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Exchange risk and universal returns: A test of international arbitrage pricing theory[☆]

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ABSTRACT

According to the international arbitrage pricing theory (IAPT) posited by Solnik (1983), currency movements affect assets' factor loadings and associated risk premiums. Based on a novel universal return decomposition, we propose an empirical model to test this proposition and perform tests using U.S. stock returns in the period 1975–2008. Our results confirm that currency movements significantly affect the market betas of a large proportion of stocks. Further cross-sectional tests indicate that currency movements affecting the market factor are significantly priced in stock returns. Based on these and other findings, we conclude that Solnik's IAPT is supported. An important implication of our findings is that exchange rate risk can broadly affect stock returns through both factor loading and residual factor channels.

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1. Introduction

According to Solnik (1983), while the form of the international arbitrage pricing theory (IAPT) model is unchanged by investors with different home currencies, factor loadings and risk premiums vary depending

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on the investor's home currency. In this paper we seek to empirically investigate this previously untested IAPT proposition. To do this, we propose a universal return relation that decomposes currency denominated returns on assets into the portions due to currency returns and noncurrency (universal) returns. We then apply this universal return decomposition to Solnik's IAPT that posits factor loadings are a function of random currency movements (i.e., exchange rate risk). Using currency returns as an instrument, an empirical IAPT can be specified that decomposes factor loadings into currency index (universal) and home currency j (e.g., U.S. dollar) components. The latter component captures the time-varying impact of exchange rate risk associated with random home currency fluctuations on factor loadings in the IAPT. Applying this empirical model to U.S. stocks in the period 1975–2008, we find that currency movements are a significant component of market factor loadings. Cross-sectional regression analyses indicate that currency movement effects on market beta are priced in U.S. stocks. Results for different test assets and time periods support these inferences.

Our findings contribute to the long-standing stock-return/exchange-risk puzzle. Upon summarizing the voluminous literature on international asset pricing, Karolyi and Stulz (2003) concluded that the relationship between stock returns and exchange rate risk is weaker than predicted by theory. Consistent with international CAPM (ICAPM) models by Adler and Dumas (1983, 1984), Solnik (1974), and Sercu (1980), exchange rate risk has traditionally been specified as a separate factor in previous empirical studies.¹ Adler and Dumas (1984) proposed regressing stock returns on exchange rate returns (i.e., the change in the value of a currency relative to a currency index composed of a basket of major currencies) to capture total exchange rate risk exposure. To control for market movements, Jorion (1990) augmented the Sharpe (1964), Lintner (1965), and Black (1972) CAPM in market model form with exchange rate returns as measured by dollar/currency-index movements and tested the sensitivity of stock returns to residual market exchange rate risk.²

Subsequent empirical studies typically follow Jorion's approach by testing residual exchange rate risk.³ Even though exchange rates are much more volatile than inflation rates, these studies typically find only limited empirical evidence of exchange rate risk in stocks (e.g., isolated to selected segments of business firms with high proportions of foreign sales, small firms, and financially distressed firms). However, when holding period returns are lengthened beyond 1 month by Chow et al. (1997) and Bodnar and Wong (2003), the significance of residual exchange rate risk tends to increase.⁴ Also, evidence by Chow and Chen (1998) suggests that smaller firms have larger exchange risk exposures compared to larger firms over longer-return horizons. In efforts to explain the exchange rate puzzle, Bartov and Bodnar (1994) cite sample selection issues and potential investor mispricing, whereas Levi (1994) notes that accurate measurement of exchange rate exposure is problematic. Also, recent work by Bartram et al. (2010) provides evidence that low estimates of exchange rate exposure can be attributed in part to the fact that firms reduce their idiosyncratic exchange rate risk by means of pass-through and operational hedging as well as financial risk management.

In this paper we seek to contribute to this literature by testing the IAPT proposition that currency movements affect systematic risk factors themselves in addition to residual exchange rate risk. Our findings indicate that exchange rate risk exists in the residual factor stock returns of some U.S. firms but more pervasively in their market factor loadings (e.g., market betas). We conclude that our results support Solnik's IAPT model. An important implication of our findings with respect to the stock-return/exchange-risk puzzle is that exchange rate risk can broadly affect stock returns through both factor loading and residual factor channels.

Section 2 introduces the concept of universal returns to show how exchange risk is embedded in asset returns denominated in a local currency. Section 3 overviews Solnik's IAPT model for different home

¹ See Vassalou (2000) for an excellent review of these and other international pricing models.

² For an excellent discussion of total and residual exchange rate risks, see Bodnar and Wong (2003).

³ In this regard, studies by Jorion (1990, 1991), Amihud (1993), Bodnar and Gentry (1993), Bartov and Bodnar (1994), Griffin and Stulz (2001), Griffin (2002), Koedijk et al. (2002), and others generally find little or no relationship between stock returns and exchange rates. Other studies by Roll (1992a), Brown and Otsuki (1993), Bailey and Chung (1995), Dumas and Solnik (1995), Chow et al. (1997), Choi et al. (1998), De Santis and Gérard (1998), He and Ng (1998), Vassalou (2000), Carrieri (2001), Williamson (2001), Bodnar et al. (2002), Bodnar and Wong (2003), Carrieri et al. (2006), Doidge et al. (2006), and Kolari et al. (2008) find some sensitivity of stock returns to exchange rate movements.

⁴ See also excellent survey studies by Stulz (1995) and Muller and Verschoor (2006).

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