Active Currency Management Part II: Is There Skill or Alpha in Currency Investing?

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Comments welcomed

PRELIMINARY

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In this paper, we provide an overview of the main features of active currency management programs, highlighting the mandates and the types of trading strategies that are often used. The traditional benchmark used to measure skill or alpha in currency investing is that the expected excess rate of return is zero. We offer an alternative standard where the expected rate of return is related to naïve style factors based on strategies that an investor could adopt assuming no special expertise. We review empirical evidence on the performance of both individual currency fund managers and indices of managers using the alternative benchmark. We find that a large percentage of variation in currency fund returns can be attributed to style indices. As a result, performance measures and rankings of currency funds may vary greatly depending on the benchmark used. We review related empirical evidence on fund management styles and survivorship and discuss the implications for currency management strategy and setting currency fund management fees.

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Active Currency Management Part II:

Is There Skill in Currency Investing (Alpha)?

A. Introduction

The landscape of active currency management has changed dramatically over the last 25 years. In the 1980s, while a small number of professionals engaged in speculative currency trading, an investment manager acquired currency exposure primarily as a by-product when investing in either foreign currency denominated stocks or bonds. A 1991 *Financial Times* article on the growing appeal of overseas assets for U.K. fund managers noted that

> Since 1987 overseas bonds have also begun to attract interest - accounting for 2 per cent of average assets by the end of 1989. In the view of many observers - though by no means all - they are set to become a permanent asset class in their own right in the 1990s.[1]

For sure, a few boutique firms that specialized in currency viewed things differently. In 1988, an article in *Pensions and Investment Age* addressing the issue of whether foreign currency holdings ought to be hedged, noted that

> Some [pension executives] also might overlay currency management onto existing international portfolios, thereby treating currency as a separate *asset class*. (emphasis added)[2]

The realization that the currency component of an international portfolio might be actively hedged, and profitably so, led some managers to consider offering currency management as a separate product. A 1988 *Financial Times* article put it this way:

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[1] Tim Dickson, "The Growing Appeal of Overseas Assets," *Financial Times*, Survey on Pension Fund Investment, April 18, 1991, p. IV.

[2] Marlene Givant, "Hedged Indexes Mulled," *Pensions and Investment Age, June 27, 1988*, p. 2.

> Fund managers can engage in more active hedging programmes on a tactical basis, but this is where the line between genuine hedging and active currency management becomes blurred. For example, many fund managers which accumulated a good in-house track record in hedging decided a few years ago to develop their experience and launch *managed currency funds*, which concentrate entirely on forecasting exchange rate movements. (emphasis added)[3]

A Lexis-Nexis search of newspapers and periodicals for the keywords "currency" and "asset class" in the same article shows only a handful of articles each year in the years prior to 1990.[4] By 2007, the annual number of mentions for this pair of keywords exceeded 1,100. While not all of these articles referred to currency *as* an asset class, the notion of taking currency formally into account and separately managed by a currency professional, has become part of the international investment manager's basic toolkit.

Despite all of the increased attention to currencies within international portfolios, some basic questions remain. The first is whether currency exposure should be left unhedged or hedged, and if the latter, whether the hedging program should be passive (in the sense of following a set rule) or active where a manager is allowed discretion to reduce, retain, or expand currency positions.[5] A second question is whether active currency managers could offer additional return (portable alpha) to institutional investors (regardless of existing foreign currency exposure) and what is the appropriate standard for evaluating their performance. And finally, there is the empirical question of whether currency managers tend to meet, fall short of, or exceed the performance standard.

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[3] Andrew Freeman, "Now Equity Managers Cut the Risk – Currency Hedging," *Financial Times*, October 26, 1989, Survey on International Fund Management, p. VI.

[4] There were no mentions of "currency" and "asset class" in the same article from 1975 until 1982. The first mention in a single article appears in 1983.

[5] See Thomas (1990) for a collection of articles that framed many of the salient issues.

In the remainder of this paper, we address all three questions, with our primary focus on the appropriate benchmark for performance and the empirical track record of active currency managers. We continue in the next section with a review of the types of mandates that are typically set for currency managers, and the types of strategies that active currency managers might employ. The mandate plays a critical role in determining the appropriate benchmark. Section C lays out the traditional benchmark for currency fund management and then develops an alternative benchmark in which expected returns depend on certain style factors. In sections D and E, we present empirical evidence on the performance of various individual currency funds and indexes of those funds. The empirical evidence shows that a high proportion of the variation in returns (meaning 50%, 60%, and in some cases 70% depending on the sample) can be explained by four style factors. While neither an index of funds, nor an average of available funds, earn alpha (relative to our alternative standard), some individual managers do. Moreover, we find some evidence of alpha persistence among individual outperforming managers.[6] Persistence is a desirable feature for plan sponsors who actively pick currency managers. These findings lead to a set of investment implications that we summarize in the final section.

B. Alternative Currency Management Mandates

While each agreement between an institutional investor and their currency manager is unique, for discussion purposes it is useful to consider first the types of mandates that are in common use

[6] Empirical evidence in Pojarliev and Levich (2010) is consistent with a significant degree of beta persistence, meaning investment style persistence, which is also advantageous for plan sponsors.

and some of their key features, and second, other structural and operational choices that differentiate mandates. By varying these contractual parameters, institutional investors influence their expected alpha (what we will call the alpha continuum) as well as their exposure to risk.

B1. Features of a Currency Mandate

There are two basic types of currency mandates. In an **absolute return mandate**, the investor seeks to earn a positive return, usually in excess of some benchmark, and subject to acceptable risk levels. With a **currency overlay mandate**, on the other hand, the investor already owns a portfolio of foreign debt or equity and the objective of the mandate is either to entirely eliminate currency risk from the portfolio, or only partially reduce currency risk while opportunistically going after return.[7]

In both absolute return and currency overlay mandates, the agreement will specify how much latitude the manager has to operate, identify provisions that constrain the manager, and of course spell out how the manager's performance will be determined and the formula for setting compensation. The main considerations stipulated in a currency mandate will include:

[7] Hedging within a currency overlay strategy often takes a fairly simplistic objective of establishing a predictable home currency value for assets denominated in a foreign currency. For example, consider an American plan sponsor whose financial statements and returns are prepared in USD. If the plan sponsor owns shares in Volkswagen valued at €100, selling 100 EUR for USD establishes a known USD value for the foreign assets. The hedge will likely be imperfect owing to the fact the EUR share price of Volkswagen itself will likely be sensitive to the EUR/USD exchange rate.

- **Passive versus active management**. A passive manager is constrained to simply track a predefined benchmark and does not seek to generate excess returns. Because most benchmarks are constructed from a clearly articulated investment process, a passive manager often follows a systematic or rule-based approach.[8] For example, if the AFX Currency Management Index based on 3 moving average trading rules and 7 currency pairs is used as a benchmark, then a passive manager could use these same moving average rules and currency pairs to govern his trading.[9] For an absolute return mandate, trading designed to mimic benchmarks based on carry trading, trend following, value trading strategies or volatility are all examples of passive strategies. For a currency overlay mandate, always fully hedging the currency position in a fixed income portfolio or always hedging 50% of the foreign currency value of the position are typical examples of passive strategies.

  On the other hand, the active manager has discretion to implement a variety of trades based on different ideas. For an absolute return mandate, the active manager seeks to add value on top of the benchmark and would do so by entering into trades that deviate from

[8] Some market professionals have taken issue with this definition. Melvin and Shand (2011) note that tracking any currency trading index involves some degree of active management as positions must be bought and sold as underlying market conditions change. While trade execution is important and can impact returns even for the manager of an S&P 500 index fund, Melvin and Shand suggest that these issues are more acute for currency where there is no natural buy and hold strategy. Melvin and Shand (2011, p. 2) conclude that "there really is no passive strategy for currency investors."

[9] The AFX Currency Management Index is based on trading in seven currency pairs weighted by their volume of turnover in the spot market, with returns for each pair based on an equally-weighted portfolio of three moving average rules (32, 61 and 117 days). The seven currency pairs are EUR-USD, USD-JPY, USD-CHF, GBP-USD, EUR-JPY, EUR-GBP, and EUR-CHF. More information about the index is available at http://www.ljmu.ac.uk/LBS/102316.htm .

the benchmark. An active currency overlay manager who felt that foreign currency had a strong chance of appreciating could hedge only 25% of the foreign currency exposure in a fixed income portfolio instead of 100% in an attempt to add extra return. Whether under an absolute return or currency overlay mandate, an active manager might adopt a systematic or rule-based investment process, a discretionally investment process, or combination of both.

- **Allowed currencies**. A currency mandate agreement will typically constrain the manager to operate within a set menu of currencies, perhaps restricted to the G3 or G10 countries where financial markets offer greater depth, or G20, or emerging market (EM) countries where markets are less liquid, but greater profit opportunities may be present. A wider range of allowed currencies may be more valuable in the case of an absolute return mandate, although some managers may prefer to limit themselves to only those currency pairs where they have greater expertise. In a currency overlay, the allowed currencies are often limited to those currencies in the underlying portfolio, although not always, as cross-hedging can be a useful tool.

- **Permitted instruments**. A currency mandate agreement may also specify which instruments the manager is permitted to use. The manager may be constrained to trade spot and forwards contracts only, or he could be allowed discretion to use plain vanilla currency options or other derivative instruments such as exotic currency options (barrier or basket options etc.). In the case of a currency overlay agreement, derivatives may offer a more efficient way of hedging particular risks in the underlying portfolio, or of taking asymmetric trades that leave the underlying portfolio unharmed if the currency moves in one direction, but allows the manager to benefit if the currency moves in a way that he

has forecasted. In the case of an absolute return mandate, derivative instruments are often a more efficient way to obtain leverage, and so whether or not they are permitted may be linked to how much leverage is allowed by the mandate.

- **Leverage.** The degree of leverage allowed is an important consideration for absolute return mandate agreements and also for currency overlays that have some return seeking objective. A manager could be constrained to use leverage, or allowed discretion to vary leverage up to some limit, depending on market conditions. For an absolute return mandate, leverage up to a factor of 10 is typical, but greater leverage is feasible and sometimes observed in certain hedge funds or managed trading accounts. Rather than specify leverage, a currency mandate could instead specify target volatility, expected return or worst permitted drawdown.

- **Performance benchmark and compensation**. Last but certainly not least, a currency mandate will specify how performance, or really outperformance, will be measured and how performance will be compensated. For an absolute return mandate, when a manager is given trading authority over a pool of funds, the benchmark for performance on those funds could be LIBID, or LIBID + X, or some other index denominated in the investor's base currency. Investing the assigned assets at LIBID is essentially risk free, while benchmarks greater than LIBID entail risk. When the manager receives only a line of credit against funds that are invested elsewhere, then the benchmark for performance can be zero, an amount X>0, or another measure of performance. A manager who never draws on the credit line, and never takes a currency position, will earn zero return and incur zero risk. Active use of the credit line in the pursuit of positive returns entails risk. Performance benchmarks for a currency overlay manager are usually designed to reflect

the returns from a continuum of hedging choices from no hedging through continuous hedging of the entire underlying position. The returns from a strategy of a continuous 50% hedge are often taken as a naïve benchmark for a currency overlay manager. We will discuss the economic rationale for these benchmarks in Section C.

Manager compensation itself often has several parameters, most always an annual management fee and a performance incentive fee based on annual returns. For high net worth individuals and funds of funds that invest in currency hedge funds, the most common fee structure is a 2% per annum management fee (based on assets under management) and a 20% share of profits earned over the year.[10] Institutional clients are likely to negotiate management fees that are far lower while still being subject to the 20% performance fee. In addition, compensation is usually governed by a high-water mark rule such that annual[11] performance fees are paid only to the extent that returns push the manager's cumulative returns above the previous high-water mark.[12]

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[10] A review of the fee structure for currency funds who report through the TASS and CISDM databases shows that the 2% management fee and 20% performance fee are the modal charges. However, some managers assess fees that are higher than the "2 and 20" and others charge less.

[11] Many funds calculate performance fees based on monthly or quarterly performance, subject to lifetime or rolling high-water marks.

[12] For example, consider an absolute return mandate where initial AUM is $100 and first year returns are 25% pushing the AUM to $125. The manager is paid a performance fee of 20% on the $25 profit, so that AUM at the start of year 2 is $120. If the manager loses 10% in year 2, AUM declines to $108 and no performance fee is paid. If the manager gains 20% in year 3, AUM rises by $21.6 to $129.6. The manager is paid his performance fee only on the portion of annual profits, $9.6 in this case, that pushes the funds AUM above the earlier high-water mark of $120.

B2. Structural and Operational Choices

The agreement between an institutional investor and manager is also likely to lay out various structural or operating principles of the relationship. Perhaps the most fundamental choice is whether, or to what degree, the account is funded or unfunded. In a **funded program**, the investor designates specific funds that are placed in custody accounts where the manager is permitted to trade. For example, a pension fund sponsor might allocate $10M to a currency fund manager. If the mandate allows for 10 times leverage, the currency manager would have up to $100M AUM to invest. These funds would be placed on deposit earning LIBID unless otherwise committed to a foreign currency trading strategy. If the pension fund sponsor had begun with $100M in global equity holdings, carving off $10M for currency would change the sponsor's exposure to $90M in global equity, and $10-$100M in currency, depending on the degree of leverage devoted to currency.

In an **unfunded program**, the plan sponsor retains custody of his underlying assets, but earmarks some of those assets to collateralize a trading account for use by the currency manager.[13] In this case, initially the currency manager has no assets and so faces a zero return unless trading positions are established.

[13] The plan sponsor may have to provide cash as collateral rather than securities. Typically, a currency overlay program for a $100 million foreign currency portfolio could be supported by $10 million in cash collateral.

In principle, an absolute return mandate could be executed through either a funded or unfunded structure. A currency overlay mandate is more commonly implemented using an unfunded structure as the plan sponsor may wish to retain the ability to trade the underlying foreign currency assets that require the overlay.

Other operational choices may be covered in a currency mandate such as which banks and exchanges may be used for trading. The introduction of so-called "prime brokerage" services by investment banks has allowed hedge fund managers to source liquidity from a variety of market makers while maintaining a credit relationship, placing collateral, and settling with a single entity – the prime broker. Thus, prime brokerage allows hedge funds, despite having a possibly limited credit history or higher risk profile, to use the prime broker's credit rating to gain access to new counterparties. Typical services offered by the prime broker are leverage, access to market liquidity, and consolidated settlement, clearing, and reporting. The availability of prime brokerage services allows more experienced currency traders and strategists to set up as currency managers who can secure sponsor mandates and operate efficiently.

B3. The Alpha Continuum and Implications of Active Currency Mandates

As the above discussion suggests, an agreement between an institutional plan sponsor and a currency manager has numerous features, some of which allow the manager to have greater latitude in pursuing excess returns and managing risks, and other aspects that constrain him. By agreeing on a mandate, the sponsor and currency manager target a combination of expected return and risk. At one extreme, the sponsor can design a currency overlay mandate intended to

provide only currency risk reduction with no expected return. And at another extreme, the sponsor can design an absolute return mandate to authorize the currency manager to hunt for the maximum alpha conditional on an acceptable level of risk.[14] Between these two extremes, we observe an alpha continuum of target alpha levels and risks.

With many possible types of mandates, each one constrained or liberated to pursue return in a unique way, it may be difficult to agree on a unique performance benchmark. Melvin and Shand (2011) highlight many of the differences in trading styles, objectives, risk management strategies, and so on that make it difficult to create a widely-accepted performance benchmark in the currency asset class. We discuss alternative performance benchmarks in the next section.

[14] By definition, alpha is the difference between the absolute return earned and the return on the benchmark, so not all absolute return is included in alpha. In the next section, we propose alternative benchmarks and alpha measures.

C. Benchmarks for Currency Fund Management

In Section B, we described two alternative currency management mandates – a currency overlay mandate and an absolute return mandate.[15] Because a currency overlay mandate is often primarily concerned with risk reduction while an absolute return mandate is more focused on generating additional returns, the methodology for benchmarking these mandates differs considerably.

In the case of a currency overlay, the objective is always to hedge some portion of the pre-existing currency risk in an asset portfolio. In addition, the mandate may also include the option for the overlay manager to capture some additional return via selective hedging. The currency overlay manager could be evaluated versus a benchmark of performance calculated as if 0% of the underlying exposure were hedged, or as if 100% of the exposure were hedged.[16] Strange (1998) argues that ultimately the performance of managers evaluated against these benchmarks depends on whether the base currency for measuring performance appreciated or depreciated over the cycle. For this reason, Strange suggests that the 50% hedge ratio became the most popular benchmark. A currency manager is deemed to add value if he outperforms a naïve strategy of hedging half the exposure, as if having no expertise to determine whether a currency was rising or falling relative to its forward premium. Strange reports that in his sample of 152

[15] The pure alpha mandate could also be thought of as an absolute return mandate.

[16] Strange (1998) refers to these as polar benchmarks.

overlay programs managed by 11 firms, on average 80% outperformed their individually specified benchmarks.[17]

In this paper, however, our primary interest concerns the benchmarking and performance of fund managers with absolute return mandates. We identify three types of benchmarks – a traditional benchmark in widespread use among currency management professionals, an alternative benchmark based on the returns of various investment style factors, and finally another alternative benchmark based on the expected return for bearing foreign exchange risk.

According to the traditional benchmark, the expected rate of return associated with holding currency risk is zero. This conventional benchmark gained credence from macroeconomic models of the 1970s supplemented by financial theory according to which currency risk was diversifiable and therefore not a risk compensated by a risk premium. Another way of expressing this idea is that foreign exchange trading is a zero-sum game where every profitable position is matched by an opposite losing position.[18] According to this argument, unlike equities or real estate, currency does not generate a net profit to reward all holders of currency risk. Moreover, to the extent that currency returns were shown to exist, empirical studies showed that these returns were uncorrelated with a general market index. Currency was therefore seen as a zero-beta asset that in equilibrium was not associated with a positive expected rate of return. And finally,

[17] Strange also notes that in his 1998 study, the earliest mandates had been given out only 10 years earlier, or about the year the financial press first began reporting on currency as an asset class.

[18] A recent article in the *Financial* Times (December 15, 2010) Lex column also makes these points.

numerous studies argued that exchange rate changes were largely unpredictable, and that the most consistent currency forecast was one based on the random walk assuming no drift.[19] In that setting, speculators have no special ability to out-forecast the market, so the expected return from currency speculation could be zero.[20]

By comparison, Arbitrage Pricing Theory (APT) offers an alternative approach for modelling the expected rate of return on financial assets.[21] APT posits that the expected return on a financial asset can be expressed as a linear function of certain macro-economic factors or market indices. APT was developed in the context of pricing stocks.[22] More recently, Fung and Hsieh (2002) used an APT framework to model hedge fund returns. The model specification takes the form

$$R_t = \alpha + \sum_i \beta_i F_{i,t} + \varepsilon_t \qquad (1)$$

where

R is the fund's return at time t

α is a measure of active manager skill,

F is a style factor,

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[19] Meese and Rogoff (1983a) are responsible for this famous result. Returning to the topic years later, Rogoff (2002) writes "To make a long story short not only have a subsequent twenty years of data and research failed to overturn the Meese-Rogoff result, they have cemented it, …"

[20] If the random walk, no drift model is taken seriously, then the carry trade in which speculators borrow a low interest rate currency and invest in a high interest rate currency ought to earn an expected profit (subject to risk).

[21] The original formulation of the APT is due to Ross (1976).

[22] For example, see Roll and Ross (1980) and Chen, Roll and Ross (1986) for empirical tests relating macroeconomic variables with stock prices. See Huberman and Wang (2005) for a review article.

β is a coefficient or factor loading that measures the sensitivity of the manager's returns to the factor, and

ε is a random error term.

Fung and Hsieh (2002) note that asset-based style factors can be interpreted in the same way as traditional market indices if two conditions are satisfied. First, there must be complete transparency in how factor returns are derived. Second, the return series must be sufficiently long to produce reliable statistical results. In principle, APT could be used for modelling currency returns if suitable factors can be identified.

Finally, a variation on the above approach makes explicit allowance for currency risk factors not captured in equation (1). Nucera and Valente (2010) argue that excess performance is that component of returns over and above what can be explained by the manager's exposure to a set of currency risk factors. For example, performance in excess of a carry trading index would represent excess performance only to the extent that the extra return was unrelated to other identifiable currency-related risks.

C.1. A Basic Factor Model for Currency Returns

Financial market theory tells us that the return of any portfolio can be decomposed into beta and alpha components. The beta component captures the systematic relationship between returns and the special factors driving returns. The beta component for currency might stem from exposures to risk factors or trading styles similar to how arbitrage pricing models have been used to relate

equity returns to various factors such as firm size, book value to market value ratios, market price to earnings ratios, and so on.

For currencies to qualify as an "asset class," there should be factors that correlate with or explain patterns of currency fund manager returns. Building on earlier hedge fund research, and several well-known currency trading strategies, Pojarliev and Levich (PL, 2008) propose four possible factors that could explain currency returns earned by professional managers. In generic terms, these factors are:

- Carry – To reflect the returns on the well-known strategy of borrowing in one or more low interest rate currencies and investing in a higher interest rate currency. A carry strategy entails risk because the low interest rate currency may depreciate, and possibly by more than the interest differential, which would result in a loss.

- Trend following – To reflect the returns of investing in currencies with upside momentum financed by borrowing in currencies with downside momentum. Trend following strategies entail many risks such as sudden reversals of trends or patterns, excessive trading costs, and so on.

- Value – To reflect the returns of borrowing in an overvalued currency and investing in an undervalued currency. A value strategy is exposed to the risk that currency values may become still more misaligned, that rates will be slow to revert toward the equilibrium (e.g. Purchasing Power Parity) value, or that the currency's long-run real exchange rate has changed consistent with a new PPP exchange rate.

• Volatility – To reflect the impact of currency volatility on trading returns. Differently from the other three factors, this factor does not represent the return of a trading strategy[23], but simply the change in foreign exchange volatility. Currency managers incur exposure to volatility risk simply by taking open currency positions, but also by using options and other derivatives whose prices are sensitive to volatility.

These four factors can be proxied by well-defined trading strategies that are easily replicated and transparent within the currency domain. As Melvin and Shand (2011) stress, there are many ways to implement any of the four proposed trading styles. For example, currency managers using a value strategy could use alternative specifications of PPP and use different indicators of misalignment to trigger their buy and sell orders. Managers might also vary the menu of currencies they monitor. To be a credible and useful benchmark, the factor model should rely on trading strategies that are purposely naïve and transparent. If so structured, a factor model then offers a reasonable benchmark which professionals could attain, and surpass if they have skills beyond these naïve strategies. In the following sections, we present an overview of the empirical evidence for the four factor model.

[23]Although some currency managers trade volatility as an asset class, anecdotal evidence suggests that they represent a very small sub-sample of the currency management industry. We are unaware of a generic, clearly defined volatility index (investible ETF), which is designed to capture the return of trading currency volatility as an asset class.

D. Empirical Evidence: The Barclay Currency Traders Index and Individual Fund Managers

To estimate the four factor model, researchers require data on currency manager returns and factors that proxy for types of trading strategies and exposures that currency managers would be likely to utilize.

D.1. Empirical Evidence with the Barclay Currency Traders Index

PL (2008) analyzed the returns of currency managers included in the Barclay Currency Traders Index. The Barclay Currency Traders Index (BCTI) is an equal-weighted composite of managed programs that trade currency futures and forwards. The BCTI offers one representative benchmark for the performance of the currency management industry.[24] The number of funds in the BCTI varied from about 40 to 70 between 1973 and 2004, and then steadily increased to 114 in 2007. After a decline during the global financial crisis, by the end of 2010, the BCTI included 119 currency programs.

To examine the relationship between currency manager returns and style factors, PL (2008) used monthly data on the BCTI for the period January 1990 until December 2006 (204 months). Exhibit 1 Panel A shows the results for equation (1) for the entire sample period (row 1) and two subperiods (rows 2 and 3). The style factors for this estimation were the Citibank Beta1 G10

[24] Other possible sources of data on overall currency fund returns include the Currency Managers Index prepared by Parker Global Strategies, the CISDM CTA Currency Indexes prepared by The Center for International Securities and Derivatives Markets at the University of Massachusetts Amherst, and the HFRX Currency Index prepared by Hedge Fund Research Inc. To our knowledge, the BCTI reflects the longest sample of data on currency manager returns.

Carry Index[25] as a proxy for a carry factor, the AFX Currency Management index as a proxy for the trend factor, the Citibank Beta1 G10 Purchasing Power Parity index as a proxy for the value factor and the average of the 1-month implied volatility for the EUR-USD exchange rate and for the USD-JPY exchange rate as a proxy for the volatility factor.

The results are quite striking. First, the R-squares of the regression for the entire 17-year sample period and the two subperiods are very high, indicating that these factors (carry, trend, value and volatility) account for roughly two-thirds to three-quarters of the variability in monthly excess returns.[26] For the entire sample, both the carry and trend factors are highly significant with positive coefficients while value has a significant negative coefficient. The negative coefficient on value indicates that a manager would profit if they held contrarian positions and the value index fell. In the first subperiod (row 2) the coefficient of value and its t-value are similar to the entire sample. But in the second subperiod (row 3) the carry coefficient is larger, trend is smaller, value become insignificant, and volatility becomes positive and significant.

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[25] The Beta1 G10 Carry Index reflects returns on a long high-yielding and short low-yielding strategy based on 10 countries and 17 currency pairs. Source: Citibank Investor Risk Advisory Group.

The AFX Index reflects returns on a trend following strategy involving three moving average rules applied to seven currency pairs, weighted by the volume of turnover in the spot market. The seven currency pairs are EUR-USD, USD-JPY, USD-CHF, GBP-USD, EUR-JPY, EUR-GBP, and EUR-CHF. Source: http://www.ljmu.ac.uk/LBS/102316.htm

The Beta1 G10 PPP Index reflects returns on 13 pairs of currencies selected from among the ten major currencies, taking long positions in currencies that are more than 20% undervalued against short positions in currencies that are more than 20% overvalued, using OECD measures of Purchasing Power Parity as a gauge for valuation. Source: Citibank Investor Risk Advisory Group.

The FX Volatility factor is a simple average of the 1-month implied volatility on EUR-USD options and USD-JPY options. Source: Citibank.

[26] Monthly excess returns are calculated by taking the manager's total return minus the periodic risk-free rate.

Second, for the entire sample and each subperiod the intercept term is small and not significantly different than zero. This result implies that as a group managers included in the BCTI on average were not able to generate alpha returns. In the 2001-06 period, for example, after accounting for our four systematic risk factors – carry, trend, value and volatility – the first three of which reflect returns on naïve currency trading strategies, alpha was -11 basis points per month or about -1.3% per year over the 72-month period. The overall excess return on the BCTI was 8 bps per month in this period, but all of that return and more (19 bps) can be attributed to the four explanatory factors.[27]

D.1.1 Robustness Checks

As a robustness check, we re-estimate equation (1) using different proxies for the risk factors carry, trend, value, and volatility. The proxies are the same variables as in PL (2010).

As a proxy for the return on the carry factor, we use the DB Currency Harvest G10 Index. This index reflects the return of being long the 3 high-yielding currencies against being short the 3 low-yielding currencies within the G10 currency universe (the Bloomberg code for this factor is DBHVG10U Index).

As a proxy for the trend-following factor, we use again the AFX Currency Management Index.[28]

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[27] Based on our estimated model, the 19 bps comprises 22 bps attributed to carry (equal to the carry coefficient multiplied by the average carry return), 4 bps to trend, -4 bps to value and -3 bps to volatility.

[28] We conclude that the AFX Currency Management Index is a good proxy for the trend factor in part because it is a transparent and consistent index that is calculated by an independent third party. The AFX Index was introduced in

We use the DB Currency Valuation Excess Return USD Index as the proxy for the returns of a value strategy. To gauge relative value, Deutsche Bank prepares a ranking based on the average daily spot rate over the last three months divided by the PPP exchange rate as published annually by the OECD. The DB Currency Valuation Excess Return USD index reflects the return of being long the 3 currencies with the highest rank (undervalued currencies) against being short the 3 currencies with the lowest rank (overvalued currencies) within G10 currency universe (the Bloomberg code for this factor is DBPPPUSF index).

Finally, we use the Deutsche Bank FX Volatility Index as the proxy for foreign exchange volatility. This index is calculated as the weighted average of 3-month implied volatility for nine major currency pairs (as provided by the British Bankers Association) with weights based on trading volume in the BIS surveys (the Bloomberg code for this factor is CVIX Index).[29] We use the first difference for this factor in equation (1) as it is not a trading strategy. We use logarithmic returns for the carry, trend and value factors.

Exhibit 1 Panel B shows the results for equation (1) for the BCTI from January 2001 until December 2006 with these alternative proxies for risk factors. The results in row 4 are almost identical to the results in row 3. The R-square for the regression is nearly identical at 78%. The trend factor exhibits similar coefficient and t-statistic. The estimated coefficient for the carry factor is much lower, but the t-statistic is similar. Value is again not significant and volatility is

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1998 (see Lequeux and Acar [1998]) and has been used for a number of years in various research papers, and therefore is known to researchers in the field.

[29] The nine currency pairs are EUR-USD, USD-JPY, USD-CHF, USD-CAD, AUD-USD, GBP-USD, EUR-JPY, EUR-GBP, and EUR-CHF.

only significant at a 10% significance level. The intercept term is -7 basis points and not statistically significant.

These results confirm that using alternative proxies for risk factors, the results are fairly similar and confirm that between January 2001 and December 2006, currency managers as a group delivered zero[30] alpha.[31] This result is not surprising and similar to findings in other asset classes.[32]

D.1.2 Extended Sample Periods

Exhibit 1 row 5 extends the sample until August 2010. The results are similar to row 4 with the notable exception that value is now significant and volatility not significant. The R-Square is slightly lower at 61% and the alpha slightly higher at -2 basis points, but again not significant.

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[30] While estimating (1) informs us about a manager's investment style, the beta coefficients are not known ex-ante and so the alpha estimates might be biased downward. Put differently, without knowledge of the betas, (1) is not an investable strategy that managers could mimic even if desired. To address such concerns, PL (2010) estimate a single-index model where the index (I_t) is an equally-weighted average of the available currency strategies. If a manager then outperforms this measure of beta, even by simply re-weighting the styles, this would constitute alpha from style allocations. PL (2010) report that the estimates of alpha are essentially unchanged when based on the single-factor model.

[31] Melvin and Shand (2011) consider using other proxies such as trend, carry and value indices prepared by Citibank, Credit Suisse and Deutsche Bank. The authors claim that regression results and estimates of alpha are sensitive to the selection of proxies for style factors.

[32] Leibowitz (2005) argues that not everyone can be a winner as attested by the narrowness of the list of great investors and that most investors should treat the market as being highly efficient.

Exhibit 1 row 6 uses only the updated sample from January 2008 until August 2010 (44 monthly observations) and represents an out-of-sample experiment.[33] The results confirm that the four factor model has explanatory power out-of-sample and over a short time horizon. The R-Square is again quite high at 51% and the intercept (alpha) is not significant. Trend is the only significant variable during this period, which could be explained by the fact that this time period spans a very turbulent period in the financial markets including the Lehman bankruptcy in September 2008, the European sovereign debt crises in early 2010 and the "flash" crash in May 2010. In addition, the carry strategy collapsed in the second half of 2008, which could explain the zero coefficient of the carry factor. Indeed, PL (2008) found that currency managers exhibit market timing skills (increasing exposures to well performing factors and decreasing exposure to poor performing factors). This suggests that currency managers might have trimmed exposure to carry in the second half of 2008.[34]

D.2. Individual Currency Manager Returns

When sufficient data are available, equation (1) can be estimated for individual currency managers. Exhibit 2 Panel A (taken from PL [2008]) shows the regression results of the four factor model for 34 individual currency managers included in the BCTI with a track record that spans a six-year period January 2001 – December 2006.

[33] We use the four factor model presented in PL (2008) with data available after publication

[34] This is reaffirmed in PL (2011a) where the authors show that the fraction of currency managers who significantly tracked carry sharply declined in the second half of 2008.

Several observations stand out. First, only 8 managers exhibit positive and significant alpha (intercept). Second, the four factor model helps to differentiate between alpha hunters who generate returns independent of simple trading strategies and beta grazers whose returns are heavily correlated with the performance of those trading strategies.[35] For example, manager M2 has significant exposure towards three factors – carry, trend, and volatility. The coefficients on these three factors are highly significant and the R-square (0.688) is the highest of all 34 managers. This manager generated an annualized excess return of 3.70% over the six-year sample, but these appear to be primarily beta returns. The alpha for M2 is negative (2 bps per month) and not statistically different than zero.

On the other end of the spectrum is manager M28. The R-square for M28 is 0.0347, among the lowest in the sample, suggesting that he has no significant exposure towards any of the four factors. However, manager M28 has generated a significant alpha of 0.29% per month. The average annualized excess return for manager M28 is 3.02%, a little less than the excess return generated by manager M2 (3.70%). However, the analysis shows that M28 is offering alpha returns while M2 is offering beta exposure.

In Exhibit 2 Panel A, the estimated R-square exceeds 50% for 9 of the 34 managers. This seems remarkable as our model uses only factors for developed market currencies while the currency managers in our sample are not restricted to these markets. These results are potentially very

[35] Leibowitz (2005) introduces the terms "alpha hunter" and "beta grazers."

important as they could have implications on pricing investment mandates. Clients may be willing to pay high fees for alpha, but beta exposure should be gained more cheaply.

Second, for these 34 managers the highest exposure is towards the trend-following factor. The trend factor was significant for 15 managers. The carry factor was significant for 8 managers and volatility and value were significant for only 7 and 5 managers, respectively. This suggests that the trend style was most prevalent among currency managers; however, other factors appeared to play a significant role for some funds. Several managers (M7, M8 and M14 for example) had negative exposure towards carry and one manager (M4) had a negative exposure towards the trend factor. Twenty-one of the 34 managers had a significant exposure to at least one factor, 9 of those had a significant exposure to two factors, and 2 funds had a significant exposure to three factors. Manager M30 had a significant exposure to all four factors. These results imply that managers have been diversifying across different styles by having exposure towards more than one style factor.

On the other hand, 13 of the 34 managers had no significant exposure towards any style factor. For these 13 managers, none of the coefficient t-statistics were significant at 95% confidence level. These managers might be classified as the true alpha hunters or they simply might be offering exposure to other trading styles or risk factors than the four considered here. Note, that not all the alpha hunters managed to generate alpha (only 8 managers deliver significant alpha).

To test for stability of these relationships over time, we divided the sample into two sub-periods, January 2001 to December 2003 and January 2004 to December 2006. The regression results for these two sub-periods are shown in Exhibit 2, Panels B and C. We identify 9 managers with positive and significant alpha in the first sub-period (2001-2003), and 7 of those 9 continue to generate positive alpha in the second sub-period (2004-2006). No manager showed significant alpha in the second half who did not also produce alpha in the first half. This offers some indication for alpha persistence and represents good news for plan sponsors. It appears those who are strong performers are likely to remain top performers when gauged over 3 year horizons.

D.3 Alternative Information Ratio

As discussed in section C, using the traditional benchmark for performance in a funded program, all excess returns above LIBID are counted as alpha returns. By definition, in the traditional benchmark, beta returns are zero. The information ratio (IR) under the traditional performance benchmark is then simply the annualized excess return divided by the annualized standard deviation of the excess returns.

However, the empirical results in Section C offer strong support for an alternative benchmark based on equation (1) in which returns can be related to a set of style factors based on common trading strategies. In this framework, returns that might have been classified as "alpha" under the traditional benchmark are really more akin to beta returns. Following equation (1), PL (2008) define α_j (alpha returns for fund manager j) as only that portion of excess returns that are not explained by the style factors, or

$$\hat{\alpha}_j = R_{j,t} - \sum_i \hat{\beta}_{i,j} F_{i,t} + \varepsilon_{j,t} \quad (2)$$

This leads to an alternative information ratio (IR*) that reflects the alternative alpha ($\hat{\alpha}$) divided by its standard deviation or tracking error. Calculations in Exhibit 3 show that for the sample of 34 managers the mean and median values of IR* are smaller than the traditional IR. Furthermore, there is a substantial impact on the ranking of funds. For example, several funds (M2, M5, M6, M17, M21 and M22) show a substantial decline using IR* compared with IR. These six managers switch from positive IR values to negative IR* values. On the other hand, several funds (M7, M8, and M32) show a marked increase using IR* rather than the traditional IR. This highlights that the four factor model could have a significant impact on the ranking of managers.

For various reasons, institutional investors are rightly concerned about how much of a manager's currency return is alpha (or excess performance) and how much is beta? First, proper return attribution could lead to some re-pricing for "active" currency products. Investors should not expect to pay alpha fees for exposure to currency style betas that could be delivered more cheaply. Second, currency beta might be less suitable for institutional investors when the goal is to diversify global equity exposure.[36] For example, the correlation of carry beta to global equities is -20% when global equities produce returns greater than one standard deviation above their mean, but it rises to 58% when equities generate returns more than one standard deviation below

[36] PL (2011b) shows that alpha hunters offer greater diversification benefits to investors with large equity exposure than beta grazers.

their means.[37] Thus, carry beta diversifies when it is not needed, i.e. in rising markets and it provides no diversification when it is most needed, i.e. in falling markets.

E. Empirical Evidence: Fund Managers on the Deutsche Bank FX Select Platform

Evaluating hedge fund performance is challenging due to the usual biases affecting hedge fund databases.[38] In particular, backfill and survivorship bias can be severe. Malkiel and Saha (2005) report that backfill bias averages 7.3 percent per year and survivorship bias averages 4.4 percent per year for hedge funds.

To address backfill and survivorship biases, we make use of the same database as used in Pojarliev and Levich (PL [2010]), i.e. daily return data for currency managers listed on the Deutsche Bank FXSelect trading platform. The FX Select data is unique relative to other hedge fund databases as it provides actual return data, made possible because gains and losses are computed by Deutsche Bank based on real trades processed through Deutsche Bank prime brokerage. The return data are audited by an independent third party. In contrast, hedge fund databases simply collect return data submitted by managers and are affected by numerous biases. This makes the FXSelect dataset especially useful to study the currency management industry.

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[37] These correlations are based on monthly return of the MSCI World Index (in local currencies) and the DB Currency Harvest G10 Index from January 1980 until September 2010. Correlations computed using different proxies for currency beta exhibits similar pattern.

[38] Fung and Hsieh (2000) examine various biases that impact the estimate of average hedge fund returns. More recently, Aggarwal and Jorion (2010) investigate bias that resulted from the merger of Tremont database into the TASS database. Aiken, Clifford and Ellis (2010) measure the self-reporting bias attributable to funds that choose to report versus those that do not.

We use data covering April 6, 2005 until March 26, 2008 as in PL (2010) and then extended through June 30, 2010 or slightly more than 5 years overall. During this sample period, 107 currency funds were active at some point on the platform. Of these, only 67 funds were active as of June 30, 2010. We label these as "live" funds. Another 40 managers joined the platform and exited prior to the end of the sample period. We label these as "dead" funds. These 40 names include funds which no longer exist and funds that still exist, but have delisted from the platform. PL (2011b) estimated the survivorship bias to be 5.30%, i.e. similar to the results reported by Malkiel and Saha (2005). The mean annual return of all 107 funds (live and dead) while listed on the platform is roughly zero at 4 basis points. The mean annual return of only the live funds is 534 basis points.

E.1 Grouping Managers into a Fund of Funds

As another robustness check to the results reported in section D, we consider a new portfolio, a "fund of funds" comprised of equally weighted positions in each of the funds available on the FX Select platform.

The return on this index can be defined as:

$$R_{FOF,t} = \sum_{j=1}^{n_t} R_{j,t} / n_t \tag{3}$$

where

$R_{j.t}$ is the weekly return for manager j at time t

n_t is the number of managers available on the platform at time t

This portfolio is rebalanced weekly with newly listed funds added and "dead" funds excluded from our fund of funds (FoF) portfolio. As a result, every one of the 107 managers who were on the platform between April 2005 and June 2010 is included in our fund–of-funds index during their active period on the platform.

We estimate equation (1) using the return of the FoF portfolio as the left hand side variable. We use the same proxies for right hand side variables as in PL (2010) and report the results in Exhibit 4. Overall, the results in Exhibit 4 support the four-factor model of currency trading returns. The model explains roughly 37% of the variability of the FoF portfolio returns. Trend appears to be the most significant factor. The trend coefficient is 0.28, larger than for any other factor and highly significant. On average, the managers on the FX Select platform seem to rely on trend-following. The trend factor alone explains 28% of the variability of the excess returns of the FoF portfolio (we have regressed the returns of FoF portfolio on each individual factor, but do not report the results). The carry coefficient is also positive and significant. The value coefficient is significant but negative, indicating that on average managers were positioned to profit from further deviations from PPP. The volatility coefficient is zero and not significant.

The point estimate for alpha in the FoF portfolio is 3 basis points and significant at the 10% level in a 2-tail test. This result implies that managers included in the FX Select platform were able to generate some alpha on average between April 2005 and June 2010. However, the alpha was not

high enough to cover fees, i.e. 3 basis points of weekly alpha result in 152 basis point annual return, which might only roughly cover the management fees.[39]

F. Conclusions and Investment Implications

Over the last decade, institutional investors have been allocating less toward traditional assets like equities and bonds, in favor of alternative investments like hedge funds, private equities and commodities. The increased interest towards alternative assets has naturally put currencies on the radar of institutional investors. Should institutional investors invest in currencies as an alternative asset class? The answer to this question is probably "yes" and the reasons are twofold. First, the FX market offers enough depth and liquidity for large institutional investors. According to the latest Central Bank Survey of Foreign Exchange and Derivatives Market Activity (BIS 2010) the daily average foreign exchange market turnover reached $4 trillion in April 2010, 20% higher than in 2007. This liquidity was precious during the market turmoil in 2008. Second, returns generated by such strategies are generally uncorrelated with returns from other asset classes (see Burnside, et al. 2007). However, one of the challenges for institutional investors after allocating assets to currency managers is to find an appropriate benchmark to gauge the performance of these managers. Without an appropriate benchmark, the investor cannot know if he should be pleased or disappointed with the results achieved by his managers, or put differently, if these managers have demonstrated true skill or not. The lack of a well established

[39] Our return data from the FX Select platform are before fees. A review of the fee structure for currency funds who report through the TASS and CISDM databases shows that the 2% management fee and 20% performance fee are the modal charges.

benchmark may be one of the reasons why allocations to currency strategies remain relatively low compared to hedge funds in general.[40]

In many studies of currency trading strategies, researchers have commonly used zero as the expected return from currency speculation and interpreted all realized returns as unusual, excess returns. In the same vein, zero has often been used as a traditional benchmark to assess the performance of currency fund managers who pursue an absolute return mandate. In contrast to the traditional benchmark, Pojarliev and Levich (2008) proposed a four-factor regression model as an alternative technique to gauge the performance of currency managers. The model estimates what portion of currency trading profits is due to exposure to these specific trading style or risk factors (or beta), and what portion is due to skill, or alpha.

In empirical tests of the four-factor model, PL (2008) and PL (2010) use different proxies for the risk factors, but the results are strikingly similar. Depending on the time period, periodicity, and model specification, four risk factors explain 50-75% in the variability of currency fund (index) returns. We have updated some of the results with more recent data and the general conclusions remain unchanged. A significant part of currency returns comes from exposure to a small set of factors that proxy the returns from well-known and easily implemented trading styles. As a

[40] BarclayHedge reports that in 2010Q4, macro style hedge funds, which include currency strategies among several others, accounted for $115.1 billion out of an estimated $2,255.6 billion in hedge fund assets under management. Similarly, currency traders were estimated at $21.55 billion out of a total $267.6 billion in assets under management at CTA accounts.

consequence, much of what might have been labelled as "alpha" under the traditional benchmark may become beta returns under the alternative benchmark.[41]

While we have reported results for a various proxies for the style factors, as Melvin and Shand (2011) caution using other style factors could impact the results. In addition, other factors we have omitted (such as drawdown of capital) could matter to investors. Despite these caveats, the notion of retaining the traditional performance benchmark (i.e. zero) and forsaking the use of a limited set of style factors as an alternative benchmark seems inconsistent with our results.

For several reasons, institutional investors should be concerned about how much of a currency manager's return is alpha and how much is beta. First, proper return attribution could lead to some re-pricing for "active" currency products. Investors should not expect to pay alpha fees for exposure to currency style betas that could be earned more cheaply. Second, currency beta might be less suitable for institutional investors when the goal is to diversify global equity exposure.

Whether there is skill or alpha in currency management can depend on the benchmark for comparison but also on the manager. The evidence we presented using the alternative benchmark support the contention that the average manager has no skill and after transaction costs the

[41] Nucera and Valente (2010) have proposed another more stringent performance benchmark (i.e. returns in excess of the currency risk premia associated with exposure to currency risk).

average alpha is negative.[42] However, PL (2008) showed that approximately one-quarter of the managers was able to generate positive and significant alpha between 2001 and 2006. The average alpha of these "stars" has been quite high at 104 bps per month or 12.48% per year and significant. Importantly, this 104 bps alpha is measured after taking into account the four explanatory factors – carry, trend, value and volatility. So in some respects, currencies seem not so different from other asset classes: The average manager may deliver zero alpha, but there exist some skilled managers who are able to deliver significant alpha.

In addition, there was substantial consistency between results in the first half of the 6-year period (2001-03) and the second half (2004-06). We identified 9 managers with positive and significant alpha in the first half of the sample, and 7 of those continue to make positive alpha in the second half. This is good news for plan sponsors as it indicates that past performance data can be an indication for future performance for individual managers.

[42] Since alpha is a zero sum game, this is true per definition.

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Exhibit 1: Excess Currency Index Returns as a Function of Four Factors

Equations in Panel A estimated with style factors A, and equations in Panel B estimated with style factors B.

		Sample Period	N (months)	Intercept	Carry	Trend	Value	Volatility	R2
Panel A	1)	1/1990-12/2006	204	-9 bps (-0.74)	0.70 (3.30)	1.28 (17.45)	-1.02 (-2.26)	0.04 (0.44)	0.664
	2)	1/1990-12/2000	132	-16 bps (-0.88)	0.75 (2.78)	1.45 (14.92)	-1.38 (-2.45)	-0.05 (-0.39)	0.680
	3)	1/2001-12/2006	72	-11 bps (-1.00)	1.04 (3.99)	0.78 (9.72)	-0.64 (-1.01)	0.34 (3.09)	0.767
Panel B	4)	1/2001-12/2006	72	-7 bps (-0.69)	0.29 (3.96)	0.79 (10.09)	-0.07 (-1.25)	0.40 (1.93)	0.778
	5)	1/2001-8/2010	116	-2 bps (-0.21)	0.21 (5.38)	0.60 (10.41)	-0.09 (-2.65)	0.13 (1.39)	0.607
	6)	1/2007-8/2008	44	4 bps (0.64)	0.04 (1.85)	0.20 (5.29)	-0.02 (-0.93)	0.03 (0.71)	0.506

Notes: The dependent variable in each regression is the monthly excess return of the Barclay Currency Traders Index minus the risk-free rate. T-statistics are in parentheses below each estimated coefficient.

Style factors A are those used in PL (2008):

The Citibank Beta1 G10 Carry Index is the proxy for a carry factor, the AFX Currency Management index is the proxy for the trend factor, the Citibank's Beta1 G10 Purchasing Power Parity index is the proxy for the value factor and the average of the 1-month implied volatility for the EUR-USD exchange rate and for the USD-JPY exchange rate is the proxy for the volatility factor.

The Beta1 G10 Carry Index reflects returns on a long high-yielding and short low-yielding strategy based on 10 countries and 17 currency pairs. Source: Citibank Investor Risk Advisory Group.

The AFX Index reflects returns on a trend following strategy involving three moving average rules applied to seven currency pairs, weighted by the volume of turnover in the spot market. The seven currency pairs are EUR-USD, USD-JPY, USD-CHF, GBP-USD, EUR-JPY, EUR-GBP, and EUR-CHF. Source: http://www.ljmu.ac.uk/LBS/102316.htm .

The Beta1 G10 PPP Index reflects returns on 13 pairs of currencies selected from among the ten major currencies, taking long positions in currencies that are more than 20% undervalued against short positions in currencies that are more than 20% overvalued, using OECD measures of Purchasing Power Parity as a gauge for valuation. Source: Citibank Investor Risk Advisory Group.

The FX Volatility factor is a simple average of the 1-month implied volatility on EUR-USD options and USD-JPY options. Source: Citibank.

Style factors B are those used in PL (2010):

The DB Currency Harvest G10 Index is the proxy for the carry index. This index reflects the return of being long the 3 high-yielding currencies against being short the 3 low-yielding currencies within the G10 currency universe (the Bloomberg code for this factor is DBHVG10U Index).

The AFX Currency Management Index is again the proxy for the trend factor.

The DB Currency Valuation Excess Return USD Index is the proxy for the returns of a value strategy. To gauge relative value, Deutsche Bank prepares a ranking based on the average daily spot rate over the last three months divided by the PPP exchange rate as published annually by the OECD. The DB Currency Valuation Excess Return USD index reflects the return of being long the 3 currencies with the highest rank (undervalued currencies) against being short the 3 currencies with the lowest rank (overvalued currencies) within G10 currency universe (the Bloomberg code for this factor is DBPPPUSF index).

The Deutsche Bank FX Volatility Index is the proxy for foreign exchange volatility. This index is calculated as the weighted average of 3-month implied volatility for nine major currency pairs (as provided by the British Bankers Association) with weights based on trading volume in the BIS surveys (the Bloomberg code for this factor is CVIX Index). The nine currency pairs are EUR-USD, USD-JPY, USD-CHF, USD-CAD, AUD-USD, GBP-USD, EUR-JPY, EUR-GBP, and EUR-CHF. We use the first difference for this factor in equation (1) as it is not a trading strategy.

Exhibit 2: Regression Results for Individual Currency Managers

Regression Results for $R_{j,t} = \alpha_j + \sum_i \beta_{i,j} F_{i,t} + \varepsilon_{j,t}$ for managers j = 1, … 34.

Panel A Based on 72 monthly observations, January 2001 – December 2006.

Manager	Intercept	T-Stat	Beta Carry	T-Stat	Beta Trend	T-Stat	Beta Value	T-Stat	Beta Volatility	T-Stat	R-Square
M1	0.0184	3.3236	-0.6550	-0.5143	-0.0269	-0.0687	-1.6564	-0.5314	-0.1815	-0.3414	0.0189
M2	-0.0020	-1.1294	2.2714	5.4067	0.9036	6.9854	0.3357	0.3265	0.3762	2.1457	0.6889
M3	0.0002	0.2317	-0.3562	-1.3858	-0.0029	-0.0370	0.6393	1.0164	0.0662	0.6172	0.0401
M4	0.0024	1.3573	-0.4595	-1.1223	-0.2625	-2.0827	2.1998	2.1954	0.3418	2.0002	0.1757
M5	-0.0034	-1.4687	2.6656	4.8841	0.7108	4.2298	-0.2206	-0.1651	0.0630	0.2768	0.5157
M6	-0.0074	-1.2462	6.6620	4.8397	1.7715	4.1797	-0.8883	-0.2636	0.2216	0.3857	0.5103
M7	0.0015	3.4981	-0.1508	-1.4402	0.0155	0.4808	-0.1610	-0.6284	0.0763	1.7460	0.1658
M8	0.0051	3.9239	-0.4723	-1.5731	0.0579	0.6264	-0.3537	-0.4812	0.2144	1.7106	0.1681
M9	0.0086	1.4950	0.1918	0.1436	0.0280	0.0681	1.3053	0.3995	0.1539	0.2761	0.0058
M10	0.0025	0.9721	0.0786	0.1297	0.0439	0.2355	0.6464	0.4356	0.0295	0.1167	0.0066
M11	-0.0015	-4.4319	-0.0810	-1.0098	-0.0138	-0.5622	0.2719	1.3853	0.0107	0.3205	0.0479
M12	0.0004	0.1100	-1.2423	-1.2625	0.5025	1.6586	2.1556	0.8951	0.7023	1.7099	0.1410
M13	0.0001	0.0482	0.1051	0.1180	1.4515	5.2885	-1.5816	-0.7250	0.5213	1.4012	0.4566
M14	0.0109	1.0571	-4.0068	-1.6923	2.1114	2.8963	-0.3642	-0.0628	-1.6972	-1.7174	0.1479
M15	-0.0002	-0.0582	1.9720	2.3417	0.9330	3.5983	-2.3471	-1.1387	0.3023	0.8600	0.3462
M16	0.0022	0.9892	-0.1483	-0.2876	0.2014	1.2678	3.5933	2.8459	0.1525	0.7083	0.1461
M17	-0.0061	-1.4582	3.2239	3.3270	0.1397	0.4685	4.8788	2.0572	0.1974	0.4882	0.3483
M18	-0.0018	-1.2855	0.3595	1.0952	-0.0601	-0.5954	1.3643	1.6981	0.2302	1.6802	0.1313
M19	0.0023	0.7936	0.5512	0.8039	-0.3075	-1.4568	-1.9338	-1.1523	0.3323	1.1612	0.0474
M20	0.0027	0.2994	-0.7516	-0.3602	5.5147	8.5848	-0.5740	-0.1124	0.6160	0.7074	0.6294
M21	-0.0041	-0.6902	2.5661	1.8694	3.0227	7.0749	0.4007	0.1180	0.3109	0.5369	0.5618
M22	-0.0004	-0.1536	1.5987	2.3802	0.3345	1.6175	2.3903	1.4541	0.2561	0.9135	0.2505
M23	0.0064	1.5299	-0.4939	-0.5120	0.3493	1.1761	1.4823	0.6278	0.6301	1.5648	0.0906
M24	0.0001	0.1236	-0.5023	-1.4654	0.9771	9.2566	0.6966	0.8302	0.0747	0.5223	0.6429

M25	0.0106	3.3421	-0.0430	-0.0590	0.1080	0.4816	3.6282	2.0347	0.6363	2.0924	0.1244
M26	0.0216	3.9814	-1.4220	-1.1389	0.1577	0.4102	1.5233	0.4985	0.7424	1.4245	0.0705
M27	-0.0003	-0.2091	0.2896	0.7629	0.4485	3.8373	-0.1075	-0.1157	0.5799	3.6603	0.4567
M28	0.0029	2.0267	-0.0783	-0.2363	-0.0064	-0.0633	-0.1904	-0.2346	0.1627	1.1755	0.0347
M29	0.0162	3.5206	-1.0116	-0.9535	0.0415	0.1271	4.8410	1.8645	0.8304	1.8753	0.0919
M30	0.0027	0.5040	4.0590	3.2210	2.0985	5.4085	-8.4047	-2.7251	1.1319	2.1520	0.5855
M31	-0.0014	-0.4590	1.5484	2.1666	1.7395	7.9050	-2.2846	-1.3061	0.4585	1.5370	0.6541
M32	0.0070	2.0515	-0.2912	-0.3673	1.5875	6.5019	-0.5135	-0.2645	0.7304	2.2068	0.5621
M33	0.0106	1.5220	1.0493	0.6563	-0.3504	-0.7118	-1.9321	-0.4938	1.8784	2.8150	0.1196
M34	0.0014	1.2557	0.5082	1.9439	0.2158	2.6814	-0.0213	-0.0333	0.1457	1.3351	0.2583
Average	0.0032	0.7461	0.5157	0.6091	0.7187	2.3961	0.2594	0.3014	0.3323	1.1784	0.2718
Maximum	0.0216	3.9814	6.6620	5.4067	5.5147	9.2566	4.8788	2.8459	1.8784	3.6603	0.6889
Median	0.0019	0.6488	0.0178	0.0295	0.2086	1.2220	0.1253	0.0424	0.2792	1.2553	0.1670
Minimum	-0.0074	-4.4319	-4.0068	-1.6923	-0.3504	-2.0827	-8.4047	-2.7251	-1.6972	-1.7174	0.0058

Results of Regression Results for $R_t = \alpha + \sum_i \beta_i F_{i,t} + \varepsilon_t$

Barclay Currency Traders Index represents an equally-weighted average of managed programs that trade currency futures and/or cash forwards in the inter bank market. Source: The Barclay Group.

The Beta1 G10 Carry Index reflects returns on a long high-yielding and short low-yielding strategy based on 10 countries and 17 currency pairs. Source: Citibank Investor Risk Advisory Group.

The AFX Index reflects returns on a trend following strategy involving three moving average rules applied to seven currency pairs, weighted by the volume of turnover in the spot market. Source: http://cwis.livjm.ac.uk/AFE/AFE_docs/AFX_Monthly.xls

The Beta1 G10 PPP Index reflects returns on 13 pairs of currencies selected from among the ten major currencies, taking long positions in currencies that are more than 20% undervalued against short positions in currencies that are more than 20% overvalued, using OECD measures of Purchasing Power Parity as a gauge for valuation. Source: Citibank Investor Risk Advisory Group.

The FX Volatility Index is a simple average of the 1-month implied volatility on EUR-USD options and USD-JPY options. Source: Citibank.

Exhibit 2: Regression Results for Individual Currency Managers

Regression Results for $R_{j,t} = \alpha_j + \sum_i \beta_{i,j} F_{i,t} + \varepsilon_{j,t}$ for managers j = 1, … 34.

Panel B Based on 36 monthly observations, January 2001 – December 2003.

Manager	Intercept	T-Stat	Beta Carry	T-Stat	Beta Trend	T-Stat	Beta Value	T-Stat	Beta Volatility	T-Stat	R-Square
M1	0.0201	2.05	-0.11	-0.05	-0.20	-0.30	-3.89	-0.82	-0.63	-0.80	0.065
M2	-0.0022	-1.04	2.28	5.17	0.93	6.18	0.73	0.70	0.23	1.36	0.821
M3	0.0039	2.65	-0.45	-1.52	-0.18	-1.82	0.08	0.11	0.17	1.51	0.139
M4	0.0027	1.07	-0.21	-0.41	-0.17	-0.95	1.58	1.28	0.17	0.86	0.114
M5	-0.0022	-0.69	1.56	2.34	0.75	3.31	1.33	0.84	0.19	0.74	0.551
M6	-0.0060	-0.744	4.038	2.43	1.83	3.24	3.07	0.78	0.53	0.82	0.554
M7	0.0018	2.53	-0.11	-0.72	0.02	0.44	-0.11	-0.32	0.04	0.76	0.102
M8	0.0059	2.72	-0.31	-0.71	0.05	0.38	-0.44	-0.42	0.14	0.81	0.111
M9	0.0191	1.65	1.29	0.54	0.05	0.07	-1.48	-0.26	-0.24	-0.26	0.013
M10	0.0076	1.53	0.65	0.63	0.10	0.30	-0.81	-0.33	-0.22	-0.55	0.026
M11	-0.0008	-1.26	-0.03	-0.29	-0.02	-0.53	0.15	0.50	-0.00	-0.12	0.039
M12	0.0003	0.06	0.93	0.81	0.39	1.00	-2.75	-1.01	0.46	1.03	0.212
M13	0.0001	0.02	1.12	0.86	1.73	3.90	-4.37	-1.42	0.12	0.23	0.541
M14	-0.0018	-0.11	-8.21	-2.34	3.33	2.79	6.17	0.75	-2.25	-1.65	0.281
M15	0.0032	0.50	2.55	1.94	1.36	3.04	-4.73	-1.52	-0.08	-0.17	0.455
M16	0.0040	1.13	0.22	0.31	0.12	0.51	2.97	1.70	0.00	0.02	0.167
M17	-0.0060	-0.92	4.24	3.20	0.32	0.71	4.45	1.42	-0.41	-0.80	0.511
M18	0.0002	0.11	0.78	1.49	-0.20	-1.15	0.64	0.52	0.23	1.16	0.189
M19	-0.0017	-0.43	0.66	0.81	0.00	0.00	-1.17	-0.61	0.11	0.36	0.035
M20	0.0100	0.96	0.58	0.27	4.53	6.22	-0.64	-0.12	0.78	0.93	0.715
M21	0.0044	0.51	2.03	1.15	2.18	3.61	2.70	0.65	0.77	1.12	0.524
M22	-0.0041	-1.02	0.13	0.16	0.92	3.23	4.25	2.15	0.00	0.01	0.396
M23	0.0017	0.26	-1.67	-1.26	1.12	2.50	3.79	1.22	0.44	0.87	0.293
M24	0.0018	0.71	-0.53	-1.02	1.16	6.49	0.63	0.51	-0.08	-0.43	0.665

M25	0.0167	3.30	0.53	0.52	0.16	0.46	2.59	1.06	0.58	1.45	0.180
M26	0.0335	3.83	-0.93	-0.52	0.18	0.30	-1.26	-0.30	0.82	1.18	0.115
M27	-0.0013	-0.50	0.46	0.84	0.51	2.74	1.05	0.81	0.51	2.43	0.523
M28	0.0074	2.81	0.02	0.04	-0.13	-0.72	-0.95	-0.75	0.24	1.16	0.072
M29	0.0246	2.87	-2.29	-1.31	-0.14	-0.24	5.03	1.22	1.33	1.96	0.165
M30	00072	1.10	4.76	3.56	1.86	4.08	-7.50	-2.38	0.77	1.48	0.702
M31	0.0019	0.42	1.59	1.67	1.74	5.36	-1.65	-0.73	0.56	1.52	0.712
M32	0.0138	2.63	0.35	0.32	1.88	5.12	-2.25	-0.89	0.36	0.87	0.657
M33	0.0101	0.88	0.74	0.31	0.26	0.32	-3.65	-0.66	1.20	1.32	0.134
M34	0.0028	1.85	0.58	1.89	0.24	2.33	0.22	0.30	0.06	0.54	0.394
“Fund of funds”	0.0052	3.71	0.50	1.74	0.78	7.92	0.11	0.16	0.20	1.81	0.823
Average	0.0053	0.92	0.51	0.62	0.78	1.85	0.11	0.12	0.20	0.64	0.329
Maximum	0.0335	3.83	4.76	5.17	4.53	6.49	6.17	2.15	1.33	2.43	0.821
Median	0.0028	0.80	0.56	0.42	0.29	0.86	0.12	0.21	0.18	0.84	0.247
Minimum	-0.0060	-1.26	-8.21	-2.34	-0.20	-1.82	-7.50	-2.38	-2.25	-1.65	0.013

Exhibit 2 Regression Results for Individual Currency Managers

Regression Results for $R_{j,t} = \alpha_j + \sum_i \beta_{i,j} F_{i,t} + \varepsilon_{j,t}$ for managers j = 1, … 34.

Panel C Based on 36 monthly observations, January 2004 – December 2006.

Manager	Intercept	T-Stat	Beta Carry	T-Stat	Beta Trend	T-Stat	Beta Value	T-Stat	Beta Volatility	T-Stat	R-Square
M1	0.0153	2.78	1.08	0.69	0.20	0.53	6.13	1.46	2.49	2.83	0.237
M2	-0.0025	-0.81	2.62	3.00	0.87	4.01	-0.43	-0.18	0.79	1.61	0.557
M3	-0.0027	-1.77	0.04	0.09	0.11	1.01	1.33	1.13	0.19	0.79	0.070
M4	0.0017	0.64	-0.44	-0.58	-0.33	-1.77	3.68	1.82	0.75	1.77	0.273
M5	-0.0055	-1.58	4.20	4.24	0.60	2.44	-1.92	-0.72	0.12	0.21	0.560
M6	-0.0111	-1.23	10.43	4.08	1.58	2.48	-4.94	-0.72	0.47	0.33	0.544
M7	0.0012	2.17	-0.16	-1.01	0.00	0.01	-0.54	-1.24	0.11	1.20	0.325
M8	0.0042	2.61	-0.54	-1.18	0.04	0.36	-0.83	-0.67	0.33	1.27	0.300
M9	-0.0009	-0.33	-0.37	-0.44	-0.14	-0.70	2.56	1.13	0.91	1.91	0.184
M10	-0.0023	-1.33	-0.13	-0.26	-0.08	-0.65	1.61	1.19	0.53	1.88	0.163
M11	-0.0022	-7.92	-0.06	-0.83	-0.01	-0.80	0.23	1.08	0.06	1.46	0.175
M12	0.0025	0.39	-3.81	-2.14	0.73	1.65	11.05	2.31	1.10	1.10	0.283
M13	-0.0001	-0.02	-0.69	-0.53	1.26	3.87	4.82	1.37	1.31	1.78	0.435
M14	0.0139	1.24	3.59	1.12	1.12	1.41	2.27	0.26	1.36	0.75	0.139
M15	-0.0042	-1.20	1.54	1.56	0.51	2.06	2.25	0.85	0.83	1.48	0.261
M16	0.0003	0.12	-0.12	-0.14	0.25	1.22	4.05	1.83	0.66	1.43	0.147
M17	-0.0075	-1.38	2.84	1.84	-0.01	-0.03	3.90	0.94	1.34	1.54	0.152
M18	-0.0031	-2.34	-0.15	-0.40	0.04	0.51	1.17	1.15	0.17	0.81	0.059
M19	0.0053	1.13	0.15	0.11	-0.53	-1.60	-3.06	-0.85	0.27	0.36	0.099
M20	-0.0014	-0.09	-2.12	-0.50	6.27	5.90	-8.43	-0.74	0.39	0.16	0.618
M21	-0.0107	-1.33	3.42	1.50	3.56	6.24	-9.58	-1.56	-0.17	-0.13	0.677
M22	-0.0002	-0.06	4.12	4.11	-0.17	-0.67	4.20	1.56	1.24	2.19	0.459
M23	0.0084	1.59	0.36	0.24	-0.35	-0.94	-0.39	-0.09	0.25	0.29	0.029
M24	-0.0020	-1.25	-0.28	-0.61	0.76	6.64	0.47	0.38	0.29	1.12	0.662

M25	0.0057	1.52	-1.27	-1.19	-0.06	-0.24	1.33	0.46	-0.03	-0.05	0.067
M26	0.0120	1.79	-2.49	-1.31	-0.07	-0.14	2.53	0.49	-0.00	-0.00	0.079
M27	0.0006	0.38	-0.41	-0.87	0.36	3.08	-4.65	-3.63	0.06	0.22	0.627
M28	-0.0006	-0.55	-0.19	-0.59	0.03	0.40	-0.25	-0.29	0.01	0.10	0.046
M29	0.0091	2.30	0.32	0.29	0.02	0.10	4.10	1.36	0.12	0.20	0.091
M30	-0.0019	-0.22	4.09	1.67	2.21	3.62	-14.86	-2.27	1.93	1.40	0.574
M31	-0.0038	-0.90	0.70	0.58	1.62	5.40	-7.25	-2.24	-0.54	-0.80	0.62
M32	0.0003	0.08	-0.83	-0.68	1.20	3.97	0.07	0.02	1.02	1.48	0.494
M33	0.0075	0.89	3.43	1.44	-0.83	-1.39	7.83	1.22	4.41	3.29	0.274
M34	-0.0000	-0.02	0.44	0.94	0.14	1.25	-1.72	-1.34	0.15	0.57	0.204
“Fund of funds”	0.0007	0.45	0.86	1.86	0.61	5.34	0.19	0.16	0.67	2.60	0.642
Average	0.0007	-0.14	0.86	0.42	0.61	1.45	0.20	0.16	0.67	1.02	0.308
Maximum	0.0153	2.78	10.43	4.24	6.27	6.64	11.05	2.31	4.41	3.29	0.677
Median	-0.0002	-0.04	-0.01	-0.03	0.13	0.77	0.82	0.42	0.36	1.11	0.267
Minimum	-0.0111	-7.92	-3.81	-2.14	-0.83	-1.77	-14.86	-3.63	-0.54	-0.80	0.029

Exhibit 3: Performance of Individual Currency Managers

Manager	Average Annual Return	Excess Annual Return	Std. Dev.	IR	Annual Alpha	Tracking Error	IR*
M1	22.0%	19.34%	14.71%	1.31	22.13	14.57	1.52
M2	6.4%	3.70%	8.62%	0.74	-2.48%	4.81%	-0.52
M3	2.5%	-0.16%	3.00%	-0.05	0.31%	2.94%	0.11
M4	5.7%	2.98%	5.16%	0.58	2.91%	4.68%	0.62
M5	5.4%	2.73%	8.00%	0.36	-4.19%	6.24%	-0.67
M6	10.7%	8.00%	22.51%	0.36	-8.97%	15.75%	-0.57
M7	4.0%	1.35%	1.31%	1.03	1.91%	1.20%	1.60
M8	7.2%	4.53%	3.77%	1.20	6.16%	3.44%	1.79
M9	14.5%	11.80%	15.32%	0.77	10.43%	15.27%	0.68
M10	6.5%	3.78%	6.96%	0.54	3.08%	6.94%	0.44
M11	0.8%	-1.87%	0.94%	-1.99	-1.86%	0.92%	-2.03
M12	1.4%	-1.26%	12.15%	-0.10	0.57%	11.26%	0.05
M13	2.3%	-0.37%	13.83%	-0.03	0.22%	10.20%	0.02
M14	8.1%	5.42%	29.34%	0.18	13.08%	27.09%	0.48
M15	5.9%	3.18%	11.92%	0.27	-0.26%	9.63%	-0.03
M16	7.7%	5.04%	6.39%	0.79	2.67%	5.90%	0.45
M17	7.1%	4.43%	13.73%	0.32	-7.39%	11.09%	-0.67
M18	2.2%	-0.49%	4.03%	-0.12	-2.21%	3.76%	-0.59
M19	5.0%	2.27%	8.04%	0.28	2.84%	7.84%	0.36
M20	6.2%	3.52%	39.21%	0.09	3.27%	23.87%	0.14
M21	5.9%	3.24%	23.98%	0.13	-5.01%	15.87%	-0.32
M22	8.0%	5.31%	8.88%	0.60	-0.54%	7.68%	-0.07
M23	9.9%	7.24%	11.57%	0.63	7.71%	11.04%	0.70
M24	2.7%	-0.02%	6.56%	0.00	0.22%	3.92%	0.06
M25	17.6%	14.90%	8.91%	1.67	12.73%	8.34%	1.53
M26	25.7%	22.98%	14.82%	1.55	25.99%	14.28%	1.82
M27	2.7%	-0.04%	5.89%	-0.01	-0.42%	4.34%	-0.10
M28	5.7%	3.02%	3.86%	0.78	3.51%	3.79%	0.93
M29	22.7%	19.97%	12.74%	1.57	19.53%	12.14%	1.61
M30	10.0%	7.27%	22.39%	0.32	3.32%	14.42%	0.23
M31	3.7%	1.02%	13.90%	0.07	-1.71%	8.18%	-0.21
M32	10.3%	7.62%	13.71%	0.56	8.50%	9.07%	0.94
M33	14.7%	11.98%	19.49%	0.61	12.72%	18.29%	0.70
M34	5.7%	2.98%	3.47%	0.86	1.72%	2.99%	0.57
Average	8.14%	5.45%		0.47	3.84%		0.34
Maximum	25.70%	22.98%		1.67	25.99%		1.81
Median	6.30%	6.30%		0.45	2.29%		0.29
Minimum	0.80%	0.80%		-1.99	-8.97%		-2.02

Notes: Based on 72 monthly observations, January 2001 – December 2006.

Exhibit 4: Excess Currency Index Returns as a Function of Four Factors

April 6 2005 – June 30 2010, 274 weekly observations

	Intercept	Carry	Trend (AFX)	Value (PPP)	Volatility	R2
1)	+3 bps	0.06	0.28	-0.05	0.00	0.37
t-value	1.71	**5.22**	**11.90**	**-3.29**	0.05	

The Deutsche Bank G10 Harvest Index is the proxy for the returns of a Carry strategy. This index reflects the return of being long the 3 high-yielding currencies against being short the 3 low-yielding currencies within G10 currency universe. The index is rebalances quarterly. Every quarter the currencies are re-ranked according to their current 3 months Libor rate. Source: Deutsche Bank and Bloomberg.

The AFX Index reflects returns on a trend following strategy involving three moving average rules applied to seven currency pairs, weighted by the volume of turnover in the spot market. Monthly data are available at http://cwis.livjm.ac.uk/AFE/AFE_docs/AFX_Monthly.xls. Source: Liverpool John Moores University.

The Deutsche Bank FX PPP Index is the proxy for the returns of a Value strategy. The average daily spot rate over the last three months is divided by the PPP exchange rate as published annually by the OECD and ranked. This index reflects the return of being long the 3 currencies with the highest rank (undervalued currencies) against being short the 3 currencies with the lowest rank (overvalued currencies) within G10 currency universe. Source: Deutsche Bank and Bloomberg.

The Deutsche Bank Currency Volatility Index (CVIX index) is the proxy for the foreign exchange volatility. It is calculated as the weighted arithmetic average of the 3 months level of implied volatility for all major currency pairs (provided by BBA) and weighted by traded market volume. Source: Deutsche Bank and Bloomberg.