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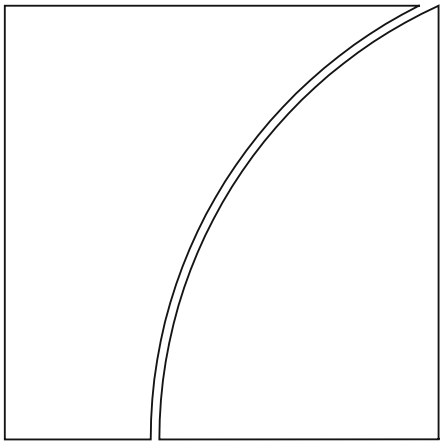

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by Fernando Avalos, Ramon Moreno and Tania Romero

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Keywords: leverage, hedge funds/mutual funds, portfolio management, capital structure, capital controls, macroprudential measures.

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Leverage on the buy side[1]

Fernando Avalos[2], Ramon Moreno[3], Tania Romero[4]

Abstract

This paper investigates the microeconomic determinants of leverage decisions by asset managers. Investment funds (the "buy side") have significantly increased their share of global capital flows in recent years. Unconventional monetary policies in advanced economies have squeezed returns while reducing borrowing costs, which in principle creates an incentive for asset managers to use more leverage. We start by studying the recent behaviour of fund leverage in different asset categories at an aggregate level. Leverage appears to have increased significantly in funds focused on the fixed income markets of emerging economies. Then we analyse the microeconomic factors that shape the leverage decision. In line with theory, we find that leverage rises with expected returns, and falls with market risk and borrowing costs. Transaction costs are also mentioned in the literature as another factor that should inhibit leverage. Lacking the requisite data, we introduce as proxies changes in capital controls and macroprudential policies, because they tend to affect expected returns in comparable ways. We find that tighter capital controls on inflows increase leverage rather than decrease it, but that macroprudential measures have no discernible effect. Finally, we discuss these results and their policy implications.

Keywords: leverage, hedge funds/mutual funds, portfolio management, capital structure, capital controls, macroprudential measures.

JEL classification: F65, G11, G15, G23.

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Introduction

Leverage was at the centre of the most recent global financial crisis. The repair of balance sheets damaged by large debts carried by banks, some non-financial corporations and even households has arguably deepened and lengthened the ensuing recession, while weakening and slowing the recovery. This is particularly true of advanced economies (AEs), where more developed financial markets allowed a rapid broadening of the pool of potential borrowers. Moreover, quick financial innovation fostered the development of increasingly complex, and sometimes poorly understood financial instruments with large debt components.[5]

After the crisis, and partially as a result of new financial regulation, banks have cut their reliance on debt to fund their operations. This deleveraging has slowed their asset growth and opened up opportunities for other financial intermediaries.[6] This process has been particularly apparent in their international operations. Turner (2014) shows that in barely two years (2010–12), the share of bank loans in new financing to emerging market economies (EMEs) has dropped from almost 60 percent to about 10 percent. The gap has been partly filled by the issuance of international debt securities, placed mainly with international investors.

In this setting, a better understanding of the behaviour of asset managers and other "buy side" investors with global reach could be of importance when evaluating financial stability risks. Since the buy side is typically believed to use very little leverage,[7] the shift from bank- to market-based financing could in principle be considered as positive for financial stability. However, events such as the mid-2013 "taper tantrum" show the potential disruptive effect of sudden jumps in risk premia originating in asset markets.[8] Feroli et al (2014) conclude that the absence of leverage is not sufficient to allay financial stability concerns. Monetary authorities must continue to be alert because macroprudential tools do not address instability that is driven by investors. Further, forward guidance may encourage risk-taking that is subject to sudden reversals.

But how much leverage does the buy side actually use? Addressing this question first, we find that, although only a minority of investment funds in our sample do use leverage, the amount of that leverage may be significant, and the funds which actually resort to leverage are typically much larger than their peers. And leveraged portfolios are more prevalent in EME-focused funds, and in fixed income markets.

Leveraged portfolios enhance the gains of successful investment strategies, at the cost of magnifying the losses when financial conditions sour. Consequently they may be

[5] See Adrian and Shin (2010a).

[6] See Shin (2013), McCauley, McGuire and Sushko (2015).

[7] Hedge funds are an exception in this regard, but even within this fund class leverage varies a lot depending on the strategy: leverage is typically very large in fixed income arbitrage funds, while distressed debt funds typically do not resort to leverage (see Barbarino (2009)).

[8] Avdjiev and Takáts (2014) show that the retrenchment was not limited to portfolio flows, as cross border bank lending also slowed sharply.

subject to severe allocation reversals and fire sales, which could sharpen the return volatility of the assets included in such portfolios. International bond markets have been an important funding source for EM governments and large corporations during the last decade, with government yields usually benchmarking corporate placements. Anecdotal evidence suggests that the migration of large EM corporates to international fixed income markets has increased the domestic funding opportunities for small and medium-sized enterprises. A sudden and lasting tightening of global financial conditions could disrupt this developing financial infrastructure in EMEs, potentially triggering a credit crunch that would be highly damaging for the real economy. The effect would be amplified if it hits leveraged portfolios, as a shock that produces losses can be propagated by so called liquidity spirals: investors facing funding constraints will close on their positions, further undercutting prices, which can lead to further tightening of funding constraints and close-outs. Recent studies have provided a theoretical framework and supporting evidence.[9] Therefore, in the remainder of the paper, we focus our attention on funds dedicated to EME bond markets, and study the determinants of their leverage decisions.

Theoretical and empirical literature on this matter is relatively scarce, but we pin down our empirical specification mainly on the theoretical work of Wang and Wang (2010) and Stein (2009): both feature relatively simple models of the leverage decision of an individual asset manager, and develop testable implications, but they did not bring those implications to the data. This paper attempts to fill that gap. Our specification also relies on the empirical findings presented by the few previous studies that look at this topic, most notably Ang et al (2011).

Since financial stability in the context of international financial flows is the ultimate concern of this paper, we also explore the impact on buy side leverage of capital controls (KCs) and macroprudential policies (MPPs). After the global financial crisis, these capital flow management (CFM) tools have been increasingly used by EMEs seeking to manage either the size of capital flows or their knock-on effects within the domestic financial sector. They fit nicely within the theoretical framework of Wang and Wang (2010) as proxies for transaction costs. The analysis of the effects of KCs and MPPs has traditionally focused on their success in achieving their intended objectives: moderating the pace and size of capital inflows, and defusing the build-up of dangerous financial vulnerabilities, respectively.[10] We take here a novel approach by focusing on the unintended consequences of such measures.

In line with theory, we find that asset managers increase leverage when expected returns increase, and tend to reduce it when market risk perception (or aversion) increases, or when funding costs or funding risks increase. Leverage is also procyclical, in the sense that fund capital gains spur further increases of borrowing, in a variation of the argument presented by Adrian and Shin (2010b) for commercial banks. Contrary to

[9] See for instance Brunnermeier and Pedersen (2009) and Brunnermeier, Nagel and Pedersen (2008).

[10] A necessarily incomplete list of the recent work on this matter include Ahmed and Zlate (2013), Brunnermeier and Sannikov (2014), Forbes, Fratzscher and Straub (2013), Forbes and Warnock (2012), Korinek and Sandri (2014), Lambert, Ramos-Tallada and Rebillard (2013), Magud, Reinhart and Rogoff (2011), and references therein.

intuition and our preliminary characterisation of them as mere transaction costs, we also find that capital controls encourage asset managers to increase leverage rather than reduce it, whereas MPPs have no impact. To the extent that leveraged portfolios are relatively more fragile (ie more subject to interruptions in funding liquidity and fire sales) than unlevered ones, then capital controls would have a detrimental impact on financial stability. One interesting policy implication is that, confronted with the choice between capital controls or macroprudential tools as a means of managing large inflows, policymakers might be better off with macroprudential tools, since they would not cause an unwelcome build-up of leverage in their lenders.

The paper is organised as follows: Section 1 reviews some basic ideas about investment fund leverage, and present recent developments observed in the data. Section 2 introduces the empirical model that will be tested, and explains the intuition of the expected results. Section 3 describers the various data sets employed, and Section 4 presents the results. Section 5 concludes.

1. Fund leverage: basic concepts and facts

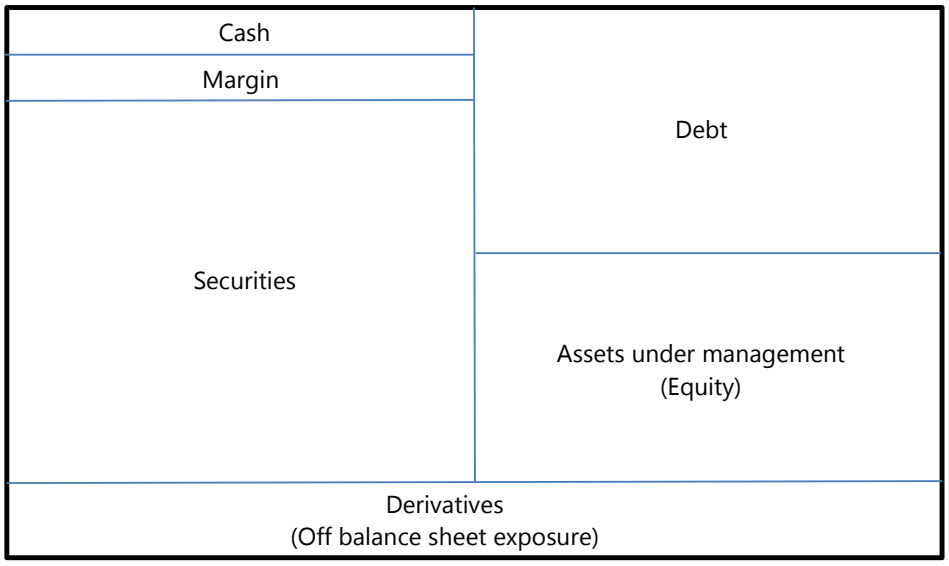
Measuring fund leverage

There are several ways in which the leverage used by an investment fund can be defined and measured. McGuire and Tsatsaronis (2008) identify two complementary types of leverage: *funding leverage*, which involves outright borrowing, and *instrument leverage*, implemented through derivative contracts that amplify the sensitivity of portfolio returns to the underlying asset risk factors. Figure 1 represents the typical balance sheet of a fund. On the source side we have its capital structure, comprising debt and the assets under management (AUM). Debt correspond to short cash positions (or short-term borrowing) and short security positions. AUM is the difference between the fund´s asset and liability positions, and represent the total claim individual investors have on the investing pool. On the asset side we have cash held in long positions,[11] securities held in long positions and margin, ie collateral typically requested by lenders in order to extend credit. Derivatives can be assets or liabilities depending on whether they are held long or short, but they are in effect off-balance sheet contingent claims. The relative size of all these different parts will depend on the type of fund and portfolio strategy. For instance, hedge funds are likely to have the largest borrowing relative to AUM, whereas passive mutual funds aimed at retail investors are likely to have minimal debt and relatively small long cash positions. Distressed debt funds use little or no leverage and keep a large share of their portfolio in cash.[12]

[11] Cash is usually held for administrative reasons, eg to meet investor withdrawals or margin calls from derivative positions.

[12] Barbarino (2009).

Figure 1: The balance sheet of an investment fund



Leverage is usually defined as a ratio of some combination of these different balance sheet parts with respect to AUM. Three definitions may be of interest: gross leverage, net leverage and long leverage.[13] Gross leverage adds the short and long positions in securities, divided by AUM. This measure is very conservative, since it treats the short and long positions as independent sources of revenue, while in many cases they are part of a single bet and tend to hedge each other.[14] As a result, gross leverage tends to overstate economic exposure.

Net leverage is the difference between long and short positions in risky assets, which corrects the bias of gross leverage but does not account for the risk created by long or short positions that are effectively independent bets. Thus this measure is likely to understate risk.

Finally, *long leverage is the ratio of long security positions to AUM*. This is probably the easiest and more common way to think about leverage. It is readily available for US-based institutions, because the SEC requires this information from any fund managing over USD 100 million. However, this measure of leverage ignores short positions, which might understate financial risks significantly

All the above measures of leverage also ignore the exposure from off-balance sheet derivative positions. Financial risk created by those positions could be substantial in some types of fund. There are diverse ways to incorporate those exposures in the

[13] Here, we follow closely the definitions in Ang et al (2011).

[14] For instance, if a manager short sells Chrysler and buys Toyota long, he is probably betting on the idiosyncratic over(under)-performance of Toyota (Chrysler). Price movements related to common factors of the automobile industry would be automatically hedged.

leverage measure at the expense of introducing some degree of heterogeneity in the final result, as explained by Ang et al (2011).[15]

In most of the analysis that follows, we focus on funding leverage by using a measure closely related to long leverage, which can be denoted as "gearing".[16] This is the ratio of long security positions in *excess* of AUM divided by AUM. The measure thus tries to capture the amount of actual short-term borrowing as a fraction of fund size, and makes no attempt to incorporate derivative exposures. We use this definition because long leverage is the only measure available in our database. Moreover, our sample is comprised mainly of actively managed but not hedge funds.[17] Therefore most of them do not use long leverage during the sample period, keeping instead some variable level of positive cash. In our empirical analysis, when gearing is negative (ie the fund keeps a positive amount of cash) we censor it at zero. We suspect that the reasons for using positive gearing (enhancing returns) and negative gearing (back-office management) are distinct and have different drivers. We test this conjecture as part of our robustness analysis, and find that the main results are unaltered whether gearing or traditional long leverage is used as the dependent variable. Finally, notice that Ang et al (2011) show empirically that all three measures of leverage are highly correlated, so that our results should be robust to the change in measure (gearing, gross leverage or net leverage), especially because our purpose is to study the determinants of leverage rather than to measure actual economic exposure.

Some stylised facts

Post-crisis, there has been a significant shift in global finance from bank-based to market-based funding. In this new phase that started around 2010, "the main stage is the bond market, especially the market for emerging market debt securities that are open to international investors" (Shin (2013)). Table 1 illustrates the point: since 2009, bond financing has become prevalent in global international financing, with an expansion exceeding $4 trillion, whereas cross border bank lending has contracted by almost $2 trillion. The relative (and absolute) contraction of cross border bank lending with respect to international bond issuance has been particularly sharp in advanced

[15] For instance, basic accounting leverage could be adjusted for derivative exposure by computing notional values of derivative contracts adjusted by the sensitivity of the derivative price to fluctuations in the underlying asset (delta). For zero-cost derivatives like swaps or futures, a measure of notional exposure to collateral cash is sometimes used. Oftentimes, (cash) equity or bond positions are also adjusted by their correlation to market returns (beta) and sensitivity to interest rate factors (eg duration and convexity), respectively. The comparability of these diverse measures is debatable.

[16] We will refer to this measure indistinctly as gearing or long leverage, and sometimes simply as leverage, when the context rules out ambiguity.

[17] Only four of the 87 funds in our database report themselves as "hedge funds," all belonging to the same parent company. There is a considerable degree of uncertainty about this classification, because the vendor does not provide specific guidelines to reporting parties as to when an investment fund should be considered as such. Therefore, the content of this variable depends on the reporting parties' subjective view of what should be considered a hedge fund.

economies, but also in EMEs international bank lending has played a diminished role vis-à-vis fixed income funding, in particular with regards to the financing of non-banks.

External financing

Cumulative changes in $ billion over the period 2009–2014 Table 1

	Cross-border bank lending	International bonds
World	–1,884	4,330
Banks	–2,616	62
Non-banks	732	4,268
Advanced economies[1]	–3,006	2,689
Banks	–3,317	–431
Non-banks	311	3,120
Emerging markets	1,122	1,641
Banks	701	492
Non-banks	421	1,148

[1] It includes developed countries, offshore centres and international organisations.

Source: BIS locational banking statistics, by residence; Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; BIS calculations.

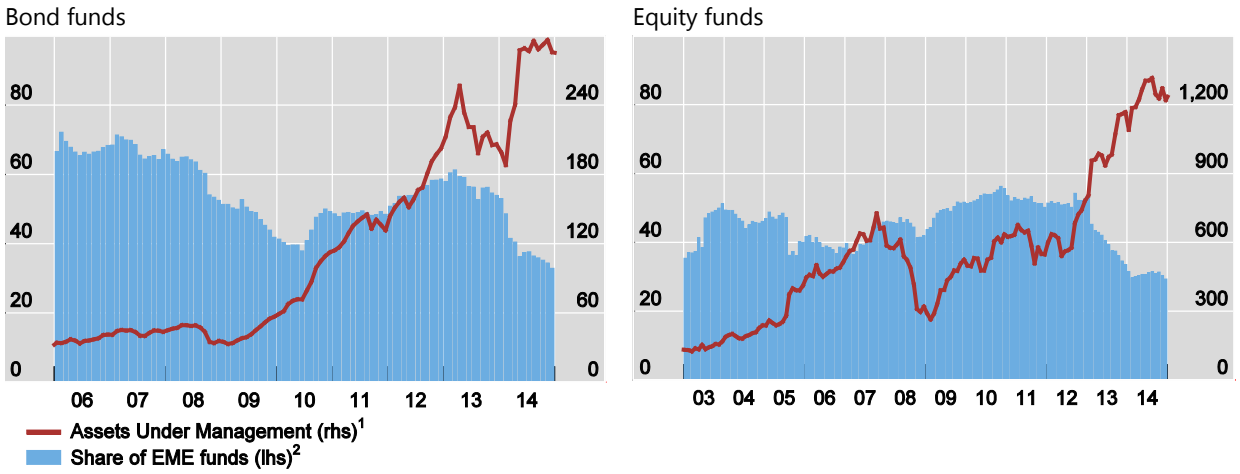
Other recent developments can be summarised as follows:

- Money invested in asset management firms has increased rapidly since 2009, especially in fixed income funds. The growth is partially explained by increase in asset prices, but net inflows are also significant. Graph 1 shows that trend in the funds included in our sample,[18] and also that EME-dedicated funds have captured a growing share of an aggressively expanding investment pool until recently. The trend was broken in early 2013, when both equity and fixed income EME-focused investment pools began to lose market share.

[18] The data set is described in Section 3.

Assets under management of EPFR reporting funds

Graph 1



[1] In billions of US dollars. [2] Share of total reported assets under management hold by EME dedicated funds, in percent.

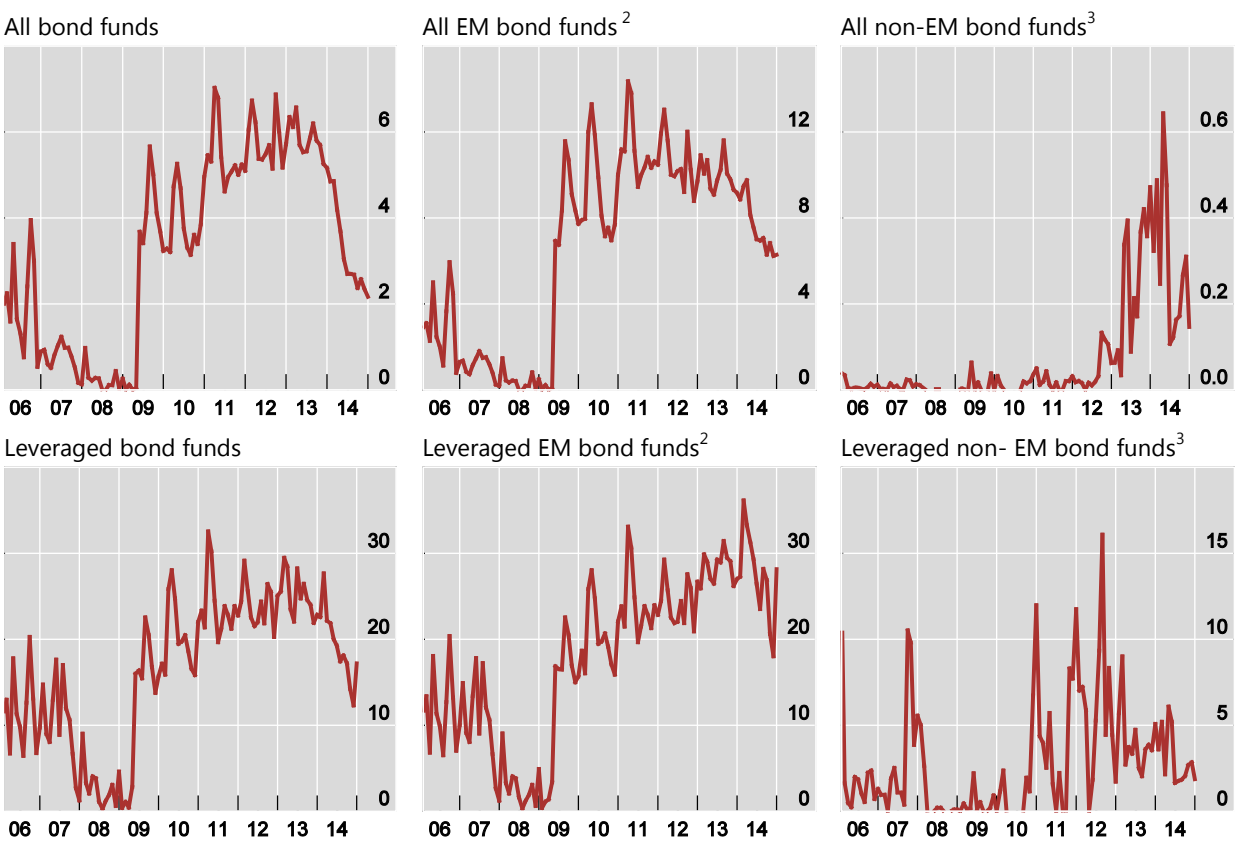
Source: EPFR; BIS calculations.

- Leverage in EME-focused funds seems to be higher than in Global funds. Graph 2 presents leverage ratios for different types of fixed income funds. The three upper panels show month-by-month averages of leverage used by all funds falling in each subgroup of the data. The three lower panels show the same statistic computed only for the funds with gearing ratio above zero during each month. The first panel on the upper left corner illustrates that leverage across all fixed income funds averaged about 2 percent in 2006, and then dropped steadily towards zero from the beginning of 2007 until mid-2008. During 2009 it surged to 3 percent of AUM, and kept increasing steadily towards 6 percent in 2013. Then it dropped quickly in 2014.[19] The next two panels in the upper row show that these dynamics are basically explained by the behaviour of EME-focused funds, since non-EME funds used essentially zero long-leverage during the sample period. The lower three panels reveal that those EME funds that actually used long leverage during the sample period had much higher ratios than the full sample average, close to 30 percent of AUM by 2013. Leveraged EM bond funds decreased their gearing less sharply than the average of all bond funds or even all EM bond funds in 2014, suggesting that investors may have shifted capital towards unleveraged funds (as we will see in Graph 4).

[19] The sudden increase in leverage that occurred during early 2009 (April) is explained by a few large funds that were previously in the sample but did not report using leverage until that date. We remove the effect of this jump in our econometric analysis.

EPFR bond funds gearing ratio[1]

As percentage of total assets under management — Graph 2



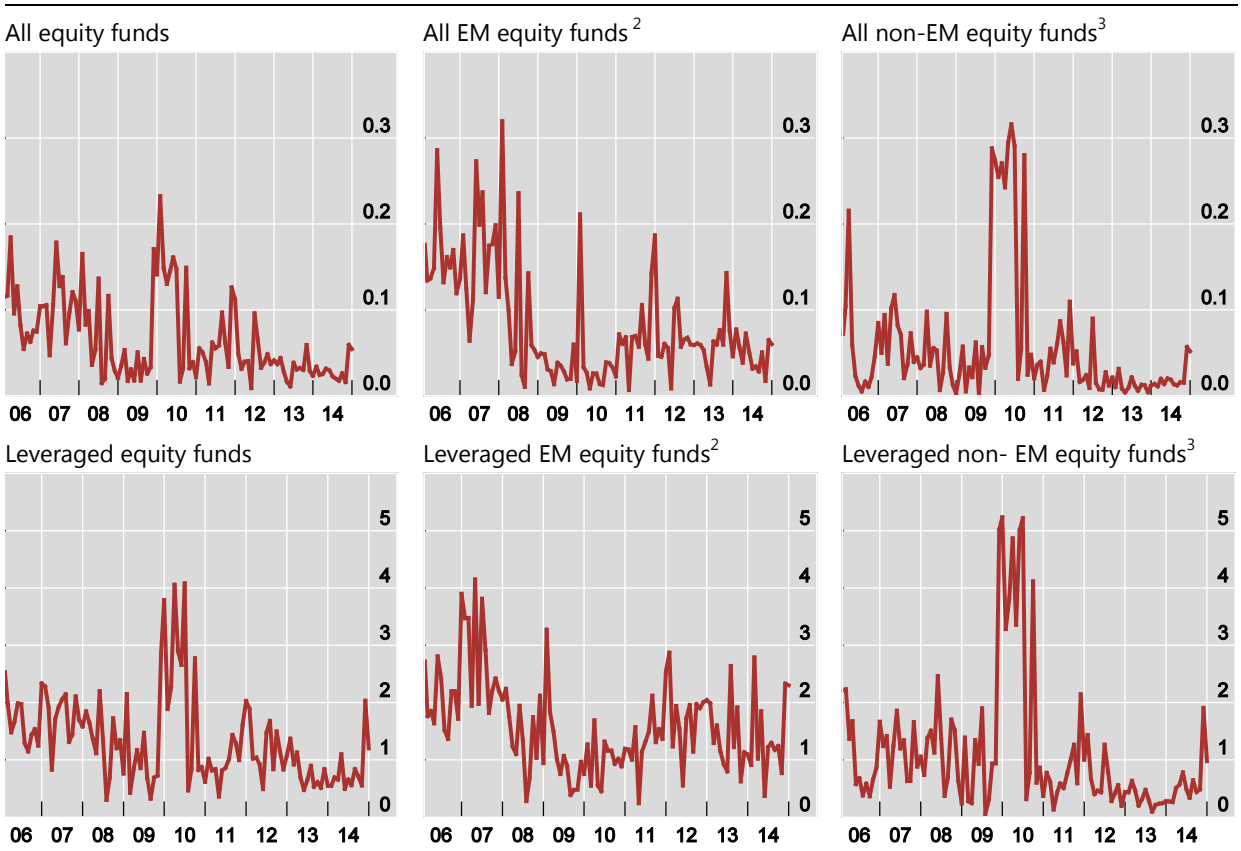
[1] Gearing is calculated as aggregate borrowing divided by total assets under management; monthly data since January 2006. [2] Funds that invest in emerging markets bonds; includes Asia ex_Japan, EMEA (European, Middle Eastern and African emerging markets), GEM (Global Emerging Markets) and Latin America bond funds. [3] Funds that are not focus exclusively on emerging markets, they could invest in both developed and emerging markets.

Source: EPFR; authors calculations.

- Leverage was more moderate for equity funds. Graph 3, with a layout similar to Graph 2, shows that non-EME-focused funds used little long leverage before or after 2008, with ratios well below 2 percent even for "leveraged" funds. On the other hand, EME-focused funds display a slight downtrend in the use of long leverage during the sample period.

EPFR equity funds gearing ratio[1]

As percentage of total assets under management — Graph 3



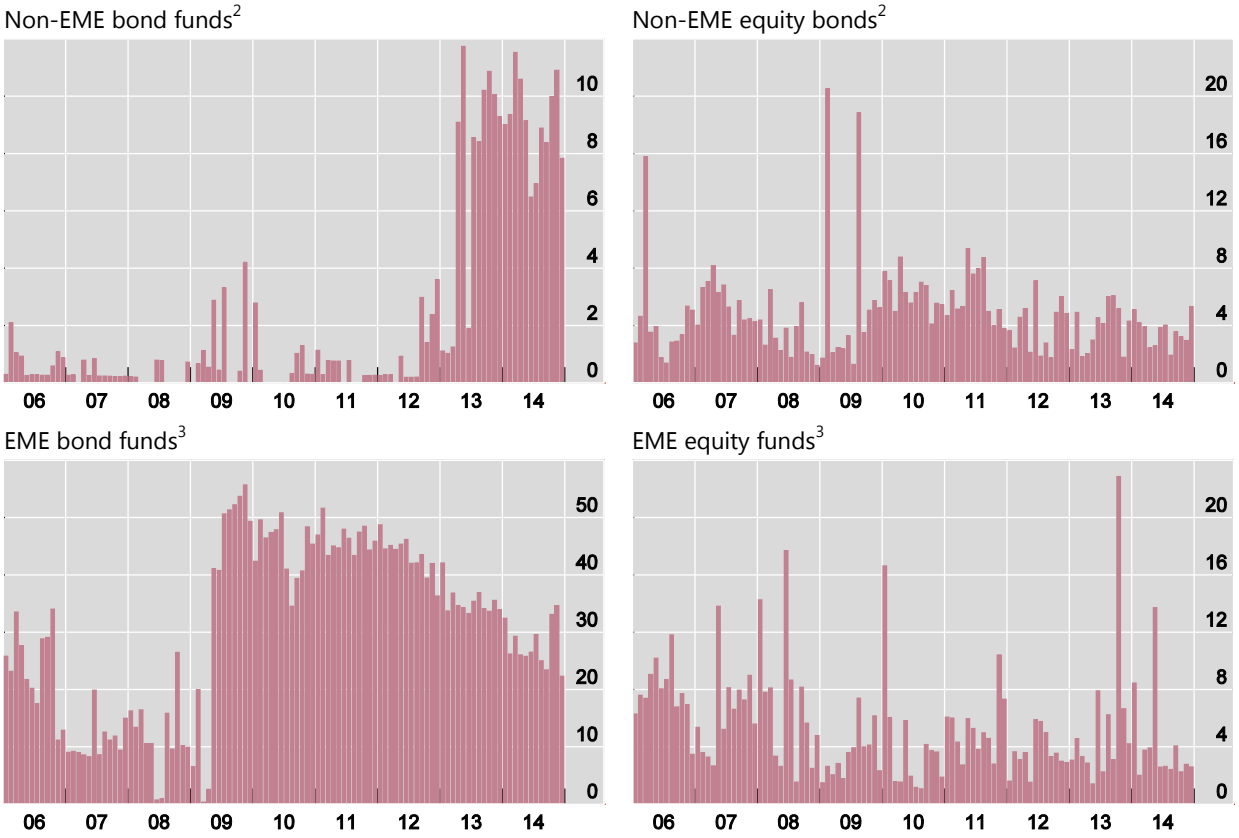
[1] Gearing is calculated as aggregate borrowing divided by total assets under management; monthly data since January 2006. [2] Funds that invest in emerging markets equitys; includes Asia ex_Japan, EMEA (European, Middle Eastern and African emerging markets), GEM (Global Emerging Markets) and Latin America equity funds. [3] Funds that are not focus exclusively on emerging markets, they could invest in both developed and emerging markets.

Source: EPFR; authors calculations.

- Leveraged funds in our sample are economically relevant. Graph 4 reveals that after 2009, EME-focused fixed income funds that used long leverage controlled almost 50 percent of the AUM. That share has decreased steadily since 2012, stabilising around 25 percent by the end of 2014, which is still larger than the pre-2008 levels that oscillated around 15 percent (Graph 4, lower right-hand panel). Fixed income funds that are not dedicated to EMEs in general did not use long leverage: before 2012, AUM overseen by leveraged funds in this group were typically less than 2 percent of the total. It has increased to about 9 percent since then, still well below the levels observed in EME bond funds (Graph 4, upper left-hand panel). On the other hand, leveraged equity funds typically managed only 5 percent of total AUM both in EME-dedicated funds and the rest.

Relative size of leveraged funds[1]

As a percentage of total assets under management within each group — Graph 4



[1] We consider as leveraged funds those whose long position on securities is higher that their assets under management. [2] Funds that are not exclusively focused on emerging markets, they could invest in both developed and emerging markets (Global, Pacific, Europe funds). [3] Funds focused on emerging markets (GEM, BRIC, Emerging Asia, Emerging Europe, LatAm funds)

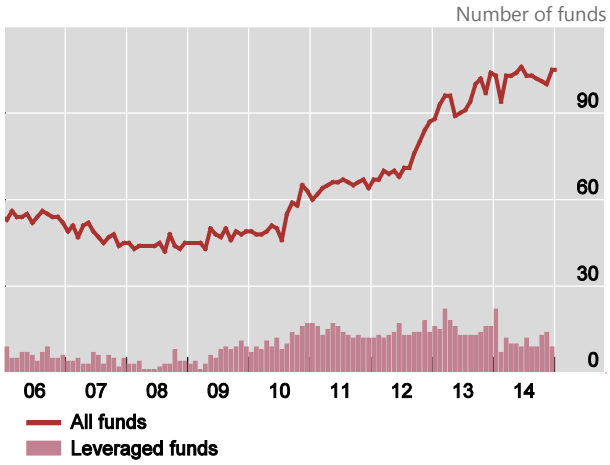
Source: EPFR; authors calculations

- Long leverage is characteristic of large EME-dedicated fixed income funds. The number of those funds using long leverage increased after 2009, but even then they were typically between 15 and 20 funds out of a sample that grew rapidly from 50 to more than 100 individual funds during the period 2009–14 (Graph 5, left-hand hand panel). But the funds using long leverage were much larger than the others: after 2009 the average leveraged bond fund had between three and four times the AUM of the average non-leveraged fund (Graph 5, right-hand hand panel). That means that the average leveraged fund oversaw around USD 2 billion more in AUM than their non-leveraged peers.

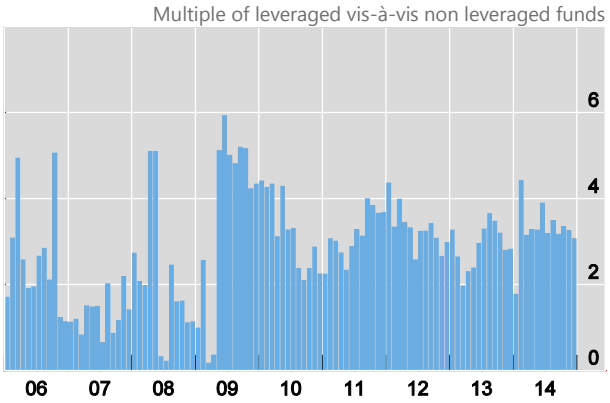
Leveraged v. Non-leveraged funds

Graph 5

Size of each group



Difference between average AUM of each group



Source: EPFR; authors calculations

Based on these empirical findings, we will devote the rest of this paper to the analysis of the determinants of long leverage used by fixed income, EME-focused investment funds. That is of interest from both a policy and practical perspective. On the policy side, since EMEs have seen the steepest increase in market-based financing since the financial crisis and have relatively less developed financial markets, they are likely to be more exposed to market tantrums, making this analysis of particular interest. On the practical side, many EMEs have resorted to capital controls and macroprudential tools frequently in recent years, and thus provide a convenient field for studying the connection between leverage and those policy tools.

2. Empirical model

There is relatively little recent theoretical analysis of the microeconomic leverage decision-making of asset managers. Most papers focus on the macroeconomic and financial stability consequences of deleveraging with less emphasis on asset manager decision-making. For instance Acharya and Viswanathan (2011) and Stein (2009) focus on borrowing costs as the main drivers of leverage, finding through different mechanisms that good times tend to increase leverage substantially. Price shocks during those times are particularly damaging because they force a larger extent of develeraging. In particular, Stein (2009) emphasises that the less abundant (costlier) is equity with respect to borrowing, the higher will be the degree of leverage in arbitrageur positions, increasing the likelihood of destabilising asset fire-sales. In a similar vein, Adrian and Shin (2010) explain how marked-to-market balance sheets of financial firms encourage a pronounced procyclical behaviour in leverage: asset prices increase during good times, reducing accounting leverage and creating "space" for

further borrowing and lending. The consequences of the downturn will depend largely on the quality of the assets created during the credit cycle upturn.[20]

Another set of papers focuses on the microeconomic drivers of leverage from the point of view of an investment manager. Dai and Sundaresan (2009) develop a model of optimal fund leverage that takes into consideration the two short option positions that build the capital structure of any fund: a short funding option vis-à-vis their prime brokers, and the short redemption option with investors. In their framework, optimal leverage depends on a number of fund-specific features, including delevering costs, portfolio Sharpe ratios, asset correlation, liquidity and volatility.

Wang and Wang (2010) model the problem of the fee-maximising, risk-neutral investment manager subject to proportional transaction costs and solvency constraints and find that optimal leverage is not very responsive to asset price drops. Consistent with some anecdotal evidence, asset managers have little incentive to sell assets and reduce leverage unless forced to, once the risky asset price has fallen. However, optimal leverage tends to decrease quickly with higher transaction costs and underlying asset price volatility, whereas it will increase with expected returns.

Within the framework of this second branch of the literature, Ang et al (2011) use a richer database than ours to address empirically a similar question on the determinants of the leverage decision of asset managers. Their work tests the relevance of several macroeconomic variables and also some fund-specific variables, as a means of gauging the impact of past returns, market and credit risk, funding costs and investor flows on leverage. In the end, they find that only a handful of all those variables are significant, although not all of them with the expected sign. In general, past returns are not significant, whereas market risk at either the fund or macro levels can be relevant, and macro measures of borrowing costs are usually inversely related to leverage. Fund flows are not significant, but industry aggregate flows sometimes can be. Following in their footsteps, we decided to pursue a more parsimonious approach. Our estimations attempt mainly to test the insights of Wang and Wang (2010) using few and mostly fund-specific variables. We estimate the following equation:

$$L_{it} = \beta_0 + \beta_1 KC_{it} + \beta_2 ER_{it-1} + \beta_3 \Delta ER_{i;t-1,t} + \beta_4 VIX_t + \beta_5 Flows_{i;t-1,t} + \beta_6 \Delta NAV_{i;t-1,t} + \varepsilon_{it} \quad (1)$$

Where L_{it} is long leverage (or gearing, as defined above) used by fund i at time t, KC_{it} is the intensity of capital controls in the portfolio of fund i during time t, ER_{it-1} is the expected excess return over Treasuries of the fund i´s portfolio in time $t-1$, $\Delta ER_{i;t-1,t}$ is the change in fund i's portfolio expected excess return between $t-1$ and t, and VIX_t is

[20] Other recent papers with the same focus include Brunnermeier, Nagel and Pedersen (2008), Brunnermeier and Pedersen (2005 and 2009), Bruno and Shin (2010), Cardozo, Cely and Murcia (2013), Fostel and Geanakoplos (2008 and 2013), among others.

the level of that index in *t*, included as a gauge of market risk perception (or aversion).[21] We also include the variable $Flows_{i;t-1,t}$ that controls for the changes in the investor capital of each fund *i* between periods *t-1* and *t* (as a percentage of AUM in *t-1*), and $\Delta NAV_{i;t-1,t}$, which is the percent change in the net asset value of the fund in that period.[22] Since ER is measured as a yield spread over comparable US Treasuries that should be highly correlated with measures of funding costs (like LIBOR), ER should already incorporate the effect of changes in funding costs, and we do not include a separate measure of such costs in our baseline estimations. We correct that omission later in our robustness analysis.

Notice that most variables in (1) except *VIX* are not macro variables, but they are defined at the fund level in a way we will explain in Section 3. Both *ER* variables attempt to capture the effect of expected returns on leverage. The higher ER_{it-1} is, the more incentive asset managers will have to increase leverage in *t* to profit from higher expected returns, as long as their fundamental view on the countries within their portfolio has not changed.[23] What if their portfolio ER changes between *t-1* and *t*? An increase in the portfolio ER will typically imply valuation losses (if the portfolio does not change between periods) or a portfolio reallocation towards higher yielding bonds.[24] In the first case and following Wang and Wang (2010), we can expect that portfolio managers will be reluctant to liquidate assets and reduce leverage in the face of realised losses.[25] In fact, we could conjecture that, if they are still convinced about their investment assessment, they will see the increase in ER as an opportunity to enlarge their exposure to higher expected returns with higher leverage. Conversely, a decrease in ER would encourage a reduction of leverage. In the second case, ie reallocation of portfolio towards higher yielding instruments, it is also natural to expect that asset managers will leverage up the higher expected returns. Therefore both coefficients for the EMBI variables should be positive. There is also an accounting reason why the coefficient on $\Delta ER_{i;t-1,t}$ should be positive: an increase in ER, if associated with a valuation loss, will reduce *NAV* (or AUM, assuming no investor flows) and necessarily force a mechanical rise in gearing, an effect that mirrors the argument of Adrian and Shin (2010). We include the ΔNAV of each fund as explanatory variable in (1) to absorb this latter effect, and prevent the blurring of the signal captured by coefficient β_3. The variable *Flows* tests whether the availability of more capital has an effect on the degree

[21] VIX stands for the Chicago Board of Options Exchange Market Volatiliy Index, which measures the implied volatility of the S&P 500 index options.

[22] The net asset value is the value per share of the fund, and as such is not affected by investors' contributions or redemptions. Therefore, its change is a measure of the change in fund value independent from capital flows.

[23] Expected returns will be higher because of the higher current yield (the size of the coupon with respect to the purchase cost of the bond) and capital gains from bond appreciation (and consequent yield reduction).

[24] Except in the unlikely event that the increase in the ER spread is exclusively caused by a decrease in the US Treasury benchmark. Needless to say, in reality the outcome will most of the time be a combination of all effects.

[25] Gromb and Vayanos (2015) obtain a comparable implication in a model of financially constrained arbitrageurs.

of leverage: an implication of Stein (2009) is that, *ceteris paribus*, a capital inflow decreases the cost of equity at the margin, and should reduce leverage.[26] Finally, the variable VIX_t is a measure of aggregate financial risk perception (or aversion), which should have a negative effect on portfolio leverage as implied by Wang and Wang (2010) and several recent contributions in the financial stability literature.[27]

Wang and Wang (2010) also give a prominent role to transaction costs as determinants of optimal leverage. Their theoretical analysis finds that for most reasonable parameterisations, increased transaction costs should reduce leverage. Transaction costs are very hard to measure, as they are not usually reported and might vary significantly depending on trade size, asset liquidity, market depth, the strength of the relationship between trader and broker, and even the time of the day or the month. However, the relatively widespread recent use of "capital flow management" (CFM) instruments in EMEs provide a close proxy of transaction costs. These measures are intended to dampen the pace and volume of capital inflows or their impact on local credit markets by increasing the cost of access for foreign residents or restricting financial activity.

Capital controls restrict cross-border financial activity based on residence of the parties involved. In contrast to the past, present-day capital controls have been relatively "market friendly": rather than imposing outright quantitative restrictions, policymakers have mostly opted for taxes or reserve requirements.[28] These measures essentially reduce the expected returns of investment in local assets and, in that sense, they behave to a large extent as transaction costs, so that they should have a detrimental impact on portfolio leverage. But there is also another possibility. If portfolio managers believe in their investment ideas, they are unlikely to feel inclined to reduce their existing positions in the country imposing capital controls on inflows. Quite to the contrary, they might see them as a confirmation of their own bullish views on its assets. Besides, new capital controls typically will affect only new positions and not the existing ones. At the same time portfolio managers will have to decide how to allocate new flows into their portfolios. Because of the incentive structure and competitive environment of investment funds, especially those that are actively managed, they might be reluctant to replicate their existing portfolio if that means a reduction in expected returns. Once again, as long as they remain convinced of their investment ideas, an alternative would be to extend the existing portfolio but taking higher leverage to compensate the expected return subtracted by tighter capital controls. In that case, portfolio leverage would be directly proportional to the intensity of capital controls: tighter capital controls would lead to higher portfolio long leverage. Which of these two effects prevails is an empirical question that can only be settled by the data.

[26] Stein does not derive this implication directly from his model, which is too stylised and does not include explicit capital flows. His argument is mainly predicated on exogenous moves on the relative cost of equity with respect to borrowing.

[27] For instance, see Adrian and Shin (2009), Adrian and Shin (2010b), Ang et al (2011). For a theoretical model with the same implication, see Fostel and Geanakoplos (2012).

[28] See Ostry et al (2011) for a comprehensive survey on recent experience with capital controls.

Other measures, typically macroprudential policies, do not discriminate based on residence but attempt to contain the local side effects of cross border or foreign exchange exposure and lending through financial regulation. Macroprudential policies take many forms and usually it is difficult to liken them to transaction costs. Moreover, as they are not aimed at non-residents, they are unlikely to affect the decision-making of the funds in our sample, which are mostly based in advanced economies. However, some measures can affect foreign investors, eg restrictions on foreign currency money market instruments or other restrictions related to foreign exchange (FX) derivatives or foreign currency transactions in general. Therefore, we test below their impact on leverage, sometimes replacing capital controls in equation (1), or alongside capital controls in an expanded version of (1).

3. Data and estimation

We rely on several data sets to construct a panel of individual fund data from January 2009 through December 2011. The estimation horizon is dictated by the availability of capital controls information, but the sample of funds is otherwise identical to that used in Graphs 1 through 5. Monthly fund data on portfolio allocations (including long/short cash positions) and changes in *NAV* and flows are obtained from EPFR Global, a data vendor. EPFR provides fund-by-fund information on global flows and portfolio country allocations for a broad array of asset managers catering to retail and institutional investors; focusing on EMEs, AEs or keeping a global coverage; investing in fixed income or equity markets; managed actively or passively. Portfolio allocation data is reported by country, and in the case of fixed income allocations it does not specify whether bonds are issued by sovereigns or corporates.

We measure country bond's excess returns with the broadly used EMBI spread.[29] By focusing on EMBI as a measure of excess returns, we assume that the expected returns of corporate bonds are highly correlated with their sovereign's, at least in their systemic component. Moreover, some of the funds in the sample also invest in local currency fixed income instruments. Once again, by relying only on EMBI as our measure of excess returns, we implicitly assume that shocks to EMBI get transmitted to a large extent to local currency-denominated bonds. Daily data for EMBI and VIX are averaged monthly. The variable ER_{it-1} is constructed monthly for each fund as a weighted average of the EMBIs of the countries in its portfolio in period $t-1$, where the weights are the portfolio allocations to each country. Whenever the allocation for a region rather than a country is reported, the EMBI for that region is used. Also for relatively small countries that do not have their own EMBI, we replace it with the index of their geographical region.[30]

[29] EMBI stands for Emerging Markets Bond Index Global, a benchmark index maintained by JP Morgan, which tracks the total returns of foreign currency denominated fixed income securities issued by sovereigns from EMEs in advanced economies financial markets. The index computes a spread over US treasuries of comparable duration. It is reported as a global index, by region, and by country, whenever the conditions for securities to be included are fulfilled.

[30] This applies only to a very few countries whose portfolio allocations are typically very small.

Graph A1 of Annex I shows the time series of the ER variable for a selection of funds in our sample. We report representative funds for each quartile of AUM, and different levels of average leverage during the sample period.

We obtain information about CFM measures from the database compiled by Forbes, Fratzscher and Straub (2013).[31] They collect weekly information on CFM changes for a sample of 60 countries, 53 of which are EMEs, from January 2009 through December 2011. They supplement the information provided by the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* with financial analyst reports, primary news sources and academic papers on the topic. They include only those policies that in any way impose restrictions on cross border financial activity based on residence (capital controls, KCs) or FX exposure (macroprudential policies, MPPs). Capital controls include taxes on cross-border flows between residents and non-residents, non-remunerated reserve requirements, special licensing requirements, and a few instances of quantitative limitations or outright bans on international transactions. They might apply to all kinds of inflows/outflows, or discriminate by type of flow (equity, bond, bank loans, or foreign direct investment (FDI)). Macroprudential measures are intended to buttress the domestic financial system against shocks associated with FX or international exposure. Therefore, they target the balance sheet vulnerabilities that might develop as a result of capital flows. They typically include limits on banks unhedged FX positions, differential reserve requirements on local and foreign currency, restrictions on foreign asset acquisition, and taxes on banks' FX transactions.

After collecting all these data in CFM changes, they label each change as a tightening (coded with +1 value) or loosening (coded with –1) of the CFM measure. They also record whether the measure is a KC (and whether it targets inflows or outflows) or MPP, and whether the policy affects the equity market, the fixed income market, FDI, bank loans, banks in general, or FX markets. They end up with 220 CFM events involving 39 of the 60 countries between 2009 and 2011.[32]

Based on this database, we construct four different definitions of KCs to use in our estimations. There is one variable encompassing all controls on capital outflows, and three progressively narrower definitions of controls on inflows: controls on all inflows, on bank borrowing and fixed income markets, and on fixed income markets only. The objective is to determine which type of control, if any, affects the leverage decision of the funds in our sample. Moreover, we want to test the impact of MPPs, so we also build four narrowing definitions of MPPs: all MPPs, measures affecting banks or FX, measures affecting mainly FX, and measures affecting money market instruments attractive to non-residents (eg deposits on resident banks). In all cases we exclude those MPPs that can be construed as attempts to curtail the domestic financial impact of capital outflows.

Once all these variables have been defined, we compute a KC or MPP intensity index for each country, starting at zero as of December 2008 and simply adding or subtracting monthly tightenings and/or loosenings of policy over the sample period. In

[31] We thank them for kindly sharing their database with us.

[32] For more details about the database, see Forbes, Fratzscher and Straub (2013).

that way, the index indicates the intensity of controls with respect to the initial position in December 2008. For instance, if country *j* introduced the first tightening of capital controls in May 2009, its KC intensity index would have zeroes on its first four observations (corresponding to January–April 2009) and would become +1 in May 2009. Moreover, if in any given month the country relaxed controls twice and tightened once (the same or different policies), it would end the month with a net loosening of –1. After these KC or MPP indices have been computed for each country, we calculated the capital control (or macroprudential measure) intensity of the fund portfolios in our sample (KC_{it} or MPP_{it}) as monthly (portfolio-) weighted averages of the countries' indices. To avoid incorporating in our measure of CFM intensity the potential effect of the endogenous portfolio reallocation caused by a change in CFM, we weight the country indices in *t* with the portfolio weights in *t-1*, prior to any contemporaneous modification. As an illustration of how these variables look like in practice, Graphs A2 and A3 of Annex I present some examples of the time series of these variables for a selection of funds in our sample. Annex II presents a summary description of variable computations.

Table 2 presents overall summary statistics for the variables employed in our baseline and robustness estimations. This is an unbalanced panel data set including observations for 87 investment funds over 36 months. They include fixed income funds dedicated to EMEs, or global funds with more than 10 percent of their portfolios allocated to EMEs, with at least five monthly observations during the sample period. We can see that the average long leverage in the sample is relatively small at almost 3 percent, but since all funds holding long cash positions (negative long leverage) are censored at zero, the average hides cases with relatively high leverage: the sample maximum is almost 51 percent, slightly above the maximum initial margin imposed by Regulation T.[33] In fact, the average gearing for funds that typically rely on it is over 15 percent, although volatility is also large at almost 13 percent, as suggested by Graphs 3 and 4. The means of the different types of KC and MPP indices indicate that most funds' portfolios have faced tighter restrictions during the sample period than in December 2008. Only capital controls on outflows were loosened on average between 2009 and 2011. On average, the funds in our sample had positive monthly inflows equivalent to 2 percent of the AUM on the previous period, although volatility was high at 18 percent. Net asset value increased a large 0.8 percent per month on average (almost 10 percent annually), with significant volatility as well, close to 3 percent.

[33] This is the Federal Reserve Board regulation that governs the operation of cash accounts, and among other things, the amount of credit that brokerage firms and dealers may extend to customers for the purchase of securities on margin.

Summary of statistics

Overall statistics for the 1989 observations — Table 2

	Mean	Std Dev	Min	Max
Leverage[1]	2.797	7.972	0	50.780
Leverage for the uncensored sample[1]	15.243	12.524	0.010	50.780
KC on inflows[2]	0.258	0.537	–0.610	4.962
KC on inflows to bonds or borrowing[2]	0.242	0.411	–0.411	3.566
KC on inflows to bonds[2]	0.234	0.298	–0.456	2.111
KC on outflows[2]	–0.512	0.365	–1.816	0.114
All MPP[2]	0.633	0.570	–0.456	2.708
MPP on banks or FX[2]	0.613	0.557	–0.456	2.681
MPP on FX[2]	0.548	0.514	–0.456	2.500
MPP on deposits by non-residents[2]	0.534	0.476	–0.162	2.273
$ER_{i,t-1}$[3]	224.501	101.224	2.629	830.222
$\Delta ER_{i,t-1,t}$[3]	–3.527	36.831	–214.424	178.512
VIX_t[4]	25.813	8.119	14.750	46.350
$Flows_t$[5]	2.098	16.846	–79.159	358.046
NAV $Change_{t-1,t}$[5]	0.848	2.902	–18.960	18.330
LIBOR 3–month[4]	0.432	0.269	0.248	1.267
OIS spread 3–month[7]	0.274	0.249	0.078	1.026

[1] As a percentage of assets under management of current period. [2] Index, December 2008 equal to zero. [3] In basis points. [4] In per cent. [5] As a percentage of assets under management of the previous period. [6] Month-over-month percentage changes. [7] In percentage points.

We proceed to estimate the coefficients in (1) using this data set. As explained in Section 1, we introduce a dummy variable in the estimation to remove the effect of the jump in long leverage recorded in May 2009. The dummy variable is equal to 1 in that month only for the funds that contribute to the jump.

There are many zeroes in the dependent variable because gearing is censored at zero. As explained before, we censor long cash positions because we cannot disentangle the positive cash held for administrative reasons from the positive cash held as part of an investment strategy. In other words, positive cash held for investment reasons is unobservable for those funds holding long cash in our sample. Therefore we estimate the coefficient vector in (1) by applying a tobit procedure to our panel, only with random effects: Greene (2004) suggests that, even though consistent estimation of the coefficient vector with fixed effects is possible, inference is not. That is because the downward bias in the asymptotic covariance matrix of the maximum likelihood estimator (MLE) of the coefficient vector cannot be removed. In order to estimate the asymptotic covariance matrix of the coefficient estimates, the residuals of the estimation need to be corrected by heteroskedasticity, autocorrelation within units (funds) and cross correlation between units. We do that by bootstrapping, ie drawing

2,000 samples with replacement from the sample corresponding to each fund, re-estimating the parameters and computing the standard errors of the bootstrapped parameters. We present and discuss the results in the following section.

4. Results

Baseline estimations

Table 3 displays the Tobit MLE of the coefficients in equation (1) for different types of capital controls: controls on capital outflows only, controls on all inflows, on inflows to bond markets and bank borrowing, and on inflows to bond markets only. The variables associated with expected returns and market volatility are highly significant and have the expected signs: leverage is significantly increased by the variables that attempt to capture expected portfolio returns and reduced by a higher perception of market risk, as reflected by the VIX. The estimates of these coefficients are similar across the different models estimated. To grasp the economic significance of the estimations, it is better to look at the marginal effects, ie the estimated leverage response by funds that are not censored (ie those that are using leverage). For instance, leverage increases by 80 bps (0.8%) for each increment of 100 bps in time *t-1* portfolio ER (the standard deviation of ER, see Table 2). Given that the average gearing of the leveraged funds in our sample is about 15 percent and the average monthly investor inflow is 2 percent (see Table 2), by doing a variation of the basic balance sheet arithmetic presented by Adrian and Shin (2010b), we conclude that for each extra dollar of AUM, the typical leveraged fund should borrow 56 cents to achieve the increased leverage target.[34]

The coefficient of ΔNAV is positive and significant at the 1 percent confidence level in all specifications. This suggests that asset managers react quickly to raise leverage and avoid a dilution of their portfolios' expected returns in the face of capital gains, in line with the implication of Adrian and Shin (2010b).[35] On the other hand, capital inflows into the funds in this sample have no statistically significant impact on leverage, against the implication in Stein (2009) that the arrival of new capital would reduce the leverage of arbitrageurs.

[34] Let´s assume that, before the change in EMBI, the AUM of the typical fund was 100 and gearing 15% of AUM. *Ceteris paribus*, after the change in EMBI, gearing has to be raised to 15.8%, with capital inflows of 2% of AUM. The new borrowing D in this simplified example is the solution to this equation: $\frac{15+D}{100+2} = 0.158$, which is 1.12. Therefore, debt must rise 56 cents per dollar of new AUM.

[35] In fact, Adrian and Shin (2010b) had in mind the behaviour of banks rather than asset managers, but an analogous reasoning can be applied in this case.

Tobit panel results: Capital controls[1] Table 3

	Controls on outflows		Controls on inflows		Controls on inflows to bond and borrowing		Controls on inflows to bonds	
	Coeff	Marg eff[2]	Coeff	Marg eff[2]	Coeff	Marg eff[2]	Coeff	Marg eff[2]
$KC_{i,t}$	–9.635**	–1.938**	6.594***	1.338***	8.093***	1.642***	13.614***	2.761***
	(3.876)	(0.792)	(2.086)	(0.437)	(2.741)	(0.571)	(4.183)	(0.874)
$ER_{i,t-1}$	0.044***	0.009***	0.039***	0.008***	0.040***	0.008***	0.045***	0.009***
	(0.012)	(0.003)	(0.011)	(0.002)	(0.011)	(0.002)	(0.011)	(0.002)
$\Delta ER_{i;t-1,t}$	0.155***	0.031***	0.145***	0.029***	0.148***	0.030***	0.152***	0.031***
	(0.019)	(0.005)	(0.018)	(0.004)	(0.018)	(0.004)	(0.018)	(0.004)
$VIX_{,t}$	–0.710***	–0.143***	–0.658***	–0.133***	–0.688***	–0.140***	–0.664***	–0.135***
	(0.146)	(0.032)	(0.126)	(0.028)	(0.128)	(0.028)	(0.119)	(0.026)
$Flows_t$	0.006	0.001	–0.032	–0.007	–0.026	–0.005	–0.017	–0.004
	(0.024)	(0.005)	(0.032)	(0.007)	(0.031)	(0.006)	(0.027)	(0.006)
NAV $Change_{t-1,t}$	0.758***	0.152***	0.662***	0.134***	0.684***	0.139***	0.746***	0.151***
	(0.169)	(0.035)	(0.151)	(0.032)	(0.154)	(0.032)	(0.170)	(0.035)
Dummy[3]	–8.073***	–1.460***	–6.506***	–1.203***	–6.879***	–1.268***	–6.845***	–1.260***
	(2.984)	(0.493)	(2.492)	(0.434)	(2.467)	(0.426)	(2.518)	(0.437)
Constant	–17.814***		–12.713***		–12.950***		–15.637***	
	(4.024)		(3.311)		(3.349)		(3.475)	
Total observations	1989		1989		1989		1989	
Left-censored observations	1624		1624		1624		1624	
pseudo-R^2	0.271		0.261		0.264		0.267	

[1] Random-effects tobit model with robust standard errors (nonparametric bootstrap) shown in parenthesis. Sample period: January 2009 to December 2011. ***, **, * indicate significance at the 1%, 5%, and 10% level. [2] Marginal effects for the expected value of the dependent variable conditional on being uncensored. [3] Indicates the jump in leverage in May 2009 present in some funds.

The coefficients on the different definitions of capital controls for inflows have the opposite sign to that predicted by Wang and Wang (2010) for transaction costs. In other words, tighter restrictions on capital inflows tend to significantly increase long leverage used by investment funds. Moreover, this effect is quantitatively larger the more closely capital controls target the fixed income market. The coefficients and marginal effects are significant at least at the 5 percent confidence levels in all cases, but the coefficient for capital controls aimed at bond markets doubles the coefficient of capital controls on all inflows.[36] The coefficients on capital controls on outflows are negative and significant, suggesting that funds tend to increase leverage in response to the loosening of this type of controls and vice versa. Therefore, capital controls on

[36] After adjusting the coefficients by the standard deviation of the respective variable, the coefficient of capital controls on inflows to bond markets is still 15% higher than the coefficient on all capital inflows.

outflows seem to work in the way predicted by Wang and Wang (2010) for transaction costs: tighter capital controls on outflows increase transaction costs (potentially driving them to infinite) and reduce leverage. In contrast to market transaction costs, the tightening or removal of capital controls on inflows provide a valuable signal to investors: countries that impose (remove) controls on inflows denote a position of relative strength (weakness). Therefore, they are likely to attract more capital, although those positions are also likely to carry more leverage to compensate for the return reduction caused by controls, especially if these are taxes or unremunerated reserve requirements. Moreover, if a portfolio manager had already invested in the country before controls on inflows are tightened, and is convinced of the investment idea, he could still try to replicate the existing portfolio with new incoming flows, using leverage to keep expected returns at the levels existing before the capital controls were tightened.

Next we analyse the role of MPPs. We replace portfolio KC intensity indices for portfolio MPP intensity indices in equation (1). MPPs are typically aimed at the local financial market, so that the impact on non-resident investment managers should be limited. But since we focus on those MPPs that affect the banking sector, the FX market and some domestic money market instruments that non-residents could consider in their portfolio allocation process, they have the potential to trigger some reactions. We examine several nested groupings of MPPs: all MPPs in our sample, MPPs that concern the banking system or the FX market, those that only affect the FX market, and those that could affect deposits of non-residents in the domestic banking sector.[37]

Table 4 displays the results. The coefficients of the variables capturing expected returns, market risk, fund flows and change in *NAV* are similar to those estimated in the previous case, preserving the sign and significance. The coefficients of the different definitions of MPPs are positive, suggesting that tighter MPPs also increase leverage, but they are barely significant at the 10% level in the case of MPPs affecting deposits of non-residents, and more weakly significant than KCs in the remaining specifications. Marginal effects are statistically significant at the 5% confidence level in most cases. Overall, the results suggest that MPPs have a positive but probably weaker effect on the long leverage decision-making of the asset managers in our sample.

[37] That includes specific restrictions to non-resident deposits or in general deposits in the domestic banking system in foreign currency.

Tobit panel results: Macroprudential policies[1] Table 4

	All		Banks or foreign exchange		Foreign exchange		Deposits of non-residents	
	Coeff	Marg eff[2]	Coeff	Marg eff[2]	Coeff	Marg eff[2]	Coeff	Marg eff[2]
$MPP_{i,t}$	5.761**	1.176**	5.835**	1.191**	5.721**	1.168**	7.418*	1.513*
	(2.740)	(0.570)	(2.794)	(0.580)	(2.870)	(0.594)	(3.895)	(0.802)
$ER_{i,t-1}$	0.047***	0.010***	0.047***	0.010***	0.045***	0.009***	0.048***	0.010***
	(0.012)	(0.003)	(0.012)	(0.003)	(0.012)	(0.003)	(0.013)	(0.003)
$\Delta ER_{i;t-1,t}$	0.154***	0.031***	0.154***	0.031***	0.153***	0.031***	0.153***	0.031***
	(0.019)	(0.004)	(0.019)	(0.004)	(0.019)	(0.004)	(0.018)	(0.004)
$VIX_{,t}$	–0.701***	–0.143***	–0.701***	–0.143***	–0.705***	–0.144***	–0.694***	–0.142***
	(0.131)	(0.029)	(0.130)	(0.029)	(0.132)	(0.029)	(0.128)	(0.028)
$Flows_t$	–0.004	–0.001	–0.004	–0.001	–0.005	–0.001	–0.006	–0.001
	(0.027)	(0.005)	(0.027)	(0.005)	(0.026)	(0.005)	(0.027)	(0.006)
NAV $Change_{t-1,t}$	0.692***	0.141***	0.690***	0.141***	0.674***	0.138***	0.663***	0.135**
	(0.161)	(0.034)	(0.160)	(0.033)	(0.156)	(0.033)	(0.161)	(0.033)
Dummy[3]	–6.264**	–1.179**	–6.257**	–1.177**	–6.545**	–1.227**	–6.325**	–1.188**
	(2.842)	(0.497)	(2.858)	(0.500)	(2.782)	(0.485)	(2.991)	(0.522)
Constant	–17.279***		–17.162***		–16.169***		–17.867***	
	(4.357)		(4.345)		(4.211)		(4.914)	
Total observations	1989		1989		1989		1989	
Left-censored observations	1624		1624		1624		1624	
pseudo-R^2	0.273		0.273		0.272		0.273	

[1] Random-effects tobit model with robust standard errors (nonparametric bootstrap) shown in parenthesis. Sample period: January 2009 to December 2011. ***, **, * indicate significance at the 1%, 5%, and 10% level. [2] Marginal effects for the expected value of the dependent variable conditional on being uncensored. [3] Indicates the jump in leverage in May 2009 present in some funds.

Next we estimate an expanded version of equation (1) that puts together KCs and MPPs, in order to verify whether interactions between the variables may affect the results. There are several pairings of CFM measures that can be tried: to preserve the convention used so far, we combine increasingly restrictive definitions of both types of measure. That is, we estimate specifications that include, successively, controls on all capital inflows and all macroprudential policies; controls on capital inflows to bond markets and bank borrowing, and macroprudential measures affecting bank activity and FX markets; and controls on capital inflows to bond markets only, and macroprudential policies impacting bank deposits of non-residents. The results are presented in Table 5, and do not deviate from previous estimates: leverage is positively related to expected returns and capital gains (change in *NAV*), negatively related to market risk perception, and is not affected by fund flows. Once again, tighter capital controls on any definition of inflows result in gearing increases, and now the size of the coefficients on MPPs are much smaller, so that MPPs have clearly no statistically significant impact on leverage. On the other hand, the size of the coefficients for non-CFM variables is remarkably similar to that observed in all previous estimations.

Tobit panel results: Capital controls and macroprudential policies[1] Table 5

	Controls on inflows and all macroprudential measures		Controls on inflows to bonds & borrowing and macroprudential measures on banks & FX		Controls on inflows to bonds and macroprudential measures on deposits of non-residents	
	Coeff	Marg eff[2]	Coeff	Marg eff[2]	Coeff	Marg eff[2]
$KC_{i,t}$	5.600**	1.135**	6.888*	1.397*	11.969***	2.424***
	(2.686)	(0.549)	(3.598)	(0.733)	(4.360)	(0.892)
$MPP_{i,t}$	1.967	0.399	1.657	0.336	2.472	0.501
	(3.119)	(0.635)	(3.299)	(0.671)	(3.640)	(0.740)
$ER_{i,t-1}$	0.042***	0.008***	0.042***	0.009***	0.047***	0.010***
	(0.012)	(0.002)	(0.012)	(0.003)	(0.012)	(0.003)
$\Delta ER_{i,t-1,t}$	0.146***	0.030***	0.148***	0.030***	0.151***	0.031***
	(0.018)	(0.004)	(0.018)	(0.004)	(0.018)	(0.004)
$VIX_{,t}$	–0.649***	–0.132***	–0.680***	–0.138***	-0.651***	–0.132***
	(0.122)	(0.027)	(0.124)	(0.027)	(0.114)	(0.025)
$Flows_t$	–0.025	–0.005	–0.021	–0.004	-0.014	–0.003
	(0.028)	(0.006)	(0.028)	(0.006)	(0.026)	(0.005)
NAV $Change_{t-1,t}$	0.690***	0.140***	0.701***	0.142***	0.757***	0.153***
	(0.153)	(0.032)	(0.155)	(0.033)	(0.169)	(0.035)
Dummy[3]	–5.913**	–1.102**	–6.391**	–1.186**	-6.181**	–1.147**
	(2.684)	(0.469)	(2.716)	(0.469)	(2.827)	(0.491)
Constant	–14.766***		–14.523***		-17.564***	
	(4.197)		(4.250)		(4.427)	
Total observations	1989		1989		1989	
Left-censored observations	1624		1624		1624	
pseudo-R^2	0.262		0.264		0.267	

[1] Random-effects tobit model with robust standard errors (nonparametric bootstrap). Sample period: January 2009 to December 2011. ***, **,* indicate significance at the 1%, 5%, and 10% level. [2] Marginal effects for the expected value of the dependent variable conditional on being uncensored. [3] Indicates the jump in leverage in May 2009 present in some funds.

The allocation of leverage

So far our empirical findings are consistent with the theoretical predictions in Wang and Wang (2010) and Adrian and Shin (2010): portfolio leverage increases with expected returns, decreases with risk and also tend to increase in the face of capital gains. A related question of policy interest concerns the way in which the incremental leverage is typically allocated: what positions are leveraged up? Is leverage allocated to the positions on the assets of the country which imposed capital controls or offered an increase in expected returns? Or are the new borrowed funds allocated more or less evenly among all portfolio positions? The answer is relevant to understand how volatility in the assets of the different countries will change at the next bout of market

stress: as explained by Stein (2009), leveraged positions are more likely to be subject to fire-sale effects. The mechanism has been extensively studied in the literature: if several arbitrageurs hold leveraged positions in certain assets, and one of them is hit by a price shock (possibly in an unrelated part of his portfolio) he might be forced to liquidate part of his leveraged positions, causing losses to others, who will need to sell to meet margin calls, potentially creating successive rounds of liquidations and price declines.[38]

An extensive analysis of this question is beyond the scope of this paper, but we can offer an educated guess based on the analysis of EPFR portfolio weights. Given the decision to increase portfolio leverage, an asset manager can allocate the borrowed funds in at least three ways: (i) evenly among the existing positions, in which case the portfolio weights of the assets will not change; (ii) concentrated in one or a few positions of the portfolio, in which case the weights of those positions will increase; or (iii) evenly among most positions except a few of them, in which case the portfolio weights of the excluded positions will decrease.[39] The ultimate decision will depend on legal, contractual, strategic or tactical considerations that might differ case by case. Let´s assume that the increase in leverage is related to the imposition of capital controls by a country (say country A) whose assets are a significant part of the portfolio. Then, following the taxonomy presented above, the portfolio manager can increase leverage in all the positions, increase leverage on the assets of country B, or increase leverage in all but the assets of country A.

Based on this very simple analysis, we conduct a number of event studies on the change of portfolio allocations to the assets of countries that modified their CFM measures during our sample period. We choose changes in CFM instruments because, contrary to the other variables in our sample, they offer clearly distinct events for study. Moreover, their analysis has an obvious policy interest. The events studied include tightening or loosening of capital controls on all inflows, all outflows, and all types of MPPs. We compute the change in allocations to country assets from the month immediately prior to the month when a CFM change is observed. We discard observations that register CFM changes in consecutive months. Then we compute the average of portfolio weight changes per event across countries and test whether these means are significantly different from zero. The results are shown in Table 6, in three columns presenting respectively the statistics for all funds, all funds leveraged in the month prior to the CFM change, and all funds non-leveraged in that month. There is a significant drop in allocations for all funds only in the event of a tightening of KC on outflows, which is mainly driven by the reaction of non-leveraged funds. However, the tightening of KCs on outflows is associated with a decrease in leverage, so this response seems to indicate a mere flight from the country's assets. Moreover, there is a significant (at the 10% level) drop in the allocations by leveraged funds to countries

[38] Examples of the extensive literature on fire-sale effects include Shleifer and Vishny (1992, 1997), Kyle and Xiong (2001), Gromb and Vayanos (2002), Morris and Shin (2004) and Brunnermeier and Pedersen (2009).

[39] In practice, there is obviously a continuum of possible allocations in between these three benchmarks that we mention for the sake of argument. Moreover, asset managers are not limited to allocating leverage between the pre-existing positions in their portfolios.

which tighten KC on inflows, which suggests that, when these funds increase leverage as part of their response, they will increase the leverage of the positions on the assets of the countries which did not modify the intensity of their KCs. All the other means are non-significantly different from zero, implying that incremental leverage is likely to be evenly spread among all the positions in the portfolio and not focused on the country which adjusted the CFM measures. That suggests that portfolio managers are willing to increase leverage to preserve the expected return of their portfolios, without increasing exposure to the potential higher volatility of the securities of the country applying CFM tools.

Change in country allocations. Event study results[1] Table 6

	All funds		Leveraged funds[2]		Non-leverage funds	
	n	$\mu(\Delta\theta_{t-1,t})$	n	$\mu(\Delta\theta_{t-1,t})$	n	$\mu(\Delta\theta_{t-1,t})$
KC on inflows						
Tightening	17	–0.037	17	–0.269*	17	0.016
		(–0.618)		(–2.055)		(0.244)
Loosening	18	0.005	15	–0.045	18	0.034
		(0.075)		(–0.228)		(0.478)
KC on outflows						
Tightening	7	–0.208*	6	0.034	7	–0.250**
		(–2.229)		(0.398)		(–2.451)
Loosening	41	–0.002	33	–0.168	41	–0.031
		(–0.035)		(–1.660)		(0.517)
MPP						
Tightening	62	0.032	58	0.198	62	0.018
		(0.769)		(1.141)		(0.336)
Loosening	36	–0.010	30	–0.099	36	0.016
		(–0.179)		(–0.896)		(0.227)

[1] The table shows, for each type of event and discriminating by type of funds, the number of events in the category (n), the mean of the average change in country allocation between t-1 and t when the country adjusted its capital-flow management measures (CFMs) ($\mu(\Delta\theta_{t-1,t})$) with its correspondent t-statistic (in parenthesis) of a t-test with H_0: $\mu=0$. *,** and *** refers to the significant level, 10%, 5% and 1% respectively, at which the H_0: $\mu=0$ could be rejected considering H_a: $\mu!=0$. [2] Understanding by leveraged funds those which incurred in borrowing one period before the adjustment to the CFMs.

Robustness

To complete the analysis we conduct some robustness analysis on the specification of equation (1). As explained above, we decided to initially leave out of the specification any explicit measure of borrowing costs for the funds in our sample. That decision was motivated partly by the desire to keep a parsimonious specification, and partly by the realisation that our measure of excess returns is a spread over US Treasuries, which intuitively should be more or less correlated with three-month Libor, the interest rate

benchmark usually used by prime brokers to set the financing costs of investment funds.[40] Therefore, the funding cost was to some extent contemplated in our measure of expected returns. However, that is clearly insufficient in view of the term premium compression and the consequent flattening of the yield curve observed in the last few years.[41] Therefore in this section we explicitly include three-month Libor as an explanatory variable in the estimation. Sometimes Libor might not present the whole picture regarding the borrowing opportunities of investment funds. In situations of financial stress, prime brokers might decide to impose quantitative limits on their customers, which might not be fully reflected in Libor fluctuations. Therefore we also add the Libor-OIS spread, which is broadly considered a measure of perceived stress in the banking system, and we include it as a more precise measure of funding risk.[42] Summary statistics for both variables are also included at the bottom of Table 1.

Table 7 displays the results for the combination of capital controls on inflows to bond markets, and macroprudential measures affecting deposits of non-residents.[43] The first two columns present the estimates of coefficients and marginal effects of the baseline model. Subsequent columns show the results for three alternative models: in model 1 Libor is included as an additional explanatory variable, in model 2 the Libor-OIS spread is included instead of Libor, and in model 3 both variables are included. As expected, the coefficients on the measures of funding costs are negative and highly significant. When both Libor and the OIS spread are included in the same estimation, only the OIS spread is statistically significant while Libor drops out. That suggests that, at least in the sample period, stress in the banking sector has been a relevant limitation in the borrowing opportunities of asset managers. In general, the baseline results are preserved without major changes: only the coefficient of $ER_{i,t-1}$ doubles with respect to the baseline, probably reflecting to some extent the mixing of effects whenever the measure of financing cost is not included.

[40] Ang et al (2011) state that the hedge funds in their sample typically borrow at three-month Libor plus fixed spread.

[41] In other words, the correlation between long-term and short-term Treasury rates probably changed during our sample period. Libor is correlated mainly with short-term Treasury rates, while EMBI spreads are calculated over longer-term rates. On the compression of term premia, see for instance Turner (2014).

[42] The overnight indexed swap (OIS) rate is the rate on a derivative contract on the overnight rate (eg the effective federal funds rate in the United States). The parties to the contract agree that one party will pay the other the difference between the term OIS rate and the average of the overnight rate during the life of the contract. Therefore, the OIS rate is a measure of the market´s expectation of the overnight interest rate during the contract´s term. Since the default risk in the OIS market is very low, the Libor-OIS spread can be considered as a measure of default risk in the banking system.

[43] The results for the other combinations of CFMs are available from the authors upon request. The results do not differ significantly from those presented in this paper.

Tobit panel results: Robustness[1]

Table 7

Capital controls on inflows to bonds and macroprudential measures on deposits of non-residents

	Baseline model		Alternative model 1		Alternative model 2		Alternative model 3	
	Coeff	Marg eff[2]	Coeff	Marg eff[2]	Coeff	Marg eff[2]	Coeff	Marg eff[2]
$KC_{i,t}$	11.969***	2.424***	6.900**	1.361**	11.158***	2.204***	11.307***	2.239***
	(4.360)	(0.892)	(3.107)	(0.621)	(4.102)	(0.806)	(3.866)	(0.765)
$MPP_{i,t}$	2.472	0.501	0.110	0.022	3.539	0.699	5.006	0.991
	(3.640)	(0.740)	(3.803)	(0.750)	(3.387)	(0.676)	(4.212)	(0.839)
$ER_{i,t-1}$	0.047***	0.010***	0.104***	0.021***	0.117***	0.023***	0.117***	0.023***
	(0.012)	(0.003)	(0.017)	(0.004)	(0.017)	(0.004)	(0.017)	(0.004)
$\Delta ER_{i;t-1,t}$	0.151***	0.031***	0.170***	0.034***	0.176***	0.035***	0.176***	0.035***
	(0.018)	(0.004)	(0.021)	(0.005)	(0.021)	(0.005)	(0.020)	(0.004)
$VIX_{,t}$	-0.651***	–0.132***	–0.536***	–0.106***	–0.476***	–0.094***	–0.464***	–0.092***
	(0.114)	(0.025)	(0.094)	(0.019)	(0.082)	(0.017)	(0.082)	(0.017)
$Flows_t$	-0.014	–0.003	–0.013	–0.003	–0.007	–0.001	–0.008	–0.002
	(0.026)	(0.005)	(0.023)	(0.005)	(0.019)	(0.004)	(0.019)	(0.004)
NAV $Change_{t-1,t}$	0.757***	0.153***	0.776***	0.153***	0.805***	0.159***	0.785***	0.156***
	(0.169)	(0.035)	(0.170)	(0.034)	(0.176)	(0.035)	(0.162)	(0.032)
LIBOR 3M			–29.746***	–5.868***			17.383	3.442
			(6.167)	(1.271)			(20.030)	(3.952)
OIS spread					–33.511***	–6.618***	–51.005**	–10.100**
					(6.465)	(1.351)	(22.390)	(4.420)
Dummy[3]	-6.181**	–1.147**	–3.103	–0.584	–2.012	–0.385	–1.768	–0.341
	(2.827)	(0.491)	(2.602)	(0.469)	(2.892)	(0.539)	(3.121)	(0.586)
Constant	-17.564***		–17.790***		–28.458***		–32.335***	
	(4.427)		(4.428)		(4.303)		(7.358)	
Total observations	1989		1989		1989		1989	
Left-censored observations	1624		1624		1624		1624	
pseudo-R^2	0.267		0.262		0.268		0.269	

[1] Random-effects tobit model with robust standard errors (nonparametric bootstrap) shown in parenthesis. Sample period: January 2009 to December 2011. ***, **, * indicate significance at the 1%, 5%, and 10% level. [2] Marginal effects for the expected value of the dependent variable conditional on being uncensored. [3] Indicates the jump in leverage in May 2009 present in some funds.

Our final exercise consists in replacing our measure of gearing for a more traditional long leverage measure: the ratio of long-held assets to AUM. In this way, we abandon our initial reluctance to mix short and long cash positions. We re-estimate the model described by (1) using standard panel data estimation methods, including three-month Libor as a proxy for borrowing costs, and using two combinations of CFM instruments: the broadest (capital controls on all inflows and all macroprudential measures) and the narrowest (capital control on inflows to bond markets and macroprudential measures affecting deposits by non-residents). The main results, presented in Table 8, are qualitatively similar to those obtained with the censored data

set, irrespective of the estimation method employed: pooled OLS, fixed or random effects. That means that leverage is directly proportional to expected returns, and inversely proportional to perceived market risk and borrowing costs. Leverage is not responsive to investor flows, but is strongly procyclical, meaning that it increases with the portfolio's NAV.[44] Finally, tighter capital controls increase leverage, while changes in the intensity of macroprudential measures do not affect it.

Panel results: Robustness – Standard definition of long leverage[1] Table 8

	Pooled OLS		Fixed effects		Random effects	
	(1)	(2)	(1)	(2)	(1)	(2)
$KC_{i,t}$	0.0647***	0.0955***	0.0373***	0.0700***	0.0408*	0.0723*
	(0.0069)	(0.0158)	(0.0094)	(0.0133)	(0.0224)	(0.0377)
$MPP_{i,t}$	–0.0032	0.0038	0.0074	0.0038	0.0055	0.0029
	(0.0056)	(0.0113)	(0.0061)	(0.0077)	(0.0107)	(0.0123)
$ER_{i,t-1}$	0.0007***	0.0008***	0.0007***	0.0007***	0.0006***	0.0007***
	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
$\Delta ER_{;t-1,t}$	0.0009***	0.0010***	0.0009***	0.0009***	0.0008***	0.0009***
	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
$VIX_{,t}$	–0.0030***	–0.0032***	–0.0026***	–0.0028***	–0.0025***	–0.0027***
	(0.0010)	(0.0010)	(0.0006)	(0.0006)	(0.0004)	(0.0004)
$Flows_t$	–0.0004***	–0.0004***	–0.0001	–0.0001	–0.0001	–0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0006)	(0.0001)	(0.0001)
NAV $Change_{t-1,t}$	0.0015	0.0016	0.0020***	0.0021***	0.0020***	0.0022***
	(0.0010)	(0.0012)	(0.0007)	(0.0008)	(0.0006)	(0.0007)
LIBOR 3M	–0.1399***	–0.1243***	–0.1308***	–0.1251***	–0.1251***	–0.1192***
	(0.0406)	(0.0441)	(0.0175)	(0.0171)	(0.0274)	(0.0278)
Dummy[3]	0.1379***	0.1369***	–0.0349	–0.0407	–0.0309*	–0.0371**
	(0.0288)	(0.0303)	(0.0338)	(0.0349)	(0.0173)	(0.0183)
Constant	0.9222***	0.9121***	0.9283***	0.9232***	0.9324***	0.9272***
	(0.0209)	(0.0201)	(0.0131)	(0.0151)	(0.0183)	(0.0206)
R-squared						
Overall	0.2992	0.2772	0.2857	0.2692	0.2886	0.2697
Within			0.2264	0.2256	0.2261	0.2254
Between			0.2264	0.1740	0.2078	0.1777

[1] Panel estimations with 36 periods (from January 2009 to December 2011) and 87 funds. Unbalanced panel. For pooled OLS and fixed effects estimations, Driscoll and Kraay standard errors (standard errors robust to heteroskedasticity, autocorrelation MA(q), and cross-sectional dependence); for random effects estimations, Rogers or clustered standard errors (standard errors are heteroskedasticity and autocorrelation consistent). ***, **, * indicate significance at the 1%, 5%, and 10% level.

(1) Capital controls on inflows and all macroprudential measures

(2) Capital controls on inflows to bonds and macroprudential measures on deposits by non-residents

[44] Notice that this latter result only holds for fixed and random effect estimates, not for pooled OLS:

5. Conclusions

Leverage in the banking system was an important ingredient in the 2008 global financial crisis. Since then, asset managers (the "buy side") have quickly increased their footprint in global financing, helped by the sharp retrenchment of banks nursing their balance sheets back to health. Balance sheet information for investment funds is much less readily available than for highly regulated banks. Using information provided by a market data vendor, we found that leverage on the buy side is not negligible, although it seems to vary considerably depending on the type of fund. Equity fund portfolios seem to be minimally leveraged, while fixed income funds tend to resort abundantly to borrowed money. Funds dedicated to global markets or advanced economies had little debt in their capital structure, whereas debt in leveraged EME fixed income funds was close to 30 percent of AUM towards the end of our sample period. The leverage ratio of EME fixed income funds surged after 2009 before falling abruptly back in 2014, although current levels are still much higher than before the surge. The number of funds using leverage is relatively small in our sample, but their size is about three times that of their unleveraged peers. They control more than 30 percent of AUM in their sector (down from 50 percent around 2010), making them quite significant players in their target markets.

We study the microeconomic determinants underlying the leverage decision-making of these market participants. In line with previous theoretical literature, we find that higher expected returns and capital gains tend to increase leverage, while an elevated perception of market risk and higher funding costs tend to reduce it. The tightening of capital controls on inflows in EMEs seems to be associated with leverage increases, which might be explained by reluctance on the part of portfolio managers to give up a profitable position because of returns-unfriendly regulation. Instead, they would choose to increase leverage in order to preserve higher expected returns, even at the cost of assuming more risk. Macroprudential measures do not have a statistically significant impact on portfolio leverage. Interestingly, the data suggest that incremental leverage related to the change in CFM instruments is allocated to all the assets in the portfolio, not necessarily to the assets of the country that is modifying its CFM measures. In this way, CFM actions taken by large EMEs, which tend to command large portfolio weights, might be causing a "policy spillover" towards other EMEs that are commonly represented in the portfolios of global asset managers. The overall effect would be an increase in asset price volatility in stress situations, because leveraged holdings are more susceptible to fire-sale episodes.

There are several directions in which this research might be extended. First, a better understanding of the determinants of leverage allocation among existing and new asset holdings would help to clarify the spread of portfolio vulnerabilities, and consequently to determine the assets most likely to suffer bouts of increased volatility in stress situations. A further interesting topic would be the determinants of asset managers' use of instrument leverage (implemented through derivatives rather than outright borrowing), which might create at least as much vulnerability as funding leverage. A more detailed analysis of the impact of different types of capital controls and macroprudential policies might serve in guiding the management of these tools. Another interesting empirical question is why EMEs seem to use more leverage than

other funds. Since the expected returns for EME fixed income securities are typically larger than for those of AEs, it is not obvious why asset managers would want to enhance EME returns, or do it to a larger extent than they leverage global or AE fixed income positions. Answering all these questions would require data sets of much greater granularity.

Policy implications are also interesting. The surprising effect of tighter capital controls on leverage calls for caution in the evaluation of policy tools: that assessment should not be based simply on the measurable ability of the tool to achieve a certain objective, but also on a careful consideration of all possible side effects. For that purpose, scholars and policymakers, especially in EMEs, might benefit from a closer interaction with market participants.

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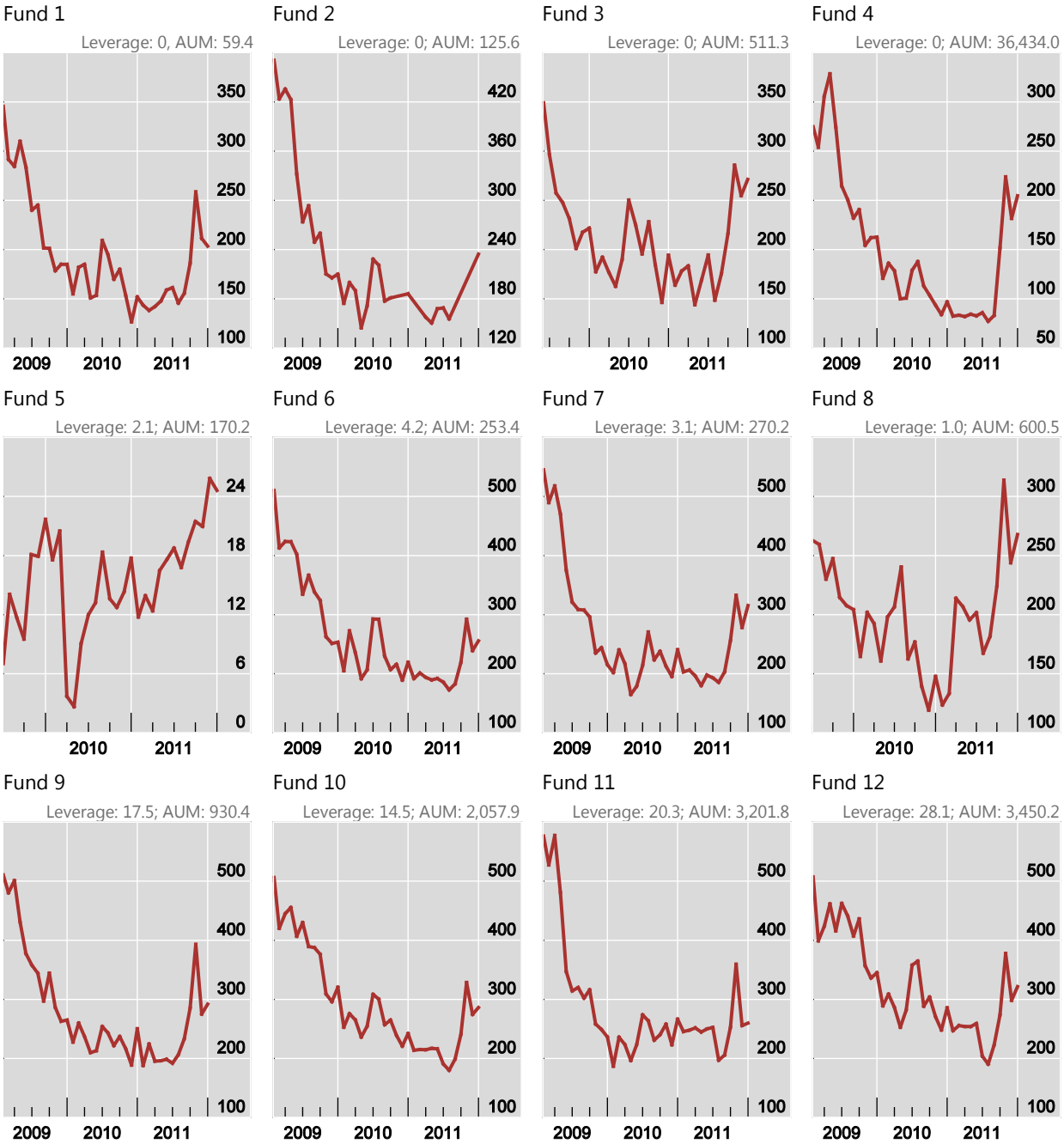
Annex I

Portfolio's measure of excess return

Selected funds. In basis points — Graph A1

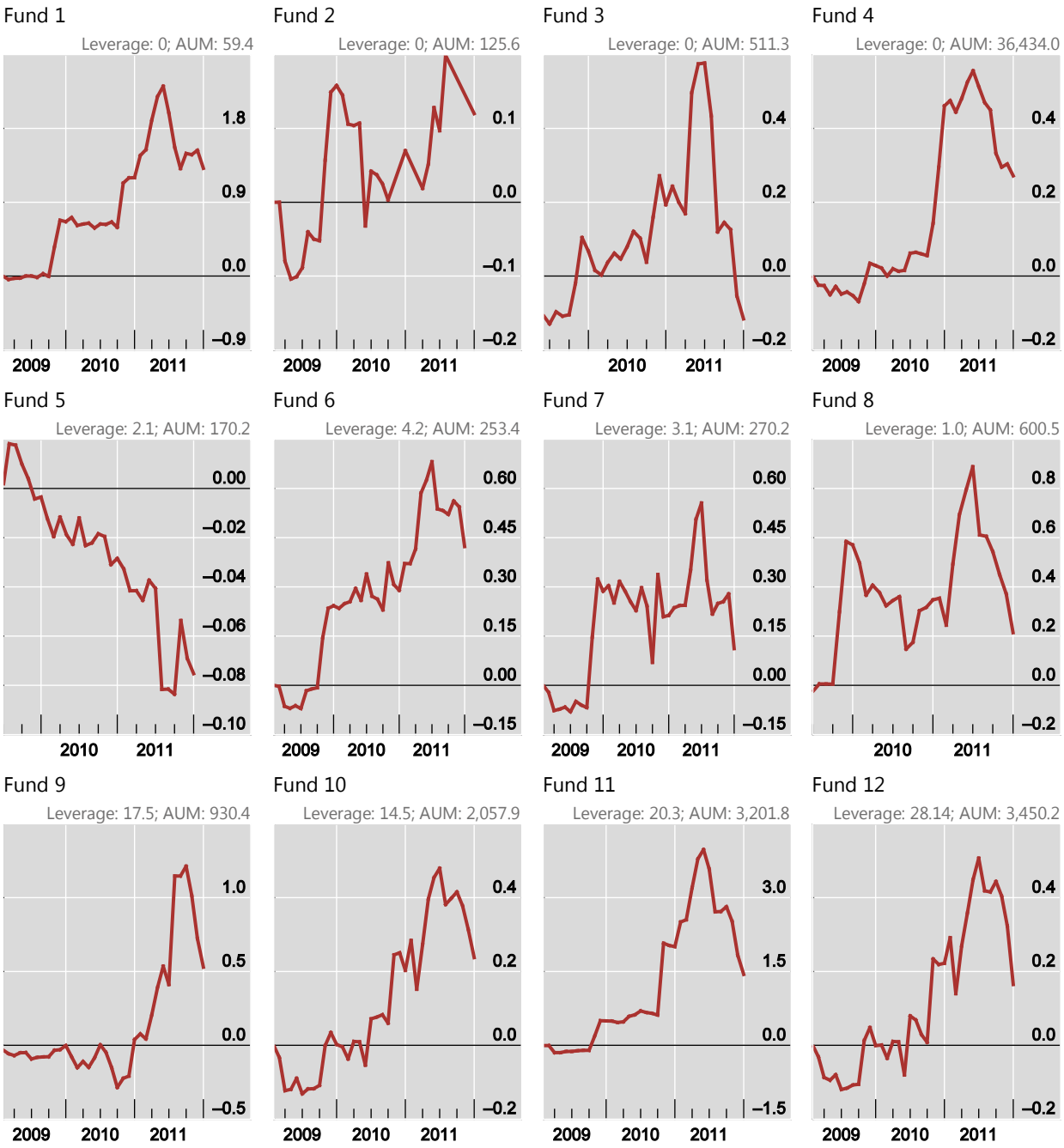


Average leverage (in per cent) and AUM (in millions of US dollars) over the sample period are shown for each selected fund.

Source: JP Morgan; EPFR.

Portfolio's measure of intensity of capital controls on inflows[1]

Selected funds. Index 2008M12=0 Graph A2

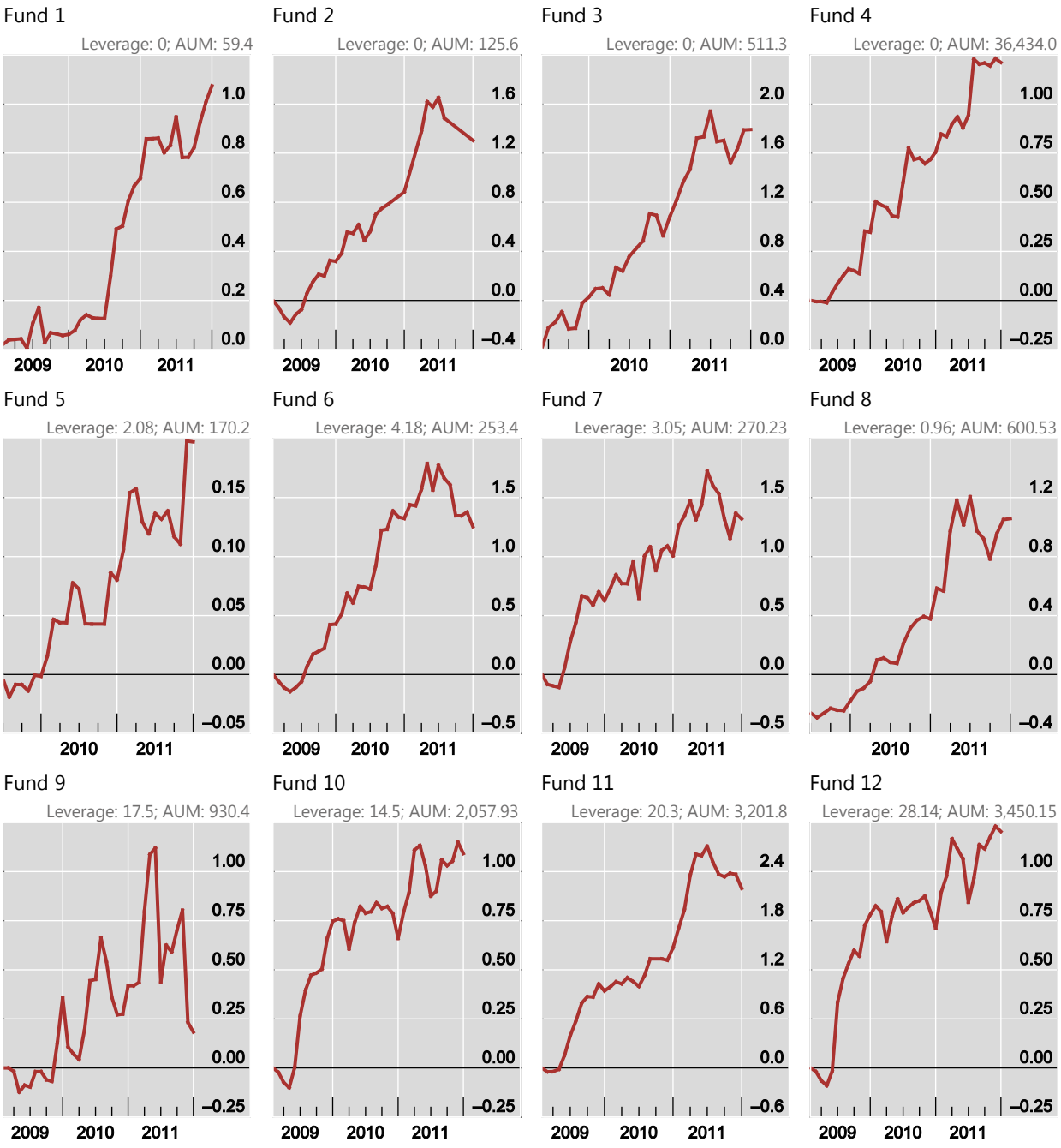


Average leverage (in per cent) and AUM (in millions of US dollars) over the sample period are shown for each selected fund.

Source: Forbes, Fratzscher & Straub (2013), "Capital Controls and Prudential Measures: What are They Good For?"; EPFR.

Portfolio's measure of intensity of macroprudential policies

Selected funds. Index 2008M12=0 Graph A3



Average leverage (in per cent) and fund size (in millions of US dollars) over the sample period are shown for each selected fund.

Source: Forbes, Fratzscher & Straub (2013), "Capital Controls and Prudential Measures: What are They Good For?"; EPFR; authors' calculations.

Annex II: Variable definitions and data sources

All data and instructions to download them from vendors are available from the authors upon request.

Data description	Table A1
L_{it} (gearing) • For each fund and month, absolute value of the negative amount of cash held as a percentage of assets under management. If a fund keeps a positive amount of cash (negative gearing), we censor it at zero. • Units: percentage of AUM_t. • Source: EPFR, country allocations by fund.	
KC_{it} / MPP_{it} (portfolio intensity index of capital controls/macroprudential measures) • For each fund and month, weighted average of the CFM measure intensity indices for the countries that constitute its portfolio, where the weights are the t-1 portfolio allocations to each country. • We compute the KC and MPP intensity indices for each country, starting at zero as of December 2008 and adding or substracting monthly tightenings and/or loosenings of policy over the sample period. • Units: Index, 2008M12=0. • Source: Database on CFM measures changes compiled by Forbes, Fratzscher & Straub (2013), "Capital Controls and Prudential Measures: What are They Good For?".	
ER_{it-1} (portfolio excess return measure) • For each fund and month, weighted average of the EMBI Global Subindices (EMBIs) of the countries that constitute its portfolio, where the weights are the portfolio allocations to each country. • Units: strip spread in basis points. • Source: J.P. Morgan.	
$\Delta ER_{i; t-1,t}$ (change in portfolio excess return) • For each fund and month, change in the excess return measure described above between periods t-1 and t, calculated as the simple difference ER_{it} - ER_{it-1}. • Units: strip spread in basis points • Source: J.P. Morgan.	
VIX_{it} (level of the VIX index) • For each month, level of the Chicago Board Options Exchange Volatility index. • Units: percent. Source: Bloomberg.	
$Flows_{i\,;\,t-1,t}$ (portfolio flows) • For each fund and month, investor flows into or out the fund. • Units: percentage of AUM_{t-1}. • Source: EPFR.	
$\Delta NAV_{i\,;\,t-1,t}$ (change in portfolio net asset value) • For each fund and month, percentage change in the net asset value of the fund between period t-1 and t. • Units: percent. • Source: EPFR.	

Note: Our sample is comprised of 87 bond funds included in the EPFR database which have an average assets allocation to emerging economies higher than 10% and have more than 5 observations over the period January 2009 to December 2011.

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