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ABSTRACT

Strategic investment decisions in pension funds are made by trustees. In making these decisions, trustees contract independent advisors such as asset managers and actuaries. Can these external advisors transfer their investment beliefs to the pension funds they contract with? We use proprietary data with the names of asset management firms and individual actuaries that service multiple pension funds to answer this question. We find that pension funds make similar decisions on strategic asset allocations in the presence of a common asset manager or a common actuary, despite significant differences in their liability structures, funding levels, or sizes. The effect is particularly strong in alternative asset classes, such as private equity, hedge funds, and real estate. If two pension funds increase their strategic allocation to alternatives by 10 percentage points in one year, then a third pension fund that contracts the same asset manager increases its strategic allocation to alternatives by 2.5 percentage points, all else being equal. The common-advisor effect might lead a pension fund to select a strategic asset allocation that is not in line with its liability structure, funding ratio, sophistication level, or organizational structure.

JEL classification: G11, G23.
Key words: Pension Funds, Asset Allocation, Alternative Asset Classes, Spatial Econometrics, Asset Management

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Pension funds are an important class of institutional investors in the economy. Assets under management in pension funds amounted to USD 42.5 trillion in 2018 in the OECD countries. Weighted according to the GDP of each OECD country, this is equivalent to an average assets-to-GDP ratio of 82.3 percent (OECD (2019)). A pension fund's assets serve to finance the future liabilities towards its beneficiaries, and a board of trustees is responsible for making investment decisions in the best interests of those beneficiaries. In preparing these investment decisions, the board of trustees typically contracts actuaries to provide support in modeling assets and liabilities and external consultants in selecting asset classes. Furthermore, the board of trustees delegates the execution of investment decisions to external asset managers (van Binsbergen et al. (2008)).[1] These asset managers often specialize in an asset class, a geographical region, or an investment style. In several countries, pension funds may adopt a governance structure in which a single asset manager, named fiduciary asset manager, is appointed to organize the full range of advisory and execution services on behalf of the pension fund.[2] Given their professional relation, (fiduciary) asset managers and actuaries are likely to influence trustees' decisions.

The most important investment decision to be taken by the board of trustees is the strategic asset allocation (SAA). This decision cannot be delegated and concerns the choice about the long-term mix of different asset classes, such as fixed income, equity, and real estate, in the investment portfolio. The SAA is the key determinant of the investment performance (Ibbotson and Kaplan (2000)), and therefore highly relevant for the long-term welfare of beneficiaries because even small differences in annual returns compound, over the accrual phase of multiple decades, into large differences in retirement income. Theory argues that the unique characteristics of a pension fund determine the SAA. These include

[1] In this paper we alternately use the terms asset managers and asset management firms. In all case we refer to the asset management firm and not an individual person.

[2] The "one-stop shop" fiduciary asset management model evolved in the Netherlands and in the UK in the early twenty-first century to address the increasing complexity of asset management. This complexity manifests itself in three ways: (1) an increasing range of complex asset classes such as hedge funds, private equity, and infrastructure; (2) increasing regulatory complexity; and (3) increasing (perceived) volatility in financial markets (van Nunen (2011)).

the structure of its liabilities, its levels of risk-aversion and funding, its size as well as its asset class risk-return expectations and the covariance between the liability return and asset class returns (Broeders and Jansen (2020)).

In contrast, we observe that pension funds with different characteristics display similarities in their SAAs. A possible explanation of these similarities is a common-advisor effect: the presence of a common advisor leads to similar decisions across pension funds with different characteristics. If a common-advisor effect exists, asset managers and actuaries are able to transfer their investment beliefs to the board of trustees that overrules a pension fund's characteristics. The common-advisor effect might therefore lead a pension fund to select a SAA that is not in line with its liability structure, funding ratio, sophistication level, or organizational structure. This asymmetry increases management costs and negatively affects performance that can lead to a potential welfare loss for the pension fund's beneficiaries (Andonov et al. (2018))

In this study, we empirically investigate if such a common-advisor effect indeed exists. For this endeavor, we rely on a unique and proprietary database with detailed information on asset management firms, actuaries, and trustees who provide services to 191 pension funds in the Netherlands. The database is provided by the prudential supervisor of Dutch pension funds, De Nederlandsche Bank. In the Netherlands, all pension funds are required by law to periodically report their financial and governance information. To identify common advisors, we create networks of pension funds. First, we create a network of pension funds that contract the same asset manager, that is, the same asset management firm for the period from 2009 to 2016. Second, we create networks of pension funds that contract the same individual actuary for each year from 2007 to 2016. We then use spatial econometrics to test the relation between the SAAs of pension funds that are conditioned on contracting the same asset manager or the same actuary. We correct in the econometric analysis for pension fund characteristics that correlate with the SAA, in particular liability duration, funding ratio, and total assets under management. This approach captures whether asset managers and actuaries transfer their investment beliefs to the board of trustees, irrespective of pension fund characteristics.

We find a strong common-advisor effect. Pension funds that contract the same asset manager or the same actuary make similar strategic investment decisions across multiple asset classes over time, and despite significant differences in their liability structures, funding ratios, or total assets. Specifically, pension funds that contract the same asset manager adjust their SAAs in the same direction in the same year. We identify this effect in all asset classes. Pension funds that contract the same actuary also adjust their strategic allocations in the same direction in the same year. The common-actuary effect mainly occurs among actuaries who are involved in the asset-liability modeling. Moreover, the effect is independent from the company that an actuary works for and indicates that actuaries incorporate their private investment beliefs in their advising.

The common-advisor effect is particularly strong in alternative asset classes such as real estate, private equity, hedge funds, and commodities. If two pension funds increase their total strategic allocation to alternative asset classes by 10 percentage points in one year, then a third pension fund that contracts the same asset manager on average increases its total strategic allocation to alternatives by 2.5 percentage points, all else being equal. Alternative asset classes are often more complex, less liquid, or more risky compared to fixed income and equity. As such, alternative asset classes require decision-makers to have specific knowledge, which trustees do not necessarily possess.[3] For this reason, the knowledge of asset managers and actuaries is valuable to trustees. In fact, not all pension funds are able to independently set up the right check and balances to assess the cost effectiveness of alternative asset classes (Andonov et al. (2015)). However, using this expert knowledge of alternatives may come with a cost: asset managers might have an incentive to advise assets that generate a high fee for the asset management firm. Actuaries that perform an advisory role too might have similar

[3]Trustees are appointed based on representation criteria (Article 100, of the Dutch Pension Act). The board of trustees needs to have sufficient investment knowledge as a group; however, not all individual trustees need to be investment experts.

incentives, for example, if they are part of a large firm that also offers asset management services.

The similarities in investment policy cannot be explained by trustees that have a seat on multiple boards. Trustees can be appointed to multiple pension funds. Therefore, rather than measuring a common-advisor effect, we might capture the influence that overlapping trustees have on the SAAs of different pension funds. To test for this influence, we use the names of individual trustees and their tenure to create networks of pension funds that have overlapping trustees for each year from 2007 to 2016. Based on these networks, we find no evidence of an overlapping trustee effect: pension funds with overlapping trustees do not make similar investment decisions over time. This finding shows that individual trustees cannot overrule the collective decision of a board. Strikingly, pension funds with the same liability duration or funding ratio also do not make similar investment decisions over time. This finding strengthens the existence of a common-advisor effect because asset managers and actuaries do influence a board's decisions.

We run several robustness checks to ensure that similar investment decisions can in fact be associated with the common-advisor effect and not to other factors such as pension funds that follow each other over time or general trends in the popularity of asset classes. First, we show that the current SAA of a pension fund is not correlated with the SAAs in the previous year of pension funds that contract the same asset manager or the same actuary. This indicates that pension funds do not follow each other's past investment decisions. Second, similar investment decisions do not arise because of trends in the popularity of some asset classes versus others. First-difference analyses of the SAAs show positive correlations among the changes in the SAAs of pension funds that contract the same asset manager or the same actuary.

Our main contribution is to show that asset managers and actuaries affect decision-making at the strategic level by transferring their investment beliefs to the board of trustees despite differences in pension funds' characteristics. Therefore, asset managers (and actuaries) can directly influence the SAAs of pension funds even though they do not have the actual power to make decisions. This finding is related to the fact that many asset managers in the sample are appointed as a fiduciary asset manager, which means that they have a significant involvement in the design of the SAA. So far, the literature shows that consultants contribute to forming return expectations (Andonov and Rauh (2019)), affecting fund flows (Jones and Martinez (2017)), and recommending commercially connected asset managers irrespective of their skills (Jaiswal (2017)). Moreover, our study shows that asset managers and actuaries transfer their investment beliefs to pension funds across multiple asset classes, while the literature on pension fund asset management primarily focuses on equities (see, e.g., Lakonishok et al. (1992a), Coggin et al., 1993, Ferson and Khang (2002), Busse et al., 2010 and Blake et al. (2013)). In the institutional investing literature, a group of institutional investors who trade in the same direction is commonly defined as herding (Lakonishok et al. (1992b), Nofsinger, J. R., & Sias (1999)). Our study therefore relates to this stream of literature, as it shows similar investment decisions by measuring the cross-sectional spatial dependence of the SAAs of pension funds that contract the same asset managers or the same actuaries over time. Our method provides a channel that leads pension funds to herd that indicates pension funds invest in the same direction in response to common signals (Froot et al., 1992, Hirshleifer et al. (1994)).[4]

Our contribution is supported by access to proprietary data. The literature that investigates the role of external advisors in pension fund management is scarce. Detailed information on the names of asset managers and actuaries and their contracts' length are generally kept confidential.[5] Similarly, there is no publicly available database that lists the board composition of pension funds. Jenkinson et al. (2016) use survey data to describe what drives investment recommendations of consultants to pension funds. Rossi et al. (2018) exploit interconnections between consultants and asset managers to investigate the performance of

[4]Our study is also related to the literature that investigates the impact of social networks on institutional investors and firms' decisions, see e.g. Cohen et al. (2008) and Bouwman (2011).

[5]As Rossi et al. (2018) point out that in the US for example, there is no publicly available database that collects the contract relations between pension funds and consultants or asset managers.

equity managers. Goyal and Wahal (2008) exploit equity managers' reports to investigate the motivations that underlie the hiring and firing decisions of pension fund sponsors. Yet, the effect of external advisors is certainly not restricted to one asset class only and, as we show, they have a more direct influence on pension funds' strategic decisions such as the SAA.

The remainder of the paper is organized as follows: We describe our data, the multiple appointments of asset managers and actuaries, and the similarities in the SAAs of groups of different pension funds in SectionI. Section II presents our hypotheses, and Section III introduces our method. Section IV presents the results. Section V covers some robustness checks, and Section VI concludes.

I. Data and networks

We conduct our study in the Dutch occupational pension funds sector. In the Netherlands, occupational pension funds have a broad coverage among workers, as there is a long tradition of providing post-retirement income. There is a variety of different pension funds, some are compulsory, and others are voluntary. Pension funds can be set up for an industry sector, an occupational group, or specifically for a large company. Some 91% of the workers automatically enroll in an employer-sponsored pension fund. The vast majority of these pensions offer a defined benefit (DB). As of December 2016, Dutch occupational pension funds managed a total of EUR 1,266 billion (USD 1,395 billion) in assets.[6]

A. Data

To test the effect of common asset managers and actuaries on the SAA, we use a balanced panel of 191 Dutch DB pension funds over the period from 2007 to 2016. The data are proprietary and come from the prudential supervisor of pension funds, De Nederlandsche

[6]Figures available at: `https://www.dnb.nl/en/statistics`.

Bank (DNB). The data are free of reporting bias, as all pension funds are obliged to report quarterly statements to the DNB. We use a balanced panel to address the consolidation that the pension sector has faced over time.[7] Pension funds that transferred assets and liabilities to an insurance company or that merged with another pension fund during the sample period are excluded from the analysis. The motivation for this exclusion is that a gradual transfer of assets to a third party can result in a non-representative SAA and mechanical portfolio comovements. Most of the pension funds that were liquidated during the sample period were small in terms of the number of beneficiaries and assets under management. Therefore, such an exclusion does not affect the coverage of our sample, because the 191 pension funds in our database report total assets that range from 89 to 94% of the total assets under management in the entire sector every year.

Pension funds report the names of the asset management firms they contract. A 2016 survey shows that more than three quarters of Dutch pension funds rely on fiduciary asset managers and this share has increased over time.[8] Asset managers can be hired by multiple pension funds. If multiple pension funds appoint a single asset manager with a fiduciary mandate to manage their assets, then these fiduciary asset managers can directly influence the trustees' decisions across different pension funds. Moreover, if the fiduciary asset managers are also the executor of the investment strategies of their clients, then they might have an incentive to advise asset classes with higher fees in order to maximize their income.[9]

Pension funds also report the name of the individual actuaries and the actuarial firms that they contract with. By law, each pension fund relies on the services of two actuaries: an advisory actuary and a certifying actuary. The advisory actuary advises on the level of contributions paid to the pension fund for the accrual of new pension benefits and determines the value of the liabilities.[10] The advisory actuary also performs asset-liability modelling

[7]Increasing cost effectiveness is the primary driver of this consolidation. The number of pension funds that operate in the Netherlands decreased from 1,060 in 1997 to 290 in 2016.

[8]For the survey see: `https://pensioenpro.nl/magazine/30002114/inhaalslag-na-aanpassing-ftk`.

[9]Before 2016, pension funds reported the names of all asset managers. From 2016 onward, pension funds are required to communicate only the names of asset managers who handle more than 30% of total assets.

[10]The value of the pension liabilities is the discounted value of the accrued pension benefit obligations.

(ALM) by assessing the long-term effect of investments, contributions, and benefit policies on the funding ratio and the claims of the various stakeholders. These stakeholders are the retirees, the current and former employees, and the employer. (Blome et al. (2007), Bauer et al. (2006)). Via the ALM study, the advisory actuary advises a SAA given the structure of the liabilities. Therefore, the advisory actuary can also influence trustees' decisions; and in the case of multiple appointments, different pension funds are likely to receive similar recommendations. The certifying actuary provides an ex-post assessment of the adequacy of the SAA of a pension fund. Therefore, the certifying actuary has no direct influence on the ALM study. But the certifying actuary can compose a remark, if she believes the SAA is not in line with the prudent person principle. According to the Dutch Pension Act, the prudent person principle means that the retirement savings must be invested in such a way as to guarantee the security, quality, liquidity, and return of the portfolio as a whole. By law, the certifying actuary must be a different person from the advisory actuary. However, a certifying actuary can be the advisory actuary at another pension fund, and vice versa. Both actuaries can work for the same actuarial firm.

On a yearly basis pension funds report information on the board of trustees such as the name, gender, age, tenure, and function of each individual trustee. The data also include the stakeholder group that each trustee represents. A trustee can represent the employer, the (current or former) employees, or the retirees in the plan. Each trustee is appointed by these "social partners". Alternatively, a trustee can also be appointed by other board members without representing a specific stakeholder group. This figure is called an independent trustee, and the board generally selects this trustee to provide specific expertise that can improve its decision-making. For example, a board may highly value an independent trustee who has experience in the asset management sector.

Panel A of Table I provides the summary statistics of the governance information. An

Changes in this value are due to variations in market interest rates, indexation of benefits, and actuarial factors such as demographic trends. The value of pension liabilities is necessary to determine the funding ratio of the pension fund.

average pension fund employs 1.79 asset managers with an average contract length of 6.42 years. Actuaries have an average contract length of 5.29 years. The average board size is 5.97 members. The average tenure of a trustee is 7.76 years. On the average board, 45% of the trustees represent the employer, 39% represent the employees, 11% represent the retirees, and 4% represent independent trustees.

For supervisory purposes, pension funds report on a quarterly basis the SAA to the DNB. For the purpose of our study, we group the investments into eight asset classes, namely equity, fixed income, real estate, private equity, hedge funds, commodities, cash, and a residual class named other investments, which among others include infrastructure investments. Quarterly reports to the DNB also include financial information such as the funding ratio, liability duration, and total assets under management. Panel B of Table I provides the summary statistics of the pension funds' financial information. On average, 58% is invested in fixed income, 31% in equity, and 10% in alternative asset classes. Most of the alternatives are allocated to real estate (6.7%), the remaining part is equally divided among private equity, hedge funds, and commodities (1.2% each). If we only consider pension funds that actually invest in alternative asset classes, then the average allocation is almost 12% over the 10-year period that includes 8.5% in real estate, 2.8% in private equity, 4.4% in hedge funds, and 3.4% in commodities. The pension funds in the sample have on average a funding ratio of 113.6% and are relatively heterogeneous in terms of the age distribution of the beneficiaries. Pension funds in the 25^{th} percentile have a liability duration lower than 15.6 years, while the pension funds in the 75^{th} percentile have a liability duration above 20.1 years. The distribution of sizes is skewed because there are a few very large pension funds in the Netherlands.

B. Pension funds' networks from multiple appointments

Our prime analysis is based on common advisors. To capture the common advisors we build networks of pension funds that are connected via asset managers and actuaries. Panel A of Table II gives the dynamics in the relations between asset managers and pension funds over time. In 2009 there were 114 asset managers working for the 191 pension funds in our sample. Of these asset managers, 46 were hired by more than one pension fund, and there were 166 pension funds whose asset managers also worked for other pension funds (pension funds can hire more than one asset manager). In 2016 the number of asset managers in the sample decreased to 46 and consequently those with multiple contracts decreased to 27. However, the number of pension funds contracting a common asset manager roughly stayed the same throughout the sample period. This finding indicates that the asset managers who exited from the sample were not those with many multiple appointments. For our analysis, we isolate the asset manager in charge of more than 30% of the total assets of a pension fund continuously over the period from 2009 to 2016. We therefore isolate only one asset manager for each pension fund. By isolating the asset managers in this way, we aim to capture the fiduciary asset managers i.e., the asset managers who are directly involved in the design of the SAAs. Pension funds are required to report the names of their asset managers; however, they do not disclose whether they are fiduciaries or not. With this procedure, we are confident that we can capture the fiduciaries, as their turnover is generally lower than other asset managers.[11] Panel A of Figure 1 displays the networks of pension funds that contract the same unique asset manager over the period from 2009 to 2016. We observe six large and separate networks of pension funds that contract the same asset managers. There are also seven smaller networks with three to five pension funds sharing the same asset managers. Our analysis henceforth will be based on these groups of asset managers.

Panel B of Table II presents the dynamics of the relations between actuaries and pension funds over time. In 2007 there were 110 actuaries in our sample, 75 of them worked for more than one pension fund, and 178 pension funds contracted either the same advisory actuary or the same certifying actuary. In 2016 the number of actuaries in the sample decreased to 98, the number of actuaries working for more than one pension fund also decreased to 57, but

[11]Some fiduciary asset managers are spin-off from a pension fund and therefore are not contracted by the pension fund, but rather a separate entity within the pension fund itself. However, these asset management firms are also contracted by other pension funds as fiduciaries.

the number of pension funds contracting the same actuary was 187. By means of example, Panel B of Figure 1 displays the networks of the 190 pension funds that contracted the same actuary in 2012. We observe that the 69 actuaries with multiple appointments connect all pension funds but one. On average the same actuary is contracted by 10 pension funds and some actuaries are contracted by up to 20 pension funds. We define two pension funds as connected if they contract the same actuary regardless of the actuary's function. Therefore, the same actuary may be an advisory actuary for one pension fund and a certifying actuary for another pension fund.

In our empirical analysis we use the fact that multiple pension funds can appoint the same trustees. Panel C of Table II shows the multiple appointments of trustees over time. As of 2007 there were 461 active trustees in our sample, 32 were appointed to more than one board, and 52 pension funds had at least one trustee on their board that also sat on other pension fund boards. As of 2016 there were 1,185 active trustees in our sample, 90 were appointed to more than one board, and 95 pension funds had at least one trustee on their board that also sat on other pension fund boards. From 2007 to 2011, the number of trustees was lower than from 2012 to 2016. This is due to the different reporting system used in the first half of the sample period. We are only able to retrieve the names of trustees active between 2007 and 2011 that were still working in 2012. From 2012 onward, we have access to the entire population of trustees.

We then use the names of trustees and their tenures to create networks of pension funds that have overlapping trustees each year from 2007 to 2016. In Panel C of Figure 1, we show the pension funds with overlapping trustees in 2012. The number of pension funds with no overlapping trustee is high. However, there are many pension funds that have one or more trustees with multiple appointments, as on average a trustee sits on four boards. In the bottom-left-hand corner of the figure, we observe a network of 61 pension funds that originates from 66 trustees. Some of these trustees sit on as many as nine boards.

C. Portfolio similarities and irregularities

The objective of a pension fund is to choose an SAA that has an optimal risk-return trade-off for the assets given the structure of the liabilities and other pension fund characteristics. Therefore we expect that pension funds with a differences in liability duration, funding ratio or size to have divergent SAAs. Our quest for a common-advisor effect starts with the observation to the contrary. In fact, if we group and compare pension funds based on some key characteristics, we see some portfolio similarities and irregularities across these groups. First, we form quartiles of pension funds based on liability duration, funding ratio and size (measured by assets under management, AUM). Figure 2 shows that the average SAAs of pension funds with different liability duration and different funding levels are rather similar. Second, in Table III we show the average allocation to fixed income, equity and alternatives for each quartile of liability duration, funding ratio and size. Next we perform a t-test on the difference between the mean of the first and fourth quartiles. Based on this table and test, we make the following observations.

Panel A of Table III show the average SAAs of pension funds by quartiles of liability duration. Liability duration summarizes the age distribution of the beneficiaries. It is a measure of the weighted average investment horizon across beneficiaries and therefore affects the SAA. Pension funds in the first and fourth quartiles have an average liability duration of 14.0 years and 22.8 years respectively. We observe that the average pension fund in the first quartile invests 56.4% in fixed income compared to 61.7% for the average pension fund in the fourth quartile. But the standard life-cycle theory predicts a higher allocation to fixed income for pension funds with shorter liability durations.[12] Furthermore, the average pension fund in the first quartile invests 11.2% of its portfolio in alternatives. But the average pension fund in the fourth quartile invests 7.7%. Economic reasoning argues that pension

[12]Life-cycle theory incorporates human capital in the optimal asset allocation, see, e.g., Bodie et al. (1992). A high liability duration is an approximation of high human capital which can be interpreted as a high allocation to bonds under the assumption that human capital has low risk.

funds with a long investment horizon can invest more in illiquid assets classes.[13]

Panel B of Table III show the average SAAs of pension funds by quartiles based on their funding ratio. Pension funds with a high funding ratio can take more investment risk. Pension funds in the first and fourth quartiles have an average funding ratio of 102.0% and 133.7% respectively. The average pension fund in the first quartile indeed invests more in fixed income and less in equity and alternatives. The average pension fund in the fourth quartile does the opposite. These differences are in line with standard economic reasoning. However, pension funds within the same quartile show a high standard deviation. This deviation indicates that differences among pension funds within the same quartile appear to be larger than the differences across pension funds of different quartiles. Comparable numbers are observed in Panel A of Table III.

Panel C of Table III show the average SAAs of pension funds by quartiles based on their assets under management. Pension funds in the first and fourth quartiles have average assets under management of EUR 105.1 million and EUR 15,760.9 million, respectively. The average pension fund in the fourth quartile allocates substantially less (12.6%) to fixed income and slightly more (1.3%) to equity than the average pension fund in the first quartile. Moreover, large pension funds in the fourth quartile allocate significantly more (10.9%) to alternative asset classes compared to small pension funds in the first quartile. This allocation indicates that large pension funds can exploit economies of scale in more sophisticated asset classes (Broeders et al. (2016b)). However, based on the high standard deviation there are also some small pension funds that invest strongly in alternative asset classes.

[13] Next to a common-advisor effect, another explanation for the low allocation to alternative asset classes in the fourth quartile is that pension funds with a high liability duration need to have sufficient liquid assets available for collateral purposes in transactions that hedge interest rate risk in interest rate swaps, see Broeders et al. (2020).

II. Hypotheses

We test four hypotheses to explain the similarities among SAAs. The first hypothesis concerns the common-advisor effect. A so called, common-advisor effect can explain the similarities among SAAs. As many pension funds contract the same asset manager or the same actuary, these external advisors might provide the same advice to their clients about the asset allocation, irrespective of pension fund characteristics.

In the second hypothesis we focus on the type of actuaries. The advisory actuary and the certifying actuary have separate roles to play at different stages of decision-making. The advisory actuary is ex ante involved through their consulting activity and via the ALM study. The certifying actuary, by contrast, is only involved ex post in verifying that the investment policy is in line with the prudent person principle. As a consequence, we predict that the influence of advisory actuaries on the similarities among SAAs is larger compared to certifying actuaries.

In the third hypothesis we turn to the trustees. The similarities among SAAs might be caused by an overlapping-trustee effect. As trustees can be appointed to more than one pension fund, they might make similar investment decisions for all pension funds to which they are appointed.

In the fourth hypothesis we explain the similarities among SAAs from similar pension fund characteristics. Pension funds with a comparable liability structure have a comparable investment horizon and cash flow needs. Therefore, these pension funds should have similar SAAs. Similarly, pension funds with comparable funding ratios face comparable funding constraints and therefore are also expected to make similar investment decisions over time. Further, pension funds of comparable size have a comparable organizational structure and sophistication level and therefore should make similar investment decisions too.

III. Methodology

We rely on spatial econometrics to test our hypotheses. Spatial econometrics measure the spatial dependence that arises when the values of a variable observed in one location depend on the values of the same variable observed in nearby locations (LeSage and Pace (2009)). Spatial dependence is a measure of correlation. We apply the concept of neighboring regions to pension funds. In our context, proximity is not given by geographical distance but by common asset managers or by common actuaries. Therefore, we argue that in our data generating process (DGP) the values observed in one pension fund depend on the values observed in other pension funds that contract the same asset managers or the same actuaries, that is, pension funds in the same network.[14] We first discuss the general specification of the spatial autoregressive model and then discuss the spatial panel specification that we use.

A. Spatial autoregressive model and weighting matrix

The spatial autoregressive model is defined as follows:

$$y_i = \rho \sum_{j=1}^{n} W_{ij} y_j + \epsilon_i \tag{1}$$

where $\sum_{j=1}^{n} W_{ij} y_j$ is the spatial lag that represents the linear combination of the values of variable y observed in neighboring pension funds. In our model y is the strategic allocation of a pension fund to a given asset class. The linear combination is defined by the $n \times n$ spatial weight matrix W. Each element w_{ij} in the weighting matrix W equals one when pension fund i and pension fund j contract the same asset manager, the same actuary, or have the same trustee. The weighting matrices are standardized by row throughout the entire analysis. This standardization means that the elements of each row of W are scaled to sum to unity.

[14] We are not the first ones to use spatial econometrics outside the domain of economic geography, see, e.g., Beck et al. (2006), Broeders et al. (2016a), Dow et al. (1984), and Simmons and Elkins (2004).

Standardizing over rows means that each individual neighboring observation has a weight that is proportional to one over the total number of neighboring observations.

Our weighting matrix faces two potential complications: network dynamics and endogeneity. The first potential complication is network dynamics. In the context of geographical proximity, borders among regions are rather stable over time (see, e.g., Mukherjee and Singer (2008) and LeSage et al. (2011)). In our context, by contrast, asset managers and actuaries are replaced over time. Therefore, over our 10-year sample period we have 10 different weighting matrices for each network. However, as shown in Table I, contract changes are not that frequent in practice. The average contract length of asset managers is almost six and a half years, and actuaries' average contract length is more than five years. In addition, SAAs are revised only every three to five years, and it takes time for a pension fund to implement these changes. Once a new SAA is decided, the next period portfolio will not immediately reflect that change. Consider for example a large pension fund, a change in the SAA might signal the market and therefore affect prices. For this reason, large pension funds only adjust their portfolios gradually. Furthermore, decisions such as investing or divesting in alternative asset classes takes time to implement due to a lack of liquidity and lock-up periods. It is not unusual to see the actual investment decisions being fully implemented months or, in some cases, even years after the board of trustees approves them.

After these considerations, we determine the weighting matrix in year t, and we then test the effect of common asset managers and common actuaries on the SAAs in the years $t, ..., t+4$. Ergo, we keep the weighting matrix constant for five years. The underlying assumption is that the decisions made in a given year will be implemented throughout the subsequent five years.

The second potential complication is endogeneity. Our aim is to use the common-advisor effect as an explanatory variable for the investment decisions. However, a pension fund's investment intentions may have already affected the decision of hiring a specific asset manager. In that case the causality runs in the opposite direction. To address this endogeneity issue, we restrict the analysis to the group of unique asset managers defined in Section I.B. We define this type of asset manager as being employed by a pension fund throughout the entire sample period and managing more than 30% of a pension fund's portfolio. We therefore isolate only one asset manager per pension fund. Since this asset manager is employed continuously over time and is responsible for a sizable share of the portfolio, they can have a significant effect on the SAA of the pension fund.[15] The weighting matrix defined by the unique asset manager is by construction constant over time and consequently no new asset managers are included. Nevertheless, some pension funds could have just hired some of these asset managers at the beginning of our sample period as a reflection of pre-sample investment intentions. In this case endogeneity could still affect our results. To be more conservative we therefore test the common-advisor effect only on the subperiod of 2012 - 2016. By doing so we are confident in saying that multiple contracts of asset managers are exogenous to any prior investment intentions.

Endogeneity is less of a concern for pension funds that contract the same actuary. Pension funds hire actuarial firms without ex ante knowing the individual actuary who will prepare the ALM study. Actuaries' main activity is not to provide a recommendation about individual investments but rather to design a set of SAAs that match the liabilities and present them to the board of trustees. In addition, the private investment beliefs of an actuary are the same regardless of the company they work for. Therefore, actuaries do not per se carry investment beliefs that belong to their firms. Precisely for this reason, we analyze the interconnections based on individual actuaries rather than at the actuarial company level.

[15]We crosschecked the list of managers that results from this approach with a survey of pension funds and fiduciaries published by PensioenPro in 2013. 25% of the pension funds in our sample declare in the PensioenPro survey to rely on the services of a fiduciary which is the same asset manager that we identify with our method.
See survey at: `https://pensioenpro.nl/nieuws/30002843/overzicht-fiduciair-managers-vermogensbeheerders-sel`

B. *Common-advisor effect, a spatial panel approach*

As common advisors are observed for multiple pension funds over time, we rely on the following spatial panel autoregressive model (SAR) to test our hypotheses:

$$\mathbf{y}_t = \rho \mathbf{W} \mathbf{y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t \tag{2}$$

where $\mathbf{y}_t$ is a vector that contains the strategic allocation in a given asset class of all 191 pension funds in year t. $\mathbf{X}_t$ is a matrix that contains pension fund characteristics that can explain the differences in the SAAs such as the funding ratio, liability duration, and size (log of total assets under management). Further, $\boldsymbol{\mu}$ and $\boldsymbol{\theta}_t$ are pension fund and year fixed effects. We include these fixed effects because we are interested in measuring how the SAA of a pension fund evolves over time as a function of the SAAs of the pension funds that contract the same asset managers or the same actuaries.[16]

The spatial correlation coefficient ρ measures the direction and the magnitude of the relation between the SAAs of pension funds that contract the same asset managers or the same actuaries. A positive and statistically significant ρ indicates a common-advisor effect. This rho means that pension funds with the same asset manager or the same actuary increase or decrease the strategic allocation in a given asset class in the same year.

IV. Results

In this section, we test our four hypotheses. We first show the results of the SAR model that tests if common asset managers or common actuaries influence the investment decisions of pension funds. Second, we test the common-advisor effect for advisory actuaries and certifying actuaries separately. Third, we test the existence of an overlapping-trustee effect on SAAs. Namely, we assess if individual trustees make similar strategic investment decisions if they are appointed to multiple pension funds. Fourth, we analyze if pension funds with

[16] See Elhorst (2013) for an excellent overview on spatial panel models.

similar liability durations, similar funding ratios, or similar sizes make similar investment decisions over time.

A. Common-asset-manager effect on the SAAs

Our first hypothesis is that common advisors lead to similarities among SAAs. We begin by estimating the common-asset-manager effect on the SAAs. As described in Section III.A, we perform this test on the subsample of 2012-2016 to avoid endogeneity concerns. Table IV summarizes the estimation results of the SAR model in Equation (2). The results indicate a strong common-asset-manager effect in all asset classes, except real estate. The ρ coefficient is 0.2463 in the first column and its interpretation is as follows: If two pension funds increase their total strategic allocation to alternative asset classes by 10 percentage points in one year, then a third pension fund that contracts the same asset manager will increase its total strategic allocation to alternatives by 2.5 percentage points, all else being equal.[17] We find a similar spatial correlation across individual alternative asset classes, ρ equals 0.3599 in commodities, 0.4064 in private equity, and equals 0.4316 in hedge funds. Common asset managers also have a comparable effect on the strategic allocation to equity ($\rho = 0.3006$) and fixed income ($\rho = 0.3911$). The only exception is real estate in which we find no evidence of a common-asset-manager effect. This exception may be because the direct investments in real estate are rather fixed and cannot be easily increased or decreased. The first column in Table IV also shows that as the funding ratio decreases, pension funds allocate less to alternative asset classes. This is in line with pension funds not gambling for resurrection by increasing their exposure to high-risk assets in the event of poor funding conditions.

Next, we analyze the common-actuary effect. We estimate Equation (2) that relies on the weighting matrices that originate from the contracts between actuaries and pension funds in 2007, 2008, 2009, 2010, 2011, and 2012. Each year, and for each asset class, we estimate the

[17] For more details on the calculation of this effect we refer to Appendix A.

common-actuary effect on the subsequent five years. For example, we build the weighting matrix from common actuaries in 2007. We then test the effect of these common actuaries on the SAAs over the period from 2007 to 2011. We repeat this analysis for each year until 2012 when the common actuaries began. Rather than producing extensive tables, we give a graphical representation of the results. In Figure 3, we plot the ρ coefficients and their confidence intervals for the regressions run with each weighting matrix for alternatives, public equity, and fixed income. Panel A shows a significant common-actuary effect in alternative asset classes over time. Each year the ρ coefficient is positive and significant with the exception of 2009. These coefficients indicate that common actuaries lead pension funds to positively correlated strategic allocations with alternatives over the subsequent five years. In other words, common actuaries lead to portfolio comovements in alternatives. Conversely, Panels B and C show that pension funds with the same actuary do not change their strategic allocations to equity and fixed income in the same direction over time.

It is reasonable to find stronger evidence of a common-actuary effect in alternatives as opposed to standard asset classes. Alternative asset classes are often more complex, less liquid, and riskier investments than public equity and fixed income. As such, they require that decision-makers have specific knowledge, which trustees do not necessarily possess (Binfare et al. (2018)). For this reason, the opinions of specialized consultants such as actuaries are highly valuable and influential.

Figure 4 displays the analysis of the common-actuary effect on the allocation to different types of alternative asset classes. The results are mixed and not as conclusive as for the aggregate alternatives portfolio (Figure 3, Panel A). We find a common-actuary effect in private equity and real estate, while we find no evidence of a common-actuary effect in hedge funds and commodities. Therefore, actuaries are able to transfer their individual investment beliefs to their clients, but this transfer is stronger in the aggregate allocation to alternatives than in some individual asset classes.

To summarize, our results indicate that a common-advisor effect exists. Pension funds that contract the same asset manager increase or decrease their strategic allocations to both alternative and standard asset classes in the same year. Pension funds that contract the same actuary also increase or decrease their strategic allocations to alternatives in the same year. Factors other than pension fund characteristics should not affect the SAAs of pension funds. Therefore, finding a positive correlation among the SAAs of pension funds with the same asset managers or actuaries indicates that these advisors transfer their investment beliefs to their clients, irrespective of pension fund characteristics.

B. Disentangling the common-actuary effect

Our second hypothesis is that common advisory actuaries lead to similarities among SAAs. In the previous section we saw that pension funds with the same actuary make similar investment decisions for alternative asset classes. We find this similarity when pension funds contract with either the same advisory or the same certifying actuary. Yet, the advisory actuary and the certifying actuary have distinctly separate roles. The advisory actuary can affect a pension fund's investment decisions ex ante. Conversely, the certifying actuary can only ex post reflect on a pension fund's investment decisions. In order to disentangle the effect of each type of actuary on the investment decisions, we estimate Equation (2) separately for pension funds with the same advisory actuary and for pension funds with the same certifying actuary. By doing so we reduce the number of multiple contracts for each actuary. On average, an advisory actuary has contracts with four pension funds. Similarly, a certifying actuary has contracts with on average four pension funds.

In line with our hypothesis, we find a strong common-actuary effect when limiting the analysis to the pension funds that contract the same advisory actuary. Differently, we find limited evidence of a common-actuary effect when limiting the analysis to the pension funds that contract the same certifying actuary. Panel A of Figure 5 displays the ρ coefficients that were estimated based on the common advisory actuaries. The coefficients are larger in magnitude and more significant than those that were estimated based on the common certifying actuaries in Panel B. Pension funds that contract the same advisory actuary have positive and significant correlation coefficients among their strategic allocations to alternatives over the entire sample period, while pension funds that contract the same certifying actuaries have positive and significant correlation coefficients only in 2007 and 2011.[18]

Furthermore, the influence that actuaries have on the SAAs of their clients could be driven by the firm that they work for. Actuarial companies typically provide models and tools to perform the ALM study for their actuaries. Actuaries from the same firm use models that reflect the same underlying assumptions, for example, on the factors that drive asset class returns. Therefore, the common-actuary effect might capture the fact that actuaries use the same technical tools. To test whether this effect exists we estimate Equation (2) separately for pension funds with the same advisory actuarial firm and pension funds with the same certifying actuarial firm. We find no evidence of an effect in alternatives. Panel C in Figure 5 shows highly non-significant ρ coefficients for the models that were estimated with pension funds with the same advisory actuarial firm. Panel D also shows non-significant ρ coefficients for the models estimated with pension funds with the same certifying actuarial firm. [19]

To summarize, our findings indicate that the common-actuary effect is mostly driven by advisory actuaries. Via their consulting activity they are in a better position to affect the investment decisions of pension funds. Moreover, the common-actuary effect is not driven by the actuarial firm of actuaries. Therefore, individual actuaries are able to transfer their private investment beliefs to their clients.

C. *Overlapping-trustees effect on the SAAs*

Our third hypothesis is that overlapping trustees lead to similarities among SAAs. In the previous sections we found the existence of a common-advisor effect. Common advisors

[18] We have similar findings for private equity, real estate, hedge funds, and commodities. The results are displayed in supplementary Figures 1 and 2 in the online appendix at `https://www.mbonetti.com/`.

[19] We report the results of the analysis for all other asset classes in supplementary Figures 3 and 4 of the online appendix.

transfer their investment beliefs to the trustees during their advisory activity; hence, they affect the SAAs. Trustees are in charge of the SAA, and legislation allows trustees to be appointed to multiple boards. In the case of multiple appointments, individual trustees will likely behave similarly across different pension funds for various reasons. The same person will in fact have the same investment beliefs and preferences (Malmendier and Nagel (2011), Dohmen et al., 2017) despite the specific characteristics of the pension fund in which they are appointed. Therefore, one may argue that the common-advisor effect that we find is in fact a mere manifestation of an overlapping-trustee effect; namely, individual trustees that make similar strategic investment decisions across different pension funds.

We test this overlapping-trustee effect by using the networks of pension funds that have overlapping trustees each year from 2007 to 2016. Next, we estimate Equation 2 where the weighting matrix W equals one when two pension funds have the same trustee sitting on their boards.[20]

In Figure 6, we display the regression coefficients that were estimated based on the weighting matrices that originate from the appointments of trustees in 2007, 2008, 2009, 2010, 2011, and 2012. Each year, and for each asset class, we estimate the overlapping-trustee effect on the subsequent five years, which is in line with prior analyses. Such a time range is also in line with the average tenure of a trustee, that is, six years (see Table I). The results provide weak evidence in support of an overlapping-trustee effect in alternative asset classes. Moreover, there is no evidence of this effect in public equity and fixed income. In fact, for fixed income we even observe two negative spatial correlation coefficients that indicate that pension funds with the same trustees in 2011 and 2012 have SAAs that move in the opposite direction in the subsequent five years. In Figure 7, we replicate the analysis

[20]Endogeneity concerns also hold for overlapping trustees. Suppose that pension fund A is advised to invest in alternative asset class z. Because the pension fund's trustees are not particularity knowledgeable on this asset class, they decide to hire independent trustee y who has an expertise in z. This trustee already works for pension fund B. To avoid this reverse causality we exclude all independent trustees from the sample. We consider only overlaps among the representatives of employer, employees, and retirees. These are appointed by the social partners based on representation criteria rather than based on their specific investment expertise.

for each alternative asset class. Only pension funds that contract the same trustees in 2007, 2009, 2010, and 2011 have significantly positive correlations in their private equity strategic portfolios over the subsequent five years. Evidence of an overlapping-trustee effect is nearly nonexistent in real estate, hedge funds, and commodities.[21]

To summarize, our findings indicate that individual trustees are not able to transfer their investment beliefs to other board members, unlike common advisors. In practice, the influence of individual trustees on the SAA is limited. One person alone cannot stir the collegial decisions of a board, let alone multiple boards at different pension funds. Even though some highly influential, experienced, or knowledgeable trustees might succeed in transferring their investment beliefs to the other board members.

D. Common pension fund characteristics and SAAs

Our fourth hypothesis is that common pension fund characteristics lead to similarities in SAAs. Pension funds with a similar liability duration have a similar age composition in terms of beneficiaries. For example, pension funds with a low liability duration have a high number of retirees. These pension funds have a comparable investment horizon and similar cash flow requirements and therefore they should make similar strategic investment decisions (Broeders et al. (2020)). To test the hypothesis, we estimate Equation (2) with a weighting matrix that equals one when two pension funds are in the same quartile of the distribution of the average liability duration, and zero otherwise. Specifically, two pension funds are "neighbors" if they have a similar average liability duration.[22] Panel A of Table

[21] Trustees that are also members of the investment committee might have more financial knowledge and a greater involvement in the investment decisions. We also test the overlapping-trustee effect by considering only multiple appointments of trustees who are also in the investment committee. The results are unchanged (unreported analysis, the results are available on request to the authors).

[22] The $\mathbf{W}$ is constant over time as we compute the time-series average of the liability duration of each pension fund, and then we separate pension funds into four quartiles. We chose this approach because the liability duration is a rather stable measure. The heterogeneity in such a measure is given by the different composition of the labor force in each sector or company. Therefore, if changes occur in the demographic structure of a pension fund, these occur very slowly over time. On the other hand, interest rate fluctuations affect the liability duration of all pension funds equally. In sum, pension funds that are in the first quartile of the liability duration distribution are likely to stay in the same quartile in the subsequent years.

V shows the results. We find that pension funds in the same maturity group do not make similar investment decisions over time. All asset classes have either a non-significant or a negative ρ that means the pension funds with similar liability durations have SAAs that are not related to each other or even move in the opposite direction over time, for example, in commodities and private equity.

We repeat the same analysis for pension funds with similar funding ratios or sizes. Panel B in Table V shows that pension funds with similar funding ratios have SAAs that are not correlated. Conversely, pension funds of similar size display a positive correlation in the strategic allocations to private equity, real estate, and public equity. Size correlates with the cost structures and investment skills of pension funds. These similarities can explain why pension funds of similar size are likely to trade the same assets at the same time. Also, it is reasonable to believe that trustees of pension funds of similar size communicate and discuss investment opportunities with each other.

E. Discussion of the key findings

Our results indicate that a common-advisor effect on the SAAs of pension funds exists. Pension funds that contract the same asset manager make similar investment decisions in all asset classes, except real estate. Many Dutch pension funds rely on fiduciary asset managers that are directly involved in the design of the SAA. Such an advisory activity allows fiduciaries to transfer their investment beliefs to the trustees. In the case of an execution-only mandate, asset managers' expertise, reputation, and negotiating power may still influence trustees' decisions.[23] Pension funds that contract the same advisory actuaries also make similar investment decisions in their alternatives portfolios. Actuaries contribute to the design of the ALM study. Therefore, finding similar SAA decisions among pension funds with the same actuary despite differences in liability duration indicates that the actuaries' investment beliefs are included in the design of the SAAs with the matching liability criterion.

[23]Because we cannot distinguish between fiduciary and execution-only mandates, we cannot say which of the two mandates affect the SAA more.

Because of their technical expertise, actuaries' opinions about the SAA can be valuable and influential for trustees. Strikingly, pension funds with a similar liability duration and funding ratio do not make similar investment decisions over time. Pension funds of similar size do exhibit portfolio comovements in equity, private equity and real estate.

V. Robustness checks

We run two robustness checks to ensure that similar investment decisions can in fact be associated with the common-advisor effect and not to other factors. First, we test the hypothesis that pension funds follow each other's strategic investment decisions over time rather than responding to a common-advisor effect. Second, we test the hypothesis that similar SAAs originate from a trend in asset classes rather than from a common-advisor effect.

A. *Time dynamics in the SAA decisions*

We find that pension funds make similar investment decisions based on contracting with the same asset managers or actuaries. We interpret this finding as a common-advisor effect. Another potential explanation is that pension funds have a tendency to replicate the past investment decisions of other pension funds (Lakonishok et al. (1992b), Blake et al. (2017)). To measure if similar investment decisions are driven by a common-advisor effect or by this replication, we rely on a dynamic model that captures both dimensions. This model tests whether the investment decisions of a pension fund are affected by both the current and the past investment decisions of pension funds with the same asset managers, the same actuaries, or that have overlapping trustees. The dynamic model is specified as follows:

$$\mathbf{y}_t = \lambda \mathbf{y}_{t-1} + \rho \mathbf{W} \mathbf{y}_t + \gamma \mathbf{W} \mathbf{y}_{t-1} + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t \tag{3}$$

where vector $\mathbf{y}_t$ includes the strategic allocation to a specific asset class of each pension fund in year t, and $\mathbf{y}_{t-1}$ is the strategic asset allocation in the same asset class the year before. Therefore, the λ coefficient captures the autocorrelation among portfolio weights of the same pension fund. Autocorrelation mechanically occurs if pension funds spread changes in their SAAs over subsequent years. $\mathbf{Wy}_t$ is the spatially lagged variable, and $\mathbf{Wy}_{t-1}$ contains the lagged SAAs of pension funds that contract the same asset managers, the same actuaries, or that have at least one overlapping trustee. $\mathbf{X}_t$ is the usual set of pension fund characteristics. We estimate the model with pension fund and year fixed effects.

Table VI presents the estimation results of Equation (3) for pension funds that contract with the same asset manager. In line with the results of the static model (in Table IV), the ρ coefficient is positive and significant both for alternative asset classes and for standard asset classes. The size of the coefficients is also similar to the size of the coefficients estimated in the static model. All asset classes display positive and significant λ coefficients. Namely, the strategic portfolio weights in each asset class are positively correlated with their lagged values. This correlation shows that pension funds gradually adjust their strategic weights over time. Moreover, γ coefficients are non-significant in both alternative and standard asset classes, or even negative in commodities (γ=-0.2767) and real estate (γ=-0.1996). Therefore, we reject the hypothesis that pension funds replicate the past investment decisions of other pension funds with common asset managers.

We then estimate the dynamic model for pension funds that contract the same actuary. As for the static model, we estimate Equation (3) with the weighting matrices that originate from the contracts between actuaries and pension funds in 2007, 2008, 2009, 2010, 2011, and 2012. Each year, and for each asset class, we estimate the common-actuary effect on the subsequent five years. For example, we build the weighting matrix to identify the common actuaries in 2007. We then test the effect of these common actuaries on the SAAs over the period from 2007 to 2011. We repeat this analysis for each year up until the contracts existing in 2012. Panel A of Figure 8 shows the ρ, λ, and γ coefficients together with their confidence intervals from the dynamic models that were estimated on the total strategic allocation to alternatives. The results indicate positive and significant ρ coefficients. The γ coefficients are typically either non-significant or negative, which indicates that pension funds do not replicate the past investment decisions of pension funds that contract the same actuary. Looking at each individual alternative asset class separately, we find a positive and significant ρ and a non-significant γ for private equity and real estate, which are in line with the results of the static model. Conversely, we find no common-actuary effect in hedge funds and commodities. Further, all asset classes display highly significant λ coefficients, that is, pension funds adjust their strategic portfolios gradually over time.[24] Therefore, we also reject the hypothesis that pension funds replicate the past investment decisions of other pension funds with common actuaries.

In Panel B of Figure 8, we find weak evidence for an overlapping-trustee effect on the SAAs. The dynamic model that was estimated on the total allocation to alternatives presents positive and significant ρ coefficients only in 2007 and 2008. The γ coefficients are non-significant. Therefore, we also reject the hypothesis that pension funds replicate the past investment decisions of other funds that appoint the same trustees. Further, λ coefficients are positive and significant and indicate that the pension funds spread changes to their SAAs over subsequent years.[25]

To summarize, the results of the dynamic spatial autoregressive model in Equation (3) confirm the findings of the static spatial autoregressive model in Equation (2). Pension funds that contract with the same asset managers increase or decrease their strategic allocations to both standard and alternative asset classes in the same year. Pension funds that contract with the same actuary also increase or decrease their strategic allocations to alternatives in the same year. Pension funds that have overlapping trustees only show weak evidence for similar investment decisions. Overall, there is no evidence that supports the hypothesis that pension funds replicate the past investment decisions of other pension funds. In fact,

[24]The results are displayed in supplementary Figure 5 of the online appendix

[25]The results for each alternative asset class separately are available in supplementary Figure 6 of the online appendix.

pension funds make similar investment decisions because they respond to common signals (Froot et al., 1992, Hirshleifer et al. (1994)) that originate from common asset managers or common actuaries. Moreover, there is a strong autocorrelation among strategic portfolio weights in all asset classes. This result confirms that pension funds change their SAAs gradually over time.

B. Spurious regressions concerns

Because strategic portfolio changes are implemented gradually over time, portfolio weights might display a trend over the 5-year subperiods that we consider for our analysis. Multiple appointments of asset managers, actuaries, and trustees also could display a trend over the same subperiods. In order to avoid any possible concern for spurious correlations, we test the following model:

$$\boldsymbol{\Delta}\mathbf{y}_t = \rho\mathbf{W}\boldsymbol{\Delta}\mathbf{y}_t + \mathbf{X}_t\beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t \tag{4}$$

where $\boldsymbol{\Delta}\mathbf{y}_t$ is the change in the strategic portfolio weight in each asset class between year t and year $t-1$ for each pension fund. All other variables have the same interpretation as in Equation (2). The ρ coefficient still represents the common-advisor effect and overlapping-trustee effect. With this approach we de-trend $\mathbf{y}_t$ by taking its first difference. This de-trending allows us to avoid any possible concern for spurious correlations.

Table VII presents the results of the first-difference model estimated on the SAAs of pension funds that contract with the same asset manager. The ρ coefficient is positive and significant both in standard and alternative asset classes. The ρ coefficients are also similar in magnitude to the ρ estimated in Equation (2).

We also estimate the first-difference model for pension funds that contract the same actuary. As in the previous sections, we estimate Equation (4) with the weighting matrices that originate from the common actuaries and pension funds in 2007, 2008, 2009, 2010, 2011, and 2012. Each year, and for each asset class, we estimate the common-actuary effect on the subsequent five years. We repeat this analysis for each year up until 2012. Panel A of Figure 9 displays the results of the first-difference model estimated on the strategic allocations to alternatives. The ρ coefficients are positive and significant. In line with prior findings, pension funds that contract the same actuary change their strategic allocations to alternatives in the same direction over time.

We then apply the same procedure to estimate the first-difference model for pension funds that have at least one overlapping trustee. Panel B of Figure 9 shows the results of the first-difference model that was estimated on the strategic allocations to alternatives. In line with prior findings there is little evidence of an overlapping-trustee effect on the SAAs.

To summarize, the first-difference analysis provides results that are in line with the analysis performed on the SAAs. Therefore, we reject the hypothesis that the common-advisor effect on the SAAs is driven by spurious correlations among the variables in the model.[26]

VI. Conclusion

We use a unique database on the governance structure and SAAs of 191 Dutch pension funds to study the effect of common asset managers and common actuaries on strategic investment decisions. We investigate whether pension funds are affected by a common-advisor effect. Namely, whether pension funds with the same asset managers or the same actuaries make similar SAA decision over time. We find a strong common-advisor effect. Pension funds with the same asset managers increase or decrease their SAAs to different asset classes in the same year. Pension funds with the same actuaries also increase or decrease their strategic allocations to alternative asset classes in the same year.

Our findings show that asset managers and actuaries transfer their investment beliefs to

[26]Supplementary Figures 7 and 8 of the online appendix give the results for the first-difference model that was estimated on each individual alternative asset class.

their clients. On the one hand, we find that pension funds with similar liability structures or similar funding ratios do not make similar investment decisions over time, despite the fact that these pension funds have similar cash flow needs or financial conditions. On the other hand, we find that pension funds that contract the same asset managers or actuaries make similar investment decisions, despite the pension funds' characteristics. Therefore, managers and actuaries' investment beliefs are included in the design of the SAAs with these characteristics. Thus, the common-advisor effect might lead pension funds to select SAAs that are not in line with their liability structures, funding ratios, sophistication, or organizational structures. Selecting a SAA not in line with a pension fund's sophistication or organizational structure has negative consequences on its performance and cost management. At the same time pension funds may also profit from the knowledge that advisors have about sophisticated asset classes.

REFERENCES

Andonov, A., Eichholtz, P., and Kok, N. (2015). Intermediated investment management in private markets: Evidence from pension fund investments in real estate. *Journal of Financial Markets*, 22:73–103.

Andonov, A., Kräussl, R., and Rauh, J. (2018). The subsidy to infrastructure as an asset class. Available at https://ssrn.com/abstract=3245543.

Andonov, A. and Rauh, J. D. (2019). The return expectations of institutional investors. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3091976.

Bauer, R., Hoevenaars, R., and Steenkamp, T. (2006). Asset liability management. In *The oxford handbook of pensions and retirement income*, pages 417–40. Oxford University Press.

Beck, N., Gleditsch, K. S., and Beardsley, K. (2006). Space is more than geography: Using spatial econometrics in the study of political economy. *International studies quarterly*, 50(1):27–44.

Binfare, M., Brown, G. W., Harris, R. S., and Lundblad, C. T. (2018). How do financial expertise and networks affect investing? evidence from the governance of university endowments. *Working Paper*, Available at https://www.rsm.nl/fileadmin/home/Department_of_Finance__VG5_/PAM2018/Final_Papers/Matteo_Binfare.pdf.

Blake, D., Rossi, A. G., Timmermann, A., Tonks, I., and Wermers, R. (2013). Decentralized investment management: Evidence from the pension fund industry. *Journal of Finance*, 68(3):1133–1178.

Blake, D., Sarno, L., and Zinna, G. (2017). The market for lemmings: The herding behavior of pension funds. *Journal of Financial Markets*, 36:17–39.

Blome, S., Fachinger, K., Franzen, D., Scheuenstuhl, G., and Yermo, J. (2007). Pension fund regulation and risk management: Results from an alm optimisation exercise. *Private Pensions Series Protecting Pensions Policy Analysis and Examples from OECD Countries: Policy Analysis and Examples from OECD Countries*, 8:161–212.

Bodie, Z., Merton, R. C., and Samuelson, W. F. (1992). Labor supply flexibility and portfolio choice in a life cycle model. *Journal of Economic Dynamics and Control*, 16(3-4):427–449.

Bouwman, C. H. (2011). Corporate governance propagation through overlapping directors. *Review of Financial Studies*, 24(7):2358–2394.

Broeders, D., Chen, D., Minderhoud, P., and Schudel, W. (2016a). Pension funds' herding. *De Nederlandsche Bank (DNB) working paper Nr.*, (503).

Broeders, D. W. and Jansen, K. A. (2020). Liability-driven investors. Available at `https://ssrn.com/abstract=3446239`.

Broeders, D. W., Jansen, K. A., and Werker, B. J. (2020). Pension fund's illiquid assets allocation under liquidity and capital requirements. *Journal of Pension Economics & Finance*, pages 1–23.

Broeders, D. W., van Oord, A., and Rijsbergen, D. R. (2016b). Scale economies in pension fund investments: A dissection of investment costs across asset classes. *Journal of International Money and Finance*, 67:147–171.

Busse, J. A., Goyal, A., and Wahal, S. (2010). Performance and persistence in institutional investment management. *Journal of Finance*, 65(2):765–790.

Coggin, T. D., Fabozzi, F. J., and Rahman, S. (1993). The investment performance of us equity pension fund managers: An empirical investigation. *Journal of Finance*, 48(3):1039–1055.

Cohen, L., Frazzini, A., and Malloy, C. (2008). The small world of investing: Board connections and mutual fund returns. *Journal of Political Economy*, 116(5):951–979.

Dohmen, T., Falk, A., Golsteyn, B. H. H., Huffman, D., and Sunde, U. (2017). Risk Attitudes across the Life Course. *Economic Journal*, 127(605):F95–F116.

Dow, M. M., Burton, M. L., White, D. R., and Reitz, K. P. (1984). Galton's problem as network autocorrelation. *American Ethnologist*, 11(4):754–770.

Elhorst, J. (2013). *Spatial Econometrics: From Cross-Sectional Data to Spatial Panels*. SpringerBriefs in Regional Science. Springer Berlin Heidelberg.

Ferson, W. and Khang, K. (2002). Conditional performance measurement using portfolio weights: Evidence for pension funds. *Journal of Financial Economics*, 65(2):249–282.

Froot, K. A., Scharfstein, D. S., and Stein, J. C. (1992). Herd on the street: Informational inefficiencies in a market with short-term speculation. *Journal of Finance*, 47(4):1461–1484.

Goyal, A. and Wahal, S. (2008). The selection and termination of investment management firms by plan sponsors. *Journal of Finance*, 63(4):1805–1847.

Hirshleifer, D., Subrahmanyam, A., and Titman, S. (1994). Security analysis and trading patterns when some investors receive information before others. *Journal of Finance*, 49(5):1665–1698.

Ibbotson, R. G. and Kaplan, P. D. (2000). Does asset allocation policy explain 40, 90, or 100 percent of performance? *Financial Analysts Journal*, 56(1):26–33.

Jaiswal, S. (2017). Connections and conflicts of interest : Investment consultants' recommendations. *Working Paper*, Available at `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3221690`.

Jenkinson, T., Jones, H., and Martinez, J. V. (2016). Picking winners? investment consultants' recommendations of fund managers. *Journal of Finance*, 71(5):2333–2370.

Jones, H. and Martinez, J. V. (2017). Institutional investor expectations, manager performance, and fund flows. *Journal of Financial and Quantitative Analysis*, 52(6):2755–2777.

Lakonishok, J., Shleifer, A., and Vishny, R. W. (1992a). The structure and performance of the money management industry. *Brookings Papers on Economic Activity. Microeconomics*, 1992:339–391.

Lakonishok, J., Shleifer, A., and Vishny, R. W. (1992b). The impact of institutional stock prices. *Journal of Financial Economics*, 32(1):23–43.

LeSage, J. and Pace, R. K. (2009). *Introduction to spatial econometrics*. Chapman and Hall/CRC.

LeSage, J. P., Pace, R. K., Lam, N., Campanella, R., and Liu, X. (2011). New orleans business recovery in the aftermath of hurricane katrina. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 174(4):1007–1027.

Malmendier, U. and Nagel, S. (2011). Depression babies: do macroeconomic experiences affect risk taking? *Quarterly Journal of Economics*, 126(1):373–416.

Mukherjee, B. and Singer, D. A. (2008). Monetary institutions, partisanship, and inflation targeting. *International Organization*, 62(2):323–358.

Nofsinger, J. R., & Sias, R. W. (1999). Herding and feedback trading by instituional and individual investors. *Journal of Finance*, 54(6):2263–2295.

OECD (2019). Pension markets in focus. Available at `http://www.oecd.org/daf/fin/private-pensions/pensionmarketsinfocus.htm`.

Rossi, A. G., Blake, D., Timmermann, A., Tonks, I., and Wermers, R. (2018). Network centrality and delegated investment performance. *Journal of Financial Economics*, 128(1):183–206.

Simmons, B. A. and Elkins, Z. (2004). The globalization of liberalization: Policy diffusion in the international political economy. *American Political Science Review*, 98(1):171–189.

van Binsbergen, J. H., Brandt, M. W., and Koijen, R. S. (2008). Optimal decentralized investment management. *Journal of Finance*, 63(4):1849–1895.

van Nunen, A. (2011). *Fiduciary management: Blueprint for pension fund excellence*, volume 415. John Wiley & Sons.

Table I: **Summary statistics**

Panel A presents information about asset managers, actuaries, and trustees that work for the 191 pension funds in our sample. All information on asset managers, actuaries, and trustees are expressed at the pension fund level. Panel B presents their financial information. The asset class allocations are percentages over total assets. The mean (standard deviation) are the average (standard deviation) across pension funds and over time (2007-2016) for each variable. For some of the variables, e.g., total assets, allocations to hedge funds, and private equity, the mean is outside the 25% - 75% interval. This is due to the skewness in the distribution.

	Obs	Mean	Std. Dev.	25^{th}	75^{th}
A. Pension fund governance information					
Asset managers					
Asset managers per pension fund	1,399	1.79	1.94	1.00	2.00
Contract length	1,399	6.42	2.02	5.00	8.00
Actuaries					
Contract length	1,888	5.29	2.52	3.00	7.00
% Advisor	1,888	48.12	9.65	50.00	50.00
% Certifying	1,888	51.88	9.65	50.00	50.00
Trustees					
Board size	1,801	5.97	2.60	4.00	8.00
Average tenure board members	1,568	7.76	3.12	5.56	9.50
% Employer representatives	1,801	44.79	19.57	37.50	50.00
% Retirees representatives	1,801	10.98	13.44	0.00	20.00
% Employees representatives	1,801	39.89	20.87	28.57	50.00
% Independent (external)	1,801	3.70	13.99	0.00	0.00
B. Pension funds financial information					
Strategic asset allocation					
Fixed income	1,910	57.83	15.06	48.18	67.79
Equity	1,910	31.40	10.97	24.48	38.08
Alternatives	1,910	9.93	8.12	3.90	15.00
Real estate	1,910	6.67	5.93	1.25	10.00
Private equity	1,910	1.19	2.63	0.00	0.80
Hedge funds	1,910	1.19	2.63	0.00	0.75
Commodities	1,910	1.20	2.02	0.00	2.10
Other investments	1,910	0.77	3.89	0.00	0.03
Cash	1,910	0.07	4.03	0.00	0.00
Pension fund characteristics					
Funding ratio	1,910	113.60	24.67	100.70	117.30
Liability duration	1,910	18.05	3.87	15.6	20.10
Total assets (in 1,000 EUR)	1,910	4,212,385	2.29e+07	181,672	1,458,313
Log total assets	1,910	13.24	1.74	12.11	14.19

Table II: **Common asset managers and actuaries**

Panel A of the table presents the number of asset managers in the sample each year, the number of asset managers working for more than one pension fund, and the number of pension funds that share at least one asset manager with another pension fund. Information about asset managers is available from 2009 through 2016. Panel B presents the number of actuaries in the sample each year, the number of actuaries providing services to more than one pension fund, and the number of pension funds whose actuary is also working for at least one other pension fund. Information about actuaries is available from 2007 through 2016. Panel B does not differentiate between advisory and certifying actuaries. Panel C presents the number of trustees active each year, the number of trustees sitting on more than one board, and the number of pension funds with at least one board member that sits on at least one other board. The statistics in the table are computed based on asset managers, actuaries, and trustees that are contracted by at least one of the 191 pension funds in the sample.

Panel A: Asset Managers			
Year	Asset managers in the sample	Asset managers with multiple contracts	Pension funds with common asset managers
2009	114	46	166
2010	107	44	165
2011	110	45	168
2012	97	46	173
2013	92	45	174
2014	66	33	162
2015	59	31	159
2016	46	27	158
Panel B: Actuaries			
Year	Actuaries in the sample	Actuaries with multiple contract	Pension funds with common actuaries
2007	110	75	178
2008	116	71	184
2009	125	73	188
2010	122	72	189
2011	127	72	189
2012	126	69	190
2013	123	69	190
2014	122	66	187
2015	113	66	187
2016	98	57	187
Panel C: Trustees			
Year	Trustees	Trustees with multiple appoint.	Funds with overlapping trustees
2007	461	32	52
2008	595	34	56
2009	709	43	58
2010	853	51	62
2011	1,031	57	72
2012	1,284	75	83
2013	1,243	78	94
2014	1,248	84	91
2015	1,226	91	94
2016	1,185	90	95

Table III: **Strategic asset allocations across quartiles**
This table shows the cross-sectional and time-series average of the SAAs across quartiles of pension funds. Quartiles are defined by liability duration (Panel A), funding ratio (Panel B), and size as measured by the assets under management in million EUR (AUM) (Panel C). Standard deviation across pension funds and time is given between brackets. In $Q4-Q1$ we present the difference in the SAAs of pension funds in the fourth and first quartile. The t-statistics are in parentheses, and * indicates statistical significance at the 10% level, ** at the % 5 level, and *** at the 1% level.

Panel A: Liability duration				
Quartile	Liability duration	Fixed income	Equity	Alternatives
Q1	14.0	56.4 (16.3)	31.1 (12.4)	11.2 (8.6)
Q2	16.7	54.1 (12.9)	34.2 (9.3)	10.9 (7.5)
Q3	18.8	59.2 (15.3)	30.5 (9.9)	9.9 (8.6)
Q4	22.8	61.7 (14.0)	29.8 (11.5)	7.7 (7.2)
Q4-Q1		5.3***	-1.3*	-3.5***
$t-stat$		(5.37)	(-1.67)	(-6.80)
Panel B: Funding ratio				
Quartile	Funding ratio	Fixed income	Equity	Alternatives
Q1	102.0	61.6 (13.6)	28.7 (11.0)	8.2 (7.3)
Q2	106.0	59.1 (15.4)	30.8 (9.4)	9.7 (7.4)
Q3	112.2	57.5 (14.1)	32.2 (10.0)	9.4 (8.4)
Q4	133.7	53.1 (15.8)	34.0 (12.6)	12.6 (8.7)
Q4-Q1		-8.5***	5.3***	4.4***
$t-stat$		(-8.87)	(6.89)	(8.43)
Panel C: AUM (in million EUR)				
Quartile	AUM	Fixed income	Equity	Alternatives
Q1	105.1	62.9 (16.9)	31.1 (12.7)	5.1 (6.0)
Q2	335.8	62.0 (14.0)	29.9 (10.8)	7.8 (6.7)
Q3	888.4	56.1 (13.0)	32.2 (9.9)	10.9 (7.0)
Q4	15,760.9	50.3 (12.4)	32.4 (10.2)	16.0 (8.4)
Q4-Q1		-12.6***	1.3*	10.9***
$t-stat$		(-13.11)	(1.74)	(22.95)

Table IV: **Common-asset manager effect on SAAs**
The table shows the estimation results of Equation 2, namely the spatial panel autoregressive model $\mathbf{y}_t = \rho \mathbf{W} \mathbf{y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$ for pension funds that contract the same asset manager. The identification of the common asset manager is defined in Section III.A. The dependent variable $\mathbf{y}_t$ is the strategic allocation to each asset class of each pension fund in year t. The ρ is the coefficient that describes the spatial correlation among the strategic portfolio weights of pension funds that contract the same asset manager. $\mathbf{W}$ is the weighting matrix that equals one when two pension funds contract the same asset manager and zero otherwise, and it is constant by construction. $\mathbf{X}_t$ is a set of control variables: funding ratio, size, and liability duration of each pension fund. And, $\boldsymbol{\mu}$ and $\boldsymbol{\theta}_t$ indicate fund and year fixed effects. The model is estimated on the subsample 2012-2016 to avoid reverse causality, as the contracts between pension funds and asset managers that define $\mathbf{W}$ exist prior to 2012. A positive and significant ρ means that pension funds contracting the same asset manager have strategic allocations that move in the same direction over time. We estimate the models for each asset class separately and report the corresponding spatial coefficients and controls. The t-statistics are in parentheses. The * indicates statistical significance at the 10% level, ** at the % 5 level, and *** at the 1% level.

	Common-asset manager effect on SAA - 2012-2016						
	Alternatives	Commodities	Private equity	Hedge funds	Real estate	Equity	Fixed income
ρ	0.2463***	0.3599***	0.4064***	0.4316***	0.1293	0.3006***	0.3911***
	(2.73)	(4.47)	(4.68)	(5.17)	(1.44)	(4.91)	(4.72)
Duration	-0.0635	0.0643	-0.0236	-0.0176	-0.0750	0.2962	0.6171
	(-0.33)	(0.63)	(-0.45)	(-0.24)	(-0.57)	(0.55)	(0.71)
Funding ratio	-0.0305***	-0.0051	-0.0008	-0.0099*	-0.0141	-0.0754	0.0612
	(-3.07)	(-1.27)	(-0.26)	(-1.82)	(-1.35)	(-1.21)	(0.82)
Log size	0.3354	0.2001	-0.0136	0.0362	0.1198	0.7477	0.6107
	(1.47)	(1.41)	(-0.24)	(0.76)	(0.62)	(1.35)	(0.36)
Year FE	YES	YES	YES	YES	YES	YES	YES
Pension fund FE	YES	YES	YES	YES	YES	YES	YES
N	955	955	955	955	955	955	955
R^2	0.1332	0.0210	0.0005	0.0038	0.0769	0.0075	0.0093

Table V: **Portfolio evolution of pension funds of similar maturities**
Panel A shows the estimation results of Equation 2, namely the spatial panel autoregressive model $\mathbf{y}_t = \rho \mathbf{W} \mathbf{y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$ for pension funds with similar average liability durations. The dependent variable $\mathbf{y}_t$ contains the strategic allocation to each asset class of each pension fund in year t. The ρ is the coefficient that describes the spatial correlation among the strategic portfolio weights of pension funds with similar liability durations. The $\mathbf{W}$ equals one when two pension funds are in the same quartile of the distribution of the average liability duration, and zero otherwise. The $\mathbf{W}$ is constant over time as we compute the time-series average of the liability duration of each pension fund, and then we separate it into four quartiles. $\mathbf{X}_t$ is a set of control variables: funding ratio, size, and liability duration of each pension fund. The model is estimated on the entire sample period: 2007-2016. A positive and significant ρ means that pension funds with similar liabilities have portfolio weights (SAAs) that move in the same direction over time. Panel B shows the estimation results of Equation 2 for pension funds with similar funding ratios. In this case, $\mathbf{W}$ equals one when two pension funds are in the same quartile of the distribution of the average funding ratio, and zero otherwise. Panel C shows the estimation results of Equation 2 for pension funds with similar sizes. In this case, $\mathbf{W}$ equals one when two funds are in the same quartile of the distribution of the average total assets, and zero otherwise. All models are estimated with pension fund and time fixed effects $\boldsymbol{\mu}$ and $\boldsymbol{\theta}_t$. The t-statistics are in parentheses. The * indicates statistical significance at the 10% level, ** at the % 5 level, and *** at the 1% level.

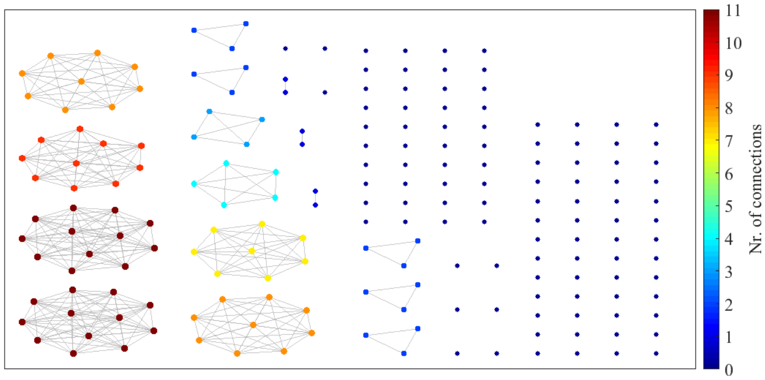
	A. Pension funds with same liability duration						
	Alternatives	Commodities	Private equity	Hedge funds	Real estate	Equity	Fixed income
ρ	-0.1660	-0.2820**	-0.3250**	-0.0889	-0.0174	0.00403	-0.0843
	(-1.09)	(-1.97)	(-2.55)	(-0.48)	(-0.14)	(0.03)	(-0.72)
Duration	-0.166	0.0221	-0.0221	-0.118	-0.0499	0.156	0.331
	(-1.11)	(0.49)	(-0.58)	(-1.31)	(-0.66)	(0.58)	(0.93)
Funding ratio	-0.0261*	-0.0023	-0.0035	-0.0039	-0.0165*	-0.0160	0.0276
	(-1.78)	(-0.58)	(-1.06)	(-0.69)	(-1.70)	(-0.89)	(1.21)
Log size	0.137	-0.0542	0.0135	0.138	0.0519	1.728**	0.874
	(0.41)	(-0.37)	(0.22)	(0.86)	(0.27)	(2.49)	(0.40)
N	1,910	1,910	1,910	1,910	1,910	1,910	1,910
R^2	0.08	0.02	0.03	0.05	0.02	0.01	0.04
	B. Pension funds with same funding ratio						
ρ	-0.1754	-0.1559	-0.0054	0.0278	-0.1579	-0.1161	-0.0373
	(-0.99)	(-1.19)	(-0.06)	(0.14)	(-1.12)	(-0.60)	(-0.27)
Duration	-0.1693	0.0201	-0.0190	-0.1164	-0.0515	0.1511	0.3240
	(-1.13)	(0.45)	(-0.50)	(-1.27)	(-0.68)	(0.57)	(0.92)
Funding ratio	-0.0269*	-0.0026	-0.0034	-0.0039	-0.0166*	-0.0140	0.0269
	(-1.80)	(-0.65)	(-1.05)	(-0.69)	(-1.69)	(-0.79)	(1.19)
Log size	0.1537	-0.0480	0.0108	0.1252	0.0629	1.7387**	0.9121
	(0.47)	(-0.33)	(0.18)	(0.73)	(0.32)	(2.48)	(0.41)
N	1910	1910	1910	1910	1910	1910	1910
R^2	0.0910	0.0133	0.0212	0.0526	0.0323	0.0042	0.0416
	C. Pension funds with same size						
ρ	0.0685	-0.4767***	0.4651***	-0.2940	0.4186***	0.2443**	0.1472
	(0.51)	(-3.29)	(5.78)	(-1.57)	(5.35)	(2.08)	(1.29)
Duration	-0.1658	0.0191	-0.0151	-0.1184	-0.0579	0.1444	0.3257
	(-1.11)	(0.43)	(-0.41)	(-1.30)	(-0.77)	(0.55)	(0.93)
Funding ratio	-0.0265*	-0.0025	-0.0025	-0.0041	-0.0178*	-0.0189	0.0290
	(-1.80)	(-0.61)	(-0.77)	(-0.70)	(-1.79)	(-1.07)	(1.26)
Log size	0.1471	-0.0565	0.0199	0.1225	0.0756	1.7235**	0.9252
	(0.44)	(-0.39)	(0.34)	(0.72)	(0.39)	(2.49)	(0.42)
N	1910	1910	1910	1910	1910	1910	1910
R^2	0.0902	0.0129	0.0871	0.0468	0.0517	0.0031	0.0483

Table VI: **Common-asset manager effect on the SAAs - Dynamic specification** The table shows the estimation results for the dynamic spatial panel autoregressive model $\mathbf{y}_t = \lambda\mathbf{y}_{t-1} + \rho\mathbf{W}\mathbf{y}_t + \gamma\mathbf{W}\mathbf{y}_{t-1} + \mathbf{X}_t\beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$ for pension funds that contract the same asset manager. The identification of the common asset manager is defined in Section III.A. The dependent variable $\mathbf{y}_t$ is the SAA for each asset class of each pension fund in year t. The $\mathbf{W}$ is the weighting matrix that equals one if two pension funds contract the same asset manager and zero otherwise, and it is constant by construction. $\mathbf{W}\mathbf{y}_t$ is the spatially lagged variable, and ρ is the coefficient that describes the spatial correlation among the strategic portfolio weights of pension funds that contract the same asset manager. $\mathbf{W}\mathbf{y}_{t-1}$ contains the lagged strategic portfolio weights of pension funds with the same asset manager. $\mathbf{X}_t$ are control variables: funding ratio, size, and the liability duration of each pension fund. The model is estimated with pension fund and year fixed effects. The model is estimated on the subsample of 2012-2016 to avoid reverse causality, as the contracts between pension funds and asset managers that define $\mathbf{W}$ that exists prior to 2012. The λ coefficient captures the autocorrelation among portfolio weights in the same asset class. The γ coefficient captures the spatial correlation with the lagged strategic portfolio weights of pension funds with the same asset manager. The t-statistics are in parentheses. The * indicates statistical significance at the 10% level, ** at the % 5 level, and *** at the 1% level.

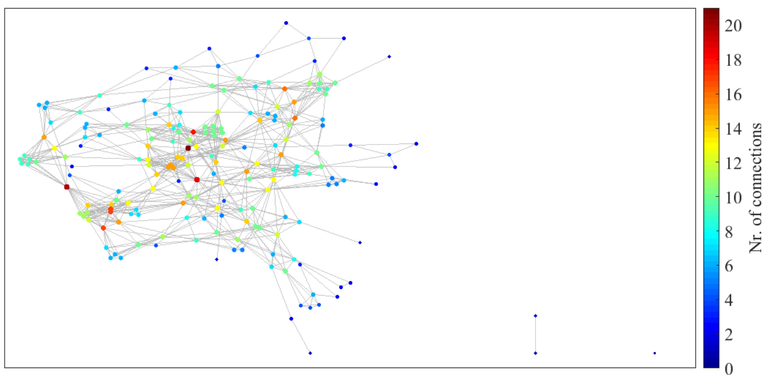
	Common-asset manager effect on SAA - 2012-2016						
	Alternatives	Commodities	Private equity	Hedge funds	Real estate	Equity	Fixed income
ρ	0.2592**	0.3428***	0.4448***	0.3899***	0.0759	0.2986***	0.4057***
	(2.50)	(3.38)	(4.64)	(5.32)	(0.97)	(4.22)	(4.83)
Alternative$_{t-1}$	0.8351***						
	(14.30)						
W*Alternative$_{t-1}$	-0.1603						
	(-1.51)						
Commodities$_{t-1}$		0.7204***					
		(11.22)					
W*Commodities$_{t-1}$		-0.2767**					
		(-2.32)					
Private equity$_{t-1}$			0.7363***				
			(12.76)				
W*Private equity$_{t-1}$			-0.1258				
			(-1.15)				
Hedge funds$_{t-1}$				0.7907***			
				(15.23)			
W*Hedge funds$_{t-1}$				0.1177			
				(1.20)			
Real estate$_{t-1}$					0.9595***		
					(10.89)		
W*Real estate$_{t-1}$					-0.1996**		
					(-2.30)		
Equity$_{t-1}$						0.4699***	
						(8.19)	
W*Equity$_{t-1}$						0.0970	
						(1.27)	
Fixed income$_{t-1}$							0.6744***
							(9.59)
W*Fixed income$_{t-1}$							-0.1221
							(-1.41)
Duration	-0.2294	-0.0466	0.0323	-0.0201	-0.2032*	-0.0462	0.9519
	(-1.27)	(-0.47)	(0.67)	(-0.37)	(-1.91)	(-0.07)	(1.09)
Funding Ratio	0.0037	0.0045	0.0007	0.0073***	-0.0090*	-0.0334	0.0123
	(0.44)	(0.96)	(0.33)	(2.87)	(-1.79)	(-0.60)	(0.20)
Log Size	0.4304**	0.1104	-0.0405	0.0267	0.4091***	0.6306	-0.3957
	(2.50)	(1.60)	(-0.85)	(0.95)	(4.13)	(1.52)	(-0.42)
Observations	764	764	764	764	764	764	764
R^2	0.8595	0.6996	0.7604	0.7156	0.8703	0.2140	0.3344

Table VII: **Common-asset-manager effect on SAAs - First-difference analysis**
The table shows the estimation results of Equation 4, namely the spatial panel autoregressive model $\mathbf{y}_t = \rho\mathbf{W}\mathbf{y}_t + \mathbf{X}_t\beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$ for pension funds that contract the same asset manager. The identification of the common asset manager is defined in Section III.A. The dependent variable $\mathbf{y}_t$ contains the changes in the strategic asset allocations to each asset class of each pension fund between year t and year $t-1$. The ρ is the coefficient that describes the spatial correlation among the changes in strategic portfolio weights of pension funds that contract the same asset manager. The $\mathbf{W}$ equals one when two funds contract the same asset manager and zero otherwise, and it is constant by construction. $\mathbf{X}_t$ is a set of control variables: funding ratio, size, and liability duration of each pension fund. And, $\boldsymbol{\mu}$ and $\boldsymbol{\theta}_t$ indicate fund and year fixed effects. The model is estimated on the subsample of 2012-2016 to avoid reverse causality. A positive and significant ρ means that pension funds with the same asset manager change portfolio weights (SAAs) in the same direction over time. We estimate the models for each asset class separately and report the corresponding spatial coefficients and controls. The t-statistics are in parentheses. The * indicates statistical significance at the 10% level, ** at the % 5 level, and *** at the 1% level.

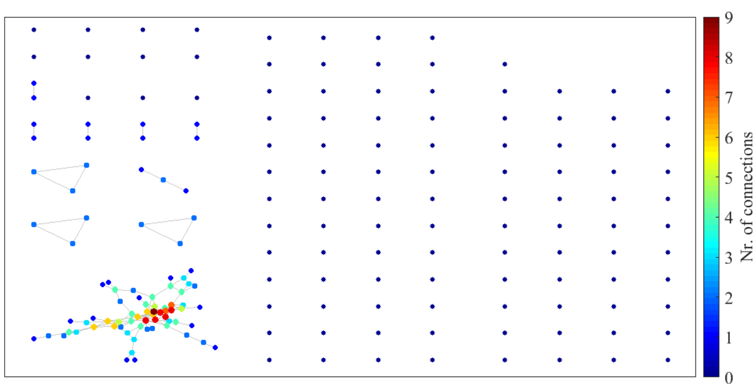
	Common-asset manager effect on changes in SAA - 2012-2016						
	Alternatives	Commodities	Private equity	Hedge funds	Real estate	Equity	Fixed income
ρ	0.1784**	0.3419***	0.3733***	0.0087	0.3934***	0.2606***	0.3538***
	(2.03)	(3.82)	(4.32)	(0.10)	(4.57)	(3.51)	(4.07)
Duration	0.2135	0.0450	0.1097	0.0025	0.0487	-0.1342	0.1607
	(1.12)	(0.54)	(1.60)	(0.02)	(0.95)	(-0.25)	(0.22)
Funding Ratio	0.0155	0.0139**	0.0129**	-0.0115	0.0005	-0.0362	-0.0015
	(1.07)	(2.41)	(2.18)	(-1.47)	(0.20)	(-0.79)	(-0.02)
Log Size	0.2153	0.1443*	-0.1595	0.2991***	-0.0652*	0.4400	-0.0809
	(1.10)	(1.90)	(-1.22)	(4.01)	(-1.70)	(1.50)	(-0.10)
Observations	955	955	955	955	955	955	955
R^2	0.0000	0.0001	0.0082	0.0026	0.0019	0.0003	0.0001



A. Unique asset managers network 2009-2016



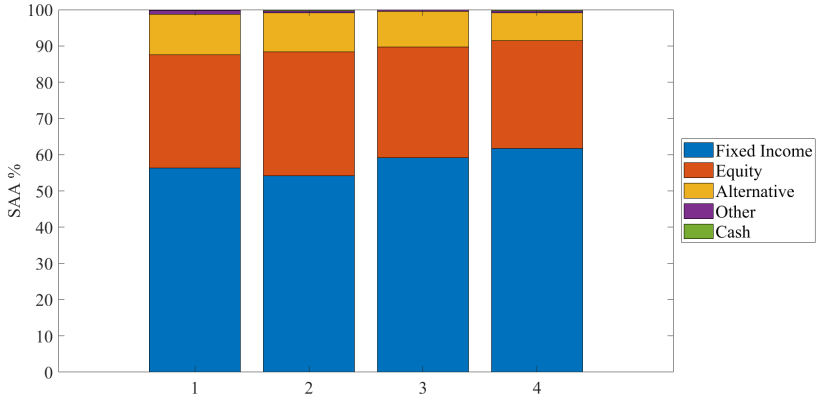
B. Actuaries network 2012



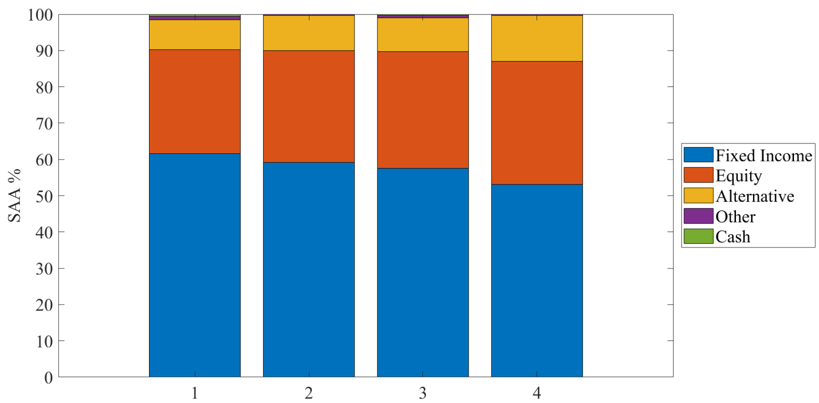
C. Trustees network 2012

Figure 1. Pension funds networks

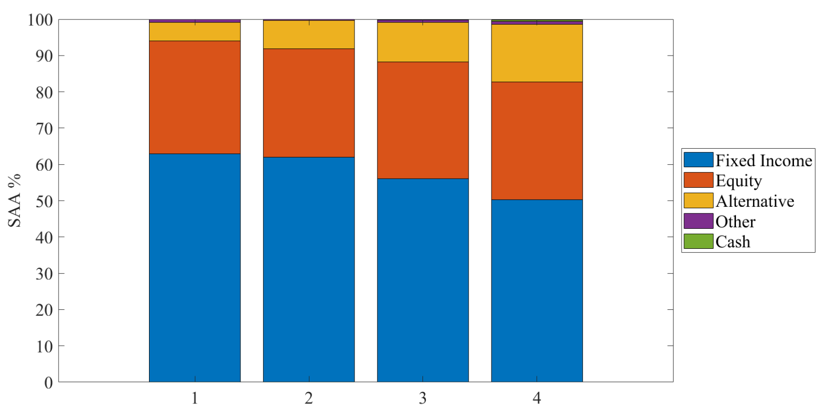
Each node in the figure is a pension fund and an edge exists between two nodes, if two pension funds contract the same unique asset manager from 2009 to 2016, the same actuary, or the same trustee. The color of each nodes indicate the number of other pension funds that have the same asset manager, same actuary, or at least one overlapping trustee.



A. Average SAA by liability duration quartiles

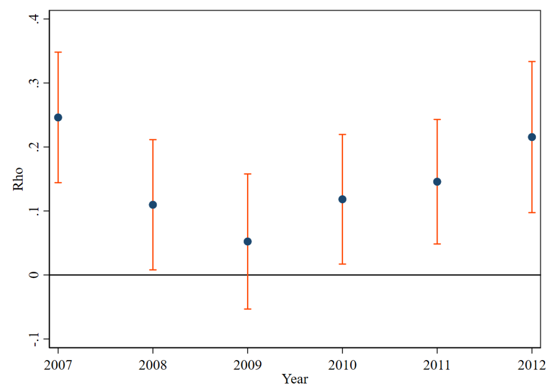


B. Average SAA by funding ratio quartiles

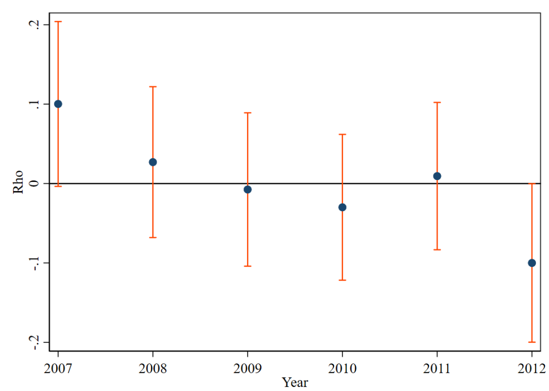


C. Average SAA by total assets quartiles

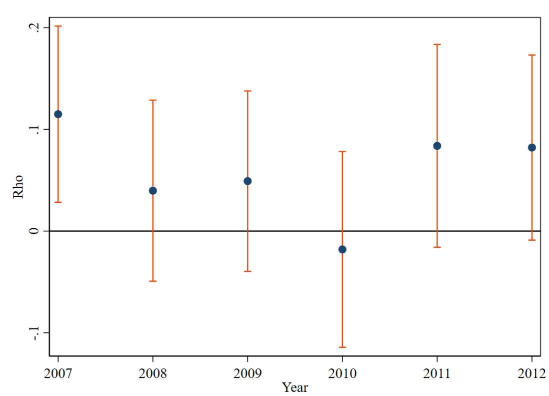
Figure 2. Strategic asset allocation across quartiles
The figure shows the cross-sectional and time-series average of the SAAs across quartiles of pension funds. Quartiles are defined by time-series average liability duration (Panel A), time-series average funding ratio (Panel B), and time-series average size (Panel C).



A. Alternatives

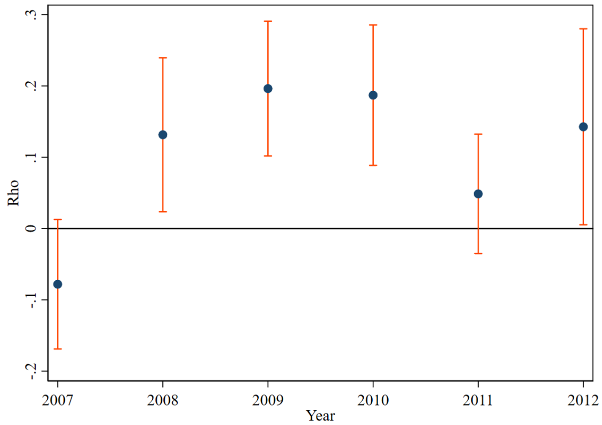


B. Equity

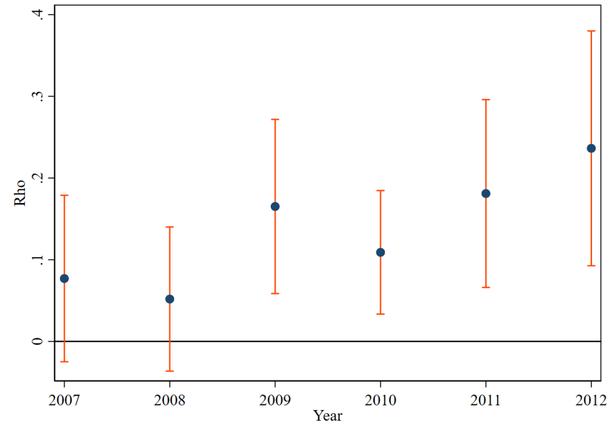


C. Fixed income

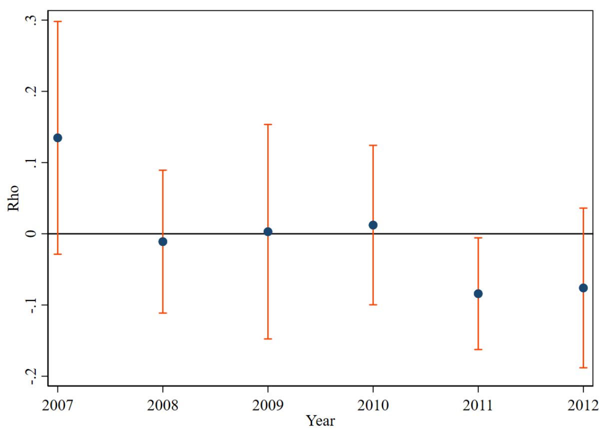
Figure 3. Common-actuary effect on SAAs
The figure displays the estimated rho coefficients with the corresponding 90% confidence interval from Equation (2): $\mathbf{y}_t = \rho \mathbf{W} \mathbf{y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$. The model is estimated every year over the period 2007-2012 on the subsequent five years. Every year, we use the weighting matrix built on pension funds with the same actuaries. In panel A the dependent variable is the strategic allocation to alternative assets of each pension fund, in Panel B the dependent variable is the strategic allocation to equity, and in Panel C the dependent variable is the strategic allocation to fixed income.



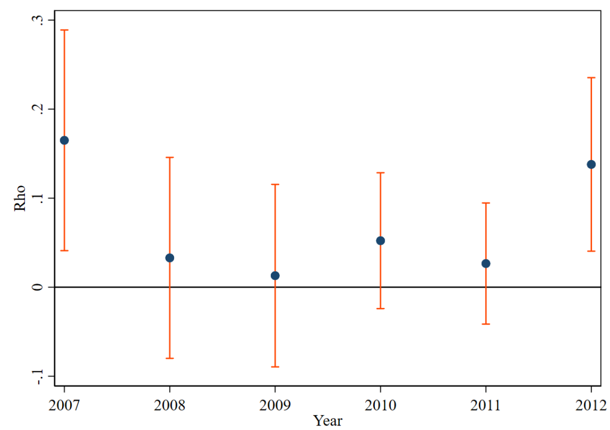
A. Private equity



B. Real estate

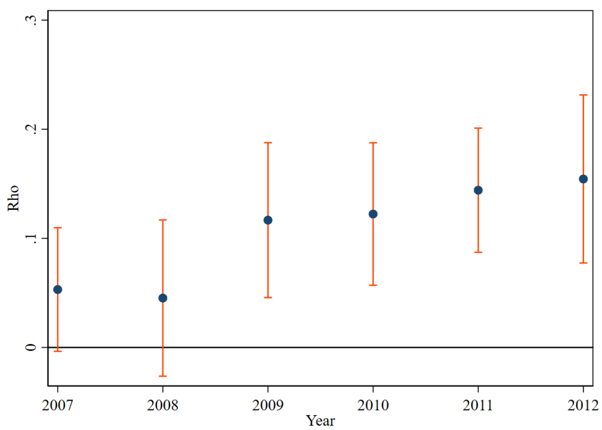


C. Hedge funds

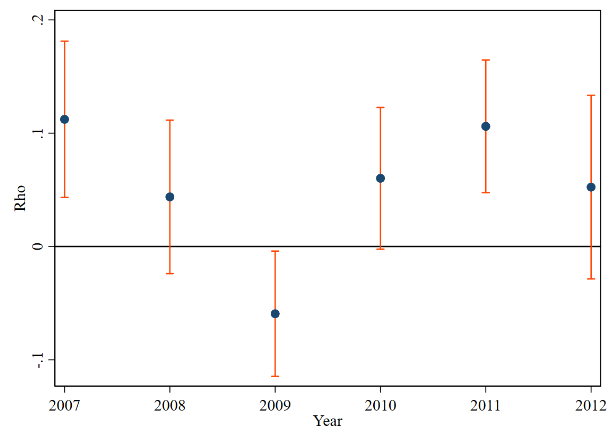


D. Commodities

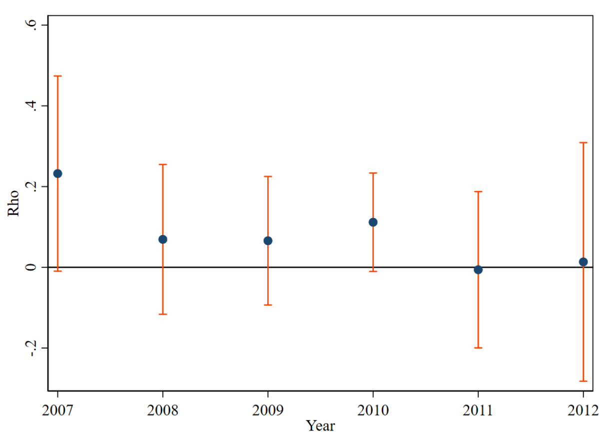
Figure 4. Common-actuary effect on alternative assets
The figure displays the estimated rho coefficients with the corresponding 90% confidence interval from Equation (2): $\mathbf{y}_t = \rho \mathbf{W} \mathbf{y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$. The model is estimated every year over the period 2007-2012 on the subsequent five years. Every year, we use the weighting matrix built on pension funds with the same actuaries. In panel A the dependent variable is the strategic allocation to private equity of each pension fund, in Panel B the dependent variable is the strategic allocation to real estate, in Panel C the dependent variable is the strategic allocation to hedge funds, and in Panel D the dependent variables if the strategic allocation to commodities.



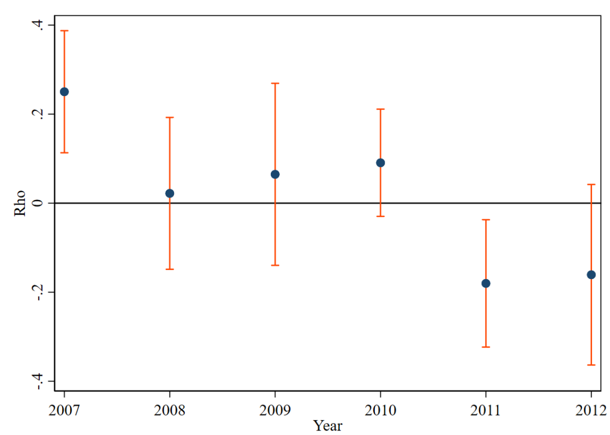
A. Alternatives - Common advisory actuary



B. Alternatives - Common certifying actuary

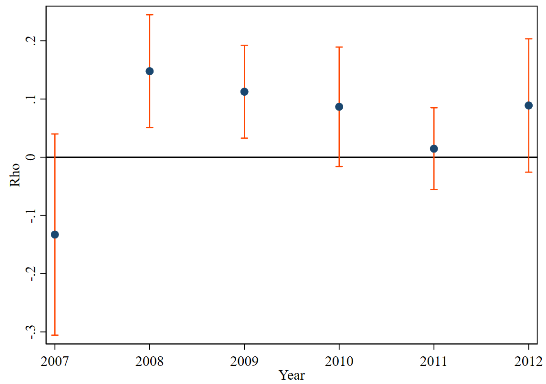


C. Alternatives - Common advisory actuarial firm

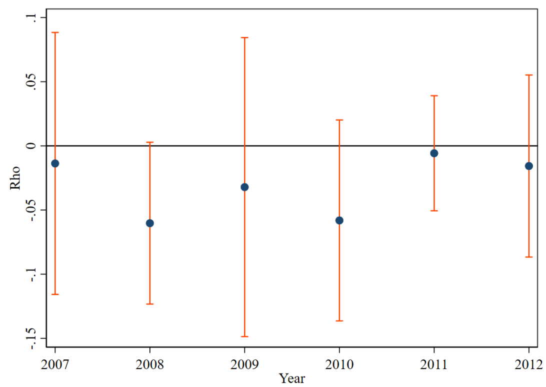


D. Alternatives - Common certifying actuarial firm

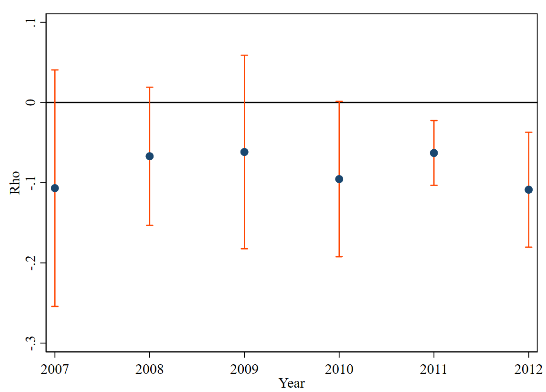
Figure 5. Common type of actuary or common actuarial firm
The figure displays the estimated rho coefficients with the corresponding 90% confidence interval from Equation (2): $\mathbf{y}_t = \rho\mathbf{W}\mathbf{y}_t + \mathbf{X}_t\beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$ where the dependent variable is the strategic allocation to alternative assets of each pension fund. Each model is estimated every year over the period from 2007-2012 on the subsequent five years. In panel A, we estimate the models using the weighting matrices built on pension funds with the same advisory actuary. In panel B, we estimate the models using the weighting matrices built on pension funds with the same certifying actuary. In panel C, we estimate the models using the weighting matrices built on pension funds with advisory actuaries from the same firm. In panel D, we estimate the models using the weighting matrices built on pension funds with certifying actuaries from the same firm.



A. Alternatives

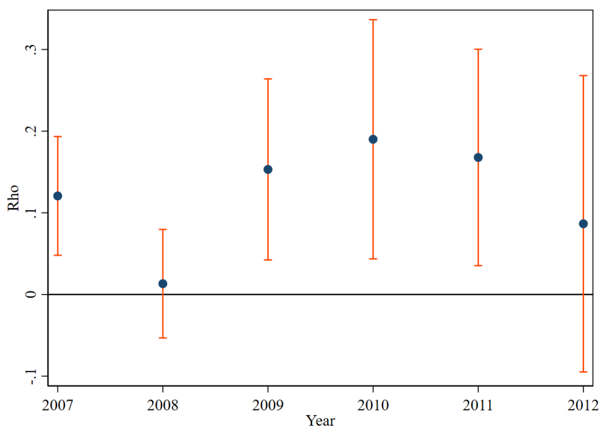


B. Equity

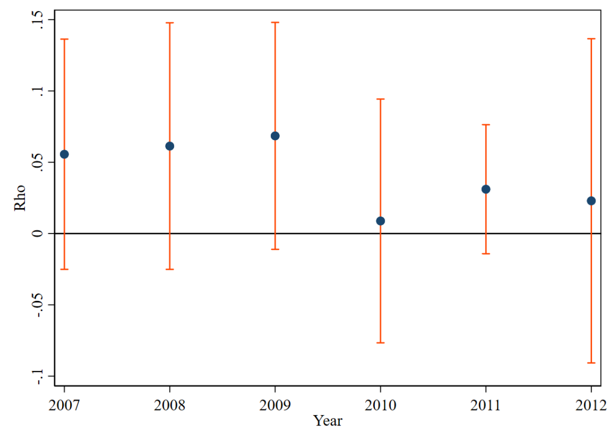


C. Fixed income

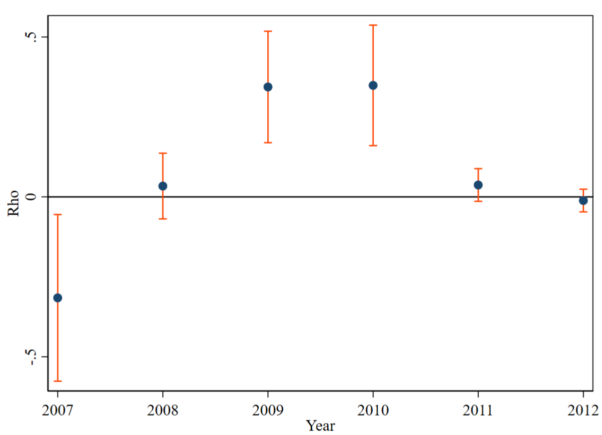
Figure 6. Overlapping-trustee effect on SAAs
The figure displays the estimated rho coefficients with the corresponding 90% confidence interval from Equation (2): $\mathbf{y}_t = \rho \mathbf{W} \mathbf{y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$. The model is estimated every year over the period from 2007-2012 on the subsequent five years. Every year, we use the weighting matrix built on pension funds that have at least one overlapping trustee. In panel A the dependent variable is the strategic allocation to alternative assets of each pension fund, in Panel B the dependent variable is the strategic allocation to equity, and in Panel C the strategic allocation to fixed income.



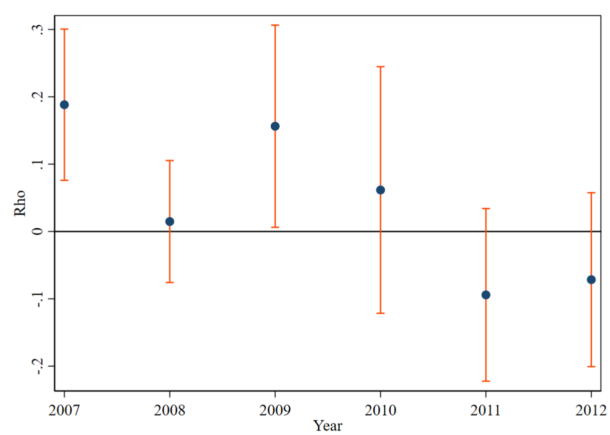
A. Private equity



B. Real estate

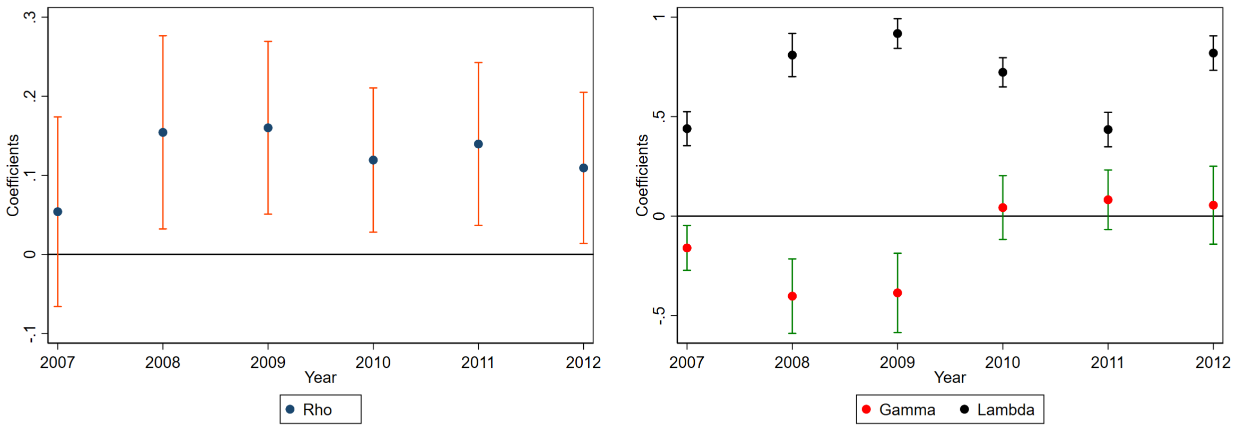


C. Hedge funds

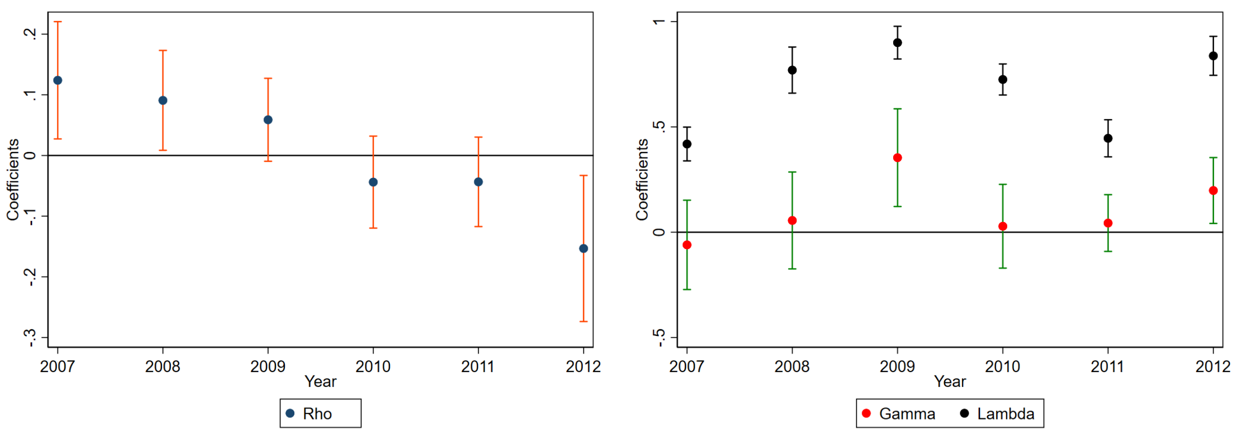


D. Commodities

Figure 7. Overlapping-trustee effect on alternative assets
The figure displays the estimated rho coefficients with the corresponding 90% confidence interval from Equation (2): $\mathbf{y}_t = \rho \mathbf{W} \mathbf{y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$. The model is estimated every year over the period from 2007-2012 on the subsequent five years. Every year, we use the weighting matrix built on pension funds that have at least one overlapping trustee. In panel A the dependent variable is the strategic allocation to private equity of each pension fund, in Panel B the dependent variable is the strategic allocation to real estate, in Panel C the dependent variable is the strategic allocation to hedge funds, and in Panel D the dependent variables if the strategic allocation to commodities.

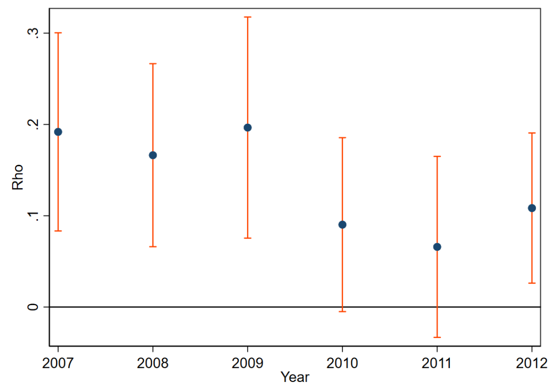


A. Alternatives - Dynamic model with common actuaries

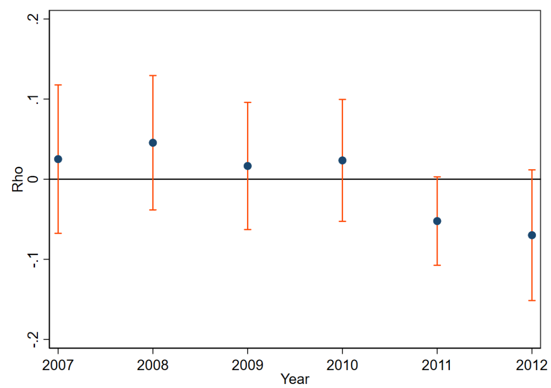


B. Alternatives - Dynamic model with overlapping trustees

Figure 8. Dynamic model for common actuaries and overlapping trustees
The figure displays the estimated coefficients rho, lambda, and gamma with the corresponding 90% confidence interval from Equation (3): $\mathbf{y}_t = \lambda\mathbf{y}_{t-1} + \rho\mathbf{W}\mathbf{y}_t + \gamma\mathbf{W}\mathbf{y}_{t-1} + \mathbf{X}_t\beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$. All models in the figure are estimated with the strategic allocation to alternative assets as the dependent variable. The $\mathbf{W}$ is the weighting matrix that equals one when two funds contract the same actuary and zero otherwise in Panel A. In panel B, $\mathbf{W}$ is the weighting matrix that equals one when two funds have at least one overlapping trustee and zero otherwise. $\mathbf{W}\mathbf{y}_t$ is the spatially lagged variable, and ρ is the coefficient that describes the spatial correlation among the strategic portfolio weights of pension funds that contract the same actuary (in Panel A) or that have at least one overlapping trustee (in Panel B). $\mathbf{W}\mathbf{y}_{t-1}$ contains the lagged strategic portfolio weights of pension funds with the same actuary or that have at least one overlapping trustee. The λ coefficient captures the autocorrelation among portfolio weights in the same asset class. The γ coefficient captures the spatial correlation with the lagged strategic portfolio weights of pension funds with the same actuary or that have at least one overlapping trustee. The models are estimated every year over the period from 2007-2012 on the subsequent five years.



A. Alternatives - First-difference model for common actuaries



B. Alternatives - First-difference model for overlapping actuaries

Figure 9. First-difference model for pension funds with common actuaries or overlapping trustees
The figure shows the estimation results for the spatial panel autoregressive model $\mathbf{\Delta y}_t = \rho \mathbf{W} \mathbf{\Delta y}_t + \mathbf{X}_t \beta + \boldsymbol{\mu} + \boldsymbol{\theta}_t + \boldsymbol{\epsilon}_t$ (Equation 4). The vector of dependent variables $\mathbf{\Delta y}_t$ contains the changes in the strategic allocation to alternatives of each pension fund between year t and year $t-1$. The $\mathbf{W}$ is the weighting matrix that equals one when two funds contract the same actuary and zero otherwise in Panel A. In panel B, $\mathbf{W}$ is the weighting matrix that equals one when two funds have at least one overlapping trustee. The ρ is the coefficient that captures the spatial correlation among the changes in the SAA of pension funds that contract the same actuary (Panel A) or that have at least one overlapping trustee (Panel B). $\mathbf{X}_t$ contains a set of control variables: funding ratio, size, and the liability duration of each pension fund. $\boldsymbol{\mu}$ and $\boldsymbol{\theta}_t$ are pension-fund and year fixed effects. The model is estimated every year over the period from 2007-2012 on the subsequent five years.

Appendix A.

In this appendix we describe how to quantify the common-advisor effect that occurs among pension funds. The common-advisor effect is measured by the ρ coefficient in a spatial autoregressive model (SAR):

$$y_{it} = \rho \sum_{j=1}^{n} W_{ij} y_{jt} + \beta \sum_{k=1}^{K} x_{itk} + \theta_t + \mu_i + \epsilon_{it} \tag{A1}$$

where the spatial autocorrelation coefficient ρ is associated with the following endogenous variable $\sum_{j=1}^{n} W_{ij} y_{jt}$ (the so called spatially lagged variable). The $\sum_{j=1}^{n} W_{ij} y_{jt}$ represents the function of the portfolio allocation of neighboring pension funds in a given asset class at time t. Equation (A1) is equivalent to Equation (2). To compute the marginal effect of a change in y_j on the value of y_i at a given time t, we need the partial derivatives of Equation (A1) with respect to y_j:

$$\frac{\partial y_{it}}{\partial y_{jt}} = \rho \sum_{j=1}^{n} W_{ij} \tag{A2}$$

All else being equal, the change in the strategic asset allocation of pension fund i (y_i) is a function of the allocation y of neighboring pension funds times ρ. For example, consider three pension funds. Their connections are identified by the row standardized weighting matrix W:

$$W = \begin{bmatrix} 0 & 1 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 1 & 0 \end{bmatrix} \tag{A3}$$

This equation means that pension funds 1 and 2 are neighbors. Pension fund 2 is a neighbor of pension fund 1 and pension fund 3. Pension fund 3 is a neighbor of pension fund 2. Based on Equation (A2) we obtain the matrix of partial derivatives:

$$
\begin{bmatrix}
\frac{\partial y_{1t}}{\partial y_{1t}} & \frac{\partial y_{1t}}{\partial y_{2t}} & \frac{\partial y_{1t}}{\partial y_{3t}} \\
\frac{\partial y_{2t}}{\partial y_{1t}} & \frac{\partial y_{2t}}{\partial y_{2t}} & \frac{\partial y_{2t}}{\partial y_{3t}} \\
\frac{\partial y_{3t}}{\partial y_{1t}} & \frac{\partial y_{3t}}{\partial y_{2t}} & \frac{\partial y_{3t}}{\partial y_{3t}}
\end{bmatrix}
= \rho
\begin{bmatrix}
0 & 1 & 0 \\
\frac{1}{2} & 0 & \frac{1}{2} \\
0 & 1 & 0
\end{bmatrix}
\tag{A4}
$$

The results in Table IV show that pension funds with the same asset managers display a ρ coefficient of 0.25 for the strategic allocation to alternatives. If we allow the asset allocation of both pension funds 1 and 3 to increase by 10 percentage points, we can compute the effect on the allocation of pension fund 2, all else being equal, as:

$$
\begin{bmatrix}
\Delta y_{1t} \\
\Delta y_{2t} \\
\Delta y_{3t}
\end{bmatrix}
= 0.25
\begin{bmatrix}
0 & 1 & 0 \\
\frac{1}{2} & 0 & \frac{1}{2} \\
0 & 1 & 0
\end{bmatrix}
\begin{bmatrix}
\Delta y_{1t} = 10 \\
\Delta y_{2t} = ? \\
\Delta y_{3t} = 10
\end{bmatrix}
\tag{A5}
$$

Therefore, taking Δy_{1t} and Δy_{3t} as given, Δy_{2t} equals 2.5 percentage points ($\Delta y_{2t} = 0.25(\frac{10}{2} + \frac{10}{2})$). Namely pension fund 2, a neighbor of pension fund 1 and pension fund 3, will increase its strategic allocation to the alternative asset class by 2.5 percentage points in response to an increase of 10 percentage points in neighboring pension funds, all else being equal.

By contrast, the effects of the independent variables $\beta \sum_{k=1}^{K} x_{itk}$ on y_{it} are not only represented by the partial derivatives. Beta coefficients are only part of these derivatives, and the spatial coefficient enters into the calculation. The ρ captures an additional spillover effect via feedback from the spatial lag. For more details on the coefficient interpretation we refer to Chapter 2 of LeSage and Pace (2009).