Relocating investments by Tunisian insurance and pension funds towards alternative assets opportunities

Ahmed Bouteska [a,1], Taimur Sharif [b,1], Mohammad Zoynul Abedin [c,d,*], Jihene Ghouli-Oueslati [d]

[a] Faculty of Economics and Management of Tunis, University of Tunis El Manar, Tunisia
[b] School of Business, Newman University, Birmingham B32 3NT, UK
[c] School of Management, Swansea University, Bay Campus, Swansea SA1 8EN, UK
[d] Teesside University International Business School, Teesside University, Middlesborough, TS1 3BX, UK

Abstract

This article explores the different barriers preventing Tunisian insurance and pension funds relocating their investments to alternative assets as a source of diversification and the different policy-led measures that could be put in place to support them during their initial years of existence. Data analysis techniques, namely multiple correspondence analysis and hierarchical classification, are employed to hold the analysis in alignment with the research aim. The study investigates four groups of Tunisian insurance and pension funds, each characterized by its own investment challenges regarding alternative assets. Subsequently, the study examines certain improvement areas, for instance, reforming the legislative framework to facilitate a supportive tax environment, ensure information symmetry and transparency, etc. The approach of this study is novel for being the first of its kind to explore Tunisian insurance and pension 'funds' investments in alternative assets through data analysis techniques. In view of the fact that the history of research on this topic has been brief and fragmented, limited mostly to mature markets, the outcomes of this research can offer useful insights for policymakers in the emerging economies, particularly those undergoing reforms in young democracies like Tunisia in Africa, Eastern and Central Europe, and Latin America.
© 2023 Published by Elsevier Inc. on behalf of The Society for Policy Modeling.

---

* Corresponding author at: School of Management, Swansea University, Bay Campus, Swansea SA1 8EN, UK.
  E-mail address: m.z.abedin@swansea.ac.uk (M.Z. Abedin).
[1] Bouteska and Sharif have equal contributions as first author.

1. Introduction

Alternative asset investment (AAI) has emerged as a relatively contemporary approach in the public-pension investment domain (Peng & Wang, 2020). Unlike traditional investment that comprises mainly of fixed-income securities (e.g., treasury and corporate bonds) and public equity (e.g., stocks), i.e., traded frequently in the open market, AAI involves financial assets, namely, private equity, hedge funds, venture capital, and real assets (e.g., real estate, gold, etc.), i.e., managed conventionally by a hedge funds or a private equity company (Peng & Wang, 2020). Some categories of AAI (e.g., private equity and venture capital) have outpaced traditional investments (e.g., public equity) with superior long run rates of return (Kaplan & Schoar, 2005; Harris et al., 2014; Ivashina and Lerner, 2019). As a result, the AAI allocations have witnessed a remarkable rise among institutional investors with a long run investment horizon (e.g., pension funds and insurance corporations) worldwide since 2001 (Cummins et al., 2018; Giuzio and Rousová, 2019; Peng & Wang, 2020). As a corresponding outcome, the holdings of short-term (< 1-year maturity) and medium-term (between 1 and 5 years maturity) assets in 34 OECD countries, Central and Eastern Europe, and Latin America in particular have seen drastic declines, implying the long-term horizon pension funds as a propitious option for diversification (IOPS, 2017; Ivashina & Lerner, 2018). For example, the average illiquid asset allocation for pension funds jumped from 4% in 1997 to 25% in 2017 in seven largest pension-holding countries (Broeders et al., 2021) and from 9% in 2001 to 34% in 2022 in the US alone (Kozlowski, 2022). Moreover, the world especially the developed countries have witnessed rising holdings of alternative assets by the insurance companies, from 8.9% to 9.6% of total investment assets over 2018, with strong signs of ongoing rises in the coming years. Among all alternative asset classes in insurers' portfolios, investments in infrastructure and alternative funds are recorded to be the fastest-growing (Giuzio and Rousová, 2019).

Extant literature highlights a number of reasons behind the diversification to AAI which are arguably non-exhaustive, hence require further investigation. However, many of these reasons seem to be influenced by the instrumental role played by new investment policies and regulatory reforms (Andonov et al., 2018). From the policy perspective, Chiboub and Benjelloun (2020) classified the pension markets in two categories: (a) countries with an Anglo-Saxon financial heritage, i.e, the US, England, Ireland, etc. and (b) those with a European financial heritage, e.g., Germany, France, Denmark, etc. The latter group of countries have certain policy bindings. For instance, Danish pension funds are not entitled to put more than 40% of their portfolio investments in risky assets, German funds cannot invest more than 30% in European equities and 25% in European real estate, whereas Portuguese pension funds are restricted to 50% of their investments in European real estate and real estate loans (Sánchez Serrano & Peltonen, 2020). These countries also bear the full brunt of the trade union regulations and are historically more concerned about their social image being known to be law-abiding welfare economies.[2] On the contrary, Anglo-Saxon countries have no such constraints and are limited only by their spirit and creativity, implying higher efficiency that European pension funds could enjoy if they had more freedom in making their investment choices (Chiboub & Benjelloun, 2020). Given the outperforming AAI, insurance and pension funds in many parts of the world are beginning to wonder and think about their investment policies, and making possible regulatory reforms to

---

[2] https://www.theglobaleconomy.com/rankings/wb_ruleoflaw/ as of 4 March 2023.

provide access to the illiquidity premium and superior prospects of diversification and returns (Ashcroft et al., 2016).

In alignment with the global trend, pension systems in the Middle East and North Africa (MENA) region have reached a crossroads. Most countries of the region set up their pension schemes in the 1970 s (Robalino, 2005) and, as of today, all countries except for Lebanon have some type of pension programme for employees in both public and private sectors, comprising a relatively modest average, i.e., about 35% of the labour force (World Bank, 2017). In parallel with the pension funds, the insurance sector also enlarged in the region, consisting largely of assets relating to short-term property investment and casualty insurance (Robalino, 2005). Only 36.7% of the work force are making effective contributions to the social insurance schemes, i.e., well below the global average (i.e., 53.7%) (ILO, 2021). Many economies in the region went through the process of privatising state-owned assets and reforming corporation tax schemes to unlock the potential of AAI. This was reflected in the expansion that the private equity sectors had already seen during 1994–2005, 41% of which were pulled in 2005 alone, revealing the prospect of this method of finance in the region (OECD, 2006). Among all, Tunisia has emerged as a regional forerunner, exhibiting a new dynamic of securing high levels of contributions from a large volume of the working citizens, and prompting pension funds and insurance companies (institutional investors) to seek diversification into new asset classes (AAI) through innovations in social security policy and investment (UN-ESCWA, 2019; ILO, 2021).

Given the AAI features of outperformance (alpha), illiquidity premium and diversification (AIMA, 2019), and Tunisia's potential in long-term investment horizon, it is of significance to focus on investigating alternative assets and developing an understanding of the barriers that prevent Tunisian pension funds and insurance companies (CNRPS[3] and CNSS[4]) from opening up to the world of AAI and facing complex market reality. Also, as the largest pension fund and the second largest institutional investor in Tunisia (i.e., CNRPS) is limited by law to invest at least 50% in government bonds, a maximum of 30% in stock exchanges, a maximum of 15% in real estate, and less than 5% in private equity (OECD, 2022), we like to explore whether the diversification in investments is constrained by public policies or regulations, or there is existence of more structural reasons. In other words, to resolve the conundrum, we like to address the following questions: What factors divert the attention of Tunisian institutional investors from the AAI market? and what kind of policy support should be put in place to encourage these new vehicles as investment diversifiers?

2. Literature review

The diverse and varied literature on alternative asset investment (AAI) covers issues related to private equity (PE), real estate (RE) and infrastructure or alternative assets in general. Literature also offers outcomes of various investigations on PE, RE, infrastructure, mortgages, and hedge funds – the illiquid asset classes where pension funds come into play as investors (Broeders et al., 2021). Due to the above interconnectivity, we follow the approach of Magweva and Sibanda (2020) to study AAI in the BRICS countries, and review prominent literature

---

[3] Caisse Nationale de Retraite et de Prévoyance Sociale (CNRPS).

[4] The Caisse nationale de s é curité sociale (CNSS) covers pension fund of private sector employees. It is much more constrained in its investments as it has to go to the market through another Tunisian public body which is responsible for investing only in government bonds market.

related to PE, RE, and infrastructure only. We explore major contributing factors to the changing dynamics of the AAI, the attractiveness of AAI, and the associated challenges, and hence develop an insightful knowledge for the construction of our research survey.

2.1. Private equity (PE)

PE covers "investments in start-ups, venture capital, buyouts, turnarounds, mezzanine debt, and distressed financing" (Andonov, 2022, p.10). Ljungqvist and Richardson (2003) identified the stylized facts that contribute to its dynamics, and highlighted two driving factors of fund performance, i.e., investment opportunities and competition. The authors also suggested the timing and illiquidity of cash flows as crucial factors behind the annual outperformance of PE funds on listed assets. For example, it would take more than 3 years to invest 56.9% of the capital allocated to the fund, more than 6 years to invest 90.5% of the capital and 8–10 years for the internal rate of return (IRR) to become positive and possibly exceed that of listed assets. Moreover, premium remunerates the illiquidity of PE and the skills of fund managers. Therefore, certain regulatory requirements for investors would be supportive to developing a certain ability to identify the top-quartile funds and recognising the importance of reflecting high patience to harvest the illiquidity premium. Phalippou and Zollo (2006) identified two parameters that determine the performance of PE, i.e., the yield on corporate bonds and the level of the stock market at the time of investment. The authors postulated some procyclicality in PE returns, based on an observed positive correlation between the performance of PE funds and the GDP growth rate, and a negative correlation between the PE performance and the interest rates, implying the ability of PE to diversify a portfolio consisting mainly of traditional assets. Likewise, Phalippou and Gottschalg (2009) showed that PE funds outperformed listed assets by 3% gross and underperformed listed assets by 3% net. The authors circumvented the problem of selection bias (i.e., influenced by over-representations of the most efficient funds in a given database) by constructing two fund samples (portfolios): a first built by the authors and a second collected from a commercial database, e.g., Preqin, Burgiss, etc. (generally used by investors and researchers), and showing an average 5% difference in performance between the two databases. This is indicative of the need of investors' knowledge or provisioning of expert support, which can be incentivised by policy. Kazemi (2012) outlined several ways to generate profit from PE, for example, by: (a) finding opportunities in an uncertain, under-researched or neglected niche, where information is proprietary, and competition is little or non-existent; (b) restructuring to shift portfolio company structures and governance to more appropriate and efficient ownership models. Also, the authors interpreted PE funds as illiquid and indicated the secondary market for these assets as very opaque and very shallow, in which transactions are too rare and sellers often act under pressure. Moreover, secondary markets tend to dry up in critical periods when liquidity is in high demand. Also, following their entry into the PE industry, the investors tend to lose control over the timing and maturity or the amount of cash flows. This complicates the task even further. To stabilize the situation, policy mandates need to be there to ensure timely availability and transparency of information. Kazemi (2012) further emphasized that the conventional tools to measure performance in PE are particularly difficult and no longer suitable to draw a clear picture (about performance). In the context of the emerging countries, Lopez-de-Silanes et al. (2013) revealed outperformance of PE on listed assets, referring to a high yield (50% IRR) from investments in the best-performing funds. This pinpoints the importance of having investors' ability in place to identify the top-quartile funds to secure high and persistent return in the world of PE. This finding is corroborative to an earlier

study by Conroy and Harris (2007) who viewed PE as a reasonably good investment strategy for those who are able to display a certain agility in the choice, analysis and identification of the best deals, i.e., top quartile funds. Very recently, Frimanslund et al. (2022) postulated illiquidity as the Achilles heel of PE investment. Since it is one of the least liquid asset classes in the market, relevant policy regulations need to be in place to ensure that the investment has a consistency with its horizon, especially when debt is excessively used as an additional source of financing.

2.2. Real estate (RE)

Real estate (RE) investments refer to direct and segregated holdings, limited partnerships, and investment trusts in the RE sector (Andonov, 2022, p.10). Earlier, Fabozzi et al. (2005) highlighted RE as an investment asset that, independently of other assets, fairly controls the risk of a portfolio consisting mainly of equities and bonds. Consequently, RE is suitable for investors who wish to earn a return while preserving their capital. Bond et al. (2006) argued liquidity risk as a partial contributor to the low RE allocations, implying that the weighting of RE falls considerably when the return is adjusted for risk over the one-year investment horizon. On the contrary, this decline is not as significant in longer investment horizons (e.g., five years) that seem to amortize the risk of RE through risk-adjustments. With reference to the US and the UK markets, Hoesli and Lizieri (2007) distinguished between long-term and short-term effects in inflation protection, and also examined the speed at which economic shocks are incorporated into return expectations. The authors suggested that RE can protect a portfolio against anticipated inflation in the long term, and that information spreads rather slowly in the RE market. Moreover, they pointed flaws in the short-term analyses that allow us to understand the capacity of RE investment to protect a portfolio against inflation. Baroni et al. (2008) suggested multiple risk factors associated with RE, e.g., lack of centralization of transactions, poor transparency, heterogeneity, RE indivisibility, and traditional confidentiality that governs this industry. Garay and Horst (2009) stressed that RE holds poor correlation with other assets and this is rather supportive to controlling portfolio risk. Further, the authors calculated and compared the results of the Markovitz model with those of some of the institutional investors, and noted a much higher weight of the RE in Markovitz's portfolio. This implies the smoothing-risk phenomenon that gives a false signal to the investor, which (therefore) should be processed before investing. Similar to Baroni et al. (2008), Kazemi (2012) pointed out some issues associated with RE, e.g., heterogeneity of investments, indivisibility, etc. which make it very difficult to sell or buy the sizes that correspond to the buyers'/ sellers' preferences, and its illiquid nature that makes it difficult to rebalance the size of the investment portfolio. Moreover, since this type of markets are quite competitive in nature, the market price tends to adjust to demand, resulting in a reduced amount of profits. However, given that RE creates multiple channels of returns to an investment portfolio, including diversifying a traditional asset (equity/bond), protecting a portfolio against inflation, and providing regular cash inflows, absolute returns and tax benefits, strict policies and their implications need to be ensured to minimize the risk factors, as outlined above. The background story of the 2008 global financial crisis (GFC) is a reminder of this need.

2.3. Infrastructure

Besides RE, the recent trend of allocating traditional asset classes in pension fund portfolios has witnessed a growing shift to investment in infrastructure (Reddy, 2016; Gupta & Sharma, 2022). It includes long-term investments (e.g., 25–99 years) in social infrastructure as well as in economic sectors, e.g., transportation, communications and utilities (Stevens & Schieb, 2007; Inderst 2010; Andonov, 2022). Despite multiple benefits to investors in the form of price-fixing monopoly, barriers to entry, meagre operating costs, etc. (Inderst, 2010), involvement of non-public investors around the world has been timid due to various obstacles (Chicker & Garvin, 2009; Gupta & Sharma, 2022). Financing methods, regulatory barriers, and lack of quality data to assess infrastructure investment risks are such barriers, as identified by Croce and Yermo (2013). In the developed country context, Della Croce and Yermo (2013) listed lack of perverse short-termism, poor financing channels, lack of expertise to manage risk, and unreliable information as some of the major reasons for under-investment of pension funds in infrastructure, and recommended strong policy framework to address these issues. Panayiotou and Medda (2014) observed investors' priority of investing in less-risky brownfield projects in the UK due to regulatory inadequacy for suitable benchmarking of infrastructure projects. Likewise, Siemiatycki (2015) examined seven largest pension funds in Canada and revealed their preference for a privately owned or brownfield assets over PPP schemes or greenfield projects in the transport sector. In the Asian context, Inderst (2016) identified lack of supportive policies as a key obstacle to easing investment rules, expanding capital markets, accessing public sector loans, seeking expert intermediary support, towards matching the institutional investments with the global standard. Oberholzer et al. (2018) emphasised that institutional investors in Africa have great potential but appear hesitant to invest in infrastructure for a number of reasons, such as, high reliance on traditional assets, poor analytical expertise in projects, insufficient volume of projects, discrepancy between the features of accessible projects and the actual policy requirements, and complex regulatory benchmarks for investments in infrastructure. Likewise, Gatzert and Kosub (2016) investigated the challenges and project-related risks that the European insurance companies face in connection with their investments in infrastructure. The authors observed the insufficiency of the European regulatory initiatives that failed in ensuring data transparency and appropriate investment channels. Using an empirical evidence of underperforming pension funds in the US, Andonov et al. (2018) expressed concern regarding the poor likelihood of diversifying pension funds to infrastructure investment in the emerging markets due to volatile policy atmosphere, rigid regulatory standards and malnourished capital markets. Savoia et al. (2019) examined 49 listed companies operating in the infrastructure sector of Brazil and suggested that the rising importance of pension funds as the caterers to infrastructure investment depends largely on government policy implications on inflation targets and structural reforms. This is a continuation of the push that the Brazilian pension funds made earlier for economic and legal reforms, which Datz (2013) named 'pension fund developmentalism'. Likewise, Eke et al. (2021) pinpointed the need for a strong policy regime in Nigeria to ensure effective diversion of the pension funds to infrastructure development, instead of consumption spending.

2.4. Summary

It is evident that AAIs possess different risk and return dynamics compared to the traditional assets, such as positive alpha that implies relatively higher risk-adjusted return of AAIs

(Schneeweis et al., 2010), and very low betas that indicate lower volatility and risk of return due to negligible correlation with traditional assets (Anson et al., 2010; Peng & Wang, 2020). Also, the market's struggles to integrate and relay usable and quality information through reliable channels (Anson et al., 2010) enable AAIs to outperform its counterparts (Kaplan & Schoar, 2005; Harris et al., 2014; Ivashina et al., 2018). Besides providing access to illiquidity premium, inclusion of insurance and pension funds in AAI brings greater potential of diversification (AIMA, 2019). Despite this, many developing countries including the MENA region have struggled to create a smooth pathway to long-term AAI. It is therefore important to explore the factors that inhibit the diversification of institutional investors to AAIs and the role that a conducive policy and regulatory framework can play to smoothen the process.

3. Data and methodology

3.1. Sample

The analysis conducted here is the first of its kind in the Tunisian context. It stems from a clear need for R&D in the field of social security. The basic idea of this is to meticulously investigate the asset allocation policy of the Tunisian institutional investors – a phase which has been generally neglected by the authorities in the series of reforms since 1990. In light of this backdrop, we chose to carry out an exhaustive questionnaire-based field survey. For constructing survey questions, we reviewed three main questionnaires on asset and liability modeling, private equity, and asset class investing risk assessment, and adapted the preliminary version to the specificities of Tunisian pension funds and insurance companies. As part of the pilot test, we sent the first copy of our questionnaire to the Tunisian Association of Capital Investors (ATIC) and one of the Tunisian pension funds (identity anonymised). In light of their feedback, we fine-tuned the questionnaire and ran another cycle of pilot test with two other pension funds prior to holding the actual survey. Based on the list provided by ATIC, we completed the survey among 16 funds, either by distributing the questionnaire electronically or manually or by organizing direct meetings with the managers, subject to their preference. We received 12 questionnaires (a response rate of 74%) and removed 2 non-operational submissions, ending with 10 complete questionnaires for the analysis, comprising three pension funds (namely, CNRPS, CNSS, CNAM), six insurance companies (namely, STAR, COMAR, AMI, MAE, MAGHREBIA, GAT), and a reinsurance company (TUNIS RE). In order to ensure confidentiality of some of the investors in the analysis, we replaced their names with codes.

3.2. Methodology

In this study, we employed two analytical tools, i.e., multiple correspondence analysis (MCA) and a hierarchical classification for the barriers and challenges to the AAIs, and a descriptive approach (without using a rigorous data analysis method) for the AAIs which reform projects. The latter aims to highlight the measures to be put in place to encourage the inclusion of AAI in the portfolio, which may interest most institutional investors in the Tunisian context. The choice of these methods has been subject to some considerations about the nature of the variables and the possible interactions between them. For instance, we used an MCA for the first part of the study as we are working on a set of individuals who represent in our case institutional investors that are studied in relation to qualitative variables, without distinction between the order of modalities. Subsequently, we extended these results using a hierarchical classification,

and due to the quantitative nature of the data, we applied it on the individual's coordinates associated with the most discriminating dimensions we selected for the MCA rather than on the raw data. This procedure will enable us to apply the hierarchical classification to quantitative data which we did not have at the beginning. The MCA maintains the same objectives as a classical data analysis technique, describing a set of complex and interrelated variables, with the minimum of uncorrelated dimensions. The latter describes the maximum amount of information contained in the variable set. Following Husson et al. (2017), we used the MCA in the dimension reduction module (for the MCA), and for the hierarchical classification, we used the hierarchical cluster analysis in the classification module.

3.2.1. Conceptual framework of the Multiple Correspondence Analysis (MCA)

MCA is a data analysis technique (adapted to qualitative data sets) which makes an assessment of the similarities between individuals and the possible associations between the variables' modalities. For this purpose, the MCA uses a particular matrix, namely, the complete disjunctive table in which a qualitative variable with K modalities is replaced by K binary variables. It is called complete as the value 1 is definitely found somewhere in the corresponding block of rows. In MCA, we use the following mathematical notations:

$V_{i,j}$ is the modality of the variable j taken by the individual i.

K_j is the number of modalities taken by the variable j.

$Y_{i,k} = 1$ whether the individual takes the modality k of the variable j, and 0 otherwise.

$I \times p_k = \Sigma Y_{i,k}$ is the number of individuals that have the k modality of the variable j.

p_k is the proportion of individuals that have the k modality of the variable j.

$\frac{1}{I}$ is the weight of each individual in the database, with $\Sigma weight = 1$..

$x_{i,k=y_{i,k}/p_k}$, in which the $x_{i,k}$ of an individual increase as the modality he possesses is rare.

$$\Sigma \frac{x_{i,k}}{I} = \frac{1 \Sigma y_{i,k}}{Ip_k} = \frac{1}{I} \times \frac{I \times p_k}{p_k} = 1$$

Since the MCA is working on the centered data, we need to centre $x_{i,k}$, therefore $x_{i,k} = \frac{y_{i,k}}{p_k} - 1$.

Let the distance between two individuals be $(i,')^2$. In this case, if two individuals take the same modalities, the distance between them will be equal to 0. If two individuals have many common modalities, their distance will be minimal. If out of two individuals, one has a very rare modality, their distance will be great. If the rarity is same, their distance will be small:

$$d(i, i')^2 = \Sigma \frac{p_k}{J} \times \left(x_{i,k} - x_{i',k}\right)^2 = \Sigma \frac{p_k}{J} \times \left(\frac{y_{i,k}}{p_k} - \frac{y_{i',k}}{p_k}\right)^2$$

$$= \frac{1}{J} \times \Sigma \frac{1}{p_k} \times (y_{i,k} - y_{i',k})^2$$

Let the distance between the individual and the gravity centre be $(i,)^2$. An individual with rare modalities will continue moving further away from the origin. Given that the gravity centre is confused with the origin, the total inertia of the scatter plot (N_i) is the weighted sum of the squares of the distances between the individuals and the gravity centre:

$$d(i, G)^2 = d(i, O)^2 = \Sigma \frac{p_k}{J} \times (x_{i,k})^2 = \Sigma \frac{p_k}{J} \times \left(\frac{y_{i,k}}{p_k} - 1\right)^2$$

$$Inertia(N_i) = \frac{1}{I} \sum d(i, O)^2 = \sum \left(\frac{1}{I \times J} \sum p_k \times \left(\frac{y_{i,k}}{p_k} - 1 \right) \right)^2$$

Hence, like the majority of factorial analysis techniques (PCA, CFA, etc.), MCA aims to build the factorial axes (that best divide individuals according to their modalities) that absorb the possible inertia. Due to the high number of modalities and factorial axes, we generally use the first axes to interpret our database. The Catell rule (the elbow rule) is used for this purpose. The idea is to read the graph of decreasing inertia per factorial axis and select the ones that occur before the elbow. For example, let us assume that two factorial axes have been selected using the Cattell (1960). To start the interpretation, we must calculate the ratio of the squared correlation between the coordinates of each individual on the two factorial axes and the values each individual takes on each variable. For example, let us consider variable V_j:

$$\eta^2(F_1, V_j) = 0.547$$

$$\eta^2(F_2, V_j) = 0.041$$

That means that the first factorial axis separates well the properties of individuals from the variable V_j and that the second one does not do it very well. Therefore, we retrieve these correlation ratios and draw the graph that plots the correlations of each variable with the two dimensions (which we initially selected using Cattell's rule). We will start by interpreting the variables with the highest correlation ratios on dimensions 1 and/or 2. Let us also note that an individual will be at the barycenter of the modalities they possess and that a modality will be at the barycenter of the individuals who possess it:

$$G_S(k) = \frac{1}{\sqrt{\lambda_S}} \sum_i \frac{y_{i,k}}{I_k} \times F_S(i), \text{ for modalities}$$

$$F_S(i) = \frac{1}{\sqrt{\lambda_S}} \sum_j \frac{y_{i,k}}{j} \times G_S(k), \text{ for individuals}$$

$$\text{With} \lambda_S = \frac{1}{J} \sum_j \frac{y_{i,k}}{j} \eta^2(F_s, V_j)$$

As a result, each individual will be on the side of the modalities they possess and on the opposite side of those they do not possess. Likewise, a modality will be on the side of the individuals who possess it and on the opposite side of those who do not.

3.2.2. Review of hierarchical classification

Hierarchical classification deals with quantitative data tables and produces a 'tree structure' that highlights the hierarchical links between individuals or groups of individuals. Two types of distance must be measured to do this, i.e., the distance between individuals, and the distance between groups of individuals. For the first one, several metrics can be used, e.g., Euclidean distance, squared Euclidean distance, Manhattan distance, maximum distance, etc. We will use the Euclidean distance that allows us to account for distances naturally:

$$d(x, y) = \sqrt{\sum_j (x_i - y_i)^2}, \text{ Euclidean distance}$$

To measure the similarity between two groups, there are also several techniques, including minimum jump (also called the shortest distance), full link (also called the longest distance),

Ward's distance, etc. In this paper, Ward's criterion will be preferred. Initially, according to Ward, each class is an individual. Then, we aggregate step by step the classes that allow us to minimize the decrease of the total inertia. Knowing that:

$$Total inertia = inertia(a) + inertia(b) = inertia(a \cup b)$$
$$- \frac{m_a m_b}{m_a + m_b} d^2(a, b)$$

With a and b, two different classes of individuals, m_a and m_b, are respectively the number of individuals, and $d^2(a,b)$ is the squared Euclidean distance between the gravity centres of groups a and b. Therefore, to minimize the loss of total inertia, $\frac{m_a m_b}{m_a + m_b} d^2(a, b)$ must be minimized. In this sense, the quantity $\frac{m_a m_b}{m_a + m_b}$ will make it possible to group classes of individuals with low weights and especially to avoid chain groupings that prevent individuals from being well spread over the different tree classes. For its part, the parameter $d^2(a,b)$ will enable grouping classes with quite close gravity centres together. Finally, we will stop the partitioning of the hierarchical tree when the decrease of the total inertia is no longer very important and the groups are sufficiently homogeneous between them.

4. Results

### 4.1. Analysis of qualitative data through MCA

Following the Cattell (1960), we refer to the graph of the total inertia represented by dimensions to choose the number of dimensions. The elbow, in this case, is at the level of the second and fourth dimensions, representing a certain difference in inertia between the second and first dimensions and between the fourth and third dimensions. Therefore, since the first dimension represents only 27.97% of the total inertia (i.e., seemingly insufficient to describe our set of variables), we focus on exhaustiveness and use three dimensions for the rest of the study.

The three-dimensional solution in Table 1 describes 64.83% of the total inertia (27.97% for dimension 1, 19.65% for dimension 2%, and 17.20% for dimension 3) and that Cronbach's alpha is 0.93 (i.e., more than 0.8). These two indicators reassure us about the relevance of our choice. Indeed, the three-dimensional solution generates sufficient explanatory power. (Fig. 1).

The first step to starting the analysis would be to read the squared correlation table. The square of the minimum correlation that we choose for every variable is 0.5, and find accordingly that the first dimension is closely related to the following variables: "pe_barri_-narowmarket, pe_barri_difficultmesur, pe_barri_youthindustri, immob_barri_hetroinvest,

Table 1
Variances (total inertia) represented by dimensions.

Dimension	Cronbach Alpha	Variance represented		
		Total (Eigenvalue)	Inertia	% of variance
1	0. 957	13.762	0. 280	27.973
2	0. 924	9.516	0. 197	19.648
3	0. 907	8.267	0. 173	17.199
Total		31.523	0. 648	
Mean	0. 934	10.515	0. 217	21.607
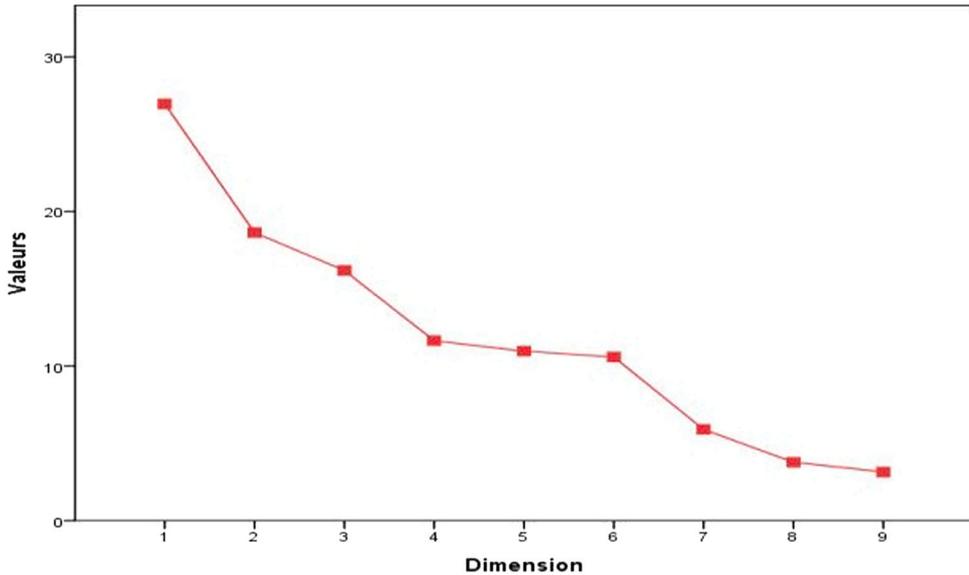
Figure 1. Summary of variances (total inertia) represented by dimensions. Notes: Axe x represents the values; Axe y represents the dimensions.

infra_barri_narowmarket, infra_barri_jcurve, infra_barri_difficultmesur, infra_barri_highloss and confort_investfund". These variables have high levels of correlation in the first dimension (greater than 0.5) and are limited in the second and third. Therefore, for these twelve variables, the modalities are distant from each other along the first dimension only. Indeed, if we take variables "pe_barri_narowmarket and infra_barri_narowmarket" as examples, we can see that the MCA has divided our database of institutional investors into two groups for each variable. A first group located in the positive quadrant, answered with a (yes), and then a second group located in the negative quadrant, answered with a (no). This discrimination applies to all twelve variables that have a high squared correlation rate in this first dimension. (Fig. 2).

The second dimension is related to variables "immob_barri_lackprof_fund, infra_barri_youthindustri, infra_barri_lackprof_fund, confort_investfund and other_mesure_challenge". These variables have high levels of correlation (greater than 0.5) in the second dimension and low levels in the first and third. Therefore, for these six variables, the modalities are only distant from each other along the second dimension. Indeed, if we take, for example, variables "immob_barri_lackprof_fund and infra_barri_lackprof_fund", we can see that the MCA has divided our institutional database into two groups for each variable. A first group in the positive quadrant answered with a (no), and then a second in the negative quadrant answered with a (yes). This discrimination applies to the five variables with high squared correlation rates in this second dimension. (Fig. 3).

The third dimension, in turn, is related to variables "pe_barri_hetroinvest, immob_barri_regllegal, immob_barri_narowmarket, and immob_barri_youthindustri". These variables have high levels of correlation in the third dimension (greater than 0.5) and low levels in the first and second. Therefore, for these four variables, the modalities are only distant from each other along the third dimension. Indeed, if we consider variables "pe_barri_hetroinvest,
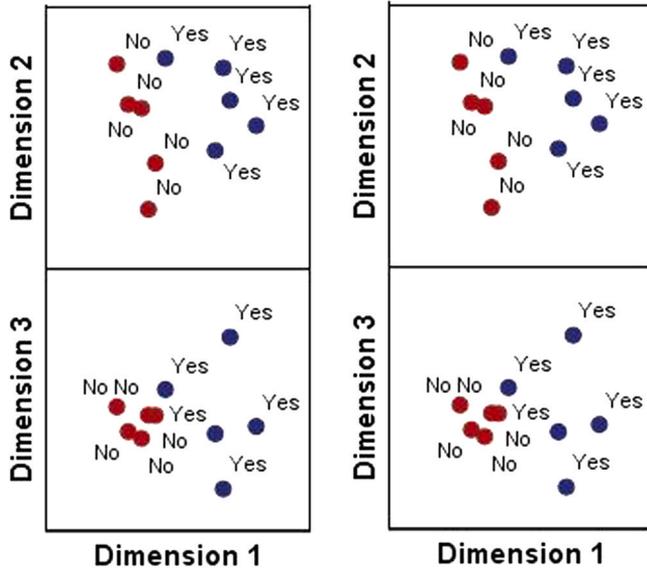
Figure 2. Responses of studied organizations to the variables. Note: (pe_barri_narowmarket and infra_-barri_narowmarket) respectively from left to right.
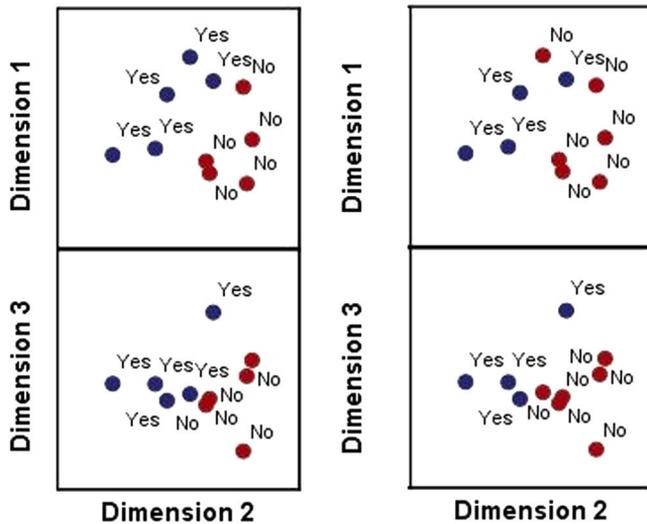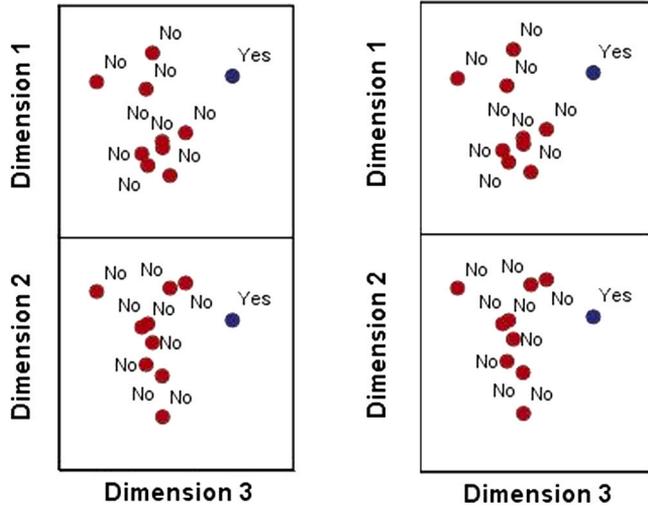

Figure 3. Responses of the studied organisms to the variables. Note: (immob_barri_lackprof_fund and infra_-barri_lackprof_fund) respectively from left to right.

immob_barri_regllegal" as an example, we see that the MCA divides our institutional database into two groups for each variable: a first group in the positive quadrant answered with a (yes), and then a second group in the negative quadrant answered with a (no). This discrimination applies to the four variables that have a high squared correlation rate in the third dimension. (Fig. 4).

Figure 4. Responses of the studied organisms to the variables. Note: (pe_barri_hetroinvest and immob_barri_regllegal) respectively from left to right.

For a more detailed interpretation, we can refer to the diagramme showing the organisms in three dimensions. Thus, we can notice that the first axis opposed two major groups: the first constituted by the following organisms: "CNAM, GAT insurance, organism D and organism B", and the second constituted by "AMI insurance, CNSS, organism C, TUNIS RE, STAR and organism A". Since under an MCA, each individual is at the barycenter of the modalities he possesses, we can say that the first group is the one that thinks that the narrowness of the Tunisian private equity market, the measurement difficulties related to private equity (PE), the youth of the PE industry, the illiquidity of PE, the heterogeneity of real estate (RE) investments, the illiquidity of RE, and regarding infrastructure, the narrowness of the market in Tunisia, exposure to the (J) curve, measurement difficulties, illiquidity and the risk of high losses, are all barriers to investing in the alternative asset universe by this group. These same organisms are generally quite comfortable working with investment funds. The second group in the negative quadrant of the same dimension is not at all convinced (we only have dichotomous variables in our database) that these barriers are the real factors that prevent it from relocating its investments to AAIs. This same group of institutional investors is generally less comfortable with the idea of working with investment funds.

The second axis also opposed the first group consisting of the following organisms: "GAT, CNAM, STAR and organism A", to the second group consisting of the following organisms: "organism B, organism D, CNSS, TUNIS RE, organism C and AMI insurance". Since under an MCA, each individual is at the barycenter of the modalities they possess, we can say that the first group is the one that thinks that the lack of professionalism of investment funds specialized in the Tunisian RE sector, the youth of the infrastructure sector industry, the lack of professionalism of investment funds specialized in the Tunisian infrastructure sector, and other measurement challenges specific to each organism, are all barriers to investing in the AAIs by the first group. These same organisms are generally moderately comfortable with the idea of working with investment funds. We can also conclude that the second group of institutional investors "organism B, organism D, CNSS, TUNIS RE, organism C and AMI insurance"
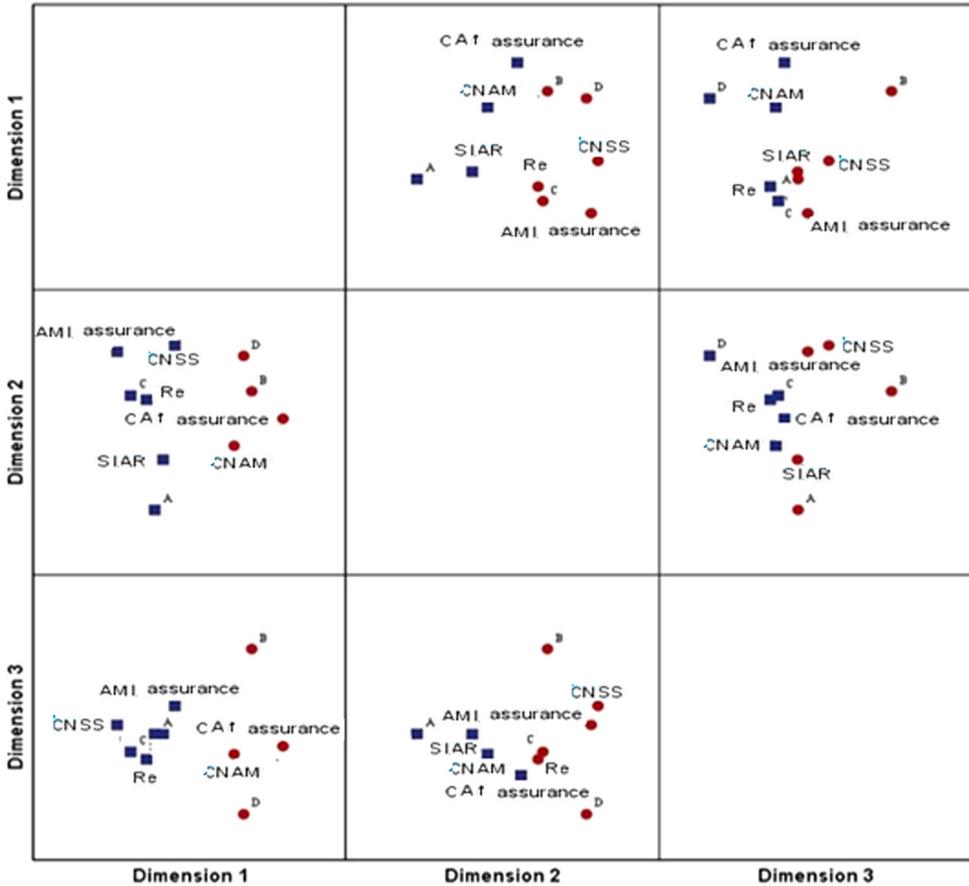
Figure 5. Organisms in the three-dimensional space.

believe that the barriers we have listed for the first group are not the ones that prevent them from investing in alternative assets.

The third factor axis, on the other hand, was composed of two main groups: a first group composed of organisms "B, CNSS, STAR, A, and AMI insurance", and a second group composed of organisms "GAT, CNAM, D, TUNIS RE, and C". Since under an MCA, each individual is at the barycenter of the modalities he possesses, we can say that the first group is the one that thinks that the heterogeneity of investments in PE, the regulatory barriers of Tunisian RE investments, the narrowness of the RE market, and the youth of the RE industry are all barriers to investing in the AAIs by this first group. We can also conclude that the second group of institutional investors "GAT, CNAM, D, TUNIS RE, and C" does not agree with the first group that these barriers are the real reasons preventing it from engaging in AAIs. (Fig. 5 and Table 2).

Before starting our study, we had to remove six variables from the analysis. By having a zero variance, the latter have no power of discrimination and cannot contribute to the construction of the three-factorial axes. These variables are as follows:

Table 2
Variables eliminated from the analysis with zero variances.

Variable	modality	Number
illiq_mesure_challenge	No	0
	Yes	10
defin_sellectreport_perf	No	10
	Yes	0
infra_barri_hetroinvest	No	10
	Yes	0
infra_barri_pooling	No	10
	Yes	0
immob_barri_pooling	No	10
	Yes	0
pe_barri_nondivisibl	No	10
	Yes	0

The findings of this study also reveal that all the institutional investors in our database have great difficulty measuring the liquidity level of AAIs, and this finding corroborates the financial literature that has postulated this as a challenging issue (AIMA, 2019). In addition to uncertainty, the situation for AAIs gets further complicated when several variables and parameters evolve in a different universe (compared to traditional assets) that operate under completely different regulations, measurement methods and analysis tools.

4.2. Hierarchical classification approach

The results of the hierarchical classification are in perfect harmony with the results obtained in the first part of the study. Indeed, the first axis (explained 27.97% of the total inertia) of the MCA divided the database into a first group consisting of organisms "CNAM, GAT insurance, D, and B", and the second comprising organisms "AMI insurance, CNSS, C, TUNIS RE, STAR, and A". As per the Wald's criterion and Euclidean distance (Chakraborty & Zhang, 2021), this classification is in perfect adequacy with the one obtained at the hierarchical classification level. Indeed, the first partitioning of the hierarchical tree leads to the same conclusions, with the first group located in the lower red rectangle and a second group in the upper red rectangle. The second MCA axis explained 19.65% of the total inertia. If we apply it in addition to the first axis, we will obtain a new distribution of our institutional investors. The latter will place organisms "TUNIS RE, C, CNSS, and AMI insurance" in the first group, "A and STAR" in a second group, "CNAM and GAT" in a third group, and organisms "B and D" in the last group. This same classification is in line with that obtained at the hierarchical classification level (blue rectangles), with a small difference at the level of the last group of organisms B and D. Indeed, the hierarchical classification devoted only one group of organisms to "CNAM, GAT, B and D" instead of two for the MCA.

In conclusion, we decided to make a compromise between the hierarchical classification and the MCA, and to retain four classification groups (ignoring the third MCA dimension). Each group of institutional investors in our database is characterized by its own investment challenges and barriers that prevent it from diversifying into AAI universe, except for the third group of organisms (STAR, A). It implies that in a two-dimensional solution, this third group of pension funds and insurance companies does not face specific investment barriers and

challenges. We can mention, for example, the lack of professional fund managers in the AAI world, the history of disappointing returns generated by Tunisian PE, etc. At this stage, given that the barriers preventing the Tunisian insurance and pension funds' diversification to AAIs are identified to the extent possible, a logical next step would be to discuss ways of improving this ecosystem, which would make it a much more attractive investment area. Therefore, this is going to be the topic of discussion in the following section of this study.

5. Regulatory reforms for Tunisian alternative assets

The financial system in Tunisia has undergone some policy-led reforms over the last ten years to enable effective mobilisation of savings for financing the economy, in alignment with the international standards. For example, as part of the diversification measures, a new asset namely Les Organismes de Placement Collectif Immobilier (OPCI) was introduced to the Tunisian financial market in 2016 to direct the long-term savings towards RE financing, aiming to offer institutional investors a new long-term regulated investment vehicle. Given that the OPCI is subject to strict control by financial market authorities and, on the contrary, the Tax reform measures of the 2020 Finance Act have provided some incentives to the OPCI investments, e.g., the 50% exemption from capital gains tax for contributions of property, it would be useful to extend this advantage to the institutional investors beyond 2020, as an assistance during their initial years of operation in the AAI market. Moreover, given that the tax environment governing alternative assets in Tunisia remains highly perfectible and Tunisian institutional investors' allegations of imprecision in the legal texts, the measure that institutional investors in our database has put at the forefront is tax reforms (69% think it is very important and 31% think it is important), implying the need for a policy measure to facilitate a conducive tax environment for AAIs in Tunisia. In this connection, one of the interventions that investors have highly appreciated is a relief from the sole responsibility of paying the value-added tax (TVA) on their management fees, as well as the abolition of registration fees in the event of the sale of unlisted shares. In our review of literature, we observed a strong commonality among researchers (e.g., Gatzert & Kosub, 2016; Andonov et al., 2018; Savoia et al., 2019; Eke et al., 2021) in emphasising the need for a conducive 'pension fund developmentalism' policy (Datz, 2013) in order to overcome volatile policy environment and rigid regulatory standards.

It is also relevant to ensure greater transparency and readability of the alternative market. We believe that this opacity nature is at two levels: with regard to investment funds, which do not have a lot of transparency obligations (at least less than listed equities), or at the level of the institutional investors, who do not have a benchmark to monitor the performance of investment funds regularly. As a result, institutional investors must, in general, complete their information (Gatzert & Kosub, 2016). This opacity is also present at the level of companies that investment funds can potentially finance. In the literature, this opacity is an advantage. Indeed, it allows these companies to avoid the transparency constraint, which weighs heavily on their performance, and thus focus on their core business. Unlike the US, the investment funds in Tunisia suffer from this opacity differently since the majority of companies, usually SMEs, underreport their earnings. Given the fairly selective criteria required by investment funds and donors, this considerably reduces the number of overwhelming targets. An associated issue with the opacity and information asymmetry is the adverse consequences investment funds and fund managers may face due to inexperience while venturing into projects that necessitate special knowledge and skills of fund supervision (Ljungqvist & Richardson,

2003; Lopez-de-Silanes et al., 2013). It is therefore imperative for them to continue seeking professional guidance from the technical experts and develop self-sufficiency eventually through this process. As a policy measure, as Clark and Evans (1998) recommended, mandatory provisioning of financial experts can be seriously considered to overcome difficulties arising from information asymmetry.

For the institutional investors in our database, we recognise the vitality of improving the entire Private Equity (PE) financing chain and therefore reflect upon the Tunisian public authority decision to refine the laws and rules related to the Organismes de Placement à capital risqué (OPCR) in 2014. Earlier, institutional investors had to invest in organizations (OPCR) that devote at least 50% of their portfolio to SMEs. This is not necessarily adapted to the needs of all institutional investors, including those who prefer less risky and more mature companies. In this connection, it was a step forward by moving from the OPCR (Organismes de Placement en Capital-Risque) to OPCVM (Organismes de Placement Collectif en valeurs mobilières), aiming to enlarge the scope of the law by covering all PE-related activities, e.g., securing the system, strengthening investor protection, matching the financial techniques with the international standards, and involving foreign investment. So, this new procedure completes the armada of supply of PEs in Tunisia, enabling the institutional investors to diversify within the same market segment. However, the segment that remains the weakest in this ecosystem is most certainly the seed capital. The ATIC (Tunisian Association of Capital Investors) in its report published in 2019 on the seed capital environment proposes several reasons that explain these difficulties, for instance, there is no clear legal definition of the Tunisian start-up, the judicial liquidation procedures related to the OPCVM that invest in seed capital are very cumbersome, etc. At the same time, ATIC has tried to design a roadmap, which can be considered as the starting point to properly support this segment of PE.

Given that many developing countries are making investments in infrastructure as part of their economic drives, the prospects of social infrastructure have drawn enormous attention during the COVID-19 (Inderst, 2020), and many scholars endorsed this as a propitious route of finance (Vassallo et al., 2018). However, since most researchers have concentrated on the European continent (Gupta & Sharma, 2022) and on economic infrastructure at large (Gharaibeh, 2019), we find it useful to propose assessments on the feasibility of issuing infrastructure bonds in the emerging regions where institutional investors, insurers in particular (Giuzio & Rousová, 2019), seem to have made their pathways towards AAIs due to better resilience to economic and financial shocks and its ability to ensure steady cash flows in the long run (Martin, 2010; Della Croce & Gatti, 2015). In order to ease diversification and attractive returns, we follow Kalmykov (2015) and recommend setting of a 65% ceiling for pension fund investment in infrastructure bonds and the rest in other classes.

At this stage, we re-emphasise the importance of the OPCI and recommend its fast operationalisation to overcome the time lags in offering support to the Tunisian institutional investors. As a result, besides transparency, these organizations will be able to reap the benefit of diversification, unlike the direct RE investment which means concentration of large investment tickets in a single project, a situation that is not necessarily supportive to promoting diversification. In this context, the OPCI can resolve this problem by taking equity stakes in several projects. Also, since it is easier to sell equity investments on the market than financing a large RE project, the OPCI can provide much more liquidity than what direct RE investments can solely do. This will eventually push the Tunisian institutional investors to relocate their funds and explore other horizons to enrich the traditional equity/bond/money portfolio.

6. Conclusion

In the actual context, that is, a low-interest rate environment, a very narrow and declining stock market, and above all a depleting reserve risk, Tunisian pension and insurance companies have evolved over the years. In light of this backdrop, we aimed to take a critical look at the asset allocation strategy of the various Tunisian pension and insurance organisms, and consequently track down some investment opportunities, i.e., alternative asset investments (AAIs) in our case. AAIs are meant to diversify the investment portfolio and drain its return. However, given the classical markets, AAIs have continued to witness a downward trend for a number of years whereas various Tunisian financial market stakeholders in general and pension or insurance companies in particular have developed a consciousness of the changing market dynamics. Indeed, given that the traditional market has tended to dry up in recent years, the pension and insurance companies have shown signs of realising the need to look for much more performance, seeking "alpha" in new investment vehicles to possibly slow down the reserve depletion date (the earliest one is expected in 2028). On the other hand, the theoretical literature has repeatedly discussed the contribution of alternative assets to an investment portfolio and the associated risks. However, all of these arguments provided us with a right background of developing a research survey questionnaire and carrying out a qualitative study on the Tunisian insurance and pension funds. Subsequently, we have been able to identify some investment barriers related to the Tunisian AAIs and think about some improvement areas. However, the objectives of this paper go beyond these accomplishments. Indeed, based on our study, we created an opportunity to invite Tunisian pension funds and insurance companies into an exploratory debate to bridge the gap between the academic and the professional worlds, which lack are quite disconnected in Tunisia.

In view of the literature related to Tunisia, we acknowledge that despite the reforms and initiatives for efficient social security fund management, e.g., higher retirement age (from 60 to 62, with a flexibility of reaching up to 65), reduced pension rates, higher contribution rates, etc., social security funds have remained the weakest area of the Tunisian financial sector, as evidenced by the continued reserve depletion risk. However, given that an actual race against time has been launched to save the pension system in Tunisia through continued reforms (e.g., parametric reform in 2019), elucidating the reserve management question for insurance and pension funds in this study would be a real step forward. Also, given that the extant research are mostly conducted on the matured markets and the history of research on diversifying institutional investments to AAIs in the developing country context is brief and fragmented (Gupta and Sharma, 2022), the outcomes of this research can offer useful insights for policymakers in the emerging economies, particularly those undergoing reforms in young democracies like Tunisia (Yerkes et al., 2022) in Africa, Eastern and Central Europe, and Latin America.

References

AIMA (2019). *UK Pension Schemes and Alternative Investments* (Working Paper)Alternative Investment Management Association (AIMA).

Andonov, A. (2022). Delegated Investment Management in Alternative Assets (May 1). ⟨http://dx.doi.org/10.2139/ssrn. 2458224⟩.

Andonov, A. , Kräussl, R, & Rauh, J (2018). The subsidy to infrastructure as an asset class. National Bureau of Economic Research Paper No. w25045.

Anson, M. J. P., Fabozzi, F. J., & Jones, F. J. (2010). *The Handbook of Traditional and Alternative Investment Vehicles: Investment Characteristics and Strategies.* John Wiley & Sons.

Ashcroft, J., Inglis, E., & Price, W. J. (2016). *Outcomes and Risk Based Supervision in Pensions: Methodology with a Case Study for Costa Rica.* World Bank.

Baroni, M., Barthélémy, F., & Mokrane, M. (2008). Un nouvel indice de risque immobilier pour le marché résidentiel parisien. *Revue économique, 59*(1), 99.

Broeders, D. W. G. A., Jansen, K. A. E., & Werker, B. J. M. (2021). Pension fund's illiquid assets allocation under liquidity and capital requirements. *Journal of Pension Economics and Finance, 20*(1), 102–124. https://doi.org/10.1017/S1474747219000398

Bond, S. A., Hwang, S., & Richards, K. (2006). Optimal allocation to real estate incorporating illiquidity risk. *Journal of Asset Management, 7*(1), 2–16.

Cattell, R. B. (1960). The salient variable similarity index for factor matching. *British Journal of Statistical Psychology—Wiley Online Library*.

Chakraborty, S., & Zhang, X. (2021). A new framework for distance and kernel-based metrics in high dimensions. *Electronic Journal of Statistics, 15*, 5455–5522. https://doi.org/10.1214/21-EJS1889

Chiboub, O., & Benjelloun, S. (2020). Alternative asset: Evidence from Moroccan Insurance and pension funds. *ACRN Journal of Finance and Risk Perspectives, 9*(1), 217–240. https://doi.org/10.35944/jofrp.2020.9.1.015

Chicker, G., & Garvin, M.J. (2009). Private equity: growing investment vehicle in infrastructure (No. 1429–2016-118654). In Proceedings of the 50th Annual Transportation Research Forum. Doi: 〈https://doi.org/10.22004/ag.econ.207723〉.

Clark, G. L., & Evans, J. (1998). The private provision of urban infra- structure: Financial intermediation through long-term contracts. *Urban Studies, 35*(2), 301–319. https://doi.org/10.1080/00420.98984998

Conroy, R. M., & Harris, R. S. (2007). How good are private equity returns? *Journal of Applied Corporate Finance, 19*(3), 96–108.

Croce, R.D., & Yermo, J. (2013). Institutional investors and infrastructure financing. p. 37.

Cummins, D., Cragg, M., Zhou, B., & de Fonseka, J. (2018). *The social and economic contributions of the life insurance industry.* Boston: The Brattle Group.

Datz, G. (2013). Brazil's pension fund developmentalism. *Competition & Change, 17*(2), 111–128. https://doi.org/10.1179/1024529413Z.00000000029

Della Croce, R., & Yermo, J. (2013). *Institutional investors and infrastructure financing. OECD Working Papers on Finance, Insurance and Private Pensions, No.36.* OECD Publishing.

Della Croce, R., & Gatti, S. (2015). International trends in infrastructure finance. In S. Caselli, G. Corbetta, & V. Vecchi (Eds.). *Public private partnerships for infrastructure and business development* (pp. 81–100). New York: Palgrave Macmillan.

Eke, O. P., Okoye, L. U., & Omankhanlen, A. E. (2021). Can pension reforms moderate inflation expectations and spur savings? Evidence from Nigeria. *Weas Transactions on Business and Economics, 18*, 324–337.

Fabozzi, F. J., Focardi, S. M., & Jonas, C. L. (2005). Market experience with modelling for defined-benefit pension funds: evidence form four countries. *Journal of Pension Economics and Finance, 4*(3), 313–327.

Frimanslund, T., Kwiatkowski, G., & Oklevik, O. (2022). The role of finance in the literature of entrepreneurial ecosystems. *European Planning Studies*. https://doi.org/10.1080/09654313.2022.2055962

Gatzert, N., & Kosub, T. (2016). Insurers' investment in infrastructure: Overview and treatment under Solvency II. *The Geneva Papers*. https://doi.org/10.1007/978-1-137-57479-4_4

Giuzio, M., & Rousová, Li (2019). *Insurers' investment strategies: Pro- or countercyclical?* Working Paper Series 2299European Central Bank.

Garay, U., & Horst, E. ter (2009). Real Estate and Private Equity: A Review of the Diversification Benefits and Some Recent. *Developments*. *The Journal of Alternative Investments, 11*(4), 90–101.

Gharaibeh, O. K. (2019). Optimal portfolio selection based on Jordanian infrastructure sub-index returns. *International Journal of Scientific & Technology Research, 8*(12), 2560–2566.

Gupta, S., & Sharma, A. K. (2022). Evolution of infrastructure as an asset class: a systematic literature review and thematic analysis. *Journal of Asset Management, 23*, 173–200. https://doi.org/10.1057/s41260-022-00255-3

Harris, R., Jenkinson, T., & Kaplan, S. (2014). Private equity performance: What do we know? *Journal of Finance, 69*, 1851–1882.

Hoesli, M., & Lizieri, C. (2007). Real Estate in the Investment Portfolio. A report prepared for the Investment Strategy Council of the Royal Ministry of Finance, Norway.

Husson, F., Josse, J., Le, S., & Mazet, J. (2017). FactoMineR: Multivariate exploratory data analysis and data mining. *R Package Version, 1*, 38.

ILO (2021). *World Social Protection Report 2020–22. Regional companion report for the Middle East and North Africa (MENA) region.* International Labour Organization (ILO).

Inderst, G. (2010). Pension fund investment in infrastructure: What have we learnt? *Pensions: An International Journal,* *15*(2), 89–99. https://doi.org/10.1057/pm.2010.4

Inderst, G. (2016). Infrastructure Investment, Private Finance, and Institutional Investors: Asia from a Global Perspective. ADBI Working Paper 555, ⟨http://dx.doi.org/10.2139/ssrn.2721577⟩.

Inderst, G. (2020). Social infrastructure finance and institutional investors. *A Global Perspective*(September 18), https://doi.org/10.2139/ssrn.3556473

IOPS (2017). *Pension Funds and the Impact of Switching Regulation on Long-term Investment. IOPS Working Papers on Effective Pensions Supervision, No.28. International Association of Pension Supervisors (IOPS).* World Bank Group.

Ivashina, V., & Lerner, J. (2018). Looking for Alternatives: Pension Investments Around the World, 2008 to 2017– Accueil. Retrieved January 6, 2020, from ⟨https://www.bibliotheques.gouv.qc.ca/bulletin_veille/looking-for-alternatives-pension-investments-around-the-world-2008-to-2017/⟩.

Kalmykov, V. (2015). Investment mechanisms of pension insurance and their role in development of national economy. *Mediterranean Journal of Social Sciences, 6*(1 S3), 50.

Kaplan, S. N., & Schoar, A. (2005). Private equity performance: Returns, persistence, and capital flows. *The Journal of Finance, 60*(4), 1791–1823.

Kazemi, H. (2012). *Alternative Investment Analyst Review.* Chartered Alternative Investment Analyst Association.

Kozlowski, R. (2022). Higher alts allocations may help cut volatility but not necessarily increase returns – CRR. *Pensions and Investments*(November 22 Issue).

Ljungqvist, A., & Richardson, M. (2003). The Investment Behaviour of Private Equity Fund Managers, RICAFE Working Paper No. 005 (October). http://ssrn.com/abstract=482546 or DOI: 10.2139/ssrn.482546.

Lopez-de-Silanes, F., Phalippou, L., & Gottschalg, O. (2013). Giants at the gate: investment returns and diseconomies of scale in private equity. *Journal of Financial and Quantitative Analysis, 50*(3), 377–411.

Magweva, R., & Sibanda, M. (2020). Inflation and infrastructure sector returns in emerging markets—panel ARDL approach (Article) *Cogent Economics & Finance, 8*(1), 1730078. https://doi.org/10.1080/23322039.2020.1730078

Martin, G. A. (2010). The long-horizon benefits of traditional and new real assets in the institutional portfolio. *The Journal of Alternative Investments, 13*(1), 6–29. https://doi.org/10.3905/jai.2010.13.1.006

Oberholzer, G., Markowitz, C., Pautz, M., Barnor, J., & Grobbelaar, N. (2018). *Infrastructure as an asset class in Africa.* The Global Eco- nomic Governance (GEG) Africa,. (Discussion Paper) ⟨http://www.gegafrica.org/item/860-infrastructure-as-an-asset-class-in-africa⟩.

OECD (2006). Venture Capital Development in MENA Countries – Taking Advantage of the Current Opportunity. *MENA Investment Policy Briefing, Issue 1.*

OECD (2022). *OECD Economic Surveys: Tunisia 2022.* Paris: OECD Publishing, https://doi.org/10.1787/7f9459cf-en

Panayiotou, A., & Medda, F. (2014). Attracting private sector partici- pation in infrastructure investment: the UK case. *Public Money & Management, 34*(6), 425–431. https://doi.org/10.1080/09540962.2014.962369

Phalippou, L., & Gottschalg, O. (2009). The performance of private equity funds. *Review of Financial Studies, 22*(4), 1747–1776.

Phalippou, L., & Zollo, M. (2006). What drives private equity fund performance. *Financial Institutions Center, 6,* 103–120.

Peng, J., & Wang, Q. (2020). Alternative investments: Is it a solution to the funding shortage of US public pension plans? *Journal of Pension Economics and Finance, 19*(4), 491–510. https://doi.org/10.1017/S147474721900012X

Reddy, W. (2016). Alternative assets–a new challenge to property? An analysis of superannuation funds. *Pacific Rim Property Research Journal, 22*(2).

Robalino, D. (2005). *Pensions in the Middle East and North Africa: Time for Change.* World Bank Publications - Books, The World Bank Group, number 7427, December.

Sánchez Serrano, A., & Peltonen, T. (2020). *Pension schemes in the European Union: challenges and implications from macroeconomic and financial stability perspectives. ESRB Occasional Paper Series.* European Systemic Risk Board,17.

Savoia, J. R. F., Securato, J. R., Bergmann, D. R., & da Silva, F. L. (2019). Comparing results of the implied cost of capital and capital asset pricing models for infrastructure firms in Brazil. *Utilities Policy, 56,* 149–158. https://doi.org/10.1016/j.jup.2018.12.004

Schneeweis, T., Crowder, G. B., & Kazemi, H. (2010). *The New Science of Asset Allocation: Risk Management in a Multi-Asset World.* John Wiley & Sons,.

Siemiatycki, M. (2015). Canadian pension fund investors in transport infrastructure: A case study. *Case Studies on Transport Policy, 3*(2), 166–175. https://doi.org/10.1016/j.cstp.2015.01.002

Stevens, B., & Schieb, P. A. (2007). Infrastructure to 2030: Main findings and policy recommendations. *Infrastructure to 2030,* 19, i–510.

UN-ESCWA (2019). *Social Protection Reform in Arab Countries.* Beirut: United Nations Economic and Social Commission for Western Asia (UN-ESCWA). ⟨https://www.unescwa.org/sites/www.unescwa.org/files/ publications/files/social-protection-reforms-arab-countries-2019-english_0.pdf⟩.

Vassallo, J. M., Rangel, T., Baeza, M. A., & Bueno, P. C. (2018). The Europe 2020 project bond initiative: An alternative to finance infrastructure in Europe. *Technological and Economic Development of Economy, 24*(1), 229–252. https://doi.org/10.3846/20294913.2016.1209251

World Bank (2017). *The Evolution of the Canadian Pension Model: Practical Lessons for Building World-Class Pension Organizations.* Washington, DC: World Bank,. ⟨https://openknowledge.worldbank.org/handle/10986/ 28828⟩ License: CC BY 3.0 IGO.

Yerkes, S., McCoy, J., Stronski, P., de Waal, T., Brechenmacher, S., Pierini, M., Sayigh, Y., & Meddeb, H. (2022). Global Lessons for Tunisia's Stalled Transition. *Carnegie Endowment for International Peace (CEIP).* ⟨https:// carnegieendowment.org/2022/07/21/global-lessons-for-tunisia-s-stalled-transition-pub-87541#conclusion⟩.