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Abstract

The decomposition of the market return into its cash-flow and discount-rate news driven components reveals that excess returns on low forward discount currency portfolios load positively on 'good' news about the stock market's discount rates while high forward discount currencies load negatively on this news. Average currency portfolio returns are hence explained by different sensitivities to discount-rate news. A two-beta version of the CAPM, distinguishing between cashflow and discount-rate news betas, is able to price both currency and stock returns at the same time. Finally, we find that the relation between stock market news and foreign currency returns varies across the two either discount-rate news or both cash-flow and discount-rate news driven stock market booms of the past two decades.

JEL classification: F31, F37, G15

Keywords: CURRENCY RETURNS, CASH-FLOW NEWS, DISCOUNT-RATE NEWS, MARKET RETURN, UIP

1 Introduction

The recent financial crisis has shifted attention to the observation that carry trades, short positions in low interest rate and long positions in high interest rate currencies, comove with stock markets during the market turbulences of 2007/2008 (Brunnermeier et al., 2009; Lustig et al., 2009). Figure 1 highlights this stylized fact by plotting the monthly excess return on the S&P500 index against the return on a carry trade strategy[1] for the sample period from December 2006 until April 2008.

[about here: Figure 1]

Lustig et al. (2009) show that the CAPM (capital asset pricing model) of Sharpe (1964) and Lintner (1965) does a remarkable job in explaining currency excess returns during crisis periods but explains these cross-sectional return differences over a longer sample period only at the cost of implausibly high risk price estimates.

This paper takes a closer look at this finding. Our starting point is the following: Empirical tests of the CAPM rely on stock market returns as a proxy of the market portfolio. We know since Campbell (1991) that stock market returns move because of news about future cash flows or unexpected future returns (discount rates). Campbell and Vuolteenaho (2004) build upon this insight to show that the simple market beta hides more than it reveals. Despite ample evidence that value stocks, i.e. stocks with high book-to-market value, offer higher average returns than their growth counterparts with low book-to-market value, their market betas are of similar size (Fama and French, 1993). Breaking unexpected movements of the market return into cash-flow and discount-rate news components, Campbell and Vuolteenaho (2004) show that differences in the exposure to the market's cash-flow news explain about a half of the cross-sectional differences between

[1] The carry trade is calculated as return differential between high forward discount and low forward discount currency portfolios constructed by Lustig et al. (2009). Section 3.2 contains a detailed description of portfolio excess returns.

value and growth stock portfolio returns while there is no significant relation between the average value and growth stock returns with their sensitivity to the market's discount-rate news. This finding is in line with the intertemporal asset pricing theory by Merton (1973) which suggests that exposure to cash-flow risks should be rewarded with a higher price of risk than an asset's sensitivity to market discount-rate risks.

We assess if this logic can be validated for assets other than stocks and apply the Campbell and Vuolteenaho (2004) "bad" cash-flow and "good" discount-rate beta CAPM version to the forward discount and currency momentum, i.e. past currency return sorted, currency portfolios of Lustig et al. (2009). In contrast to the evidence for value and growth stocks, we find that the cross-sectional differences in the forward discount sorted currency portfolio excess returns are explained by their sensitivity to the stock market's discount-rate news. The risk price of the market's discount-rate news component is negative which could be rationalized by the fact that we follow Campbell and Vuolteenaho (2004) in defining discount-rate news as "better than expected". A low sensitivity to this "good" news must be rewarded with a higher risk price than a high sensitivity to the "better than expected" discount-rate news. An instance of this pattern has been recently observed in attempts to explain cross-sectional differences in European value and growth stocks with the two-beta variety of the CAPM from a national investor's perspective (Nitschka, 2010). In addition, we find that the two-beta CAPM is able to price both stock and currency portfolio excess returns. Confirming Campbell and Vuolteenaho (2004), average stock returns, the 25 book-to-market and size sorted portfolios from Fama and French (1993), are priced by the differences in the sensitivity to cash-flow news while at the same time currency excess returns are priced by their different sensitivities to discount-rate news.

Finally, we explore the evolution of foreign currencies' risk exposure to unexpected stock market movements over different time horizons with a particular interest in the past two decades. This exercise is motivated by Campbell et al. (2010), who show that the importance of cash-flow and discount-rate news for movements of the market return varies over time. According to the main results of Campbell et al. (2010), the stock market boom of the middle to late 1990s was driven by news about discount rates while a mix of cash-flow and discount-rate news drove the boom period from 2002 to 2007. We assess if the difference in the driving forces of the U.S. stock market during these periods has any impact on our two-beta CAPM based explanation for cross-sectional differences in currency excess returns. Three findings emerge from this exercise. First, we do not find a significant relationship between stock market news and average currency excess returns for the stock market downturn of the early 2000s. Second, differences in the sensitivity to discount-rate news explain average currency excess returns in the boom period from 2002 to 2007 when both cash-flow and discount-rate news contribute to rising stock market prices. Third, in contrast to the results for the latter boom period and the full sample period, currency excess returns during the boom period in the mid to late 1990s seem to be rationalized by their sensitivities to the market's cash-flow news. This latter finding is particularly interesting as this stock market surge is mainly driven by discount-rate news.

The remainder is organized as follows. Section 2 briefly sketches the decomposition of stock returns into cash-flow and discount-rate shocks to break the single CAPM beta of foreign currencies into a cash-flow and a discount-rate beta. Section 3 describes the data. Section 4 presents our empirical results for the U.S. stock market and foreign currency returns and Section 5 concludes.

2 Stock Market Return Decomposition

A standard present value relation states that changes in asset prices must be associated with changes in expected future cash flows or discount rates. This section briefly sketches the log-linear approximate relation which allows to empirically break the returns on the market portfolio into cash-flow and discount-rate components.

Using a first-order Taylor expansion, Campbell and Shiller (1988a) approximate the log one-period return, $r_{t+1} = \ln(P_{t+1} + D_{t+1}) - \ln(P_t)$, around the mean log dividend-price ratio, $\overline{(d_t - p_t)}$, where P_t is price, D_t is the dividend, and lower-case letters are used for logs. The resulting log-linear relation can be applied to any asset return:

$$r_{t+1} \approx k + \rho p_{t+1} + (1-\rho)\, d_{t+1} - p_t \tag{1}$$

where k and ρ are parameters[2] in the linearization, and ρ is strictly less than unity.

Using (1), one can show[3] that the log price-dividend ratio is determined by the expected value of future discounted dividend growth and returns

$$p_t - d_t = \frac{k}{1-\rho} + E_t \sum_{s=0}^{\infty} \rho^s \left[\Delta d_{t+1+s} - r_{t+1+s}\right] \tag{2}$$

where E_t denotes a rational expectation formed at the end of period t and Δ denotes a one-period backward difference. Intuitively, a high stock price today is either associated with high dividends or low returns in the future. Further applying (2) to substitute p_t and p_{t+1} out of the approximate equation (1), Campbell (1991) shows that the unexpected stock return at any time can be decomposed into news about future cash flows (i.e., dividends or consumption) and news about future discount rates (i.e., expected returns). Following Campbell (1991), we write the unpredicted component of return on a stock market index as

$$r^M_{t+1} - E_t r^M_{t+1} = (E_{t+1} - E_t) \left\{ \sum_{s=0}^{\infty} \rho^s \Delta d^M_{t+1+s} - \sum_{s=1}^{\infty} \rho^s r^M_{t+1+s} \right\} \tag{3}$$

where the cash-flow news

$$N^M_{CF,t+1} \equiv (E_{t+1} - E_t) \sum_{s=0}^{\infty} \rho^s \Delta d^M_{t+1+s} \tag{4}$$

[2] More specifically, the parameters are defined by $\rho \equiv \frac{1}{1+\exp\left(\overline{d_t - p_t}\right)}$ and $k \equiv -\ln\rho - (1-\rho)\ln(1/\rho - 1)$. Interestingly, the interpretation of the discount coefficient ρ should not necessarily be linked to the time-series average of the log dividend yield. For example, Campbell (1993, 1996) links it to the average log consumption-wealth ratio.

[3] Specifically, relation (2) results from rearranging (1) for the current stock price, solving it forward iteratively, imposing the standard transversality condition, $\lim_{s\to\infty} \rho^s \left(d_{t+s} - p_{t+s}\right) = 0$, and subtracting the current dividend.

corresponds to revision in expectations about future dividend growth and discount-rate news

$$N^M_{DR,t+1} \equiv (E_{t+1} - E_t) \sum_{s=1}^{\infty} \rho^s r^M_{t+1+s} \tag{5}$$

corresponds to revision in expectations about future discount rates. Even though equations (1)-(3) hold only as approximations, we follow the literature[4] and treat them as exact. While an increase in expected cash flows must be associated with a capital gain, a rise in discount rates leads to a capital loss. Furthermore, as argued by Campbell and Vuolteenaho (2004), returns caused by cash-flow news are never reversed since the shock is permanent. By contrast, returns generated by discount-rate news pertain their mean reverting feature due to the transitory nature of a shock. Hence, the cash-flow news component could be interpreted as permanent, the discount-rate component as transitory part of a stock return.

In order to identify market cash-flow and discount-rate news, we follow Campbell (1991) and assume that the data are generated by a first-order[5] vector autoregressive (VAR) model

$$\mathbf{z}_{t+1} = \mathbf{a} + \mathbf{\Gamma} \mathbf{z}_t + \mathbf{u}_{t+1} \tag{6}$$

where $\mathbf{z}_{t+1}$ is a m-by-1 state vector with r^M_{t+1} as its first element, $\mathbf{a}$ and $\mathbf{\Gamma}$ are m-by-1 vector and m-by-m companion matrix of constant parameters, and $\mathbf{u}_{t+1}$ is an i.i.d. m-by-1 vector of shocks. The model in (6) produces future market returns forecasts

$$E_t r^M_{t+1+s} = \mathbf{e1}' \mathbf{\Gamma}^{s+1} \mathbf{z}_t \tag{7}$$

where $\mathbf{e1}$ denotes a m-by-1 vector whose first element is one and the remain-

[4] Campbell and Shiller (1988a) and Campbell (1991) find that the approximation error is small enough and does not affect the results significantly.

[5] As discussed by Campbell and Shiller (1988a), the assumption that the VAR is first-order is not restrictive, since this formulation also allows for higher-order VAR models by stacking lagged values into the state vector.

ing elements are all zero. Provided that the data are generated by the process in (6), the discounted sum of changes in future return expectations (i.e., the discount-rate news) can be written as

$$\begin{aligned} N^M_{DR,t+1} &= \mathbf{e1}'\sum_{s=1}^{\infty}\rho^s\mathbf{\Gamma}^s\mathbf{u}_{t+1} \\ &= \mathbf{e1}'\rho\mathbf{\Gamma}\left(\mathbf{I}-\rho\mathbf{\Gamma}\right)^{-1}\mathbf{u}_{t+1} \\ &= \mathbf{e1}'\boldsymbol{\lambda}\mathbf{u}_{t+1} \end{aligned} \tag{8}$$

where $\boldsymbol{\lambda} \equiv \rho\mathbf{\Gamma}\left(I-\rho\mathbf{\Gamma}\right)^{-1}$ and $\mathbf{e1}'\boldsymbol{\lambda}$ captures the effect of each VAR state variable shock on discount-rate expectations.[6] Since the identity $\mathbf{e1}'\mathbf{u}_{t+1} = N^M_{CF,t+1} - N^M_{DR,t+1}$ holds true, $t+1$ cash-flow news can be identified as

$$N^M_{CF,t+1} = \left(\mathbf{e1}' + \mathbf{e1}'\boldsymbol{\lambda}\right)\mathbf{u}_{t+1}. \tag{9}$$

The decomposition in equation (3) might be useful in several ways. First, it allows us to study the relative importance of permanent and transitory news components of the stock market index. Secondly, it allows us to understand how currency portfolio returns react to equity market news arrival. In particular, we can investigate how currency returns interact with changes in market discount rates and cash flows.

Empirical evidence suggests that the uncovered interest parity condition fails to hold with the exception of high inflation countries (Hansen and Hodrick, 1980; Fama, 1984; Bansal and Dahlquist, 2000). We therefore define the currency return as $cr^k_t = i^k_t - i_t - \Delta e^k_{t+1}$ where i^k_t denotes country k interest rate, i_t its home country, here United States, equivalent and Δe^k_{t+1} the change in the log spot exchange rate of country k relative to the home currency. Alternatively one could define $cr^k_t = f^k_t - e^k_{t+1}$ exploiting that covered interest rate parity, $f^k_t - e^k_t = \Delta e^k_{t+1}$, holds at daily or lower frequencies (Akram et al., 2008).

At the end of each period t, Lustig et al. (2009) allocate all currencies in a

[6] As discussed by Campbell and Vuolteenaho (2004), the weight of the variable in equation (8) depends on its persistence and on the absolute value of a variable's coefficient in the first regression of the VAR.

sample of 37 countries to six portfolios on the basis of their forward discounts observed at the end of period t. The receptiveness of currency excess return cr^i_{t+1} of portfolio i to stock market cash-flow news is referred to as cash-flow beta of portfolio i

$$\beta^i_{MCF} \equiv \frac{Cov\left(cr^i_{t+1}, N^M_{CF,t+1}\right)}{Var\left(r^M_{t+1} - E_t r^M_{t+1}\right)}, \tag{10}$$

the discount-rate beta is defined analogously

$$\beta^i_{MDR} \equiv \frac{Cov\left(cr^i_{t+1}, -N^M_{DR,t+1}\right)}{Var\left(r^M_{t+1} - E_t r^M_{t+1}\right)}. \tag{11}$$

Both betas obviously add up to the traditional CAPM market beta

$$\beta^i = \beta^i_{MCF} + \beta^i_{MDR}. \tag{12}$$

3 Data

3.1 VAR State Variables

Bianchi (2010) points out that the market return decomposition into its news components and the subsequent "bad beta, good beta" analysis of Campbell and Vuolteenaho (2004) depends strongly on the use of the small stock value spread and the extraction of news series over a sample period that includes the stock market crash that preceded the great depression. Bianchi (2010) shows that the value spread inherits important information from the great depression, such that the original VAR of Campbell and Vuolteenaho (2004) can also be described as a two-state Markov-switching process. One regime is closely related to the great depression, the other is not. The former regime receives a large weight when agents form their expectations according to the ICAPM. Hence, as Campbell and Vuolteenaho (2004) exploit basic insights of the ICAPM, their results strongly depend on this great depression regime. Against this backdrop, we follow as closely as possible Campbell and Vuolteenaho (2004) in specifying the VAR model. The state variables are defined as follows. First, the excess market return r_M^e is measured as the log excess return on the CRSP value-weight index. Second, the yield spread ty between long-term and short-term bonds in measured in annualized percentage points. The original yield spread measured as in Campbell and Vuolteenaho (2004) as the difference between the ten-year constant maturity taxable bond yield and the yield on short-term taxable notes is available up to 2001:12. Since 2002 we measure the spread by the difference between the market yield on U.S. Treasury securities at ten-year constant maturity[7], quoted on investment basis from the Federal Reserve[8] and the annualized three-month U.S. Treasury bill rate. Third, the market's smoothed price-earnings ratio is constructed as the log ratio of the S&P 500 price index[9] to a ten year moving average of S&P 500 earnings. Finally, the fourth variable, the small-stock value spread vs, is computed from the Kenneth R. French data library[10] as the difference between the log book-to-market ratios of small value and small growth stocks. Further details on data construction are available in the appendix to Campbell and Vuolteenaho (2004). Our monthly sample period is running from 1928:12 to 2008:05.

3.2 Currency Portfolio Returns

We use the monthly data set consisting of six foreign currency portfolio returns from a perspective of a U.S. investor constructed by Lustig et al. (2009).[11] The sample contains 37 countries, including both developed and emerging markets for which forward contracts are traded. At the end of month $t+1$, all currencies in the sample are allocated into six portfolios on the basis of their forward discounts[12] observed at the end of period t, net of

[7] To check how closely our measure of yield spread is related to that of Campbell and Vuolteenaho (2004) we have calculated it also for the period prior to 2002. The correlation between both spread measures for the period 1928-2001 turned out highly significant.

[8] http://www.federalreserve.gov/releases/h15/data.htm

[9] Online data is available on http://www.econ.yale.edu/~shiller/data.htm.

[10] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[11] Monthly foreign currency excess return data are available on http://hlustig2001.squarespace.com/downloadable-data/.

[12] Under the covered interest rate parity, the forward discount is equal to the interest rate differential. The cross-section of foreign currency portfolio returns formed on the

transaction costs. The portfolios are rebalanced at the end of every month, so that the first portfolio always contains currencies with smallest forward discounts and portfolio six always contains the largest forward discount currencies. The currency excess return CR^i_{t+1} for portfolio i is computed as the average of the currency excess returns in portfolio i. The currency portfolio returns take into account transaction costs, i.e. bid and ask spreads. Lustig et al. (2009) provide further details on portfolio building methodology. Moreover, Lustig et al. (2009) regard currency portfolios formed according to the previous months' currency excess returns, i.e. momentum. Monthly currency momentum returns are available since December 1983. We thank Adrien Verdelhan for graciously providing us with this data.

Figure 2 presents annualized mean returns (in percentage points) as well as Sharpe ratios on six forward discount rates sorted currency portfolios, on the left, and on six momentum sorted currency portfolios, on the right. Portfolio F1(M1) contains currencies with lowest forward discounts (lowest past returns). Portfolio F6(M6) contains currencies with the highest forward discounts (highest past returns). The data are monthly and the sample period is 1983:12-2008:04.

As visualized in Figure 2, average returns on both portfolio sets increase almost monotonically. The pattern in Sharpe ratios strongly resembles the results obtained by Lustig and Verdelhan (2007), who study risk premia across currency portfolios sorted on past interest rates. For forward discount rate sorted portfolios, average returns vary from -1.23 up to 4.33 percent p.a. Similarly, past losers portfolio M1 promises an excess return of about -1 percent per year and past winners portfolio M6 delivers on average an annual return slightly exceeding the 4 percent mark. A short position in low interest rate currencies and a long in high interest rate currencies implies thus an average return of 5.56 percent p.a. which is of comparable order of magnitude as excess return in equity markets. Analogously, a carry trade strategy in momentum portfolios promises on average a return somewhat higher than 5 percent.

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basis of the foreign interest rates has been studied deeply by Lustig and Verdelhan (2007).

[about here: Figure 2]

4 Empirical Results

4.1 VAR Dynamics

Table 1 reports the basic characteristics of a first-order VAR model, estimated using OLS and employing $\rho = 0.95^{1/12}$ for monthly data. The results do not alter qualitatively for other plausible parameter values. Each row of the table corresponds to a different dependent variable listed in the header of the row. OLS t-statistics are reported in parentheses below the coefficient estimates. The first five columns give coefficients on the explanatory variables listed in the column header; the last column shows the adjusted $\overline{R}^2$ statistics.

The top row of Table 1 gives the results of the stock market return forecasting equation when lags of returns, price-earnings ratio, value spread, and term yield are applied as regressors. All four state variables exhibit some forecasting potential. In line with previous findings, the momentum property is strongly pronounced for monthly returns. The past small-stock value spread negatively forecasts the stock market with a t-statistic of 2.34. Consistent with the literature, the coefficient on term yield is positive and statistically significant. Finally, similar to Campbell and Shiller (1988b), Campbell and Vuolteenaho (2004), and Campbell et al. (2010), a higher price-earnings ratio is statistically significantly associated with lower returns. The $\overline{R}^2$ statistic for the return equation is 2.19% over the full sample.

[about here: Table 1]

The next rows summarize the forecasting power of the VAR system for the remaining state variables. Overall, $\overline{R}^2$ statistics are relatively high and the autoregressive coefficients of the price-earnings ratio, value spread, and term yield are all very close to unity. Several authors have documented and discussed the difficulty of statistical inference and coefficient interpretation resulting from high variable persistence[13] (e.g. Kendall, 1954; Stambaugh, 1999).

Paying caution to the statistical issues mentioned above, the implied news series are extracted from the VAR system using equations (8) and (9). The shocks to cash flows are almost uncorrelated with shocks to expected returns with a correlation coefficient of -0.02.

4.2 Cash-Flow and Discount-Rate Risks of Foreign Currencies

Many studies use equation (3) to investigate equities. Individual stocks as well as broad equity indices have been explored within this framework. To explain the differences in returns across high interest rate and low interest rate currencies, we investigate the interactions between permanent and transitory shocks to the total market wealth, on the one hand, and foreign currency returns, on the other.

Table 2 displays the cash-flow and discount-rate betas of the 12 currency portfolio returns as defined in equations (10) and (11). Panel A delivers the betas for forward discount sorted portfolios, panel B for the currency momentum portfolios.

In line with the results reported in the Lustig et al. (2009) web appendix, the stock market betas, β_M^i, of the currency portfolio excess returns, i.e. the sum of cash-flow and discount-rate betas, are relatively small. In addition, they are mostly negative but do not reveal a clear pattern. This is true for both forward discount and currency momentum sorted currency portfolios.

Campbell and Vuolteenaho (2004) show that differences in cash-flow betas rationalize why value stocks offer higher average returns than growth stocks. Value stocks' cash-flow betas are higher than growth stocks' cash-flow betas. As the ICAPM implies that cash-flow risk should be rewarded with a higher

[13] The appendix to Campbell and Vuolteenaho (2004) discusses the problems associated with persistent forecasting variables and shows that there is little finite-sample bias in the estimated news terms computed using a nonlinear transformation of the companion matrix.

risk price, value stocks have to promise higher returns. This reasoning does not seem to pertain in the context of excess returns on foreign currency portfolios. Neither differences in forward discount nor currency momentum sorted currency portfolio returns seem to be driven by differences in their cash-flow betas.

Interestingly, there is a pattern in discount-rate betas of forward discount sorted currency portfolio returns as mirrored in the last line of Panel A of Table 2. Moving from the low to high forward discount sorted currency portfolios, discount-rate betas decrease with the exception of portfolio F4. Note that we followed Campbell and Vuolteenaho (2004) in defining discount-rate news as "better than expected" news. The low forward discount portfolio return covaries positively with this good news and hence offers a lower return than its high forward discount counterpart that covaries negatively with the good news. An instance of this pattern is also reported in Nitschka (2010) in the context of explaining the cross-section of European value and growth portfolios from the perspective of a national investor. However, we do not find such a pattern for the currency momentum sorted portfolio returns.

In sum, there seems to be a relation between discount-rate betas and excess returns on forward discount sorted currency portfolios. Hence, we should expect the dispersion in the sensitivity to the market's discount-rate news to explain average returns on the forward discount currency portfolios.

[about here: Table 2]

4.3 Cross-Sectional Pricing Results

4.3.1 Full Sample Period

We use the cash-flow and discount-rate betas as well as the market betas from the previous subsection, presented in Table 2, to assess the explanatory power of the CAPM and the two-beta version of the CAPM when confronted with returns on foreign currencies. Therefore, we follow Fama and MacBeth

(1973) and run cross-sectional regressions of the Lustig et al. (2009) currency portfolio excess returns on either their market betas or their estimated cash-flow and discount-rate betas at each point in time, i.e.

$$cr_t^i = \beta_M^i \lambda_M + v_t, \forall t \tag{13}$$

or

$$cr_t^i = \beta_{CF}^i \lambda_{CF} + \beta_{DR}^i \lambda_{DR} + v_t, \forall t \tag{14}$$

with cr_t^i the excess return on currency portfolio i as defined in previous sections. We do not consider constant terms in the cross-sectional regressions as we deal with excess returns. Our cross-sectional pricing exercises over the sample period from 1983:11 to 2008:4 are summarized in Table 3. Panel A of Table 3 provides the results for the single-beta CAPM. Panel B of Table 3 gives the corresponding results for the two-beta CAPM. We confront the two models with four sets of test assets. The results for the different test assets are reported in the columns (1) to (4). Table 3 reports second-stage Fama-MacBeth estimates of the risk prices using (1) six forward discount rate sorted, (2) six currency momentum sorted, (3) all twelve currency portfolio, and (4) six forward discount sorted currency portfolio returns together with the 25 Fama and French (1993) size and book-to-market sorted stock portfolios as test assets.

[about here: Table 3]

At first glance, the performance of the CAPM does not seem to be particularly bad. As the first column of Panel A of Table 3 shows, the CAPM explains about a half of the cross-sectional dispersion in forward discount sorted currency portfolio returns. The risk price of the market return, however, is about seven times larger than the sample average of 5.9% p.a. The second column shows that the CAPM is not able to explain average returns on currency momentum sorted currency portfolios. Considering both forward discount and currency momentum sorted portfolios as test assets, the market return is significantly priced but the risk price is again too high. Additionally including the 25 Fama and French (1993) book-to-market and size sorted stock portfolio returns drives down the risk price but at the expense of very high pricing errors. In sum, our results confirm the point made by Lustig et al. (2009). The CAPM is not a good model for the pricing of foreign currency returns despite its benign performance during the recent crisis period.

Panel B of Table 3 gives the corresponding results for the two-beta CAPM. In line with the pattern in cash-flow and discount-rate betas of forward discount sorted currency portfolio returns highlighted above, differences in discount-rate betas explain the cross-sectional dispersion in these currency portfolio returns. The risk price is negative but can be easily explained. Since we follow Campbell and Vuolteenaho (2004) in defining discount-rate news as 'better than expected', the excess returns on the low forward discount currency portfolio loads positively on the market's discount-rate news while the high forward discount currency portfolio covaries negatively with the good news. Hence, the risk price has to be negative. This pattern has been observed by Nitschka (2010), who assesses if the cross-sectional dispersion in European value and growth stock portfolio returns can be explained from a national investor's perspective using two-beta versions of the CAPM. Table 3 additionally reveals that the two-beta variety of the CAPM gives slightly lower pricing errors than the single-beta CAPM but the fit is not much better. It fails to explain the cross-sectional variation in currency momentum sorted currency portfolios (see column (2) of Panel B) which explains its relatively poor performance when confronted with both forward discount and currency momentum sorted currency portfolios (see column (3) of Panel B). It is clear from these findings that the two-beta CAPM is not a perfect description of foreign currency returns' cross-sectional dispersion. The two-factor model by Lustig et al. (2009) currently seems to be the best model for that purpose.

The two-beta CAPM, however, is very useful to reveal that different asset classes react differently to news driving stock market returns. The fourth column of Panel B of Table 3 presents the risk price estimates when forward discount sorted currency portfolios and 25 book-to-market and size sorted stock portfolios are jointly considered as test assets. It shows that both cash-flow and discount-rate news are significantly priced. This finding reflects the main result of this paper – forward discount rate sorted currency portfolio returns are explained by differences in their sensitivities to the stock market's discount-rate news – and the seminal contribution of Campbell and Vuolteenaho (2004) showing that cash-flow news drives average returns on value and growth stocks. The two-beta variety of the CAPM allows to price both asset classes at the same time while highlighting the different sources of differences in average stock and foreign currency returns.

4.3.2 Stock Market Booms and Busts

So far we have documented that there is a relation between the cross-section of foreign currency returns and news about expected returns on the U.S. stock market. Recently, Campbell et al. (2010) emphasized that stock market booms and crashes in the past two decades had different causes. They find that the stock market boom of the mid-1990s was primarily driven by rational investor's expectation about falling discount rates, while the subsequent bust in 2000 - 2002 reflected an increase in discount rates. The following boom of the early and mid-2000s was fuelled by a mix of cash-flow and discount-rate news, but the latest bust is clearly driven by worse cash-flow prospects.

In this section, we assess if the relation between currency portfolio returns and stock market news that we presented in the previous section is influenced by the particular driving forces of the stock market. Using the forward discount sorted currency portfolio returns as test assets, we therefore assess the performance of the two-beta CAPM for three subsample periods following Campbell et al. (2010): (1) 1995:01 – 2000:02, (2): 2000:03 – 2002:08, and (3) 2002:09 – 2007:08. Table 4 summarizes our results. Each column displays the results for one of the three subsample periods. Risk prices and pricing errors are in annualized percentage points.

[about here: Table 4]

Campbell et al. (2010) show that the stock market surge from the mid- to end-1990s was primarily driven by lower expected discount rates. Interestingly, the cross-section of forward discount sorted currency portfolio returns seems to be explained by cash-flow news during this period as column (1) in Table 4 suggests. This finding stands in marked contrast to our results over the full sample period. The second column of Table 4 shows that we cannot relate average currency returns to the stock market's news series during the crash period. The results presented in the third column of Table 4 for the stock market boom phase of 2002 – 2007, driven by both cash-flow and discount-rate news according to Campbell et al. (2010), delivers again the pattern observed over the full sample period. Differences in the sensitivity to discount-rate news partly explain cross-sectional dispersion in average foreign currency portfolio returns.

The differences between the pricing results for the two stock market boom periods are striking. A comparison between these two stock market boom periods delivers also interesting differences in terms of average foreign currency returns. As revealed by Table 5, while still exhibiting the monotonically increasing pattern from low to high forward discount currencies, average foreign currency returns were all negative during the 1990s stock market surge (see column (1) of Table 5) but positive in the 2002 – 2007 boom period.

[about here: Table 5]

Taken together, the descriptive statistics and the pricing exercises conducted in this section show that the distinction between expected discount-rate and cash-flow news driven periods matters for the pricing of foreign currency returns. While the basic finding of Lustig and Verdelhan (2007) and Lustig et al. (2009), average excess returns monotonically increase with average forward discounts or interest rate differentials, pertains to both stock market boom periods under study, the explanation of their cross-sectional differences varies. What is even more striking is the marked difference in the level of foreign currency returns during the stock market boom periods. The sign of currency returns does not seem to be only linked to stock market up- and downturns as suggested by Lustig et al. (2009) but also influenced by the kind of news driving the stock market.

5 Conclusions

Over long time periods, low interest rate/forward discount currencies typically payoff poorly, whereas high interest rate/forward discount currencies consistently generate positive excess returns. To understand what hides behind profitable carry trade strategies, this paper studies the interaction between aggregate stock and foreign exchange markets. We start by decomposing the market return into its "bad" cash-flow and "good" discount-rate components. This decomposition allows to show that excess returns on low forward discount sorted currency portfolios load positively on "good" news about the market's discount-rate news whereas their high forward discount counterparts load negatively on this "better than expected" news about future returns. In line with this observation, this paper shows that average returns on forward discount sorted currency portfolios are related to differences in their sensitivity to the stock market's discount-rate news. These results also highlight that neither variety of the CAPM, single- or two-beta, is a particularly good model for explanations of foreign currency returns compared to the benchmark of the Lustig et al. (2009) two-factor model. The two-beta model, however, prices both stock and currency returns at the same time.

With a focus on the two recent stock market booms in the U.S., we additionally present evidence of a link between the relative dominance of the two stock market's news components and explanations for the cross-sectional dispersion in foreign currency returns. During the stock market boom from 2002 to 2007, driven by a mix of cash-flow and discount-rate news, differences in the sensitivity to discount-rate news explain average returns on forward discount sorted currency portfolio returns. In contrast to this finding and our results over the full sample period, average excess returns on currency portfolios during the stock market surge in the mid- and end-1990s are explained by their exposure to the stock market's cash-flow news. This finding is particularly interesting since this stock market boom period was primarily driven by discount-rate news.

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7 Tables

Table 1: VAR Characteristics

The table shows the OLS parameter estimates for a first-order VAR model including a constant, the market return (r^M), price-earnings ratio (pe), small-stock value spread (vs) and term yield spread (ty). OLS t-statistics are in parentheses. Each row corresponds to a different dependent variable. The first five columns report coefficients on the explanatory variables listed in the column header; the last column shows the adjusted $\overline{R}^2$ statistics. The sample period is 1928:12-2008:04.

	constant	r_t^M	ty_t	pe_t	vs_t	$\overline{R}^2(\%)$
r_{t+1}^M	0.00	0.10	0.01	-0.02	-0.01	2.19
	(3.39)	(2.96)	(1.98)	(-3.03)	(-2.34)	
ty_{t+1}	0.00	0.03	0.89	-0.03	0.08	83.09
	(0.22)	(0.20)	(60.31)	(-1.10)	(3.02)	
pe_{t+1}	0.00	0.52	0.00	0.99	-0.00	99.07
	(1.90)	(23.87)	(0.94)	(296.57)	(-0.96)	
vs_{t+1}	0.00	-0.01	0.00	-0.00	0.99	98.37
	(1.14)	(-0.27)	(0.05)	(-0.37)	(209.16)	

Table 2: Cash-Flow and Discount-Rate Betas

The table presents estimated cash-flow and discount-rate betas relative to the total market beta for twelve currency portfolios. Panel A describes forward discount rate sorted currency portfolios. Panel B describes momentum sorted currency portfolios.

Panel A: Forward Discount Date Sorted						
Portfolio	F1	F2	F3	F4	F5	F6
β^i_M	0.04	-0.07	-0.21	-0.02	-0.31	-0.23
β^i_{CF}	-0.14	-0.12	-0.16	-0.10	-0.10	0.04
β^i_{DR}	0.18	0.05	-0.05	0.08	-0.21	-0.27
Panel B: Currency Momentum Sorted						
Portfolio	M1	M2	M3	M4	M5	M6
β^i_M	-0.46	-0.21	0.01	-0.11	-0.07	-0.20
β^i_{CF}	-0.12	-0.20	-0.08	-0.12	-0.05	-0.03
β^i_{DR}	-0.34	-0.01	0.09	0.01	-0.02	-0.17

Table 3: Fama-MacBeth Cross-Sectional Regressions

The table reports the Fama-MacBeth estimates of the risk prices using (1) six forward discount rate sorted currency portfolios, (2) six currency momentum sorted currency portfolios, (3) all twelve currency portfolios, and (4) six forward discount rate sorted currency portfolios as well as 25 size and book-to-market sorted stock portfolio returns as test assets. Fama-MacBeth (1973) t-statistics are in parentheses. Panel A reports results from standard CAPM; Panel B reports results from two-beta CAPM. Risk prices, mean squared pricing errors (MSE) and the mean absolute pricing errors (MAE) are reported in percentage points p.a.

	(1)	(2)	(3)	(4)
Panel A: CAPM				
λ_M	42.05	19.32	35.33	8.58
	(2.89)	(1.25)	(2.72)	(2.55)
R^2	0.55	-0.02	0.22	0.20
MSE	2.44	5.47	4.80	12.88
MAE	1.39	1.88	1.61	2.55
Panel B: Two-Beta CAPM				
λ_{CF}	-5.35	-5.27	-3.19	10.97
	(-0.51)	(-0.50)	(-0.32)	(3.30)
λ_{DR}	-11.83	-0.87	-6.62	-1.58
	(-2.77)	(-0.24)	(-1.89)	(-2.21)
R^2	0.51	-0.29	-0.05	0.60
MSE	2.09	5.34	4.55	6.44
MAE	1.10	2.05	1.79	2.02

Table 4: Fama-MacBeth Cross-Sectional Regressions

The table reports the Fama-MacBeth estimates of cash-flow and discount-rate news risk prices using six forward discount rate sorted currency portfolios as test assets for the two-beta CAPM. Column (1) reports results for the sample period 1995:01 – 2000:02, column (2) the corresponding results for the sample period 2000:03 – 2002:08, and finally column (3) gives estimates for the period from 2002:09 – 2007:08. Fama-MacBeth (1973) t-statistics are in parentheses. Risk prices, mean squared pricing errors (MSE) and the mean absolute pricing errors (MAE) are reported in percentage points p.a.

	(1)	(2)	(3)
	Two-Beta CAPM		
λ_{CF}	2.01	15.28	25.30
	(2.10)	(0.58)	(0.64)
λ_{DR}	0.36	-4.72	-60.29
	(0.64)	(-0.39)	(-2.97)
R^2	0.31	-0.01	0.43
MSE	4.23	14.27	5.28
MAE	1.84	3.34	1.87

Table 5: Average Currency Excess Returns

The table reports average excess returns on forward discount sorted currency portfolios for three subsample periods. Column (1) reports returns for the sample period 1995:01 – 2000:02, column (2) the corresponding excess returns for the sample period 2000:03 – 2002:08, and finally column (3) gives currency portfolio returns for the period from 2002:09 – 2007:08. All returns are reported in percentage points p.a. Portfolio F1 contains currencies with lowest forward discounts. Portfolio F6 contains currencies with the highest forward discounts.

	(1)	(2)	(3)
Average Currency Returns			
F1	-7.56	-7.61	0.98
F2	-4.56	-5.17	1.38
F3	-3.62	-0.44	5.41
F4	-4.91	3.25	5.35
F5	-2.31	-1.71	6.21
F6	-0.02	1.75	9.78

8 Figures

Figure 1: Foreign Exchange and Equity Markets

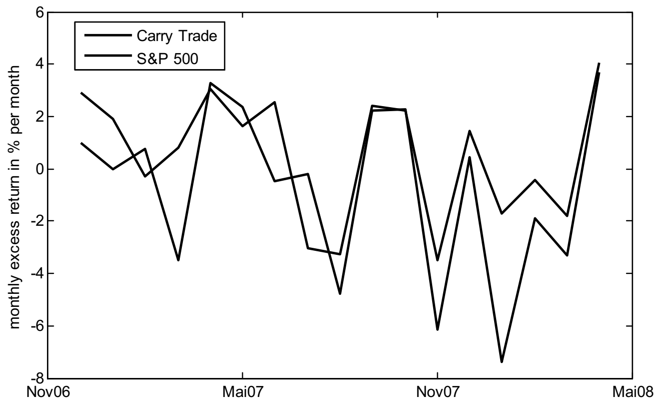
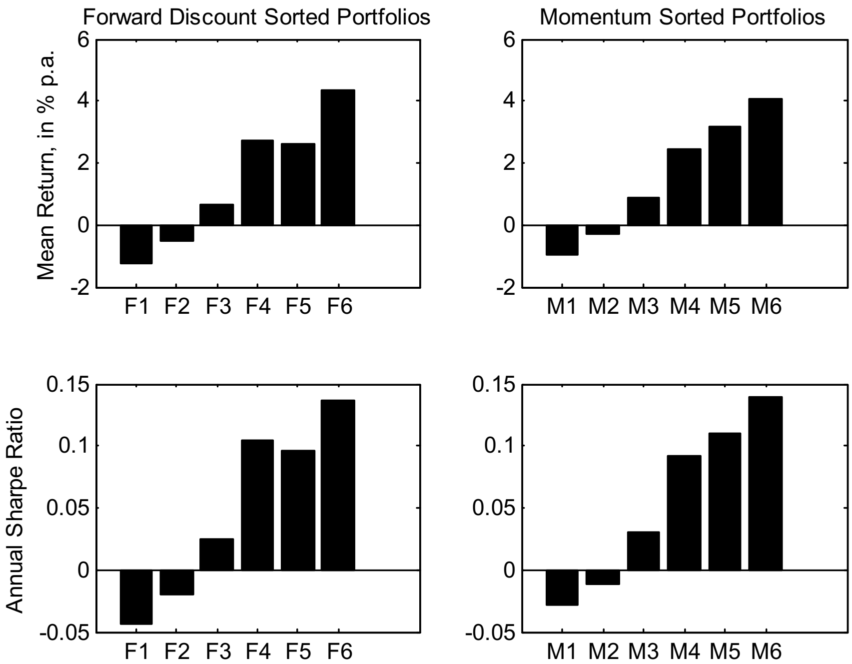


Figure 2: Twelve Foreign Currency Portfolios

The figure plots average returns (in % p.a.) and annual Sharpe ratios on six forward discount rate and six momentum sorted currency portfolios over the sample period from 1983:12-2008:04.



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