Economic Modelling 30 (2013) 595–601

Contents lists available at SciVerse ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Has the structural break slowed down growth rates of stock markets?

Paresh Kumar Narayan [a,*], Seema Narayan [b], Sagarika Mishra [a]

[a] Financial Econometrics Group, School of Accounting, Economics and Finance, Deakin university, Melbourne, Australia
[b] School of Economics, Finance, and Marketing, Royal Melbourne Institute of Technology University, Melbourne, Australia

ARTICLE INFO

Article history:
Accepted 2 October 2012

JEL classification:
C22
G14
G15

Keywords:
Common structural break test
Stock markets

ABSTRACT

In this paper, we use the common structural break test suggested by Bai et al. (1998) to test for a common structural break in the stock prices of the US, the UK, and Japan. On the basis of the structural break, we divide each country's stock price series into sub-samples and investigate whether or not the structural break had slowed down the growth of stock markets. Our main findings are that when stock markets are modelled in a trivariate sense the common structural break turns out to be 1990:02, with the confidence interval including several episodes, such as the asset price bubble when housing prices and stock prices in Japan reached a peak in 1988/1989, the early 1990s recession in the UK, the business cycle peak of July 1990, the August 1990 Iraqi invasion of Kuwait and the March 1991 business cycle trough. Annual average growth rates suggest that the structural break has slowed down the growth rate of the US, the UK and Japanese stock markets.

1. Introduction

There is a substantial literature (see, *inter alia*, Balvers et al., 2000; Brorsen and Buguk, 2003; Chaudhuri and Wu, 2003; Fama and French, 1988a, 1988b; Kim et al., 1991; Lo and MacKinlay, 1988; Poterba and Summers, 1988; Richards, 1995, 1997) that examines the behaviour of stock prices. This paper is an extension of this research agenda but differs from the extant literature in four ways: (a) it examines confidence intervals for the break date when stock prices in the USA, the UK and Japan are considered individually, (b) it examines whether or not the break in stock prices of different countries occurred at the same time, (c) it examines the interval estimate of the break date, when the date is modelled as common across the three countries, and (d) on the basis of the common structural break, it divides each country's stock price series into sub-samples and calculates annual average growth rates with the aim of investigating whether or not structural breaks have slowed down growth of stock markets. At this point it is important to highlight the fact that our paper is different from the literature (see Lee et al., 2010; Narayan, 2008; Narayan and Smyth, 2007) which has modelled stock prices using multiple structural break unit root tests. While this literature has extracted structural breaks for individual markets, we search for breaks that are common to a group of markets.

From the extant literature (see, *inter alia*, Claessens and Kristin, 2001; Claessens et al., 2001; Manzana-Arago and Fernandez-Izquierdo, 2007; Yang et al., 2004), we know that although stock markets in different countries differ in terms of size, structure, and geographic location, they exhibit a high-degree of correlation due to interdependence among them. Since there is a high correlation among stock markets across countries, it will be interesting to model them in order to find a common structural break in a multivariate setting than in a univariate setting.

The aims of this paper are achieved by using a technique for constructing asymptotically valid confidence intervals for the date of a single break in multivariate time series developed by Bai et al. (1998). There are two key advantages of using this technique: (1) an interval estimate of the break date, by virtue of providing sample certainty, is more useful in understanding the importance of shocks that create such breaks; and (2) there are many factors that may be crucial in explaining the existence of breaks. It also helps researchers understand the various reasons behind breaks, such as macroeconomic shocks, technology shocks, and political shocks. So gains can be achieved by modelling for a common break in the stock market indices in a multivariate framework.[1]

In the case of stock markets, there are several episodes, such as the stock market crash in 1987, the oil crisis in the 1970s, the Asian

[1] We include the three largest markets because they are broadly homogeneous. A shock can only be common if it is considered for markets that are homogenous. Although it is true that even the largest markets will respond heterogeneously to the shock. Therefore, whether or not a shock impacts the market is one thing, and the magnitude of the effect is completely another. We thank one referee of this journal for making this point and encouraging us to include it here.

* Corresponding author.
E-mail addresses: Narayan@deakin.edu.au (P.K. Narayan), seema.narayan@rmit.edu.au (S. Narayan), Sagarika.mishra@deakin.edu.au (S. Mishra).

0264-9993/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.econmod.2012.10.001

Financial crisis in 1997 and the global financial crisis of 2007, among others, that could result in breaks that have been simultaneous across countries; see Section 2 for a detailed discussion drawing on contagion effect. As a result, Bai et al. (1998) observe that gains in precision can be obtained by a multivariate treatment, where variables are modelled as breaking contemporaneously across series.

Briefly foreshadowing our main results, we find that when stock markets are modelled in a trivariate sense the common structural break turns out to be 1990:02. The associated confidence interval for this common break date includes several episodes, such as the asset price bubble when housing prices and stock prices in Japan reached a peak in 1988/1989, the early 1990s recession in the UK, the business cycle peak of July 1990, the August 1990 Iraqi invasion of Kuwait and the March 1991 business cycle trough. Our analysis of the annual average growth rates suggests that the structural break has slowed down the growth rate of the UK, the US and Japanese stock markets.

The rest of the paper is organized as follows. Section 2 provides the motivation for the empirical analysis conducted in this paper. In this section, we draw on the "contagion effects" literature to provide an overview of how contagion effects can lead to a common structural break among stock markets. Section 3 includes a brief discussion of the methodology. Section 4 entails the empirical results, and the final section provides some concluding remarks.

2. Contagion effect as a cause for a common structural break

In this section, we discuss the contagion effect that can be perceived as a source of a common structural break. In general, the literature takes two lines of interpretation on the contagion effect. The first view originates from the fact that market economies are interdependent. Trade liberalization has contributed to macroeconomic similarities or dissimilarities, which has stimulated international trade as countries identify their areas of comparative advantage. Such integration of economies creates opportunities for offshore investment. Interdependence of this sort can lead to co-movement in financial asset prices. This is commonly referred to as "fundamentals-based contagion". For related discussions, see Baur (2003), Chuhan et al. (1998) and Corsetti et al. (1998).

Several other factors, such as recessions or booms and oil price shocks, can trigger this kind of co-movement. It follows that, and as shown in Calvo and Reinhart (1996), shocks regardless of whether they are of a global or local nature, are transmitted across countries through real and financial linkages. If countries share common or similar macroeconomic conditions, then a crisis, or shock, may spread contagiously among countries. Moser (2003: 159) explains this point more clearly by stating, "… several countries are hit by a common global or regional external shock …. Candidates for such adverse common shocks with the potential for inflicting balance of payment difficulties, particularly in emerging market economies, are changes in global (US) interest rates, exchange rates between major currencies, commodity prices, or recessions in major industrial countries".

The second line of interpretation perceives contagion emerging from financial crises, which arise not from macroeconomic fundamentals but from the behaviour of investors or other financial agents. This is often referred to as "irrational contagion", associated with financial panic, herd behaviour, loss of confidence and increases in risk aversion (Karolyi, 2004).

Liquidity and other constraints on lenders or investors can be used to explain individual rational behaviour. If banks from a common creditor country, in the face of deteriorating quality of their loans, reduce the overall risk of the loan portfolio, the liquidity problems and the incidence of financial contagion might spread to those countries whose financial assets are widely traded in global markets and whose markets are more liquid (Goldfajn and Valdes, 1997; Karolyi, 2004; Kodres and Pritsker, 2002). It follows that when financial institutions face a default in one country, they tend to withdraw capital not only from that country, but also from other countries so that they avoid further decline in their asset values (see Kaminsky and Reinhart, 2000). This behaviour is commonly referred to as the common creditor hypothesis.

3. Methodology and theoretical model

This section draws heavily on the work of Bai et al. (1998), who consider the model which describes the system of equations as

$$y_t = \mu + \sum_{j=1}^{p} A_j y_{t-j} + \Gamma X_{t-1} + d_t(k)\left(\lambda + \sum_{j=1}^{p} B_j y_{t-1} + \Pi X_{t-1}\right) + \varepsilon_t \quad (1)$$

where γ_t, μ, λ, and ε_t are $n\times 1$ and $\{A_j\}$ and $\{B_j\}$ are $n\times n$; $d_t(k)=0$ for $t\le k$ and $d_t(k)=1$ for $t>k$; and X_t is a matrix of stationary variables. From Eq. (1), assuming that only a subset of coefficients, such as the intercept has a possible break and because tests based on a partial model have more power than a full structural change model, Bai et al. (1998) propose a more compact form of the model as:

$$y_t = Z'_t(k)\beta + \varepsilon_t.$$

$Z'(k)_t = ((V'_t \otimes I), d_t(k)(V'_t \otimes I)S')$ and $\beta = (\theta', (S\delta)')'$, where $V' = \left(1, y'_{t-1}, \ldots, y'_{t-p}, X'_{t-1}\right)_t$, $\theta = \mathrm{Vec}(\mu, A_1, \ldots, A_p, \Gamma)$, $\delta = \mathrm{Vec}(\lambda, B_1, \ldots, B_p, \Pi)$, I is an $n\times n$ identity matrix, and S, whose rank is equal to the number of coefficients that are allowed to change, is a selection matrix containing 0's and 1's. Bai et al. (1998) apply the sequence of F-statistics to test for a break in the coefficients: $S\delta=0$ for $k=k_*+1,\ldots,T-k_*$, where k_* represents some trimming value. Hence, the null hypothesis is that there is no structural break. To test for a break, Bai et al. (1998) use two tests — the maximum Wald statistic and the logarithm of exponential Wald statistic.

There is a growing literature (see *inter alia*, Fernandez-Serrano and Sosvilla-Rivero, 2001; Masih and Masih, 1997, 1999, 2002) that examines the interdependence of stock markets using cointegration analysis of stock price indices of two or more countries. A finding of cointegration is taken as evidence in favour of stock market interdependence because it indicates a common force, such as arbitrage activity, that brings the stock markets together in the long run. Therefore, testing for cointegration is tantamount to a test of the level of arbitrage activity in the long-run.

In theory, if stock markets are not cointegrated, this implies that arbitrage activity to bring markets together in the long-run is zero (Masih and Masih, 1997, 1999, 2002). Given the theoretical and practical implications of testing for cointegration of stock markets, we investigate evidence for a cointegration relationship between the stock markets of the US, the UK and Japan.

Indeed the main goal of this exercise, as explained earlier, is to search for a common break in these stock markets. To achieve this, a test for cointegration is necessary since Bai et al. (1998) propose a test for the null hypothesis of a structural break in cointegrated models. For a cointegrated model, Bai et al. (1998) show that Eq. (1) can be written in a vector error correction model (VECM) as follows:

$$\Delta Y_t = \mu + \lambda d_t(k_0) + A(L)\Delta Y_{t-1} + \gamma\alpha' Y_{t-1} + \varepsilon_t \quad (2)$$

where Y_t can be perceived as the stock price series and $X_t = \alpha' Y_{t-1}$.

4. Empirical results

4.1. Data and preliminary analysis of stock indices

In this paper, we study the stock market price indices of the US, the UK and Japan using monthly data spanning 1965:12 to 2010:05. The data are obtained from the *OECD Main Economic*