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Redesigning fees and capital requirements
For Polish Open Pension Funds

Abstract

The paper concerns fees charged by Pension Societies (*Powszechne Towarzystwa Emerytalne, PTE*) on managing Open Pension Funds (*Otwarte Fundusze Emerytalne, OFE*), and capital requirements imposed PTEs. OFEs constitute the fully funded part of the mandatory pension system in Poland, launched in 1999.

In 2010 the public debate concerning OFE was focused on costs, risk, and returns on pension savings accumulated in OFEs. Quite comprehensive project of new regulations have been presented to the public in October 2010 [1]. The project has been worked out by a team of experts, with the author of this paper being responsible for new system of fees and capital requirements. In December 2010 politicians have shifted the debate towards challenges coming from the budget deficit and rising public debt. However, there is still a hope that a professional debate on how to enhance OFE's performance will come back.

The project is aimed at linking PTE's returns closer to returns earned on OFE's assets, as well as at linking capital requirements closer to guarantees issued by PTE to OFE's members. This is done in the context of multifunds, where the life-cycle programme assumes allocation to the dynamic sub-fund during young ages, and gradual reallocation towards the conservative sub-fund when approaching retirement.

The life-cycle reallocation plan makes sense of course only when each sub-fund follows the imposed investment strategy. Thus the design of fees/penalties and related capital requirements should ensure that investment strategies follow risk profiles predefined by setting benchmarks specific to different sub-funds. On the other hand, incentives to replicate imposed benchmarks as closely as possible may have distorting effect on the whole financial market, and finally may turn out to be detrimental to the welfare of future pensioners. Thus the aim is to design such a system, which produces incentives for moderate departures from imposed benchmarks, and penalizes departures that are too large.

The paper gives a brief overview of drawbacks of the existing system of fees/penalties and capital requirements, and the description of a new project. The method of testing of a new design (whether incentives to depart from benchmarks are nor too strong neither too weak) is briefly described. Tests were based on the assumption that PTEs maximise expected returns on fees less penalties related to the given level of own capital required, and to the related risk. Some comments on the role of competition on the field of attracting participants are also presented.

1. Pension debate in Poland

The new Polish pension system has been launched in 1999, replacing the old PAYG DB system. The new system is composed by three parts:

- mandatory Notional Defined Contribution pillar I,

- mandatory Fully Funded DC pillar II,

- voluntary FF pillar III.

All three parts are based on individual accounts, however, accounts in pillar II and III are backed by financial assets, whereas accounts in pillar I are just recorded liabilities of the social security state institution, ZUS. Pension rights accrued prior to the reform have been transformed into initial balances of accounts in pillar I. Accounts in pillar II started from null as well as various forms of accounts of those who decided to enter pillar III. Since 1999 till recent changes mandatory contributions were directed to pillar I (12.22% of salaries) and to pillar II (7.3% of salaries).

New pillar II is serviced by Open Pension Funds (*Otwarte Fundusze Emerytalne, OFE*), and Pension Societies (*Powszechne Towarzystwa Emerytalne. PTE*), being separate private companies managing pension savings accumulated in OFEs. Although several malfunctions of the new pillar II have been debated earlier, the debate was limited to the quite narrow circle of academics and professionals. Intensification of the public debate on pillar II has been triggered off by the financial crisis. The public became aware of fees charged by PTEs, especially badly perceived at the time when the value of OFEs' assets started to decrease despite the large inflow of new contributions. The debate among professionals has been focused mostly on measures to improve efficiency of OFE until recently. Since the end of year 2010 politicians redirected the debate into issues and challenges coming from budget deficit and public debt. Before that, in October 2010, the team of experts:

- Marek Góra (leader), Agnieszka Chłoń-Domińczak, Wojciech Otto, Dariusz Stańko, and Michał Szymański, presented the Report [1] untitled „Security through diversity. Improving efficiency of Open Pension Funds. Proposals of amendments." *(in Polish)*

In fact, the Report contains quite comprehensive new design of regulations rather than just amendments. The paper is devoted to present the design, with special emphasis on a new system of fees and capital requirements to be imposed on PTEs.

2. Major changes

Several changes proposed in the Report are in fact responses to criticism of the existing solutions

- Replacement of unique fund by multifunds with risk profile suited to the life-cycle of participants is a response to the obvious inadequacy of unique risk profile for young and old workers. Proposed solutions include the default path of reallocation of pension savings from the dynamic sub-fund towards the conservative one when approaching retirement age, and the range of free choice for individuals wishing to depart from the default path.

- Replacement of endogenous benchmark (weighted average rate of return of all OFE) by exogenous benchmarks is a response to several drawbacks of the existing system. A major one is a well known phenomenon of herding behaviour with its counter-efficiency effects. In our opinion it is only a part of a problem. Namely, the herding effect is a result of incentives to shape investment strategies by small and medium sized OFE as to follow market leaders. However, these incentives do not shape the investment strategy of leaders. This is a good reason why Supervision is unwilling to depart from numerous administrative measures (list of admitted types of securities, percentage limits imposed on classes of instruments etc.). Without these measures Supervision has no way to control the size of risk undertaken by PTE on behalf of OFE participants. Exogenous benchmarks and moderate incentives for following them might allow for relaxing most of administrative restrictions.

- Redesign of the system of fees/penalties charged/paid by PTE. The existing system imposes too severe penalties on PTE whose OFE has not achieved Minimum Required Rate of Return, with inadequately weak incentives to perform better than average. This strong asymmetry of incentives together with endogenous benchmark causes the herding behaviour.

- Introduction of capital requirements adequate to risk borne by PTE. So far capital requirements are defined in absolute terms, which is totally inadequate to risk borne by possible penalties that are proportional to the amount of assets of managed OFE.

- Suppression of acquisition. Acquisition of members is financed from fees imposed on OFE's members, and from their point of view is useless. Several pathologies are observed as well on the primary market (young persons entering the labour market for the first time) as on the secondary market (changing OFE). Apart of making room for reducing fees, suppression of acquisition might shift competition between PTE from the battlefield for members into the battlefield for higher rates of return. Suppression of acquisition should also strengthen small OFE, as they generally have not been able so far to avoid loosing members efficiently acquired by sales force of larger OFEs.

3. Multifunds and benchmarks

According to the Report, each PTE would run sub-funds A (dynamic), B (medium), and C conservative). Benchmarks for each of sub-fund are composed by:

- 60% domestic stocks, 15% foreign stocks, and 25% bonds/bills   (sub-fund A)
- 35% domestic stocks, and 65% bonds/bills   (sub-fund B)
- 7.5% domestic stocks, and 92.5% bonds/bills   (sub-fund C)

Default life-cycle plan is scheduled as follows:

- Young participant contributes to A.
- Since the age of 55 until retirement a participant gradually converts assets from A to C, according to the rule that all new contributions are directed to C, and twice a year the

portfolio is rebalanced in order to achieve the share of C equal subsequently 5%, 10%, 15%, …, 95%, 100% of aggregate amount in both accounts in A and C.

- Sub-fund B plays a role of a continuator of the existing unique fund. One option is that it will dwindle within a decade or two as a result of gradual transfer of assets to A or C. Another option is that substantial part of participants will stick voluntarily to stay in B, and so it will play a role as an alternative (to A) sub-fund, especially for middle aged.

The Report leaves some scope for individual choice. However, this scope does not allow for immediate transfer of assets between sub-funds. Individual decision concern initiation of transfer that would be then realized over the long period, similarly as default transfer from A to C described above. The exception is made for members having very low actual balance.

The above solutions have been designed so as to achieve two goals. The main goal comes from behavioural finance, and consists in assuring that the system will work for the interest of future pensioners, and against known deficiencies of rationality of individuals, especially apparent when decisions are undertaken under uncertainty, complexity, and have long-term consequences. The secondary goal is the stabilization effect of OFE investments for the capital and financial markets in Poland.

4. Making PTE to follow benchmarks

Any plan of life-cycle reallocation (whether default or individually rescheduled) makes sense only when each sub-fund really follows the declared investment strategy. Thus incentives to follow benchmarks should be strong enough to ensure that PTE's investment strategies are in accordance with the risk profile assumed for sub-funds A, B and C. However, too strong incentives could pose threats for the system:

- large market share of investors having their hands tied leaves too much room for making easy money by other players

- strict replication of benchmarks excludes OFE from their activity on the primary market for IPOs, restricting their engagement to the secondary market

- enforcing PTE to replicate benchmarks removes responsibility for performance from PTE to authorities/mechanisms determining the structure of benchmark in detail, including the rules of raising equity at Warsaw Stock Exchange

Thus the system of incentives should reward extra returns due to **moderate departures** from benchmark portfolio, and penalize extra losses due to **large departures** from benchmark portfolio.

5. Fees/penalties related to benchmarks

According to the Report, fees and penalties charged/paid by PTE are composed from four elements (charge on contributions, fixed fee on assets, and two kinds of variable fees). One of variable fees (assuming also a penalty) is related to benchmark. Each year fees/penalties are to be calculated by comparing actual rate of return (AR) with benchmark rate of return (BR), and

with satisfactory rate of return (*SR*). All three rates for sub-fund C are based on one-year period. In case of sub-funds A and B they are calculated over three-year periods, and not annualized.

The fees are defined as follows:

- Fee = 5% × min{3%; max[*AR-BR*; 0]} × NetAssets   (sub-fund A)

- Fee = 5% × min{2%; max[*AR-BR*; 0]} × NetAssets   (sub-fund B)

- Fee = 5% × min{0.6%; max[*AR-BR*; 0]} × NetAssets   (sub-fund C)

The general definition of the penalty is the same for all sub-funds:

- Penalty = 20% × max{*SR-AR*; 0} × NetAssets,

  with separate definitions of the Satisfactory Rate of Return:

- *SR* = min{*BR*; 90%*BR*} − 10%   (sub-fund A)

- *SR* = min{*BR*; 95%*BR*} − 5%   (sub-fund B)

- *SR* = min{*BR*; 98.25%*BR*} − 1.25%   (sub-fund C)

As compared to the existing system, there are several differences. First of all we have 3 separate designs of fees/penalties proposed to new sub-funds instead of one design concerning the existing unique fund. More detailed comparisons make sense between the old design and the new one proposed for the sub-fund B, as their risk profiles are similar. Main changes are as follows:

- The endogenous benchmark is replaced by the exogenous one.

- The existing penalty accounts to 100% of deficit below the *SR*, and the Report proposes to replace it by 20%, and to shift 80% of the relative loss to members.

- The reward for good performance is higher, however, capped. It should produce stronger incentives for moderate departures from benchmark, of course when analyses made by asset managers are promising. However, the cap reduces incentives to seek for extremely high profits.

- Under the existing system *SR* = min{50%*BR*; *BR*-4%}. New proposal for sub-fund B produces slightly wider range (*BR–SR*) when *BR* < 11.11%, and narrower range otherwise. In our opinion a very wide range for "good times" assumed by the existing system is illusory: each investment decision has consequences at three nearest settlement dates, and - especially in case of a distant settlement date - we don't know in advance whether *BR* at the end of the day would be rather 50% than -15%. Thus high actual rates should not motivate PTE to take too much risk, as this can cause the necessity to pay large penalty in the future (possibly not at the nearest settlement date, but at the next or even the third one). In a sense new design produces more coherent signals to investment managers.

- Proposed frequency of setting fees/penalties related to benchmarks is lower: under existing rules setting is done twice a year.

6. Capital requirements – general remarks

Necessity of capital requirements stems from risk of penalties to be possibly paid by PTE. In general, existing rules assume much higher penalties, and totally inadequate capital requirements expressed in absolute amounts instead of percentages of managed assets. These requirements have been more or less adequate during first years after 1999, and still are close to be adequate for few smallest funds. The strategy realized in fact by PTE is to avoid penalty at any price rather than to be prepared to pay the penalty when it happens. Differences between rates achieved by individual funds are small, and even though they come not only from differences between intended strategies, but (at least partly) from inability to replicate the benchmark[1]. We believe that this is a wrong strategy. No one can totally exclude the possibility to fall below the *SR*. Rational strategy is rather to avoid losses, but not at any cost. Avoiding losses makes sense when they could outweigh possible lost opportunities. Thus we propose to remove the extreme asymmetry between rewards and penalties from the existing system, and to introduce at the same time capital requirements that would (flexibly) charge PTE by cost of capital in a way that should moderate their risk appetite.

The general construction is similar to that used in insurance, and is composed of two levels:

- Minimum Capital Requirement   (MCR)
- Solvency Margin: $SM = 2 \times MCR$

Both numbers are to be calculated each month for each sub-fund separately. Supervisor's actions should be triggered when free assets of PTE fall below capital requirements (aggregated over sub-funds A, B and C), according to the rules:

- mild intervention should be implemented when only SM is violated
- severe actions have to be undertaken when also MCR is violated

7. Calculating MCR

Proposed MCR formulae differ only by the minimum level of MCR set in percentages of net assets of a sub-fund

- $MCR = \max\{0.4\%; (MCR1+MCR2)\} \times NetAssets$ (sub-fund A)
- $MCR = \max\{0.3\%; (MCR1+MCR2)\} \times NetAssets$ (sub-fund B)
- $MCR = \max\{0.2\%; (MCR1+MCR2)\} \times NetAssets$ (sub-fund C)

MCR1 represents expected penalties or expected excess of *AR* over *SR* at the nearest settlement dates under the assumption that *AR* and *BR* will move parallelly from now till the nearest settlement dates. One can read this component as a "reserve for expected penalties"; however, under certain circumstances this number can be negative.

MCR2 represents risk stemming from possible divergence of *AR* and *BR* from now till the nearest settlement dates.

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[1] Replicating the average portfolio of all OFE is difficult in practice, as details of OFE's portfolios are disclosed only once a year, and are made public with some delay to the accounting date of 31 December.

7.1. Calculating MCR1

MCR1 for sub-fund C equals zero just after settlement of the last accounting year. At the end of each of first 11 months of the current year:

- $MCR1 = 20\% \times \max\{SR\text{-}AR; 0\} - 10\% \times \max\{AR\text{-}SR; 0\}$,

with *AR* and *SR* calculated over time elapsed from the beginning of year.

Formulae for MCR1 for sub-funds A and B are based on the same idea, but more complex due to setting fees/penalties each year on the basis of rates representing last 3 years. Let us take the following notations:

- *AR*1 and *SR*1, for rates of return over elapsed part of a 36-months period that ends at the nearest settlement date

- *AR*2 and *SR*2, for rates of return over elapsed part of a 36-months period that ends at the next settlement date

Now the formula for MCR1 reads:

- $MCR1 = 20\% \times [\max\{SR1\text{-}AR1; 0\} + \max\{SR2\text{-}AR2; 0\}]$,

  when *AR*1<*SR*1 or *AR*2<*SR*2;

- $MCR1 = -10\% \times \min\{AR1\text{-}SR1; AR2\text{-}SR2\}$,

  when both differences *AR*1-*SR*1 and *AR*2-*SR*2 are non-negative.

Additional complication arises when *AR*1<*SR*1. In this case the resulting expected penalty transferred from PTE to the sub-fund raises immediately its rate of return, which should be accounted for when calculating *AR*2 (*omitted in the formula for simplicity*).

7.2. Calculating MCR2

MCR2 is calculated at the end of month *t* on the basis of recursive formula (the same for all sub-funds):

- $MCR2_t = \max\{0.2 \times |AR_t\text{-}BR_t|; 0.95 \times MCR2_{t\text{-}1}\}$

  where AR_t and BR_t denote rates of return over month *t*.

MCR2 is a measure of risk stemming from deviations of *AR* from *BR* with following properties:

- under assumption that $0.2 \times |AR_t\text{-}BR_t|$ are i.i.d. (fixed investment strategy) MCR2 fluctuates around the quantile of order 95% of that variable

- the above property is relatively robust under a range of reasonable distributions assumed for the variable $0.2 \times |AR_t\text{-}BR_t|$

- when an active strategy is replaced by a passive one, MCR2 decreases by about ¼ within 6 months, and by about ½ within a year

- MCR2 increases quickly to a new equilibrium level once passive strategy is replaced by an active one

It has to be noted, that most of properties of the above dynamic risk measure have been set by Monte-Carlo method. Generally, this type of recursion is unknown to mathematicians analysing stochastic processes. Some generalisations of the proposed dynamic measure are also quite promising (all properties could be enhanced at the cost of a more complex recursive formula). Research on this issue is in progress.

7.3. Interplay of elements of MCR

One of the simplest parameters of the MCR formula, namely, a minimum level of MCR, defines the basic level of active investment strategy. Above this level higher expected returns entail higher capital requirements (and related cost of capital), however:

- Good results achieved in recent periods reduces the component MCR1, and so makes room for higher MCR2, which allows for a more active strategy without rising cost of capital

- Poor results in recent periods increase MCR1, and so PTE is motivated to restructure portfolio towards the benchmark, unless own assets are well in excess of capital requirements

- Transparent and frequently monitored solvency requirements makes the supervision relatively easy and efficient

- Recovery plan in case of moderate violation of SM requirement is simple: restructuring portfolio towards the benchmark should usually suffice to reduce capital requirements below the actual level of PTE's free assets in few months

8. Fees unrelated to benchmarks

The Report proposes:

- The reduction of fixed commission on assets (maintaining the degressive scale of rates)

- Introduction of a new variable fee of a type known as High-Water Mark.

The new variable fee is to be charged at 2% of the excess of the value of the Participation Unit (PU) over its previously attained maximum, times the number of PUs issued by the sub-fund. An additional rule to the well known mechanism is that the „previously attained maximum" is once a year inflated by latest CPIndex. **As a result, the fee can be read as a share of a provider in permanent real returns on investments of entrusted assets.** Reduction of rates of fixed commission on assets and introduction of HWM fee are calibrated so as to keep the expected fees unchanged (roughly).

The reason of replacement of some part of fixed commissions by HWM is rather political than economic. The goal is to avoid temporary coincidences of high profits of PTE and heavy losses of OFE's members. This happened in 2008 and partly in 2009, and was very badly perceived by the public. This time it was of course a problem of sudden and deep fall in nominal rates of

return. However, equally unacceptable could be the case of sudden and large inflation shock. That is why we proposed an inflationary correction to the classical construction of the HWM.

9. Other changes that may have substantial impact on PTE's incentives

Incentives produced by the proposed system of fees and penalties have been tested by simulations designed under the assumption that PTEs maximise fees less penalties related to the required capital, with some risk aversion taken into account. The approach neglected the long term impact of investment performance on gaining new members. The simplification was justified by the evidence that the main factor driving migrations of older members between OFEs and gaining young ones is sales force. Impact of good/bad investment performance has been very limited, if any. Situation changed when the political decision of suppressing acquisition has been undertaken. This happened when the Report was already done in 99%, and so we are aware of inadequacy of some solutions recommended in its published version.

The problem whether acquisition has any value added for members is not a new one, and proposals to suppress acquisition (and reduce fees adequately) have been debated for a long time. Apart of costs/benefits considerations unrestricted acquisition is also incriminated for strengthening the tendency towards concentration of the market. Various measures have been applied already in order to reverse or at least slow down the concentration process.

One of the counter-concentration measures concerns rules of allocating to OFE young people who have not made their own choice. The rule introduced in 1999 was simple: four times a year indecisive newcomers are allocated randomly to existing OFEs in numbers proportional to their current market shares. Fears concerning the progress of concentration process induced regulators to change the rule in 2003. Since then all newcomers to the labour market recorded by ZUS who have not made their own choice are allocated twice a year in equal numbers to these OFEs (out of total number of 14 of them), which:

- Have achieved at the last two settlements dates rates of return higher than average (so far there are two settlement dates each year)

- Have their market share (measured by managed assets) smaller than 10% - practically this condition excludes 3 largest OFEs

Rules introduced in 2003 have produced also incentives for good performance, especially strong in case of smallest OFEs, for which the inflow of newcomers is (in relative numbers) the largest. But still the acquisition of members (mainly older ones) weakens the position of small OFEs. As a result their market share remains roughly the same until then. The process of gaining new members and loosing older ones could be well illustrated by few numbers. The share of 4 smallest OFE in the market as measured in 2009 by various indicators accounted for:

- 5.9% as measured by entrusted assets (at the end of year)

- 7.0% as measured by contributions collected during the year

- 10.1% as measured by total number of members (e.o.y.)

- 15.8% as measured by number of members no older than 25 (e.o.y.)

Since 2010 rates of fixed commission on assets have been changed. The degressive scale of rates was amended by the cap, reducing the marginal rate to zero for OFE's assets in excess of 45 billions PLN (about 9.5 billion £). Intentions were probably very simple – just to reduce profits of largest OFEs. But results turned out to be quite interesting – two largest OFE withdrew from acquisition activity almost immediately, the third one (with assets approaching 25 billions PLN) reduced it radically a bit later. 7 medium OFE have intensified acquisition on the market for transfers of members (to a diverse extent, of course), starting to deprive of members mainly 3 largest OFEs, as well as continuing to do so in respect of 4 smallest ones. The game is now quite intensive. In fact it is a race against time as suppression of acquisition comes in effect as of 1 January 2012.

Once acquisition is suppressed, allocation of new members to OFEs may turn to be driven by OFEs' investment performance much more than in the past. This concerns as well choices made by newcomers to the labour market as the effect of possibly larger share of those who are allocated by the ballotage. This means that the exclusion of 3 largest OFEs from the ballotage needs reconsideration. What matters from our point of view, however, is that incentives for departing from benchmarks may become too strong, causing too risky strategies undertaken by PTE. Theoretically the mechanism produces no incentives for achieving extremely high rates of returns. In order to take part in the ballotage of new members it suffices to achieve the rate of return higher than average, no matter how large the excess is. However, in practice there is no way to assure that we can outperform the average (or any other benchmark) by a fraction of a percentage point. Also it can be argued that attracting new members may be easier if returns on investment are extraordinary, and not just better than benchmark. So the problem whether incentives for active asset management are not too strong, remains. Maybe proposed fees due to overperforming benchmarks are too large, or even may be suspended at all.

When thinking about the room to reduce fees one has to take into account another recent change. Since May 2011 contributions to OFE have been reduced to 2.3% of salaries (from previous rate 7.3%), and so PTEs' commission on contributions dropped accordingly. It may change in favour of PTE as contribution rate is planned to rise gradually during next 5 years. However, this depends on the development of the debate, and as such is highly uncertain.

10. Active versus passive asset management, and other open issues

Issues raised in the last section are part of a more general problem, whether it is in the interest of future pensioners to allow for active asset management by PTE, and to bear associated costs. An alternative supported by some economists in Poland is to change regulations towards those applied to ETFs in order to make "certain savings on commissions at the cost of loosing uncertain and doubtful profits". We (me together with other authors of the Report) are convinced that this is not a good alternative. However, the debate in this respect is a fundamental one, and beliefs are not sufficient here. As for now, no coherent system of arguments is ready to be presented. However, we are ready at least to design a way of thinking that we recommend.

Firstly we note the large literature focused on a question whether active management (based as well on technical as on fundamental analyses) can produce rates of return systematically higher than the market index (including dividends) without raising risk, and the associated problem of

predictability of rates of return on equities. As for now, the problem is not resolved. Evidence from some countries/periods show that active management makes sense for fund's members, but other countries and periods seem to prove the opposite.

However, in our opinion this general issue is abused when debating solutions for the pension system. The problem we really face is whether it makes sense to suppress active management for a number of institutional investors whose large market share comes from stable inflow of pension contributions. It does not matter whether suppression results directly from law, or from too strong incentives to replicate benchmarks, or from fees too low to cover costs of professional active management. In any case passive strategy cannot be replaced by an active one when the latter becomes justified, and members cannot redirect their pension savings to institutions free to apply active management. As in every game, the one whose hands are tied becomes the looser. Enforcing PTE to replicate benchmarks removes responsibility for performance from PTE to authorities and mechanisms determining the structure and adjustments of benchmark in detail, including the rules of raising equity at the Warsaw Stock Exchange. Distorted market mechanism could possibly lead to much wider consequences than just losses of OFE's members.

Shortly speaking, we don't see any easy way to show how much we can win allowing active management. Easier is to show how much we can loose otherwise. Anyway, we think that this issue is a central one and worth professional economic debate.

Of course the most important practical issue is how to stop politician's advances in using OFE's assets for reducing the disclosed part of the public debt.

For the applied mathematician perhaps the most interesting is the example of inspirations coming from practice. MCR2 measures in fact the Value at Risk coming from deviations of actual rates of return from benchmark rates. The measure has been invented *ad hoc*. Invention has been driven just by intuition concerning ability of the measure to adjust to changes of volatility of the underlying process, with additional assumption that the shape of the distribution is known only roughly, and that the adjustment should be quicker when volatility increases than in case of its decrease. Fortunately, the invented measure turned out to have desired properties. Surprisingly, both the measure and the problem solved satisfactorily by the measure have not been yet analysed by mathematicians. Research on properties of the measure and its generalisations is in progress.

Literature:

[1] Chłoń-Domińczak Agnieszka, Góra Marek, Otto Wojciech, Stańko Dariusz, Szymański Michał, "Bezpieczeństwo dzięki różnorodności. Poprawa efektywności funkcjonowania otwartych funduszy emerytalnych. Propozycje zmian." KPRM (*The Chancellery of the Prime Minister*) 2010