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How important is asymmetric covariance for the risk premium of international assets?

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Abstract

This paper empirically investigates the importance of asymmetric conditional covariance when computing the risk premium of international assets. Conditional second moment asymmetry of equity indices is significant and varies over time. The risk premia estimated allowing for asymmetry are statistically and economically different from risk premia estimated without allowing for asymmetry. In particular, an international investor who ignores covariance asymmetry overestimates required returns for equities of the G4 countries and for the world market, on average.

JEL classification: G10; G12; G15; C52

Keywords: Time-varying covariance asymmetry; International asset pricing; Risk premia estimation

1. Introduction

The international asset pricing models of Solnik (1974), Sercu (1980), and Adler and Dumas (1983) suggest that, when purchase power parity (PPP) does not hold, exposure to foreign exchange risk is priced.[1] In such a setting, the equilibrium required return of any asset depends on its covariance with the market portfolio, and its covariance with the foreign exchange rates. In other words, it is foreign exchange risk and its pricing that sets models of integrated international capital market aside from domestic models.

The main question this paper asks is, "If investors are compensated for *foreign exchange rate risk*, in addition to *market risk*, does it matter whether they take into account conditional covariance asymmetry when estimating the risk premium?" This question is of interest of academics and practitioners alike. For instance, financial institutions and multinational companies use estimates of the risk premium for the evaluation of foreign projects and international M&A activities. Such estimates of the risk premium are important because they affect the discount rate of future cash flows and hence the judgment on which foreign investment opportunities a firm should undertake (see e.g. Bodnar et al. (2003)).

For individual assets, asymmetric conditional volatility refers to the negative correlation between current returns and future volatility. That is, volatility tends to be lower after a positive return than after a negative return of the same magnitude. Asymmetry in domestic individual stocks and indices is often referred to as the *leverage effect*. Black (1976) first conjectured that changes in the market value of equity of firms could cause asymmetry. Another hypothesis is that the asymmetric volatility response to returns shocks could be due to time-varying

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[1] Adler and Dumas (1983) for instance provide several references showing that purchase power parity does not hold at any time horizon. More recently, Engel (1999) and Ng and Perron (2002) confirm in particular that PPP does not hold even in the long run.

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risk premia. This is often referred to as the *volatility feedback* effect.[2]

A growing body of research investigates variance and covariance asymmetry. Several studies focus mainly on the second moments. In these studies, the risk premium is not the center of attention.[3] Other papers that investigate asymmetry focus on domestic assets. They hence abstract from foreign currency exchange risk[4] Other works look at asymmetric second moment of assets of foreign countries, but they do so outside the framework of a theoretical model of international capital market equilibrium. They also abstract from foreign currency exchange risk.[5] From these studies, it emerges that asymmetry is a well-established empirical fact in US indices.

The evidence supporting asymmetry is also mounting for international assets. Foreign assets are attractive because they provide potential for diversification beyond domestic assets due to low inter-country correlations. However, Odier and Solnik (1993) and Longin and Solnik (2001) show that these correlations increase in bear market. In other words, the benefits of diversification may not be available when investors need them the most. Longin and Solnik (2001) conclude that the asymmetric correlation pattern should become a key property of any multivariate equity return model to match. It is thus noteworthy that none of the studies mentioned above investigates the importance of asymmetric covariance in the context of an equilibrium model of international capital markets that allows for both market and foreign exchange risk. This paper empirically investigates the importance of asymmetric conditional covariance for the estimation of the risk premium of international assets.

Dumas and Solnik (1995) show that exchange risk premia for the four largest equity markets, namely US, Germany, Japan, and UK, are non-negligible components of the risk premium. De Santis and Gérard (1998) provide a measure of these foreign exchange risk premia. The existence of foreign exchange risk premia implies that an international investor cannot infer whether covariance asymmetry affects the risk premium of international assets from results based on domestic models. In fact, whether conditional covariance asymmetry matters for asset pricing in international markets is still an outstanding question. This paper aims at filling this gap in the literature.

It is conceivable that the asymmetric response is not only present in international assets, but it also varies over time. Indeed, both the leverage hypothesis and the volatility feedback conjecture are compatible with time variation in the asymmetric response. The leverage effect hypothesis suggests that the asymmetric response is largely due to the change in the firms' capital structure. If this was the case, then the changes in the relative weights of the market value of equity and debt would determine time variation in the asymmetric response at the firm level. If volatility feedback was the main reason for asymmetry, then investors' reaction to news, particularly bad news, may be more pronounced depending on the phase of the business cycle. I explicitly test the hypothesis that the asymmetric response may vary over time.

The results of this paper are summarized as follows: in the context of the De Santis and Gérard (1998) conditional implementation of the Adler and Dumas (1983) international asset pricing model (IAPM), I reject the hypothesis of no covariance asymmetry in international assets in favor of the alternative that the covariance responds asymmetrically. In addition, for the equity indices, I find that the asymmetric response significantly varies over time. The main finding is however that the world market risk premium and the equity risk premia estimated without allowing for asymmetry are statistically and economically different from those that obtain allowing for asymmetry. In particular, the results suggest the an international investor who ignores covariance asymmetry overestimates the required returns from equities. The differences are economically significant, as they range between 62 and 189 basis points per year on average, depending on the international index and the specification of asymmetry considered. For foreign exchange deposits, the risk premia estimated without allowing for asymmetry are significantly different from those that obtain allowing for asymmetry, but they are smaller and also depend on the form of asymmetry considered.

The rest of the paper is organized as follows: Section 2 presents the empirical implementation of the international asset pricing model. Section 3 introduces the specification allowing for the constant and time-varying asymmetry in the conditional second moments. Section 4 presents the estimation methodology and the results. Section 5 presents statistical tests highlighting the importance of second moments asymmetry for the estimation of the risk premium. Some economic implications of the results are also discussed in this section. Section 6 concludes.

2. International asset pricing model

This section presents the implementation of the international asset pricing model (IAPM) for the G4 countries: Germany, Japan, UK, and US. Due to the large share of market capitalization relative to the world market, this set of countries is the one that is often the object of study. The IAPM of Adler and Dumas (1983) suggests that exposure to foreign exchange risk should be priced when purchasing power parity (PPP) does not hold. Applied to the G4 markets, the model can be represented as a system of eight equations of the form

[2] For early work on asymmetry see also Christie (1982) and Brown et al. (1988).

[3] See e.g. Kroner and Ng (1998), De Goeij and Marquering (2004), and Cappiello et al. (2003).

[4] Classic references are Campbell and Hentschel (1992) and Wu (2001).

[5] See e.g. Theodossiou and Lee (1995), Bekaert and Harvey (1997), Koutmos and Booth (1995), Bekaert and Wu (2000), and Warren and Faff (2004).