IS EXCHANGE RISK PRICED BEYOND INTERTEMPORAL RISK?

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Overview

- Background and motivation
- The research question
- Methodology
- Results
- Conclusions
Background

- Merton (1973): when the investor faces time-varying investment opportunities the portfolio holdings will also include hedge positions

- Dumas and Solnik (1995): “a conditional static asset-pricing model is internally inconsistent.”

- Harvey (1991) and Ferson and Harvey (1993) find evidence that investment opportunities in international markets vary over time
Research objective and preview of results

- Investigate whether the exchange risk is priced once the intertemporal risk is taken into account
- Investigate whether intertemporal risk, as proxied by the returns on long-term bonds, is priced
- Results I: Exchange risk is indeed an important component of risk premium in addition to the market and intertemporal risks
- Results II: Intertemporal risk is priced
Literature


- Ng (2004) and Chang et al. (2005) test Intertemporal IAPMs

- Adler and Prasad (1992) and Robotti (2001)
Methodology

• We test an Intertemporal IAPM similar to that in Adler and Prasad (1992) and Robotti (2001)

• We develop an orthogonalization approach that conditionally purges the exchange risk factors from their co-variations with the market and intertemporal hedge factors

• The resulting exchange factors can be interpreted as pure currency risks
The pricing equation

\[
E_t[r_{it+1}] = \gamma_{mt} \text{Cov}_t[r_{it+1}, r_{mt+1}] + \sum_{\ell=1}^{L+1} \gamma_{\pi t}^\ell \text{Cov}_t[r_{it+1}, r_{\pi t+1}] \\
+ \sum_{k=1}^{K} \sum_{\ell=1}^{L+1} \gamma_{kt}^\ell \text{Cov}_t[r_{it+1}, r_{kt+1}]
\]

\(\gamma_{mt} \equiv 1/\alpha^m\) is the equilibrium price of global market risk, with \(\alpha^m\) the aggregate risk tolerance

\(\gamma_{\pi t}^\ell \equiv -H_P^\ell P^\ell/W^m \alpha^m\) are the equilibrium prices of the inflation risk of country \(l\)

\(\gamma_{kt}^\ell \equiv -H_k^\ell /W^m \alpha^m\) are the equilibrium prices of the intertemporal risk
• Monthly MSCI total return, world market index, the G4 market and bond indices from January 1973 to December 2003 (372 observations)

• Excess return on the long-term bond indices from Global Financial Data

• Exchange rates are from the IFS database. All returns are in US dollars, in excess of the three-month US T-Bill

• The instruments used to forecast excess returns are a constant, a dummy for the month of January, the federal fund rate, the dividend yield of the world market, and the US default and term premiums
Conditional orthogonalization

We propose a conditional orthogonalization approach based on managed portfolios

\[ r_{bt+1} = \phi_{b0t} + \phi_{bmt}r_{mt+1} + u_{bt+1} \]

where

\[ \phi_{b0t} \equiv Z_t \delta_{b0} \]
\[ \phi_{bmt} \equiv Z_t \delta_{bm} \]

and \( \delta' \)s are time-invariant parameters \( u_{bt+1} \) and is a zero-conditional mean error term that is conditionally orthogonal to the market factor.
Condional orthogonalization of the factors

The orthogonalized long-term bond factor is

\[ r_{bt+1}^\perp \equiv r_{bt+1} - \phi_{bmt} r_{mt+1} \]
\[ = \phi_{b0t} + u_{bt+1} \]

- The investor *dynamically hedge* the bond exposure to market risk rather than passively buy and hold the market.
- \( r_{bt+1}^\perp \) is the return of a bond portfolio hedged against market risk
- We rank the bonds from the lowest \( R^2 \). We get the World Market factor as the first variable, followed by the US, Japanese, UK, and German bond factors, followed by the British pound, the Japanese yen, and the German mark
Our theoretical model implies that the prices of risk are time-varying. We assume that the prices of risk vary linearly with the default and term risk premiums:

\[
\begin{align*}
\gamma_{mt} &= \varphi_m Q_t \\
\gamma_{bt} &= \varphi_b Q_t \\
\gamma^e_{lt} &= \varphi^e_l Q_t
\end{align*}
\]

where the $\varphi$’s are weighting vectors and $Q_t$ is the subset of $Z_t$ that contains a constant, the default risk premium, and the term risk premium.
The System

We derive the econometric system following Harvey (1989). We stack the forecasting and prediction errors into the following system which we estimate by GMM where the cross-equation covariance matrix $\Omega$ is estimated with Zellner’s (1962) SUR effects from the first stage OLS residuals:

$$
\varepsilon_{t+1} = \begin{bmatrix}
[r_{it+1} - (Z_t \delta_i + \rho_i r_{it})'] \\
[r_{it+1} - v_{it+1} (Q_t \varphi_m r_{mt+1} + \sum_{\ell=1}^L Q_t \varphi^\ell_b r_{bt+1}^\perp + \sum_{\ell=2}^L Q_t \varphi^\ell_e r_{et+1}^\perp)]
\end{bmatrix}
$$
Conclusion I

- Exchange risk is priced, even after conditionally orthogonalizing exchange rate to the market and all the bond factors
- The magnitude of the prices of currency risk is unchanged after orthogonalization, which provides support to the idea that the exchange risk is driven by the purchasing power risk, and it does not subsume intertemporal risk
- The exclusion of the October 1987 crash does not affect these results
Conclusion II

- The prices of intertemporal risk are highly significant in all cases, but smaller than those of the currency risks.
- Unlike the prices of foreign exchange risk, the magnitudes of the prices of intertemporal risk are sensibly affected by the orthogonalization procedure, suggesting that the bond factors capture some of the market risk.
- Exchange risk seems to be related to PPP deviations rather than to the stochasticity of investment opportunities.
- The size and sign of the price of world market risk is affected by the common covariation with the bond factors.