CONTEMPORARY ECONOMIC POLICY

DOES THE RIGHT TO CHOOSE MATTER FOR DEFINED CONTRIBUTION PLANS?

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We find that sensitivity of fund flows and fund performance are both related to participants' right to choose their investments in defined contribution plans. Under the Mandatory Provident Fund system of Hong Kong, both employers and employees are required to contribute to a retirement account. Originally, employees' investment choices were restricted to a subset of funds chosen by their employers. The system was later modified so that employees are allowed to invest in any fund within the system. We present evidence that flows of fund have become more sensitive to past fund performance after this policy change, and that average fund performance in the system has also improved. Based on the improvement in fund performance, we estimate the accumulated cost of the lack of choice to be around 10% of the current total asset value of the system. (*JEL* G14, G18)

I. INTRODUCTION

Defined contribution plans are one of the main components of retirement systems (World Bank 1994). For a retirement system to be effective in providing support to retirees, it is crucial to understand how the design of the defined contribution plan is related to its performance. In this paper, we study one aspect of this relationship.

Similar to the 401(k) plans in the United States, the original design of the Mandatory Provident Fund (MPF) system in Hong Kong requires participants to choose their investment in a two-stage process. In the first stage, employers select defined contribution plans. Then, participants (i.e., the employees) invest their contributions to funds provided by the plans chosen by their employers. In response to the long-standing criticism on the unsatisfactory performance of the MPF system, a regulatory reform called the Employee Choice Arrangement (ECA) was implemented in 2012. Under the ECA, participants' right to choose investment is expanded from funds in the employers' chosen plans to any defined contribution plans available in the system. This policy change provides a unique opportunity to study the effect of an expansion of participants' right to choose investment on the performance of defined contribution plans.

One way participants' right to choose could improve performance is that participants are able to "vote with their feet." Studies on participants' fund choice in the defined contribution plans, however, suggest that the investment choice of participants could be sticky.[1] For example, Choi et al. (2002) find that participants seldom opt out of the default investment funds chosen by their employers even when they are given the right to do so. If participants do not vote with their feet to invest their savings in funds with better performance, it is unlikely that participants' right

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1. For other examples, see Benartzi and Thaler (2001), Madrian and Shea (2001), Agnew, Balduzzi, and Sunden (2003), Duflo and Saez (2003), Carroll et al. (2009), and Dahlquist and Martinez (2013).

ABBREVIATIONS

CAPM: Capital Asset Pricing Model
ECA: Employee Choice Arrangement
MPF: Mandatory Provident Fund
MPFA: Mandatory Provident Fund Schemes Authority

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to choose could provide sufficient incentive for investment managers to compete on performance. To shed light on this, we study the change in sensitivity of fund flows in the MPF system to performance when participants are given greater autonomy to make investment decision.

Does competition lead to better performance in the mutual funds? Using the number of funds and the concentration index as proxies of competition intensity, Keswani and Stolin (2006) find that fund performance is less persistent in more competitive sectors.[2] Del Guercio and Reuter (2014), on the other hand, study how investment managers behave under different rules of competition, using the fact that different clienteles of funds are being sold directly to retailers and indirectly through brokers. Investors in the broker-sold segment are looking for other services rather than performance. They show that the funds in the direct-sold segment report significant higher alphas than funds in the broker-sold segment. Similarly, Massa (2003) shows that the more a fund is perceived by investors as a differentiated product, the less incentive there is for its manager to generate performance. Gaspar, Massa, and Matos (2006) suggest another reason for the underperformance of funds in a sector where performance is a less important criterion of competition. They find that fund management companies strategically transfer performance from "high-value" member funds to "low-value" member funds. The performance of funds in a sector where performance is a less important criterion is obviously less "valuable" than in a sector where performance is valued more.

These studies on the relationship between how investment managers compete and fund performance may help us understand the influence of the ECA on the performance of funds in the MPF system. Before the implementation of the ECA, employers were given priority in the investment process: they chose the fund providers, and their employees were largely "stuck" with that choice. This results in a weak incentive for the fund providers to compete on performance. The implementation of the ECA, on the other hand, gives greater autonomy to employees to choose their investment funds and makes performance a more important competition criterion.

This paper has two contributions. First, literature on defined contribution plans suggests that fund flows in these plans are sticky. Since policy changes like the ECA are rare, the effect of greater flexibility to choose on the sensitivity of fund flows remains unexplored. We make use of the unique opportunity of a policy change in Hong Kong to shed light on this question. Second, studies on the relationship between competition and fund performance usually need proxies for the intensity of competition. These proxies could be nevertheless subject to noise. In contrast, the ECA provides a natural experiment to investigate how fund performance changes when competition is introduced exogenously.

The paper is organized as follows. In Section II, we describe the main features of the MPF system. In particular, we explain how its two-stage investment process has largely reduced the incentive for managers to produce performance. Sources of data are described in Section III. We investigate the effect of the ECA on the performance-sensitivity of fund flows in Section IV. In Section V, we directly examine the fund performance in the pre- and post-ECA period. A simple model is offered in Section VI to explain these empirical findings. In Section VII, we conclude with an estimate for the cost of limiting participants' right to choose investment funds in the pre-ECA period.

II. BACKGROUND

A. The Mandatory Provident Fund System in Hong Kong

The MPF system of Hong Kong was launched in late 2000 as a policy response to the aging population. In 2014, the value of assets in the MPF system reached US$72 billion, which was about 6% of the assets managed by the retail funds in Hong Kong. Though the size of the MPF system is still relatively small compared to that of the retail funds, it has been growing rapidly at an annual rate of 18% over the past 10 years.

Similar to the 401(k) plans in the United States, the MPF system is a defined contribution plan managed by the private sector. In Hong Kong, MPF schemes are mainly operated by scheme sponsors that offer bundled arrangements of trustee, administrative, and investment services. Even though the trustees are regulated by the Mandatory Provident Fund Schemes

2. In contrast, Wahal and Wang (2011) find a negative relationship between competition and fund performance using overlap in stock held as the proxy for competition intensity. They use the overlap of underlying stocks between funds as the proxy of competition. Higher overlap means more competition of funds in investing in the underlying stocks (the inputs), leading to lower performance of these funds.

Authority (MPFA) and are required "to exercise its fiduciary duty in operating MPF schemes in the interest of scheme members,"[3] sponsors play the major role of designing the investment menus and setting fees for MPF schemes (Ernst and Young 2012). Nevertheless, a majority of trustees and sponsors belong to the same corporations.

Investment management of the constituent funds (i.e., funds available under the MPF schemes) is delegated to investment managers. In return, the investment managers and other service providers (including trustees and custodian) are compensated with fees as fixed percentages of the scheme or fund assets. The compensation is either stipulated separately for the trustees, administrators, and investment managers, or it is reported as a single management fee without specifying the allocations. Investment managers of funds under the MPF system are therefore, as their counterparts in 401(k) plans, incentivized to perform and generate performance-sensitive fund flows.

B. Participants' Right to Choose and Competition on Performance

Before the policy change in November 2012, the investment choice follows a two-stage process.[4] In the first stage, employers select from the available MPF schemes. Then, participants invest their contributions to funds provided by the schemes chosen by their employers. Participants' lack of right to choose in the first stage is a potential reason for insufficient competition on performance in the MPF system (Ernst and Young 2012). This argument notwithstanding, are there other mechanisms in the two-stage process that motivate service providers to perform?

First, employers may have an incentive to choose high-performing schemes for the employees. This would surely encourage sponsors to include high-performing funds and in turn, motivate the funds to perform. In Hong Kong, employers rarely sponsor their own schemes. The majority of employers choose MPF schemes that are sponsored by banks, insurance companies, and mutual fund families.[5] Instead of choosing schemes best serving the interest of the scheme participants, however, studies on the 401(k) plans in the United States suggest that employers could obtain *quid pro quo* directly from their choices of schemes. For example, Cohen and Schmidt (2009) find that family trustees significantly overweight and are reluctant to sell their 401(k) client firm's stock. Cvijanovic, Dasgupta and Zachariadis (2016) also find that service providers are more likely to vote with the management of their 401(k) clients.

Second, scheme participants' right to choose constituent funds in the second stage may still motivate funds to compete on performance, especially if high-performing funds are added and low-performing ones are removed regularly from the investment menu. In the MPF system, the average number of funds provided by a scheme is around 14 and two-thirds of schemes have funds managed by more than one investment manager. Similar to the United States, however, a large share of funds and fund assets are managed by investment managers affiliated with the scheme sponsors (which are called affiliated funds). As of October 2012, around 60% of funds and 63% of fund assets in each MPF scheme are affiliated funds. Pool, Sialm, and Stefanescu (2016) find that in the United States these affiliated funds are less likely to be added or removed based on their investment performance. This persistence, in turn, results in poor investment performance of these affiliated funds as documented in Doellman and Sardarli (2016). The prominence of affiliated funds in the investment menu and the "distorted" preference of the sponsors to keep these funds on the list suggest that the incentive for funds to

3. From the website of the MPFA, http://www.mpfa.org.hk/engm/mpf_system/system_features/service_providers/index.jsp.

4. There are only two exceptions where participants have the right to select the MPF schemes by themselves before the launch of ECA. First, self-employed persons are allowed to select the MPF schemes for themselves. However, they represent a relatively small proportion of total participants in the system, which is about 8%. Second, when employees change their employment, they are allowed to transfer their savings accumulated in the previous employments to any other scheme as "personal account." Indeed, shortly after a 6-year implementation of MPF system, each participant has one "personal account" on average in 2006. This investment flexibility, however, does not apply to their contributions from the current employments which are still required to be allocated among the funds in the schemes chosen by their employers. The ever increasing number of "personal accounts" may also imply that participants pay less attention with the savings accumulated in previous employment. As of 31 March, 2015, the average number of personal accounts per participant is almost two.

5. The only employer-sponsored scheme in the MPF is sponsored by Sun Hung Kai Property, a listed real estate giant in Hong Kong. Employer-sponsored schemes and the Master Trust schemes (i.e., schemes sponsored by non-employer financial institutions), except for different membership restrictions, are essentially the same. Only employees of the sponsoring employer are eligible to join the employer-sponsored schemes.

compete on performance in the second stage is also rather weak.

Therefore, it appears that mechanisms other than the participants' right to choose schemes are not likely to lead to performance-sensitive fund flows. Furthermore, employees and employers in Hong Kong are legally required to make mandatory contributions to the MPF system, meaning that participants do not even have the right to opt out and threaten to sell poor performing funds.[6]

C. The Employee Choice Arrangement

The ECA was first proposed in 2008 and finally implemented in November 2012. Its aim is to encourage investment managers to perform by giving participants more flexibility to choose funds under any MPF scheme. Under the new policy, once every year employees may choose to transfer their savings accumulated in the scheme chosen by the current employers to any other schemes in the MPF system. This greatly expands the fund choice from a subset in a certain scheme to the universe of funds in over 30 schemes. In particular, the number of available funds increases from about 10 to 300, and the number of available investment managers increases from about 3 to over 20.

While the policy change is drastic, its effect on the MPF system may be weak due to three reasons. First, participants could be passive and simply keep their investment to the original scheme chosen by their employers. This tendency could be strong since participants' choice of schemes is only in effect for one year. That is, employees have to actively transfer their accumulated savings to their preferred schemes every year, or the new savings will be invested into the schemes originally chosen by their employers. Second, the participants' behavior documented in Agnew and Szykman (2005) suggests that greater number of investment options may not lead to more performance-sensitive fund flows due to information overload. Third, participants are only allowed to transfer their contributions, and the part of savings contributed by their employers is still required to stay in the scheme chosen by the employers.

Theoretically, it is unclear whether participants' greater autonomy to choose investment in the defined contribution plans affects the performance sensitivity of fund flows and performance of the plans. We are providing empirical evidence in support of such effects in this paper.

III. DATA DESCRIPTION

The data used in our analysis mainly comes from two sources and their summary statistics are given in Table 1.[7] Monthly returns, total expense ratios of funds and investment objectives are obtained from Datastream. The dataset covers 263 mutual funds in the retail sector and 698 constituent funds in the MPF system. Monthly returns are available from December 2000 (the launch date of the MPF system) to November 2014. Total expense ratios of funds are not available until 2005.

We obtain the data on size and age for funds in the MPF system from the monthly report of MPFA. This dataset only covers the period from September 2007 to September 2014. Even though the MPFA report is prepared monthly, nearly all the scheme administrators update their fund size only every 6 months. To ensure comparability across schemes with different updating frequencies and facilitate interpretation, fund flows computed from the fund size between two updating dates are standardized to monthly flows using compounding average. To estimate the fund alphas in the four-factor model for performance evaluation, we obtain the monthly returns for the four-factor portfolios in the global market, European market, Japanese market, Asia Pacific market (excluding Japan), and the North American market from the Fama–French data library.[8]

IV. PERFORMANCE SENSITIVITY OF FUND FLOWS

One of the major objectives of ECA, as emphasized by the MPFA, is to improve fund performance by giving greater autonomy of fund

6. All employees and self-employed persons aged 18 to 64 are covered by, and must participate in, the system. Both the employee and employer are required to regularly contribute 5% of the income to an MPF scheme. Originally, income beyond HK$20,000 is exempted, and persons earning below HK$4,000 are also not required to contribute. Since then the two limits have been gradually increased to HK$30,000 and HK$7,100 respectively.

7. To answer the research questions in this paper, it would be ideal to have fund flows data from the retail sector and transaction history of individual participants' of the MPF system. Since such data are either confidential or require substantial financial cost to obtain, we are not able to provide more powerful tests in this paper.

8. http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

TABLE 1
Summary Statistics

	Whole Period	Pre-ECA	Post-ECA
MPFA reports (from Sep 2007 to Sep 2014)			
Monthly Return (in %)	0.26	0.30	0.18
Fund Flows (in USD million)	1.12	1.06	1.21
Fund Flows (in % of Fund Size)	5.52	5.10	6.18
Fund Size (in USD million)	120.20	110.79	136.87
Age (in years)	7.49	6.96	8.44
Total Expense Ratio (in %)	1.78	1.85	1.67
Volatility (in %)	3.83	4.31	3.09
Scheme Size (in USD million)	1465.90	1186.71	1974.13
Number of Sponsors	22	22	22
Number of Schemes	38	38	38
Number of Funds	530	492	519
Bond Funds	49	38	49
Equity Funds	227	211	227
Mixed Assets	131	126	131
Others	123	117	112
Datastream data for funds in 5 equity markets(from Dec 2000 to Nov 2014)			
Funds in MPF system			
Monthly Return	0.52	0.42	0.90
Total Expense Ratio	1.94	2.01	1.77
Number of Funds	134	128	134
Funds in retail sector			
Monthly Return	0.69	0.59	0.95
Total Expense Ratio	0.99	1.03	0.91
Number of Funds	89	67	89

choice to the participants. As mentioned in the introduction, however, previous studies on the defined contribution pension plans suggest that the investment choice of participants could be sticky. If the ECA does not have any effects on the stickiness of participants' fund choice, it is unlikely that the expanded set of fund choice could create any significant incentive to perform in the MPF system.

To investigate whether participants make use of the greater autonomy provided by the ECA, we consider the regression

$$FF_{i,t} = \alpha + \beta_1 FF_{i,t-1} + \beta_2 Performance_{i,t-1} + \boldsymbol{\gamma}\mathbf{X_t} + \varepsilon_{i,t}$$

where $\mathbf{X_t}$ is a list of control variables that includes log fund size, log age of fund, total expense ratio, volatility, scheme size, dummies for investment objectives, service providers, and year effects. The fund flows of fund i at time t, $FF_{i,t}$, is defined as the difference between the fund assets at time t less the product of assets in the last reporting period, including the fund's return during that period. Following the literature, percentage fund flows is defined as the fund flows divided by the fund's assets at the last period used. The performance sensitivity of fund flows is captured by β_2 after controlling for the lagged fund flows and other lagged fund characteristics such as the logarithm of fund size, total expense ratio, volatility of monthly returns, and the logarithm of the size of the scheme which the fund belongs to.

Fund performance is measured in two ways using the monthly return of the fund from $t-1$ to $t-12$. First, we compute the fund relative return as the fund return minus the average return of all funds with the same investment objective. We then estimate the sensitivity of fund flows to a change (in percentage point) of the fund's relative return. Second, we use the performance percentile rank of the fund across all funds with the same investment objective as the performance measure. Funds in the worst performance percentile of a category have a rank of 1 while funds in the best performance percentile have the rank of 100.

As seen in Table 2, results from the two different performance measures are highly consistent. In the pre-ECA period, coefficients of both measures of fund performance are small, having the wrong sign, and statistically insignificant. The results suggest that even though participants could transfer their accumulated savings across funds within the scheme chosen by their employers, better performing funds are not rewarded with greater fund flows. This finding is consistent with the limited choice of investment managers in the same scheme, which makes transfer of assets between funds within a scheme unattractive.

Regression results for relative return suggest that an increase in one percentage point in fund performance (relative to other funds with same objective) increases the monthly fund flows by one percentage point in the post-ECA period. With an average monthly fund flow of 6% during the sample period, this estimate implies that a fund could increase its percentage flow by 4% by improving its monthly return by one standard deviation (i.e., 0.23%). The result in the fourth column suggests that a 10-percentile increase in fund performance rank increases the monthly fund flows by 1% (or 0.06 percentage point).

It is possible that the performance sensitivity of fund flows is nonlinear, so we add to the regression interaction terms of the relative return and the performance percentile dummies (the top 20%, the bottom 20%, and the rest) among all funds with the same objectives. The results in Table 3, again, support the conclusion

TABLE 2
Performance Sensitivity of Fund Flows

	Relative Return		Performance Percentile	
	Pre-ECA	**Post-ECA**	**Pre-ECA**	**Post-ECA**
Performance	−0.043 (0.127)	0.997*** (0.316)	0.001 (0.002)	0.006** (0.003)
$Flow_{t-1}$	0.083 (0.058)	0.108** (0.043)	0.084 (0.058)	0.105** (0.043)
Log Fund Size	−0.227*** (0.082)	−0.337*** (0.114)	−0.277*** (0.082)	−0.341*** (0.114)
Log Age	−2.273*** (0.400)	−2.743*** (0.308)	−2.267*** (0.400)	−2.750*** (0.307)
Total Expense Ratio	−0.732*** (0.225)	−0.849*** (0.221)	−0.712*** (0.223)	−0.852*** (0.222)
Volatility	0.066*** (0.018)	0.008 (0.049)	0.066*** (0.018)	−0.001 (0.048)
Log Scheme Size	0.211* (0.115)	0.366*** (0.104)	0.216* (0.115)	0.368*** (0.108)
Observations	1,312	990	1,306	979
Adjusted R^2	0.374	0.549	0.371	0.544

Notes: Dummies for the investment objectives obtained from Datastream, scheme service providers, and year effect are included in the regression but estimates are not reported for brevity. Standard errors in the parentheses are adjusted for clustering at the fund level.
*, **, and *** denote estimates that are significant at 10%, 5%, and 1%, respectively.

TABLE 3
Nonlinearities in Performance Sensitivity of Fund Flows

	Relative Return		Performance Percentile	
	Pre-ECA	**Post-ECA**	**Pre-ECA**	**Post-ECA**
Top 20% * Performance	−0.004 (0.221)	1.110** (0.548)	0.001 (0.002)	0.006** (0.003)
Middle * Performance	0.162 (0.212)	0.576 (0.388)	0.007 (0.012)	0.008* (0.004)
Bottom 20% * Performance	0.023 (0.195)	1.238* (0.709)	0.005 (0.004)	0.012 (0.021)
Observations	1,306	979	1,306	979
Adjusted R^2	0.370	0.544	0.372	0.542

Notes: Dummies for the investment objectives obtained from Datastream, scheme service providers, and year effect are included in the regression but estimates are not reported for brevity. Other control variables follow the specification in Table 1. Standard errors in the parentheses are adjusted for clustering at the fund level.
*, **, and *** denote estimates that are significant at 10%, 5%, and 1%, respectively.

that the fund flows are more sensitive to performance in the post-ECA period. The nonlinearity of performance sensitivity in that period, however, is less conclusive. The regression estimated with the relative return shows higher sensitivities in the high and low performance groups, both economically and statistically. The regression using performance percentile, on the other hand, shows mixed results. The estimated coefficient of the performance is greater in the bottom percentile but not statistically significant. The sensitivities of fund flows in the high and middle performance groups are more significant with smaller coefficients.

Our results show that fund flows are more sensitive to fund performance after the launch of ECA. However, we are unable to tell whether such change in performance sensitivity of fund flows is a result of the flexibility of participants to transfer their accumulated savings across schemes as allowed by the ECA. The best way to answer this question is to investigate the sources of fund flows, studying whether the new fund flows are transferred from other funds in the same scheme or other schemes. Unfortunately, such data are not available to us. Alternatively, some indirect evidence can be obtained from the estimation of performance sensitivity of the total flows to the scheme (i.e., scheme flows). Given that the performance sensitivity of fund flows is a result of transfer of assets from other schemes, performance sensitivity of fund flows should exist at both individual fund as well as scheme levels.

Hence we run a regression similar to the previous one for scheme flows. Total flows to a scheme are computed by aggregating the flow of all funds of a specific scheme. As usual, we include the lagged scheme flows and a set of lagged variables for scheme characteristics that could be directly measured which are the logarithm of scheme size, logarithm of scheme age, and the number of funds in that scheme. We also try to control for fund characteristics (which could not be aggregated

TABLE 4
Performance Sensitivity of Scheme Flows

	Average Performance Percentile of Funds		Net Performance Indicator	
	Pre-ECA	**Post-ECA**	**Pre-ECA**	**Post-ECA**
Performance	−0.003 (0.002)	0.017*** (0.005)	0.001 (0.001)	0.006*** (0.002)
$Flow_{t-1}$	0.024 (0.152)	0.283*** (0.096)	0.028 (0.151)	0.298*** (0.101)
Log Scheme Size	−0.078 (0.065)	−0.021 (0.035)	−0.077 (0.065)	−0.024 (0.035)
Log Age	−0.837*** (0.283)	−1.252*** (0.278)	−0.835*** (0.282)	−1.211*** (0.290)
No. of Funds	0.036*** (0.011)	0.017* (0.009)	0.035*** (0.012)	0.019** (0.009)
Average TER	−0.400* (0.217)	−0.133 (0.208)	−0.387* (0.218)	−0.163 (0.214)
Average Volatility	0.014 (0.027)	0.092 (0.056)	0.015 (0.027)	−0.080 (0.058)
Observations	214	134	214	134
Adjusted R^2	0.382	0.652	0.381	0.646

Notes: Dummies for the scheme service providers and year effect are included in the regression but estimates are not reported for brevity. Standard errors in the parentheses are adjusted for clustering at the scheme level.
*, **, and *** denote estimates that are significant at 10%, 5%, and 1%, respectively.

or directly measured at the scheme level) by using their simple averages, such as the average of funds' total expense ratio and the average of funds' volatility.

Measuring the performance of a scheme comprising funds with different investment objectives and characteristics poses a significant challenge for the estimation. For example, it is difficult to tell whether participants only consider the performance of the best performing fund or the average performance of all funds in the scheme in making a transfer decision. Two measures are used to proxy for the performance of a scheme. First, we adopt a simple measure of scheme performance by using the average of the performance percentile of funds in that scheme. Second, we attempt to compute an indicator of the "net performance" of a scheme using the difference between the percentage of funds in the scheme in the top 20% performance percentile and percentage of funds in the bottom 20% performance percentile.[9]

The estimation results for the performance sensitivity of scheme flows are in Table 4. Estimations using both scheme performance proxies give similar results. Scheme flows become more sensitive to the scheme performance in the post-ECA period while performance sensitivity in the pre-ECA period is not significantly different from zero. This result suggests that participants do exercise their right to choose funds across schemes allowed by the ECA. Furthermore, fund performance is found to be a significant factor behind participants' investment decision.

9. That is, we calculate $(Number\ of\ Top20\%\ Funds_{s,t} - Number\ of\ Bottom20\%\ Funds_{s,t})/Total\ Number\ of\ Funds_{s,t}$.

V. FUND PERFORMANCE

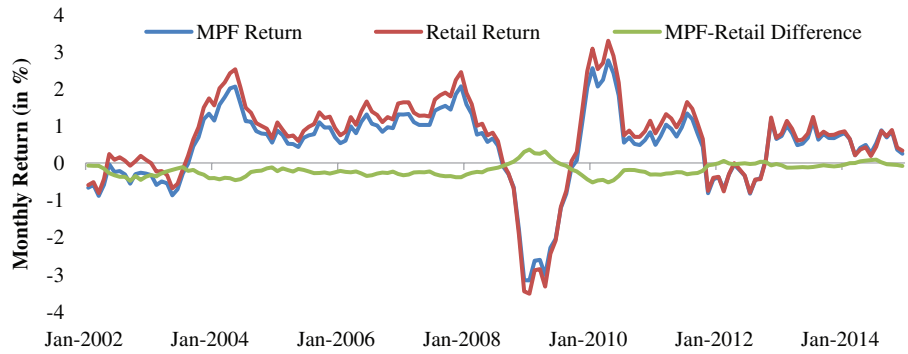
As of 2013, mutual fund assets in the retail sector in Hong Kong amounted to USD 1,290 billion doubling from USD 551 billion in 2004. Similar to the funds in the MPF system, most of the retail funds are equity funds and bond funds.[10] Unsurprisingly, many investment managers of the retail funds such as Invesco, Fidelity, Allianz, and Schroder are also scheme sponsors or investment managers in the MPF system. The funds in the MPF system, however, have long been criticized for their poor investment performance compared to the peers in the retail sector.

Figure 1 gives a quick comparison of the average monthly returns between funds in the MPF system and those from the retail sector throughout the sample period. Funds in the MPF system are consistently found to have lower monthly returns than their peers in the retail sector before the implementation of ECA and the underperformance is found to be highly consistent across different investment objectives. This difference in average returns between the two sectors, however, has largely disappeared in the post-ECA period.

We use asset pricing models to adjust funds' returns for their different exposures to risks. Fama and French (1993) propose a three-factor model for stock returns. In addition to the market return suggested by the capital asset pricing model (CAPM), the three-factor model includes the excess returns of portfolios with small-versus-large stocks and value-versus-growth stocks which are found to be empirically relevant. Carhart (1997) extends the three-factor

10. Statistics from Hong Kong Securities and Futures Commission.

FIGURE 1
Monthly Returns of Funds in MPF System and Retail Sector



Source: Datastream and authors' calculation.

model by adding the return of a portfolio with winners-versus-losers stocks, in view of the short-term momentum anomaly proposed by Jegadeesh and Titman (1993).

Fama and French (2012) present strong evidence on the validity of the four-factor model in developed markets. The risk-adjusted return captured by the four-factor model, indeed, is commonly used to evaluate and compare fund performance in the literature, for example, Carhart (1997), Kosowski et al. (2006), Fama and French (2010), Wahal and Wang (2011), and Del Guercio and Reuter (2014). In this section, we follow the literature to use the fund alphas captured from the four-factor model to evaluate the impact of the ECA on fund performance.

A. Methodology: Measuring Risk-Adjusted Returns

We follow Carhart (1997) to estimate the risk-adjusted returns. The fund performance is measured as the monthly risk-adjusted return ("alpha") in the following equation:

$$\alpha_{it} = R_{it} - \beta_{1i,t-1} RMRF_t - \beta_{2i,t-1} SMB_t - \beta_{3i,t-1} HML_t - \beta_{4i,t-1} WML_t$$

where α_{it} is the monthly risk-adjusted return, *RMRF* is the excess market return, *SMB*, *HML,* and *WML* are factor-mimicking portfolios for size, book-to-market equity, and momentum. The factor loadings $\beta_{1i,t-1}$, $\beta_{2i,t-1}$, $\beta_{3i,t-1}$ and $\beta_{4i,t-1}$ are estimated using the four-factor model over the prior 36-month period.

To evaluate the performance of funds in the MPF system in the pre-ECA and post-ECA periods, we first estimate the following model for the funds in the MPF system using the Fama and Macbeth (1973) approach:

$$\alpha_{i,t} = \mu_{i,t} + \gamma_{i,t} C_{i,t} + \varepsilon_{i,t}$$

where μ is the fund alpha after controlling for a set of fund characteristics variables including logarithm of fund age, logarithm of fund size, and total expense ratio.

Instead of comparing the fund alphas of funds in the MPF system in the two periods, we also study the change of fund performance in the MPF system using the alpha differential between retail funds and funds in the MPF system. To obtain the alpha differential, the monthly alphas are estimated with the following model using the Fama and Macbeth (1973) approach:

$$\alpha_{i,t} = \mu_{i,t} + \theta_t D_{MPF} + \gamma_{i,t} C_{i,t} + \varepsilon_{i,t}$$

where D_{MPF} is a dummy variable which equals to one for mutual funds in the MPF system and θ_t represents the performance differential between the retail funds and funds in the MPF system in month t. Since fund characteristics of retail funds are not available in our dataset, the only control variable included in this regression is the total expense ratio. Given that differences in fund characteristics between the two groups are relatively stable in the pre-ECA and post-ECA periods, the absence of other control variables in the regression should not be a major concern.

The Datastream dataset used for the study of fund performance is not free from survivorship bias which only contains funds existing as of November 2014. The survivorship bias is known to result in an upward bias in estimating fund

TABLE 5
Fund Performance in the MPF System in the Pre- and Post-ECA Period

	(1)			(2)		
	Pre-ECA	**Post-ECA**	**Diff.**	**Pre-ECA**	**Post-ECA**	**Diff.**
Carhart 4-factor Model						
Alpha	−3.390 (2.092)	0.421 (0.447)	3.811** (1.639)	−3.254 (2.112)	0.374 (0.433)	3.628** (1.656)
Log Fund Size	−0.003 (0.037)	−0.014 (0.028)	−0.010 (0.049)	−0.012* (0.037)	−0.023 (0.031)	−0.010 (0.048)
Log Age	0.486 (0.331)	−0.107 (0.078)	−0.593** (0.267)	0.505 (0.326)	−0.059 (0.086)	−0.565** (0.045)
TER				−0.109 (0.086)	−0.120** (0.044)	−0.012 (0.098)
Observations	4,739	2,671		4,739	2,671	
Adjusted R^2	0.505	0.454		0.512	0.457	
CAPM						
Alpha	−1.980 (1.432)	0.549 (0.353)	2.529* (1.343)	−1.882 (1.40)	0.507 (0.346)	2.390* (1.403)
Log Fund Size	−0.007 (0.033)	−0.021 (0.026)	−0.014 (0.043)	−0.011 (0.032)	−0.029 (0.027)	−0.019 (0.040)
Log Age	0.275 (0.228)	−0.066 (0.067)	−0.341 (0.220)	0.300 (0.217)	−0.021 (0.072)	−0.321 (0.215)
TER				−0.127* (0.074)	−0.114*** (0.040)	0.013 (0.080)
Observations	4,739	2,671		4,739	2,671	
Adjusted R^2	0.486	0.482		0.491	0.485	

Notes: Alphas are computed as the difference between actual return and the expected return of the 4-factor model estimated over the prior 36 months. Estimated alphas are then regressed on the set of control variables and dummies of investment objectives. Standard errors in the parentheses are estimated using the Fama–Macbeth approach, corrected for serial correlation and heteroskedasticity.

* Significant at 10%, ** significant at 5%, *** significant at 1%.

performance.[11] The empirical study on the effect of a policy change on the fund performance in this paper, however, should be less affected by the survivorship bias. In this section, the performances of funds in the MPF system are compared between the pre-ECA and the post-ECA periods. Funds with poor performance that drop out of sample are excluded in both periods. Upward bias on fund performance, if any, would exist for both periods and is therefore less likely to influence the estimation of a change in fund performance between the two periods. The particular concern of survivorship bias in this study is that high-performing funds in the MPF system in the pre-ECA period become low-performing and are terminated in the post-ECA period. To find out the severity of this potential problem, the number of terminated funds in the post-ECA period is extracted from the survivorship-bias-free MPFA reports. The number of funds that has been terminated or merged in the post-ECA period in the sample used for studying fund performance is three, which is only around 2% of the whole sample.

B. Empirical Results

Comparison of Fund Performance between Two Periods. The four-factor model is estimated for all the 223 funds over a 14-year sample period, and there are 15,479 monthly alphas and factor loadings.[12] The estimated alphas and factor loadings over the full sample period for the retail funds and MPF are provided in Appendix A. The estimated factor loadings suggest that retail funds and funds in the MPF system follow similar investment strategies. Factor loadings of the two groups of funds are of the same sign and statistical significance in most cases. As in the previous studies on mutual funds, loadings on the market excess return are close to one for funds in both sectors. The negative and significant loadings on *SMB* indicate that both retail funds and funds in the MPF system bias their investments toward larger firms. The results suggest that the four factors are all significant determinants of fund returns, and that comparing the raw returns of the funds directly is misleading.

Funds in the two sectors both have negative alphas across different markets. The alphas for retail funds, however, are insignificant in the full sample and for almost all individual markets. Funds under the MPF system, on the other hand, consistently report negative and significant alphas across markets. It means that, ignoring transaction costs, an investor can outperform the funds under the MPF system with a portfolio replicating the four risk factors in the model.

Table 5 reports the fund performance of funds in the MPF system before and after the launch

11. See, for example, Malkiel (1995).

12. The number of monthly alphas is less than the product of 223 funds times 168 months as some of the funds do not exist throughout the sample period.

TABLE 6
Fund Performance between Funds in the Retail Sector and MPF System

	(1)			(2)		
	Pre-ECA	**Post-ECA**	**Diff.**	**Pre-ECA**	**Post-ECA**	**Diff.**
Carhart 4-factor Model						
Constant	−0.097 (0.285)	−0.318 (0.321)	−0.222 (0.429)	−0.012 (0.299)	−0.236 (0.315)	−0.223 (0.433)
MPF	−0.158*** (0.058)	−0.038 (0.066)	0.121 (0.168)	−0.075 (0.077)	0.0452 (0.060)	0.120 (0.096)
TER				−0.081 (0.053)	−0.089** (0.035)	−0.008 (0.897)
Observations	8,743	3,685		8,743	3,685	
Adjusted R^2	0.420	0.431		0.430	0.432	
CAPM						
Alpha	−0.028 (0.258)	0.042 (0.323)	0.070 (0.419)	0.036 (0.256)	0.118 (0.315)	0.083 (0.421)
MPF	−0.202*** (0.066)	−0.044 (0.066)	0.158 (0.096)	−0.145 (0.089)	0.032 (0.055)	0.177* (0.093)
TER				−0.057 (0.045)	−0.082* (0.040)	−0.025 (0.060)
Observations	8,743	3,685		8,743	3,685	
Adjusted R^2	0.423	0.457		0.431	0.459	

Notes: Alphas are computed as the difference between actual return and the expected return of the 4-factor model estimated over the prior 36 months. Estimated alphas are then regressed on the dummy for funds in MPF system and dummies for investment objectives. The total expense ratio is included in the regression in particular specification. Standard errors in the parentheses are estimated using the Fama–Macbeth approach, corrected for serial correlation and heteroskedasticity.

* Significant at 10%, ** significant at 5%, *** significant at 1%.

of the ECA. The upper panel presents the results using the fund alphas from the four-factor model. The first regression shows a significant improvement in the monthly alpha after the launch of the ECA, from the highly negative (but statistically insignificant) −3.4% to an insignificant 0.4%.

Total expense ratio is likely one of the channels for funds to improve their performance under competition in the post-ECA period, and it is included in the second regression, together with other control variables. The total expense ratio is negatively related with the fund performance and is well documented in the literature. The improvement in fund alpha is slightly reduced once the total expense ratio is controlled. This is consistent with the fact that funds in the MPF system report a reduction of total expense ratio by about 0.27 percentage point after the launch of the ECA. The improvement of fund performance, however, remains large and significant. It is likely that, other than the reduction of expense ratio, there are other factors behind the improvement of fund performance in the MPF system. The estimation using the alphas from a simple CAPM (presented in the lower panel) gives similar results as those from the four-factor model.

Difference-in-Difference Comparison. Another test is to compare funds in the MPF system with their peers in the retail sector. The results are in Table 6. As in the previous subsection, regressions are estimated both with and without the total expense ratio. The constant term in all regressions represents the average alpha of retail funds. Consistent with the literature, there is no evidence that funds, on average, consistently generate abnormal positive return.

The MPF dummy variable measures the performance difference between the two groups of funds. Funds in the MPF system are found to underperform by 0.16 percentage point. The underperformance is reduced in the post-ECA period and it is no longer statistically significant.

The underperformance of funds in the MPF system becomes smaller and statistically insignificant when the total expense ratio is included in the regression in both the pre-ECA and post-ECA periods. Consistent with the previous result solely using the funds in the MPF system, it suggests that total expense ratio could be an important factor behind the improvement of performance. Though statistically insignificant, the result in the last column shows that the monthly alpha of the funds in the MPF system, when compared to their peers in the retail sector, improves by 0.12 percentage point on average in the post-ECA period. Specifications using alphas from CAPM show similar results, except that there is a larger improvement in performance after the launch of the ECA.

To check how robust the difference-in-difference results are, we consider two more specifications. First, identifiers of funds' investment managers are obtained from the Datastream and the principal brochures of the MPF schemes. Dummies of investment managers

TABLE 7
Alternative Specifications

	a. Control for Investment Managers		b. Exclusion of Post-announcement Period	
Reported Variable: MPF Dummy	**w TER**	**w/o TER**	**w TER**	**w/o TER**
Carhart 4-factor Model				
Pre-ECA	−0.113*** (0.040)	−0.108* (0.057)	−0.233** (0.105)	−0.090 (0.148)
Post-ECA	−0.008 (0.032)	0.005 (0.043)	−0.038 (0.066)	0.045 (0.060)
Diff.	0.106* (0.055)	0.113 (0.118)	0.195 (0.128)	0.135 (0.160)
CAPM				
Pre-ECA	−0.082* (0.044)	−0.102* (0.056)	−0.247** (0.102)	−0.275* (0.137)
Post-ECA	0.000 (0.029)	0.025 (0.042)	−0.043 (0.065)	0.032 (0.055)
Diff.	0.082 (0.057)	0.128* (0.070)	0.204 (0.125)	0.307** (0.140)

Notes: Alphas are computed as the difference between actual return and the expected return of the 4-factor model or CAPM estimated over the prior 36 months. Estimated alphas are then regressed on the dummy for funds in MPF system and dummies for investment objectives. The total expense ratio and dummies for investment managers are included in the regression in particular specification. Standard errors in the parentheses are estimated using the Fama–Macbeth approach, corrected for serial correlation and heteroskedasticity.

* Significant at 10%, ** significant at 5%, *** significant at 1%.

(i.e., one dummy variable for each manager) are included in the estimation to control for the influence of specific investment managers on fund performance. Second, the period after the announcement of the proposed ECA and before the implementation of the policy (i.e., from October 2008 to October 2012) are excluded to remove the anticipatory effect of the expected policy change. The coefficient estimates for the MPF dummy are reported in Table 7. The coefficient is found to be negative in the pre-ECA period and insignificantly different from zero in the post-ECA period in all cases except one. As expected, the change in fund performance differential between the MPF system and retail sector becomes larger when the anticipatory effect is removed from the estimation.

C. Alternative Estimation Strategy: Adding Fixed Effects

The baseline models are estimated with fund-level fixed effects as a robustness check. The fixed effects can capture unobserved time-invariant characteristics of funds and year-specific variations.

The estimation results are in Table 8. In the upper panel, we estimate the change of performance of funds in the MPF system with a dummy for post-ECA period. The coefficient estimate for the dummy in the fixed-effects model is much smaller than that from the Fama–Macbeth approach. One explanation is that year fixed effects are controlled for. The effect of the ECA from the difference-in-difference specification with fixed effects in the lower panel, on the other hand, is more in line with the result using the Fama–Macbeth approach with alphas captured from the Carhart 4-factor model. The difference-in-difference results estimated with the alphas captured from the CAPM remain positive but are no longer statistically significant. One explanation is that the alphas estimated with the CAPM are less accurate and sensitive to the change of investment strategies which are not considered by the CAPM. The three other factors in the Carhart model (i.e., *SMB*, *HML*, and *WML* factors), however, are highly significant in the monthly return regression.

VI. A SIMPLE MODEL

In this section, we use a one-period model to explain the intuition behind the empirical results. In particular, we focus on how higher performance sensitivity of fund flows, induced by giving the participants the right to choose their investment funds, can lead to both a lower expense ratio and better performance.

The investment manager's compensation depends on both the total expense ratio charged on the investment fund and the fund assets at the end of a period. The latter can be written as

$$(R + e\,(R - TER))\,FA$$

where FA is the initial fund assets, R is the gross return of the fund, TER is the total expense ratio, and e is sensitivity of the fund flow to the net fund performance. Given the initial fund assets, the end-period fund assets grow from two sources.

TABLE 8
Models with Fixed Effects

	Fund Performance in MPF System			
	Carhart 4-factor Model		CAPM	
	(1)	(2)	(3)	(4)
Post-ECA	0.391*** (0.083)	0.390*** (0.083)	0.134* (0.071)	0.133* (0.072)
Log Fund Size	−0.220* (0.121)	−0.209* (0.126)	−0.314*** (0.112)	−0.303*** (0.117)
Log Age	0.281 (0.378)	0.246 (0.381)	0.494 (0.367)	0.459 (0.370)
TER		−0.503*** (0.178)		−0.495*** (0.183)
Observations	7,410	7,410	7,410	7,410
Adjusted R^2	0.007	0.007	0.006	0.007
	Difference-in-Difference: MPFs vs Retail Funds			
	Carhart 4-factor Model		CAPM	
	(1)	(2)	(3)	(4)
MPF *Post-ECA	0.168*** (0.057)	0.163*** (0.056)	0.063 (0.068)	0.060 (0.067)
TER		−0.039 (0.109)		−0.021 (0.139)
Observations	12,428	12,428	12,428	12,428
Adjusted R^2	0.007	0.007	0.009	0.009

Notes: Alphas are computed as the difference between actual return and the expected return of the 4-factor model or CAPM estimated over the prior 36 months. Estimated alphas are then regressed on variables in alternative specifications using fixed effect model. Year effect is included but not reported.

* Significant at 10%, ** significant at 5%, *** significant at 1%.

First, there is the growth of fund assets through the gross return. Second, there is the inflow of additional assets which is positively related to the net performance ($R - TER$) of the fund. The investment manager may increase fund performance by putting more effort l, at the cost of a disutility $c(l)$ which is increasing in l.

By choosing the total expense ratio TER and level of effort l, the investment manager maximizes compensation less the disutility from effort:

$$TER\,(R\,(l) + e\,(R\,(l) - TER))\,FA - c\,(l)\,.$$

From the above objective function, we can obtain two first-order conditions:

$$R'\,(l)\,TER\,(1+e)\,FA = c'\,(l)\,,$$
$$(1+e)\,R\,(l) = 2eTER.$$

According to the first condition, the manager chooses an effort level which equalizes the marginal return from higher income and the marginal disutility. In the second condition, the investment manager balances the benefit from a higher expense ratio with the cost of less fund flows.

Assuming a constant marginal disutility of effort, a change in performance sensitivity e affects both fund performance and expense ratio:

$$\frac{dTER}{de} = \frac{-TER}{1+e} < 0, \quad \frac{dR}{de} = \frac{2TER}{(1+e)^2} > 0.$$

Since the increase in performance sensitivity of fund flows makes a higher expense ratio more costly, the investment manager reduces expense ratio under higher performance sensitivity. On the other hand, the benefit of putting more effort in generating performance increases when fund flows are more sensitive to performance. Therefore, the investment manager is willing to put more effort to generate fund return, and the fund return under a higher performance sensitivity of fund flows is also higher.

VII. CONCLUSION

We provide empirical evidence that the fund flows in the MPF system have become more sensitive after the launch of the ECA. Moreover, the fund performance as measured by the fund alphas has also improved in both absolute terms and relative to their peers in the retail sector. The results are robust to alternative specifications and estimation strategies. We also find that the improvement in fund performance is partly explained by a reduction in expense ratio.

The cost of limiting the participants' right to choose is large. Using a monthly extra discount of 0.16% in fund performance for funds in the MPF system compared to the retail funds in the pre-ECA period (see the four-factor model results in Table 6), the *accumulated* cost of limited participants' right could reach 13 billion or 10% of total assets of equity funds in 2012 (see Appendix B for the details of computation).[13] The significant cost suggests that participants' right to choose is an important element in a defined contribution plan.

APPENDIX A: ALPHAS AND FACTOR LOADINGS OF FUNDS IN THE MPF SYSTEM AND THE RETAIL SECTOR

	Retail					MPF				
	Alpha	**RMRF**	**SMB**	**HML**	**WML**	**Alpha**	**RMRF**	**SMB**	**HML**	**WML**
Full sample period										
All Funds	−0.117	1.005***	−0.100**	0.037	0.005	−0.254***	0.992***	−0.104**	0.036	0.001
	(0.098)	(0.015)	(0.045)	(0.068)	(0.020)	(0.090)	(0.009)	(0.050)	(0.064)	(0.016)
Global Equity	−0.085	1.015***	−0.066	−0.060	0.058	−0.210*	1.000***	−0.089	−0.053	0.037
	(0.127)	(0.034)	(0.074)	(0.108)	(0.035)	(0.109)	(0.020)	(0.070)	(0.090)	(0.033)
North American	−0.085	1.015***	−0.066	−0.060	0.058	−0.210*	1.000***	−0.089	−0.053	0.037
Equity	(0.127)	(0.034)	(0.074)	(0.108)	(0.035)	(0.109)	(0.020)	(0.070)	(0.090)	(0.033)
European Equity	−0.029	0.931***	−0.187***	0.115*	0.009	−0.230*	0.875***	−0.168***	0.270***	0.003
	(0.132)	(0.014)	(0.043)	(0.063)	(0.028)	(0.134)	(0.024)	(0.042)	(0.061)	(0.010)
Asia Pacific	−0.188	1.038***	−0.137**	0.156***	−0.092	−0.330*	1.016***	−0.143**	0.238***	−0.100*
(Ex. Japan Equity)	(0.203)	(0.030)	(0.062)	(0.059)	(0.064)	(0.196)	(0.044)	(0.062)	(0.078)	(0.056)
Japanese Equity	−0.126	1.025***	−0.206***	−0.211***	0.084**	−0.163	0.994***	−0.165***	−0.110**	0.001
	(0.133)	(.0.030)	(0.022)	(0.045)	(0.042)	(0.145)	(0.045)	(0.056)	(0.051)	(0.035)
Pre-period										
All Funds	−0.100	1.002***	−0.136*	0.036	−0.004	−0.245**	0.994***	−0.136**	0.034	−0.003
	(0.115)	(0.018)	(0.074)	(0.077)	(0.022)	(0.106)	(0.011)	(0.065)	(0.064)	(0.019)
Global Equity	−0.028	1.010***	−0.112	−0.048	0.072*	−0.174	0.996***	−0.122	−0.049	0.051
	(0.147)	(0.040)	(0.110)	(0.091)	(0.038)	(0.128)	(0.025)	(0.093)	(0.077)	(0.036)
North American	−0.293**	1.004***	−0.071	−0.022	0.025	−0.440***	1.003***	−0.056	−0.079***	0.001
Equity	(0.128)	(0.024)	(0.046)	(0.022)	(0.047)	(0.123)	(0.025)	(0.041)	(0.024)	(0.053)
European Equity	−0.088	0.940***	−0.184***	0.105	0.031	−0.312**	0.898***	−0.151***	0.277***	0.015*
	(0.154)	(0.018)	(0.052)	(0.084)	(0.030)	(0.156)	(0.008)	(0.044)	(0.075)	(0.008)
Asia Pacific (Ex.	−0.163	1.048***	−0.210***	0.154**	−0.146***	−0.317	1.035***	−0.213***	0.243***	−0.149***
Japan Equity)	(0.239)	(0.033)	(0.068)	(0.070)	(0.030)	(0.232)	(0.041)	(0.032)	(0.090)	(0.027)
Japanese Equity	−0.126	1.025***	−0.206***	−0.211***	0.084	−0.163	0.994***	−0.165***	−0.110**	0.001
	(0.133)	(0.030)	(0.022)	(0.045)	(0.042)	(0.145)	(0.045)	(0.056)	(0.051)	(0.035)
Post-period										
All Funds	−0.193	1.019***	0.056*	0.043	0.045***	−0.295**	0.981***	0.037	0.042	0.017**
	(0.158)	(0.007)	(0.033)	(0.035)	(0.000)	(0.142)	(0.010)	(0.035)	(0.039)	(0.000)
Global Equity	−0.338	1.039***	0.142***	−0.115*	−0.006	−0.371*	1.020***	0.059	−0.072	−0.026***
	(0.215)	(0.010)	(0.034)	(0.059)	(0.007)	(0.184)	(0.014)	(0.038)	(0.054)	(0.006)
North American	−0.076	1.059***	−0.114***	0.156***	−0.057***	−0.156	1.038***	−0.081***	0.074***	−0.041**
Equity	(0.155)	(0.018)	(0.022)	(0.011)	(0.017)	(0.122)	(0.015)	(0.021)	(0.012)	(0.019)
European Equity	0.238	0.894***	−0.201***	0.158***	−0.089***	0.135	0.770***	−0.241***	0.238***	−0.049***
	(0.226)	(0.011)	(0.012)	(0.017)	(0.005)	(0.212)	(0.014)	(0.012)	(0.020)	(0.006)
Asia Pacific (Ex.	−0.300	0.993***	0.192***	0.165***	0.151***	−0.390	0.930***	0.169***	0.214***	0.123***
Japan Equity)	(0.340)	(0.002)	(0.047)	(0.045)	(0.001)	(0.299)	(0.001)	(0.042)	(0.039)	(0.005)
Japanese Equity	−0.003	1.106***	−0.173***	−0.084***	0.088**	0.221	1.120***	−0.285***	−0.012	0.121***
	(0.283)	(0.002)	(0.020)	(0.028)	(0.006)	(0.284)	(0.010)	(0.016)	(0.021)	(0.014)

Notes: Alphas are computed as the difference between actual return and the expected return of the 4-factor model estimated over the prior 36 months. Standard errors in the parentheses are estimated using the Fama–Macbeth approach, corrected for serial correlation and heteroskedasticity.
* Significant at 10%,** significant at 5%,*** significant at 1%.

13. Since our study focuses on the performance of *equity funds* in the MPF system, the estimated cost does not include that from the other sectors. Also notice that this cost is the cost to the participants, and it is not necessarily social cost. The cost could be a transfer from the investors to the management companies in the form of fund expense.

APPENDIX B: ESTIMATED ANNUAL LOSS

As of June of	Total Asset Value of Equity Fund under MPF System	Annual Loss with Less Competition
2001	4,189	80
2002	7,804	150
2003	9,027	173
2004	15,232	292
2005	22,239	427
2006	33,579	645
2007	55,034	1,057
2008	68,734	1,320
2009	71,572	1,374
2010	98,000	1,882
2011	138,156	2,653
2012	132,127	2,537
Accumulated total		12,589

Notes: All figures are in million Hong Kong dollars. Total asset values of equity funds under the MPF system come from various issues MPF Schemes Statistics Digest prepared by the MPF Authority at http://www.mpfa.org.hk/eng/information_centre/statistics/mpf_schemes_statistical_digest/index.jsp. The annual cost is computed with 0.158% times 12 months times the total asset value.

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