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Mutual fund families, market segmentation and financial performance.

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Keywords: Mutual funds, financial intermediation, market structure, discrete choice and performance.

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Abstract: Why are there so many mutual funds around? What leads the industry to segment itself into an ever-increasing number of categories? What can be said about such a market configuration in terms of welfare? To address these questions we model the process that endogenously leads to market segmentation and to fund proliferation in the mutual fund industry.

We argue that these phenomena can be seen as marketing strategies used by the managing companies to exploit investors' heterogeneity. We explain category and fund proliferation providing an industry-specific micro foundation on the basis of basis of the "spillover" that the perfomance of a fund provides to all the other funds belonging to the same family.

We argue that market forces may induce a sub-optimal number of mutual funds and categories and identify the factors that determine such inefficiency.

Mutual fund performance is endogenously derived as a function of investors' and managing companies' tastes and technology. This lets us shed new light on the determinants of mutual fund performance and reconsider the traditional methods of testing fund efficiency.

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1 Introduction

In the present paper we provide a framework to explain market segmentation and product proliferation in the mutual fund industry. In particular, we ask why there are so many mutual funds and what leads the industry to segment itself into an ever-increasing number of categories. We argue that market forces may induce a sub-optimal number of mutual funds and categories and identify the factors that determine such inefficiency.

We show that, redefining management company's investment decisions in terms of both numbers of funds to establish within a category and number of categories to enter, we can reformulate performance as a function of the managing company marketing policy, as well as of the market structure the fund operates. A "structural" definition of performance is therefore provided, to be compared with the "reduced form" traditionally estimated in the empirical finance literature.

The most glaring stylized fact about the mutual fund industry is the existence of a very high number of funds, differentiated into market "categories" and run by relatively few managing companies. Nowadays, the number of mutual funds in the US has already overtaken the number of stocks traded on both the NYSE and the AMEX added together, reaching over 6,000 units. In particular, in the period 1987-1997 the number of mutual funds has grown from 2,317 to 6,778, while the number managing companies has only slightly increased, from 314 to 424. During the same time also the degree of segmentation of the industry has grown, reaching around 41 different categories in 1997.

This can hardly be explained in terms of the traditional finance literature, not only because there already exists a number of securities sufficient to pursue optimal investment strategies,[1] but also because market segmentation makes it harder to improve absolute performance. Indeed, segmentation reduces the scope and range of activity of the manager and forces him to invest only in the assets specific to the fund's category, [2] possibly hampering his market timing skills.[3]

A second important feature is the role increasingly played by marketing and segmentation strategies in an industry traditionally based on a homogeneous product. The proliferation of the

[1] In the US market the phenomenon is even more striking as the number of funds is now bigger than the number of stocks.

[2] For example, a Pacific Basin fund will find it difficult to switch into British stocks.

[3] The existence of a mutual fund industry could be justified if it helps to reduce transaction costs, thanks to the possibility of conducting large-size transactions at low costs. Even so, a limited number of mutual funds would be more than enough to complete the task of mimicking the risky portfolios at low costs for most investors.

number of funds and categories has been accompanied by an explosion in the amount of information gathered by specialized magazines and publications *(Barrons, BusinessWeek, Consumer Reports*) in response to investors' need to evaluate funds. Between the two events there seems to be a strong two-way causality: while the rise in the number of funds has increased the public desire for more information, more information has also made it more difficult for mutual fund companies to differentiate themselves. This has led them to rely increasingly on marketing strategies in order to raise the market's heterogeneity and to make inter-fund comparison harder, so as to affect the way investors "perceive" funds. From this perspective, market segmentation and fund proliferation become optimal strategies.

In particular, *market segmentation* increases product differentiation, limiting competition to the funds belonging to the same category, while *fund proliferation* increases market coverage. It relies either on the creation of many funds in order to hide the poor performers merging them into the best ones,[4] or on the use of "incubator fund strategies".[5]

The issue of brand proliferation in the mutual fund industry has gone unnoticed in the financial literature. Only recently Khorana and Servaes (1999) empirically analyze the determinants of mutual fund starts, identifying a series of factors that induce the managing company to set up new funds. Among the main determinants, they identify: the existence of economies of scale and scope, the fund family's prior performance, the decision by large competing families to open similar funds in the previous year, the overall level of fund invested, ….The novel contribution of the present paper is to set up a model that, starting from these stylized facts, explains what determines the decision to set up new funds within existing categories (*fund proliferation*) and to enter new categories (*category proliferation*).

We argue that funds' marketing strategies rely on *investors' heterogeneity and limited information*, but that these factors by themselves are only necessary but not sufficient conditions to justify category proliferation. In particular, we identify three competing factors affecting managing companies' choice between fund and category proliferation: *signalling externality*, *risk hedging externality* and *learning-by-doing externality*.

The main implication of this approach is that p*erformance itself becomes an endogenous function of investors' and managing companies' characteristics*. We, therefore, provide a "structural"

[4] A *brand proliferation* strategy would lead a managing company to increase its number of funds in order to "steal" competitors' market share and deter entry by rivals. This would allow it to sustain excess profits.

specification of performance, in contrast to the traditional "reduced form" usually estimated in the empirical finance literature.

The paper is divided into two parts. In the first part we describe the model, focusing on the determinants of number of funds, number of categories and performance. In the second part we deal with welfare issues.

2 The basic framework

2.1 A general set-up

Managing companies' marketing strategies hinge *upon investors' limited information and heterogeneity.*

- *Limited information* implies that investors, not having a full information set, are not capable of assessing the true quality of the product they purchase (mutual funds). Therefore, they use all the signals they have available to evaluate the overall quality of the managing company that provides them. Among these signals the performance of the other funds belonging to the same managing company plays a particular role as investors implicitly assume that part of the superior managing skills displayed in the management of a particular fund can also be conveyed to the management of all the other funds run by the same management company. This creates the possibility of a "signaling externality" that stimulates category proliferation. Indeed, if investors perceive funds in different categories as different products, a new fund would not compete directly with any fund of the family in the already existing categories. At the same time, though, a high performance of a fund in a *new* category would send a positive signal on the quality of the managing company that positively affects all its funds. The positive externality is, therefore, due to the fact that investors are heterogeneous and do not perceive funds in different categories as close substitutes for one another, while they use them as signals of the managing company's overall ability.

Managing companies systematically exploit this externality by setting up "flagship funds" designed to provide exceptionally high performance and distinguish themselves from competing companies. Anecdotal empirical evidence shows that often no managing fees are charged on the

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[5] This consists of setting up many funds closed to outside investment. Once some have established a good history in terms of performance, the company would market them as "flagship" or "star" funds of the family, closing down all the other (the majority) incubator funds that have performed poorly.

flagship funds. Given that funds' performances are evaluated net of managing fees,[6] this strategy boosts performance. The fact that managing companies are willing to take losses on such funds just to signal their quality to the market is a clear indicator of the type of effort the mutual fund industry is devoting to marketing activities.

- Investors are defined as *consumers who pick the funds on the basis of the whole bundle of services they provide,* as opposed to mean-variance maximizers as it is usually the case in the finance literature. To cater for investors' desires, managing companies behave as multi-product firms. They decide to start up a new fund within a category or to enter a new category on the basis of market characteristics (e.g., the elasticity of the demand function, the degree of heterogeneity among funds within the same category, the heterogeneity among categories) as well as firm-specific considerations. These include the ability to provide investors with an adequate bundle of utility (e.g., performance, quality of services provided, fees charged) and the costs incurred to do that (e.g., start-up costs, and managing expenses). The existence of many product lines (funds) offered in many sectors (categories) provides the managing company with a trade-off between the benefits provided by "*risk-hedging*" and the economies of scale generated by "*learning-by-doing*". Category proliferation provides risk-hedging as it makes the overall portfolio of the fund family more diversified. Conversely, fund proliferation within a category allows the managing company to concentrate on categories characterized by better than average returns. It also allows the company to better develop expertise of a particular category, reaping a "learning-by-doing" type of economies of scales.

In order to be able to capture these effects and describe the interaction between fund managing companies and investors, we use an industrial organization approach. Mutual fund companies are described as multi-product firms, each one running several funds, operating in different market segments and competing in many dimensions on the basis of the services provided to the investors. Investors are represented as consumers who choose one fund over alternative investment opportunities, assessing the whole bundle of services the fund provides.

Assumption 1: There are G *financial market groups or families* of funds in the market, each run by a different management company. Each fund is distinguishable according to the primary type of securities in which it invests (i.e., equity funds, bond funds, balanced funds, money market

[6] For example in the Wiesenberger Report.

funds,…) and/or the investment style (i.e., growth fund, cash fund, income fund,…). These characteristics define the *category* (i.e. market segment) the fund belongs to. The managing company of each of the G groups must choose the number of categories it is simultaneously operating (I_g) and the number of funds it is managing in each category (M_{ig}). A single family can have more than one fund in a particular category.

Let's consider, for example, the most a-priori homogeneous type of product: the index fund category. The Fidelity Group has three S&P500 index funds: the Spartan US Equity Index ($12.9 billion), the Spartan Market Index ($5.8 billion) and the VIP Market Index ($3.0 billion). They invest in the same type of asset (S&P500), but differentiate themselves in terms of some "other marketing characteristics". The Spartan US Equity Index is a no-load fund, the Spartan Market Index has a 1/2 % charge for redemption within 90 days, and the VIP Market Index is sold principally through insurance channels. Also, there is a strong difference between the two Spartan indexes in terms of minimum initial investment that is equal to 10,000 dollars for the Spartan market Index (1/2 % load fund) and 100,000 dollars for the Spartan US equity Index (no-load fund).

2.2 Demand side

Assumption 2: There is a continuum of heterogeneous investors, of total mass *N*, with idiosyncratic tastes that differ in terms of perception and evaluation of the bundles of services provided by the fund, as well as in terms of risk exposure. They perceive funds in different categories and also funds within the same category as differentiated products. That is, each fund is a bundle of cost-benefit characteristics which differentiate it from other funds and which provide the basis for investors' assessment and evaluation. Each investor chooses a fund on the basis of the level of utility[7] the particular fund offers him over the others. The net utility the *ath* investor derives from the *kth* fund, operating in the *ith* category and belonging to the *gth* group can be described as:

1) $$U^{a}_{ikg} = fund\text{'}s\, characteristics + consumer\text{'}s\, tastes = E(gpe_{ikg}) + gq_g - p_{ikg} - p_g + \xi^{a}_{ikg}$$

[7] We refer the reader to Anderson, De Palma and Thisse (1994) for a detailed description of the discrete choice models in an imperfect competition framework.

That is, the utility the *ath* investor derives from the *ith* fund is a function of the fund's characteristics $(E(gpe_{ikg}) + gq_g - p_{ikg} - p_g)$, as well as of his own specific idiosyncratic tastes (ξ^a_{ikg}). We assume that each investor is perceiving and valuing performance differently, according to his own idiosyncratic tastes where ξ_{ikga} captures agents' heterogeneity in terms of preferences for cash flows (pe_{ikg}) and other additional benefits (q_g). The characteristics the investor takes into account are defined in terms of the benefits he derives from investing in the fund (i.e. performance and other benefits) and the expenses he incurs to do so (fees).

There are two types of fees: load fees (p_g) which are paid only once, at the entrance of the family of funds, and are assumed to be the same across all funds of the same family,[8] and a management fee (p_{ikg}) that varies for each fund. The latter represents the part of price directly related to the size of the managed portfolio.

Here, $E(gpe_{ikg})$ is the expected performance of the *kth* fund, belonging to the *gth* group and operating within the *ith* category, gross of the fees the managing company charges. Given that usually performance is reported net of management fees, investors' decisions are based on net performance $(pe_{ikg} = gpe_{ikg} - fee_{ikg})$. We will, therefore, focus on net performance.

We define as additional benefits (gq_g) the ones not directly expressible in terms of a traditional mean-variance framework. They include the provision of checking facilities, the linkage to an insurance scheme, the possibility of using the money deposited with the fund to qualify for a particular minimum deposit requirement with the bank of the group, and so on. The investor weights the quality and number of related services provided by all funds belonging to the *gth* group and within the *ith* category.

To be able to concentrate on the "signaling externality" provided by performance, we assume that the additional benefits are the same for all the funds of the same family. As in the case of performance, we will focus on the benefits net of load fees $(q_g = gq_g - p_g)$.

The advantage of this specification is that it avoids the limitations in representing the decision process of the standard models. These models in general assume that the investor has "perfect discriminatory power and unlimited information processing capacity" and that he is therefore

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[8] Sometime the fund also charges "switch fees", that is, fees the investor has to pay to move his investments over two funds belonging to the same family. To avoid arbitrage opportunities, usually switch fees and load fees are structured in a way that the investor is made to pay an "investment fee" uniform with all the funds of the same group, and then he is free to move across funds.

“capable of ranking all the alternatives in a well-defined and consistent manner”. This is not always necessarily true as, “when faced with a choice among several alternatives, people often experience uncertainty and inconsistency. That is, people are not sure which alternative they should select, nor do they always take the same choice under seemingly identical conditions” (Tversky (1969)). Therefore, the parameter ξ_{ikg}^{a} can be interpreted as the random component of a stochastic decision process in which the “alternatives are successively eliminated until a single one remains” (Tversky (1972)), or, in other words, the random characteristics that differentiate otherwise deterministic utility functions.

Alternatively, ξ_{ikg}^{a} can be seen as the probabilistic component of investors’ stochastic utility functions (McFadden (1981)), that is, the idiosyncratic taste differences of investors. All the investors differ one from another “only with respect to some characteristics unobservable to the modeler, so that the modeler can at best predict individual’ choice up to a probability function” (Manski (1977)).

In both interpretations, the decision process can be better represented as a “probabilistic process” where all the alternatives are defined in terms of a finite set of characteristics. An individual “might forget to take into account some of the characteristics of an alternative or making an error evaluating the importance of one or another characteristics associated with an alternative”.

This intuition fits very well our problem, for two orders of reasons. First this approach accommodates, at least partially, the objection that the decision to invest in a mutual fund is an essentially irrational decision, not explainable in terms of the standard model of full rationality.

Second, this approach directly tackles investors’ heterogeneity. Intuitively we can say that investors are exposed to different idiosyncratic endowment shocks and use mutual funds to hedge personal income fluctuations. It follows that the return on a mutual fund is differently evaluated according to its correlation with investor’s other sources of income and his idiosyncratic cash flow needs. Given that investors’ risk aversion changes across individuals and the desired portfolio is affected by the correlation with individual wealth and income, which are highly variable across individuals, a specific description of investors desired portfolios would be infeasible.

Note that assuming linearity in utility does not necessarily imply risk neutrality. It can be shown[9] that if individual preferences are drawn from the HARA class, they form a Wilson (1968) syndicate. In this case, aggregating principals is equivalent to having a single principal with risk tolerance equal to the sum of individual risk tolerances. Therefore, if individual risk tolerances are kept constant, increasing the number of agents increases the aggregate level of risk tolerance. For a sufficiently high number of individuals, the aggregate (syndicate) risk tolerance goes to zero. We can therefore assume that individuals are grouped in a continuum of syndicates, each risk neutral and characterized by different idiosyncratic preferences[10] for cash flows and other additional benefits.

THEOREM 1: *If we assume that* ξ^{a}_{ikg} *is i.i.d. distributed as a double exponential and that there are* $\{1,...,g,...G\}$ *competing managing companies,* $\{1,...,i,...I_g\}$ *market categories and* $\{1,...,k,...M_{ig}\}$ *funds managed within the same group, we can express investor's demand for the kth fund belonging to the gth group and operating within the ith category as:*

$$2)\quad P_{ikg} = P_i P_{kg|i}$$

where:

$$P_{kg|i} = \frac{\exp\phi_{ikg}}{\sum_{h=1}^{M_{ig}} \exp\phi_{ihg} + \sum_{c=1}^{G-1}\sum_{h=1}^{M_{ig}} \exp\phi_{jhc}},\quad P_i = \frac{\exp(\frac{S_i}{\mu_1})}{\sum_{j=1}^{I} \exp(\frac{S_j}{\mu_1})},\quad S_i = \mu_2 \ln\left\{\sum_{h=1}^{M_{ig}} \exp\frac{\phi_{ihg}}{\mu_2} + \sum_{c=1}^{G-1}\sum_{h=1}^{M_{ig}} \exp\frac{\phi_{ihc}}{\mu_2}\right\}$$

and $\phi_{ikg} = E(pe_{ikg}) + q_g - p_{ikg} + \xi^{a}_{ikg}$*, is the bundle of characteristics that such a fund provides (Anderson, De Palma and Thisse 1994).*

Here μ_1 measures the degree of heterogeneity among different categories, while μ_2 measures the degree of heterogeneity among funds within the same category.[11]

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[9] See Stoughton (1993) for a detailed description of the aggregation process that leads to the syndicate in a contract theory set up.

[10] We can also assume that investors already have a well-diversified portfolio so that $E(pe_{ikg})$ represents the expected performance (net of risk) they require from a particular fund.

[11] Both measures are bounded between zero (when all the funds are perceived to be same) and one (when all the funds are perceived as completely different products).

The beauty of this specification is that it allows us to rationalize the way investors decide to invest: first investors choose the category which best suits their investment needs (P_i) . They then decide which fund to invest in, picking it among only funds of the selected category $(P_{kg|i})$.

Furthermore, given that we have a continuum of investors, defined in the unitary interval, the demand of each one of them can be seen as the market share of the investor with the particular idiosyncratic characteristics, or as his probability of purchase. In particular, P_{ikg} can be intuitively seen as the probability of choosing the *kth* fund within the *ith* category and belonging to the *gth* group.

P_i is the *unconditional* probability that the investor decides to invest in the *ith* category. For example, a risk averse individual with a short-term investment horizon would prefer the more liquid and less volatile category of money market funds as opposed to equity funds.

$P_{kg|i}$ is the probability of choosing the specific *kth* fund *conditional* upon the choice of the *ith* category? For example, the risk averse individual who has decided to invest in money market funds, picks the specific *kth* fund among all the money market funds according to its specific characteristics.

Assumption 4: Investors do not know the performance of each fund, but derive expectations of it by looking at some signals such as the past performance of the fund they are going to invest and the performance of the other funds managed by the same managing company (Ψ_g) according to:

$$(3)\ E_t(pe_{ikg,t+1}) = pe_{ikgt} + \Psi_{gt},$$

where $\Psi_g = \sum_{j=1}^{I_g} \sum_{h=1}^{M_{jg}} pe_{jhg}$.

The rationale is that the mere fact that a fund of the same family has scored well in its own category strongly affects investor's demand for all funds run by the same managing company. This can be interpreted as a *signal* released by the managing companies to *distinguish themselves from competitors* in the market. Investors receive the signal and interpret it, believing *that part of the superior managing skills displayed in the management of the flagship fund will also be conveyed to the management of other funds run by the same managing company*. We are not assuming that investors assess the ability of a managing company *only* on the basis of the ranking of its best performing managed fund. But, given the imperfect information, investors use the performance of the best fund within a family *in addition* to the other signals (such as a fund's specific performance, quality of services provided, etc.) to evaluate the overall ability of the family's managing company.

We assume that the expectation is linear. From now on, for clarity of exposition, we omit the time subscript. The model can be seen as intertemporal only inasmuch as investors' expectations are shaped on the basis of actual performance.

2.3 Supply Side

Assumption 5: The managing company has to decide on the number of categories to enter, the number of funds to establish within each category and the performance and additional services to provide. We adopt a profit-maximization approach that, in line with recent literature,[12] defines as the main goal of a managing company the maximization of a fund's size in terms of managed assets rather than the maximization of its performance.[13] In fact, given that most of the fees paid by the unit holder are proportional to funds' managed assets, profits are maximised when net fund-raising is maximised. It follows that better performance becomes instrumental in greater fund-raising and the subsequent increase in managed assets becomes a sort of remuneration in an "incentive compatible contract scheme" by which the group of investors-principals forces the managing company-agent to provide such performance.

Unlike this literature, however, we consider performance as only one of the many dimensions in which the funds can compete to attract investors.[14] The profit function can, therefore, be defined as:

4)

$$\pi_g = \sum_{j=1}^{I_g} \sum_{h=1}^{M_{jg}} \left[N(p_g + p_{jhg} - cq_g - cpe_{jhg}) P_{jhg} - k_g - K_g \right] = \sum_{j=1}^{I_g} \sum_{h=1}^{M_{jg}} \left[Nmu_{jhg} P_{jhg} - k_g - K_g \right]$$

where N is the number of potential investors and cq_g and cpe_{ikg} are, respectively, the costs incurred by the managing company for the provision of services for each fund unit (gq_g) and for the provision of a certain level of performance (gpe_{ikg}). We assume that the costs incurred to

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[12] Chevalier and Ellison.

[13] In this scheme, end-of-the-year window dressing operations enacted by fund managers can be rationalizable as a possible last moment effort aimed at increasing performances before investors' judgment.

[14] It follows that in some circumstances a managing company may optimally choose not to seek higher performance, but to resort to other "marketing tools" in order to maximize assets.

provide services decrease with the amount provided $(\frac{\partial cq_g}{\partial q_g} < 0)$. That is, the group enjoys economies of scale and learning by doing in providing these services.

The variables k_g and K_g represent the fixed costs incurred, respectively, to start up a new fund and to enter a new category. Without loss of generality, both are assumed to be fund and category invariant, i.e., to depend only on the cost structure of the managing company. One can think of them as a learning cost due to the different type of knowledge that the new area requires[15] (compared to the others in which the company is already operating).

The company chooses the level of performance net of managing fees for each funds of the family, the quality and number of related services offered at family level, net of load fees, the number of funds offered within each category and the number of categories to enter. The objective of the company is to maximize profits and, therefore, to increase both its mark-up (mu_{ikg}) and its market share (P_{ikg}).

So far, the model is merely deterministic, but this is unrealistic in an industry characterized by a high degree of randomness in the main type of service provided, i.e. performance. As a matter of fact, the managing company can not determine with certainty the control variable pe_{ikg}, or, if it can, the cost incurred to do so is stochastic and not fully forecastable.

Assumption 6: We assume the cost incurred to provide a certain level of performance (cpe_{ikg}) to be stochastic[16] and equal to:

$$5)\quad cpe_{ikg} = pe_{ikg}\frac{\zeta_g}{M_{ig}} + pe_{ikg}\varepsilon_i \text{, with } \varepsilon_i \approx N(\eta_i, \sigma_i).$$

[15] For example, the knowledge required to deal with fixed income assets can be very different from that necessary to invest into stocks or derivatives. Also, sometimes market location and the type of trading dramatically affect the kinds of knowledge required.

[16] We think that the main “performance-enhancing” activity is not research, which we can consider as a fixed cost, but the fees and the performance bonuses paid to the fund managers. These can be considered as a marginal cost, a cost that is variable and linked to the desired target of performance (under the assumption that higher remuneration can “buy” better fund managers). Furthermore, it is worth noting that we are considering performance gross of expenses. If performance were post-expense, given that expenses are passed through to the fund investors, it would turn out to be stochastic.

That is, the total cost cpe_{ikg} is made up of two different components: the first $(pe_{ikg} \frac{\zeta_g}{M_{ig}})$ is a deterministic function of the level of a fund's performance (pe_{ikg}): the higher the performance the fund provides, the higher the cost it incurs (where ζ_g is a proportionality coefficient).

Indeed, given that a fund's ability to beat the market depends on the quality of its managers and the incentive provided, the cost involved in providing a better-than-average performance rises with the level of such performance. The cost of providing a certain performance decreases with the number of funds the company has already set up in the same category. Indeed, the more specialized the company is (i.e. the higher the number of funds per category), the more it can benefit from some learning-by-doing or scale effects due to the development of a particular knowledge in a specific category. The intuition is that the higher the number of funds the managing company has within the same category, the higher the expertise it has accumulated in the particular area.

The second component $(pe_{ikg}\varepsilon_i)$ is still related to the desired level of performance, but varies randomly over time and depends on the stochastic characteristics of the returns in the particular category (ε_i). This affects the total portfolio riskiness in two ways: on one side, the higher the level of uncertainty, the more difficult it is for the managing company to reach the desired level of performance. On the other side, the managing company is already managing assets in other categories, and entering a new category provides an opportunity to hedge overall exposure.

Unlike the case for the number of funds, having entered more categories does not necessarily imply a better expertise, as the categories are very different in terms of the characteristics of the assets where they mainly invest. There is, therefore, a trade-off between the number of funds and the number of categories similar to the one existing between capital deepening and capital widening.

Assumption 7: The managing company is risk averse, and maximizes a function $V\{E(\pi_g)\}$ of profits, where profits (π_g) are defined in equation 5).

Recent empirical studies (C. Becker, W. Ferson, D. Myers and M. Schill (1998))[17] show that the mutual funds behave as risk averse[18] agents. Risk aversion increases the incentive to set up new

17 Using a sample of more than 400 US mutual funds for 1976-94, Ferson *et al* estimate that mutual funds behave as risk averse, benchmark investors.

funds and enter additional categories in order to hedge both absolute and relative performance risk. Indeed, a risk averse company may wish to enter a new category or set up a new fund so as to hedge not only the risk of a low performance, but also the risk that all funds will have a low performance relative to that of their competitors (relative performance risk). Indeed, if investors' demand for a single fund is affected by the performance of all the other funds of the same family, a risk averse company may wish to reduce both 'absolute performance risk' and 'relative performance risk'.

3 Market competitive equilibrium: number of funds, categories and performance.

Following the standard literature, we hypothesize a *two-stage game: first the managing company decides simultaneously the number of categories to enter and the number of funds for each category. Then, conditional upon them, it selects the level of performance and the quality and number of services to provide.*

To solve the model, we work backwards starting from the managing company's choice about performance-services conditional upon the number of categories entered and the number of funds already established within each of them. Then, we solve for the number of funds and categories. Finally, we look at the free entry solution to determine the equilibrium number of funds and compare such equilibrium with the welfare optimum.

THEOREM[19] 2: *Under the assumptions stated above, the model has a subgame perfect Nash equilibrium to the two-stage product-line-sector game. Such equilibrium is defined in terms of nested logit demand,* $X_{ikg} = NP_{ikg}$ *and the mark-up charged by the managing company is:*

$$\text{(7)}\quad \begin{aligned} mu_{ikg} &= \left[\frac{\partial c_{qg}}{\partial q_g} A_{ig}\,\frac{1}{P_{ikg}} + \frac{\zeta_g}{M_{ig}} + E(\varepsilon_i) + R_g \operatorname{cov}(\pi_g, \varepsilon_{ig})\right]\frac{\mu_2}{(1-P_g)} = \\ &\mu_2\left[\frac{\partial c_{qg}}{\partial q_g} A_{ig}\,\frac{1}{P_{ikg}} + \frac{\zeta_g}{M_{ig}} + \eta_i + R_g(\vartheta_{ig} I_{ig} + \beta_{ig})\right]\left[1 + \frac{\Omega_g}{\mu_2}\right], \end{aligned}$$

for i=1,...,i,..., I_g *, where:*

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[18]A possible justification of the empirically found risk aversion is the fact that fund-managers are remunerated in terms of the overall performance of the family of funds they manage and that managing company acts in the best interest of its managers who are risk averse and cannot diversify such risk.

$$A_{ig} = \frac{\partial \Psi_g}{\partial pe_{ikg}}, \qquad \eta_i = E(\varepsilon_i), \qquad \text{cov}(\pi_{ig}, \varepsilon_{market}) = \vartheta_{ig} I_g, \qquad \beta_{ig} = \text{cov}(\pi_{ig}, \varepsilon_i - \varepsilon_{market}),$$

$$\Omega_g = \mu_2 \frac{\sum_{j=1}^{I_g} \sum_{h=1}^{M_{jg}} \exp(\frac{\phi_{jhg}}{\mu_2})}{\sum_{\substack{c=1 \\ c \neq g}}^{G-1} \sum_{i=1}^{I_c} \sum_{h=1}^{M_{jc}} \exp(\frac{\phi_{jhc}}{\mu_2})} \quad and \quad R_g = -\frac{E\{\frac{\partial V^2(\pi_g)}{\partial \pi_g}\}}{\frac{\partial V(\pi_g)}{\partial \pi_g}} \pi_g .$$

Mark-up can be interpreted as the return that the managed assets provide to the managing company. In standard finance the required return on an asset is a function of investor's degree of risk aversion and on the ability of the asset to provide a hedge against risk, that is the covariance between investor's income (or consumption) and asset returns. Analogously, the mark-up is positively related to the degree of risk aversion of the managers (R_g) and to the covariance between the overall profits of the managing company (income) and the random rate of return of the category that characterises the returns of the new fund (asset return). In particular, the more risk averse managers are, the more they have to be remunerated to incur the costs related to an uncertain level of performance.

An interesting insight comes from the decomposition of the covariance of profits with the returns of the category into two components: the covariance between profits and the market returns $(\vartheta_{ig} I_g)$ and the covariance between profits and the difference between a category's returns and market returns (β_{ig}). The first component is directly proportional to the number of categories entered (through the proportionality coefficient ϑ_{ig}). The intuition is that increasing the number of categories helps the portfolio diversification of the managing company because it makes the returns on its total managed assets more in line with the market portfolio. Indeed, each category represents a part of the market, and the higher the number categories the fund is already operating, the more correlated fund's returns are within the market and the more the portfolio managed by the fund approaches the market portfolio. In particular, the effect of entering an additional category depends on the already existing portfolio composition of the managing company and on the way the idiosyncratic shock of the particular category co-varies with it. Here ϑ_{ig} captures the effect that entering an additional category has on the correlation between the returns on the assets managed by the managing company and the returns on the additional category. The higher ϑ_{ig}, the more the entrance into a new category contributes to align the

[19] All of the following propositions will be proved in the Appendix.

composition of the managed assets to the market portfolio. That is, *the marginal value of a specific fund increases when the new fund provides a form of risk diversification for the managing company*.

The second component, that is, the covariance between profits and the difference between the category's returns and market returns, captures the idiosyncratic shock of the particular category, or the part of it in excess of the market. It represents the benefits accrued to a managing company from being able to concentrate on categories characterized by better than average returns.

Finally, Ω_g captures the externality effect that the performance of a family produces on all the funds of the same family.[20]

THEOREM 3: *In a symmetric equilibrium, the optimal number of funds offered by each family within a category is:*

$$(8)\; M = \frac{\vartheta R \zeta}{2A\zeta \frac{\partial cq}{\partial q} + (\eta + \beta R)\left[\vartheta R - \frac{K}{\Omega N}\right] + \frac{k}{\Omega N}\zeta},$$

while the optimal number of categories entered by a family is:

$$(9)\; I = \frac{2A\zeta \frac{\partial cq}{\partial q} + (\eta + \beta R)\left[\vartheta R - \frac{K}{\Omega N}\right] + \frac{k}{\Omega N}\zeta}{\vartheta R(\frac{K}{\Omega N} - \vartheta R)}.$$

In particular, assuming that $K > \vartheta R \Omega N$, the partial derivatives of the supply of funds is:

$$10)\; \frac{\partial M}{\partial A} < 0, \frac{\partial M}{\partial \eta} > 0, \frac{\partial M}{\partial \beta} > 0, \frac{\partial M}{\partial \vartheta} > 0, \frac{\partial M}{\partial R} > 0, \frac{\partial M}{\partial k} < 0, \frac{\partial M}{\partial K} > 0, \frac{\partial M}{\partial \zeta} < 0 \frac{\partial M}{\partial (\frac{\partial cq}{\partial q})} < 0.$$

If we also assume that *k* is sufficiently greater than *K*, that is the cost of setting up a new fund within an existing category is higher than the cost of entering a new category, we have we have:

$$11)\; \frac{\partial M}{\partial G} < 0, \frac{\partial M}{\partial \mu_2} > 0, \frac{\partial M}{\partial N} > 0.$$

[20] The mark-up still depends on the number of funds within each category and on the number of categories entered. The choice of these variables at the second and third step of the game will determine its absolute size.

Also, still assuming that $K > \vartheta R\Omega N$, the partial derivatives of the supply of funds are:

$$\frac{\partial I}{\partial A} > 0, \frac{\partial I}{\partial \eta} < 0, \frac{\partial I}{\partial \beta} < 0, \frac{\partial I}{\partial \vartheta} > 0, \frac{\partial I}{\partial R} <> 0, \frac{\partial I}{\partial k} > 0,$$

12) $$\frac{\partial I}{\partial K} < 0, \frac{\partial I}{\partial G} < 0, \frac{\partial I}{\partial \mu_2} < 0, \frac{\partial I}{\partial N} > 0, \frac{\partial I}{\partial \zeta} > 0 \frac{\partial I}{\partial (\frac{\partial cq}{\partial q})} > 0.$$

That is, the decision to set up a new fund and the one to enter a new category are a function of some cost-performance characteristics of the managing company as well as of the market structure. Some interesting conclusions are worth stressing.

• First of all, even though the model is explicitly designed to consider product differentiation, the decision to enter a category is not influenced by the degree of heterogeneity among categories (μ_1) and is affected, *but not exclusively motivated,* by the degree of heterogeneity within each category (μ_2) . That is, *consumer heterogeneity is not sufficient for fund and category proliferation.* There are other elements that play a major role in inducing the managing firm to differentiate and provide incentives not considered by the traditional *cost benefit analysis.* Some of these elements can be considered as externalities as the benefits derived from setting-up a new fund do not accrue only to the fund, but positively affects all the other funds of the family. These externalities are: "*signaling externalities*", "*risk-hedging externality*" and "*learning-by-doing externality*". Some other elements are related to the market structure, such as potential demand and number of competitors.

We look at these different components separately, starting from the standard cost benefit analysis to seeing how much they differ from it.

• From a pure *standard cost benefit analysis,* the benefits of entering a new category are weighted against the ones of setting up of additional funds within the existing categories on the basis of net payoffs (returns minus costs incurred to provide them) *specific to each fund*. A first glance at equations 8 and 9 shows that, if the average return within the generic category is sufficiently high, or the cost of generating it is sufficiently low, fund proliferation is better than category proliferation. If, on the contrary, the payoff is low, or the costs of generating it are high, it is worth going for additional categories.

In particular, if the rate of return of the average category (η) is high and the managing company is already positioned in categories providing a return higher than the average market rate $(high\ \mathrm{cov}(\pi, \varepsilon - \varepsilon_{market}))$ it pays off to increase the number of funds within the existing categories, without venturing into new ones. Analogously, it is preferable to establish additional funds within the existing categories if the cost of either producing performance (ζ), or providing services (cq) is low. Therefore, the incentive to enter a new category is a negative function of both the rate of return of the average category and the degree of correlation between the managing company's overall profit structure and the category's excess returns over market returns. Conversely, it is positively related to the cost of generating performance and services within each category.

The effect of fixed costs is different. Higher costs to enter a new category (*K*) tilt the choice in favor of setting up new funds within the existing categories as opposed to the one of entering new categories. Conversely, higher costs of setting up a new fund (*k*) induce the managing company choose the entrance into new categories.

- Entering a new category also generates a *positive externality*, as the performance in one category positively affects all the funds run by the same family in the other categories (*A*). The reason why we call it an externality is that the benefits spill over all funds of the same family, regardless of the category they belong to.

Notice that we are not exogenously imposing that entering a new category increases the probability of getting a better relative performance (ranking). Nor are we assuming that the managing company is able to hide its bad performers and display the good ones ("incubator funds strategy"). This would only make our results stronger. The positive externality is the endogenous result of the existence of heterogeneity among investors in terms of tastes and investment decisions. It follows from the fact that agents' preferences are not constrained as in the typical financial models that assume perfect substitutability among financial products. A direct consequence of the existence of finite and different elasticities of substitution among funds within the same category and funds in different categories is that, for a managing company, having a well performing fund in a new category is worth more than having a well performing fund within an existing category.

The degree of heterogeneity plays a crucial role: the more heterogeneous the investors are, the more a good performance of a fund positively reflects on all the funds of the same family, without providing direct competition to the other funds of the family. Higher investors' heterogeneity within a category (μ_2) favours the decision to set up a new fund as opposed to the one of entering a new category. The intuition is that if investors are heterogeneous within a category, the managing company does not have to enter new categories to differentiate its funds from its competitors.

- Entering new categories helps also to diversify total risk. If the returns generated from the assets in the new category are not perfectly correlated with those of the already managed ones, entering a new category can *reduce the overall volatility and risk* of the whole funds' family ("*risk-hedging externality*")[21]. This effect is stronger the more the entrance in the new category shifts the portfolio composition of the managed assets toward the market portfolio $(higher\,\vartheta)$. If, on the contrary, the idiosyncratic component of the new category is correlated to the returns of the already managed assets $(high\,\beta)$, entering the new category would only increase risk and, therefore, the incentive to enter the new category drops. Notice that the direct effect of a change in risk aversion is indeterminate, as it is directly related to both ϑ and β and it only plays a role of amplifying them.

- In general, the benefits of risk-hedging are traded off against the benefits of specialization. Given that the cost of providing a certain performance decreases with the number of funds the company has already set up in the same category, entering an additional category means foregoing benefits in terms of *learning-by-doing* that come with a strategy of fund proliferation within the same category.

- Finally, both fund and category proliferation are positively affected by the *market structure*, defined in terms of potential demand (*N*). Indeed, a bigger market allows the company to expand the number of funds and enter new categories without the need to reduce the mark-up. Conversely, a higher number of competitors (*G*) reduces the incentive to both enter new categories and set up new funds within the existing categories.

Corollary 1: The equilibrium level of performance can be defined as:

$$(13)\quad gpe - p = pe = \frac{\mu_2(1+\Omega)N\left[\frac{\partial c}{\partial q}AMI + \zeta + \eta + R\beta\right] - cq}{\zeta + \eta + R(\beta + \vartheta)} =$$

[21] This happens if $(\mathrm{cov}(\pi, \varepsilon_{market}) < 1)$.

$$= \frac{\mu_2\left(1+\frac{G}{G-1}\right)N\left[\zeta\left(1+\frac{A\frac{\partial c_q}{\partial q}G}{[(G-1)K-G\vartheta R]}\right)+\eta+R(\beta+\vartheta)\right]-cq}{\zeta+\eta+R(\beta+\vartheta)}.$$

This shows that, if the *level of performance is not an objective per se,* but the managing company considers it as a part of a game, its definition is more complex than is traditionally assumed in finance. The intuition is that performance is one of the ways the managing company attracts investors and, as such, it has to be weighted against the other alternatives. In particular, we can determine the main determinants of performance considering:

$$\text{(14)}\quad \begin{aligned} &\frac{\partial pe}{\partial A}>0, \frac{\partial pe}{\partial \eta}<0, \frac{\partial pe}{\partial \beta}<0, \frac{\partial pe}{\partial \vartheta}>0, \frac{\partial pe}{\partial R}<>0, \frac{\partial pe}{\partial N}>0,\\ &\frac{\partial pe}{\partial K}<0, \frac{\partial pe}{\partial G}>0, \frac{\partial pe}{\partial \mu_2}>0, \frac{\partial pe}{\partial \zeta}<0, \frac{\partial pe}{\partial(\frac{\partial cq}{\partial q})}>0, \frac{\partial pe}{\partial cq}<0. \end{aligned}$$

The choice of the desired level of performance depends on the trade-off between the costs incurred to provide it, the cost of the alternative tools the management company has to attract investors and the benefits it generates.

- In terms of *costs,* performance increases with the marginal costs of the alternative services the managing company offers to its investors (i.e. non performance-related services, $(\partial c_q / \partial q)$) and decreases with the cost of providing it (ζ). An implicit costs is due to the fact that entering an additional category increases the alignment of the overall managed assets' returns with market returns (ϑ), reducing hedging benefits. For analogous reason the level of performance is negatively related to the correlation between the overall returns of the managed assets of the family and the average return of the category (β). Indeed, the higher the correlation, the fewer the benefits from risk diversification that the new fund provides and the higher the required performance.

Also, the expected positive relationship between the performance of the fund and the return in the particular category is reversed, with *a negative relationship between the performance and rate of return of the particular segment in which the fund is operating* (η).

• The desired level of performance depends on the *benefits it can provide to the fund's family as a whole*. In particular, given that higher performance for one fund can spill over to all the other funds of the group (externality effect represented by *A*), the level of performance is positively related to the degree to which it gets amplified across funds.

• Finally, it is worth noting that also the *structure of the market* affects performance. Market structure elements, such as potential demand (*N*), heterogeneity among investors (μ_2) and the degree of competitiveness induce higher performance. Indeed, the higher the number of competitors (*G*), the more the managing company has to either reduce the managing fees, or to generate higher gross performance. The intuition is that competition drives prices down. At the same time, a higher the demand increases the reward of higher performance.

These results prompt us to reconsider the traditional types of empirical tests used to measure mutual fund efficiency. It appears that if we want to measure and assess a fund's efficiency using performance, we cannot abstract from the structure of the market as well as from the overall cost-performance situation of the whole funds' family. Indeed, the behavior of the managing company is closer to that of an imperfect competitor than to that of a perfectly competitive one.

THEOREM 4: *At a free-entry equilibrium, the optimal number of managing companies is a function of:*

$$(15)\ \frac{\partial G}{\partial A} > 0, \frac{\partial G}{\partial \eta} < 0, \frac{\partial G}{\partial \beta} < 0, \frac{\partial G}{\partial \vartheta} > 0, \frac{\partial G}{\partial R} <> 0, \frac{\partial G}{\partial k} > 0, \frac{\partial G}{\partial K} < 0, \frac{\partial G}{\partial \mu_2} > 0, \frac{\partial G}{\partial N} > 0.$$

Imposing a zero profit condition and solving for the equilibrium number of families, we can derive the relationship between market competitive structure and market characteristic. We use as proxy of market competitiveness the number of competing managing companies.

The first intuitive result is that the bigger the potential demand (*N*) and the more heterogeneous the market is (μ_2), the greater the number of managing companies existing at equilibrium.

An interesting result is the negative relationship between the number of companies and category's average rate of return. The lower the rate, the lower the pressure on the companies to provide higher performance and the lower the cost of operating on the market and therefore, the greater the number of competing companies. Analogously, the number of companies entering a category is a positive function of the benefits the category provides in terms of both positive signaling externality (*A*) and risk diversification (ϑ).

The number of companies is also affected by the fixed costs of entering the industry. In particular, it seems that the most important constraint is not the cost of setting up the fund, but the cost of entering the category itself. This can be interpreted as a sort of "know-how" barrier that requires companies to acquire a minimum of expertise before being able to operate in a new category.

4 Is the market providing too many funds and categories? A welfare analysis.

Let us now compare, in terms of welfare, the competitive solution with the one derived by maximizing a social welfare function. The total welfare is defined as:

$$16)\quad W = N\mu_1 \ln \sum_{j=1}^{I} \exp \frac{\mu_2 \ln(\sum_{c=1}^{G}\sum_{h=1}^{M} \frac{\exp\phi_{jhc}}{\mu_2})}{\mu_1} + \sum_{c=1}^{G}\pi_c$$

where the first term represents the total consumers' surplus, and the second one total producers' surplus. All the variables are defined as before.

Theorem 5: *At the optimum, the conditions are:*

$$17)\ \zeta_g + \eta + R_g(\beta_g + \vartheta_g) = 1, \quad \text{and} \quad \frac{\partial c q_g}{\partial q_g} = 1.$$

The optimal number of funds to be offered within each category is equal to:

$$18)\ M = \frac{K\mu_2}{k(\mu_1 - \mu_2)}$$

$$19)\ I = \frac{(\mu_1 - \mu_2)N}{(G-1)K}.$$

while the value of G is indeterminate.

A first observation is that, unlike the competitive case, *the degree of heterogeneity between categories affects the optimal number of funds and categories.* In particular, increasing the degree of heterogeneity within categories (μ_2) increases the number of funds and reduces the number of categories. On the contrary, increasing the degree of heterogeneity across categories (μ_1) increases the number of categories and reduces the number of funds within each category. The intuition is that the degree of heterogeneity across categories is in some way creating barriers, segmenting the market and making it more profitable to enter an additional category. Conversely, a higher degree of heterogeneity within a particular category increases the segmentation within the category, allowing more companies to operate there. Also, the number of categories and funds are inversely related to the fixed cost incurred to set them up (respectively, *K* and *k*).

We are now able to compare the competitive market solution with the welfare one. A cursory comparison shows that for most values of the parameters,[22] the difference between the competitive market solution and the welfare optimum depends on the relative size of the fixed costs (*k* and *K*). In particular, if the fixed cost of entering an additional category (*K*) is higher than that of setting up a new fund (*k*), the competitive solution provides too many categories and too few funds within each category. On the contrary, if the fixed cost of setting up a new fund (*k*), is higher than the cost of entering an additional category (*K*), the competitive solution provides too few categories and too many funds within each category.[23]

Let us now proceed to a more rigorous comparison and lets' define:

$$difm = mco - mcp \;\; and \;\; difi = ico - icp,$$

where *difm* is the difference between the number of funds within each category at the competitive solution (*mco*) and the number of funds at the optimum solution (*mcp*), and *difi* is the difference between the number of categories at the competitive solution (*ico*) and the number of categories at the optimum solution (*icp*). Using equations 8), 9), 19) and 20), we have:

$$(20)\; \frac{\partial difm}{\partial A} < 0, \frac{\partial difm}{\partial \eta} > 0, \frac{\partial difm}{\partial K} < 0, \frac{\partial difm}{\partial k} > 0, \frac{\partial difm}{\partial \mu_1} > 0, \frac{\partial difm}{\partial \mu_2} < 0, \frac{\partial difm}{\partial \zeta} < 0,$$

if we also assume that k >> K, we have:

$$(21)\; \frac{\partial difm}{\partial \Omega} > 0, \frac{\partial difm}{\partial \beta} > 0, \frac{\partial difm}{\partial \vartheta} > 0, \frac{\partial difm}{\partial R} > 0.$$

Also

$$(22)\; \begin{array}{l} \frac{\partial difI}{\partial A} > 0, \frac{\partial difI}{\partial \eta} < 0, \frac{\partial difm}{\partial \beta} < 0, \frac{\partial difm}{\partial \vartheta} > 0, \frac{\partial difm}{\partial R} <> 0, \\ \frac{\partial difI}{\partial K} < 0, \frac{\partial difI}{\partial k} > 0, \frac{\partial difI}{\partial \mu_1} < 0, \frac{\partial difI}{\partial \mu_2} > 0, \frac{\partial difI}{\partial \zeta} > 0, \frac{\partial difI}{\partial \Omega} <> 0. \end{array}$$

[22] We assume that *(G-1)K > N.*

[23] Given that the number of managing companies is indeterminate in the optimum solution, we make the comparison at the same number of managing companies. That is, we select a number of families (*G*) which is equal to that of the competitive solution.

These are the determinants of the difference between the optimum and the competitive solution.

- The first result is that an increase in the *degree of heterogeneity* among categories (μ_1) induces too many funds and too few categories, while an increase in the degree of heterogeneity within each category (μ_2) induces too many categories and too few funds. Therefore the optimal number of funds and categories cannot be determined a priori, but depends on investors' characteristics.

- The second result is that the "*externalities*" that determine category proliferation are also the ones that induce welfare reducing effects. In particular, the *signaling externality* (*A*) generates a solution with too many categories and too few funds within each category. Managing companies' efforts to differentiate themselves using techniques such as "flagship funds" stimulate category proliferation, reducing welfare.

Also the *hedging externality* (ϑ) induces both too many funds within a category and too many categories. The intuition is that the fact that managing companies use their funds to hedge risk induces them to establish too many funds within each category. Each single company considers only the effects in terms of its own risk diversification, without internalizing the cost it is putting on the industry as a whole in terms of excessive number of funds.

Risk aversion and "learning by doing externality" also play a role, as the more risk averse the managers are and the higher the know-how that can be accumulated by specializing in a particular category, the more managers will resort to fund proliferation, over-providing funds.

Analogously, an increase in the average return (η) induces too many funds and too few categories.

- Finally, the probability that the market provides the optimum number of funds and categories is affected by the fixed costs. In particular, the fixed cost to enter a new category induces both too many funds per category and too many categories, while an increase in the fixed cost to set up a new fund induces both too many categories and too many funds within a category.

5 Conclusion

In the present paper, we have provided an industry-specific micro foundation that integrates a financial economics and industrial organisation to address the issue of what is driving fund and category proliferation in the mutual fund industry. We have shown that these phenomena could be interpreted as marketing strategies used by the managing companies to exploit investors' heterogeneity. We have argued that these marketing strategies hinge upon *investors' limited information* and on the *identifications of the investors with heterogeneous consumers*.

In particular, we have shown that investors' heterogeneity, by itself is only a necessary, but not a sufficient condition to justify category proliferation, and we have identified three competing effects to explain category and fund proliferation. They are "signalling externality", "hedging externality" and "learning-by-doing externality".

We have shown that the market competitive solution can over-provide categories and under-provide funds within each category, if compared to the welfare optimum, and we have explained such a difference in terms of market structure and the managing company's overall cost-performance characteristics.

We have derived close form solutions for the equilibrium level of performance, the number of categories and the number of funds within each category that can be directly empirically estimated. In particular, we have provided a structural specification of *performance as endogenous function of investors' and managing companies' tastes and technology.*

The model we propose lends itself to useful applications and extensions. In particular, it would be worth endogenizing the relationship between the mutual fund industry and financial markets in general. This would consider how mutual funds managers act strategically to increase, not only their respective market share within the mutual fund industry, but also the overall market share of the mutual fund industry vis-à-vis other alternative sources of investments, (stocks, bonds, derivatives) and other financial intermediaries (banks, insurance companies).

Future research may also focus on the empirical implications of estimating a fully-fledged structural specification of performance versus the traditional estimated reduced form ones.

APPENDIX

Proof 1: See Anderson, De Palma and Thisse (1994).

Proof 2: At the first stage, we solve the sub-game in terms of net performance and net services provided. We therefore assume that the company chooses performance net of management fees and services net of load fees. This hypothesis simplifies the calculations, without reducing the explanatory power of the model.

The managing company maximises:

$$Max_{\{pe_{ikg},q_g\}}E\left\{V\left[\sum_{j=1}^{I}\sum_{h=1}^{M_j}\left[N(p_{jhg}-cq_{jg}-cpe_{jhg})P_{jhg}-k_g-K_g\right]\right]\right\}$$

with respect to p_{ikg} , q_g , pe_{ikg} , for all *j=1,...,i,...I* and *h=1,...,k,...,M*. This yields:

$$1)E\{\frac{\partial V}{\partial \pi_g}\frac{\partial \pi_g}{\partial pe_{ikg}}\}=E\left\{\begin{array}{l}\frac{\partial V}{\partial \pi_g}[-P_{ikg}(\frac{\partial g(.)}{\partial pe_{ikg}}+\varepsilon_i)+\\ \sum_{j=1}^{I}\sum_{h=1}^{M_g}(p_{jhg}+p_g-cq_{ig}-cpe_{ihg})\{-\frac{1}{\mu_2}P_{jhg}(-A_{jg}+\Delta_{jg}+P_{g|j}A_{ig})+\\ \frac{1}{\mu_1}(\Delta_{jg}+A_{ig}P_{g|j}-A_{ig}\sum_{j=1}^{I}\Delta_j P_j P_{g|j}A_{ig}-P_{ikg})P_{jh}\}+\\ (p_{ikg}+p_g-cq_{ig}-cpe_{ikg})\frac{1}{\mu_2}P_{ik}+\\ \sum_{h=1}^{M_u}(p_{ihg}+p_g-cq_{ihg}-cpe_{ihg)})(\frac{1}{\mu_1}-\frac{1}{\mu_2})P_{ih}P_{H|ig}]\end{array}\right\}=0$$

$$2)E\{\frac{\partial V}{\partial \pi_g}\frac{\partial \pi_g}{\partial q_g}\}=E\left\{\begin{array}{l}\frac{\partial V}{\partial \pi_g}[-P_g+\sum_{j=1}^{I}(p_{ikg}-cq_{ikg}-cpe_{ikg})\left[\frac{1}{\mu_2}(P_{g|j}-1)-\frac{1}{\mu_1}P_{g|j}\right]\sum_{h=1}^{M_j}P_{jhg}+\\ \frac{1}{\mu_1}P_g\sum_{j=1}^{I}(p_{ikg}-cq_{ikg}-cpe_{ikg})\sum_{h=1}^{M_j}P_{jhg}]\end{array}\right\}=0$$

where $A_{ikg}=\frac{\partial \Psi_{ig}}{\partial pe_{ijg}}$, that is the effect on managing company *g*'s global rankings induced by the performance of some of its own funds' performances, while $\Delta_{ig}=\sum_{\substack{c=1\\c\neq g}}^{G-1}\frac{\partial \Psi_{ic}}{\partial pe_{ijc}}$, is the effect on managing company *g*'s global rankings induced by the performance of its own funds' performances.

Assuming that $cpe_{ikg} = \frac{pe_{ikg}\zeta_g}{M_{ig}} + pe_{ikg}\varepsilon_i$, where $\varepsilon_i \approx N(\eta_i, \sigma_i)$, eq. 1) becomes:

$$3)\ P_{ikg} = \frac{\sum_{j=1}^{I}(\frac{1}{\mu_1} - \frac{1}{\mu_2})P_{g|j} + \sum_{j=1}^{I} a_{jg}\frac{1}{\mu_2} - \frac{1}{\mu_1}\sum_{j=1}^{I} a_{jg}P_g}{(\frac{\partial cpek_{ikg}}{\partial pe_{ikg}} + E[\varepsilon_i] + R\,\mathrm{cov}[\pi_g \varepsilon_i]) + (\frac{1}{\mu_2} - \frac{1}{\mu_2})mu_{ig}P_{g|i} - mu_{ig}\frac{1}{\mu_2} + \frac{1}{\mu_1}\sum_{j=1}^{I} a_{jg}} A_{ig}$$

for all $h \neq k$, for all *h=1,...,k,...,M*.

To express the results in terms of risk aversion, we used the property that, given two random variables, *E[x,y]=E[x]E[y]+Cov[x,y]*, and Stein's Lemma, which states that, given two random variables *x* and *y*, bivariate normally distributed and a function g(x), differentiable and satisfying some regularity conditions, we can write:

$$4)\ \mathrm{cov}(f(x), y) = \mathrm{cov}(x, y)E\{\frac{\partial[f(x)]}{\partial x}\}.$$

In our case, the two random variables are cpe_{ikg} and ε_i, while the *f* function is the profit functions $\pi_g(cpe_{ikg})$. It satisfies the differentiability and regularity conditions required by Stein's Lemma. The company *g*'s absolute risk aversion is :

$$R_g = -\frac{\frac{\partial^2 V(\pi_g)}{\partial\ (\pi_g)^2}}{\frac{\partial V(\pi_g)}{\partial(\pi_g)}}.$$

Then, substituting equation 2 into equation 1, after some simple manipulations, we get:

$$(5)\quad \begin{aligned} mu_{ikg} &= \left[\frac{\partial c_{qg}}{\partial q_g}A_{ig}\frac{1}{P_{ikg}} + \frac{\zeta_g}{M_{ig}} + E(\varepsilon_i) + R_g\,\mathrm{cov}(\pi_g, \varepsilon_{ig})\right]\frac{\mu_2}{(1-P_g)} = \\ &\mu_2\left[\frac{\partial c_{qg}}{\partial q_g}A_{ig}\frac{1}{P_{ikg}} + \frac{\zeta_g}{M_{ig}} + \eta_i + R_g(\vartheta_{ig}I_{ig} + \beta_{ig})\right]\left[1 + \frac{\Omega_{ig}}{\mu_2}\right], \end{aligned}$$

for i=1,...,i,..., I_g *, where:*

$A_{ig} = \dfrac{\partial \Psi_g}{\partial pe_{ikg}}$, $\eta_i = E(\varepsilon_i)$, $\mathrm{cov}(\pi_{ig}, \varepsilon_{market}) = \vartheta_{ig} I_g$, $\beta_{ig} = \mathrm{cov}(\pi_{ig}, \varepsilon_i - \varepsilon_{market})$,

$$\Omega_g = \mu_2 \frac{\sum_{j=1}^{I}\sum_{h=1}^{M} \exp(\frac{\phi_{jhg}}{\mu_2})}{\sum_{\substack{c=1 \\ c \neq g}}^{G-1}\sum_{i=1}^{I}\sum_{h=1}^{M} \exp(\frac{\phi_{jhc}}{\mu_2})}.$$

Proof 3: To solve the model at the next stage of the game, we impose symmetry among funds and categories, assuming that the mark-up is the same across funds in different categories, that is, $mu_{jhg} = mu_{jg} = mu$, for all *j=1,…I,…I* and *h=1,…,k,…M*. Also, since we seek a symmetric solution, we assume that all the competing families offer the same number of funds within each category and enter the same number of categories $(respectively\ M_c\ and\ I_c,\ for\ each\ j = 1,...,i,...I\ and\ for\ each\ c \neq g)$. Applying the results from Anderson, De Palma and Thisse (1994), we know that there exists a unique price equilibrium for the subgame at which the managing company *g* establishes M_g funds and enters I_g categories, while the competitors establish M_c funds and enter I_c categories, for each j = 1,…,i,…I and c ≠ g. The managing company maximizes profits with respect to the number of funds within each category (M_g, I_g), that is:

$$6)\ Max_{\{I_g, M_g\}} \pi_g = Max_{\{I_g, M_g\}} \sum_{j=1}^{I_g} \left\{ Nmu_{jg} P_{jg} - M_g k_g - K_g \right\}$$

for all *j=1,..,i,...I*. We impose a symmetric solution, and assume that different managing companies have the same cost and performance structures, such that:

$$\beta_g = \beta_g = \beta,\ k_g = k_c = k,\ K_g = K_c = K,\ cq_g = cq_c = cq,$$
$$\Omega_g = \Omega_c = \Omega;\ \zeta_g = \zeta_c = \zeta; R_g = R_c = R;\ A_g = A_c = A;$$

Deriving the FOCs, after some tedious algebra, we get:

$$(7)\ M = \frac{\vartheta R \zeta}{2A\zeta \frac{\partial cq}{\partial q} + (\eta + \beta R)\left[\vartheta R - \frac{K}{\Omega N}\right] + \frac{k}{\Omega N}\zeta}$$

and

$$(8)\ I = \frac{2A\zeta\frac{\partial cq}{\partial q} + (\eta+\beta R)\left[\vartheta R - \frac{K}{\Omega N}\right] + \frac{k}{\Omega N}\zeta}{\vartheta R(\frac{K}{\Omega N} - \vartheta R)}.$$

Assuming that N is sufficiently greater than k and K, the most of the derivatives have well defined signs:

$$\frac{\partial M}{\partial A} = \frac{-2R\vartheta\zeta^2\frac{\partial c_q}{\partial q}}{\left[(\eta+\beta R)\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + 2A\zeta\frac{\partial c_q}{\partial q} + \frac{k\zeta(G-1)}{\mu_2 N}\right]^2} < 0;$$

$$\frac{\partial M}{\partial \eta} = \frac{-R\vartheta\zeta\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right)}{\left[(\eta+\beta R)\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + 2A\zeta\frac{\partial c_q}{\partial q} + \frac{k\zeta(G-1)}{\mu_2 N}\right]^2} < 0;$$

$$\frac{\partial M}{\partial \beta} = \frac{-R^2\vartheta\zeta\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right)}{\left[(\eta+\beta R)\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + 2A\zeta\frac{\partial c_q}{\partial q} + \frac{k\zeta(G-1)}{\mu_2 N}\right]^2} < 0;$$

$$\frac{\partial M}{\partial \vartheta} = \frac{-R^2(\eta+\beta R)\vartheta\zeta}{\left[(\eta+\beta R)\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + 2A\zeta\frac{\partial c_q}{\partial q} + \frac{k\zeta(G-1)}{\mu_2 N}\right]^2} + \frac{R\zeta}{\left[(\eta+\beta R)\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + 2A\zeta\frac{\partial c_q}{\partial q} + \frac{k\zeta(G-1)}{\mu_2 N}\right]} > 0;$$

$$\frac{\partial M}{\partial R} = \frac{-R\vartheta\zeta\left[(\eta+\beta R)\vartheta + \beta\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + R\vartheta\right]}{\left[(\eta+\beta R)\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + 2A\zeta\frac{\partial c_q}{\partial q} + \frac{k\zeta(G-1)}{\mu_2 N}\right]^2} + \frac{-\vartheta\zeta}{\left[(\eta+\beta R)\left(R\vartheta - \frac{K(G-1)}{N\mu_2}\right) + 2A\zeta\frac{\partial c_q}{\partial q} + \frac{k\zeta(G-1)}{\mu_2 N}\right]} > 0;$$

$$\frac{\partial M}{\partial k}=\frac{-(G-1)R\vartheta\zeta^{2}}{\mu_2 N\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}<0;$$

$$\frac{\partial M}{\partial K}=\frac{-(G-1)R(\eta+\beta R)\vartheta\zeta}{\mu_2 N\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}>0;$$

$$\frac{\partial M}{\partial \zeta}=\frac{-\left(2A\frac{\partial c_q}{\partial q}+\frac{K(G-1)}{N\mu_2}\right)R\vartheta\zeta}{\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}+\frac{R\vartheta}{\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]}<0;$$

$$\frac{\partial M}{\partial\left(\frac{\partial c_q}{\partial q}\right)}=\frac{-2AR\vartheta\zeta^{2}}{\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}<0;$$

$$\frac{\partial M}{\partial\left(\frac{\partial c_q}{\partial q}\right)}=\frac{2AR\vartheta\zeta^{2}}{\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}<0;$$

If we also assume that *k* is sufficiently greater than *K*, we can sign the following derivatives:

$$\frac{\partial M}{\partial G}=\frac{-R\vartheta\zeta\left(\frac{k\zeta-K(\eta+\beta R)}{\mu_2 N}\right)}{\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}>0;$$

$$\frac{\partial M}{\partial \mu_2}=\frac{-R\vartheta\zeta(G-1)\left(K\eta+\beta KR-k\zeta\right)}{\mu_2^2 N\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}>0;$$

$$\frac{\partial M}{\partial N}=\frac{-R\vartheta\zeta(G-1)\left(K\eta+\beta KR-k\zeta\right)}{\mu_2 N^2\left[(\eta+\beta R)\left(R\vartheta-\frac{K(G-1)}{N\mu_2}\right)+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}\right]^2}<0.$$

For the determinants of the optimal number of categories to be entered, instead, it is enough to assume that N is sufficiently greater than k and K, to have all the derivatives with well defined signs:

$$\frac{\partial I}{\partial A}=\frac{2\frac{\partial c_q}{\partial q}\zeta}{R\vartheta\left(\frac{K(G-1)}{N\mu_2}-R\vartheta\right)}>0.$$

$$\frac{\partial I}{\partial \eta}=-\frac{1}{R\vartheta}<0.$$

$$\frac{\partial I}{\partial \beta}=-\frac{1}{R\vartheta}<0.$$

$$\frac{\partial I}{\partial \vartheta}=\frac{\mu_2 N(\eta+\beta R)}{\vartheta[-K+GK-\mu_2 NR\vartheta]}+\frac{(\eta+\beta R)\left[R\vartheta-\frac{K(G-1)}{\mu_2 N}\right]+2A\zeta\frac{\partial c_q}{\partial q}+\frac{k\zeta(G-1)}{\mu_2 N}}{\vartheta\left[\frac{K(G-1)}{\mu_2 N}-R\vartheta\right]^2}+$$

$$\frac{(\eta K(1-G)+\beta KR(1-G)+\eta\mu_2\vartheta NR+\beta\mu_2 NR^2\vartheta-k\zeta+Gk\zeta+2AN\zeta\mu_2\frac{\partial c_q}{\partial q}}{R\vartheta^2(K(1-G)+NR\mu_2\vartheta)}>0;$$

$$\frac{\partial I}{\partial R}=\frac{(\eta K+\beta KR(1-G)+\eta\mu_2\vartheta NR+\beta\mu_2 NR^2\vartheta-k\zeta+Gk\zeta+2AN\zeta\mu_2\frac{\partial c_q}{\partial q}}{R^2\vartheta(K(1-G)+NR\mu_2\vartheta)^2}<>0;$$

$$\frac{\partial I}{\partial k}=\frac{\zeta(1-G)}{R\vartheta(K-GK+\mu_2 NR\vartheta)}>0;$$

$$\frac{\partial I}{\partial K}=\frac{\zeta(G-1)\left(k-kG-2AN\mu_2\frac{\partial c_q}{\partial q}\right)}{R\vartheta(K-GK+\mu_2 NR\vartheta)^2}<0;$$

$$\frac{\partial I}{\partial \zeta}=\frac{-k+Gk+2AN\frac{\partial c_q}{\partial q}\mu_2}{R\vartheta(-K+GK-\mu_2 NR\vartheta)}>0;$$

$$\frac{\partial I}{\partial G}=-\frac{\mu_2 N\zeta\left(2AK\frac{\partial c_q}{\partial q}+kR\vartheta\right)}{R\vartheta(K-GK+\mu_2 NR\vartheta)^2}<0;$$

$$\frac{\partial I}{\partial \mu_2} = -\frac{(G-1)N\zeta\left(2AK\frac{\partial c_q}{\partial q} + kR\vartheta\right)}{R\vartheta(K - GK + \mu_2 NR\vartheta)^2} < 0;$$

$$\frac{\partial I}{\partial N} = \frac{(G-1)\mu_2\zeta\left(2AK\frac{\partial c_q}{\partial q} + kR\vartheta\right)}{R\vartheta(K - GK + \mu_2 NR\vartheta)^2} > 0;$$

$$\frac{\partial I}{\partial\left(\frac{\partial c_q}{\partial q}\right)} = -\frac{2AN\zeta\mu_2}{R\vartheta(K - GK + \mu_2 NR\vartheta)} > 0.$$

Corollary 1: Using equation 5), we can write:

$$9)\quad gpe - p = pe = \frac{\mu_2(1+\Omega)N\left[\frac{\partial c}{\partial q}AMI + \zeta + \eta + R\beta\right] - cq}{\zeta + \eta + R(\beta + \vartheta)} =$$

$$= \frac{\mu_2\left(1+\frac{G}{G-1}\right)N\left[\zeta\left(1+\frac{A\frac{\partial c_q}{\partial q}G}{[(G-1)K - G\vartheta R]}\right) + \eta + R(\beta+\vartheta)\right] - cq}{\zeta + \eta + R(\beta + \vartheta)}.$$

Proof 4: The free-entry equilibrium number of families is calculated substituting for *M* and *I* in the profit function and imposing a zero profit condition. The number of families (*G*) can be found solving the following cubic equation:

$$10)\quad \begin{aligned}&(G-1)^3(d^2k^2K - bdkK^2 - cdK^3) + \\ &(G-1)^2(-cd^2k^2 + 2bcdkK + 2ad^2kK + 2c^2dK^2 + cd^2K^2) + \\ &(G-1)(-bdc^2k - 2acd^2k - ad^3k + b^2dK - c^3dK + abd^2K - c^2d^2K) + \\ &(-cdb^2 - abcd^2 - 2a^2d^3) = 0\end{aligned}$$

Given that an explicit solution for G would be too complicated, we report only the derivatives of *G* with respect to the main parameters. The derivatives are calculated by simulation, experimenting with different parameters.

Proof 5: The Central Planner maximises total welfare with respect to $q_g, pe_{ikg}, M_{ic}, I_c, G$ for all j=1,...,i,...I and h=1,...,k,...,M and c=1,...,g,...G. Total welfare is defined as the sum of consumer surplus and total profits.

$$11)\quad W = N\mu_1 Log(\sum_{j=1}^{I}\exp\left\{\frac{\mu_2 Log[\sum_{c=1}^{G}\sum_{h=1}^{M_{cj}}\exp(\frac{\phi_{jhc}}{\mu_2})]}{\mu_1}\right\} + \sum_{c=1}^{G}\pi_c \quad ,$$

Solving for the optimal level of net performance and additional services, the FOCs are, respectively:

$$12)\quad \mu_1\left\{\zeta_i + \eta_i + R_i(\beta_i + \vartheta_i) + \frac{1}{\mu_1}\sum_{j=1}^{I}P_j mu_j\right\} = mu_i$$

$$13)\quad \mu_1\left\{(\frac{\partial cq_i}{\partial q_i} - 1 + \frac{1}{\mu_1}\sum_{j=1}^{I}P_j mu_j\right\}\frac{1}{1-P_i} = mu_i$$

From eq.12) we have:

$$14)\quad \zeta_g + \eta + R_g(\beta_g + \vartheta_g) = 1, \quad \text{and} \quad \frac{\partial cq_g}{\partial q_g} = 1.$$

Then, solving for the optimal number of funds in each category, the number of categories and the number of families, we have the FOCs:

$$15)\quad \frac{\mu_2}{M} - IGk = 0,$$

$$16)\quad \frac{(\mu_1 - \mu_2)}{GK_g} - I = 0,$$

$$17)\quad \mu_2(\frac{1}{G} + \frac{1}{M}) - IMk - IK = 0$$

after some manipulations we get: $M = \frac{K\mu_2}{k(\mu_1 - \mu_2)}$ and $I = \frac{\mu_{1-}\mu_2}{(G-1)K}$, while G is indeterminate. That any number of families is consistent with the optimum.

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