FOREIGN EXCHANGE EXPOSURE AND THE TERM-STRUCTURE OF INDUSTRY COST OF EQUITY

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ABSTRACT

Using a single-factor Global CAPM (GCAPM) and a two-factor International CAPM (InCAPM), we study the effect of foreign exchange (FX) exposure on the term structure of industry cost of equity of 39 U.S. industries. Expanding the methodology developed by Ang and Liu (2004), we estimate the term structure of industry expected returns at the end of 2011 and find that: 1) Capturing FX exposure in the asset-pricing model changes the position and shape of the spot discount curves; 2) The average industry FX risk premium is around 2.81% for cash flows with short-term maturities (around 34% of the total industry cost of equity); 3) For most industries the FX risk premium declines with increasing cash flow maturities; 4) The pricing error from ignoring the term structure is substantially larger than the pricing error resulting from the omission of the FX risk component.

Keywords: Cost of Capital Term Structure, Foreign Currency Risk Premium, Global Market Risk Premium, Industry Cost of Capital, Short-term and Long-term Foreign Currency Exposure, Global CAPM, International CAPM

JEL Classifications: G12, G15; EFM Classification Code: 330

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I. Introduction and Motivation

Current advances in the international asset pricing literature indicate that foreign exchange (FX) risk is a priced factor at the industry level. Francis, Hasan and Hunter (2008), use a conditional version of the three-factor Fama and French model and find that all of the industries used in their sample (36 U.S. industries) have a significant currency risk premium that adds about 2.47% to the industry cost of equity. The authors argue that methodological weakness rather than FX hedging explains the paucity of results in previous industry-level studies.

The empirical findings of Francis et al. (2008) differ substantially from previous studies which generally fail to find significant pricing effects of FX shocks at the industry-level[1]. Applying a multifactor APT setting, Jorion (1991 finds that the unconditional FX risk premium is small and statistically insignificant for U.S. Industries. Bodnar and Gentry (1993) study the FX exposures and characteristics of Canadian, Japanese and U.S. industries. Although their study finds that FX rates partially explain industry returns on the economy-wide level, only 20% to 35% of industries show significant FX exposures. Griffin and Stulz (2001) observe that FX rate

[1] Several studies find that FX risk is priced on the aggregate market level (see Bartram and Bodnar, 2007 for an inclusive summary of literature). Dumas and Solnik (1995) use unconditional and conditional asset pricing models to study equity and currency returns in Germany, U.S., U.K., and Japan. The use of the conditional asset pricing model indicates that FX exposure is priced on the aggregate stock market level. De Santis and Gérard (1998) utilize a conditional international CAPM with a GARCH parameterization and find evidence of time-varying global market and FX risk; however their findings suggest that for the U.S. market the FX risk premium is only a small fraction of the total risk premium. Carrieri, Errunza and Majerbi (2006) employ a conditional setting to study equity returns of 10 developed and 12 developing countries. The authors also find that FX risk is a significant component of equity returns and spillover effects are exist during emerging market crises.

shocks explain almost nothing of relative industry performance. Studying factors affecting the FX exposure of U.S. manufacturing industries, Allayannis and Ihrig (2001) find that only 4 out of 18 industries are exposed to FX risk.

Contrasting the multi-industry studies is Williamson's (2001) work on the U.S. and Japanese automotive industries. Williamson (2001) incorporates changes in the industry competitive environment and finds substantial time-varying FX exposure. A puzzling empirical result is reported by Choi and Prasad (1995), who find significant FX exposure on individual firm level but report a substantial loss in significance when firms are aggregated into industry portfolios (this has become part of the "FX exposure puzzle"[2]).

Our paper provides two contributions to the current literature. First, expanding the methodology of Ang and Liu (2004), we estimate cost of equity term structures for 39 U.S. industries. Estimating industry discount rate curves with and without an FX risk component allows us to study the FX risk premiums for expected cash flows with different maturities. Thus we gain insight into the term structure of the FX risk premium itself. Second, the provided methodology can be applied to value projects assuming that the risk free rate, the price of global market risk, the price of FX risk, the global market exposure coefficient and the FX exposure coefficient of an industry change over time. This is particularly valuable since it is unlikely that over the long horizons of many capital budgeting problems valuation parameters remain unchanged.

The dynamic nature of the market risk premium is documented by Jagannathan, McGratten and Scherbina (2000) who observe a decline in the risk premium after 1970. Similarly, Fama and French (2002) document substantial changes in the U.S. market risk premium between 1872 and 1999. Fama and French (1997) report substantial time-variation in

[2] See Bartram and Bodnar (2007) for an inclusive discussion of the FX Exposure Puzzle.

factor loadings of asset pricing models for industry portfolios. This is consistent with the observation that risk profiles of industries change over time. In the international finance literature, Allayannis (1997), Brunner et al. (2000), Allayannis and Ihrig (2001), Williamson (2001), and Dominguez and Tesar (2006) document time-variation in industry FX exposure coefficients. De Santis and Gérard (1998) find that dynamic conditional moments are not sufficient to capture the pricing effects of FX risk in conditional models with GARCH parameterizations without allowing for time variation of price of risk (global market risk as well as foreign currency risk). Francis et al. (2008) find similar results using industry returns and two currency factors (developed and developing country currencies).

In addition to the time-varying nature of asset pricing parameters, several papers in the FX literature suggest that short-term FX exposure is economically different from long-term FX exposure. Chow, Lee and Solt (1997a), find that using long-horizon data captures FX exposures more clearly[3]. By studying earnings data of industries they find that interest rate and cash-flow effects are offsetting over short horizons but complementary over long horizons, which leads to negative short-run but positive long-run FX exposures. Bredin and Hyde (2011) decompose the FX exposures of industry portfolios into a cash flow and discount rate component and find that many U.S. and foreign industries are subjected to cash flow and discount rate FX exposures. The study also finds that for U.S. industries unexpected changes in FX rates mainly affect discount rate news, which indicates that such FX shocks are transitory in nature. Conversely FX shocks for industries in most of the other G7 countries primarily affect industry cash flows and are therefore permanent. Changing industry FX exposure coefficients, a dynamic price of FX risk

[3] Chow, Lee and Solt (1997a) observe that if FX changes contain information about future interest rates and future expected cash flows that are further than a one-period horizon, short-term FX exposure estimates will not capture the full picture. Bodnar and Wong (2003) attribute increase in statistical significance of FX exposures based on longer-horizon data mainly to reduced noise in the FX exposure estimates.

and differences between short-run and long-run industry FX exposures are likely to result in a time-varying FX risk premium.

We use conditional versions of the one-factor Global CAPM (GCAPM) and the two-factor International CAPM (InCAPM) to estimate industry discount rate spot curves for the end of our sample period (December 2011). We find that, on average, the industry FX risk premium is around 2.81% (or roughly 34% of total industry cost of equity) for expected cash flows with maturities between 1 to 3 years. The FX risk premium then rapidly declines with increasing cash flow maturities and reaches 0.22% (1.68% of the total risk premium) around years 16 to 17. Consequently, we find that omitting the FX risk premium leads to mispricing that is economically significant and particularly affects short to mid-term projects for most industries. Moreover our study finds that much of the cross-sectional variation in short-term risk premiums is explained by industry characteristics that are commonly associated with FX exposure.

The organization of this paper is as follows. Section two describes estimating industry cost of equity term structures. Section three describes the data and empirical specifications. In section four we presents empirical estimates of industry spot discount curves and discuss the results and implications. Section five concludes the paper.

II. Estimating the Term Structure of Expected Returns

We expand the methodology used by Ang and Liu (2004) by adding an FX risk component and estimate spot discount rates for U.S. industries and a pooled industry portfolio. Assuming that the expected return of a security is given by:

$$e^{(\mu_t)} = E_t\left[\frac{P_{t+1} + D_{t+1}}{P_t}\right] \tag{1}$$

where P_t is the price and D_t is the cash flow which follows a specified process then the price of a security can be expressed as:

$$P_t = E_t\left[\sum_{s=1}^{\infty}\left(\prod_{k=0}^{s-1} e^{-\mu_{t+k}}\right) D_{t+s}\right] \tag{2}$$

If expected returns and cash flow growth rates are time varying and correlated, i.e. the simplifying assumptions of a Gordon model are violated, equation (2) has to be evaluated directly. Whereas Ang and Liu (2004) use the conditional CAPM model, we use two alternative conditional model specifications: 1) a single-factor Global CAPM (GCAPM) and 2) a two-factor International CAPM (InCAPM).

$$\mu_t = Rf_t + \beta_t GRP_t \tag{3}$$

$$\mu_t = Rf_t + \beta_t GRP_t + \gamma_t CRP_t \tag{4}$$

where μ_t is the log expected return, Rf_t is the risk-free rate, β_t is the time-varying beta, γ_t is the time-varying FX exposure coefficient, GRP_t is the time-varying price of global market risk, and CRP_t is the time-varying price of currency risk. We choose two alternative international asset pricing models because we are not only interested in industry spot discount curves that explicitly capture industry FX exposures (based on the two-factor InCAPM), but also the FX risk premium, which can be approximated as the difference in the industry spot discount curves obtained by models (3) and (4).

To take the expectation in (2) we need to estimate the evolution of β_t, γ_t, GRP_t, CRP_t and the cash flows of the security: $g_t = ln(D_{t+1}/D_t)$. For our analysis using the two-factor InCAPM we define a state vector: $X_t = (g_{t+1} Rf_t \beta_t GRP_t \gamma_t CRP_t)'$. The corresponding state vector for the single-factor GCAPM does not include the conditional FX exposure coefficients (γ_t) and the time-varying price of currency risk (CRP_t). We assume that the state vector follows a VAR(1) process and expected log returns take the form:

$$X_t = c + \Phi X_{t-1} + \Sigma^{1/2} \epsilon_t \tag{5}$$

$$\mu_t = X_t + X_t' \Omega X_t \tag{6}$$

where $\epsilon_t \sim IID\ N(0, I)$ and Ω is a symmetric $K \times K$ matrix of the following form[4]:

$$\Omega = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1/2 & 0 & 0 \\ 0 & 0 & 1/2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1/2 \\ 0 & 0 & 0 & 0 & 1/2 & 0 \end{bmatrix} \tag{7}$$

Then the spot expected return $\mu_t(n)$ is given by:

$$\mu_t(n) = \alpha + A(n) + B(n)' X_t + X_t' G(n) X_t \tag{8}$$

[4] To obtain Ω for the single-factor GCAPM, we reduce the dimensions of the matrix by dropping the last two columns and bottom two rows.

where α is a constant, $A(n)$ is a scalar, $B(n)$ is a 6×1 vector[5] and $G(n)$ is a 6×6 symmetric matrix. If the conditional asset pricing model used for the spot discount rate curves is correctly specified, then α in equation (8) is zero. Since we are mainly interested in the difference between the discount rate spot curves based on the single-factor GCAPM and the two-factor InCAPM, and not particularly if GCAPM is the best available conditional model, we include the calibration parameter α. The coefficients of equation (3) are given by:

$$A(n) = \left(\bar{a}(n) - a(n)\right)/n \quad (9)$$

$$B(n) = \left(\bar{b}(n) - b(n)\right)/n \quad (10)$$

$$G(n) = -H(n)/n \quad (11)$$

where $a(n), b(n), H(n), \bar{a}(n)$, and $\bar{b}(n)$ are based on the following recursions:

$$a(n+1) = a(n) - \alpha + \left(e_1 + b(n)\right)' c + c'H(n)c - \frac{1}{2} ln\left(det\left(I - 2\Sigma H(n)\right)\right)$$
$$+ \frac{1}{2}\left(e1 + b(n) + 2H(n)c'\left(\Sigma^{-1} - 2H(n)\right)\right)^{-1} \left(e1 + b(n) + 2H(n)c\right) \quad (12)$$

$$b(n+1) = \Phi'\left(e_1 + b(n)\right) + 2\Phi'H(n)c$$
$$+ 2\Phi'H(n)\left(\Sigma^{-1} - 2H(n)\right)^{-1}\left(e_1 + b(n) + 2H(n)c\right) \quad (13)$$

$$H(n+1) = -\Omega + \Phi'H(n)\Phi + 2\Phi'H(n)\left(\Sigma^{-1} - 2H(n)\right)^{-1} H(n)\Phi \quad (14)$$

$$\bar{a}(n+1) = \bar{a}(n) + e_1'c + \bar{b}(n)'c + \frac{1}{2}\left(e_1 + \bar{b}(n)\right)' \Sigma \left(e_1 + \bar{b}(n)\right) \quad (15)$$

$$\bar{b}(n+1) = \Phi'\left(\mathrm{e}_1 + \bar{\mathrm{b}}(\mathrm{n})\right) \quad (16)$$

[5] $B(n)$ is a 4×1 vector, $G(n)$ is a 4×4 and $e1$ is a 4×1column vector for the single-factor GCAPM.

e_1 represents a 6×1 column vector of zeros with a 1 in the first place and the following are the initial conditions for the recursions.

$$a(1) = -\alpha + e_1'c + \frac{1}{2}e_1'\Sigma e_1 \tag{17}$$

$$b(1) = \Phi' e_1 \tag{18}$$

$$H(1) = -\Omega \tag{19}$$

$$\bar{a}(1) = e_1'c + \frac{1}{2}e_1'\Sigma e_1 \tag{20}$$

$$\bar{b}(1) = \Phi' e_1 \tag{21}$$

III. Empirical Specification and Data

We use a sample of Nasdaq-, AMEX- and NYSE-traded firms between January 1978 and December 2011 to construct our industry spot discount curves. Using monthly data from CRSP on stock returns with and without dividends, stock prices and number of shares outstanding, we assign firms to 39 value-weighted industry portfolios based on their two-digit SIC classifications. We follow the convention of previous industry-level FX pricing studies and use the industry classifications suggested by Bodnar and Gentry (1993)[6].

[6] Bodnar and Gentry (1993) chose industries which are believed to be exposed to unexpected changes in FX rates. Thus the industry sample is not representative of all U.S. industries but rather industries with significant FX rate exposures.

For each value-weighted industry portfolio, we use a moving sum of 12-month continuously compounded portfolio returns to compute monthly returns with an annual horizon. To estimate dividend cash flow growth rates (g_t), we compute monthly industry portfolio dividends as the difference between the portfolio value-weighted monthly returns with, and without dividends from CRSP, multiplied by the portfolio's average stock price. Annual dividend growth is calculated as $g_t = ln(D_{t+1}/D_t)$ where D_t is the 12-month moving sum of monthly dividends.

In spirit of Fama MacBeth (1973) we use 60-month rolling windows to estimate the time-varying factor loadings of our two asset-pricing models: First, using a single-factor GCAPM we estimate the time-varying global market exposures of the industry portfolios.

$$R_t^{PF} - Rf_{t-1} = \alpha_t + \beta_t^{SF} GRP_t^* + u_t \qquad (22)$$

where R_t^{PF} is the value-weighted portfolio log return; $GRP_t^* = R_t^M - Rf_{t-1}$ is the observed and noisy price of global market risk at time t with R_t^M being the log return of the global market that is measured by the MSCI World Index[7] and Rf_{t-1} being the yield on a 1-Month U.S. Treasury Bill. Second, we use a two-factor InCAPM to estimate time-varying global market and FX exposures.

$$R_t^{PF} - Rf_{t-1} = \alpha_t + \beta_t^{TF} GRP_t^* + \gamma_t CRP_t^* + u_t \qquad (23)$$

[7] Although the MSCI All Country Index captures a larger portion of all markets in the world and therefore is more closely a true global index, the data is only available after January 1988. We choose to proxy global market returns with the MSCI World index that mainly covers developed countries but is available from January 1970 forth.

where $CRP_t^* = R_t^X - Rf_{t-1}$ is the noisy price per unit of foreign currency risk with R_t^X being the log returns of an inflation-adjusted foreign currency basket.[8] All returns are continuously compounded monthly returns.

In Table I we provide average estimates and standard deviations of the time-varying global market (beta) and FX risk (gamma) loadings based on estimates of model (23). Next to these estimates we also include selected summary statistics of continuously compounded portfolio log returns and dividend growth rates of the value-weighted industry portfolios. Industry portfolio returns and dividend growth are monthly frequency data with an annual horizon. The sample period spans January 1978 to December 2011 and includes all firms traded on Nasdaq, AMEX and the NYSE that match the two-digit SIC code of our sample industries. We require firms to have a minimum of 36 consecutive stock return and price observations to be assigned to an industry portfolio.

Lastly we report annualized portfolio alphas, which are used to calibrate the industry spot discount rate curves as described in section II. Portfolio alphas are estimated by regressing monthly portfolio excess returns on a constant (α) and the excess returns of the global market portfolios using data from 1978 to 2011. Essentially α allows us to calibrate the spot discount rate curves based on the GCAPM model. To be able to obtain FX risk premium estimates we use the same calibrations to estimate InCAPM-based spot discount rate curves.

Average annual industry returns range from 6.1% (for the wood industry) to 19.3% (for the business services industry). The average variation of annual industry portfolio is 26.2% (with a maximum of 42.6% for the movies industry and a minimum of 15.2% for the food industry.

[8] R_t^X are the log returns of a foreign currency basket (the U.S. Fed's Real Major Currency Basket (MCI)) expressed in USD terms.

Dividend growth rates, although being relatively small in magnitude, are also volatile (8.7% on average). Moreover, the results in Table I also illustrate cross-sectional differences as well as time-variation of global market and FX rate exposures of our industry sample.

[Insert Table I approximately here]

We estimate the price of global market risk (GRP_t) and the price of currency risk (CRP_t) using a set of instrumental variables. There is a wide array of informational instruments that are commonly used in the asset pricing literature[9]. More specifically, in the international asset pricing literature, Dumas and Solnik (1995) use lagged equity index returns, dividend yield, a January effect dummy, a U.S. bond yield, and a short Euro deposit rate. Similarly, De Santis and Gérard (1998) include the dividend of the world index (MSCI), the change in the U.S. term premium, the change in the Eurodollar deposit rate, and the U.S. default premium. We follow Francis et al. (2008) and use the Federal Funds rate (FED); the term premium ($TERM$), which is the difference in yields of the U.S. Treasury constant-maturity 10-Year and the 1-Year notes; and the default premium (DEF), which is the yield spread between Moody's Baa and Aaa- rated bonds, as instruments for the price of global market risk (GRP_t). The set of instruments for the price of currency risk (CRP_t) includes: the Federal Funds Rate (FED); the Export Ratio (EXP), which is the ratio of U.S. exports to U.S. GDP; and the Import Ratio (IMP), which is the ratio of U.S. exports to U.S. GDP. In addition to the set of informational instruments we take advantage of potential autocorrelations in the prices of global market and currency risk and add the lagged values of GRP and CRP to the information set.

[9]Among others, see Bekaert and Hodrick (1992) for an investigation of equity and FX excess returns. Also, Ferson and Harvey (1993) find that much of the equity excess return predictability can be attributed to changing price of global market risk.

The estimated coefficients of the following two models are used to generate the fitted values of GRP_t and CRP_t:

$$GRP_t^* = \theta_0 + \theta_1 GRP_{t-1}^* + \theta_1 FED_{t-1} + \theta_2 TERM_{t-1} + \theta_3 DEF_{t-1} + \varepsilon_t \tag{24}$$

$$CRP_t^* = \delta_0 + \delta_1 CRP_{t-1}^* + \delta_2 FED_{t-1} + \delta_3 EXP_{t-1} + \delta_4 IMP_{t+1} + \varepsilon_t \tag{25}$$

where $GRP_t^* = R_t^M - Rf_{t-1}$ is the observed and noisy price of global market risk for time t. R_t^M is the log return of the global market that is measured by the MSCI World Index. Similarly, $CRP_t^* = R_t^X - Rf_{t-1}$ where R_t^X are the log returns of a real foreign currency basket.

Table II reports the regression results of the price of global market and currency risk regressions (24) and (25). The adjusted R^2 are 1.99% for the price of global market risk and 13.28% for the price of currency risk. P-values are based on Newey-West HAC standard errors. Robust Wald statistics reject the null hypothesis of no explanatory power in the predictive equations at the 95% confidence level.

[Insert Table II approximately here]

IV. The Term Structure of Industry Expected Returns

We begin our analysis by estimating cost of equity term structures for industry- and a pooled industry portfolio at the end of our sample period. We show that the position and shape of industry cost of equity term structures is affected by the inclusion of the FX risk premium. We also observe that FX risk premiums have term structures which vary considerably in position and shape across different industries. In the second subsection we demonstrate that potential mispricing due to the choice of discount rates is economically significant and can be substantial.

We continue our analysis and illustrate that cross-sectional difference in short-term FX risk premiums can be explained by industry characteristics. We conclude section IV with a series of robustness tests.

A. Estimated Industry Spot Discount Rates

We begin our analysis by estimating spot discount rate curves for the pooled industry portfolio and present the results in the top panel of Figure 1. The dotted line shows the term structure of the average industry cost of equity based on a single-factor GCAPM. This term structure does not explicitly capture the FX exposure of industries (some of the industry FX exposure is captured by the global market stock return index). The solid line is the average industry cost of equity term structure which is based on a two-factor InCAPM. The later model explicitly accounts for FX industry exposure as can be seen by its model specification in equation (23).

Although spot discount rate curves can take a variety of shapes similar to interest rate term structures, we observe positively sloping cost of equity term structures similar to prior results by Ang and Liu (2004). The average cost of equity for short-term maturity cash flows is 5.4% according to the GCAPM model and 8.21% if the asset pricing approach includes an FX risk component. The average cost of equity peaks around 13% for cash flows with 10 to 12 year maturities. Our initial results suggest that including the FX risk component affects both, the position but also the shape of the spot discount rate curve.

Similar to Francis et al. (2008), we find an economically significant positive FX risk premium for the average industry's cost of equity. Comparing cost of equity term structures, we find that the FX risk premium plays a more important role for expected cash flows with shorter maturities. We observe an FX risk premium of 2.81% (34.3% of the total risk premium) for one-year maturity cash flows. The FX risk premium then declines to 0.22% (1.7% of the total risk premium) for cash flows maturities between 15 to 18 years and then slightly increases to 0.42% (3.4% of the total risk premium) for cash flows with 30-year maturities.

Observing an economically significant FX risk premium, we conjecture that the asset pricing model used to estimate industry cost of equity term structures should capture FX risk. Our results are also important because we observe that the FX risk premium displays a term structure. This suggests that financial managers and investors should be weary of applying constant estimates of FX risk premiums. In sum, our initial results suggest that financial managers can make two different FX-risk related pricing errors: First, omitting the FX risk component altogether and second, assuming a constant FX risk premium for cash flows across all maturities.

[Insert Figure 1 approximately here]

Using the two-factor InCAPM, we estimate spot discount rate term structures for all industries in our sample and present the results in Table III. We observe substantial cross-sectional differences in the level and shape of the discount rate spot curves. Although the majority of industries display positively sloping discount rate spot curves, some industries display flat or even negatively-sloped cost of equity term structures. For example, the electric equipment industry (SIC 36) has an almost flat term structure, whereas the stone industry (SIC 32) displays sharply increasing discount rates (2.55% for 1-year maturity cash flows and 11.02%

for 30-year maturity cash flows). Conversely, the apparel store industry (SIC 56) has a slightly decreasing term structure.

[Insert Table III approximately here]

The cross-sectional differences in cost of equity term structures suggest that FX risk premiums could also display substantial differences in their term structures. In Figure 2 we estimate FX risk premiums for an industry subsample that includes: building and construction (SIC 15), apparel (SIC 23), industrial machinery and computers (SIC 35), transportation equipment (SIC 37), air transportation (SIC 45), and hotels (SIC 70).

Similar to our initial observations we find that industry FX risk premiums are positive and substantially larger for expected short-term cash flows. For most of our industry sub-sample the FX risk premiums then sharply decline for longer-term cash flows even turning negative (up to -2% for the building & construction and apparel industries). Other industries, such as the transportation equipment and hotel industries have mostly positive FX risk premiums, even for longer-maturity expected cash flows.

Our study is not the first to find negative FX risk premiums. In a sub-period analysis De Santis and Gérard (1998) observe negative FX risk premiums for much of the first half of the 1980's. During that time period negative FX risk premiums for the U.S. market as a whole more than offset the market risk premium, turning the total premiums negative. Although some of our industries have negative FX risk premiums for longer-maturity expected cash flows, total FX risk premiums are still positive (see the spot discount rate curves in Table III).

[Insert Figure 2 approximately here]

B. Mispricing – Choosing Discount Rates

In this subsection we investigate the economic significance of potential pricing errors resulting from the choice of the underlying asset pricing model. In Table IV, we compute the values of 30-Year $1 annuities using: 1) a constant cost of equity based on the single-factor GCAPM ($GCAPM_Con$), 2) a constant cost of equity based on the two-factor InCAPM ($InCAPM_Con$), 3) the discount rate term structure based on the single-factor GCAPM ($GCAPM_Term$), and 4) the discount rate spot curve based on the two-factor InCAPM ($InCAPM_Term$).

We assume that the 'correct' asset pricing model captures the term-structure of industry cost of capital and explicitly accounts for industry FX exposure ($InCAPM\_Term$). This approach allows us to investigate three potential pricing errors. First, accounting for term structure of spot discount rates but failing to capture industry FX exposure (estimating $GCAPM\_Term$). Second, capturing the FX industry exposure explicitly but failing to account for the term-structure of industry cost of equity (estimating $InCAPM\_Con$). Finally, valuing projects/investments with a constant discount rate that does not capture industry FX exposure (estimating $GCAPM\_Con$). We define mispricing as:

$$pricing\ error = \frac{wrong - correct}{correct} \tag{26}$$

where 'wrong' is the dollar value of the annuity that either omits the FX component or assumes a constant industry cost of equity, or both.

In Panel A of Table IV we report the valuation [and mispricing] results for our industry subsample and the pooled industry portfolio. First, we observe large differences in valuations for each of the industries and discount-rate scenarios chosen. Failing to explicitly account for the FX exposure in the air transportation industry underestimates the value of the 30-year annuity by

15.66%. Similar under-valuations are observed for the apparel (-13.25%) and the building and construction industries (-12.52%). The under-valuations are a direct result of the FX risk premium term structures (recall in Figure 2 that for these particular industries the FX risk premiums are positive for short-term expected cash flows but then turn negative on the longer end of the term structure). For the transportation equipment and hotel industries, as well as the pooled industry portfolio, FX risk premiums are positive even on the longer end of their discount rate spot curves. Consequently, the omission of industry FX risk results in overestimation in the long-term annuity values (3.93% for the pooled industry portfolio).

Similar to the findings of Ang and Liu (2004), we observe that ignoring the term structure of industry cost of equity results in substantial valuation errors. Capturing FX industry exposure but applying a constant cost of equity results in substantial under-valuation for projects in the air transportation (-32.81%) and apparel industries (-23.28%). Conversely, over-valuations result in the hotel industry (38.33%) as well as for the pooled industry portfolio (9.76%).

[Insert Table IV approximately here]

Given the shapes of the spot discount curves, pricing errors are different for annuities with different maturities. We focus on one type of pricing error – the omission of the industry FX risk premium from the estimated spot discount rate curves and continue our analysis by estimating cumulative valuation errors over 30 year horizons.

In Figure 3, the valuation results reflect the positive FX risk premiums for short-term cash flows across all of the industries. The omission of the industry FX risk premium leads to overvaluation in the range between 2% to 6% for short-term projects. Valuation errors become substantially negative for many of the industries, reflecting the negative FX risk premiums on the longer end of the spot curves of the building and construction, apparel, industrial machinery and computers, and air transportation industries. Conversely, the valuation errors for the transportation equipment and hotel industries are positive for all project maturities up to 30 years.

[Insert Figure 3 approximately here]

C. Industry Characteristics and FX Risk Premiums

Thus far our results show substantial differences in FX risk premiums among industries. To gain further insight, we explore whether industry characteristics can help explain the observed differences in industry cost of equity. To motivate our set of explanatory variables we draw upon previous work in the FX exposure and international asset pricing literature[10]. We investigate the relation between industry FX risk premiums and the following industry characteristics:

Firm Size: The effect of firm size on industry FX risk premiums is ambiguous. Although, most empirical studies find a negative relation between firm size and FX risk premiums (see for example Bodnar and Wong, 2003), the opposite is also observed (see for example the study by He and Ng (1998) that finds a positive correlation between Japanese multinational firms and

[10] Dominuguez and Tesar (2006) find that FX exposures are correlated with firm size, multinational status, foreign sales, international assets, and competitiveness and trade at the industry level. Chow, et al. (1997b) find a negative relation between FX exposure magnitude and firm size and but no statistically significant relation to foreign sales. Conversely, Jorion (1990) finds a positive relation between foreign involvement (magnitude of foreign sales) and FX exposures of U.S. multinational firms. Choi and Prasad (1995) study a sample of U.S. multinationals and find that foreign operating profits, foreign sales, and foreign assets are linked to cross-sectional differences in FX exposures. Bodnar and Wong (2003) report a substantial negative size effect on FX exposure magnitudes. Starks and Wei (2005) posit that firms with low liquidity can experience financial distress due to FX shocks. He and Ng (1998) find that Japanese multinational firms with high leverage or low liquidity are subject to less FX exposure. Francis et al. (2008), find that foreign trade, competition, growth opportunities, leverage, liquidity, and firm size help to explain cross-sectional differences in industry FX risk exposures.

their FX exposures). We include $SIZE$, which is the natural log of the average market capitalization of the industry portfolio from 1978 to 2011.

International Involvement: Numerous studies find positive correlations between FX risk premiums and measures of international involvement. Based on data availability we follow Francis et al. (2008) and include $FINC$, which is the industry's ratio of foreign income to sales[11].

Leverage: Industries with higher leverage can have higher FX risk premiums due to their increased sensitivity of cash flows to unexpected changes in FX rates. On the other hand, optimal hedging theories stipulate that more leveraged industries have an increased incentive to hedge their FX exposures due to their larger expected costs of financial distress (He and Ng, 1998). We measure the industry's leverage as the ratio of short- and long-term liabilities to total assets (LEV).

Liquidity: Industries with less liquidity are more likely to experience financial distress due to FX shocks (Starks and Wei, 2005), which would result in larger FX risk premiums. Conversely, based on the argument by He and Ng (1998), industries with less liquidity have larger incentives to hedge their FX exposures, similar to highly leveraged industries. This would result in reduced FX risk premiums. We measure liquidity (LIQ) with the average industry Quick-Ratio.

Growth Opportunities: FX exposure of industries results in increased volatility of their cash flows, which in turn can exacerbate the underinvestment problem. The study by Campa (1994) shows that FX-related uncertainty reduces investment of U.S. firms in the chemical

[11] We also use alternative measures of international involvement, such as the ratios of foreign income to total income; foreign income to domestic income and foreign income to total assets. All of the measures yield similar results, particularly identical signs of the estimated coefficients.

processing industry. Since industries with high growth opportunities already face greater underinvestment costs (Geczy, Minton, and Shrand, 1997), we would expect to find a higher FX risk premium. We estimate average industry Market-to-Book ratios $(GROW)$ as proxies for industry growth opportunities.

Using annual accounting data from Compustat we calculate industry portfolio characteristics. Since we are interested in explaining FX risk premium term structures at the end of 2011, we average the annual observations from 1978 to 2011 of the industry characteristics. We then estimate the following model for our cross-section of 39 U.S. industries:

$$FX_{Premium,i} = \alpha + \beta_1 SIZE_i + \beta_2 FINC_i + \beta_3 LEV_i + \beta_4 LIQ_i + \beta_5 GROW_i + \varepsilon_i \qquad (27)$$

where $FX_{Premium,i}$ is one of the following FX risk premiums: 1) FX risk premium short, which is the industry FX risk premium for cash flows with a 1-Year maturity; 2) FX risk premium medium, this is the 10-Year maturity FX risk premium; 3) FX risk premium long, is the industry FX risk premium for cash flows with a 30-Year maturity.

The results in Table V illustrate that industry characteristics help to explain cross sectional differences in short-term FX risk premiums. The adjusted R^2 for the 1-Year FX risk premium is 33% however industry characteristics rapidly loose explanatory power for longer-term FX risk premiums (the adjusted R^2 for the 10-Year FX risk premium declines to 3.4% and -3.8% for the 30-Year FX risk premium). Holding all else equal, 1-Year industry FX risk premiums are smaller for industries with smaller average firms, smaller for industries with higher proportion of foreign-based income, and higher for industries with large growth opportunities. Although industry characteristics loose explanatory power for the 10-Year FX risk premiums, we observe that industries with higher proportions of foreign-based income also have higher FX risk premiums. The same result can be observed for FX risk premiums on the long end (for expected cash flows with 30-Year maturities).

Perhaps surprising is the observation that industries with high proportions of foreign-based income have smaller short-term FX risk premiums and, more intuitive, higher FX risk premiums for mid- to long-term cash flow maturities. It is possible that industries with high proportions of foreign-based income have the expertise and the incentive to hedge their short-term FX exposures more effectively. However, as noted by international finance literature, FX exposure in the long-run is more complex (mostly economic exposure) and harder to hedge. Thus industries (with high proportions of foreign-based income) will command higher (lower) FX risk premiums in the long-run (short-run).

A similar argument can be made for industries with high liquidity. According to optimal hedging theory firms with low liquidity have higher incentive to hedge their exposures, including their FX exposures (He and Ng, 1998). Industries with high levels of liquidity may choose not to hedge their FX exposures in the short-run (Froot, Scharfstein, and Stein, 1993) and thus command a higher FX risk premium for the short-term. On the other hand, industries with high levels of liquidity are better able to absorb adverse FX rate changes. Considering that FX hedging can be limited for long-run exposures, industries with higher liquidity would be relatively less risky with respect to FX changes and command a smaller FX risk premium for long-maturity cash flows.

In Panel B we observe that industry growth opportunities are positively correlated with average industry size and proportion of foreign income. To check the robustness of our models, we run versions that omit our proxy for industry growth opportunities $(GROW)$ but do not observe any significant changes in results[12].

[Insert Table V approximately here]

D. Additional Tests and Robustness

Real and Nominal FX Exchange Rates: In the first part of this subsection we investigate whether the choice of a real versus nominal FX index affects our findings. As Bartram and Bodnar (2007) point out, both nominal as well as real FX rate measures have been used with little difference in short-horizon results[13]. However, our study considers long valuation horizons for which inflation should be taken into consideration. Moreover, our choice of the real MCI index preserves the comparability of our results with Francis et al. (2008).

Figure 4 illustrates the discount rate spot curves for the pooled industry portfolio at the end of December 2011. The dotted line is the industry term structure that measures FX rates with the nominal Major Currency Index, whereas the solid line is our previously estimated term structure based on real FX changes. Figure 4 illustrates that the shape of the spot discount rate curve is affected by the choice of an inflation adjusted or not-adjusted FX rate measure. We observe that the FX risk premium based on the nominal FX rate measure more rapidly decreases and also reaches negative values for cash flows with maturities between 10 to 30 years.

[Insert Figure 4 approximately here]

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[12] These results have been omitted for sake of brevity but will be provided by the authors upon request.
[13] Examples include Bodnar and Wong (2003) and Choi and Prasad (1995).

Predicting risk premiums with an AR(1) process: The estimation process of spot discount rate curves requires estimating the prices of global market – and FX rate risk (we are referring here to the prices per unit of risk, previously denoted as GRP_t and CRP_t). The literature on the predictability of stock market returns and FX rate changes is vast. The choice of predictive variable plays an important role and in this part of our robustness checks we investigate whether the assumption of a more naïve expectations process significantly affects our results.

In the top part of Figure 5 we compare the spot discount rate curves for the pooled industry portfolio using: 1) Our previously used predictive variables: federal funds rate, term spread and bond risk spread for aggregate market returns and the federal funds rate, import and export ratios for aggregate currency basket returns. 2) A more naïve expectations process where we assume that expected global market and the currency returns follow an autoregressive process with lag one (AR(1)).

The results in the top part of Figure 5 suggest that assuming an AR(1) expectations process might considerably underestimate industry cost of equity. Although the position and shape of the spot discount rate curve is substantially different, the difference in FX risk premiums for the industries is not. The FX risk premium is still positive for short-term expected cash flows and then declines for mid-to longer term maturities. The FX risk premium based on the AR(1) process declines faster and reaches a lower level (0.3% for the AR(1) compared to 0.5% for the instrumental variables approach).

We conclude that constructing spot discount rate curves and extracting the term-structures of FX risk premiums is more sensitive to changes in predictive variables and real vs. nominal FX rate measures than estimating constant FX risk premiums. However, our main conclusions about the shape, and to a large part, the magnitude of industry FX risk premiums are not affected by these possible modifications.

V. Conclusions

In this study we use conditional versions of the one-factor Global CAPM (GCAPM) and the two-factor International CAPM (InCAPM) to estimate industry discount rate spot curves. The main contributions of our paper are: 1) Study the effects of FX exposure on the industry cost of equity term structure; 2) Provide a valuation framework that captures the industry's FX exposure and allows pricing parameters to change during the valuation horizon.

Using an industry sample based on Bodnar and Gentry (1993), we find that, on average, the industry FX risk premium is around 2.81% (or roughly 34% of total industry cost of equity) for expected cash flows with maturities between 1 to 3 years. The FX risk premium, for most industries then rapidly declines with increasing cash flow maturities and can become negative. Consequently, we find that omitting the FX risk premium along with not accounting for the term structure of industry cost of equity leads to substantial mispricing, assuming a constant stream of expected cash flows. Moreover, out study finds that industry characteristics that are traditionally used in FX exposure studies, partially explain cross-sectional differences in industry cost of equity term structures.

Our study highlights that FX exposure at the industry-level is significant, particularly for expected cash flows with 1 to 15 year maturities. We also posit that FX risk premiums, like the cost of equity itself, have term structures that should not be ignored. Although we provide more insight into the differences between short- and long-term FX risk premiums, our paper highlights the need for further research in this particular part of international finance.

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Table I
Selected Industry Portfolio Summary Statistics

Table I reports summary statistics for 39 value-weighted industry portfolios (following Bodnar and Gentry, 1993). Alpha denotes the CAPM alpha from running regressions of monthly industry excess returns onto a constant and the excess global market returns. Dividend growth is calculated as $g_t = ln(D_{t+1}/D_t)$ where D_t is the 12-month rolling sum of monthly industry dividends that are calculated as the difference between monthly CRSP returns with and without dividends (Ang and Liu, 2004). Beta and Gamma are the average slope coefficients of estimating the two-factor InCAPM using 60-month rolling period regressions. The data includes all firms traded on the NYSE, Nasdaq and Amex between January 1978 and December 2011 with a minimum of 36 consecutive price and return observations per firm. Industry portfolio returns and dividend growth are monthly frequency data with an annual horizon (continuously compounded).

			Beta		**Gamma**		**Returns**		**Dividend Growth**	
SIC	**Industry**	**Alpha**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
10	Metal	-0.001	1.021	0.110	0.235	0.231	0.103	0.336	-0.002	0.102
13	Oil	0.009	0.998	0.085	-0.275	0.215	0.108	0.271	0.000	0.056
15	Construct.	0.006	1.838	0.327	-1.086	0.260	0.110	0.391	0.004	0.117
16	Oth.Const.	-0.018	1.262	0.153	-0.573	0.191	0.082	0.262	-0.003	0.058
20	Food	0.062	0.916	0.147	-0.322	0.081	0.138	0.152	0.000	0.064
21	Tobacco	0.112	0.762	0.082	-0.372	0.241	0.186	0.245	0.001	0.047
22	Textile	-0.027	1.123	0.088	-0.662	0.134	0.074	0.276	-0.004	0.102
23	Apparel	0.019	1.333	0.135	-0.933	0.127	0.113	0.281	-0.001	0.050
24	Wood	-0.042	1.392	0.184	-0.497	0.166	0.061	0.248	-0.001	0.085
25	Furniture	0.013	1.239	0.127	-0.728	0.145	0.118	0.268	-0.002	0.054
26	Paper	-0.011	1.064	0.077	-0.375	0.100	0.082	0.235	-0.001	0.065
27	Printing	-0.001	1.077	0.081	-0.438	0.155	0.095	0.241	-0.001	0.053
28	Chemicals	0.049	0.949	0.077	-0.227	0.095	0.131	0.173	0.000	0.025
29	Refining	0.053	0.855	0.100	-0.246	0.163	0.135	0.168	-0.001	0.028
30	Rubber	0.024	1.229	0.117	-0.539	0.126	0.120	0.266	-0.001	0.045
31	Leather	-0.011	1.176	0.092	-0.985	0.149	0.089	0.269	-0.005	0.336
32	Stone	-0.047	1.272	0.078	-0.561	0.127	0.066	0.283	-0.009	0.204
33	Prim.Met.	-0.024	1.206	0.089	-0.224	0.120	0.091	0.322	-0.002	0.078
34	Met.Prod.	0.033	1.057	0.085	-0.366	0.096	0.126	0.193	-0.002	0.025
35	Mach.Com	0.017	1.192	0.068	-0.446	0.065	0.116	0.240	-0.002	0.048
36	Elec.Equ.	0.018	1.563	0.160	-0.634	0.102	0.130	0.367	-0.001	0.047
37	Tran.Equ.	-0.006	1.145	0.058	-0.578	0.117	0.094	0.253	-0.003	0.049
38	Instru.	0.030	1.146	0.128	-0.459	0.094	0.123	0.188	0.000	0.030
40	Rail	0.063	1.013	0.091	-0.353	0.132	0.150	0.213	-0.001	0.055
42	Motor	-0.002	1.086	0.137	-0.539	0.190	0.082	0.207	0.002	0.078
44	Water	-0.026	1.257	0.073	-0.690	0.282	0.080	0.342	0.000	0.083
45	Air	-0.033	1.303	0.141	-0.700	0.136	0.070	0.301	-0.001	0.112
48	Comm.	0.011	0.852	0.088	-0.397	0.066	0.103	0.267	-0.002	0.061
49	Utilities	0.035	0.649	0.115	-0.303	0.140	0.107	0.157	-0.001	0.014
50	Wholesale	-0.008	1.235	0.130	-0.491	0.108	0.088	0.211	-0.001	0.052
53	Merchand.	0.083	1.203	0.159	-1.012	0.144	0.171	0.219	0.002	0.035
54	Food.Sto.	0.048	0.923	0.099	-0.692	0.135	0.128	0.220	-0.002	0.214
56	Appar.Sto.	0.050	1.604	0.206	-1.292	0.200	0.154	0.327	0.002	0.091
58	Rest.	0.055	1.212	0.248	-0.610	0.129	0.138	0.184	0.004	0.097
59	Misc.Ret.	0.042	1.234	0.146	-0.756	0.137	0.135	0.218	-0.002	0.051
65	RealEst.	0.011	1.295	0.144	-0.642	0.236	0.120	0.309	0.003	0.157
70	Hotels	-0.001	1.315	0.167	-0.584	0.142	0.112	0.392	-0.003	0.134
73	Bus.Serv.	0.089	1.464	0.133	-0.359	0.074	0.193	0.313	0.002	0.197
78	Movies	0.079	1.393	0.094	-1.108	0.214	0.188	0.426	0.000	0.224

Table II
Predicting the Risk Premiums

Table II reports coefficients (robust p-values), robust Wald statistics [Chi-Squared values] and adjusted R^2 values for the predictive regressions for the global market risk premium (GRP) and the foreign currency risk premium (CRP). We use the following two regression equations to model the ex-ante risk premium expectations:

$$GRP_t^* = \theta_0 + \theta_1 GRP_{t-1}^* + \theta_1 FED_{t-1} + \theta_2 TERM_{t-1} + \theta_3 DEF_{t-1} + \varepsilon_t$$
$$CRP_t^* = \delta_0 + \delta_1 CRP_{t-1}^* + \delta_2 FED_{t-1} + \delta_3 EXP_{t-1} + \delta_4 IMP_{t+1} + \varepsilon_t$$

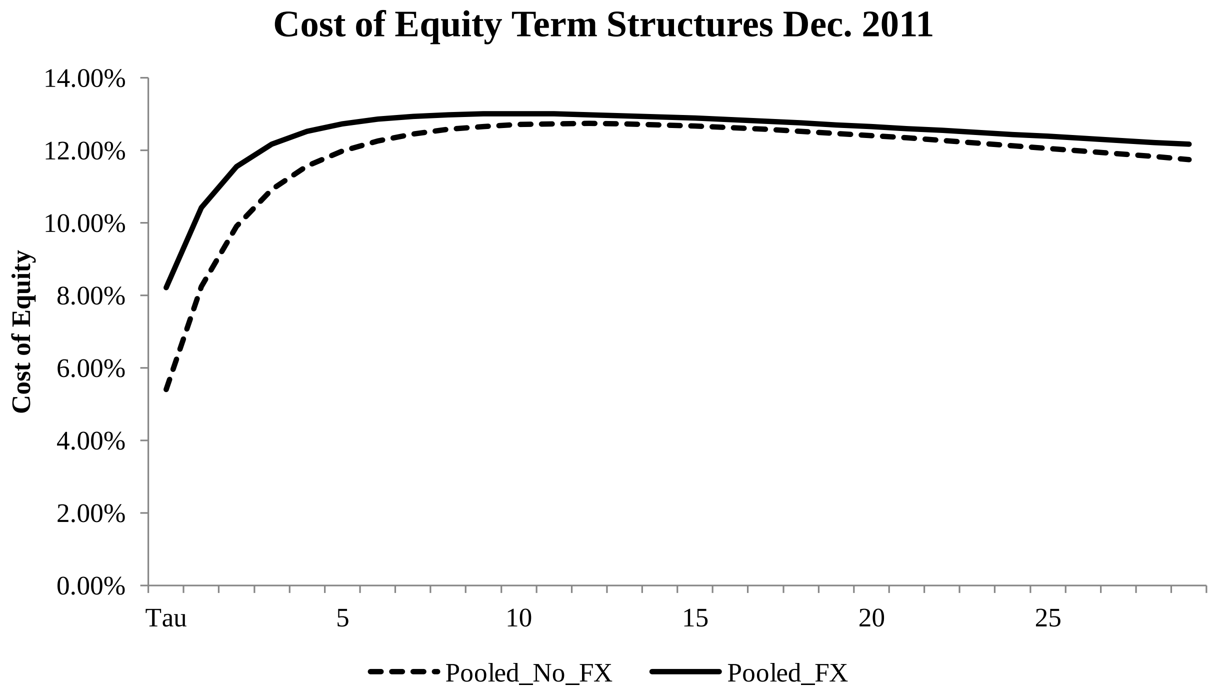
where GRP_t^* and CRP_t^* are the monthly log excess returns of the global market portfolio and the foreign currency portfolio. Following Francis et al. (2008) we use the one-period lagged predictive instruments: The U.S. Federal Funds rate (FED); the term premium (TERM), which is the yield spread between the constant-maturity 10-Year and 1-Year notes; the default premium (DEF), which is the yield spread between the Moody's Baa and Aaa bonds, the export ratio (EXP), which is the ratio of U.S. exports and U.S. GDP; and similarly the import ratio (IMP), computed as the ratio of imports and GDP. The estimation window spans monthly data from 1970 to 2011 for the GRP, and 1978 to 2011 for the CRP (due to data availability).

Panel A: Predicting the Global Market Risk Premium

	Constant	**GRP**	**FED**	**TERM**	**DEF**	**Wald**	$\boldsymbol{Adj. R^2}$
GRP	**-0.0049**	**0.1110**	**-0.2293**	**0.2210**	**0.4729**	**12.2600**	**0.0199**
p-values	(0.4447)	(0.0529)	(0.0469)	(0.2208)	(0.5118)	[0.0155]	

Panel B: Predicting the MCI Currency Risk Premium

	Constant	**CRP**	**FED**	**EXP**	**IMP**	**Wald**	$\boldsymbol{Adj. R^2}$
CRP	**0.0029**	**0.3160**	**0.0015**	**-3.4314**	**1.7165**	**112.1900**	**0.1328**
p-values	(0.6757)	(<.0001)	(0.9580)	(0.0058)	(0.0149)	[<.0001]	



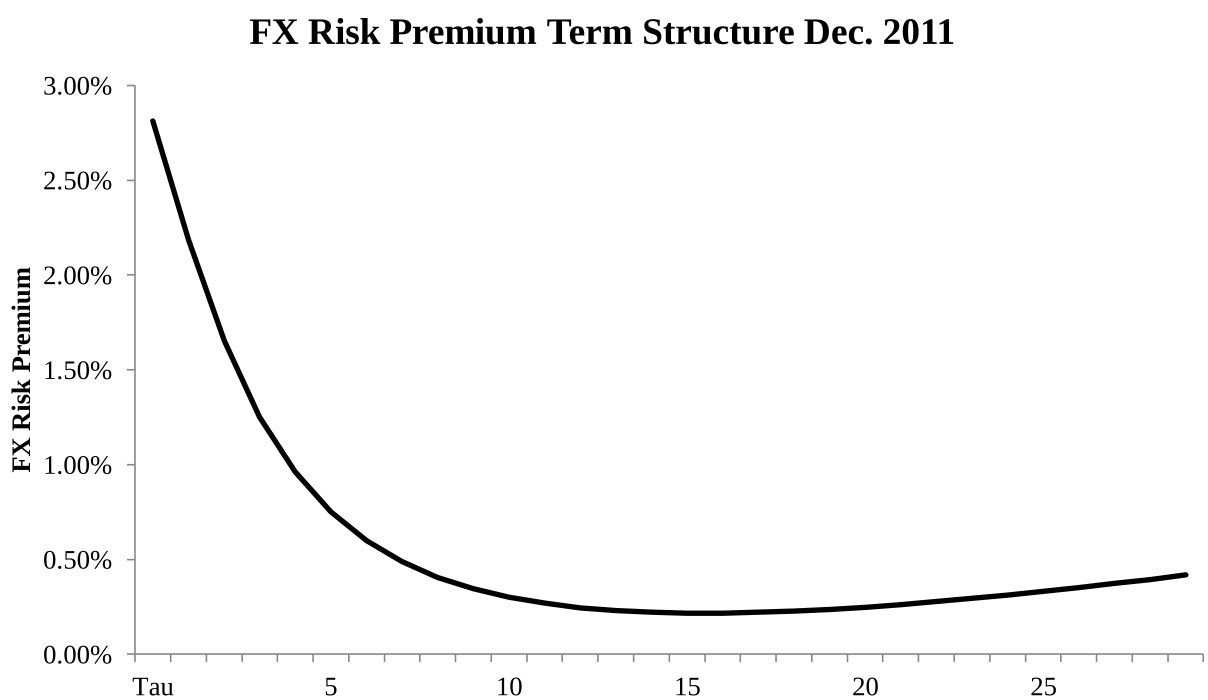


Figure 1. Discount Curves for the Average Industry Portfolio – December 2011. The top of Figure 1 shows the discount curves $\mu_t(n)$, with n years on the horizontal axis, computed at the end of our sample period (December 2011) for the pooled industry portfolio. The $Pooled\_FX$ discount curve includes the FX component (based on the two-factor InCAPM), whereas the $Pooled\_NoFX$ discount curve is based on the single-factor GCAPM. The bottom of Figure 1 shows the term structure of the FX risk of the pooled industry portfolio.

Table III
Industry Cost of Equity Term Structures Dec 2011

Table III reports industry discount rate curves. The cost of equity estimates are based on the two-factor InCAPM and therefore capture the FX risk component. The estimation window includes data from January 1978 to December 2011. Discount rate curves are calculated for the end of the sample period.

	Industry	**1**	**2**	**3**	**4**	**5**	**7**	**10**	**15**	**20**	**30**
10	Metal	0.38%	5.35%	8.19%	9.97%	11.14%	12.49%	13.37%	13.72%	13.58%	12.82%
13	Oil	4.45%	8.00%	10.05%	11.30%	12.10%	13.00%	13.54%	13.67%	13.46%	12.74%
15	Construct.	11.36%	12.75%	12.69%	12.31%	11.93%	11.33%	10.71%	10.03%	9.53%	8.80%
16	Oth.Const.	3.88%	8.19%	9.75%	10.54%	10.93%	11.23%	11.21%	10.77%	10.19%	8.98%
20	Food	9.41%	10.17%	10.55%	10.78%	10.92%	11.07%	11.14%	11.14%	11.10%	10.99%
21	Tobacco	14.55%	15.24%	15.46%	15.58%	15.65%	15.73%	15.78%	15.80%	15.78%	15.73%
22	Textile	4.66%	7.03%	8.12%	8.65%	8.94%	9.21%	9.34%	9.34%	9.26%	9.00%
23	Apparel	10.56%	8.17%	8.12%	8.47%	8.80%	9.22%	9.51%	9.67%	9.70%	9.66%
24	Wood	2.70%	5.63%	6.63%	6.99%	7.10%	7.08%	6.87%	6.41%	5.92%	5.01%
25	Furniture	8.94%	11.94%	13.33%	13.97%	14.29%	14.56%	14.63%	14.48%	14.22%	13.60%
26	Paper	3.93%	6.78%	8.25%	9.07%	9.58%	10.12%	10.45%	10.58%	10.49%	10.11%
27	Printing	5.73%	7.59%	8.44%	8.89%	9.15%	9.40%	9.51%	9.45%	9.29%	8.88%
28	Chemicals	8.54%	9.14%	9.49%	9.70%	9.85%	10.03%	10.17%	10.27%	10.32%	10.34%
29	Refining	8.42%	10.52%	11.58%	12.12%	12.41%	12.64%	12.63%	12.36%	12.00%	11.30%
30	Rubber	8.45%	10.54%	11.64%	12.25%	12.61%	12.97%	13.12%	13.04%	12.82%	12.31%
31	Leather	7.43%	7.53%	7.35%	7.14%	6.96%	6.70%	6.49%	6.33%	6.26%	6.21%
32	Stone	2.55%	5.89%	7.66%	8.70%	9.37%	10.14%	10.69%	11.06%	11.15%	11.02%
33	Prim.Met.	2.90%	5.35%	6.71%	7.54%	8.10%	8.79%	9.37%	9.88%	10.17%	10.46%
34	Met.Prod.	7.95%	10.26%	11.82%	12.74%	13.30%	13.89%	14.19%	14.16%	13.90%	13.21%
35	Mach.Com	7.77%	8.93%	9.44%	9.74%	9.93%	10.15%	10.27%	10.29%	10.23%	10.04%
36	Elec.Equ.	10.55%	10.31%	10.42%	10.52%	10.60%	10.67%	10.70%	10.66%	10.59%	10.45%
37	Tran.Equ.	6.04%	8.29%	9.46%	10.14%	10.57%	11.05%	11.39%	11.57%	11.58%	11.41%
38	Instru.	8.12%	9.75%	10.35%	10.66%	10.82%	10.95%	10.97%	10.86%	10.70%	10.36%
40	Rail	10.77%	12.14%	12.82%	13.18%	13.38%	13.54%	13.53%	13.31%	13.00%	12.36%
42	Motor	5.25%	5.55%	5.76%	5.86%	5.90%	5.92%	5.89%	5.79%	5.68%	5.46%
44	Water	3.97%	4.92%	5.58%	5.96%	6.18%	6.38%	6.40%	6.19%	5.86%	5.09%
45	Air	5.26%	5.25%	5.10%	4.90%	4.72%	4.43%	4.14%	3.85%	3.68%	3.50%
48	Comm.	6.41%	7.48%	8.02%	8.28%	8.42%	8.52%	8.53%	8.41%	8.25%	7.92%
49	Utilities	6.19%	7.67%	8.43%	8.85%	9.09%	9.34%	9.47%	9.46%	9.35%	9.05%
50	Wholesale	5.56%	7.47%	8.24%	8.56%	8.69%	8.71%	8.53%	8.12%	7.69%	6.93%
53	Merchand.	16.22%	15.30%	14.63%	14.15%	13.80%	13.37%	13.02%	12.75%	12.62%	12.49%
54	Food.Sto.	11.31%	11.70%	11.69%	11.57%	11.43%	11.20%	10.95%	10.69%	10.50%	10.23%
56	Appar.Sto.	15.44%	15.93%	15.61%	15.23%	14.89%	14.38%	13.90%	13.41%	13.10%	12.71%
58	Rest.	10.90%	11.44%	11.67%	11.79%	11.86%	11.92%	11.94%	11.90%	11.85%	11.75%
59	Misc.Ret.	11.54%	11.69%	11.66%	11.60%	11.53%	11.43%	11.33%	11.21%	11.12%	11.00%
65	RealEst.	8.24%	12.06%	14.00%	15.10%	15.77%	16.52%	17.00%	17.17%	17.06%	16.50%
70	Hotels	6.75%	10.26%	12.28%	13.53%	14.34%	15.31%	16.01%	16.45%	16.52%	16.23%
73	Bus.Serv.	15.40%	16.48%	17.05%	17.39%	17.61%	17.86%	18.03%	18.13%	18.14%	18.10%
78	Movies	18.57%	17.51%	16.93%	16.54%	16.26%	15.85%	15.45%	15.01%	14.69%	14.16%

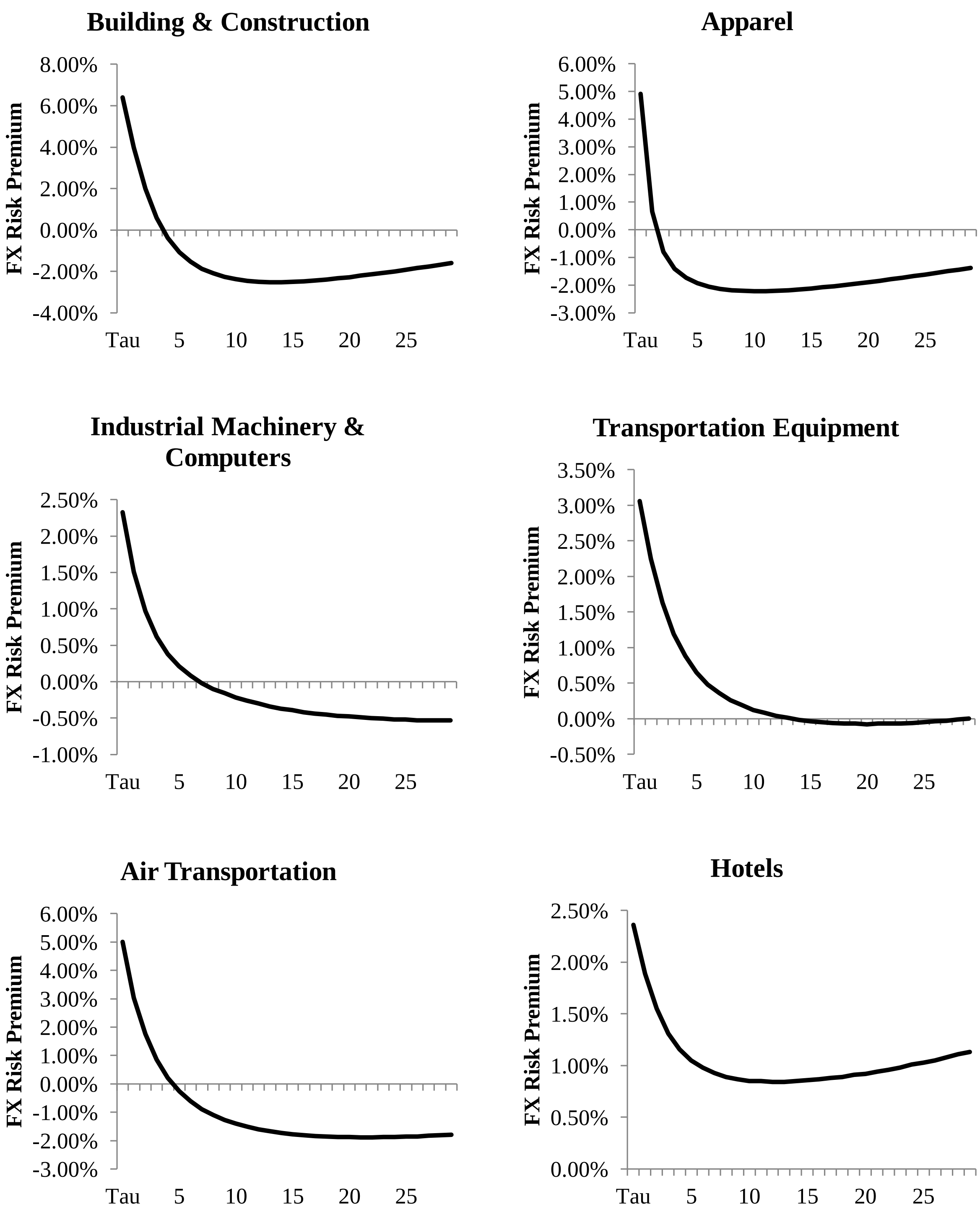


Figure 2. Selected Industry FX Risk Premiums– December 2011. Figure 2 shows FX Risk premiums at the end of our sample period (December 2011), for a sub-sample of six industries: 1) SIC 15 Building and Construction; 2) SIC 45 Air Transport; 3) SIC 70 Hotels; 4) SIC 35 Industrial Machinery & Computers; 5) SIC 37 Transportation Equipment; and 6) SIC 23 Apparel. The FX risk-premium is defined as the difference between the two discount curves based on the GCAPN and InCAPM.

Table IV
Valuation and Mispricing

In Table IV we value an end-of-year $1 annuity for a window of 30-Years using: 1) Constant industry cost of equity estimates based on the single-factor GCAPM model ($GCAPM_Con$); constant industry cost of equity estimates on the two-factor InCAPM ($InCAPM_Con$); the discount rate spot curve based on the single-factor GCAPM model ($GCAPM_Term$); and finally, the term structure of the cost of industry equity capital based on the two-factor InCAPM ($InCAPM_Term$). We assume a valuation date of December 2011. Panel A reports the $ value of the 30-Year annuities in bold numbers. The pricing error is defined as: $\frac{Wrong-correct}{correct}$ where we assume that $InCAPM\_Term$ is the most complete model that captures the FX risk aspect and changing betas, gammas and risk premiums. [Mispricing is reported in percentage terms]. We report results for the following subsample: Building and Construction (SIC 15), Apparel (SIC 23), Industrial Machinery and Computers (SIC 35), Transportation Equipment (SIC 37), Air Transportation (SIC 45), Hotels (SIC 70), and the pooled industry portfolio. Panel B presents the static global market and FX risk loadings of the models (the estimation period is 1978 to 2011) and the resulting constant industry cost of equity estimates. Robust (Newey-Weat HAC) P-values are reported in brackets.

Panel A: Mispricing Effects	$GCAPM\_Con$	$InCAPM\_Con$	$GCAPM\_Term$	$InCAPM\_Term$
Building and Construction	9.8576	7.4894	8.0752	9.2307
	[6.79%]	[-18.86%]	[-12.52%]	
Apparel	9.4431	7.5660	8.5549	9.8621
	[-4.25%]	[-23.28%]	[-13.25%]	
Industrial Machinery and Computers	9.3488	8.3607	9.2270	9.3375
	[0.12%]	[-10.46%]	[-1.18%]	
Transportation Equipment	11.5727	9.7649	8.7999	8.5934
	[34.67%]	[13.63%]	[2.40%]	
Air Transportation	16.6864	11.8432	14.8663	17.6274
	[-5.34%]	[-32.81%]	[-15.66%]	
Hotels	10.0803	8.9382	6.8721	6.4614
	[56.01%]	[38.33%]	[6.36%]	
Pooled Industry Portfolio	9.6761	8.4767	8.0265	7.7229
	[25.29%]	[9.76%]	[3.93%]	
Panel B: Static Model Estimates	β^{TF}	γ	$Static\_NO$	$Static\_FX$
Building and Construction	**1.3985**	**-0.9560**	**0.1047**	**0.1401**
	(0.0000)	(0.0000)		
Apparel	**1.2146**	**-0.7800**	**0.1098**	**0.1387**
	(0.0000)	(0.0000)		
Industrial Machinery and Computers	**1.2153**	**-0.3794**	**0.1110**	**0.1250**
	(0.0000)	(0.0013)		
Transportation Equipment	**1.2207**	**-0.5059**	**0.0871**	**0.1058**
	(0.0000)	(0.0000)		
Air Transportation	**1.1955**	**-0.8577**	**0.0530**	**0.0847**
	(0.0000)	(0.0000)		
Hotels	**1.4280**	**-0.3876**	**0.1022**	**0.1165**
	(0.0000)	(0.0662)		
Pooled Industry Portfolio	**1.1016**	**-0.4416**	**0.1069**	**0.1232**
	(0.0000)	(0.0000)		

Figure 3. Cumulative Pricing Errors for Selected Industries. Figure 3 shows the pricing error of a n-period $1 annuity, where n is depicted on the x-axis. The Figure shows the results for a sub-sample of six industries: 1) Building and Construction (SIC 15); 2) Apparel (SIC 23); 3) Industrial Machinery and Computers (SIC 35); 4) Transportation Equipment (SIC 37); 5) Air Transportation (SIC 45); and 6) Hotels (SIC 70). We assume that the 'correct' model is the term structure that was calculated using a two-factor InCAPM. This model captures the FX exposure if industries. The 'wrong' model in our analysis is the one-factor GCAPM that ignores industry FX exposure. The valuation date is December 2011.

Table V
FX Risk Premiums and Industry Characteristics

In Panel A of Table V we present results of the following cross-sectional regressions for our 39 U.S. industries:

$$FX_{Premium,i} = \alpha + \beta_1 SIZE_i + \beta_2 FINC_i + \beta_3 LEV_i + \beta_4 LIQ_i + \beta_5 GROW_i + \varepsilon_i$$

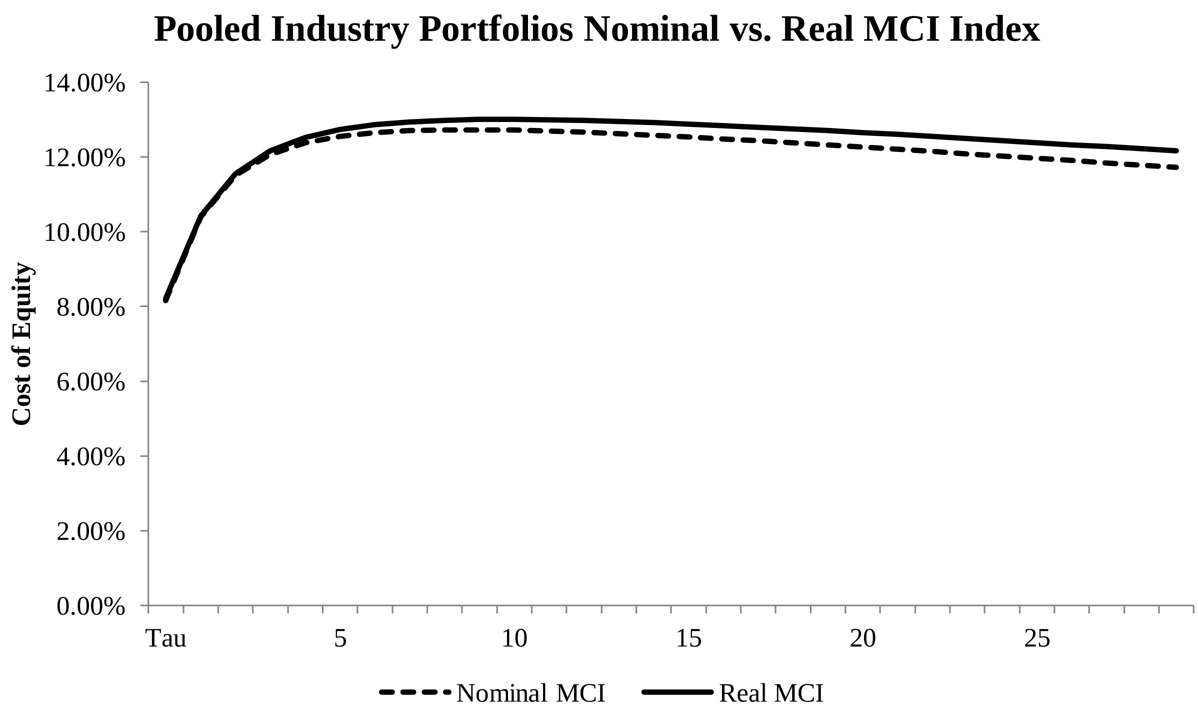
where $FX_{Premium,i}$ is one of the following FX risk premiums: 1) FX risk premium short, which is the industry FX risk premium for cash flows with a 1-Year maturity; 2) FX risk premium medium, this is the 10-Year maturity FX risk premium; 3) FX risk premium long, is the industry FX risk premium for cash flows with a 30-Year maturity. $SIZE$ is the average industry log size (market capitalization), $FINC$ is calculated as $|PIFO|/Sales$ where $PIFO$ is 'income before taxes from a foreign source' and $Sales$ is average sales revenue, LEV is the ratio of the sum of short-term and long-term debt and assets; LIQ is the average Quick ratio, and $GROW$ is the average Market-to-Book ratio of the industry. All industry characteristics are average values based on annual Compustat data spanning the period 1978 to 2011. White's HC-consistent P-Values are shown in parentheses. Panel B shows the correlations between the industry characteristics.

Panel A: Regression Results

$Intercept$	$SIZE$	$FINC$	LEV	LIQ	$GROW$	$FTest$	$Adj. R^2$
FX Risk Premium Short							
0.0418	**-0.0086**	**-0.1289**	**0.0460**	**0.0184**	**0.0114**	**4.75**	**0.3306**
(0.0021)	(0.0031)	(0.0096)	(0.1186)	(0.1261)	(0.0061)	(0.0022)	
FX Risk Premium Medium							
-0.0067	**0.0022**	**0.0425**	**-0.0056**	**-0.0104**	**-0.0038**	**1.27**	**0.0343**
(0.4740)	(0.1762)	(0.0194)	(0.6820)	(0.1066)	(0.1189)	(0.3000)	
FX Risk Premium Long							
0.0023	**0.0003**	**0.0421**	**-0.0065**	**-0.0117**	**-0.0020**	**0.72**	**-0.0381**
(0.8247)	(0.8649)	(0.0417)	(0.7006)	(0.1325)	(0.4102)	(0.6124)	

Panel B: Correlations of Industry Characteristics

	$SIZE$	$FINC$	LEV	LIQ	$GROW$
$SIZE$	**1**	**0.1094**	**0.2659**	**-0.2152**	**0.4535**
		(0.5072)	(0.1019)	(0.1883)	(0.0037)
$FINC$		**1**	**-0.1686**	**0.2337**	**0.3510**
			(0.3049)	(0.1522)	(0.0285)
LEV			**1**	**-0.1549**	**0.0381**
				(0.3464)	(0.8180)
LIQ				**1**	**-0.1639**
					(0.3188)
$GROW$					**1**



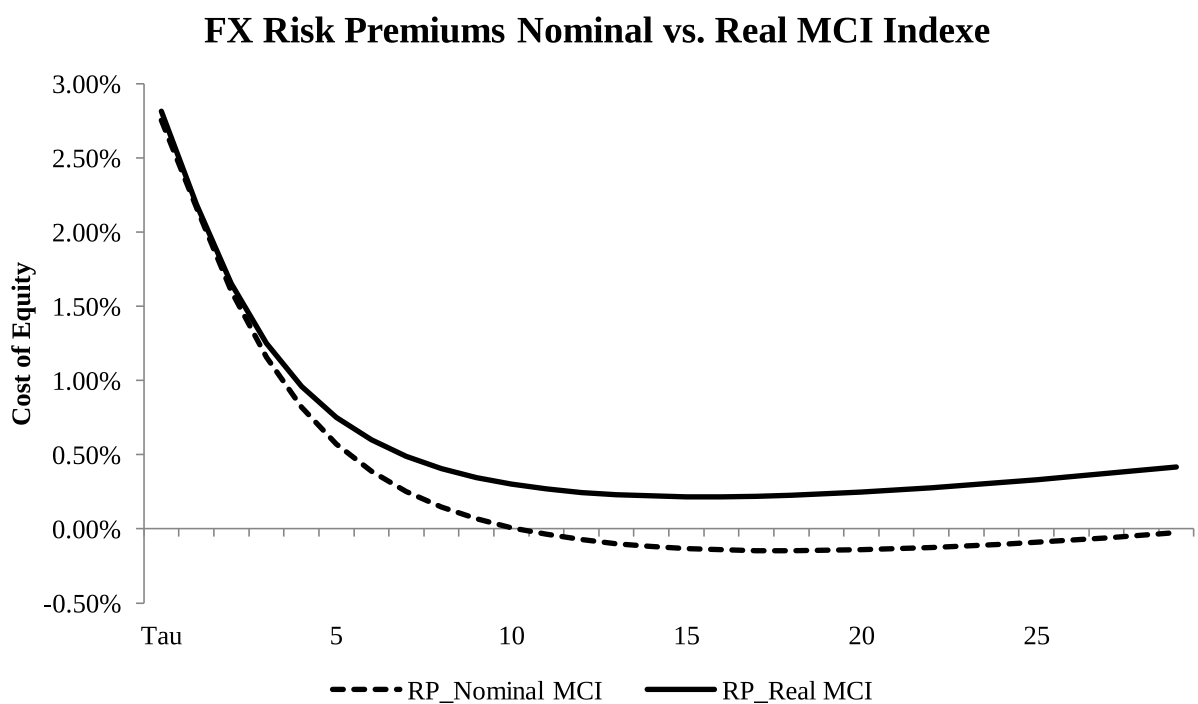
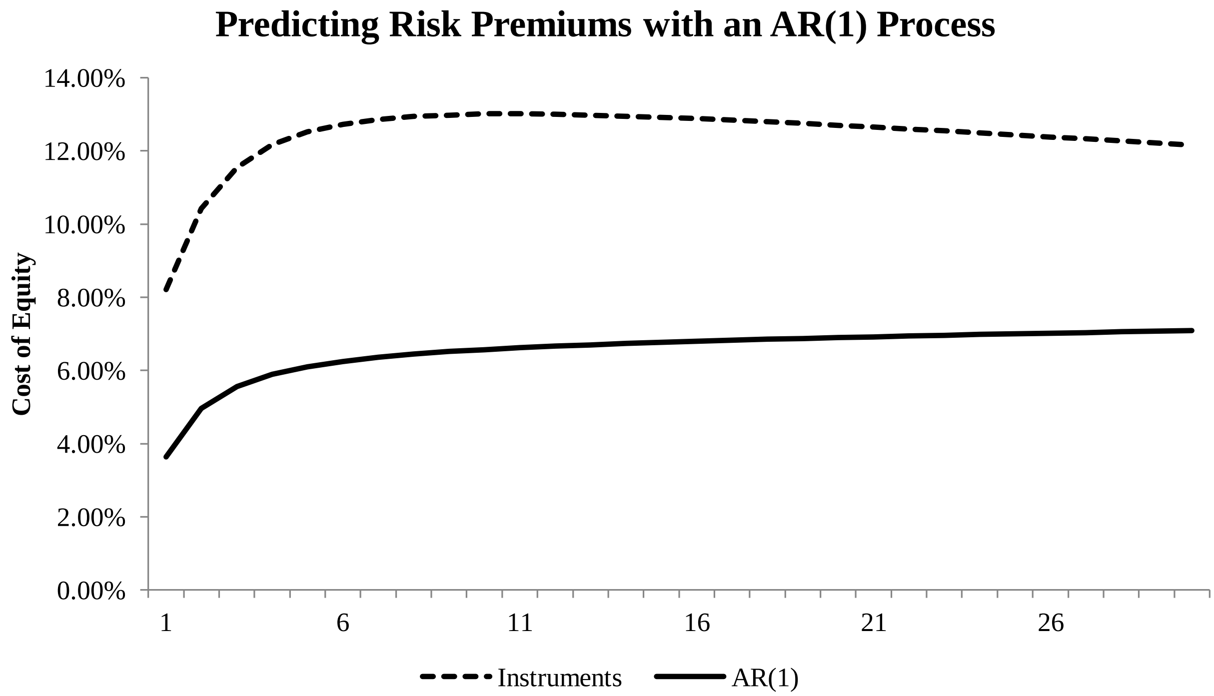


Figure 4. Discount Curves for the Pooled Industry Portfolio – Nominal vs. Real MCI Index. The top of Figure 4 shows the discount curves $\mu_t(n)$, with n years on the horizontal axis, computed at the end of our sample period (December 2011) for the pooled industry portfolio. The graph compares the results based on the two-factor InCAPM, using both, a nominal Major Currency Index, as well as our previously real MCI Index. The bottom of Figure 1 shows the corresponding two FX risk premiums for the pooled industry portfolio.



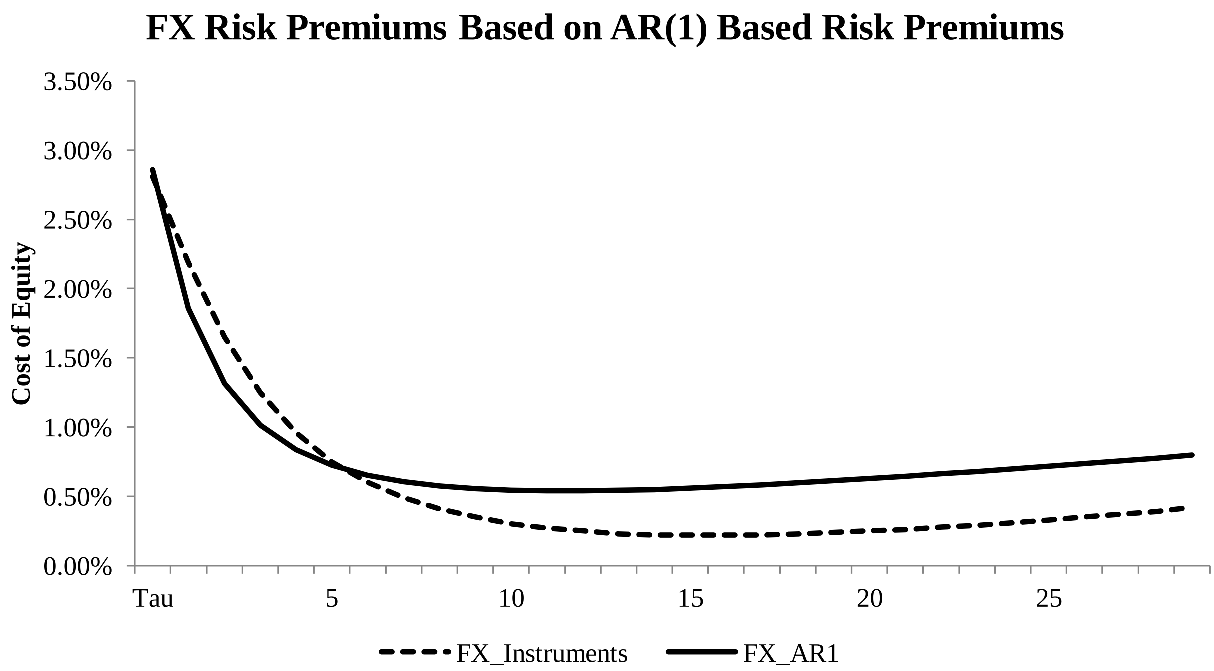


Figure 5. Discount Curves for the Pooled Industry Portfolio – Predicting Risk Premiums with an AR(1) Process. The top of Figure 5 shows the discount curves $\mu_t(n)$, with n years on the horizontal axis, computed at the end of our sample period (December 2011) for the pooled industry portfolio. The graph compares the results based on the two-factor InCAPM, using risk premiums on the previously used instrumental variable approach and a simpler AR(1) process. The bottom of Figure 1 shows the corresponding two FX risk premiums for the pooled industry portfolio.