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2014

The Macrotheme Review
A multidisciplinary journal of global macro trends

Assessing the strictness of portfolio-related regulation of pension funds: Rethinking the definition of prudent

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Abstract

The paper features one of the most calling interrelation in today's pension universe, namely the interplay between regulatory activity and future pensioners' wealth. The paper attempts to explore this tradeoff, casting a closer glance solely at portfolio-related regulatory measures and investment performance of pension plans. The effort to classify and rank OECD regulatory regimes is made, which is not straightforward given the variety of unique approaches to regulation in this respect. Afterwards, a simple cross-section model is run that displays how the strictness of oversight affects the risk-return profile of pension instruments. The analysis embraces the 2001 to 2012 period, as this the period for which detailed OECD statistics are available. Conclusion and suggestions for further investigation tie up the article.

Keywords: pension funds regulation, pension funds performance, portfolio-related regulation, regulatory impact

1. Introduction

Following the recent financial crisis, and taking into account the rather gloomy demographic outlook of many developed societies, safety net policies are due to be fundamentally restructured. Pension systems are one of the most essential elements of these policies, yet also one of the most perplexing for various social planners. The level of regulatory strictness in this domain varies substantially among countries and the debate is nowhere near consensus on whether the ever-increasing stock of regulation leaves the societies better off. The regulatory mix forged by authorities is abundant and tends to embrace fund's corporate governance, disclosure requirements and performance presentation, minimum required performance, fees and commissions, rules of valuation as well as any other legal, administrative and operational factors.

It has to be noted that the relative importance of pension funds industry, expressed as a percentage of assets against the GDP, varies heavily from country to country, reaching or exceeding 100 percent in the Netherlands, Iceland, Switzerland or the United Kingdom, while comprising only a tiny fraction of national accounts in France, Greece, Luxembourg or Slovenia. This, along with other macroeconomic, financial sector or institutional factors, many of which

were studied by Musalem and Pasquini (Musalem and Pasquini 2012), might determine the level of awareness that policy makers attach to the underlying problem.

This paper is interested solely in the portfolio-related regulations[1] and the reason for its inspection is twofold. First, they are most relevant from the perspective of funds' beneficiaries, who are presumably most concerned with the rate of return and risk exposures of investment vehicles, and not so much with other funds' characteristics. Second, despite the number of complexities, they are fairly tangible. On the whole, the dichotomy prevails. The Anglo-Saxon investment culture allows for more liberal stance based on the so-called prudent man rule or on the general requirement of diversification, whereas the oversight is much sterner in continental Europe and often resorts to explicit quantitative restriction (Antolin 2008, 5). There are quite a few exceptions to this cliché, though.

The quantitative restrictions are introduced on assets believed to be vulnerable to high volatility, insufficient liquidity and high investment risk. This often seems to be assessed on a standalone basis, whereas investments should rather be seen in the context of the whole portfolio, where risks might cancel out or be effectively diversified. Therefore, the research question is whether the state institutions' legislation acts in the best interest of an investor[2], maximizing her risk-return profile (in other words: risk-adjusted return). The hypothesis that fueled the research process was that repressive regulation restricts pension funds from taking the full advantage of the opportunities the market offers, thus deteriorating the value delivered to investors. Following this chapter, the brief literature review is made, as well as the theoretical justification demonstrating the feasibility of this study. The last but one section displays and discusses the preliminary results of econometric modeling. The next steps are enumerated in the last chapter, along with conclusions.

The goal of the paper is to lay foundations for further analysis on whether the conventional understanding of prudent regulation is in the best interest of future pensioners. The simple check is whether the rigorous oversight brings the indented value added.

2. Literature review and theoretical foundations

Not much of the existing literature has explicitly raised the tradeoff between constraints to portfolio construction and the risk-return profile of the pertinent portfolios. Few of relevant examples include Davis (1998; 2001; 2002), Srinivas and Yermo (1999), Srinivas, Whitehouse, and Yermo (2000), Davis and Hu (2008), Tapia (2008), Bohl, Lischewski, and Voronkova (2010), Love et al. (2011), Bijapur et al. (2012), Hribernik and Jakopanec (2012), Musalem and Pasquini (2012), Shi and Werker (2012), Xiao and Xiao (2012) and particularly Boon et al. (2013). The latter will serve here as a rough point of departure for the methodology used. There is also a relatively broad selection of the papers written in Spanish which deal with the pension systems that were established in the Latin America, constituting a vital element of the economic debate in this part of the world. Nevertheless, it has to be explicitly emphasized that there is still a

[1] Notions such as portfolio regulation, investment restrictions or portfolio restrictions will be used interchangeably with portfolio-related regulation throughout the paper.

[2] Given that funded pension schemes are obligatory in many countries, the term "investor" may equally well be phrased as "citizen". Notions such as future pensioners, retirees or beneficiaries will be also used interchangeably with „investors" throughout the paper.

noticeable deficit in the field of broad-based, empirical and methodologically sound research that explores the link between asset restrictions and risk-adjusted performance.

Although one may assume that the only goal of the pension regulatory body should be to maximize the fund beneficiary's expected payoff, it needs to be recognized at this point that portfolio-related regulatory measures may also be backed by some auxiliary intentions other than this. One possible motivation might be the preoccupation with supporting domestic capital markets (Kowalewski 2010), by capping the allowed investment in foreign securities. Moreover, as it was indicated by Thomas, Spataro, and Mathew (2013) for OECD countries, there is a negative and statistically significant relationship between the share of pension funds' assets invested in stocks and stock market volatility, which means that the activity of pension funds serves as a reliable market stabilizer. Similar inferences may be drawn from Muller et al. (2012). On another note, while regulations should only apply to this fraction of pension funds that are collected from citizens on an obligatory basis by state or state-owned entity (see Vittas 1998, 3–4), this is not always the case. As Davis (2001, 17) instructs, excessive regulatory burdens carry the risk of discouraging pension providers in a voluntary environment. Thus, the very existence of regulation may give birth to uninvited (and hardly quantifiable) side effects.

One of the recent papers that embraces the interrelation between regulation and return is that of Boon et al. (2013). Three dimensions of regulatory activity were put under scrutiny: investment restrictions, minimum performance or benefit guarantee, and the type of supervising authority. In general, they found no significant impact of regulatory strictness on pension funds' investment performance. Only after the incorporation of macroeconomic dummies, it turned out that stringent portfolio limits may be considered harmful in emerging market economies, as contrary to advanced economies. Despite having found no convincing conclusion, Boon et al. believe that it is due to data-related reasons (quality, comparability across countries, and the particular time period sampled).

There are several points of critique that might be raised with regard to the methodology used in Boon et al. First, the identification of investment restriction is not very sophisticated. They are measured "by counting the number of asset classes and subclasses in which a quantitative limit exists" (Boon et al. 2013, 5), disregarding the character of an asset class and the depth of the restriction. Second, when portfolio restrictions cannot be reconciled with the analogous data on performance, which is typical for countries with multiple pension schemes, the authors derived a median of the asset allocation limits, which is quite a naïve approach that may lead to erroneous inferences. Third, the data on pension funds' performance are taken from multiple sources (OECD, FIAP[3] and AIOS[4]), which adds up to the risk of losing data consistency as not only different countries report incompatibly to data aggregators, but also these institutions follow disparate performance presentation regimes. However, this last caveat is somehow excusable, as the overarching goal was to enrich the feeble data set.

Furthermore, Musalem and Pasquini (2012) have built an extensive data set with an intention to untangle the impact of a broad set of variables on pension plans' performance and volatility. The

[3] La Federación Internacional de Administradoras de Fondos de Pensiones (International Federation of Pension Fund Administrators).
[4] La Asociación Internacional de Organismos de Supervisión de Fondos de Pensiones (International Association of Supervisory Organisms of Pension Funds).

shortcoming of their paper is that they did not manage to merge return and volatility into a single dependent variable. Out of the variables that are aligned with the goals of this paper, the "foreign investment limit" is interesting. It was found insignificant in the determination of returns, but proved moderately useful in determining their standard deviations. The less strict the constraints on foreign investment, the bigger volatility. Nevertheless, the authors treat this particular finding as preliminary. Tapia (2008) developed a similar study to Musalem and Pasquini, but he failed to execute econometric analysis in any form in order to inspect the link between investment restrictions and performance.

Another exceptionally useful paper is the one of Bijapur, Croci, and Zaidi (2012) where asset regulations levied on life insurance companies are inspected. The accessibility of life insurance data is considerably better than the accessibility of pension funds statistics, as the authors succeeded in gathering more than 2,000 observations, which paved the way for a robust modeling. In essence, explicit investment limits on particular asset classes have been found to impede portfolio diversification and lead to significantly lower risk-adjusted returns. Moreover, the jurisdictions that imposed the most repressive caps on asset allocation fare the worst.

In their empirical paper based on the data provided by two Slovenian pension funds, Hribernik and Jakopanec (2012) insist that the key in managing pension investment scheme lies in the appropriate matching of assets and liabilities in terms of duration, profitability and riskiness. The authors doubt that restrictions on investments are needed as long as investment managers are capable of prudently handling the underlying assets.

Bohl, Lischewski, and Voronkova (2010) have performed a comparative analysis of Polish and Hungarian pension funds, while paying attention to some elements of regulatory and macroeconomic frameworks. They found that the investment restrictions in Hungary have translated to an excessive investment into government securities, and this effect was not so much pronounced in Poland. The theoretical contribution of this paper lies in recognizing the vital part played by the domestic capital market in introducing pension reforms. The underperformance of Hungarian investment programs with relation to Polish ones was associated with inferior size and liquidity of the equity market. The reason for including various indicators related to capital markets seems generally well-grounded. It is rather clear that pension funds refine their portfolios in reaction to what happens in the broad markets. As Bikker, Broeders, and de Dreu (2010) state, "investment policies of pension funds are partially driven by the cyclical performance of the stock market". Also, interestingly, they found that Dutch pension funds respond asymmetrically to equity market shocks and rebalance their portfolios more decisively in downturns rather than upturns. There are of course more papers that point out the link between financial market turmoil and deteriorated performance of pension plans (Leiner-Killinger, Nickel, and Slavík 2010).

Davis and Hu (2008) make an interesting comparison of broadly defined investment regimes of Canada, the United Kingdom and the United States. Despite the prevailing prudent man rule, Canadian pension funds are still subject to some residual quantitative restrictions, which are not present in the other two states. Crunching the very long data series of 1966-2006, the authors argue that Canadian funds notoriously underperformed their benchmarks. Concurrently, US funds achieved better results and UK funds actually almost always outperformed their target rates of return. Although the results do not always lend support to their hypothesis, the authors are convinced that this gap in performance can be attributed to portfolio restrictions. Thus, they make

a claim in favor of elimination of all outstanding quantitative regulations in Canada. This verdict stays in line with the earlier findings of Davis (2002), where he had maintained that quantitative restriction are desirable only "in certain circumstances that may hold temporarily in emerging market economies". Similarly, Davis (2001) indicates that there is a strong case for pension funds to follow prudent man approach, although both of the considered approaches seek to guarantee proper diversification.

An interesting paper on the consequences of the increased interest of pension funds in high-quality long bonds was published by Xiao and Xiao (2012). Using econometric techniques, they indicate that the supply of this sub-class of bonds may soon turn out to be insufficient, which would result in soaring the cost of delivering pensions. This shows that it is systemically dangerous if pension funds exhibit excess prudence, a sign of which is the flight into safe bonds. This excess prudence may possibly be exacerbated by the regulatory zeal.

Srinivas and Yermo (1999), as well as Srinivas, Whitehouse, and Yermo (2000) call attention to the pension plans suspected of having a tendency to benchmark one against the other. The chain of events that they replicate in a paper starts with the image of governments striving to win legitimacy for the newly created pension funds. The false vision was that draconian regulations effectively ensure maximum returns. As a matter of fact, the regulatory overkill has only caused pension funds' portfolios to be practically indistinguishable, as the regulation provided hardly any incentive for pension funds to differentiate by excelling in investment management. Therefore, the authors called for the liberalization of portfolio requirements, but it mostly remained a lone voice in the wilderness.

Out of theoretical papers, one is worth the attention. Shi and Werker (2012) confirm that institutional investors constrained by asset regulation tend to invest more in the risk-free instruments than unconstrained investors. The motivation behind their research is the observation that the regulatory horizon does not correspond to the institutional investors' investment horizon, being usually much longer, which is sub-optimal in terms of performance.

This paper sets foundations for further analysis concerning enriching pension funds' portfolios with more alternative assets. While there is no official definition of what alternative assets comprise, hedge funds, private equity and venture capital, commodities, real estate as well as infrastructure investments typically fall into this category (Laboul and Della Croce 2013, 4 footnote). Particularly, as Barber and Wang (2013) indicated in their recent study, top US educational endowments[5] perform well relative to public stock and bond benchmarks because of large allocations to alternative investments. These allocations explain the majority of the superior financial result of top-performing vehicles in the last two decades. By the same token, Hoevenaars et al. (2008, 2967) point out that the alternative asset classes add value for long-term investors, as they have a term structure of risk that by and large overlaps a term structure of pension fund's risk. Pension funds are, by their nature, the long-term oriented institutions and since their liabilities exhibit the longest duration in the market (Blake 1999), so should their assets. Rose and Seligman (Rose and Seligman 2013) indicate in their primary study that the beta-driven motivation of investments in alternatives (i.e. diversification) is now more common than alpha-driven (i.e. earning excess returns). On the contrary, Robertson and Wielezynski

[5] A type of institutional investor that is relatively similar to pension funds with regard to investment horizons.

(2008) show that whereas the investment returns of pension plans with allocations in alternative assets of at least 10 percent is superior, they insist that it comes with a significantly and consistently higher standard deviation. All in all, no significant differences in risk-adjusted returns is seen. However, their sample is very limited, as it comprises only 39 pension plans in a timespan of unceased prosperity from 2002 to 2006. There is also a discussion on possible inclusion of derivatives into pension portfolios (Cui, Oldenkamp, and Vellekoop 2013).

Business research suggests that hypothetical strategies that include alternative securities may be superior to conventional portfolios. For example, the so-called 60/30/10 (i.e. 60% equity, 30% bonds, 10% alternatives) allocations are typically superior to conventional 60/40 (i.e. 60% equity, 40% bonds) allocation. The quarterly data for the period 1990-2010 indicate that while S&P Total Return Index earned 9.6% annually, private equity reached 14.3% and hedge funds – 11.9% (PwC 2012). Taking the longer stream of data, while S&P 500 offered an annual expected return of 9.92% with a standard deviation of 13.98% in the period from 1990 to September 2008, hedge funds turned out to exceed these numbers. Even funds of funds displayed only a slightly lower annual return of 8.97%, but with a tremendously lower volatility (standard deviation of 5.78%). This gave a Sharpe ratio of 0.88 as compared with 0.43 for S&P 500 and 0.45 for 10-Year U.S. Treasury (Anson and CAIA Association 2009, 153).

3. Results

3.1 Data

All private pensions' statistics come from the Global Pension Statistics database run by the Organization for Economic Co-operation and Development (OECD), which seems to also have the broadest and the deepest insight into the investment-related regulations of pension funds. Since 2001, the OECD publishes the survey of investment regulations[6] (Organization for Economic Co-operation and Development 2013) , which is a helpful tool in reducing the paucity of data. However, the struggle for comparability is not over. First, the approaches or even philosophies of regulations are extremely heterogeneous. The strictness of regulatory burden may not be compared straightforwardly between countries, mainly due to the fact that the complexities of particular pension systems make each of them quite unique (see Malone 1999, 57; Stojanović and Krišto 2013). Second, it is sometimes not better with performance reporting. For instance, the U.S. market, representing most pension assets under management but also most lax approach to regulation, cannot be covered in this study due to the scarcity of pension fund data (Bauer and Frehen 2007). Moreover, restrictions on investing future pensioners' assets in hedge funds or private equity differ by U.S. state (Rose and Seligman 2013, 5). An apparent conclusion is that there is a clear tie between the strictness of regulation and the available database on pension funds. One can have both or none.

What adds up to the difficulty of comparing various regimes is the lack of consensus in interpretation of certain variables. Several dummies from Antolin (2008) on mandatory/voluntary or defined benefit/defined contribution do not match the dummies of Musalem and Pasquini (2012) for the analogous periods. Even worse, the discord is on more fundamental issues. While

[6] The time range of the surveys spans from 2001 to 2012, but there was no survey for 2005. Therefore, the proxies for 2005 regulations are present in the model only if the regulations for 2004 and 2006 are identical, which is the indicator of stable regulatory environment in these days.

Canada seems to be an unrestricted paradise for portfolio managers, as seen from OECD statistics, Davis and Hu (2008) criticize this country for the departure from prudent man rule, raising both theoretical and empirical arguments for its superiority as compared with quantitative asset restrictions.

Pension statistics have been assembled only since recently, hence the full panel analysis would not be very fruitful and would probably fail in exhibiting any kind of trend. Particularly, given the fact that policy shocks (i.e. modifications of pension scheme's asset allocation rules) are rather rare and ascribing appropriate lags would be problematic. This, however, does not shut the door before full panel analysis to be made in the future.

The data summary is presented in Table 1 and descriptive statistics follow in Table 2.

The approach to rank regulatory regimes is shown in the Appendix. In brief, countries that set caps on particular asset classes at reasonable levels are not penalized for regulation (0.0). However, if the limits are stricter than the arbitrarily assumed threshold, a fine is ascribed to this jurisdiction (0.5). If a given asset class is not available for investment, a jurisdiction gets full penalty (1.0).

The OECD pension plans' investment performance is assessed by two versions of the Sharpe ratio (consult Table 1 for more information) and by the Sortino ratio. The Sharpe ratio is a well-established metrics with a long track record in the investment industry. Essentially, it measures the excess return per unit of deviation in an investment program. The generic formula for the Sharpe ratio is therefore:

$$Sharpe\ ratio = \frac{excess\ return}{std.dev.of\ excess\ return} = \frac{actual\ return - risk\ free\ rate}{std.dev.of\ excess\ return}$$

Contrary to the Sharpe ratio, the Sortino ratio proposed as an alternative in this paper, does not have academic roots, as it was developed by the investment industry. The key modification that the Sortino ratio introduces in gauging risk-adjusted returns is that it penalizes the investment program solely for the negative (below target) volatility. Thus, it ignores the upside volatility on the grounds that it is clearly welcomed by investors. Whereas the Sharpe ratio of an investment program has little direct meaning when not benchmarked against its peers, the value of the Sortino ratio is even less interpretable on a standalone basis. There are several competing methods of computing this ratio. The generic formula is:

$$Sortino\ ratio = \frac{portfolio\ return - target\ return}{downside\ risk}$$

The different approaches concern the calculation of the denominator, i.e. the downside risk. In this paper, the square root of the 2nd lower partial moment is applied for this purpose:

$$downside\ risk = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(actual\ return - target\ return)^2 f(t)}$$

where:

$$f(t) = 1 \; if \; return < target \; return$$

$$f(t) = 0 \; if \; return \geq target \; return$$

The Sortino ratio has many virtues, although it is much more difficult to calculate (Rollinger and Hoffman 2013), what presumably translates to its limited use. Nevertheless, it is very well aligned with the objectives of this paper, since it is indeed not intended to penalize those pension fund regimes that exhibit excess, but positive volatility.

For the sake of this model, the risk-free rate embodied by the 10-year government bond yields is used as the risk-free rate in the Sharpe ratio formula and as the target return in the Sortino ratio formula. All returns are nominal.

As far as possible, the series are assembled using a single source to maximize the odds for comparability and consistency. This, however, does not make a seamless data set. The methodological problems are overwhelming. To name only few:

– The availability of gross investment income variable was insufficient, therefore the variable taken is net investment income, which is before tax, but – unfortunately - after deduction of investment management costs. This may contaminate the actual relationship between regulation and pure play performance.

– Many countries covered by the OECD statistical database do not differentiate returns by type of investment regime (e.g. defined benefit vs. defined contribution or mandatory vs. voluntary). Simultaneously, they usually do so when reporting investment restrictions. As a result, matching regulations with returns and volatilities is practically unfeasible in some jurisdictions. Due to these difficulties, several countries must have been excluded from the analysis.[7] When in doubt, Boon et al. (2013) used a median. This, however, seems to be an oversimplification.

This is compounded with numerous minor problems like different valuation methods or blank or unclear fields in the investment restriction surveys. After adjustments, the volume of sound and reliable data is even more limited, which is rather unsatisfying given short and only annual time series.

3.2 Regressions

Caps on particular asset classes were not significant when introduced to the model individually. Therefore, two synthetic variables were created: reg_agg_1 and reg_agg-2. Basically, reg_agg_1 sums up the penalties a jurisdiction received for restricting asset classes that are considered risky (equity, real estate, investment funds[8] and a global limit for foreign investments). On the

[7] Data on Finland (2007-2012), Germany, Luxembourg (2007-2012) and Portugal (2007-2012) were not used in the model. Although similar reservations appeared with regard to Estonia, Poland and Slovakia, these data have not been excluded, as it is known that the alternative pension systems comprise an insignificant proportion of the total asset allocation. Furthermore, although two pension investment programs exist in Hungary (mandatory and voluntary), the applicable regulatory frameworks are by and large identical.

[8] The "investment funds" component of reg_agg_1 was calculated as a mean of penalties ascribed to a jurisdiction in categories "private investment funds" and "retail investment funds".

contrary, reg_agg_2 aggregates the caps levied upon less risky asset classes: bonds and deposits. In consequence, the reg_agg_1 adopts the values from 0 to 4, and reg_agg_2 adopts the values from 0 to 2 (practically, the maximum is 0.5). The bigger their numerical representation, the more restrictive the regulatory policy is.

The results of simple OLS regressions are presented in Table 3, Table 4 and Table 5. When the Sharpe ratio (either the one based on 3-year volatility or the one based on all-sample volatility) is used as the dependent variable, the reg_agg_1 is significant if included singly. Unfortunately, its coefficient is positive which means that stricter regulatory environments explain superior risk-adjusted returns. This is in conflict with the theory. However, after the inclusion of macroeconomic controls, the significance of reg_agg_1 fades out. Instead, the performance of domestic equity market and the domestic equity market's liquidity become significant explanatory variables (both with positive coefficients in the first specification and negative in the second specification, with the latter result being rather puzzling). Additionally, when the Sortino ratio serves as the explained variable, recession dummy and liquidity are significant and come with the right sign. The risk-free rate is also significant, but exhibits a positive coefficient, which is not very convincing.

Generally, a refinement of the model where the dependent variable is the Sortino ratio, which discriminates between up and down volatility, turns out to be unsuccessful at this point.

The coefficients, given the way variables were constructed, are not directly interpretable. They solely indicate whether the increased drill leads funds to be better off or worse off.

The reported R-squareds are low, but this is not untypical for this kind of study. Moreover, the emphasis here is put on determining significant regressors first. The unobserved variation is thought to be mostly due to manager skill and ignored macroeconomic factors. Moreover, in this study the benchmark for investment returns is the risk-free rate only. It is probable that after incorporating relevant benchmarks for all asset classes the average Sharpe ratio would oscillate around zero or even be negative. As for now, we adopt a beneficiary's perspective who is generally not interested by how much their pension plans beat the benchmark, but rather by how much they beat the inflation.

4. Conclusions, limitations and avenues for further research

With the current specifications and limited amount of data input, no convincing relationships may be heralded. The synthetic variable computed in order to account for the regulatory strictness with regard to allocations in risky assets was not significant when other macroeconomic variables were also incorporated. Various macroeconomic variables, such as recession, equity market performance, liquidity on the equity market and the risk-free rate, proved significant in at least one specification. Nevertheless, signs of the accompanying coefficients sometimes happened to be counter-intuitive. In sum, despite the fairly supportive evidence of both theoretical and empirical literature, unravelling the elements of regulatory framework that significantly deteriorate risk-adjusted investment returns of pension funds remains problematic. The conclusive research papers that have been published so far in this area usually based on well-reported data for relatively small number of jurisdictions. Seemingly, accounting for the vast heterogeneity present in the OECD member states is a bit more challenging endeavor.

The irremovable limitation of this study comes from – what has already been mentioned – the heterogeneity of the lines along which regulatory guidelines are passed, and by the fact that these regulations are mostly taken at face value. It is sometimes the case that unofficial or implicit regulation, or even a quasi-regulation, is in fact more powerful that the official and explicit one. There are hardly any tools available to address this problem in a methodologically rigorous manner. One of the ideas, however, might be to inspect how investment limits influence the actual allocations to a given asset class. If the actually realized allocation to, say, equities is 39.5 percent with a regulatory cap of 40 percent, an inference may be made that the regulation is material. If the realized allocation is e.g. 20 percent, the materiality factor shrinks.

The unprecedented share of pension fund wealth in global assets, and the vital impact the profitability of these investments exerts over the lives of many prospective pensioners, still calls for a thorough study. Pension funds exert profound influence on the market and also fulfill crucial social role while managing enormous wealth of individuals. It is of everyone's interest that these funds are invested as effectively as possible. The question of whether alternative securities prove their potential to boost pension plans' financial standing is subject to an extended scrutiny in the consecutive versions of this paper. The article itself constitutes a preliminary research in a sense that there are numerous follow-ups that might be pursued on its foundations. This paper is intentionally crafted to facilitate further steps in terms of comparing the current risk-return profile of selected portfolios with hypothetical portfolios that include currently prohibited or restricted financial instruments.

It is obvious that this paper is an invitation to further work either in the field of methodology or in the realm of improved theoretical insights. The following has to be done in particular:

– Developing new variables for unlisted equity cap and unlisted bonds cap that are more differentiating between countries than overall limits on equity and bonds.
– Introducing a dummy variable to distinguish defined benefit and defined contribution plans, since as Davis (2001, 17) underlines the regulatory approach is fundamentally different, since the former have a guarantee component and more resemble a life insurance, whereas the latter more resemble mutual funds.
– Introducing several other controls to better explain the heterogeneity of returns, although given limited number of observations, the set of controls will rather be modest.
– Including more factors for the sake of verifying if funds are achieving alpha returns.
– Better match the regulatory regime to the performance figures for countries with multiple funds within the framework of one system.
– Create virtual alternative portfolios to check its influence on overall return. Some technical remarks were provided e.g. by Schweizer (2008).

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Appendix: The approach to the assessment of regulatory strictness

The table features the rules governing the value of penalty ascribed to reviewed jurisdictions.

<table>
<tr><th>Value of penalty:</th><th>0</th><th>0.5</th><th>1</th></tr>
<tr><td colspan="4">Portfolio ceilings for broad asset classes</td></tr>
<tr><td>Equity</td><td>No limits or limits down to 80% for at least one sub-class (e.g. listed equity), with none of sub-classes (e.g. unlisted equity) being entirely prohibited</td><td rowspan="7">Allowed, but limited in a way stricter than in the left column; some of sub-classes may be prohibited</td><td rowspan="7">Each of the sub-classes is not allowed, apart from rare or unusual exceptions</td></tr>
<tr><td>Real estate</td><td>No limits or limits down to 20% for at least one sub-class (e.g. mortgage-backed securities), with none of sub-classes (e.g. direct investment) being entirely prohibited</td></tr>
<tr><td>Bonds</td><td>No limits or limits down to 80% for at least one sub-class (e.g. unlisted bonds), with none of sub-classes (e.g. corporate bonds) being entirely prohibited</td></tr>
<tr><td>Retail investment funds</td><td rowspan="3">No limits or limits down to 20% for at least one sub-class, with none of sub-classes being entirely prohibited</td></tr>
<tr><td>Private investment funds</td></tr>
<tr><td>Loans[9]</td></tr>
<tr><td>Bank deposits</td><td>No limits or limits down to 80% for at least one sub-class, with none of sub-classes being entirely prohibited</td></tr>
<tr><td>Global investment limit in foreign assets</td><td>There is no limit or the limit is negligible (down to 60%), with all asset classes allowed and with none of geographies being excluded</td><td>Allowed globally with a limit up to 60%, or some asset classes restricted, or some geographies restricted</td><td>Investing in foreign assets is prohibited, apart from rare or unusual exceptions</td></tr>
</table>

A way to improve the statistics would be to include a dedicated sub-category for infrastructure, as the trend of greater allocation is forthcoming (Della Croce 2012; Della Croce, Schieb, and Stevens 2011; Towers Watson 2012).

[9] The regulatory data displayed in the column "Loans" was not precise enough for its inclusion in the model. Some jurisdictions understand this asset class as the ability to invest in collateralized loan obligations or similar securitized loan-related instruments, whereas the other interpret it simply as the facility to issue loans using fund's money, e.g. to individuals being pension plan members.

In order to give a glimpse on how the process is carried out, two out of the most complex examples are described below:

Hungary (2012)

Asset class	Equity	Real estate	Bonds	Retail investment funds	Private investment funds	Bank deposits	Global investment limit in foreign assets
Description of limits	Listed equities: No limit. Non-listed equities: 5% (both domestic and foreign). Conventio-nal portfolio: max. 10%. Balanced portfolio: min. 10%, max. 40%. Growth portfolio: min. 40%.	Mandatory pension funds (MPF): 5% directly, 10% together with real estate investment funds. Voluntary pension funds (VPF): 10% directly or through real estate investment funds. Conventio-nal portfolio: 0%. Balanced portfolio: max. 10%. Growth portfolio: max. 20%.	Governm. bonds: No limit. Hungarian corporate bonds: 10%. Hungarian municipal bonds: 10%. Mortgage bonds: 25%.	No limit.	Derivative fund: 5%. Risk capital: 5%. Conventio-nal portfolio: 0 %. Balanced portfolio: max. 3%, max. 2% per issuer. Growth portfolio: max 5%, max 2% per issuer.	Listed: No limit.	Within investment made abroad, the ratio of investment in non-OECD countries shall not exceed 20%.
Penalty	0.0	0.5	0.0	0.0	0.5	0.0	0.0

Mexico (2012)

Asset class	Equity	Real estate	Bonds	Retail investment funds	Private investment funds	Bank deposits	Global investment limit in foreign assets
Description of limits	No limit. 30% in securities not admitted to trading on a regulated market.	30% (joint limit with mortgage loans). In a unique real estate will be a 10% and in a real estate UCIT a 20%.	No limit. 30% in bonds not admitted to trading on a regulated market.	No limit (whenever UCITs satisfy legal require-ments). Individually 20% (if UCITs).	30% in private investment funds (indivi-dually 2%). Exception: investment funds that invest in other investment funds (this exception is not applicable to Spanish private investment funds).	No limit. Indivi-dually 20% (joint limit with every asset issued by the same entity).	No limit.
Penalty	0.0	0.0	0.0	0.0	0.0	0.0	0.0

This approach proves its superiority over Boon et al. (2013), as it is tolerant towards limits set at reasonable levels. None of the asset classes above were awarded a maximum penalty of 1.0. In a binary assessment system developed by Boon et al., most of the above asset classes were probably punished.

Table 1.

Data summary.

	Variable	Description	Unit	Source
1	sharpe_ratio, sharpe_ratio_2	Sharpe ratio of pension funds' nominal investment returns in a given jurisdiction in a given year. Two versions of Sharpe ratios were calculated that differ in how volatility was measured.[10]	pure number	Own calculation
2	sortino_ratio	Sortino ratio of pension funds' nominal investment returns in a given jurisdiction for the previous three years.[11]	pure number	
3	reg_agg_1	Synthetic variable indicating a magnitude of limiting investments considered risky.[12]	pure number	OECD, own interpretation
4	reg_agg_2	Synthetic variable indicating a magnitude of limiting investments considered safe.[13]	pure number	
5	aec	Dummy for an advanced economy, as reported by the International Monetary Fund	dummy	IMF
6	recession	A dummy that adopts 1 if GDP growth is negative.	dummy	World Bank
7	risk_free_rate	Long-term interest rate, 10-year government bonds in most cases.	percent	OECD in most cases
8	equity_mkt	Annual change in S&P Global Equity Indices that measures price change in the stock markets.	percent	World Bank
9	turnover	A proxy for market liquidity: turnover ratio is the total value of shares traded during the period divided by the average market capitalization for the period.	percent	

[10] Precisely, the volatility in Sharpe ratio I is computed as the standard deviation of nominal investment returns reported for the previous three years. For the first two years in a sample, a standard deviation of the third year in the sample is used. The volatility in Sharpe ratio II is the standard deviation of all available investment returns in a sample, exactly what Boon et al. (2013) have proposed. It is thus less accurate than Sharpe ratio I, but more instructive about the long-term tendency.

[11] For Sortino ratio, first two years in a sample are lost.

[12] In essence, the goal of both synthetic variables was to compute a compound "nuisance factor" being a numerical representation of restrictions identified in a particular jurisdiction. In other words, the analysis ranks particular regimes according to the nuisance conveyed by them when it comes to asset allocation. Again, it is evident that quantitative restrictions are just a single element of the regulatory mosaic, and the actual regulatory burden may differ significantly from what the quantitative caps indicate.

[13] cf. footnote above.

Table 2.

Descriptive statistics of individual data series.

Variable	Mean	Median	Maximum	Minimum	Std. dev.	Skewness	Kurtosis	Obs
sharpe_ratio	-0.1646	0.2337	24.0719	-30.2632	4.8175	-1.1439	17.2835	252
sharpe_ratio_2	-0.3097	0.2008	2.6286	-8.3894	1.6712	-1.9375	7.8032	258
sortino_ratio	0.0480	0.0250	2.8256	-0.9962	0.6174	1.0622	5.7393	190
reg_agg_1 <0;4>	0.9147	0.7500	4.0000	0.0000	0.9559	1.1733	3.8808	296
reg_agg_2 <0;2>	0.1474	0.0000	0.5000	0.0000	0.2283	0.8999	1.8099	329
aec	0.7672	1.0000	1.0000	0.0000	0.4233	-1.2643	2.5984	335
recession	0.1459	0.0000	1.0000	0.0000	0.3535	2.0062	5.0250	329
risk_free_rate	5.1998	4.6950	45.000	-0.1000	3.4529	5.8240	58.7084	334
equity_mkt	10.7554	14.8044	113.2000	-69.9427	33.6887	-0.1475	3.0449	311
turnover	78.1490	71.4030	269.8216	0.3527	50.5842	0.6743	3.2036	329

Table 3.

Regression results with Sharpe ratio (based on the 3-year volatility) as the dependent variable.

	Dependent variable: Sharpe ratio I		
	(1)	(2)	(3)
intercept	-1.00 ** (0.47)	-1.00 ** (0.48)	0.47 (1.55)
reg_agg_1	0.88 ** (0.41)	0.98 ** (0.54)	0.77 (0.63)
reg_agg_2		-0.53 (1.89)	0.46 (1.95)
aec			1.00 (1.09)
recession			-0.81 (0.88)
risk_free_rate			-0.121 (0. 141)
equity_mkt			0.0266 *** (0.0101)
turnover			-0.0221 *** (0.0073)
n	226	226	214
R^2	0.0203	0.0207	0.1062

Table 4.

Regression results with Sharpe ratio (based on the all-sample volatility) as the dependent variable.

	Dependent variable: Sharpe ratio II		
	(1)	(2)	(3)
intercept	-0.595 *** (0.164)	-0.596 *** (0.164)	0.34 (0.48)
reg_agg_1	0.233 * (0.141)	0.178 (0.185)	0.114 (0.198)
reg_agg_2		0.29 (0.65)	0.56 (0.61)
aec			-0.01 (0.34)
recession			-0.04 (0.28)
risk_free_rate			-0.129 *** (0.044)
equity_mkt			-0.0189 *** (0.0032)
turnover			-0.0061 *** (0.0023)
n	226	226	214
R^2	0.0121	0.0130	0.2373

Table 5.

Regression results with Sortino ratio as the dependent variable.

	Dependent variable: Sortino ratio		
	(1)	(2)	(3)
intercept	0.021 (0.069)	0.020 (0.069)	-0.22 (0.21)
reg_agg_1	0.019 (0.064)	0.020 (0.089)	0.042 (0.100)
reg_agg_2		-0.01 (0.29)	-0.26 (0.29)
aec			-0.043 (0.147)
recession			-0.267 ** (0.117)
risk_free_rate			0.0199 (0.0184)
equity_mkt			0.00442 *** (0.00135)
turnover			0.00237 ** (0.00097)
n	172	172	163
R^2	0.0005	0.0005	0.1250