. Speculative bubbles theories are coming back not only as a mean of evaluating the nature of these crises but also as a tool of early detection of financial fragility. Such an early detection could enable Central Banks to stabilize efficiently financial markets thus avoiding the moral hazard involved in the last resort lender intervention. A large array of speculative bubbles tests are currently available. But periodically « exploding » bubbles (Evans, 1991 ; Froot and Obstfeld, 1991) – which can generate the most realistic stock price processes – can escape detection by traditional co-integration tests. Correction of those tests for the bias and kurtosis introduced by bubbles can improve their detection and make co-integration tests a better tool for preventing crises. Implementing such corrected co-integration tests on stock data for Germany, France, the United States, Japan and the United Kingdom does not allow us to reject the speculative bubble hypothesis.

Key Words : Stock market, speculative bubble, financial crisis.
J.E.L Classification: E44.

1. Introduction : Speculative bubbles as a sign of financial fragility

Speculative bubbles are at the same time a sign of financial fragility and a cause of crisis, as such they have contributed to the Asian crisis (Sarno and Taylor, 1999). Bubble tests can therefore be used to assess the risk of a financial crash and, together with other measures of financial fragility, to secure a good timing of preventive actions. Bubbles detection is of great interest to the authorities in charge the monetary policy and financial markets supervision. Central banks should be the first interested. Traditionally the first Central banks mission is to promote consumption prices stability. But another assignment of Central Banks could be to guarantee financial markets stability. This second aim seems to take a growing importance : J-C Trichet, Governor of the Bank of France has recently declared, during a conference on Central Banks missions, "the history of the years 1980 has shown that we have to take interest in possible financial bubbles, even if consumption price stability is completely insured »[1]. To preserve financial stability Central Banks and Supervisors already have some tools. First of all, Supervisors meetings organized at the Bank of International Settlements (Basle Committee) allow to define harmonized prudential rules for the banking sector. Secondly, in case of financial crashes - as was observed in 1987 – Central Banks can play the part of the last resort lender, that is they can increase the liquidity of the economy to avoid the contagion of bankruptcies. But prudential rules do not insure completely against stock market crashes and the last resort lender intervention has the well known disadvantage of causing moral hazard. The guarantee given by the Central Bank can induce investors to take more risks than they would otherwise. In this case it seems more efficient to prevent the growing of speculative bubbles without waiting for them to explode by themselves. Central bankers could

[1] Conference for the 200 years of the Bank of France, Bank of France Bulletin, n°79, July 2000.

try to counter such bubbles either by early credit restriction or by influencing forecasts. for instance by publicly denouncing stock prices overvaluation. But to do that they need first to be able to detect speculative bubbles.

Detecting speculative bubbles is not always easy for at least two reasons: speculative bubbles definition is somewhat ambiguous and controversial, speculative bubbles tests have some drawbacks.

A speculative bubble can be characterized very generally as "a rise [...] of the price [...] of an array of assets in a continuous process, the initial rise creating forecasts of furthers rises and attracting new buyers, in general speculators interested in the rise of the price of the asset rather than in its use or its potential incomes"[2]. Such speculative phenomenon are far from new[3]. But this definition is more complex than it appears ; it covers in fact two kinds of bubbles : rational bubbles (Blanchard and Watson, 1982 ; Tirole, 1982 and 1985 ; ...) and "irrational" bubbles (Frankel and Froot, 1986 ; Orlean 1990). The last kind are based on the hypothesis of limited rationality and imperfect information. This hypothesis can be justified by two [illegible]: first, the volume of speculative transactions implies heterogeneous forecasts, second, faced with an infinity of speculative solutions rational speculators have no means to coordinate their bubbles or sunspot forecasts[4]. However the rational bubble theory has the advantage of showing rigorously that it can be rational and profitable to bet on a growing disconnection between the actual price of an asset and its "fundamental" (or theoretical price). It is this disconnection which is dangerous for the economy by causing a growing risk of crash and diverting financing from more useful allocation.

The interest of bubbles detection has brought to a large array of tests. Their results can be delicate to interpret because these tests can sometimes confuse bubbles with other phenomenon[5]. Moreover, the development of new types of rational bubbles models in the years 1990 (Evans, 1991 ; Froot et Obstfeld, 1991) has shown the complexity of some possible bubbles. The common characteristic of those "second generation"' bubbles is that

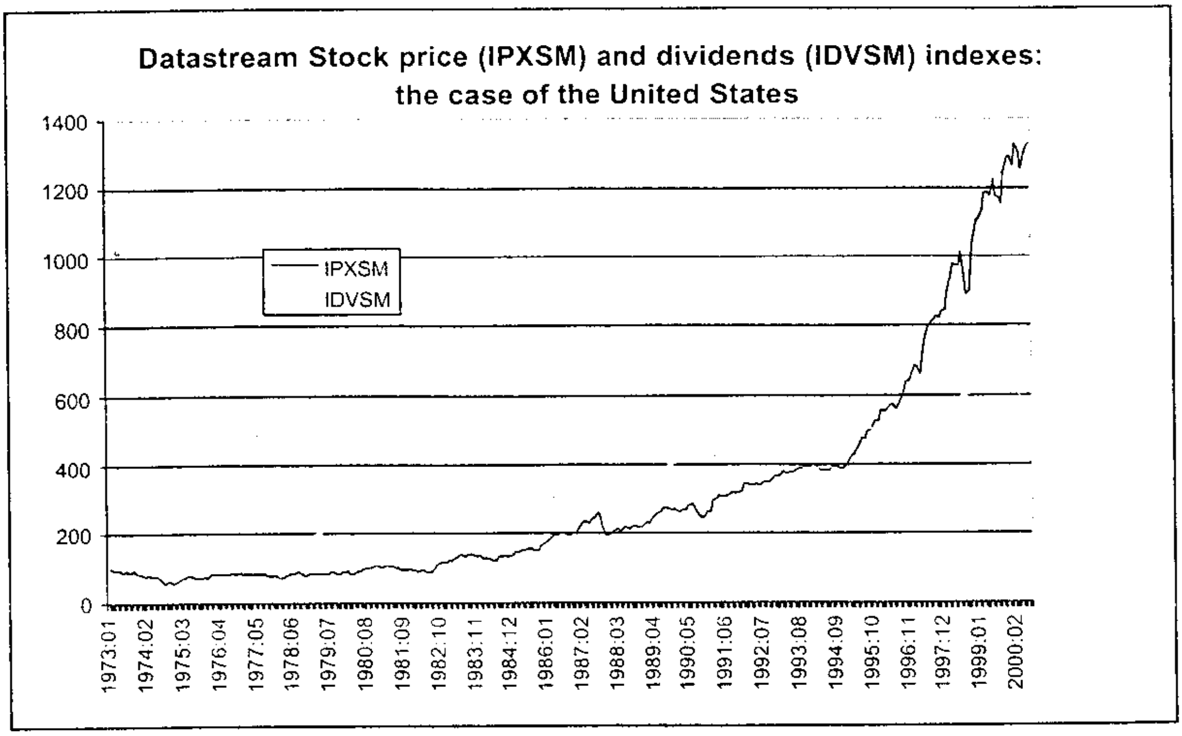
[2] C.Kindelberger. Palgrave dictionary.

[3] Amongst the most famous ancient bubbles are: the bubble on tulips price (1636-1637), the "Mississippi" bubble on the stock price of the East India Company (1717-1721), the south sea bubble on the stocks of the company of the same name (1720).

[4] This impinges on question of how bubbles start. Overabundant credit is often mentioned as a favourable ground for bubble and more generally for financial unstability.

[5] Amongst others: forecasts of extreme price variation (the so called « peso problem »), forecasted change in economic policies, overreaction to news.

they do not diverge continuously anymore. They are thus consistent with the observation, on long periods, of asset price series repeatedly affected by "bubbles" and crashes. But it also this realism that allows such bubbles to escape detection by the traditional co-integration tests (Evans, 1991). A correction of those tests for the bias and kurtosis implied by bubbles can improve their detection.



We will apply these corrected tests of co-integration to the detection of bubbles on the main European stock markets and on the Japanese and American stock exchanges, to be able to draw some comparisons. The choice of the stock market (rather that the exchange rate market for instance) can be justified in two ways. On one hand, the existence of speculative bubbles is very plausible on this market[6]. On the other hand, the rise of stock markets from the beginning of the 1990s to the year 2000 is threatening when compared to the relatively low rate of growth of the economy or to the growth of the dividends, as shows the American graphic on stock index and dividends[7]. It should be interesting to compare the situation of this market to that of its main competitors. We will first **(2.)** present the theoretical foundations of

[6] A rational bubble is only possible on infinite life assets like stocks (Tirole). The retroaction of assets price on some of their explanatory variable can also be used to exclude *ex ante* the existence of rational divergent bubbles on assets such as exchange rates (Timmermann, 1992 ; Raymond, 1993). Almost all theoretical explanatory variables of the exchange rates can be strongly suspected of being affected by past exchange rates. There far less theoretical reasons for suspecting such a retroaction from stocks prices on dividends.

[7] If there is no bubble, dividends and prices should be highly correlated in the long term (section 2, equation (7)).

the stock market co-integration tests. Then we will (3.) detail the data used and the results of the implementation of those tests on this database.

2. Co-integration tests and the detection of bubbles in stock prices

By definition, the rate of return R_{t+1} of an investment in stocks is given by the sum of the price change $(P_{t+1} - P_t)$ and the dividend divided by the initial price of the investment:

$$R_{t+1} = \frac{P_{t-1} - P_t + D_{t+1}}{P_t} \tag{1}$$

The average return (presumed constant) can then be written:

$$R = \frac{E_t(P_{t+1} + D_{t+1})}{P_t} - 1$$

That is:

$$P_t = \frac{E_t(P_{t+1} + D_{t+1})}{1+R} \tag{2}$$

where $E_t()$ is the expectation conditional on information available at time t.

The following solution for the stock price obtains:

$$P_t = \sum_{i=1}^{T} \frac{E_t(D_{t+i})}{(1+R)^i} + \frac{E_t(P_{t+T})}{(1+R)^T} \tag{3}$$

When there is no divergent rational bubble, the conditional expectation of the price at an infinitely remote horizon T+1 is a finite value, so the *weighted* conditional expectation of this price et time T+1 goes to zero as T+1 tends towards infinity *e.g.* the second term of equation (3) disappears. This condition –called transversality condition- writes:

$$\lim_{T \to +\infty} \frac{E_t(P_{t+T})}{(1+R)^T} = 0 \tag{4}$$

Under this hypothesis of no rational divergent bubble the stock price is equal to its fundamental value :

$$Pf_t = \sum_{i=1}^{+\infty} \frac{E_t(D_{t-i})}{(1+R)^i} \tag{5}$$

Equation (5) can also be rewritten :

$$Pf_t = \frac{1+R}{R} \sum_{i=1}^{+\infty} \frac{E_t(\Delta D_{t+i})}{(1+R)^i} + \frac{D_t}{R}$$

which gives: $Pf_t - \frac{D_t}{R} = \frac{1}{R}\sum_{i=1}^{+\infty}\frac{E_t(\Delta D_{t+i+1})}{(1+R)^i}$ (6)

Equation (6) means that even if stock prices and dividends are I(1) (stationary when differenced at least one time), then under the transversality condition (4), their linear combination should be stationary: if there is no bubble the two series are co-integrated.

But it could be that the logarithm of the dividend is integrated of order one and not the dividend series itself. In this case (see proof in the appendix) the condition of no bubble leads to:

$$d_t - p_t = -\frac{k}{1-\rho} + \sum_{i=0}^{+\infty}\rho^i E_t(-\Delta d_{t+1+i} + r_{t+1+i}) \quad (7)$$

where p_t, d_t and r_t are respectively the logarithms of price, of dividends and of the return $(1+R_t)$.

Thus, when the no bubble condition is fulfilled, the logarithms of the stock price and of the dividends should be co-integrated if the rate of return r is stationary.

If this is not the case equation (7) can be rewritten as:

$$d_t - p_t = -\frac{k}{1-\rho} + \sum_{i=0}^{+\infty}\rho^i E_t(-\Delta d_{t+1+i}) + \frac{1}{1-\rho}\sum_{i=0}^{+\infty}\rho^i E_t(\Delta r_{t+1+i}) + \frac{r_t}{1-\rho}$$

That is :

$$d_t - p_t - \frac{r_t}{1-\rho} = -\frac{k}{1-\rho} + \sum_{i=0}^{+\infty}\rho^i E_t(-\Delta d_{t+1+i}) + \frac{1}{1-\rho}\sum_{i=0}^{+\infty}\rho^i E_t(\Delta r_{t+1+i}) \quad (8)$$

If there is no bubble the logarithm of the prix on dividend ratio and of the rate of return are co-integrated.

On the opposite the existence of divergent rational bubbles means the transversality condition is violated so equations (5) to (8) can not be derived. There is then an infinity of stock price solutions consistent with equation (2) of the form:

$P_t = Pf_t + B_t$ (9)

Where the bubble term B_t is defined as:

$E_t(B_{t+1}) = (1+R)B_t$ (10)

With $B_t \geq 0\ \forall$ t so as to respond to the constraint of a positive stock price P_t.

Such bubbles are however submitted too very strong restrictions. Diba and Grossman (1987) have shown that such bubbles can never really explode because their existence basically implies they always stay strictly positive. The rational bubble defined by equation (10) can thus never disappear and reappear which seems in contradiction with the observation successions of booms and crashes in the stock markets.

New models of rational bubble have been developed at the beginning of the years 1990 to take into account the criticism of Diba and Grossman (1987). These new bubbles share a common characteristic: they do not diverge continuously. They are of two kinds: the intrinsic bubble kind (Froot and Obstfeld, 1991) and the strictly positive kind (Evans, 1991).

Obstfeld and Froot (1991) suppose that bubbles are a non linear function of fundamentals (dividends here), that themselves follow a log normal distribution. So the bubble and the price stock both depend on the fundamentals. Their covariance can however be negative. An intrinsic bubble does not always increase the volatility of the stock price and it does not diverge continuously.

Stricltly positive bubble defined by Evans (1991) are bubbles following a switching process of a sophisticated kind. These bubbles never really disappear but they diminish periodically. Evans (1991) gives the following example of a strictly positive bubble:

$$B_{t+1} = (1+R)B_t u_{t+1} \text{ if } B_t \leq \alpha \qquad (11)$$

$$B_{t+1} = \left[\delta + \left(\frac{1+R}{\pi}\right)\theta_{t+1}\left[B_t - \delta(1+R)^{-1}\right]\right]u_{t-1} \text{ if } B_t > \alpha \qquad (12)$$

Where α and δ are positive parameters such as $0 < \delta < \alpha$, u_{t+1} is a positive exogenous random variable, independently and identically distributed, such as $E_t(u_{t+1})=1$, θ is an exogenous Bernouilli process, *i.i.d.*, which takes the value 1 with a π probability and the value 0 with probability $(1-\pi)$.

In the first regim (equation11), the bubble increases at the average factor of $(1+R)$, which is inferior to the factor of growth of the second regim $\left(\frac{1+R}{\pi}\right)$, to which it switches automatically as soon as it reaches the value α. But in the second regim (equation 12) the bubble has a probability $(1-\pi)$ of "exploding", that is here to decrease suddenly back to a positive but lower average of δ. If the observed u_{t+1} is then sufficiently low, the bubble process switches back to a regim of low rate of growth.

Evans (1991) shows that such bubbles can easily escape detection by co-integration tests : the hypothesis of no co-integration (*e.g*; presence of bubble) is often wrongly rejected.
Taylor and Peel (1998) suggest an improvement of co-integration based bubble tests by the use of the estimator devised by (1996). It is about correcting the least means squares estimators of the bias and the kurtosis introduced in the residuals by the existence of bubbles. The authors show on the basis of Monte Carlo simulations that this method significantly improves the detection of bubbles « à la Evans ». The implementation of this method to the US, German, French, Japanese and English stock markets is developed in the following third section.

3. Implementation to the US, German, French, Japanese and English stock markets

Following the methodology developed in section (2) the three co-integration relationships derived from equation (5) have been tested.
Equation (6) implies the existence of a co-integration relation between prices and dividends if dividends are integrated of order one:

$$P_t = a_1 + b_1 D_t + u1_t \qquad (13)$$

where $u1_t$ is a stationary residual.
Equation (7) implies the existence of a co-integrating relationship between the logarithms of prices and of dividends if the series of dividends in logarithm is integrated of order one and if the return r_t is stationary:

$$p_t = a_2 + b_2 d_t + u2_t \qquad (14)$$

where $u2_t$ is a stationary residual.
Equation (8) implies the existence of a co-integrating relationship between the logarithm of the dividend on price ratio and the logarithm of the return:

$$d_t - p_t = a_3 + b_3 r_t + u3_t \qquad (15)$$

where $u3_t$ is a stationary residual.

Testing the co-integration amounts to testing for the stationarity of the residual ui_t, which can be done by the mean of the estimation of:

$$\Delta ui_t = \beta ui_{t-1} + \varepsilon_t \qquad \text{for i= 1,2, 3} \qquad (16)$$

where ε_t is the new residual.

The hypothesis of no co-integration is then the null hypothesis $\beta=0$ while the alternative hypothesis of stationarity implies $\beta<0$.

The test statistic is given by:

$CRT = \frac{\hat{\beta}}{\sqrt{\hat{V}(\beta)}}$ whose distribution is not known under the null hypothesis. The critical values must be tabulated by means of simulations.

To correct for the bias and kurtosis introduced in the residuals by the bubble (under the null hypothesis) Taylor and Peel (1998) suggest the use of the two stages estimation method by Im (1996). The first stage is to estimate equation (16) so as to use the residuals and the estimated variance to construct the vector $\hat{w}_t$:

$$\hat{w}_t = \left(\left(\hat{u}_t^3 - 3\sigma^2 \hat{u}_t\right), \left(\hat{u}_t^2 - \hat{\sigma}^2\right)\right) \qquad (17)$$

The second stage is to reestimate an equation of the form (16) but with the introduction of the vector $\hat{w}_t$ to correct the estimator of β of the bias and the kurtosis of the residuals:

$$\Delta ui_t = \beta ui_{t-1} + \gamma \hat{w}_t + \mu_t \qquad (18)$$

where μ_t is a white noise.

The corrected statistic of the test is then given by:

$CRTA = \frac{\hat{\beta}*}{\sqrt{\hat{V}(\beta*)}}$ where $\hat{\beta}*$ is the estimator of the least means squares in equation (18).

The variance of $\hat{\beta}*$ is estimated (Im, 1996) by:

$$\hat{V}(\beta*) = \sigma_A^2\left(\ddot{X}'\left(I_T - \ddot{W}\left(\ddot{W}'\ddot{W}\right)\ddot{W}'\right)^{-1}\ddot{X}\right)$$

where $\ddot{X}$ is the (T,k) matrix of the centered fundamental variables –which is here a (T,1) vector of the lagged series of residuals -, $\ddot{W}$ is the (T,2) matrix of the centered series of $\hat{w}_t$, and:

$$\sigma_A^2 = \sigma^2 - \frac{\mu_3^2\left(\mu_6 - 6\mu_4\sigma^2 + 9\sigma^6 - \mu_3^2\right) - 2\mu_3\left(\mu_4 - 3\sigma^4\right)\left(\mu_5 - 4\mu_3\sigma^2\right) + \left(\mu_4 - 3\sigma^4\right)^2\left(\mu_4 - \sigma^4\right)}{\left(\mu_4 - \sigma^4\right)\left(\mu_6 - 6\mu_4\sigma^2 + 9\sigma^6 - \mu_3^2\right) - \left(\mu_5 - 4\mu_3\sigma^2\right)}$$

The data on which we implement this procedure are extracted from Datastream. They are the datastream price index series and the corresponding series of dividends, from January 1973 to August 2000. The frequency is monthly.

Table 1 : Stationarity Tests ♦

	Y	ΔY	Log(Y)	Δlog(Y)	Conclusion
Germany					
Y=D	3,06	-16,6*	1,94	-15,3*	D and log(D are I(1)
Y=P	3,6	-19,9*	2,88	-15,1*	P and log(P) are I(1)
Y=log(D/P)	-0,26	-17,4*			Log(D/P) is I(0)
Y=r	-15,9*				r is I(0)
France					
Y=D	3,55	-14,7*	0,72	-13,4*	D and log(D) are I(1)
Y=P	7,33	-20,4*	0,72	-18,3*	P and log(P) are I(1)
Y=log(D/P)	-0,89	-16,2*			Log(D/P) is I(0)
Y=r	-18,5*				r is I(0)
Japan					
Y=D	-2,71	-13,3*	-3,39*	-13,3*	D is I(1), log(D) is I(0)
Y=P	-1,56	-16,6*	-0,9	-16,4*	P and log(P) are I(1)
Y=log(D/P)	-0,89	-16,8*			Log(D/P) is I(0)
Y=r	-15,6*				r is I(0)
The United Kingdom					
Y=D	0,38	-18,1*	-3,64*	-15,4*	D is I(1), log(D) is I(0)
Y=P	3,89	-19,9*	0,69	-19,3*	P and log(P) are I(1)
Y=log(D/P)	-0,2	-19,5*			Log(D/P) is I(0)
Y=r	-20,6*				r is I(0)
The United States					
Y=D	-0,23	-13,3*	-5,5*	-14,62*	D is I(1), log(D) is I(0)
Y=P	7,01	-15,8*	3,14	-24,8*	P and log(P) are I(1)
Y=log(D/P)	2,59	-23,3*			Log(D/P) is I(0)
Y=r	-20,7*				r is I(0)

♦ Dickey-Fuller statistic not corrected for the non dividend series (as it is not supposed to by affected by a bubble), corrected statistic for the others series.
* rejection of the hypothesis of nonstationarity at 5%

The stationarity tests reported in le table 1 corroborate the results usually found for the French stock market. The stock prices are integrated of order one in logarithm as well as in non transformed level, while for price stocks in logarithm the conclusions are split between integration of order one and stationarity, finally the return series r_t is stationary without any differencing.

Before applying corrected CI tests to the data we have checked if there is some skewness and excess kurtosis in the stock prices in level, in logarithms and in first differences.

Table 2 : Skewness and excess kurtosis

	FRANCE	GERMANY	UK	USA	JAPON
P :					
SK. Sign.	1.78 0.00%	1.69 0.00%	1.06 0.00%	1.77 0.00%	0.30 2.69%
KUR. Sign.	3.45 0.00%	2.59 0.00%	0.21 45%	2.3 0.00%	-1.1 0.00%
p :					
SK. Sign.	0.06 65%	0.44 0.01%	-0.18 18%	0.51 0.02%	-0.31 2.2%
KUR. Sign.	-1.22 0.00%	-0.83 0.02%	-1.17 0.00%	-0.85 0.16%	-1.41 0.00%
Δp :					
SK. Sign.	-0.66 0.00%	-1.13 0.00%	0.48 0.04%	-0.48 0.03%	-0.17 19%
KUR. Sign.	1.64 0.00%	5.69 0.00%	10.58 0.00%	1.91 0.00%	0.83 2.32%

(H0 : SK ou KUR=0, sign. < 5% =< rejet H0)

According to the results presented in table 2 there is almost always both skewness and excess kurtosis in the stock prices, and there is always at least skewness or kurtosis.

Table 3 :Tests of non co-integration (existence of bubble): CRTA statistic♦♦

equation	Germany	France	Japan	United-Kingdom	United States
(13) P and D	-2,17	0,35	-1,38	-0,34	1,13
(14) p and d	-2,5	-1,74	-2,25	-1,90	-1,14
(15) d-p and r	-0,63	-2,12	-2,34	-1,25	-2,75

♦♦ Taylor and Peel (1998) have - from 20 000 of samples of 116 observations length - tabulated a critical value of -3,79 for CRTA.

* rejection at 5% of the non co-integration hypothesis *e.g.* rejection of the hypothesis of the presence of bubble.

The results of the bubble tests reported in table 2 never allow to reject the hypothesis of no co-integration. that is they never allow to reject the hypothesis that speculative divergent bubble do exist on the stock markets under study.

4. Interpretation and conclusion of part I

The implementation of the corrected co-integration tests does not allow here to reject the hypothesis of speculative bubbles on the German, French, Japanese, English and American stocks exchanges.

The growing disconnection observed these last years between the stock prices and the dividends can then be interpreted as a serious threat to the financial stability of the main stock markets. This a rather a striking and disquieting result as the study is limited to traditional stocks of the "old economy", which by nature are far more speculative than the stocks of the "new economy" whose fundamentals are not yet well known (the estimation of the forthcoming dividends of new activities is very difficult and uncertain, leaving a greater scope for speculation). Some further tests should allow to confirm this bubble hypothesis and to be more specific about pace at which such bubbles have been/are growing. It could also be interesting to try to link the existence of bubbles with contagion.

Part 2 (forthcoming): Testing for international causalities between non fundamental components of Stock Prices

A preliminary test : are there CI relationships between the 5 Stock Prices ? To check it we have proceeded to Johansen CI tests

LAMBDA MAX TESTS
(with unconstrained constant and trend, 2 lags)
(AKAIKE and HANNAN QUINN give 2 lags. SWARTZ gives one lag)

h	Calculated Statistic.	90%	95%
0	31.72 <	33.74	36.41
1	21.97 <	27.76	30.33
2	15.06 <	21.53	23.78
3	6.23 <	14.84	16.87
4	0.14 <	2.57	3.74

H0 : r=h accepted against H1 : r=h+1 when the calculated statistic is below the critical value.

Here H0 is always accepted. More specifically : r=0 is accepted against r=1. It means the hypothesis that there are no CI relationships between the five stock prices can not be rejected..

THE TRACE TESTS
(with unconstrained constant and trend, 2 lags)
(AKAIKE and HANNAN QUINN give 2 lags, SWARTZ gives one lag)

h	Calculated Statistic	90%	95%
0	75.11	> 73.40	< 77.74
1	43.40 <	50.74	54.64
2	21.42 <	31.42	34.55
3	6.37 <	16.06	18.17
4	0.14 <	2.57	3.74

H0 : r≤h accepted against H1 :r≥h+1 when the calculated statistic is below the critical value.

Again, H0 can never be rejected at à 5%, more specifically r=0 cannot be rejected against r≥1. The hypothesis according to which there are no CI relationships can not be rejected.

These results could mean there is no need to fear that in the long run bubbles could be transmitted from a market to another. But one should be very cautious in interpreting these very preliminary results: these first tests do not take into account the exchange rates (the indices are measured in different currencies : euros, dollars, yens and British pounds) and, furthermore, testing short run causalities between non fundamental components could give very different results.

Appendix:

To get to equation (7) in the text:

$$d_t - p_t = -\frac{k}{1-\rho} + \sum_{i=0}^{\infty} \rho^i E_t\left(-\Delta d_{t+1-i} + r_{t+1+i}\right),$$

the starting point is the definition of the rate of return r_{t+1} :

$$\begin{aligned} r_{t+1} &= \log(P_{t+1} + D_{t+1}) - \log(P_t) \\ &= \log(P_{t+1}) + \log\left(1 + \frac{D_{t+1}}{P_{t+1}}\right) - \log(P_t) \\ &= p_{t+1} - p_{t+l} + \log(1 + \exp(d_{t+1} - p_{t+1})) \qquad (A1) \end{aligned}$$

The second term of (A1) is a non linear function of the log of the dividend on the price $(d_{t+1} - p_{t+1})$ which can be linearized by a Taylor first order approximation around the mean ratio of the log dividend on the log of price*(d-p)*. Which gives :

$$r_{t+1} \approx k + \rho\, p_{t+1} + (1-\rho) d_{t+1} - p_t \qquad (A2)$$

with: $\rho = \dfrac{1}{1+\exp(d-p)}$ et $k = -\log(\rho) - \log\left(\dfrac{1}{\rho} - 1\right)(1-\rho)$

The linear approximation (A2) is the better the lesser is the dispersion around the mean *(d-p)*. Campbell *et alii* (1997, p.262) find this is a good approximation on US data because the US returns evaluated according to (A2) have a strong correlation with the observed returns.

Equation (A2) is a linear differential equation for prices which can be written –taking the conditional expectation- as:

$$p_t \approx k + \rho\, E_t(p_{t+1}) + (1-\rho)E_t(d_{t+1}) - E_t(r_{t+1}) \qquad (A3)$$

Which under the transversality condition (no bubble) gives the following solution:

$$p_t = \frac{k}{1-\rho} + \sum_{i=0}^{+\infty} \rho^i\, E_t\left[(1-\rho)d_{t+i+1} - r_{t+i+1}\right] \qquad (A4)$$

Equation (A4) can then be rewritten as:

$$p_t - d_t = \frac{k}{1-\rho} + \sum_{i=0}^{+\infty} \rho^i\, E_t\left[\Delta d_{t+i+1} - r_{t+i+1}\right]$$

which gives: $d_t - p_t = \dfrac{-k}{1-\rho} + \sum_{i=0}^{+\infty} \rho^i\, E_t\left[-\Delta d_{t+i+1} + r_{t+i+1}\right]$

which matches equation (7) in the text.

References:

Blanchard O. and Watson M. (1982)°: « Bubbles, Rational Expectations and Financial Markets », in Crisis in the Economic and Financial structure, Lexington Books.

Chung H. and Lee B-S. : « Fundamental and nonfundamental components in stock prices of Pacific-Rim countries », *Pacific-Basin Finance Journal* (Elsevier) 6, pp.321-346, 1998.

Campbell J.Y., Lo A.W., MacKinlay A.C. (1997) : The Econometrics of Financial Markets, Princeton University Press.

Diba B.T. and Grossman H.T. (1987): « On the inception of rational bubbles », *Quarterly Journal of Economics*, 102.

Evans G. (1991) : « Pitfalls in Testing for Explosive Bubbles in Asset Prices », *American Economic Review*, September.

Frankel J.A. and Froot K. (1986) : « The dollar as a speculative bubble: a tale of fundamentalists and chartists », *NBER WP*, n°1854, MIT.

Froot K. and Obstfeld M. (1991) : « Intrinsic Bubbles : the Case of Stock Prices », *American Economic Review*, December 1991.

Orlean A. (1990) : « Contagion des opinions et fonctionnement des marches financiers », *Revue Economique*, n°4, July.

Raymond H. (1993): « Dynamique du taux de change : evaluation et interpretation du phenomene d'instabilite »,PHd Thesis, University of Paris I.

Sarno L. and M.P. Taylor (1999) : « Moral hazard, asset price bubbles, capital flows, and the East Asian crisis : the first tests », *Journal of International Money and Finance*, 18, pp. 637-657.

Taylor M.P. and Peel D.A. (1998) : « Periodically collapsing stock price bubbles: a robust test», *Economics Letters*, 61, pp 221-228.

Timmermann A. (1982) : « Present Value Models with Feedback: Solutions, Stability, Bubbles and some Empirical Evidence », Birbeck College, Université de Londres, mimeo, August 1992.

Tirole J. (1982) : « On the Possibility of Speculation under Rational Expectations », *Econometrica*, vol. 50, n°5.

Tirole J. (1985) : « Asset bubbles and Overlapping Generation », *Econometrica*, vol. 53, n°6.

Wu Y. (1995) : « Are there rational bubbles in foreign exchange markets : evidence from an alternative test», *Journal of International Money and Finance*, vol.14, n° 1, 1995