ESSAYS IN EMPIRICAL ASSET PRICING

by

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ABSTRACT

XI MO. Essays in empirical asset pricing. (Under the direction of DR. YUFENG HAN &DR. I-HSUAN ETHAN CHIANG)

This dissertation contains two essays on empirical asset pricing. The first essay tests a two-beta currency pricing model that features betas with risk-premium news and real-rate news of the currency market. I find that the beta associated with risk-premium news is “bad” because of a significantly positive price of risk of 2.52% per year; beta with global real-rate news is “good” because of a negative price of risk. Moreover, I show that the price of risk-premium-beta risk is countercyclical, whereas the price of the real-rate beta risk is procyclical. Under my two-beta asset pricing model, most prevailing currency trading strategies have either excessive “bad beta” or too little “good beta”, thus fail to deliver abnormal performance. The main driver of the results is precautionary savings, consistent with my theoretical implications.

In the second essay, I test whether the trend factor works across different countries and markets. I find consistent evidence that the trend factor which captures information in moving average prices of various time lengths, can generate positive Sharpe ratio across most of the developed countries. It outperforms the market portfolio, short-term reversal, momentum, and long-term reversal in most of the developed countries. I further examine how cultural differences influence the success of the trend factor. The empirical results show that the trend factor is more profitable in countries where the individualism is higher. The performance of the global trend factor is robust to different subperiods and subsamples. From an asset pricing perspective, it also performs well in explaining returns of global portfolios sorted based on different attributes.

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1.1 Introduction

This paper tests a new two-beta intertemporal capital asset pricing model (ICAPM) for currencies and uses it to analyze currency trading strategies.

Recent literature on currency risk premiums has identified the predominant common factor in currency returns as the "dollar factor," an equally weighted portfolio of floating exchange rate currencies (see Lustig, Roussanov, and Verdelhan (2011), Menkhoff, Sarno, Schmeling, and Schrimpf (2012a), Brusa, Ramadorai, and Verdelhan (2017), Verdelhan (2018) among others). Although the dollar factor resembles the "market portfolio" in CAPM, it is a stylized fact that the relation between currency returns and currency betas with respect to the dollar factor, called "dollar betas," is too flat to explain the cross-sectional variation in expected returns. [1]

We address the "flat dollar beta versus premium" issue differently. Motivated by the decomposition of the real exchange rates into risk-premium and real-rate components (see Froot and Ramadorai (2005), Engel (2016), Balduzzi and Chiang (2020)), we decompose the conventional dollar beta into two betas: beta with currency market risk-premium news ("risk-premium beta") and beta with market-wide real interest rate news ("real-rate beta"). The two news components are not highly correlated, and the two new betas capture distinct components of currency returns, so they can explain more cross-sectional variations in currency risk premiums. This framework extends the two-beta model of Campbell and

[1] Researchers have proposed other factors, such as consumption (Lustig and Verdelhan (2007)), slope (Lustig, Roussanov, and Verdelhan (2011)), volatility (Menkhoff, Sarno, Schmeling, and Schrimpf (2012a)), downside risk (Lettau, Maggiori, and Weber (2014)), global dollar and carry (Verdelhan (2018),) coskewness (Chan, Yang, and Zhou (2018)), and tail risk (Gao, Lu, and Song (2019)), among others.

Vuolteenaho (2004) featuring stock return comovements with equity market discount-rate news ("discount-rate beta") and equity market cash-flow news ("cash-flow beta"); note the Campbell and Vuolteenaho (2004) model is motivated by the Campbell and Shiller (1988) decomposition of the dividend-to-price ratio into discount-rate and cash-flow components.

We ask the following empirical questions: Are the two new currency betas associated with significant prices of beta risks? Are there—borrowing the terminology of Campbell and Vuolteenaho (2004)—"good betas" (betas associated with relatively low price of risk) and "bad betas" (betas associated with relatively high price of risk)? Do the prices of risks comove with economic conditions? Finally, can the model explain rewards from notable currency trading strategies, such as carry trade, momentum, and value strategies?

Employing the two new currency betas, we test the two-beta ICAPM for currency returns. Our test features time-varying betas and time-varying prices of beta risks and hence generalizes the formulation of Campbell and Vuolteenaho (2004) that primarily focuses on the case with constant betas and constant prices of beta risks. Modeling time-variation in risk measures and risk premiums is crucial when testing currencies, because a vast empirical literature rejects the uncovered interest rate parity, suggesting time-variation in risk premiums. Lustig, Roussanov, and Verdelhan (2014) show that currency risk premiums are predictable by the average forward discount (AFD), a countercyclical economic indicator, and Balduzzi and Chiang (2020) show that the real exchange rate predicts currency risk premiums negatively. Theories also suggest time-varying currency risk premiums, which can be due to a surplus consumption differential (Verdelhan (2010)), a consumption volatility differential (Bansal and Shaliastovich (2013)), and rare disasters (Farhi and Gabaix (2016)), among others, and these theories reproduce empirical currency return predictability patterns.

The economic mechanism behind our formulation is intuitive. Assets with a positive risk-premium beta are risky, because their returns are lower when domestic investors become more risk averse or when domestic volatility is higher. Hence, we conjecture that the risk-premium beta is associated with countercyclical and an unconditionally positive price of risk. On the other hand, from the perspective of a U.S. investor, assets with a positive real-rate beta are hedges, because their returns are higher when the domestic inflation is high or when the domestic nominal interest rate is low. Note that low interest rates are associated with a bad economic state in the United States, where precautionary savings dominate. Hence, we conjecture that the real-rate beta is associated with procyclical and an unconditionally negative price of risk. In the relative sense, the risk-premium currency beta is the "bad beta," whereas the real-rate beta is the "good beta." Formally, inspired by Lustig, Roussanov, and Verdelhan (2011, 2014), and particularly Verdelhan (2018), we use a simple no-arbitrage model with both country-specific and global volatilities to derive the above implications. Assuming precautionary savings dominate in the home country, the model suggests that the cross-sectional variation in betas is due to various exposures to country-specific or global shocks and high risk-premium-beta currencies depreciate in bad times, whereas high real-rate-beta currencies appreciate in bad times. The model also motivates time-variation in betas and prices of risks, which is driven by U.S. and global volatilities and can be potentially explained by AFD or real exchange rates.

Our empirical tests assume the United States is the home country, and the two-beta currency ICAPM robustly produces evidence consistent with our theoretical predictions. The risk-premium beta is associated with a significantly positive *unconditional* price of risk of 2.52% per year (t-ratio = 3.42), and the real-rate beta has a negative price of risk.[2] Furthermore, we document even stronger and more robust *conditional* price of risk results. Using the countercyclical indicator AFD to represent economic conditions, we find the price of risk-premium-beta risk is *countercyclical*: the risk-premium beta becomes relatively "better" in good times (i.e., a lower price of risk) and "worse" in bad times (i.e., a higher price of risk). The price of risk-premium-beta risk is 4.44% (t-ratio = 7.80) per annum higher when AFD rises by 1 standard deviation. On the other hand, the price of real-rate-beta risk is *procyclical*:

[2]To illustrate the statistical and economic significance, here we take the estimates from a no-intercept model with rolling betas, associated with time-varying prices of beta risks, whose dynamics is driven by AFD.

investors are willing to pay more to hold a hedge during bad times and pay less in good times. When an intercept (the risk premium of a zero-beta portfolio) is allowed, it is estimated at -0.01% per month and statistically indistinguishable from zero (t-ratio $= -0.44$), suggesting that the two-beta ICAPM explains the cross-section of currency premiums very well. It is noteworthy to mention that these results are free of look-ahead bias, because the news, the betas, and AFD are all observable at time t, whereas the dependent variable is the time $t+1$ excess currency return. We also use a simulation to validate that these results are not due to errors-in-variable and finite-sample biases.

We then utilize our estimation results to analyze the performance of several notable recent currency trading strategies, including a dollar carry trade (Lustig, Roussanov, and Verdelhan (2014)), a high-minus-low carry trade, a country-level carry trade, a purchasing power parity (PPP) deviation, a momentum, and a value (Asness, Moskwitz, and Pedersen (2013)) strategies. We find most currency trading strategies either have excessive "bad beta" or too little "good beta," failing to deliver abnormal performance. The only strategy with a significantly positively alpha is the high-minus-low carry trade. The other strategies do not have a significantly positive bias-adjusted alpha.

This paper is related to Atanasov and Nitschka (2015), who adopt the same equity market setting of Campbell and Vuolteenaho (2004) to study currency returns. In turn, their "market portfolio" is the CRSP stock market index; their "discount-rate beta" and "cash-flow beta" capture cross-market comovement between currency returns and *domestic equity-market* discount-rate and cash-flow news; and their dynamics of conditional expectations are based on equity-market state variables, like in Campbell and Vuolteenaho (2004). We argue that currency market-wide news is more relevant than equity market news, because exchange rates hinge on cross-country differentials in interest rates and in purchasing power, which are not explicit in the equity-market news components. For example, precautionary savings, as a main driver of our results, are absent in equity-market news. Although the analysis of Atanasov and Nitschka (2015) obtains interesting results (that the betas with respect to equity discount-rate/cash-flow news are good/bad betas, consistent with Campbell and Vuolteenaho (2004)), our empirical analysis differs from theirs, because (1) we use the dollar factor as the market factor; (2) our decomposition of the conventional beta is motivated by an exact present value decomposition of real exchange rates; and (3) we allow for time-varying prices of risks, explicitly driven by macroeconomic variables, with potentially richer implications.[3] These considerations are consistent with recent developments in currency studies, and their theoretical implications are discussed in this paper. Furthermore, we take a step forward to show that our framework can explain the profitability of various currency trading strategies.

1.2 A Two-Beta ICAPM for Currencies

1.2.1 Risk-premium news and real-rate news

Suppose $s_{j,t}$ is the time t directly quoted log nominal exchange rate of the currency of country j; $\tilde{s}_{j,t}$ is the log real exchange rate of currency j (defined as the log nominal exchange rate, plus the differential between foreign and domestic log price levels); $dr_{j,t}$ is the log nominal risk-free interest-rate differential between country j and the home country; and $d\pi_{j,t}$ is the log inflation differential between country j and the home country. Throughout this paper, we use $X_{j,t}$ to denote a time t observable variable X of currency or country j, $\tilde{X}$ to denote the real (as opposed to nominal) quantity of X, $dX_{j,t}$ to denote the differential in X between country j and the home country, and $\Delta X_t \equiv X_t - X_{t-1}$ to denote the first-order difference in X.

The log excess return on currency j is defined as

$$\xi_{j,t} \equiv \Delta s_{j,t} + dr_{j,t-1} = (\Delta s_{j,t} + d\pi_{j,t}) + (dr_{j,t-1} - d\pi_{j,t}) \tag{1.1}$$

$$\equiv \Delta \tilde{s}_{j,t} + d\tilde{r}_{j,t}, \tag{1.2}$$

[3] Interestingly, the results of Atanasov and Nitschka (2015) are reversed after controlling for our risk-premium and real-rate betas.

where the log real currency return and the real interest rate differential are

$$\Delta\tilde{s}_{j,t} \equiv \Delta s_{j,t} + d\pi_{j,t}, \tag{1.3}$$

$$d\tilde{r}_{j,t} \equiv dr_{j,t-1} - d\pi_{j,t}, \tag{1.4}$$

respectively. The present value decomposition of real exchange rates (Froot and Ramadorai (2005), Engel (2016), Balduzzi and Chiang (2020)) is

$$\tilde{s}_{j,t} - E(\tilde{s}_{j,t}) = -\sum_{i=1}^{\infty} E_t(\xi_{j,t+i}) + \sum_{i=1}^{\infty} E_t(d\tilde{r}_{j,t+i}) \tag{1.5}$$

(see the Internet Appendix for the proof). Equation (1.5) shows that the real exchange rate dynamics are driven by cumulative deviations from uncovered interest rate parity, as well as cumulative deviations from real rate equality. Unlike the first-order approximate decomposition of the dividend-to-price ratio of Campbell and Shiller (1988), the above decomposition is an *exact* decomposition. This decomposition only requires a weak condition: the deviation from purchasing power parity has a well-defined long-run mean; that is, the real exchange rate is stationary.[4]

We can utilize the present value decomposition of real exchange rates in Equation (1.5) to decompose an excess currency return innovation into two news components:

$$\xi_{j,t+1} - E_t(\xi_{j,t+1}) \tag{1.6}$$

$$= -\underbrace{\sum_{i=1}^{\infty} [E_{t+1}(\xi_{j,t+1+i}) - E_t(\xi_{j,t+1+i})]}_{\textbf{risk-premium news}} + \underbrace{\sum_{i=1}^{\infty} [E_{t+1}(d\tilde{r}_{j,t+i}) - E_t(d\tilde{r}_{j,t+i})]}_{\textbf{real-rate news}} \tag{1.7}$$

$$\equiv -\eta^{\xi}_{j,t+1} + \eta^{d\tilde{r}}_{j,t+1}, \tag{1.8}$$

where both news components—risk-premium news (η^{ξ}_{t+1}) and real-rate news ($\eta^{d\tilde{r}}_{t+1}$)—capture

[4]Even if we allow for nonstationarity and include an additional correction term in our decomposition of currency return innovation, the impact is empirically very small and negligible.

changes of conditional expectations due to updated information set (see the Internet Appendix for the derivation; see also Campbell (1991), Froot and Ramadorai (2005)).[5] Throughout, we reserve the term "news" for the above updates of long-term expectations. Short-term differences between realizations and conditional expectations will be called "innovations."

1.2.2 Dynamics of state variables

To operationalize the two-way decomposition of currency excess return innovations, we must describe the dynamics of the state variables. Following Balduzzi and Chiang (2020), we assume the following vector autoregressive (VAR) process:

$$y_{j,t+1} = B_j y_{j,t} + \epsilon_{j,t+1}, \tag{1.9}$$

where $y_{j,t} = y^{\dagger}_{j,t} - E(y^{\dagger}_{j,t})$ and $y^{\dagger}_{j,t} = [\xi_{j,t}\ dr_{j,t}\ d\pi_{j,t}\ \tilde{s}_{j,t}]^{\top}$. Note the above choice of VAR variables and framework leads to reliable and robust results. For example, Balduzzi and Chiang (2020) use the same VAR to reproduce some empirical stylized facts that are initially obtained by a vector error correction model (VECM). This VAR formulation also addresses the criticism raised by Chen and Zhao (2009) of the unreliable empirical results in Campbell and Vuolteenaho (2004): Chen and Zhao (2009) find the return decomposition may be empirically sensitive to the dynamics of state variables, especially when not all of the components of return are explicitly modeled. For example, the VAR of Campbell and Vuolteenaho (2004) only models the discount rate, and the cash flow component is the residual in the return innovation. Chen and Zhao (2009) suggest a remedy: each component should be modeled directly, which is exactly the case of our VAR. In fact, it is a very parsimonious formulation in this regard.

[5] Although it is possible to have a finer decomposition to separate real-rate effects into nominal rate effects and inflation effects, little variation is driven by inflation. Empirically, we experiment with a three-way decomposition of the betas and find qualitatively similar results.

According to the VAR model, the risk-premium and real-rate news are

$$\eta^{\xi}_{j,t+1} = \iota_1^{\top}[(I - B_j)^{-1}B_j]\epsilon_{j,t+1}, \tag{1.10}$$

$$\eta^{d\tilde{r}}_{j,t+1} = (\iota_2 - \iota_3)^{\top}[(I - B_j)^{-1}]\epsilon_{j,t+1}, \tag{1.11}$$

where ι_i is a selection vector with the ith element being 1 and 0 otherwise. See the Internet Appendix for the derivation.

1.2.3 Currency betas

As the dollar factor (D) is an equally weighted portfolio of available currencies, its excess return is

$$\xi_{D,t+1} \equiv \frac{1}{N_t}\sum_j \xi_{j,t+1}, \tag{1.12}$$

for all j available in both t and $t+1$, and N_t is the number of these available currencies. The definitions of risk-premium news and real-rate news of the dollar factor follow:

$$\xi_{D,t+1} - E_t(\xi_{D,t+1}) = -\frac{1}{N_t}\sum_j \eta^{\xi}_{j,t+1} + \frac{1}{N_t}\sum_j \eta^{d\tilde{r}}_{j,t+1} \tag{1.13}$$

$$\equiv -\eta^{\xi}_{D,t+1} + \eta^{d\tilde{r}}_{D,t+1}. \tag{1.14}$$

Following Campbell and Vuolteenaho (2004), we define currency j's betas with respect to the dollar factor news:

$$\textbf{Risk-premium beta of currency } j\textbf{:} \quad \beta^{\xi}_j = \frac{\mathbf{cov}[\xi_{j,t+1} - E_t(\xi_{j,t+1}), -\eta^{\xi}_{D,t+1}]}{\mathbf{var}[\xi_{D,t+1} - E_t(\xi_{D,t+1})]}, \tag{1.15}$$

$$\textbf{Real-rate beta of currency } j\textbf{:} \quad \beta^{d\tilde{r}}_j = \frac{\mathbf{cov}[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{d\tilde{r}}_{D,t+1}]}{\mathbf{var}[\xi_{D,t+1} - E_t(\xi_{D,t+1})]}, \tag{1.16}$$

where particular attention must be paid to the negative signs associated with risk-premium news. The overall beta β^D_j, which is the conventional CAPM beta, is the sum of the two betas:

$$\beta_j^D = \frac{\mathbf{cov}[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \xi_{D,t+1} - E_t(\xi_{D,t+1})]}{\mathbf{var}[\xi_{D,t+1} - E_t(\xi_{D,t+1})]} = \beta_j^{\xi} + \beta_j^{d\tilde{r}}, \tag{1.17}$$

and $\beta_D^D = 1$, trivially.[6] Replacing unconditional variances and covariances by conditional moments, conditioning on time t information, obtains conditional version of betas: $\beta_{j,t}^{\xi}$, and $\beta_{j,t}^{d\tilde{r}}$, and of two-way decomposition of the conditional overall dollar beta, such that

$$\beta_{j,t}^D = \beta_{j,t}^{\xi} + \beta_{j,t}^{d\tilde{r}}. \tag{1.18}$$

1.2.4 Price of risk and rewards for risk

With the two betas, we posit the following two-beta ICAPM for currencies:

$$E_t(\xi_{j,t+1}) = \beta_{j,t}^{\xi}\lambda_t^{\xi} + \beta_{j,t}^{d\tilde{r}}\lambda_t^{d\tilde{r}}, \tag{1.19}$$

where λ_t^{ξ} and $\lambda_t^{d\tilde{r}}$ are the price of risk-premium-beta risk and the price of real-rate-beta risk, conditional on time t information set. Motivated by Ferson and Harvey (1991), the price of beta risk is assumed to be affine in macroeconomic variables z_t:

$$\textbf{Price of risk-premium-beta risk:} \quad \lambda_t^{\xi} = \lambda_0^{\xi} + z_t^{\top}\lambda_z^{\xi}, \tag{1.20}$$

$$\textbf{Price of real-rate-beta risk:} \quad \lambda_t^{d\tilde{r}} = \lambda_0^{d\tilde{r}} + z_t^{\top}\lambda_z^{d\tilde{r}}. \tag{1.21}$$

Here, λ_0 can be interpreted as the *unconditional* price of risk in time dimension if the unconditional mean of z_t is removed from z_t. More restricted models may set beta, the price of beta risk, or both to be time invariant. Furthermore, to avoid confusion with other "risk-premium"-related terms, we call the product of a beta and its price of risk the "reward for

[6] A subtle difference between our beta definition and that of Campbell and Vuolteenaho (2004) is their first term inside the covariance operator is $\xi_{j,t+1}$, whereas we use $\xi_{j,t+1} - E_t(\xi_{j,t+1})$ to demonstrate that $N^{-1}\sum_j(\beta_j^{\xi} + \beta_j^{d\tilde{r}}) = N^{-1}\sum_j \beta_j^D = 1$ is ensured. Both definitions are in fact equivalent, because the conditional expectation is driven by lagged instruments, which are orthogonal to innovations.

beta risk," namely,

$$\textbf{Reward for risk-premium-beta risk in currency } j\textbf{:} \quad \beta^{\xi}_{j,t}\lambda^{\xi}_{t}, \tag{1.22}$$

$$\textbf{Reward for real-rate-beta risk in currency } j\textbf{:} \quad \beta^{d\tilde{r}}_{j,t}\lambda^{d\tilde{r}}_{t}. \tag{1.23}$$

1.2.5 Key insights

Are the risk-premium and real-rate betas "good" or "bad"? We provide an intuitive answer in this section.

Assets with positive risk-premium beta or, equivalently $\mathbf{cov}[\xi_{j,t+1}-E_t(\xi_{j,t+1}), -\eta^{\xi}_{D,t+1}] > 0$, are systematically risky. This is because when domestic risk aversion becomes surprisingly larger (or consumption becomes more volatile), domestic investors require higher risk premiums and market-wide risk-premium news is positive ($\eta^{\xi}_{D,t+1} > 0$, or equivalently $-\eta^{\xi}_{D,t+1} < 0$). Hence, positive market-wide risk-premium news is *bad* news.[7] Assets with surprisingly lower return ($\xi_{j,t+1} - E_t(\xi_{j,t+1}) < 0$) will hurt the domestic investors, and, thus, investors require positive risk premium from positive risk-premium-beta currencies. If the price of risk were time varying, we conjecture it is countercyclical, which can be theoretically motivated by countercyclical risk aversion in the habit model of Campbell and Cochrane (1999) and Verdelhan (2010) or by changes in the consumption volatility in the long-run risks model of Bansal and Yaron (2004) and Bansal and Shaliastovich (2013).[8] Empirically, Lustig, Roussanov, and Verdelhan (2014) show AFD positively predicts currency risk premiums, and Balduzzi and Chiang (2020) show the real exchange rate negatively predicts currency risk premiums. As AFD is countercyclical and real exchange rate is procyclical, currency risk premiums are known to be countercyclical.

On the other hand, assets with a positive real-rate beta or, equivalently, $\mathbf{cov}[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{dr}_{D,t+1}] > 0$, are hedges. This is because positive market-wide real-rate news

[7]Although this argument is intuitive, it may overlook the effects of global shocks on countries with various exposures. See Section 1.2.6 for further details.

[8]Long-run risks models can technically generate procyclical risk premium by setting the intertemporal elasticity of substitution lower than 1, which is counterfactual.

($\eta^{d\tilde{r}}_{D,t+1} > 0$) is due to a lower domestic nominal interest rate (which is procyclical because of the precautionary savings effects) or higher domestic inflation (which reduces internal purchasing power), and investors are worse off in either situation.[9] Hence, positive market-wide real-rate news is also *bad* news.[10] Assets with a surprisingly higher return ($\xi_{j,t+1} - E_t(\xi_{j,t+1}) > 0$) give domestic investors a hedge, and, hence, the price of real-rate-beta risk should be negative. When allowing for time variation, we conjecture that the price of real-rate-beta risk is procyclical. In other words, investors with a preference for countercyclical risk premiums should be willing to pay more to hold the hedge in bad times.

Note our two-beta ICAPM has very different theoretical implications from those in the model of Campbell and Vuolteenaho (2004) and Atanasov and Nitschka (2015), whose prices of risks are both theoretically positive. Although our risk-premium component shares a similar mechanism with their discount-rate component, our real-rate component is conceptually different from their cash-flow component. This is because a positive equity market cash-flow shock is good news to an investor who holds the market portfolio, whereas a positive currency market real-rate news can make domestic investors worse off.

1.2.6 A no-arbitrage model with global and country-specific shocks

We now relate our risk-premium beta and real-rate beta to the affine class of no-arbitrage models with global and country-specific shocks.[11] This model shows that we need both risk-premium and real-rate betas to explain the cross-section of currency premiums, that the

[9] Note these comparisons can be in *relative* sense, because in equilibrium models the exchange rates are determined by the *relative* states of the economy, i.e., the log pricing kernel differential. For example, an interest rate differential can be higher, when both domestic and foreign countries have higher interest rates, whereas the domestic increment is smaller than the foreign increment.

[10] While both risk-premium news and real-rate news are bad news, they are fundamentally different risks. Risk-premium news is related to market risk aversion and/or volatility, whereas real-rate news is related to the degree of precautionary savings.

[11] The model presented here shares similarities with the models in Lustig, Roussanov, and Verdelhan (2011, 2014), and particularly Verdelhan (2018). Lustig, Roussanov, and Verdelhan (2011, 2014) do not have enough flexibility to allow for two betas to drive the cross-sectional variation in risk premiums. Verdelhan (2018) have separate sets of shocks for states of the economy versus state variables, but the correlation structure is unclear. We follow term structure model convention, as well as Lustig, Roussanov, and Verdelhan (2011, 2014), to tighten these shocks such that we do not need to specify the correlation structure of the two sets of shocks, while keeping the results trackable.

higher risk-premium-beta currencies are systematically riskier, and that higher real-rate-beta currencies are hedges. Furthermore, the prices of risks are correlated with AFD or average real exchange rates. Assuming complete financial markets and frictional goods market, we start from the model developed by Verdelhan (2018), who assumes the log real pricing kernel in country j follows an affine conditionally Gaussian process:[12]

$$-\tilde{m}_{j,t+1} = c_j + \chi_j \sigma_{j,t}^2 + \tau_j \sigma_{w,t}^2 + \gamma_j \sigma_{j,t} u_{j,t+1} + \delta_j \sigma_{w,t} u_{w,t+1} + \kappa_j \sigma_{j,t} u_{g,t+1}, \tag{1.24}$$

where the state variables are the country-specific volatility ($\sigma_{j,t}^2$) and world volatility ($\sigma_{w,t}^2$), and they follow square-root processes (Lustig, Roussanov, and Verdelhan (2011), Lustig, Roussanov, and Verdelhan (2014)):

$$\sigma_{j,t+1}^2 = (1-\rho)\mu + \rho \sigma_{j,t}^2 - \nu \sqrt{\sigma_{j,t}^2} u_{j,t+1}, \tag{1.25}$$

$$\sigma_{w,t+1}^2 = (1-\rho_w)\mu_w + \rho_w \sigma_{w,t}^2 - \nu_w \sqrt{\sigma_{w,t}^2} u_{w,t+1}. \tag{1.26}$$

Here, the Feller condition holds to ensure positive volatilities. A country-specific shock, $u_{j,t}$, is diversifiable when the number of countries N is large. We have two common, undiversifiable shocks: $u_{w,t+1}$ is a global shock associated with a country-specific parameter δ_j, and, hence, the differential in responses is permanent. The second global shock, $u_{g,t+1}$, is associated with the product of $\kappa_j \sigma_{j,t}$, and the differential in responses is transitory, because the product depends on country-specific economic conditions ($\sigma_{j,t}$). $u_{j,t}$ and $u_{w,t+1}$ appear in both the pricing kernel and the volatility processes. Parameters associated with the shocks, including γ_j, δ_j, κ_j, ν, and ν_w, are all positive. The shocks are standard normal and independent of each other. Throughout this section, the country subscript for variables and parameters is suppressed for the home country. Note both the domestic and the global shocks are *good*

[12] For simplicity we follow convention and consider an inflation-neutral model. Empirically, the consensus in the literature is that most movements in currencies are driven by the real effects. One could possibly include an inflation process, like the one used in Lustig, Roussanov, and Verdelhan (2014), but its variation does not enter risk premiums.

shocks, because positive shocks lower volatilities.

With the lognormal pricing kernel, we can find the real interest rates using $\tilde{r}_{j,t} = -[E_t(\tilde{m}_{j,t+1}) + \mathbf{var}_t(\tilde{m}_{j,t+1})/2]$. Motivated by Lustig, Roussanov, and Verdelhan (2011) and Verdelhan (2018), we assume $0 < \chi < (\gamma^2 + \kappa^2)/2$ for the home country to highlight the dominant precautionary savings effect in the United States. For simplicity, we set $\chi_j = (\gamma_j^2 + \kappa_j^2)/2$ for all other countries, leading to

$$\tilde{r}_{j,t} = c_j + (\tau_j - \frac{1}{2}\delta_j^2)\sigma_{w,t}^2, \tag{1.27}$$

$$\tilde{r}_t = c + \left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right]\sigma_t^2 + (\tau - \frac{1}{2}\delta^2)\sigma_{w,t}^2. \tag{1.28}$$

The assumption $\chi - (\gamma^2 + \kappa^2)/2 < 0$ shows that the domestic real rate drops when the domestic volatility is higher. The real rate differential is

$$d\tilde{r}_{j,t} = \tilde{r}_{j,t} - \tilde{r}_t = (c_j - c) - \left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right]\sigma_t^2 + \left[(\tau_j - \tau) - \frac{1}{2}(\delta_j^2 - \delta^2)\right]\sigma_{w,t}^2. \tag{1.29}$$

Here, countries with lower interest rates tend to have higher τ_j and lower δ_j. To impose the dominance of precautionary savings effect in the domestic country in the relative sense, we further assume $(\bar{\tau}_j - \tau) - (\bar{\delta}_j^2 - \delta^2)/2 > 0$, where the bars denote a cross-sectional average, that is, $\bar{X} = \sum_j X_j/N$, such that the real rate differential on average increases when global risk is higher. Lustig, Roussanov, and Verdelhan (2011) have a similar consideration and impose country-specific restrictions; hence, our assumption is weaker. This assumption is also realistic, because empirically the real rate differential, relative to the United States, is positive on average. Under this assumption, the average forward discount is *countercyclical*, that is, positively related to volatilities:

$$AFD_t \equiv \overline{\tilde{r}_{j,t}} - \tilde{r}_t = (\bar{c}_j - c) - \left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right]\sigma_t^2 + \left[(\bar{\tau}_j - \tau) - \frac{1}{2}(\overline{\delta_j^2} - \delta^2)\right]\sigma_{w,t}^2. \tag{1.30}$$

We can also find the real currency depreciation for currency j:

$$-\Delta\tilde{s}_{j,t+1} = \tilde{m}_{t+1} - \tilde{m}_{j,t+1} \tag{1.31}$$

$$= (c_j - c) + (\chi_j\sigma_{j,t}^2 - \chi\sigma_t^2) + (\tau_j - \tau)\sigma_{w,t}^2$$
$$+ (\gamma_j\sigma_{j,t}u_{j,t+1} - \gamma\sigma_t u_{t+1}) + (\delta_j - \delta)\sigma_{w,t}u_{w,t+1} + (\kappa_j\sigma_{j,t} - \kappa\sigma_t)u_{g,t+1}. \tag{1.32}$$

Here, currencies with lower δ_j (recall these are higher interest rate currencies) or lower $\kappa_j\sigma_{j,t}$ tend to depreciate more when there is a negative global shock ($u_{w,t+1} < 0$ or $u_{g,t+1} < 0$, respectively). In addition, under stationarity, the real exchange rates are

$$\tilde{s}_{j,t} = E(\tilde{s}_{j,t}) - \sum_{i=1}^{\infty} E_t(\Delta\tilde{s}_{j,t+i}) \tag{1.33}$$

$$= E(\tilde{s}_{j,t}) + \chi_j\frac{1}{1-\rho}\sigma_{j,t}^2 + (\tau_j - \tau)\frac{1}{1-\rho_w}\sigma_{w,t}^2 - \chi\frac{1}{1-\rho}\sigma_t^2, \tag{1.34}$$

with a cross-sectional average of

$$\overline{\tilde{s}_{j,t}} = \overline{E(\tilde{s}_{j,t})} + \frac{1}{1-\rho}\overline{\chi_j\sigma_{j,t}^2} + (\bar{\tau}_j - \tau)\frac{1}{1-\rho_w}\sigma_{w,t}^2 - \chi\frac{1}{1-\rho}\sigma_t^2. \tag{1.35}$$

The time t currency risk premium and the time $t+1$ excess return innovation are

$$E_t(\xi_{j,t+1}) = \frac{1}{2}(\gamma^2 + \kappa^2)\sigma_t^2 - \frac{1}{2}(\delta_j^2 - \delta^2)\sigma_{w,t}^2 - \chi_j\sigma_{j,t}^2, \tag{1.36}$$

$$\xi_{j,t+1} - E_t(\xi_{j,t+1}) = -(\gamma_j\sigma_{j,t}u_{j,t+1} - \gamma\sigma_t u_{t+1})$$
$$- (\delta_j - \delta)\sigma_{w,t}u_{w,t+1} - (\kappa_j\sigma_{j,t} - \kappa\sigma_t)u_{g,t+1}, \tag{1.37}$$

respectively.

Given the processes for the volatilities, the real-rate news of currency j is

$$\eta_{j,t+1}^{d\tilde{r}} = \left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right]\frac{\nu}{1-\rho}\sigma_t u_{t+1} - \left[(\tau_j - \tau) - \frac{1}{2}(\delta_j^2 - \delta^2)\right]\frac{\nu_w}{1-\rho_w}\sigma_{w,t}u_{w,t+1}, \tag{1.38}$$

and the risk-premium news is the difference between real-rate news and excess return innovation, that is, $\eta^{\xi}_{j,t+1} = \eta^{d\tilde{r}}_{j,t+1} - [\xi_{j,t+1} - E_t(\xi_{j,t+1})]$. For the dollar factor, its real-rate news is

$$\eta^{d\tilde{r}}_{D,t+1} = \left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right] \frac{\nu}{1-\rho} \sigma_t u_{t+1} - \left[(\bar{\tau}_j - \tau) - \frac{1}{2}(\overline{\delta^2_j} - \delta^2)\right] \frac{\nu_w}{1-\rho_w} \sigma_{w,t} u_{w,t+1}. \quad (1.39)$$

The assumptions of $\chi - (\gamma^2 + \kappa^2)/2 < 0$ and $(\bar{\tau}_j - \tau) - (\overline{\delta^2_j} - \delta^2)/2 > 0$ guarantee that real-rate news is bad news, because it is positive when the shocks are negative. The risk-premium news of the dollar factor, assuming N is large and the law of large numbers holds, is

$$\eta^{\xi}_{D,t+1} \xrightarrow{N\to\infty} \eta^{d\tilde{r}}_{D,t+1} - \gamma \sigma_t u_{t+1} + (\bar{\delta}_j - \delta)\sigma_{w,t+1} u_{w,t+1} + (\overline{\kappa_j \sigma_{j,t}} - \kappa \sigma_t) u_{g,t+1}. \quad (1.40)$$

Following Lustig, Roussanov, and Verdelhan (2011) and Verdelhan (2018), we assume $\bar{\delta}_j - \delta = 0$ and drop the term $(\bar{\delta}_j - \delta)\sigma_{w,t+1} u_{w,t+1}$. Furthermore, a sufficient condition for risk-premium news being bad news is $\overline{\kappa_j \sigma_{j,t}} - \kappa \sigma_t < 0$ (Verdelhan (2018) also focuses on this case), such that the risk-premium news is positive when domestic and global shocks are negative. This condition suggests that when the domestic country is more sensitive to the global shock, a bad global shock will induce domestic investors to demand higher risk premiums.[13] Importantly, the conditional variation in risk-premium news, net of the influence of the real-rate news, is only driven by domestic volatility after we assume $\bar{\delta}_j - \delta = 0$. As this difference is perfectly correlated with the excess return innovation in the dollar factor, this evidence reinforces that the dollar beta itself insufficiently explains the currency risk premiums. The real-rate beta

[13]Conversely, when the domestic country's sensitivity to global shock is below average, $\overline{\kappa_j \sigma_{j,t}} - \kappa \sigma_t > 0$, a bad global shock *decreases* risk-premium news. In this case, whether positive risk-premium news refers to good or bad news depends on the source of the shock and on the domestic country's relative sensitivity to global shocks. If the term $(\overline{\kappa_j \sigma_{j,t}} - \kappa \sigma_t) u_{g,t+1}$ dominates the variation of the risk-premium news, positive risk-premium news can be good news. Intuitively, when the domestic country's sensitivity to a global shock is below average, the country is less vulnerable to bad global shocks and can better weather the global storm, compared with an average country, and the domestic investors' required risk premiums on risky assets will be relatively lower.

is proportional to

$$\mathbf{cov}_t[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{d\tilde{r}}_{D,t+1}] = \beta^{d\tilde{r}}_{j,t} \times \mathbf{var}_t[\xi_{D,t+1} - E_t(\xi_{D,t+1})] \tag{1.41}$$

$$= \gamma \left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right] \frac{\nu}{1-\rho}\sigma_t^2 + (\delta_j - \delta)\left[(\bar{\tau}_j - \tau) - \frac{1}{2}(\overline{\delta_j^2} - \delta^2)\right] \frac{\nu_w}{1-\rho_w}\sigma^2_{w,t}, \tag{1.42}$$

where $\mathbf{var}_t[\xi_{D,t+1} - E_t(\xi_{D,t+1})] = \gamma^2\sigma_t^2 + (\overline{\kappa_j\sigma_{j,t}} - \kappa\sigma_t)^2$. The cross-sectional variation in the real-rate beta is driven by δ_j. Given that $(\bar{\tau}_j - \tau) - (\bar{\delta_j^2} - \delta^2)/2 > 0$, high δ_j currencies ("hedges") are high real-rate-beta currencies, and the real-rate betas are likely good betas. Consider the regressions of $\xi_{D,t+1}$ on $\beta^{d\tilde{r}}_{D,t}$, where the slope coefficient is proportional to[14]

$$\mathbf{cov}\{E_t(\xi_{D,t+1}), \mathbf{cov}_t[\xi_{D,t+1} - E_t(\xi_{D,t+1}), \eta^{d\tilde{r}}_{D,t+1}]\} \tag{1.43}$$

$$= \frac{1}{2}\gamma\left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right](\gamma^2 + \kappa^2)\frac{\nu}{1-\rho}\mathbf{var}(\sigma_t^2) < 0. \tag{1.44}$$

The time t *cross-sectional* covariance between currency premiums and the real-rate betas is proportional to

$$\mathbf{cov}\{E_t(\xi_{j,t+1}), \mathbf{cov}_t[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{d\tilde{r}}_{j,t+1}]\} \tag{1.45}$$

$$= -\frac{1}{2}[\sigma^2_{w,t}]^2\left[(\bar{\tau}_j - \tau) - \frac{1}{2}(\overline{\delta_j^2} - \delta^2)\right]\frac{1}{1-\rho_w}\nu_w\mathbf{cov}(\delta_j - \delta, \delta_j^2 - \delta^2)$$

$$- \sigma^2_{w,t}\left[(\bar{\tau}_j - \tau) - \frac{1}{2}(\overline{\delta_j^2} - \delta^2)\right]\frac{1}{1-\rho_w}\nu_w\mathbf{cov}(\delta_j - \delta, \chi_j\sigma^2_{j,t}), \tag{1.46}$$

where the first term is obviously negative and procyclical, because $\mathbf{cov}(\delta_j - \delta, \delta_j^2 - \delta^2) > 0$ given that $\delta_j > 0$. The second term depends on the covariance between the global shock exposure and the sensitivity to domestic volatility ($\mathbf{cov}(\delta_j - \delta, \chi_j\sigma^2_{j,t})$), which should be positive because the real-rate betas are bad betas. Furthermore, as shown above, because the price of real-rate-beta risk is a function of $\sigma^2_{w,t}$, it is time varying and can be correlated

[14] This slope coefficient is different from the unconditional price of risk, which would be obtained using a cross-sectional or panel regression with a panel of currency data.

with AFD or an average of real exchange rates.[15]

The risk-premium beta is proportional to

$$\mathbf{cov}_t[\xi_{j,t+1} - E_t(\xi_{j,t+1}), -\eta^{\xi}_{D,t+1}] = \beta^{\xi}_{j,t} \times \mathbf{var}_t[\xi_{D,t+1} - E_t(\xi_{D,t+1})] \tag{1.47}$$

$$= -\mathbf{cov}_t[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{d\tilde{r}}_{D,t+1}] + \gamma^2\sigma_t^2 + (\kappa_j\sigma_{j,t} - \kappa\sigma_t)(\overline{\kappa_j\sigma_{j,t}} - \kappa\sigma_t), \tag{1.48}$$

whose cross-sectional variation is driven by δ_j (in $\mathbf{cov}_t[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{d\tilde{r}}_{D,t+1}]$) and $\kappa_j\sigma_{j,t}$. Because the higher risk-premium-beta currencies have a lower δ_j or a lower $\kappa_j\sigma_j$ (given $\overline{\kappa_j\sigma_{j,t}} - \kappa\sigma_t < 0$), and they tend to have negative excess return innovation when there are bad domestic or global shocks, the risk-premium beta is likely to be a bad beta. Intuitively, the slope coefficient of the regressions of $\xi_{D,t+1}$ on $\beta^{\xi}_{D,t} = -\beta^{d\tilde{r}}_{D,t} + 1$ is positive, which can be implied by Equation (1.44). In addition, the real-rate beta and the risk-premium beta capture different state variables associated with different parameters driving the cross-sectional variation. This result reinforces the need for two betas instead one.

The time t *cross-sectional* covariance between the currency premiums and risk-premium betas is proportional to

$$\mathbf{cov}\{E_t(\xi_{j,t+1}), \mathbf{cov}_t[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{\xi}_{j,t+1}]\} \tag{1.49}$$

$$\begin{aligned} &= -\mathbf{cov}\{E_t(\xi_{j,t+1}), \mathbf{cov}_t[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{d\tilde{r}}_{j,t+1}]\} \\ &\quad - \frac{1}{2}\sigma^2_{w,t}(\overline{\kappa_j\sigma_{j,t}} - \kappa\sigma_t)\mathbf{cov}(\kappa_j\sigma_j, \delta_j^2) - (\overline{\kappa_j\sigma_{j,t}} - \kappa\sigma_t)\mathbf{cov}(\kappa_j\sigma_j, \chi_j\sigma^2_{j,t}), \end{aligned} \tag{1.50}$$

where the last two terms are positive and countercyclical when the exposure to the transitory global shock is positively correlated with the permanent global shock and domestic volatilities, which is implied by the property that the risk-premium betas are bad betas. Because the above terms are functions of the United States and global volatilities, the price of risk-premium-beta risk is time varying and can be correlated with AFD or an average of

[15] Hence, our empirical formulation of the time-varying prices of risks can be viewed as a linear approximation.

the real exchange rates.

At this stage it is worthwhile to compare our betas with the dollar and carry betas of Verdelhan (2018). Our betas come from an exact decomposition of real exchange rates, whereas Verdelhan (2018) forms long-short portfolios to separate various driving forces. As a result, both of our betas are time varying, whereas the carry beta of Verdelhan (2018) is fixed. Furthermore, we show that both prices of risk are time varying, functions of U.S. and global volatilities, and can be correlated with AFD or average real exchange rates. As our betas provide an alternative way to describe the mechanism, an interesting empirical question would consider which set of betas works better. In a robustness check below, we will find our main results still hold when controlling for the carry beta, and the resultant price of carry beta risk has the *wrong* sign.

1.3 Tests of the Two-Beta Currency ICAPM

1.3.1 Data

We obtain end-of-month observations for the period January 1986 to December 2017 for Reuters spot exchange rates, 1-month forward exchange rates, Eurocurrency 1-month nominal interest rates, and consumer price index (CPI),[16] for the following 34 countries:

- *Developed countries*: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany (the Deutsche mark is replaced by euro from 1999 onward), Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom.

- *Emerging market countries*: Czech Republic, Hungary, India, Indonesia, Kuwait, Malaysia, Mexico, Philippines, Poland, South Africa, South Korea, Taiwan, and Thailand.

All the data are available from Datastream. Our final data set has 7,304 month-currency observations.

[16]CPI data are usually announced in the middle of the month, and we treat them as month-end observations to avoid look-ahead bias. Furthermore, heterogeneity in countries' consumption bundles is not a concern, because we remove the means from the instrumental variables in the VAR system; in other words, we remove the country fixed effects.

Assuming the United States is the domestic country, we construct the following variables: the log real exchange rate is the log spot exchange rate, plus the differential between the foreign and domestic log CPI. Nominal interest rates are the log Eurocurrency nominal interest rates. Inflation is the first difference in the log CPI. Excess currency return is the first difference in the log spot rate, plus a lagged nominal interest rate differential.

Table 1.1 presents the descriptive statistics for excess returns, interest rate differentials, inflation differentials, and real exchange rates. All the statistics in the table are the cross-sectional averages of individual currency statistics. With a monthly expected return of 0.13% and standard deviation of 3.14%, currencies have an annualized Sharpe ratio around 0.14. The median of the excess return is much larger than its mean, suggesting a left-skewed distribution. The nominal interest rate differential is highly autocorrelated. The mean of inflation is about 0.20% per month, much higher than its median (0.08%), suggesting right-skewed distribution. Real exchange rates, for illustrative purposes, are based on the assumption that PPP holds in December 1995 (the first month with all currencies present). On average, the real exchange rate is negative, suggesting that the internal purchasing power of the U.S. dollar is lower than its external purchasing power, and a U.S. consumption bundle is on average more expensive than that of other countries'.

Panel B of Table 1.1 presents the correlations between state variables. Excess currency returns are weakly correlated with the concurrent interest rate differential and inflation differential, and the real exchange rate is positively correlated with the concurrent excess return and the interest rate differential.

1.3.2 VAR and news estimation

Following Froot and Ramadorai (2005), we assume the VAR process is common for all currencies (i.e., $B_j = B \forall j$), and we run a panel regression (pooled time-series and cross-sectional regression) to estimate the VAR. The panel regression pools all currencies together and utilizes more observations and thus leads to more precise estimates and avoids implausible, explosive dynamics. Mark and Sul (2001), Rapach and Wohar (2002), and Jordà and

Taylor (2012) also use panel regressions to estimate exchange rate dynamics and find robust results. Once we have the common VAR estimates, we apply them to individual currencies to construct innovations to state variables, as well as risk-premium and real-rate news.

Columns 2-7 in Panel A of Table 1.2 report the full sample VAR estimates obtained from a panel regression. These results provide a long-term perspective. Both the nominal interest rate differential and real exchange rate are persistent. The excess return and nominal interest rate differential predict positive subsequent excess currency returns, suggesting short-term momentum and carry strategies. On the other hand, the inflation differential and real exchange rate predict negative future currency excess returns, although only the real exchange rate has a significant predictive power. The R-squared is the lowest for the return prediction equation (2%), whereas it is much higher for the equations for nominal interest rate differential and real exchange rate (41% and 96%, respectively). F-tests reject the null that all estimates are jointly zero in all four equations. Although not reported in the table, the largest eigenvalue is 0.97, suggesting this is a stationary system.

Our baseline empirical analysis implements VAR on a rolling basis. Throughout this paper, we follow the convention in currency pricing, e.g. Lustig, Roussanov, and Verdelhan (2011), among others, to set the window size to 36 months whenever a rolling-window estimation is involved. Note our main results remain robust, or even strengthened in many cases, when we experiment with other window sizes; see the Internet Appendix for cases with window size of 48 and 60 months.

Columns 8-13 in Panel A of Table 1.2 report the time-series averages of the 36-month rolling VAR estimates and statistics. Several interesting patterns emerge: excess currency returns become more predictable, although the predictive power of the nominal interest rate differential becomes weaker due to recent failure of the carry trade. Inflation differential becomes less predictable, and its predictive power for other state variables becomes weaker too. F-statistics remain large and reject the zero-coefficient joint null in all equations.

Columns 2-5 in Panel B of Table 1.2 report the descriptive statistics for the two dollar factor news components implied by the full-sample VAR. Risk-premium news is more volatile (standard deviation of 2.06%), whereas the volatility of real-rate news is smaller (0.42%). The correlation between risk-premium news and real-rate news is -0.37, and, hence, they jointly have the potential to better grasp the cross-sectional variation in currency premiums.[17] Columns 6-9 in Panel B of Table 1.2 report the time-series average of the 36-month rolling estimates. The average standard deviations of the news components are slightly smaller than the full-sample standard deviations, and even more interestingly, the average correlation is -0.30, lower than the full-sample estimate.

Figure 1.1 plots the rolling estimates of the risk-premium news and real-rate news of the dollar factor, as well as the rolling correlation between the news components. In each 36-month rolling window, we estimate a VAR and form the news components within the rolling window. In each rolling window, the top and the middle figures plot the last observations of the news components in Month 36, and the bottom figure plots the correlation between the news components within the window in Month 36. The risk-premium news of the dollar factor clearly peaks during the Asian Financial Crisis and Internet bubble burst. A notable peak of the real-rate news of the dollar factor occurs during the global financial crisis. The rolling correlation is clearly time-varying; it is positive 25% of the time, and it is mostly negative in the last decade.

Given the relatively low volatility in the real-rate news component, one might wonder whether it can help explain a significant portion of systematic variation in currencies. We argue it is still crucial despite its low volatility, which is simply a scaling issue. What matters is the correlation structure: as long as the two news components are not highly correlated with each other, the comovement with the real-rate news has the potential to explain the

[17] The sign of the correlation can go either way. The no-arbitrage model in Section 1.2.6, suggesting that the correlation between the two news components depends on cyclicality of interest rates and sensitivity to a global shock, can have the flexibility to generate either positively or negatively correlated news components. Here we find risk-premium news and real-rate news, both are bad news, are negatively correlated unconditionally. As a comparison, Campbell and Vuolteenaho (2004) find discount-rate news (bad news) and cash-flow news (good news) are positively correlated unconditionally.

systematic variation in currency returns.[18]

1.3.3 Time-series evidence and beta estimates

Table 1.3 reports each currency's risk-premium betas and real-rate betas, using Equations (1.15) and (1.16), respectively. Beside each beta estimate is its t-ratio, based on GMM standard errors (see the Internet Appendix for details). Columns 2-5 are based on full-sample estimates (unconditional, fixed betas), and Columns 6-9 are time-series averages of 36-month rolling estimates/statistics. We use the following procedure to obtain rolling betas: we use currencies without missing observations from month $t-35$ to t to run a panel regression to estimate a VAR, back out the innovations of each currency, decompose excess return innovations into risk-premium and real-rate news, aggregate the news into dollar factor news by taking averages, and calculate the risk-premium and real-rate betas. We roll the estimation window forward to proceed the same analysis. Figure 1.2 depicts the time-series of the time-t rolling risk-premium betas of the dollar factor (top figure) and the rolling real-rate betas of the dollar factor (middle figure). Both risk-premium and real-rate betas of the dollar factor are typically positive through time.

All full-sample beta estimates are strongly significantly different from zero. Out of 34 currencies, the averages of rolling t-ratios associated with rolling risk-premium betas (real-rate betas) are greater than 2.00 in 34 (26) instances. To avoid the multiple comparison problem, we also report the Bonferroni criterion implied p-values (the number of currencies multiplied by the smallest p-value from the individual t-tests), which are all 1% or smaller, well below the conventional significance level. This time-series evidence shows that currency excess returns strongly respond to both risk-premium and real-rate news of the dollar factor.

The magnitudes of the betas have interesting patterns. The unconditional risk-premium betas, ranging from 0.35 (Taiwan) to 1.39 (Hungary) are larger than the unconditional real-rate betas, because risk-premium news is the dominant driver in the time-series variation

[18] Along the same lines, while Cochrane (2008), among others, finds equity cash-flow news is much less volatile than equity discount-rate news, Campbell and Vuolteenaho (2004) still find cash-flow beta matters in equity returns.

in excess return innovations, as shown in Froot and Ramadorai (2005) and Balduzzi and Chiang (2020). All risk-premium betas are significantly positive or, equivalently, $\mathbf{cov}[\xi_{j,t+1} - E_t(\xi_{j,t+1}), -\eta^{\xi}_{D,t+1}] > 0$. On the other hand, ranging from 0.02 (Kuwait) to 0.16 (Hungary and Indonesia), the unconditional real-rate betas are much lower than the risk-premium betas. All of the real-rate betas are positive, that is, $\mathbf{cov}[\xi_{j,t+1} - E_t(\xi_{j,t+1}), \eta^{d\tilde{r}}_{D,t+1}] > 0$. Therefore, all the currencies have both a positive "risky component" (the risk-premium beta) and a positive "hedging component" as their systematic components, and the risky systematic component outweighs the hedging systematic component. Overall, the average risk-premium beta is 0.90, and the average real-rate beta is 0.10; both are for the dollar factor (hence the sum is 1.0). The averages of the rolling estimates have similar magnitudes: the average of rolling risk-premium beta is 0.91, and the average of rolling real-rate beta is 0.09.

The betas have different degrees of cross-sectional dispersion and cross-sectional correlations, and their empirical patterns support our conditional two-beta framework. We use the coefficients of variation (CV) to measure dispersion: unconditional risk-premium betas have a CV of 0.33, and unconditional real-rate betas have a CV of 0.37, which are both smaller than the time-series average of CVs of rolling betas: 0.56 for rolling risk-premium betas, and 0.51 for rolling-real rate betas. We also compute the cross-sectional correlations between betas: the cross-sectional correlation between the unconditional risk-premium betas and the unconditional real-rate betas is 0.95, while the time-series average of correlations of the two sets of rolling betas is substantially smaller: 0.60; the time series of the correlations of the two sets of rolling betas is depicted in the bottom of Figure 1.2. Furthermore, risk-premium betas are perfectly positively correlated with the overall betas, but real-rate betas are highly positively correlated with the overall betas only unconditionally (correlation is 0.96), but not conditionally (average correlation is 0.63).[19] Combining with the evidence that the low

[19]Given that the correlation between the overall dollar betas and the risk-premium betas is high, plus the risk-premium betas and the real-rate betas are also correlated, one may claim that it is sufficient to consider only the overall dollar betas. Our empirical evidence in Section 1.3.4 shows otherwise, because the decomposition of the overall dollar beta into two betas strengthens the explanatory power of the risk-premium betas. On the other hand, using only the overall dollar betas, without decomposing them into two sets of betas, masks the explanatory power of the risk-premium betas. Furthermore, we perform two additional

correlation between risk-premium news and real-rate news, our two-way decomposition of conventional betas may help mitigate the "flat dollar beta versus premium" problem in the asset pricing tests, especially in the conditional setting.

1.3.4 Tests of the two-beta ICAPM

To implement the two-beta asset pricing model for currencies, consider the following regression model:

$$\xi_{j,t+1} = a + \lambda_t^{\xi}\beta_{j,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{j,t}^{d\tilde{r}} + u_{j,t+1}, \tag{1.51}$$

where the time-varying betas are 36-month rolling betas, as in the cross-sectional study of common currency factors by Lustig, Roussanov, and Verdelhan (2011). We assume the time-varying prices of beta risks are linear in time-t macroeconomic variables, as in Equations (1.20) and (1.21). We consider two succinctly chosen macroeconomic variables: the average forward discount (Lustig, Roussanov, and Verdelhan (2014)), and a log real exchange rate index[20] ($reri_t$). These macroeconomic variables capture both domestic and global effects, as shown in the no-arbitrage model. For interpretation purposes, we standardize each macroeconomic variable. It is noteworthy to mention that the news, the betas, and the macroeconomic variables are all observable at time t, whereas the dependent variable is the time $t+1$ excess currency return, and, hence, our results from the models with time-varying betas and prices of risks are free of look-ahead bias.

AFD is motivated by Lustig, Roussanov, and Verdelhan (2014) and Verdelhan (2018).[21]

experiments to address this issue. In the first experiment, we replace the risk-premium betas by the overall betas, while keeping the real-rate betas; in the second experiment, we orthogonalize the risk-premium betas and the real-rate betas. We find robust results (available from the Internet Appendix) and they suggest that it is crucial to include the real-rate betas.

[20] We construct a real exchange rate index (RERI) similar to the Federal Reserve Board's construction of the real trade-weighted U.S. dollar index, except that (1) we use direct quotes, instead indirect quotes, and (2) we use equal weights, instead of trade weights, for all currencies. The logarithm of RERI is $reri$. Note this is slightly different from the average of log real exchange rates, because we take the average (to mimic the Federal Reserve's approach) before taking the logarithm.

[21] In his cross-sectional regression of currency returns on dollar betas, Verdelhan (2018) goes long (short) on all currencies when AFD is positive (negative). One way to interpret this framework is to consider the price of risk as a function of the sign of AFD, taking the value of either λ or $-\lambda$. In our setting, the prices of risks are affine in AFD.

Lustig, Roussanov, and Verdelhan (2014) show that AFD is negatively correlated with income and production, and hence is countercyclical. To revalidate this feature using our data, we form a real activity variable using the principal component analysis of Ang and Piazzesi (2003), and the time-series regression of real activity on AFD obtains a slope coefficient of -0.49 with a Newey-West t-ratio of -2.88; hence, AFD is countercyclical.[22,23]

Standard representative agent model would indicate real exchange rate reflects marginal utility differential between foreign and home countries. When the real exchange rate is high, the foreign country has a relatively higher marginal utility, and hence the home country is in a good economic state. In our sample, RERI is weakly positively correlated with real activity, after controlling for AFD. A regression of the real activity on AFD and $reri$ obtains coefficients of -0.48 and 0.08, with t-ratios of -2.78 and 0.68, respectively.

Following Cochrane (2011), Lustig, Roussanov, and Verdelhan (2011), and Chan, Yang, and Zhou (2018), we estimate the asset pricing model in Equation (1.51) using a panel regression. Note conventional cross-sectional regressions are not applicable here because of the presence of common macroeconomic variables z_t in the prices of beta risks. Another advantage of a panel regression is it puts more weight on time periods with larger cross-sections, whereas conventional cross-sectional regressions overweigh periods with fewer observations. In certain periods when the cross-section of currencies is small, cross-sectional regression may not be plausible or may generate noisy estimates in a multivariate regression. Currency data are highly unbalanced panel data, so panel regression analysis is more appropriate.[24] The

[22] We find the principal components of four series: the growth rate of the Help Wanted Advertising in Newspapers index, replaced by the Job Openings and Labor Turnover Survey from 2001 onward (HELP/JOLTS), unemployment (UE), the growth rate of employment (EMPLOY), and the growth rate of industrial production, where growth rates are 12-month log differences. The real activity variable is the first principal component if the factor loadings are positive for HELP/JOLTS, EMPLOY, and IP and negative for UE; switch the sign if the factor loadings are negative for HELP/JOLTS, EMPLOY, and IP and positive for UE.

[23] In a separate exercise, we model the prices of risks as linear functions of both the fitted value and the residual from the regression of AFD on real activities, to separate different sources of shocks. Both components have significant explanatory power over coefficients of the same signs, and the signs are consistent with our main results.

[24] To increase the power of the tests, our baseline tests are based on an unbalanced panel, because using a balanced panel limits the sample size. When we perform the tests on balanced panels of portfolios in the Internet Appendix, our main results remain robust.

panel regression approach is common in the study of the cross-section of currency premiums (see Sarno and Schmeling (2014) for an example).[25] For statistical inferences, we use the clustered standard errors following Thompson (2011). Specifically, we use the standard errors clustered by currency, not by time or by both currency and time, because (1) Thompson (2011) suggests clustering by the smaller dimension, and (2) concurrent common shocks are already controlled when macroeconomic variables are present in the prices of risks.[26]

For comparison, we also implement the model with time-varying betas but constant prices of beta risks:

$$\xi_{j,t+1} = a + \lambda_0^{\xi}\beta_{j,t}^{\xi} + \lambda_0^{d\tilde{r}}\beta_{j,t}^{d\tilde{r}} + u_{j,t+1}, \tag{1.52}$$

as well as the model with constant prices of beta risks and fixed betas

$$\xi_{j,t+1} = a + \lambda_0^{\xi}\beta_{j}^{\xi} + \lambda_0^{d\tilde{r}}\beta_{j}^{d\tilde{r}} + u_{j,t+1}, \tag{1.53}$$

where the fixed betas are full sample estimates.

Table 1.4 has the key results of this paper. It reports the price of beta risk estimates and their t-ratios; the intercept terms are present in Models (1)–(5) and absent in Models (6)–(10). Except for Models (1) and (6), all the models feature time-varying betas. Models (1) and (6) have constant prices of beta risks, and fixed betas. Models (2) and (7) also have constant prices of beta risks, but the betas are rolling betas. Models (3)–(5) and (8)–(10) have rolling betas and time-varying prices of risks, driven by AFD and/or real exchange rate index. The root-mean-square error (RMSE) of each model is reported to illustrate the economic magnitude of pricing errors; note RMSE is inversely related to R-squared hence the latter is not tabulated. Models controlling for other factor loadings or anomalies obtain

[25]Our baseline estimation does not control for fixed effects, because we intend to capture both the cross-sectional variation in risk premiums and the time-series dynamics of prices of risks. We find similar or stronger results when we control for time (currency) fixed effects in order to focus on cross-sectional (time-series) explanatory power (see the Internet Appendix).

[26]Based on our simulated distributions of the parameter estimates, inferences based on asymptotic tests using standard errors clustered by currency are more accurate, whereas tests based on double-clustered standard errors are too conservative and lead to a downward-biased power distortion.

qualitatively similar results and are discussed in Section 1.3.6.

Model (1) of Table 1.4 shows that only the risk-premium beta is priced and is associated with 0.32% per month of price of beta risk. The positive price of risk-premium-beta risk remains a prevailing stylized fact in Models (2), (3), (4), and (5), where the unconditional price of risk-premium-beta risk is between 0.04% and 0.21% per month. The problem with Model (1) is that the intercept, interpreted as the zero-beta portfolio expected excess return, is −0.08% and statistically significant. It is largely reduced when we introduce time variation in betas; for example, the intercept term is 0.00% in Model (2).

Model (3) further introduces time-varying prices of beta risks, which are driven by AFD. Compared with the goodness of fit of Model (2), that of Model (3) improves substantially. The unconditional price of risk-premium-beta risk is strongly statistically positive. On the other hand, the unconditional price of real-rate-beta risk is strongly negative. The RMSEs for pricing are also reduced. Hence, consistent with our theoretical prediction, the risk-premium beta is a "bad beta," whereas the real-rate beta is a "good beta." The price of risk evidence in Model (3) also makes economic sense because AFD, a countercyclical variable, drives the price of risk-premium-beta risk higher, and the price of real-rate-beta risk lower, suggesting that investors demand more rewards for risk-taking and are willing to pay more to hold hedges during bad times, consistent with our conjecture. The intercept term remains small and insignificant (−0.01%, with a t-ratio of −0.44).

Model (4) uses a real exchange rate index to model the time variation in the price of risk. In this model, neither risk-premium beta nor real-rate beta is associated with a significant unconditional price of risk. The coefficient associate with the interaction between risk-premium beta and real exchange rate index is negative and statistically significant, suggesting countercyclical price of risk-premium-beta risk, which is consistent with our theoretical prediction. However, the coefficient associated with the interaction between the real-rate beta and the real exchange rate index is also negative, suggesting a countercyclical price of real-rate-beta risk, which is inconsistent with theoretical prediction. Another issue with Model (4) is its intercept is strongly significant.

Model (5) uses both AFD and real exchange rate index to model time-varying prices of risks, and it inherits similar patterns from Models (3) and (4). Again, the problem is the negative coefficient associated with the interaction between real-rate beta and real exchange rate index, which is inconsistent with our theoretical prediction.

Given that many intercept terms are not statistically significant, we reestimate the models, excluding the intercept term, and report the results in Models (6)–(10) of Table 1.4; doing so also obtains more efficient estimates. We find the signs and magnitudes of the parameter estimates are very close to the results in the with-intercept counterpart, with the only exception being the case of constant betas: slope coefficients in Models (1) and (6) are very different. This evidence reinforces the need for time-varying betas. Interestingly, the RMSEs are quantitatively similar. We proceed with the Model (8) (i.e., the no-intercept version of Model (3)) in our analysis of the currency trading strategies in the next section.

To understand the economic underpinnings of the estimates, take Model (8) for example: the unconditional price of risk-premium-beta risk is 0.21% per month (t-ratio $= 3.42$), or 2.52% per annum. A standard deviation increase in AFD is associated with a 0.37% per month (t-ratio $= 7.80$), or 4.44% per annum, increase of the price of risk-premium-beta risk. On the other hand, the unconditional price of real-rate-beta risk is -0.81% per month (t-ratio $= -2.56$), or -9.72% per annum, and a standard deviation increase in AFD is associated with a -3.05% per month (t-ratio $= -7.14$), or -36.60% per annum, change of the price of real-rate-beta risk. Note these numbers are economically *reasonable*, because, on average, the risk-premium beta is around 0.91 and the real-rate beta is around 0.09.[27]

A general message from Table 1.4 is that the risk-premium beta is a "bad beta" and the real-rate beta is a "good beta." At first glance, although the evidence that the risk-premium

[27] Our findings share some similarities with those of Lustig, Roussanov, and Verdelhan (2014) and Verdelhan (2018), who respectively document countercyclical currency risk premiums driven by the AFD, and the importance of the dollar factor. Different from their findings, we show that decomposing the dollar beta into two distinct, news-driven betas can explain the variation in currency risk premiums better, and the AFD is a predominant driver of the prices of beta risks.

beta being a "bad beta" is strong and robust, it is seemingly striking because Campbell and Vuolteenaho (2004) and Atanasov and Nitschka (2015), both using equity market data to construct market news and decompose betas, find the discount-rate beta is a good beta. The fundamental difference between their formulation and ours is that our real-rate news is bad news, whereas their cash-flow news is good news. In the setting of Campbell and Vuolteenaho (2004) and Atanasov and Nitschka (2015), both cash-flow news and (negative of) discount-rate news are good news, and hence discount-rate beta can be "good" because discount-rate news is transitory, while cash-flow news is persistent.[28]

Figure 1.3 plots the time-series of price of risk-premium-beta risk and the price of real-rate-beta risk. Price of risk-premium-beta risks is generally positive through time, showing that the risk-premium beta is a "bad beta" unconditionally. The price of real-rate-beta risk, on the other hand, is primarily negative through the time, confirming that it is a so-called "good beta." The two curves appear to be mirror images, which is because they are driven by a common variable, AFD, in opposite directions.

Figure 1.4 depicts the time-series of the ex ante reward for risk-premium-beta risk (top), and the ex ante reward for the real-rate-beta risk (middle), both for the dollar factor, as well as the sum of the two rewards (bottom). The ex ante reward for risk-premium-beta risk is primarily positive, while the reward for real-rate-beta risk is mostly negative. The sum of the ex ante rewards is mostly positive, although it becomes substantially negative during the global financial crisis.

1.3.5 Errors-in-variable and finite-sample biases

Our results are conditional on the VAR estimates and beta estimates, and hence are subject to errors-in-variable biases. Furthermore, the test statistics may not follow their asymptotic distributions and hence are subject to finite-sample biases. To evaluate the effects of the

[28]The mechanism in the model of Campbell and Vuolteenaho (2004) can be illustrated using a simple intertemporal framework: a discount-rate shock that negatively affects the wealth portfolio can also enhance future investment opportunities, whereas a cash-flow shock only affects the wealth portfolio, without improving future investment opportunities. Under the same framework, an interpretation of our results is that real-rate news that negatively affects wealth may simultaneously enhance future investment opportunities.

biases, we use a bootstrap to simulate currency returns and other state variables under the null of no time-series return predictability and no cross-sectional cross-currency dependence, while preserving serial and cross-sectional dependence within each currency (see the Internet Appendix for the bootstrapping procedure).

Table 1.5 reports the bias-corrected price of risk estimates, and their p-values, based on clustered standard errors, as well as on the empirical distribution of the point estimates under the null. The bias-correction reconfirms our baseline results: most price of risk estimates in the models with rolling betas are nearly unchanged, hence our key results remain robust. The p-values based on clustered standard errors are largely consistent with our sample inference. We also report another p-value, based on the empirical distribution of the estimates under the null, and they produce strong rejection of the null.

It is evident that our results are not spurious when examining the empirical distributions of the estimates. Figure 1.5 uses a Gaussian kernel to plot the bootstrapped distribution of the coefficient associated with risk-premium beta (top left), with the interaction of risk-premium beta and AFD (bottom left), with the real-rate beta (top right), and with the interaction between real-rate beta and AFD (bottom right), under the null of no time-series return predictability and no cross-currency dependence. These densities are centered around zero (indicating that the biases in the sample estimates are tiny), with possible asymmetries and thick tails. The sample estimates, represented by asterisks, are clearly "outliers" to these densities.

Overall, the impact of the errors-in-variable and finite-sample biases, if not in our favor, is very minor. Hence, we will continue using the asymptotic tests based on clustered standard errors in the robustness checks.

1.3.6 Robustness of results

Our key empirical results remain robust when we

1. augment test asset space by assuming the factors (risk-premium and real-rate news components) are correctly priced (see Lewellen, Nagel, and Shanken (2010));

2. control for attributes, including interest rate differential, momentum, value (Asness, Moskwitz, and Pedersen (2013)), and return predictability (Ferson and Harvey (1999));

3. control for other betas, including carry beta (Lustig, Roussanov, and Verdelhan (2011) ,Brusa, Ramadorai, and Verdelhan (2017), Verdelhan (2018), among others), decomposed carry betas (into risk-premium and real-rate portions, similar to our baseline dollar beta decomposition), global dollar beta (Verdelhan (2018)), equity market cash-flow beta and discount-rate beta (Atanasov and Nitschka (2015)), consumption beta (Lustig and Verdelhan (2007)), and tail risk beta (Gao, Lu, and Song (2019));

4. correct the bias in VAR estimates (Bekaert, Hodrick, and Marshall (1997));

5. use portfolios, instead of individual currencies, as the test assets, where the portfolios are sorted by interest rate differential, momentum, value, or real exchange rate;

6. control for currency and time fixed effects;

7. employ alternative estimation procedures, including time-series regressions (Chan, Yang, and Zhou (2018)), and cross-sectional regressions;

8. decompose AFD into two orthogonal components, both of which drive the dynamics of prices of risks.

The Internet Appendix provides further details and tabulated results of the above robustness checks.

1.4 Risk and Reward of Currency Trading Strategies

We consider the model with no intercept, with time-varying betas and time-varying prices of beta risks, characterized by AFD only (see Model (8) of Table 1.4), as the "baseline case" to analyze the risk and reward features of the following strategies:

- Dollar carry: Following Lustig, Roussanov, and Verdelhan (2014), each month we go long all currencies if the average forward discount among the developed countries is positive, and short all currencies if that average is negative.

- High-minus-low (HML) carry: Lustig, Roussanov, and Verdelhan (2011) sort currencies based on currencies' interest rate differential into six portfolios each month. We follow them to construct our high (interest rate) minus low (interest rate) carry strategy.

- Country-level carry: Each month we go long all of the currencies with a positive interest rate differential and short all negative interest rate differential currencies.

- Purchasing power parity deviation: Following Menkhoff, Sarno, Schmeling, and Schrimpf (2016), we assume PPP holds at some point (here we pick December 1995, the first month with all currencies available) to reset the (log) real exchange rate to zero for all currencies. Each month, we go long in low real exchange rate currencies and short in high real exchange rate currencies.

- Momentum: The momentum measure for a currency is its past 12-month cumulative excess return on the currency, skipping the most recent month's observation (Asness, Moskwitz, and Pedersen (2013), Menkhoff, Sarno, Schmeling, and Schrimpf (2012b)). Following the way Asness, Moskwitz, and Pedersen (2013) construct the momentum strategy, each month we weight currency in proportion to their cross-sectional rank based on their momentum measure minus the cross-sectional average rank of momentum measure.

- Value: Our value measure is the 5-year moving average of real exchange depreciation. We use the same weighting scheme as in momentum strategy to construct our value strategy (Asness, Moskwitz, and Pedersen (2013)).

For comparison, we also include the dollar factor as a benchmark.

For each strategy, we compute the portfolio beta each month based on the portfolio weights. Then we can calculate the reward for each beta risk, that is, the product of beta and its price of risk, and obtain the time series of reward for risk-premium-beta risk and reward for real-rate-beta risk. We analyze each strategy as follows:

1. Find the time-series average of excess returns and each type of reward, and the abnormal performance measures.

2. Decompose the variance of the total reward: find the variance share of each reward relative to the sum of all rewards. Specially, we find

$$\frac{\mathbf{cov}(\lambda_t^{\xi}\beta_{q,t}^{\xi}, \lambda_t^{\xi}\beta_{q,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}})}{\mathbf{var}(\lambda_t^{\xi}\beta_{q,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}})} + \frac{\mathbf{cov}(\lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}}, \lambda_t^{\xi}\beta_{q,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}})}{\mathbf{var}(\lambda_t^{\xi}\beta_{q,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}})} = 1, \tag{1.54}$$

   where the left-hand side has shares because of the two different rewards for taking beta risks.

3. Regress each beta on the macroeconomic variable (AFD).

4. Regress each reward on AFD.

Panel A of Table 1.6 reports the time-series averages of total excess returns, rewards for beta risks, abnormal performance, as well as the variance decomposition results. The abnormal performance of strategy q is measured by its raw alpha:

$$\alpha_q = \frac{1}{T}\sum_t u_{q,t+1} = \frac{1}{T}\sum_t \left[\xi_{q,t+1} - (\lambda_t^{\xi}\beta_{q,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}})\right]. \tag{1.55}$$

Dollar portfolio has 0.16% of average monthly excess return, 0.19% monthly reward for risk-premium-beta risk, and −0.08% of reward for real-rate-beta risk, and all of them are statistically significant. Because the baseline asset pricing model does not include a constant and is estimated by a panel regression, the dollar factor alpha is nonzero (0.04%, which is statistically insignificant). Hence, we define "adjusted alpha" to remove this bias:

$$Adj.\ \alpha_q = \frac{1}{T}\sum_t (u_{q,t+1} - u_{D,t+1}) \tag{1.56}$$

$$= \frac{1}{T}\sum_t \left[\xi_{q,t+1} - (\lambda_t^{\xi}\beta_{q,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}})\right] - \left[\xi_{D,t+1} - (\lambda_t^{\xi}\beta_{D,t}^{\xi} + \lambda_t^{d\tilde{r}}\beta_{D,t}^{d\tilde{r}})\right]. \tag{1.57}$$

For the dollar factor, the adjusted alpha is trivially zero. Furthermore, 59% of its reward variability is due to reward for risk-premium-beta risk, and 41% is due to real-rate-beta risk.

The dollar carry strategy earns a significantly positive reward for risk-premium-beta risk (0.29% per month) and also pays a substantial reward for real-rate-beta risk (−0.21%). Its adjusted alpha is 0.09% and is insignificant. HML carry is the only strategy with a significantly positive adjusted alpha of 0.47% per month, with a Newey-West-adjusted t-ratio of 3.00.[29] HML carry has very little reward from risk-premium-beta and pays some real-rate-beta premium (−0.04%). Most of the reward variation is due to real-rate-beta risk, instead of risk-premium-beta risk. Value strategy is the only strategy with a positive reward from real-rate-beta risk-taking, meaning that its real-rate beta is frequently negative. As a general message, if a strategy has a substantially positive reward for risk-premium-beta risk, or the reward for real-rate beta is not negative enough, it is unlikely to have a positive bias-adjusted abnormal return.

Note the decomposition of the total reward variability exercise highlights the importance of including real-rate beta into the currency pricing model. In *all* of the 6 active trading strategies, the real-rate reward accounts for more than half of the systematic variation, ranging from 51% (dollar carry) to 79.55% (momentum).

Panel B of Table 1.6 reports the slope coefficients of the regression of beta on the macroeconomic variable, AFD. A positive slope coefficient indicates that the beta is countercyclical, because AFD is countercyclical. Both dollar carry and country-level carry strategies have

[29]This result is related to Lustig, Roussanov, and Verdelhan (2014), who show that HML carry returns cannot be predicted by AFD. As we employ a model whose prices of risks are driven by AFD, this model is likely to indicate that HML carry has abnormal performance.

significantly countercyclical risk-premium betas, and, when combined with countercyclical price of risk-premium-beta risk, their reward for risk-premium-beta risk will be strongly countercyclical. On the other hand, dollar carry, counter-level carry, and momentum strategies have significantly countercyclical real-rate betas. Combined with procyclical price of real-rate-beta risk, these strategies pay substantial amount to hedge in bad times.

Panel C of Table 1.6 reports the slope coefficients of the regression of rewards on AFD. For the dollar portfolio, the reward for risk-premium-beta risk is countercyclical, and the reward for real-rate-beta risk is procyclical. In aggregate, the total rewards is countercyclical. 3 of the 6 active strategies share this common pattern, indicating that rewards are primarily earned in a countercyclical way, especially the dollar carry strategy.

Our analysis of trading strategy risk and reward provides a framework to evaluate performance of trading strategies under changing economic conditions. Although we explicitly use portfolio weights to calculate risk and reward measures, in practice we do not need portfolio weights information; as long as portfolio returns are observable, we can easily calculate time-varying betas.

1.5 Alternative Reference Currencies versus Cyclicality of Interest Rates

Our baseline setting assumes that the United States is the home country, and in this section we switch to another currency as the reference currency. For each country in our data set, one at a time, we assume it is the home country and form state variables and macroeconomic variables accordingly, and reestimate the two-beta currency pricing model for the given reference currency. This exercise is interesting because our key results, in particular that the real-rate beta is "good beta" and becomes better in bad times, critically ties to the procyclical feature of the domestic interest rate in the United States (hence countercyclical interest rate differential). The procyclical behavior of interest rate is a stylized fact for developed countries, while in emerging markets interest rates are countercyclical (see recent studies by Durdu, Nunes, and Sapriza (2013), Fernández and Gulan (2015), among others).[30] We conjecture that real-rate beta remains good beta when a developed country is the home country, while it can be associated with a *positive* price of risk when the reference currency is an emerging market currency.[31]

Table 1.7 reports the results for Model (8) of various reference currencies and shows that the cyclicality of interest rates does affect the results. Note now AFD is defined relative to the reference currency country, instead of the United States. Panel A shows that, when the home country is a developed country, the results are similar to our baseline results: the risk-premium beta is a bad beta and gets worse in bad times, whereas the real-rate beta is a good beta and gets better in bad times. Of the 21 developed country currencies, 16 of them have a positive λ_0^{ξ} (among them 9 are significant), and 15 of them have a positive λ_{AFD}^{ξ} (among them 8 are significant). On the other hand, 14 of them have negative $\lambda_0^{d\tilde{r}}$ (among them 11 are significant), and 14 of them have negative $\lambda_{AFD}^{d\tilde{r}}$ (among them 6 are significant).[32]

The results are largely reversed when the home country is an emerging market country. Panel B shows that, when the home country is an emerging market country, the risk-premium beta is a good beta and gets better in bad times, whereas the real-rate beta may become a bad beta and worsen in bad times.[33] Of the 13 emerging market country currencies, 9 of them have negative λ_0^{ξ} (among them 7 are significant), 10 of them have positive λ_{AFD}^{ξ}

[30] When we use a panel regression to regress each country's real activity on its interest rate and on the interaction of an emerging market dummy and the interest rate, we obtain slope coefficients of 23.43 and −73.72, with t-ratios of 2.58 and −8.36, respectively. This evidence validates the procyclical (countercyclical) pattern of interest rates in developed (emerging market) countries.

[31] When revisiting the no-arbitrage model, one clearly sees that real-rate beta becomes *bad* beta when precautionary savings are absent and domestic interest rates are countercyclical. In this case, $\chi-(\gamma^2+\kappa^2)/2 > 0$ and $(\bar{\tau}_j - \tau) - (\delta_j^2 - \delta^2)/2 < 0$, and Equation (1.42) shows that risky (low δ_j) currencies have a *higher* real-rate beta, and, hence, it is a bad beta.

[32] Similarly to our baseline results, the unconditional price of real-rate beta risk is much larger (in absolute value) than the unconditional price of risk-premium beta risk, across different reference currencies. This is because, as in our baseline case, the risk-premium betas are much larger than the real-rate betas in magnitude.

[33] The no-arbitrage model in Section 1.2.6 uncovers these implications. When the domestic country's sensitivity to a global shock is below average, $\overline{\kappa_j \sigma_{j,t}} - \kappa\sigma_t > 0$, a high $\kappa\sigma_t$ currency (which is safe) has higher risk-premium beta, which—combined with the effect of real-rate beta—becomes a good beta (see Equation (1.48)).

(among them 8 are significant).[34] On the other hand, 8 of them have positive $\lambda_0^{d\tilde{r}}$ (among them 5 are significant), and 7 of them have negative λ_{AFD}^{ξ} (among them 4 are significant).

1.6 Conclusion

We test a new two-beta ICAPM for currencies featuring betas with respect to international financial market risk-premium news and real-rate news. In this paper, we asked the following questions: Are the betas associated with significant prices of beta risks? Are there "good betas" and "bad betas"? Do the prices of risks comove with economic conditions? Finally, can the model explain rewards from notable currency trading strategies, such as carry trade and value strategies?

Our empirical investigation assumes the United States as the home country and leads to the following answers to our research questions. Unconditionally, the risk-premium beta is the "bad beta," and the real-rate beta is the "good beta." Even stronger evidence indicates that the risk-premium beta is associated with a countercyclical price of risk, whereas the real-rate beta is associated with a procyclical price of risk, which is, in fact, consistent with the notion of hedging demand. These empirical results can be reconciled by a simple no-arbitrage model, which suggests that the betas are time varying and cross-sectionally capture various exposures to country-specific and global shocks and that their prices of risks are also time varying and governed by U.S. and global volatilities. When we apply our model estimates to notable strategies, we find most currency trading strategies are unsuccessful: they either bear too much risk or pay too little for hedging.

Our key results are driven by the dominant precautionary savings effect in the United States. Interestingly, these results still hold for most developed countries (when they are assumed to be the home country), where interest rates are also conventionally procyclical. Conversely, the results are largely reversed—yet still consistent with a theoretical prediction—when the home country is an emerging market country, where interest rates

[34]When domestic interest rates are countercyclical, AFD is procyclical. See Equation (1.30) for a theoretical justification.

are countercyclical.

The rich implications from our model can be applied to currency portfolio choices, performance evaluations for currency trading, costs of capital calculations in international budgeting, or other international investment contexts.

Table 1.1: Descriptive statistics

This table reports the descriptive statistics for the state variables in the VAR. ξ is the excess currency return; dr is the interest rate differential; $d\pi$ is the inflation differential; and $\tilde{s}$ is the real exchange rate. Panel A reports the cross-sectional average of the mean, the median, the standard deviation (SD), the minimum, the maximum, and the first-order autocorrelation (AR1). All numbers in panel A, except for AR1 coefficients, are multiplied by 100. For presentation purposes, the real exchange rate is calculated based on the assumption that PPP holds in December 1995. Panel B reports the contemporaneous correlations between the state variables.

A. Descriptive statistics for state variables

Variable	Mean	Median	SD	Min	Max	AR1
ξ	0.13	0.35	3.14	-14.84	10.63	0.06
dr	0.34	0.17	0.76	-0.38	4.45	0.85
$d\pi$	0.20	0.08	0.82	-2.65	5.33	0.23
$\tilde{s}$	-12.02	-10.42	17.27	-58.91	22.99	0.98

B. Contemporaneous correlations

Correlations	ξ	dr	$d\pi$	$\tilde{s}$
ξ	1.00	0.06	-0.01	0.13
dr	0.06	1.00	0.16	0.14
$d\pi$	-0.01	0.16	1.00	-0.06
$\tilde{s}$	0.13	0.14	-0.06	1.00

Table 1.2: VAR parameter estimates

Panel A reports estimates from a VAR panel regression using all currencies. The first column has the dependent variables: the currency excess return (ξ_{t+1}), the interest rate differential (dr_{t+1}), the inflation differential ($d\pi_{t+1}$), and the real exchange rate ($\tilde{s}_{t+1}$), all with unconditional means removed. The t-ratios are in parentheses, based on clustered standard errors following Thompson (2011). F-statistics test the joint significance for all parameter estimates in the same regression equation, with p-values in the parentheses. Columns 2-7 are full-sample estimates. Columns 8-13 are time-series averages of 36-month rolling-window estimates/statistics. Panel B reports the covariance (in basis points, under "Cov Mat") of currency-market risk-premium news (η^{ξ}) and real-rate news ($\eta^{d\hat{r}}$), the standard deviations (in percentage, under "SD/Corr," diagonal terms) of the news components, and the correlation (in percentage, under "SD/Corr," off-diagonal terms) between the news components. Columns 2-5 are based on full-sample estimates, and Columns 6-9 are time-series averages of 36-month rolling-window estimates.

A. VAR parameter estimates

	Full sample						Rolling					
	ξ_t	dr_t	$d\pi_t$	$\tilde{s}_t$	R^2	F-stat	ξ_t	dr_t	$d\pi_t$	$\tilde{s}_t$	R^2	F-stat
ξ_{t+1}	0.08	0.59	-0.04	-0.02	0.02	51.03	0.05	0.67	-0.07	-0.09	0.09	16.75
	(1.98)	(3.43)	(-0.35)	(-3.93)		(0.00)	(0.55)	(1.91)	(-0.13)	(-2.47)		(0.01)
dr_{t+1}	-0.00	0.59	0.08	-0.00	0.41	1518.08	-0.00	0.54	-0.01	-0.00	0.44	336.68
	(-1.42)	(3.53)	(2.87)	(-1.04)		(0.00)	(0.08)	(7.50)	(1.04)	(-0.23)		(0.01)
$d\pi_{t+1}$	-0.03	0.29	0.25	-0.00	0.18	466.98	-0.01	0.08	0.09	-0.01	0.09	21.59
	(-3.20)	(2.60)	(3.49)	(-3.82)		(0.00)	(-1.26)	(0.40)	(1.00)	(-1.98)		(0.03)
$\tilde{s}_{t+1}$	0.05	-0.13	0.21	0.98	0.96	49044.36	0.04	-0.25	0.01	0.90	0.83	1021.98
	(1.46)	(-0.57)	(1.29)	(170.57)		(0.00)	(0.43)	(-1.02)	(0.11)	(27.82)		(0.00)

B. Dollar factor news

	Full sample				Rolling			
	Cov Mat		SD/Corr		Cov Mat		SD/Corr	
	η^{ξ}	$\eta^{d\tilde{r}}$	η^{ξ}	$\eta^{d\tilde{r}}$	η^{ξ}	$\eta^{d\tilde{r}}$	η^{ξ}	$\eta^{d\tilde{r}}$
η^{ξ}	4.23	-0.32	2.06	-37.00	3.81	-0.20	1.87	-30.48
$\eta^{d\tilde{r}}$	-0.32	0.17	-37.00	0.42	-0.20	0.19	-30.48	0.38

Table 1.3: Beta estimates

This table reports each currency's beta estimates and their t-ratios, all estimated by GMM. The row labeled "Coeff. var." reports the coefficient of variation for each type of beta across all currencies. The row labeled "Corr. w/ β^D" reports the cross-sectional correlation with overall betas. The row labeled "Corr. w/ $\beta^{d\tilde{r}}$" reports the cross-sectional correlation with real-rate betas. The row labeled "$N \times \min p$" reports the product of the sample size and the minimum p-value among all individual t-tests. Columns 2-5 are based on full-sample estimates, and Columns 6-9 are time-series averages of 36-month rolling-window estimates.

	Full sample estimates				Rolling averages			
	Risk-premium beta		Real-rate beta		Risk-premium beta		Real-rate beta	
Country	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
Australia	0.88	11.34	0.09	4.73	0.85	5.50	0.09	2.07
Austria	1.12	15.04	0.15	6.72	1.36	20.43	0.15	5.72
Belgium	1.17	16.83	0.14	7.01	1.33	17.38	0.15	6.41
Canada	0.47	8.56	0.05	3.86	0.46	3.43	0.05	1.37
Czech	1.24	19.72	0.14	9.50	1.26	7.91	0.15	3.09
Denmark	1.15	34.23	0.12	9.59	1.16	12.39	0.12	3.67
Finland	1.17	17.34	0.11	5.60	1.33	11.12	0.12	3.64
France	1.13	17.10	0.14	7.01	1.27	17.89	0.15	6.57
Germany	1.14	34.38	0.13	12.31	1.17	12.31	0.13	3.81
Greece	0.92	8.80	0.13	4.57	0.84	9.13	0.17	5.27
Hungary	1.39	15.93	0.16	8.27	1.32	7.72	0.16	3.12
India	0.71	7.58	0.09	4.56	0.69	4.15	0.11	2.13
Indonesia	1.25	4.92	0.16	3.93	1.21	3.59	0.13	1.73
Ireland	1.13	23.85	0.12	8.17	1.18	13.56	0.11	4.13
Italy	1.04	10.37	0.10	4.27	0.90	5.04	0.12	3.29
Japan	0.61	8.02	0.06	4.38	0.69	3.50	0.07	1.30
Kuwait	0.19	5.72	0.02	4.30	0.14	2.87	0.01	1.58
Malaysia	0.52	6.12	0.05	3.07	0.44	3.83	0.04	1.77
Mexico	0.58	5.65	0.07	3.54	0.45	2.67	0.05	1.44
Netherlands	1.13	15.01	0.14	6.30	1.38	18.62	0.14	5.12
New Zealand	0.96	12.97	0.11	7.21	0.97	5.68	0.10	2.19
Norway	1.13	23.55	0.13	9.95	1.17	10.64	0.13	3.23
Philippines	0.50	7.13	0.04	3.50	0.45	3.51	0.04	1.55
Poland	1.32	17.37	0.13	7.15	1.28	9.22	0.14	3.30
Portugal	0.95	8.63	0.12	5.90	1.11	15.89	0.20	7.88
Singapore	0.51	15.72	0.05	5.12	0.52	6.69	0.05	2.44
South Africa	1.09	13.92	0.12	7.34	1.06	5.41	0.11	2.09
South Korea	1.04	10.69	0.11	4.39	0.95	6.50	0.11	2.47
Spain	1.11	13.58	0.11	5.18	1.18	7.62	0.13	4.53
Sweden	1.14	26.96	0.11	9.09	1.16	9.91	0.12	3.16
Switzerland	1.08	19.60	0.12	10.00	1.14	8.11	0.13	3.25
Taiwan	0.35	10.49	0.05	7.79	0.39	3.95	0.04	1.86
Thailand	0.60	6.39	0.06	5.09	0.70	4.80	0.07	2.04
United Kingdom	0.79	12.42	0.10	8.07	0.77	6.72	0.10	2.76
Dollar portfolio	0.90		0.10		0.91		0.09	
Coeff. var.	0.33		0.37		0.56		0.51	
Corr. w/ β^D	1.00		0.96		1.00		0.63	
Corr. w/ $\beta^{d\tilde{r}}$	0.95				0.60			
$N \times \min p$		0.00		0.00		0.00		0.00

Table 1.4: Prices of beta risks

This table reports results from a panel regression for the two-beta ICAPM for currencies. λ's are the price of risk measures: the superscript denotes the source of beta risk, including the risk-premium-beta risk (ξ) and real-rate-beta risk ($d\tilde{r}$); the subscript "0" denotes the unconditional price of risk; and other subscripts denote the associated macroeconomic variables, including the average forward discount (AFD) and the log real exchange rate index ($reri$). The prices of risks and the intercept, interpreted as the risk premium of a zero-beta portfolio, are expressed as percentages. Beneath the regression estimates are the t-ratios (in parentheses), based on clustered standard errors following Thompson (2011). The last column reports pooled root-mean-square pricing errors ($RMSE$, in percentage). Models (1) and (6) use fixed betas, and the other models use 36-month rolling betas.

Model	*Intercept*	λ_0^ξ	λ_{AFD}^ξ	λ_{reri}^ξ	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.08	0.32			-0.84			3.282
	(-2.20)	(3.07)			(-1.10)			
(2)	0.00	0.11			-0.12			3.066
	(0.43)	(2.05)			(-0.41)			
(3)	-0.01	0.21	0.37		-0.81	-3.05		3.054
	(-0.44)	(3.38)	(7.75)		(-2.55)	(-7.14)		
(4)	0.06	0.04		-0.19	0.08		-0.53	3.054
	(2.84)	(0.67)		(-4.12)	(0.32)		(-1.29)	
(5)	0.03	0.16	0.42	-0.26	-0.60	-2.60	-0.07	3.042
	(1.71)	(2.64)	(9.40)	(-5.65)	(-1.91)	(-6.11)	(-0.18)	
(6)		0.19			-0.38			3.282
		(1.97)			(-0.48)			
(7)		0.11			-0.11			3.066
		(2.19)			(-0.39)			
(8)		0.21	0.37		-0.81	-3.05		3.054
		(3.42)	(7.80)		(-2.56)	(-7.14)		
(9)		0.08		-0.19	0.12		-0.52	3.054
		(1.73)		(-3.94)	(0.48)		(-1.25)	
(10)		0.19	0.42	-0.26	-0.58	-2.60	-0.06	3.042
		(3.24)	(9.39)	(-5.53)	(-1.85)	(-6.08)	(-0.17)	

Table 1.5: Prices of beta risks, with bootstrap corrections

This table reports results from a panel regression for the two-beta asset pricing model for currencies, where the finite-sample and errors-in-variable biases in point estimates and test statistics are corrected using 5,000 bootstrapped repetitions under the null of no time-series return predictability and no cross-sectional dependence across countries. p-values based on clustered standard errors (in parentheses) and the empirical distribution of the estimates (in curly brackets) appear under each estimate. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$
(1)	-0.09	-0.12			-0.80		
	(0.33)	(0.24)			(0.70)		
	{0.27}	{0.79}			{0.01}		
(2)	0.01	0.11			-0.12		
	(0.86)	(0.12)			(0.79)		
	{0.92}	{0.09}			{0.11}		
(3)	-0.01	0.21	0.37		-0.81	-3.05	
	(0.85)	(0.01)	(0.00)		(0.09)	(0.00)	
	{0.92}	{0.00}	{0.00}		{0.00}	{0.00}	
(4)	0.06	0.04		-0.22	0.08		-0.57
	(0.23)	(0.59)		(0.01)	(0.83)		(0.37)
	{0.26}	{0.61}		{0.01}	{0.30}		{0.00}
(5)	0.03	0.16	0.42	-0.29	-0.60	-2.60	-0.10
	(0.48)	(0.04)	(0.00)	(0.00)	(0.19)	(0.00)	(0.90)
	{0.55}	{0.04}	{0.00}	{0.00}	{0.00}	{0.00}	{0.40}
(6)		-0.39			-0.33		
		(0.47)			(0.85)		
		{0.89}			{0.05}		
(7)		0.11			-0.11		
		(0.07)			(0.78)		
		{0.06}			{0.09}		
(8)		0.21	0.37		-0.81	-3.06	
		(0.01)	(0.00)		(0.07)	(0.00)	
		{0.00}	{0.00}		{0.00}	{0.00}	
(9)		0.08		-0.22	0.12		-0.56
		(0.17)		(0.01)	(0.72)		(0.38)
		{0.25}		{0.01}	{0.11}		{0.00}
(10)		0.19	0.43	-0.29	-0.58	-2.60	-0.10
		(0.01)	(0.00)	(0.00)	(0.17)	(0.00)	(0.90)
		{0.02}	{0.00}	{0.00}	{0.00}	{0.00}	{0.43}

Table 1.6: Risks and rewards for currency trading strategies

This table reports risk and reward measures of seven currency trading strategies, including the passive dollar portfolio. The rewards for strategy q are the products of various betas (β) and their associated prices of risks (λ), whose superscript denotes the source of beta risk, including risk-premium-beta risk (ξ) and real-rate-beta risk ($d\tilde{r}$). Panel A reports the time-series averages of the excess returns, rewards, and raw and bias-adjusted alphas (in percentage), and the variance shares of rewards (in percentage), and their t-ratios (in parentheses). Panels B and C report the slope coefficients, above their t-ratios (in parentheses), of regressions of strategy betas (panel B) or strategy rewards (panel C) on AFD. All t-ratios are based on Newey-West standard errors.

A. Reward attribution

	Time-series average			Alpha		Variance share	
	ξ_q	$\lambda_t^{\xi}\beta_{q,t}^{\xi}$	$\lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}}$	α	$Adj.\alpha$	$\lambda_t^{\xi}\beta_{q,t}^{\xi}$	$\lambda_t^{d\tilde{r}}\beta_{q,t}^{d\tilde{r}}$
Dollar carry	0.21	0.29	-0.21	0.13	0.09	49.31	50.69
	(7.88)	(9.50)	(-7.13)	(1.07)	(0.83)	(4.97)	(5.10)
HML carry	0.50	0.02	-0.04	0.51	0.47	35.59	64.41
	(33.16)	(1.08)	(-1.76)	(3.47)	(3.00)	(1.96)	(3.54)
Country-level carry	0.21	0.02	-0.03	0.22	0.18	43.92	56.08
	(21.20)	(2.03)	(-2.38)	(2.52)	(1.37)	(2.48)	(3.16)
PPP	0.02	0.01	-0.00	0.01	-0.03	20.45	79.55
	(6.79)	(3.85)	(-1.00)	(0.79)	(-0.29)	(1.15)	(4.49)
Momentum	0.01	0.04	-0.07	0.04	0.00	54.19	45.81
	(0.59)	(1.25)	(-2.36)	(0.43)	(0.00)	(3.10)	(2.62)
Value	0.21	0.01	0.02	0.19	0.17	47.67	52.33
	(13.26)	(0.31)	(0.83)	(1.94)	(1.03)	(2.72)	(2.99)
Dollar	0.16	0.19	-0.08	0.04		59.42	40.58
	(6.27)	(4.60)	(-2.02)	(0.37)		(3.73)	(2.55)

B. Regression of beta on macroeconomic variable

Dep. var.	$\beta^{\xi}_{q,t}$	$\beta^{d\tilde{r}}_{q,t}$
Dollar carry	59.22	5.85
	(6.21)	(4.85)
HML carry	5.24	1.12
	(0.85)	(1.36)
Country-level carry	7.93	0.90
	(2.52)	(2.01)
PPP	-1.03	-0.12
	(-1.75)	(-1.07)
Momentum	6.65	2.21
	(0.97)	(2.57)
Value	2.17	-0.45
	(0.42)	(-0.70)
Dollar	-0.05	0.05
	(-0.08)	(0.08)

C. Regression of rewards on macroeconomic variable

Dep. var.	$\lambda^{\xi}_t \beta^{\xi}_{q,t}$	$\lambda^{d\tilde{r}}_t \beta^{d\tilde{r}}_{q,t}$	$\lambda^{\xi}_t \beta^{\xi}_{q,t} + \lambda^{d\tilde{r}}_t \beta^{d\tilde{r}}_{q,t}$
Dollar carry	0.21	-0.10	0.10
	(7.11)	(-2.92)	(4.81)
HML carry	0.05	-0.03	0.01
	(1.55)	(-1.09)	(0.85)
Country-level carry	0.02	0.00	0.02
	(1.05)	(0.20)	(1.64)
PPP	0.01	-0.01	-0.00
	(2.62)	(-2.54)	(-0.04)
Momentum	0.07	-0.07	0.00
	(1.12)	(-1.18)	(0.10)
Value	-0.00	0.04	0.04
	(-0.04)	(1.14)	(1.91)
Dollar	0.34	-0.26	0.08
	(150.06)	(-13.83)	(4.00)

Table 1.7: Prices of beta risks, change of reference currency

This table reports results from a panel regression for the two-beta asset pricing model for currencies with time-varying betas associated with AFD-driven time-varying prices of risks, using various reference currencies. See the caption to Table 1.4 for further details.

A. Developed Countries

Home	λ_0^{ξ}		λ_{AFD}^{ξ}		$\lambda_0^{d\tilde{r}}$		$\lambda_{AFD}^{d\tilde{r}}$		$RMSE$
Country	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio	
Australia	0.14	1.99	0.87	11.34	-1.76	-5.37	-3.61	-8.34	3.386
Austria	0.13	1.04	0.14	1.11	-0.29	-0.64	1.48	2.16	2.784
Belgium	0.23	2.79	0.13	1.21	-1.99	-2.43	1.19	1.06	2.716
Canada	0.00	0.01	0.39	6.63	0.56	1.93	-1.49	-6.21	3.063
Denmark	0.06	1.22	0.20	3.42	-0.27	-1.19	-0.14	-0.71	2.744
Finland	0.24	3.60	-0.11	-1.59	-1.48	-4.43	-0.23	-0.52	3.129
France	0.11	0.81	0.09	0.57	-1.16	-2.31	-0.32	-0.39	2.737
Germany	0.12	3.57	0.05	1.60	-0.55	-1.98	0.94	3.07	2.747
Greece	0.21	0.85	0.19	0.60	-1.60	-2.66	-2.37	-1.97	3.738
Ireland	-0.38	-5.22	-0.11	-1.58	0.56	2.93	-0.28	-2.52	2.747
Italy	-0.49	-2.39	0.20	2.06	2.65	2.06	0.41	0.44	2.909
Japan	0.27	8.89	0.16	2.76	0.25	1.18	-0.84	-2.26	3.873
Netherlands	0.25	4.10	0.24	2.17	-1.84	-2.12	0.72	0.58	2.841
New Zealand	-0.13	-2.28	-0.01	-0.11	-0.50	-2.40	-0.20	-0.26	3.396
Norway	0.10	3.91	-0.03	-0.75	-0.63	-3.81	-0.37	-1.86	2.944
Portugal	-0.64	-1.51	0.14	0.36	3.74	1.49	0.63	0.31	3.489
Singapore	-0.01	-0.24	-0.05	-1.37	0.66	4.23	-0.19	-0.68	2.625
Spain	0.43	1.85	-0.43	-4.54	-3.97	-3.25	3.48	6.43	2.953
Sweden	0.05	1.09	0.26	6.17	0.19	0.75	-0.10	-0.46	2.974
Switzerland	0.16	4.59	0.50	10.66	-0.36	-1.08	-1.13	-4.56	3.040
United Kingdom	0.24	5.91	0.11	1.54	-0.80	-3.79	-0.12	-0.48	3.096

B. Emerging Market Countries

Home	λ_0^{ξ}		λ_{AFD}^{ξ}		$\lambda_0^{d\tilde{r}}$		$\lambda_{AFD}^{d\tilde{r}}$		$RMSE$
Country	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio	
Czech	-0.23	-2.16	0.38	4.45	0.40	0.77	-0.11	-0.67	3.248
Hungary	-0.11	-2.50	0.06	0.50	-0.33	-1.05	0.07	0.24	3.485
India	-0.97	-16.65	0.57	6.09	0.50	3.97	-1.51	-3.03	2.448
Indonesia	-0.32	-10.44	0.90	23.61	0.25	0.78	3.45	9.26	4.040
Kuwait	-0.05	-1.83	-0.01	-0.30	0.92	3.99	-0.83	-4.95	2.812
Malaysia	0.31	6.33	-0.36	-4.88	-0.71	-3.00	0.12	0.41	4.373
Mexico	-0.08	-2.26	0.89	21.89	-3.55	-16.80	4.03	9.84	3.455
Philippines	-0.04	-1.42	0.14	2.77	0.26	2.31	-0.17	-0.61	2.953
Poland	-0.58	-3.77	0.30	2.31	2.59	3.82	1.45	4.08	3.423
South Africa	0.13	3.70	0.45	9.41	-0.81	-3.09	-0.07	-0.39	4.119
South Korea	-0.10	-2.83	-0.01	-0.26	0.37	1.08	1.69	4.70	3.181
Taiwan	0.01	0.27	0.06	1.04	0.97	3.61	-0.46	-2.01	2.856
Thailand	0.08	1.70	0.25	6.95	-1.08	-2.40	-1.20	-6.67	3.700

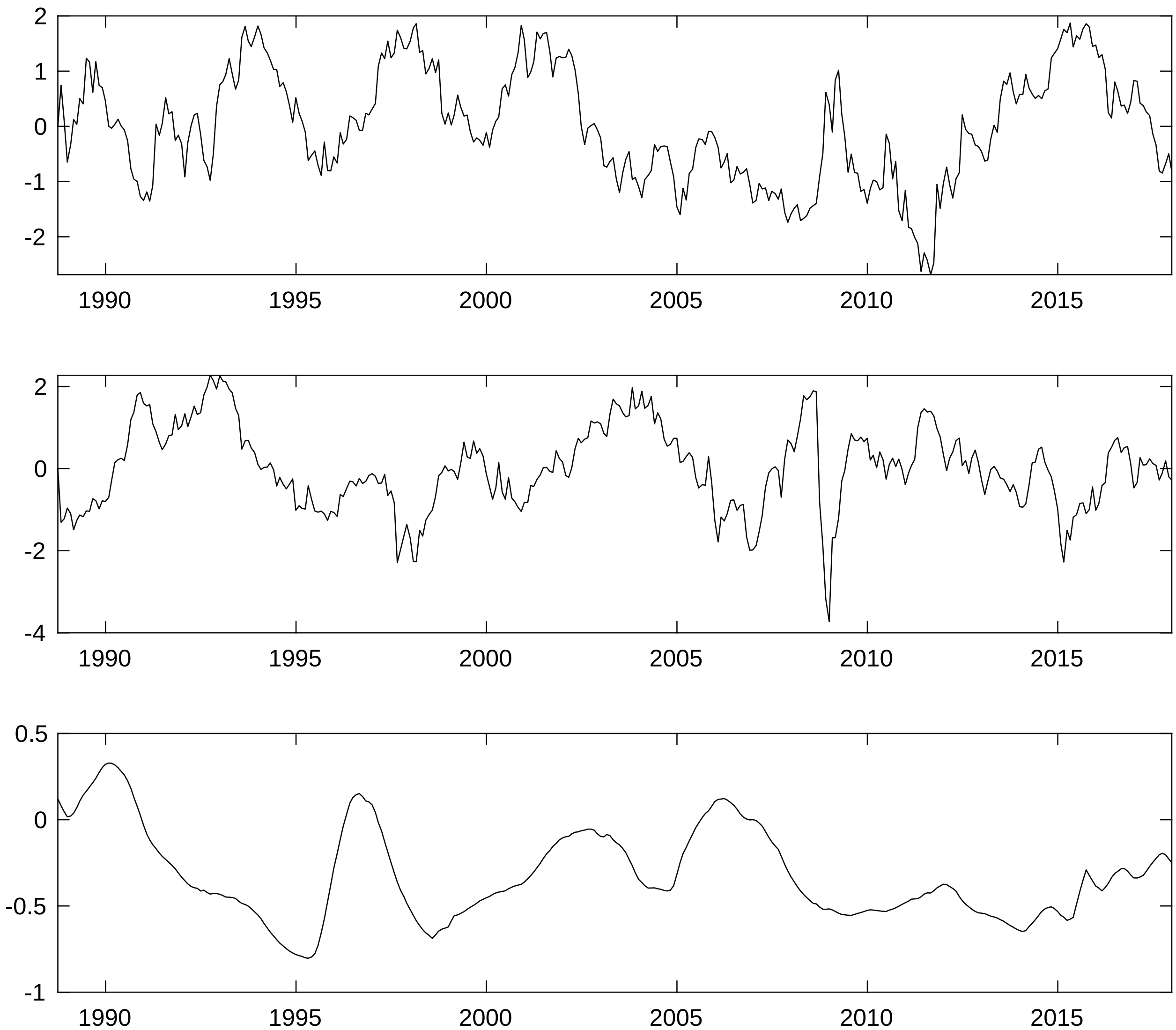

Figure 1.1: Dollar factor news, rolling estimates

This figure plots the time series of risk-premium news of the dollar portfolio (top), the real-rate news of the dollar portfolio (middle), and their correlations (bottom), using a 36-month rolling window. The plotted news components are the last observations of each moving window. For illustration purposes, the news components are exponentially smoothed using a decay factor of 0.92 and then standardized.

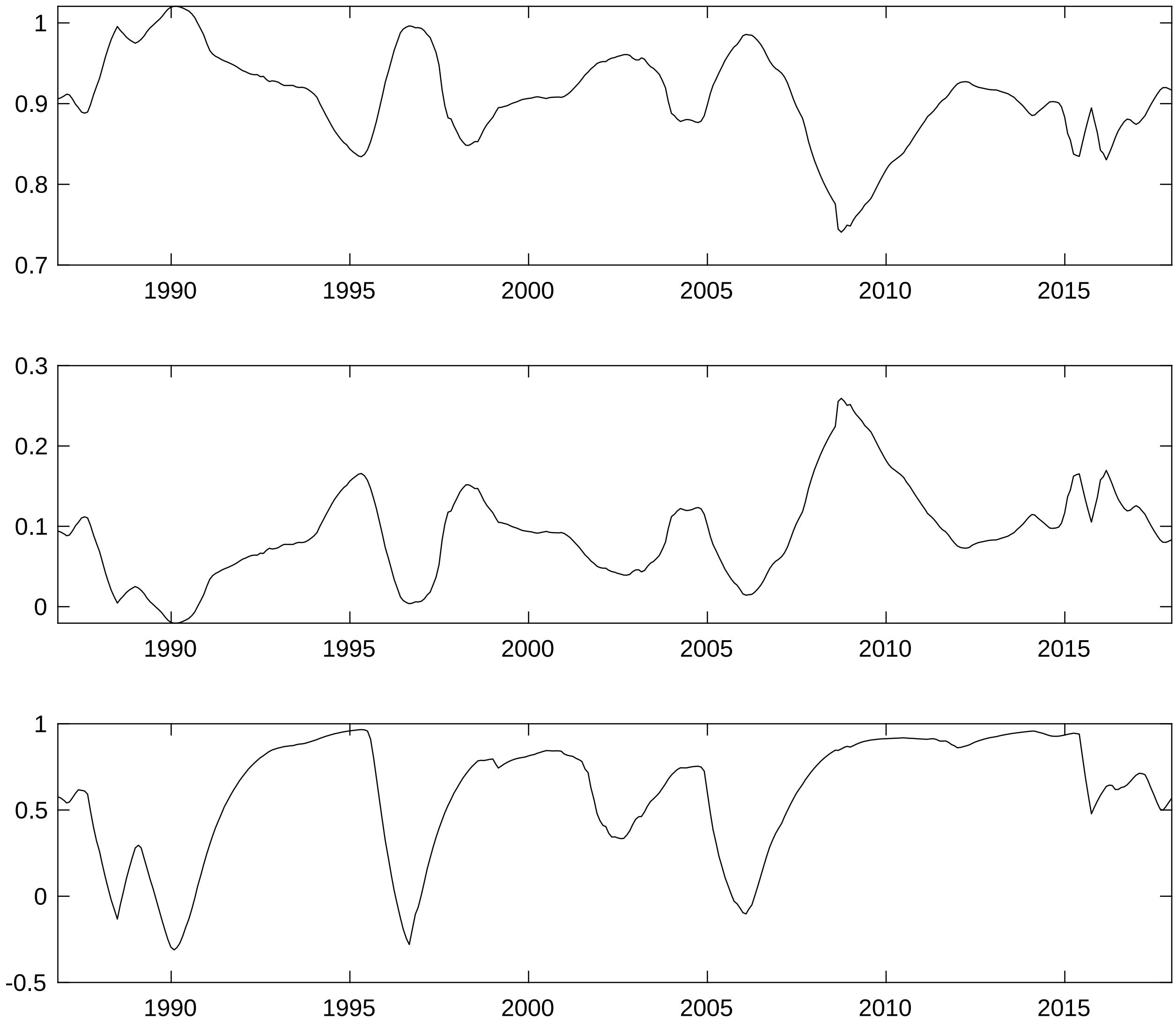

Figure 1.2: Betas, rolling estimates

This figure plots the time series of the risk-premium beta for the dollar portfolio (top), the real-rate beta for the dollar portfolio (middle), and the cross-sectional correlation between risk-premium and real-rate betas of all currencies (bottom). All betas are 36-month rolling estimates.

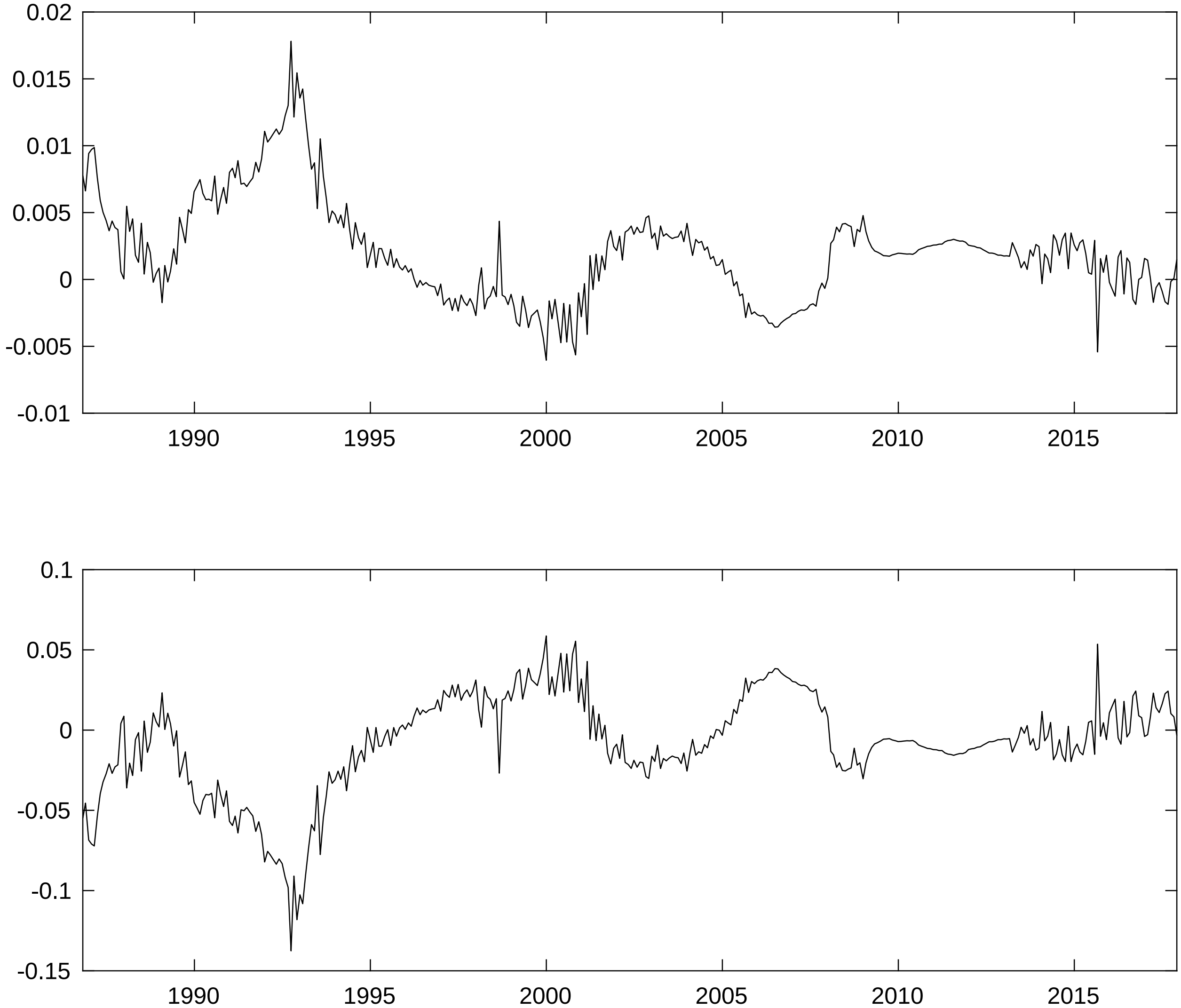

Figure 1.3: Prices of beta risk

This figure plots the time series of the prices of risk-premium-beta risk (top) and of real-rate-beta risk (bottom).

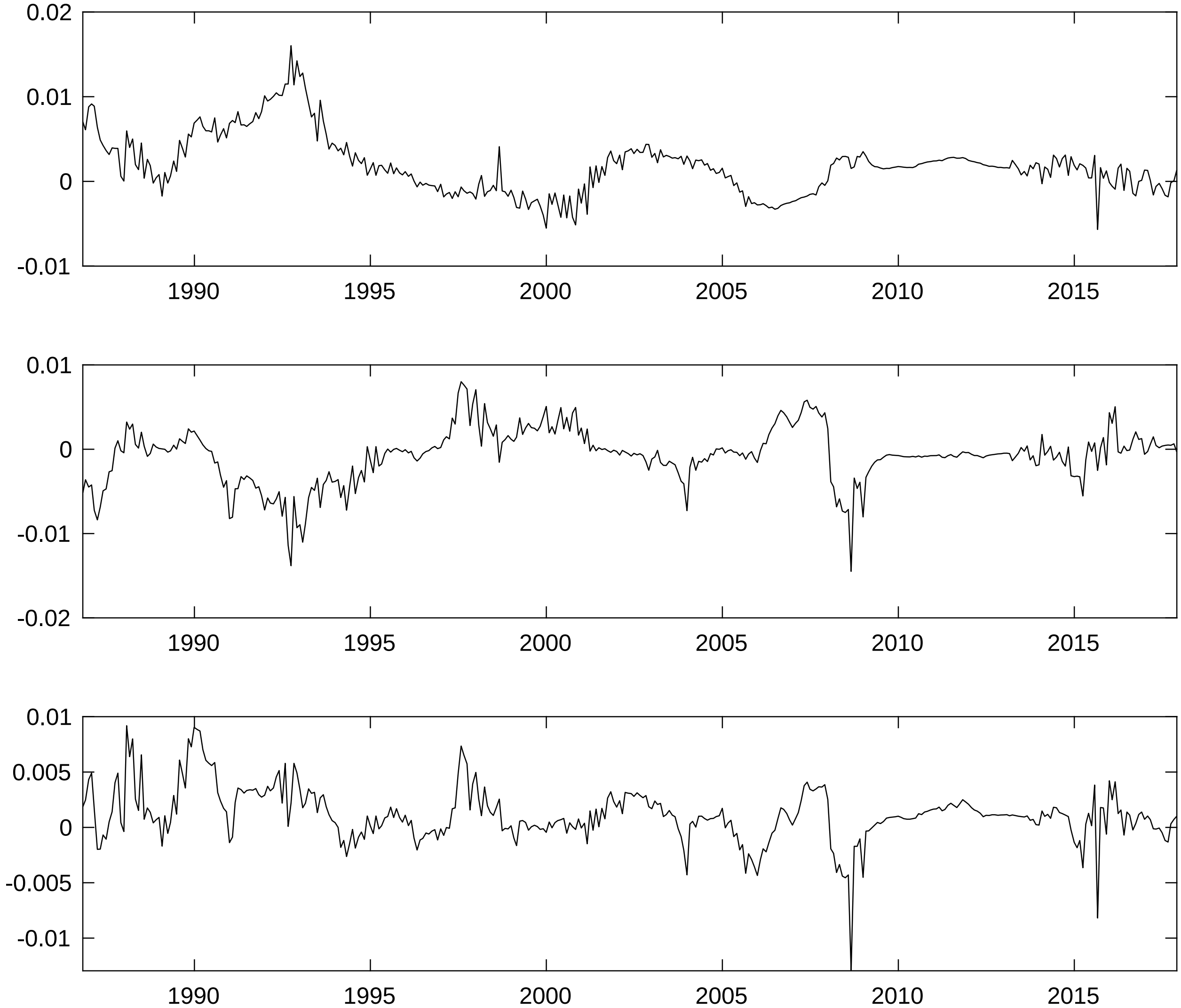

Figure 1.4: Rewards for beta risk, dollar factor

This figure plots the time-series of the ex ante reward (i.e., the product of beta and its price of risk) for risk-premium-beta risk (top), and the ex ante reward for the real-rate-beta risk (middle), both for the dollar factor, as well as the sum of the two rewards (bottom).

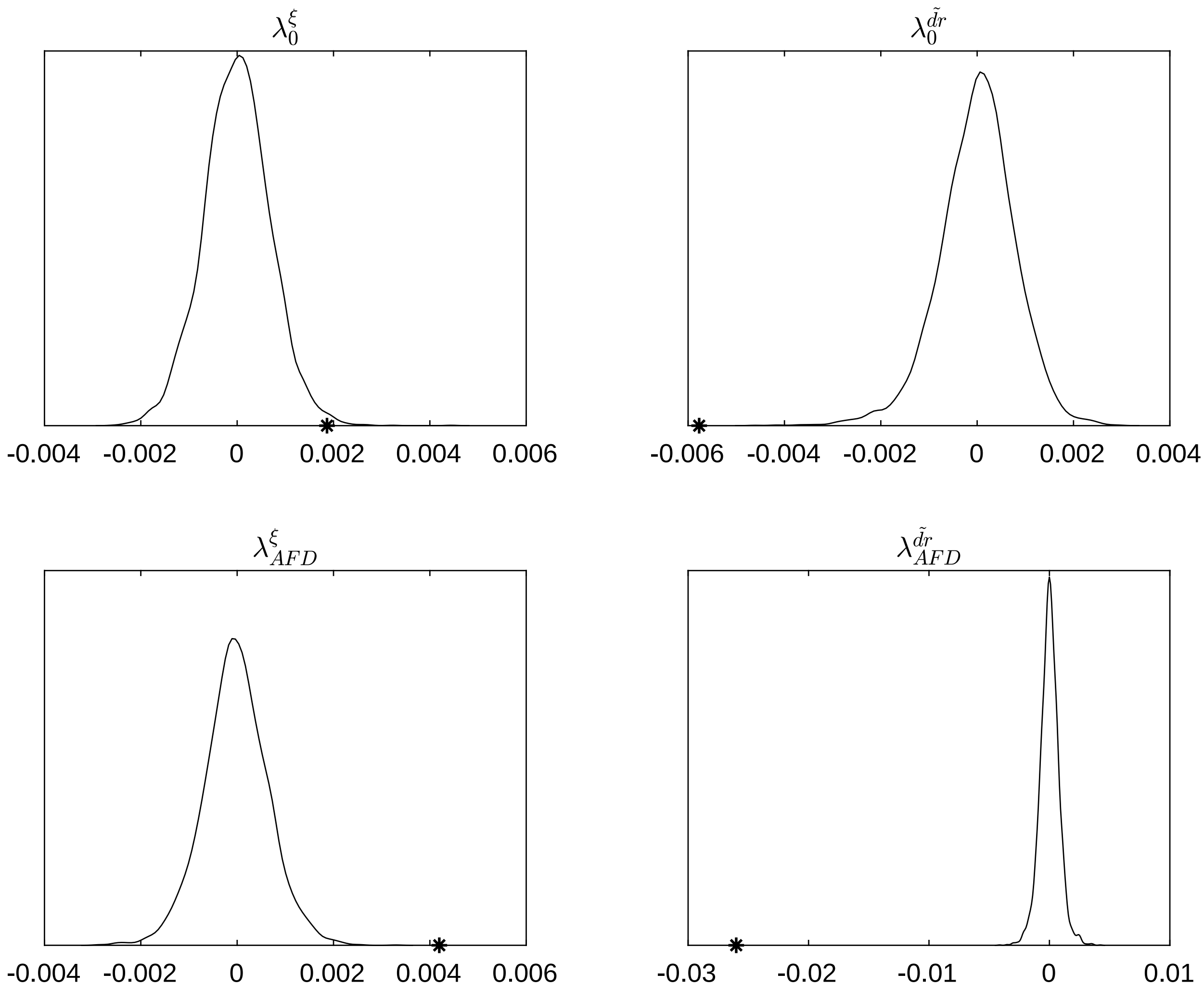

Figure 1.5: Empirical distribution of prices of beta risks under the no-predictability no-dependence null

This figure uses a Gaussian kernel to plot the bootstrapped distribution of the coefficient associated with the risk-premium beta (top left), the interaction of risk-premium beta and AFD (bottom left), the real-rate beta (top right), and the interaction between real-rate beta and AFD (bottom right), under the null of no time-series return predictability and no cross-currency dependence. Asterisks indicate the sample estimates.

CHAPTER 2: TREND FACTORS AROUND THE WORLD: DO CULTURAL DIFFERENCES EXPLAIN THE PERFORMANCE DIFFERENCES?

2.1 Introduction

There are three well-known stock price trends that are difficult to explain by the factor models: the momentum effects documented by Jegadeesh and Titman (1993), the short-term reversals documented by Jegadeesh (1990), and the long term reversals documented by Bondt and Thaler (1985). Thus, it becomes interesting to see whether combining all the price moving average information could generate substantial additional economic gains. Han, Zhou, and Zhu (2016) introduce a trend factor that exploits the short-, intermediate-, and long-term price signals and they show that this trend factor can outperform any of the above three effects in U.S. stock market, with very limited exploration in other G7 countries. This is in line with the evidence that the setting of the trend factor goes beyond a simply synthesis and can still incorporate accurate information even if the performance of some of its components (i.e., momentum effect) is reverse in some regions (i.e., Asian markets).

Despite its promise, to shed light on the key issue of "whether the trend factor is likely a genuine factor" (Han, Zhou, and Zhu (2016), p.368), the use of global data would be crucial for two reasons. one is simply to mitigate the well-known data-mining concern. Han, Zhou, and Zhu (2016) explore the data of other G7 countries for this purpose, while their investigation in this regard is limited. Another reason is to reveal the scope of applicability of the factor, as the factor could still be a genuine factor but only under certain conditions, such as a factor in a regional rather than a global context. The latter is clearly suggested by the voluminous literature documenting the profitability of the momentum, short-term reversal, and long-term reversal strategies in the international equity market. For example, Rouwenhorst (1998) document that the European equity markets exhibit medium-term return continuation and Griffin, Ji, and Martin (2003) find that the short-term momentum profits around the world, Chui, Titman, and Wei (2003) show that the opposite results exists for momentum strategy in Asian markets, which they argue is due to the cultural differences. The mixed performance of these well-known strategies at different time horizons motivates us to thoroughly examine whether the trend factor of Han, Zhou, and Zhu (2016) may perform well throughout the world.

In this paper, we use the same procedure introduced by Han, Zhou, and Zhu (2016) to construct the trend factor for 40 markets (22 developed countries other than United States and 18 emerging countries respectively). The inclusion of major emerging stock markets in the sample is important, as emerging economies already cover more than 1/3 world GDP and emerging markets generally behave quite differently from developed markets. We find that the trend factor performs well and outperforms the short-term reversal, momentum, and long-term reversal strategies in most developed countries. Specially, the average magnitude of trend profits is about 19% per year (before the allowance for risk and transaction costs) for the developed countries. Second, we provide the evidence that the heterogenous trend profits across the stock markets are related to cultural differences. The trend profits are significantly higher in those countries where the individualism is higher. Finally, we form a global trend factor combining the countries' individual trend factor together, and show that it outperform the global market and global momentum factors. Furthermore, the global trend factor performs better than the global momentum factor in explaining the portfolios' returns.

This study contributes to the literature in the following aspects. First, we present the most robust evidence thus far that the trend factor is likely a genuine factor in two dimensions. On the one hand, the trend factor incorporating information from different time-horizons outperforms the three separate price trends, short-term reversal, momentum, and long-term reversal in most developed countries. And its profit is hard to be explained away by existing capital asset pricing models. While Han, Zhou, and Zhu (2016) focus on the CAPM alpha, we regress the profitability of the trend factor on Fama-French six factor model,[1] the trend factors can generate significantly positive alphas in most 40 countries. Additionally, we regress the trend factor on three separate price trends, and present that these separate price trends cannot fully explain the trend factor. On the other hand, we form the global trend factor portfolio combining the countries' individual trend factor together, and show that the global trend factor performs better than the global momentum factor and Fama-French's five global factors in explaining the cross-sectional portfolios returns. For stock portfolios sorted on different criteria, the Gibbons, Ross, and Shaken (1989) statistics of the CAPM with the global trend factor are smaller than other asset pricing models including CAPM with the global momentum factor and Fama-French's five-factor model.

Second, shedding more light on how to apply the trend factor in the international context, we present new evidence that the global trend factor can explain most individual trend factors, while the individual trend factors cannot explain the global trend factor. The performance of the global trend factor is also consistently better than the global market and global momentum factor in different subsamples and subperiods.

Finally, given the evidence that the trend factor may be a genuine factor across countries under certain conditions rather than unconditionally and universally, this paper further examines the extent to which the trend profit is generated by psychological biases of traders (a more micro-level factor) and the legal environments of these markets under considerations (a more macro-level factor). We use four dimensions of cultural differences introduced by Hofstede (2001) to proxy the psychological biases of traders: power distance, individualism, masculinity, and uncertainty avoidance. Although these measures are widely used by many researchers in accounting (Schultz, Johnson, Morris, and Dyrnes (1993) and Kachelmeier and Shehata (1997)), economics (Franke, Hofstede, and Bond (1991) and Weber, Shenkar, and Raveh (1996)), and management (Geletkanycz (1997) and Tan, Wei, Watson, and Walczuch

[1]We regress the trend profits on Fama and French (2015)'s five factor plus the momentum factor

(1998)), Chui, Titman, and Wei (2010) is the first to link the cultural differences with stock returns in finance literature. They examine how cultural differences influence the returns of momentum strategies and find that individualism is positively associated with the momentum profits. The countries with higher individualism index tends to be more overconfident, where investors taking more risks in the equity market and gaining more if they use momentum strategy. Consistent with Chui, Titman, and Wei (2010), we empirically show that the magnitude of trend profits are higher in those countries where the individualism is higher, despite the substantial difference between the momentum factor and the trend factor.

There is also a substantial literature links the differences of equity markets to countries' different legal system, accounting standards, and disclosure requirements etc. Porta, Lopez-De-Silanes, Shleifer, and Vishny (1997) and Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998) document that the countries with poorer investor protections or under French civil law have smaller or narrower capital markets compared with countries with stronger investor protections and under common-law. Mclean, Zhang, and Zhao (2012) further document that stronger investor protection is associated with greater investment sensitivity to Tobin's q and lower investment sensitivity to cash flow, and hence generating stronger profits in those countries. Porta, Lopez-De-Silanes, and Shleifer (2006) provide strong evidence that laws mandating disclosure and facilitating private enforcement through liability rules can benefit stock markets. We include all these potential determinants of stock markets and show that the trend factor performs better in countries where the legal enforcement is higher and public firms issue (repurchase) less stocks.

2.2 Trend Factor

In this section, we discuss the methodology for constructing the trend factor and the data used in this paper.

2.2.1 Methodology

We follow Han, Zhou, and Zhu (2016) to construct the trend factor for each country's stock market. We first calculate the MA with lag L on the last trading day of each month.

$$A_{jt,L} = \frac{P^t_{j,d-L+1} + P^t_{j,d-L+2} + ... + P^t_{j,d-1} + P^t_{j,d}}{L} \tag{2.1}$$

where $P^t_{j,d}$ is the closing price for stock j on the last trading day d of month t, and L is the lag length. We use the MA signals with several different lag lengths, including 3-, 5-, 10-, 20-, 50-, 100-, 200-, 300-, and 400-days, to capture short-, intermediate-, and long-term price patterns in the trend factor. Then, we normalize the moving average prices by the closing price on the last trading day of the month following Han, Zhou, and Zhu (2016),

$$\tilde{A}_{jt,L} = \frac{A_{jt,L}}{P^t_{jd}} \tag{2.2}$$

We next run the cross-sectional regression in each month t on stock return at time t on normalized MA signals at time $t-1$ to obtain the time-series of the coefficients on the signals,

$$r_{j,t} = \beta_{0,t} + \sum_i \beta_{i,t}\tilde{A}_{jt-1,L_i} + \epsilon_{j,t}, j = 1, ..., n \tag{2.3}$$

where $r_{j,t}$ is the stock j's return in month t, and $\tilde{A}_{jt-1,L_i}$ is the trend signal of stock j at the end of month $t-1$ with lag L_i. From the cross-sectional regression, we could get coefficient $\beta_{i,t}$ of the trend signal with lag L_i in month t. The the expected return for month $t+1$ at month t be estimated

$$E_t[r_{j,t+1}] = \sum_i E_t[\beta_{i,t+1}]\tilde{A}_{jt,L_i} \tag{2.4}$$

where $E_t[\beta_{i,t+1}]$ is the estimated expected coefficient of the trend signal with lag L_i,

$$E_t[\beta_{i,t+1}] = \frac{1}{12}\sum_{m=1}^{12}\beta_{i,t+1-m} \tag{2.5}$$

which is the average of the estimated loadings on the trend signals over the past 12 months.

Now, we are ready to construct the trend factor. We sort all stocks into ten portfolios by their expected returns we estimated above. The portfolios are equal-weighted and rebalanced every month. The return difference between the decile portfolio of the highest expected returns and the decile portfolio of the lowest is defined as the return on the trend factor. In other words, the trend factor buys stocks with highest expected return estimated by MA signals and shorts stocks with lowest expected returns.

2.2.2 Data

We use the daily stock prices (denominated at U.S. dollars) obtained from Worldscope data in Thomson Reuters Datastream for the following 44 countries:

- *G6 countries except for United States (G6)*: Canada, France, Germany, Italy, Japan, and United Kingdom
- *Other developed countries*: Australia, Austria, Belgium, Denmark, Finland, Greece, Hong Kong, Ireland, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, and Switzerland.
- *Emerging market countries*: Argentina, Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Pakistan, Peru, Phillippines, Poland, Russia, South Africa, Sri Lanka, Taiwan, Thailand, and Turkey.

We form our portfolios and rebalance them at the monthly frequency for each country or region based on the month-end moving average signals. For each month, we drop all the observations for the country (region) if the total number of firms in that country is less than 100. Thus, we drop Argentina, Colombia, Hungary, and Indonesia in our sample.

Additionally, at end of each month, we exclude stocks with prices below $3 for developed countries and $1 for emerging countries (price filter). Han, Zhou, and Zhu (2016) also drop stocks that are in the smallest decile sorted with NYSE breakpoints (size filter). Our results are very similar if we use both price filter and size filter.

2.3 Trend factor across the world

In this section, we compare the performance of the trend factor with that of market, momentum, short-term reversal, and long-term reversal for each country.

2.3.1 Summary statistics

Table 2.1 compares the starting date, the monthly average returns (as %). t-ratios, and Sharpe ratios for the trend factor and value-weighted market portfolio for each country in our sample, including G6 countries (except for United States), other 16 developed countries, and 18 emerging markets. The results for Argentina, Colombia, Hungary, and Indonesia are absent because they do not have enough firms (less than 100 firms) each month to construct the trend factor. Since the trend portfolio is the long-short portfolio, we calculate the market return in excess of the U.S. risk-free rate for each country.

Panel A of Table 2.1 reports the results for G6 countries excluding United States. The trend factor among all of the G6 countries have significantly positive monthly average returns, while the market portfolio get much lower and marginally significant monthly average returns. The highest average monthly return of the trend factor among G6 countries is 4.28% for Canada, which is much higher than 0.42% monthly returns of Canada's market portfolio. The lowest return of the trend factor among G6 countries is 1.00% for United Kingdom, which is higher than its market portfolio, 0.34%. The average monthly return of the trend factor for Japan is 1.40%, comparing with its market portfolio −0.03%. Concerning about the return-risk tradeoff, we also calculate the Sharpe ratios by dividing the average monthly returns by the standard deviation of trend factor. The Sharpe ratios of trend factor range from 0.22 (Italy) to 0.89 (Canada), which are much higher than the Sharpe ratios of market portfolio, ranging from −0.00 (Japan) to 0.09 (Canada, France, and United Kingdom). The average trend profits for G6 countries is 23.27% per year, slightly higher than the trend profit in the United States (19.56%) documented in Han, Zhou, and Zhu (2016).

Panel B of Table 2.1 reports the summary statistics for other 16 developed countries excluding G6. Most of the developed countries get significantly positive monthly average returns except for Ireland and New Zealand. The highest monthly returns of the trend factor among these developed countries is 2.34% for Australia, which is much higher than its market return 0.55%, with similar standard deviation. The monthly return for trend factor ranges from 0.25% (New Zealand) to 2.34% (Australia), comparing to the market portfolio ranging from 0.06% (Portugal) to 0.78% (Denmark). Except for Ireland and New Zealand, the Sharpe ratios of trend factor range from 0.11 (Hong Kong) to 0.44 (Australia), which are much higher than the Sharpe ratios of the market portfolios, ranging from 0.01 (Portugal) to 0.16 (Switzerland). The average profit of the trend factor for the developed countries excluding G6 is 12.93% per year.

The performance of the trend factor in emerging markets (Panel C of Table 2.1) is much weaker compared with developed countries. Brazil, India, Israel, Poland, South Africa, and Sri Lanka get significantly positive returns on the trend factor. Other 12 emerging markets get either insignificant monthly returns or lower returns than the market portfolios. Though the performance of the trend is weaker in the emerging markets, there are still 8 out of 18 emerging markets which have higher Sharpe ratios on the trend factor than that of the market portfolios. And the profit of the trend factor for emerging market, which is 9.26%, is much higher than the market portfolio (1.64% per year).

2.3.2 Trend factor and other trend signals

Because the trend factor is the combination of all price trend signals of stock returns, thus it is important to compare the trend factor with these well-known price-trend signals. Table 2.2 compares the average returns (as %), t-ratios and Sharpe ratios of the trend factor, short-term reversal effect (SREV), momentum effect (MOM), and long-term reversal effect (LREV). To get these three effects, we sort stocks into ten portfolios based on their lag monthly returns and rebalance portfolios monthly. The SREV is the difference of average one-month lag returns between the lowest decile and the highest decile. The long-term reversal portfolios are constructed monthly using the cumulative prior 13-60 months return decile breakpoints and the LREV is the difference of the average one-month holding period returns between the lowest decile and the highest decile. We sort the momentum portfolios based on their prior 2 to 12 cumulative returns and the MOM is the difference of the average one-month return between the highest decile and the lowest decile.

Panel A of Table 2.2 reports the comparison among different trend-signal strategies for G6 countries. The LREV performs not well in these G6 countries. Canada and Japan get insignificant average monthly returns on LREV, while other G6 countries get significantly negative average monthly returns on LREV. Different from the LREV, the trend factor considers the "long-term momentum" effect in these countries instead. Thus, the trend factor can still work well when the LREV generates negative returns. For the SREV, United Kingdom gets significantly negative monthly returns and Italy gets insignificantly positive returns. Other 4 countries get significantly positive monthly returns on SREV. The MOM works pretty well for the G6 countries, indicating that the momentum strategy is the most important contribution to trend factor. The trend factor which capture the price trend up to 400 days including short-term reversal and momentum works very well for G6 countries. The trend factor is superior to the SREV in these G6 countries with both higher monthly returns and higher Sharpe ratios. The trend factor for United Kingdom is inferior to the MOM because the SREV including in the trend factor works not well in United Kingdom. Other 5 countries get higher monthly returns and Sharpe ratios of the trend factor than those of MOM.

Panel B of Table 2.2 shows that other developed countries excluding G6 have either negative or insignificantly positive returns for SREV and LREV. The trend factor outperforms the SREV and LREV with significantly positive monthly returns and higher Sharpe ratios for all of these developed countries. Among these 16 developed countries, Australia, Belgium, Finland, Greece, Portugal, Singapore and Switzerland have significantly positive monthly returns and higher Sharpe ratios on trend factor comparing with MOM. Because the SREV and LREV do not works very well in these developed countries, the momentum factor contributes most to the returns of trend factor. However, the Sharpe ratios of the trend factor are still higher than the Sharpe ratios of the momentum factor in most developed countries.

Panel C of Table 2.2 shows a different story for emerging markets. Among the 18 emerging markets, the momentum factor works in only 6 of them. The MOM performs well in Brazil, India, Israel, Poland, South Africa, and Taiwan. The trend factor performs even better in these markets except for Taiwan. The LREV gets either negative or insignificant positive returns, showing that the LREV does not work in any of the emerging markets in our sample. The SREV works well in in only 3 out of the 18 emerging markets: China, Israel, and Korea. The trend factor works pretty well in Brazil, India, Israel, Poland, South Africa, and Sri Lanka. Among the markets with positive factor returns, the Sharpe ratios of trend factor ranges from 0.01 (Malaysia) to 0.46 (Sri Lanka), comparing with the MOM ranging from 0.01 (Turkey) to 0.35 (South Africa). And there are 12 emerging markets with higher Sharpe ratio of trend than that of momentum factor among the 18 emerging markets. The results show that though the trend factor is weaker in emerging markets, it outperforms MOM, SREV, and LREV in most of the regions. Additionally, the MOM is the most important contribution to the performance of trend factor, while the trend factor generally would behave better than the MOM when the SREV works well in that country.

Overall, the results suggest that the trend factor which capturing short-, median-, and long-term price trends outperform SREV, MOM, and LREV in most of the countries. Among these three price trends, the median-term return continuation seems to be the most important contribution to the trend factor.

2.3.3 Regression of the trend factor on other trend signals

Since our trend factor uses information on the short-term, intermediate-term, and long-term price trends, and because the three trends are traditionally captured by the short-term reversal, momentum, and long-term reversal effects, it is interesting to see whether the three factors could fully explain the performance of the trend factor for each country. Thus, we regress the trend factor of each country on its market factor (MKT), SREV, MOM, and SREV to see whether the trend factor could deliver abnormal performance after controlling these four effects.

$$r_{Trend,t} = \alpha + \beta_{MKT} r_{MKT,t} + \beta_{SREV} r_{SREV,t} + \beta_{MOM} r_{MOM,t} + \beta_{LREV} r_{LREV,t} + error_t \quad (2.6)$$

where $r_{Trend,t}$, $r_{SREV,t}$, $r_{MOM,t}$, and $r_{LREV,t}$ are the returns for trend factor, short-term reversal factor, momentum factor, and long-term reversal factor. $r_{MKT,t}$ is the excess return for market portfolio.

Table 2.3 presents the results for G6 countries in Panel A. the MOM factor has a significantly positive effect on the trend factor for all of the G6 countries, while the LREV has no effect on the trend factor. SREV has a positive effect on Japan while a negative effect on United Kingdom. Except for United Kingdom, the trend factor could still generate significantly positive α after controlling for country's market factor and other three single-trend factors. The trend factor gets $\alpha = 4\%$ (with t-ratio 8.17) in Canada, suggesting that our trend factor contains much more information than the information captured from SREV, MOM, and LREV and cannot be fully explained by them.

Panel B of Table 2.3 shows that there are 10 out of 16 other developed countries (excluding G6) where the trend factor could deliver abnormal performance after controlling the market, SREV, MOM, and LREV. Among the 6 developed countries where the trend factor could not generate positive α, the trend factor is fully explained by the MOM in Austria and Spain, fully explained by the SREV in Hong Kong, and fully explained by the MOM and the LREV in Denmark. The MOM positively explains the performance of trend, while the SREV negatively explains the trend performance simultaneously in Ireland, showing that the stock market in Ireland mainly have short-term and intermediate-term momentum. The MOM have a positive β loading on the trend factor, showing that the MOM indeed is the key contribution to our trend factor. However, the significant positive alphas in most of the developed countries show that the trend factor contains some information which is absent in the MOM and the trend factor could not be replaced by the MOM.

The result for emerging markets in panel C of Table 2.3 is different with the result for developed countries. There are 6 out of 18 emerging markets where the trend factor could deliver abnormal performance after controlling the market, SREV, MOM, and LREV. The MOM could not positively explain the performance of the trend factor in 8 emerging markets, and there are even negative β loadings on the MOM for Korea, Pakistan, Sri Lanka, and Thailand. The SREV positively explains the performance of the trend factor in China and Mexico, but negatively explains the performance of the trend in Chile, Poland, and Thailand. The LREV positively explains the performance of the trend in Israel and Mexico, but negatively explain the its performance in Russia and Sri Lanka. Even though the trend factor could be explained by the three single-trend factors in 12 emerging markets, the effects for these three single-trend factors on the Trend are mixed across different countries. Thus, using the Trend combining all time-lengths trend signals could give us more information for investment.

The overall results suggest that the short-, intermediate-, and long-term price trend signal are different across very different across different countries. And the trend factor could not be fully explained by these three single price trend signal, especially for the developed countries. Thus, using the trend factor which capture price trend information from different time length seems to be more rational than simply using the single time length price trend signal in the international equity market.

2.3.4 Trend vs Fama-French 5 factors and the momentum factor

Our previous results show that the trend factor performs very well in most of the developed countries and could not be fully explained by the three single price trend signals. Thus it is important to ask whether the trend factor could be explained by the capital asset pricing models. Thus, we regress the return of the trend factor on the Fama-French's six-factor model.

$$\begin{aligned} r_{Trend,t} &= \alpha + \beta_{MKT} r_{MKT,t} + \beta_{SMB} r_{SMB,t} + \beta_{HML} r_{HML,t} \\ &+ \beta_{RMW} r_{RMW,t} + \beta_{CMA} r_{CMA,t} + \beta_{MOM} r_{MOM,t} + \nu_t \end{aligned} \tag{2.7}$$

The factor data are available from Ken French's online data library. We regress the return of trend factor of developed countries on the factors constructed for developed countries, and regress the return of the trend factor of emerging markets on the factors constructed for emerging markets. Table 2.4 reports the regression coefficients and t-ratios based on Newey and West (1994) robust standard errors.

Panel A of Table 2.4 shows that the trend factor in Canada, France, Germany, and United Kingdom generates significant alphas in the regression, suggesting that the Fama-French's six-factor asset pricing model cannot explain the outstanding performance of the trend factor in the G6 countries. The factor loadings on market factor are insignificant for all G6 countries, except for Italy with significantly negative β loading. The factor loadings on momentum factor are all significantly positive except for Canada.

Panel B of Table 2.4 presents results for other developed countries excluding G6. Similarly to the results for G6 countries, only the momentum factor gets consistent and significantly positive β loadings for each country. The trend factor in 12 out of 16 countries could generate positive abnormal returns with significant α. The average α for developed countries is 1%. The trend factor could deliver abnormal performance for most of the developed countries under the six-factor asset pricing model.

Though the result for emerging markets in Panel C of Table 2.4 is weaker, the trend factor in 8 out of 18 emerging markets could generating significant α under Fama-French six-factor asset pricing model. The returns of the trend factor seem to be less sensitive to the momentum factor for the emerging markets, as the coefficients on the momentum factor is significantly positive in only 7 out of 18 countries.

Overall speaking, even though the global momentum factor seem to be an important factor in asset pricing models to explain the performance of the trend factor for each country with significantly positive β loading, Fama-French's six-factor asset pricing model cannot fully explain the performance of the trend factor in the international stock markets.

2.4 Trend factor and countries' different characteristics

The previous section shows that the trend factors perform well in most of developed countries and cannot be fully explained by the existing capital asset pricing models. In this section, we investigate whether the trend factor in individual countries performs similarly or differently, and how the countries' different characteristics affect the performance of the trend factor.

We include U.S. data as well in this section. We exclude U.S. equity market in the previous section because Han, Zhou, and Zhu (2016) have already shown that the performance of trend factor is extraordinary even during the recession. The process we construct the data factor for U.S. stock market is the same with Han, Zhou, and Zhu (2016). We use the daily stock prices from January 1, 1980 through December 31, 2017 obtained from the Center for Research in Security Prices (CRSP). We include all domestic common stocks listed on the NYSE, AMEX, and Nasdaq stock markets, and exclude stocks do not have a CRSP share code of 10 or 11. At the end of each month, we exclude stocks with prices below \$5 and stocks that are in the smallest decile sorted with NYSE breakpoints.

2.4.1 Correlation among individual countries' trend performance

The previous results suggest that the trend factors are more profitable in developed countries than in emerging markets. However, the existing capital asset pricing models cannot fully explain why the trend factor can perform well in developed countries. We firstly study whether the trend factors perform similarly among developed (emerging) countries.

Table 2.5 reports the correlation of the trend profits among different countries. As panel A of Table 2.5 reports, the highest correlation among the developed countries is the correlation between United Kingdom and France (0.71), followed by the correlation between France and Finland with 0.61. Japan has very low correlation of the trend performance with any other countries in our sample, ranging from -0.05 with Greece to 0.17 with New Zealand. The trend performance in United States tends to move in an opposite direction with other countries, ranging from -0.37 with Switzerland to 0.17 with Canada. Thus, the trend factor performs very differently among developed countries even though it performs well in most of the developed countries.

Panel B of Table 2.5 shows that the correlations of the trend profits are small among emerging markets, ranging from the -0.40 (between Poland and Pakistan) to 0.39 (between Russia and Thailand). The correlation among different region is inconsistent as well. The trend factor in Pakistan has the correlation of -0.28 with the trend in India and -0.30 with the trend in Philippines, while the correlation between Pakistan and Thailand is 0.33.

Panel C of Table 2.5 presents the cross correlation between the developed countries and emerging countries. The highest correlation is 0.53, which is between Poland and Austria. While the lowest correlation is between Russia and Finland, which is -0.45.

The performance of the trend factor which cannot be fully explained by most of the capital asset pricing models, are quite different across different countries. Thus, we study how the countries' cultural differences and other countries' characteristics can affect the performance of the trend factor across different countries in this section.

2.4.2 Do Cultural differences explain the trend performance: portfolio analysis

In this section, we investigate the relation between countries' cultural differences and the profitability of trend factors across countries.

2.4.2.1 Cultural differences

According to Hofstede (2001), there are four dimensions of national cultures: power distance (from small to large), individualism (versus collectivism), masculinity (versus femininity), and uncertainty avoidance (from weak to strong). Together these four dimensions forms a four-dimensional model of differences among national cultures and each country in this model is characterized by a score on each of the four dimensions. Figure 2.1 illustrate the four cultural measures among countries.

Chui, Titman, and Wei (2010) firstly show that individualism can positively affect country's momentum strategy, indicating that cultural differences can cause stock return heterogeneity among countries. Therefore, we further investigate how cultural differences could affect the trend returns among different countries.

Power distance is defined as the extent to which the less powerful members of institutions and organizations within a country accept that power is distributed unequally. The people in the country with small power distance tend to treat everyone equally, have equal rights, and have narrow salary range compared with the people in the large power distance. Malaysia has the highest power distance index, while Austria has the lowest power distance index in our sample. We hypothesize that the trend factor might deliver higher profits in countries with small power distance index, since people in those countries might be more risk-tolerant and be less afraid of losing. Figure 2.2 shows that the power distance index negatively related to the trend returns.[2]

Individualism is the societies where people are expected to look after himself or herself and his or her immediate family. Collectivism as its opposite is the societies in which people are

[2] If we regress the countries' average trend factor on one and the countries' power distance index, the coefficient on power distance index is -0.01% with a t-ratio of -2.80.

integrated into strong and cohesive groups, which throughout people's lifetime to protect them in exchange for unquestioning loyalty. The country with high individualism index stresses more on the personal interest, privacy, and freedom, and the self-actualization by every individual is an ultimate goal. United States is the highest individualism country, and Pakistan is most collectivism country in our sample. Chui, Titman, and Wei (2010) documents that investors in higher individualism countries tend to be more overconfident, willing to take more risks, and investing more. Thus, the momentum strategy will become more profitable in those countries. We have the similar hypothesis here that the trend factor might performs better in countries with higher individualism index. Figure 2.2 shows that the individualism index positively related to the trend returns.[3]

Masculinity represents societies where social gender roles are clearly distinct. In other words, in the country with high masculinity index, men are supposed to be assertive, tough, and focused on material success whereas women are supposed to be more modest, tender, and concerned with quality of life. Femininity represents the societies in which the social gender roles overlap that both men and women are supposed to be modest, tender, and concerned with the quality of life. Japan has the highest masculinity index, and Sweden has the lowest one. Masculinity tends to affect the trend profits in either way. On the one hand, men in higher masculinity countries might be more overconfident, thus leading to a higher trend return; on the other hand, people in less masculinity countries might become more equally, thus people's risk tolerance tends to be higher when they go into the stock market. Figure 2.2 illustrates that the trend factor is more profitable in countries where social roles are more clearly distinct.

Uncertainty avoidance is defined as the extend to which the members of a culture feel threatened by uncertain or unknown situations and try to avoid such situations. The feeling is in a need for predictability. People in the countries with strong uncertainty avoidance tend

[3]The coefficient on individualism is -0.02% with a t-ratio of 2.91 when we regress countries' average trend return on one and the countries' individualism index.

to have fear of ambiguous situations and of unfamiliar risks. Greece is the most uncertainty avoidance country, and Singapore is the least uncertainty avoidance country. Uncertainty avoidance is more like a risk-tolerance measure, investors in less uncertainty avoidance countries tend to be more risk-tolerant, leading to a higher profit of the trend factor. Figure 2.2 presents that the trend factor is less profitable in countries where uncertainty avoidance is higher.

2.4.2.2 Portfolio analysis results

We equally classify countries into three groups, from high to low, based on their scores on the four cultural measures respectively. We report the average monthly returns on both country-average and composite portfolios in Table 2.6. The country-average portfolio is a portfolio that puts equal weight on each country's trend portfolio in each group. The formation of the composite portfolio is similar to that of the trend portfolio in each country. The trend profits remain the same among different groups as the scores of PDI (panel A) and MAS (panel C) increase, thus the trend factor does not perform differently in different degrees of PDI and MAS. In other words, the different power distance and social gender distinction do not affect the profits of the trend factors.

Panel B of Table 2.6 reveal that trend profits monotonically increase with IDV. The average monthly return on low-IDV composite portfolios is indifferent from 0, while the return on high-IDV composite portfolios is 1.64% with a t-statistic of 8.74. The spread between the high-IDV and the low-IDV composite portfolio is 2.05%, highly significant with a t-statistic of 5.04. The spread in average returns between high-IDV and low-IDV country-average portfolios is 0.64%, which is marginally significant. The results indicates that the trend factor does not perform well in low-IDV countries.

Panel D of Table 2.6 show that trend profits monotonically decrease with UAI. The average monthly return on low-UAI country-average portfolios is 1.3% with a t-statistic of 10.48, while the return on high-UAI country-average portfolios is 0.86% with a t-statistic of 5.68.

The spread between the high-UAI and low-UAI average portfolio is −0.44% with a t-statistic of −2.44. Similarly, the spread is average returns between high-UAI and low-UAI composite portfolios is −0.53% per month with a t-statistic of −2.07. Though the trend factor performs well in either low-UAI or high-UAI countries, the magnitude of the trend profits is higher in countries with low uncertainty avoidance.

2.4.3 Determinants of cross-country trend strategies: regression analysis

In this section, we examine other possible cross-country determinants of trend profits. We regress the profits of the trend factor on the cultural differences and other potential determinants.

$$Trend_{jt} = \alpha_0 + \Gamma_j Culture_j + \Theta_j X_j + \Lambda_{jt} C_{jt} + \epsilon_j t \tag{2.8}$$

where $Trend_{jt}$ is the return on the trend factor in country j in month t, $Culture_j$ is a vector of cultural differences. X_j is a vector of explanatory variables that are constant over time while C_{jt} is a vector of control variables that are changing through time. We use the Fama and MacBeth (1973) regression to estimate equation (2.8). The t-statistics of the averages of the time-series estimates from these month-by-month, cross-sectional regressions are adjusted for heteroskedasticity and autocorrelation using the Newey and West (1994) method.

2.4.3.1 Cultural differences

Panel A of Table 2.7 reports the regression results for each cultural measures respectively in column (1) to column (4) and combine all cultural measures together in column (5).

We include firm size and stock return volatility to control for the speed of information flow and information uncertainty. Chui, Titman, and Wei (2010) show that median firm size of a country have a significant negative impact on the momentum profits. Because the trend factor is closely related to the momentum factor, it is logic to include the average of the firm size to see whether the firm size could affect the performance of the trend factor across countries.[4] Thus, we control the firm size in our Fama and MacBeth (1973) regression when testing the effect of countries' characteristics on the trend profits. The data of size variable for each firm are from Datastream. We calculate the average of firm size each month for each country.

$$SZ_t = \frac{1}{n}\sum_{i=1}^{n} size_{i,t}$$

where the $size_{i,t}$ is the lag market capitalization of firm i in month t.

Zhang (2006) use stock volatility as a proxy for information uncertainty and finds that the higher stock volatility is associated with higher momentum profits. We also calculate the monthly standard deviation for individual stocks using daily data and compute the average standard deviation for each country.

$$V_t = \frac{1}{n}\sum_{i=1}^{n} V_{i,t}$$

where the $V_{i,t}$ is the monthly stock volatility of firm i in month t.

Because we use the U.S. dollar when investigating the performance of the trend strategies, the profits of the trend factor consist two parts: the return from the trend factor and the appreciation (depreciation) of the local currency to U.S. dollar. Controlling for the monthly excess returns for each currency, we rule out the impact of the foreign exchange rate on the trend factor. We also control for the countries' change of GDP and GDP level to rule out the impact of the economy condition for each country.

The results from the Fama and MacBeth (1973) regressions reported in Panel A of Table 2.7 show how cultural differences affect the trend returns. For each column, we include one

[4]To rule out the impact of individualism on the momentum portion, which is documented by Chui, Titman, and Wei (2010), we run the panel regression of the trend factor on the momentum strategy first, and then run the cross sectional regressions of residuals on the cultural variables, the coefficient is 0.02%, with a t-ratio of 4.39.

cultural variable, and in the last column, we combine the four cultural variables together. Interestingly, the coefficient on PDI is insignificantly negative if we put it as the explanatory variable, and become significantly positive when combine four cultural variables together. If we put individualism index itself as the explanatory variable, the coefficient on IDV is 0.02 with a t-ratio of 3.72. The results on individualism index is robust when we combine the four cultural variables together and control other potential determinants of trend profits.[5] Though uncertainty avoidance had a negative impact on trend return in our portfolios analysis, the coefficient for UAI is -0.01% with a t-ratio of -1.89. The reason might because uncertainty avoidance is related to risk, and we have already include stock return volatility as controls in our cross-sectional regressions. Among the control variables, the firm size and GDP level are negatively related to trend profits while the stock return volatility is positively related to trend profits.

Combining the portfolios sorting analysis and cross-sectional regressions together, we show that individualism index has a robust positive effect on the trend factor.

2.4.3.2 Investor Protection, law enforcement, and accounting standards

A substantial literature examines how the degree of investor protections affects the financing and investing behavior across different countries. Porta, Lopez-De-Silanes, Shleifer, and Vishny (1997) show that countries with poorer investor protections (including both shareholder and creditor rights) have smaller and narrower capital markets (including primary and secondary financial markets). In particular, the common law countries have both the strongest investor protections. Mclean, Zhang, and Zhao (2012) show that the relation between Tobin's q and investment is stronger in countries that offer more investor protection. They further show that the investor protection encourages efficient investment by promoting accurate share prices and reducing financial constraints. Thus,we hypothesize that the different performance of the trend factor across different countries might come from the different

[5] Even if we limit our sample into developed countries only, the coefficient on the Individualism index is 0.02%, with a t-ratio of 2.96.

level of investor protections. Following Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998), The proxies for the investor protection we consider include the index of shareholder rights (Antidirector), the index of debtholder rights (Creditor), and the dummy variable whether the country is common law country. We describe each of the country-level variables in detail in the paper's Internet Appendix. Column (2) of Panel B in Table 2.7 provides little evidence that the degree of investor protection can increase the trend profits.

The countries' different legal system might be another attribute to the trend profits in the international stock markets. Porta, Lopez-De-Silanes, Shleifer, and Vishny (1997), Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998), and Porta, Lopez-De-Silanes, and Shleifer (2006) show that common law countries tend to have stronger investor protections and greater private enforcement than do civil law countries. Thus, the different legal enforcement might have impact on the performance of the trend factor. Following the earlier work, we include the following variables for law enforcement: Efficiency of countries' legal environment (Efficiency), law and order tradition (Rule of Law), corruption in government (Corruption),and risk of expropriation (Expropriation). The detailed description are in the paper's Internet Appendix. Column (3) of Panel B in Table 2.7 reveal that countries different legal system has little impact on the trend factor.

Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998) document that French-origin law countries tend to have weakest accounting quality and poorest investor protection in the security markets. Choi and Wong (2007) suggest that securities issuance is positively associated with the appointment of Big 5 auditors in weak legal environments. Thus, auditors may serve as a good corporate governance substitute when investor protection or legal enforcement is weak. We include two accounting measures as proxies for the accounting quality: accounting standards scores (Accounting) and the market share of Big 5 auditors. Column (4) in Panel B of Table 2.7 reveal that the investors in the countries with stronger accounting quality tend to generate more profits using the trend strategy.

2.4.3.3 Disclosure requirements, Role of supervisor, and criminal sanctions

Porta, Lopez-De-Silanes, and Shleifer (2006) document that the development of stock markets is strongly associated with extensive disclosure requirements and a relatively low burden of proof on investors seeking to recover damages resulting from omissions of material information from the prospectus. We hypothesize that the larger and more developed equity markets can increase the trend profits. As suggested by Porta, Lopez-De-Silanes, and Shleifer (2006), we include disclosure requirement index (Disclosure) and liability standards (Liability). Column (5) of Panel B in Table 2.7 provides little evidence that the extensive disclosure requirements or low burden of proof of investors seeking to recover damages can increase the trend profits.

We follow Porta, Lopez-De-Silanes, and Shleifer (2006) to include the following sets of variables as proxies for the role of supervisor: the characteristics of supervisor (Supervisor), the power of supervisor including rule-making power (Rule-making) and investigating power (Investigative). Porta, Lopez-De-Silanes, and Shleifer (2006) document that neither the characteristics (independence and focus) of the supervisor nor his power matter for the development of the financial markets. Our empirical results in Column (6) of Panel B in Table 2.7 are consistent with Porta, Lopez-De-Silanes, and Shleifer (2006) that the independence and power of supervisor can not benefit investor for larger profits from the trend strategy.

Porta, Lopez-De-Silanes, and Shleifer (2006) also investigate criminal and non-criminal sanctions for violations of securities laws. These sanctions may involve ordering the directors of a public firm to rectify noncompliance with disclosure requirements, to institute changes recommended by outside reviewers, and to compensate investors for their losses. As suggested by Porta, Lopez-De-Silanes, and Shleifer (2006), we use Order index as the proxy for non-criminal sanctions and Criminal index as a proxy for criminal sanctions. Column (7) of Panel B in Table 2.7 reveal that the if the non-criminal sanctions involve ordering the directors of a public firm to rectify noncompliance with disclosure requirements, to institute changes recommended by outside reviewers, or compensate investors for their losses when violations of securities laws happen, the investors can generate more profits using the trend factor.

2.4.3.4 Access to external finance

As Porta, Lopez-De-Silanes, and Shleifer (2006) and Mclean, Zhang, and Zhao (2012) show that the stronger investor protection laws encourage accurate shares prices, more developed financial markets, efficient investment, and better access to external finance, we investigate whether the easy access to raise capital can help benefit investors from generating larger trend profits. We use two variables: Access and Nonzero. Access is directly an index measures the ease with which firms issue securities. Nonzero is the percentage of firm-month observations in each country that either issued or repurchased shares. The results showing in Column (8) of Panel B in Table 2.7 show that the trend factor performs better in countries where firms are easier to issue securities and get external funding.

2.4.3.5 A comprehensive model

It would be interest to include all the variables containing the cultural differences, legal differences, and accounting differences across countries in one regression. However, we have limited degrees of freedom because our cross-country sample has a relatively limited number of countries. Thus, we include only the variables that are significant at the 5% level from previous columns in Column (9) of Panel B in Table 2.7. These regressions include the power distance index (PDI), individualism index (IDV), accounting standards (Accounting), non-criminal sanctions index (Order), the ease of public firm to raise capital (Access). The coefficient estimates on individualism index (IDV) and non-criminal sanctions index (Order) are significant and have the same signs as those in previous columns.

2.5 Global trend factor

Given that the trend strategies perform well but different in most countries, U.S. investors might get diversification benefits by investing the global trend factor portfolios. In this section, we investigate the diversification effect of the global trend factor and how it works in explaining returns of portfolios sorted based on different attributes.

2.5.1 Investing in the trend factors globally

We start this section by examining the out-of-sample performance of the global trend portfolios constructed by trend factors for each country. We consider four types of global trend factor.

The first type of the global trend factor (GTF) is the equally-weighted trend portfolio. Investors put equal weights on the trend strategies of each countries. The profits of the equally-weighted global trend is simply the arithmetic mean of the trend profits for individual countries.

$$GTF_t^{EW} = \frac{\sum_{j=1}^{N} Trend_{j,t}}{N} \tag{2.9}$$

where N is the number of the countries in our sample and $Trend_{j,t}$ is the trend profit at month t for country j. As shown in Table 2.8, we find this equally weighted portfolio has an annualized return of 15.6% (with a t-ratio of 12.95), which is significantly positive and higher than that of equally-weighted market (7.68%) as well as that of equally-weighted momentum portfolio (11.52%). The results are still robust if we limit our sample to developed countries (Panel B of Table 2.8) or to emerging countries (Panel C of Table 2.8) when constructing the global portfolios.

The second type of the global trend factor is the value-weighted trend portfolio. Investors put more weights on the country's trend strategy if the country has higher average firm size and put less weights on the country's trend otherwise. We can calculate the profits of the value-weighted global trend factor:

$$GTF_t^{VW} = \frac{\sum_{j=1}^{N} Trend_{j,t} \times SZ_{j,t}}{\sum_{j}^{N} SZ_{j,t}}. \tag{2.10}$$

Empirically, we find this value-weighted portfolio has an annualize Sharpe return of 11.52% (with t-ratio of 12.95), which is significantly positive. The Sharpe ratio of this value-weighted trend portfolio is 0.71, which is larger than that of the value-weighted market (0.16) and value-weighted momentum portfolio (0.69).

The third type of the global trend factor is the mean-variance portfolio. Suppose r_t is a vector for countries' trend return at time t, we use a 60-month window to estimate the covariance matrix $\Sigma_t = \mathbf{cov}(r_t)$ and the average trend return vector μ_t. Then we form a step-ahead portfolio with a portfolio weight vector ω_t, that solves

$$\max_{\omega} \omega_t^\top \mu_t - \frac{\gamma}{2}\omega_t^\top \Sigma_t \omega_t, \tag{2.11}$$

subject to

$$\omega^\top \mathbf{1} = 1, \text{and } 0 < \omega < 1. \tag{2.12}$$

This portfolio maximize the return while minimizing the variance assuming the risk-aversion, γ, for the investor is 5. Concerning about the extreme positions in the mean-variance portfolio, we set two additional constraints: the investing weight for a particular country should be nonnegative and should not exceed 100%. Using trend factors for all countries in our sample, the Sharpe ratio is 0.94, much higher than the global market (withe Sharpe ratio of 0.12) and global momentum (with Sharpe ratio of 0.36). The results are similar when we limited our sample into developed countries only. The mean-variance portfolios for the global market and global momentum are quite similar with their equally-weighted and value-weighted portfolios; while the mean-variance portfolios for the global trend factor is more impressive with 4.09% average return and 0.91 Sharpe ratio. For emerging markets, the Sharpe ratios for the global trend mean-variance portfolio is 0.36. Though it is lower compared with the developed countries, it still outperforms the global market (with Sharpe ratio of 0.05) and global momentum (with Sharpe ratio of 0.17).[6]

2.5.2 Performance of equally-weighted global portfolio

We further investigate the performance of the equally-weighted global portfolios (EW trend factor) in this section.

Table 2.9 tabulates the coefficient estimates from the spanning regressions of individual trend factor on EW trend factor in Column (1) and the coefficient estimates from the spanning regressions of global trend factor on the individual trend factor in Column (2).

Panel A of Table 2.9 show that most of the developed countries has statistically insignificant alphas or even significantly negative alphas after controlling the global EW trend factor. Only 5 countries generate statistically significantly positive alphas. From the perspective of economic significance, we find the alphas of individual trend on the EW trend factor are less than 1% for most countries with Canada being the only country that generate $\alpha = 2\%$ with t-ratio of 6.22. Additionally, the large and signifiant betas in Column (1) suggest that the EW trend factor can explain all of the individual trend factors except for New Zealand. On the other hand, the spanning alphas of the EW trend factor on the individual trend factor are all statistically significant though most individual trend factors are significantly correlated with the EW trend factor.

The results are robust for the emerging countries as shown in Panel B of Table 2.9. There are few significantly positive alphas except for Brazil, South Africa, and Sri Lanka. While the EW trend factor can generate significantly positive alphas on all of the spanning regressions.

It is of interest to see how the EW factors perform in good times and bad times. We address this issue by dividing our sample period into expansion periods and recession periods according to the definition of NBER. Panel A of Table 2.10 shows that the EW trend factor performs the best during the expansion. The average return is 1.31% and the Sharpe ratio is

[6]The results are similar if we use 48-moving window to form the mean-variance portfolio. And the results are robust if we set risk-aversion as 1, 3, 7, and 10. The Sharpe ratios for global trend are around 0.9 using all countries to construct the mean-variance portfolio.

0.85. The EW momentum factor and the EW market portfolio also perform well during the expansion, with the Sharpe ratios of 0.53 and 0.21, respectively. The average returns and Sharpe ratios of the EW trend are slightly lower in recession periods. The average return declines to 1.23% and the Sharpe ratio declines to 0.39. The EW market portfolio suffers an average loss of −1.27% per month in recession. Though the EW momentum and EW short-term reversal have positive returns during the recession, they experience lower Sharpe ratios compared with the EW trend factor. The performance of the EW trend factor is the best and robust either in expansions or in recessions. Because it is based on moving average signals of not only the short-term, but also the intermediate- and long-term.

The results are robust if we limit our sample to developed markets in panel B. During the expansion, the Sharpe ratio of EW trend is 0.91, followed by the EW momentum (0.55). During the recession, the Sharpe ratio of EW trend declines to 0.28, which is still higher than the EW momentum (0.19).

Panel C of Table 2.10 limits our sample to emerging markets. The EW trend and EW momentum perform similarly during the expansion. The Sharpe ratios are 0.27 and 0.23 respectively. However, the Sharpe ratio for the EW trend is 0.44, much higher than that of EW momentum (0.01) during the recession.

The superior performance of the global trend factor is robust when we

- divide the whole sample period into high investment-sentiment and low investment-sentiment;
- divide the whole sample period into positive market-state and negative market-state;
- divide the whole sample period into high market-volatility and low market-volatility.

The Internet Appendix provides further details and tabulated results of the above robustness checks.

2.5.3 Asset pricing tests

In this section, we examine how well the EW global trend factor can explain the returns for stock portfolios sorted by size and book-to-market and stock portfolios sorted by size and momentum.

Consider the 25 portfolios formed based an independent double-sort by the size and book-to-market for developed countries [7], we investigate how well their returns are explained by the CAPM (Column 2-3), or by the CAPM plus the global momentum factor (Column 4-5), or by Fama-French's five-factor model (Column 6-7), or by CAPM with the global trend factor (Column 7-8) in Table 2.11. There are 22(out of 25) portfolios with significantly positive α under CAPM. Only 3 portfolios could be fully explained. Neither adding the momentum factor in CAPM nor using Fama-French's five-factor model could help explain the portfolio returns. The CAPM with the global trend factor model could fully explain 9 (out of 25) portfolios, showing that the trend factor could help with explain the portfolio returns. To access the cross-section overall pricing errors, we report the GRS test of Gibbons, Ross, and Shaken (1989) in the last row. Though all the asset pricing models here are rejected by the GRS test, the CAPM with the trend factor performs the best among others with the lowest GRS statistics 4.21 (compared with the GRS statistics for the CAPM of 7.57 and the GRS for Fama-French's five-factor model 5.10).

We also consider the 25 portfolios sorted based on size and momentum in Table 2.12 and the 32 triple-sorted portfolios based on size, book-to-market, and operating profitability in Table 2.13. The CAPM with the global trend factor has the lowest GRS statistic compared with CAPM, CAPM with the global momentum factor, and Fama-French's five-factor model.

Overall, in comparison with the global momentum factor, the global trend factor not only has the greater Sharpe ratio, but also performs better in explaining the returns for different sorted portfolios.

[7] The global sorted portfolio data are available from Ken French's data library

The results remain robust when we

- consider other double sorted portfolios, including portfolios sorted on size and investment, and portfolios sorted on size and operating profitability;
- consider other triple sorted portfolios, including portfolios sorted on size, book-to-market, and operating profitability; and portfolios sorted on size, operating profitability, and investment;
- use the equal-weighted portfolios, including double sorted portfolios and triple sorted portfolios;
- use the value-weighted global trend factor as the global trend factor in the asset pricing tests.

The Internet Appendix provides further details and tabulated results of the above robustness checks.

2.6 Conclusion

We construct a trend factor for each country with a cross-section regression approach incorporating information used in the three major price patterns: the short-term reversal effects, the momentum effects, and the long-term reversal effects. We rank the stocks based on their forecasted expected returns from the cross-sectional regression. The difference between the highest ranked and lowest ranked decile portfolios is the trend factor. The trend factor works pretty well in most of the developed countries and outperform the market, momentum, long-term reversal, and short-term reversal effects.

We further show that the superior performance of the trend factor could not be explained by the existing capital asset pricing models. Neither Fama and French (2015) fix-factor nor the three moving-average signal factors (short-term reversal, momentum, and long-term reversal) could fully explain the profits of the trend factor, providing a challenge to the traditional risk-based theories.

The evidence in this paper indicates that cultural differences (a more micro-level factor) can have an important effect on stock return, which is consistent with the idea that investors in different countries have different psychological biases and perform differently in the stock markets. From the macro-level perspective, this paper considers the impact of legal environment on the trend profits as well. Our results show that the trend factor is more profitable in countries where the individualism index is higher, the non-criminal sanctions index is higher, or the percentage of firms that issue or repurchase stocks is lower.

By combining individual trend factor for each country together as the global trend portfolio, we present new evidence that the global trend factor can explain most individual trend factor, while the individual trend factors cannot explain the global trend factor. The global trend portfolios consistently outperform the global market, momentum, short-term reversal, and long-term reversal portfolios. The results are consistent and robust when we limit our sample into different time periods or different subsamples.

Finally, we show that the global trend factor outperforms the global momentum factor and Fama-French's global five factors in explaining the portfolios' returns. The GRS statistics are smallest for CAPM plus the global trend factor when analyzing global portfolios sorted on different criteria.

Table 2.1: Summary statistics for trend factor

This table reports the summary statistics of the trend factor and market factor for all markets around the world, segregated by G6 markets in panel A, non G6 developed markets in panel B, and emerging markets in panel C. The sample period is reported for each country. The market factor returns are excess returns in excess of the U.S. risk-free rate. For each factor, we report sample mean in percentage, t-ratio, and Sharpe ratio.

Panel A. G6 countries

		Trend			Market		
Country	Starting date	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Canada	1985:2	4.28	15.98	0.87	0.42	1.68	0.09
France	1985:2	1.65	9.60	0.52	0.42	1.68	0.09
Germany	1985:2	2.16	9.84	0.54	0.31	1.31	0.07
Italy	1991:2	1.15	3.97	0.22	0.31	1.01	0.06
Japan	1985:2	1.40	6.76	0.37	-0.03	-0.09	-0.00
UK	1985:2	1.00	5.23	0.29	0.34	1.58	0.09

Panel B. Other developed countries

		Trend			Market		
Country	Starting date	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Australia	1989:3	2.34	8.02	0.44	0.55	1.91	0.10
Austria	1999:9	1.08	3.97	0.27	0.55	1.56	0.11
Belgium	1993:12	1.29	6.14	0.36	0.50	2.01	0.12
Denmark	1993:4	1.11	5.72	0.33	0.78	3.13	0.18
Finland	2000:6	1.25	3.91	0.27	0.21	0.46	0.03
Greece	1995:12	1.32	2.78	0.17	0.19	0.39	0.02
Hongkong	1994:6	1.06	1.77	0.11	0.57	1.48	0.09
Ireland	2004:6	0.46	0.65	0.05	0.38	0.74	0.06
Netherlands	1985:2	0.94	5.21	0.28	0.53	2.20	0.12
New Zealand	2004:10	0.25	0.47	0.04	0.58	1.45	0.12
Norway	1997:3	0.89	3.38	0.21	0.53	1.35	0.09
Portugal	1998:11	0.95	3.57	0.24	0.06	0.19	0.01
Singapore	1999:1	1.24	2.07	0.13	0.24	0.65	0.04
Spain	1994:8	0.49	2.15	0.13	0.53	1.63	0.10
Sweden	1994:5	1.29	4.50	0.27	0.74	2.16	0.13
Switzerland	1991:5	1.30	7.05	0.39	0.67	2.85	0.16

Panel C. Emerging markets

		Trend			Market		
Country	Starting date	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Brazil	1999:8	1.26	5.12	0.34	1.17	1.92	0.13
Chile	2003:2	-0.33	-0.80	-0.06	1.21	2.76	0.21
China	2005:7	0.53	1.24	0.09	1.01	1.77	0.13
India	1995:2	1.39	3.31	0.20	0.79	1.57	0.09
Israel	1992:9	1.89	5.51	0.32	0.26	0.65	0.04
Korea	1992:5	-0.23	-0.58	-0.03	0.65	1.14	0.06
Malaysia	1991:12	0.14	0.26	0.01	0.58	1.27	0.07
Mexico	1999:2	0.49	1.41	0.09	0.81	2.06	0.14
Pakistan	2002:6	1.21	1.59	0.11	0.87	1.65	0.11
Peru	2003:8	-1.22	-1.85	-0.14	1.45	3.41	0.25
Philippines	2003:10	0.57	0.70	0.04	0.16	0.35	0.02
Poland	2002:11	1.50	3.94	0.29	0.98	1.67	0.12
Russia	2013:4	-0.14	-0.17	-0.02	0.31	0.41	0.05
South Africa	1995:1	1.59	5.97	0.36	0.47	1.14	0.07
Sri Lanka	2010:1	4.09	5.27	0.46	0.61	1.02	0.09
Taiwan	1994:10	-0.07	-0.21	-0.01	0.34	0.76	0.05
Thailand	1993:6	0.74	1.51	0.09	0.58	1.11	0.06
Turkey	1996:9	0.48	1.25	0.08	1.42	1.69	0.11

Table 2.2: Trend factor comparison with other time-length factors

This table compares the trend factors with other three well-known stock price trends: the short-term reversal (SREV), momentum factor (MOM) and long-term reversal (LREV) for all of the markets in our sample, segregated by G6 markets in panel A, non-G6 developed markets in panel B, and emerging markets in panel C. The sample period is reported for each country. For each factor, we report sample mean in percentage, t-ratio, and Sharpe ratio.

Panel A. G6 countries

		Trend			SREV			MOM			LREV		
Country	Starting date	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Canada	1985:2	4.28	15.98	0.87	0.84	3.36	0.18	1.16	4.91	0.27	0.02	0.09	0.00
France	1985:2	1.65	9.60	0.52	0.71	4.00	0.22	1.29	7.32	0.40	-0.44	-2.93	-0.15
Germany	1985:2	2.16	9.84	0.54	0.32	1.37	0.07	1.92	7.81	0.43	-0.80	-5.62	-0.28
Italy	1991:2	1.15	3.97	0.22	0.07	0.34	0.02	0.98	3.72	0.21	-0.47	-2.49	-0.14
Japan	1985:2	1.40	6.76	0.37	1.16	5.56	0.30	0.43	2.01	0.11	0.12	0.78	0.04
UK	1985:2	1.00	5.23	0.29	-0.63	-4.19	-0.23	1.27	7.32	0.40	-0.52	-3.59	-0.18

Panel B. Other developed countries

		Trend			SREV			MOM			LREV		
Country	Starting date	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Australia	1989:3	2.34	8.02	0.44	0.15	0.53	0.03	1.71	5.41	0.30	-0.25	-0.57	-0.03
Austria	1999:9	1.08	3.97	0.27	-0.21	-0.86	-0.06	1.31	5.21	0.35	-0.15	-0.69	-0.05
Belgium	1993:12	1.29	6.14	0.36	0.37	2.01	0.12	1.27	5.81	0.34	-0.53	-3.10	-0.18
Denmark	1993:4	1.11	5.72	0.33	-0.07	-0.35	-0.02	1.30	6.02	0.35	0.25	1.30	0.08
Finland	2000:6	1.25	3.91	0.27	-0.09	-0.34	-0.02	1.09	3.47	0.24	-0.27	-0.91	-0.06
Greece	1995:12	1.32	2.78	0.17	0.47	1.35	0.08	0.68	1.43	0.09	0.48	0.90	0.06
Hongkong	1994:6	1.06	1.77	0.11	-1.66	-2.96	-0.18	1.06	2.07	0.12	0.20	0.26	0.02
Ireland	2004:6	0.46	0.65	0.05	-0.30	-0.49	-0.04	0.66	1.08	0.08	-0.88	-1.74	-0.14
Netherlands	1985:2	0.94	5.21	0.28	-0.08	-0.42	-0.02	1.15	5.27	0.29	-0.38	-2.15	-0.11
New Zealand	2004:10	0.25	0.47	0.04	-0.38	-0.81	-0.06	1.04	2.28	0.18	0.10	0.19	0.01
Norway	1997:3	0.89	3.38	0.21	-0.22	-0.86	-0.05	1.04	3.88	0.25	-0.31	-1.35	-0.09
Portugal	1998:11	0.95	3.57	0.24	-0.70	-2.89	-0.19	0.55	2.22	0.15	-0.06	-0.26	-0.02
Singapore	1999:1	1.24	2.07	0.13	-0.30	-0.57	-0.03	0.69	1.35	0.08	0.71	1.31	0.08
Spain	1994:8	0.49	2.15	0.13	-0.28	-1.38	-0.08	1.10	4.64	0.28	-0.42	-1.87	-0.11
Sweden	1994:5	1.29	4.50	0.27	-0.01	-0.04	-0.00	1.37	5.04	0.30	-0.69	-2.83	-0.17
Switzerland	1991:5	1.30	7.05	0.39	0.03	0.20	0.01	1.25	6.26	0.35	-0.22	-1.14	-0.06

Panel C. Emerging markets

		Trend			SREV			MOM			LREV		
Country	Starting date	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Brazil	1999:8	1.26	5.12	0.34	0.17	0.76	0.05	0.89	3.53	0.24	-0.36	-1.37	-0.09
Chile	2003:2	-0.33	-0.80	-0.06	0.13	0.21	0.02	0.75	1.14	0.09	-0.13	-0.24	-0.02
China	2005:7	0.53	1.24	0.09	1.11	3.63	0.27	-0.01	-0.02	-0.00	0.48	0.95	0.07
India	1995:2	1.39	3.31	0.20	-0.27	-0.84	-0.05	1.10	2.86	0.17	0.21	0.68	0.04
Israel	1992:9	1.89	5.51	0.32	1.08	3.69	0.21	1.16	3.97	0.23	-0.74	-2.77	-0.16
Korea	1992:5	-0.23	-0.58	-0.03	3.92	5.35	0.31	-0.10	-0.15	-0.01	-0.21	-0.31	-0.02
Malaysia	1991:12	0.14	0.26	0.01	-0.53	-1.33	-0.08	0.60	1.32	0.07	0.48	0.93	0.05
Mexico	1999:2	0.49	1.41	0.09	0.06	0.20	0.01	0.03	0.11	0.01	-0.16	-0.47	-0.03
Pakistan	2002:6	1.21	1.59	0.11	1.02	1.34	0.09	0.86	1.25	0.09	0.75	1.24	0.09
Peru	2003:8	-1.22	-1.85	-0.14	-0.91	-1.55	-0.11	1.04	1.41	0.10	0.69	0.78	0.06
Philippines	2003:10	0.57	0.70	0.04	0.80	1.02	0.07	0.19	0.22	0.01	0.16	0.19	0.01
Poland	2002:11	1.50	3.94	0.29	-0.53	-1.61	-0.12	1.52	3.69	0.27	-0.10	-0.28	-0.02
Russia	2013:4	-0.14	-0.17	-0.02	-0.83	-1.02	-0.13	1.65	1.89	0.25	-0.64	-0.70	-0.09
South Africa	1995:1	1.59	5.97	0.36	0.11	0.47	0.03	1.54	5.84	0.35	-0.19	-0.79	-0.05
Sri Lanka	2010:1	4.09	5.27	0.46	1.05	1.31	0.11	0.74	0.81	0.07	1.06	1.21	0.11
Taiwan	1994:10	-0.07	-0.21	-0.01	-0.30	-1.08	-0.06	0.88	2.80	0.17	-0.52	-1.04	-0.06
Thailand	1993:6	0.74	1.51	0.09	-0.64	-1.26	-0.07	0.33	0.73	0.04	0.31	0.62	0.04
Turkey	1996:9	0.48	1.25	0.08	0.00	0.01	0.00	0.07	0.18	0.01	-0.34	-0.75	-0.05

Table 2.3: Regression of trend factor on other single trend factors

This table reports the time-series regression for countries' trend factor on its market factor (MKT), short-term reversal (SREV), momentum factor (MOM) and long-term reversal (LREV). Newey and West (1994) robust t-statistics are in parentheses. The results for G6, non-G6 developed, and emerging markets are presented in panel A, B, and C, respectively.

Panel A. G6 countries

Country	α	MKT	SREV	MOM	LREV
Canada	0.04	-0.05	0.06	0.18	0.14
	(8.17)	(-0.71)	(0.48)	(1.88)	(1.71)
France	0.01	-0.01	0.07	0.63	0.03
	(2.75)	(-0.20)	(0.41)	(4.28)	(0.34)
Germany	0.01	-0.12	0.13	0.53	-0.00
	(4.89)	(-1.34)	(1.42)	(7.03)	(-0.01)
Italy	0.01	0.10	-0.02	0.52	0.14
	(2.29)	(1.18)	(-0.24)	(3.66)	(1.16)
Japan	0.01	0.06	0.27	0.31	-0.09
	(5.28)	(1.46)	(2.50)	(2.80)	(-0.71)
UK	0.00	0.02	-0.28	0.60	0.01
	(0.66)	(0.67)	(-2.68)	(7.80)	(0.08)

Panel B. Other developed countries

Country	α	MKT	SREV	MOM	LREV
Australia	0.02	0.01	-0.05	0.07	0.02
	(7.40)	(0.22)	(-0.50)	(0.83)	(0.34)
Austria	0.01	-0.09	0.04	0.41	-0.02
	(1.54)	(-1.35)	(0.39)	(3.17)	(-0.21)
Belgium	0.01	-0.15	0.04	0.45	-0.04
	(2.86)	(-2.96)	(0.47)	(3.74)	(-0.53)
Denmark	0.00	0.08	0.16	0.54	0.14
	(1.54)	(1.49)	(1.92)	(6.02)	(2.40)
Finland	0.01	-0.02	0.03	0.42	-0.07
	(1.99)	(-0.41)	(0.29)	(2.45)	(-0.61)
Greece	0.01	-0.07	-0.05	0.23	0.15
	(2.76)	(-0.80)	(-0.29)	(1.40)	(1.66)
Hongkong	0.01	-0.11	-0.21	0.15	0.05
	(1.08)	(-0.93)	(-2.16)	(1.37)	(0.89)
Ireland	0.00	-0.11	-0.27	0.34	-0.12
	(0.11)	(-1.27)	(-2.06)	(2.01)	(-0.88)
Netherlands	0.01	-0.01	-0.06	0.32	-0.02
	(3.63)	(-0.16)	(-0.54)	(5.56)	(-0.34)
New Zealand	-0.00	0.15	-0.00	0.20	0.07
	(-0.08)	(1.24)	(-0.03)	(1.35)	(0.76)
Norway	0.01	-0.06	0.05	0.35	0.04
	(2.11)	(-1.22)	(0.64)	(3.95)	(0.52)
Portugal	0.01	-0.02	-0.18	0.32	-0.01
	(2.49)	(-0.31)	(-2.00)	(4.89)	(-0.13)
Singapore	0.01	0.01	-0.11	0.31	0.00
	(1.98)	(0.05)	(-1.13)	(1.93)	(0.06)
Spain	-0.00	0.04	-0.12	0.44	0.10
	(-0.03)	(0.63)	(-1.52)	(5.31)	(0.96)
Sweden	0.01	-0.07	-0.11	0.37	-0.01
	(2.69)	(-1.14)	(-0.89)	(3.77)	(-0.10)
Switzerland	0.01	-0.10	-0.10	0.50	-0.00
	(4.02)	(-2.56)	(-1.41)	(6.21)	(-0.01)

Panel C. Emerging countries

Country	α	MKT	SREV	MOM	LREV
Brazil	0.01	-0.04	-0.13	0.29	0.11
	(4.12)	(-1.56)	(-1.47)	(3.24)	(1.63)
Chile	-0.00	-0.11	-0.11	0.11	0.01
	(-0.60)	(-1.82)	(-3.48)	(2.19)	(0.18)
China	-0.00	0.21	0.39	0.13	-0.00
	(-0.24)	(4.14)	(2.39)	(1.14)	(-0.05)
India	0.01	0.09	0.02	0.58	0.02
	(1.94)	(1.47)	(0.15)	(4.20)	(0.16)
Israel	0.02	0.07	-0.04	0.49	0.22
	(3.68)	(1.07)	(-0.33)	(3.11)	(2.55)
Korea	0.00	0.04	-0.08	-0.03	0.00
	(0.18)	(0.53)	(-1.16)	(-0.45)	(0.02)
Malaysia	0.00	-0.14	0.20	0.22	0.15
	(0.17)	(-0.70)	(0.83)	(1.26)	(1.30)
Mexico	0.00	0.01	0.18	0.33	0.22
	(1.56)	(0.09)	(1.96)	(3.42)	(2.44)
Pakistan	0.01	0.03	-0.10	-0.06	-0.07
	(1.32)	(0.18)	(-1.46)	(-0.44)	(-0.68)
Peru	-0.01	-0.15	-0.08	0.08	-0.08
	(-1.43)	(-1.01)	(-0.49)	(0.57)	(-0.86)
Philippines	0.00	0.36	0.12	0.14	0.07
	(0.40)	(2.44)	(1.24)	(1.91)	(1.00)
Poland	0.01	-0.03	-0.28	0.45	0.04
	(2.15)	(-0.51)	(-3.31)	(4.41)	(0.53)
Russia	-0.00	0.04	0.07	0.03	-0.26
	(-0.48)	(0.21)	(0.47)	(0.20)	(-1.95)
South Africa	0.01	0.07	-0.03	0.57	0.01
	(3.12)	(1.69)	(-0.28)	(8.83)	(0.06)
Sri Lanka	0.04	0.19	0.21	-0.07	-0.17
	(4.84)	(1.54)	(1.15)	(-0.42)	(-2.00)
Taiwan	-0.00	0.04	-0.12	0.33	0.10
	(-1.18)	(0.52)	(-0.99)	(3.75)	(1.59)
Thailand	0.01	0.04	-0.35	-0.01	-0.05
	(1.12)	(0.43)	(-2.82)	(-0.10)	(-0.50)
Turkey	0.00	0.01	-0.00	0.19	-0.05
	(1.22)	(0.09)	(-0.02)	(2.71)	(-0.72)

Table 2.4: Regression of trend factor on Fama French 5 factors and Momentum

This table reports the time-series regression for countries' trend factor on Fama French 5 factors and momentum factor, segregated by G7 markets in panel A, non G7 developed markets in panel B, and emerging markets in panel C. Newey and West (1994) robust t-statistics are in parentheses.

Panel A: G6 countries

Countries	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{MOM}
Canada	0.04	0.06	-0.19	-0.26	0.54	0.59	0.07
	(8.86)	(0.94)	(-1.30)	(-1.50)	(2.18)	(2.66)	(0.72)
France	0.01	-0.04	-0.13	0.42	-0.08	0.21	0.45
	(5.20)	(-0.80)	(-1.55)	(3.88)	(-0.52)	(1.89)	(6.00)
Germany	0.02	-0.03	0.18	0.63	-0.01	0.38	0.47
	(6.98)	(-0.49)	(1.30)	(4.07)	(-0.04)	(1.98)	(4.87)
Italy	0.01	-0.17	0.09	-0.07	-0.33	-0.14	0.60
	(3.09)	(-2.55)	(0.44)	(-0.24)	(-1.16)	(-0.53)	(4.45)
Japan	0.01	0.00	-0.07	0.05	-0.28	-0.21	0.22
	(4.34)	(0.04)	(-0.55)	(0.36)	(-1.56)	(-1.03)	(3.15)
UK	0.01	-0.08	-0.16	-0.08	-0.35	-0.17	0.51
	(4.30)	(-1.77)	(-1.15)	(-0.45)	(-1.76)	(-0.86)	(5.15)

Panel B: Other developed countries

Countries	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{MOM}
Australia	0.02	0.08	-0.10	0.08	0.07	0.18	0.11
	(6.24)	(0.81)	(-0.57)	(0.50)	(0.26)	(0.71)	(1.20)
Austria	0.01	-0.03	-0.26	-0.05	-0.03	0.31	0.48
	(2.18)	(-0.43)	(-1.55)	(-0.31)	(-0.08)	(1.55)	(4.35)
Belgium	0.01	-0.21	-0.31	0.03	-0.55	0.10	0.41
	(5.15)	(-3.18)	(-2.74)	(0.27)	(-2.43)	(0.56)	(3.33)
Denmark	0.01	-0.08	-0.22	0.03	-0.56	-0.13	0.36
	(5.26)	(-1.26)	(-1.82)	(0.31)	(-3.22)	(-0.88)	(3.72)
Finland	0.01	0.09	-0.03	-0.44	-0.69	0.47	0.42
	(3.17)	(1.04)	(-0.12)	(-1.66)	(-1.97)	(1.49)	(1.97)
Greece	0.01	-0.21	-0.14	0.37	-0.98	-0.64	0.83
	(2.24)	(-1.70)	(-0.63)	(1.09)	(-2.12)	(-1.40)	(4.18)
Hongkong	0.02	-0.29	-0.37	-0.46	-1.06	-0.34	0.36
	(2.80)	(-2.12)	(-0.99)	(-1.25)	(-1.98)	(-0.66)	(1.73)
Ireland	0.00	-0.18	-0.35	-0.50	-1.62	1.07	1.02
	(0.37)	(-0.78)	(-0.92)	(-0.70)	(-1.30)	(1.27)	(1.93)
Netherlands	0.01	-0.12	-0.17	0.02	-0.30	0.11	0.30
	(4.04)	(-2.54)	(-1.49)	(0.15)	(-1.38)	(0.87)	(4.22)
New Zealand	0.00	0.21	0.15	-0.59	-0.83	-0.41	0.28
	(0.45)	(1.14)	(0.42)	(-1.20)	(-1.19)	(-0.51)	(1.18)
Norway	0.01	-0.05	0.01	-0.05	0.04	0.23	0.19
	(2.34)	(-0.69)	(0.04)	(-0.24)	(0.16)	(1.04)	(2.23)
Portugal	0.01	0.02	-0.02	0.26	0.28	0.30	0.21
	(1.66)	(0.21)	(-0.12)	(1.53)	(0.98)	(1.45)	(3.21)
Singapore	0.01	-0.23	-0.29	0.01	-0.75	-0.10	0.34
	(2.37)	(-1.38)	(-0.75)	(0.03)	(-1.41)	(-0.23)	(1.66)
Spain	0.00	-0.07	-0.16	0.31	-0.18	-0.27	0.42
	(0.85)	(-0.93)	(-1.18)	(1.68)	(-0.85)	(-1.56)	(4.42)
Sweden	0.01	-0.01	0.11	0.33	0.11	0.32	0.37
	(2.61)	(-0.19)	(0.47)	(1.20)	(0.32)	(1.05)	(2.95)
Switzerland	0.01	-0.12	-0.03	0.22	0.03	-0.08	0.36
	(4.96)	(-2.24)	(-0.24)	(1.84)	(0.15)	(-0.48)	(4.02)

Panel C: Emerging countries

Countries	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{MOM}
Brazil	0.01	-0.17	-0.25	-0.06	0.01	-0.04	0.14
	(4.21)	(-2.93)	(-1.78)	(-0.41)	(0.06)	(-0.22)	(1.03)
Chile	-0.01	-0.02	0.38	0.54	0.70	1.00	-0.10
	(-2.07)	(-0.13)	(1.56)	(1.32)	(1.87)	(2.40)	(-0.70)
China	-0.00	0.19	0.23	0.21	-0.39	0.63	0.41
	(-0.36)	(1.71)	(0.74)	(0.80)	(-1.06)	(1.58)	(2.48)
India	0.01	-0.03	0.08	-0.41	0.03	0.26	0.66
	(1.88)	(-0.35)	(0.30)	(-1.52)	(0.09)	(1.15)	(3.01)
Israel	0.02	0.10	-0.08	-0.38	0.35	0.50	0.30
	(3.64)	(1.29)	(-0.40)	(-1.25)	(1.25)	(2.45)	(2.19)
Korea	-0.00	0.01	0.34	0.10	-0.17	-0.02	-0.01
	(-0.61)	(0.19)	(1.32)	(0.34)	(-0.47)	(-0.73)	(-0.05)
Malaysia	-0.00	0.09	0.16	-0.40	-0.35	0.01	0.61
	(-0.09)	(0.85)	(0.64)	(-1.33)	(-0.81)	(1.11)	(1.35)
Mexico	0.00	-0.07	-0.14	-0.08	0.16	-0.24	0.55
	(0.73)	(-0.88)	(-0.68)	(-0.32)	(0.52)	(-0.79)	(3.05)
Pakistan	0.01	0.25	0.64	0.32	0.44	-0.14	-0.61
	(0.80)	(1.45)	(1.82)	(0.59)	(0.44)	(-0.19)	(-1.01)
Peru	-0.01	0.05	0.53	0.05	0.05	-0.44	0.16
	(-1.37)	(0.26)	(1.47)	(0.14)	(0.08)	(-0.62)	(0.51)
Philippines	-0.00	0.15	0.84	0.50	1.07	0.97	-0.27
	(-0.44)	(0.74)	(1.55)	(0.72)	(1.34)	(1.55)	(-0.81)
Poland	0.01	-0.05	0.21	0.14	-0.16	0.49	0.53
	(2.38)	(-0.45)	(0.99)	(0.61)	(-0.37)	(1.13)	(2.83)
Russia	-0.02	0.77	0.15	-0.48	2.18	2.23	0.18
	(-1.51)	(2.52)	(0.30)	(-0.66)	(3.10)	(2.38)	(0.32)
South Africa	0.01	0.08	-0.11	0.11	0.34	-0.38	0.41
	(4.01)	(1.42)	(-0.87)	(0.87)	(1.46)	(-1.90)	(3.75)
Sri Lanka	0.04	-0.01	-0.26	0.93	0.23	-1.40	0.54
	(5.52)	(-0.04)	(-0.54)	(1.16)	(0.23)	(-1.67)	(1.78)
Taiwan	-0.00	-0.03	0.02	0.11	-0.50	-0.71	0.42
	(-0.11)	(-0.34)	(0.12)	(0.59)	(-1.47)	(-1.96)	(2.38)
Thailand	0.00	0.18	0.58	0.56	0.36	-0.60	-0.07
	(0.69)	(2.13)	(2.49)	(1.98)	(0.75)	(-2.26)	(-0.43)
Turkey	-0.00	0.03	0.17	0.48	0.66	0.08	0.10
	(-0.37)	(0.43)	(0.62)	(1.90)	(1.74)	(0.27)	(0.60)

Table 2.5: Correlation of countries' trend factor

This table reports the trend's correlation across different countries. Panel A presents the trend correlation of developed countries. Panel B shows the correlation of emerging countries. Panel C presents the cross-sectional correlation across developed and emerging countries.

Panel A. Developed countries

	1	2	3	4	5	6	7	8	9	10	11
1.Canada	1.00	0.29	0.32	0.32	0.09	0.36	0.17	0.33	0.29	0.26	0.26
2.France	0.29	1.00	0.52	0.66	0.10	0.71	-0.36	0.03	0.54	0.60	0.47
3.Germany	0.32	0.52	1.00	0.47	0.16	0.62	-0.13	0.11	0.60	0.59	0.51
4.Italy	0.32	0.66	0.47	1.00	0.06	0.53	-0.32	-0.13	0.51	0.53	0.36
5.Japan	0.09	0.10	0.16	0.06	1.00	0.05	0.08	-0.11	0.19	0.08	0.16
6.UK	0.36	0.71	0.62	0.53	0.05	1.00	-0.18	0.22	0.49	0.68	0.43
7.US	0.17	-0.36	-0.13	-0.32	0.08	-0.18	1.00	0.10	-0.24	-0.29	-0.25
8.Australia	0.33	0.03	0.11	-0.13	-0.11	0.22	0.10	1.00	0.09	-0.01	0.12
9.Austria	0.29	0.54	0.60	0.51	0.19	0.49	-0.24	0.09	1.00	0.54	0.49
10.Belgium	0.26	0.60	0.59	0.53	0.08	0.68	-0.29	-0.01	0.54	1.00	0.59
11.Denmark	0.26	0.47	0.51	0.36	0.16	0.43	-0.25	0.12	0.49	0.59	1.00
12.Finland	0.18	0.65	0.41	0.47	0.02	0.61	-0.37	0.11	0.40	0.47	0.46
13.Greece	0.20	0.44	0.34	0.37	-0.05	0.45	-0.17	0.00	0.31	0.56	0.34
14.Hongkong	0.06	0.38	0.25	0.35	-0.07	0.40	-0.27	0.09	0.11	0.28	0.26
15.Ireland	0.26	0.63	0.41	0.47	0.09	0.57	-0.24	0.08	0.30	0.39	0.17
16.Netherlands	0.11	0.44	0.37	0.30	0.09	0.33	-0.28	-0.01	0.31	0.56	0.48
17.New Zealand	-0.07	0.08	-0.14	0.08	0.17	-0.04	0.00	-0.05	0.08	-0.16	-0.20
18.Norway	0.17	0.35	0.31	0.31	0.07	0.27	-0.04	0.07	0.24	0.41	0.26
19.Portugal	0.25	0.32	0.31	0.37	0.12	0.24	-0.07	-0.03	0.30	0.31	0.29
20.Singapore	0.07	0.31	0.27	0.14	-0.02	0.26	-0.19	0.06	0.11	0.38	0.33
21.Spain	0.14	0.52	0.45	0.53	-0.00	0.40	-0.35	-0.04	0.40	0.53	0.38
22.Sweden	0.16	0.48	0.50	0.39	0.14	0.58	-0.24	0.12	0.48	0.47	0.46
23.Switzerland	0.37	0.64	0.57	0.48	0.09	0.52	-0.37	0.02	0.48	0.63	0.56

Panel A. Developed countries (continued)

	12	13	14	15	16	17	18	19	20	21	22	23
1.Canada	0.18	0.20	0.06	0.26	0.11	-0.07	0.17	0.25	0.07	0.14	0.16	0.37
2.France	0.65	0.44	0.38	0.63	0.44	0.08	0.35	0.32	0.31	0.52	0.48	0.64
3.Germany	0.41	0.34	0.25	0.41	0.37	-0.14	0.31	0.31	0.27	0.45	0.50	0.57
4.Italy	0.47	0.37	0.35	0.47	0.30	0.08	0.31	0.37	0.14	0.53	0.39	0.48
5.Japan	0.02	-0.05	-0.07	0.09	0.09	0.17	0.07	0.12	-0.02	-0.00	0.14	0.09
6.UK	0.61	0.45	0.40	0.57	0.33	-0.04	0.27	0.24	0.26	0.40	0.58	0.52
7.US	-0.37	-0.17	-0.27	-0.24	-0.28	0.00	-0.04	-0.07	-0.19	-0.35	-0.24	-0.37
8.Australia	0.11	0.00	0.09	0.08	-0.01	-0.05	0.07	-0.03	0.06	-0.04	0.12	0.02
9.Austria	0.40	0.31	0.11	0.30	0.31	0.08	0.24	0.30	0.11	0.40	0.48	0.48
10.Belgium	0.47	0.56	0.28	0.39	0.56	-0.16	0.41	0.31	0.38	0.53	0.47	0.63
11.Denmark	0.46	0.34	0.26	0.17	0.48	-0.20	0.26	0.29	0.33	0.38	0.46	0.56
12.Finland	1.00	0.34	0.44	0.52	0.38	-0.08	0.32	0.10	0.34	0.28	0.48	0.43
13.Greece	0.34	1.00	0.20	0.27	0.39	0.06	0.25	0.29	0.28	0.45	0.20	0.37
14.Hongkong	0.44	0.20	1.00	0.24	0.23	-0.08	0.26	-0.04	0.22	0.15	0.31	0.28
15.Ireland	0.52	0.27	0.24	1.00	0.27	0.12	0.34	0.14	0.23	0.23	0.34	0.40
16.Netherlands	0.38	0.39	0.23	0.27	1.00	-0.02	0.37	0.29	0.35	0.42	0.30	0.53
17.New Zealand	-0.08	0.06	-0.08	0.12	-0.02	1.00	-0.17	0.12	0.03	0.03	0.01	-0.06
18.Norway	0.32	0.25	0.26	0.34	0.37	-0.17	1.00	0.13	0.29	0.18	0.08	0.32
19.Portugal	0.10	0.29	-0.04	0.14	0.29	0.12	0.13	1.00	0.11	0.38	0.16	0.36
20.Singapore	0.34	0.28	0.22	0.23	0.35	0.03	0.29	0.11	1.00	0.18	0.17	0.25
21.Spain	0.28	0.45	0.15	0.23	0.42	0.03	0.18	0.38	0.18	1.00	0.30	0.55
22.Sweden	0.48	0.20	0.31	0.34	0.30	0.01	0.08	0.16	0.17	0.30	1.00	0.49
23.Switzerland	0.43	0.37	0.28	0.40	0.53	-0.06	0.32	0.36	0.25	0.55	0.49	1.00

Panel B. Emerging Countries

	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
24.Brazil	1.00	-0.01	0.07	0.30	0.19	0.18	0.28	0.31	-0.15	0.12	0.02	0.21	-0.19	0.20	0.01	-0.05	-0.14	0.21
25.Chile	-0.01	1.00	0.08	0.10	0.11	0.09	-0.00	0.06	-0.09	0.12	-0.12	0.10	0.04	-0.06	0.14	-0.01	0.15	-0.05
26.China	0.07	0.08	1.00	0.10	0.20	-0.03	0.14	0.14	-0.09	0.05	-0.06	-0.03	-0.17	-0.03	0.03	0.10	-0.15	-0.10
27.India	0.30	0.10	0.10	1.00	0.26	-0.05	0.20	0.34	-0.28	-0.24	-0.13	0.31	-0.14	0.26	-0.02	-0.05	-0.20	0.11
28.Israel	0.19	0.11	0.20	0.26	1.00	0.08	0.13	0.12	-0.34	-0.08	0.08	0.34	-0.30	0.15	0.10	-0.19	-0.16	0.03
29.Korea	0.18	0.09	-0.03	-0.05	0.08	1.00	0.09	-0.06	-0.14	0.01	0.12	0.07	0.07	-0.04	-0.05	-0.06	0.18	0.15
30.Malaysia	0.28	-0.00	0.14	0.20	0.13	0.09	1.00	0.08	-0.17	0.07	0.01	0.35	0.02	-0.03	-0.03	0.02	-0.02	0.12
31.Mexico	0.31	0.06	0.14	0.34	0.12	-0.06	0.08	1.00	-0.29	-0.04	0.13	0.21	-0.29	0.17	-0.03	-0.19	-0.38	-0.05
32.Pakistan	-0.15	-0.09	-0.09	-0.28	-0.34	-0.14	-0.17	-0.29	1.00	0.24	-0.30	-0.40	0.26	0.03	-0.09	0.22	0.33	0.11
33.Peru	0.12	0.12	0.05	-0.24	-0.08	0.01	0.07	-0.04	0.24	1.00	-0.01	-0.00	0.11	0.11	0.02	0.03	0.22	0.03
34.Philippines	0.02	-0.12	-0.06	-0.13	0.08	0.12	0.01	0.13	-0.30	-0.01	1.00	0.11	-0.09	0.13	-0.06	-0.14	0.02	-0.04
35.Poland	0.21	0.10	-0.03	0.31	0.34	0.07	0.35	0.21	-0.40	-0.00	0.11	1.00	-0.12	0.01	0.00	-0.06	-0.11	-0.08
36.Russia	-0.19	0.04	-0.17	-0.14	-0.30	0.07	0.02	-0.29	0.26	0.11	-0.09	-0.12	1.00	-0.07	-0.15	0.02	0.39	0.17
37.South Africa	0.20	-0.06	-0.03	0.26	0.15	-0.04	-0.03	0.17	0.03	0.11	0.13	0.01	-0.07	1.00	-0.11	0.22	0.04	0.07
38.Sri Lanka	0.01	0.14	0.03	-0.02	0.10	-0.05	-0.03	-0.03	-0.09	0.02	-0.06	0.00	-0.15	-0.11	1.00	-0.01	0.00	0.09
39.Taiwan	-0.05	-0.01	0.10	-0.05	-0.19	-0.06	0.02	-0.19	0.22	0.03	-0.14	-0.06	0.02	0.22	-0.01	1.00	0.24	0.08
40.Thailand	-0.14	0.15	-0.15	-0.20	-0.16	0.18	-0.02	-0.38	0.33	0.22	0.02	-0.11	0.39	0.04	0.00	0.24	1.00	0.13
41.Turkey	0.21	-0.05	-0.10	0.11	0.03	0.15	0.12	-0.05	0.11	0.03	-0.04	-0.08	0.17	0.07	0.09	0.08	0.13	1.00

Panel C. Cross correlation between developed countries and emerging countries

	1	2	3	4	5	6	7	8	9	10	11
24.Brazil	0.27	0.34	0.30	0.17	0.04	0.32	-0.15	0.23	0.23	0.37	0.27
25.Chile	0.01	0.15	0.01	0.14	0.11	0.11	-0.06	-0.04	0.11	0.01	-0.02
26.China	0.06	0.18	0.34	0.16	0.07	0.32	-0.14	0.12	0.20	0.31	0.28
27.India	0.24	0.40	0.39	0.44	-0.08	0.48	-0.15	-0.01	0.38	0.41	0.30
28.Israel	0.20	0.40	0.27	0.32	0.08	0.37	-0.06	0.18	0.41	0.34	0.27
29.Korea	0.16	0.07	-0.04	0.06	-0.02	0.01	0.12	-0.07	0.01	0.06	-0.07
30.Malaysia	0.21	0.22	0.32	0.12	-0.17	0.35	-0.14	0.12	0.23	0.22	0.14
31.Mexico	0.22	0.37	0.33	0.27	0.12	0.29	-0.27	-0.08	0.38	0.39	0.40
32.Pakistan	-0.24	-0.50	-0.48	-0.42	-0.11	-0.45	0.16	0.05	-0.47	-0.45	-0.23
33.Peru	0.04	-0.00	-0.09	-0.12	-0.08	0.06	-0.06	0.24	-0.19	-0.07	-0.12
34.Philippines	0.02	0.17	0.18	-0.01	-0.04	-0.02	-0.16	0.09	0.12	-0.04	-0.11
35.Poland	0.11	0.48	0.40	0.45	0.00	0.44	-0.33	0.03	0.53	0.39	0.13
36.Russia	-0.06	-0.41	-0.25	-0.20	0.06	-0.35	0.21	0.06	-0.21	-0.48	-0.45
37.South Africa	0.19	0.12	0.14	0.01	0.16	0.17	0.09	0.28	-0.01	0.06	0.19
38.Sri Lanka	-0.11	-0.01	0.02	-0.03	-0.01	0.06	0.04	0.07	0.02	0.04	0.22
39.Taiwan	-0.07	-0.18	-0.16	-0.03	-0.05	-0.11	0.08	0.05	-0.26	-0.14	-0.10
40.Thailand	-0.33	-0.41	-0.30	-0.39	-0.10	-0.37	0.24	0.03	-0.36	-0.46	-0.37
41.Turkey	0.13	-0.01	-0.03	0.01	-0.02	-0.03	0.10	0.10	-0.09	-0.14	0.05

Panel C. Cross correlation between developed countries and emerging countries (Continued)

	12	13	14	15	16	17	18	19	20	21	22	23
24.Brazil	0.33	0.25	0.13	0.36	0.31	-0.18	0.25	0.16	0.27	0.17	0.20	0.29
25.Chile	0.10	0.04	-0.01	0.15	-0.04	0.04	0.09	-0.02	-0.09	0.12	0.18	0.13
26.China	0.31	0.14	0.32	0.15	0.20	-0.11	0.16	0.08	0.21	0.19	0.27	0.23
27.India	0.31	0.31	0.32	0.39	0.09	-0.19	0.36	0.03	0.26	0.21	0.32	0.30
28.Israel	0.39	0.31	0.21	0.40	0.08	-0.01	0.29	0.10	0.21	0.08	0.36	0.26
29.Korea	0.14	0.16	0.02	0.12	0.12	0.08	0.19	-0.00	0.13	-0.06	0.01	-0.09
30.Malaysia	0.31	0.18	0.10	0.19	0.14	-0.23	0.05	-0.08	0.03	0.23	0.17	0.15
31.Mexico	0.18	0.23	0.24	0.26	0.32	-0.11	0.35	0.24	0.27	0.27	0.17	0.41
32.Pakistan	-0.28	-0.33	-0.13	-0.46	-0.20	-0.20	-0.19	-0.30	-0.26	-0.32	-0.38	-0.48
33.Peru	0.02	0.06	0.06	-0.05	0.03	-0.05	-0.05	-0.04	-0.03	0.12	-0.08	-0.02
34.Philippines	-0.03	0.02	0.02	0.15	0.11	0.19	0.14	0.05	0.11	0.06	0.04	0.08
35.Poland	0.38	0.21	0.10	0.51	0.11	0.08	0.19	0.07	-0.05	0.37	0.45	0.35
36.Russia	-0.45	-0.36	-0.17	-0.34	-0.40	0.05	-0.24	-0.14	-0.44	-0.19	-0.29	-0.46
37.South Africa	0.13	0.12	0.15	0.07	0.05	0.08	0.16	0.01	0.25	0.12	0.20	0.15
38.Sri Lanka	-0.03	0.10	-0.05	0.06	0.09	0.00	-0.07	0.06	-0.02	0.06	0.12	0.01
39.Taiwan	-0.15	-0.08	-0.03	0.01	-0.15	0.16	-0.09	-0.03	-0.05	0.07	-0.16	0.00
40.Thailand	-0.27	-0.35	-0.14	-0.29	-0.38	-0.01	-0.08	-0.39	-0.13	-0.26	-0.19	-0.38
41.Turkey	0.04	-0.06	0.05	0.03	-0.05	-0.16	0.02	-0.07	0.10	-0.16	0.00	-0.08

Table 2.6: Trend profits and cultural differences: portfolio analysis

This table reports average monthly trend profits (%) in U.S. dollars for country-average portfolios (Column Average) and composite portfolios (Column Composite) classified by Hofstede (2001)'s four culture indices: power distance (PDI) in panel A, individualism (IDV) in panel B, masculinity (MAS) in panel C, and uncertainty avoidance (UAI) in panel D. The country-average portfolio is a portfolio that puts equal weight on each country-specific trend portfolio in this group. The formation of the composite portfolio is similar to that of the trend portfolio in each country. At the end of each month, all countries in our sample are divided into three groups based on their scores on the four culture indices respectively. In each group, we could form the country-average (or composite) portfolios with highest expected returns (High $E(r)$), lowest expected returns (Low $E(r)$), and the trend factor (High $E(r)$ minus low $E(r)$). The Newey and West (1994) robust t-statistics are in parentheses.

Panel A. PDI

	Average			Composite		
	High $E(r)$	Low $E(r)$	Trend	High $E(r)$	Low $E(r)$	Trend
High	1.40	0.33	1.06	1.24	0.12	1.12
	(3.48)	(0.88)	(5.25)	(3.38)	(0.34)	(4.84)
2	1.24	0.14	1.11	1.02	-0.24	1.26
	(4.33)	(0.46)	(8.48)	(3.16)	(-0.62)	(5.91)
Low	1.12	-0.15	1.27	0.91	-0.27	1.17
	(3.80)	(-0.43)	(8.75)	(3.15)	(-0.75)	(6.98)
High minus low	0.27	0.48	-0.21	0.34	0.39	-0.05
	(1.09)	(2.19)	(-0.96)	(1.42)	(1.77)	(-0.21)

Panel B. IDV

	Average			Composite		
	High $E(r)$	Low $E(r)$	Trend	High $E(r)$	Low $E(r)$	Trend
High	1.17	-0.21	1.38	1.12	-0.52	1.64
	(4.03)	(-0.62)	(9.64)	(3.54)	(-1.36)	(8.74)
2	1.44	0.09	1.34	1.03	-0.00	1.04
	(4.78)	(0.27)	(11.83)	(3.33)	(-0.01)	(4.47)
Low	1.04	0.27	0.77	0.09	0.39	-0.29
	(2.42)	(0.72)	(2.52)	(0.20)	(0.71)	(-0.83)
High minus low	-0.01	-0.65	0.64	1.07	-0.98	2.05
	(-0.04)	(-2.40)	(1.80)	(1.70)	(-1.31)	(5.04)

Panel C. MAS

	Average			Composite		
	High $E(r)$	Low $E(r)$	Trend	High $E(r)$	Low $E(r)$	Trend
High	1.10	-0.07	1.16	0.71	-0.13	0.84
	(4.20)	(-0.22)	(9.36)	(2.56)	(-0.36)	(4.02)
2	1.25	-0.24	1.49	1.28	-0.89	2.17
	(3.24)	(-0.59)	(7.87)	(3.42)	(-2.01)	(10.70)
Low	1.37	0.54	0.83	1.19	0.25	0.94
	(4.24)	(1.66)	(5.79)	(4.02)	(0.72)	(5.84)
High minus low	-0.27	-0.60	0.33	-0.47	-0.37	-0.10
	(-1.60)	(-3.68)	(1.97)	(-2.20)	(-1.64)	(-0.43)

Panel D. UAI

	Average			Composite		
	High $E(r)$	Low $E(r)$	Trend	High $E(r)$	Low $E(r)$	Trend
High	1.34	0.48	0.86	1.09	0.12	0.97
	(4.11)	(1.49)	(5.68)	(3.44)	(0.34)	(4.80)
2	1.20	-0.04	1.24	1.00	-0.16	1.16
	(3.96)	(-0.11)	(9.06)	(3.42)	(-0.45)	(6.67)
Low	1.13	-0.18	1.30	0.91	-0.60	1.50
	(3.63)	(-0.52)	(10.48)	(2.64)	(-1.46)	(7.53)
High minus low	0.22	0.66	-0.44	0.19	0.72	-0.53
	(0.95)	(3.32)	(-2.44)	(0.67)	(2.67)	(-2.07)

Table 2.7: Trend profits and cultural differences: regression analysis

This table reports the cross-sectional regression for countries' trend factor on countries' culture differences and other country's characteristics with the Newey and West (1994) robust t-statistics in parentheses. Panel A reports the results related to four cultural differences: power distance (PDI), individualism (IDV), masculinity (MAS), and uncertainty avoidance (UAI). Column (1) to (4) reports the four cultural differences respectively and column (5) reports the four cultural measures together. Panel B are cross-sectional regressions on cultural variables and other characteristics. Column (1) reports the cultural differences only. Column (2) shows the results related to proxies of investor rights. These variables include shareholder rights (Antidirector), debtholder rights (Creditor), and the common law origin (Common). Column (3) presents the results associated with legal efficiency. These variables are law efficiency (Efficiency), the assessment of law tradition (Rule of Law), the assessment of the government corruption (Corruption), and the risk of outright confiscation (risk of expropriation). Column (4) reports the results related to accounting standards (Accounting) and the percentage of big 5 auditors' market share (Big 5). Column (5) presents the results related to proxies of disclosure requirements. The proxies are disclosure requirements index (Disclosure) and liability standard index (Liability). Column (6) show the results related to characteristics of supervisor in security markets. The variables include supervisor characteristics index (Supervisor), rule-making power index (Rule-making), and investigative powers index (Investigative). Column (7) shows the results related to proxies for sanctions. The proxies consists orders index (Order) and criminal index (Criminal). Column (8) reports the results related to country's accessibility to raise equity capital (Access) and the percentage of firm-month observations in each country that either issued or repurchased shares (Nonzero). The control variables include average firm size (lgsz), average stock return volatility (retstd), change of real foreign exchange rate (cfx), change of GDP (CGDP), and GDP (GDP).

Panel A. Trend factor on culture differences

	(1)	(2)	(3)	(4)	(5)
PDI	-0.01				0.01
	(-1.44)				(2.14)
IDV		0.02			0.02
		(3.72)			(4.66)
MAS			0.00		0.01
			(1.19)		(1.53)
UAI				-0.01	-0.01
				(-1.89)	(-1.51)
Size	-0.04	-0.14	-0.05	-0.06	-0.21
	(-1.13)	(-3.40)	(-1.48)	(-1.66)	(-4.12)
Volatility	1.20	1.27	1.19	1.14	1.15
	(6.12)	(6.23)	(5.83)	(5.69)	(5.66)
Cfx	0.01	0.02	-0.01	0.02	-0.00
	(0.33)	(0.50)	(-0.32)	(0.43)	(-0.09)
CGDP	-17.29	-10.42	-17.49	-18.53	-18.87
	(-1.54)	(-0.89)	(-1.47)	(-1.79)	(-1.30)
GDP	-0.06	-0.08	-0.07	-0.07	-0.09
	(-1.85)	(-2.37)	(-1.95)	(-2.10)	(-2.76)
Intercept	6.97	6.79	6.54	6.91	6.10
	(6.73)	(6.22)	(5.88)	(6.22)	(5.69)

Panel B. Trend factor on countries' characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PDI	0.01								0.01
	(2.14)								(1.59)
IDV	0.02								0.02
	(4.66)								(3.22)
MAS	0.01								
	(1.53)								
UAI	-0.01								
	(-1.51)								
Antidirector		0.03							
		(0.51)							
Creditor		-0.11							
		(-1.54)							
Common		0.23							
		(1.09)							
Efficiency			-0.01						
			(-0.11)						
Rule of Law			0.14						
			(1.60)						
Corruption			0.17						
			(1.88)						
Expropriation			-0.24						
			(-1.47)						
Accounting				0.03					-0.00
				(2.48)					(-0.34)
Big5				-0.00					
				(-1.04)					
Disclosure					0.59				
					(1.02)				
Liability					0.20				
					(0.56)				
Supervisor						0.34			
						(1.54)			
Rule-making						-0.23			
						(-1.38)			
Investigative						0.27			
						(1.00)			
order							0.49		0.45
							(2.28)		(2.03)
criminal							-0.04		
							(-0.14)		
Anti-self								-0.15	
								(-0.40)	
Access								0.43	0.03
								(2.90)	(0.18)
Nonzero								-0.01	
								(-1.72)	
Size	-0.21	-0.07	-0.08	-0.08	-0.06	-0.01	-0.07	-0.03	-0.18
	(-4.12)	(-1.68)	(-2.02)	(-2.35)	(-1.38)	(-0.34)	(-1.95)	(-0.58)	(-4.65)
Volatility	1.15	1.04	1.34	1.08	1.00	1.11	1.03	1.27	0.98
	(5.66)	(4.88)	(6.37)	(5.10)	(5.20)	(5.59)	(5.03)	(4.73)	(4.84)
Cfx	-0.00	0.02	0.01	0.02	0.01	0.01	-0.00	0.03	0.07
	(-0.09)	(0.47)	(0.12)	(0.53)	(0.41)	(0.29)	(-0.08)	(0.47)	(1.04)
CGDP	-18.87	-16.64	3.50	-2.66	-26.32	-21.77	-14.54	-2.72	-13.73
	(-1.30)	(-1.11)	(0.22)	(-0.18)	(-1.89)	(-1.39)	(-0.98)	(-0.12)	(-0.99)
GDP	-0.09	-0.08	-0.08	-0.10	-0.09	-0.06	-0.07	-0.03	-0.08
	(-2.76)	(-2.39)	(-2.53)	(-3.32)	(-2.05)	(-1.75)	(-2.09)	(-1.06)	(-2.81)
Intercept	6.10	6.50	7.21	5.52	5.92	5.94	6.07	4.73	5.40
	(5.69)	(5.89)	(4.91)	(5.04)	(6.19)	(5.94)	(5.38)	(3.37)	(3.65)

Table 2.8: Global trend factor portfolio

This table compares the mean (%) with t-ratios in parethesis, standard deviation (%), and Sharpe ratio of global trend portfolios with global market and momentum portfolios. The equally-weighted trend factor is putting equal weight on each country's trend factor and the value-weighted trend factor is putting more weight on countries with larger firm size and less weight on countries with smaller firm size. The third and fourth portfolios are mean-variance portfolios. The former one is using the rolling-window and the latter is using the recursive-window. The global market portfolios and global momentum portfolios are constructed under the same procedure. Panel A reports the global factors using all countries in our sample. Panel B limit the sample to developed countries and panel C to emerging markets only.

Panel A. All countries

	Equally-weighted			Value-weighted			Mean-variance		
	mean	std	Sharpe	mean	std	Sharpe	mean	std	Sharpe
Trend	1.30	1.73	0.75	0.96	1.36	0.71	4.53	4.83	0.94
	(12.73)			(12.95)			(12.26)		
Market	0.64	4.36	0.15	0.44	2.83	0.16	0.58	4.93	0.12
	(2.48)			(1.24)			(1.76)		
Momentum	0.96	2.22	0.43	0.94	1.35	0.69	1.43	4.01	0.36
	(7.01)			(4.88)			(6.59)		

Panel B. Developed countries

	Equally-weighted			Value-weighted			Mean-variance		
	mean	std	Sharpe	mean	std	Sharpe	mean	std	Sharpe
Trend	1.48	2.01	0.74	1.20	1.74	0.69	4.09	4.48	0.91
	(11.82)			(11.79)			(11.14)		
Market	0.58	4.13	0.14	0.49	4.34	0.11	0.47	4.37	0.11
	(2.48)			(1.19)			(1.63)		
Momentum	1.10	2.48	0.44	1.03	2.55	0.40	1.58	3.72	0.42
	(7.32)			(4.14)			(6.84)		

Panel C. Emerging countries

	Equally-weighted			Value-weighted			Mean-variance		
	mean	std	Sharpe	mean	std	Sharpe	mean	std	Sharpe
Trend	0.75	2.63	0.28	0.54	1.65	0.33	1.92	5.36	0.36
	(4.94)			(5.11)			(4.49)		
Market	0.65	5.63	0.12	0.38	3.26	0.12	0.38	6.88	0.05
	(1.62)			(0.88)			(0.65)		
Momentum	0.62	3.06	0.20	0.88	1.56	0.57	0.79	4.53	0.17
	(3.21)			(4.06)			(2.84)		

Table 2.9: Spanning test for global trend factor

This table reports the spanning regression for the global equally-weighted trend factor on individual trend trend factor in column (1) and the regressions for the individual trend factors on the global EW trend factor in column (2). The t-statistics are Newey and West (1994) robust t-statistics. Panel A reports the results for developed countries and panel B reports the results for emerging countries.

Panel A. Developed countries

	(1)				(2)			
	α		β		α		β	
	Coef	t-ratio	Coef	t-ratio	Coef	t-ratio	Coef	t-ratio
Canada	0.02	6.22	1.15	6.52	0.01	5.75	0.14	6.77
France	0.00	0.36	1.09	4.53	0.01	7.65	0.18	3.61
Germany	0.01	3.39	0.47	1.99	0.01	8.14	0.09	2.06
Italy	-0.01	-1.96	1.56	5.13	0.01	9.35	0.17	6.30
Japan	0.01	2.42	0.69	4.36	0.01	10.96	0.14	5.49
UK	-0.00	-0.29	0.79	5.04	0.01	10.25	0.20	4.38
US	0.01	1.83	0.36	1.39	0.01	11.97	0.10	1.70
Australia	0.01	2.30	1.00	4.22	0.01	9.85	0.10	6.33
Austria	0.00	0.38	0.89	3.17	0.01	6.13	0.16	2.89
Belgium	0.00	0.59	0.89	2.94	0.01	6.87	0.20	3.83
Denmark	0.00	0.24	0.91	4.59	0.01	7.53	0.23	5.57
Finland	0.00	0.32	1.03	1.84	0.01	5.04	0.13	1.92
Greece	-0.00	-0.45	1.45	3.78	0.01	8.17	0.07	2.66
Hongkong	-0.01	-1.88	2.10	4.54	0.01	9.17	0.06	4.48
Ireland	-0.03	-2.86	3.85	5.17	0.01	8.42	0.10	4.98
Netherlands	-0.00	-0.28	0.86	7.30	0.01	10.38	0.22	5.94
New Zealand	0.00	0.19	0.14	0.41	0.01	6.57	0.01	0.42
Norway	0.00	0.43	0.73	4.19	0.01	7.03	0.13	2.77
Portugal	0.00	0.97	0.66	5.14	0.01	6.75	0.12	3.87
Singapore	-0.02	-2.30	2.61	5.71	0.01	9.65	0.08	4.82
Spain	-0.00	-1.31	0.78	4.07	0.01	9.12	0.16	3.22
Sweden	-0.00	-0.61	1.35	5.88	0.01	7.51	0.17	5.06
Switzerland	0.00	1.02	0.84	4.61	0.01	7.04	0.22	4.25

Panel B. Emerging countries

	(1)				(2)			
	α		β		α		β	
	Coef	t-ratio	Coef	t-ratio	Coef	t-ratio	Coef	t-ratio
Brazil	0.01	2.03	0.58	2.80	0.01	5.18	0.12	2.11
Chile	-0.01	-2.35	0.79	3.62	0.01	7.09	0.06	2.97
China	-0.01	-1.52	1.24	6.24	0.01	6.63	0.09	3.29
India	0.00	0.38	1.07	3.71	0.01	8.40	0.06	2.89
Israel	0.00	0.93	1.25	4.47	0.01	8.17	0.10	4.34
Korea	-0.01	-2.47	0.97	2.83	0.01	11.40	0.06	4.55
Malaysia	-0.02	-1.32	1.44	2.90	0.01	11.25	0.05	4.85
Mexico	0.00	0.11	0.43	1.70	0.01	7.87	0.05	1.46
Pakistan	0.01	0.76	-0.15	-0.13	0.01	8.84	-0.00	-0.13
Peru	-0.03	-1.84	1.68	1.71	0.01	7.17	0.05	3.98
Philippines	-0.01	-1.53	1.87	3.10	0.01	8.82	0.04	4.09
Poland	0.01	0.75	1.07	2.16	0.01	4.50	0.10	1.77
Russia	-0.01	-1.18	1.82	1.53	0.01	4.93	0.04	1.81
South Africa	0.01	2.83	0.47	2.93	0.01	8.54	0.07	2.72
Sri Lanka	0.04	5.54	0.65	1.54	0.01	4.01	0.02	1.55
Taiwan	-0.00	-0.97	0.34	1.14	0.01	10.08	0.03	1.36
Thailand	-0.00	-0.03	0.67	1.17	0.01	11.21	0.03	1.56
Turkey	0.00	0.02	0.44	1.49	0.01	9.26	0.04	1.69

Table 2.10: The EW trend factors and other factors: different business cycles

This table compares the average monthly return and Sharpe ratio of equally-weighted trend factor with other four equally-weighted global factors: market, momentum, short-term reversal, and long-term reversal in different time periods. The whole sample period is divided into expansion period and recession period according to NEBR's definition of business cycle. Panel A reports the results for all countries, panel B for developed countries, and panel C for emerging countries.

Panel A. All countries as global

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.30	0.96	0.64	-0.06	0.31	0.75	0.43	0.15	-0.03	0.16
	(12.73)	(7.01)	(2.48)	(-0.52)	(3.33)					
Expansion	1.31	0.99	0.83	-0.06	0.32	0.85	0.53	0.21	-0.04	0.18
	(13.75)	(8.63)	(3.73)	(-0.58)	(3.88)					
Recession	1.23	0.64	-1.27	-0.01	0.25	0.39	0.14	-0.18	-0.00	0.07
	(1.81)	(0.64)	(-0.87))	(-0.01)	(0.37)					

Panel B. Developed countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.48	1.10	0.58	-0.15	0.20	0.74	0.44	0.14	-0.08	0.10
	(11.82)	(7.32)	(2.48)	(-1.21)	(1.82)					
Expansion	1.51	1.11	0.78	-0.18	0.23	0.91	0.55	0.21	-0.10	0.12
	(13.91)	(9.08)	(3.91)	(-1.51)	(2.35)					
Recession	1.16	1.02	-1.40	0.16	-0.02	0.28	0.19	-0.21	0.05	-0.00
	(1.26)	(0.91)	(-1.04))	(0.25)	(-0.02)					

Panel C. Emerging countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	0.75	0.62	0.65	0.24	0.34	0.28	0.20	0.12	0.08	0.12
	(4.94)	(3.21)	(1.62))	(1.25)	(2.19)					
Expansion	0.72	0.68	0.81	0.26	0.35	0.27	0.23	0.16	0.08	0.12
	(4.66)	(3.65)	(2.23)	(1.25)	(2.10)					
Recession	1.04	0.04	-1.17	0.08	0.30	0.44	0.01	-0.13	0.03	0.09
	(1.90)	(0.03)	(-0.57)	(0.14)	(0.46)					

Table 2.11: Explaining size and book-to-market sorted portfolios for developed countries

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and book-to-market portfolios. The portfolios are value-weighted. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1	0.00	0.08	-0.00	-0.54	0.00	2.54	-0.00	-0.23
S1BM2	0.00	2.04	0.00	1.50	0.01	3.97	0.00	0.96
S1BM3	0.01	3.94	0.01	3.16	0.01	4.88	0.00	1.63
S1BM4	0.01	4.71	0.01	4.30	0.01	4.90	0.01	3.38
S1BM5	0.01	6.09	0.01	5.82	0.01	5.74	0.01	5.01
S2BM1	0.00	0.50	0.00	0.06	0.01	3.74	0.00	0.07
S2BM2	0.00	2.80	0.00	2.36	0.01	4.77	0.00	1.64
S2BM3	0.00	4.44	0.00	4.39	0.01	4.30	0.01	3.43
S2BM4	0.01	4.74	0.01	5.25	0.00	4.15	0.01	5.20
S2BM5	0.01	4.76	0.01	5.50	0.00	4.00	0.01	4.57
S3BM1	0.00	1.03	0.00	0.65	0.01	4.37	0.00	0.57
S3BM2	0.00	3.07	0.00	2.47	0.01	4.39	0.00	1.49
S3BM3	0.00	5.22	0.01	5.90	0.00	4.47	0.01	5.46
S3BM4	0.01	5.01	0.01	6.63	0.00	4.08	0.01	5.32
S3BM5	0.01	4.47	0.01	5.49	0.00	4.09	0.01	4.17
S4BM1	0.00	2.36	0.00	1.84	0.01	6.69	0.00	0.96
S4BM2	0.00	4.79	0.00	4.98	0.00	4.40	0.00	4.40
S4BM3	0.00	4.95	0.00	6.15	0.00	4.28	0.01	4.83
S4BM4	0.01	4.84	0.01	6.06	0.00	4.42	0.01	4.40
S4BM5	0.01	3.84	0.01	5.12	0.00	3.59	0.01	3.67
S5BM1	0.00	2.17	0.00	2.17	0.01	5.94	0.00	2.25
S5BM2	0.00	4.41	0.00	4.19	0.01	6.49	0.00	1.94
S5BM3	0.00	4.06	0.00	4.76	0.00	4.09	0.00	3.70
S5BM4	0.00	3.89	0.01	4.89	0.00	3.34	0.01	3.56
S5BM5	0.00	2.51	0.01	4.10	0.00	3.05	0.01	2.83
GRS	7.57	(0.00)	7.22	(0.00)	5.10	(0.00)	4.21	(0.00)

Table 2.12: Explaining size and momentum sorted portfolios for developed countries

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and momentum portfolios. The portfolios are value-weighted. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1MOM1	-0.00	-0.49	0.00	1.50	0.00	0.73	0.01	2.62
S1MOM2	0.01	4.03	0.01	5.18	0.00	3.78	0.01	5.37
S1MOM3	0.01	6.68	0.01	6.61	0.01	6.39	0.01	6.84
S1MOM4	0.01	8.54	0.01	7.43	0.01	7.47	0.01	6.27
S1MOM5	0.01	6.41	0.01	4.99	0.01	6.83	0.01	2.92
S2MOM1	-0.00	-0.17	0.00	3.03	0.00	1.41	0.01	3.54
S2MOM2	0.00	3.57	0.01	6.40	0.00	3.59	0.01	5.68
S2MOM3	0.01	5.31	0.01	5.70	0.00	3.86	0.01	5.24
S2MOM4	0.01	7.04	0.01	6.25	0.01	5.19	0.00	4.49
S2MOM5	0.01	5.61	0.01	3.78	0.01	5.40	0.00	0.74
S3MOM1	0.00	0.38	0.01	4.55	0.00	1.54	0.01	4.41
S3MOM2	0.00	3.19	0.01	6.42	0.00	2.88	0.01	4.83
S3MOM3	0.01	4.98	0.01	6.05	0.00	3.70	0.01	4.68
S3MOM4	0.01	6.24	0.00	5.50	0.00	4.31	0.00	3.56
S3MOM5	0.01	4.87	0.00	2.71	0.01	4.78	-0.00	-0.25
S4MOM1	0.00	0.23	0.01	5.14	0.00	1.83	0.01	4.30
S4MOM2	0.00	3.28	0.01	7.37	0.00	3.45	0.01	4.95
S4MOM3	0.01	5.81	0.01	6.67	0.00	5.00	0.01	4.04
S4MOM4	0.01	5.96	0.00	4.89	0.00	4.43	0.00	2.32
S4MOM5	0.01	4.88	0.00	2.78	0.01	4.44	-0.00	-0.17
S5MOM1	-0.00	-0.02	0.01	4.08	0.00	2.14	0.01	3.72
S5MOM2	0.00	2.66	0.01	6.78	0.00	3.39	0.01	4.12
S5MOM3	0.00	4.58	0.00	5.24	0.00	4.69	0.00	2.63
S5MOM4	0.01	5.21	0.00	3.85	0.00	4.99	0.00	0.73
S5MOM5	0.01	3.09	0.00	0.57	0.01	3.86	-0.00	-1.08
GRS	9.81	(0.00)	8.80	(0.00)	7.32	(0.00)	6.63	(0.00)

Table 2.13: Explaining triple sorted portfolios for developed countries

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using $3 \times 2 \times 2$ size, book-to-market, and operating profitability portfolios. The portfolios are value-weighted. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1OP1	-0.00	-1.24	-0.01	-1.82	0.01	2.33	-0.01	-1.40
S1BM1OP2	-0.00	-1.25	-0.00	-1.28	0.00	2.43	-0.00	-0.87
S1BM1OP3	0.00	2.69	0.00	2.21	0.01	4.39	0.00	2.09
S1BM1OP4	0.01	4.94	0.01	4.52	0.00	4.51	0.01	4.09
S1BM2OP1	-0.00	-0.35	-0.00	-0.77	0.00	2.54	-0.00	-0.61
S1BM2OP2	0.00	2.32	0.00	2.37	0.00	3.10	0.00	1.77
S1BM2OP3	0.01	5.33	0.01	5.97	0.00	4.19	0.01	5.52
S1BM2OP4	0.01	5.51	0.01	6.51	0.01	4.38	0.01	6.14
S1BM3OP1	0.00	2.44	0.00	2.00	0.00	2.41	0.00	0.90
S1BM3OP2	0.01	5.06	0.01	5.57	0.00	4.59	0.01	4.37
S1BM3OP3	0.01	5.64	0.01	6.49	0.01	4.42	0.01	5.84
S1BM3OP4	0.01	5.87	0.01	6.73	0.01	4.67	0.01	6.23
S1BM4OP1	0.00	2.62	0.01	2.93	0.00	2.12	0.01	2.42
S1BM4OP2	0.01	4.46	0.01	4.83	0.00	4.05	0.01	4.42
S1BM4OP3	0.01	4.73	0.01	5.60	0.01	4.17	0.01	5.45
S1BM4OP4	0.01	3.86	0.01	4.60	0.01	3.04	0.01	4.41
S2BM1OP1	-0.00	-0.32	-0.00	-0.77	0.01	4.93	-0.00	-1.04
S2BM1OP2	0.00	0.81	0.00	0.64	0.01	5.11	0.00	0.23
S2BM1OP3	0.00	2.19	0.00	2.39	0.01	6.07	0.00	2.31
S2BM1OP4	0.00	3.34	0.00	3.43	0.01	5.42	0.00	3.34
S2BM2OP1	-0.00	-1.46	-0.00	-0.59	0.00	3.75	-0.00	-0.31
S2BM2OP2	0.00	4.01	0.00	4.14	0.01	5.49	0.00	2.94
S2BM2OP3	0.00	3.99	0.00	4.60	0.00	3.33	0.00	2.59
S2BM2OP4	0.01	5.10	0.01	4.33	0.00	4.19	0.00	2.67
S2BM3OP1	0.00	1.29	0.00	2.17	0.00	3.62	0.00	1.68
S2BM3OP2	0.00	4.01	0.01	5.36	0.00	3.14	0.01	3.43
S2BM3OP3	0.01	4.86	0.01	5.19	0.00	3.98	0.01	4.01
S2BM3OP4	0.01	4.68	0.01	5.29	0.00	2.80	0.01	3.39
S2BM4OP1	0.00	1.64	0.00	3.18	0.00	2.92	0.00	2.46
S2BM4OP2	0.01	3.60	0.01	5.09	0.00	2.90	0.01	3.15
S2BM4OP3	0.01	3.72	0.01	4.37	0.00	2.55	0.01	3.05
S2BM4OP4	0.01	3.95	0.01	3.97	0.00	2.73	0.00	1.51
GRS	6.40	(0.00)	6.03	(0.00)	4.17	(0.00)	4.04	(0.00)

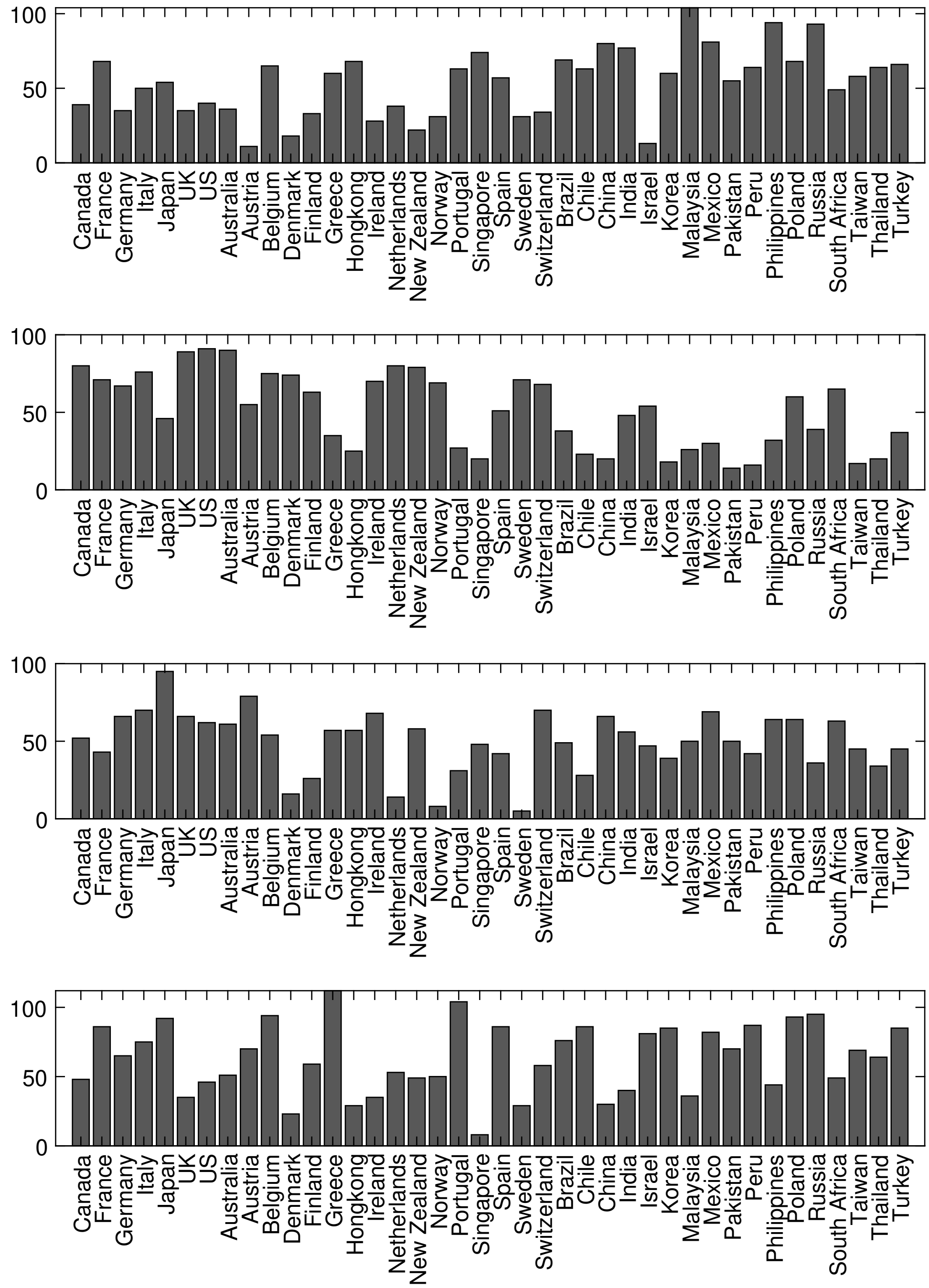

Figure 2.1: Cultural differences among countries

This figure plots the four dimensions of cultural measures among different countries. The four dimensions of cultural differences are power distance index (the first), individualism index (the second), masculinity(the third), and uncertainty avoidance (the fourth).

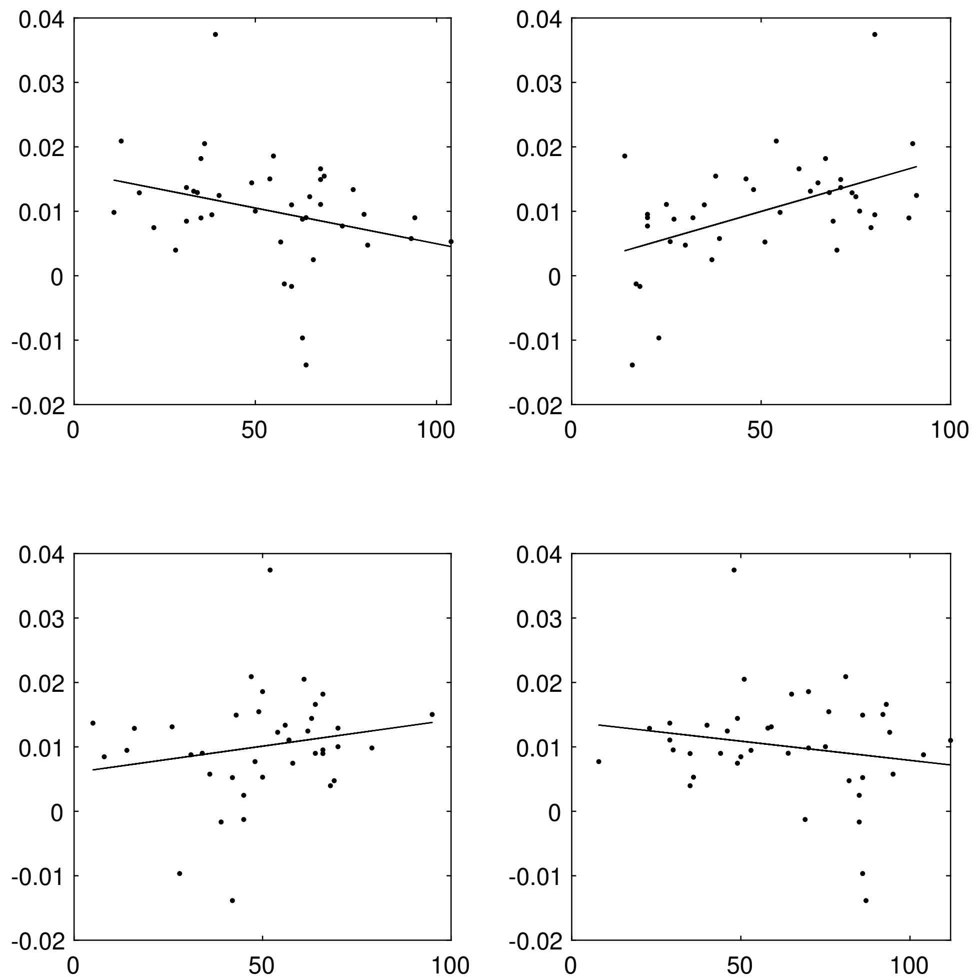

Figure 2.2: Cultural differences among countries

This figure plots the relation between countries' average trend returns and the four cultural measures respectively. The four dimensions of cultural measures are power distance index (upper left corner), individualism index (upper right corner), masculinity (bottom left corner), and uncertainty avoidance (bottom right corner).

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APPENDIX A: A "BAD BETA, GOOD BETA" ANATOMY OF CURRENCY RISK PREMIUMS AND TRADING STRATEGIES

A.1 Present Value Decomposition of Real Exchange Rates

We drop the currency subscript j for brevity. Iterate Equation (1.2) forward and sum

$$\sum_{i=1}^{T} \xi_{t+i} = \sum_{i=1}^{T} \Delta \tilde{s}_{t+i} + \sum_{i=1}^{T} d\tilde{r}_{t+i} = \tilde{s}_{t+T} - \tilde{s}_t + \sum_{i=1}^{T} d\tilde{r}_{t+i}. \tag{A.1}$$

Take conditional expectations; let $T \to \infty$; and rearrange

$$\tilde{s}_t - E_t(\tilde{s}_{t+\infty}) = -\sum_{i=1}^{\infty} E_t(\xi_{t+i}) + \sum_{i=1}^{\infty} E_t(d\tilde{r}_{t+i}). \tag{A.2}$$

Assume $E_t(\tilde{s}_{t+\infty}) = E(\tilde{s})$,

$$\tilde{s}_t - E(\tilde{s}) = -\sum_{i=1}^{\infty} E_t(\xi_{t+i}) + \sum_{i=1}^{\infty} E_t(d\tilde{r}_{t+i}), \tag{A.3}$$

which is Equation (1.5).

A.2 Decomposing Currency Return Innovations

Given Equations (1.2) and (1.5), the excess currency return is

$$\begin{aligned}
\xi_{t+1} &= \Delta \tilde{s}_{t+1} + d\tilde{r}_{t+1} = \tilde{s}_{t+1} - \tilde{s}_t + d\tilde{r}_{t+1} \\
&= E(\tilde{s}) - \sum_{i=1}^{\infty} E_{t+1}(\xi_{t+1+i}) + \sum_{i=1}^{\infty} E_{t+1}(d\tilde{r}_{t+1+i}) \\
&\quad - \left[E(\tilde{s}) - \sum_{i=1}^{\infty} E_t(\xi_{t+i}) + \sum_{i=1}^{\infty} E_t(d\tilde{r}_{t+i}) \right] + d\tilde{r}_{t+1} \\
&= -\sum_{i=1}^{\infty} (E_{t+1} - E_t)\xi_{t+1+i} + \sum_{i=1}^{\infty} (E_{t+1} - E_t) d\tilde{r}_{t+1+i} \\
&\quad - \left[-E_t(\xi_{t+1}) + E_t(d\tilde{r}_{t+1}) \right] + d\tilde{r}_{t+1},
\end{aligned} \tag{A.4}$$

where the operator $(E_{t+1} - E_t)$ finds changes of conditional expectations due to an updated information set, that is, $(E_{t+1} - E_t)X_{t+i} \equiv E_{t+1}(X_{t+i}) - E_t(X_{t+i})$. Rearrange the following:

$$\begin{aligned}
\xi_{t+1} - E_t(\xi_{t+1}) &= -\sum_{i=1}^{\infty}(E_{t+1} - E_t)\xi_{t+1+i} + \sum_{i=1}^{\infty}(E_{t+1} - E_t)d\tilde{r}_{t+1+i} + d\tilde{r}_{t+1} - E_t(d\tilde{r}_{t+1}) \\
&= - \underbrace{\sum_{i=1}^{\infty}(E_{t+1} - E_t)\xi_{t+1+i}}_{\textbf{risk-premium news}} + \underbrace{\sum_{i=1}^{\infty}(E_{t+1} - E_t)d\tilde{r}_{t+i}}_{\textbf{real-rate news}} && \text{(A.5)} \\
&\equiv -\eta^{\xi}_{t+1} + \eta^{d\tilde{r}}_{t+1}, && \text{(A.6)}
\end{aligned}$$

which is Equation (1.8).

A.3 From VAR to News

According to the VAR model in Equation (1.9), the risk-premium news is

$$\begin{aligned}
\eta^{\xi}_{t+1} &= \iota_1^{\top}[(I - B)^{-1}By_{t+1} - (I - B)^{-1}B^2 y_t] && \text{(A.7)} \\
&= \iota_1^{\top}[(I - B)^{-1}B](y_{t+1} - By_t) && \text{(A.8)} \\
&= \iota_1^{\top}[(I - B)^{-1}B]\epsilon_{t+1}, && \text{(A.9)}
\end{aligned}$$

where ι_i is a selection vector with the ith element being 1 and 0 otherwise. The real-rate news is

$$\begin{aligned}
\eta^{d\tilde{r}}_{t+1} &= \iota_2^{\top}[y_t + (I - B)^{-1}y_{t+1} - y_t - (I - B)^{-1}By_t] \\
&\quad - \iota_3^{\top}[(I - B)^{-1}y_{t+1} - (I - B)^{-1}By_t] && \text{(A.10)} \\
&= \iota_2^{\top}[(I - B)^{-1}](y_{t+1} - By_t) - \iota_3^{\top}[(I - B)^{-1}](y_{t+1} - By_t) && \text{(A.11)} \\
&= \iota_2^{\top}[(I - B)^{-1}]\epsilon_{t+1} - \iota_3^{\top}[(I - B)^{-1}]\epsilon_{t+1} && \text{(A.12)} \\
&= (\iota_2 - \iota_3)^{\top}[(I - B)^{-1}]\epsilon_{t+1}. && \text{(A.13)}
\end{aligned}$$

A.4 No-Arbitrage Model and Forward Premium Puzzle

To accommodate the forward premium puzzle, we need

$$\begin{aligned}\text{cov}[E_t(\xi_{j,t+1}), \tilde{r}_{j,t} - \tilde{r}_t] = & -\frac{1}{2}(\gamma^2 + \kappa^2)\left[\chi - \frac{1}{2}(\gamma^2 + \kappa^2)\right]\mathbf{var}(\sigma_t^2) \\ & -\frac{1}{2}(\delta_j^2 - \delta^2)\left[(\tau_j - \tau) - \frac{1}{2}(\delta_j^2 - \delta^2)\right]\mathbf{var}(\sigma_{w,t}^2) > 0, \qquad \text{(A.14)}\end{aligned}$$

which works particularly well for currencies with a large departure (either positive or negative) from the U.S. interest rate. A sufficient condition for the above inequality is

$$(\delta_j^2 - \delta^2)(\tau_j - \tau) < 0. \qquad \text{(A.15)}$$

A.5 GMM Standard Errors of Betas

Note one can assess the statistical significance of the betas directly. Take the risk-premium beta as an example:

$$\beta_j^\xi = \frac{\mathbf{cov}[\xi_{j,t+1} - E_t(\xi_{j,t+1}), -\eta_{D,t+1}^\xi]}{\mathbf{var}[\xi_{D,t+1} - E_t(\xi_{D,t+1})]}. \qquad \text{(A.16)}$$

Because innovation and the news are both mean zero, we can find beta as

$$\beta_j^\xi = \psi_1(\psi_2)^{-1}, \qquad \text{(A.17)}$$

$$\psi_1 = T^{-1}\sum_t g_{1,t+1}, \text{where } g_{1,t+1} = -\eta_{D,t+1}^\xi[\xi_{j,t+1} - E_t(\xi_{j,t+1})], \qquad \text{(A.18)}$$

$$\psi_2 = T^{-1}\sum_t g_{2,t+1}, \text{where } g_{2,t+1} = [\xi_{D,t+1} - E_t(\xi_{D,t+1})]^2, \qquad \text{(A.19)}$$

and its variance as

$$e_{1,t+1} = g_{1,t+1} - \psi_1, \tag{A.20}$$

$$e_{2,t+1} = g_{2,t+1} - \psi_2, \tag{A.21}$$

$$\mathbf{cov}(\psi) = T^{-1}\mathbf{cov}(e_t), \text{where } \psi = (\psi_1 \quad \psi_2)^\top, e_t = (e_{1,t} \quad e_{2,t})^\top \tag{A.22}$$

$$\mathbf{var}(\beta_j^{\xi}) = \nabla^\top \mathbf{cov}(\psi)\nabla, \tag{A.23}$$

$$\nabla = [(\psi_2)^{-1} \quad -\psi_1(\psi_2)^{-2}]^\top. \tag{A.24}$$

For $\beta_j^{d\tilde{r}}$, set $g_{1,t+1} = \eta_{D,t+1}^{d\tilde{r}}[\xi_{j,t+1} - E_t(\xi_{j,t+1})]$, and the other steps follow.

A.6 Bias-Corrected VAR

We use the following procedure to correct the bias in VAR estimates.

1. For a given sample (a rolling window for the rolling beta cases or the full sample for the fixed beta case), use the sample estimate $\hat{B}$ to form the panel of VAR residuals $\hat{\epsilon}_{j,t}$.

2. Create a bootstrapped panel data set:

   (a) Set $y_{j,0}^b$ to a vector of zeros.

   (b) Randomly draw a 4×1 vector from $\hat{\epsilon}_{j,t}$, call it $\epsilon_{j,1}^b$, and form $y_{j,1}^b = \hat{B}y_{j,0}^b + \epsilon_{j,1}^b$.

   (c) Repeat and iterate forward $W + T_j$ times to obtain a time series of $W + T_j$ observations and discard the first W observations, where $W = 60$ is the length of the warm-up period.

   (d) Add $E(y_j^\dagger)$ to $y_{j,t}$ to form $(y_{j,t}^\dagger)^b$. This is a bootstrapped sample of $(y_{j,t}^\dagger)^b$ for currency j with T_j observations.

   (e) Repeat the above steps for all currencies and construct the whole panel. The bootstrapped data are aligned in the same way as in the original data set, which has the same data availability as the original data.

3. Estimate a VAR using the bootstrapped sample and obtain $\hat{B}^b$. Discard it and restart if the largest eigenvalue of $\hat{B}^b$, in absolute terms, is greater than 1.

4. Repeat the above procedure until $\mathcal{N}^b = 5,000$ estimates of stationary $\hat{B}^b$ are obtained.

5. The bias-corrected VAR estimates will be $\hat{B}^C = 2\hat{B} - \sum \hat{B}^b/\mathcal{N}^b$. Use $\hat{B}^C$ in place of $\hat{B}$ when proceeding with the rest of the analysis.

A.7 Bootstrap Correction for Errors-in-Variable and Finite-Sample Biases

We use the following procedure to correct the biases in price of risk point estimates and their p-values.

1. Form the panel of VAR residuals using the following *restricted* VAR estimates:

$$\check{B} = \begin{bmatrix} \mathbf{0}^\top \\ \iota_2^\top \hat{B} \\ \iota_4^\top (\hat{B} - I) - \iota_2^\top \\ \iota_4^\top \hat{B} \end{bmatrix}, \tag{A.25}$$

$$\check{\epsilon}_{j,t} = \begin{bmatrix}\iota_1 & (\iota_4 - \iota_3) & \iota_3 & \iota_4\end{bmatrix}^\top \times \left[y_{j,t} - \check{B} y_{j,t-1}\right], \tag{A.26}$$

   where $\hat{B}$ is the full sample *unrestricted* VAR estimate. This formulation, motivated by Cochrane (2008) and Balduzzi and Chiang (2020), removes the time-series return predictability.

2. Follow Item 2 in Appendix A.6 to construct a bootstrapped panel data set, replacing $\hat{B}$ with $\check{B}$ and $\epsilon^b_{j,t}$ with $\check{\epsilon}_{j,t}$. This restriction again follows Cochrane (2008) and Balduzzi and Chiang (2020). Because we simulate state variables country by country, we do not preserve cross-sectional dependence.

3. Use the bootstrapped sample to calculate point estimates ($\hat{\lambda}^b$) and test statistics ($\hat{t}^b$).

4. Repeat the above procedure for $\mathcal{N}^b$ times.

5. Correct parameter estimates and test statistics (original sample estimates are denoted by a hat "$\hat{\ }$"):

   - Correct the bias of λ: the bias-corrected λ is $\hat{\lambda} - (\mathcal{N}^b)^{-1} \sum \hat{\lambda}^b$, which is under the null of $\lambda = 0$.

- Bootstrapped p-value based on simulated distribution: Calculate the p-value based on the distribution of $\hat{\lambda}^b$. For two-tail tests, the p value is $2 \times \mathbf{Prob}(\hat{\lambda}^b < \hat{\lambda})$ when $\mathbf{Prob}(\hat{\lambda}^b < \hat{\lambda}) \leq 1/2$, or $2[1 - \mathbf{Prob}(\hat{\lambda}^b < \hat{\lambda})]$ when $\mathbf{Prob}(\hat{\lambda}^b < \hat{\lambda}) > 1/2$.

A.8 Robustness Checks

A.8.1 Augmented test asset space

Lewellen, Nagel, and Shanken (2010) suggest including a traded factor in the test assets to improve the tests of asset pricing models. In our context, we add the excess return of the dollar factor to the dependent variable and add the risk-premium and real-rate betas of the dollar factor to the explanatory variables. Our results, available in Table A.1, are strengthened: unconditionally, the risk-premium-beta is a bad beta, and the real-rate beta is a good beta. The price of risk-premium-beta risk is countercyclical, and the price of real-rate-beta risk is procyclical, when AFD is the driver. The point estimates are nearly unaffected, and statistical significance is strengthened. These results indicate that our main results are robust to the Lewellen, Nagel, and Shanken (2010) augmentation of the test asset space.

A.8.2 Controlling for currency-specific attributes

We add the following currency-specific anomaly variables in our model, one at a time: the interest rate differential, momentum, and value. In addition, motivated by Ferson and Harvey (1999), we also control for the predictive component of currency excess returns, that is, $\iota_1^\top \hat{B}_t y_{j,t}$. None of them changes our main results, and only the interest rate differential has robust and significant explanatory power. Tables A.2, A.3, A.4, and A.5 provide the above results.

A.8.3 Controlling for betas with other factors

One common cure for the "flat dollar beta versus premium" problem is to include a "carry" factor as the second factor (e.g., Lustig, Roussanov, and Verdelhan (2011); Brusa, Ramadorai, and Verdelhan (2017); Verdelhan (2018), among others). We add beta with respect to the carry factor of Verdelhan (2018), that is, a high-minus-low portfolio from six forward-discount-sorted portfolios, to our existing two-beta ICAPM and perform the analysis in

Section 1.3.4. Our main results remain robust, and the carry beta is associated with a significantly positive price of risk. Given that carry beta captures similar attributes as the real-rate beta does in the no-arbitrage model, the positive price of carry beta risk is counterintuitive.

We further decompose a carry beta into a risk-premium portion and a real-rate portion, similar to our baseline dollar beta decomposition. When we control for these decomposed carry betas, with fixed or time-varying prices risks, our main results are unaltered. The risk-premium portion of the carry beta behaves very similar to the overall carry beta, and the real-rate portion of the carry beta does not help explain the currency risk premiums.

We also consider the global dollar beta, proposed by Verdelhan (2018). Results are unaltered, when we only control for the global dollar beta or for both the carry and the global dollar betas.

Atanasov and Nitschka (2015) use the "cash-flow beta" and the "discount-rate beta" to capture the cross-market comovement between currency returns and *equity-market news*. When we include these two betas in our model, our main results are still robust, and the two betas are associated with statistically insignificant prices of risks, with signs sensitive to model specifications. Interestingly, when betas are time-varying, the Atanasov and Nitschka (2015) results are reversed, i.e., cash-flow betas are good betas, and discount-rate betas are bad betas. Results can be consistent with Atanasov and Nitschka (2015) results only when betas are constant, but the model is likely misspecified.

Motivated by Lustig and Verdelhan (2007), we also control for betas with respect to U.S. consumption growth, which is the log growth rate of CPI-deflated per capita personal consumption expenditures. The consumption beta is associated with a negative price of risk for time-varying beta cases. Our main results remain robust.

Gao, Lu, and Song (2019) construct "GRIX" and "FXRIX" indexes to capture global or currency ex ante tail risk concerns. When we add a beta with respect to GRIX or FXRIX in our model, we find these tail risk betas are associated with significantly negative prices of risk, consistent with the findings of Gao, Lu, and Song (2019). Our results are robust or strengthened; in particular, the unconditional prices of risk-premium and real-rate risks become even more statistically significantly.

Lastly, we also experiment with replacing the risk-premium betas by the overall dollar betas.

Tables A.6, A.7, A.8, A.9, A.10, A.11, A.12, and A.15 provide the above mentioned results.

A.8.4 Bias correction of VAR estimates

We use a simulation to correct the bias in the VAR estimates. Section A.6 details the simulation procedure, which is motivated by Bekaert, Hodrick, and Marshall (1997) and allows for nonnormality in the innovations. With the bias correction, our results remain qualitatively unaltered. See Table A.16 for details.

A.8.5 Portfolio-level analysis

We analyze the sorted portfolios and find qualitatively similar results. Following Lustig, Roussanov, and Verdelhan (2011), we sort currencies into six portfolios by their interest rate differentials. The results show that high interest rate currencies have a high risk-premium beta and a high real-rate beta in the full sample. The panel regression evidence shows that the risk-premium beta is a bad beta, and the real-rate beta is a good beta. The prices of risks display patterns similar to that for individual currencies.

We replicate the same analyses using momentum, value, or real exchange rate sorted portfolios. The results for the beta estimates show that the relation between betas and momentum, value, or real exchange rate is no longer monotonic. The tests of the two-beta currency pricing model produce results qualitatively similar to our baseline results.

Tables A.17, A.18, A.19, A.20, A.21, A.22, A.23, and A.24 provide the detailed results. Note some portfolio-level results in these tables, mainly the estimates of the unconditional prices of beta risks, may become statistically weaker than the baseline results. We attribute it to a sample size issue because forming portfolios results in a significant reduction of the number of available observations. These estimates remain economically significant because their magnitudes and signs are qualitatively consistent with the baseline results.

A.8.6 Other estimation methods

We follow the currency pricing literature to use a 36-month rolling-window when estimating time-varying betas. Results are robust or strengthened when we use other window lengths. See Tables A.25 and A.26 for 48-month and 60-month cases.

Our baseline tests do not consider fixed effects. When fixed effects are controlled, the main results remain robust. See Tables A.27 and A.28 that control time and currency fixed effects, respectively.

So far whenever we estimate the two-beta currency pricing model in Equation (1.51), we use a panel regression, instead of the familiar cross-sectional regression, because the latter cannot handle models with common variations in the cross-section (e.g., AFD and/or the real exchange rate index). One work-around is to implement the following two-step procedure, which is loosely motivated by Brennan, Chordia, and Subrahmanyam (1998):[1] the first step is to run a panel regression of excess currency returns on the interactions between betas and macroeconomic variable(s),

$$\xi_{j,t+1} = [\lambda_z^{\xi}]^\top \beta_{j,t}^{\xi} z_t + [\lambda_z^{d\tilde{r}}]^\top \beta_{j,t}^{d\tilde{r}} z_t + u_{j,t+1}^{aux}, \tag{A.27}$$

and report the point estimates (λ_z) and their t-ratios based on clustered standard errors. In the second step, we run feasible-generalized-least-squares cross-sectional regressions of the panel regression residuals on a constant and the betas,

$$\hat{u}_{j,t+1}^{aux} = a + \lambda_0^{\xi} \beta_{j,t}^{\xi} + \lambda_0^{d\tilde{r}} \beta_{j,t}^{d\tilde{r}} + u_{j,t+1}^{csr}, \tag{A.28}$$

and report the point estimates (intercept and λ_0) and their t-ratios based on Fama-MacBeth standard errors; note the Shanken adjustment is not directly applicable here because of the way the betas are defined. This procedure obtains results qualitatively similar to the baseline results (see Table A.29 for the details). For example, when there is no intercept and AFD is the macroeconomic variable, the risk-premium beta is a bad beta, associated with a significantly positive unconditional price of risk, and a countercyclical conditional price of risk; the real-rate beta is a good beta, associated with a negative (though insignificant) unconditional price of risk, and a procyclical conditional price of risk.

Yet another way to test the two-beta currency pricing model in Equation (1.51) is to run time-series regressions on *each* individual currency; this method is motivated by Chan, Yang,

[1]Brennan, Chordia, and Subrahmanyam (1998) first run a *time-series* regression of stock returns on the factors of an assumed beta-pricing model, and save the residuals. Then they run a *cross-sectional* regression of the residuals on a constant and an array of characteristics. Similarly, our first step removes the common variation, and our second step runs a cross-sectional regression.

and Zhou (2018). Specifically, we estimate Model (8) at the currency level:

$$\xi_{j,t+1} = (\lambda^{\xi}_{0,j} + \lambda^{\xi}_{AFD,j} AFD_t)\beta^{\xi}_{j,t} + (\lambda^{d\tilde{r}}_{0,j} + \lambda^{d\tilde{r}}_{AFD,j} AFD_t)\beta^{d\tilde{r}}_{j,t} + u_{j,t+1}, \tag{A.29}$$

where all λ's are indexed by j, because we have separate sets of estimates for different currencies. The results (detailed in Table A.30) show that, of the total 34 currencies, $\lambda^{\xi}_{0,j}$ is significantly positive for 9 currencies and $\lambda^{\xi}_{AFD,j}$ is significantly positive for 10 currencies. On the other hand, $\lambda^{d\tilde{r}}_{0,j}$ is significantly negative (positive) for only 3 (2) currencies, whereas $\lambda^{d\tilde{r}}_{AFD,j}$ is significantly negative for 14 currencies. This evidence is consistent with our main results. We also run the time-series regression using the dollar portfolio (this is related to the intuition for the signs of the prices of risks in the theory section) and obtain essentially the same results as the main results.

A.8.7 Orthogonal betas and state variables

Table A.31 reports the results for the two-beta currency pricing model, where the risk-premium betas are orthogonal to the real-rate betas. The results are qualitatively similar to the main results. Table A.32 decomposes the state variable AFD into a component related to the real activity, i.e., the projection of AFD onto real activities, and an orthogonal component. The results show that both the fitted and orthogonal components drive the time-variation in conditional prices of beta risks with consistent signs.

Table A.1: Prices of beta risks, with augmented test asset space

This table reports results from a panel regression for the two-beta asset pricing model for currencies, with an augmented test asset space like in Lewellen, Nagel, and Shanken (2010). See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.08	0.32			-0.88			3.242
	(-2.18)	(3.13)			(-1.16)			
(2)	0.01	0.11			-0.14			3.028
	(0.68)	(2.16)			(-0.49)			
(3)	-0.00	0.21	0.38		-0.82	-3.08		3.016
	(-0.30)	(3.52)	(8.18)		(-2.69)	(-7.47)		
(4)	0.06	0.04		-0.19	0.06		-0.53	3.016
	(2.94)	(0.72)		(-4.26)	(0.26)		(-1.33)	
(5)	0.03	0.16	0.42	-0.26	-0.61	-2.63	-0.07	3.003
	(1.77)	(2.75)	(9.91)	(-5.84)	(-2.03)	(-6.40)	(-0.18)	
(6)		0.19			-0.41			3.242
		(2.05)			(-0.52)			
(7)		0.12			-0.13			3.028
		(2.35)			(-0.47)			
(8)		0.21	0.38		-0.83	-3.08		3.016
		(3.61)	(8.23)		(-2.70)	(-7.47)		
(9)		0.09		-0.19	0.11		-0.52	3.016
		(1.89)		(-4.06)	(0.43)		(-1.29)	
(10)		0.19	0.42	-0.26	-0.59	-2.63	-0.06	3.004
		(3.42)	(9.89)	(-5.71)	(-1.96)	(-6.37)	(-0.17)	

Table A.2: Prices of beta risks, controlling for the nominal interest rate differential

This table reports results from a panel regression for the two-beta asset pricing model for currencies, while controlling for the nominal interest rate differential. See Table 1.4 caption for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	dr	$RMSE$
(1)	-0.07	0.48			-3.60			56.59	3.273
	(-1.70)	(4.11)			(-3.24)			(7.16)	
(2)	-0.07	0.09			-0.16			65.15	3.058
	(-5.52)	(1.84)			(-0.54)			(11.52)	
(3)	-0.07	0.17	0.32		-0.87	-3.16		66.60	3.046
	(-5.37)	(3.00)	(6.94)		(-2.86)	(-7.91)		(11.60)	
(4)	-0.01	0.01		-0.17	0.08		-0.74	65.72	3.046
	(-0.62)	(0.17)		(-3.36)	(0.31)		(-1.99)	(13.53)	
(5)	-0.02	0.13	0.37	-0.23	-0.64	-2.69	-0.16	56.12	3.037
	(-1.21)	(2.06)	(8.36)	(-4.52)	(-2.08)	(-6.53)	(-0.43)	(10.39)	
(6)		0.37			-3.19			56.65	3.273
		(3.29)			(-2.85)			(7.19)	
(7)		0.04			-0.20			63.43	3.058
		(0.85)			(-0.70)			(11.42)	
(8)		0.12	0.32		-0.91	-3.17		65.11	3.047
		(2.29)	(7.02)		(-3.02)	(-8.03)		(11.31)	
(9)		-0.00		-0.17	0.07		-0.74	65.39	3.046
		(-0.01)		(-3.36)	(0.28)		(-1.99)	(13.07)	
(10)		0.11	0.37	-0.23	-0.65	-2.69	-0.16	55.58	3.037
		(2.02)	(8.39)	(-4.56)	(-2.13)	(-6.56)	(-0.44)	(10.28)	

Table A.3: Prices of beta risks, controlling for momentum

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for momentum. See the caption to Table 1.4 for further details.

Model	*Intercept*	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	*Momentum*	*RMSE*
(1)	-0.03	0.47			-2.66			-0.41	3.253
	(-0.75)	(3.46)			(-2.61)			(-1.20)	
(2)	0.00	0.11			-0.12			-0.17	3.066
	(0.35)	(2.01)			(-0.42)			(-0.58)	
(3)	-0.01	0.21	0.37		-0.81	-3.05		-0.01	3.054
	(-0.45)	(3.24)	(7.74)		(-2.53)	(-7.51)		(-0.04)	
(4)	0.06	0.03		-0.19	0.11		-0.60	0.35	3.054
	(2.89)	(0.46)		(-4.15)	(0.41)		(-1.41)	(1.12)	
(5)	0.03	0.15	0.42	-0.26	-0.58	-2.62	-0.12	0.31	3.041
	(1.84)	(2.39)	(9.44)	(-5.69)	(-1.81)	(-6.40)	(-0.30)	(1.02)	
(6)		0.41			-2.44			-0.41	3.253
		(3.42)			(-2.43)			(-1.20)	
(7)		0.12			-0.12			-0.17	3.066
		(2.12)			(-0.41)			(-0.59)	
(8)		0.21	0.37		-0.81	-3.05		-0.01	3.054
		(3.27)	(7.79)		(-2.55)	(-7.51)		(-0.03)	
(9)		0.07		-0.19	0.15		-0.58	0.34	3.054
		(1.52)		(-3.95)	(0.56)		(-1.36)	(1.06)	
(10)		0.18	0.42	-0.25	-0.56	-2.62	-0.11	0.30	3.041
		(2.99)	(9.40)	(-5.56)	(-1.75)	(-6.36)	(-0.28)	(0.98)	

Table A.4: Prices of beta risks, controlling for value

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for value. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$Value$	$RMSE$
(1)	-0.17	0.42			-1.36			0.41	3.096
	(-4.34)	(4.27)			(-1.83)			(3.02)	
(2)	-0.08	0.16			-0.02			0.33	3.049
	(-6.32)	(3.48)			(-0.07)			(3.31)	
(3)	-0.07	0.44	0.63		-1.19	-3.07		0.18	3.034
	(-5.43)	(10.93)	(17.92)		(-4.66)	(-9.38)		(1.48)	
(4)	-0.07	0.16		-0.24	0.25		-0.87	-0.52	3.036
	(-5.87)	(3.71)		(-6.29)	(1.23)		(-2.23)	(-3.62)	
(5)	-0.06	0.50	0.75	-0.34	-1.05	-2.82	-0.42	-0.79	3.016
	(-5.35)	(14.17)	(28.40)	(-10.27)	(-4.55)	(-8.86)	(-1.04)	(-4.67)	
(6)		0.13			-0.22			0.40	3.096
		(1.33)			(-0.28)			(2.91)	
(7)		0.10			-0.08			0.31	3.050
		(2.24)			(-0.31)			(3.24)	
(8)		0.38	0.63		-1.24	-3.07		0.16	3.034
		(9.50)	(17.95)		(-4.99)	(-9.45)		(1.37)	
(9)		0.11		-0.24	0.20		-0.88	-0.53	3.036
		(2.52)		(-6.36)	(0.99)		(-2.26)	(-3.75)	
(10)		0.45	0.75	-0.34	-1.09	-2.82	-0.43	-0.80	3.016
		(12.59)	(28.49)	(-10.43)	(-4.85)	(-8.89)	(-1.06)	(-4.76)	

Table A.5: Prices of beta risks, controlling for return predictability

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for the predictable component of currency excess returns using lagged instruments. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$Forecast$	$RMSE$
(1)	-0.11	0.39			-1.61			0.71	3.285
	(-2.80)	(3.30)			(-1.80)			(3.33)	
(2)	0.02	0.11			-0.13			-0.05	3.066
	(1.16)	(2.04)			(-0.45)			(-0.60)	
(3)	0.01	0.21	0.37		-0.82	-3.06		-0.05	3.054
	(0.40)	(3.41)	(7.78)		(-2.63)	(-7.19)		(-0.50)	
(4)	0.05	0.03		-0.19	0.09		-0.53	0.03	3.054
	(1.96)	(0.64)		(-4.07)	(0.36)		(-1.29)	(0.33)	
(5)	0.02	0.16	0.42	-0.26	-0.58	-2.59	-0.07	0.06	3.042
	(0.71)	(2.64)	(9.34)	(-5.58)	(-1.86)	(-6.10)	(-0.19)	(0.57)	
(6)		0.20			-0.80			0.49	3.285
		(1.90)			(-0.90)			(1.99)	
(7)		0.12			-0.12			-0.04	3.066
		(2.22)			(-0.41)			(-0.50)	
(8)		0.22	0.37		-0.82	-3.06		-0.04	3.054
		(3.53)	(7.82)		(-2.60)	(-7.16)		(-0.49)	
(9)		0.06		-0.19	0.13		-0.52	0.07	3.054
		(1.30)		(-3.94)	(0.52)		(-1.26)	(0.76)	
(10)		0.17	0.42	-0.26	-0.56	-2.59	-0.07	0.08	3.042
		(2.91)	(9.34)	(-5.54)	(-1.82)	(-6.06)	(-0.18)	(0.74)	

Table A.6: Prices of beta risks, controlling for carry beta

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for beta with respect to the carry factor. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$Carry$	$RMSE$
(1)	-0.09	0.20			-0.27			0.19	3.064
	(-3.31)	(2.24)			(-0.38)			(4.94)	
(2)	0.03	0.07			-0.20			0.19	3.064
	(2.08)	(1.35)			(-0.70)			(4.56)	
(3)	0.03	0.15	0.38		-0.97	-3.28		0.25	3.051
	(1.92)	(2.80)	(7.98)		(-3.19)	(-8.33)		(5.80)	
(4)	0.09	-0.03		-0.19	0.01		-0.72	0.25	3.051
	(4.03)	(-0.61)		(-3.55)	(0.05)		(-1.75)	(3.37)	
(5)	0.07	0.10	0.42	-0.25	-0.72	-2.78	-0.21	0.27	3.038
	(3.39)	(1.79)	(9.42)	(-4.75)	(-2.41)	(-6.80)	(-0.56)	(3.83)	
(6)		0.04			0.37			0.19	3.064
		(0.53)			(0.51)			(5.01)	
(7)		0.09			-0.18			0.19	3.064
		(1.88)			(-0.63)			(4.58)	
(8)		0.17	0.38		-0.95	-3.28		0.24	3.051
		(3.43)	(7.98)		(-3.09)	(-8.22)		(5.74)	
(9)		0.04		-0.18	0.08		-0.70	0.24	3.051
		(1.09)		(-3.33)	(0.30)		(-1.65)	(2.95)	
(10)		0.15	0.42	-0.25	-0.68	-2.77	-0.20	0.26	3.038
		(3.14)	(9.33)	(-4.57)	(-2.23)	(-6.67)	(-0.53)	(3.45)	

Table A.7: Prices of beta risks, controlling for decomposed carry betas

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for risk-premium and real-rate betas with respect to the carry factor. See the caption to Table 1.4 for further details.

Model	*Intercept*	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$Carry^{\xi}$	$Carry^{d\tilde{r}}$	$RMSE$
(1)	-0.12	0.17			0.15			0.33	-2.36	3.281
	(-3.90)	(1.16)			(0.14)			(3.76)	(-2.51)	
(2)	0.02	0.07			-0.19			0.20	-0.04	3.064
	(1.74)	(1.42)			(-0.70)			(3.42)	(-0.08)	
(3)	0.04	0.15	0.39		-0.99	-3.35		0.22	0.74	3.050
	(2.71)	(2.68)	(8.60)		(-3.19)	(-8.02)		(4.15)	(1.30)	
(4)	0.08	-0.02		-0.20	0.02		-0.66	0.29	-0.52	3.050
	(3.70)	(-0.41)		(-4.12)	(0.10)		(-1.62)	(4.14)	(-0.94)	
(5)	0.07	0.10	0.42	-0.25	-0.72	-2.77	-0.21	0.27	0.20	3.038
	(3.54)	(1.78)	(10.14)	(-5.13)	(-2.42)	(-6.48)	(-0.56)	(3.98)	(0.35)	
(6)		0.04			0.48			0.26	-1.81	3.282
		(0.22)			(0.37)			(2.31)	(-1.53)	
(7)		0.09			-0.18			0.20	-0.06	3.064
		(1.89)			(-0.64)			(3.41)	(-0.12)	
(8)		0.18	0.39		-0.96	-3.34		0.22	0.71	3.050
		(3.43)	(8.59)		(-3.06)	(-7.86)		(4.09)	(1.22)	
(9)		0.04		-0.20	0.07		-0.64	0.28	-0.60	3.051
		(1.03)		(-3.96)	(0.31)		(-1.53)	(3.81)	(-1.02)	
(10)		0.15	0.42	-0.25	-0.67	-2.75	-0.19	0.26	0.14	3.038
		(3.10)	(10.06)	(-4.97)	(-2.24)	(-6.32)	(-0.51)	(3.68)	(0.23)	

Table A.8: Prices of beta risks, controlling for decomposed carry betas associated with a time-varying price of risk

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for risk-premium and real-rate betas with respect to the carry factor, associated with time-varying price of risk. See the caption to Table 1.4 for further details.

Model	*Intercept*	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$carry_0^{\xi}$	$carry_{AFD}^{\xi}$	$carry_{reri}^{\xi}$	$carry_0^{d\tilde{r}}$	$carry_{AFD}^{d\tilde{r}}$	$carry_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.12	0.17			0.15			0.33			-2.36			3.281
	(-3.90)	(1.16)			(0.14)			(3.76)			(-2.51)			
(2)	0.02	0.07			-0.19			0.20			-0.04			3.064
	(1.74)	(1.42)			(-0.70)			(3.42)			(-0.08)			
(3)	0.04	0.18	0.49		-0.87	-3.33		0.14	-0.48		0.41	0.26		3.041
	(2.84)	(2.72)	(8.41)		(-2.46)	(-6.80)		(2.62)	(-5.63)		(0.69)	(0.55)		
(4)	0.05	0.01		-0.23	-0.09		-0.70	0.30		0.12	-0.41		0.85	3.049
	(3.43)	(0.27)		(-5.12)	(-0.32)		(-1.66)	(5.18)		(1.59)	(-0.80)		(1.49)	
(5)	0.05	0.15	0.48	-0.24	-0.63	-2.55	-0.51	0.21	-0.47	0.13	-0.04	-0.13	1.09	3.030
	(3.17)	(2.36)	(9.63)	(-5.97)	(-1.76)	(-5.62)	(-1.23)	(3.67)	(-5.25)	(1.72)	(-0.08)	(-0.30)	(1.75)	
(6)		0.04			0.48			0.26			-1.81			3.282
		(0.22)			(0.37)			(2.31)			(-1.53)			
(7)		0.09			-0.18			0.20			-0.06			3.064
		(1.89)			(-0.64)			(3.41)			(-0.12)			
(8)		0.22	0.49		-0.84	-3.32		0.14	-0.48		0.38	0.28		3.041
		(3.38)	(8.41)		(-2.36)	(-6.67)		(2.59)	(-5.49)		(0.63)	(0.59)		
(9)		0.05		-0.23	-0.06		-0.69	0.30		0.12	-0.45		0.89	3.049
		(1.44)		(-5.09)	(-0.21)		(-1.60)	(4.95)		(1.60)	(-0.87)		(1.49)	
(10)		0.19	0.49	-0.24	-0.60	-2.54	-0.50	0.20	-0.47	0.13	-0.08	-0.10	1.12	3.030
		(3.18)	(9.62)	(-5.96)	(-1.67)	(-5.51)	(-1.20)	(3.54)	(-5.17)	(1.73)	(-0.15)	(-0.24)	(1.75)	

Table A.9: Prices of beta risks, controlling for the global dollar beta

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for beta with respect to the global dollar factor. See the caption to Table 1.4 for further details.

Model	*Intercept*	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	*Global*	*RMSE*
(1)	-0.10	0.34			-0.45			-0.06	3.282
	(-2.83)	(3.23)			(-0.59)			(-1.23)	
(2)	-0.00	0.14			-0.08			-0.06	3.066
	(-0.03)	(1.32)			(-0.24)			(-0.24)	
(3)	-0.03	0.34	0.38		-0.66	-3.06		-0.24	3.053
	(-2.40)	(3.47)	(8.36)		(-1.74)	(-7.31)		(-1.02)	
(4)	0.15	-0.41		-0.25	-0.42		-0.48	0.82	3.052
	(8.00)	(-3.14)		(-5.49)	(-1.34)		(-1.25)	(3.09)	
(5)	0.09	-0.15	0.40	-0.29	-0.92	-2.54	-0.03	0.56	3.040
	(6.03)	(-1.28)	(9.05)	(-6.22)	(-2.37)	(-5.77)	(-0.09)	(2.16)	
(6)		0.19			-0.40			0.00	3.282
		(1.95)			(-0.50)			(0.06)	
(7)		0.14			-0.08			-0.06	3.066
		(1.35)			(-0.24)			(-0.24)	
(8)		0.31	0.38		-0.70	-3.06		-0.21	3.053
		(3.18)	(8.39)		(-1.85)	(-7.34)		(-0.91)	
(9)		-0.22		-0.24	-0.23		-0.47	0.66	3.052
		(-1.71)		(-4.78)	(-0.76)		(-1.19)	(2.43)	
(10)		-0.03	0.41	-0.28	-0.81	-2.55	-0.03	0.45	3.041
		(-0.23)	(9.16)	(-5.77)	(-2.10)	(-5.78)	(-0.08)	(1.73)	

Table A.10: Prices of beta risks, controlling for the global dollar and carry betas

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for betas with respect to the global dollar factor and the carry factor. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$Global$	$Carry$	$RMSE$
(1)	-0.14	0.48			-1.27			-0.11	0.13	3.282
	(-3.51)	(3.95)			(-1.85)			(-1.39)	(3.11)	
(2)	0.02	0.08			-0.18			-0.02	0.19	3.064
	(1.77)	(0.65)			(-0.53)			(-0.09)	(4.54)	
(3)	0.01	0.25	0.39		-0.86	-3.29		-0.17	0.24	3.051
	(0.56)	(2.17)	(8.57)		(-2.28)	(-8.47)		(-0.66)	(5.80)	
(4)	0.19	-0.54		-0.25	-0.55		-0.68	0.92	0.27	3.048
	(9.40)	(-4.05)		(-4.71)	(-1.76)		(-1.84)	(3.33)	(3.75)	
(5)	0.14	-0.28	0.40	-0.29	-1.12	-2.71	-0.18	0.67	0.29	3.037
	(8.45)	(-2.39)	(9.08)	(-5.12)	(-2.85)	(-6.35)	(-0.49)	(2.41)	(4.10)	
(6)		0.25			-1.01			-0.02	0.10	3.282
		(2.40)			(-1.29)			(-0.29)	(2.34)	
(7)		0.11			-0.15			-0.04	0.19	3.064
		(0.93)			(-0.45)			(-0.17)	(4.59)	
(8)		0.26	0.39		-0.85	-3.28		-0.18	0.24	3.051
		(2.40)	(8.63)		(-2.27)	(-8.43)		(-0.70)	(5.83)	
(9)		-0.28		-0.23	-0.30		-0.65	0.70	0.25	3.049
		(-2.18)		(-3.99)	(-0.98)		(-1.64)	(2.51)	(2.96)	
(10)		-0.09	0.41	-0.28	-0.93	-2.72	-0.17	0.50	0.27	3.037
		(-0.76)	(9.15)	(-4.66)	(-2.40)	(-6.28)	(-0.45)	(1.80)	(3.40)	

Table A.11: Prices of beta risks, controlling for the equity cash-flow and discount-rate betas

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for betas with respect to equity market cash-flow and discount-rate news. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	λ^{CF}	λ^{DR}	$RMSE$
(1)	-0.12	0.30			-0.84			0.72	0.03	3.281
	(-4.31)	(3.85)			(-1.34)			(3.22)	(0.09)	
(2)	0.02	0.11			-0.16			-0.85	0.47	3.061
	(1.26)	(1.72)			(-0.56)			(-2.75)	(2.84)	
(3)	0.01	0.19	0.33		-0.84	-3.09		-0.90	0.37	3.049
	(0.71)	(2.63)	(6.19)		(-2.80)	(-7.47)		(-2.55)	(1.96)	
(4)	0.09	0.01		-0.21	0.10		-0.88	-1.08	0.83	3.044
	(3.86)	(0.23)		(-4.30)	(0.38)		(-2.18)	(-3.30)	(3.75)	
(5)	0.07	0.14	0.38	-0.27	-0.53	-2.34	-0.42	-0.70	0.87	3.035
	(3.21)	(1.94)	(7.25)	(-5.66)	(-1.79)	(-5.78)	(-1.11)	(-2.04)	(4.36)	
(6)		0.10			0.03			0.87	-0.41	3.281
		(1.31)			(0.04)			(3.43)	(-0.96)	
(7)		0.12			-0.14			-0.85	0.47	3.061
		(1.92)			(-0.52)			(-2.77)	(2.84)	
(8)		0.20	0.33		-0.84	-3.09		-0.90	0.37	3.049
		(2.78)	(6.21)		(-2.78)	(-7.45)		(-2.56)	(1.96)	
(9)		0.08		-0.21	0.16		-0.86	-1.10	0.79	3.045
		(1.44)		(-3.98)	(0.63)		(-2.09)	(-3.39)	(3.47)	
(10)		0.19	0.38	-0.27	-0.49	-2.35	-0.40	-0.71	0.85	3.035
		(2.82)	(7.17)	(-5.39)	(-1.64)	(-5.76)	(-1.06)	(-2.08)	(4.21)	

Table A.12: Prices of beta risks, controlling for the consumption beta

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for beta with respect to U.S. consumption growth. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$Consumption$	$RMSE$
(1)	-0.11	0.48			-2.18			0.08	3.282
	(-3.07)	(4.87)			(-2.84)			(7.28)	
(2)	0.00	0.15			-0.03			-0.08	3.063
	(0.04)	(2.40)			(-0.11)			(-3.85)	
(3)	-0.00	0.23	0.34		-0.74	-3.13		-0.08	3.051
	(-0.11)	(3.40)	(6.83)		(-2.43)	(-7.09)		(-3.29)	
(4)	0.05	0.07		-0.19	0.16		-0.51	-0.07	3.052
	(2.73)	(1.27)		(-4.08)	(0.63)		(-1.25)	(-2.97)	
(5)	0.03	0.18	0.39	-0.25	-0.58	-2.70	0.01	-0.05	3.041
	(1.73)	(2.75)	(8.69)	(-5.55)	(-1.87)	(-6.08)	(0.02)	(-2.02)	
(6)		0.29			-1.34			0.06	3.282
		(2.80)			(-1.54)			(5.12)	
(7)		0.15			-0.03			-0.08	3.063
		(2.50)			(-0.11)			(-3.85)	
(8)		0.23	0.34		-0.74	-3.13		-0.08	3.051
		(3.51)	(6.87)		(-2.44)	(-7.09)		(-3.29)	
(9)		0.11		-0.19	0.19		-0.50	-0.08	3.052
		(2.21)		(-3.93)	(0.78)		(-1.22)	(-2.94)	
(10)		0.21	0.40	-0.25	-0.56	-2.70	0.01	-0.05	3.041
		(3.32)	(8.70)	(-5.43)	(-1.81)	(-6.05)	(0.03)	(-2.01)	

Table A.13: Prices of beta risks, controlling for the GRIX beta

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for beta with respect to the global ex ante tail risk concerns index (GRIX). See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$GRIX$	$RMSE$
(1)	-0.00	0.57			-3.31			-35.60	3.232
	(-0.00)	(3.40)			(-2.29)			(-6.97)	
(2)	0.06	0.26			-0.53			-4.63	3.252
	(1.98)	(5.14)			(-1.83)			(-2.78)	
(3)	-0.01	0.53	0.51		-1.00	-1.95		-5.23	3.238
	(-0.45)	(12.54)	(8.19)		(-3.84)	(-3.67)		(-2.48)	
(4)	-0.04	0.45		0.13	-1.32		0.86	-2.06	3.241
	(-1.24)	(5.65)		(2.66)	(-2.96)		(1.64)	(-1.28)	
(5)	-0.07	0.65	0.49	0.08	-1.91	-2.69	1.24	-1.63	3.229
	(-2.00)	(10.90)	(7.25)	(1.87)	(-4.31)	(-4.50)	(2.21)	(-0.61)	
(6)		0.57			-3.31			-35.60	3.232
		(3.33)			(-2.24)			(-6.97)	
(7)		0.30			-0.48			-4.54	3.252
		(6.34)			(-1.73)			(-2.63)	
(8)		0.52	0.51		-1.01	-1.96		-5.23	3.238
		(12.46)	(8.22)		(-4.01)	(-3.70)		(-2.50)	
(9)		0.42		0.13	-1.33		0.84	-2.14	3.241
		(6.04)		(2.58)	(-3.02)		(1.65)	(-1.31)	
(10)		0.59	0.48	0.08	-1.94	-2.70	1.22	-1.72	3.229
		(12.14)	(6.95)	(1.80)	(-4.47)	(-4.59)	(2.18)	(-0.65)	

Table A.14: Prices of beta risks, controlling for the FXRIX beta

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for beta respect to foreign exchange ex ante tail risk concerns index (FXRIX). See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$FXRIX$	$RMSE$
(1)	0.03	0.38			-1.24			-0.13	3.233
	(0.40)	(2.03)			(-0.75)			(-7.44)	
(2)	-0.09	0.47			-0.65			-0.15	3.243
	(-2.66)	(6.56)			(-2.56)			(-8.09)	
(3)	-0.10	0.61	0.42		-1.04	-2.39		-0.13	3.234
	(-2.61)	(11.42)	(6.50)		(-4.14)	(-5.15)		(-5.71)	
(4)	-0.10	0.52		0.11	-1.15		0.55	-0.09	3.239
	(-2.68)	(6.17)		(2.29)	(-2.84)		(1.05)	(-3.27)	
(5)	-0.10	0.68	0.45	0.06	-1.82	-2.80	1.10	-0.06	3.228
	(-2.69)	(10.91)	(6.94)	(1.46)	(-4.24)	(-5.36)	(1.99)	(-2.08)	
(6)		0.44			-1.53			-0.13	3.233
		(2.34)			(-0.91)			(-7.93)	
(7)		0.40			-0.69			-0.14	3.243
		(6.59)			(-2.82)			(-6.48)	
(8)		0.54	0.42		-1.09	-2.40		-0.12	3.234
		(11.95)	(6.32)		(-4.59)	(-5.26)		(-4.78)	
(9)		0.45		0.10	-1.19		0.54	-0.08	3.239
		(6.45)		(2.25)	(-3.00)		(1.05)	(-2.69)	
(10)		0.59	0.44	0.06	-1.87	-2.81	1.10	-0.05	3.229
		(12.03)	(6.74)	(1.47)	(-4.41)	(-5.47)	(1.97)	(-1.67)	

Table A.15: Prices of beta risks, dollar and real-rate betas

This table reports results of a panel regression for the two-beta asset pricing model for currencies, where the risk-premium betas are replaced by dollar betas. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^D	λ_{AFD}^D	λ_{reri}^D	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.08	0.32			-1.16			3.282
	(-2.20)	(3.07)			(-1.35)			
(2)	0.00	0.11			-0.23			3.066
	(0.43)	(2.05)			(-0.67)			
(3)	-0.01	0.21	0.37		-1.02	-3.43		3.054
	(-0.44)	(3.38)	(7.75)		(-2.73)	(-7.44)		
(4)	0.06	0.04		-0.19	0.05		-0.34	3.054
	(2.84)	(0.67)		(-4.12)	(0.17)		(-0.77)	
(5)	0.03	0.16	0.42	-0.26	-0.76	-3.02	0.19	3.042
	(1.71)	(2.64)	(9.40)	(-5.65)	(-2.12)	(-6.71)	(0.45)	
(6)		0.19			-0.57			3.282
		(1.97)			(-0.64)			
(7)		0.11			-0.23			3.066
		(2.19)			(-0.68)			
(8)		0.21	0.37		-1.02	-3.43		3.054
		(3.42)	(7.80)		(-2.73)	(-7.45)		
(9)		0.08		-0.19	0.04		-0.33	3.054
		(1.73)		(-3.94)	(0.14)		(-0.75)	
(10)		0.19	0.42	-0.26	-0.76	-3.02	0.19	3.042
		(3.24)	(9.39)	(-5.53)	(-2.12)	(-6.68)	(0.46)	

Table A.16: Prices of beta risks, with bias-corrected VAR

This table reports results of a panel regression for the two-beta asset pricing model for currencies, where the news are generated using bias-corrected VAR estimates based on 5,000 bootstrap repetitions. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.08	0.32			-0.83			3.282
	(-2.20)	(3.04)			(-1.08)			
(2)	-0.01	0.12			-0.06			3.068
	(-0.75)	(2.31)			(-0.24)			
(3)	-0.01	0.22	0.38		-0.77	-3.08		3.054
	(-1.17)	(3.55)	(8.33)		(-2.64)	(-8.59)		
(4)	0.05	0.05		-0.18	0.10		-0.66	3.056
	(2.46)	(0.87)		(-3.78)	(0.43)		(-1.69)	
(5)	0.02	0.17	0.42	-0.25	-0.57	-2.61	-0.09	3.042
	(1.21)	(2.77)	(9.58)	(-5.45)	(-1.93)	(-6.84)	(-0.25)	
(6)		0.19			-0.36			3.282
		(1.94)			(-0.45)			
(7)		0.11			-0.06			3.068
		(2.27)			(-0.26)			
(8)		0.21	0.38		-0.78	-3.08		3.054
		(3.49)	(8.38)		(-2.68)	(-8.61)		
(9)		0.08		-0.18	0.13		-0.66	3.056
		(1.82)		(-3.63)	(0.58)		(-1.66)	
(10)		0.19	0.42	-0.25	-0.56	-2.61	-0.09	3.043
		(3.28)	(9.56)	(-5.36)	(-1.88)	(-6.82)	(-0.24)	

Table A.17: Beta estimates, interest-rate-differential-sorted portfolios

This table reports the full-sample beta estimates of six interest-rate-differential-sorted portfolios and their t-ratios, which are estimated by GMM.

	Risk-premium Beta		Interest-rate Beta		Overall Beta	
Portfolio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
lowest	0.72	16.35	0.07	6.54	0.79	16.54
2	0.84	22.84	0.08	8.89	0.93	24.98
3	0.86	25.48	0.09	9.87	0.95	26.65
4	0.96	26.22	0.10	10.04	1.07	27.36
5	1.01	30.45	0.11	8.60	1.12	29.69
highest	1.04	19.16	0.11	7.93	1.15	18.77

Table A.18: Prices of beta risks, interest-rate-differential-sorted portfolios

This table reports results of a panel regression for the two-beta asset pricing model for currencies, using six interest-rate-differential-sorted portfolios as the test assets. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-1.03	1.09			2.02			2.503
	(-8.58)	(3.67)			(0.81)			
(2)	-0.22	0.37			-0.20			2.500
	(-1.57)	(1.64)			(-0.36)			
(3)	-0.25	0.44	0.33		-0.60	-3.23		2.489
	(-1.61)	(1.74)	(7.21)		(-1.11)	(-4.38)		
(4)	-0.22	0.34		-0.18	0.18		-0.75	2.489
	(-1.31)	(1.50)		(-2.14)	(0.34)		(-1.08)	
(5)	-0.22	0.39	0.36	-0.23	-0.29	-2.75	-0.24	2.479
	(-1.44)	(1.64)	(14.69)	(-2.81)	(-0.62)	(-3.94)	(-0.44)	
(6)		-2.84			28.04			2.505
		(-2.45)			(2.62)			
(7)		0.16			-0.40			2.501
		(1.28)			(-0.70)			
(8)		0.20	0.33		-0.81	-3.20		2.489
		(1.56)	(6.32)		(-1.47)	(-4.54)		
(9)		0.13		-0.18	-0.02		-0.73	2.490
		(1.19)		(-2.15)	(-0.04)		(-1.07)	
(10)		0.18	0.36	-0.23	-0.48	-2.73	-0.23	2.479
		(1.49)	(12.02)	(-2.85)	(-1.04)	(-4.06)	(-0.42)	

Table A.19: Beta estimates, momentum-sorted portfolios

This table reports the full-sample beta estimates of six momentum-sorted portfolios and their t-ratios, which are estimated by GMM.

	Risk-premium Beta		Interest-rate Beta		Overall Beta	
Portfolio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
lowest	0.97	14.16	0.12	8.96	1.08	14.35
2	0.75	18.19	0.09	10.30	0.85	18.23
3	0.95	24.63	0.10	9.08	1.05	25.94
4	0.92	15.71	0.09	8.88	1.01	16.41
5	0.95	23.52	0.10	11.02	1.05	25.81
highest	0.82	16.91	0.08	6.85	0.90	16.75

Table A.20: Prices of beta risks, momentum-sorted portfolios

This table reports results of a panel regression for the two-beta asset pricing model for currencies, using six momentum-sorted portfolios as the test assets. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	0.80	0.87			-14.84			2.504
	(4.00)	(3.39)			(-7.24)			
(2)	0.07	0.12			-0.99			2.499
	(0.43)	(1.13)			(-1.44)			
(3)	0.03	0.20	0.31		-1.35	-2.64		2.491
	(0.21)	(1.87)	(4.72)		(-1.98)	(-4.68)		
(4)	0.14	0.05		-0.15	-0.90		-0.28	2.494
	(0.84)	(0.40)		(-2.23)	(-1.39)		(-0.59)	
(5)	0.08	0.15	0.34	-0.20	-1.27	-2.31	0.08	2.485
	(0.54)	(1.16)	(6.00)	(-2.99)	(-2.03)	(-4.13)	(0.20)	
(6)		1.67			-14.00			2.505
		(3.62)			(-3.24)			
(7)		0.19			-0.90			2.499
		(2.01)			(-1.78)			
(8)		0.23	0.31		-1.32	-2.64		2.491
		(2.27)	(5.18)		(-2.45)	(-4.72)		
(9)		0.18		-0.15	-0.75		-0.28	2.494
		(1.73)		(-2.23)	(-1.48)		(-0.55)	
(10)		0.22	0.34	-0.20	-1.18	-2.32	0.09	2.485
		(1.99)	(6.67)	(-3.02)	(-2.25)	(-4.27)	(0.21)	

Table A.21: Beta estimates, value-sorted portfolios

This table reports the full-sample beta estimates of six value-sorted portfolios and their t-ratios, which are estimated by GMM.

	Risk-premium Beta		Interest-rate Beta		Overall Beta	
Portfolio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
lowest	0.88	17.12	0.10	8.51	0.97	18.34
2	0.85	18.56	0.09	7.97	0.94	19.44
3	0.87	24.73	0.11	10.08	0.98	25.44
4	0.94	27.69	0.11	11.08	1.05	28.23
5	0.90	23.74	0.10	8.58	1.01	23.35
highest	0.85	16.23	0.09	8.98	0.94	16.60

Table A.22: Prices of beta risks, value-sorted portfolios

This table reports results of a panel regression for the two-beta asset pricing model for currencies, using six value-sorted portfolios as the test assets. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.48	0.71			0.05			2.508
	(-0.29)	(0.35)			(0.01)			
(2)	-0.17	0.36			-0.18			2.482
	(-2.26)	(1.94)			(-0.46)			
(3)	-0.25	0.42	0.14		0.10	-0.88		2.479
	(-3.46)	(2.44)	(3.02)		(0.20)	(-2.96)		
(4)	-0.28	0.48		-0.23	0.08		-0.54	2.470
	(-4.55)	(3.56)		(-2.20)	(0.21)		(-0.79)	
(5)	-0.36	0.57	0.23	-0.27	0.32	-0.88	-0.54	2.464
	(-5.83)	(4.76)	(5.99)	(-2.49)	(0.65)	(-2.81)	(-0.77)	
(6)		-0.04			1.89			2.508
		(-0.05)			(0.29)			
(7)		0.18			-0.27			2.482
		(1.53)			(-0.64)			
(8)		0.17	0.13		-0.07	-0.75		2.480
		(1.45)	(2.66)		(-0.15)	(-2.25)		
(9)		0.20		-0.22	-0.07		-0.49	2.471
		(2.02)		(-2.05)	(-0.17)		(-0.67)	
(10)		0.21	0.21	-0.27	0.07	-0.69	-0.50	2.466
		(2.10)	(6.10)	(-2.30)	(0.15)	(-2.12)	(-0.65)	

Table A.23: Beta estimates, real exchange-rate-sorted portfolios

This table reports the full-sample beta estimates of six real exchange-rate-sorted portfolios and their t-ratios, which are estimated by GMM.

	Risk-premium Beta		Interest-rate Beta		Overall Beta	
Portfolio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
lowest	0.87	21.38	0.09	7.89	0.97	22.24
2	0.86	19.64	0.09	8.48	0.95	20.70
3	0.92	22.75	0.10	10.41	1.02	23.98
4	0.96	20.99	0.11	8.82	1.07	20.93
5	1.00	33.13	0.10	7.74	1.10	33.32
highest	0.88	19.43	0.09	8.45	0.98	19.78

Table A.24: Prices of beta risks, real exchange-rate-sorted portfolios

This table reports results of a panel regression for the two-beta asset pricing model for currencies, using six real exchange-rate-sorted portfolios as the test assets. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.91	0.14			9.55			2.507
	(-1.15)	(0.22)			(1.72)			
(2)	0.12	0.01			-0.39			2.502
	(0.76)	(0.13)			(-0.55)			
(3)	0.09	0.09	0.32		-0.78	-3.15		2.490
	(0.65)	(0.80)	(5.42)		(-1.19)	(-6.73)		
(4)	0.01	0.10		-0.14	0.13		-1.03	2.492
	(0.11)	(0.76)		(-2.15)	(0.24)		(-2.11)	
(5)	-0.00	0.17	0.34	-0.19	-0.36	-2.68	-0.45	2.482
	(-0.04)	(1.24)	(6.91)	(-3.39)	(-0.63)	(-4.94)	(-1.03)	
(6)		-0.90			10.03			2.507
		(-0.92)			(1.14)			
(7)		0.12			-0.29			2.502
		(1.07)			(-0.46)			
(8)		0.17	0.32		-0.71	-3.16		2.490
		(1.43)	(5.54)		(-1.18)	(-6.79)		
(9)		0.11		-0.14	0.14		-1.03	2.492
		(0.96)		(-2.11)	(0.30)		(-2.10)	
(10)		0.16	0.34	-0.19	-0.37	-2.68	-0.45	2.482
		(1.29)	(7.02)	(-3.28)	(-0.67)	(-4.95)	(-1.03)	

Table A.25: Prices of beta risks, 48-month rolling-window estimation

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while the time-varying betas are obtained by a 48-month rolling-window estimation. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.07	0.25			-0.44			3.291
	(-1.93)	(2.09)			(-0.52)			
(2)	0.01	0.16			-0.66			3.051
	(0.60)	(3.93)			(-3.89)			
(3)	-0.00	0.22	0.35		-0.38	-2.45		3.036
	(-0.31)	(5.65)	(6.65)		(-2.13)	(-7.06)		
(4)	0.06	0.08		-0.18	-0.42		-0.24	3.043
	(2.50)	(1.55)		(-3.87)	(-1.55)		(-1.15)	
(5)	0.03	0.26	0.49	-0.33	-1.16	-3.38	1.30	3.024
	(1.07)	(4.37)	(10.16)	(-5.64)	(-4.02)	(-6.96)	(4.43)	
(6)		0.12			0.01			3.291
		(1.15)			(0.01)			
(7)		0.17			-0.65			3.051
		(4.36)			(-3.88)			
(8)		0.21	0.35		-0.38	-2.45		3.036
		(5.88)	(6.65)		(-2.22)	(-7.06)		
(9)		0.12		-0.18	-0.38		-0.23	3.043
		(2.89)		(-3.59)	(-1.44)		(-1.13)	
(10)		0.28	0.49	-0.33	-1.14	-3.38	1.31	3.024
		(5.67)	(10.19)	(-5.45)	(-4.04)	(-6.96)	(4.43)	

Table A.26: Prices of beta risks, 60-month rolling-window estimation

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while the time-varying betas are obtained by a 60-month rolling-window estimation. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.09	0.24			-0.25			3.291
	(-2.25)	(2.03)			(-0.30)			
(2)	-0.04	0.34			-1.51			3.048
	(-3.04)	(8.23)			(-10.82)			
(3)	-0.05	0.43	0.26		-1.95	-1.56		3.042
	(-3.98)	(9.07)	(7.21)		(-8.99)	(-4.52)		
(4)	-0.01	0.28		-0.03	-1.26		-1.40	3.036
	(-0.46)	(8.45)		(-0.90)	(-8.36)		(-6.25)	
(5)	0.00	0.34	0.23	-0.07	-1.57	-0.47	-1.34	3.031
	(0.02)	(7.78)	(6.23)	(-1.67)	(-7.85)	(-1.20)	(-5.06)	
(6)		0.09			0.29			3.292
		(0.85)			(0.34)			
(7)		0.30			-1.54			3.048
		(8.31)			(-11.55)			
(8)		0.39	0.26		-1.98	-1.56		3.043
		(8.38)	(7.25)		(-9.44)	(-4.51)		
(9)		0.28		-0.03	-1.26		-1.40	3.036
		(8.74)		(-0.90)	(-8.62)		(-6.25)	
(10)		0.34	0.23	-0.07	-1.57	-0.47	-1.34	3.031
		(8.16)	(6.23)	(-1.67)	(-8.00)	(-1.20)	(-5.06)	

Table A.27: Prices of beta risks, controlling for time fixed effects

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for time fixed effects. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	0.01	0.08			1.28			2.513
	(0.55)	(0.65)			(1.38)			
(2)	-0.00	0.03			0.60			2.271
	(-0.05)	(0.59)			(1.40)			
(3)	-0.00	0.11	0.22		-0.09	-2.22		2.269
	(-0.04)	(1.96)	(2.64)		(-0.24)	(-2.96)		
(4)	-0.00	-0.04		-0.24	0.70		-0.10	2.267
	(-0.05)	(-0.66)		(-3.36)	(1.68)		(-0.16)	
(5)	-0.00	0.07	0.30	-0.28	0.05	-1.91	0.25	2.265
	(-0.04)	(1.09)	(3.68)	(-4.03)	(0.12)	(-2.23)	(0.37)	
(6)		0.09			1.16			2.513
		(0.73)			(1.24)			
(7)		0.03			0.60			2.271
		(0.59)			(1.40)			
(8)		0.11	0.22		-0.09	-2.22		2.269
		(1.96)	(2.64)		(-0.24)	(-2.96)		
(9)		-0.04		-0.24	0.70		-0.10	2.267
		(-0.65)		(-3.36)	(1.68)		(-0.16)	
(10)		0.07	0.30	-0.28	0.05	-1.91	0.25	2.265
		(1.09)	(3.68)	(-4.03)	(0.12)	(-2.23)	(0.37)	

Table A.28: Prices of beta risks, controlling for currency fixed effects

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while controlling for currency fixed effects. See the caption to Table 1.4 for further details. Note Models (1) and (6) are skipped because controlling for currency fixed effects is implausible for models with fixed betas.

Model	*Intercept*	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	*RMSE*
(2)	-0.03	0.08			-0.15			3.064
	(-3.64)	(1.02)			(-0.52)			
(3)	-0.02	0.14	0.28		-0.92	-3.35		3.051
	(-1.70)	(1.18)	(2.45)		(-3.17)	(-8.84)		
(4)	-0.03	0.02		-0.13	-0.17		-0.18	3.063
	(-4.01)	(0.28)		(-1.34)	(-0.65)		(-0.43)	
(5)	-0.02	0.14	0.36	-0.18	-1.10	-3.53	0.58	3.050
	(-2.63)	(1.20)	(3.22)	(-1.63)	(-3.56)	(-8.64)	(1.30)	
(7)		0.08			-0.15			3.064
		(1.02)			(-0.52)			
(8)		0.14	0.28		-0.92	-3.36		3.051
		(1.18)	(2.45)		(-3.17)	(-8.82)		
(9)		0.02		-0.13	-0.17		-0.21	3.063
		(0.27)		(-1.27)	(-0.63)		(-0.48)	
(10)		0.14	0.36	-0.18	-1.10	-3.54	0.55	3.050
		(1.21)	(3.22)	(-1.59)	(-3.53)	(-8.62)	(1.24)	

Table A.29: Prices of beta risks, panel and cross-sectional regressions

This table reports two-step estimation results for the two-beta asset pricing model for currencies. In the first step, we run panel regressions of excess currency returns on the interactions between betas and macroeconomic variable(s) and report the point estimates (λ_z) and their t-ratios based on clustered standard errors. In the second step, we run feasible generalized least squares cross-sectional regressions of the panel regression residuals on a constant (when applicable) and the betas and report the point estimates (intercept and λ_0) and their t-ratios based on Fama-MacBeth standard errors. See the caption to Table 1.4 for further details.

Model	*Intercept*	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$
(1)	0.01	-0.02			1.37		
	(0.11)	(-0.06)			(0.52)		
(2)	0.20	0.37			-3.45		
	(1.57)	(1.32)			(-2.21)		
(3)	0.12	0.88	0.30		-2.88	-2.62	
	(1.60)	(1.49)	(6.74)		(-1.31)	(-7.99)	
(4)	0.19	0.26		-0.20	-2.69		-0.43
	(1.33)	(0.87)		(-4.69)	(-1.74)		(-1.17)
(5)	0.03	0.21	0.36	-0.25	-2.72	-2.24	-0.16
	(0.39)	(0.73)	(8.69)	(-6.79)	(-1.76)	(-7.16)	(-0.49)
(6)		0.02			1.34		
		(0.05)			(0.54)		
(7)		0.54			-2.44		
		(2.05)			(-1.56)		
(8)		0.49	0.30		-2.11	-2.62	
		(1.87)	(6.74)		(-1.35)	(-7.99)	
(9)		1.26		-0.20	-14.77		-0.43
		(1.77)		(-4.69)	(-1.18)		(-1.17)
(10)		0.48	0.36	-0.25	-2.15	-2.24	-0.16
		(2.13)	(8.69)	(-6.79)	(-1.42)	(-7.16)	(-0.49)

Table A.30: Prices of beta risks, currency-level time-series regressions

This table reports currency-level time-series regression results for Model (8) of Table 1.4, that is, the zero-intercept two-beta asset pricing model with time-varying betas and AFD-driven prices of risks. We report the regression coefficient estimates (see the caption to Table 1.4 for definitions) and their t-ratios based on Newey-West standard errors. The last column reports the adjusted R^2's in percentages.

	λ_0^{ξ}		λ_{AFD}^{ξ}		$\lambda_0^{d\tilde{r}}$		$\lambda_{AFD}^{d\tilde{r}}$		Adj.R^2
Country	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio	
Australia	0.60	2.98	0.96	3.59	-1.82	-0.99	-6.95	-3.43	3.98
Austria	-0.05	-0.08	0.83	0.83	2.72	1.16	0.12	0.03	3.35
Belgium	-0.80	-2.92	-0.47	-1.42	5.80	3.66	4.94	2.07	4.92
Canada	0.24	0.90	0.22	0.77	-1.65	-0.99	-4.48	-2.21	0.27
Czech	0.49	1.83	0.52	1.64	-1.54	-0.90	-5.10	-2.18	0.86
Denmark	0.12	0.70	0.51	2.67	-0.24	-0.17	-3.26	-2.09	1.23
Finland	-0.19	-0.61	-0.06	-0.17	1.96	0.74	-0.82	-0.21	-1.06
France	-0.47	-1.42	-0.03	-0.06	3.65	1.97	2.10	0.71	1.37
Germany	0.18	1.07	0.50	2.57	-0.95	-0.69	-3.60	-2.30	1.09
Greece	5.95	2.84	6.88	3.18	-35.90	-1.66	-39.25	-1.81	7.96
Hungary	0.58	1.73	0.58	1.66	-1.84	-0.82	-5.89	-2.02	1.25
India	0.34	0.71	-1.48	-3.60	0.44	0.24	1.63	0.34	-0.18
Indonesia	0.64	1.83	0.34	0.64	-1.55	-0.55	-0.47	-0.10	-0.31
Ireland	0.35	1.47	0.41	1.53	-1.50	-0.89	-3.95	-1.69	-0.07
Italy	-0.07	-0.16	-0.64	-1.07	1.67	0.64	4.22	0.92	-2.61
Japan	-0.41	-2.02	0.47	2.14	2.33	1.77	0.71	0.39	1.72
Kuwait	0.24	0.67	-1.03	-1.42	-3.02	-1.32	-12.24	-2.10	0.84
Malaysia	-0.16	-0.26	0.05	0.05	0.78	0.24	1.16	0.26	-1.16
Mexico	0.67	1.24	-0.66	-1.15	-6.21	-1.80	-2.51	-0.53	3.01
Netherlands	-0.04	-0.06	0.90	0.90	2.09	0.60	-0.61	-0.13	0.95
New Zealand	0.62	3.30	0.65	2.56	-2.22	-1.28	-3.76	-1.46	1.42
Norway	0.20	1.06	0.48	2.20	-1.22	-0.76	-4.55	-2.48	1.42
Philippines	0.32	1.00	0.21	0.50	-1.38	-0.59	3.45	0.93	-0.92
Poland	0.30	1.12	0.00	0.01	-1.39	-0.67	-5.06	-2.07	1.61
Portugal	4.03	4.79	3.92	3.61	-18.34	-1.95	-16.03	-1.25	22.45
Singapore	0.04	0.22	0.48	1.98	0.04	0.03	-3.14	-1.11	0.32
South Africa	0.08	0.30	0.33	1.30	0.56	0.27	-1.88	-0.97	-0.31
South Korea	0.97	2.17	0.56	1.10	-6.26	-1.61	-9.61	-1.79	3.42
Spain	-0.15	-0.39	0.49	0.75	2.46	1.14	0.38	0.11	0.78
Sweden	0.19	0.97	0.37	1.16	-1.23	-0.76	-4.60	-2.48	1.09
Switzerland	-0.10	-0.55	0.51	2.27	1.03	0.85	-3.04	-2.01	1.29
Taiwan	0.32	0.86	0.51	1.15	-2.16	-0.78	-0.66	-0.16	-0.16
Thailand	0.68	1.62	0.27	0.55	1.09	0.25	6.50	0.92	2.19
United Kingdom	0.41	1.71	0.18	0.65	-2.89	-1.45	-4.52	-1.91	1.90
Dollar Portfolio	0.28	1.81	0.48	2.55	-1.08	-0.75	-3.78	-2.10	1.30
$N \times \min p$		0.00		0.00		0.00		0.00	

Table A.31: Prices of beta risks, orthogonal betas

This table reports results of a panel regression for the two-beta asset pricing model for currencies, while the risk-premium betas are orthogonal to the real-rate betas. See the caption to Table 1.4 for further details.

Model	$Intercept$	λ_0^{ξ}	λ_{AFD}^{ξ}	λ_{reri}^{ξ}	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD}^{d\tilde{r}}$	$\lambda_{reri}^{d\tilde{r}}$	$RMSE$
(1)	-0.08	0.22			-0.84			3.282
	(-2.20)	(6.05)			(-1.10)			
(2)	-0.00	0.10			-0.12			3.066
	(-0.02)	(3.08)			(-0.40)			
(3)	-0.00	0.13	0.08		-0.81	-3.01		3.053
	(-0.14)	(3.17)	(2.17)		(-2.69)	(-7.30)		
(4)	0.07	0.04		-0.24	0.07		-0.51	3.054
	(3.40)	(0.76)		(-5.27)	(0.25)		(-1.08)	
(5)	0.04	0.09	0.17	-0.26	-0.60	-2.55	-0.04	3.042
	(1.99)	(1.95)	(4.01)	(-6.41)	(-1.91)	(-6.13)	(-0.10)	
(6)		0.15			-0.38			3.282
		(10.10)			(-0.48)			
(7)		0.10			-0.12			3.066
		(3.58)			(-0.40)			
(8)		0.12	0.08		-0.81	-3.01		3.053
		(3.59)	(2.18)		(-2.69)	(-7.28)		
(9)		0.09		-0.24	0.07		-0.48	3.054
		(2.42)		(-4.77)	(0.22)		(-0.99)	
(10)		0.13	0.17	-0.26	-0.61	-2.56	-0.03	3.042
		(3.26)	(3.98)	(-6.08)	(-1.90)	(-6.09)	(-0.06)	

Table A.32: Prices of beta risks, two-way decomposition of AFD

This table reports results of a panel regression for the two-beta asset pricing model for currencies, where the betas are 36-month rolling betas, and the prices of risks are driven by two orthogonal components of AFD: the projection of AFD onto real activities and the residuals (global component).

Model	$Intercept$	λ_0^{ξ}	$\lambda_{AFD,RA}^{\xi}$	$\lambda_{AFD,ORTH}^{\xi}$	$\lambda_0^{d\tilde{r}}$	$\lambda_{AFD,RA}^{d\tilde{r}}$	$\lambda_{AFD,ORTH}^{d\tilde{r}}$	$RMSE$
(i)	-0.01	0.15	4.16		0.09	-19.89		3.044
	(-1.16)	(4.24)	(11.71)		(0.54)	(-11.02)		
(ii)	-0.00	0.20		0.32	-0.78		-2.72	3.057
	(-0.33)	(3.11)		(6.80)	(-2.20)		(-6.11)	
(iii)	-0.02	0.21	3.87	0.24	-0.42	-18.10	-1.98	3.039
	(-1.69)	(4.73)	(11.63)	(5.12)	(-1.92)	(-10.78)	(-4.79)	
(iv)		0.14	4.15		0.08	-19.89		3.044
		(4.12)	(11.72)		(0.49)	(-11.04)		
(v)		0.20		0.32	-0.78		-2.72	3.057
		(3.15)		(6.83)	(-2.21)		(-6.11)	
(v)		0.20	3.87	0.24	-0.44	-18.10	-1.99	3.039
		(4.59)	(11.62)	(5.14)	(-2.00)	(-10.80)	(-4.80)	

APPENDIX B: TREND FACTORS AROUND THE WORLD: DO CULTURAL DIFFERENCES EXPLAIN THE PERFORMANCE DIFFERENCES?

B.1 Country-level variables

Our objective is to test whether the different countries' characteristic could affect the performance of the trend factor. We include measures for culture differences, shareholder rights, creditor rights, and legal enforcement.

B.1.1 Culture differences

We use Hofstede (2001)'s four dimension of culture differences:

- *Power distance (PDI)*: The extent to which the less powerful members of institutions and organizations within a country accept that power is distributed unequally. The people in the country with small power distance tend to treat everyone equally, have equal rights, and have narrow salary range compared with the people in the large power distance.

- *Individualism (IDV)* The societies where people are expected to look after himself or herself and his or her immediate family. Collectivism as its opposite is the societies in which people are integrated into strong and cohesive groups, which throughout people's lifetime to protect them in exchange for unquestioning loyalty. The country with high individualism index stress more on the personal interest, privacy, and freedom, and the self-actualization by every individual is an ultimate goal.

- *Masculinity (MAS)* The societies where social gender roles are clearly distinct. In the country with high masculinity index, men are supposed to be assertive, tough, and focused on material success whereas women are supposed to be more modest, tender, and concerned with quality of life. Femininity represents the societies in which the social gender roles overlap that both men and women are supposed to be modest, tender, and concerned with the quality of life.

- *Uncertainty avoidance(UAI)* The extend to which the members of a culture feel threatened by uncertain or unknown situations and try to avoid such situations. The feeling is in a need for predictability. People in the countries with strong uncertainty avoidance tend to have fear of ambiguous situations and of unfamiliar risks.

B.1.2 Investor rights

We include the following proxies for investor rights introduced by Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998):

- *Antidirector rights (Antidirector)* An index aggregating the shareholder rights. The index is formed by adding 1 when (1) the country allows shareholders to mail their proxy vote to the firm, (2) shareholders are not required to deposit their shares prior to a general shareholders meeting, (3) cumulative voting or proportional representation of minorities in the board of directors is allowed, (4) an oppressed minorities mechanism is in place, (5) the minimum percentage of share capital that entitles a shareholder to call for an extraordinary shareholders' meeting is less than or equal to 10 percent (the sample median), or (6) shareholders have preemptive rights that can be waived only by a shareholders' vote. The index ranges from zero to six

- *Creditor rights (Creditor)* An index aggregating different creditor rights. The index is formed by adding 1 when (1) the country imposes restrictions, such as creditors' consent or minimum dividends to file for reorganization; (2) secured creditors are able to gain possession of their security once the reorganization petition has been approved; (3) secured creditors are ranked first in the distribution of the proceeds that results from the disposition of the assets of a bankrupt firm; (4) the debtor does not retain the administration of its property pending the resolution of the reorganization. The index ranges from zero to four.

- *Common* a dummy variable that is equal to one if a country is of common law origin and zero if the country is of civil law origin.

B.1.3 legal enforcement

We include proxies for law enforcement following Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998):

- *Efficiency of judicial system (Efficiency)* Assessment of the "efficiency and integrity of the legal environment as it affects business, particularly foreign firms' produced by the country risk rating agency Business International Corp. It "may be taken to represent investors' assessments of conditions in the country in question." Scale from zero to ten; with lower scores, lower efficiency levels.

- *Rule of law (Rule of Law)* Assessment of the law and order tradition in the country produced by the country risk rating agency International Country Risk (ICR). Scale from zero to ten, with lower scores for less tradition for law and order.

- *Corruption (Corruption)* ICR's assessment of the corruption in government. Lower scores indicate that "high government officials are likely to demand special payments" and "illegal payments are generally expected throughout lower levels of government" in the form of "Bribes connected with import and export licenses, exchange controls, tax assessment, policy protection, or loans." Scale from zero to 10, with lower scores for higher levels of corruption.

- *Risk of expropriation (Expropriation)* ICR's assessment of the risk of "outright confiscation" or "forced nationalization." Scale from zero to ten, with lower scores for higher risks.

B.1.4 Accounting standards

We include two variables related to accounting standards following Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998) and Choi and Wong (2007):

- *Accounting standards (Accounting)* Index created by examining and rating companies' 1990 annual reports on their inclusion or omission of 90 items. These items fall into seven categories: general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items. A minimum of three companies in each country were studied. The companies represent a cross section of various industry groups; industrial companies represented 70 percent, and financial companies represented the remaining 30 percent.

- *Big 5* The percentage of big 5 auditors' market share.

B.1.5 Disclosure requirements

The variables which proxy the disclosure requirements are introduced by Porta, Lopez-De-Silanes, and Shleifer (2006):

- *Disclosure requirements index (Disclosure)* The index of disclosure equals the arithmetic mean of the following indices:

  - *Prospectus* Equals one if the law prohibits selling securities that are going to be listed on the largest stock exchange of the country without delivering a prospectus to potential investors; and equals zero otherwise.

  - *Compensation* An index of prospectus disclosure requirements regarding the compensation of the Issuer's directors and key officers. Equals one if the law or the listing rules require that the compensation of each director and key officer be reported in the prospectus of a newly listed firm; equals one half if only the aggregate compensation of directors and key officers must be reported in the prospectus of a newly listed firm; and equals zero when there is no requirement to disclose the compensation of directors and key officers in the prospectus for a newly listed firm.

- *Shareholders* An index of disclosure requirements regarding the Issuer's equity ownership structure. Equals one if the law or the listing rules require disclosing the name and ownership stake of each shareholder who, directly or indirectly, controls 10% or more of the Issuer's voting securities; equals one half if reporting requirements for the Issuer's 10% shareholders do not include indirect ownership or if only their aggregate ownership needs to be disclosed; and equals zero when the law does not require disclosing the name and ownership stake of the Issuer's 10% shareholders. We combine large shareholder reporting requirements imposed on firms with those imposed on large shareholders themselves.
- *Inside ownership* An index of prospectus disclosure requirements regarding the equity ownership of the Issuer's shares by its directors and key officers. Equals one if the law or the listing rules require that the ownership of the Issuer's shares by each of its director and key officers be disclosed in the prospectus; equals one half if only the aggregate number of the Issuer's shares owned by its directors and key officers must be disclosed in the prospectus; and equals zero when the ownership of the Issuer's shares by its directors and key officers need not be disclosed in the prospectus.
- *Irregular contracts* An index of prospectus disclosure requirements regarding the Issuer's contracts outside the ordinary course of business. Equals one if the law or the listing rules require that the terms of material contracts made by the Issuer outside the ordinary course of its business be disclosed in the prospectus; equals one half if the terms of only some material contracts made outside the ordinary course of business must be disclosed; and equals zero otherwise.
- *Transactions* An index of the prospectus disclosure requirements regarding transaction between the Issuer and its directors, officers, and/or large shareholders (i.e., "related parties"). Equals one if the law or the listing rules require that all

transactions in which related parties have, or will have, an interest be disclosed in the prospectus; equals one half if only some transactions between the Issuer and related parties must be disclosed in the prospectus; and equals zero if transactions between the Issuer and related parties need not be disclosed in the prospectus.

- *Liability standard index (Liability)* The index of liability standards equals the arithmetic mean of the following indices:

  - *Liability standard for the issuer and its directors* Index of the procedural difficulty in recovering losses from the Issuer and its directors in a civil liability case for losses due to misleading statements in the prospectus. The liability standard applicable to the Issuer's directors equals one when investors are only required to prove that the prospectus contains a misleading statement. Equals two thirds when investors must also prove that they relied on the prospectus and/or that their loss was caused by the misleading statement. Equals one third when investors must also prove that the director acted with negligence. Equals zero if restitution from directors is either unavailable or the liability standard is intent or gross negligence.

  - *Liability standard for distributors* Index of the procedural difficulty in recovering losses from the Distributor in a civil liability case for losses due to misleading statements in the prospectus. Equals one when investors are only required to prove that the prospectus contains a misleading statement. Equals two thirds when investors must also prove that they relied on the prospectus and/or that their loss was caused by the misleading statement. Equals one third when investors must also prove that the Distributor acted with negligence. Equals zero if restitution from the Distributor is either unavailable or the liability standard is intent or gross negligence.

  - *Liability standard for accountants* Index of the procedural difficulty in recovering losses from the Accountant in a civil liability case for losses due to misleading statements in the audited financial information accompanying the prospectus. Equals one when investors are only required to prove that the audited financial information accompanying the prospectus contains a misleading statement. Equals two thirds when investors must also prove that they relied on the prospectus and/or that their loss was caused by the misleading accounting information. Equals one third when investors must also prove that the Accountant acted with negligence. Equals zero if restitution from the Accountant is either unavailable or the liability standard is intent or gross negligence.

B.1.6 Characteristics and power of supervisor of security markets

The variables associated with the role of supervisor are introduced by Porta, Lopez-De-Silanes, and Shleifer (2006):

- *Supervisor characteristics index (Supervisor)* The arithmetic mean of the following three indices:
  - *Appointment* Equals one if a majority of the members of the Supervisor are not unilaterally appointed by the Executive branch of government; and equals zero otherwise.
  - *Tenure* Equals one if members of the Supervisor cannot be dismissed at the will of the appointing authority; and equals zero otherwise.
  - *Focus* Equals one if separate government agencies or official authorities are in charge of supervising commercial banks and stock exchanges; and equals zero otherwise.
- *Rule-making power index (Rule-making)* An index of the power of the Supervisor to issue regulations regarding primary offerings and listing rules on stock exchanges. Equals one if the Supervisor can generally issue regulations regarding primary offerings and/or

listing rules on stock exchanges without prior approval of other governmental authorities. Equals one half if the Supervisor can generally issue regulations regarding primary offerings and/or listing rules on stock exchanges only with the prior approval of other governmental authorities. Equals zero otherwise.

- *Investigative powers index (Investigative)* The arithmetic mean of the following two indices:
  - *Document* An index of the power of the Supervisor to command documents when investigating a violation of securities laws. Equals one if the Supervisor can generally issue an administrative order commanding all persons to turn over documents; equals one half if the Supervisor can generally issue an administrative order commanding publicly traded corporations and/or their directors to turn over documents; and equals zero otherwise.
  - *Witness* An index of the power of the Supervisor to subpoena the testimony of witnesses when investigating a violation of securities laws. Equals one if the Supervisor can generally subpoena all persons to give testimony; equals one half if the Supervisor can generally subpoena the directors of publicly traded corporations to give testimony; and equals zero otherwise.

B.1.7 Sanctions

The indices measuring the criminal and non-criminal sanctions for violations of securities laws are introduced by Porta, Lopez-De-Silanes, and Shleifer (2006):

- *Orders index (Order)* The arithmetic mean of the following three indices:
  - *Orders issuer* An index aggregating stop and do orders that may be directed to the Issuer in case of a defective prospectus. The index is formed by averaging the subindexes of orders to stop and to do. The subindex of orders to stop equals one if the Issuer may be ordered to refrain from a broad range of actions; equals one

half if the Issuer may only be ordered to desist from limited actions; and equals zero otherwise. The subindex of orders to do equals one if the Issuer may be ordered to perform a broad range of actions to rectify the violation; equals one half if the Issuer may only be ordered to perform limited actions; and equals zero otherwise.

- *Orders distributor* An index aggregating stop and do orders that may be directed to the Distributor in case of a defective prospectus. The index is formed by averaging the subindexes of orders to stop and to do. The subindex of orders to stop equals one if the Distributor may be ordered to refrain from a broad range of actions; equals one half if the Distributor may only be ordered to desist from limited actions; and equals zero otherwise. The subindex of orders to do equals one if the Distributor may be ordered to perform a broad range of actions to rectify the violation; equals one half if the Distributor may only be ordered to perform limited actions; and equals zero otherwise.
- *Orders accountant* An index aggregating stop and do orders that may be directed to the Accountant in case of a defective prospectus. The index is formed by averaging the subindexes of orders to stop and to do. The subindex of orders to stop equals one if the Accountant may be ordered to refrain from a broad range of actions; equals one half if the Accountant may only be ordered to desist from limited actions; and equals zero otherwise. The subindex of orders to do equals one if the Accountant may be ordered to perform a broad range of actions to rectify the violation; equals one half if the Accountant may only be ordered to perform limited actions; and equals zero otherwise.

• *Criminal index (Criminal)* The arithmetic mean of the following three indices:

- *Criminal director/officer* An index of criminal sanctions applicable to the Issuer's directors and key officers when the prospectus omits material information. The subindex for directors/key officers equals zero when directors cannot be held criminally liable when the prospectus is misleading. Equals one half if directors/key officers can be held criminally liable when aware that the prospectus is misleading. Equals one if directors/key officers can also be held criminally liable when negligently unaware that the prospectus is misleading.

– *Criminal distributor* An index of criminal sanctions applicable to the distributor when the prospectus omits material information. Equals zero if the distributor cannot be held criminally liable when the prospectus is misleading. Equals one half if the distributor can be held criminally liable when aware that the prospectus is misleading. Equals one if the distributor can also be held criminally liable when negligently unaware that the prospectus is misleading.

– *Criminal accountant* An index of criminal sanctions applicable to the Accountant when the financial statements accompanying the prospectus omit material information. Equals zero if the Accountant cannot be held criminally liable when the financial statements accompanying the prospectus are misleading. Equals one half if the Accountant can be held criminally liable when aware that the financial statements accompanying the prospectus are misleading. Equals one if the Accountant can also be held criminally liable when negligently unaware that the financial statements accompanying the prospectus are misleading.

B.1.8 Accessibility to raise equity capital

We include two variables related to the external financing accessibility following Porta, Lopez-De-Silanes, and Shleifer (2006) and Mclean, Zhang, and Zhao (2012):

- *Access* An index ranging from 1 (strongly disagree) to 7 (strongly agree) that measures the ease with which firms issue securities.

- *Nonzero* The percentage of firm-month observations in each country that either issued or repurchased shares

B.2 Robustness Checks

B.2.1 Alternative ways of forming the trend factor

We form the trend factor using lags 1, 28, 56, 336, 364, and 560 days and present the results for the new trend factor for each country in Tables B.1, B.2, B.3, B.4.

The simple moving average trading rule in technical analysis suggests that a positive moving-average to price ratio predicts negative returns. We impose this restriction when forming the trend factor and the results are in Tables B.5, B.6, B.7, B.8.

B.2.2 Turnover rate and transaction costs

We present the average turnover rate and break-even costs for the trend factor in Table B.9.

B.2.3 Performance of trend factor under other asset pricing models

We test the trend factor under q5 model introduced by Hou, Xue, and Zhang (2015) and Hou, Mo, Xue, and Zhang (2020). The results are in Table B.10.

B.2.4 Relation between trend factor and cultural differences

Since Chui, Titman, and Wei (2010) documents the positive relation between individualism and the momentum. We cancel out the impact of individualism on momentum first, and then test whether the individualism can affect the residual of the trend factor. The results are reported in Table B.11.

The data for emerging countries might be of lower quality and the stock markets for emerging markets are often illiquid. Thus we limit our sample into developed countries and study the relation between trend factor and cultural differences. The results are in Table B.12.

B.2.5 Performance of the global trend factor

We study the performance of the global trend factor under different subsample periods. We firstly divide the sample based on the investment sentiment index (constructed by Baker and Wurgler (2006) and Baker and Wurgler (2007)). Table B.13 shows that the EW global trend factor has the highest Sharpe ratio either in high-sentiment period (0.93) or in low-sentiment period (0.6). The results are robust when we limit our sample into the developed countries (panel B) or limit the sample to the emerging markets (panel C).

Secondly, we divide the sample according to the state of market (see Cooper, Gutierrez Jr., and Hameed (2004)). We define the market state as "positive" if the cumulative return of the CRSP value-weighted index over the past 36 moths is positive and define the market state as "negative" if the cumulative return is negative. Table B.14 show that the EW global trend portfolio performs the best in the positive market state with the highest Sharpe ratio (0.86), followed by the EW momentum portfolio (0.55). Though the Sharpe ratio of the global trend factor declines to 0.40 when the market state is negative, it is still the highest among all of the EW global portfolios. The results are robust if we limit our sample to the developed countries (panel B) or emerging markets only (panel C).

We lastly divide the sample according to the degree of the market volatility. We calculate the global market volatility and define the the periods as "high volatility" if the market volatility is higher than the median and define the period as "low volatility" if the market volatility is lower than the median. Table B.15 show the results for all countries in our sample (panel A), developed countries only (panel B), and emerging countries (panel C). The EW trend factor perform better during low volatility periods with either higher monthly returns or lower stock standard deviation. For the cross-sectional comparison, the trend factor always outperforms other EW factors including the momentum factor in either "high volatility" period or "low volatility" period.

B.2.6 Cross-sectional pricing tests

We analyze the pricing ability of the global trend factor using different sorted portfolios as well:

- 5×5 portfolios sorted on size and investment;
- 5×5 portfolios sorted on size and operating profitability;
- $2 \times 4 \times 4$ portfolios sorted on size, book-to-market, and investment;
- $2 \times 4 \times 4$ portfolios sorted on size, operating profitability, and investment.

The results are robust that the global trend factor could reduce the GRS statistics compared with the CAPM, CAPM with momentum, and Fama-French 5 factor model. See Tables B.16, B.17, B.18, B.19 for details.

We also consider the equal-weighted sorted portfolios from French's website. The results are robust and similar with the results using value-weighted portfolios. See Tables B.20, B.21, B.22, B.23, B.24, B.25 for details.

Notice that we use equally-weighted global trend factor in our asset pricing tests. The results are robust when we use value-weighted global trend factor in the asset pricing tests. See Tables B.26, B.27,B.28, B.29,B.30, B.31, B.32, B.33, B.34, B.35 for details.

Table B.1: Trend factor vs. market factor

This table reports the summary statistics of the trend factor and market factor for all markets around the world, segregated by G6 markets in panel A, non G6 developed markets in panel B, and emerging markets in panel C. The sample period is reported for each country. The market factor returns are excess returns in excess of the U.S. risk-free rate. For each factor, we report sample mean in percentage, t-ratio, and Sharpe ratio.

Panel A. G6 countries

	Trend			Market		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Canada	2.52	7.12	0.50	0.46	1.84	0.10
France	1.51	6.20	0.36	0.74	2.61	0.14
Germany	1.84	7.26	0.45	0.40	1.55	0.09
Italy	0.76	3.25	0.15	0.31	1.02	0.06
Japan	1.14	4.55	0.28	0.35	1.06	0.06
UK	0.91	4.50	0.25	0.54	2.27	0.12

Panel B. Other developed countries

	Trend			Market		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Australia	1.36	4.00	0.23	0.56	1.84	0.11
Austria	0.82	2.57	0.19	0.55	1.23	0.11
Belgium	1.25	5.56	0.35	0.50	1.74	0.12
Denmark	0.97	4.90	0.29	0.78	2.70	0.18
Finland	0.54	1.66	0.11	0.21	0.44	0.03
Greece	1.05	2.12	0.13	0.19	0.32	0.02
Hongkong	0.19	0.29	0.02	0.57	1.43	0.09
Ireland	0.42	0.49	0.05	0.38	0.66	0.06
Netherlands	0.79	3.97	0.22	0.70	3.01	0.16
New Zealand	0.78	1.24	0.10	0.58	1.36	0.12
Norway	1.05	3.27	0.22	0.53	1.21	0.09
Portugal	0.63	2.23	0.14	0.06	0.16	0.01
Singapore	-0.22	-0.33	-0.02	0.24	0.53	0.04
Spain	0.44	1.73	0.12	0.53	1.53	0.10
Sweden	0.78	2.42	0.16	0.74	1.90	0.13
Switzerland	0.96	6.16	0.29	0.67	2.78	0.16

Panel C. Emerging markets

	Trend			Market		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Brazil	0.85	3.21	0.21	1.17	1.72	0.13
Chile	0.72	1.54	0.12	1.21	2.42	0.21
China	0.66	1.80	0.10	1.01	1.50	0.13
India	1.70	3.69	0.25	0.79	1.38	0.09
Israel	1.51	4.84	0.25	0.26	0.57	0.04
Korea	0.43	0.91	0.06	0.65	1.10	0.06
Malaysia	0.52	1.11	0.07	0.58	1.11	0.07
Mexico	0.67	2.52	0.14	0.81	1.81	0.14
Pakistan	0.87	1.47	0.09	0.87	1.33	0.11
Peru	-0.44	-0.83	-0.07	1.45	2.82	0.25
Philippines	1.92	2.17	0.14	0.16	0.27	0.02
Poland	1.30	3.53	0.26	0.98	1.49	0.12
Russia	0.54	1.06	0.11	0.31	0.39	0.05
South Africa	1.41	4.23	0.30	0.47	1.16	0.07
Sri Lanka	3.86	5.13	0.45	0.61	0.82	0.09
Taiwan	0.31	0.95	0.05	0.34	0.69	0.05
Thailand	1.00	2.49	0.13	0.58	0.99	0.06
Turkey	0.37	0.89	0.06	1.42	1.76	0.11

Table B.2: Trend factor comparison with other time-length factors

This table compares the trend factors with other three well-known stock price trends: the short-term reversal (SREV), momentum factor (MOM) and long-term reversal (LREV) for all of the markets in our sample, segregated by G6 markets in panel A, non-G6 developed markets in panel B, and emerging markets in panel C. The sample period is reported for each country. For each factor, we report sample mean in percentage, *t*-ratio, and Sharpe ratio.

Panel A. G6 countries

	Trend			SREV			MOM			LREV		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Canada	2.52	7.12	0.50	0.96	3.62	0.21	1.27	4.66	0.29	0.02	0.08	0.00
France	1.51	6.20	0.36	0.71	4.01	0.20	1.21	6.22	0.33	-0.44	-3.32	-0.15
Germany	1.84	7.26	0.45	0.38	2.21	0.09	1.66	6.06	0.37	-0.80	-4.97	-0.28
Italy	0.76	3.25	0.15	0.07	0.36	0.02	0.98	3.66	0.21	-0.47	-2.25	-0.14
Japan	1.14	4.55	0.28	1.12	6.17	0.29	0.39	1.71	0.09	0.12	0.73	0.04
UK	0.91	4.50	0.25	-0.58	-3.67	-0.21	1.13	5.69	0.36	-0.52	-3.18	-0.18

Panel B. Other developed countries

	Trend			SREV			MOM			LREV		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Australia	1.36	4.00	0.23	0.30	1.01	0.06	1.64	4.65	0.26	-0.25	-0.52	-0.03
Austria	0.82	2.57	0.19	-0.21	-0.89	-0.06	1.31	4.19	0.35	-0.15	-0.60	-0.05
Belgium	1.25	5.56	0.35	0.37	2.03	0.12	1.27	5.15	0.34	-0.53	-3.32	-0.18
Denmark	0.97	4.90	0.29	-0.07	-0.30	-0.02	1.30	5.43	0.35	0.25	0.98	0.08
Finland	0.54	1.66	0.11	-0.09	-0.37	-0.02	1.09	3.32	0.24	-0.27	-0.76	-0.06
Greece	1.05	2.12	0.13	0.47	1.27	0.08	0.68	1.48	0.09	0.48	0.77	0.06
Hongkong	0.19	0.29	0.02	-1.66	-2.96	-0.18	1.06	2.12	0.12	0.20	0.28	0.02
Ireland	0.42	0.49	0.05	-0.30	-0.47	-0.04	0.66	0.91	0.08	-0.88	-1.52	-0.14
Netherlands	0.79	3.97	0.22	-0.12	-0.79	-0.04	1.26	5.60	0.31	-0.38	-1.99	-0.11
New Zealand	0.78	1.24	0.10	-0.38	-0.80	-0.06	1.04	2.00	0.18	0.10	0.19	0.01
Norway	1.05	3.27	0.22	-0.22	-0.83	-0.05	1.04	3.37	0.25	-0.31	-1.49	-0.09
Portugal	0.63	2.23	0.14	-0.70	-2.57	-0.19	0.55	2.10	0.15	-0.06	-0.24	-0.02
Singapore	-0.22	-0.33	-0.02	-0.30	-0.51	-0.03	0.69	1.26	0.08	0.71	1.07	0.08
Spain	0.44	1.73	0.12	-0.28	-1.51	-0.08	1.10	4.64	0.28	-0.42	-1.77	-0.11
Sweden	0.78	2.42	0.16	-0.01	-0.04	-0.00	1.37	4.69	0.30	-0.69	-2.48	-0.17
Switzerland	0.96	6.16	0.29	0.03	0.18	0.01	1.25	5.70	0.35	-0.22	-0.96	-0.06

Panel C. Emerging markets

	Trend			SREV			MOM			LREV		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Brazil	0.85	3.21	0.21	0.17	0.70	0.05	0.89	3.15	0.24	-0.36	-1.21	-0.09
Chile	0.72	1.54	0.12	0.13	0.20	0.02	0.75	1.43	0.09	-0.13	-0.24	-0.02
China	0.66	1.80	0.10	1.11	3.84	0.27	-0.01	-0.02	-0.00	0.48	0.91	0.07
India	1.70	3.69	0.25	-0.27	-0.82	-0.05	1.10	2.77	0.17	0.21	0.62	0.04
Israel	1.51	4.84	0.25	1.08	4.06	0.21	1.16	4.05	0.23	-0.74	-2.47	-0.16
Korea	0.43	0.91	0.06	3.92	6.61	0.31	-0.10	-0.15	-0.01	-0.21	-0.31	-0.02
Malaysia	0.52	1.11	0.07	-0.57	-1.32	-0.08	0.63	1.41	0.08	0.45	0.95	0.05
Mexico	0.67	2.52	0.14	0.06	0.21	0.01	0.03	0.11	0.01	-0.16	-0.46	-0.03
Pakistan	0.87	1.47	0.09	1.02	1.56	0.09	0.86	1.42	0.09	0.75	1.26	0.09
Peru	-0.44	-0.83	-0.07	-0.91	-1.76	-0.11	1.04	1.23	0.10	0.69	0.64	0.06
Philippines	1.92	2.17	0.14	0.80	0.91	0.07	0.19	0.24	0.01	0.16	0.20	0.01
Poland	1.30	3.53	0.26	-0.53	-1.65	-0.12	1.52	3.17	0.27	-0.10	-0.23	-0.02
Russia	0.54	1.06	0.11	-0.83	-1.09	-0.13	1.65	1.87	0.25	-0.64	-0.54	-0.09
South Africa	1.41	4.23	0.30	0.11	0.46	0.03	1.54	5.55	0.35	-0.19	-0.76	-0.05
Sri Lanka	3.86	5.13	0.45	1.05	1.44	0.11	0.74	0.92	0.07	1.06	1.02	0.11
Taiwan	0.31	0.95	0.05	-0.30	-1.29	-0.06	0.88	2.88	0.17	-0.52	-1.10	-0.06
Thailand	1.00	2.49	0.13	-0.64	-1.34	-0.07	0.33	0.80	0.04	0.31	0.63	0.04
Turkey	0.37	0.89	0.06	0.00	0.01	0.00	0.07	0.17	0.01	-0.34	-0.78	-0.05

Table B.3: Regression of trend factor on other single trend factors

This table reports the time-series regression for countries' trend factor on its market factor (MKT), short-term reversal (SREV), momentum factor (MOM) and long-term reversal (LREV). Newey and West (1994) robust t-statistics are in parentheses. The results for G6, non-G6 developed, and emerging markets are presented in panel A, B, and C, respectively.

Panel A. G6 countries

Country	α	MKT	SREV	MOM	LREV
Canada	0.02	-0.14	0.21	0.36	0.15
	(5.58)	(-2.55)	(2.27)	(3.94)	(2.19)
France	0.01	0.00	0.08	0.65	0.05
	(2.82)	(0.02)	(0.55)	(4.90)	(0.54)
Germany	0.01	-0.09	0.06	0.56	0.05
	(4.59)	(-1.18)	(0.73)	(6.71)	(0.57)
Italy	0.00	0.06	-0.10	0.43	-0.01
	(1.39)	(0.69)	(-1.14)	(3.58)	(-0.06)
Japan	0.01	0.04	0.34	0.42	-0.03
	(2.50)	(0.95)	(3.75)	(3.52)	(-0.24)
UK	0.00	0.03	-0.17	0.62	0.18
	(1.07)	(0.83)	(-1.47)	(5.79)	(2.34)

Panel B. Other developed countries

Country	α	MKT	SREV	MOM	LREV
Australia	0.01	-0.01	-0.02	0.03	0.01
	(3.35)	(-0.19)	(-0.16)	(0.28)	(0.19)
Austria	0.00	-0.01	0.04	0.57	-0.05
	(0.20)	(-0.15)	(0.45)	(4.06)	(-0.45)
Belgium	0.01	-0.09	0.10	0.55	-0.05
	(2.63)	(-2.00)	(1.22)	(8.65)	(-0.72)
Denmark	0.00	0.04	0.07	0.47	0.19
	(1.47)	(0.89)	(0.81)	(7.20)	(2.37)
Finland	0.00	0.08	-0.02	0.29	-0.05
	(0.44)	(1.23)	(-0.22)	(1.32)	(-0.41)
Greece	0.01	-0.04	-0.16	0.19	0.22
	(2.02)	(-0.40)	(-1.08)	(1.24)	(2.84)
Hongkong	-0.00	-0.04	-0.34	0.00	-0.02
	(-0.47)	(-0.32)	(-2.23)	(0.02)	(-0.28)
Ireland	-0.00	-0.00	-0.18	0.53	-0.03
	(-0.00)	(-0.02)	(-1.82)	(3.07)	(-0.28)
Netherlands	0.00	0.04	-0.15	0.34	-0.09
	(1.38)	(0.75)	(-1.52)	(5.41)	(-1.40)
New Zealand	0.00	0.18	-0.19	0.14	-0.07
	(0.70)	(1.44)	(-1.49)	(0.88)	(-0.72)
Norway	0.01	-0.11	-0.08	0.52	0.04
	(2.15)	(-1.87)	(-0.74)	(5.33)	(0.40)
Portugal	0.00	0.02	-0.29	0.28	-0.03
	(0.93)	(0.21)	(-3.36)	(3.05)	(-0.33)
Singapore	-0.00	-0.27	-0.04	0.16	-0.01
	(-0.47)	(-1.42)	(-0.32)	(0.88)	(-0.06)
Spain	-0.00	0.06	-0.25	0.47	0.21
	(-0.39)	(1.17)	(-2.96)	(8.57)	(3.30)
Sweden	0.00	-0.01	-0.06	0.31	-0.07
	(0.97)	(-0.13)	(-0.49)	(2.47)	(-0.55)
Switzerland	0.01	-0.07	-0.09	0.38	-0.08
	(3.14)	(-1.77)	(-0.85)	(4.67)	(-1.17)

Panel C. Emerging countries

Country	α	MKT	SREV	MOM	LREV
Brazil	0.00	-0.06	0.04	0.47	0.01
	(1.89)	(-1.74)	(0.48)	(4.18)	(0.11)
Chile	0.01	0.04	-0.21	-0.03	0.06
	(1.65)	(0.52)	(-3.54)	(-0.39)	(0.75)
China	0.00	0.29	0.38	0.11	-0.15
	(0.06)	(4.07)	(2.02)	(0.90)	(-1.35)
India	0.01	0.08	-0.32	0.30	-0.12
	(2.78)	(1.14)	(-2.19)	(2.08)	(-0.93)
Israel	0.01	0.03	-0.02	0.50	0.20
	(3.05)	(0.41)	(-0.15)	(3.28)	(2.33)
Korea	0.01	0.07	-0.08	0.09	0.08
	(1.65)	(0.98)	(-1.97)	(1.47)	(0.94)
Malaysia	0.00	-0.03	0.00	0.22	0.11
	(0.82)	(-0.23)	(0.02)	(1.37)	(1.32)
Mexico	0.01	0.02	-0.28	0.10	0.10
	(2.38)	(0.23)	(-3.88)	(1.36)	(1.35)
Pakistan	0.01	-0.18	0.22	0.01	-0.04
	(1.56)	(-1.80)	(2.04)	(0.08)	(-0.39)
Peru	-0.01	0.18	-0.18	0.03	-0.02
	(-1.92)	(1.66)	(-2.97)	(0.43)	(-0.25)
Philippines	0.02	0.25	-0.02	-0.09	0.03
	(2.09)	(1.40)	(-0.15)	(-0.58)	(0.43)
Poland	0.01	-0.04	-0.39	0.34	-0.05
	(1.97)	(-0.77)	(-4.05)	(4.82)	(-0.54)
Russia	0.00	0.16	-0.02	-0.00	-0.13
	(0.84)	(0.90)	(-0.19)	(-0.04)	(-1.49)
South Africa	0.01	0.14	-0.07	0.53	0.20
	(1.72)	(2.48)	(-0.53)	(6.82)	(2.00)
Sri Lanka	0.04	0.17	0.07	-0.11	-0.12
	(4.42)	(1.05)	(0.49)	(-0.63)	(-1.49)
Taiwan	-0.00	0.13	0.02	0.40	-0.04
	(-0.34)	(1.74)	(0.14)	(5.19)	(-0.59)

Table B.4: Regression of trend factor on Fama French 5 factors and Momentum

This table reports the time-series regression for countries' trend factor on Fama French 5 factors and momentum factor, segregated by G7 markets in panel A, non G7 developed markets in panel B, and emerging markets in panel C. Newey and West (1994) robust t-statistics are in parentheses.

Panel A: G6 countries

Countries	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{MOM}
Canada	0.02	0.09	-0.00	0.08	0.41	0.65	0.29
	(4.51)	(1.12)	(-0.02)	(0.48)	(1.68)	(3.16)	(2.56)
France	0.01	0.03	0.02	0.26	0.12	0.21	0.41
	(5.34)	(0.58)	(0.34)	(2.08)	(0.86)	(1.70)	(4.55)
Germany	0.01	-0.06	0.18	0.63	0.21	0.26	0.53
	(6.49)	(-0.84)	(1.42)	(4.47)	(0.86)	(1.37)	(6.21)
Italy	0.00	-0.09	0.34	-0.01	0.21	-0.14	0.44
	(1.27)	(-1.24)	(1.74)	(-0.04)	(0.78)	(-0.72)	(4.30)
Japan	0.01	-0.01	-0.11	-0.02	-0.39	-0.00	0.38
	(3.19)	(-0.19)	(-0.86)	(-0.14)	(-1.76)	(-0.02)	(3.55)
UK	0.01	-0.09	-0.06	-0.15	-0.45	-0.04	0.57
	(3.82)	(-1.86)	(-0.42)	(-0.81)	(-2.19)	(-0.21)	(5.33)

Panel B. Other developed countries

Countries	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{MOM}
Australia	0.01	-0.00	-0.16	0.25	0.12	0.09	0.33
	(2.28)	(-0.02)	(-0.86)	(1.08)	(0.41)	(0.26)	(2.70)
Austria	0.01	-0.05	-0.11	0.04	-0.31	0.15	0.41
	(1.69)	(-0.53)	(-0.74)	(0.17)	(-0.93)	(0.53)	(2.37)
Belgium	0.01	-0.13	-0.24	0.24	-0.21	0.14	0.36
	(4.66)	(-1.80)	(-2.24)	(1.83)	(-1.07)	(0.96)	(4.37)
Denmark	0.01	-0.09	-0.10	0.20	-0.22	0.10	0.36
	(3.47)	(-1.51)	(-0.92)	(1.89)	(-1.43)	(0.58)	(4.84)
Finland	0.00	0.03	0.05	0.40	-0.15	-0.59	0.56
	(0.35)	(0.34)	(0.22)	(1.34)	(-0.36)	(-1.45)	(2.29)
Greece	0.01	-0.16	-0.19	0.34	-0.03	-0.63	0.61
	(1.14)	(-0.95)	(-0.69)	(0.92)	(-0.05)	(-1.27)	(2.70)
Hongkong	0.00	-0.09	-0.01	-0.31	-0.99	0.29	0.24
	(0.65)	(-0.59)	(-0.03)	(-0.85)	(-1.70)	(0.51)	(1.18)
Ireland	-0.00	-0.07	-0.61	-0.69	-1.13	1.38	1.19
	(-0.01)	(-0.38)	(-1.43)	(-0.92)	(-0.98)	(1.86)	(2.48)
Netherlands	0.00	-0.07	-0.00	0.27	-0.15	-0.26	0.32
	(2.05)	(-1.26)	(-0.01)	(1.69)	(-0.74)	(-1.70)	(4.45)
New Zealand	0.01	-0.09	-0.49	-0.49	-0.21	-1.44	0.30
	(1.30)	(-0.55)	(-1.16)	(-0.98)	(-0.33)	(-2.22)	(1.21)
Norway	0.00	-0.10	0.11	0.42	0.54	0.03	0.30
	(1.35)	(-1.23)	(0.72)	(2.05)	(1.94)	(0.12)	(2.55)
Portugal	0.01	-0.07	-0.01	-0.43	-0.08	0.33	0.13
	(2.05)	(-0.80)	(-0.06)	(-1.89)	(-0.24)	(1.37)	(1.61)
Singapore	-0.00	-0.19	-0.68	0.13	-0.63	0.34	0.55
	(-0.56)	(-0.99)	(-1.62)	(0.36)	(-1.26)	(0.73)	(2.46)
Spain	0.00	-0.06	-0.09	0.19	-0.02	0.04	0.35
	(0.51)	(-0.81)	(-0.73)	(1.22)	(-0.11)	(0.23)	(4.69)
Sweden	0.01	0.08	0.06	-0.29	0.22	0.49	0.18
	(1.87)	(1.03)	(0.31)	(-1.04)	(0.70)	(1.63)	(1.07)
Switzerland	0.01	-0.13	0.05	0.09	-0.19	-0.31	0.33
	(4.89)	(-2.58)	(0.49)	(0.75)	(-1.17)	(-2.65)	(4.09)

Panel C. Emerging countries

Brazil	0.01	-0.12	0.17	-0.07	0.02	-0.28	0.43
	(2.46)	(-2.17)	(1.31)	(-0.45)	(0.09)	(-1.47)	(2.53)
Chile	0.00	0.03	0.45	0.66	0.63	0.40	0.04
	(0.07)	(0.22)	(1.82)	(1.43)	(1.31)	(0.73)	(0.29)
China	0.00	0.19	0.59	0.18	0.31	0.26	-0.11
	(0.52)	(1.66)	(1.85)	(0.63)	(0.56)	(0.56)	(-0.46)
India	0.02	-0.03	-0.30	-0.71	-0.21	0.04	0.53
	(2.78)	(-0.34)	(-0.87)	(-1.82)	(-0.50)	(0.18)	(2.29)
Israel	0.01	0.03	-0.06	-0.38	0.16	0.42	0.29
	(3.62)	(0.42)	(-0.34)	(-1.28)	(0.61)	(2.06)	(2.20)
Korea	0.01	-0.07	-0.39	-0.43	-0.66	-0.02	0.11
	(1.74)	(-0.92)	(-1.14)	(-2.20)	(-1.39)	(-0.71)	(0.81)
Malaysia	0.00	0.14	0.37	-0.49	0.11	0.01	0.43
	(0.60)	(1.51)	(2.27)	(-1.42)	(0.33)	(1.19)	(2.02)
Mexico	0.01	-0.01	-0.18	0.08	-0.08	-0.22	0.20
	(1.59)	(-0.06)	(-0.99)	(0.33)	(-0.24)	(-0.62)	(1.27)
Pakistan	0.01	0.30	0.79	-0.34	-0.48	0.50	-0.76
	(2.04)	(1.94)	(1.67)	(-0.64)	(-0.71)	(0.65)	(-2.57)
Peru	-0.01	0.16	0.59	0.22	-0.37	-0.59	0.07
	(-1.06)	(1.33)	(1.41)	(0.72)	(-0.64)	(-1.40)	(0.28)
Philippines	0.02	0.20	-0.38	0.19	0.97	-0.30	-0.62
	(1.92)	(1.11)	(-0.69)	(0.27)	(1.23)	(-0.50)	(-1.21)
Poland	0.01	-0.16	0.11	0.09	-0.43	-0.10	0.51
	(3.03)	(-1.53)	(0.49)	(0.34)	(-1.07)	(-0.28)	(3.12)
Russia	0.01	-0.01	-0.11	0.27	0.68	0.49	-0.59
	(1.07)	(-0.04)	(-0.23)	(0.45)	(0.79)	(0.57)	(-1.65)
South Africa	0.01	0.15	0.11	0.17	0.26	-0.05	0.52
	(1.99)	(2.17)	(0.64)	(1.28)	(1.13)	(-0.28)	(4.03)
Sri Lanka	0.03	0.28	0.27	0.83	0.74	0.24	0.38
	(4.10)	(1.16)	(0.86)	(1.11)	(0.66)	(0.28)	(1.30)
Taiwan	0.00	-0.00	0.20	-0.02	-0.13	-0.52	0.35
	(0.72)	(-0.02)	(0.96)	(-0.06)	(-0.45)	(-1.10)	(1.97)
Thailand	0.01	0.11	0.43	0.26	0.41	-0.32	-0.12
	(1.80)	(1.16)	(1.87)	(0.93)	(1.09)	(-0.81)	(-0.69)
Turkey	0.00	0.08	0.22	-0.30	-0.02	0.50	0.05
	(0.74)	(0.92)	(1.08)	(-1.58)	(-0.05)	(1.53)	(0.24)

Table B.5: Trend factor vs. market factor

This table reports the summary statistics of the trend factor and market factor for all markets around the world, segregated by G6 markets in panel A, non G6 developed markets in panel B, and emerging markets in panel C. The sample period is reported for each country. The market factor returns are excess returns in excess of the U.S. risk-free rate. For each factor, we report sample mean in percentage, t-ratio, and Sharpe ratio.

Panel A. G6 countries

	Trend			Market		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Canada	-1.20	-3.53	-0.23	0.42	1.68	0.09
France	-0.37	-1.87	-0.09	0.42	1.68	0.09
Germany	0.17	0.74	0.04	0.31	1.31	0.07
Italy	-0.30	-1.15	-0.06	0.31	1.01	0.06
Japan	-1.12	-4.78	-0.25	-0.03	-0.09	-0.00
UK	0.81	3.99	0.23	0.34	1.58	0.09

Panel B. Other developed countries

	Trend			Market		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Australia	-0.26	-0.68	-0.04	0.55	1.91	0.10
Austria	-0.22	-0.69	-0.06	0.55	1.56	0.11
Belgium	-0.08	-0.30	-0.02	0.50	2.01	0.12
Denmark	0.26	1.27	0.08	0.78	3.13	0.18
Finland	-0.05	-0.15	-0.01	0.21	0.46	0.03
Greece	0.42	0.76	0.05	0.19	0.39	0.02
Hongkong	1.51	2.39	0.15	0.57	1.48	0.09
Ireland	-0.13	-0.18	-0.02	0.38	0.74	0.06
Netherlands	0.14	0.64	0.03	0.53	2.20	0.12
New Zealand	0.88	1.91	0.15	0.58	1.45	0.12
Norway	-0.04	-0.15	-0.01	0.53	1.35	0.09
Portugal	0.35	1.33	0.09	0.06	0.19	0.01
Singapore	0.26	0.53	0.03	0.24	0.65	0.04
Spain	0.40	1.78	0.09	0.53	1.63	0.10
Sweden	0.46	1.66	0.09	0.74	2.16	0.13
Switzerland	0.09	0.46	0.03	0.67	2.85	0.16

Panel C. Emerging markets

	Trend			Market		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Brazil	-0.38	-1.31	-0.09	1.17	1.92	0.13
Chile	-0.62	-1.48	-0.10	1.21	2.76	0.21
China	-0.47	-1.10	-0.08	1.01	1.77	0.13
India	0.70	1.61	0.10	0.79	1.57	0.09
Israel	-0.31	-0.95	-0.05	0.26	0.65	0.04
Korea	0.06	0.12	0.01	0.65	1.14	0.06
Malaysia	-0.22	-0.40	-0.02	0.58	1.27	0.07
Mexico	0.05	0.13	0.01	0.81	2.06	0.14
Pakistan	-0.60	-0.91	-0.07	0.87	1.65	0.11
Peru	0.25	0.38	0.03	1.45	3.41	0.25
Philippines	-2.08	-3.32	-0.19	0.16	0.35	0.02
Poland	1.06	2.44	0.20	0.98	1.67	0.12
Russia	-0.78	-1.07	-0.15	0.31	0.41	0.05
South Africa	0.47	1.76	0.10	0.47	1.14	0.07
Sri Lanka	-0.91	-1.31	-0.12	0.61	1.02	0.09
Taiwan	0.51	1.33	0.08	0.34	0.76	0.05
Thailand	0.33	0.77	0.04	0.58	1.11	0.06
Turkey	0.20	0.53	0.03	1.42	1.69	0.11

Table B.6: Trend factor comparison with other time-length factors

This table compares the trend factors with other three well-known stock price trends: the short-term reversal (SREV), momentum factor (MOM) and long-term reversal (LREV) for all of the markets in our sample, segregated by G6 markets in panel A, non-G6 developed markets in panel B, and emerging markets in panel C. The sample period is reported for each country. For each factor, we report sample mean in percentage, *t*-ratio, and Sharpe ratio.

Panel A. G6 countries

	Trend			SREV			MOM			LREV		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Canada	-1.20	-3.53	-0.23	0.84	3.36	0.18	1.16	4.91	0.27	0.02	0.09	0.00
France	-0.37	-1.87	-0.09	0.71	4.00	0.22	1.29	7.32	0.40	-0.44	-2.93	-0.15
Germany	0.17	0.74	0.04	0.32	1.37	0.07	1.92	7.81	0.43	-0.80	-5.62	-0.28
Italy	-0.30	-1.15	-0.06	0.07	0.34	0.02	0.98	3.72	0.21	-0.47	-2.49	-0.14
Japan	-1.12	-4.78	-0.25	1.16	5.56	0.30	0.43	2.01	0.11	0.12	0.78	0.04
UK	0.81	3.99	0.23	-0.63	-4.19	-0.23	1.27	7.32	0.40	-0.52	-3.59	-0.18

Panel B. Other developed countries

	Trend			SREV			MOM			LREV		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Australia	-0.26	-0.68	-0.04	0.15	0.53	0.03	1.71	5.41	0.30	-0.25	-0.57	-0.03
Austria	-0.22	-0.69	-0.06	-0.21	-0.86	-0.06	1.31	5.21	0.35	-0.15	-0.69	-0.05
Belgium	-0.08	-0.30	-0.02	0.37	2.01	0.12	1.27	5.81	0.34	-0.53	-3.10	-0.18
Denmark	0.26	1.27	0.08	-0.07	-0.35	-0.02	1.30	6.02	0.35	0.25	1.30	0.08
Finland	-0.05	-0.15	-0.01	-0.09	-0.34	-0.02	1.09	3.47	0.24	-0.27	-0.91	-0.06
Greece	0.42	0.76	0.05	0.47	1.35	0.08	0.68	1.43	0.09	0.48	0.90	0.06
Hongkong	1.51	2.39	0.15	-1.66	-2.96	-0.18	1.06	2.07	0.12	0.20	0.26	0.02
Ireland	-0.13	-0.18	-0.02	-0.30	-0.49	-0.04	0.66	1.08	0.08	-0.88	-1.74	-0.14
Netherlands	0.14	0.64	0.03	-0.08	-0.42	-0.02	1.15	5.27	0.29	-0.38	-2.15	-0.11
New Zealand	0.88	1.91	0.15	-0.38	-0.81	-0.06	1.04	2.28	0.18	0.10	0.19	0.01
Norway	-0.04	-0.15	-0.01	-0.22	-0.86	-0.05	1.04	3.88	0.25	-0.31	-1.35	-0.09
Portugal	0.35	1.33	0.09	-0.70	-2.89	-0.19	0.55	2.22	0.15	-0.06	-0.26	-0.02
Singapore	0.26	0.53	0.03	-0.30	-0.57	-0.03	0.69	1.35	0.08	0.71	1.31	0.08
Spain	0.40	1.78	0.09	-0.28	-1.38	-0.08	1.10	4.64	0.28	-0.42	-1.87	-0.11
Sweden	0.46	1.66	0.09	-0.01	-0.04	-0.00	1.37	5.04	0.30	-0.69	-2.83	-0.17
Switzerland	0.09	0.46	0.03	0.03	0.20	0.01	1.25	6.26	0.35	-0.22	-1.14	-0.06

Panel C. Emerging markets

	Trend			SREV			MOM			LREV		
Country	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio	Mean	T-ratio	Sharpe ratio
Brazil	-0.38	-1.31	-0.09	0.17	0.76	0.05	0.89	3.53	0.24	-0.36	-1.37	-0.09
Chile	-0.62	-1.48	-0.10	0.13	0.21	0.02	0.75	1.14	0.09	-0.13	-0.24	-0.02
China	-0.47	-1.10	-0.08	1.11	3.63	0.27	-0.01	-0.02	-0.00	0.48	0.95	0.07
India	0.70	1.61	0.10	-0.27	-0.84	-0.05	1.10	2.86	0.17	0.21	0.68	0.04
Israel	-0.31	-0.95	-0.05	1.08	3.69	0.21	1.16	3.97	0.23	-0.74	-2.77	-0.16
Korea	0.06	0.12	0.01	3.92	5.35	0.31	-0.10	-0.15	-0.01	-0.21	-0.31	-0.02
Malaysia	-0.22	-0.40	-0.02	-0.53	-1.33	-0.08	0.60	1.32	0.07	0.48	0.93	0.05
Mexico	0.05	0.13	0.01	0.06	0.20	0.01	0.03	0.11	0.01	-0.16	-0.47	-0.03
Pakistan	-0.60	-0.91	-0.07	1.02	1.34	0.09	0.86	1.25	0.09	0.75	1.24	0.09
Peru	0.25	0.38	0.03	-0.91	-1.55	-0.11	1.04	1.41	0.10	0.69	0.78	0.06
Philippines	-2.08	-3.32	-0.19	0.80	1.02	0.07	0.19	0.22	0.01	0.16	0.19	0.01
Poland	1.06	2.44	0.20	-0.53	-1.61	-0.12	1.52	3.69	0.27	-0.10	-0.28	-0.02
Russia	-0.78	-1.07	-0.15	-0.83	-1.02	-0.13	1.65	1.89	0.25	-0.64	-0.70	-0.09
South Africa	0.47	1.76	0.10	0.11	0.47	0.03	1.54	5.84	0.35	-0.19	-0.79	-0.05
Sri Lanka	-0.91	-1.31	-0.12	1.05	1.31	0.11	0.74	0.81	0.07	1.06	1.21	0.11
Taiwan	0.51	1.33	0.08	-0.30	-1.08	-0.06	0.88	2.80	0.17	-0.52	-1.04	-0.06
Thailand	0.33	0.77	0.04	-0.64	-1.26	-0.07	0.33	0.73	0.04	0.31	0.62	0.04
Turkey	0.20	0.53	0.03	0.00	0.01	0.00	0.07	0.18	0.01	-0.34	-0.75	-0.05

Table B.7: Regression of trend factor on other single trend factors

This table reports the time-series regression for countries' trend factor on its market factor (MKT), short-term reversal (SREV), momentum factor (MOM) and long-term reversal (LREV). Newey and West (1994) robust t-statistics are in parentheses. The results for G6, non-G6 developed, and emerging markets are presented in panel A, B, and C, respectively.

Panel A. G6 countries

Country	α	MKT	SREV	MOM	LREV
Canada	-0.01	-0.16	-0.63	0.30	-0.05
	(-3.38)	(-3.02)	(-7.01)	(4.54)	(-0.67)
France	-0.01	-0.07	-0.59	0.51	-0.05
	(-3.33)	(-1.85)	(-8.25)	(8.07)	(-0.82)
Germany	-0.00	-0.13	-0.48	0.41	0.07
	(-1.15)	(-3.49)	(-7.72)	(8.42)	(1.12)
Italy	-0.01	-0.11	-0.58	0.41	0.05
	(-2.26)	(-2.16)	(-6.86)	(4.69)	(0.68)
Japan	-0.00	-0.10	-0.68	0.37	-0.10
	(-2.99)	(-3.47)	(-16.51)	(8.14)	(-1.47)
UK	0.00	-0.06	-0.67	0.42	0.08
	(0.25)	(-1.85)	(-7.60)	(5.37)	(1.12)

Panel B. Other developed countries

Country	α	MKT	SREV	MOM	LREV
Australia	-0.01	-0.27	-0.37	0.39	-0.02
	(-2.09)	(-4.06)	(-4.87)	(7.33)	(-0.36)
Austria	-0.01	-0.06	-0.15	0.41	0.07
	(-2.63)	(-1.18)	(-1.99)	(4.13)	(0.73)
Belgium	-0.01	-0.13	-0.41	0.44	-0.16
	(-2.62)	(-2.77)	(-6.33)	(7.55)	(-2.47)
Denmark	-0.00	-0.05	-0.52	0.35	0.03
	(-1.11)	(-1.46)	(-7.91)	(4.72)	(0.71)
Finland	-0.00	-0.05	-0.46	0.38	0.01
	(-1.80)	(-1.42)	(-6.66)	(3.76)	(0.09)
Greece	0.01	-0.15	-0.77	0.20	0.20
	(1.41)	(-1.86)	(-6.37)	(1.54)	(2.33)
Hongkong	0.00	-0.19	-0.54	0.22	-0.05
	(1.03)	(-1.54)	(-8.47)	(3.53)	(-1.21)
Ireland	-0.00	-0.24	-0.35	0.20	-0.15
	(-0.73)	(-2.56)	(-4.30)	(1.56)	(-1.56)
Netherlands	-0.00	-0.10	-0.56	0.48	0.06
	(-2.23)	(-1.99)	(-7.92)	(7.84)	(0.95)
New Zealand	0.01	-0.07	-0.41	0.17	0.01
	(1.40)	(-0.91)	(-5.05)	(2.21)	(0.25)
Norway	-0.00	-0.00	-0.57	0.32	0.16
	(-1.84)	(-0.04)	(-6.85)	(4.50)	(1.43)
Portugal	0.00	-0.04	-0.32	0.13	-0.07
	(0.22)	(-0.75)	(-4.45)	(1.93)	(-1.14)
Singapore	0.00	-0.39	-0.19	0.16	0.04
	(0.34)	(-3.47)	(-2.97)	(2.13)	(0.73)
Spain	-0.00	-0.13	-0.45	0.41	-0.00
	(-0.54)	(-2.18)	(-5.76)	(5.66)	(-0.04)
Sweden	0.00	-0.12	-0.62	0.31	0.00
	(0.55)	(-2.56)	(-9.50)	(5.05)	(0.01)
Switzerland	-0.00	-0.03	-0.61	0.41	0.06
	(-2.82)	(-0.75)	(-9.27)	(7.66)	(1.55)

Panel C. Emerging countries

Country	α	MKT	SREV	MOM	LREV
Brazil	-0.00	-0.10	-0.51	0.24	-0.10
	(-1.76)	(-2.76)	(-5.27)	(2.30)	(-1.18)
Chile	-0.01	0.10	-0.15	0.05	-0.06
	(-1.85)	(1.23)	(-2.61)	(0.61)	(-0.91)
China	0.00	-0.20	-0.66	0.07	-0.01
	(1.20)	(-2.36)	(-6.59)	(0.61)	(-0.14)
India	0.00	-0.05	-0.65	0.30	0.14
	(0.72)	(-0.97)	(-5.50)	(3.35)	(2.01)
Israel	-0.00	-0.18	-0.51	0.41	0.12
	(-0.43)	(-3.69)	(-6.23)	(5.32)	(1.98)
Korea	0.00	-0.00	-0.07	-0.04	-0.08
	(0.55)	(-0.01)	(-1.09)	(-0.51)	(-0.96)
Malaysia	-0.01	-0.35	-0.31	0.56	0.04
	(-1.12)	(-2.56)	(-2.40)	(3.46)	(0.39)
Mexico	0.00	-0.20	-0.40	0.26	0.09
	(0.86)	(-2.66)	(-4.13)	(3.11)	(1.39)
Pakistan	-0.00	-0.12	-0.22	-0.03	-0.03
	(-0.35)	(-1.18)	(-2.87)	(-0.28)	(-0.32)
Peru	0.00	-0.21	-0.19	0.40	-0.11
	(0.06)	(-1.51)	(-1.79)	(3.00)	(-1.22)
Philippines	-0.02	-0.25	-0.07	0.01	-0.07
	(-2.90)	(-2.36)	(-1.03)	(0.13)	(-1.16)
Poland	0.00	-0.02	-0.50	0.32	0.11
	(0.93)	(-0.49)	(-4.33)	(3.35)	(1.54)
Russia	-0.01	0.01	-0.19	-0.03	-0.07
	(-1.24)	(0.07)	(-1.59)	(-0.32)	(-0.56)
South Africa	-0.00	-0.06	-0.48	0.38	0.17
	(-0.04)	(-1.60)	(-5.94)	(6.53)	(2.54)
Sri Lanka	-0.00	-0.14	-0.24	-0.12	-0.06
	(-0.58)	(-0.92)	(-1.52)	(-1.29)	(-0.63)
Taiwan	0.00	-0.16	-0.62	0.42	0.10
	(0.19)	(-2.00)	(-4.89)	(3.77)	(1.06)

Table B.8: Regression of trend factor on Fama French 5 factors and Momentum

This table reports the time-series regression for countries' trend factor on Fama French 5 factors and momentum factor, segregated by G7 markets in panel A, non G7 developed markets in panel B, and emerging markets in panel C. Newey and West (1994) robust t-statistics are in parentheses.

Panel A: G6 countries

Countries	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{MOM}
Canada	-0.02	-0.10	-0.52	0.15	0.40	0.40	0.45
	(-4.55)	(-1.36)	(-3.13)	(0.54)	(1.48)	(1.80)	(4.21)
France	-0.01	-0.14	-0.12	0.17	0.14	0.08	0.46
	(-4.08)	(-2.93)	(-1.03)	(1.07)	(0.65)	(0.58)	(6.53)
Germany	-0.00	-0.13	-0.05	0.48	0.42	0.30	0.54
	(-1.81)	(-2.25)	(-0.29)	(1.87)	(1.53)	(1.51)	(4.97)
Italy	-0.01	-0.07	0.14	-0.26	0.41	0.66	0.52
	(-2.53)	(-0.88)	(0.86)	(-1.52)	(1.72)	(2.99)	(6.29)
Japan	-0.01	-0.29	-0.47	0.24	0.00	-0.28	0.42
	(-4.43)	(-4.50)	(-3.44)	(1.41)	(0.02)	(-1.09)	(4.09)
UK	0.01	-0.12	-0.22	-0.04	0.03	0.05	0.50
	(3.11)	(-2.84)	(-1.75)	(-0.25)	(0.18)	(0.26)	(5.32)

Panel B. Other developed countries

Countries	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{MOM}
Australia	-0.01	-0.22	-0.05	0.09	0.28	0.37	0.42
	(-1.69)	(-2.12)	(-0.26)	(0.32)	(0.82)	(1.29)	(4.70)
Austria	-0.00	-0.05	-0.01	-0.17	-0.10	0.44	0.33
	(-1.51)	(-0.78)	(-0.08)	(-0.92)	(-0.35)	(1.27)	(3.43)
Belgium	-0.00	-0.16	-0.20	0.02	0.24	0.27	0.35
	(-1.52)	(-2.81)	(-1.43)	(0.16)	(1.04)	(1.50)	(4.10)
Denmark	-0.00	-0.08	-0.26	0.15	-0.06	0.17	0.38
	(-0.04)	(-1.61)	(-2.39)	(1.14)	(-0.35)	(0.84)	(5.58)
Finland	-0.00	-0.06	-0.10	-0.13	-0.01	0.39	0.47
	(-1.26)	(-0.83)	(-0.69)	(-0.57)	(-0.05)	(1.25)	(3.04)
Greece	-0.00	-0.35	0.07	0.11	0.97	-0.10	0.34
	(-0.13)	(-2.75)	(0.26)	(0.27)	(2.31)	(-0.22)	(1.39)
Hongkong	0.01	-0.54	-0.29	-0.15	0.46	0.28	0.38
	(2.39)	(-3.87)	(-0.92)	(-0.33)	(0.96)	(0.60)	(1.94)
Ireland	-0.00	-0.36	-0.43	-0.75	-0.88	0.33	0.74
	(-0.03)	(-1.80)	(-1.06)	(-1.19)	(-0.87)	(0.43)	(1.81)
Netherlands	-0.00	-0.17	-0.07	0.24	0.04	-0.15	0.57
	(-0.61)	(-3.23)	(-0.37)	(1.26)	(0.16)	(-0.84)	(6.64)
New Zealand	0.01	0.08	-0.45	-0.28	0.34	0.01	0.29
	(1.46)	(0.48)	(-1.29)	(-0.57)	(0.53)	(0.03)	(2.51)
Norway	-0.01	-0.10	0.17	0.40	0.55	-0.26	0.28
	(-1.54)	(-1.03)	(1.09)	(1.64)	(1.74)	(-1.08)	(2.43)
Portugal	0.00	-0.12	-0.18	0.01	0.11	0.01	0.04
	(1.39)	(-1.55)	(-1.41)	(0.07)	(0.52)	(0.07)	(0.65)
Singapore	0.00	-0.39	-0.34	0.08	-0.27	0.08	0.62
	(0.07)	(-2.33)	(-1.46)	(0.25)	(-0.67)	(0.17)	(3.34)
Spain	-0.00	-0.12	-0.05	0.07	0.66	0.25	0.29
	(-0.31)	(-2.00)	(-0.34)	(0.39)	(2.91)	(1.34)	(3.43)
Sweden	-0.00	-0.00	-0.03	0.62	0.74	0.10	0.49
	(-1.13)	(-0.01)	(-0.17)	(2.42)	(2.16)	(0.40)	(4.70)
Switzerland	-0.00	-0.06	-0.12	0.00	0.13	0.32	0.44
	(-1.59)	(-1.26)	(-1.09)	(0.02)	(0.95)	(2.06)	(5.94)

Panel C. Emerging countries

Brazil	-0.00	-0.20	0.14	-0.06	-0.31	-0.07	0.40
	(-1.14)	(-3.09)	(0.65)	(-0.44)	(-1.37)	(-0.28)	(3.35)
Chile	-0.01	0.14	0.11	-0.27	0.39	0.94	-0.31
	(-1.39)	(1.18)	(0.42)	(-0.68)	(0.74)	(1.89)	(-2.11)
China	-0.01	-0.25	-0.27	0.30	0.34	-0.17	0.40
	(-1.30)	(-2.42)	(-1.16)	(0.98)	(0.84)	(-0.46)	(1.98)
India	0.01	-0.14	-0.45	-0.59	-0.13	0.41	0.63
	(0.94)	(-1.75)	(-1.18)	(-1.64)	(-0.37)	(1.27)	(3.35)
Israel	-0.00	-0.26	-0.03	0.08	-0.24	0.14	0.33
	(-1.20)	(-4.01)	(-0.22)	(0.48)	(-1.01)	(0.70)	(2.88)
Korea	-0.00	0.10	0.34	0.04	0.57	-0.05	0.33
	(-0.82)	(0.88)	(1.15)	(0.13)	(1.09)	(-2.89)	(1.34)
Malaysia	-0.01	-0.10	0.10	0.52	0.30	0.01	0.83
	(-1.78)	(-0.85)	(0.53)	(1.54)	(0.81)	(0.56)	(3.07)
Mexico	0.00	-0.19	-0.14	-0.33	0.02	0.21	0.39
	(0.24)	(-2.39)	(-0.63)	(-1.15)	(0.06)	(0.86)	(2.73)
Pakistan	0.00	0.07	-0.21	-1.21	-1.08	0.43	0.09
	(0.45)	(0.49)	(-0.49)	(-2.95)	(-1.80)	(0.70)	(0.34)
Peru	-0.00	0.07	0.11	-0.40	-0.92	1.38	0.35
	(-0.01)	(0.48)	(0.30)	(-0.93)	(-1.42)	(2.29)	(1.50)
Philippines	-0.01	-0.33	-0.30	-0.66	-1.07	-0.10	-0.15
	(-1.40)	(-2.40)	(-0.74)	(-1.42)	(-1.47)	(-0.20)	(-0.51)
Poland	0.00	-0.13	-0.07	0.53	0.28	-0.02	0.54
	(1.06)	(-1.24)	(-0.34)	(1.72)	(0.54)	(-0.07)	(3.35)
Russia	-0.01	-0.09	0.93	0.69	0.66	0.21	0.12
	(-1.12)	(-0.48)	(2.49)	(0.84)	(0.65)	(0.21)	(0.28)
South Africa	0.00	-0.06	0.12	0.20	0.07	-0.20	0.47
	(0.23)	(-1.40)	(0.80)	(1.29)	(0.29)	(-0.88)	(4.14)
Sri Lanka	-0.02	-0.01	-0.14	-0.12	2.11	0.32	-0.26
	(-1.97)	(-0.02)	(-0.40)	(-0.18)	(2.01)	(0.38)	(-1.22)
Taiwan	0.01	-0.21	-0.01	-0.02	-0.05	-0.45	0.35
	(0.90)	(-2.80)	(-0.08)	(-0.12)	(-0.18)	(-1.34)	(1.43)
Thailand	0.00	-0.07	0.06	-0.06	-0.26	0.26	0.19
	(0.49)	(-0.69)	(0.26)	(-0.18)	(-0.46)	(0.73)	(1.10)
Turkey	-0.00	-0.11	0.01	0.01	0.18	0.45	0.42
	(-0.42)	(-1.44)	(0.03)	(0.04)	(0.50)	(1.35)	(2.12)

Table B.9: Turnover rates and break-even costs

This table reports the average turnover rates and break-even transaction costs (BETCs) for trend factor and momentum. The results for G6, non-G6 developed, and emerging markets are presented in panel A, B, and C, respectively.

Panel A. G6 countries

	Average turnover(%)		BETCs(%)	
Country	Trend	Momentum	Trend	Momentum
Canada	247.49	128.91	1.73	0.90
France	235.36	129.74	0.70	1.00
Germany	244.08	131.42	0.88	1.46
Italy	241.81	132.50	0.48	0.74
Japan	248.92	133.86	0.56	0.32
UK	227.81	128.13	0.44	0.99

Panel B. Other developed countries

	Average turnover(%)		BETCs(%)	
Country	Trend	Momentum	Trend	Momentum
Australia	248.27	130.41	0.94	1.31
Austria	235.07	128.63	0.46	1.02
Belgium	237.06	130.35	0.54	0.97
Denmark	230.03	128.53	0.48	1.01
Finland	231.23	131.53	0.54	0.83
Greece	242.02	132.35	0.55	0.52
Hongkong	258.26	136.89	0.41	0.77
Ireland	245.73	137.24	0.19	0.48
Netherlands	228.69	129.41	0.41	0.89
New Zealand	240.34	136.02	0.10	0.76
Norway	235.29	129.34	0.38	0.81
Portugal	228.68	129.45	0.42	0.42
Singapore	247.48	138.20	0.50	0.50
Spain	226.06	130.99	0.22	0.84
Sweden	234.40	130.44	0.55	1.05
Switzerland	236.09	129.69	0.55	0.97

Panel C. Emerging markets

	Average turnover(%)		BETCs(%)	
Country	Trend	Momentum	Trend	Momentum
Brazil	237.69	130.24	0.53	0.69
Chile	245.41	141.71	-0.13	0.53
China	248.20	137.17	0.21	-0.01
India	242.50	131.87	0.57	0.83
Israel	249.89	131.91	0.76	0.88
Korea	262.46	138.42	-0.09	-0.08
Malaysia	238.26	131.93	0.06	0.46
Mexico	237.74	134.55	0.21	0.03
Pakistan	253.32	134.93	0.48	0.64
Peru	247.75	130.04	-0.49	0.80
Philippines	252.25	137.44	0.22	0.14
Poland	241.70	130.92	0.62	1.16
Russia	238.87	142.03	-0.06	1.16
South Africa	7407.28	11898.93	0.02	0.01
Sri Lanka	256.99	137.83	1.59	0.54
Taiwan	245.05	135.07	-0.03	0.65
Thailand	245.56	134.64	0.30	0.24
Turkey	251.17	136.51	0.19	0.05

Table B.10: Regression of trend factor on q5 factors

This table reports the time-series regression for countries' trend factor on q5 factors, segregated by G7 markets in panel A, other developed markets in panel B, and emerging markets in panel C. Newey and West (1994) robust t-statistics are in parentheses.

Panel A: G6 countries

Countries	α	β_{MKT}	β_{ME}	β_{IA}	β_{ROE}	β_{EG}
Canada	0.03	0.00	0.00	-0.00	0.00	0.00
	(8.89)	(2.01)	(0.58)	(-0.72)	(1.61)	(1.40)
France	0.01	-0.00	0.00	0.00	0.00	0.00
	(5.39)	(-0.01)	(0.23)	(0.36)	(2.51)	(0.94)
Germany	0.02	-0.00	0.00	0.00	0.00	0.00
	(5.40)	(-0.66)	(1.63)	(2.62)	(3.28)	(0.30)
Italy	0.01	-0.00	0.00	-0.00	0.00	-0.00
	(4.64)	(-2.23)	(1.54)	(-0.96)	(1.49)	(-0.54)
Japan	0.01	0.00	0.00	0.00	0.00	0.00
	(5.76)	(0.81)	(0.22)	(0.19)	(0.64)	(0.10)
UK	0.01	-0.00	0.00	-0.00	0.00	0.00
	(4.70)	(-1.60)	(1.20)	(-2.80)	(0.95)	(0.76)

Panel B. Other developed countries

Countries	α	β_{MKT}	β_{ME}	β_{IA}	β_{ROE}	β_{EG}
Australia	0.02	0.00	-0.00	-0.00	0.00	-0.00
	(6.42)	(0.69)	(-0.94)	(-0.81)	(0.77)	(-0.11)
Austria	0.01	-0.00	0.00	-0.00	0.00	-0.00
	(3.41)	(-1.53)	(0.45)	(-0.10)	(0.30)	(-0.08)
Belgium	0.01	-0.00	0.00	-0.00	0.00	0.00
	(4.90)	(-1.74)	(0.08)	(-1.42)	(1.45)	(0.29)
Denmark	0.01	0.00	0.00	0.00	0.00	-0.00
	(4.57)	(1.16)	(1.27)	(0.42)	(1.65)	(-0.66)
Finland	0.01	0.00	-0.00	-0.00	0.00	-0.00
	(4.54)	(0.01)	(-0.15)	(-0.70)	(0.17)	(-0.26)
Greece	0.01	0.00	0.00	-0.00	0.01	0.00
	(2.03)	(0.83)	(1.17)	(-0.19)	(2.10)	(0.44)
Hongkong	0.01	-0.00	0.00	-0.01	0.01	-0.01
	(2.85)	(-1.09)	(0.41)	(-2.14)	(2.58)	(-1.89)
Ireland	0.01	-0.00	-0.01	-0.00	0.02	-0.02
	(1.19)	(-1.36)	(-1.51)	(-1.14)	(1.56)	(-1.50)
Netherlands	0.01	-0.00	0.00	-0.00	0.00	0.00
	(3.90)	(-0.75)	(1.32)	(-0.72)	(1.86)	(1.48)
New Zealand	0.00	0.00	-0.00	-0.01	0.00	-0.00
	(0.26)	(1.65)	(-0.61)	(-1.29)	(1.91)	(-0.87)
Norway	0.01	-0.00	0.00	0.00	0.00	-0.00
	(3.62)	(-1.46)	(1.08)	(1.10)	(2.03)	(-2.20)
Portugal	0.01	-0.00	0.00	0.00	0.00	-0.00
	(3.08)	(-0.58)	(2.41)	(0.64)	(2.09)	(-0.26)
Singapore	0.01	0.00	0.00	-0.00	0.01	-0.00
	(2.02)	(0.79)	(0.05)	(-0.40)	(1.37)	(-0.63)
Spain	0.01	-0.00	0.00	-0.00	0.01	-0.00
	(2.11)	(-0.34)	(0.27)	(-1.20)	(4.06)	(-1.97)
Sweden	0.01	-0.00	0.00	0.00	0.00	0.00
	(3.50)	(-1.22)	(1.41)	(0.46)	(0.74)	(0.76)
Switzerland	0.01	-0.00	0.00	-0.00	0.00	0.00
	(6.23)	(-1.46)	(1.44)	(-0.10)	(2.02)	(0.90)

Panel C. Emerging countries

Countries	α	β_{MKT}	β_{ME}	β_{IA}	β_{ROE}	β_{EG}
Brazil	0.01	-0.00	0.00	0.00	0.00	-0.00
	(4.89)	(-2.34)	(0.92)	(0.05)	(0.65)	(-0.63)
Chile	-0.00	-0.00	0.00	-0.00	-0.00	0.00
	(-0.25)	(-2.11)	(0.32)	(-0.38)	(-0.33)	(0.13)
China	0.01	0.00	-0.00	-0.00	0.00	-0.00
	(1.29)	(0.43)	(-0.27)	(-0.52)	(0.45)	(-0.46)
India	0.02	-0.00	0.00	-0.00	0.00	-0.00
	(2.99)	(-1.26)	(0.21)	(-1.92)	(0.62)	(-0.36)
Israel	0.02	0.00	0.00	-0.00	0.00	0.00
	(4.01)	(0.47)	(1.12)	(-1.27)	(0.49)	(1.00)
Korea	-0.00	0.00	-0.00	0.00	-0.00	-0.00
	(-0.41)	(0.85)	(-2.96)	(0.13)	(-0.29)	(-0.19)
Malaysia	0.01	-0.00	0.00	-0.00	-0.00	-0.00
	(1.11)	(-1.61)	(0.93)	(-0.76)	(-0.28)	(-0.68)
Mexico	0.01	-0.00	-0.00	-0.00	0.00	-0.00
	(2.07)	(-0.74)	(-0.77)	(-2.31)	(2.49)	(-1.43)
Pakistan	0.02	-0.00	0.00	0.00	-0.00	-0.01
	(1.58)	(-0.65)	(0.91)	(0.24)	(-0.11)	(-1.04)
Peru	-0.01	0.00	-0.00	-0.00	0.01	-0.00
	(-1.69)	(2.05)	(-0.82)	(-0.49)	(1.31)	(-0.01)
Philippines	-0.00	0.00	0.00	0.00	0.00	0.01
	(-0.37)	(1.35)	(1.14)	(0.88)	(1.29)	(1.59)
Poland	0.02	-0.00	-0.00	-0.00	0.00	-0.00
	(4.79)	(-1.65)	(-0.53)	(-1.21)	(0.46)	(-0.87)
Russia	-0.00	0.00	-0.01	-0.00	-0.00	-0.00
	(-0.28)	(0.20)	(-1.31)	(-0.28)	(-0.15)	(-0.12)
South Africa	0.01	0.00	-0.00	-0.00	0.00	-0.00
	(4.66)	(3.75)	(-0.47)	(-0.86)	(2.72)	(-0.26)
Sri Lanka	0.04	0.00	0.00	-0.00	0.01	-0.00
	(4.48)	(2.50)	(0.54)	(-0.04)	(1.49)	(-0.18)
Taiwan	-0.00	0.00	-0.00	-0.00	0.00	0.00
	(-1.07)	(2.07)	(-1.74)	(-0.30)	(0.53)	(1.08)
Thailand	0.00	0.00	0.00	0.00	-0.00	0.00
	(0.81)	(1.25)	(1.04)	(1.06)	(-0.35)	(0.35)
Turkey	0.01	-0.00	-0.00	0.00	-0.00	-0.00
	(1.44)	(-0.41)	(-0.80)	(0.56)	(-0.71)	(-0.12)

Table B.11: Non-momentum trend factor and cultural differences

This table reports the cross-sectional regression for countries' non-momentum trend factor on countries' culture differences with the Newey and West (1994) robust t-statistics in parentheses. The results cancel out the impact of individualism on the momentum, and relate the residual of trend factor to four cultural differences: power distance (PDI), individualism (IDV), masculinity (MAS), and uncertainty avoidance (UAI). Column (1) to (4) reports the four cultural differences respectively and column (5) reports the four cultural measures together. The control variables include average firm size (lgsz), average stock return volatility (retstd), change of real foreign exchange rate (cfx), change of GDP (CGDP), and GDP (GDP).

	(1)	(2)	(3)	(4)	(5)
PDI	-0.01				0.01
	(-1.62)				(1.24)
IDV		0.02			0.02
		(4.04)			(4.39)
MAS			0.00		0.01
			(1.46)		(1.51)
UAI				-0.00	-0.00
				(-1.11)	(-0.64)
Size	-0.05	-0.15	-0.07	-0.06	-0.20
	(-1.35)	(-3.89)	(-1.85)	(-1.86)	(-4.18)
Volatility	1.08	1.11	1.04	1.00	1.10
	(6.13)	(6.21)	(5.78)	(5.53)	(5.86)
Cfx	0.02	0.03	-0.01	0.04	0.01
	(0.56)	(0.58)	(-0.27)	(0.93)	(0.18)
CGDP	-29.22	-27.37	-38.38	-30.04	-42.80
	(-1.81)	(-1.73)	(-1.84)	(-1.77)	(-1.52)
GDP	-0.06	-0.07	-0.06	-0.06	-0.06
	(-1.73)	(-2.14)	(-1.54)	(-1.80)	(-1.73)
Intercept	6.69	6.29	5.98	6.31	5.74
	(6.94)	(6.28)	(5.82)	(6.26)	(5.36)

Table B.12: Trend factor and cultural differences for developed countries

This table reports the cross-sectional regression for developed countries' trend factor on countries' culture differences with the Newey and West (1994) robust t-statistics in parentheses. The four cultural differences are: power distance (PDI), individualism (IDV), masculinity (MAS), and uncertainty avoidance (UAI). Column (1) to (4) reports the four cultural differences respectively and column (5) reports the four cultural measures together. The control variables include average firm size (lgsz), average stock return volatility (retstd), change of real foreign exchange rate (cfx), change of GDP (CGDP), and GDP (GDP).

	(1)	(2)	(3)	(4)	(5)
PDI	-0.00				0.01
	(-0.13)				(1.35)
IDV		0.01			0.02
		(1.82)			(2.96)
MAS			0.00		0.00
			(0.23)		(0.25)
UAI				0.00	0.00
				(0.39)	(0.28)
Size	-0.10	-0.14	-0.12	-0.10	-0.17
	(-2.40)	(-2.84)	(-2.57)	(-2.38)	(-3.10)
Volatility	1.61	1.62	1.66	1.57	1.59
	(7.12)	(7.19)	(7.33)	(7.55)	(7.97)
Cfx	0.02	0.04	-0.02	0.04	0.02
	(0.59)	(0.98)	(-0.32)	(0.77)	(0.34)
CGDP	-45.01	-35.57	-11.00	-29.33	-38.00
	(-1.32)	(-1.10)	(-0.29)	(-0.79)	(-0.99)
GDP	-0.01	-0.04	-0.02	-0.02	-0.06
	(-0.33)	(-0.76)	(-0.39)	(-0.40)	(-1.22)
Intercept	8.32	8.25	8.48	8.09	7.72
	(6.36)	(6.49)	(6.89)	(6.43)	(6.86)

Table B.13: Global trend factor vs. Other factors in different investment sentiment subperiods

This table compares the average monthly return and Sharpe ratio of equally-weighted trend factor with other four equally-weighted global factors: market, momentum, short-term reversal, and long-term reversal in different time periods. The whole sample period is divided into high-sentiment period and low-sentiment period according to Baker and Wurgler (2006). Panel A reports the results for all countries, panel B for developed countries, and panel C for emerging countries.

Panel A. All countries as global

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.30	0.96	0.64	-0.06	0.31	0.75	0.43	0.15	-0.03	0.16
	(12.73)	(7.01)	(2.48)	(-0.52)	(3.33)					
High sentiment	1.51	1.12	0.56	0.03	0.25	0.93	0.56	0.13	0.02	0.13
	(11.64)	(7.25)	(1.62)	(0.19)	(2.46)					
Low sentiment	1.10	0.81	0.72	-0.14	0.37	0.60	0.33	0.17	-0.09	0.19
	(7.43)	(3.58)	(1.99))	(-1.01)	(2.39)					

Panel B. Developed countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.48	1.10	0.58	-0.15	0.20	0.74	0.44	0.14	-0.08	0.10
	(11.82)	(7.32)	(2.48)	(-1.21)	(1.82)					
High sentiment	1.76	1.21	0.58	-0.08	0.13	1.02	0.59	0.14	-0.04	0.06
	(14.21)	(7.34)	(1.85)	(-0.49)	(0.93)					
Low sentiment	1.20	0.99	0.59	-0.22	0.28	0.54	0.35	0.14	-0.11	0.13
	(5.97)	(3.93)	(1.73))	(-1.26)	(1.63)					

Panel C. Emerging countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	0.75	0.62	0.65	0.24	0.34	0.28	0.20	0.12	0.08	0.12
	(4.94)	(3.21)	(1.62))	(1.25)	(2.19)					
High sentiment	0.75	0.81	0.34	0.46	0.39	0.25	0.23	0.06	0.11	0.12
	(2.87)	(3.05)	(0.64)	(1.29)	(1.69)					
Low sentiment	0.75	0.44	0.96	0.03	0.30	0.34	0.17	0.18	0.02	0.11
	(5.12)	(1.61)	(1.78)	(0.19)	(1.44)					

Table B.14: Global trend factor vs. Other factors in different market states

This table compares the average monthly return and Sharpe ratio of equally-weighted trend factor with other four equally-weighted global factors: market, momentum, short-term reversal, and long-term reversal in different time periods. The whole sample period is divided into positive market state and negative market state. Panel A reports the results for all countries, panel B for developed countries, and panel C for emerging countries.

Panel A. All countries as global

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.30	0.96	0.64	-0.06	0.31	0.75	0.43	0.15	-0.03	0.16
	(12.73)	(7.01)	(2.48)	(-0.52)	(3.33)					
Positive market state	1.38	1.00	0.70	-0.11	0.34	0.86	0.55	0.18	-0.07	0.19
	(13.06)	(9.11)	(3.16)	(-0.97)	(3.56)					
Negative market state	0.90	0.77	0.34	0.24	0.18	0.40	0.21	0.05	0.12	0.06
	(2.71)	(1.31)	(0.32))	(0.74)	(0.48)					

Panel B. Developed countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.48	1.10	0.58	-0.15	0.20	0.74	0.44	0.14	-0.08	0.10
	(11.82)	(7.32)	(2.48)	(-1.21)	(1.82)					
Positive market state	1.55	1.10	0.72	-0.22	0.24	0.92	0.58	0.20	-0.12	0.13
	(13.91)	(9.87)	(3.68)	(-1.73)	(2.22)					
negative market state	1.11	1.07	-0.13	0.22	-0.01	0.35	0.24	-0.02	0.09	-0.00
	(2.13)	(1.57)	(-0.13))	(0.55)	(-0.02)					

Panel C. Emerging countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	0.75	0.62	0.65	0.24	0.34	0.28	0.20	0.12	0.08	0.12
	(4.94)	(3.21)	(1.62))	(1.25)	(2.19)					
Positive market state	0.79	0.69	0.48	0.24	0.30	0.29	0.23	0.09	0.07	0.10
	(4.42)	(3.55)	(1.22)	(1.06)	(1.69)					
Negative market state	0.56	0.35	1.36	0.23	0.52	0.29	0.11	0.20	0.09	0.17
	(2.56)	(0.65)	(1.23)	(0.72)	(1.53)					

Table B.15: Global trend factor vs. Other factors in different market volatility

This table compares the average monthly return and Sharpe ratio of equally-weighted trend factor with other four equally-weighted global factors: market, momentum, short-term reversal, and long-term reversal in different time periods. The whole sample period is divided into high-volatility period and low-volatility period. Panel A reports the results for all countries, panel B for developed countries, and panel C for emerging countries.

Panel A. All countries as global

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.30	0.96	0.64	-0.06	0.31	0.75	0.43	0.15	-0.03	0.16
	(12.73)	(7.01)	(2.48)	(-0.52)	(3.33)					
High volatility	1.41	0.81	0.14	0.15	0.36	0.66	0.29	0.03	0.07	0.15
	(8.51)	(3.26)	(0.32)	(0.83)	(2.13)					
Low volatility	1.20	1.11	1.14	-0.26	0.27	1.00	0.81	0.34	-0.20	0.22
	(10.10)	(11.52)	(4.86))	(-2.63)	(2.80)					

Panel B. Developed countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	1.48	1.10	0.58	-0.15	0.20	0.74	0.44	0.14	-0.08	0.10
	(11.82)	(7.32)	(2.48)	(-1.21)	(1.82)					
High volatility	1.68	1.03	0.10	0.04	0.26	0.66	0.33	0.02	0.02	0.10
	(7.95)	(3.75)	(0.26)	(0.21)	(1.29)					
Low volatility	1.28	1.17	1.07	-0.35	0.15	1.02	0.77	0.32	-0.22	0.11
	(10.67)	(11.72)	(4.58))	(-2.84)	(1.40)					

Panel C. Emerging countries

	Return					Sharpe				
Time period	trend	momentum	market	longrev	shortrev	trend	momentum	market	longrev	shortrev
Whole	0.75	0.62	0.65	0.24	0.34	0.28	0.20	0.12	0.08	0.12
	(4.94)	(3.21)	(1.62))	(1.25)	(2.19)					
High volatility	0.57	0.17	0.26	0.59	0.33	0.18	0.04	0.04	0.15	0.08
	(2.24)	(0.53)	(0.38)	(1.96)	(1.14)					
Low volatility	0.93	1.07	1.03	-0.11	0.36	0.50	0.58	0.27	-0.05	0.25
	(4.97)	(6.54)	(2.96)	(-0.61)	(2.91)					

Table B.16: Explaining size and investment sorted portfolios for developed countries (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and investment portfolios. The portfolios are value-weighted. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1INV1	0.01	4.62	0.01	3.94	0.01	4.54	0.01	2.44
S1INV2	0.01	7.13	0.01	6.84	0.01	6.16	0.01	5.14
SINV3	0.01	6.51	0.01	6.04	0.01	6.00	0.01	4.54
S1INV4	0.01	5.42	0.01	5.20	0.01	4.94	0.01	4.61
S1INV5	0.00	1.45	0.00	0.95	0.00	3.09	0.00	0.91
S2INV1	0.01	4.34	0.01	4.35	0.00	3.91	0.00	2.96
S2INV2	0.01	6.25	0.01	6.42	0.01	5.53	0.01	4.76
S2INV3	0.01	5.56	0.01	6.10	0.01	4.68	0.01	4.75
S2INV4	0.01	5.02	0.01	5.07	0.01	4.33	0.01	3.56
S2INV5	0.00	0.98	0.00	0.67	0.01	3.41	0.00	0.81
S3INV1	0.01	4.68	0.01	5.02	0.00	4.48	0.01	4.38
S3INV2	0.01	5.72	0.01	6.96	0.00	5.13	0.01	5.66
S3INV3	0.01	6.48	0.01	7.09	0.00	5.25	0.01	5.30
S3INV4	0.01	4.66	0.01	5.72	0.01	4.11	0.01	4.50
S3INV5	0.00	0.48	0.00	0.36	0.00	3.47	0.00	0.49
S4INV1	0.01	4.63	0.01	5.42	0.00	4.27	0.01	3.73
S4INV2	0.01	6.05	0.01	6.77	0.00	5.51	0.01	4.42
S4INV3	0.01	6.12	0.01	7.62	0.00	5.80	0.01	5.44
S4INV4	0.01	5.35	0.01	6.10	0.01	5.26	0.01	4.85
S4INV5	0.00	1.19	0.00	0.85	0.01	5.09	0.00	0.80
S5INV1	0.01	4.95	0.01	5.31	0.01	5.65	0.00	3.17
S5INV2	0.00	4.18	0.00	4.77	0.00	4.10	0.00	2.94
S5INV3	0.00	3.96	0.00	4.62	0.01	4.88	0.00	3.04
S5INV4	0.00	2.71	0.00	3.08	0.01	5.40	0.00	2.77
S5INV5	0.00	1.57	0.00	1.56	0.01	5.38	0.00	2.11
GRS	9.35	(0.00)	9.12	(0.00)	6.33	(0.00)	5.22	(0.00)

Table B.17: Explaining size and operating profitability sorted portfolios (value-weighted)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and operating profitability portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1OP1	0.00	2.70	0.00	2.05	0.01	3.74	0.00	0.99
S1OP2	0.01	6.38	0.01	6.38	0.01	5.96	0.01	5.93
S1OP3	0.01	6.20	0.01	6.01	0.01	6.10	0.01	5.05
S1OP4	0.01	6.47	0.01	6.03	0.01	6.09	0.01	5.69
S1OP5	0.01	6.21	0.01	5.22	0.01	5.90	0.01	5.07
S2OP1	0.00	1.42	0.00	1.03	0.01	4.07	0.00	0.32
S2OP2	0.01	5.18	0.01	5.48	0.00	4.23	0.01	4.51
S2OP3	0.01	4.84	0.01	5.43	0.00	3.78	0.01	4.96
S2OP4	0.01	5.14	0.01	5.82	0.00	3.98	0.01	5.26
S2OP5	0.01	6.15	0.01	5.42	0.01	5.21	0.01	3.78
S3OP1	0.00	1.59	0.00	1.36	0.01	4.50	0.00	0.34
S3OP2	0.00	4.53	0.01	5.27	0.00	4.22	0.01	4.54
S3OP3	0.01	6.09	0.01	7.12	0.00	4.71	0.01	5.66
S3OP4	0.01	5.28	0.01	6.03	0.00	3.85	0.01	5.15
S3OP5	0.01	5.55	0.01	5.69	0.00	4.51	0.01	4.48
S4OP1	0.00	1.29	0.00	1.20	0.01	4.88	0.00	0.69
S4OP2	0.01	5.71	0.01	6.70	0.00	4.72	0.01	5.19
S4OP3	0.01	5.96	0.01	6.68	0.00	5.29	0.01	5.30
S4OP4	0.01	5.64	0.01	6.73	0.00	5.62	0.01	5.41
S4OP5	0.01	5.99	0.01	5.92	0.00	4.85	0.00	3.70
S5OP1	-0.00	-0.98	-0.00	-0.02	0.01	3.96	0.00	0.24
S5OP2	0.00	2.68	0.00	3.61	0.01	5.07	0.00	2.97
S5OP3	0.00	3.93	0.00	4.56	0.01	4.57	0.00	3.05
S5OP4	0.00	4.73	0.00	4.91	0.01	5.52	0.00	3.06
S5OP5	0.01	4.54	0.00	4.42	0.01	5.42	0.00	3.53
GRS	7.26	(0.00)	6.96	(0.00)	5.04	(0.00)	5.47	(0.00)

Table B.18: Explaining triple sorted portfolios based on size, book-to-market, and investment (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using $2 \times 4 \times 4$ size, book-to-market, and investment portfolios. The portfolios are value-weighted portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1INV1	0.00	2.09	0.00	1.31	0.01	3.61	0.00	0.41
S1BM1INV2	0.01	5.31	0.01	4.72	0.01	5.53	0.00	2.70
S1BM1INV3	0.00	3.67	0.00	3.28	0.01	4.08	0.01	2.75
S1BM1INV4	0.00	0.38	0.00	0.08	0.00	2.97	0.00	0.28
S1BM2INV1	0.01	4.11	0.01	3.89	0.01	3.88	0.00	2.20
S1BM2INV2	0.01	5.79	0.01	6.32	0.00	4.97	0.01	5.58
S1BM2INV3	0.01	5.34	0.01	6.02	0.01	4.37	0.01	5.27
S1BM2INV4	0.00	2.32	0.00	2.41	0.00	3.12	0.00	2.27
S1BM3INV1	0.01	5.52	0.01	5.51	0.01	4.53	0.01	3.81
S1BM3INV2	0.01	6.10	0.01	6.51	0.01	4.92	0.01	5.49
S1BM3INV3	0.01	5.95	0.01	6.97	0.01	5.01	0.01	6.24
S1BM3INV4	0.00	2.98	0.01	3.81	0.00	2.68	0.01	3.74
S1BM4INV1	0.01	4.04	0.01	4.41	0.01	3.20	0.01	4.07
S1BM4INV2	0.01	5.42	0.01	6.02	0.01	4.89	0.01	5.74
S1BM4INV3	0.01	4.13	0.01	4.74	0.00	3.81	0.01	4.17
S1BM4INV4	0.00	2.68	0.01	3.10	0.00	2.69	0.01	3.03
S2BM1INV1	0.00	3.53	0.00	3.34	0.01	4.82	0.00	1.80
S2BM1INV2	0.00	2.81	0.00	3.31	0.01	3.74	0.00	1.95
S2BM1INV3	0.00	1.64	0.00	1.77	0.01	4.99	0.00	2.24
S2BM1INV4	0.00	2.00	0.00	1.68	0.01	6.09	0.00	1.75
S2BM2INV1	0.00	4.52	0.00	4.67	0.00	4.05	0.00	3.80
S2BM2INV2	0.00	4.81	0.00	4.82	0.00	4.72	0.00	2.95
S2BM2INV3	0.00	4.04	0.00	4.56	0.00	4.10	0.00	1.92
S2BM2INV4	0.00	1.78	0.00	2.11	0.01	4.52	0.00	2.97
S2BM3INV1	0.01	4.62	0.01	4.88	0.00	4.53	0.01	2.81
S2BM3INV2	0.00	4.31	0.01	5.78	0.00	2.74	0.01	5.26
S2BM3INV3	0.01	4.55	0.01	5.29	0.01	4.82	0.01	3.17
S2BM3INV4	0.00	2.56	0.00	2.92	0.00	2.24	0.00	1.67
S2BM4INV1	0.01	3.50	0.01	4.62	0.00	3.50	0.01	3.02
S2BM4INV2	0.01	3.74	0.01	4.61	0.00	3.50	0.01	3.35
S2BM4INV3	0.00	2.77	0.01	4.39	0.00	2.40	0.01	2.68
S2BM4INV4	0.00	0.56	0.00	2.12	0.00	1.11	0.00	1.56
GRS	6.12	(0.00)	5.73	(0.00)	4.05	(0.00)	3.79	(0.00)

Table B.19: Explaining triple sorted portfolios based on size, operating profitability, and investment (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using $2 \times 4 \times 4$ size, operating profitability, and investment portfolios. The portfolios are equal-weighted portfolios. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1OP1INV1	0.00	1.10	0.00	0.67	0.01	2.66	0.00	0.01
S1OP1INV2	0.00	2.28	0.00	1.53	0.01	2.86	-0.00	-0.07
S1OP1INV3	0.00	0.50	0.00	0.20	0.00	1.08	0.00	0.01
S1OP1INV4	-0.00	-1.96	-0.01	-2.27	0.00	1.41	-0.01	-1.43
S1OP2INV1	0.01	4.17	0.01	4.35	0.00	3.95	0.01	3.95
S1OP2INV2	0.01	5.34	0.01	5.41	0.00	5.34	0.00	3.74
S1OP2INV3	0.01	5.01	0.01	5.13	0.01	5.58	0.00	3.11
S1OP2INV4	0.00	0.02	0.00	0.15	0.00	2.28	0.00	0.40
S1OP3INV1	0.01	5.78	0.01	6.11	0.01	4.63	0.01	5.40
S1OP3INV2	0.01	6.17	0.01	6.92	0.01	4.89	0.01	6.27
S1OP3INV3	0.01	5.84	0.01	6.22	0.01	4.87	0.01	5.59
S1OP3INV4	0.00	2.89	0.00	2.85	0.00	3.64	0.00	2.74
S1OP4INV1	0.01	6.75	0.01	7.14	0.01	5.59	0.01	7.07
S1OP4INV2	0.01	6.31	0.01	7.30	0.01	4.96	0.01	6.23
S1OP4INV3	0.01	5.81	0.01	6.22	0.01	4.64	0.01	5.66
S1OP4INV4	0.01	4.10	0.01	3.53	0.01	4.05	0.01	3.09
S2OP1INV1	0.00	1.19	0.00	2.37	0.01	4.12	0.00	1.69
S2OP1INV2	0.00	1.46	0.00	2.64	0.00	3.14	0.00	2.00
S2OP1INV3	0.00	1.67	0.00	3.15	0.01	3.69	0.00	2.95
S2OP1INV4	-0.00	-1.51	-0.00	-1.52	0.00	3.43	-0.00	-1.72
S2OP2INV1	0.00	3.92	0.01	4.09	0.01	4.37	0.00	2.57
S2OP2INV2	0.00	4.67	0.01	5.47	0.00	4.12	0.01	3.79
S2OP2INV3	0.00	3.12	0.00	4.25	0.01	4.07	0.00	3.03
S2OP2INV4	0.00	2.73	0.00	3.22	0.01	4.37	0.00	3.14
S2OP3INV1	0.01	5.07	0.01	5.29	0.00	4.09	0.01	2.86
S2OP3INV2	0.01	4.39	0.01	4.58	0.00	3.22	0.01	2.74
S2OP3INV3	0.00	3.76	0.00	4.36	0.01	4.26	0.00	2.51
S2OP3INV4	0.00	2.61	0.00	2.79	0.01	5.39	0.01	2.94
S2OP4INV1	0.01	5.16	0.01	4.85	0.00	4.37	0.00	3.30
S2OP4INV2	0.01	4.62	0.01	5.27	0.00	4.10	0.01	3.88
S2OP4INV3	0.00	3.51	0.00	3.22	0.01	5.18	0.00	2.31
S2OP4INV4	0.01	3.12	0.00	2.88	0.01	5.44	0.01	2.72
GRS	6.64	(0.00)	6.46	(0.00)	4.22	(0.00)	4.11	(0.00)

Table B.20: Explaining double sorted portfolios based on size and book-to-market (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and book-to-market portfolios. The portfolios are equal-weighted portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1	0.00	1.16	0.00	1.23	0.01	3.40	0.01	1.95
S1BM2	0.01	2.65	0.01	2.74	0.01	4.83	0.01	3.05
S1BM3	0.01	3.93	0.01	4.16	0.01	6.06	0.01	4.28
S1BM4	0.01	4.69	0.01	4.78	0.01	6.10	0.01	4.65
S1BM5	0.01	7.56	0.01	7.51	0.01	9.17	0.02	6.67
S2BM1	0.00	0.04	0.00	0.44	0.01	3.05	0.00	1.24
S2BM2	0.00	2.32	0.00	2.76	0.01	4.23	0.01	2.94
S2BM3	0.00	4.01	0.01	5.20	0.01	4.48	0.01	4.85
S2BM4	0.01	4.58	0.01	6.03	0.01	4.65	0.01	5.32
S2BM5	0.01	4.64	0.01	6.70	0.01	4.66	0.01	5.32
S3BM1	0.00	0.76	0.00	1.21	0.01	3.98	0.00	2.31
S3BM2	0.00	2.50	0.00	3.12	0.01	3.83	0.01	3.79
S3BM3	0.00	4.50	0.01	6.52	0.00	4.11	0.01	5.14
S3BM4	0.01	4.66	0.01	7.61	0.00	4.29	0.01	5.06
S3BM5	0.01	4.17	0.01	6.37	0.00	4.35	0.01	4.78
S4BM1	0.00	2.17	0.00	2.50	0.01	5.92	0.01	3.17
S4BM2	0.00	4.49	0.01	5.51	0.01	4.42	0.01	5.33
S4BM3	0.00	4.61	0.01	6.83	0.00	4.27	0.01	5.07
S4BM4	0.01	4.57	0.01	6.80	0.00	4.24	0.01	5.08
S4BM5	0.01	3.58	0.01	6.08	0.00	3.64	0.01	4.37
S5BM1	0.00	1.78	0.00	2.24	0.01	5.06	0.01	3.86
S5BM2	0.01	5.78	0.01	7.14	0.01	6.26	0.01	5.07
S5BM3	0.00	4.70	0.01	7.04	0.00	4.85	0.01	4.91
S5BM4	0.01	3.82	0.01	5.93	0.00	3.38	0.01	3.92
S5BM5	0.01	3.52	0.01	6.03	0.01	4.21	0.01	3.80
GRS	11.18	(0.00)	11.88	(0.00)	9.77	(0.00)	8.01	(0.00)

Table B.21: Explaining double sorted portfolios based on size and momentum (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor, using the portfolios sorted based on size and momentum. The portfolios are equal-weighted portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1MOM1	0.00	1.80	0.01	3.13	0.01	3.05	0.01	3.44
S1MOM2	0.01	5.59	0.01	6.23	0.01	6.39	0.01	6.33
S1MOM3	0.01	8.26	0.01	7.87	0.01	9.20	0.01	7.89
S1MOM4	0.01	9.63	0.01	8.57	0.01	9.12	0.01	7.83
S1MOM5	0.02	7.35	0.01	6.23	0.02	8.23	0.01	4.43
S2MOM1	-0.00	-0.02	0.01	3.08	0.00	1.45	0.01	3.50
S2MOM2	0.00	3.65	0.01	6.37	0.00	3.60	0.01	5.73
S2MOM3	0.01	5.45	0.01	5.80	0.00	4.06	0.01	5.52
S2MOM4	0.01	7.40	0.01	6.66	0.01	5.36	0.01	4.50
S2MOM5	0.01	5.92	0.01	4.19	0.01	5.68	0.00	1.13
S3MOM1	0.00	0.55	0.01	4.57	0.00	1.60	0.01	4.55
S3MOM2	0.00	3.27	0.01	6.40	0.00	2.83	0.01	4.98
S3MOM3	0.01	5.12	0.01	6.19	0.00	3.74	0.01	4.84
S3MOM4	0.01	6.44	0.00	5.77	0.00	4.44	0.00	4.13
S3MOM5	0.01	5.10	0.00	3.00	0.01	4.93	-0.00	-0.13
S4MOM1	0.00	0.26	0.01	4.89	0.00	1.78	0.01	4.40
S4MOM2	0.00	3.37	0.01	7.59	0.00	3.40	0.01	5.06
S4MOM3	0.01	5.72	0.01	6.62	0.00	4.75	0.01	4.00
S4MOM4	0.01	6.11	0.00	5.09	0.00	4.71	0.00	2.36
S4MOM5	0.01	5.13	0.00	3.04	0.01	4.76	-0.00	-0.03
S5MOM1	0.00	0.41	0.01	5.68	0.00	1.99	0.01	4.24
S5MOM2	0.00	3.39	0.01	8.03	0.00	3.72	0.01	4.63
S5MOM3	0.01	5.52	0.01	6.64	0.00	4.97	0.01	3.83
S5MOM4	0.01	6.65	0.00	5.40	0.01	5.54	0.00	2.51
S5MOM5	0.01	4.22	0.00	2.05	0.01	4.47	-0.00	-0.50
GRS	10.43	(0.00)	9.36	(0.00)	8.29	(0.00)	7.57	(0.00)

Table B.22: Explaining double sorted portfolios based on size and investment (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and investment portfolios. The portfolios are equal-weighted portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1INV1	0.01	6.40	0.01	6.28	0.01	7.42	0.02	5.55
S1INV2	0.01	8.14	0.01	8.17	0.01	9.31	0.01	7.45
SINV3	0.01	7.20	0.01	7.15	0.01	8.29	0.01	6.18
S1INV4	0.01	5.55	0.01	5.77	0.01	6.23	0.01	5.61
S1INV5	0.00	1.83	0.00	2.02	0.01	3.48	0.01	2.69
S2INV1	0.01	4.23	0.01	5.48	0.01	4.25	0.01	4.80
S2INV2	0.01	6.33	0.01	7.91	0.01	6.42	0.01	6.44
S2INV3	0.01	5.39	0.01	7.05	0.01	5.04	0.01	5.15
S2INV4	0.01	4.55	0.01	5.58	0.01	4.39	0.01	4.42
S2INV5	0.00	0.39	0.00	1.00	0.01	2.88	0.01	2.30
S3INV1	0.01	4.47	0.01	6.22	0.01	4.53	0.01	5.31
S3INV2	0.01	5.39	0.01	8.08	0.00	5.45	0.01	5.80
S3INV3	0.01	5.80	0.01	7.64	0.01	5.25	0.01	5.56
S3INV4	0.01	4.28	0.01	6.32	0.01	4.12	0.01	4.85
S3INV5	0.00	0.07	0.00	0.89	0.01	2.71	0.00	2.06
S4INV1	0.01	4.51	0.01	6.40	0.01	4.25	0.01	4.94
S4INV2	0.01	6.08	0.01	8.51	0.01	5.73	0.01	6.16
S4INV3	0.01	5.43	0.01	8.14	0.01	5.28	0.01	4.91
S4INV4	0.01	4.67	0.01	6.29	0.01	4.95	0.01	5.18
S4INV5	0.00	0.98	0.00	1.68	0.01	4.29	0.01	3.01
S5INV1	0.01	5.51	0.01	7.61	0.01	5.54	0.01	5.18
S5INV2	0.01	4.79	0.01	7.37	0.00	4.43	0.01	4.60
S5INV3	0.01	5.49	0.01	7.85	0.01	5.27	0.01	5.17
S5INV4	0.00	4.69	0.01	6.74	0.01	5.43	0.01	4.80
S5INV5	0.00	0.99	0.00	1.62	0.01	4.38	0.01	3.08
GRS	14.75	(0.00)	15.05	(0.00)	11.83	(0.00)	9.75	(0.00)

Table B.23: Explaining double sorted portfolios based on size and operating profitability (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and operating profitability portfolios. The portfolios are equal-weighted portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1OP1	0.01	4.47	0.01	4.51	0.01	6.28	0.01	4.17
S1OP2	0.01	7.52	0.01	7.77	0.01	8.53	0.01	7.27
S1OP3	0.01	6.98	0.01	7.02	0.01	8.28	0.01	6.08
S1OP4	0.01	6.68	0.01	6.70	0.01	7.64	0.01	6.45
S1OP5	0.01	6.57	0.01	6.16	0.01	7.11	0.01	6.23
S2OP1	0.00	1.19	0.00	2.09	0.01	3.91	0.01	2.54
S2OP2	0.01	5.16	0.01	6.70	0.01	4.88	0.01	5.45
S2OP3	0.01	4.56	0.01	6.08	0.00	3.94	0.01	5.22
S2OP4	0.01	4.73	0.01	6.05	0.00	4.09	0.01	4.91
S2OP5	0.01	5.00	0.01	5.23	0.01	4.34	0.01	4.23
S3OP1	0.00	1.22	0.00	2.45	0.01	3.94	0.01	3.08
S3OP2	0.00	4.29	0.01	6.50	0.00	4.34	0.01	5.35
S3OP3	0.01	5.38	0.01	7.40	0.01	4.77	0.01	5.21
S3OP4	0.01	4.72	0.01	6.60	0.00	3.81	0.01	5.13
S3OP5	0.01	4.81	0.01	5.85	0.00	4.00	0.01	4.54
S4OP1	0.00	0.99	0.00	2.28	0.01	4.09	0.01	3.43
S4OP2	0.01	5.06	0.01	7.51	0.01	4.52	0.01	5.51
S4OP3	0.01	5.51	0.01	7.41	0.01	5.26	0.01	5.25
S4OP4	0.01	5.46	0.01	7.52	0.01	5.41	0.01	5.50
S4OP5	0.01	5.19	0.01	6.65	0.00	4.24	0.01	5.61
S5OP1	0.00	0.33	0.00	1.92	0.01	4.10	0.00	3.32
S5OP2	0.01	4.34	0.01	6.85	0.01	5.14	0.01	4.25
S5OP3	0.00	4.76	0.01	6.82	0.01	4.71	0.01	5.13
S5OP4	0.01	5.50	0.01	7.06	0.00	4.55	0.01	4.59
S5OP5	0.01	6.19	0.01	7.42	0.01	5.53	0.01	5.60
GRS	7.78	(0.00)	8.73	(0.00)	6.85	(0.00)	7.67	(0.00)

Table B.24: Explaining triple sorted portfolios based on size, book-to-market, and investment (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using $2 \times 4 \times 4$ size, book-to-market, and investment portfolios. The portfolios are equal-weighted portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1INV1	0.01	3.48	0.01	3.68	0.01	5.21	0.01	3.64
S1BM1INV2	0.01	4.88	0.01	5.26	0.01	6.19	0.01	5.17
S1BM1INV3	0.00	3.10	0.01	3.42	0.01	4.02	0.01	3.71
S1BM1INV4	0.00	0.32	0.00	0.56	0.00	2.56	0.00	1.60
S1BM2INV1	0.01	5.39	0.01	5.57	0.01	6.34	0.01	5.11
S1BM2INV2	0.01	6.70	0.01	7.42	0.01	6.88	0.01	6.54
S1BM2INV3	0.01	5.41	0.01	6.09	0.01	5.86	0.01	5.30
S1BM2INV4	0.00	2.07	0.01	2.60	0.01	3.49	0.01	3.06
S1BM3INV1	0.01	6.66	0.01	6.63	0.01	7.07	0.01	5.77
S1BM3INV2	0.01	7.75	0.01	8.36	0.01	8.63	0.01	7.46
S1BM3INV3	0.01	6.56	0.01	7.29	0.01	7.40	0.01	6.42
S1BM3INV4	0.01	2.93	0.01	3.77	0.01	3.95	0.01	3.62
S1BM4INV1	0.02	7.53	0.02	7.55	0.01	8.28	0.02	6.70
S1BM4INV2	0.01	8.49	0.01	8.69	0.01	10.02	0.02	8.07
S1BM4INV3	0.01	6.98	0.01	7.49	0.01	8.37	0.01	6.88
S1BM4INV4	0.01	4.37	0.01	4.73	0.01	5.34	0.01	4.44
S2BM1INV1	0.00	4.05	0.01	4.74	0.01	4.95	0.01	3.90
S2BM1INV2	0.00	3.34	0.00	5.37	0.01	4.03	0.01	4.67
S2BM1INV3	0.00	3.78	0.01	4.94	0.01	5.47	0.01	4.60
S2BM1INV4	0.00	0.93	0.00	1.07	0.01	5.16	0.00	1.98
S2BM2INV1	0.01	6.48	0.01	8.40	0.01	5.97	0.01	6.59
S2BM2INV2	0.01	7.17	0.01	9.19	0.01	5.78	0.01	5.89
S2BM2INV3	0.01	4.82	0.01	6.39	0.01	4.32	0.01	4.52
S2BM2INV4	0.00	1.95	0.00	2.94	0.01	4.58	0.01	3.77
S2BM3INV1	0.01	4.91	0.01	6.58	0.00	4.76	0.01	5.01
S2BM3INV2	0.01	5.40	0.01	7.89	0.00	4.58	0.01	5.34
S2BM3INV3	0.01	4.37	0.01	6.89	0.00	4.05	0.01	4.26
S2BM3INV4	0.00	2.05	0.01	4.24	0.00	2.53	0.01	4.16
S2BM4INV1	0.01	3.62	0.01	5.96	0.00	3.23	0.01	4.78
S2BM4INV2	0.01	4.98	0.01	6.89	0.00	4.92	0.01	5.10
S2BM4INV3	0.01	4.07	0.01	6.08	0.00	3.95	0.01	3.66
S2BM4INV4	0.00	1.56	0.01	4.62	0.00	2.24	0.01	3.38
GRS	11.50	(0.00)	11.15	(0.00)	9.27	(0.00)	7.62	(0.00)

Table B.25: Explaining triple sorted portfolios based on size, operating profitability, and investment (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 2 × 4 × 4 size, operating profitability, and investment portfolios. The portfolios are equal-weighted portfolios. The global trend factor is equally weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1OP1INV1	0.01	4.74	0.01	4.88	0.01	5.85	0.02	4.26
S1OP1INV2	0.01	5.10	0.01	5.13	0.01	6.36	0.01	4.58
S1OP1INV3	0.00	2.35	0.01	2.59	0.01	3.66	0.01	2.85
S1OP1INV4	-0.00	-0.00	0.00	0.30	0.01	2.36	0.01	1.43
S1OP2INV1	0.01	7.17	0.01	7.50	0.01	8.68	0.02	7.11
S1OP2INV2	0.01	7.62	0.01	8.04	0.01	9.52	0.01	7.86
S1OP2INV3	0.01	5.61	0.01	6.22	0.01	7.07	0.01	5.46
S1OP2INV4	0.00	1.32	0.00	1.83	0.01	2.91	0.01	2.25
S1OP3INV1	0.01	7.24	0.01	7.51	0.01	8.03	0.01	6.68
S1OP3INV2	0.01	7.81	0.01	8.89	0.01	7.84	0.01	7.55
S1OP3INV3	0.01	7.05	0.01	7.66	0.01	7.69	0.01	6.84
S1OP3INV4	0.00	3.33	0.01	3.82	0.01	4.48	0.01	4.06
S1OP4INV1	0.01	7.23	0.01	7.58	0.01	7.73	0.02	7.13
S1OP4INV2	0.01	7.56	0.01	8.35	0.01	7.33	0.01	7.04
S1OP4INV3	0.01	6.23	0.01	6.88	0.01	5.89	0.01	6.32
S1OP4INV4	0.01	4.03	0.01	3.89	0.01	4.46	0.01	4.01
S2OP1INV1	0.00	2.71	0.01	4.78	0.01	3.74	0.01	4.35
S2OP1INV2	0.00	3.92	0.01	6.71	0.00	5.12	0.01	4.72
S2OP1INV3	0.00	3.18	0.01	5.91	0.01	4.78	0.01	4.40
S2OP1INV4	-0.00	-0.75	-0.00	-0.04	0.01	3.86	0.00	1.22
S2OP2INV1	0.01	4.94	0.01	6.86	0.00	4.41	0.01	5.25
S2OP2INV2	0.01	6.04	0.01	8.44	0.00	5.09	0.01	5.02
S2OP2INV3	0.01	4.65	0.01	6.38	0.01	4.54	0.01	4.44
S2OP2INV4	0.00	2.69	0.00	3.90	0.01	4.25	0.01	3.63
S2OP3INV1	0.01	5.15	0.01	6.58	0.00	3.96	0.01	4.95
S2OP3INV2	0.01	6.18	0.01	7.86	0.01	5.44	0.01	5.35
S2OP3INV3	0.01	5.48	0.01	7.32	0.01	4.88	0.01	4.40
S2OP3INV4	0.00	3.53	0.01	4.87	0.01	5.00	0.01	4.66
S2OP4INV1	0.01	6.37	0.01	8.14	0.01	4.79	0.01	5.58
S2OP4INV2	0.01	5.97	0.01	8.27	0.00	4.72	0.01	5.47
S2OP4INV3	0.01	5.41	0.01	7.19	0.01	4.64	0.01	5.24
S2OP4INV4	0.00	3.12	0.00	3.34	0.01	4.20	0.01	3.72
GRS	11.44	(0.00)	11.26	(0.00)	9.17	(0.00)	7.58	(0.00)

Table B.26: Explaining size and book-to-market sorted portfolios (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and book-to-market portfolios. The portfolios are value-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1	0.00	0.08	-0.00	-0.54	0.00	2.54	-0.00	-0.18
S1BM2	0.00	2.04	0.00	1.50	0.01	3.97	0.00	1.02
S1BM3	0.01	3.94	0.01	3.16	0.01	4.88	0.01	1.67
S1BM4	0.01	4.71	0.01	4.30	0.01	4.90	0.01	3.50
S1BM5	0.01	6.09	0.01	5.82	0.01	5.74	0.01	5.23
S2BM1	0.00	0.50	0.00	0.06	0.01	3.74	0.00	0.03
S2BM2	0.00	2.80	0.00	2.36	0.01	4.77	0.00	1.62
S2BM3	0.00	4.44	0.00	4.39	0.01	4.30	0.01	3.40
S2BM4	0.01	4.74	0.01	5.25	0.00	4.15	0.01	5.33
S2BM5	0.01	4.76	0.01	5.50	0.00	4.00	0.01	4.74
S3BM1	0.00	1.03	0.00	0.65	0.01	4.37	0.00	0.54
S3BM2	0.00	3.07	0.00	2.47	0.01	4.39	0.00	1.40
S3BM3	0.00	5.22	0.01	5.90	0.00	4.47	0.01	5.52
S3BM4	0.01	5.01	0.01	6.63	0.00	4.08	0.01	5.39
S3BM5	0.01	4.47	0.01	5.49	0.00	4.09	0.01	4.44
S4BM1	0.00	2.36	0.00	1.84	0.01	6.69	0.00	0.86
S4BM2	0.00	4.79	0.00	4.98	0.00	4.40	0.00	4.59
S4BM3	0.00	4.95	0.00	6.15	0.00	4.28	0.01	4.89
S4BM4	0.01	4.84	0.01	6.06	0.00	4.42	0.01	4.54
S4BM5	0.01	3.84	0.01	5.12	0.00	3.59	0.01	3.88
S5BM1	0.00	2.17	0.00	2.17	0.01	5.94	0.00	2.50
S5BM2	0.00	4.41	0.00	4.19	0.01	6.49	0.00	2.11
S5BM3	0.00	4.06	0.00	4.76	0.00	4.09	0.00	3.96
S5BM4	0.00	3.89	0.01	4.89	0.00	3.34	0.01	3.89
S5BM5	0.00	2.51	0.01	4.10	0.00	3.05	0.01	3.26
GRS	7.57	(0.00)	7.22	(0.00)	5.10	(0.00)	4.61	(0.00)

Table B.27: Explaining size and book-to-market sorted portfolios (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and book-to-market portfolios. The portfolios are equal-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1	0.00	1.16	0.00	1.23	0.01	3.40	0.01	2.04
S1BM2	0.01	2.65	0.01	2.74	0.01	4.83	0.01	3.15
S1BM3	0.01	3.93	0.01	4.16	0.01	6.06	0.01	4.43
S1BM4	0.01	4.69	0.01	4.78	0.01	6.10	0.01	4.93
S1BM5	0.01	7.56	0.01	7.51	0.01	9.17	0.02	7.14
S2BM1	0.00	0.04	0.00	0.44	0.01	3.05	0.00	1.20
S2BM2	0.00	2.32	0.00	2.76	0.01	4.23	0.01	2.94
S2BM3	0.00	4.01	0.01	5.20	0.01	4.48	0.01	4.98
S2BM4	0.01	4.58	0.01	6.03	0.01	4.65	0.01	5.56
S2BM5	0.01	4.64	0.01	6.70	0.01	4.66	0.01	5.64
S3BM1	0.00	0.76	0.00	1.21	0.01	3.98	0.00	2.29
S3BM2	0.00	2.50	0.00	3.12	0.01	3.83	0.01	3.82
S3BM3	0.00	4.50	0.01	6.52	0.00	4.11	0.01	5.36
S3BM4	0.01	4.66	0.01	7.61	0.00	4.29	0.01	5.20
S3BM5	0.01	4.17	0.01	6.37	0.00	4.35	0.01	5.13
S4BM1	0.00	2.17	0.00	2.50	0.01	5.92	0.01	3.03
S4BM2	0.00	4.49	0.01	5.51	0.01	4.42	0.01	5.63
S4BM3	0.00	4.61	0.01	6.83	0.00	4.27	0.01	5.18
S4BM4	0.01	4.57	0.01	6.80	0.00	4.24	0.01	5.31
S4BM5	0.01	3.58	0.01	6.08	0.00	3.64	0.01	4.68
S5BM1	0.00	1.78	0.00	2.24	0.01	5.06	0.01	3.88
S5BM2	0.01	5.78	0.01	7.14	0.01	6.26	0.01	5.42
S5BM3	0.00	4.70	0.01	7.04	0.00	4.85	0.01	5.28
S5BM4	0.01	3.82	0.01	5.93	0.00	3.38	0.01	4.35
S5BM5	0.01	3.52	0.01	6.03	0.01	4.21	0.01	4.30
GRS	11.18	(0.00)	11.88	(0.00)	9.77	(0.00)	8.72	(0.00)

Table B.28: Explaining size and momentum sorted portfolios (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and momentum portfolios. The portfolios are value-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1MOM1	-0.00	-0.49	0.00	1.50	0.00	0.73	0.01	2.72
S1MOM2	0.01	4.03	0.01	5.18	0.00	3.78	0.01	5.68
S1MOM3	0.01	6.68	0.01	6.61	0.01	6.39	0.01	6.98
S1MOM4	0.01	8.54	0.01	7.43	0.01	7.47	0.01	6.32
S1MOM5	0.01	6.41	0.01	4.99	0.01	6.83	0.01	3.29
S2MOM1	-0.00	-0.17	0.00	3.03	0.00	1.41	0.01	3.66
S2MOM2	0.00	3.57	0.01	6.40	0.00	3.59	0.01	5.78
S2MOM3	0.01	5.31	0.01	5.70	0.00	3.86	0.01	5.42
S2MOM4	0.01	7.04	0.01	6.25	0.01	5.19	0.01	4.51
S2MOM5	0.01	5.61	0.01	3.78	0.01	5.40	0.00	0.95
S3MOM1	0.00	0.38	0.01	4.55	0.00	1.54	0.01	4.63
S3MOM2	0.00	3.19	0.01	6.42	0.00	2.88	0.01	5.03
S3MOM3	0.01	4.98	0.01	6.05	0.00	3.70	0.01	4.89
S3MOM4	0.01	6.24	0.00	5.50	0.00	4.31	0.00	3.70
S3MOM5	0.01	4.87	0.00	2.71	0.01	4.78	-0.00	-0.10
S4MOM1	0.00	0.23	0.01	5.14	0.00	1.83	0.01	4.52
S4MOM2	0.00	3.28	0.01	7.37	0.00	3.45	0.01	5.06
S4MOM3	0.01	5.81	0.01	6.67	0.00	5.00	0.01	4.12
S4MOM4	0.01	5.96	0.00	4.89	0.00	4.43	0.00	2.62
S4MOM5	0.01	4.88	0.00	2.78	0.01	4.44	-0.00	-0.02
S5MOM1	-0.00	-0.02	0.01	4.08	0.00	2.14	0.01	4.08
S5MOM2	0.00	2.66	0.01	6.78	0.00	3.39	0.01	4.39
S5MOM3	0.00	4.58	0.00	5.24	0.00	4.69	0.00	2.85
S5MOM4	0.01	5.21	0.00	3.85	0.00	4.99	0.00	1.14
S5MOM5	0.01	3.09	0.00	0.57	0.01	3.86	-0.00	-0.89
GRS	9.81	(0.00)	8.80	(0.00)	7.32	(0.00)	6.97	(0.00)

Table B.29: Explaining size and momentum sorted portfolios (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5×5 size and momentum portfolios. The portfolios are equal-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1MOM1	0.00	1.80	0.01	3.13	0.01	3.05	0.01	3.65
S1MOM2	0.01	5.59	0.01	6.23	0.01	6.39	0.01	6.67
S1MOM3	0.01	8.26	0.01	7.87	0.01	9.20	0.01	8.04
S1MOM4	0.01	9.63	0.01	8.57	0.01	9.12	0.01	8.10
S1MOM5	0.02	7.35	0.01	6.23	0.02	8.23	0.01	4.81
S2MOM1	-0.00	-0.02	0.01	3.08	0.00	1.45	0.01	3.60
S2MOM2	0.00	3.65	0.01	6.37	0.00	3.60	0.01	5.84
S2MOM3	0.01	5.45	0.01	5.80	0.00	4.06	0.01	5.69
S2MOM4	0.01	7.40	0.01	6.66	0.01	5.36	0.01	4.44
S2MOM5	0.01	5.92	0.01	4.19	0.01	5.68	0.00	1.34
S3MOM1	0.00	0.55	0.01	4.57	0.00	1.60	0.01	4.79
S3MOM2	0.00	3.27	0.01	6.40	0.00	2.83	0.01	5.18
S3MOM3	0.01	5.12	0.01	6.19	0.00	3.74	0.01	5.10
S3MOM4	0.01	6.44	0.00	5.77	0.00	4.44	0.00	4.29
S3MOM5	0.01	5.10	0.00	3.00	0.01	4.93	0.00	0.02
S4MOM1	0.00	0.26	0.01	4.89	0.00	1.78	0.01	4.59
S4MOM2	0.00	3.37	0.01	7.59	0.00	3.40	0.01	5.15
S4MOM3	0.01	5.72	0.01	6.62	0.00	4.75	0.01	4.08
S4MOM4	0.01	6.11	0.00	5.09	0.00	4.71	0.00	2.67
S4MOM5	0.01	5.13	0.00	3.04	0.01	4.76	0.00	0.09
S5MOM1	0.00	0.41	0.01	5.68	0.00	1.99	0.01	4.61
S5MOM2	0.00	3.39	0.01	8.03	0.00	3.72	0.01	4.94
S5MOM3	0.01	5.52	0.01	6.64	0.00	4.97	0.01	4.01
S5MOM4	0.01	6.65	0.00	5.40	0.01	5.54	0.00	2.85
S5MOM5	0.01	4.22	0.00	2.05	0.01	4.47	-0.00	-0.29
GRS	10.43	(0.00)	9.36	(0.00)	8.29	(0.00)	7.89	(0.00)

Table B.30: Explaining size and investment sorted portfolios (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5 × 5 size and investment portfolios. The portfolios are value-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1INV1	0.01	4.62	0.01	3.94	0.01	4.54	0.01	2.55
S1INV2	0.01	7.13	0.01	6.84	0.01	6.16	0.01	5.29
SINV3	0.01	6.51	0.01	6.04	0.01	6.00	0.01	4.72
S1INV4	0.01	5.42	0.01	5.20	0.01	4.94	0.01	4.82
S1INV5	0.00	1.45	0.00	0.95	0.00	3.09	0.00	0.99
S2INV1	0.01	4.34	0.01	4.35	0.00	3.91	0.00	2.96
S2INV2	0.01	6.25	0.01	6.42	0.01	5.53	0.01	4.89
S2INV3	0.01	5.56	0.01	6.10	0.01	4.68	0.01	4.88
S2INV4	0.01	5.02	0.01	5.07	0.01	4.33	0.01	3.63
S2INV5	0.00	0.98	0.00	0.67	0.01	3.41	0.00	0.91
S3INV1	0.01	4.68	0.01	5.02	0.00	4.48	0.01	4.52
S3INV2	0.01	5.72	0.01	6.96	0.00	5.13	0.01	5.81
S3INV3	0.01	6.48	0.01	7.09	0.00	5.25	0.01	5.32
S3INV4	0.01	4.66	0.01	5.72	0.01	4.11	0.01	4.60
S3INV5	0.00	0.48	0.00	0.36	0.00	3.47	0.00	0.54
S4INV1	0.01	4.63	0.01	5.42	0.00	4.27	0.01	3.81
S4INV2	0.01	6.05	0.01	6.77	0.00	5.51	0.01	4.51
S4INV3	0.01	6.12	0.01	7.62	0.00	5.80	0.01	5.57
S4INV4	0.01	5.35	0.01	6.10	0.01	5.26	0.01	4.80
S4INV5	0.00	1.19	0.00	0.85	0.01	5.09	0.00	0.84
S5INV1	0.01	4.95	0.01	5.31	0.01	5.65	0.00	3.38
S5INV2	0.00	4.18	0.00	4.77	0.00	4.10	0.00	3.13
S5INV3	0.00	3.96	0.00	4.62	0.01	4.88	0.00	3.25
S5INV4	0.00	2.71	0.00	3.08	0.01	5.40	0.00	3.27
S5INV5	0.00	1.57	0.00	1.56	0.01	5.38	0.00	2.43
GRS	9.35	(0.00)	9.12	(0.00)	6.33	(0.00)	5.87	(0.00)

Table B.31: Explaining size and investment sorted portfolios (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 5 × 5 size and investment portfolios. The portfolios are equal-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1INV1	0.01	6.40	0.01	6.28	0.01	7.42	0.02	5.95
S1INV2	0.01	8.14	0.01	8.17	0.01	9.31	0.01	7.80
SINV3	0.01	7.20	0.01	7.15	0.01	8.29	0.01	6.42
S1INV4	0.01	5.55	0.01	5.77	0.01	6.23	0.01	5.98
S1INV5	0.00	1.83	0.00	2.02	0.01	3.48	0.01	2.79
S2INV1	0.01	4.23	0.01	5.48	0.01	4.25	0.01	4.91
S2INV2	0.01	6.33	0.01	7.91	0.01	6.42	0.01	6.76
S2INV3	0.01	5.39	0.01	7.05	0.01	5.04	0.01	5.49
S2INV4	0.01	4.55	0.01	5.58	0.01	4.39	0.01	4.59
S2INV5	0.00	0.39	0.00	1.00	0.01	2.88	0.01	2.37
S3INV1	0.01	4.47	0.01	6.22	0.01	4.53	0.01	5.58
S3INV2	0.01	5.39	0.01	8.08	0.00	5.45	0.01	6.00
S3INV3	0.01	5.80	0.01	7.64	0.01	5.25	0.01	5.75
S3INV4	0.01	4.28	0.01	6.32	0.01	4.12	0.01	5.03
S3INV5	0.00	0.07	0.00	0.89	0.01	2.71	0.00	2.12
S4INV1	0.01	4.51	0.01	6.40	0.01	4.25	0.01	5.06
S4INV2	0.01	6.08	0.01	8.51	0.01	5.73	0.01	6.36
S4INV3	0.01	5.43	0.01	8.14	0.01	5.28	0.01	5.08
S4INV4	0.01	4.67	0.01	6.29	0.01	4.95	0.01	5.37
S4INV5	0.00	0.98	0.00	1.68	0.01	4.29	0.01	3.12
S5INV1	0.01	5.51	0.01	7.61	0.01	5.54	0.01	5.42
S5INV2	0.01	4.79	0.01	7.37	0.00	4.43	0.01	5.00
S5INV3	0.01	5.49	0.01	7.85	0.01	5.27	0.01	5.68
S5INV4	0.00	4.69	0.01	6.74	0.01	5.43	0.01	5.35
S5INV5	0.00	0.99	0.00	1.62	0.01	4.38	0.01	3.40
GRS	14.75	(0.00)	15.05	(0.00)	11.83	(0.00)	10.77	(0.00)

Table B.32: Explaining triple sorted portfolios on size, book-to-market, and investment (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using $2 \times 4 \times 4$ size, book-to-market, and investment portfolios. The portfolios are value-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1INV1	0.00	2.09	0.00	1.31	0.01	3.61	0.00	0.36
S1BM1INV2	0.01	5.31	0.01	4.72	0.01	5.53	0.00	2.61
S1BM1INV3	0.00	3.67	0.00	3.28	0.01	4.08	0.01	2.74
S1BM1INV4	0.00	0.38	0.00	0.08	0.00	2.97	0.00	0.40
S1BM2INV1	0.01	4.11	0.01	3.89	0.01	3.88	0.00	2.19
S1BM2INV2	0.01	5.79	0.01	6.32	0.00	4.97	0.01	5.68
S1BM2INV3	0.01	5.34	0.01	6.02	0.01	4.37	0.01	5.57
S1BM2INV4	0.00	2.32	0.00	2.41	0.00	3.12	0.00	2.44
S1BM3INV1	0.01	5.52	0.01	5.51	0.01	4.53	0.01	3.82
S1BM3INV2	0.01	6.10	0.01	6.51	0.01	4.92	0.01	5.75
S1BM3INV3	0.01	5.95	0.01	6.97	0.01	5.01	0.01	6.55
S1BM3INV4	0.00	2.98	0.01	3.81	0.00	2.68	0.01	3.74
S1BM4INV1	0.01	4.04	0.01	4.41	0.01	3.20	0.01	4.27
S1BM4INV2	0.01	5.42	0.01	6.02	0.01	4.89	0.01	5.95
S1BM4INV3	0.01	4.13	0.01	4.74	0.00	3.81	0.01	4.26
S1BM4INV4	0.00	2.68	0.01	3.10	0.00	2.69	0.01	3.12
S2BM1INV1	0.00	3.53	0.00	3.34	0.01	4.82	0.00	1.97
S2BM1INV2	0.00	2.81	0.00	3.31	0.01	3.74	0.00	2.03
S2BM1INV3	0.00	1.64	0.00	1.77	0.01	4.99	0.00	2.48
S2BM1INV4	0.00	2.00	0.00	1.68	0.01	6.09	0.00	1.92
S2BM2INV1	0.00	4.52	0.00	4.67	0.00	4.05	0.00	3.99
S2BM2INV2	0.00	4.81	0.00	4.82	0.00	4.72	0.00	3.15
S2BM2INV3	0.00	4.04	0.00	4.56	0.00	4.10	0.00	2.17
S2BM2INV4	0.00	1.78	0.00	2.11	0.01	4.52	0.00	3.24
S2BM3INV1	0.01	4.62	0.01	4.88	0.00	4.53	0.01	2.91
S2BM3INV2	0.00	4.31	0.01	5.78	0.00	2.74	0.01	5.41
S2BM3INV3	0.01	4.55	0.01	5.29	0.01	4.82	0.01	3.53
S2BM3INV4	0.00	2.56	0.00	2.92	0.00	2.24	0.00	2.06
S2BM4INV1	0.01	3.50	0.01	4.62	0.00	3.50	0.01	3.21
S2BM4INV2	0.01	3.74	0.01	4.61	0.00	3.50	0.01	3.65
S2BM4INV3	0.00	2.77	0.01	4.39	0.00	2.40	0.01	3.12
S2BM4INV4	0.00	0.56	0.00	2.12	0.00	1.11	0.00	1.87
GRS	6.12	(0.00)	5.73	(0.00)	4.05	(0.00)	4.04	(0.00)

Table B.33: Explaining triple sorted portfolios on size, book-to-market, and investment (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using $2 \times 4 \times 4$ size, book-to-market, and investment portfolios. The portfolios are equal-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1BM1INV1	0.01	3.48	0.01	3.68	0.01	5.21	0.01	3.76
S1BM1INV2	0.01	4.88	0.01	5.26	0.01	6.19	0.01	5.28
S1BM1INV3	0.00	3.10	0.01	3.42	0.01	4.02	0.01	3.80
S1BM1INV4	0.00	0.32	0.00	0.56	0.00	2.56	0.01	1.69
S1BM2INV1	0.01	5.39	0.01	5.57	0.01	6.34	0.01	5.32
S1BM2INV2	0.01	6.70	0.01	7.42	0.01	6.88	0.01	6.73
S1BM2INV3	0.01	5.41	0.01	6.09	0.01	5.86	0.01	5.64
S1BM2INV4	0.00	2.07	0.01	2.60	0.01	3.49	0.01	3.29
S1BM3INV1	0.01	6.66	0.01	6.63	0.01	7.07	0.01	6.12
S1BM3INV2	0.01	7.75	0.01	8.36	0.01	8.63	0.01	7.88
S1BM3INV3	0.01	6.56	0.01	7.29	0.01	7.40	0.01	6.86
S1BM3INV4	0.01	2.93	0.01	3.77	0.01	3.95	0.01	3.70
S1BM4INV1	0.02	7.53	0.02	7.55	0.01	8.28	0.02	7.20
S1BM4INV2	0.01	8.49	0.01	8.69	0.01	10.02	0.02	8.49
S1BM4INV3	0.01	6.98	0.01	7.49	0.01	8.37	0.01	7.22
S1BM4INV4	0.01	4.37	0.01	4.73	0.01	5.34	0.01	4.56
S2BM1INV1	0.00	4.05	0.01	4.74	0.01	4.95	0.01	3.82
S2BM1INV2	0.00	3.34	0.00	5.37	0.01	4.03	0.01	4.73
S2BM1INV3	0.00	3.78	0.01	4.94	0.01	5.47	0.01	4.70
S2BM1INV4	0.00	0.93	0.00	1.07	0.01	5.16	0.00	2.01
S2BM2INV1	0.01	6.48	0.01	8.40	0.01	5.97	0.01	6.82
S2BM2INV2	0.01	7.17	0.01	9.19	0.01	5.78	0.01	6.31
S2BM2INV3	0.01	4.82	0.01	6.39	0.01	4.32	0.01	4.76
S2BM2INV4	0.00	1.95	0.00	2.94	0.01	4.58	0.01	3.98
S2BM3INV1	0.01	4.91	0.01	6.58	0.00	4.76	0.01	5.13
S2BM3INV2	0.01	5.40	0.01	7.89	0.00	4.58	0.01	5.61
S2BM3INV3	0.01	4.37	0.01	6.89	0.00	4.05	0.01	4.48
S2BM3INV4	0.00	2.05	0.01	4.24	0.00	2.53	0.01	4.46
S2BM4INV1	0.01	3.62	0.01	5.96	0.00	3.23	0.01	5.20
S2BM4INV2	0.01	4.98	0.01	6.89	0.00	4.92	0.01	5.51
S2BM4INV3	0.01	4.07	0.01	6.08	0.00	3.95	0.01	3.91
S2BM4INV4	0.00	1.56	0.01	4.62	0.00	2.24	0.01	3.84
GRS	11.50	(0.00)	11.15	(0.00)	9.27	(0.00)	8.07	(0.00)

Table B.34: Explaining triple sorted portfolios on size, operating profitability, and investment (value-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using $2 \times 4 \times 4$ size, operating profitability, and investment portfolios. The portfolios are value-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1OP1INV1	0.00	1.10	0.00	0.67	0.01	2.66	-0.00	-0.04
S1OP1INV2	0.00	2.28	0.00	1.53	0.01	2.86	-0.00	-0.10
S1OP1INV3	0.00	0.50	0.00	0.20	0.00	1.08	-0.00	-0.00
S1OP1INV4	-0.00	-1.96	-0.01	-2.27	0.00	1.41	-0.01	-1.47
S1OP2INV1	0.01	4.17	0.01	4.35	0.00	3.95	0.01	4.08
S1OP2INV2	0.01	5.34	0.01	5.41	0.00	5.34	0.00	3.81
S1OP2INV3	0.01	5.01	0.01	5.13	0.01	5.58	0.00	3.15
S1OP2INV4	0.00	0.02	0.00	0.15	0.00	2.28	0.00	0.51
S1OP3INV1	0.01	5.78	0.01	6.11	0.01	4.63	0.01	5.56
S1OP3INV2	0.01	6.17	0.01	6.92	0.01	4.89	0.01	6.45
S1OP3INV3	0.01	5.84	0.01	6.22	0.01	4.87	0.01	5.73
S1OP3INV4	0.00	2.89	0.00	2.85	0.00	3.64	0.00	2.79
S1OP4INV1	0.01	6.75	0.01	7.14	0.01	5.59	0.01	7.42
S1OP4INV2	0.01	6.31	0.01	7.30	0.01	4.96	0.01	6.54
S1OP4INV3	0.01	5.81	0.01	6.22	0.01	4.64	0.01	5.85
S1OP4INV4	0.01	4.10	0.01	3.53	0.01	4.05	0.01	3.25
S2OP1INV1	0.00	1.19	0.00	2.37	0.01	4.12	0.00	1.82
S2OP1INV2	0.00	1.46	0.00	2.64	0.00	3.14	0.00	2.03
S2OP1INV3	0.00	1.67	0.00	3.15	0.01	3.69	0.00	3.12
S2OP1INV4	-0.00	-1.51	-0.00	-1.52	0.00	3.43	-0.00	-1.67
S2OP2INV1	0.00	3.92	0.01	4.09	0.01	4.37	0.00	2.74
S2OP2INV2	0.00	4.67	0.01	5.47	0.00	4.12	0.01	4.12
S2OP2INV3	0.00	3.12	0.00	4.25	0.01	4.07	0.01	3.37
S2OP2INV4	0.00	2.73	0.00	3.22	0.01	4.37	0.00	3.43
S2OP3INV1	0.01	5.07	0.01	5.29	0.00	4.09	0.01	2.97
S2OP3INV2	0.01	4.39	0.01	4.58	0.00	3.22	0.01	2.80
S2OP3INV3	0.00	3.76	0.00	4.36	0.01	4.26	0.00	3.00
S2OP3INV4	0.00	2.61	0.00	2.79	0.01	5.39	0.01	3.32
S2OP4INV1	0.01	5.16	0.01	4.85	0.00	4.37	0.00	3.52
S2OP4INV2	0.01	4.62	0.01	5.27	0.00	4.10	0.01	4.25
S2OP4INV3	0.00	3.51	0.00	3.22	0.01	5.18	0.00	2.60
S2OP4INV4	0.01	3.12	0.00	2.88	0.01	5.44	0.01	2.94
GRS	6.64	(0.00)	6.46	(0.00)	4.22	(0.00)	4.51	(0.00)

Table B.35: Explaining triple sorted portfolios on size, operating profitability, and investment (equal-weighted portfolios)

This table compares the pricing ability of the market factor, the momentum factor, Fama-French 5 factors, and the trend factor using 2 × 4 × 4 size, operating profitability, and investment portfolios. The portfolios are equal-weighted. The global trend factor is value-weighted. The α and its Newey and West (1994) t-ratio for each portfolio under different asset pricing models are reported. Column 2-3 report the results for CAPM with the global market factor. Column 4-5 present results for CAPM plus the global momentum factor. Column 6-7 are the results for Fama-French 5 factor model, and the last two columns are the results for CAPM plus the global trend factor. The GRS test statistics as well as its p-value are reported on the last row for each asset pricing model.

	CAPM		CAPM with MOM		FF5		CAPM with Trend	
Portfolio	α	t-ratio	α	t-ratio	α	t-ratio	α	t-ratio
S1OP1INV1	0.01	4.74	0.01	4.88	0.01	5.85	0.02	4.46
S1OP1INV2	0.01	5.10	0.01	5.13	0.01	6.36	0.01	4.73
S1OP1INV3	0.00	2.35	0.01	2.59	0.01	3.66	0.01	2.91
S1OP1INV4	-0.00	-0.00	0.00	0.30	0.01	2.36	0.01	1.42
S1OP2INV1	0.01	7.17	0.01	7.50	0.01	8.68	0.02	7.45
S1OP2INV2	0.01	7.62	0.01	8.04	0.01	9.52	0.01	8.07
S1OP2INV3	0.01	5.61	0.01	6.22	0.01	7.07	0.01	5.81
S1OP2INV4	0.00	1.32	0.00	1.83	0.01	2.91	0.01	2.40
S1OP3INV1	0.01	7.24	0.01	7.51	0.01	8.03	0.01	7.07
S1OP3INV2	0.01	7.81	0.01	8.89	0.01	7.84	0.01	8.01
S1OP3INV3	0.01	7.05	0.01	7.66	0.01	7.69	0.01	7.14
S1OP3INV4	0.00	3.33	0.01	3.82	0.01	4.48	0.01	4.23
S1OP4INV1	0.01	7.23	0.01	7.58	0.01	7.73	0.02	7.74
S1OP4INV2	0.01	7.56	0.01	8.35	0.01	7.33	0.01	7.49
S1OP4INV3	0.01	6.23	0.01	6.88	0.01	5.89	0.01	6.57
S1OP4INV4	0.01	4.03	0.01	3.89	0.01	4.46	0.01	4.16
S2OP1INV1	0.00	2.71	0.01	4.78	0.01	3.74	0.01	4.48
S2OP1INV2	0.00	3.92	0.01	6.71	0.00	5.12	0.01	4.96
S2OP1INV3	0.00	3.18	0.01	5.91	0.01	4.78	0.01	4.52
S2OP1INV4	-0.00	-0.75	-0.00	-0.04	0.01	3.86	0.00	1.23
S2OP2INV1	0.01	4.94	0.01	6.86	0.00	4.41	0.01	5.39
S2OP2INV2	0.01	6.04	0.01	8.44	0.00	5.09	0.01	5.35
S2OP2INV3	0.01	4.65	0.01	6.38	0.01	4.54	0.01	4.72
S2OP2INV4	0.00	2.69	0.00	3.90	0.01	4.25	0.01	3.82
S2OP3INV1	0.01	5.15	0.01	6.58	0.00	3.96	0.01	5.17
S2OP3INV2	0.01	6.18	0.01	7.86	0.01	5.44	0.01	5.48
S2OP3INV3	0.01	5.48	0.01	7.32	0.01	4.88	0.01	4.71
S2OP3INV4	0.00	3.53	0.01	4.87	0.01	5.00	0.01	5.00
S2OP4INV1	0.01	6.37	0.01	8.14	0.01	4.79	0.01	5.73
S2OP4INV2	0.01	5.97	0.01	8.27	0.00	4.72	0.01	5.85
S2OP4INV3	0.01	5.41	0.01	7.19	0.01	4.64	0.01	5.56
S2OP4INV4	0.00	3.12	0.00	3.34	0.01	4.20	0.01	4.00
GRS	11.44	(0.00)	11.26	(0.00)	9.17	(0.00)	8.11	(0.00)