SPECULATIVE BUBBLES UNDER CROSS SECTIONAL DEPENDENCE

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ABSTRACT: This paper study empirically a model for speculative bubbles (Campbell, 2000). The idea is to investigate the existence of a stable (no-explosive) relationship among stock prices, dividends and returns in international markets over the period 1991-2006. First, we check for panel unit root in log dividend-price ratio and in the real returns using cross-sectional dependence tests in order to verify "no bubble" hypothesis. Second, we check for co-integrating relationship between the log dividend-price ratio and real returns using a new panel co-integration test (Westerlund, 2005). If a stable (equilibrium) relationship is rejected, the "no bubble" hypothesis is also rejected.

KEYWORDS: Panel data, Cointegration, Speculative bubbles, International financial markets

1 Introduction

The fundamental value of a security can be viewed as the present value of all its future cash flows. The divergence of the actual price of a financial asset from its fundamental value is called a bubble.
The question of the presence of speculative bubbles in financial markets has been addressed in several works (Santos & Woodford, 1997; Kaizoji, 2000; Montrucchio & Privileggi, 2001; Scheinkman & Xiong, 2003; Sornette, 2003; Semet, Gelly, Schoenauer & Sebag, 2004).
The aim of this work is to check the presence of speculative bubbles in the international stock markets via a "global" analysis of a Campbell model (2000). The general idea is to verify or reject the existence of a stable (no-explosive) relationship among stock price, dividends and returns in the international stock markets over the period 1991-2005. Several works (e.g. Campbell & Shiller, 1987; Diba & Grossman, 1988; Evans, 1991; Charemza & Deadman, 1995; Herrera & Perry, 2001) use unit root and co-integration tests in a times series context to analyze the presence of speculative bubbles in the markets.
In finite sample, unit root test procedures are known to have limited power against

the alternative hypothesis with highly persistent deviation from equilibrium (Frankel & Rose, 1996) and this problem seems to be particularly severe for small samples (Campbell & Perron, 1991).
It is noteworthy that the use of panel data increases the power of the unit root tests by increasing the number of cross-sectional units (Banerjee, 1999).
We improve the existent literature by using new panel unit root and co-integration tests under cross-sectional dependence hypothesis in order to capture the global financial world behaviour. Cross-sectional dependence hypothesis is assumed, since the cross-sectional independence is rather restrictive and somewhat unrealistic in the majority of macroeconomic applications of unit root tests, where co-movements of economies are often observed (Phillips & Sul, 2003; O'Connel, 1998). Monthly data from 10 countries in the period 1991-2006 are used.* Moreover, we split the whole period into two sub-periods (1991-1997; 1998-2006) in order to test the robustness of our results to changes of the sample. Evidence of unit root process for the variables considered is found and "no bubbles" hypothesis is rejected. Panel co-integration tests reject the hypothesis of a long run relationship between total returns and the log dividend yield in all cases.

2 Campbell's model

The definition of return provides the following relationship at time t between returns R_t, dividends D_t and prices P_t

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

Using a first-order Taylor expansion around the mean log dividend-to-price ratio, and imposing a no-bubbles terminal condition, one get

$$p_t-d_t=\frac{k}{1-\rho}+\mathbf{E}_t\sum_{j=0}^{\infty}\rho^j[\Delta d_{t+j+1}-r_{t+j+1}]. \tag{1}$$

3 Panel unit root

In our analysis, we consider three tests based on the cross-sectional dependence (Bai & Ng, 2004 (BNG), Moon & Perron, 2004 (MP), Pesaran, 2005 (PS)).
BNG consider a factor model, and propose to pool the individual Augmented Dickey-Fuller (ADF) t-statistics with de-factored estimated components. However, these individual time series tests have the same low power as those based on the initial series. MP also developed several unit root tests in which the cross-sectional units are correlated. To model the cross-sectional dependence, MP provided an approximate linear

*The countries are: Australia, Canada, France, Germany, Honk Kong, Japan, Netherlands, Spain, UK, USA.

dynamic factor model in which the panel data are generated by both idiosyncratic shocks and unobservable dynamic factors that are common to all individual units but to which each individual reacts heterogeneously.
In order to deal with the problem of cross-sectional dependence PS does not consider the deviations from the estimated common factor. Instead he suggests augmenting the standard DF (or ADF) regression with the cross section averages of lagged levels and first-differences of the individual series. The panel unit root tests are then based on the average of individual cross-sectionally augumented ADF statistics (CADF).

4 Panel cointegration

After performing panel unit root tests, we apply the Durbin-Hausman panel cointegration test proposed by Westerlund (2005). The Durbin-Hausman panel (DH_p) cointegration test allows for cross-sectional dependence that it is modelled by a factor model in which the errors of the equation are generated by both idiosyncratic innovations and unobservable factors that are common across the members of the panel.

5 Data used

Data for 27 stock markets are extracted from Datastream (2006). Monthly stock prices index series and the corresponding series of dividends over the period 1991-2005 are taken.

6 Conclusion

In this paper we present empirical evidence of the bubbles phenomena in the international stock markets over the period 1991-2005. If bubbles exist in financial markets, asset prices will differ from their fundamental values. Stock prices and dividends are stationary around a stochastic trend. These findings are confirmed when a sub-sample of periods is taken into account.
The results we obtained are completely consistent with the historical occurrence of speculative bubbles.

References

BAI, J. & NG S. 2004. A PANIC Attack on Unit Root and Cointegration. *Econometrica*, **72**, 1127-1177.
BANERJEE, A. 1999. Panel data unit root and cointegration: an overview. *Oxford Bulletin of Economics and Statistics*, **61**, 607-629.
CAMPBELL, J. Y. 2000. Asset pricing at the millenium. *Journal of Finance*, **55**(4).
CAMPBELL, J. Y. & SHILLER, R. J. 1987. Cointegration and Tests of Present Values Models. *Journal of Political Economy*, **95**, 1062-1088.

CAMPBELL, J. Y. & PERRON, P. 1991. Pitfalls and opportunities: what macroeconomists should know about unit roots. *NBER Technical Working Paper*, no. 100.
CHAREMZA, W. W. & DEADMAN, D. F. 1995. Speculative bubbles with stochastic explosive roots: the failure of unit root testing. *Journal of Empirical Finance*, **2**, 153-163.
DIBA, B. T. & GROSSMAN, H. I. 1988. Explosive Rational Bubbles in Stock Prices?. *American Economic Review*, **78**, 520-530.
EVANS, G. W. 1991. Pitfalls in testing for Explosive Bubbles in Asset Prices. *American Economic Review*, **81**, 746-754.
FRANKEL, J. & ROSE, A. 1996. A panel project on purchasing power parity: mean reversion within and between countries. *Journal of International Economics*, **40**, 209-224.
HERRERA, S. & PERRY, G. 2001. Tropical Bubbles: asset prices in Latin America, 1980-2001. *Policy Research Working Paper*, no. 2724, The World Bank.
KAIZOJI, T. 2000. Speculative bubbles and crashes in stock markets: an interacting-agent model of speculative activity. *Physica A*, **287**(3), 493-506.
MONTRUCCHIO, L. & PRIVILEGGI, F. 2001. On Fragility of Bubbles in Equilibrium Asset Pricing Models of Lucas-Type. *ICER Working Papers - Applied Mathematics Series*, no. 05-2001.
MOON, H. R. & PERRON, B. 2004. Testing for a Unit Root in Panels with Dynamic Factors. *Journal of Econometrics*, **122**, 81-126.
O'CONNEL, P. G. J. 1998. The overvaluation of purchasing power parity. *Journal of International Economics*, **44**, 1-19.
PESARAN, H. 2005. A simple panel unit root test in the presence of Cross Section Dependence. *Mimeo*, Cambridge University and USC.
PHILLIPS P. C. B. & SUL, D. 2003. Dynamic Panel Estimation and Homogeneity Testing Under Cross Section Dependence. *Econometric Journal*, **6**, 217-259.
SANTOS, M. & WOODFORD, M. 1997. Rational Asset Pricing Bubbles. *Econometrica*, **65**(1), 19-58.
SCHEINKMAN, J. A. & XIONG, W. 2003. Overconfidence and Speculative Bubbles. *Journal of Political Economy*, **111**(6).
SEMET, Y., GELLY, S., SCHOENAUER, M. & SEBAG, M. 2004. Artificial agents and speculative bubbles. *Computational Finance and its Applications*, Costantino, M. & Brebbia, C. A. (eds.), WIT Press.
SORNETTE D. 2003. Critical market crashes. *Physics Reports*, **378**(1), 1-98.
WESTERLUND, J. 2005. Panel Cointegration Test of the Fisher Hypothesis. *Mimeo*, School of Economics and Management, Lund University.