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Country world betas: The link between the stock market beta and macroeconomic beta

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ABSTRACT

We assess the connection between stock market linkages and macroeconomic linkages by using a world index model. Specifically, we test the association between the stock market beta (the sensitivity of country stock market index to world index) and macroeconomic betas (the sensitivity of national output and inflation to world output and inflation). Output betas account for about 20–26% of the cross-section of stock market betas. Controlling for previously-documented factors affecting stock market comovements: world output volatility is somewhat significant, while inflation betas, trade openness and world stock market volatility are insignificant in accounting for variation in stock market betas.

1. Introduction

The connection between stock market cross-country correlations and macroeconomic linkages has been a central theme in financial economics (see, for example, King and Wadhwani, 1990; Connolly and Wang, 2003). This question has been directly addressed by Bracker et al. (1999), Bracker and Koch

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(1999), Pretorius (2002), Dumas et al. (2003), Forbes and Chinn (2004) and Tavares (2009). In these papers, bilateral correlations between countries' stock market returns are related to bilateral macroeconomic linkages.[1]

The current paper takes a different approach to this issue by investigating a potential linkage between the sensitivity of a country's national stock index to a world stock index and the sensitivity of its output and inflation to world output and inflation. The former has been labeled a country's world beta in international capital asset pricing models (e.g., Errunza and Losq, 1985; Harvey, 1991; Harvey and Zhou, 1993). We label the latter a country's *macroeconomic beta*, and to distinguish the two, we call the former the *stock market beta*. The intuition behind this approach is to relate stock market comovements to exposures to world macroeconomic factors. The bilateral correlations employed in the previous literature are intimately related to countries' world betas, as shown by Morana and Beltratti (2008).[2] Focusing on betas instead of correlations or R^2s from a world factor model enables us to associate the riskiness of a country's stock market with its macroeconomic riskiness.

Such an approach links our work to consumption-based world CAPM models (e.g., Li and Zhong, 2005), and offers a testable rational channel to explain the variation in cross-country stock market correlations. If stock markets rationally respond to macroeconomic factors, variation in stock market betas should be, to a significant degree, accounted for by macroeconomic betas. We exclude financial and other variables that lead macroeconomic variables, and focus purely on macroeconomic information.

The fundamental value of a stock equals to the sum of the present value of the firm's expected future cash flows. National output has typically been used as a proxy for marketwide-aggregated expected future cash flows (e.g., Fama, 1990; Ammer and Mei, 1996). In the denominator of the stock pricing equation is the discount rate, a main component of which is the inflation rate. Thus, the concept of macroeconomic betas is operationalized using output and inflation. The main component we leave out is the time variation in risk aversion, studied by Chue (2005): the correlations in the "endowment process" (i.e., output growth) is considered as a lower bound for stock market correlations.

We estimate stock market betas via regressions of country index real returns on contemporaneous and lagged MSCI world index real returns, which has been shown by Harvey and Zhou (1993) to be an efficient world portfolio. Macroeconomic betas (*output beta* and *inflation beta*, respectively) are estimated via regressions of national output growth and inflation on contemporaneous and lagged world output growth and inflation shocks. As proxies for national output, we use industrial production and GDP real growth rates published by OECD. World output is represented by OECD totals. Similarly, we use country inflation rates and OECD inflation rate, measured as percentage change in CPI.

Allowing for a sufficient number of lags is important in these regressions as macroeconomic shocks may propagate gradually and with speeds differing across countries, while stock markets react instantaneously in advance. Therefore, current stock market correlations may reflect subsequent and cumulative, rather than current, correlations of output, as discussed by Ammer and Mei (1996) and Dumas et al. (2003).[3] As public information (macroeconomic announcements) fail to fully account for stock market comovements, the remaining rational alternative to contagion is global private information about factors that will affect future values of macroeconomic variables (see Connolly and

[1] Some papers approach this question by measuring the reaction of one (typically small) country's stock market to macroeconomic announcements in another (typically large) country (usually US). See, for example, Becker et al. (1995), Connolly and Wang (2003) and Albuquerque and Vega (2009). Kizys and Pierdzioch (2009) investigate whether changes in correlations could be explained by asymmetric macroeconomic shocks. Another path of this literature investigates whether cross-country correlations vary with business cycle synchronicity measured by growth rate (Erb et al., 1994) or inflation (Cai et al., 2009). In a related paper, Cheung et al. (1997) identify US spread variables and future OECD industrial production growth rates as global common drivers of national return variation that give rise to stock market comovements.

[2] Consider a world factor model: $r_{jt} = E_{t-1}(r_{jt}) + \beta_{jt}F_t + \varepsilon_{jt}$ where r_{jt} is the return of country j's stock market, F_t is the return on a world index, and ε_{jt} is the idiosyncratic variation. Then, under perfect market integration, the bilateral correlation between the stock market returns of country j and i is a function of β_i and β_j:

$$Cor_{t-1}(r_{jt}, r_{it}) = \frac{\beta_{it}\beta_{jt}\sigma^2_{F_t}}{\sqrt{\beta^2_{it}\sigma^2_{F_t}+\sigma^2_{it}}\sqrt{\beta^2_{jt}\sigma^2_{F_t}+\sigma^2_{jt}}}.$$

[3] Pointing to lags in international transmission of economic shocks, Ammer and Mei (1996) suggest that contemporaneous output correlation may understate the magnitude of real integration.