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The Optimal Design of Funded Pension Plans: Unbundling Financing and Investment*

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Abstract

The design of fully funded pension plans is affected by governance and incentive problems, as underlined by the experience of several countries. The analytic perspective of contract theory allows to detect the nature of such problems: pension-fund managers have strong incentives to manipulate market expectations about their capacity through wasteful activities (e.g. marketing). The design of funded pension plans has, thus, to trade-off efficiency losses and gains linked to high-powered incentives associated to the competition among fund managers. By means of a simple theoretical setting, this trade-off is shown to be driven by the integration of financing (contribution collection) and investment (asset allocation and management) activities. A separation of financing and investment allows to centralize the former and allocate collected money to a sector of competitive fund managers, via an auction mechanism. Under contract incompleteness, the quasi-competitive setting of funded pillar is proven to be Pareto-superior to the market of competitive pension funds (integrating financing and investment).

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1 Introduction

Several countries passed or are currently implementing reforms of their pension systems involving a partial switch from pay-as-you-go (PAYG) to fully funded (FF) plans (Feldstein [12]). There is wide consensus on the view that old-age retirement schemes should be based on a mixed framework in which the traditional PAYG first pillar is complemented by a mandatory FF second pillar, and possibly by a voluntary third pillar; possible differences are linked to the specific development stage of involved countries (The World Bank [25]; Srinivas *et al.* [23]).

The main argument in favor of a mixed scheme and of the introduction or strengthening of FF pension plans is related to the financial crisis of PAYG systems determined by adverse demographic trends, and hence to the opportunity to implement tax-smoothing policies by accumulating capital (so called, *pre-funding*; Feldstein and Liebman [13])[1]. Other important arguments put forward to support the introduction of FF schemes are related to the enhancement of economic efficiency: (1) market allocation of private (pension) savings insures efficient allocation of capital, thus high rates of return and economic growth (production efficiency); (2) funded pensions widen individual opportunity to choose preferred risk-return bundles, thus improving individual welfare (consumption efficiency).

The current mainstream approach to pension reform (Cangiano *et al.* [6]; Schiff *et al.* [21]; Feldstein [12]) is to create (or strengthen) a financial sector characterized by special operators (the pension funds) and regulated by some governmental authority; individuals select the pension fund that will manage their *individual accounts* and, with certain limitations, the asset allocation policy. In this framework, efficiency (both on the consumption and production sides) would be driven by the competition among different pension-fund managers to attract individual retirement contributions: hence, basically by fund managers' *career concern* (Acemoglu *et al.* [1]; Besley and Prat [4]).

FF plans based on individual accounts are spreading both in quantitative terms (as a share of FF pension plans) and in different countries (Besley and Prat [5]). However, in the traditional institutional framework of some countries (e.g. USA and UK), the typical form of FF pensions used to be the company-*sponsored* plan (Davis [7]). The main difference between company-sponsored and individually-sponsored plans is the mechanism to determine pension rights. Company-sponsored plans are typically defined benefit (DB): the company defines workers' pension rights (often taking the form of annuity) and *commits* to finance it; moreover, the definition of pension rights is clearly *bundled* with other aspects of the occupational treatment that is offered to workers. Plans based on individual accounts are always defined contribution (DC): individuals (mandatorily) contribute to pension funds that commit to pay annuities determined by the financial returns on contributed capital[2]. The trend of the FF pension industry towards DC plans based on

[1] Remarking that - independently of accumulation rules - pension rights are explicit contingent liabilities of the public sector or private institutions with respect to households, the argument for pre-funding within the pension system is based on the same theoretical considerations grounding public debt policies oriented to smooth tax burden over time.

[2] At retirement age, payments of both DB and DC pension funds can take the form of capital (instead of annuities), as well; however, the possibility to obtain capital payments instead of annuities is often limited

individual accounts can be related to the structural change in the economic systems, relying more and more on the mobility of workers among different firms and regions. DB company plans are affected by a *portability* problem[3], that is easily overcame by DC plans based on individual accounts.

Another explanation of the trend towards DC plans is the risk of under-funding that has affected many company plans, often in relation with company crisis: asset management of pension funds sponsored by companies is often used as a tool to manipulate reported budgetary data of sponsors (Bergstresser *et al.* [3]). Though DB plans are affected by the risk of underfunding, approaching the problems of company pension plans to public PAYG pensions ones, the DC plans has not been free from critiques.

A major problem of DC plans based on individual accounts is the relatively high (administrative) cost for households (Mitchell [18]; Whitehouse [24]). As Diamond and Orzag [9] put it: *"Individual accounts would unquestionably entail administrative costs not present under traditional Social Security. [...] How high those costs would be in reality would depend on a number of factors, including how centralized the system of accounts was and how limited the investment choices were; the level of service provided (...); the size of the accounts; and the rules and regulations governing them. The higher the administrative costs, the lower the ultimate benefit a worker would receive, all else equal, since more of the funds in the accounts would be consumed by these costs, and less would be left over to pay retirement benefits."*

As other financial industries, pension funds are featured by scale economies. But, a wide consensus identifies an important component of high administrative costs of pension funds in the *marketing* and *switching* costs (Feldstein [12]), that are absent in company pension funds or in PAYG systems. However, supporters of reforms introducing or widening the role of DC plans based on individual accounts also stress that these costs do not *usually* overweight efficiency benefits linked to the introduction of FF plans. Admittedly, this has been a problem in Latin America experience and it is likely to suggest a more cautious approach in transition and small economies, that are featured by limited and inefficient financial markets and institutions (Cangiano *et al.* [6]; Schiff et al. [21]; Srinvas *et al.* [23]; Greco [14]).

Historical experience has shown that the risk of high costs of DC pension plans as well as the risk of underfunding of DB company plans are typically shared between pensioners and the government (either in the form of bail-out of underfunded plans or in the form of warranty of minimum returns to pensioners). To face such problems, some economists proposed to *nationalize* or centralize the funded pillar, thus benefitting of enhanced risk-pooling and low administrative costs of concentrated schemes. The potential huge size of aggregate funded pillar with respect to the economic and financial dimensions of countries (see Table 1) suggest to carefully consider the risk of political interference in economy and financial markets that such institutional solution would entail (James *et al.* [15]; Eaton and Nofsinger [11]; Feldstein [12]). A problem that can be hardly overcame by regulations,

by law.

[3]Say, limitations to full recognition of acquired pension rights among different DB plans, linked to different technical and institutional problems.

given that governments lack of effective commitment technologies to counter it (Besley and Prat [5]). Moreover, restricting public fund manager's discretion, to control the risk of political interference, is likely to waste the gains of the FF pillar, that are generated by efficient capital allocation.

A regulatory approach to tackle scale-economies and reduce marketing and switching costs has been proposed by James *et al.* ([15]): centralization of contribution collection, limitation of fund manager services (and marketing), constraints to asset allocation policies. These anticompetitive rules would reduce, though not eliminate, efficiency costs linked to competition amongst fund managers; but, this benefit is balanced by a reduction in the choice freedom of individuals among different risk-return bundles. A rather limited sacrifice, in the real world: it is, indeed, questionable whether individuals are actually able to choose their *preferred* risk-return bundle over a life-long time span; an issue related to personal agency problems highlighted by economic literature (e.g. Diamond [8]).

The experience of the last quarter of century has underlined the role of institutional design in warranting the capacity of the FF pension schemes to deliver the goods they were conceived for. Following the intuition provided by Besley and Prat [5]: much in the same way PAYG pension schemes has experienced credibility problems linked to time inconsistency of governments in managing pension rights, FF private (and public) pension plans has misperformed because of governance and incentive problems. The institutional settings adopted to carry out services like pension provision involve specific choices in terms of sharing of risks and of regulation of incentives of involved players (Acemoglu *et al.* [1]).

In a contract theory perspective, this paper develops an analysis of the optimal institutional design of DC pension plans (based on individual accounts) aiming at improving efficiency. The stylized setting of the model is characterized by individuals that (mandatorily) contribute to the FF scheme during their working life to obtain a pension in their retirement life. There is an industry of (pension) fund managers competing to increase the size of their managed assets, that cannot be distinguished on the basis of their competence (or effort). This is a major source of contract incompleteness between the sponsor of the pension plan and the fund manager. The rate of return that the fund managers are able to determine is a random variable depending on their competence and effort. However, *"[...] high-powered incentives would be costly because producers could shift their effort to unproductive activities to manipulate the market's perception of their ability [...]"* (Acemoglu *et al.* 2003, p. 3). In our setting, assuming that the FF pension plans are organized in the form of competitive pension funds, the fund managers are provided with high-powered incentives to compete and attract individuals' pension contributions; this, in turn, determines a Pareto-inferior equilibrium due to the wasteful effort that fund managers effect to manipulate market expectations.

Following the suggestion by Acemoglu *et al.* [1], a Pareto-improvement can be obtained by reducing the power of the fund managers' incentives: for example, by creating larger (less competitive) pension funds or by centralizing the FF plans in an unique (public) plan. As already argued, such institutional design solutions have been proposed in the economic literature and both are affected by a loss in terms of efficiency.

A crucial observation for our argument is that FF pension schemes integrate differ-

ent technological and economic phases. Following Besley and Prat [4] and [5], we can distinguish two main phases of FF pension plans (or, in the language of contract theory, areas of control rights): *financing* (i.e. contribution collection) and *investment* (i.e. asset allocation and management). As James *et al.* [15] and Feldstein [12] point out: investment requires specific and high value expertise and it is the driver of (capital allocation) efficiency of FF plans; conversely, financing is featured by relevant scale economies and it is likely to introduce perverse incentives, distorting asset management.

The above considerations suggest to investigate the efficiency features of an alternative institutional setting of the FF plan *unbundling financing and investment* (Greco [14] calls such institutional framework *quasi-competitive* - QC): financing is centralized, and the collected money is allocated to the fund managers through an *auction* mechanism. Then, individual pensions are determined by the average return on invested assets. The QC plan hinders any individual choice in terms of risk-return bundle, as already argued. The auction mechanism works as a commitment technology allowing the FF pillar to *select the right incentives* of the fund managers (namely, to increase actual rate of return on pension savings), disregarding wasteful activities (i.e. to manipulate market expectations)[4]. The main result of the paper is to show that the QC plan is Pareto-superior to the possible alternative integrating financing and investment (say, a market of competitive pension funds), in a setting of contract incompleteness and limited commitment capacity of government. The analysis takes into account the possibility of default of fund managers, as well.

The paper is organized as follows. In Section 2 a simple model of the economy is presented and its first best working is considered to establish a benchmark. Section 3, then, introduces asymmetric information and incomplete contracts to analyze competition of fund managers, and Section 4 shows the Pareto-superiority of a centralized mechanism that allocates pension savings to fund managers via a very simple auction. Section 5 concludes.

2 The Model

The economy is made by an infinite number of identical households of mass 1. The utility function of the representative household $u = v(w) + p_i$ is increasing in its factors' remuneration, w, and its pension p_i: the factors' remuneration is exogenous and net of mandatory contribution to the (funded) pension scheme, that is normalized to 1; the pension is determined by a defined contribution plan as $p_i = r_i \cdot (1 - \omega_i)$, the capitalization of the contribution invested through the pension-fund manager $i \in I$, r_i, net of the asset management fee, ω_i. The timing of pension financial investment requires that during the accumulation period administrative costs (say, ω_i) are paid out of workers contributions (1), the remaining funds $(1 - \omega_i)$ are actually invested in pension accumulation plan,

[4]The fundamental difference with respect to the framework of Acemoglu *et al.* [1] is that the institutional setting considered in this paper, by unbundling financing and investment phases of pension service, is able to *selectively* regulate the potential of fund-managers' incentives.

yielding a rate r_i for each invested unit of capital[5].

I is the set of fund managers collecting contributions, that depends on the institutional structure of the funded pension scheme; two alternative settings are henceforth considered: competitive pension funds, where $I = I_c \equiv \{1, ..., n\}$ is given by a (potentially infinite) number of fund managers that are freely allowed to enter the market of pension funds; and monopolistic pension fund, where $I = I_p \equiv \{P\}$ is given by an unique (possibly public) mandatory pension scheme. The gross rate of return on pension savings, r_i, is a random variable distributed following the probability function $F(r \mid \theta_i)$ (twice continuously differentiable), that depends on the intrinsic skill of the fund manager: $\theta_i \in \{0, 1\}$. The probability function is assumed to be identically and independently distributed across different fund managers, and to be featured by first order stochastic dominance: higher skill raises the probability of high rates of return on managed assets ($F(r \mid 0) > F(r \mid 1)$). Hence, the expected return is higher for high-skill fund managers than for low-skill fund managers: $E(r \mid 1) > E(r \mid 0)$.

2.1 Competitive pension funds

Let $I = I_c$; households choice of a pension fund takes place in a long run perspective. Moreover, the competitive setting affords households the right to change at any time their fund manager, paying a switching fee. To keep the analysis very simple, the switching costs between different fund managers are assumed away[6], thus households may switch among different fund managers along their working life to maximize their expected revenue, and competition among fund managers can be analyzed in a long run perspective.

Fund managers are allowed to enter asset management market at any time, choosing their skill level ($\theta_i \in \{0, 1\}$); the chosen skill level implies a fixed (non-sunk[7]) cost $C(\theta_i)$, namely: being a good (high-skill) fund managers entails a positive cost $C(1) = C \in (0, c]$; conversely, no fixed cost is associated to entry in the market as bad (unskilled) fund manager ($C(0) = 0$). Moreover, the fund manager $i \in I_c$ has to pay a marginal cost $2 \cdot c \cdot b_i$ to manage an asset mass of measure $b_i \in [0, 1]$ (i.e. the fund manager's market share, that, by the normalization of household's contribution to 1, corresponds to the mass of households served by the concerned fund manager).

Fund managers organize a retail branch of their business, ensuring them - if necessary - a suitable *marketing of their skill*, and the *collection of the contributions* from the households choosing them. A fairly realistic assumption is that, whenever information is not fully available to all households, a marketing effort $m_i \in \Re_+$ is necessary to spread the information and/or manipulate the market perception about actual fund-manager's skill. Such activities typically imply additional fixed costs for fund managers. Hence, the generic

[5]The underlying and fairly mild assumption is that the financial cost of borrowing money to cover (hence, to postpone) administrative costs during the accumulation period is higher (or equal) than the rate of return of capital accumulated in the pension scheme. Therefore, actual capital accumulation in the pension scheme is $1 - \omega_i$.

[6]This assumption does not entail a loss of generality of our main conclusion: introducing a positive switching fee reinforces all arguments in favor of monopolistic collection of pension savings.

[7]The assumption that investment in skill does not involve sunk costs is required to allow the auction mechanism in Section 4 to reach first best Pareto-efficiency.

fund manager-$\{i\}$'s marketing fixed costs are $c(\theta_i, m_i) = \gamma(\theta_i) \cdot m_i$: increasing in effort m_i, and satisfying the single crossing condition, $\partial_{m_i} c(1, m_i) - \partial_{m_i} c(0, m_i) = \gamma(1) - \gamma(0) < 0$[8]. The single crossing assumption is a relatively mild one: it implies that high-skill fund managers find it less costly to produce the same marketing effort than low-skill fund managers. In other terms, though marketing effort in itself is *cheap talking* - since it does not directly produce hard information for households about the true capacity of fund managers, by single crossing condition, we assume that it is more easy and less costly for a fund manager to tell people that he is a good one, if it is true[9].

After entering the market and choosing the skill level, each fund manager $i \in I_c$ maximizes her profit $\pi(\omega_i, m_i; \theta_i) = (\omega_i - c \cdot b_i) \cdot b_i - C(\theta_i) - c(\theta_i, m_i)$, implementing a marketing effort m_i (to spread information and/or manipulate market expectations about her skill) and fixing her asset management fee ω_i. The fund manager profit is a function of her expected market share b_i that, in turn, depends on her strategy $(\{\omega_i, m_i\})$ and on the strategy of competing fund managers $(\{\omega_j, m_j\}_{j \in I_c/\{i\}})$. Fund managers that do not cover their management and fixed costs fail. Thus, the minimum *credible* fee that fund manager can propose to households has to cover average costs. In other terms, whenever a fund manager proposes a fee that is below average costs, households anticipate that she will fail and that fund-manager loss will be covered by the return of asset management.

After each household observes fund-managers strategies $\{\omega_j, m_j\}_{j \in I_c}$ and infers their skills $(\{\hat{\theta}_j(\omega_j, m_j)\}_{j \in I_c})$, it chooses the fund managing its pension savings. Under the assumption of competitive pension funds, the market share of the fund manager $i \in I_c$ is determined as the sum of all households opting for it: $b_i = \int_0^1 b_i^h dh$, where

$$b_i^h \equiv \begin{cases} 1 & if \quad E(p_i) > E(p_j) \\ b^h \in \{0, 1\} & if \quad E(p_i) = E(p_j) \\ 0 & if \quad E(p_i) < E(p_j) \end{cases}$$

for any $i \neq j$, with $i, j \in I_c$. And, quite trivially, each household chooses the fund manager with lower management fee, for given skill

$$b_i^h \mid_{\theta_i = \theta_j} \equiv \begin{cases} 1 & if \quad \omega_i < \omega_j \\ b^h \in \{0, 1\} & if \quad \omega_i = \omega_j \\ 0 & if \quad \omega_i > \omega_j \end{cases}$$

for any $i \neq j$, with $i, j \in I_c$. Whenever households are unable to distinguish between $k \in \mathbb{N}$ (with $k \geq 2$) fund managers, they are assumed to uniformly distribute among them; thus, the market share is equal for all the concerned managers: $b = \frac{1}{k}$. Furthermore, any fund manager may ration its offer, admitting only a share $\bar{b}_i < b_i$ to benefit of her asset management service. By definition, the market share is trivial whenever $b_i = 0$ but at least one household chooses i.

[8] Namely, $\partial^2_{\theta_i m_i} c(\theta_i, m_i) = \partial_\theta \gamma < 0$.

[9] For example, we could imagine that a public authority forbids (and controls) fund managers from declaring false information, thus low-skill fund managers find more hard to circumvent such limitation by marketing effort.

In the long run market equilibrium: (1) pension funds operating on the market yield non-negative profits, and (2) potential pension funds would earn negative profits whenever they enter the market (and serve a non-trivial market share - i.e. $b_i \in (0, 1]$).

2.1.1 Full information benchmark

As first, let assume that the fund manager's skill is verifiable and contractible. Under this assumption, marketing is useless and, since it increases fixed costs, fund managers optimally fix it to zero ($m_i = 0$) whatever their skill: hence, the payoff functions of high-skill fund managers are $\pi_i(\omega_i, 0, 1) = (\omega_i - c \cdot b_i) \cdot b_i - C$; while for low-skill fund managers it is $\pi_j(\omega_j, 0, 0) = (\omega_j - c \cdot b_j) \cdot b_j$.

Under full information, households are able to contractually discriminate fund managers by skill. Let $n_0, n_1 \in \mathbb{N}$, such that $n_0 + n_1 \geq 1$, be respectively the number of low- and high-skill fund managers operating on the market at equilibrium. A necessary condition, characterizing the equilibrium can be established.

Lemma 1 *If a full information equilibrium exists, all fund managers price at their marginal costs; moreover: (1) each low-skill fund manager serves a trivial market share $b(0) = 0$; (2) each high-skill fund manager serves the minimum efficient market share $b(1) = b^*$*[10].

Proof. Observe that free entry insures that all fund managers operating on the market earn zero profits, otherwise other potential fund managers would enter with slightly lower fees and steal their market share. Remark that profit maximization implies the marginal cost pricing rule ($\omega_i = 2 \cdot c \cdot b_i$), entailing positive profits for low-skill fund managers unless $b_i = 0$. Consider now the high-skill fund managers. Remark that, by assumption, $C \leq c$, hence $b^* \leq 1$. Assume, by contradiction, that (at least) the high-skill fund manager $i \in I_c$ has a market share $b_i \neq b^*$. If $b_i > b^*$, the average cost is higher than the minimum; by free entry assumption, the concerned fund manager prices at her average cost ($\omega_i = c \cdot b_i + \frac{C}{b_i} > c \cdot b^* + \frac{C}{b^*}$). However, this is incompatible with the existence of the equilibrium[11]: hence, $b_i \leq b^*$, for any $i \in I_c$. Assume, now, that $b_i < b^*$: the average cost is higher than the minimum; by free entry, the concerned fund manager prices at her average cost: $\omega_i = c \cdot b_i + \frac{C}{b_i}$. If at least another high-skill fund manager j operating on the market has $b_j < b^*$, with fee $\omega_j = c \cdot b_j + \frac{C}{b_j}$, she can make positive profits by an appropriate reduction of her fee, thus attracting a portion of the market share of i. Thus, assume that all fund managers but i operate at the minimum efficient scale (b^*) and - by free entry assumption - price at their marginal (and average) cost. In such a case, households served by i (at an higher fee) would opt for others but are rationed. But, any other high-skill fund manager makes positive profits by increasing fee and widening market share. That

[10] Where $b^* \equiv argmin \quad c \cdot b + \frac{C}{b} \quad = \sqrt{\frac{C}{c}}$.

[11] Another high-skill fund manager, j, may enter the market offering a contract to a rationed market share $\bar{b}_j \in [b^*, b_i)$ at a fee ω_j below ω_i - thus attracting potentially the entire market share of i - and above the corresponding average cost ($c \cdot \bar{b}_j + \frac{C}{\bar{b}_j}$) - thus, earning a positive profit.

contradicts the equilibrium assumption. ■

Lemma 1 implies that, in equilibrium (provided that it exists), all fund managers with the same skill implement the same strategy and, therefore, the households distribute uniformly among fund managers with the same skill, namely: the equilibrium strategy of low-skill managers entails $\omega(0) = b(0) = 0$, and the one of high-skill managers is such that $b(1) = b^*$, and $\omega(1) = 2 \cdot \sqrt{c \cdot C}$.

Now, household's (equilibrium) choice between low- and high-skill fund manager can be determined. Throughout the paper, we assume that the sufficient condition

$$E(r \mid 1) \cdot \left(1 - 2 \cdot \sqrt{c \cdot C \cdot \frac{\gamma(0)}{\gamma(0) - \gamma(1)}}\right) > E(r \mid 0) \tag{1}$$

holds, insuring that at the equilibrium (independently of the assumption about information completeness) each household strictly prefers an high-skill manager to a low-skill one.

In other terms, we assume that high-skill technology is sufficiently *cheap*, as compared to the gain in increased (expected) return[12]. Conversely, when the fixed cost associated to high-skill ($C > 0$) is excessively high with respect to the expected return differential[13], each household strictly prefers a low-skill manager to an high-skill one; so investing in high-skill technology implies an inefficient allocation of resources[14].

The following proposition characterizes the equilibrium.

Proposition 2 *Under fund managers' skill verifiability, a market equilibrium exists such that only n^* high-skill fund managers operate on the market if and only if $\frac{1}{b^*} = n^* \in \mathbb{N}$.*

Proof. By Lemma 1, low- and high-skill fund managers price at their marginal cost, hence by (1) households always opt for the latter ones that uniformly share the market among them. The sufficient condition is straightforward. For the necessary condition, if $\frac{1}{b^*}$ is not an integer the equilibrium does not exist. Assume, by contradiction, that it exists: let n^{**} be the (integer) number of high-skilled fund managers operating on the market. By Lemma 1, high-skill fund manager price at their marginal (and average minimum) cost and serve the minimum efficient market share; hence necessarily $n^{**} < \frac{1}{b^*}$, implying that a non-trivial mass $1 - n^{**} \cdot b^*$ of households would remain unsatisfied, that contradicts the the existence of the equilibrium given that some incumbent fund manager could raise her fee and serve the remaining market share. ■

In the following, we assume that the minimum efficient market share is compatible with the (full information) equilibrium, that is warranted whenever $\sqrt{c} = n^* \cdot \sqrt{C}$ with

[12]Let us remark that in the case of symmetric information, a condition $E(r \mid 1) \cdot (1 - 2 \cdot \sqrt{c \cdot C}) > E(r \mid 0)$ - less restrictive than (1) - would be sufficient. However, when asymmetric information is introduced fund managers implement strategies that increase their fixed costs (to signal their skill) and a stronger sufficient condition - say, (1) - is required.

[13]In particular, when $E(r \mid 1) \cdot (1 - 2 \cdot \sqrt{c \cdot C}) < E(r \mid 0)$.

[14]Let us remark that when $E(r \mid 1) \cdot (1 - 2 \cdot \sqrt{c \cdot C}) = E(r \mid 0)$ households are indifferent between low- and high-skill fund manager: the cost of expertise exhaust all differential expected returns.

$n^* \in \mathbb{N}$[15]. With this additional specification - insuring the existence of the equilibrium, the market of pension funds is contestable by potential new entrants, which warrants that first-best Pareto-efficient allocation is reached.

3 Competitive pension funds with unverifiable skills

Assume now that fund managers' skills are unobservable and unverifiable. In this case, the full information (separating) equilibrium is incentive incompatible for low-skill fund managers. Any low-skill fund manager can enter the market making positive profits.

Proposition 3 *Whenever marketing is hindered, only a separating equilibrium exists such that an infinite number of low-skill and no high-skill fund managers operate.*

The proof follows by a traditional *lemon-market* argument. However, high-skilled fund managers may signal their skill to the market through marketing activities, entailing higher fixed costs. As usual with only two types, two kinds of equilibria - pooling or separating - may arise.

3.1 Pooling equilibria

A pooling equilibrium is featured by an unique strategy $\{\omega^p, m^p\}$ implemented by all the n^p fund managers operating on the market. Given that in a pooling equilibrium each fund manager is perceived as having the same ex ante probability to be high-skill, say $\lambda \in (0,1)$ (that is, possibly, a function of the fund managers' strategy), the expected return of asset management of any fund manager in the pooling equilibrium is

$$E(r) = \lambda \cdot E(r \mid 1) + (1 - \lambda) \cdot E(r \mid 0)$$

And households distribute uniformly among the fund managers ($b_i = b^p$).

Is a pooling equilibrium robust to possible deviations? As usual, the answer depends on the assumptions that we make about households beliefs out of the (pooling) equilibrium. In the following, we introduce an equilibrium dominance refinement of households' beliefs facing deviations of operating (or entering) fund managers: the probability that a given

[15]It is worth remarking that if the differential in expected return is lower than the minimum average cost of the high-skill fund managers, the equilibrium exists and it is such that only an infinite number n_0 of low-skill fund managers operate on the market (while high-skill pension funds are excluded, because of their expensiveness). Such a prediction of the model is quite intuitive: whenever the financial technology of pension funds is very expensive, unskilled fund managers (say, self-made fund management) is the unique viable funded retirement plan. Finally, when the two technologies are indifferent for households, multiple market equilibrium configurations arise: only an infinite number of low-skill fund managers; only n^* high-skill fund managers; or a mix of the two. In this latter case, the necessary and sufficient condition about the compatibility between the minimum operative scale of the high-skill fund manager and the size of the market is no more necessary, given that low-skill fund manager may behave as buffer sector absorbing the market share that is not served by high-skill fund managers.

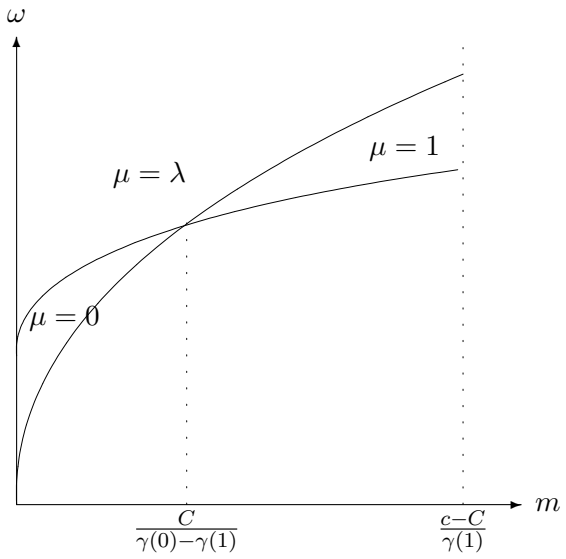

Figure 1: *Households' beliefs and fund managers' strategies*

fund manager implementing a strategy $\{\omega', m'\}$ (out of the pooling equilibrium) is high-skill is

$$\mu(1 \mid \omega', m') = \begin{cases} 1 & if \quad \pi(1, \omega', m') \geq 0 \quad \pi(0, \omega', m') < 0 \\ 0 & if \quad \pi(1, \omega', m') < 0 \quad \pi(0, \omega', m') \geq 0 \\ \lambda \in (0,1) & otherwise \end{cases}$$

Let us remark that, for a given pooling equilibrium strategy, $\{\omega^p, m^p\}$, low-skill fund managers' profit is strictly greater than high-skill one, whenever $m^p < \frac{C}{\gamma(0)-\gamma(1)}$. Conversely, low-skill fund managers' profit is strictly smaller than high-skill one, whenever $m^p > \frac{C}{\gamma(0)-\gamma(1)}$; and the profit of the two types is the same when $m^p = \frac{C}{\gamma(0)-\gamma(1)}$. By these considerations, households' beliefs can be characterized in the space of fund-managers strategies as shown in Figure 1: for relatively high fees and low marketing efforts ($\mu = \lambda$), both types of fund-manager earn non-negative profits, thus this is the region of strategies constituting potential pooling equilibria, it they exists; for intermediate fees and low marketing efforts (region $\mu = 0$), only low-skill fund-managers earn non-negative profits, while high-skill managers do not operate on the market because of negative profits, thus strategies in this region are compatible only with separating equilibria; the same is true for intermediate fees and high marketing effort (region, $\mu = 1$), where low-skill fund managers make negative profits and high-skill fund managers make non-negative profits, thus these strategies are compatible only with separating equilibria; finally, for low fees and relatively high marketing effort (blank region), no fund manager can operate and these strategies cannot be credibly implemented by any fund manager.

The characterization of pooling equilibria requires a thinner specification of households' beliefs, namely of λ, related to the strategies that are implemented by the fund managers operating on the market out of the (pooling or separating) equilibrium. What households

should rationally conclude when observing a fund manager proposing a given level of ω, out of the equilibrium (other things equal)? Without further specification of fund-managers' behaviors, here we make the rather natural assumption that households are unable to conclude anything by a deviation on ω in itself, hence: λ is unaffected by changes in ω. Thus, we have

Lemma 4 *Assume that λ is unaffected by ω, and that a pooling equilibrium exists, then it is characterized by a strategy, $\{\omega^p, m^p\}$, such that $0 = \pi(1, \omega^p, m^p) \leq \pi(0, \omega^p, m^p)$*[16].

Proof. Let $m^p \leq \frac{C}{\gamma(0)-\gamma(1)}$ (or $m^p \geq \frac{C}{\gamma(0)-\gamma(1)}$), then $\pi(1, \omega^p, m^p) \leq \pi(0, \omega^p, m^p)$ (or $\pi(1, \omega^p, m^p) \geq \pi(0, \omega^p, m^p)$). Assume, by contradiction, that high-skill (or low-skill) fund managers earn positive profits, another high-skill (or low-skill) fund manager can enter the market and earn positive profits by proposing a contract with $\omega < \omega^p$, given that households will consider him as having the same expected return than incumbents but a strictly lower cost. Now, assume that the pooling equilibrium is such that $\pi(1, \omega^p, m^p) > \pi(0, \omega^p, m^p) = 0$, then an high-skill fund manager could enter the market by proposing a slightly lower fee, keeping constant the marketing effort; households would perceive this new entrant as an high-skill (given that his strategy would be in the region $\mu = 1$). Thus, a pooling equilibrium must be such that $0 = \pi(1, \omega^p, m^p) \leq \pi(0, \omega^p, m^p)$. ■

Lemma 4 brings us to have potentially many pooling equilibria. A further specification of λ is required to determine a single equilibrium.

$$\partial_m \lambda > \frac{\gamma(1)}{E(r \mid 1) - E(r \mid 0)} \cdot \sqrt{\frac{c}{C + \gamma(1) \cdot m}} \tag{2}$$

Condition (2) implies that moving along the iso-profit curve of high-skill fund managers (i.e. selecting bundles $\{\omega^p, m^p\}$ such that $\pi(1, \omega^p, m^p) = 0$) affects the expected returns of households (via the probability that selected fund manager is an high-skill one) more than the management fee (that has to increase - or reduce - to compensate for variation of marketing effort and keep high-skill fund manager profit equal to zero). Thus, increasing the marketing effort is a worthy policy for high-skill fund managers that are able, by this strategy, to signal their capacity to the market. The economic intuition for such a specification is that households, by observing higher marketing effort are more confident - other things equal - that the concerned fund manager is a good one. In some sense, marketing entails some informational content.

Proposition 5 *Let (2) hold, then no pooling equilibrium exists.*

Proof. Assume, by contradiction, that $\{\omega^p, m^p\}$ is a (pooling) equilibrium strategy of fund managers. By Lemma (4), $\pi(1, \omega^p, m^p) = 0$, and $\pi(0, \omega^p, m^p) \geq 0$; thus, by (2), an high-skill fund manager may enter the market and earn positive profits by a suitable slight increase of m^p, and ω^p. ■

[16] Of course, single fund-manager's market share is the minimum efficient scale for high-skill fund managers.

3.2 Separating equilibrium

The analysis of pooling equilibria showed that whenever the effect of marketing on households' beliefs about fund managers is sufficiently strong, with respect to the increase of management fees, then no pooling equilibrium exists. Proposition 5 also characterizes the unique separating equilibrium of the pension funds market.

Corollary 6 *Let (2) hold, then an unique separating equilibrium exists such that only n^s high-skill fund managers operate on the market if and only if $n^s \in \mathbb{N}$. Moreover, fund managers operate at their minimum efficient scale, b^s, and earn zero profits, implementing the equilibrium strategy $\{\omega^s, m^s\}$*[17].

Proof. Assume that an unique separating exists. Let us remark that $m^s = \frac{C}{\gamma(0)-\gamma(1)}$ is the minimum marketing effort required to hinder entrance of low-skill fund managers on the market. Moreover, by free entry, high-skill fund managers operate at their minimum efficient scale ($b^s = \sqrt{\frac{C\cdot\gamma(0)}{c\cdot(\gamma(0)-\gamma(1))}}$) which implies the amount of efficient fee ($\omega^s = 2\cdot\sqrt{c\cdot C\cdot\frac{\gamma(0)}{\gamma(0)-\gamma(1)}}$). By the same argument of Lemma 2, the equilibrium exists if and only if $n^s = \frac{1}{b^s} \in \mathbb{N}$. ■

Assuming that high-skill is always a worthy investment in social terms, say that it increases the capacity of fund managers to raise rate of returns on managed assets - condition (1), asymmetric information - without any signalling technology - determines a stark inefficiency result, by forcing high-skill managers (that necessarily have to bear fixed costs) out of the market. However, following the traditional idea of signalling models, some costly activities can be undertaken by good managers to signal themselves and try to improve their payoffs. Such activities, as marketing or advertising, are here considered as pure *burning money* to show own strength and do not convey (hard) information to households about the true capacity of fund managers. In this new scenario, under the assumption (2) only high-skill fund managers operate on the market; hence, signalling is an effective technology to correct asymmetric information, but it involves a welfare loss with respect to complete information. Such welfare loss can be very intuitively measured in terms of reduction in the expected rate of return on pension savings

$$\Delta E(p) \equiv E(r \mid 1)\cdot 2\cdot\sqrt{c\cdot C}\cdot\left(\sqrt{\frac{\gamma(0)}{\gamma(0)-\gamma(1)}}-1\right) > 0$$

that becomes more and more relevant as the difference in the marginal cost of marketing of low- and high-skill fund managers ($\gamma(0)-\gamma(1)$) approaches to zero, requiring higher and higher investments in marketing to high-skill fund managers to implement a separating strategy.

[17] Where: $b^s = \sqrt{\frac{C\cdot\gamma(0)}{c\cdot(\gamma(0)-\gamma(1))}}$; $\omega^s = 2\cdot\sqrt{c\cdot C\cdot\frac{\gamma(0)}{\gamma(0)-\gamma(1)}}$; $m^s = \frac{C}{\gamma(0)-\gamma(1)}$.

4 Quasi-competition: unbundling financing and investment

In this Section, a different institutional setting is considered. A monopolistic (say, public) pension fund collects all households' contributions, that by assumption sum to 1, and allot the right to manage a portion of total asset mass to a number of fund managers through an auction mechanism. Government can design a credible mechanism allocating collected assets to fund managers participating to the auction, and involving a payment that can be linked to the true performance of fund managers.

Here is the major divide between the market of competitive pension funds and the quasi-competitive mechanism: private fund managers (competing to collect pension savings) cannot write credible contracts with workers to link their fees to asset management performance[18], in bad states (r low) they would fail and households' pension would necessarily be determined as residual claim (i.e. gross return on invested assets less operating and fixed costs of failed manager); government, on the contrary, is able to design contracts with single fund managers allowing also for their default, given that it is able to pool such risks and compensate them on aggregate.

Government has to implement an incentive-compatible auction mechanism, maximizing the aggregate rate of return - net of aggregate payments to fund managers - enticing an optimal number of high-skill fund managers to participate and low-skill fund managers not to participate (say, to self-select). Given our very simple setting, the auction designed by government is trivial.

As first, we *assume* that marketing is useless in the framework of the quasi-competitive scheme designed and implemented by government. This is not a trivial assumption: marketing, in our model, is a form of wasteful expenditure that fund managers use to signal themselves in the pension funds' market. Assuming that no other wasteful activity is relevant for the working of auction designed by government is equivalent to assume that government can credibly commit to the allocation and payment rules of optimally designed auction, and in particular not to distort such rules in relationship to wasteful activities (say, corruption).

Having assumed away marketing (or other wasteful efforts), government knows that first-best efficiency requires that only high-skill fund managers obtain the right to manage a part of aggregate collected money. In particular, the optimal number of fund managers is $n^* = \frac{1}{b^*}$, where b^* is the first-best efficient operative scale of pension-savings management. Whenever the auction mechanism is able to correctly induce self-selection of fund managers, it is well possible that more than n^* high-skill fund managers apply to manage a part of pension savings. In such a case, we assume that government select randomly just n^* fund managers[19].

The auction mechanism implies a payment from the government to each fund manager, i, actually managing a lot b^* of pension savings that depends on the performance of other

[18] By the same token, high-skill fund managers cannot design credible contracts allowing them to signal their skill through management fees instead of marketing (that would reduce the main source of pension-fund market inefficiency).

[19] To avoid any sort of inefficiency, we assumed that investment in skill is not a sunk cost. The relaxation of this assumption is an interesting area of our future investigation.

fund managers ($j \in \{1, ..., n^*\}$ and $j \neq i$) equal to $\tau(r_i, \mathbf{r}_{-i})$ (with $\mathbf{r}_{-i}$ the vector of rate of return obtained by fund managers other than i). Whenever the performance of a fund manager implies that the payment, $\tau(r_i, \mathbf{r}_{-i})$, is not sufficient to cover operative and fixed costs, then the concerned fund manager fails and its assets and liabilities are taken by government (that is the residual claimant).

Under these specifications, the program of government is

$$\begin{aligned} \max_{\tau(.)} E(r \mid 1) - \int ... \int \tau(\mathbf{r}) \cdot f(r \mid 1)^{n^*} \cdot \mathbf{dr} \\ s.t. \\ \int ... \int \tau(r_i, \mathbf{r}_{-i}) \cdot f(r \mid 1)^{n^*} \cdot \mathbf{dr} - c \cdot b^{*2} - C \geq 0 \quad (\mu) \\ \int ... \int \tau(r_i, \mathbf{r}_{-i}) \cdot f(r \mid 0) \cdot f(r \mid 1)^{n^*-1} \cdot \mathbf{dr} - c \cdot b^{*2} \leq 0 \quad (\theta) \end{aligned} \tag{3}$$

where the first constraint insures participation of high-skill fund manager (provided that other high-skill fund managers participate), and the second constraint insures incentive-compatibility of low-skill fund manager (provided that the other fund managers participating are high-skill).

Given the allocation mechanism underlying the auction, that is trivially determined by the simple structure of our problem, many different payment functions can implement it. The following lemma provides a sufficient condition characterizing a monotonic payment function.

Lemma 7 *A payment function from government to fund managers, $\tau(r_i, \mathbf{r}_{-i})$, generically non-decreasing in r_i and strictly increasing for a generic subset of values of r_i, implements the optimal auction mechanism.*

Proof. The proposition follows by the remark that participation and incentive constraints in (3) imply

$$\int \left(\int ... \int \tau(r_i, \mathbf{r}_{-i}) f(r \mid 1)^{n^*-1} \cdot \mathbf{dr} \right) \cdot (f(r_i \mid 1) - f(r_i \mid 0)) \cdot dr \geq C > 0$$

by which

$$\int \left(\int ... \int \partial_{r_i} \tau(r_i, \mathbf{r}_{-i}) f(r \mid 1)^{n^*-1} \cdot \mathbf{dr} \right) \cdot (F(r_i \mid 0) - F(r_i \mid 1)) \cdot dr \geq C > 0$$

■

The very simple auction designed by government implements the first best Pareto-efficient solution, therefore

Proposition 8 *When fund-managers' skill are unverifiable, a quasi-competitive pension scheme centralizing collection of pension contributions and allocating them through an auction mechanism is Pareto-superior to a competitive market of pension funds.*

The proof follows by the contrast of results obtained in Section 3 and in this Section, also considering that this result holds also if marketing effort is, by some regulation, assumed away in the case of the competitive pension funds, that would imply that only bad fund managers stay on the market in equilibrium.

5 Conclusion

In a very simple model, we proved that unless information about fund managers' skills is assumed complete, a competitive market of pension funds fails to reach first-best Pareto-efficient allocation. If good managers cannot signal their capacity, a stark version of the traditional lemon-market argument applies, and only bad managers stay on the market in equilibrium - given that good fund managers are unable to cover fixed costs associated to their skill. If good managers are able to signal their skill through wasteful effort, say marketing, then the equilibrium of competitive market improves but first-best efficiency cannot be reached because of the negative effect of marketing (fixed) costs on the net rate of return that is warranted to pensioners. Whenever government is able to credibly design and implement an auction mechanism allocating pension savings - that are centrally collected - to fund managers, it is able to improve on the competitive market and, in particular, it is able to reach first-best Pareto-efficiency.

Admittedly, our analysis is very simple and relies very much on the assumption that government auction is unaffected by efficiency problems. Whenever problems like corruption or similar political economy concerns are introduced in the picture, the strong result reached by this paper is likely to be revised and possibly it could be lost. However, in general we expect that the comparison between inefficient institutions (competitive market *versus* quasi-competitive mechanism) will not be trivial and a scope for the mechanism here proposed (say, to centralize collection of pension savings and to allocate them via an auction) should, generically, resist.

Another interesting extension of our model is to take into account moral hazard. Our setting is a pure adverse selection one. We expect that the introduction of moral hazard in the form of effort that fund managers can implement to move upward the probability of high rates of return do not affect very much our main results (say, the inefficiency of competitive pension funds and the superiority of quasi-competitive mechanism). However, another form of moral hazard can be relevant in this case: some payment functions implementing our mechanism provide a premium for good performances and punish with default bad performances, in a world in which fund managers choose the structure and riskiness of their portfolio such payment functions may foster investment strategies - like *gambling for resurrection* - that increase the overall default probability of fund managers. Careful analysis of the optimality features of the auction mechanism and of its robustness against such behaviors will be a subject of our future research.

Further extensions of our investigations will touch the very implementation problems that proves crucial to assess the viability of our proposal. Once implemented, a FF plan would intermediate a sizable amount of money; as argued, this is a major concern against the proposal to nationalize it (James et al. [15]; Feldstein [12]), and it is a good

reason to carefully analyze implementation technicalities. In the regime situation, the QC plan should be based on a national fund financed by a mandatory contribution on workers (and/or employers). A central authority would be responsible for it (to keep low administration costs, it could be done by the body managing the PAYG pillar). The money raised within the QC plan is lent, through the auction mechanism, to a group of primary dealers: private (and public) institutions eligible for borrowing by the national fund.

As argued the auction mechanism has a key role in warranting the *selection of incentives* of the fund managers. Therefore, the technicalities featuring the lending relationship between the national public body collecting money and the primary dealers are crucial to warrant the actual effectiveness of this selection process, and to avoid perverse effects. Future research will investigate the role of differentiation of credit riskiness among the primary dealers. The requirement of very high credit merit of the primary dealers may restrict too much their number and create problems of collusion among them. Conversely, a loose rating requirement may foster adverse selection and moral hazard problems: the worst primary dealers (in terms of credit risk) may win more auctioned funds, thus increasing the default rate of winning fund managers. In turn, these opportunistic behaviors would reduce the overall return rate of the QC plan. To avoid such problems, mechanisms based on collateralizing techniques will be considered.

Another important issue is the role of a minimum warranted rate of return for the invested contributions in the framework of a QC pension plan, taking into account the joint effect of risk-pooling implicit in the QC plan and, possibly, the insurance effect linked to the multi-pillar structure of the whole pension system (the minimum pension warranty is assured by the PAYG pillar).

Finally, possible distortions of the investment policies of the primary dealers could be introduced by the political systems through the lending relations. Given that the government cannot perfectly commit not to implement these policies, this problem cannot be overcame in the considered framework. However, such limitations to the investment policies of FF plans are actually part of many existing systems and are not specific or even enhanced within the proposed institutional setting.

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Table 1: *Pension funds' capitalization (year 2002; Source: OECD [20])*

Countries	Percent of GDP	Percent of market capitalization
Austria	4.4	26.8
Belgium	5.6	10.8
Canada	47.6	60.5
Czech Republic	3.3	22.3
Denmark	28.6	64.3
Finland	8.0	7.6
France	4.0	9.8
Germany	3.8	11.0
Hungary	5.2	26.4
Iceland	99.3	133.9
Italy	2.0	5.1
South Korea	2.2	4.8
Mexico	4.9	30.0
Netherlands	99.6	103.3
New Zeland	15.1	41.2
Norway	4.6	12.9
Poland	4.4	28.0
Portugal	13.4	37.8
Slovak Republic	20.1	46.2
Spain (year 2001)	5.9	7.4
Sweden	4.2	5.7
Switzerland	125.5	61.4
United Kingdom (year 2001)	73.3	48.4
United States	56.9	53.7
Total Euro Area	**13.4**	**30.1**
Total OECD	**27.0**	**39.1**
Brazil	9.3	37.3
Bulgaria	1.0	24.1
Estonia	14.7	49.1
Slovenia	0.4	1.5
Hong Kong and China	17.1	6.0
Indonesia	2.5	14.8
Kazakhstan	7.8	n.d.
Singapore	63.9	55.3
Thailand	8.8	22.5