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Abstract

This paper identifies major determinants of mutual fund flows to Hong Kong equities, which is essential for financial regulators and investors to understand potential sources of instability in domestic financial markets. We find that fund flows to global equities outweigh other fund-specific factors, suggesting that, other things being equal, mutual funds' portfolio rebalancing could strongly determine the direction and magnitude of mutual fund flows in Hong Kong. Moreover, there are signs that the return-chasing behaviours of fund managers and investors amplify fund flows' volatility in times of financial turbulence, resulting in a much stronger redemption of Hong Kong-invested funds during market downturns. We also find that fund outflows require more than eight quarters in extreme cases to be fully replenished. These findings underscore the importance of portfolio diversification and hedging strategies for fund managers and investors of mutual funds to avoid international financial contagion. They also draw an implication for introducing necessary macro-prudential tools to the asset management sector in Hong Kong to maintain financial stability.

Keywords: Mutual funds, portfolio rebalancing, event studies, panel data, quantile regressions, time series models
JEL classification: C32, G14, G23

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1. Introduction

Mutual funds have played an ever-increasing role in financial markets in the past few decades. According to the International Investment Fund Association, the net asset value of worldwide open-end funds exceeded US$40 trillion as of the end of 2016, a fourfold increase in comparison to assets managed at the end of 2001. In line with the global market, the asset size of mutual funds in Hong Kong has grown considerably. The net asset value of mutual equity funds authorised in Hong Kong swelled to US$599 billion as at the end of 2016, which is about 16% of the Hong Kong stock market capitalisation.

With such significant clout in financial markets, having an understanding of mutual fund flows is vital for investors and financial regulators, as these flows are a potential source of instability in domestic financial markets in times of financial crisis.[1] A recent and notable instance occurred in Hong Kong, where mutual funds were reportedly under fire sales between the third quarter of 2015 and the first quarter of 2016. Some major redemptions at individual fund levels exceeded 20% of their net asset values (NAV) and some reached as much as 80%, prompting the securities regulator to put these funds on high alert.[2] Since the fire sales originated from some heavily redeemed funds invested in the A and H-share markets,[3] Mainland China's sector index (i.e, Hang Seng China Enterprises Index, or H-share Index) fell sharply from 14,800 points in the second quarter of 2015 to 7,500 points in the first quarter of 2016. The fall dragged Hong Kong stock prices down by one-third.

In this paper, we explore potential vulnerabilities arising from mutual funds and their relevant policy actions by identifying major driving factors of flows of funds invested in Hong Kong equities. We first identify macroeconomic factors that are relevant to aggregate fund flows into Hong Kong equities.

[1] The importance of financial intermediaries on financial stability has been well discussed in literature. Early studies show asset market liquidity is closely linked to the funding of financial intermediaries (Shleifer and Vishny, 1992). This link is further empirically supported by Coval and Stafford (2007), who show that forced redemptions in mutual funds as a consequence of funding shocks can significantly affect domestic equity prices. Some studies also find that stock market volatility increases with an increase in equity fund flows (Cao et al., 2008; Qureshi et al., 2017). Jank (2012) adds that the positive co-movement of flows into equity funds and stock market returns can be explained by a common response to macroeconomic news.

[2] See Leung (2016) for discussion on liquidity risk management of investment funds.

[3] During the episodes of A-share market correction, more than half of the listed stocks were suspended and the short-lived circuit breaker brought the whole market to a standstill multiple times. In the face of the stock suspension, fund managers sold H-share stocks dual-listed in the A-share market so as to hedge against the risk of price falls in the A-share market.

Finding that macroeconomic variables are insufficient in explaining the fund flows, we further identify fund-specific factors that are relevant to flows at the individual fund level. Apart from these identifications, we use an event study methodology to assess the depth of outflows from the funds and how much time it takes for the outflows to be replenished in Hong Kong.

The main empirical findings can be summarised as follows. First, many popular macroeconomic variables are not correlated with fund flows in aggregate to Hong Kong equities, reflecting that macroeconomic conditions play only a little role in the fund flows. At the individual fund level, flows to Hong Kong equities move strongly together with flows to global equities, suggesting that allocation of funds to Hong Kong are strongly driven by the funds' portfolio rebalancing. Second, flows of funds to Hong Kong equities is significantly correlated with returns of said funds and the stock market, implying that mutual funds would be redeemed (or purchased) during market downturns (upturns). Such return-chasing trading behaviours of fund managers and investors could be pro-cyclical, thereby amplifying the volatility of fund flows in Hong Kong. Finally, during adverse outflows of funds led by portfolio rebalancing, fund outflows from Hong Kong can be substantial and require more than eight quarters in extreme cases to be fully replenished.

This paper's contribution to the literature on mutual fund flows is threefold. First, it details a unique econometric approach that excels in handling highly complex fund flows. Previous studies on determinants of fund flows are commonly based on conventional regression tools, whose results may reflect how driving factors are linked to average fund flows. However, the distribution of these flows is usually heavily skewed and their mean estimates provide little information about the effect at any part of the distribution. Thus, conventional methods may not be directly applicable when fund flows are drastic. In this study, we identify the determinants of fund flows for central tendency, for inflows and for outflows separately using quantile panel data regression, an advanced regression-based technique that considers quantiles and panel data regressions in one specification. Second, unlike most studies using funds in aggregate, we use a large sample of individual fund data in this analysis, which provides a more comprehensive picture of the fund flows. Covering the sample period from 2007 to 2016, the sample data consists of 27,423 actively managed open-end mutual funds with Hong Kong equity exposures. Last but not least, whereas most of the related studies focus on funds' performance (i.e., price returns), this study is one of a few focusing on the determinants of mutual

funds flows (i.e., quantity), providing much needed insight and serving as a catalyst for further discourse on fund flows. Our results therefore shed light on international fund flows arising from the asset management sector, which is essential for financial regulators and investors to formulate relevant policies on the sector to avoid financial contagion.

The rest of the paper is organised as follows. Section 2 reviews some relevant studies in literature. Section 3 discusses the data and methodology of our empirical analysis. Section 4 summarises key empirical findings. Section 5 concludes

2. Related literature

There are many discussions about factors driving mutual funds flows in literature of financial fragility in the asset management industry. One important strand of research studies adverse consequences of portfolio rebalancing of investment funds. Hau and Rey (2004) evidence that changes in foreign equity returns and currency returns would trigger international investors' rebalancing their investment portfolio at the global level. Using data on global mutual funds, Jotikasthira et al. (2012) further find that fund flows are highly responsive to contagious portfolio rebalancing at the global level. This suggests that many countries are subject to the channel of global contagion and any funding shocks experienced by a country where funds are domiciled could translate into fire sales in countries in the same portfolio of the funds. Built on Jotikasthira's approach, Puy (2016) finds that emerging markets' funding is heavily affected in portfolio rebalancing when financial conditions in developed markets change.

Another strand discusses trading behaviours of mutual fund investors and fund managers.[4] Based on micro-level data, Raddatz and Schmukler (2012) show that their trading behaviours are return-chasing. Through examining relationship between fund flows and returns, fund managers and investors would reduce their exposure at the world level during bad times and increase it during good times. The

[4] Earlier studies (e.g., Warther, 1995; Edelen and Warner, 2001) evidence that aggregate fund flows are linked with stock market returns at the macro-level (e.g., the relationship between the aggregate fund flow and market returns).

resulting effect would be pro-cyclical, which accelerates price movements and increases volatility.[5] In a similar context, institutional investors' behaviours of momentum trading with the market, positive feedback trading and herding also contribute to asset price volatility (Sias, 1996; Nofsinger and Sias, 1999; Kaminsky et al., 2004; Sias, 2004; Qureshi et al., 2017). Other than these behaviours, Morris et al. (2017) find that fund managers are cash hoarding in response to redemptions. The authors attribute this behaviour to the precautionary motive given that, if current redemptions are indication of future redemptions, fund managers would like to hoard more cash to be better prepared for future redemptions in the face of redemptions.

There are also comparisons between domestic fundamentals and external factors in determining fund flows in the literature.[6] Evidence is, however, mixed. Qureshi et al. (2017) find that equity and balance fund flows are significantly correlated with all selected macroeconomic variables in Asia emerging markets. Better (worse) economic prospects are strongly associated with more (less) fund flows but lower (higher) market volatility. However, Calvo et al. (1993), Chuhan et al. (1998), Kim (2000), and Ghosh et al. (2012) argue that external factors are more important than domestic fundamentals. Based on regional fund indices, Puy (2016) finds that only trade openness out of selected macroeconomic variables explains equity fund flows, suggesting little role for domestic macroeconomic conditions.

3. Data description and methodology

3.1 Mutual funds invested in Hong Kong equities

In this paper, we study open-end mutual funds invested in Hong Kong equities.[7] The open-ended mutual funds are characterised as being highly transparent with the investment decisions easy to identify and monitor. Whenever there is significant fund injection or redemption, fund managers will

[5] In line with this, Li et al. (2015) find that fund flows are pro-cyclical ahead of the business cycle and counter-cyclical after the business cycle. Oh and Parwada (2007) also find that Korean equity fund managers tend to increase stock purchases in times of rising market volatility disregarding fundamental information and to sell in times of wide dispersion in investors belief.

[6] In terms of equity market performance, Griffin et al. (2004) suggest that both domestic and global stock market returns are important in understanding cross-border equity flows.

[7] Mutual funds are portfolios of financial instruments, including cash, stocks, bonds and others, chosen by a portfolio or fund manager in accordance with the fund's specialised investment strategies.

buy or sell across markets and financial instruments largely proportionally in accordance with the fund's specialised investment strategies.

The key variable of fund flows concerned in this study is the "flows of individual funds invested in Hong Kong equities", or, for short, "fund flows to Hong Kong". Specifically, using the quarterly frequency data of total net assets (TNA),[8] fund *j*'s TNA invested in Hong Kong equities ($TNA_{j,t}^{HK}$) at the end of quarter t is defined as

$$TNA_{j,t}^{HK} = TNA_{j,t} \times W_{j,t}^{HK} \quad (1)$$

where $TNA_{j,t}$ is the TNA of the fund during the period and $W_{j,t}^{HK}$ is the portfolio weighting of the fund on Hong Kong equities. Now the fund flows to a sample fund *j* in quarter *t*, are defined as:

$$flow_{j,t} = \frac{TNA_{j,t}^{HK}/TNA_{j,t-1}^{HK}}{1+r_t} - 1 \quad (2)$$

where $r_{j,t}$ is the quarterly return for fund *j* over the quarter *t*.

We first remove all funds that are not actively traded and which merged or did not survive in the fourth quarter of 2016. We then impose the following requirements on the flows data to exclude abnormally volatile fund flows in the sample: (i) fund flows to Hong Kong being not less than -100% and not greater than 2000%; (ii) fund flows to China being not less than -100% and not greater than 2000%; (iii) fund flows to global equities being not less than -100% and not greater than 2000%; (iv) cash exposures being not less than -100% and not greater than 100%;

Individual fund data is sourced from the Morningstar database.[9] As at the end of 2016, a total of 429,087 individual open-end funds worldwide are reported in the database. Of these, 71,666 funds have exposure to Hong Kong equities in this study. Since no investment return on Hong Kong equities for each individual fund (i.e., $r_{j,t}$) is available from the data source, we use the market return of the Hong Kong stock market index (i.e., Hang Seng Index or HSI) as a proxy. In other words, all funds

[8] Since most allocation details are reported on quarterly basis, quarterly data is used in this analysis.

[9] Disclaimer: Morningstar's data providers do not guarantee the accuracy, completeness or timeliness of any information provided by them and shall have no liability for their use.

invested in Hong Kong are assumed to experience the same return and to be reasonably close to the stock market index return.[10, 11]

After this data screening, the final sample consists of 27,423 open-end funds. Figure 1 depicts the TNA of these funds (covering cash and investments in equities, fixed incomes and others) and equity assets (covering only equity investments in Hong Kong, China and global markets) in the fourth quarter of 2016. Among all the funds considered in the quarter, most of the TNA of their assets is invested in equities (i.e., 74%, see the left hand panel). These assets, as depicted in Figure 2 (see the upper panel), have increased rapidly over the past decade. Most of these TNA are dollar-based (see the lower panel) with shares steadied at 60% at the end of 2016. Assets denominated in other currencies (particularly euro, Canadian dollar and British pound) have also increased notably, reflecting that these investments have been more diversified in terms of base currency.

Among all the equity assets (see the right hand panel of Figure 1), 92% of these assets are invested in global markets and the remaining assets are invested in Hong Kong (2%) and Mainland China (6%). Figures 3 and 4 depict the aggregate TNA invested in Hong Kong equities (denoted by $AggTNA_t^{HK}$) and its growth (denoted by $Aggflow_t$) by attributions to the funds' price and flow. They are defined as

$$AggTNA_t^{HK} = \sum_j TNA_{j,t}^{HK} \quad (3)$$

and

$$Aggflow_t = \frac{AggTNA_t^{HK}/AggTNA_{t-1}^{HK}}{1+r_t} - 1 \quad (4)$$

where r_t is the market returns of HSI. As can be seen, the asset size drops notably in several episodes of global market turbulence, including (i) collapse of the US subprime industry at the end of 2007 and 2008; (ii) concerns about Greece's bailout at the end of 2010; (iii) euro debt crisis in end-2011; and (iv) A-share stock market corrections from late 2014 to early 2016. Among these episodes,

[10] This assumption may not be too strong given the documented synchronicity of returns across assets within countries, especially in developing financial markets (Morck et al., 2000). Furthermore, most of the funds usually invest in constituent stocks of the Hang Seng Index or major stocks in the Hong Kong stock market, so these funds' returns tend to move in tandem with the returns of the market index in general.

[11] One alternative is the investment return of fund j on "global exposures". This proxy, however, is mostly unrelated to the fund's investment in the Hong Kong equity market as its underlying exposures are mostly outside Hong Kong and cover non-equity assets (e.g., global equity and fixed income markets). When financial markets in Hong Kong perform differently from the global financial markets, this proxy could be substantially deviated from the true return. Hence, this alternative is not considered in this analysis.

the most drastic asset decline is observed in the subprime crisis with a fall of 30% in the quarter. Using the stock market return as a proxy of returns of individual funds, the net flows to these funds are estimated to vary between -150% and 100% before 2007 and between -50% and 50% after 2007 (Figure 4). In particular, during the subprime crisis, the net flow out of funds reaches 54%.

3.2 Potential determinants

Macroeconomic factors

At an aggregate level, we test whether several macroeconomic variables are drivers of fund flows in aggregate to Hong Kong. These selected variables are found relevant to mutual fund flows to eurozone (Hau and Lai, 2016).

Their definitions and expected coefficient signs are described in Table A1 in Annex. These variables include:

(i) Excess return of HSI – it checks whether favourable market returns, measured by difference between HSI and MSCI returns, can correlate with more equity fund inflows in Hong Kong.

(ii) Spot exchange rate of Renminbi and the dollar index – they test whether the strengths of the Hong Kong dollar against Renminbi and other major currencies have direct impact on fund flows to Hong Kong from the rest of the world, given Hong Kong's close relationships with Mainland China and with global markets.

(iii) Difference between short-term interest rates in US and Hong Kong – it tests whether the cost of funding has any short-run impact on fund flows in Hong Kong. Theoretically, fund investors shift their portfolio investment more into equity markets at lower real interest rates, causing significant equity price inflation in an economy.

(iv) Local business cycle – it examines whether the local business cycle has any influence on investors' fund allocation decisions, thus the fund flows to Hong Kong. Several local macro variables are included in the analysis, such as output gap, credit growth, GDP growth and growth in real money supply.

(v) Global stock market uncertainty – it tests whether higher stock market volatility discourages investment in equities.

Fund-specific factors

Several fund-specific factors, covering the funds' international exposures and financial fundamental/healthiness, are considered important for driving fund flows to Hong Kong. Their definitions and expected coefficient signs are described in Table A1 in Annex. Four factors are useful to directly address our research questions, including:

(vi) Flows to global equities (or, in full, "flows of funds invested in global equities excluding Hong Kong and Mainland China markets") – It tests whether the direction of fund flows to Hong Kong is consistent with flows during portfolio rebalancing at a global level. Empirical contributions have found compelling evidence of "contagious" portfolio rebalancing at the fund level with adverse consequences for countries in the same portfolio (Raddatz and Schmukler, 2012; Jotikasthira et al., 2012). We use this variable to reflect part of this fund's strategy for buying or selling equity assets of individual markets in response to changes in global financial markets and economic conditions. A positive coefficient sign is expected and the magnitude indicates the strength of the co-movement.

(vii) Asset allocation to Hong Kong – Similar to the considerations for flows to global equities, this variable is used to test whether portfolio rebalancing could alter portfolio allocation in Hong Kong and fund flows to Hong Kong in response to funding shocks from investors (Jotikasthira et al. 2012). This variable measures how Hong Kong is weighted in the fund's portfolio. Thus, a positive coefficient suggests that the larger the weight, the more the fund flows to Hong Kong.

(viii) Flows to Mainland China[12] (or, in full, "flows of funds invested in the Mainland equities") – This variable checks whether fund flows to Hong Kong move closely with those to Mainland China. Their co-movement can be explained by two reasons. First, many Hong Kong-listed companies have already had substantial Mainland exposures over the past decades during which China has successfully liberalised its financial markets. Second, as seen in the Mainland stock market corrections in 2015/2016, fund managers sold Hong Kong stocks as a

[12] Since flows to Mainland China may be partly driven by flows to global equities, we use the residual extracted from a pooled least square regression model of the flows to the Mainland on the flows to global equities to control for this effect. The final variable is measured by "res_flow^{CN}" in the following specification $flow_{j,t}^{CN} = \alpha + \beta * flow_{j,t}^{Global\ equity} + res\_flow_{j,t}^{CN}$. Details can be seen in Table A1 in Annex.

proxy hedging when the trading of many stocks in Mainland China were suspended.[13] Thus, a positive coefficient sign is expected and the magnitude indicates the strength of their co-movement.

(ix) Excess return of HSI and fund return – The variables jointly test whether they are contemporaneously correlated with fund flows. This means that positive (or negative) returns are associated with inflows into (or outflows from) mutual funds, while fund inflows (or outflows) are associated with an upward (or downward) price pressure on fund returns.[14] The positive significance of the variables could be a signal of return chasing. That is, fund managers and investors reduce their exposure to a market when investment returns decline (during bad times) and increase it when returns rise (during good times). Such behaviour can lead to more pro-cyclical and volatile fund flows in times of crisis (see Raddatz and Schmukler, 2012; Brandao-Marques et al., 2015). Therefore, a positive coefficient suggests that the pro-cyclicality effect exists in fund investment in Hong Kong. Note that, as discussed in the previous section, this fund-specific return may not be fully relevant for fund flows to Hong Kong. Therefore, we additionally consider the excess return of the Hang Seng Index from the MSCI World Index as an alternative to measure a general market return in Hong Kong equities.

Apart from these key factors, some other fund-specific variables that measure the fund's financial fundamental/healthiness are also considered relevant to fund flows. These variables include:

(x) Fund family size – This is commonly considered in some studies but its relationship with fund flows seems to be ambiguous. On the one hand, the coefficient is positive because large family funds benefit from economies of scale. This enables them to enjoy lower research and administrative expenses, lower lending fees and better trading commissions (see Rompotis,

[13] Proxy hedging is commonly used in currency trading. In our context, it refers to the fact that, while the parent companies were halted from trading, the fund manager may sell the corresponding subsidiary companies listed in Hong Kong to hedge against the risk of price falling.

[14] This is also consistent with the smart money hypothesis examined by Gruber (1996), which hypothesises that investors display some fund selection ability as they tend to invest in funds with subsequent good performance. Therefore, fund flows should have a positive correlation with future returns. Gruber (1996) shows that funds experiencing net inflows (in the past three months) perform significantly better than funds that experience outflows. However, Sapp and Tiwari (2004) argue that the smart money effect is explained by momentum. Ferreira et al. (2013) find no evidence of a statistically significant relation between flows and subsequent performance in the sample of US funds. In contrast, they find that non-US funds that receive more new money perform better subsequently than those that receive less new money.

2007; Khorana et al., 2009). On the other hand, the coefficient could be negative because larger mutual fund managers must necessarily trade larger volumes of stock, which attracts the attention of other market participants and therefore suffers higher price impact costs (see Chen et al., 2004).

(xi) Fund return volatility – It controls for the effect that risk-averse investors tend to avoid funds with volatile prices, given that fund returns are similar. Moreover, many researchers document an asymmetric relationship between mutual fund flows and past performance. Funds with superior previous performance enjoy disproportionately large new money inflows, while funds with poor performance record smaller outflows (Sirri and Tufano, 1998). Cao (2008) showed inflow was associated with lower volatility and outflow was associated with higher volatility in the next day. In view of these reasons, the coefficient is expected to be positive.

(xii) Fund age – It measures a fund's longevity and its manager's ability. This is calculated by the time the fund has survived since its inception date. The effect of age on fund flows can run in both directions. As discussed in Ferreira et al. (2013), younger mutual funds can be more agile and committed to achieve better performance to survive. However, younger funds can face higher costs and suffer from lack of experience during the start-up period.

(xiii) Cash ratio – The ratio may reflect a fund's liquidity since a typical open-end fund with more cash can satisfy more investors' redemption without requiring the fund to immediately liquidate its underlying assets.[15] The ratio may run in another direction for two reasons. First, it reflects an opportunity cost due to loss of investment opportunity. A fund with more cash means it invests less in other financial instruments and reduces the fund's potential long-term return. This suggests a higher opportunity cost due to loss of investment opportunities (Nascimento and Powell, 2010). Second, the cash ratio may reflect fund managers' precautionary behaviour. As discussed in Morris et al. (2017), if current redemptions are indication of future redemptions, fund managers would like to hoard more cash to be better prepared for future redemptions in the face of current redemptions. Therefore, the effect of cash reserves on fund flows can run in both directions.

[15] In exceptional circumstances, when there is heavy redemption pressure and capital is immediately demandable, funds without significant cash reserves have no choice but to sell holdings quickly since the open-ended mutual fund is extremely reliant on outside capital as a fund source.

(xiv) Change in debt-to-capital ratio – It measures a fund's financial leverage. The higher the debt-to-capital ratio, the more vulnerable the fund is and the more the fund flows out. Therefore, the coefficient sign is expected to be negative.

All this data is sourced or derived from the Morningstar database. Descriptive statistics of all relevant fund flows, fund-specific data and financial market data is summarised in Table 1. As can be seen, the quarterly fund flows data is asymmetric and heavily skewed to the right, given that their skewness substantially deviates from zero. This suggests that the funds have a higher chance of outflows than inflows and the inflow quantity can be huge during a quarter.

3.3 Model of mutual fund flows

We use a multifactor regression model to test significance of macroeconomic variables, denoted by MV_t^i, in a specification of aggregate fund flows. Specifically,

$$AggFlow_t = \theta_0 + \sum_{i=1}^{K} \theta_i MV_t^i + \epsilon_t \quad (5)$$

where θ_i is the coefficient of a macroeconomic variable and ϵ_t is the residual of the model, and $AggFlow_t$ refers to the net flow of funds defined in Equation (3). The specification is estimated by the least squares method with white heteroscedasticity-consistent standard errors and covariance.

Since substantial changes in individual fund flows may be offset in aggregate, we study the fund flows at the individual fund level. Empirically speaking, we employ a fixed-effect quantile panel data regression model to link fund flows to Hong Kong (i.e., $flow_{j,t}$) with potential variables of fund-specific information (denoted by X_t) and lagged flows (i.e., $flow_{j,t-1}$). This model is a fixed-effect panel data regression run over the dimensions of time and individual funds with a specific constant term for each individual fund. The model is also a quantile regression in which the inflows and outflows can be separately identified and characterised. Therefore, in one specification, the model captures the potential effect of large redemptions of funds with cross-sectional and longitudinal dimensions being controlled for.[16]

[16] Details of the econometric model can be found in Powell (2016).

Given that mutual fund flows are strongly correlated to past performance (e.g., Sirri and Tufano, 1998; Coval and Stafford, 2007),[17] the flows are separated into their expected and unexpected components in estimation. This is where the expected component is the fitted values of the autoregressive model, and the unexpected component is its residuals (Jank, 2012). The unexpected component can be regarded as the excess flows conditional on past flows' momentum (i.e., expected component).

Specifically, we filter out the first three lagged flows from the flows (i.e., $flow_{j,t}$) by the following pooled least squares model:

$$flow_{j,t} = \beta_0 + \beta_1 \cdot flow_{j,t-1} + \beta_2 \cdot flow_{j,t-2} + \beta_3 \cdot flow_{j,t-3} + flowXlag_{j,t}. \quad (6)$$

The residual extracted from the specification above, i.e., $flowXlag_{j,t}$, is used for further analysis. We estimate the model for the τ-th quantile of $flowXlag_{j,t}$, denoted by $flowXlag_{j,t}^{\tau}$:

$$flowXlag_{j,t}^{\tau} = \theta_j + \phi_X' X_t + \gamma flowXlag_{j,t-1} + \varepsilon_{j,t}^{\tau} \quad (7)$$

where $\varepsilon_{j,t}^{\tau}$ is the τ-th quantile of $\varepsilon_{j,t}$ and θ_j is the fixed effect of fund *j*. The coefficient vector $\alpha = (\theta_j, \phi_X', \gamma)$ is estimated by the generalised method of moments (GMM). The method allows the parameters to vary based on an unknown function of the fixed effect and an observation-specific disturbance term while relaxing the identification assumptions required for other generalised quantile regressions such as cross-sectional quantile regressions and instrumental variable quantile regressions.

3.4 Event study methodology

Identification of major determinants introduced in the previous section provides an overview of major risk factors that contemporaneously contribute to fund outflows. However, it could not answer whether

[17] Two alternatives have been considered for robustness checks. The first one is a specification of the fund flows with the effect of fund flows to global equities being controlled for, which tests whether the attributions of all other factors remain the same based on a two-step approach. The second alternative is a specification of fund flows without controlling for the lagged effects. These estimation results turn out to be largely consistent with the present model. Hence, they are not reported in this study.

the fund outflows would be permanent or temporary. Therefore, we use the event study to elicit the effect of significant factors on fund flows over time. The basic idea is that it identifies the fund flows attributable to an event being studied over time with changes stemming from non-event fluctuations being controlled in the regression. The event considered for each fund in this study refers to a situation when the fund's characteristic (e.g., cash ratio) falls below an extreme level. More details of the event definition are discussed in next session.

Specifically, for each fund *j*, we first run the following multiple regression model using data in the estimation window (i.e., M quarters before the quarter of the actual event and N quarters following the quarter after the event):

$$\varepsilon_{j,t}^{\tau} = \sum_{k=-M}^{k=N} \gamma_{j,k} D_{j,k} + \varepsilon_t \quad (8)$$

where $\varepsilon_{j,t}^{\tau}$ extracted from Equation (7) represents excess fund flows to Hong Kong after controlling for fund-specific factors and lagged fund flows, and $D_{j,k}$ equals one in the event in quarter *t* and zero otherwise. Thus, the coefficient $\gamma_{j,k}$ reflects the quarterly leading (when $k < 0$), coincident (when $k = 0$), and lagging (when $k > 0$) effect of the event on the flows. Thereafter, we calculate the average excess fund flows in each quarter and then use the time series of mean flows for statistical inference to control for potential cross-sectional dependence in the quarterly excess flows.[18]

Theoretically, if the mutual fund brings information to fund flows through their redemption, we should see a fall in excess flows in the period when the fund is redeemed largely, and then no drift in excess flows following the redemption. However, if the mutual fund redemption is driven by necessity, rather than information, and if this forced redemption results in fire sale prices, then we should see a significant fund flow out over the period when the fund is forced to sell. This will be followed by a period of fund purchases compensating those who provided liquidity in the crisis period.

[18] In the spirit of Fama and MacBeth (1973) and most of the related studies, this procedure gives equal weight to each quarterly observation, rather than to each individual observation.

4. Empirical results

4.1 What are the major determinants of aggregate fund flows?

Table 3 reports the estimated coefficients of the aggregate fund flows. Given that some explanatory variables, including interest rate differentials, US exchange rates, and real money growth, are substantially correlated with others (Table 2), we re-estimate the models with three alternative combinations of independent variables for robustness checks.

Under column (1), where all variables are incorporated in estimation, we find all the macroeconomic variables are insignificant except for the variables of economic growth and lagged aggregate fund flows at a 5% level of significance. Signs of estimated coefficients suggest that an increase in aggregate fund flows to Hong Kong equities is associated with increases in economic growth and aggregate fund flows in the previous quarter. These results remain largely robust when considering alternative-model specifications listed under columns (2)-(4), except that the variable of Renminbi exchange rate is found marginally significant under column (2).

Our findings are in line with findings of case studies that show domestic macroeconomic conditions have little effect on investment fund flows. Moreover, fund flows to Hong Kong are affected by the Renminbi exchange rate. This may be partly explained by the fact that Mainland Chinese investors may diversify their Renminbi exposures following currency depreciation expectation and switch to global non-Renminbi investments, especially in the Hong Kong market, which Mainland investors are more familiar with.

4.2 How are mutual fund flows to Hong Kong, China and global markets related in crisis?

We take a closer look at the tail dependence between fund flow data in this section since extreme fund flows tend to be highly correlated during crisis periods. We focus this examination on two episodes: (i) collapse of the US subprime industry in the fourth quarter of 2007; and (ii) sharp corrections in the A-share stock market in the third quarter of 2015. These episodes were identified as extreme in our earlier section.

Figure 5 depicts the distributions of fund flows to global equities (in the left column) and flows to Mainland China (right column). The flow quantity is shown on the y-axis and quantile of the flows is on the x-axis. Based on the full sample of investment funds (see the blue line), at the 10% extremity,[19] the outflows from global equities and the inflows to global equities are 14.4% and 33.7% respectively in the fourth quarter of 2007. The fund flows appear to be less severe in the third quarter of 2015, with the outflows and inflows at the 10% extremity being 14.7% and 29.6% respectively.

When considering a subsample of funds that experienced extreme outflows from Hong Kong equities (see the red line),[20] the international fund flows appear consistently responsive. During the A-share market corrections in the third quarter of 2015, the fund outflows from global equities could reach 80% at the 10% extremity, which is stronger than those seen in the fourth quarter of 2007. Meanwhile, some funds with outflows from Mainland China are also highly responsive. The outflow from the Mainland at the 10% extremity could be more than 90% during the two crisis episodes.[21] These results suggest that (i) the impact of the A-share market correction is considerable on Hong Kong equities and (ii) extreme outflows from global equities are strongly associated with outflows from Hong Kong equities during the two crisis episodes.

4.3 What are major determinants of mutual fund flows at the individual fund level?

We estimate the unexpected flows at median (i.e., $\tau = 0.5$) to examine the relationship between the flows to individual funds and driving factors in times of normal fund flows. We also estimate the flows at quantiles of 0.25 (i.e., $\tau = 0.25$) and 0.75 (i.e., $\tau = 0.75$) to examine the responsiveness of individual funds with outflows (that usually occurs during bad times) and individual funds with inflows (that usually occurs during good times) respectively to driving factors. Since several drastic fund flows in early 2000 may not be informative given that the total asset size and number of funds remain small

[19] The term "fund outflows (inflows) at the 10% extremity" refers to the fund flows at the 10th (90th) percentile.

[20] The subsample of funds refers to those with extreme outflows from Hong Kong equities at 5% extremity.

[21] For the fourth quarter of 2007, the fund outflows from the Mainland appear weaker despite strong outflows from Hong Kong. This may be attributable to the facts that (i) the Mainland China was not the centre of the earthquake during the 2008 global financial crisis and (ii) the financial markets in Hong Kong and the Mainland have not been deeply integrated in early years.

and scarce, we focus on the sample period covering the first quarter of 2007 to the fourth quarter of 2016, which covers several major events in the past decade.[22]

Tables 4, 5 and 6 report the estimated coefficients in Equation (7) for individual funds with normal fund flows (i.e., $\tau = 0.50$), extreme outflows (i.e., $\tau = 0.25$) and extreme inflows (i.e., $\tau = 0.75$) respectively. Apart from the full set of independent variables in estimation, we also consider various combinations of these variables for robustness checks. These estimates are standardised coefficients (or beta coefficients in terms of statistics), meaning that dependent and independent variables are statistically standardised so their means and variances are zero and unity respectively. The advantage of using the standardised coefficients is that the coefficients ignore the variables' scale of units, which makes identification of the relative importance of selected driving factors easier. In other words, the larger the coefficient magnitude, the more the sensitivity of the independent variable to the fund flows will be.

On individual funds with normal fund flows (Table 4), some major findings are presented:

- Except for the excess return of HSI and fund family size, all the factors concerned under column (1) are found statistically significant at a 5% level. In this case, flows to an individual fund are positively correlated with fund flows to global equities and to China, asset allocation to Hong Kong, fund returns, and fund age; but negatively correlated with the fund's change in debt-to-capital ratio, fund return volatility, cash ratio, and fund flows at the previous quarter.
- Comparing all coefficients under columns (1) and (2), the variable of flows to global equities has the largest coefficient in magnitude, followed by the asset allocation to Hong Kong and flows to China. When excluding these variables in estimation, the explanatory power of the specification evaluated by the pseudo R-squared is reduced noticeably from 44% to 23% (see columns (3) and (4)).[23] These reflect the importance of global fund flows for the fund flows in Hong Kong. Other significant fund-specific factors have a small coefficient under all other columns, which may suggest that their impact would be significant only when these factors deteriorate drastically and frequently.

[22] Estimation results based on the sample period from the first quarter of 2001 to the fourth quarter of 2016 are largely consistent with those based on previous years' data. Estimation results will be available upon request.

[23] Pseudo R^2 is calculated by $R^2 = 1 - \sum_{j,t} \varepsilon_{j,t}{}^2 / \sum_{j,t} \left(y_{j,t} - \bar{y}\right)^2$, where ε is the error term and y is the dependent variable

On individual funds with extreme outflows (Table 5), several findings are summarised below:

- Almost all the factors under column (1) are found statistically significant at a 5% level, except for fund age. The estimation results suggest that outflows from an individual fund are significantly associated with (i) outflows from the fund's exposures to global equities and Mainland China; (ii) declines in the fund's asset allocation to Hong Kong, fund return and family size; (iii) increases in the fund's debt-to-capital ratio, fund return volatility, cash ratio and the lagged fund flows; and (iv) a decrease in excess return of HSI.
- The factor of fund flows to global equities has the largest contribution to the fund outflows under column (1). This suggests that funds' investment in Hong Kong would move strongly with the funds' worldwide investment during market downturns. Given this strong co-movement, any shocks from global equities could translate into fire sales in economies in the same portfolio, including Hong Kong. Thus, funds' portfolio rebalancing could be contagious with adverse consequences for funds' investment in Hong Kong.
- Unlike the results for normal fund flows, variables of fund performance (i.e., excess HSI returns and individual fund return) are positively significant under column (1). Their significance remains unchanged when the flows to global equities are excluded (column (3)). These results imply that outflows from a fund tend to be more extreme when the fund's return declines. This is consistent with a conjecture that a fund would adjust its investment in Hong Kong when the fund's investment returns change or crisis strikes, thereby amplifying shocks over Hong Kong and across economies.

On funds with extreme inflows (Table 6), many of the selected variables are found statistically significant at a 5% level. In particular, some key results are discussed:

- The variable of flows to global equities is statistically significant at a 5% level. Importantly, their coefficients are notably larger (e.g., 0.702 for the flows to global equities under column (1)) than those reported under fund outflows. This reflects that the responsiveness to flows to global equities is ceteris paribus stronger during fund inflows than during fund outflows.
- Among variables of financial fundamentals, only the change in debt-to-capital ratio is significant at a 5% level with a negative estimated sign, reflecting that a fund with a lower leverage tend to

have more inflows, regardless of whether the fund has a higher fund return volatility, cash ratio, fund age and fund family size, other things being equal. Most of these variables, however, become significant when the variables of flows to global equities and/or fund returns are removed (see columns 2-4).

4.4 Event studies

In the previous section, we identify that the fund flows triggered by portfolio rebalancing and the pro-cyclical trading behaviour of investors and fund managers, and fund flows to Mainland China have a considerable impact on the fund flows to Hong Kong. We now use the event study methodology to explore how the fund flows to Hong Kong change when these factors change adversely in a time horizon of 10 quarters.

We first define the event for each factor. On the effect of global portfolio rebalancing, we consider an adverse change in fund flows to global equities as the event,

'Event 1: Fund *j*'s flows to global equities (denoted by $X_{j,t}^{1}$) fall below a level of c_1'.

For each Fund j in quarter t, a dummy variable is then defined as:

$$D_{j,t}^{1} = \begin{cases} 1 & \text{when } X_{j,t}^{1} \leq c_1 \\ 0 & \text{otherwise} \end{cases}.$$

Based on the setting, the coefficients $\gamma_{j,-M}, \ldots, \gamma_{j,0}, \ldots, \gamma_{j,N}$ measure the excess amount of fund flows to Hong Kong evolving M quarters before the event and N quarters after the event occurs at quarter 0.

Similarly, we consider adverse changes in fund flows to Mainland China and the fund's return as the remaining two events in this analysis. Specifically, they are:

'Event 2: Fund *j*'s flows to Mainland China (denoted by $X_{j,t}^{2}$) fall below a level of c_2'

and

'Event 3: Fund *j*'s return (denoted by $X_{j,t}^{3}$) fall below a level of c_3'

The dummy variable of each event for each fund j in quarter t is defined as:

$$D_{j,t} = \begin{cases} 1 & \text{when } X_{j,t}^{K} \leq c_K \\ 0 & \text{otherwise} \end{cases}$$

where K = 1,2,3. Assuming considerable and plausible shocks for these factors, the levels of c_1, c_2, c_3 are set to be their lower quantile (i.e, 25th percentile) based on their historical information. During 2001-2016, the 25th percentiles of the three factors are -5.3%, -12.9%, and -3.1% respectively (see Table 1).

Figure 6 displays the cumulative excess fund flows when the selected driving factors are stressed at quarter 0. In other words, assuming that the fund flow is 0% at quarter -4, Figure 6 depicts the cumulative changes to the event quarter (i.e., quarter 0), and to the quarters immediately proceeding until the end of the observation window (i.e., quarter 6). We find significant fund outflows in quarter 0 and the quarters immediately proceeding under Event 1. Over the quarter in which Event 1 occurs, the average outflow is about 10%. Importantly, the downward pattern eventually reverses once the event impact dissipates. However, the reverse trend is slow and over the eight quarters after the event quarter, the cumulative outflow retreats to about 5%. Under events 2 and 3, the outflows are less prominent, with an average outflow of 3- 6%, and the outflows would be fully replenished in eight quarters.

5. Conclusion

This paper identifies potential major factors driving mutual fund flows to Hong Kong equities. We find that flows of mutual funds to Hong Kong equities are strongly determined by flows of the funds to China and global equities and by fund returns. Apart from these factors, funds' fundamentals are mostly significant in the episode of outflows, but only the leverage of funds is found significant in the episode of inflows. Finally, after controlling for all major factors, the excess amount of outflows from Hong Kong appear temporary, however, the recovery process would be slow and take more than eight quarters in extreme cases.

This paper raises two issues that are relevant to the Hong Kong mutual fund industry. First, runs and contagion (particularly spillovers from Mainland China) are possible even in mutual funds invested in liquid assets. Second, given that fund managers and investors tend to buy (sell) securities at a

premium (discount) when prices go up (down) that digress prices away from fundamental values, the investment return by this trading strategy could be severely negative in the long run, increasing the chances of creating asset price booms or busts in Hong Kong. These issues not only underscore the importance of market diversification and hedging strategies for fund managers and investors of mutual funds to avoid international financial contagion, but also draw a possible implication for introducing necessary macro-prudential tools to the non-banking sector in Hong Kong to maintain financial stability in Hong Kong. In light of these findings, the role played by the mutual fund industry should be paid more attention.

There are limitations in this empirical analysis. First, our mutual fund data comes from a single data source that collects survey-based data regularly. The data quality is therefore highly subject to the survey's response rate and the coverage of the overall asset management sector. Another limitation is that our sample may include some types of funds that are particularly illiquid in the sample period. Moreover, the data frequency for country weighting is in general low (quarterly in our case). Thus, empirical results (e.g., whether investment managers and investors are return-chasing or not) may need further robustness checks. Further research is therefore needed for assessing the importance of phenomenon when considering the policy implications of our findings.

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Table 1. Descriptive statistics of open-end funds and other financial variables

Period: 2001-2016	Min	25 Pc	Median	75 Pc	Max	SD	Skewness	N
Flow data								
Flows to Hong Kong (%)	-100	-14.3	2.01	22.6	1999	127	7.7	360,572
Flows to global equities (%)	-100	-5.27	0.61	9.99	1,993	87.7	10.4	360,572
Flows to China (%)	-100	-12.9	4.65	29.0	2,000	140	6.94	360,572
Fund-specific data								
Asset allocation to Hong Kong (%)	-82.74	-0.12	0.00	0.10	71.7	1.65	-11.43	357,779
Fund family size (in log)	12.4	23.5	25.0	26.1	29.5	2.05	-0.52	360,212
Fund return (%)	-64.8	-3.07	1.12	5.33	53.9	7.32	-0.66	360,572
Fund return volatility (%)	0.08	2.62	3.58	4.89	22.4	2.03	1.72	360,572
Fund age (month)	4	35	69	115	1,024	71.88	2.41	360,572
Cash ratio (%)	-97.9	2.05	4.62	9.49	99.9	8.62	2.80	360,572
Change in debt-to-capital ratio (%)	-41.5	-0.25	0.04	0.41	37.7	1.29	3.96	359,866
Financial variables								
Excess return of HSI (%)	-12.3	-4.68	0.08	4.29	27.8	7.20	0.93	64

Sources: Morningstar and Bloomberg.

Table 2. Correlation matrix

	Aggregate fund flows to Hong Kong	Difference in real rate (HK vs. US)	Excess return of HSI	Output gap in Hong Kong	Credit growth in Hong Kong	Change of HK GDP growth	Change of HK real money growth rate	Change in VIX Index	Percentage change in DXY Index	Percentage change in Renminbi spot
Aggregate fund flows to Hong Kong	1.00	0.16	-0.06	-0.11	-0.18	0.04	0.00	-0.15	0.06	0.24
Difference in real rate (HK vs. US)	0.16	1.00	-0.03	-0.01	-0.48	-0.07	-0.01	0.11	-0.12	0.62
Excess return of HSI	-0.06	-0.03	1.00	0.06	0.16	0.03	0.65	-0.30	-0.38	0.18
Output gap in Hong Kong	-0.11	-0.01	0.06	1.00	0.26	0.29	-0.01	-0.11	-0.23	0.19
Credit growth in Hong Kong	-0.18	-0.48	0.16	0.26	1.00	-0.05	0.02	0.09	-0.07	-0.06
Change of HK GDP growth	0.04	-0.07	0.03	0.29	-0.05	1.00	-0.03	0.20	0.09	0.00
Change of HK real money growth rate	0.00	-0.01	0.65	-0.01	0.02	-0.03	1.00	-0.43	-0.25	0.04
Change in VIX Index	-0.15	0.11	-0.30	-0.11	0.09	0.20	-0.43	1.00	0.36	0.00
Percentage change in DXY Index	0.06	-0.12	-0.38	-0.23	-0.07	0.09	-0.25	0.36	1.00	-0.34
Percentage change in Renminbi spot	0.24	0.62	0.18	0.19	-0.06	0.00	0.04	0.00	-0.34	1.00

Table 3. Estimation results of fund flows to Hong Kong on aggregate level specified in Equation (5) (full sample period: 2001-2016)

	Dependent Variable: Aggregate fund flows to Hong Kong			
Independent variable	(1)	(2)	(3)	(4)
Difference in real rate (HK vs. US)	0.016	---	0.013	0.016
Excess return of HSI	0.598	0.538	0.118	0.657
Output gap in Hong Kong	-0.055	-0.051	-0.048	-0.053
Credit growth in Hong Kong	0.850	0.162	0.708	0.860
Change of HK GDP growth	1.396**	1.277*	1.325**	1.376**
Change of HK real money growth rate	-0.008	-0.007	---	-0.008
Change in VIX Index	-0.002	-0.001	0.000	-0.003
Percentage change in DXY Index	-0.345	-0.348	-0.405	---
Percentage change in Renminbi spot	0.035	0.072*	0.046	0.040
Lag of aggregate fund flows to HK	-0.262**	-0.273**	-0.297**	-0.262**
Constant	0.039	0.054	0.045	0.039
Period	62	62	62	62
Adjusted R^2	0.086	0.094	0.086	0.102
Q statistics	6.135	6.390	7.467	5.975

Notes:
(1) '**' denotes a 5% significance level, '*' denotes a 10% significance level. The null hypothesis that the error terms are zero mean.
(2) Q statistics at lag four show that the null hypothesis of zero correlation up to the fourth lag cannot be rejected at 5% significance level in all regression models.

Source: HKMA staff estimate.

Table 4. Estimation results of normal fund flows to Hong Kong specified in Equation (7)

	Dependent Variable: Unexpected flows to Hong Kong (at τ = 0.50)			
Normal fund flows (τ = 0.50)	(1)	(2)	(3)	(4)
Flows to global equities	0.646*	0.646*		
Asset allocation to Hong Kong	0.124*	0.120*		
Flows to China	0.092*	0.124*		
Excess return of HSI	0.000		0.005*	
Fund return	0.045*		0.038*	
Change in debt-to-capital ratio	-0.002*	-0.001	-0.008*	-0.007*
Fund return volatility	-0.011*	-0.007*	-0.015*	-0.017*
Cash ratio	-0.004*	-0.001	0.021*	0.020*
Fund age	0.002*	0.004*	-0.031*	-0.034*
Fund family size	-0.001	0.008*	0.007*	0.014*
Lag dependent variable	-0.021*	-0.022*	-0.011*	-0.012*
Number of securities	18,669	18,669	18,685	18,685
Period	36	36	36	36
N	248,513	248,513	248,624	248,624
Pseudo R^2	0.447	0.446	0.236	0.232

Notes:
(1) '*' denotes a 5% significance level
(2) Pseudo R^2 is calculated by $R^2 = 1 - \frac{\sum_{j,t} {\varepsilon_{j,t}}^2}{\sum_{j,t}\left(y_{j,t}-\bar{y}\right)^2}$, where ε is the error term and y is the dependent variable
(3) The null hypothesis that the error terms are zero mean cannot be rejected under 5% significance level in all regression models.

Source: HKMA staff estimate.

Table 5. Estimation results of extreme outflows to Hong Kong specified in Equation (7)

	Dependent Variable: Unexpected flows to Hong Kong (at τ = 0.25)			
Fund outflows (τ = 0.25)	(1)	(2)	(3)	(4)
Flows to global equities	0.561*	0.558*		
Asset allocation to Hong Kong	0.113*	0.110*		
Flows to China	0.058*	0.060*		
Excess return of HSI	0.004*		0.010*	
Fund return	0.045*		0.041*	
Change in debt-to-capital ratio	-0.005*	-0.005*	-0.010*	-0.010*
Fund return volatility	-0.007*	-0.012*	-0.004	-0.007
Cash ratio	-0.007*	-0.008*	0.016*	0.016*
Fund age	0.002	0.001	-0.016*	-0.019*
Fund family size	0.011*	0.013*	0.015*	0.023*
Lag dependent variable	-0.021*	-0.021*	-0.014*	-0.014*
Number of securities	18,669	18,669	18,685	18,685
Period	36	36	36	36
N	248,513	248,513	248,624	248,624
Pseudo R^2	0.443	0.439	0.237	0.232

Notes:
(1) '*' denotes a 5% significance level
(2) Pseudo R^2 is calculated by $R^2 = 1 - \frac{\sum_{j,t} {\varepsilon_{j,t}}^2}{\sum_{j,t} (y_{j,t} - \bar{y})^2}$, where ε is the error term and y is the dependent variable
(3) The null hypothesis that the error terms are zero mean cannot be rejected under 5% significance level in all regression models.

Source: HKMA staff estimate.

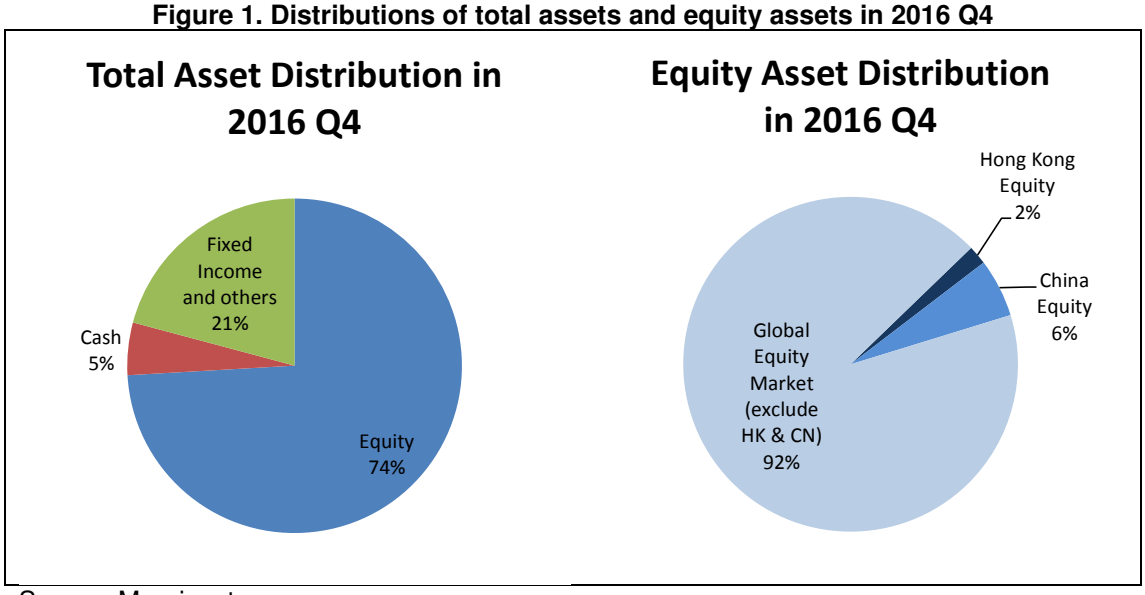
Table 6. Estimation results of extreme inflows to Hong Kong specified in Equation (7)

	Dependent Variable: Unexpected flows to Hong Kong (at τ = 0.75)			
Fund inflows (τ = 0.75)	(1)	(2)	(3)	(4)
Flows to global equities	0.702*	0.695*		
Asset allocation to Hong Kong	0.127*	0.115*		
Flows to China	0.185*	0.191*		
Excess return of HSI	0.008*		0.009*	
Fund return	0.042*		0.035*	
Change in debt-to-capital ratio	-0.003*	-0.003*	-0.011*	-0.011*
Fund return volatility	0.016	-0.015*	-0.014*	-0.016*
Cash ratio	0.001	0.001	0.040*	0.038*
Fund age	0.003	0.013*	-0.059*	-0.057*
Fund family size	0.001	-0.017*	0.012	0.006
Lag dependent variable	-0.022*	-0.023*	-0.008*	-0.008*
Number of securities	18,669	18,669	18,685	18,685
Period	36	36	36	36
N	248,513	248,513	248,624	248,624
Pseudo R^2	0.448	0.446	0.237	0.232

Notes:
(1) '*' denotes a 5% significance level
(2) Pseudo R^2 is calculated by $R^2 = 1 - \frac{\sum_{j,t} \varepsilon_{j,t}{}^2}{\sum_{j,t} (y_{j,t} - \bar{y})^2}$, where ε is the error term and y is the dependent variable
(3) The null hypothesis that the error terms are zero mean cannot be rejected under 5% significance level in all regression models.

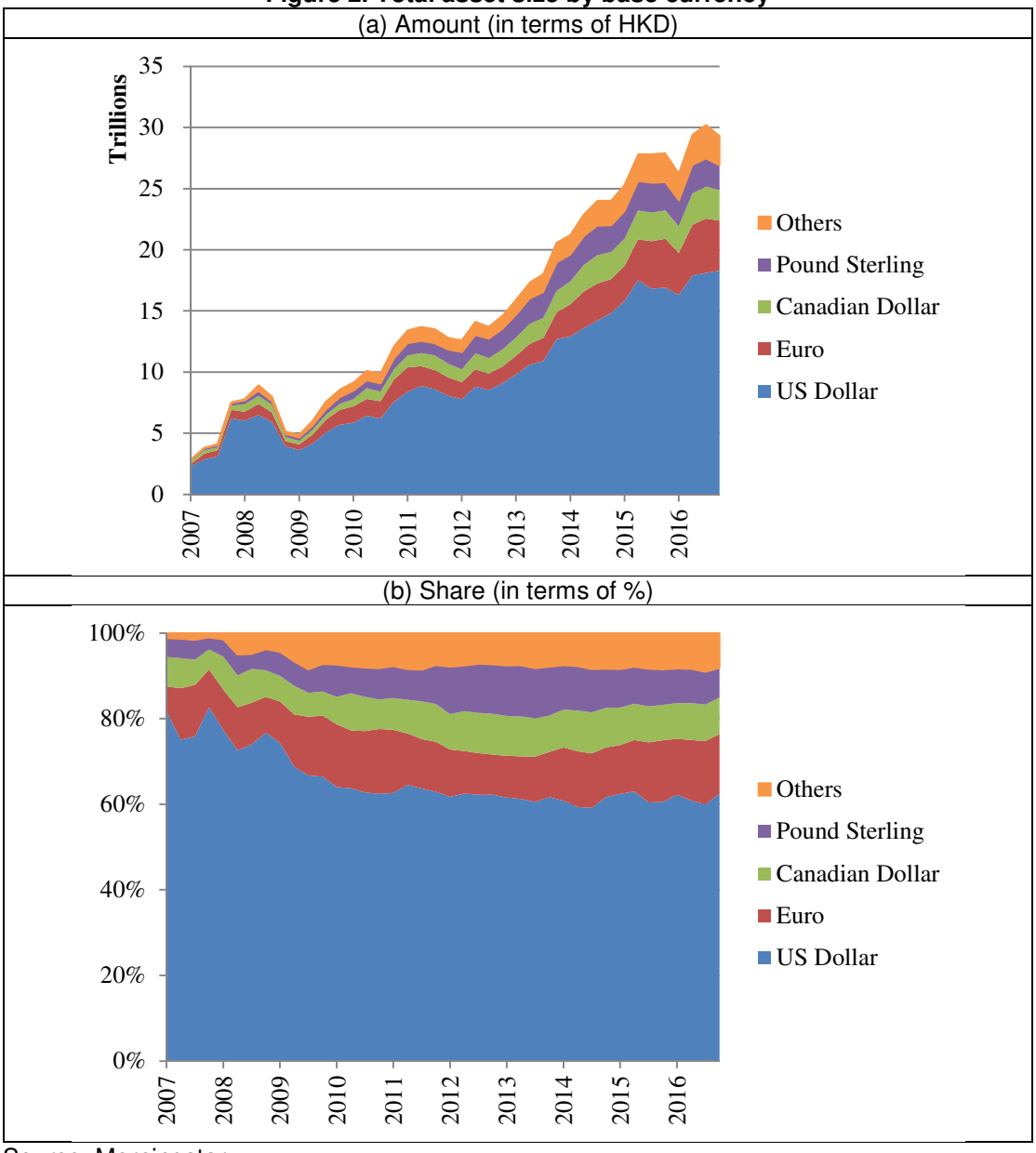
Source: HKMA staff estimate.

Figure 1. Distributions of total assets and equity assets in 2016 Q4



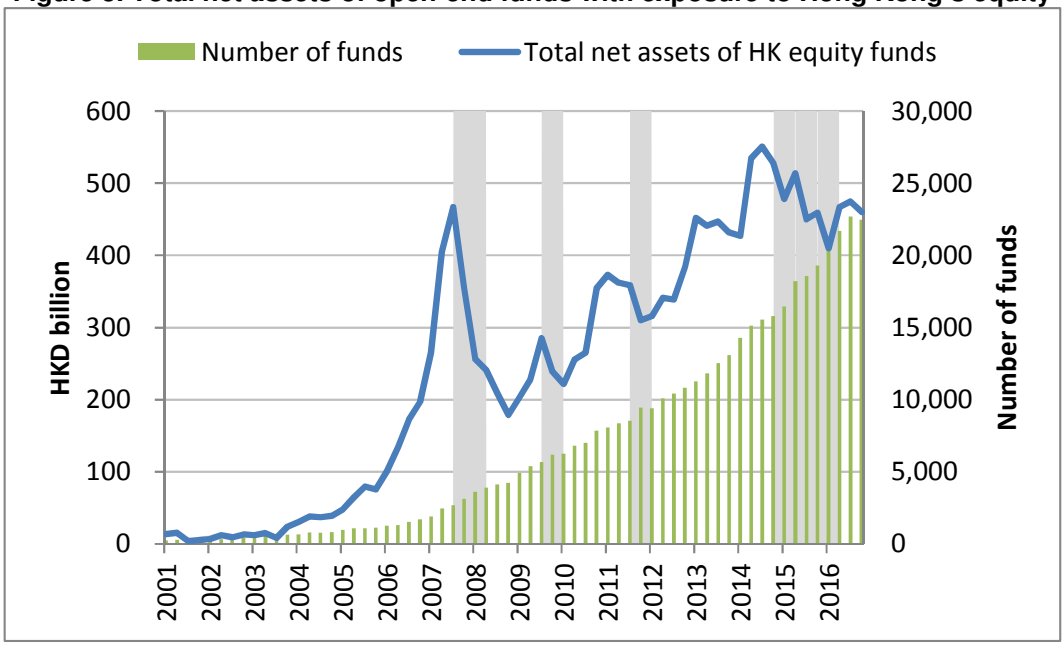
Source: Morningstar.

Figure 2. Total asset size by base currency



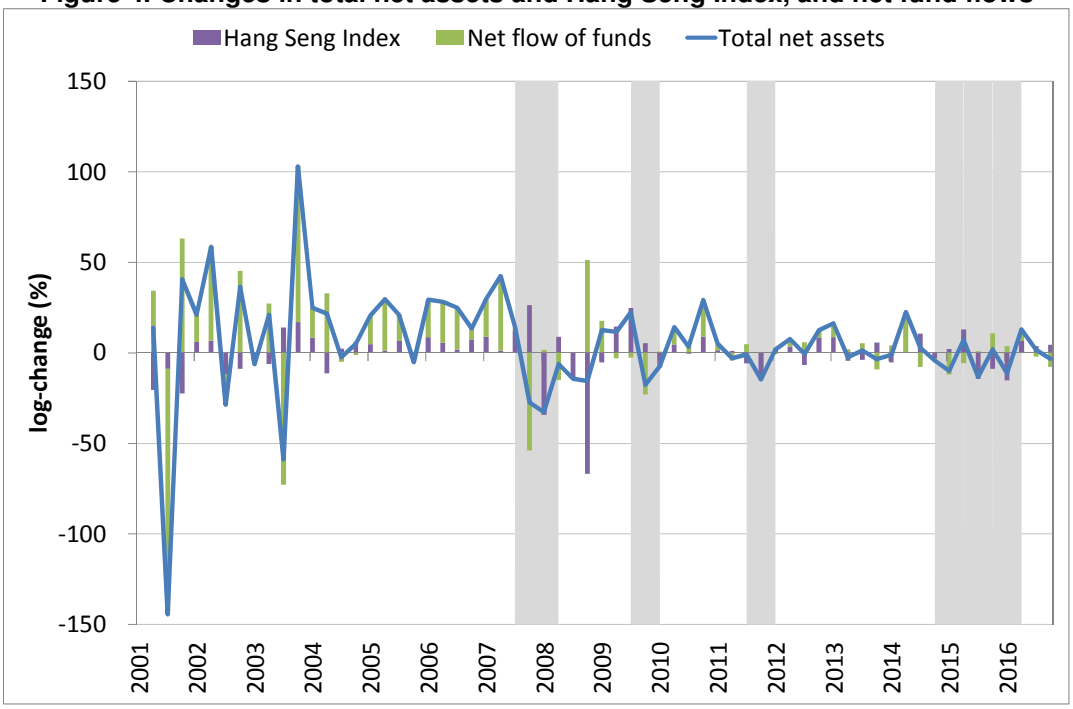
Source: Morningstar.

Figure 3. Total net assets of open-end funds with exposure to Hong Kong's equity



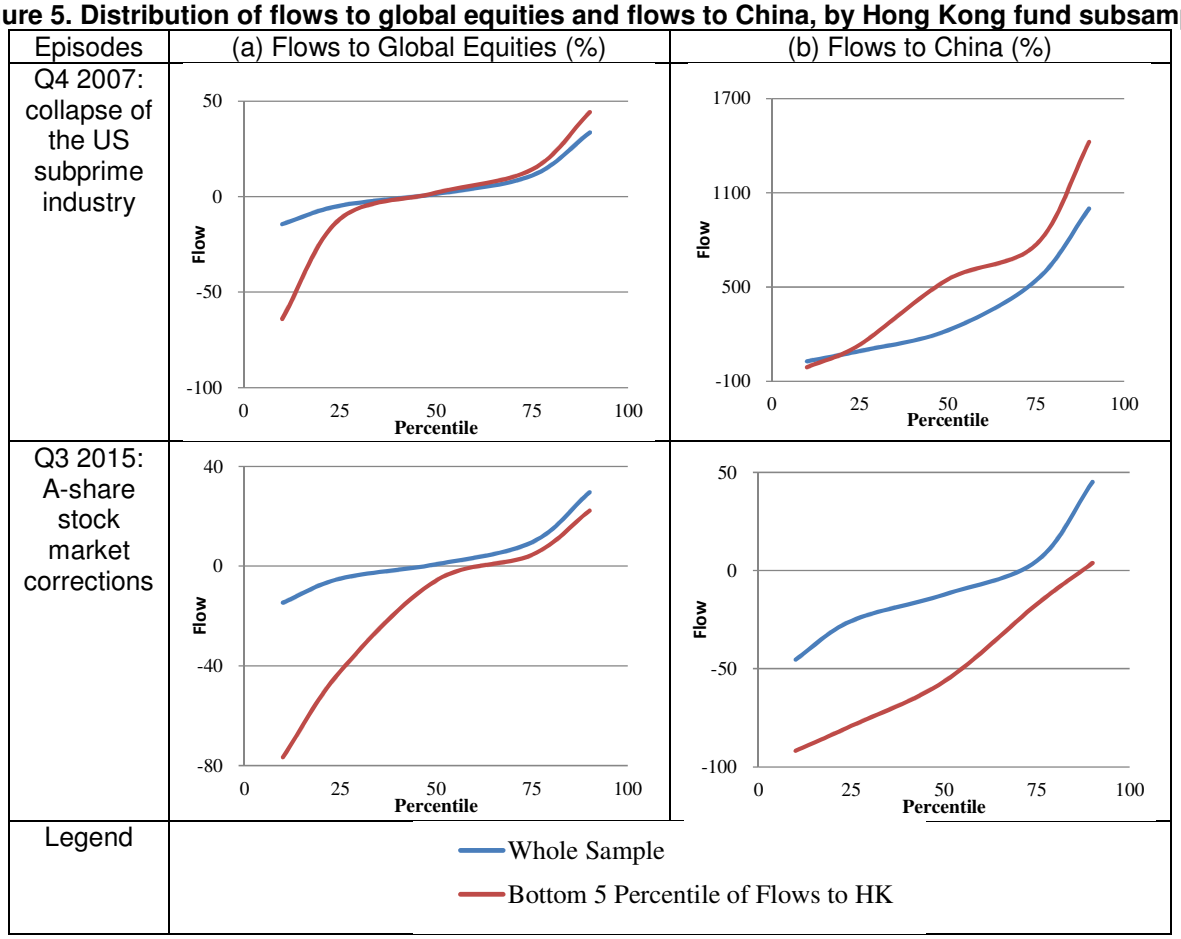
Source: Morningstar.

Figure 4. Changes in total net assets and Hang Seng Index, and net fund flows



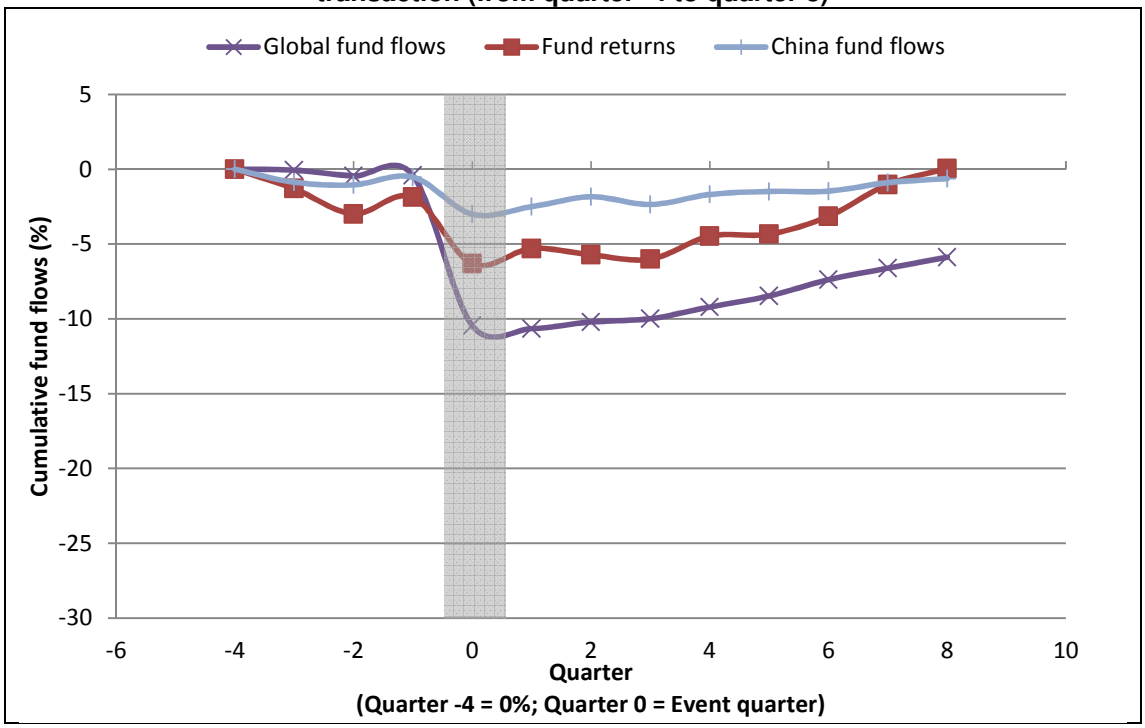
Sources: Morningstar and Bloomberg.

Figure 5. Distribution of flows to global equities and flows to China, by Hong Kong fund subsample



Source: Morningstar and HKMA staff estimate.

Figure 6. Cumulative average fund flows around various types of mutual fund stock transaction (from quarter -4 to quarter 8)



Source: HKMA staff estimate.

Annex

Table A1. Variable definitions, rationales and expected signs

Variable	Definition	Economic rationale of the coefficient sign	Exp.sign
Dependent Variable			
Fund flows to HK	The percentage change in the fund's TNA that invested in Hong Kong equity market, net of return of Hong Kong equity market or specifically: $TNA_{j,t}^{HK} = TNA_{j,t} \times W_{j,t}^{HK}$ and $flow_{j,t} = \frac{TNA_{j,t}^{HK} / TNA_{j,t-1}^{HK}}{1 + r_t} - 1$		
Macroeconomic variable			
Difference in real rate (HK vs. US)	Real rate in HK - Real rate in US Real rate in HK: 3-month Hong Kong Interbank Offer Rate (HIBOR) - inflation rate in Hong Kong Real rate in US: 3-month London Interbank Offered Rate (LIBOR) - inflation rate in US	To test whether the difference between real rate in Hong Kong and real rate in US has any impact to Hong Kong flows. Higher rate differential represents increased opportunity cost of investment in Hong Kong.	-
Excess return of HSI	Excess return of HSI: Difference between return of Hang Seng Index and return of the MSCI World Index	To test whether investors and fund managers are return-chasing or not. When excess return are contemporaneously correlated with the fund flows, sharp performance of Hong Kong Stock market may stimulate investors' incentiveness to buy Hong Kong equities.	+
Output gap in Hong Kong	Output gap is measured by the difference between actual gross domestic product (GDP) and potential GDP scaled by potential GDP	To test whether output gap in Hong Kong has any influence on Hong Kong fund flows.	+
Credit growth in Hong Kong	Quarterly percentage changes in total loans and advances in Hong Kong	To test whether credit growth in Hong Kong entices investors to seek more risky investment positions.	+
Change Hong Kong GDP growth rate	Difference in quarterly growth rate of GDP in Hong Kong	To test whether local business cycle has any influence on investors fund allocation decisions.	+
Change Hong Kong real money growth rate	Difference in M2 growth rate and inflation rate in Hong Kong	To test the impact of Hong Kong real money growth rate on Hong Kong fund flows.	+
Change in VIX index	CBOE volatility index, implied volatility of S&P 500 index options over the next 30 day period	VIX Index represents the market sentiment. High volatility should discourage investment on mutual funds.	-
Percentage change in DXY Index	The US Dollar Index indicates the general international value of the US dollar. Positive value means dollar appreciation.	As Hong Kong dollar is pegged with USD due to LERs, the dollar weakness/strength has direct impact on the fund flows from the rest of the world. Appreciation of US dollar is expected to correlate with more aggregate mutual fund inflows to Hong Kong. On the other hand, portfolio rebalancing channel implies investors from non-dollar jurisdictions may repatriate dollar equity wealth after its appreciation.	+/-
Percentage change in Renminbi Spot	Two steps are involved: (1) Find the percentage change in the Renminbi spot exchange rate versus US dollar; (2) Since the percentage change in the Renminbi spot may be partly driven by the percentage change in the DXY index, we use the residual extracted from a least square regression model of the percentage	Depreciation in Renminbi may trigger investment interest of Chinese investors' to global non-CNY funds. As Chinese investors are more familiar with the Hong Kong market, it is expected that they will have more interest on funds with Hong Kong exposures.	+

	change in the Renminbi spot on the percentage change in the DXY Index to control for this effect. Positive value means Renminbi depreciation.		
Fund-specific factors			
Fund flows to global equities	Percentage changes in the fund's TNA net of fund's return or specifically: $TNA_{j,t}^{Global\ equity} = TNA_{j,t} \times W_{j,t}^{Global\ equity}$ and $flow_{j,t}^{Global\ equity} = \frac{TNA_{j,t}^{Global\ equity} / TNA_{j,t-1}^{Global\ equity}}{1+r_t} - 1$	To test whether global portfolio rebalancing at the fund level impacts the flows to Hong Kong. Since flows to each jurisdiction due to fund injection or liquidation largely follows fund's global asset allocation strategy, global portfolio rebalancing could be regarded "contagious" and could have adverse consequences for countries in the same portfolio in times of crisis.	+
Fund flows to China (with the "flows to global equities" being controlled for)	Two steps are involved: (1) The percentage change in the fund's TNA that invested in China equity market, net of return of China equity market, or specifically: $TNA_{j,t}^{CN} = TNA_{j,t} \times W_{j,t}^{CN}$ and $flow_{j,t}^{CN} = \frac{TNA_{j,t}^{CN} / TNA_{j,t-1}^{CN}}{1+r_t} - 1$ (2) Since the flows to China may be partly driven by the flows to global equities, we use the residual extracted from a pooled least square regression model of the flows to China on the flows to global equities to control for this effect. The final variable is measured by "res_flow" in the following specification: $flow_{j,t}^{CN} = \alpha + \beta * flow_{j,t}^{Global\ equity} + res\_flow_{j,t}^{CN}$	To check whether fund flows to Hong Kong and to China move closely together due to high integration between Hong Kong and China equity markets. Their co-movement can be explained by two reasons. First, many Hong Kong listed companies have already had substantial Mainland exposures over the past decades during which the China has successfully liberalised its financial markets. Second, as seen in the Chinese stock market corrections in 2015/2016, the fund managers sold Hong Kong stocks as a proxy hedging when the trading of many stocks in China were suspended.	+
Asset allocation to Hong Kong	Net change in portfolio weighting of Hong Kong stock market (i.e., $\Delta W_{j,t}^{HK}$)	To test whether global portfolio rebalancing at the fund level impacts the flows to Hong Kong, similar to considerations for the variable of flows to global equities. As the fund flows to Hong Kong depends on Hong Kong's weighting in the fund's portfolio, the larger the weight, the more the fund managers would invest in Hong Kong equity market.	+
Fund family size	Sum up all the funds under the same company identified by fund's firm name identification number in the database	Large family funds could benefit from economies of scale, but trade larger volumes of stock which attracts the attention of other market participants and therefore suffers higher price impact costs.	+/-
Fund return volatility	Standard deviation of the monthly returns of the fund over the past year	Risk-averse investors tend to avoid funds with volatile prices.	-
Fund age (month)	The duration that the fund has survived since its inception date	It provides a measure of a fund's longevity and its manager's ability. On one hand, younger mutual funds would be more agile and committed to achieve better performance to survive, but on the other hand, younger funds could face higher costs and suffer from lack of experience during the start-up period.	+/-

Cash ratio	The percentage of the fund's assets in cash	A fund's cash may play the role of reserve to satisfy the investors' demand for redemption on the one hand. On the other hand, more cash means the fund invests less in other financial instruments and reduces the fund's potential return in long term, resulting in a higher opportunity cost for the fund.	+/-
Change in Debt-to-capital ratio	It is calculated by the net change in long-term debt (excluding other liabilities) divided by total capitalisation (the sum of common equity plus preferred equity plus long-term debt)	It measures a fund's financial leverage. Other things being equal, the higher the debt-to-capital ratio, the higher the firm's financial leverage, so the more vulnerable the fund.	-