Do Demand Curves for Currencies Slope Down? Evidence from the MSCI Global Index Change

Harald Hau*

INSEAD

Massimo Massa**

INSEAD

Joel Peress***

INSEAD

*Department of Finance, Boulevard de Constance, 77305 Fontainebleau Cedex, France. Telephone: (33)-1 6072 4484. Fax: (33)-1 6072 4045. E-mail: harald.hau@insead.edu. Web page: http://www.haraldhau.com

**Department of Finance, Boulevard de Constance, 77305 Fontainebleau Cedex, France. Telephone: (33)-1 6072 4481. Fax: (33)-1 6072 4045. E-mail: massimo.massa@insead.edu. Web page: http://faculty.insead.fr/massa

***Department of Finance, Boulevard de Constance, 77305 Fontainebleau Cedex, France. Telephone: (33)-1 6072 4035. Fax: (33)-1 6072 4045. E-mail: joel.peress@insead.edu. Web page: http://faculty.insead.fr/peress

Abstract

Traditional portfolio balance theory derives a downward sloping currency demand function from limited international asset substitutability. Historically, this theory enjoyed little empirical support. We provide direct evidence by examining the exchange rate effect of a major redefinition of the MSCI Global Equity Index in 2001 and 2002. The index redefinition implied large changes in the representation of different countries in the MSCI Global Equity Index and therefore produced strong exogenous equity flows by index funds. Our event study reveals that countries with a relatively increasing equity representation experienced a relative currency appreciation upon announcement of the index change. Moreover, stock markets that are upweighted (downweighted) feature a higher (lower) permanent comovement of their currency with the basket of other MSCI currencies.

Keywords: Index Revision, International Asset Substitution, Exchange Rate Comovements

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To what extent do exogenous demand shocks move financial market prices? Can they propagate from one asset class to another? These are the questions we address in this paper. The first question – commonly referred to as the resilience of a market – has been examined extensively for individual equity prices.[1] Much less is known about the resilience of macroeconomic prices such as exchange rates.[2] Yet exchange rates are particularly important and their alleged misalignment is at the core of a large literature on external imbalances. Imperfect exchange rate resilience underlies the traditional portfolio approach to exchange rates, which derives a downward-sloping demand curve for foreign balances from imperfect international asset substitutability. The growing quantitative importance of equity flows has increased interest in the portfolio channel of exchange rate theory.

The second question relates to the propagation of uninformative demand shocks across markets. The traditional literature focuses on frictionless markets in which the propagation is information-based, i.e., comovements in asset prices reflect comovements in their fundamental values. However in the presence of frictions such as transaction costs, trading restrictions or imperfect information, assets with unrelated fundamentals may comove merely because investors assign them to similar categories. For example, Barberis and Shleifer (2003) argue that investors tend to categorize assets into styles (e.g., value vs. growth or small-cap vs. large-cap), and allocate funds at the level of these styles rather than at the individual asset level. As they move funds across styles, they induce a correlation across the returns of assets classified into the same style, even if the cashflows of these assets are uncorrelated. Barberis, Shleifer, and Wurgler (2005) provide persuasive evidence that such style investing generates comovement among stocks, but there is no evidence to date that it can induce comovement across different asset classes such as stocks and currencies.

The correlation structure between capital flows and exchange rate movements has been the subject of much empirical research. But causal inference is hampered by a lack of clear identification. While flows may trigger exchange rate movements, flows may themselves be induced by investors' trend-chasing behavior. Similarly, though it can readily be observed that assets belonging to different classes (e.g., equity and fixed income) can move in sync or anti-sync, establishing a directional link from one asset class to another remains a challenge. This paper examines a unique natural experiment in which the effects of flows on exchange rates can be measured for truly exogenous and uninformative portfolio flows, namely the rebalancing of the MSCI Global Equity Index.

In December 2000, Morgan Stanley Capital International (MSCI) announced a major redefinition of its international equity indices. The new index weights would be based on the freely floating proportion of a stock's capitalization instead of the market capitalization itself. This implied a large change for the equity representation of many countries in the MSCI Global Equity Index, also referred to as MSCI ACWI (All Country World Index). Approximately \$300 to \$350 billion may be directly indexed to MSCI equity indices.[3] The up- or downweighting of a country or currency area therefore triggered considerable exogenous capital in- or outflow. The MSCI redefinition provides a natural experiment for the exchange rate effect of equity flows. Moreover, because demand shocks clearly originate in the equity market, it offers the opportunity to test whether they are transmitted to the currency market.

We first establish that upweighted stocks earn large excess returns around the announcement event. For example, a strategy that buys a stock upweighted by one standard deviation and sells a stock downweighted by the same amount yields an average abnormal return of 1.18% over a 12-day window. This return opportunity is quantitatively similar for various window sizes and measures of stock returns, namely raw or abnormal relative to an international asset pricing model, or returns denominated in dollars or in local currency. These results conform to previous studies of domestic equity index changes. They show that the equity impact of index changes carries over to international indices (i.e., that the global demand for stocks slopes down).

We then turn our attention to the currency market. We document that the announcement event caused a systematic exchange rate appreciation for (relatively) upweighted countries. Over an 8-trading day window around the announcement event, the 16 most upweighted currencies appreciate relative to the 17 most downweighted countries on average by more than 2%. While the exact magnitude of the effect is sensitive to the size of the event window and the estimation procedure, its qualitative nature and statistical significance is robust.

Our findings not only provide evidence that the demand for currencies slopes down, they also demonstrate that shocks to equities can propagate to currencies. Moreover, they have important implications for the current debate about international current account imbalances. If exogenous capital inflows can strengthen the domestic exchange rate, then such flows may be the source of currency overvaluation and the cause of current account deficits rather than their mere consequence. The issue of causality becomes even more important in light of the increasing quantitative significance of international equity flows over the last decade. A further implication is that any anticipation of future sterilized intervention by central banks can have an immediate exchange rate impact.[4]

Finally, we explore whether changes to country weights in the MSCI Gobal Equity Index also modify the permanent correlation structure of exchange rates. Individual stocks have been shown to comove more with an index upon their addition to the index. We find strong evidence that the same is true of currencies when their representation in a global equity index changes. We show that upweighted (downweighted) currencies tend to comove more (less) with the other currencies in the MSCI Global Equity Index.

The paper is structured as follows. In the next section, we discuss the testable hypotheses. In Section 2, we review the literature. Section 3 describes the institutional background and provides summary statistics on our experiment. In Section 4, we explain the statistical methodology. The results are presented in Section 5.1 for the equity market and in Sections 5.2 and 5.3 for the currency market. Though we focus our attention on the announcement of the index redefinition, we discuss briefly in section 5.4 how the market reacted when the index changes were implemented. Section 6 features a discussion of our findings. In Section 6.1, we examine whether the index redefinition had any impact on currencies' comovement. In Section 6.2, we discuss whether the effect on the level of exchange rates should persist. A conclusion follows.

1 Hypotheses

We develop two testable hypotheses that help structure our empirical analysis. The index redefinition presents a natural experiment in which the equity flows result from exogenous rebalancing needs of global index funds. This implies that these flows are not related to asymmetric information shocks or other endogenous shocks. The event study therefore allows us to assess directly whether exogenous global equity flows have an impact on domestic equity prices and exchange rates. Our analysis proceeds in two steps, starting from the equity market (Hypothesis H1) and then moving to the currency market (Hypothesis H2). Under hypothesis H1, stocks are not perfect substitutes for one another in international equity markets – their global demand slopes down. Hence, upweighted stocks see their demand shift up and their price rise, while downweighted stocks see their demand shift down and their price fall.

H1. The global demand for stocks slopes down.

Imperfect equity substitutability implies that stock prices react to a global index redefinition. Stocks *which are upweighted (downweighted) in a global index earn positive (negative) returns.*

The alternative hypothesis is that of complete stock substitutability, which rules out any price effect. A non-rejection of Hypothesis H1 opens the possibility for the index redefinition to generate country-wide demand shocks.[5] Hypothesis H2 investigates whether such shocks have an impact on exchange rates.

H2. The demand for currencies slopes down.

Imperfect currency substitutability implies that exchange rates react to a global index redefinition. Currencies that are upweighted (downweighted) in the index experience an exchange rate appreciation (depreciation).

Under this hypothesis, exogenous shocks to the global demand for stocks aggregate at the country level and generate exogenous shocks to the demand for currencies. If currencies are not perfect substitutes for one another, then the index change can have a measurable impact on exchange rates. We emphasize that Hypothesis H2 does not subsume Hypothesis H1. In other words, observing a currency effect but no equity effect is possible. Indeed, if the global demand for an upweighted country's equity shifts up but local investors in that country are willing to accommodate the excess demand, then there will be no observable change in the country's equity prices. Yet, to the extent that funds do not flow out of the country, i.e., local investors invest their proceeds in local securities such as non-index stocks or fixed income assets, there will be an excess demand for the country's currency, which in turn can trigger a currency appreciation. The alternative to H2 states that the index redefinition does not affect exchange rates.

2 Literature

2.1 Evidence on price pressure

Our work is methodologically related to event studies of the equity price impact of (domestic equity) index changes. There is evidence that demand curves for stocks slope down. S&P 500 index inclusions (exclusions) increase (decrease) stock prices (Garry and Goetzmann, 1986; Harris and Gurel, 1986; Shleifer, 1986; Dillon and Johnson, 1991; Beneish and Whaley, 1996; Lynch and Mendenhall, 1997). Chen (2006) and Onayev and Zdorovtsov (2008) find similar effects for redefinitions of Russell indices, which represent smaller stocks, and document in addition changes in stocks' liquidity. Most similar to our study, Kaul, Mehrotra and Morck (2000) examine index reweighting for stocks in the Toronto Stock Exchange 300 index and find that upweighted stocks experience a persistent positive price effect. Greenwood (2005) studies the Nikkei 225 reweighting. Taking a portfolio approach, he shows both theoretically and empirically that limits to arbitrage are related to the risk contribution of the demand shock to the portfolio risk of an arbitrageur. Chakrabarti, Huang, Jayaramana and Lee (2005) study changes to MSCI indices as we do, but they examine equities while our focus is on currencies. They find that the rebalancing of 29 MSCI country indices carried out quarterly between 1998 and 2001 leads to effects that are similar to those reported for the United States.

While the short-term price effect of index inclusions is not controversial, its persistence is debated. Shleifer (1986) argues that when a firm is added to the S&P 500, its stock price permanently increases by 2.79%. His observation is confirmed by Garry and Goetzmann (1986), who find no reversal of short-term announcement returns, but is contradicted by Harris and Gurel (1986) and Lynch and Mendenhall (1997), who report some evidence of reversal. Massa, Tong, and Peyer (2004) help reconcile these results by showing that companies may offset the initial price effect of the index inclusion by issuing more shares.

While this literature has focused so far on domestic indices and the impact of their redefinitions on the equity market, we examine a global index. Beyond investigating whether domestic equity effects carry over to an international environment, the MSCI experiment allows us to study potential currency effects. Moreover, because demand shocks clearly originate in the equity market, we can provide direct evidence of their propagation to the currency market. That is, we can test whether shocks in the equity market are transmitted to the currency market. Our paper is the first to provide direct evidence of such a causal linkage. As the transmission of demand shocks from the equity to the currency market induces a correlation between stocks and currencies – upweighted (downweighted) countries see both their equity and currency appreciate (depreciate), our paper also relates to the large literature on comovement. But in contrast to this literature, it displays evidence of comovement across asset classes rather than within an asset class. For example, Barberis, Shleifer, and Wurgler (2005) show that stocks included in the S&P 500 index comove more with each other. Boyer (2004) documents a similar phenomenon when stocks switch from a S&P/BARRA Value and Growth index to another index.

Our paper also connects to a broader literature that assesses whether demand and supply shocks correlate with individual stock returns. Time series studies on block purchases and sales of stocks as well as of the trades of institutional investors have consistently uncovered evidence of temporary price pressure on individual securities conditional upon unusual demand or supply (Lakonishok, Shleifer, and Vishny, 1991,1992; Chan and Lakonishok, 1993, 1995). In the international finance literature, Froot, O'Connell, and Seasholes (1998) have shown that local stock prices are sensitive to international investor flows, and that transitory inflows have a positive future impact on returns. Focusing on mutual funds, Warther (1995) and Zheng (1999) have documented that investor supply and demand effects may aggregate to the level of the stock market itself. Goetzmann and Massa (2002) show that, at daily frequency, inflows into S&P500 index funds have a direct impact on the stocks that are part of the index. Generally, the results in this stream of literature are contingent on implicit or explicit identification assumptions. In contrast to the aforementioned event studies, causal inference is problematic.

2.2 Price Pressure for Exchange Rates?

Our study is also part of the strand of research that links exchange rate movements to currency order flows – a measure of net buying pressure. Evans and Lyons (2002a, 2002c) document a strong contemporaneous correlation between currency returns and order flows. The reason for this correlation, they argue, is that order flows proxy for aggregate information flows. They develop models of FX trading in the presence of dispersed information that can explain over 60% of the daily Deutsche mark /dollar exchange rate movements. In a related paper (Evans and Lyons, 2002b), they show that trades following macroeconomic news have higher price impact. They estimate that the price impact per dollar traded is about 10% higher per news announcement in the previous hour. The MSCI Global Equity Index rebalancing that we examine here is unlikely to represent a source of macroeconomic information. It allows us to focus instead on the price impact of uninformative flows.

Uninformative flows lie at the center of the traditional portfolio approach to exchange rates. It views assets in different currencies as imperfect substitutes (Kouri, 1983; Branson and Henderson, 1985). This implies typically that the demand for foreign exchange balances slopes downward. Historically, the portfolio balance theory enjoyed little empirical support.[6] Hau and Rey (2003) provide microfoundations to the portfolio balance theory in a dynamic incomplete market framework. They derive a positive correlation between capital flows and exchange rate returns and find empirical support for the model implications in recent data. Froot and Ramadorai (2004) use a simple VAR framework to document very persistent exchange rate effects related to U.S. institutional in- and outflows. Pavlova and Rigobon (2003) and Hau and Rey (2004) use model-based identification assumptions to assess the role of capital flows for exchange rate movements. In all these studies, causal inference is contingent on the validity of the identification assumptions. The MSCI index redefinition provides a natural experiment in which the currency impact of portfolio flows can be measured for truly exogenous and uninformative flows.

The resilience of the exchange rate is also at the core of a literature on the effectiveness of central bank interventions (Edison, 1993). Recent studies based on microeconomic data provide evidence that central bank interventions indeed create a price effect. Payne and Vitale (2003) show price pressure effects for interventions by the Swiss central bank. Dominquez (2003) documents a short-term daily and intra-day volatility effect related to central bank intervention. However, these studies on central bank interventions are inherently ambiguous about the nature of the exchange rate effect. Indeed, besides the traditional "portfolio effect" of the intervention, a "signaling effect" provides an alternative interpretation of the data. Central bank interventions may reveal information about the bank's future monetary policy.

3 Institutional Background

3.1 MSCI and its Index Maintenance

Morgan Stanley Capital International Inc. (MSCI) is a leading provider of equity (international and U.S.), fixed income and hedge fund indices. The MSCI Equity indices are designed to be used by a wide variety of global institutional market participants. They are available in local currency and U.S. dollars (US$), and with or without dividends reinvested.[7] MSCI's global equity indices have become the most widely used international equity benchmarks by institutional investors. Close to 2,000 organizations worldwide currently use the MSCI international equity benchmarks. Over US$ 3 trillion of investments were benchmarked against these indices worldwide and approximately US$ 300 to 350 billion are directly indexed at the time of the experiment.[8] The indices with the largest international coverage are the MSCI ACWI (All Country World Index), which includes 50 developed and emerging equity markets, the MSCI World Index (based on 23 developed countries), the MSCI EM (Emerging Markets) Index (based on 27 emerging equity markets), the MSCI EAFE (Europe, Australasia, Far East) Index (based on 21 developed countries outside of North America), the MSCI Europe [based on 14 EU countries (except Luxemburg), plus Norway and Switzerland].

Over time, MSCI's methodology has evolved in order to ensure that the equity index series continue to properly represent these markets and maintain their benchmark character. The design and implementation of the index construction is based on a broad and fair market representation. In theory, a total market index, representing all listed securities in a given market, would achieve this goal. However, in practice, a total market index including all the stocks would be difficult to use as a benchmark for international investors. Therefore, MSCI builds up the indices from industry group level by restricting itself to securities that are truly replicable in global institutional portfolios of reasonable size. To maintain the goal of broad and fair market representation and reflect the evolution of the underlying markets, the indices must be reviewed regularly, which comprises inclusions and exclusions of index components.[9]

MSCI commits in its published guidelines to the principles of transparency and independence from outside interests. All reviews and changes are announced at least two weeks in advance or as early as possible prior to their implementation. Only in rare cases are events announced during market hours for implementation on the same or following day.[10]

3.2 The Announcement Process

In February 2000, MSCI communicated that it was reviewing its weighting policy and that it was considering a move to index weights defined by the freely floating proportion of the stock value. Such free-float weights would take account of restrictions like Foreign Ownership Limits (FOLs) in different countries and therefore would better reflect the limited investibility of many stocks. Free-float weights where subsequently adopted by MSCI's competitor Dow Jones on September 18, 2000. On the next day, MSCI published a consultative paper on possible changes and elicited comments from its clients. On December 1, 2000, MSCI announced that it would communicate its decision on the redefinition of the MSCI Global Equity Index on December 10, 2000. Fund managers could by then infer that MSCI's adoption of free floats weights was imminent. The second announcement on December 10, 2000 provided the time table for the implementation of the index change in two steps and the new target for market representation was 85% up from previously 60%. To minimize the price impact of the redefinition, the equity indices would adjust 50% towards the new index on November 30, 2001 and the remaining adjustment was scheduled for May 31, 2002.

MSCI's decision was broadly in line with the previous consultative paper. Only the target level of 85% was somewhat higher (by 5%) and the implementation timetable was somewhat longer than most observers had expected.[11] December 10, 2000, therefore marks the confirmation of existing market expectations. Most participants appear to have anticipated the adoption of free float weights at least since the first announcement ten days earlier. An examination of transaction volumes in the Euro/Dollar spot market confirms this view. We use FX transaction data previously used and documented by Breedon and Vitale (2004).[12] The data consist of all electronically brokered spot transactions in both the EBS and Reuters D-2000 trading platforms on any given day from August 1, 2000 to January 24, 2001. The exact size of each transaction (in terms of dollar value) is unknown, but separate volume statistics indicate that the average FX spot transaction size in the EBS platform amounts to \$3.14 million and is somewhat lower for trades in the Reuters system.[13] In the relevant time period, EBS accounts for approximately 81% of all electronically brokered spot trades in the Euro/Dollar market.

Figure 1 shows total excess trading volume (by number of transactions net of day-of-the-week effects) for a 1-month window around December 1, 2000. We obtain excess volume by subtracting from the gross number of transactions on any given day the average number of transactions for the same day of the week over the sample period. The FX volume on Friday, December 1, 2000 (just before the MSCI announcement) is characterized by a small positive excess volume of 574 transactions. More striking is the trading volume on the first working day following the announcement, namely Monday, December 4. It exceeds the average Monday trading volume by 5,911 transactions. By contrast, trading volume on Monday, December 11, the first working day after the second announcement, was below average. The transaction volumes indicate that December 1, 2000, was the relevant news event and we refer to this first date as the relevant announcement date. But information leakages even prior to December 1, 2000 are plausible, as well. The foreign exchange abnormal spot volume did also peek on November 30, 2000, with a total excess volume of 3,545 transactions.

3.3 The New Index Methodology

The new methodology differs from the previous equity index definition in two aspects. First, stock selection is based on freely floating capital as opposed to market capitalization. Second, the market representation is enhanced in the new index. MSCI defines the free float of a security as the proportion of shares outstanding that is available for purchase by international investors. In practice, limitations on the investment opportunities of international institutions are common due to so-called "strategic holdings" by either public or private investors. Given that disclosure requirements generally do not permit a clear identification of "strategic" investments, MSCI labels shareholdings by classifying investors as strategic and non-strategic. Freely floating shares include those held by households, investment funds, mutual funds and unit trusts, pension funds, insurance companies, social security funds, and security brokers. The non-free float shares include those held by governments, companies, banks (excluding trusts), principal officers, board members, and employees. Non-free float is also defined in terms of foreign ownership restrictions. Such Foreign Ownership Limits (FOLs) can come from law, government regulations, company by-laws, and other authoritative statements. MSCI free float-adjusts the market capitalization of each security using a factor referred to as the Foreign Inclusion Factor (FIF). For securities subject to FOLs, the FIF is equal to the lesser of the FOL (rounded to the closest 1% increment) and the free float available to foreign investors (rounded up to the closest 5% increment above 15% and to the closest 1% below a 15% free float). Securities with a FIF of less than 15% across all share classes are generally not eligible for inclusion in the MSCI indices.[14]

The second goal of the equity index modification was an enhanced market representation. In its new indices, MSCI targets a free float-adjusted market representation of 85% within each industry and country, compared to the 60% share based on market capitalization in the old index. Because of differences in industry structure, the 85% threshold may not be uniformly achieved. Moreover, the occasional over- and under-representation of industries may also imply that the aggregate country representation may deviate from the 85% target.[15]

The overall index rebalancing effect is illustrated in Figure 2, which plots the percentage change in index weight for each country in the Gobal Equity Index (ACWI) as a function of the initial weight. The percentage weight change Δw_i is expressed in percentage terms (relative to the midpoint) as:

$$\Delta w_i = \frac{w_i^n - w_i^o}{\frac{1}{2}\left(w_i^n + w_i^o\right)},$$

where w_i^o and w_i^n represent, respectively, the old and new index weight of country i. Normalizing by the average country weight allows to adjust for the size of the country's economy.[16] Figure 2 shows that most countries were in fact downweighted, and many by a considerable amount in percentage terms. The most important beneficiaries of the new methodology are the U.S., the

U.K., and Ireland, with percentage weight increases of 12%, 10.9% and 11.4%, respectively. The main losers in percentage terms are Columbia with a decrease by −98.3%, India by −97.1%, and the Czech Republic by −96.7%. In the subsequent analysis, we assign countries to groups according to their weight change. To simplify the exposition, we refer to countries with the largest (smallest) weight change as 'upweighted (downweighted) countries' respectively, even though some 'upweighted countries' are actually downweighted.

The initial sample consists of the 50 countries in the MSCI ACWI.[17] We exclude the U.S. as the dollar constitutes our reference currency. We also remove Argentina, Brazil, and Turkey because these countries experienced major currency crisis before or during the period of our analysis. Since the 11 countries in the Euro zone share one common exchange rate, we aggregate these observations into one so that the old (new) weight equals the sum of the 11 country weights in the old (new) index. The final sample consists of 36 countries with exchange rate data, of which 10 are from developed and 26 are from emerging markets. Three countries, namely China, Malaysia, and Hong Kong, maintained their currencies pegged to the U.S. dollar. We therefore excluded these three currencies from our sample, which leaves us with 33 countries and 2,436 stocks.[18] Cross-sectional summary statistics for the weight changes of countries and stocks are reported in Table 1. The table also provides summary statistics on the cross-sectional exchange rate and stock returns for the announcement event windows. Because of the predominant role of the U.S. dollar in the global MSCI index, we express all exchange rate changes in dollars per local currency. Generally, we denote by e_{it} the value of currency i at date t. An appreciation of currency i against the dollar implies $\Delta e_{it} > 0$. All exchange rate and stock returns data was obtained from Datastream. Daily exchange rate returns are based on log exchange rate changes since the previous (end of the day) London price fixing.

4 Statistical Methodology

An index fund should rebalance its portfolio close to the implementation of the index change. This timing will minimize the tracking error relative to the valid benchmark. On the other hand, a possible price impact justifies a more gradual rebalancing towards the new index. Risk arbitrageurs are likely to anticipate the price impact of index trackers and front-run their reallocation. As in most studies, we focus our attention on the announcement event (but also discuss the implementation events) and use a symmetric window of a few days around it. This is the most appropriate method to capture front-running effects. We experiment with both a short window of 6 trading days and a longer window of 12 trading days. Generally, we cannot exclude the possibility that a large proportion of any possible exchange rate effect occurs outside our chosen event window.[19] The qualitative nature of our evidence is therefore more relevant than its quantitative aspect.

4.1 Equity Market

We use a standard least squares approach to check whether upweighted (downweighted) stocks earn positive (negative) returns. Specifically, we regress individual stock returns on their weight change and a constant:

$$\Delta r_{ij} = \alpha_0 + \alpha_1 \Delta w_{ij} + \mu_{ij}, \tag{1}$$

where Δr_{ij} is the return on stock j (which trades in country i) over the announcement window and Δw_{ij} is the change in its index weight, defined as above as $\Delta w_{ij} = 2(w_{ij}^n - w_{ij}^o)/\left(w_{ij}^n + w_{ij}^o\right)$. The coefficient α_1 captures the systematic effect of weight changes on stock returns, while the constant α_0 identifies changes that are common to all stocks over the widow. Under Hypothesis H1, its estimate $\widehat{\alpha}_1$ should be significantly positive. We employ various measures of stock returns. We start with raw stock returns, denominated both in the local currency (the currency of country i) to factor out currency effects, and in U.S. dollars. Then we use abnormal stock returns, based on a two-factor international asset pricing model that includes both domestic and global market risk (e.g., Foerster and Karolyi,1999). Specifically, we regress individual stock returns on a constant, the return on a domestic market index, and the return on a global index :

$$r_{ijt} = \beta_{ij0} + \beta_{ijD} \times r_{Dit} + \beta_{ijW} \times r_{Wt} + \varepsilon_{ijt},$$

where r_{ijt} is the (log) return on day t on stock j in country i, r_{Dit} is the return on country i's domestic market index (the Datastream index for country i) on day t, and r_{Wt} is the return on the global market index (the Datastream world index) on day t.[20] The estimated coefficients are a constant β_{ij0}, stock j's loading on the domestic market index β_{ijD}, and its loading on the global market index β_{ijW}. The regressions are estimated using daily returns over a pre-announcement window of 100 trading days from $t = -107$ to $t = -8$ (from July 4, 2000 to November 21, 2000). Abnormal returns are then calculated over the announcement window as:

$$r_{ijt} - (\beta_{ij0} + \beta_{ijD} \times r_{Dit} + \beta_{ijW} \times r_{Wt}),$$

for $t = -2$ to $t = +3$ for a 6-day window or for $t = -5$ to $t = +6$ for a 12-day window. As with raw returns, we estimate abnormal stock returns both in local currency and U.S. dollars. To obtain abnormal stock returns in local currency (U.S. dollars), we use returns on the stock, the domestic index, and the global index denominated in the local currency (U.S. dollars). We report standard errors adjusted using White's correction for heteroskedasticity, as well as clustered around countries.

4.2 Currency Market

Given the large cross-section of stocks, a simple least squares approach yields accurate estimates of the slope of the demand for stocks, α_1. This is no longer the case when we turn to exchange rates. We therefore assess the relation between country weight changes and currency returns using three different tests. First, we carry out a non-parametric Fisher test. This test examines whether the ranking of the percentage weight change Δw_i is related to the ranking of the exchange rate change Δe_i^s over the event window, where s denotes the window length. An advantage of the Fisher test is that it represents an exact test and is therefore particularly appropriate for small samples. Its null hypothesis is a non-zero correlation between the currencies return over the event window and the weight change. A problem with the test is that such a non-zero correlation might also exist outside the event period in normal times. If, for example, exchange rate correlations among upweighted exchange rates are systematically different from exchange rate correlations among downweighted currency, then the null hypothesis of the Fisher test could be rejected over any arbitrary time interval. In this case, the Fisher test provides necessary but not sufficient evidence to claim any event specific effect. Unfortunately, we find evidence of such correlation clustering in the dimension of the country weight changes. Currency pairs of upweighted countries comove more than currency pairs, consisting of one up- and one downweighted country (we describe the evidence for this phenomenon in the next section). The null hypothesis of the Fisher test may therefore be too general for the problem at hand. We need a model specification that identifies an event-specific effect against the background of an arbitrary contemporaneous correlation structure of all exchanges rates.

Our second test addresses the issue of correlation clustering by explicitly accounting for the covariance structure of all currencies. To obtain reliable covariance estimates, we combine the event sample with historical exchange rate data. The historical data covers weekly exchange rate returns from July 1, 1996 to July 1, 2000. The weekly returns are measured from the Monday closing price to the next Monday closing price. We define a time dummy D_t, which equals one for the week with the announcement date (December 1, 2000) and zero for the historical data period. The weekly exchange rate return Δe_{it} is regressed on the demeaned scaled weight change $\Delta\overline{w}_i$ for currency i (defined as $\Delta\overline{w}_i = \Delta w_i - \frac{1}{N}\sum_{n=i}^{N}\Delta w_i$) interacted with the time dummy D_t. Formally, we have:

$$\Delta e_{it} = \alpha_0 + \alpha_1 D_t + \alpha_2(\Delta\overline{w}_i \times D_t) + \mu_{it}.$$

We report coefficient estimates $\widehat{\alpha}_1$ and $\widehat{\alpha}_2$ under both OLS and a panel error-adjusted procedure. In the latter, the coefficients are estimated using a Prais-Winsten regression and the standard errors are adjusted by assuming the disturbances are heteroskedastic and contemporaneously correlated across panels and time (which we refer to as a "general covariance structure"). The coefficient α_2 captures the systematic effect of the weight change on the exchange rate, while the coefficient α_1 reflect dollar specific effects common to all currencies. Hypothesis H2 is consistent with a significantly positive $\widehat{\alpha}_2$.

Our third test pushes the analysis of currencies one step further. It accounts for the possibility that currency trades induced by the index redefinition may not be spread uniformly over the event window, so identifying the days on which they are more intense can improve the power of our tests. It is plausible that arbitrageurs take positions simultaneously in all currencies. In that case, above average trading in one currency can serve as a proxy for the 'speculative intensity' common to all currencies.

Euro/Dollar orderflow statistics obtained from Breedon and Vitale (2004) allow us to carry out this analysis. These data consist of the number of daily buy- minus sell-initiated orders in the two important interdealer trading systems EBS and Reuters D-2000 over a window ranging from August 2000 to January 2001 (i.e., a period that straddles the announcement). The daily frequency of the orderflow data allows to distinguish trading days characterized by particularly large dollar purchases within the event window. The U.S. equity market was upweighted in the MSCI Global Equity Index relative to all other markets including the Euro-denominated equity markets. We expect therefore to observe positive orderflows OF_t for days of strong speculative trading induced by the index rebalancing. For the event window, we define $\overline{OF}_t$ as the demeaned daily FX orderflow and assume it provides an appropriate intertemporal measure of speculative intensity common to all currency markets. We interact orderflow with the demeaned cross-sectional weight change to generate a panel structure with both daily and country variation. This allows us to repeat the multivariate regression on daily data. We use again a general covariance structure across all the exchanges and time to control for correlation clustering. The time dummy D_t now equals one for each of day around the announcement date and zero otherwise. In particular, we estimate the linear regression:

$$\Delta e_{it} = \alpha_0 + \alpha_1 D_t + \alpha_2(\Delta\overline{w}_i \times D_t) + \alpha_3(\overline{OF}_t \times D_t) + \alpha_4\left(\Delta\overline{w}_i \times \overline{OF}_t \times D_t\right) + \mu_{it},$$

Under Hypothesis H2, the estimates of $\widehat{\alpha}_2$ and/or $\widehat{\alpha}_4$ should be significantly positive. The coefficients α_1 and α_3 again capture dollar-specific effects common to all currencies.

5 Results

5.1 Equity Market

Table 2 reports estimates of cross-sectional least squares regressions of individual stock returns on individual stock weight changes. In Panel A, stock returns are measured in local currency in order to exclude any exchange rate effect. We therefore look at excess returns from the perspective of a local investor. In Panel B, we measure stock returns in U.S. dollars. We report standard errors corrected for heteroskedasticity using White's adjustment, as well as clustered by country. Table 2 shows strongly significant estimates of α_1 whether returns are raw or abnormal and whether they are denominated in the local currency or U.S. dollars. This effect is also quantitatively large. A strategy that buys an upweighted stock by one standard deviation and sells a downweighted stock by the same amount yields an average abnormal return of 1.18% (= $1.18 \times 2 \times 0.502$) over a 12-day window. This return opportunity is quantitatively similar for the 6-day window and whether returns are denominated in dollars or local currency.

Thus, upweighted stocks experience excess returns around the announcement event, consistent with Hypothesis H1. These results conform to previous studies of domestic equity index changes. They show that the equity impact of index changes carries over to international indices (i.e., that the global demand for stocks slopes down). The significant intercept α_1 identifies common factors affecting equity markets around the world over the event widow, as well as an appreciation of most sample currencies against the U.S. dollar for dollar returns.

5.2 Currency Market

Having established that the index redifinition has an impact on individual stocks, we investigate whether its effect spreads to currencies. First, we represent the exchange rate behavior around the announcement date visually. Figure 3 plots exchange rate returns over a 6-day window against a country's percentage weight change. The upward sloping regression line indicates that a weight increase leads to a currency appreciation. The economic magnitude of the effect is sizable. The fitted line has a slope of 2.49, which implies that a 10% weight increase of a currency is associated with a 0.249% appreciation. Approximately \$300 billion is directly benchmared to the MSCI index. The averge currency has a weight of 2.2% in the index. A 10% weight increase therefore translates into a capital flow of \$0.66 billion ($0.022 \times 0.1 \times 300$ bn). An (uninformative) capital flow of \$1 billlion therefore amounts to an average appreciation of 0.38% (0.249%/0.66). As a comparison, Evans and Lyons (2002a) estimate that a \$1 billion (informative) FX order flow moves the \$/DM exchange rate by 0.5%.

We can also characterize the elasticity of arbitrageurs' demand for currencies as 40.16 (1/2.49%). This elasticity is substantially larger than that estimated for stocks by Kaul, Mehrotra and Morck (2000) and Wurgler and Zhuravskaya (2002).[21] It reflects arbitrageurs' greater willingness to flatten the aggregate demand curve for currencies. This is expected given the higher liquidity of FX market.

The sample of 33 countries is then split into two subsamples containing the 16 (most) upweighted and the 17 (most) downweighted countries. Figures 4 and 5 show an equally-weighted index representing the average cumulative exchange rate effect for each subsample. Figure 4 uses the U.S. dollar as the reference currency while Figure 5 uses a basket of currencies, weighted according to their capitalization in the MSCI Global Equity Index in order to neutralize any dollar effect (the dollar weakened against the basket over the period). Both figures show that upweighted countries experienced an exchange rate appreciation compared to downweighted countries. The gap across the two groups grows almost continuously over the eight trading days from November 27 to December 6, 2000. Information leakages prior to December 1, 2000, as well as a slow information diffusion thereafter may explain the gradual nature of the effect. The figures also give insights into its economic significance. Over the eight trading days, the exchange rate gap exceeds 2%. The average percentage weight change in the sample of upweighted countries is -15%, while the average percentage weight change in the subsample of downweighted countries is -70%. We conclude that the economic significance of the exchange rate effect is considerable.

We discuss next the statistical significance of the exchange rate effect. Table 3 present the results of the Fisher test on the two subsamples. For each currency, we compute cumulative changes over a 6-day and 12-day window around the event. The Fisher test rejects the null hypothesis for both window sizes at a 1% level. We conclude that there is a statistically significant relationship between weight and exchange rate changes, as postulated by Hypothesis H2.

To explore exchange rate correlation clustering in the dimension of the weight change, we calculate daily currency returns over a 4-year period prior to July 1, 2000. Exchange rate behavior during this period should not be affected by the changes to the index announced much later. We form all 528 ($0.5 \times 33 \times 32$) currency pairs and calculate the correlations for (1) pairs of only upweighted currencies, (2) pairs of only downweighted currencies, and (3) pairs of one up- and one downweighted currency. The correlation statistics are reported in Table 4. The group of upweighted currencies has clearly the highest mutual correlation, with an average of 20.8% relative to an overall correlation of 10.4% for all currency pairs. Exchange rate correlations are clustered in the dimension of weight changes. In particular, the median correlation of currency pairs within the same weight-change group is higher than for pairs across groups. The Fisher test in Table 4 confirms the association of weight-change group and correlation clustering at a 1% significance level.

In Tables 5 and 6 (Column (1)), we report the estimation results for the regressions using a general covariance structure across currencies and time that accounts for correlation clustering. In Table 5, based on weekly observations, the slope coefficient α_2 in Column (1) has a positive and statistically significant sign. It implies a return difference between the average upweighted and downweighted currencies of 1.19% (2.159×0.55) over a week. The positive coefficient α_1 indicates that the event week was marked by an appreciation of most sample currencies against the dollar. The explanatory power over the event week is remarkably strong. The R-squared is 38%, compared to 0.8% over the entire sample period.

Table 6 presents similar results using daily returns. The number of time series observations increases from 174 weekly returns in Table 5 to 980 daily returns in Table 6. A small number of return outliers during the Asian and Russian currency crisis were discarded.[22] Column (1) in Panel A (6-day window) and Panel B (12-day window) displays estimates of the coefficient α_2 that are positive and statistically significant at the 1% level. The coefficient implies an average return difference of 1.36% ($0.413 \times 0.55 \times 6$) between upweighted and downweighted currencies over six trading days. Again, the explanatory power over the event period is strong (the R^2 is approximately 20% and 13% in the 6- and 12-day windows, compared to 0.2% over the entire sample period).

Finally, we exploit the daily orderflow data in the Euro/Dollar market. Column (2) in Table 6 shows that the orderflow $\overline{OF}_t$ itself does not explain the intertemporal pattern of exchange rate changes around the announcement. However, the interaction term between weight changes and orderflow during the event window days, namely $\Delta\overline{w}_i \times \overline{OF}_t \times D_t$, produces a statistically significant positive coefficient in Panel B. Intuitively, orderflow in the Dollar/Euro market proxies for the intertemporal intensity of currency speculation in favor of the dollar. Over the event window, orderflow should pick up currency speculation related to MSCI Gobal Equity Index weight change. Interacted with the weight change, it proxies for 'speculation intensity' in each individual currency. The positive sign on the coefficient α_4 provides additional support in favor of a downward sloping demand for currencies. The coefficient α_2 captures the time average of the weight change impact and remains positive, significant and of similar magnitude as in Column (1).

5.3 Robustness checks

In this section, we check whether the results obtain under alternative normalizations of the weight change. We relied so far on the change in countries' index representation to predict their currency impact. We used relative weight change since one would expect this impact to depend on the size of the FX markets – currencies in which the daily trading volume is smaller should be more sensitive to the index redefinition. Specifically, we divided a measure of the absolute (dollar) flow into country i's currency, $w_i^n - w_i^o$, by the value (in dollars) of country i's equity in the index, $(w_i^n + w_i^o)/2$. We assumed that the latter is positively related to the size of the market for currency i.

To check the robustness of our results, we scale instead the absolute weight change with direct estimates of the size of the currency market. Obtaining data on daily currency trading volume is not an easy task. Therefore, we rely on three-yearly surveys published by the Bank for International Settlement (BIS).[23] The survey closest to the MSCI redefinition was undertaken in April 2001 and the average daily FX volumes are published by currency and trading instrument. We derive two proxies for trading volume: Spot FX Volume and Total FX Volume. The latter measure includes outright forward contracts and swap contracts. Figures 6 and 7 show that both proxies are closely related to our previous scaling variable. Figure 6 (respectively Figure 7) plots the log Spot FX Volume (respectively Total FX volume) against the log average of the old and new weights, $\left(w_i^n + w_i^o\right)/2$. A formal test based on a linear regression indicates that the log of the MSCI weights explains 85% (respectively 80%) of the variation in the log Spot FX Volume (respectively Total FX volume).

We then reestimate both the daily and weekly currency regressions using these new proxies for trading volume. The results are reported in Table 5, Columns (3) and (4) and in Table 6, Columns (3) to (6). They confirm the previous conclusions: the index rebalancing has a strong impact on currencies whether we use the 6-day or the 12-day window. For example, in the case of a 6-day window (Table 6, Panel A), a one standard deviation increase in a country's weight changes leads to a 0.71% $(0.155 \times 0.76 \times 6)$ appreciation in its currency if the scaling is based on Spot FX Volume and to a 0.67% $(0.286 \times 0.39 \times 6)$ appreciation if the scaling is based on Total FX Volume.

In summary, all three statistical procedures (Fisher test, regressions on weight changes, and regressions on weight changes interacted with the Euro/Dollar order flow) and the various definitions of the weight changes show a positive and statistically significant relationship between weight increases and currency appreciations. The exact magnitude of the effect is sensitive to the window size, estimation procedure, and the weight definition, and cannot be determined with much accuracy. But the qualitative results are robust across window sizes, sampling frequencies, and alternative time spans for the exchange rate data.[24] The results also obtain when we do not exclude the three countries that experienced a currency crisis during our data period (Turkey, Argentina, and Brazil) or the three countries with a pegged currency (China, Malaysia, and Hong Kong). In addition, weight changes interacted with orderflow account for the panel structure of currency returns around the announcement event. This is consistent with the idea that orderflow in the Euro/Dollar market proxies for speculative intensity in all currencies. Overall, the evidence strongly supports the notions that shocks originating in the equity market spillover to the currency market, and that currencies are imperfect substitutes for one another.

5.4 Implementation Effects

We focused so far on the market's reaction to the announcement of the MSCI Global Equity Index redefinition. We examine next the market's reaction to its implementation. As described above, the redefinition took place in two steps. On November 31, 2001, half of the changes were implemented for the existing index constituents and all the new constituents were added at half of their final weight. The rest of the changes occurred on May 31, 2002.

Previous studies that distinguish between a price impact occurring at the announcement of an index change from one occurring at its implementation find evidence of a "reversal" on the implementation day. Such a pattern has been observed, for example, in the case of changes to the S&P500 index occurring after 1990, when S&P started announcing changes to its index. Beneish and Whaley (1996) and Lynch and Mendenhall (1997) report that added stocks earn positive abnormal returns upon announcement but negative abnormal returns upon implementation, thereby partially offsetting the initial gains. The common interpretation is that arbitrageurs trading on the announcement date overestimate the demand by index funds adjusting their portfolios on the implementation date.

Our results are consistent with these studies. Table 7 displays the equity and currency responses on the first implementation date (November 31, 2001). Panel A reports results based on U.S. dollar stock returns. Results for local currency stock returns are similar and omitted for brevity. In contrast to the announcement event, the estimated coefficient on the weight change is negative in most specifications, indicating that upweighted stocks earned negative returns upon implementation. The results for currencies also differ from those of the announcement event. Panel B presents nonparametric Fisher tests and OLS estimations similar to those carried out at the announcement, with a general covariance structure that accounts for correlation clustering. The Fisher test reveals no statistical difference in exchange rates across up- and downweighted countries. In the multivariate estimation, weekly currency returns are regressed on the (demeaned) percentage weight change $\Delta\overline{w}_i$ interacted with a time dummy D_t that marks the event week around November 30, 2001. The estimates of α_1, the slope coefficient on $\Delta\overline{w}_i \times D_t$, are negative as in the equity market, but not significantly so. The negative slopes in the equity and currency markets suggest that speculators inaccurately estimated the amount of capital reallocated by index funds or the inventory accumulation of other speculators. If they overestimate the former or underestimate the later, then their aggregate trades may exceed the index funds' reallocations and lead to negative price effects.[25] Excessive speculative behavior may be a pervasive problem in rare events such as announced global index changes where the scope for learning is limited.

The equity and currency effects on the second implementation date (May 31, 2002) are presented in Table 8. The slope estimates are once again negative in the equity market. In the currency market in contrast, the Fisher and the multivariate estimates both indicate that exchange rate returns are positively associated with country weight changes. The null hypothesis of no association is rejected at the 1% significance level by the Fisher test and by the multivariate regression for the 12-day window. The disconnect between the two markets – upweighted stocks do earn negative returns while upweighted currencies earn positive returns – suggests that local and global speculators are behaving differently. Indeed, a negative equity effect on the one hand points to large speculative equity positions being unwound, thereby offsetting index funds' equity reallocations. The positive exchange rate effect, on the other hand, indicates that no such unwinding is taking place in the currency market. It is plausible that local speculators are off-loading their positions while global speculators are not, perhaps because they have already done so on the first implementation date (when no currency effect was found). According to this scenario, global index funds' purchases of upweighted stocks are offset in the equity market by local arbitrageurs' sales but their purchases of upweighted currencies are not, leading to an appreciation of upweighted currencies but no appreciation of upweighted stocks.

To summarize, we find in line with the literature that gains made on upweighted stocks and upweighted currencies upon announcement are partially reversed upon implementation. These reversals can be interpreted as signs of expectational errors or coordination failures amongst speculators. Indeed, they face the daunting problem of having to forecast both the capital flows by index funds and the contrarian positions of other speculators. Moreover, the contrasting outcomes across the two markets, in particular on the second implementation date, suggest that local and global speculators follow different strategies. It appears that global arbitrageurs, unlike local arbitrageurs, unwound their position on the first implementation date.

6 Discussion

6.1 Currency comovement

The literature on equity index changes finds that stocks added to an index tend to comove more with this index (e.g., Barberis, Shleifer, and Wurgler, 2005). We investigate here whether the same is true of currencies (i.e., whether upweighted (downweighted) currencies tend to comove more (less) with the other currencies in the MSCI index).

To test this prediction, we apply the methodology developed by Barberis, Shleifer, and Wurgler

(2005). We construct a currency index, representing the average return on a basket of currencies. We measure both the equally- and the value-weighted return on the basket, where the weights in the latter case equal the MSCI country weights. We evaluate currencies' correlation with the basket by regressing the daily return on a currency i on the daily basket return. A positive slope coefficient reflects the fact that currencies tend to fluctuate together. To avoid spurious effects, we remove the contribution of currency i to the basket. This implies that the basket always consists of all currencies except the dollar and the currency that is the dependent variable.

We use daily data on exchange rates covering two-year periods before and after the announcement event (1998-1999 and 2003-2004) and test whether currencies' correlation with the basket has changed. We run the following panel regression:

$$\begin{aligned}\Delta e_{it} \quad = \quad & \alpha_0 + \alpha_1 Basket_t + \alpha_2 \Delta\overline{w}_i + \alpha_3 D_t + \alpha_4 \left(\Delta\overline{w}_i \times Basket_t\right) + \alpha_5 \left(D_t \times Basket_t\right) + \\ & + \alpha_6 \left(D_t \times \Delta\overline{w}_i\right) + \alpha_7 \left(\Delta\overline{w}_i \times Basket_t \times D_t\right) + \varepsilon_{it}, \qquad (2)\end{aligned}$$

where Δe_{it} measures the percentage change in the currency i on day t, $Basket_t$ is the return on our constructed index on day t (equally or value weighted), $\Delta\overline{w}_i$ is the weight change for currency i, and D_t is a dummy variable that equals 0 in the pre-event period (1998-1999) and 1 in the post-event period (2003-2004). The coefficient of interest is α_7, which multiplies $\Delta\overline{w}_i \times Basket_t \times D_t$. A positive coefficient estimate indicates that upweighted currencies comove more with the basket in the post-event period, as expected. We estimate Equation (2) as a pooled regression with robust standard errors, clustered by both country and date, as well as a panel regression with errors that are correlated across panels.

The results are reported in Table 9. Panel A uses an equally-weighted basket, while Panel B uses a value-weighted one. The results show a significantly positive value for α_7, across the different specifications. This suggests that following the rebalancing, upweighted currencies tend to comove more with each other than downweighted currencies. The results are not only statistically significant, but also economically large. Indeed, the estimate for α_7 is about as large as that for α_4, the coefficient on the interaction between $Basket_t$ and $\Delta\overline{w}_i$. This suggests that the magnitude of the comovement across currencies doubles in the post-event window relative to the pre-vent window.

Interestingly, the estimates of α_1 and α_5 are statistically positive across specifications. The positive coefficient estimate on $Basket_t$, α_1, captures the commonality of shocks across currencies, but it could also reflect shocks to the dollar, which affect both the currency on the left-hand side and the basket (since currencies are all denominated against the dollar). This commonality appears to have intensified in the post-event period, as indicated by the positive coefficient estimate on $Basket_t \times D_t$, α_5. That is, currencies comove more with the basket after the event, regardless of their reweighting. This may be the result of intensifying international capital flows, perhaps because more capital is benchmarked to the MSCI index now that it is free-float adjusted.

The increased comovement between exchange rate returns Δe_{it} and the term $\Delta \overline{w}_i \times Basket_t$ for the period December 2000 to December 2002 ($D_t = 1$) relative to the preceding two years ($D_t = 0$) can also be illustrated by a moving (constant) kernel regression. For a moving window MW of 180 days, we estimate the coefficient α_3 as:

$$\Delta e_{it} = \alpha_0 + \alpha_1 Basket_t + \alpha_2 \Delta \overline{w}_i + \alpha_3 \times \Delta \overline{w}_i \times Basket_t, \qquad t \in MW$$

and plot the estimate $\widehat{\alpha}_3$ against the midpoint of the window. Figure 8 illustrates the increase of the comovement coefficient $\widehat{\alpha}_3$ in 2000. The vertical line marks the announcement date of the MSCI index change on December 1, 2000. The coeffcient $\widehat{\alpha}_3$ is persistently higher for the two-year period following the index change.

6.2 Is the currency effect permanent?

While our evidence shows that the index redefinition has an effect on the level of exchange rates that is both statistically and economically sizable in the short term, it is unclear whether or not it should persist. This ambiguity is also present in the literature on domestic index additions. While Harris and Gurel (1986) and Schleifer (1986) argue for a permanent effect, Beneish and Whaley (1996), and Lynch and Mendenhall (1997), examining S&P 500 index changes that were announced before being implemented, find that the announcement effects are partially reversed on the following days. The literature on block trades also reports evidence of temporary price pressure on individual stocks conditional upon unusual demand or supply (Lakonishok, Shleifer, and Vishny, 1991; Chan and Lakonishok, 1993, 1995). In the international finance literature, Froot, O'Connell and Seasholes (1998) find that local stock prices are sensitive to international investor flows, and that transitory inflows have a positive future impact on returns.

Since our analysis is based on short windows (from 6 or 12 days around each event for the return analysis, to two years for the comovement analysis), the effect may just be transitory and disappear after a few years. Here, we share the methodological limitations encountered by the papers that study the equity impact of index changes. Any long-term conclusion requires an estimation window so long that the ability of the standard event methodology to pin down changes in a statistical meaningful way is hampered. Indeed, other confounding effects may alter the relationship, and the underlying assumption of a constant stock (currency) sensitivity to index weight changes is less accurate. However, within the limited two-year window, the results clearly point in the direction of an increased comovement.

From a theoretical perspective, any discussion of the persistence of the exchange rate effect is still more complicated. According to the standard theory of money, exchange rates are a function of the relative supply of and demand for money. Any theoretical conclusion within a monetary framework depends on whether index changes modify the relative money demand temporarily or permanently. Arguments in favor of both hypotheses can be made. The reallocation of the index capital itself represents a one-time surge in the relative money demand for the upweighted country. But if a higher index representation leads to permanently higher relative asset turnover and generates related cash positions, changes in the money demand might be of a permanent nature.[26] In light of this theoretical ambiguity, we refrain from making any predictions about the long-term behavior of exchange rates. But their short-term reaction to the index change shown in Figure 4 is still of a strikingly magnitude and is likely to have real effects.

The evidence of a downward sloping demand curve for currencies presents evidence for international market segmentation. Assets denominated in different currencies are imperfect substitutes. Therefore even uninformative equity flows as those resulting from an index revision result in an exchange rate adjustment. Such imperfect international asset substitutability is also supported by evidence on persistent violations of uncovered interest parity, which are the underlying source of so-called carry trades. International arbitrage forces in the currency market appear too weak to maintain uncovered interest rate party. They also appear too weak to provide a flat currency supply curve to accommodate uninformative equity flows from an index revision.

7 Conclusions

The exchange rate reaction to exogenous capital flows has long been an open issue in international finance. Empirical work suffered from a lack of clear identification of capital flow shocks. At the same time, the growing quantitative importance of international equity flows has revived interest in the traditional portfolio channel of exchange rate determination. The MSCI Global Equity Index redefinition announced in December 2000 provides an ideal natural experiment to examine the impact of clearly exogenous equity flows on a large number of exchange rates. Moreover, because demand shocks clearly originate in the equity market, the redefinition offers the opportunity to test whether they are transmitted to the currency market.

We find that upweighted stocks and upweighted currencies earn large excess returns around the announcement of the index change. In other words, the global demand for stocks and the demand for currencies both slope down. Our results demonstrate that shocks to the equity market can propagate to the currency market. They also provide statistically and economically strong evidence that currencies – which form by most accounts, the most liquid asset class – have a limited resilience. Our findings imply that foreign capital inflows may in principle cause exchange rate appreciations and current account deficits, as opposed to the reverse linkage underlying much of the macroeconomic literature.

Notes

[1]We use the term "resilience" here to denote the price impact with respect to uninformative demand shocks as opposed to market depth, which refers to the price impact of general order flow (from both informed and uninformed investors).

[2]It is by no means clear how resilient currencies are. On one hand, a large literature shows that the demand for stocks slopes down (i.e., their resilience is limited). On the other hand, currencies are viewed as a the most liquid asset class. For example, Menkhoff and Taylor (2007) estimate that currency turnover exceeds equity turnover by a factor of three in the seven largest financial centers in the world.

[3]See the investment newsletter 'Spotlight on: Throwing Weights Around,' Hewitt Investment Group, December 2000.

[4]An example of such an annoucement is the Plaza Accord in September 1985 when the G5 countries promised to intervene in currency markets to obtain a devalued dollar.

[5]Hypothesis H1 does not subsume Hypothesis H2. That is, observing an equity effect but no currency effect is possible, for example, if some international investors are willing to accomodate the excess demand for upweighted currencies.

[6]For a survey of the relevant literature, see Rogoff (1984) and Hodrick (1987).

[7]Aggregating individual securities by different criteria, MSCI creates a broad base of indexes such as Global, Regional, and Country Equity Indexes, Sector, Industry Group and Industry Indexes, Value and Growth Indexes, Small Cap Equity Indexes, Hedged and GDP-weighted Indexes, Custom Equity Indexes, and Real Time Equity Indexes.

[8]See the investment newsletter 'Spotlight on: Throwing Weights Around,' Hewitt Investment Group, December 2000.

[9]The index maintenance can be described by three types of reviews. First, there are annual full country index reviews (at the end of May) in which MSCI re-assesses systematically the various dimensions of the equity universe for all countries. Second, there are quarterly index reviews (at the end of February, August, and November), in which other significant market events are accounted for (e.g., large market transactions affecting strategic shareholders, exercise of options, share repurchases, etc.). Thirdly, ongoing event-related changes like mergers and acquisitions, bankruptcies or spin-offs are implemented as they occur.

[10]A more descriptive text announcement is sent out to clients for significant events like additions and deletions of constituents and changes in free float larger than US$ 5 billion or with an impact of more than 1% of the constituent's underlying country index.

[11]See again the investment newsletter 'Spotlight on: Throwing Weights Around,' Hewitt Investment Group, December 2000.

[12]We thank Francis Breedon and Paolo Vitale for generously sharing the data.

[13]See Table 3 in Breedon and Vitale (2004).

[14]Exceptions to this general rule are made only in significant cases, where exclusion of a large company would compromise the index's ability to fully and fairly represent the characteristics of the underlying market.

[15]MSCI's bottom-up approach to index construction may lead to a large company in an industry not being included in the index, while a smaller company from a different industry might be included.

[16]The weight level is commensurate to the size of a country's economy. Smaller countries experience smaller *absolute* weight changes. Yet the impact on their currency is unlikely to be smaller. Furthermore, there is no need to deduct from country weights the weight assigned to the U.S. though exchange rates are calculated against the U.S. dollar since our tests are based on how exchange rates move relative to one another (i.e., a reweighting of the U.S. affects all countries in a similar way). We confirm in section 6.3 that our results are robust to the use of alternative measures of the weight change.

[17]The 50 index countries are: Argentina, Australia, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Egypt, Hong Kong, Hungary, India, Indonesia, Israel, Japan, Jordan, Korea, Malaysia, Mexico, Morocco, New Zealand, Norway, Pakistan, Peru, Philippines, Poland, Russia, Singapore, South Africa, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, United States, Venezuela, and the 11 Euro area countries, namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain.

[18]We check that our results are robust to the inclusion of the three countries that experienced a currency crisis or of the three countries with pegged currencies.

[19]Any information leakage about the index change prior to the event window implies that we tend to underestimate the equity and exchange rate effects. Estimates are therefore only lower bounds for the full effect of the index change.

[20]To avoid any "circularity" in our argument, we do not use MSCI indices to compute abnormal returns. Unreported results based on MSCI indices are analogous.

[21]Kaul, Mehrora and Morck (2000) report an elasticity of 10.5 based on the revision of the Toronto Stock Exchange 300 index. Wurgler and Zhuravskaya (2002) estimate an elasticity of 8.24 based on additions to the S&P 500 index.

[22]We discard a daily return observation if the exchange rate moved by more than 5% over one day.

[23]The BIS survey does not report FX trading volume data for six countries, namely Egypt, Jordan, Sri Lanka, Morocco, Pakistan, and Venezuela. These countries were dropped from the subsequent analysis.

[24]We confirmed the results using exchange rate data spanning two or three years instead of four years.

[25]Witness to this daunting problem is the declaration of Peter Lockyer, head of risk management at Merrill Lynch Investment Managers: "It will be very interesting to see exactly what happens. Active fund managers, passive fund managers and hedge funds will all want to benefit from these changes at others' expense. This means having to second-guess when and what these other investors will do. The effect may be to push certain key stocks in an unexpected direction." (*Financial Times*, May 17, 2001).

[26]Moreover, the monetary authorities might respond to any change in the (permanent) relative money demand. If the central bank is concerned about asset price inflation or the price increase of imports, it may reduce the money supply and this reaction may potentially magnify the short-run exchange rate change. However, under any type of foreign currency peg, the central bank may respond to the increased money demand by a corresponding increase in the money supply. The latter channel would neutralize the persistence of the exchange rate effect even if the money demand does increase permanently. The monetary regime of the country under consideration should therefore matter for the persistence of the exchange rate effect.

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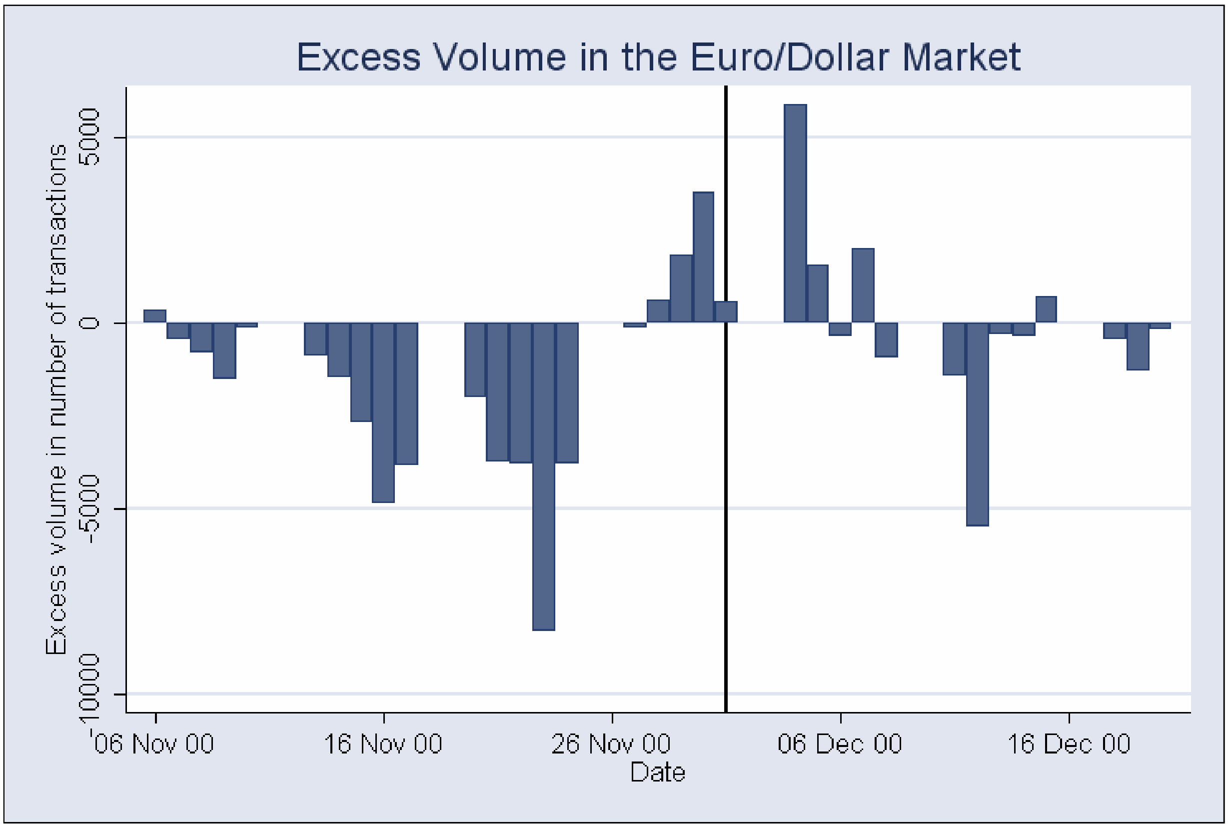

Figure 1: Plotted is the daily transaction volume in the Euro/Dollar spot market around December 1, 2000, net of day-of-the-week effects. The volume data consist of the daily number of transactions in both the EBS and Reuters D-2000 spot trading platforms (see Breedon and Vitale, 2004). The average trading volume (in terms of number of transactions) for the same day of the week over the 6-month period from 01/08/2000 to 24/01/2001 is subtracted from the trading volume on a given day. The black vertical line marks the first announcement day (Dec. 1, 2000). Trading volume peaks on the first trading day (Dec. 4, 2000) that follows it but does not on the first trading day after the second announcement (Dec. 11, 2000).

Figure 2: The percentage weight change of a country in the MSCI Global Equity Index (ACWI) is plotted against the log level of the country's weight prior to the index redefinition. The 50 index countries are Argentina (AR), Australia (AU), Brazil (BR), Canada (CA), Chile (CL), China (CN), Colombia (CB), Czech Republic (CZ), Denmark (DK), Egypt (EY), Hong Kong (HK), Hungary (HN), India (IN), Indonesia (ID), Israel (IS), Japan (JP), Jordan (JO), Korea (KO), Malaysia (MY), Mexico (MX), Morocco (MC), New Zealand (NZ), Norway (NW), Pakistan (PK), Peru (PE), Philippines (PH), Poland (PO), Russia (RS), Singapore (SG), South Africa (SA), Sri Lanka (CY), Sweden (SD), Switzerland (SW), Taiwan (TA), Thailand (TH), Turkey (TK), United Kingdom (UK), United States (US), Venezuela (VE), and the Euro Area (EU). The Euro Area aggregate is composed of 11 countries, namely Austria (OE), Belgium (BG), Finland (FN), France (FR), Germany (BD), Greece (GR), Ireland (IR), Italy (IT), Netherlands (NL), Portugal (PT), and Spain (ES).

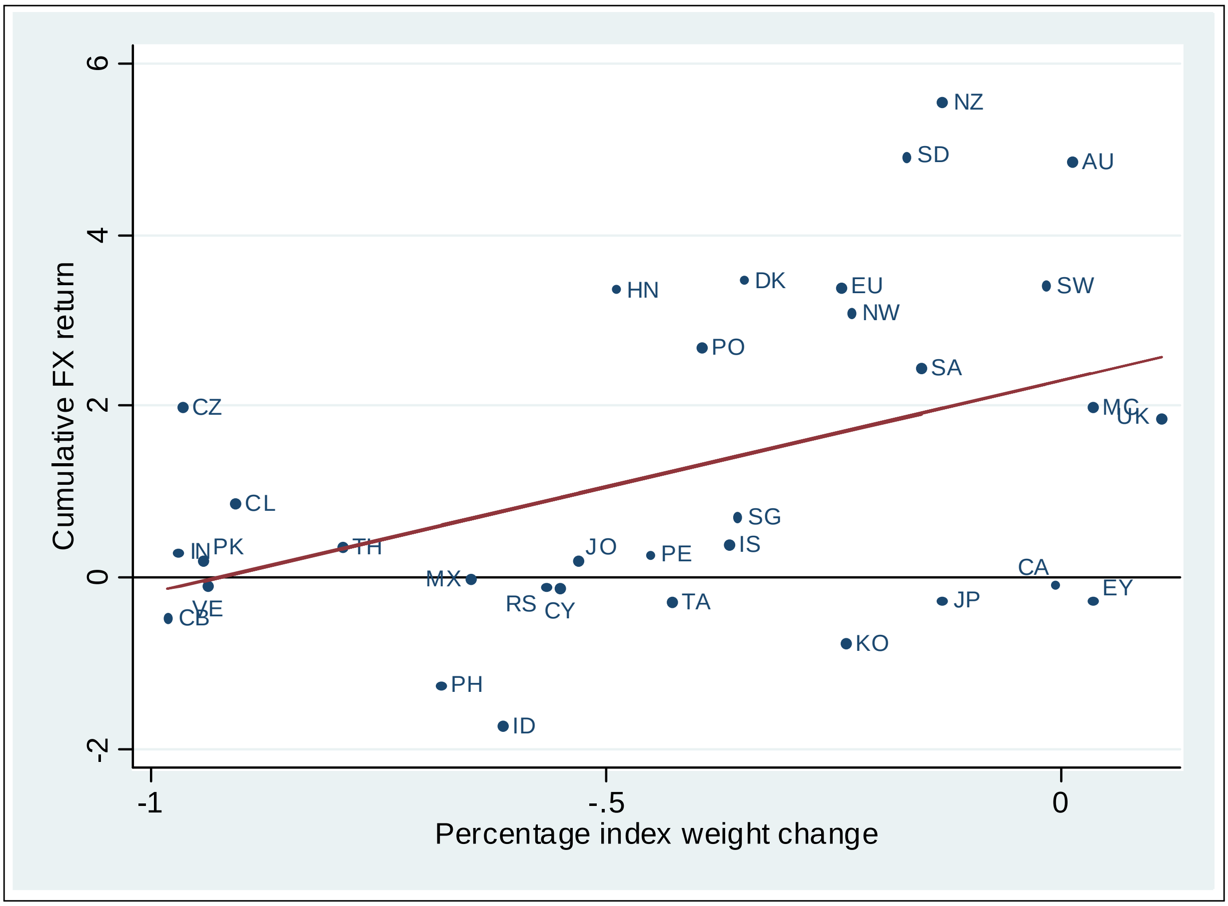

Figure 3: Exchange rate returns (denominated in dollar per local currency and expressed in percentage points) over a 6-day window (Δe_i^6) are plotted against the index weight changes (Δw_i). The solid curve displays the fitted values from an OLS regression of exchange rate returns on index changes. The regression yields $\Delta e_i^6 = 2.30 +\ 2.49 * \Delta w_i$ where the t-statistics on Δw_i equals 2.99, the number of observations is 33 and the R^2 equals 17%. The sample countries consists of the 50 countries in MSCI ACWI index from which were excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), and three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey). See Figure 2 for country labels.

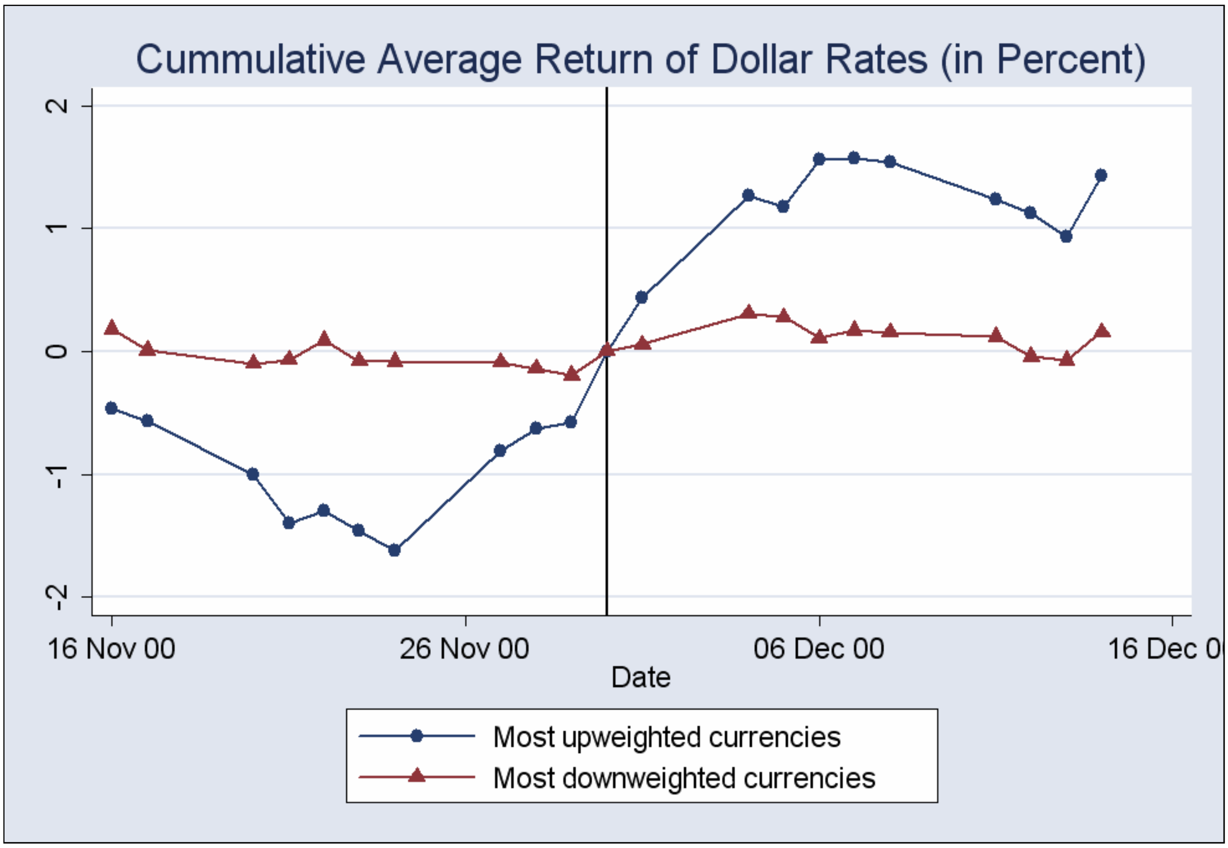

Figure 4: The average cummulative exchange rate returns (denominated in dollar per local currency and expressed in percentage points) are plotted for the 16 most upweighted and 17 most downweighted currencies around the announcement of the MSCI index redefinition (December 1, 2000). For the event day, the cumulative returns are normalized to be zero. The sample countries consists of the 50 countries in MSCI Global Equity Index (ACWI) index from which were excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), and three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey).

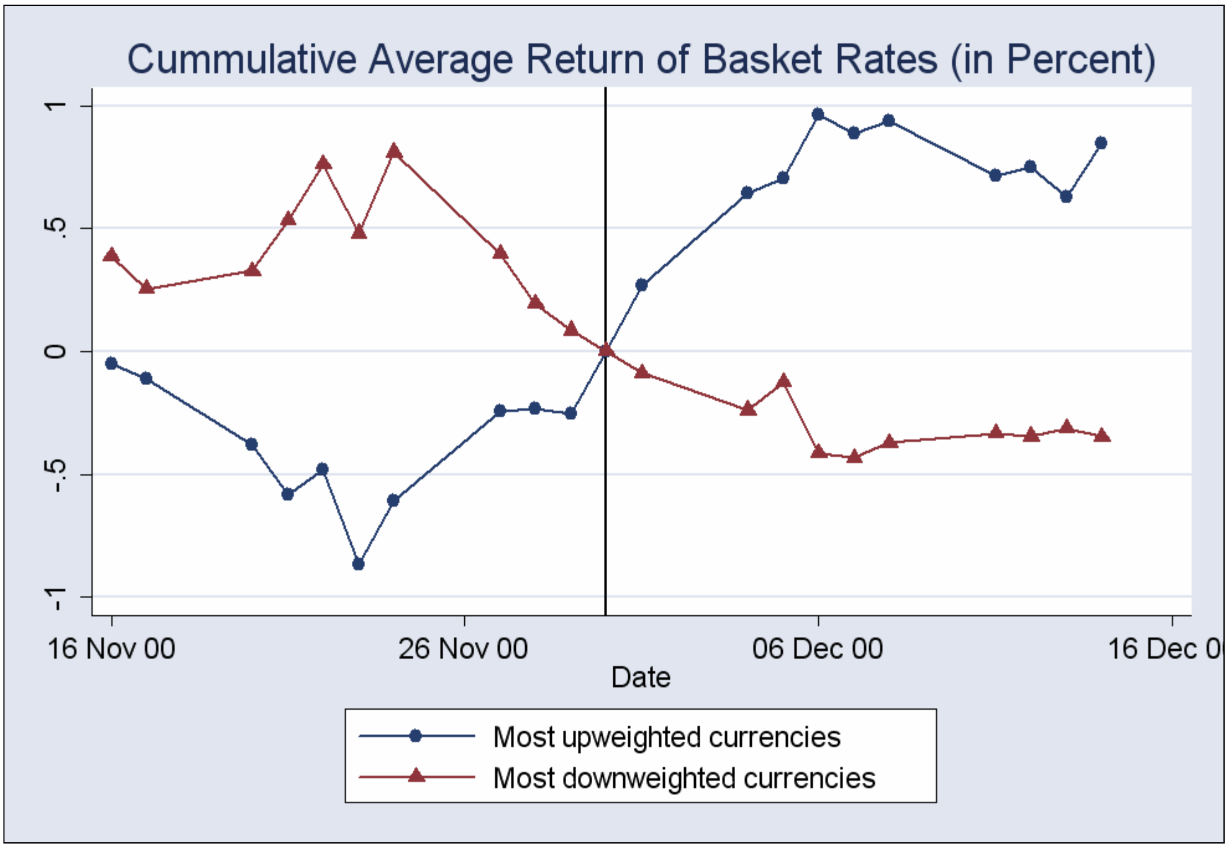

Figure 5: The average cummulative exchange rate returns (expressed relative to a basket of currencies and in percentage points) are plotted for the 16 most upweighted and 17 most downweighted currencies around the announcement of the MSCI index redefinition (December 1, 2000). For the event day, the cumulative returns are normalized to be zero. The sample countries consists of the 50 countries in MSCI Gobal Equity Index (ACWI) from which were excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), and three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey).

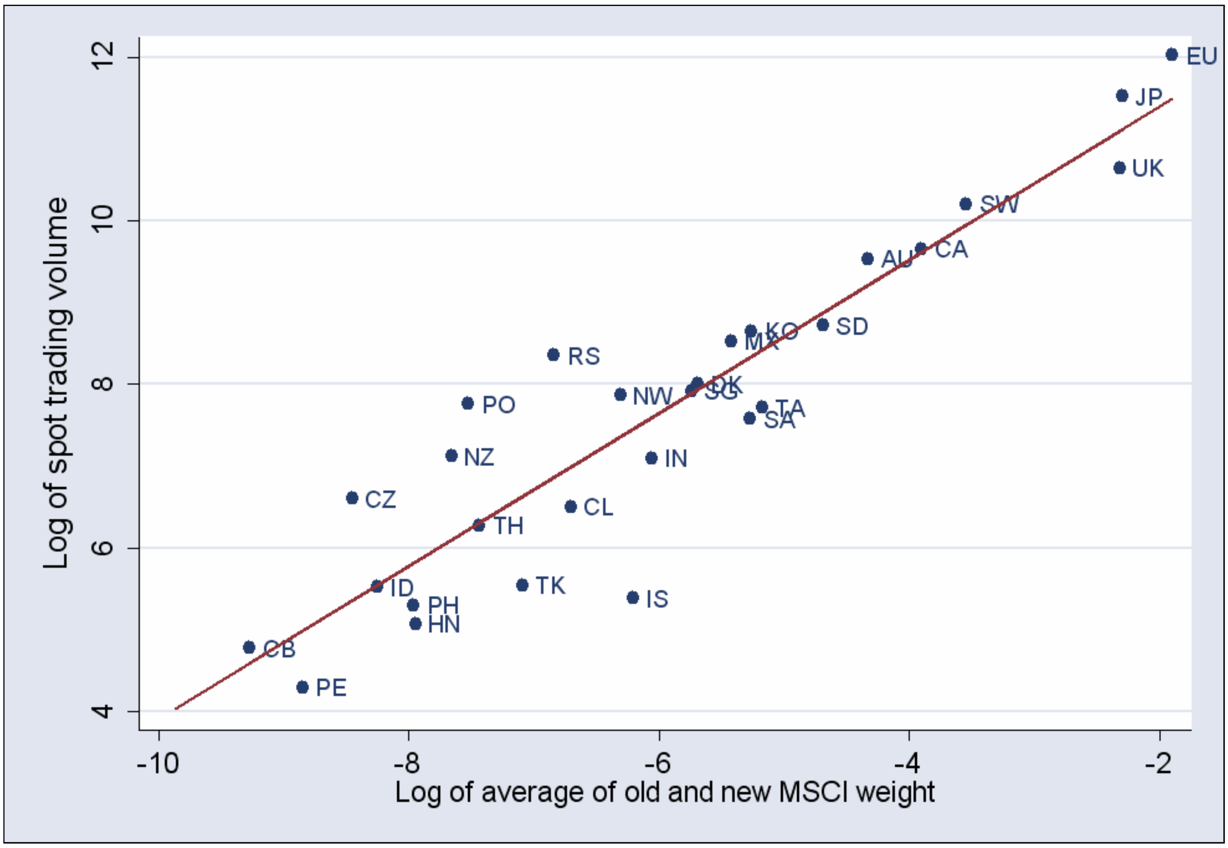

Figure 6: The spot FX trading volume as a function of the average of the old and new MSCI index weights. The figure plots the log spot FX volume against the log average of the old and new weights, $(w_i^n + w_i^o)/2$. FX volume data are obtained from the BIS April 2001 Survey. The sample countries consists of the 50 countries in MSCI Gobal Equity Index (ACWI) from which were excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey), and six countries not surveyed by the BIS (Egypt, Jordan, Sri Lanka, Morocco, Pakistan, and Venezuela).

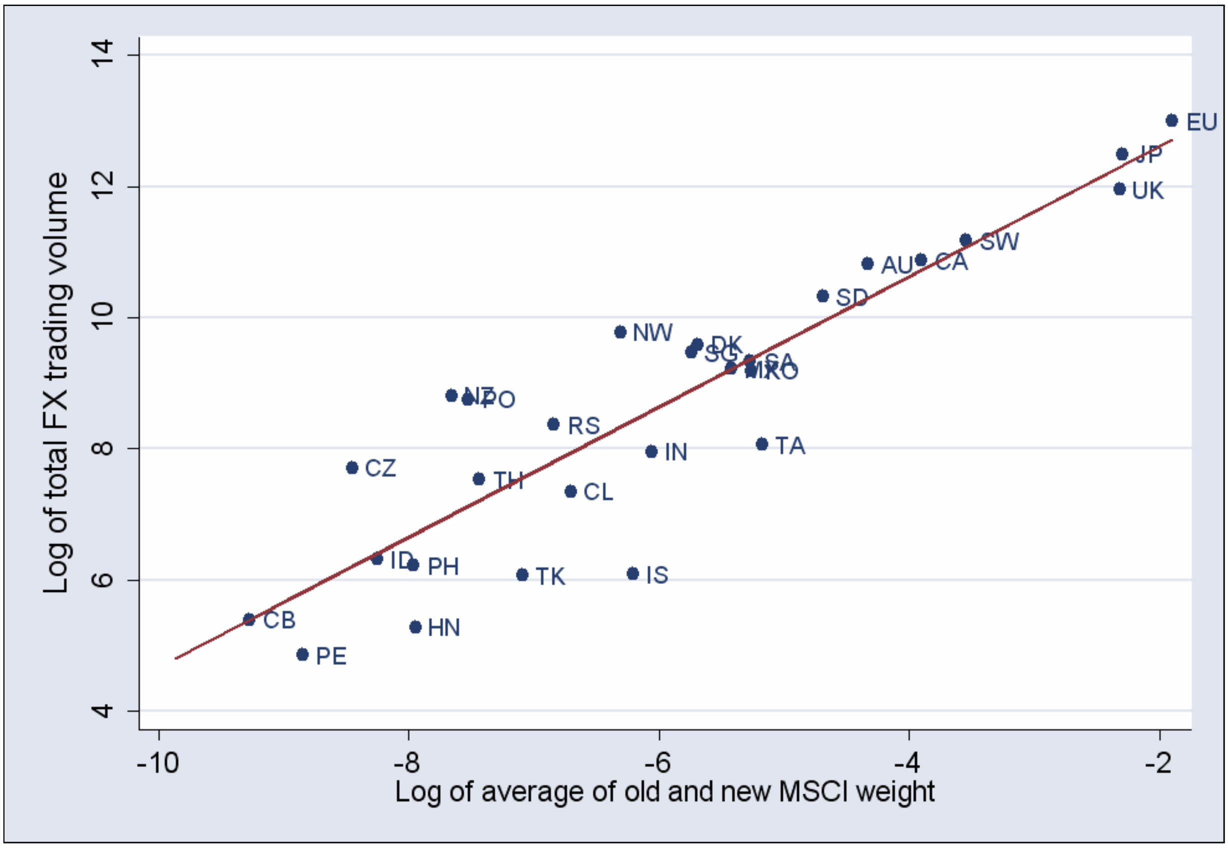

Figure 7: The spot FX trading volume as a function of the average of the old and new MSCI index weights. The figure plots the log total FX volume against the log average of the old and new weights, $(w_i^n + w_i^o)/2$. In addition to spot trading volume, Total FX Volume includes outright forward contracts and swap contracts and is obtained from the BIS April 2001 Survey. The sample countries consists of the 50 countries in MSCI Global Equity Index (ACWI) from which were excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey) and six countries not surveyed by the BIS (Egypt, Jordan, Sri Lanka, Morocco, Pakistan, and Venezuela).

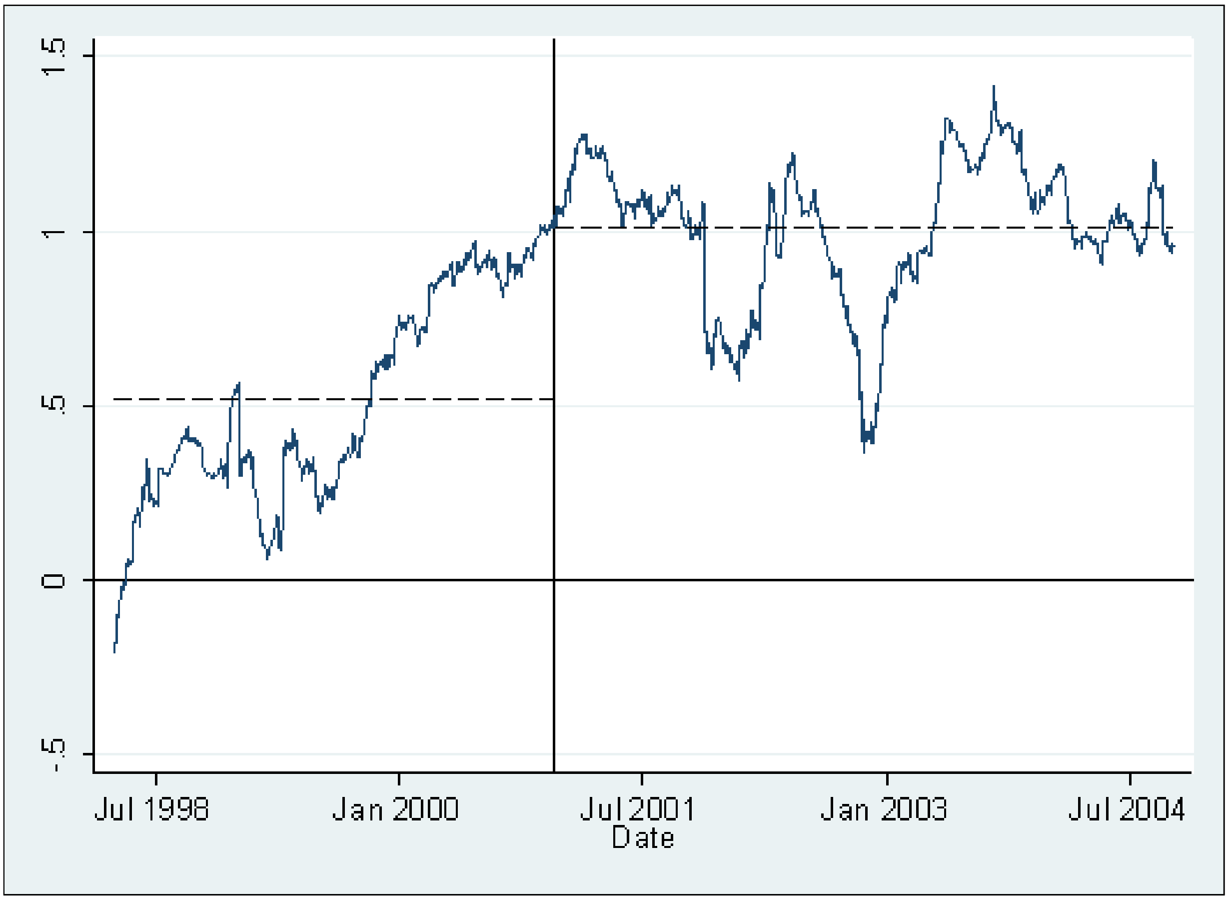

Figure 8: The graph plots the OLS regression coefficient $\widehat{\alpha}_3$ of pooled exchange rate returns Δe_{it} on the interaction term $\Delta\overline{w}_i \times Basket_t$ for a moving window of 180 days. The regression controls for the index percentage weight change of a country $\Delta\overline{w}_i$ and the return $Basket_t$ of the currency basket. The comovement coefficient is plotted for the midpoint of the time window with equal weight on each observation. The vertical line marks the announcement of the MSCI index change on December 1, 2000.

Table 1:
Summary statistics

For the sample countries, we report summary statistics on different measures of country index reweighting, Δw_i, on dollar exchange rate return, Δe_i, and individual stock returns, Δr_{ij}, for stock j trading in country i. The country weight change $w_i^n - w_i^o$ is scaled by (i) the mean between new and old country weights $\frac{1}{2}(w_i^n + w_i^o)$, (ii) the total FX market volume in currency i, Vol_i^{FX} or (iii) the FX spot market volume, Vol_i^{SP}. In addition to spot trading volume, total FX Volume includes outright forward contracts and swap contracts. Currency trading volume is available in the BIS currency market survey for April 2001 for a subsample of 27 currencies. For stock returns, we report both raw and abnormal (log) returns denominated in either the local currency or U.S. dollars. Abnormal stocks returns are computed for each stock using a two-factor international asset pricing model that includes both domestic and global market risk (see the text for details). Exchange rates, index, and individual stock returns are log returns in percentage points and measured over a symmetric 6 and 12 trading day window (marked by superscript 6 and 12, respectively) around the announcement day of the index reweighting (December 1, 2000). The exchange rate statistics exclude Argentina, Brazil, and Turkey because they experienced a major currency crisis around the time of our analysis, as well as China, Hong Kong, and Malaysia because their currencies were pegged to the U.S. dollar. The permanent constituents are all the stacks that belonged to the index before and after the experiment (i.e., not added or dropped).

		Obs.	Mean	S.D.	Min	Max
Scaled weights						
	Country weight change					
$\Delta w_i = \frac{w_i^n - w_i^o}{\frac{1}{2}(w_i^n + w_i^o)}$	(i) Percent (elative to mean)	33	−0.4269	0.3385	−0.9825	0.1086
$\Delta w_i^{FX} = \frac{w_i^n - w_i^o}{Vol_i^{FX}}$	(ii) Scaled by total FX volume	27	−0.2910	0.3939	−1.6812	0.0688
$\Delta w_i^{SP} = \frac{w_i^n - w_i^o}{Vol_i^{SP}}$	(iii) Scaled by FX spot volume	27	−0.6124	0.7626	−3.3807	0.2549
$\Delta w_{ij} = \frac{w_{ij}^n - w_{ij}^o}{\frac{1}{2}(w_{ij}^n + w_{ij}^o)}$	Stock weight change (percent)	2436	−0.1045	1.1778	−2.0000	2.0000
Currency market						
Δe_i^6	Dollar exchange rate return	33	1.2800	2.0977	−1.7462	5.7440
Δe_i^{12}	Dollar exchange rate return	33	1.2986	2.2191	−2.0783	5.4302
OF_t	Orderflow (Euro/Dollar)	12	1.422	1.127	−0.334	2.658
Equity market						
Δr_{ij}^6	Dollar raw stock return	2412	1.8968	78.6483	−117.7486	40.6059
	Dollar abnormal stock return	2362	0.2517	7.4863	−120.7578	38.2560
Δr_{ij}^{12}	Dollar raw stock return	2410	3.7697	10.7915	−98.5579	46.5046
	Dollar abnormal stock return	2362	0.2435	9.8080	−107.5854	46.0544
Δr_{ij}^6	Local currency raw stock return	2412	0.83335	7.7611	−121.154	40.6059
	Local currency abnormal stock return	2362	0.0863	7.4969	−114.3833	38.2560
Δr_{ij}^{12}	Local currency raw stock return	2410	2.5729	10.7093	−102.5828	46.5046
	Local currency abnormal stock return	2362	0.1310	9.7947	−99.3108	44.6548

Table 2:
Individual stock return regression

We perform a cross-sectional least squares regression of the return of stock j in country i on the stock's percentage weight change in the MSCI Global Equity Index (ACWI), $\Delta w_{ij} = \frac{w_{ij}^n - w_{ij}^o}{\frac{1}{2}\left(w_{ij}^n + w_{ij}^o\right)}$. Panel A reports estimates based on stock returns denominated in the local currency of country i, and Panel B estimates based on stock returns denominated in U.S. dollars. Raw and abnormal stock returns are measured (in percentage points) over a 6- and 12-day event window around the announcement day of the index reweighting (December 1, 2000). Abnormal returns in local currency and U.S. dollars are computed for each stock using a two-factor international asset pricing model that includes both domestic and global market risk (see the text for details). We report in parentheses robust standard errors adjusted for heteroskedasticity using White's correction ("OLS" column) and clustered by country ("OLS Clustered" column). We indicate by *, **, and *** indicate significance at the 5%, 3% and 1% level, respectively.

Panel A: Individual stock returns in local currency

$$\Delta r_{ij} = \alpha_0 + \alpha_1 \Delta w_{ij} + \mu_{ij}$$

	Raw returns OLS		Abnormal returns OLS		Raw returns OLS clustered		Abnormal returns OLS clustered	
Window size	6 Days	12 Days	6 Days	12 Days	6 Days	12 Days	6 Days	12 Days
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	0.894***	2.716***	0.124	0.189	0.894**	2.716***	0.124	0.189
	(0.157)	(0.216)	(0.154)	(0.201)	(0.427)	(0.849)	(0.209)	(0.394)
Δw_{ij}	0.565***	1.303***	0.327**	0.502***	0.565**	1.303**	0.327*	0.502**
	(0.152)	(0.205)	(0.150)	(0.187)	(0.270)	(0.544)	(0.165)	(0.243)
Obs.	2412	2410	2362	2362	2412	2410	2362	2362
R^2	0.0074	0.0206	0.0027	0.0037	0.0074	0.0206	0.0027	0.0037

Panel B: Individual stock returns in U.S. dollars

$$\Delta r_{ij} = \alpha_0 + \alpha_1 \Delta w_{ij} + \mu_{ij}$$

	Raw returns OLS		Abnormal returns OLS		Raw returns OLS clustered		Abnormal returns OLS clustered	
Window size	6 Days	12 Days	6 Days	12 Days	6 Days	12 Days	6 Days	12 Days
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	1.960***	3.919***	0.289*	0.303	0.020	0.039	0.289	0.303
	(0.159)	(0.217)	(0.153)	(0.200)	(0.426)	(0.727)	(0.238)	(0.473)
Δw_{ij}	0.582***	1.357***	0.321**	0.513***	0.582**	0.136***	0.321**	0.513**
	(0.152)	(0.204)	(0.151)	(0.188)	(0.221)	(0.481)	(0.158)	(0.248)
Obs.	2412	2410	2362	2362	2412	2410	2362	2362
R^2	0.0076	0.0220	0.0026	0.0037	0.0076	0.0220	0.0026	0.0038

Table 3:
Nonparametric test for independence of MSCI index reweighting and exchange rate change

The sample currencies are split into the 16 most upweighted and the 17 most downweighted currencies and alternatively into the 16 appreciating and the 17 most depreciation currencies. The Fisher test evaluates the likelihood of observed association under the null hypothesis that there is no relationship between the two sorting criteria. The currency appreciations are measured as the cumulative return (in dollars per local currency) over a 6- and 12-day window around the announcement day of the index reweighting (December 1, 2000). The sample countries consists of the 50 countries in MSCI Global Equity Index (ACWI) index from which were excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), and three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey).

Window size	6 Days	12 Days
	(1)	(2)
Two-sided Fisher test		
p-value	0.005	0.000
One-sided Fisher test		
p-value	0.004	0.000
Number of obs.	33	33

Table 4:
Correlation structure of currency pairs

We form all 528 currency pairs and calculate the correlation of (log) daily exchange rate changes for the four-year period from July 1, 1996 to July 1, 2000. We group currencies into the 16 most upweighted and 17 most downweighted ones. Reported are summary statistics for the correlation of (1) currency pairs for which both currencies are upweighted, (2) currency pairs for which both currencies are downweighted. and (3) currency pairs for which one currency is upweighted and the other is downweighted. The Fisher test evaluates the likelihood of the observed association (under the null hypothesis of no relationship) between the criterion (C1) of having an above median correlation for any currency pair and the criterion (C2) that both currencies in this pair are from the same group of either only up- or only downweighted currencies. The sample countries consists of the 50 countries in MSCI Global Equity Index (ACWI) from which were excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), and three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey).

Groups of currency pairs			Obs.	Mean	Median	S.D.	Min	Max
(1)	$Corr(\Delta e_{i_1}^{up}, \Delta e_{i_2}^{up})$		120	0.208	0.132	0.257	−0.093	0.985
(2)	$Corr(\Delta e_{i_1}^{dw}, \Delta e_{i_2}^{dw})$		136	0.061	0.040	0.108	−0.071	0.608
(3)	$Corr(\Delta e_{i_1}^{up}, \Delta e_{i_2}^{dw})$		272	0.081	0.033	0.166	−0.281	0.862
All	$Corr(\Delta e_{i_1}, \Delta e_{i_2})$		528	0.104	0.046	0.188	−0.280	0.985
Fisher test								
Two-sided test	(p-value)	0.004						
One-sided test	(p-value)	0.002						

Table 5:
Regressions for weekly exchange rate returns

We perform OLS regressions of the (log) weekly exchange rate change Δe_{it} (denominated in dollar per local currency and expressed in percentage points) on the scaled country weight changes $\Delta\overline{w}_i$ defined as the (demeaned) ratio of the weight change $w_i^n - w_i^o$ of each currency i and a scaling factors (SF_i). The respective scaled weight change is interacted with a time dummy D_t marking the event week around the announcement event (December 1, 2000).resulting in the following specification:

$$\Delta e_{it} = \alpha_0 + \alpha_1 D_t + \alpha_2 \left(\Delta\overline{w}_i \times D_t\right) + \mu_{it}.$$

As scaling factors for weight changes we use: the average of a country's new and old new weight, $\frac{1}{2}(w_i^n + w_i^o)$, in Columns (1) and (2); its total FX currency market volume, Vol_i^{FX}, in Column (3); and its total FX spot market volume, Vol_i^{SP}, in Column (4). In addition to spot trading volume, total FX Volume includes outright forward contracts and swap contracts. The estimation uses four years of weekly data exchange rate data from July 1, 1996 to July 1, 2000. The sample countries consists of the 50 countries in MSCI Global Equity Index (ACWI) from which are excluded the U.S., the 11 Euro zone countries that are aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), and three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey). FX volume data obtained from the BIS survey of April 2001 is available only for a reduced set of 27 currencies. Standard errors for correlated panels accounting for a general covariance structure across of all currencies and time are reported in parentheses. We indicate by *, **, and *** significance at the 5%, 3% and 1% level, respectively. The constant term is not reported.

Scaling factor (SF_i)	$\frac{1}{2}(w_i^n + w_i^o)$	$\frac{1}{2}(w_i^n + w_i^o)$	Vol_i^{FX}	Vol_i^{SP}
	(1)	(2)	(3)	(4)
D_t	1.345***	1.455***	1.500***	1.500***
	(0.446)	(0.508)	(0.512)	(0.512)
$\Delta\overline{w}_i \times D_t$	2.159***	2.567***	1.727***	0.957***
	(0.658)	(0.802)	(0.523)	(0.286)
R^2 (for event week)	0.380	0.404	0.375	0.384
Currency obs.	33	27	27	27
Time obs.	174	174	174	174

Table 6:
Regression for daily exchange rate returns

We perform OLS regressions of the (log) daily exchange rate change Δe_{it} (denominated in dollar per local currency and expressed in percentage points) on the scaled weight change $\Delta \overline{w}_i$ defined as the (demeaned) ratio of the weight change $w_i^n - w_i^o$ of each currency i and a scaling factors (SF_i), the (demeaned) order flow in the Euro/Dollar market $\overline{OF}_t$, and the interaction term $\Delta \overline{w}_i \times \overline{OF}_t$. Each term is interacted with a dummy variable D_t, which marks alternatively an event window of 6 trading days (Panel A) or 12 trading days (Panel B) around the announcement of the index redefinition (December 1, 2000). Formally, the regression specification is given by:

$$\Delta e_{it} = \alpha_0 + \alpha_1 D_t + \alpha_2 \left(\Delta \overline{w}_i \times D_t\right) + \alpha_3 \left(\overline{OF}_t \times D_t\right) + \alpha_4 \left(\Delta \overline{w}_i \times \overline{OF}_t \times D_t\right) + \mu_{it}.$$

As scaling factors for weight changes we use: the average of a country's new and old new weight, $\frac{1}{2}(w_i^n + w_i^o)$, in Columns (1) and (2); its total FX currency market volume, Vol_i^{FX}, in Column (3) and (4); and its total FX spot market volume, Vol_i^{SP}, in Column (5) and (6). In addition to spot trading volume, total FX Volume includes outright forward contracts and swap contracts. The estimation uses 4 years of daily data exchange rate data from July 1, 1996 to July 1, 2000. The sample countries consist of the 50 countries in MSCI Global Equity Index (ACWI) from which we excluded the U.S., the 11 Euro zone countries that were aggregated into one, three countries with pegged currencies (China, Hong Kong, and Malaysia), and three countries that experienced a major currency crisis around the time of our analysis (Argentina, Brazil, and Turkey). FX volume data obtained from the BIS survey of April 2001 is available only for a reduced set of 27 currencies. Standard errors for correlated panels accounting for a general covariance structure across all currencies and time are reported in parentheses. We indicate by *, **, and *** significance at the 5%, 3% and 1%, respectively. The constant term is not reported.

Panel A: 6-Day event window

Scaling factor (SF_i)	$\frac{1}{2}(w_i^n + w_i^o)$	$\frac{1}{2}(w_i^n + w_i^o)$	Vol_i^{FX}	Vol_i^{FX}	Vol_i^{SP}	Vol_i^{SP}
	(1)	(2)	(3)	(4)	(5)	(6)
D_t	0.230***	0.230***	0.267***	0.267***	0.267***	0.267***
	(0.081)	(0.081)	(0.094)	(0.094)	(0.094)	(0.094)
$\Delta\overline{w}_i \times D_t$	0.413***	0.413***	0.286***	0.286***	0.155***	0.155***
	(0.130)	(0.130)	(0.105)	(0.105)	(0.057)	(0.057)
$\overline{OF}_t \times D_t$		−0.019		0.075		0.075
		(0.078)		(0.088)		(0.088)
$\Delta\overline{w}_i \times \overline{OF}_t \times D_t$		0.191		0.159		0.089
		(0.123)		(0.098)		(0.053)
R^2 (event period)	0.183	0.206	0.178	0.200	0.180	0.204
Currency obs.	33	33	27	27	27	27
Time obs.	980	980	980	980	980	980

Panel B: 12-Day event window

Scaling factor (SF_i)	$\frac{1}{2}(w_i^n + w_i^o)$	$\frac{1}{2}(w_i^n + w_i^o)$	Vol_i^{FX}	Vol_i^{FX}	Vol_i^{SP}	Vol_i^{SP}
	(1)	(2)	(3)	(4)	(5)	(6)
D_t	0.143**	0.143**	0.166**	0.166**	0.166**	0.166**
	(0.057)	(0.057)	(0.067)	(0.067)	(0.067)	(0.067)
$\frac{w_i^n - w_i^o}{SF_i} \times D_t$	0.300***	0.300***	0.199***	0.199***	0.109***	0.109***
	(0.093)	(0.092)	(0.074)	(0.074)	(0.040)	(0.040)
$\overline{OF}_t \times D_t$		−0.007		0.110		0.110
		(0.056)		(0.063)		(0.063)
$\frac{w_i^n - w_i^o}{SF_i} \times \overline{OF}_t \times D_t$		0.229***		0.184***		0.102***
		(0.088)		(0.071)		(0.038)
R^2 (event period)	0.085	0.129	0.083	0.083	0.083	0.134
Currency obs.	33	33	27	27	27	27
Time obs.	986	986	986	986	986	986

Table 7:
Stock and exchange returns around the first implementation of the MSCI index redefinition (November 30, 2001)

We analyze individual stock returns (Panel A) and exchange returns (Panel B) around the first implementation of the MSCI index redefinition. The index adjusted 50% towards the new index on November 30, 2001 and the remaining adjustment occurred on May 31, 2002. See Table 2 for details on the individual stock return regressions. See Table 3 for details on the nonparametric Fisher test carried out on exchange rates, and Table 6 for details on the regressions on daily currency returns. The currency return regressions in Panel B use the scaled (and demeaned) weight change $\Delta\overline{w}_i$ with the scaling factor $SF_i = \frac{1}{2}(w_i^n + w_i^o)$ interacted with a time dummy D_t marking alternatively a 6 or 12 trading day event window around November 30, 2001. Standard errors for correlated panels accounting for a general covariance structure across of all currencies are reported in parentheses. We indicate by *, **, and *** significance at the 5%, 3% and 1% level, respectively.

Panel A: Individual stock returns in local currency

$$\Delta r_{ij} = \alpha_0 + \alpha_1 \Delta w_{ij} + \mu_{ij}$$

	Raw returns OLS		Raw returns OLS clustered		Abnormal returns OLS clustered	
Window size	6 Days	12 Days	6 Days	12 Days	6 Days	12 Days
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.043***	2.240***	1.043	2.240***	−0.079	0.765**
	(0.143)	(0.212)	(0.740)	(0.939)	(0.239)	(0.329)
Δw_{ij}	−0.453***	−0.864***	−0.453	−0.864***	−0.625***	−0.898***
	(0.118)	(0.175)	(0.311)	(0.301)	(0.185)	(0.206)
Obs.	2432	2432	2432	2432	2362	2362
R^2	0.0057	0.0094	0.0057	0.0094	0.0115	0.0102

Panel B: Exchange rate returns

Nonparametric Fisher test

Window size	6 Days	12 Day
Two-sided		
p-value	0.169	1.000
One-sided		
p-value	0.112	0.571
Obs.	33	33

Weekly currency return regressions

$$\Delta e_{it} = \alpha_0 + \alpha_1 D_t + \alpha_2 (\Delta\overline{w}_i \times D_t) + \mu_{it}$$

Window size	6 Days	12 Days
D_t	0.014	0.042
	(0.081)	(0.057)
$\Delta w_i \times D_t$	−0.070	−0.050
	(0.100)	(0.071)
Currency obs.	33	33
Time obs.	980	986

Table 8:
Stock and exchange returns around the second implementation of the MSCI index redefinition (May 31, 2002)

We analyze individual stock returns (Panel A) and exchange returns (Panel B) around the second implementation of the MSCI index redefinition. The index adjusted the remaining 50% towards the new index on May 31, 2002 (the index adjusted the first 50% on November 30, 2001). See Table 2 for details on the individual stock return regressions. See Table 3 for details on the nonparametric Fisher test carried out on exchange rates, and Table 6 for details on the regressions on daily currency returns. The currency return regressions in Panel B use the scaled (and demeaned) weight change $\Delta\overline{w}_i$ with the scaling factor $SF_i = \frac{1}{2}\left(w_i^n + w_i^o\right)$ interacted with a time dummy D_t marking alternatively a 6 or 12 trading day event window around May 31, 2002. Standard errors for correlated panels accounting for a general covariance structure across of all currencies are reported in parenthesis. We indicate by *, **, and *** significance at the 5%, 3% and 1% level, respectively.

Panel A: Individual stock returns in local currency

$$\Delta r_{ij} = \alpha_0 + \alpha_1 \Delta w_{ij} + \mu_{ij}$$

	Raw returns OLS		Raw returns OLS clustered		Abnormal returns OLS clustered	
Window size	6 Days	12 Days	6 Days	12 Days	6 Days	12 Days
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-1.992^{***}	-3.152^{***}	-1.992^{***}	-3.152^{***}	-0.641^{**}	-0.846^{*}
	(0.114)	(0.176)	(0.408)	(0.667)	(0.271)	(0.421)
Δw_{ij}	-0.221^{**}	-0.827^{***}	-0.221	-0.827^{**}	-0.180	-0.788^{***}
	(0.098)	(0.160)	(0.196)	(0.347)	(0.116)	(0.197)
Obs.	2434	2434	2434	2434	2362	2362
R^2	0.0021	0.0123	0.0021	0.0123	0.0016	0.0132

Panel B: Exchange rate returns

Nonparametric Fisher test

Window size	6 Days	12 Days
Two-sided		
p-value	0.005	0.038
One-sided		
p-value	0.004	0.027
Obs.	33	33

Weekly currency returns regressions

$$\Delta e_{it} = \alpha_0 + \alpha_1 D_t + \alpha_2(\Delta\overline{w}_i \times D_t) + \mu_{it},$$

Window size	6 Days	12 Days
D_t	0.086	0.067
	(0.081)	(0.057)
$\Delta\overline{w}_i \times D_t$	0.107	0.203^{***}
	(0.100)	(0.071)
Currency obs	33	33
Time obs.	980	986

Tabel 9

Changes in currency comovements following the MSCI index redefinition

This table examines whether currencies that are upweighted (downweighted) commove more (less) with the other currencies in the index. Daily data on exchange rates covering two-year periods before and after the announcement event (1998-1999 and 2003-2004) are used to estimate the following panel regression:

$$\begin{aligned}\Delta e_{it} &= \alpha_0 + \alpha_1 Basket_t + \alpha_2 \Delta\overline{w}_i + \alpha_3 D_t + \alpha_4(\Delta\overline{w}_i \times Basket_t) + \\ &\quad + \alpha_5(D_t \times Basket_t) + \alpha_6(D_t \times \Delta\overline{w}_i) + \alpha_7(D_t \times \Delta\overline{w}_i \times Basket_t) + \varepsilon_{it},\end{aligned}$$

where Δe_{it} measures the percentage change in the currency i on day t, $Basket_t$ is the return on a constructed index of currencies on day t (equally or value weighted), $\Delta\overline{w}_i$ represents the scaled weight change defined as the (demeaned) ratio of the weight change $w_i^n - w_i^o$ of currency i and the scaling factor $SF_i = \frac{1}{2}(w_i^n + w_i^o)$, D_t is a dummy variable that equals 0 in the pre-event period (1998-1999) and 1 in the post-event period (2003-2004). Panel A shows the results based on the basket constructed as an equally-weighed index of currency returns, while Panel B presents the results based on the basket constructed as a value-weighted index of currency returns. We report OLS coefficients for the pooled currency data and consider alternative specification based on different treatments of the errors. Column (1) presents standard errors corrected for heteroskedasticity using White's adjustment. Columns (2), (3), and (4) allow for additional error clustering by country, day and country, and day, respectively. In Column (5), the coefficients are estimated using a Prais-Winsten regression, which allow for serial correlation. Standard errors here are adjusted assuming the disturbances are heteroskedastic and contemporaneously correlated across panels. In Column (6) we estimate a panel with country fixed effects. We report the standard errors below the coefficients. ***, **, and * represent significance levels at 1%, 5% and 10%, respectively. The constant term is not reported The variable D_t has been divided by 100.

Panel A: Equally-weighted basket of currency returns

Error structure		Country custer	Day custer	Both clusters	Prais-Winsten	Country FE
	(1)	(2)	(3)	(4)	(5)	(6)
$Basket_t$	0.636***	0.636***	0.636***	0.636***	0.636***	0.636***
	0.032	0.103	0.032	0.103	0.010	0.032
$\Delta\overline{w}_i$ $(\times 10^{-1})$	−0.004**	−0.004*	−0.004*	−0.004*	−0.004*	−0.004
	0.002	0.002	0.002	0.002	0.002	0.000
D_t $(\times 10^{-2})$	−0.012	−0.012	−0.012**	−0.012	−0.012***	−0.012
	0.009	0.011	0.006	0.008	0.004	0.009
$\Delta\overline{w}_i \times Basket_t$	0.117*	0.117	0.117	0.117	0.117*	0.117*
	0.068	0.276	0.095	0.283	0.068	0.068
$D_t \times Basket_t$	0.223***	0.223	0.223***	0.223	0.223***	0.223***
	0.038	0.134	0.059	0.141	0.014	0.038
$D_t \times \Delta\overline{w}_i$ $(\times 10^{-2})$	0.026	0.026	0.026	0.026	0.026	0.026
	0.025	0.028	0.031	0.033	0.030	0.026
$D_t \times \Delta\overline{w}_i \times Basket_t$	0.903***	0.903**	0.903***	0.903***	0.903***	0.903***
	0.102	0.334	0.117	0.339	0.099	0.102
Currency obs.	33	33	33	33	33	33
Time obs.	1044	1044	1044	1044	1044	1044
R^2	0.059	0.059	0.059	0.059	0.059	0.059

Panel B: Value-weighted basket of currency returns

Error structure		Country custer	Day custer	Both clusters	Prais-Winsten	Country FE
	(1)	(2)	(3)	(4)	(5)	(6)
$Basket_t$	31.580***	31.580***	31.580***	31.580***	31.580***	31.580***
	2.064	5.117	2.310	5.221	0.952	2.063
$\Delta\overline{w}_i$ $(\times 10^{-1})$	−0.004**	−0.004**	−0.004**	−0.004	−0.004**	−0.004
	0.002	0.002	0.002	0.000	0.002	0.000
D_t $(\times 10^{-2})$	−0.025***	−0.025***	−0.025**	−0.025**	−0.025***	−0.025***
	0.009	0.011	0.011	0.012	0.008	0.009
$\Delta\overline{w}_i \times Basket_t$	25.338***	25.338	25.338***	25.338*	25.338***	25.338***
	35.850	15.030	4.259	15.145	3.022	3.842
$D_t \times Basket_t$	10.261***	10.261**	10.261***	10.261**	10.261***	10.261***
	2.250	4.627	2.476	4.741	1.291	2.250
$D_t \times \Delta\overline{w}_i$ $(\times 10^{-2})$	0.0268	0.0268	0.0268	0.0268	0.0268	0.0268
	0.0252	0.0266	0.0256	0.0269	0.0244	0.0252
$D_t \times \Delta\overline{w}_i \times Basket_t$	29.522***	29.522**	29.522***	29.522***	29.522***	29.522***
	5.015	11.148	5.123	11.197	4.158	5.007
Currency obs.	33	33	33	33	33	33
Time obs.	1044	1044	1044	1044	1044	1044
R^2	0.058	0.058	0.058	0.058	0.058	0.058