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## *Can auctions help reduce mandatory pension fund fees?\**

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### Abstract

Companies that manage mandatory pension funds are frequently accused of excessive fee taking. International analyses have found that in countries with legal caps, commissions remain within these caps; hence, market competition does not function. Surprisingly, there are few international cases where local regulators implement mechanisms to facilitate competition. The variety of auction mechanisms available raises the question of whether an optimal solution exists for this purpose. Therefore, in this study, we present evidence, based on a controlled regulatory experiment, on the fee-reduction potential of reverse auctions.

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*Keywords:* FDC, mandatory pension system, reverse auctions, multi-criteria auctions, experiments.

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### 1 Introduction

Cost efficiency of the pension system is one of the factors affecting pension adequacy. In particular, the mandatory pension system should provide cost competitive solutions to retain democratic support for its existence. At the same time the actual level of commissions charged by the firms (MF) managing the pensions funds (PF) has been frequently perceived to be too high, for example, in the case of Latin

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America states (Queisser, 1998), Mexico (Aguila *et al.*, 2008), Poland (Wieteska, 2011) and the USA 401k plans as well (Ayres and Curtis, 2014). Therefore, the excessive fees seem to be a common challenge for policymakers around the globe.

In this paper we recommend the introduction of a reverse auction mechanism to facilitate fee competition, motivating our research efforts by the recent promising Peruvian and Chilean experiences. Therefore, by hiring more than 200 university students to take part in a MF market simulation experiment, we document in this study the outcomes of the controlled laboratory experiment on the role of reverse auctions. We verified three auction protocols and found the all-pay auction, which would be a true novelty in this area, to have the greatest potential for a fee reduction. Despite the fact that the experimental assumptions resemble Polish market conditions, we identify the dominant factors driving the outcomes, which should make the obtained conclusions more general. Moreover, we argue that without the use of additional solutions like auctions investigated in the paper, competition is unlikely to emerge in this market. This should motivate the appropriate regulatory bodies to reconsider the current policies, which are usually based on the use of fee-caps.

The remainder of the paper is organized as follows: Section 2 surveys the literature to address the questions why do the existing fee caps may be not enough. Section 3 provides a brief description of the Polish pension system and MF market. Section 4 presents our model. Section 5 contains a detailed description of the laboratory experiment used in this study. Section 6 reports the empirical outcomes. Section 7 concludes the study. Finally, Appendices A and B provide an in-depth analysis of the research outcomes.

## 2 Literature review

One of the most popular solutions applied in the regulatory policy of pension funds industry has been to establish fee caps. Skypala (2015) provides a meaningful illustration from the UK, where fees have risen since caps were discarded in 1980. This implies that economies of scale, which has been confirmed by many studies of the pension fund industry (e.g., Dobronogov and Murthi, 2005; James, 2005; Sy and Liu, 2010), did not translate into more favourable conditions for clients but only into bigger companies' gains (Rudolph and Rocha, 2007). In fact, in many countries with legal caps, the market average coincided with the legal maximum fees, especially in the mandatory systems (Ionescu and Robles, 2014). Consequently, caps should not be viewed as perfect tools. Additionally, doubts about the 'right' level of caps will always be present (Whitehouse, 2000).

A unique solution was employed in Sweden, where the government introduced the PPM (*Prempensionsmyndigheten*) – or Premium Pension Authority in English. PPM is a clearinghouse for fund transactions, which keeps individual accounts, collects and provides (daily) information on participating funds, provides information services to participants and is the monopoly annuity provider (Palmer, Sweden's New FDC Pension System, 2005). The collectively provided accounts' administration services drive down the actual costs for fund managers and they must rebate to PPM a share of the fees, which are further passed by PPM to investors (Sundén, 2004).

PPM can also execute its monopolistic position by requiring that the marginal cost of investing additional funds would decrease with the volume of PPM assets invested (Palmer, 2008). Additionally, charges are expressed as a percentage of PPM assets held by all the PPM funds owned by the managing company, which additionally supports the reduction of commissions.

Of course, one could argue that instead of employing the Swedish model or complex tools, like the reverse auctions advocated in this paper, the regulator could simply lower the fee caps, which would force all MFs to lower their fees. One argument against this is simple: due to the asymmetry of information, the regulator does not have perfect knowledge on how deeply it can cut the maximum fee without endangering the financial stability of MFs and the efficient functioning of the market. Any non-market intervention of that type is risky, as it might cause more problems than it solves. Auctions, as a market institution, are believed to be generally more efficient with respect to this problem,<sup>1</sup> although their relative efficiency depends on market circumstances and therefore should be experimentally tested.

Nevertheless, it is intriguing to consider why market competition has not worked. The Bertrand competition model demonstrates that even with just two firms in the market, one can expect a price war. One reason for the lack of price competition in the pension fund industry could then simply be that the market does not meet the assumptions of the Bertrand model: it can be neither homogeneous nor perfectly transparent, and additionally, members may face exit barriers<sup>2</sup> – all of which make a reduction in commissions not very profitable for a fund. Cross-country experience reveals that clients do not pay much attention to commission levels. Instead, they are mainly driven in their choices by marketing activities (advertising, promotional gifts) (Queisser, 1998; Chybalski, 2011), which have frequently constituted a significant part of MF expenditures (Impavido and Rocha, 2006). Moreover, the complexity of fees charged and the presumably low financial literacy of many clients may weaken the impact of information about commission cuts, thus additionally lowering the expected gains of such a decision by an MF.

However, even with a homogeneous and transparent market with no entry/exit barriers, price competition is not necessarily inevitable. Sweezy's kinked demand curve model of oligopoly predicts that firms would be reluctant to lower prices, as they would fear that it would be matched by a similar cut in prices by competitors. Thus, a reluctance to lower commissions might be seen as reflecting a tacit agreement among MFs. Simply, all MFs understand that cutting commissions could be a spark that would start a price war, which they want to avoid. If the deteriorating market situation or regulatory shifts do not force them to make changes, they can all stick to their initial prices for a longer period of time.

<sup>1</sup> See for instance (Wang, 1993), demonstrating a higher efficiency of auctions, compared with the posted-prices system. A fee cap introduced by the government can be looked upon as a posted price in this context.

<sup>2</sup> For example, in the case of Poland some MFs have established reduced contribution fees for long-term members. Additionally, a small one-time fee was paid by individuals who switch MFs. Nowadays, exit costs are limited to filling out the appropriate documents, which can be submitted every two years during a four-month 'transfer window' that is announced every 2 years.

This latter model may suggest that some additional tools should be utilized to induce market competition. One potential solution may be a reverse auction mechanism. In fact, some countries have already used this idea in their pension systems. Bolivia ran an international competitive bidding process to choose MFs allowed to operate in its market (von Gersdorff, 1997). A similar move was later undertaken by Kosovo, a step recognized as the main cause of much lower fees experienced in both countries compared with other economies in their regions (James, 2005). India introduced an auction in 2009 to determine the lowest cost MF. As a consequence of using an unorthodox auction mechanism, the management fee settled at close to zero.<sup>3</sup>

Other evidence that has inspired our study comes from Chile and Peru. In 2008, the Chilean government introduced a reverse auction designed to force operating MFs to lower their fee levels. In the auction, which is held every second year, MFs are asked what level of fees they would apply to new contributions. The winner, the MF that indicates the lowest price, is rewarded with the right to acquire the contributions of all new participants joining the pension system for a period of 2 years (when the next auction will be conducted). Moreover, the benefits of the lower fees are experienced by all PF participants, whose contributions are managed by the winning company, as price discrimination is not allowed so that the MF must charge all its clients the same fee. Apart from the benefit of acquiring new clients, the winning MF gains public attention and can expect additional clients who switch from MFs that charge higher fees. [Figure 1](#) demonstrates that the years after an auction brought continuing decreases in fee levels charged.

The 2012 Peruvian pension reform introduced an auction system very similar to the one successfully implemented in Chile, with the same reward system, involving the acquisition of all new clients for the following 2-year period. The reform in Peru changed the system of fees, converting from a system of fees based on salaries to a system of fees based on account balances. As all new clients will pay fees based on account balances, existing clients will be charged a mixed commission partly based on new contributions and partly based on account balances. The transition period will last until 2023 when the contribution fee disappears.

The experiences of Chile and Peru suggest that the introduction of auctions might be an efficient means of reducing fees charged by MFs. Nevertheless, before implementing a similar concept in the other market, a number of issues must be reconsidered. Up to our best knowledge, in the existing literature, there are no studies discussing the selection of the auction mechanism in this particular area. At the same time, an efficient auction design always depends on the properties of the given market and the specific goals of the auctioneer. Therefore, our research objective is to deliver a framework for setting up the laboratory experiment, which addresses these key questions. In this study, we hope to bridge this gap.

<sup>3</sup> India ran a multi-object auction to grant several licenses to manage funds gathered by the National Pension Scheme. Using a first-price sealed-bid auction, it introduced a rule that all MFs that want to acquire a license must match the lowest fee bid. As a consequence, the fee reached in 2009 was 0.0009%. In another auction, ran in 2014, the lowest fee MF bid was 0.01% (Bhaskaran, 2015).

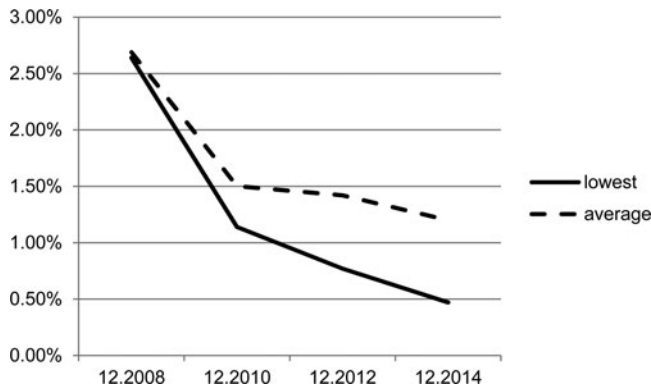


Figure 1. Changes in fee levels charged by Chilean pension funds after the introduction of the auction mechanism.

*Source:* Calculations based on statistical data from Centro de Estadísticas de Superintendencia de Pensiones, <http://www.safp.cl>. All data are for the 31.12 of the respective years. Average values are weighted by the number of fund members. The average fee level for 2014 is estimated from (Ionescu and Robles, 2014).

### 3 The pension system and MF market

To verify the hypotheses we need to establish a set of assumptions referring to the pension system and MFs market. In our model, we have decided to employ a few key points from Polish pension reality. This is due to the fact, that Poland, similarly to many Central and Eastern European (CEE) states (Schwarz, 2011), is an example of a country which has introduced the mandatory capital pension pillar according to the policy recommendations described in the seminal (World Bank, 1994) report: *Averting the Old Age Crisis*. Consequently, in this section, we sketch major elements of Polish system and underline the regional commonalities to justify the further selection of model assumptions.

#### 3.1 Polish pension system and the recent regulatory shifts in the CEE states

Poland was among the first countries in Central and Eastern Europe to implement pension reform (1999) to address the population ageing problem. The two main policy moves were the transition from a defined benefit (DB) to a defined contribution (DC) rule and establishing the funded part of the system. Under the DC rule, individual accounts are set up for participants, with fixed contributions transferred by employers and employees. The pension is calculated individually for each participant and depends solely on the value of accumulated receivables, the return on accumulated assets and life expectancy at the age of retirement. The Polish system is based on three pillars. Under the 1<sup>st</sup> pillar, receivables have a non-financial character (non-financial or notional defined contribution – NDC), whereas, under the two other pillars, financial securities are collected (funded defined contribution – FDC). In contrast to the 3<sup>rd</sup> pillar, the 1<sup>st</sup> and 2<sup>nd</sup> pillars are financed by mandatory pension

contributions.<sup>4</sup> The overall mandatory pension contribution was established at 19.52% of gross salary, with 12.22% and 7.3% divided between the 1<sup>st</sup> and 2<sup>nd</sup> pillars, respectively (Chłóń *et al.*, 1999). Until 2011, the reform did not experience any regulatory changes. That year, probably due to the worsening budgetary outlook, the contribution to the 2<sup>nd</sup> pillar was cut by 5 percentage points and the contribution to the 1<sup>st</sup> pillar increased by the same share. As the economic downturn became the global phenomenon that time, the similar policy steps reducing the contributions to the capital pillars were also introduced in the other countries of CEE region, for example, in Estonia, Latvia, Lithuania, and Romania (Velculescu, 2011).

Then, in 2014, the government introduced the default option of transferring further pension contributions solely (i.e., 19.52%) to the 1<sup>st</sup> pillar while leaving the collected financial securities in the 2<sup>nd</sup> pillar. At the same time, the T-bonds issued by the Polish government, which comprised approximately 51.5% of the PFs portfolio, were converted into 1<sup>st</sup> pillar receivables recorded on individual accounts. Again, the parallel moves oriented on transferring the assets, at least partly, to the non-financial pillar were also performed in Bulgaria and Hungary.

### 3.2 The MF market

The two main (in terms of revenues collected) types of fees charged by Polish MFs are as follows:

- (a) An upfront fee on contributions, with the maximum level set by the regulator at 1.75%.
- (b) A management fee on assets, based on a regressive algorithm, so the fee falls with the growth of pension assets. Similar to the upfront fee, a cap on marginal rates is established.

There is also a premium fee, which is charged for superior performance relative to other funds' investment results, but their importance for MFs' revenues is less significant.

As can be seen, besides the fee caps, Polish regulators have not designed any mechanism directly intended to put pressure on the funds to lower their fees, probably assuming that they would do so anyway to beat their competitors. This assumption seems plausible once we take into account a large number of competing funds. When the system was started, the number of MFs was 15. Assuming an equal market share for each firm, that meant that the Herfindahl-Hirschman Index (HHI) – which is a popular measure of market concentration (Belleflamme and Peitz, 2002) – would equal 0.0667, indicating low market concentration. The actual HHI value for the Polish market in 2015,<sup>5</sup> with 12 MFs left at that moment, was 0.1118 when measured

<sup>4</sup> However, in 2014, the government made the contribution to the capital pillar quasi-mandatory. This means that individuals may decide if his or her contribution is split between two pillars or is transferred to the 1<sup>st</sup> pillar alone. We use the term 'quasi-mandatory' to distinguish the 2<sup>nd</sup> pillar from the 3<sup>rd</sup> voluntary pillar, where none of the part of mandatory contribution can be transferred.

<sup>5</sup> Market shares are based on [http://www.knf.gov.pl/Images/Kwartalnik\\_OFE\\_2015\\_IV\\_kw\\_\(20160218\)\\_tcm75-45989.xls](http://www.knf.gov.pl/Images/Kwartalnik_OFE_2015_IV_kw_(20160218)_tcm75-45989.xls) (last accessed: 28<sup>th</sup> September 2016).

by the number of members and 0.1467 when measured by net assets, both of which imply a medium concentration level.

However, contrary to the regulator's expectations, a decrease in the level of commissions charged by the funds has not been observed. In 2016,<sup>6</sup> only two MFs have cut their upfront fees – to 1.7% and 0.75%<sup>7</sup> – while the others have retained the allowed maximum. Previously, when the cap was set at 3.5%, only two funds decided to offer marginal discounts of 0.05 and 0.1 percentage points. It must be noted, however, that a cut in the contribution fee does not lead to a severe reduction in funds' revenues, as their main revenue source is the management fee. Consequently, none of the MFs has decided to cut its marginal management fee. The data provided by Polish Financial Supervision Authority (KNF)<sup>8</sup> demonstrates that in 2015 MF revenues from contribution fees equalled 48,000,000 PLN, whereas revenues from management fees were as high as 741,000 PLN.<sup>9</sup>

The similar system of commissions can be also found in the other countries of the CEE region where the capital pension pillar is available. While in all of them the fee based on the stock of assets is charged, there are some exceptions where the fee on contribution is absent, for example, in Estonia. Together with the above mentioned recent shifts limiting the inflow of contributions, the management fee plays a principal role in the MFs revenues now or should become a dominant one in the future due to the accumulation of PFs assets.

#### 4 The model

The main hypothesis proposed in this study is that the introduction of an auction will lead to a substantial decrease in management fees, that is, the average management fee after the auction will be significantly lower than in the periods prior to it. Apart from the main hypothesis, there are additional specific hypotheses that concern individual decisions made by auction participants or the efficiency of various auction mechanisms. These hypotheses will be introduced in detail in the upcoming chapters.

Before we describe the experimental protocol, as well as the results, we need to explain the assumptions that were made in modelling the simulated market. First, we have decided to cut the number of MFs to 6, compared with 12 in the actual Polish market. This change was motivated by the feasibility of the project; with 12 students simulating one market the cost of the whole research would be too high. Even though the simulated market did not have to mimic the real one, as our goal was to compare the relative efficiency of auctions and not to make detailed forecasts, we tried to keep the concentration level in the experiment as close as possible to the real one. That was done by minimizing the difference between the real market HHI

<sup>6</sup> As on 30<sup>th</sup> September 2016 [http://www.knf.gov.pl/Images/Informacja\\_dot\\_OFE\\_26-10-2016\\_tcm75-48480.pdf](http://www.knf.gov.pl/Images/Informacja_dot_OFE_26-10-2016_tcm75-48480.pdf) (last accessed: 11<sup>th</sup> January 2017).

<sup>7</sup> In fact, 0.75% of contributions are charged by government agencies, that is, 0.4% by the Social Security Office, 0.3% by the Guarantee Fund and the rest by the Polish Financial Supervision Authority. Consequently, lowering the fee to this level results in zero profit from this revenue source.

<sup>8</sup> [http://www.knf.gov.pl/Images/Kwartalnik\\_OFE\\_2015\\_IVkw\\_k\\_tcm75-45989.xls](http://www.knf.gov.pl/Images/Kwartalnik_OFE_2015_IVkw_k_tcm75-45989.xls) (last accessed: 28<sup>th</sup> September 2016).

<sup>9</sup> 1 PLN was approximately 0.23 EUR at the end of 2015.

and the modelled one, using two HHI measures: the standard one, and the normalized one, where the latter was calculated according to the following formula:

$$nHHI = \frac{HHI - (1/n)}{1 - (1/n)}, \quad (1)$$

that is, normalized for the number of firms. This led us to a market structure with the following market shares: 29%, 26%, 20%, 10%, 10%, and 5%.<sup>10</sup>

It was assumed that costs of an MF have the following linear form:

$$TC(A) = \alpha A + \beta, \quad (2)$$

where  $TC$  is the total cost,  $A$  is the value of net assets, and  $\alpha$ ,  $\beta$  are parameters.

Although the linear form of the total cost function and the assumption that the parameters,  $\alpha$  and  $\beta$ , have the same values for all MFs are simplifications needed for experimental purposes, it turns out that the specification fits the data extremely well, showing that there are grounds for believing that variable costs depend linearly on asset value. The parameters of Equation (2) were estimated using the linear regression and data from the Polish MFs market at the end of 2015,<sup>11</sup> resulting in the values  $\alpha = 6.01$  PLN for each 1,000 PLN of net assets and  $\beta = 10.86$  mln PLN.<sup>12</sup>

MFs make decisions concerning four variables: contribution fee ( $f_C$ ), management fee ( $f_m$ ), and investment levels in two risky assets ( $r_1$ ,  $r_2$ ). The contribution and management fees cannot exceed the current caps, which are 1.75% and 0.54% (annually), respectively.

The investment decision is made as simple as possible. Participants decide only on the fraction of the money to be invested in two types of risky assets, where  $r_1$  is the amount of money invested in medium risk assets, and  $r_2$  is the amount of money invested in high-risk assets. The rest is invested in risk-free bonds. Participants know the distributions of returns from both types of investment, which are modelled to have independent normal distributions.

According to the aforementioned default option of automatic enrolment in the 1<sup>st</sup> pillar, introduced in 2014, only approximately 15% of PF members<sup>13</sup> decided to continue transferring part of their pension contributions to the 2<sup>nd</sup> pillar. Henceforth, we will call these members the *active* members and the remaining majority the *inactive* members (their accumulated funds are still managed by the MF, but no new contributions are made). When weighted by the value of assets, the share of active members is actually higher, and closer to 25% and so in the model, we assume it to be on this

<sup>10</sup> The real HHI (measured by net assets at the end of 2015) is 0.147, and the one resulting from the model is 0.214. For normalized HHI, these values are 0.0691 and 0.0574, respectively.

<sup>11</sup> [http://www.knf.gov.pl/Images/Kwartalnik\\_OFE\\_2015\\_IVkw\\_k\\_tcm75-45989.xls](http://www.knf.gov.pl/Images/Kwartalnik_OFE_2015_IVkw_k_tcm75-45989.xls) (last accessed: 28<sup>th</sup> September 2016).

<sup>12</sup> The coefficient of determination equals 0.97. The value of  $\beta$  (fixed cost) is statistically insignificant ( $p = 0.051$ ), which was expected, but the crucial point is that the value of  $\alpha$  is statistically significant ( $p = 3.410^{-09}$ ) and, moreover, quite stable over the years, as the estimated data from three other years studied yields values of 5.09 (2011), 4.45 (2012), and 5.17 (2013). In each of these years, the value of the  $\alpha$  parameter was statistically significant, and the value of the  $\beta$  parameter (the fixed cost) was statistically insignificant. This demonstrates that there are reasonable grounds to believe that variable costs do actually depend linearly on the value of net assets, a relationship that is similar across various funds.

<sup>13</sup> <http://mu.rf.gov.pl/58/art-6.html> (last accessed: 28<sup>th</sup> September 2016).



level. As only a very small percentage (approximately 1%) of new people<sup>14</sup> entering the system now decide to become members of PFs, in the model we assumed that there are no new inflows of members to the system.

The marginal analysis of the MF's profit function shows<sup>15</sup> that a decrease in the management fee by 0.01 percentage point will be profitable if it is compensated by the acquisition of additional 68,100 members. In case of the contribution fee, this number equals 1,300. Taking into account the actual shifts in the number of members observed in the Polish market, and the fact that the aforementioned threshold values are underestimated,<sup>16</sup> it is never in MF's interest to cut the management fee. In contrast to the management fee, though, one should expect a greater willingness to lower the contribution fee on the MF side. This is due to the fact that new contributions do not carry much weight in the MF revenue structure and so obtaining the new members (with their accumulated assets) might be tempting. Decisions taken by MFs in the Polish market are in line with the conclusions reached in the marginal analysis: three MFs have cut their contribution fees, and none have ever cut their management fees. The profit analysis demonstrates that it is not in an MF's interest to lower the management fee, which is why we argue for the introduction of an auction. Although this research was inspired by the Chilean and Peruvian experiences, the modelled market differs so much from the South American ones that it demands a completely different approach. First, the market concentration level is lower than that in the South American countries. Second, the Chilean auctions concerned only the fee level on new contributions, as that was the main source of revenues for MFs. As a consequence, the natural reward in the auction was the acquisition of new members. This solution created incentives for an MF to lower its fee on new contributions and to benefit new members by allocating them to the lowest cost funds. In the modelled market we have two types of fees, and it is the management fee that weighs more heavily on members. Moreover, due to recent trends observed in the CEE states, the flow of new contributions has been significantly reduced. Therefore, we modelled the number of new members entering the system to be very small, and so a reward system like that of Chile would most likely not play its allotted role in the markets like Polish one.

Thus, we suggest a different reward mechanism – that the winning MF be rewarded with the acquisition of some of the assets of already-existing members. For that purpose, the assets of inactive members could be used.<sup>17</sup> Inactive members do not pay a fee on contributions (as their new contributions are transferred to the 1<sup>st</sup> pillar only),

<sup>14</sup> <http://www.polskieradio.pl/42/273/Artykul/1267682,OFE-czy-ZUS-Mlodzi-Polacy-wyberaja-ZUS> (last accessed: 28<sup>th</sup> September 2016).

<sup>15</sup> See detailed analysis in Appendix A.

<sup>16</sup> The highest recorded quarterly net inflow of members to a single Polish PF has never been greater than 30,000. The estimated threshold values for the actual market are 590,000 (management fee), and 11,300 (distribution fee), respectively (see Appendix A).

<sup>17</sup> For example, it could be the assets of those members who were randomly drawn into the PF before the 2014 reform, as they did not submit any declaration regarding the selection of an PF. In some periods (draws were organized two times per year), the share of 'uninterested' new members even reached 50%. Hence, if they showed no interest in the selection of an PF, they should not be dissatisfied if their assets are managed by the lowest cost MF. [http://www.knf.gov.pl/opracowania/rynek\\_emerytalny/dane\\_o\\_rynku/rynek\\_ofe/Losowania\\_ZUS/losowania\\_zus.html](http://www.knf.gov.pl/opracowania/rynek_emerytalny/dane_o_rynku/rynek_ofe/Losowania_ZUS/losowania_zus.html) (last accessed: 28<sup>th</sup> September 2016).

so the fee on new contributions cannot be a criterion in the auction. Those members would only be interested in the management fee and the rate of return on their assets, so those two variables would be the criteria used in the auction.

In consequence, it was decided to experimentally test a two-criteria scoring auction, with the main criterion being the management fee and the secondary criterion being the rate of return. The rate of return is not a variable decided upon by auction participants, as its value is calculated as the actual rate of return achieved by the fund in the periods following an auction. Each fund learns about those values and points reached for this criterion prior to the auction, so it knows where it stands relative to competitors.

It is difficult to determine how the two criteria should be weighted in the scoring auction.<sup>18</sup> The rate of return might have a tremendous impact on the situations of fund members: huge profits can double the value of the fund, whereas substantial losses can consume a major part of it. The role of the management fee is less spectacular; the values it could take range between 0% (hypothetically) and 0.54% (maximum), so it would never dramatically affect the situations of fund members.<sup>19</sup>

On the other hand, the value of the management fee is stable. The clients of the winning MF are guaranteed that they will not be charged a fee higher than the declared commission for a period of 2 years. In the case of the rate of return, there is no guarantee; hence, persistence in rates of return among PFs has not been observed (Kominek, 2006).

Taking that into account, we decided to assign a much higher weight of 0.8 to the management fee and only 0.2 to the rate of return. With the maximal score set at 1,000 points, an MF can maximally reach 200 points for the rate return and 800 points for the management fee. In the case of the management fee, a linear scoring rule is used, with a maximal value of 0.54% and a minimal value of 0.3%,<sup>20</sup> that is, the score is calculated using the following formula:

$$S_m = S(f_m) = 800 \times \frac{0.54\% - f_m}{0.24\%}, \quad (3)$$

In the case of the rate of return, a linear scoring rule would be difficult to introduce, as it is hard to predict what range actual rates of returns would take, and we would like to avoid setting them arbitrarily for each new auction. For that reason, it was decided to introduce the highest bid – lowest bid scoring rule (Dimitri *et al.*, 2006):

$$S_r = S(r) = 200 \times \frac{r - r_{lowest}}{r_{highest} - r_{lowest}}, \quad (4)$$

<sup>18</sup> Moreover, if returns are purely random, the argument for a two-criteria auction disappears. In reality, a part of the pension fund portfolio may be invested in low liquid market segments, where there exists a real opportunity to employ a successful active management strategy. For this reason, we will investigate both the one criterion auction and the scoring auction to compare their results.

<sup>19</sup> However, in the current low interest rate environment, the importance of commissions charged by MFs becomes more significant.

<sup>20</sup> This value cannot be too low, as we want the auction to differentiate between participating MFs, but low enough so that MFs would have difficulties achieving it. The final set of value results from the game parameters.

where  $r_{lowest}$ , and  $r_{highest}$  are, respectively, the lowest and highest rates of return obtained by all MFs participating in the auction.

The main difference between formulas (3) and (4) is that in the former case, the threshold values are predetermined, whereas in the latter case, they result from the specific data. The consequence of this is that the MF with the lowest rate of return will earn 0 points on that criterion, and the MF with the highest rate of return will earn 200 points. The maximum 200 point differential in the case of the rate of return corresponds to a 0.06% differential in the case of the management fee, that is, by how much the poorest performing MF would have to cut its management fee to make up for lost points.

Of course, we could consider a different auction design, for example, one in which MFs declare a minimal guaranteed rate of return over the next 2 years. In the case of this auction protocol, we could consider a much higher weight for the rate of return. However, there are some risks in implementing a solution of this type. Will MFs be willing to risk declaring any positive value in such an auction? And if so, would that not result in a much safer investment policy in the coming years, providing members of the winning fund with the lowest rate of return in the market? Finally, there is an adverse selection risk. There is a danger that the MFs in the worst financial conditions would be desperate enough to risk guaranteeing positive rates of return, which could have fatal consequences in the future for both these MFs and the financial security of their clients.

A decision to use a scoring auction does not predetermine which auction mechanism is adapted. As a benchmark model, a first-score auction was the first auction mechanism we applied. Under this mechanism, participants make sealed-bids of management fees, and the winner is the MF that obtains the highest score in terms of both criteria employed. After the auction, the winning bidder applies the declared value of the management fee, which cannot be lowered for 2 years.

However, there is one flaw that arises in the application of this or any other standard auction rule. As the auction forces the winning MF to lower the management fee, it does not introduce any incentives for losing MFs to do the same. Of course, this problem has also been observed with the South American auctions described in Section 3: as Figure 1 demonstrates, the minimal fee level applied is much lower than the weighted average; the largest MFs did not necessarily cut their fees to such an extent. When planning the auction in Chile, the hope was that other MFs would be forced to lower their fees as well in response to greater market pressure and potential shifts of their members to the lowest fee fund. In Poland, due to the non-transparency of the market and the limited number of active members left, this problem might be even more serious.

Therefore, we decided to experimentally test a non-standard auction mechanism that is widely known in the auction literature, namely, a (first-price) all-pay auction (Krishna, 2002). This is a sealed-bid mechanism, just like the first-score auction, with one important difference – under this mechanism, it is not just the winner that has to pay his or her bid; the rule applies to every bid made in the auction. If the all-pay auction design was introduced in the case of the scoring auction under study, all participating MFs would have to maintain the management fees asked in the auction for a period of 2 years, even if they lose the auction. The auction theory does not

provide an unequivocal conclusion on the efficiency of all-pay auctions, given risk-averse bidders and market asymmetries (Baye *et al.*, 1996). Thus, its relative efficiency compared with the first-price sealed-bid auction must be tested experimentally.

## 5 The experimental design

The experiment was conducted as a multi-round experiment, with an unknown number of rounds and a rule that one round corresponds to 1 year in the real economy. It was designed and implemented using the zTree environment (Fischbacher, 2007). Students of the Wroclaw University of Economics voluntarily enrolled in the experiment through the Internet.<sup>21</sup> Although there were students from various years of study, who therefore had different levels of economic knowledge and experience, we did not observe any significant differences in their decisions.<sup>22</sup> The experiment began with instructions that included true or false questions to check the students' comprehension of the game rules. Following the instructions, a one-trial round was played, and all doubts concerning the rules were publicly cleared up before starting the actual experiment.

Significant parts of the instructions and explanations were intended to ensure that all students understood the incentive system. As the model was asymmetrical, with students differing in the starting numbers of assets and profits achieved, it was decided that the participants' rewards would be based on their relative performance, that is, on the extent to which they were able to increase their MF's profits. Therefore, the final reward depended on the relationship between the average profit achieved by a participant and his or her starting profit, determined by the initial game parameters.

Students could keep track of their rewards, as information about their current pay-off levels was available on computer screens throughout the game. It was emphasized on several occasions that each participant's reward depends only on his or her profits and does not depend on the profits amassed by other MFs.

As an incentive system extra points for the classes, which affected students' final grades, were awarded. There are reasons why this type of incentive was believed to work best. First, when using classroom points, we avoid any income effects, which are known as a weak point in financial rewards. All students were in a similar position: the experiments were carried out at the beginning of the semester when none of the students had any points from their courses and therefore, all students reached similar utility from each awarded point. The maximum number of points that students could win during the experiment was 10% of the total number of points from

<sup>21</sup> Using students is a standard in economic experiments. One could argue that the results of decisions taken by the actual MFs managers would be more insightful, but in fact this is not recommended. Putting aside the problem that enrolling the actual managers in the experiment would be very difficult and costly, they have a conflict of interest, that potentially could affect the results of the experiment. The fact that students are no experts in the field under study is not a problem, as long as we compare the results of various treatments, i.e. look at the relative differences in functioning of different market institutions, and not the specific values of fees reached.

<sup>22</sup> The largest group consisted of 2<sup>nd</sup> year students (39%), but 1<sup>st</sup> year (26%), 4<sup>th</sup> year (16%), and 5<sup>th</sup> year (19%) students also participated in the experiment.

the course, which is a significant reward for any student. Our experience from the previous years, concerning auction experiments with classroom points, demonstrates that this is, in fact, a very strong incentive: the number of volunteers was spectacular, participants were highly motivated, and when asked in a post-experiment survey to value one classroom point, the median answer was 30 PLN. Given an average payoff of 3.3 points, the average payoff was valued at 100 PLN, or 23 EUR,<sup>23</sup> a significant value in the case of Polish students (Kuśmierczyk, 2013). Therefore, we can say that our experience demonstrates a known fact, noted by Friedman and Sunder (1994, p. 43.): ‘grades can elicit high levels of motivation and effort from subjects without spending money’. Finally, a system of financial rewards would entail tax reporting obligations by participants, an additional obstacle that could discourage some potential volunteers.

After the instructions and the trial round, the actual experiment began. At first, students were not informed that an auction would be introduced into this market, as we needed to observe how competition would work without it. After two rounds of competition, students were informed about the auction and provided with instructions. Thereafter, the auction was run every second year.

Each decision round was followed by a results window, which provided all the necessary information:

- on the financial results of the individual MFs: revenues from all sources, costs, the rate of return, profit, number of members, and the current payoff;
- on the current market situation: fee levels and fee level changes for all MFs, rates of return achieved, shifts in the number of members, and profit changes.

Apart from the abovementioned elements, participants were allowed to use an online text messenger. Chat messages were sent to all market participants at the same time, and there was a limit of two messages per round. The chat window was introduced to facilitate potential collusion that could occur in this market. Although students were encouraged to use it freely, in fact, the chat did not play a significant role in the experiment.

All experiments were conducted using the Wrocław University of Economics’ laboratory facilities. The average time of an experiment was 2 hours, which allowed us to simulate 9 years in the market.

### *5.1 Game parameters/treatments*

Summing up, the simulation of the pension fund market was run with the following assumptions:

- A. Six MFs compete in the market, with the following market shares: 29%, 26%, 20%, 10%, 10%, and 5%.
- B. The total number of members is 16,500,000; 75% of them (i.e. 12,375,000) are inactive, and 25% (i.e. 4,125,000) are active. These numbers remain constant

<sup>23</sup> According to the exchange rate in the time of experiment (2016).

- throughout the simulation: there are no new entrants or withdrawals from the system.
- C. The members are homogeneous. As the total value of assets of all PFs is 140 billion PLN, the value of assets per member is 8,485 PLN. All active members pay a new contribution each year of 650 PLN.<sup>24</sup>
  - D. All MFs have cost functions given by (2), with  $\alpha = 3$  PLN/1,000 of assets and  $\beta = 1,000,000$  PLN.<sup>25</sup>
  - E. The maximal values of the fees match the real ones, that is, 0.54% annually in the case of the management fee and 1.75% in the case of the distribution fee. In the game, the players start with values 0.50% and 1.50% for the management fee and distribution fee, respectively, so as not to suggest to them that the maximal fees are necessarily optimal.
  - F. Apart from the decisions about fee values, participants determine what shares of assets are invested in three types of investments. The rate of return on risky investments is drawn from a normal distribution,  $N(7.58\%, 5.72\%)$ , and for moderately risky investments, the following normal distribution is used:  $N(4.29\%, 1.92\%)$ . The remaining assets are invested in a risk-free investment, with a rate of return of 2%. The randomization processes for the two risky investments are independent, as are the draws in each subsequent period. However, the draws for different members in the same decision period are not independent; in fact, the returns on risky investments of various MFs are very close to each other (they differ by random, marginal values to differentiate the final rates of return, which affect the premium fees and the auction results).
  - G. The shifts of members between the funds were calculated using a simple algorithm. It was assumed that the members might decide to change funds due to one of the three criteria: the management fee, the distribution fee, and the last round's rate of return. For each of these criteria, the maximum number of members changing funds was independently set at 1% of all active members, and potential switches of members were distributed proportionally according to the parameter values. Setting the values on these levels made a decrease of the management fee unprofitable, as determined by the theoretical analysis.<sup>26</sup> In the period just after the auction, the proportion of members considering a change of fund was increased to 5% to simulate an effect of greater awareness on the clients' side.
  - H.

<sup>24</sup> Again, 1 PLN was approximately 0.23 EUR in the time of experiment.

<sup>25</sup> The value of fixed costs was found to be insignificant and so its value was set at the arbitrary level of 1,000,000 PLN. The actual value of average variable costs is approximately 5–6 PLN/1,000 assets. In the experiment, this value was lowered to provide players with a wider range of possible choices of management fee. This does not affect the direction of the expected changes or the relative efficiency of auction mechanisms, but it does affect the final level of the management fee reached, which should be higher in the actual market. At the same time, we advocate introducing passive management in the case of pension funds, which could bring variable costs down.

<sup>26</sup> The total number of active members was 4,125,000, and at most 1% of them, that is, 41,250 were simulated to consider the change of the fund. The threshold value, making a marginal decrease of the management fee profitable, was 68,100 for the average-sized fund. Theoretically, the smallest fund could reach the inflow of members of that magnitude (for it the threshold value was 20,400 – see Appendix A), but this could only happen under very specific, and rather unlikely conditions.

With respect to the decisions periods, various pieces of information were revealed to facilitate the decision process: the expected rate of return, the expected number of members who would shift, the expected profit. Students could test all of them for various fee levels and the investment options considered. Forecasts were made with the *ceteris paribus* assumption, that is, none of the competitors change any of their parameters.

- I. To help the students make rational decisions concerning bids in the auction periods, they were given information about the estimated break-even value of the management fee, calculated from the following relationship:

$$E[TP(f_m^0 | \textit{lose}')] = E[TP(f_m^* | \textit{win}')], \quad (5)$$

where  $f_m^*$  is the break-even value of the management fee, understood as the value of the management fee that, after an MF has won an auction (and gained additional members), yields the MF the same profit it would have had, if it had lost the auction and lost 10% of its inactive members but retained a higher (current) management fee ( $f_m^0$ ). The students received exhaustive explanations of how this value should be interpreted.<sup>27</sup> Naturally, the break-even management fee values depended on the fund's market share, as it was more profitable for small funds to cut this fee. Table 1 presents the values of  $f_m^*$  at the initial market shares as well as the point advantage ( $\Delta S_m$ ) in the auction resulting from the scoring system used.

As Table 1 demonstrates, the auction was, in fact, asymmetrical, with an *a priori* advantage given to the smallest MF. The additional factor that introduces asymmetry into this market was the points received for the accumulated rate of return, which were revealed to participants prior to the auction.

Apart from multi-criteria auctions, which are our main focus of interest, we decided to run additional experiments that would test the efficiency of a one-criterion auction, that is, the auction in which the management fee is the only criterion by which the winner is established. The elimination of the accumulated rate of return from the criteria list has two important consequences, from the perspective of auction theory.

First, it makes the auction less asymmetric. The smallest funds still have an advantage, as they have a lower break-even fee, but because points for the rate of return are no longer added, no MF can be *a priori* sure of winning the auction.

Second, in a one-criterion auction, we no longer need the scoring function, as the winner is simply the MF that asks the lowest management fee. That means that the minimal value of the management fee (for two-criteria auctions, it is 0.30%) is no longer needed. It is, however, hard to predict the consequences of its elimination: on the one hand, MFs are free to offer lower fees in the auction; on the other hand, there is no natural anchor value in the game, and hence, firms might offer higher fees.

<sup>27</sup> Students were advised that this is the threshold value and that it is just an estimate that does not take into account the dynamics of the market and all potential changes. In fact, it might be optimal to bid a lower value if one has a strategic plan for a longer time span: win several auctions with low values of the management fee and then increase it, realizing that the inactive members cannot quit your fund, as they cannot take decisions of that sort. In fact, few students have been observed to use this strategy.

Table 1. *The values of the break-even management fee levels at the initial market shares*

MF	Market share (%)	$f_m^*$ (%)	$\Delta S_m$
F1	29	0.449	–
F2	26	0.445	13.33
F3	20	0.436	43.33
F4	10	0.408	136.67
F5	10	0.408	136.67
F6	5	0.376	243.33

Source: Own study.

Table 2. *The experimental treatments*

Treatment	Auction	No. of participants [ $N_i$ ]	No. of groups [ $G_i$ ]
2FSA	Two-criteria first score auction	72	12
2ALL	Two-criteria all-pay auction	90	15
1ALL	One-criterion all-pay auction	54	9

Source: Own study.

The main factor changed in subsequent treatments of the experiment was the auction mechanism. Table 2 presents information on all treatments used in the experiment.

All treatments started with two decision periods, without any information or even a hint that any auction was scheduled. As those periods are identical in all treatments, the decisions made were grouped together and are referred to as the *NA* (i.e., non-auction) treatment. In the analyses that follow, when referring to the auction treatments, we are usually comparing the results of the seven periods that followed the first introduction of an auction. Nevertheless, in a few cases, it will be helpful to use the information from all nine decision periods. To avoid unnecessary confusion, we will use the same symbols in both cases, with an additional note if needed.

## 6 Empirical findings

In this part, we start by looking at the main hypothesis, that is, whether the auctions successfully lower management fees, which is the main rationale for their potential implementation. Additionally, we will compare the efficiency of the auction mechanisms under study. A detailed analysis of the participants' strategies is presented in Appendix B.

The first observation, based on these data, is a confirmation of the prediction that with no auction, a decrease in the management fee should not be expected. The simulations were started at a value 0.5%, so the participants had to decide which was more profitable: to decrease or increase its value. The average value of the management fee in the first two periods (i.e., prior to the auction) was 0.5152%, demonstrating a shift



upward, closer to the maximal value of 0.54%. In the case of the distribution fee, shifts in value were observed in both directions, and the average value is very close to the starting one.

Auctions did generally play their role in bringing down management fees. In all cases under study, both the average and minimal values of this fee were significantly lower than before the auction. However, one of the auction mechanisms turned out to be much more efficient than the others – the two-criteria all-pay auction forced participants to cut their fees most sharply. One reason for this could be that the minimal value of 0.3% served as an anchor. A management fee that low has been observed on several occasions under treatment *2ALL* but was very rare under treatment *1ALL*.

To test the statistical significance of the management fee values, a series of statistical tests was run. Before reporting the results of those tests, however, we must look more closely at the data collected. The statistics presented in Table 3 were calculated on the basis of individual decisions taken by participating students. With seven sessions conducted in each treatment, the total number of individual decisions is 7, quite a high number. For example, under treatment *2FSA*, 504 individual decisions would be taken (see Table 2). However, the main problem with testing these individual decisions is their interdependence: it would be naive to believe that students' decisions concerning management fee levels in subsequent rounds were independent (in fact, strong dependency among those decisions was observed).

Therefore we have decided to run the statistical tests for three groups of aggregated data:

- (a) *Stud* data, that is, students' averages; for each participant just one number is taken into account, that is, the average of all decisions, which reduces the number of data to  $N_i$ ; the dependency problem is avoided, but the disadvantage is that we are unable to analyze the weighted averages, that are of most concern;
- (b) *Mark* data, that is, market averages: taking the weighted average management fee for each session, reducing the number of data to  $7G_i$ ; the benefit is working on weighted averages, but the disadvantage is the potential problem of data dependencies;
- (c) *Group* data, that is, group averages; we take just one number for each experimental group: the sessions' average value of the market-weighted average management fees; this avoids the dependency problem, and enables us to work on weighted averages, but reduces the size of a data sample to just  $G_i$ .

The reduction in the number of data could be a huge problem, as decisions concerning management fees do not follow a normal distribution; in fact, such data are not even symmetric. This necessitates the utilization of rank sum tests, which might be inconclusive, given the limited amount of data. All test results reported below were obtained using the one-tailed Wilcoxon–Mann–Whitney test (Hollander and Wolfe, 1973) in R.<sup>28</sup> The null hypothesis is that the measures of central tendency are

<sup>28</sup> R Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL <http://www.R-project.org/> (last accessed 28<sup>th</sup> September 2016).

Table 3. Fee levels prior to and after the auction (in % values)

Treatment	Management fee		Distribution fee	
	Weighted average	Lowest	Weighted average	Lowest
NA	0.5152 (0.0163)	0.4815 (0.0486)	1.5094 (0.0910)	1.2481 (0.2198)
2FSA	0.4769 (0.0232)	0.3646 (0.0442)	1.5691 (0.082)	1.2116 (0.2936)
2ALL	0.4296 (0.0294)	0.3564 (0.0435)	1.5789 (0.1168)	1.3443 (0.2292)
1ALL	0.4580 (0.0271)	0.3792 (0.0417)	1.5507 (0.1224)	1.2576 (0.3114)

Source: Own study.

Note: Weighted averages are the fee average levels weighted in all decision periods by market shares. The values in brackets are standard deviations.

equal; therefore, rejection of the null hypothesis indicates that differences between the statistics are statistically significant.

The paper's main hypothesis is that auctions help reduce the average management fee. Therefore, first, the results of treatments *2FSA*, *2ALL*, and *1ALL* were tested against the results of the *NA* treatment, that is, against data from the first two sessions, run prior to the auctions. Second, we pairwise tested the hypotheses that the management fees in treatments *2FSA*, *2ALL*, and *1ALL* are equal, with the alternative hypotheses that  $f_m^{2ALL} < f_m^{1ALL} < f_m^{2FSA}$ . Table 4 provides the p-values.

As can be seen, all test results are conclusive and strongly support all hypotheses. The management fees from the post-auction rounds are all significantly lower than those from the prior-auction rounds. The management fee level reached in the two-criteria all-pay auction (treatment *2ALL*) is significantly lower than that reached in the one-criterion all-pay auction (treatment *1ALL*), which in turn is significantly lower than that reached in the two-criteria first-score auction (treatment *2FSA*). Moreover, the test leads to a rejection of the null hypotheses even in the case of the highly reduced *group* data, which avoid the potential problem of data dependencies.

Figure 2 compares the average levels of the management fees in all treatments, showing that the higher efficiency of the multi-criteria all-pay auction is not the effect of the shock resulting from the introduction of the new, non-standard auction rule but is observed in all periods of the experiment.

More insight into potential differences in auctions' efficiencies might be gained when we more closely examine individual strategies applied in auctions, which is left for Appendix B. The analysis there shows that participants used different strategies in the auctions under study. Responding rationally to the specific rules of the all-pay auctions, they did offer higher management fees there, compared with the first-score auction. Nevertheless, unlike in the all-pay auctions, the losing participants of the first-score auction were not obliged to keep the fees on the levels bid, which resulted with the higher value of the weighted management fee in the post-auction periods.

Table 4. *P-values for Wilcoxon–Mann–Whitney test concerning the management fee values*

Tests:	Stud data	Mark data	Group data
$H_0 : f_m^{2FSA} = f_m^{NA}, H_1 : f_m^{2FSA} < f_m^{NA}$	$p = 3.5 \times 10^{-5}$	$p < 2.2 \times 10^{-16}$	$p = 3.7 \times 10^{-8}$
$H_0 : f_m^{2ALL} = f_m^{NA}, H_1 : f_m^{2ALL} < f_m^{NA}$	$p < 2.2 \times 10^{-16}$	$p < 2.2 \times 10^{-16}$	$p = 6.3 \times 10^{-13}$
$H_0 : f_m^{1ALL} = f_m^{NA}, H_1 : f_m^{1ALL} < f_m^{NA}$	$p = 1.1 \times 10^{-11}$	$p < 2.2 \times 10^{-16}$	$p = 7.9 \times 10^{-9}$
$H_0 : f_m^{2FSA} = f_m^{2ALL}, H_1 : f_m^{2FSA} > f_m^{2ALL}$	$p = 5.0 \times 10^{-11}$	$p < 2.2 \times 10^{-16}$	$p < 3.9 \times 10^{-5}$
$H_0 : f_m^{1ALL} = f_m^{1ALL}, H_1 : f_m^{2FSA} > f_m^{1ALL}$	$p = 0.0033$	$p = 2.2 \times 10^{-5}$	$p = 0.0294$
$H_0 : f_m^{2ALL} = f_m^{1ALL}, H_1 : f_m^{2ALL} < f_m^{1ALL}$	$p = 1.2 \times 10^{-8}$	$p = 0.0003$	$p = 0.006$

Source: Own study, using R.

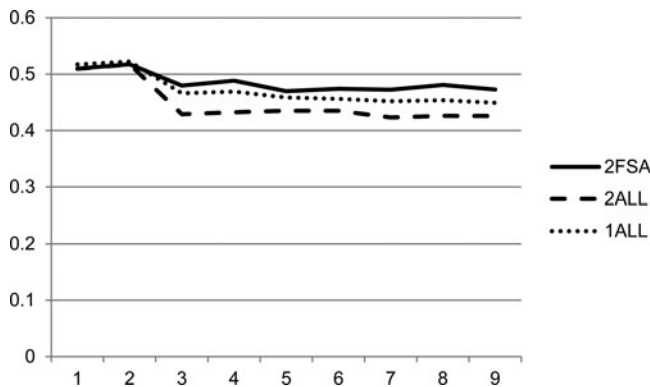


Figure 2. The average level of the management fee by rounds.

Source: Own study.

Note: The graph includes the first two periods, which took place prior to the auction.

## 7 Conclusions

The Polish MF market has been notorious for collecting the maximum available fees, which have been a source of public criticism. International experience shows that this is a universal phenomenon: given low transparency in the market and reluctance of MFs to start a price war, it is generally observed that the MFs stick to the maximal, legal fee caps.

This paper discusses the potential role of auctions in enforcing lower management fees. Unlike the Chilean and Peruvian experiences, we demonstrate that the Polish and the other pension systems in CEE face a completely different set of challenges and require a different auction system due to the dominant role of asset management fee in MFs revenues. Therefore, we propose a two-criteria scoring auction, where MFs compete on the rate of return and management fee, fighting over a chance to win part of the inactive members' assets managed by competitors. Our experiments have demonstrated that the most efficient solution might be a variant of the all-pay

auction, one that forces all MFs (and not just the winning one) to keep the management fee at a lower level.

This result is interesting for a number of reasons. First, it provides an interesting application of the all-pay auction. All-pay auctions have been known and studied in the auction literature for decades, with applications that have included the lobbying process, R&D competition, and penny auctions. Nevertheless, to the authors' best knowledge, its potential application to pensions systems has not previously been studied, and the analyses presented in this paper might provide some insight into its properties and applicability. Second, it presents an alternative to current Polish regulations, an alternative that might succeed in lowering MF costs, from members' perspectives. It is also worth to underline that even if government cancel the opportunity to transfer the part of mandatory pension contribution to the second pillar, still the MFs will manage the huge stock of assets.<sup>29</sup> Third, our results suggest that the all-pay auction (or a variant) might be a useful mechanism in all countries irrespective of the fees' structure and their importance for MF revenues. Our experiment reveals that standard auction mechanisms are not as efficient as they need to be, as they (directly) affect only the winning bidder. This finding is in line with the Chilean experiences where the difference between the lowest and the average fee level has been substantial (Figure 1). Consequently, the all-pay auction might be instrumental in reducing that gap.

A potential argument that could be raised against the application of an auction mechanism is that the auction could enforce a fee level that is so low that it would adversely affect the financial stability of MFs. This is what has actually occurred in India, where the auction has brought fees down to nearly zero and has thus been strongly criticized by market participants. However, it is well-known from the practice of auction design (Klemperer, 2004) that the auction mechanism should be carefully tailored to the properties of the specific market and the auctioneer's goals. India's auction ignited a price war<sup>30</sup> and tempted some MFs to try to expel some of their competitors from the market. Our case and the auction we are advocating for are completely different from the Indian case, as are the challenges we are facing.

Our study did not address all the problems, and it definitely must be continued. Among the unsolved problems is the role of the tacit agreement in the pension market. To give the participants in our experiments a chance to form cartels, they were given an opportunity to use chat. Unfortunately, this tool was used only occasionally and never became crucial to the functioning of the market. Therefore, we are considering introducing some changes to the communication system that will make participants feel more comfortable using it, perhaps by leaving participants unattended in the classroom and allowing for open discussion.

<sup>29</sup> This is very likely scenario for the next years in Poland according to the official government announcements. It is planned (as on January 2017) that 75% of the accumulated assets will be transferred from the 2<sup>nd</sup> to the 3<sup>rd</sup> pillar to individual accounts, hence; the challenge of the excessive fees will not disappear without additional regulatory moves. <http://www.rp.pl/Ubezpieczenia/301029930-25-proc-srodkow-z-OFE-na-FRD-75-proc-na-III-filar.html#ap-1> (last accessed 1<sup>st</sup> June 2017).

<sup>30</sup> At the same time, we find numerous examples of price wars in markets that lack the auction mechanism; hence, this risk seems unavoidable.

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### Appendix A – Threshold values of members' shifts

Let us denote the total number of PF members by  $X$  and the share of active members by  $\omega$ . PF members are modelled as homogeneous. At the beginning of the experiment, their accrued assets are set equal ( $a$ ), and in each round, active members make new contributions to the fund at the fixed value of  $c$ .

MF revenues come from three sources:

- an upfront fee from new contributions (only active members),
- a management fee, based on accumulated assets (all members),
- a premium management fee,  $f_p$ , that depends on the funds' investment results in the previous period and has a maximum value of 0.06% (annually) of acquired assets.

Summing up, MF profits each year are calculated in the following way:

$$TP(A, C, f_m, f_p, f_c) = f_m \cdot A + f_p \cdot A + f_c \cdot C - \alpha A - \beta, \quad (6)$$

or:

$$TP(X, f_m, f_p, f_c) = (f_m + f_p - \alpha) \cdot \omega X + f_c \cdot c \omega X - \beta, \quad (7)$$

where  $TP$  is total profit,  $A$  is the total value of net assets, and  $C$  is the total value of new contributions.

Two variables controlled by participants ( $f_m, f_c$ ) directly affect profits, whereas the last one ( $r$ ) affects it indirectly, as it is responsible for the rate of return earned by the fund, which in turn influences  $f_p$ . Values of these variables are also (to some extent) taken into consideration by existing and potential fund members and so affect the values of assets and contributions in the next rounds.

Let us use (7) to analyze the role of fee levels in total profits earned by calculating the partial derivatives of the  $TP$  function:

$$\frac{\partial TP}{\partial f_m} = aX + (f_m + f_p - \alpha) \frac{a \cdot \partial X}{\partial f_m} + f_c \frac{c \cdot \partial(\omega X)}{\partial f_m},$$

so that:

$$\frac{\partial TP}{\partial f_m} = aX + [a(f_m + f_p - \alpha) + c \cdot f_c] \frac{\partial X}{\partial f_m}; \quad (8)$$

and

$$\frac{\partial TP}{\partial f_c} = (f_m + f_p - \alpha) \frac{a \cdot \partial X}{\partial f_c} + c\omega X + f_c \frac{c \cdot \partial(\omega X)}{\partial f_c},$$

so that:

$$\frac{\partial TP}{\partial f_c} = c\omega X + [a(f_m + f_p - \alpha) + c \cdot f_c] \frac{\partial X}{\partial f_c}. \quad (9)$$

Using these derivatives, one can calculate how many new members an MF would have to acquire to compensate for the lower fees charged. Setting (8) equal to 0, we obtain:

$$\frac{\partial X}{\partial f_m} = - \frac{aX}{[a(f_m + f_p - \alpha) + c \cdot f_c]}, \quad (10)$$

where  $\partial X/\partial f_m$  shows the change in the number of fund members due to a change in the value of the management fee. Taking the values from the model<sup>31</sup> and applying them to (10), we find that lowering the management fee by 0.01 percentage point would be profitable for the average-sized firm if and only if it resulted in the acquisition of the additional 68,100 members. The profitability of a decrease in the management fee depends on the market share of the MF. For the smallest MF in the simulated market structure, this number is 20,400, whereas for the largest one it is 118,400.

Let us now take a closer look at (6). Setting it equal to 0, we obtain:

$$\frac{\partial X}{\partial f_c} = - \frac{c\omega X}{[a(f_m + f_p - \alpha) + c \cdot f_c]}, \quad (11)$$

where  $\partial X/\partial f_c$  shows the change in the number of fund members due to a change in the contribution fee. Again, substituting values from the model, we find that lowering the contribution fee by 0.01 percentage point would be profitable for the average-sized fund if and only if it resulted in the acquisition of the additional 1,300 members. For the smallest and largest MF in the simulation these data equal 400, and 2,300, respectively.

It is worth mentioning that the threshold values in case of the actual market are most likely higher than the numbers resulting from the theoretical analysis.<sup>32</sup>

<sup>31</sup> We used the following values:  $X = 2,750,000$ ,  $f_m = 0.54\%$ ,  $f_p = 0.03\%$ ,  $\alpha = 0.003$ ,  $a = 8,485$ ,  $c = 650$ .

<sup>32</sup> Using the value of the AVC resulting from the estimation (6.01 PLN/1000) and taking into consideration the fact that 0.75% of the distribution fee is charged by the regulator (i.e. is not a part of MFs profits) we reach that the necessary value of shifts for the average-sized firm is 590,000 in case of management fee

### Appendix B – Individual strategies

Let us now look more deeply into the participants' strategies. The simulations were always started with initial values of the contribution and management fees equal to 1.5 and 0.5%, respectively. By not starting the experiment with the maximum values, participants were allowed to judge for themselves whether upward or downward movements of those fees would be more profitable. As has already been explained, due to the non-transparency of the market, it was never beneficial to lower the management fee, and in fact, such moves were rarely observed. In their first decisions, 70.4% of participants decided to increase the management fee, and just 13.9% lowered it. In the second round of the experiment, 75% of participants kept the management fee above 0.50%, while willingness to lower the distribution fee was greater. In the first year, 44.9% of participants increased the distribution fee, but an almost equal number, 40.3%, decreased it. The numbers in the second round were similar. There are two arguments that can be used to explain the difference between the participants' strategies concerning the management and distribution fees. First, as was demonstrated by the theoretical analyses, there is a huge difference between the marginal benefits of lowering these fees: a 0.01% point decrease in the management fee would be profitable if it was followed by a 68,100 increment in the number of members, but in the case of the distribution fee, only 1,300 would be enough. While reaching the first number was impossible under the experimental regime, the second one was easily achievable. Second, revenues from fees charged on new contributions formed a small share of total MF revenues; therefore, it was more difficult for participants to determine its optimal level.

After the two initial periods, an auction was announced, the rules of which changed in subsequent treatments. In treatment *2FSA*, students participated in the two-criteria first-score auction; treatment *2ALL* tested the efficiency of the two-criteria all-pay auction, and treatment *1ALL* simulated the one-criterion all-pay auction. Table 5 shows the main statistics concerning the value of the management fee bid in the auctions under study.

As can be seen, participants showed the highest willingness to cut the management fee under treatment *2FSA*, that is, in the case of the first-score auction. This is demonstrated by a number of variables: the lowest value of the average bid (0.4298%), the lowest percentage of bids at the level of 0.5% or higher (12.2%), and the average distance between participants' bids and the break-even value. This last statistic is even negative, which means that bidders asked fees below the hypothetical break-even point; nevertheless, the distance is close to zero. All these results were anticipated: in the case of the first-score auction, the losing bidders did not have to keep the management fee at the level they had bid in the auction, and so their willingness to cut was higher.

Participants were much more reluctant to lower fees in the case of the all-pay auctions (treatments *2ALL* and *1ALL*), where the fee bid had to be maintained for 2

(compared to 68,100 in the simulation), and 11,300 in case of the distribution fee (compared with 1,300 in the simulation).



Table 5. *Main auction statistics by treatments*

Statistics	2FSA (%)	2ALL (%)	1ALL (%)
Average bid	0.4298	0.4420	0.4726
Percentage of bids equalling 0.3%	2.1	3.1	0.5
Percentage of bids $\geq 0.5\%$	12.2	28.3	48.61
Average distance between bid and $f_m^*$	-0.0012	0.0427	0.0527
Efficiency	31	53	44

Source: Own study.

Note: Statistics calculated on the basis of decisions from periods 3–9.

years: they bid significantly above the value of the break-even point, and many decided to offer fees close to the maximum. By doing so, they lowered their chances of winning the auction but at least were able to keep the management fee high in the post-auction periods. As can be seen, under treatment *1ALL*, as many as 48.61% of participants decided to bid 0.5% or higher.

To test the statistical significance of the differences in auction strategies, a Wilcoxon–Mann–Whitney test was run, comparing the bid values and the average distance between participants' bids and the break-even value. Again, the tests were run pairwise, for two groups of data: *all*, using all auction decisions of the participants (number of data points equal to  $4N_i$ ), and *stud*, using the average value for each student ( $N_i$  data points). Each student participated in four auctions. Their bidding strategies in those auctions could be interdependent (e.g., reflecting a bidder's attitude towards risk), but at the same time, participants could face different strategic incentives in subsequent auctions, and so using all data appears to be less problematic than in tests concerning management fees. Table 6 provides the p-values, demonstrating that the differences in auction strategies were in fact significant.

All the auctions under study have relatively low efficiency, measured as a percentage of auctions won by the strongest bidder (the one that would get the highest number of points by bidding  $f_m^*$ ), which is due to the complex nature of the auctions under study. Interestingly, however, the efficiency of the all-pay auctions is higher than that of the standard first-score auction.<sup>33</sup> Most likely, this is due to the fact that in the case of all-pay auctions, weaker bidders decided to withdraw from the auction competition (by bidding values close to 0.54%), which increased the chances that the strongest bidders would win the auction.

Let us now take a closer look at the participants' strategies in the subsequent auctions, starting with the *two-criteria first-score auction*. Figure 3 shows the average and minimal levels of the management fee, including the first two non-auction periods.

<sup>33</sup> Only the difference between treatments *2FSA* and *2ALL* is statistically significant. Using a one-tailed binomial test for two proportions, the null hypothesis of equal proportions was rejected, with  $p = 0.011$ . With respect to the remaining pairs, the p values are 0.11 (*2FSA* vs. *1ALL*) and 0.20 (*2ALL* vs. *1ALL*).

Table 6. *P-values for Wilcoxon–Mann–Whitney test concerning management fee values*

Tests	All data	Stud data
$H_0 : b^{2FSA} = b^{2ALL}, H_1 : b^{2FSA} < b^{2ALL}$	$p = 0.009$	$p = 0.062$
$H_0 : b^{2FSA} = b^{1ALL}, H_1 : b^{2FSA} < b^{1ALL}$	$p = 2.7 \times 10^{-15}$	$p = 2.0 \times 10^{-6}$
$H_0 : b^{2ALL} = b^{1ALL}, H_1 : b^{2ALL} < b^{1ALL}$	$p = 4.7 \times 10^{-8}$	$p = 0.0004$
$H_0 : d^{2FSA} = d^{2ALL}, H_1 : d^{2FSA} < d^{2ALL}$	$p = 5.0 \times 10^{-15}$	$p = 1.3 \times 10^{-9}$
$H_0 : d^{2FSA} = d^{1ALL}, H_1 : d^{2FSA} < d^{1ALL}$	$p < 2.2 \times 10^{-16}$	$p = 1.7 \times 10^{-11}$
$H_0 : d^{2ALL} = d^{1ALL}, H_1 : d^{2ALL} < d^{1ALL}$	$p = 0.002$	$p = 0.009$

Source: Own study, using R.

Note: The variable b shows the bid value, and d shows the average distance between participants' bids and the break-even value.

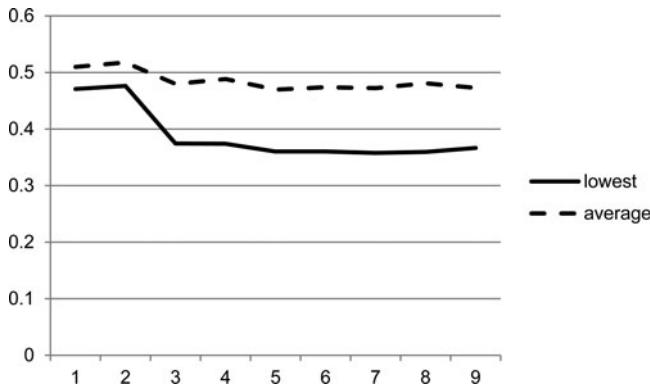


Figure 3. The average and the minimal level of the management fee in treatment 2FSA.

Source: Own study.

Note: The graph includes the first two periods, which took place prior to the auction.

As we can see, there is a clear-cut in the management fee after the first two non-auction periods, but unfortunately, it concerns mainly the lowest fee levels. These come from the auction winners, who were obliged to keep the management fee low but unfortunately were not matched in their fee reductions by other MFs. The bidders who lost the auction were rationally returning to their fee levels from the pre-auction periods.

Let us now take a closer look at the price strategies in the auction. In the first-score auction, two parameters affected the final score: the rate of return and the management fee. As the rate of return had already been determined, and the resulting points had been revealed prior to the auction, the participants only had to decide on the management fee. The participants were provided with information on their break-even management fee levels, which can be treated as zero profit levels. The

participants should have bid above these levels unless they had a more complex long-term strategy.<sup>34</sup>

The auction theory generally has little to say about optimal strategies in asymmetrical auctions. Luckily, however, in this case, with points based on rates of return and break-even management fee levels of all participants publicly announced, it is possible to say more about optimal bidding strategies. Notice that the bidder who reached the maximum number of points for the rate of return would know precisely what management fee he or she should bid to be sure of winning. Specifically, winning would be achieved by bidding the higher of two numbers: the aforementioned threshold bid and the break-even management fee. Knowing this, the next bidder in line could, by analogy, determine his or her strategy, etc. Although this might not necessarily be the optimal strategy in a formal sense, it is reasonable to expect that participants would follow a similar line of reasoning. Let us demonstrate, using an example.

Let us say that the numbers under the study are given in [Table 7](#).

Where  $S_r$  is the number of points for the rate of return,  $\Delta S_m$  is the difference in the number of points for the management fee between F1 and the subsequent MF, assuming all participants bid  $f_m^*$ , and  $S$  is the sum of  $S_r$  and  $\Delta S_m$ .

Firm F6 is the strongest in the auction, with an advantage over F4 of 27.66 points (364.33–336.67). Its rational strategy is to bid the value of  $f_m$  that solves the following equation:

$$S(f_m) = S(0.376\%) - 27.66, \quad (12)$$

Using formula (3), we find that  $f_m$  equals 0.3843%. The remaining MFs have nothing to lose, so they should bid their  $f_m^*$  values. Therefore, if students' reasoning resembles this analysis, most of them should bid their  $f_m^*$  values, and only the strongest ones should bid slightly above it.

The average distance between participants' bids and  $f_m^*$  (–0.0012%) seems to suggest that bidders did actually offer fees close to the strategies described above. However, a closer look at the data shows that the situation was more complicated, with bidders using various strategies. In fact, 30.2% of all bids made in treatment 2FSA were close to  $f_m^*$  (differing by no more than 0.01%), 38.2% of them were higher, and 31.6% were lower. The low efficiency of the auction is one more piece of evidence that bidders' strategies were actually far from the theoretical predictions.

The introduction of the two-criteria auction has one more potential long-term consequence. As it pays to have as many points as possible in the auction, the implementation of the auction might incline the participants in the coming periods to become less risk-averse or even risk-seeking, thus investing more in the riskiest investments.

Let us now move to the analysis of the *two-criteria all-pay auction*. The only difference between this auction mechanism and the first-score auction was that it required all bidders to maintain the management fees bid in the auction. Of course, this is a fundamental difference, which should have made all participants bid more carefully. [Figure 4](#) shows the average and minimal level of the management fee, including in the first two non-auction periods.

<sup>34</sup> See discussion in footnote 27.

Table 7. *The optimal strategy in the first-score auction*

MF	$S_r$	$f_m^*$ (%)	$\Delta S_m$	$S$
F1	69	0.449	0	69
F2	163	0.445	13.33	176.33
F3	25	0.436	43.33	68.33
F4	200	0.408	136.67	336.67
F5	0	0.408	136.67	136.67
F6	121	0.376	243.33	364.33

Source: Own study.

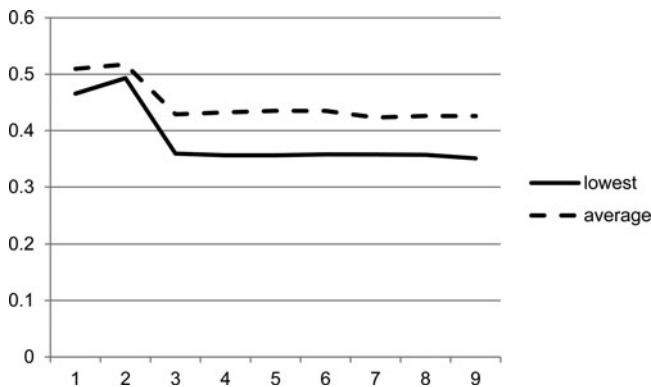


Figure 4. The average and the minimal level of the management fee in treatment 2ALL.

Source: Own study.

Note: The graph includes the first two periods, which took place prior to the auction.

In this case, the auction lowered not just the lowest fee levels charged but also had a tremendous impact on the average levels. One could say that this a natural consequence of the auction rules, but in fact, it is not so trivial; rational bidders, knowing that their chances of winning the auction are very low, should have bid higher management fee values – they would lose the auction, but at least they would not have to maintain a low management fee in the 2 years to come.

In the case of the first-score auction, it was possible to characterize the optimal bidding strategies. Unfortunately, it was more complicated in the case of the all-pay auction. Certainly, we should have observed higher bids than in the first-score auction, and Table 4 shows that this did occur. The only statistic that shows a higher willingness to bid low is the percentage of bids at the minimal value of 0.3%. This might be due to the high risk involved in an all-pay auction; losing such an auction with a low management fee might be very painful from a financial perspective, so some bidders may bid the minimal value to guarantee that they win. Nevertheless, most participants

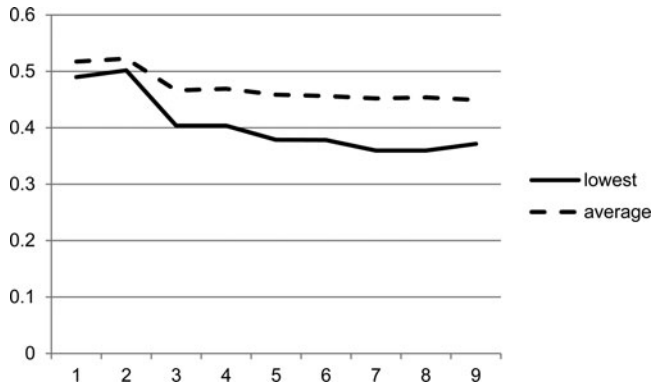


Figure 5. The average and the minimal level of the management fee in treatment 1ALL.

Source: Own study.

Note: The graph includes the first two periods, which took place prior to the auction.

competing in treatment 2ALL bid above the break-even value: as many as 63.0% of bidders bid at least 0.01 percentage point above  $f_m^*$ . Moreover, this number is underestimated, as some learning effects were observed. Because the rules of the all-pay auction were slightly counterintuitive, students had to learn the optimal strategies. In the first auction, just 41.1% of participants bid significantly above  $f_m^*$ , but this number grew with time to stabilize at approximately 73% in the final two auctions played. By analogy, in the first auction played, 35.6% of students bid below  $f_m^*$ , and in the final auctions played, this number was just 10%.

Finally, in treatment 1ALL, it was decided to experimentally test the efficiency of the *one-criterion all-pay auction*. It was interesting to see what the actual role of the rate of return as an auction criterion was. Did the additional asymmetry brought into the auction by this criterion positively or negatively affect auction's efficiency? Figure 5 shows the average and minimal levels of the management fee, including the first two non-auction periods.

In the case of the one-criterion all-pay auction, we can also observe a significant cut in the average level of the management fee, even though its magnitude is smaller than in the case of the multi-criteria all-pay auction. As it remains a strongly asymmetrical auction, it is hard to determine the optimal bidding strategies. Nevertheless, they should not differ much from those in the two-criteria auction. Notice that the marginal profitability of the fee cut is similar in treatments 2ALL and 1ALL, as the past rate of return is irrelevant in this case.

However, it turned out that one minor element played a significant role in players' strategies and might have been instrumental in how deeply they cut their fees. The rules of the scoring auction demanded the establishment of a minimal fee level, which was necessary to calculate points based on this criterion. This minimal value was fixed at 0.3%. In the one-criterion auction, no points were calculated, as the winner was simply the bidder with the lowest management fee asked. In this case, no

minimal value of  $f_m$  was used. It might seem that when there is a minimum constraint (treatment *2ALL*), fee levels bid by participants should be higher than when there is no such constraint (treatment *1ALL*). However, the opposite was observed. We believe that the minimum fee of 0.3% served as an anchor in the two-criteria all-pay auction, and that is why, paradoxically, lower management fees were observed in this case. Simply put, when participants were not given information on the lowest value, their bids were significantly higher than that, but when it was introduced, they seemed to stick to it more closely.

Examining the statistics presented in [Table 4](#), we see that under treatment *1ALL*, only 0.5% of bids were made at a value of 0.3% (compared with 3.1% in treatment *2ALL*). The average margin over the break-even value is higher (0.0527% vs. 0.0427%), and consequently, the value of the average bid made is higher (0.4726% vs. 0.4298%). A similar pattern is observed when we look more deeply into the individual bidding strategies in treatment *1ALL*. The average percentage of bids that are significantly higher than  $f_m^*$  turns out to be 73.6% (compared with 63.9% in treatment *2ALL*), and the percentage of bids below the break-even point is lower (11.6% vs. 16.7%).<sup>35</sup>

<sup>35</sup> The differences between those values are insignificant in the last two auctions, which means, that differences were mainly observed in the first two auctions.