



Inflation risk and international asset returns

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ABSTRACT

We show that inflation risk is priced in international asset returns. We analyze inflation risk in a framework that encompasses the International Capital Asset Pricing Model (ICAPM) of Adler and Dumas (1983). In contrast to the extant empirical literature on the ICAPM, we relax the assumption that inflation rates are constant. We estimate and test a conditional version of the model for the G5 countries (France, Germany, Japan, the UK, and the US) over the period 1975–1998 and find evidence of statistically and economically significant prices of inflation risk (in addition to priced nominal exchange rate risk). Our results imply a rejection of the restrictions imposed by the ICAPM. In an extension of our analysis to 2003, we show that even after the termination of nominal exchange rate fluctuations in the euro area in 1999, differences in inflation rates across countries entail non-trivial real exchange rate risk premia.

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1. Introduction

As investors are concerned with asset returns expressed in real terms, uncertainty about inflation is a potentially important source of risk. Since the work of Bodie (1976) and Fama and Schwert (1977), a large literature has developed studying whether various asset classes provide a hedge against inflation. Furthermore, a substantial body of research analyzes inflation risk premia in bond returns (e.g., Evans, 1998; Buraschi and Jiltsov, 2005; Ang and Bekaert, 2008; Joyce et al., forthcoming). However, the issue whether inflation is a priced risk factor in stock returns has received little attention. Theoretical research by Elton et al. (1983) and Stulz (1986) analyzes the impact of inflation on stock returns in domestic asset pricing models. Empirical work by Chen et al. (1986) and Ferson and Harvey (1991) shows that, among other economic risk factors, expected and unexpected inflation capture some of the variation in returns on portfolios of US equities in a domestic asset pricing context.

It is natural to investigate the impact of inflation risk on asset prices in an international context. Inflation risk may be at least partially diversifiable internationally. Moreover, theoretical international asset pricing models suggest a close link between inflation risk and exchange rate risk. However, the extant literature on

international asset pricing commonly assumes inflation rates to be constant.¹ In this paper, we adopt a global perspective and estimate the prices of risk related to the inflation rates in various individual countries using data on international stock returns. Our approach has its foundation in theoretical asset pricing models, as opposed to an empirically inspired multifactor model. The methodology we employ not only enables us to test the conditional version of asset pricing models, but also takes account of important characteristics of asset returns (such as heteroskedasticity) that other studies leave unmodeled. And since we estimate a fully parameterized model, we can recover the time-varying risk premia of market, exchange rate, and inflation risk in asset returns.

International asset pricing models study how expected asset returns are formed when investors differ in their country of residence. When investors from different countries have identical investment and consumption opportunity sets, we can straightforwardly generalize the domestic Capital Asset Pricing Model (CAPM) to an International CAPM (ICAPM) in which the global market portfolio is the only priced risk factor (see Grauer et al., 1976). When purchasing power parity (PPP) does not hold, however, investors from different countries have different

¹ The few empirical asset pricing papers that do incorporate inflation risk draw on empirically motivated factor models and merely examine inflation risk factors aggregated over many countries, jointly with a substantial number of other global economic risk variables, and/or in an unconditional framework. See, e.g., Ferson and Harvey (1993, 1994) and Vassalou (2000).

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consumption opportunity sets.² Consequently, investors evaluate the (real) returns from the same security differently. In that case, the market portfolio is no longer the only priced risk factor. In the ICAPM of Adler and Dumas (1983), asset returns depend on their covariance with both global market returns and exchange rate returns. Other international asset pricing models under heterogeneous consumption opportunity sets are developed by Solnik (1974), Sercu (1980) and Stulz (1981).³

Empirical evidence indicates that exchange rate risk is priced in international asset returns. Dumas and Solnik (1995) estimate a conditional ICAPM and report evidence of exchange rate risk premia in the returns on the stock markets of Germany, Japan, the UK, and the US over the period 1970–1991. De Santis and Gérard (1998) employ a more comprehensive econometric methodology to test the ICAPM for the same four countries over the period 1973–1994. Their analysis supports a conditional ICAPM that includes both global market risk and three currency risk factors related to the German mark, the Japanese yen, and the British pound.

However, these studies exclusively test the version of the ICAPM developed by Solnik (1974) and Sercu (1980). Their model is a special case of the Adler and Dumas (1983) model in which all domestic inflation rates expressed in local currency are assumed to be non-stochastic. Consequently, the real exchange rate risk factors in the ICAPM of Adler and Dumas (1983) are replaced by nominal exchange rate risk factors in the Solnik–Sercu model. The implications of the restriction that inflation rates are constant have not been investigated to date. While inflation rates are known to be substantially less volatile than nominal exchange rates at short horizons, it is not obvious that this implies that uncertainty about future inflation is relatively unimportant to investors. (It is also unclear what this simplification buys, as the literature on measuring inflation is well-developed.)

As highlighted by, e.g., Brennan and Xia (2002), Campbell and Viceira (2001) and Campbell et al. (2003), uncertainty about inflation plays a central role in dynamic asset allocation decisions, especially for long-term investors. Moreover, hedging inflation risk is significantly more complicated than hedging exchange rate risk. Hence, expected asset returns may well contain non-negligible inflation risk premia. Furthermore, the ICAPM of Solnik–Sercu neglects the possibility that real exchange rate risk is priced when nominal exchange rate fluctuations are absent. For example, nominal exchange rate fluctuations within the European Economic and Monetary Union (EMU) ceased to exist at the introduction of the euro in 1999. However, European inflation risk may still be priced in asset returns.

Our contribution is four-fold. First, our paper is among the first to test the ICAPM of Adler and Dumas (1983) with real exchange rate risk factors.⁴ Second, we investigate whether the distinction between real and nominal exchange rates matters for the inferences drawn from international asset pricing tests. We show that prices of risk related to some currencies are no longer significant when real instead of nominal exchange rates are used as risk factors, indicating that previous studies overstate the significance of currency risk. Third, these findings suggest that inflation risk partially offsets nominal exchange rate risk and raise the question whether inflation risk constitutes a distinct source of priced risk. In the model of Adler and

Dumas (1983), the prices of inflation and nominal exchange rate risk are restricted to be equal. Relaxing this restriction leads to a model in which asset returns depend on their sensitivity to both inflation risk and nominal exchange rate risk. Our approach allows for an assessment of the significance of inflation risk premia and offers a new empirical test of the ICAPM. Our results indicate that (i) inflation risk is an important and independent priced risk factor in international asset returns and (ii) we can reject the restrictions imposed by the ICAPM of Adler and Dumas (1983). Fourth, we examine whether real exchange rate risk is priced within the euro area after 1999.

We estimate and test a conditional version of the ICAPM of Adler and Dumas (1983) for the equity markets of France, Germany, Japan, the UK, and the US. Our main analyses concern the period 1973–1998, since the nominal exchange rate of the French franc versus the German mark experiences an abrupt structural break at the introduction of the euro in 1999. In the second part of the paper, we extend the sample period to 2003 to examine the impact of the introduction of the euro on the importance of inflation risk.

Following De Santis and Gérard (1998), we employ a parsimonious multivariate GARCH process to test the pricing implications of the model. We confirm the results of previous studies that the (time-varying) prices of nominal exchange rate risk related to all four exchange rates in the sample are significantly different from zero. However, the prices of real exchange rate risk are only significant for the exchange rates of Germany versus Japan and the UK. This result implies that the choice of real versus nominal exchange rates matters in international asset pricing tests. Relaxing the restriction that the prices of nominal exchange rate risk and inflation risk are equal, we report evidence in favor of priced inflation risk for all countries in the sample (in addition to significant prices of risk for all four nominal exchange rates). We reject the hypotheses that the prices of inflation risk are constant over time and that they are equal to zero. We show that inflation risk is not only statistically significant, but also has an economically important contribution to expected international asset returns. Inflation risk premia in asset returns are generally of the same order of magnitude as nominal exchange rate risk premia.

An interesting application of the model concerns the post-euro period. Although nominal exchange rate fluctuations were terminated within the euro area in 1999, differences in inflation may entail non-trivial real exchange rate risk. An analysis of the equity markets of France, Germany, Japan, the UK, and the US over the period 1973–2003 indicates that the risk premium related to the German–French inflation differential is still important in the post-euro period. This finding suggests that even for closely integrated countries with a common currency, investors demand a risk premium for their exposure to inflation risk.

2. The model

Our study starts out with the ICAPM of Adler and Dumas (1983). We can construct the model as follows. Consider a world economy with $L + 1$ countries (currencies), numbered $l = 0, 1, \dots, L$, with currency 0 as the measurement or numeraire currency. Apart from the measurement currency deposit, there are $M = N + L + 1$ securities, comprising of N equities or portfolios of equities, L non-measurement currency deposits, and the world portfolio of equities which is the M th and last security. All returns are expressed in the numeraire currency and in excess of the risk-free rate, which corresponds to the short-term deposit rate in the numeraire currency. We can express the pricing restrictions on asset i imposed by the conditional version of the ICAPM of Adler and Dumas (1983) as follows:

² Deviations from PPP occur either because of differences in preferences across countries or due to deviations from the law of one price. We refer to Adler and Dumas (1983) for an exposition of this point.

³ See Dumas (1994) and Stulz (1995) for an overview of international asset pricing.

⁴ Carrieri et al. (2006) also examine whether real exchange rate risk is priced. However, they employ exchange rate indices and hence deviate from the theoretical setting of Adler and Dumas (1983). In addition, they focus on the exchange rate risk of emerging markets, for which the assumption of constant inflation is clearly violated. Our study demonstrates the importance of risk factors related to uncertain inflation in developed capital markets.

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