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Master of Science Degree Thesis:

Pension Funds' Investment and Economic Growth

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Author
Tsopeis V. Evangelos

Academic Supervisor
Prof. Michael Anthropelos

Committee
Prof. Panagiotis Asimakopoulos & Prof. Christodoulos Stefanadis

Abstract

During the recent decades pension fund assets are facing a significant growth due to the general shift of policy makers from the traditional define benefit scheme to define contribution scheme. Countries are facing difficulties managing their pension liabilities mainly from population ageing (United Nations, 2017) and from decreasing fertility rates that occurred worldwide, on a total of 50% decline for the last 70 years (World Economic Forum, 2022). To face these demographic changes, countries are heading towards structural reforms, implementing more sustainable funded or semi-funded pension systems than the PAYG system as they used to. The main purpose of this research is to investigate whether there is a link between the increasing trend in pension funds investment due to their increased assets under management and real economic growth in the OECD countries. To determine if there is statistical significance between the two parameters, we retrieved historical observations of all 38 OECD member countries over the period of 2006-2021. Several econometrical tools are implemented in order to exploit whether a positive relation exists between these two variables overtime.

Key Words:

pension reform, pension funds investment, economic growth

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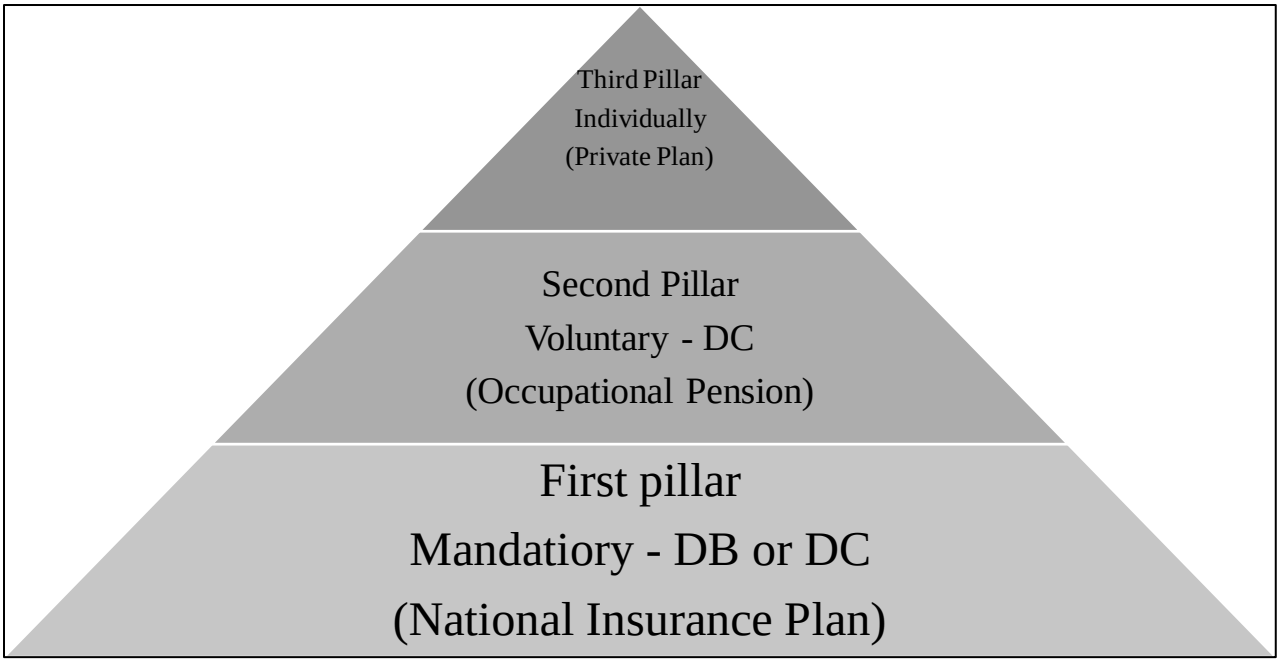
1. Introduction

The sole purpose of this thesis is to examine whether there is a statistically significant link between increasing pension assets and economic growth. Pension funds investment and their effect on economic growth has been a very controversial subject and nowadays more vital than ever. The importance of this subject mainly originates from the structural need of governments to reform their pension fund systems to more efficient and sustainable versions.

Pension systems in general are separated in numerous categories and structures (OECD, 2005). Policy makers have separated pension systems into three pillars: Public pensions, occupational pensions and personal pensions. The key differences that define these systems mainly comes from the obligation of participating (mandatory or optional) and whether this system is funded or not. Since we want to determine whether there is an effect of the pension assets growth and the domestic output, we mainly want to focus on the systems that operate by collecting contributions and hold these assets for the workers until they retire. At this point, it would be useful to present the most acknowledged systems that have seen approval in the world economies.

Figure.1 Three pillar pension system pyramid



First and most commonly observed, is the defined benefit system (DBs) also called as pay-as-you-go (PAYG), in which the amount of income of the retirees is based on their earnings and the length of their employment years. The funding of this system is made by contributions that collected from those that are in employment and transferred on the those on retirement. For most of the countries worldwide, this particular system represents the core of their first or second pillar and has a mandatory profile. One of the basic characteristics of this plan is that retirees enjoy a predictable

income since the pension policy is relatively stable in most of the countries, providing better financial security for the elder. One of the main challenges of this system is that the distributions received to the retirees, are heavily relied on the fiscal policy of the time they enjoy.

Alternative to the defined benefit system and most noticed in occupational pension schemes, is the defined contribution system (DCs) or a funded pension system. In this case the pension benefits are based on the total contributions paid from employers and workers plus the total return of the accumulated invested capital through the employment status years of the beneficiaries. During employment years, contributions are held as a portion of the workers' salary plus their employers' contributions and held on investable individual accounts. When the beneficiaries retire, these pension benefits are distributed back to them from their individual account and not from the contributions of the current workers as on the (PAYG) system. Furthermore, the most notable difference between the two systems is that participants in the second case, carry market risk since their contributions are invested in the financial markets according to their risk appetite. As a result, their pension income cannot be predictable on comparison with the first case. On the other hand, beneficiaries take advantage of the long-term positive effect that potentially markets offer. These particular schemes most of the times remain optional for workers to participate or not.

Combinations of defined benefit (DBs) and defined contribution systems (DCs) or semi-funded systems, are the most common system that countries use globally. This system provides the advantages of the safety net of a PAYG system but at the same time the advantages of a capitalized system as mentioned before. We mainly observe that in most of the countries the pension system is based on a multi-pillar model where on the first pillar a DBs exists on a state basis and on a second a DCs as occupational pension schemes which produce additional benefits and diversification for the retirees.

Finally, according to (Palmer & Holzmann, 2006), we observe another alternative which is, the non-financial defined contribution (NDC) schemes. NDC is defined as contribution PAYG schemes in which retirement benefits are associated with the contributions made over the individual's working life, which characterizes the defined contribution part and these benefits are financed by contributions from the current workers, representing the PAYG part of the scheme. Contributions accumulated by individuals during their working years are recorded into individual accounts only for accounting purposes instead of being invested in the financial markets. The NDC pension structure is implemented on a first or second pillar mandatory basis in Italy, Latvia, Norway, Poland, Sweden and in Greece which are at a phase of transformation (OECD, 2021).

Furthermore, it is widely observed the implementation of a third pillar model, in which employees contribute to their personal fully funded accounts with their contributions on a volunteer basis most commonly in case they want to further enhance their future pension income. We notice an essential growth on these plans especially in the OECD countries area for the recent years, thus we assume that a portion of pension assets growth also originates from this trend (OECD, 2021).

During recent decades economies are facing multiple challenges regarding their pension obligations. Therefore, they address the issue by adopting transition from PAYG systems to semi or fully funded, in order to transform their liability into a more sustainable solution for the longer term. It is a measure

that received approval widely since the late 1980's worldwide and has now become one of the most significant priorities for most of the countries since the demographic problem is escalading in accelerating paces and so the needs for public spendings.

According to the (World Health Organization, 2022), by 2030, 1 in 6 people in the world will be aged 60 years or over. At this time the share of the population aged 60 years and over will increase from 1 billion in 2020 to 1.4 billion. By 2050, the world's population of people aged 60 years and older will double (2.1 billion). The number of persons aged 80 years or older is expected to triple between 2020 and 2050 to reach 426 million. Furthermore, lower birth rates can also present challenges for pension systems, particularly in countries that rely heavily on a pay-as-you-go systems where current workers contribute to support the pensions of retirees. Under these circumstances, in order to solve this issue of increasing number of beneficiaries and the decreasing number of contributors, policy makers internationally are scheduling methods to bypass this upcoming funding gap, by suggesting fundamental reforms from the status quo of the pension systems.

Academics present several solutions to address this issue but with questionable economic and social impacts. For the purposes of this study, we mainly want to focus on the solution in which governments will decide to fully transform their pension systems into capitalized systems in which savings of today are invested and redistributed to the beneficiaries when they retire and as a result the fiscal costs of this policy actually minimizes to zero. What we really want to investigate in this paper is whether this reform also provides additional support to the gross domestic product via other channels.

As we will explore further on, there are multiple channels that this transition mainly provides support on the domestic economy. One of the main channels that a positive relationship between gross domestic product and pension investments exists, is that one of the key advantages of fully funded systems is that by origination these systems enforce the local economy saving rates, since the young generations are forced to save in order to guarantee a pension benefit in the future. These savings are placed in the capital markets (mostly in the local, since portfolio managers maintain a home bias) and thus stimulate investment rates, and thereby the economic growth.

The thesis is structured as follows.

In chapter 2, we are going to present some of the most influential studies regarding the topic we are addressing. Furthermore, we are going to review the arguments these authors propose in order to reach conclusions for the subject they exam. Overall, we introduce arguments and conclusions that do not only support the conclusions that we finally reached, but also, we will present studies that review this particular matter from all range of scopes.

In chapter 3, we are going to introduce some of the key figures regarding pension assets and how this market differs in size for a number of countries. In addition, we are going to observe how these

values fluctuate through the specified timeframe of this study. Also, we are going to present the size of pension assets the countries maintain and how these assets shape relative to each country GDP. Finally, we are going to present the leaders and the losers for each of these ratios and reach conclusion regarding their systems and how their pension policies influence these ratios.

In the next chapter we are going to proceed with the specification of the model we are going to use in order to reach statistical findings and introduce the variables that we selected to include in our model. For each of these variables we are going to fully provide a definition and why and how we believe these parameters correlate with our dependent value, which in our case is GDP.

In chapter 5, we are going to further analyse the trends that seems to form on average between our selected dependent variable and all independent variables. We will mainly focus on the reason these linear trends tend to shape overtime between these variables.

In chapter 6, we are going to introduce several econometrical tools that we used in order to export conclusions. Furthermore, in this chapter we will proceed with several unit root tests in order to determine whether our variables maintain stationarity or not and after making all the necessary adjustments, we implemented several econometrical tools with multiple regressions, in order to investigate whether a significant relationship exists between pension assets and GDP. Last but not least, we will examine whether these values that we are mainly interested shape a cointegration relationship and proceed with the final statistical evaluations.

Finally, in the last chapter after accumulating all the necessary findings from all previous chapters, we will proceed to the final conclusions related to the subject of this study and provide relevant proposals for potential policy shifts.

2. Literature Review

Empirical literature that covers the subject we are about to introduce, is rich with multiple conclusions and for a variety of countries and timeframes. To begin with our approach, it would be necessary to present the general framework and the sizes of the pension markets we are going to focus at the time writing this paper. According to (OECD, 2022), pension assets have increased faster than GDP over the last two decades, highlighting the growing importance of retirement savings worldwide. The ratio between total OECD pension assets and total OECD GDP rose from 59% at end-2001 to 64% at end-2011 and 105% at end-2021. Pension assets in the OECD area therefore exceeded the sum of the GDPs of all OECD countries at the end of 2021. Nine OECD countries had pension assets exceeding their GDP at end-2021, compared to six at end-2011 and two at end-2001. While the United States was topping the ranking at end-2001, Denmark is now the OECD country with the largest amount of pension assets relative to GDP (233% at end-2021), followed by Iceland (219%) and the Netherlands (213%). Finally, one of the main findings of this report indicates that assets in defined contribution and personal plans are increasing faster than in defined benefit plans in most of the reporting countries.

Regarding the relationship of GDP an pension assets a milestone study that covered this topic is (Davis and Hu, 2004), which advocated a statistically significance on the impact from pension assets growth to the domestic output on a long term horizon. Furthermore, the study found important evidence that emerging markets economies had benefited more from pension funds growth than the developed OECD country members. In addition (Hu, 2005) showed that a strong positive link between pensions GDP growth rate. The author believes that this effect might be due to less labour market distortion following pension reform and pension funds' increasing participation in corporate governance, thus improving corporate performance on the firm level and economic productivity on the macro level. On an additional study (Davis & Hu, 2008), the same authors found evidence that pension assets/GDP positively and significantly affects output per head, consistently for both the OECD countries and EMEs, while effects are consistently larger for EMEs than for OECD countries.

An additional study that reviewed the impact of the pension reform in Chile examined by (Holzmann, 1997), reached to conclusion that a shift from an unfunded to a funded scheme may create positive externalities (on labour and financial markets), thereby accelerating the growth rate. Furthermore, these potential (endogenous or transitory) growth effects ease or perhaps even eliminate the double burden for the transition generation (if measured according to the old growth path). Similarly, (Farayibi, 2016) reviewed that the increases in pension fund contributions from both private and public sectors in Nigeria, had positively affected economic growth.

Another relevant study of (Paul Mylonas and Christine de la Maisonneuve, 1999) examined the idiosyncratic characteristics of the Greek pension system and reviewed the sustainability of the model. The authors observed that a fundamental drawback of a pure pay-as-you-go system is the potential for large inter-generational transfers when the population growth declines or turns negative. In many other countries with similar circumstances, the pay-as-you-go systems have accumulated a significant (though usually insufficient) amount of savings in anticipation of the population's ageing

– in essence acting as a partially funded system. Finally, the researchers proposed the switching at a pure funded system, whereby contributions are saved and are the only source of making future pension payments (no cost is borne by the budget) entails finding the resources to finance the present value of the net liabilities of all existing and future pensions.

In addition and according to (Borsch, Koke, & Winter, 2005), one of the main reasons which this certain transition is beneficial, is because shifting from an unfunded to a funded system may lead to a higher economic growth as aggregate saving rates increase. As a result, a portion of the increase of savings rates will be invested in the capital markets and provide development in market capitalization. Especially in the smaller countries the effect would be multiplied, since they suffer from capital shortages and illiquidity. Hence, this effect would result lower cost of capital for the domestic companies and greater market efficiency.

On a similar scope, (Walker & Lefort , 2002) and (Ashok , Spataro, & Nanditha, 2014) reached some other conclusions regarding the link between pension investments and economic growth. First, they exported significant evidence that the accumulation of institutional capital from the increasing pension assets, lead corporate managements to implement reform, which have both the effects on transparency and integrity. Secondly and similar to (Borsch, Koke, & Winter, 2005), they found significant improvements in liquidity and depth of the markets, as well as lower volatility on the tradable securities, resulting a lower cost of capital for the domestic corporations. Last, they showed a strong relationship between financial market integration and the pension reform. In conclusion, all the mentioned arguments could potentially lead to positive effects for economic scaling and growth.

An additional positive catalyst of the previously mentioned financial market development would be that the foreign direct investments which are basically attracted by mature and well-established capital markets, would attract additional positive inflows of investments and further enhance the balance of payments, endorsing even further the GDP growth (Alfaro , Chanda, Kalemli-Ozcan, & Sayek, 2004). Evidence shows that countries with better developed markets tend to attract significantly more FDI than those that do not.

Furthermore, (Gordon & Tessa, 2004) have figured that institutional investors as pension funds, are influencing managements to improve corporate governance, increase transparency, accountability and to raise social and environmental standards of corporate behaviours. Therefore, if a significant proportion of firms, whether directly or indirectly affected by pension fund activism, will tend to improve the general corporate performance.

In a contrarian study (Zandberg & Spierdijk, 2013), failed to find any effect on the short run of increasing funding on pensions with growth, but only a modest effect on the long run. Furthermore, they concluded that additional savings do not translate into greater economic growth, or capital market development and reduced labour market distortions have less importance than researchers believe. Finally, they assumed that their findings might reflect a weaker link between funding and saving than is commonly found on the relevant papers, perhaps because pension funds invest a significant amount of their assets abroad.

3. Data Sample and Preliminary Findings

In this section of the paper, we are going to introduce some of the key numerical factors of our dataset. Our datasets were primarily obtained from widely accepted economic institutes such as the World Bank and the OECD libraries, in order to achieve the best possible accuracy and credibility on our findings. For the purposes of our analysis, we chose to select timeseries data for all 38 OECD country members over the period of 2006-2021. We also attempted to gather data for the years before 2006, but with no result as we found incomplete data for many of the countries of our analysis. Under these circumstances, we decided to navigate our research through the period after 2006 where the data collection was trustworthy and accessible for the majority of the countries. Finally, we did not include the year of 2022 since many of the countries had not submitted to their domestic authorities many of their macro indicators that we are interested on measuring. Under these limitations on our data, in this section we will present the most important statistical findings, primarily for our leading factors of pension fund assets and pension fund assets relative to gross domestic product through the selected countries and periods.

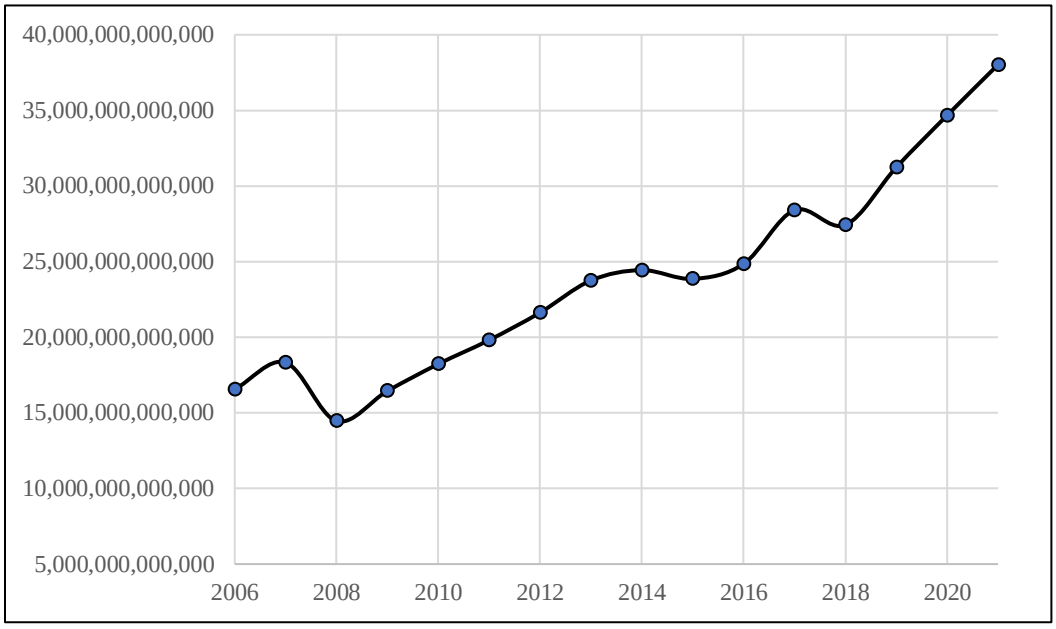
Beginning with our analysis, we believe it would be extremely useful to present the evolution and the trend of the pension assets of all country members combined for each year, so that we get a first flavour of the numbers and the fluctuations through time. Table 3.1 below presents the total pension assets of our sample and the year over year percentage changes.

Table 3.1 Total pension assets in USD ($) of all OECD countries per year plus their percentage change on a year over year basis.

Year	Total Pension Assets ($)	*YoY (%)*
2006	16,560,487,643,000	-
2007	18,328,042,262,000	*10.14%*
2008	14,459,274,192,000	*-23.71%*
2009	16,448,129,173,000	*12.89%*
2010	18,229,118,243,000	*10.28%*
2011	19,813,758,573,000	*8.34%*
2012	21,628,834,585,000	*8.77%*
2013	23,755,386,356,000	*9.38%*
2014	24,439,475,167,000	*2.84%*
2015	23,858,935,092,000	*-2.40%*
2016	24,851,952,961,000	*4.08%*
2017	28,406,675,005,000	*13.37%*
2018	27,427,572,968,000	*-3.51%*
2019	31,237,240,921,000	*13.01%*
2020	34,677,989,324,000	*10.45%*
2021	38,023,320,445,000	*9.21%*

Source: (OECD, 2023)

Chart 3.1 Total pension assets in $ of all OECD countries



Based on both Table 3.1 and Chart 3.1, we can easily notice a long-term accumulation in pension assets through the examined years, with a dynamic growth momentum on a year over year basis (double digit growth almost for every year).

The worst year in our data is the year 2008 in which we observe a significant loss of 23,71% on year over year basis. According to the annual report conducted by the OECD for the pension markets developments, called "Pension Markets in Focus" edited by (Yermo & Salou , 2008), it is clear that the main reason of this decrease of assets is due to the financial crisis that hit the world during this period of time. Key drivers of the losses were the price fall that occurred in the financial markets during 2007 & 2008, combined with the fact that the funding levels went down by more than 10% on average, creating a funding gap as high as USD 2 trillion. Furthermore, the rate of companies reaching insolvency increased rapidly leading on further cutting pension benefits. Albeit this great loss occurred, we can see that after 2008 pension assets came back to the long-term increasing trend.

The year on our sample in which record growth is achieved is the year 2017. We observe that the pension assets in total for the OECD countries grew by 13,37%, the biggest growth rate on our sample. According to the annual report conducted by the OECD called "Pension Funds in Figures" in 2018 for the reference year of 2017 (Antolin, Despalins, & Payet, 2018), authors specify the main reasons of this significant growth. First, international capital markets showed spectacular performance in this year. As a result, many of the countries that where heavily allocated in equity investments achieved pretty solid returns, driving the aggregate returns of the total assets positive. Also, a great proportion of the growth for pension assets occurred from the very good performance in real estate assets worldwide, in which once again most of the countries had a significant weight of their pension assets allocated in this specific asset class.

Continuing with our analysis, we believe that it would also be appropriate to calculate the pension assets (PA) to GDP ratios through the defined time period, as it would be useful in order to proceed with comparisons between the countries on a common basis. First, we present table 3.2 in which we present the nominal amount of pension assets for all country members through the interested period.

As we notice on Chart 3.2.1, there is clear dominance in the assets under management for the United States of America in nominal USD terms (red line) compared with all other countries, peaking on 2021 at 22.886 trillion USD, reaching the spectacular percentage of 60,1% of all OECD pension assets combined. These figures indicate a very well-developed pension system, but it would be necessary to further analyse it in on relative basis (PFA/GDP) as mentioned earlier.

Latvia, Greece and Luxembourg maintained the smaller nominal average value on our timeframe, shaping at 370.599.938$, 914.252.875$, 1.419.260.125$ respectively. On a simple moving average for all of the examined countries excluding the USA, the assets under management are shaping 205,08 billion USD, as when we include the USA the same indicator reaches 263,41 billion USD, showing the direct impact that this specific country creates on the average.

Chart 3.2.1 Pension Assets in billions USD

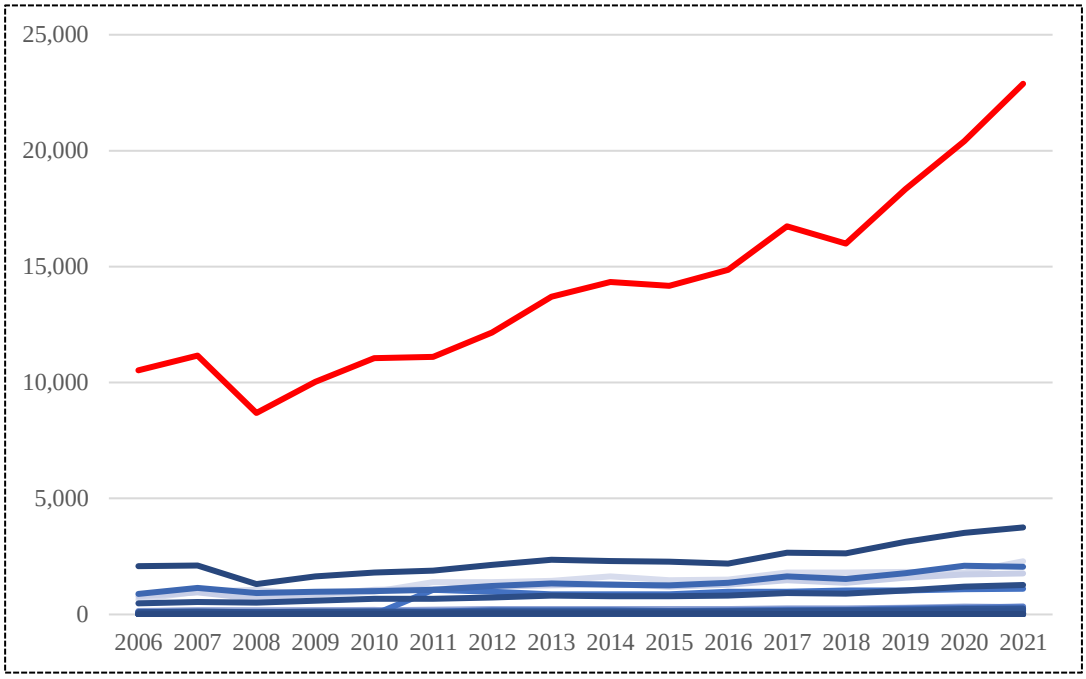
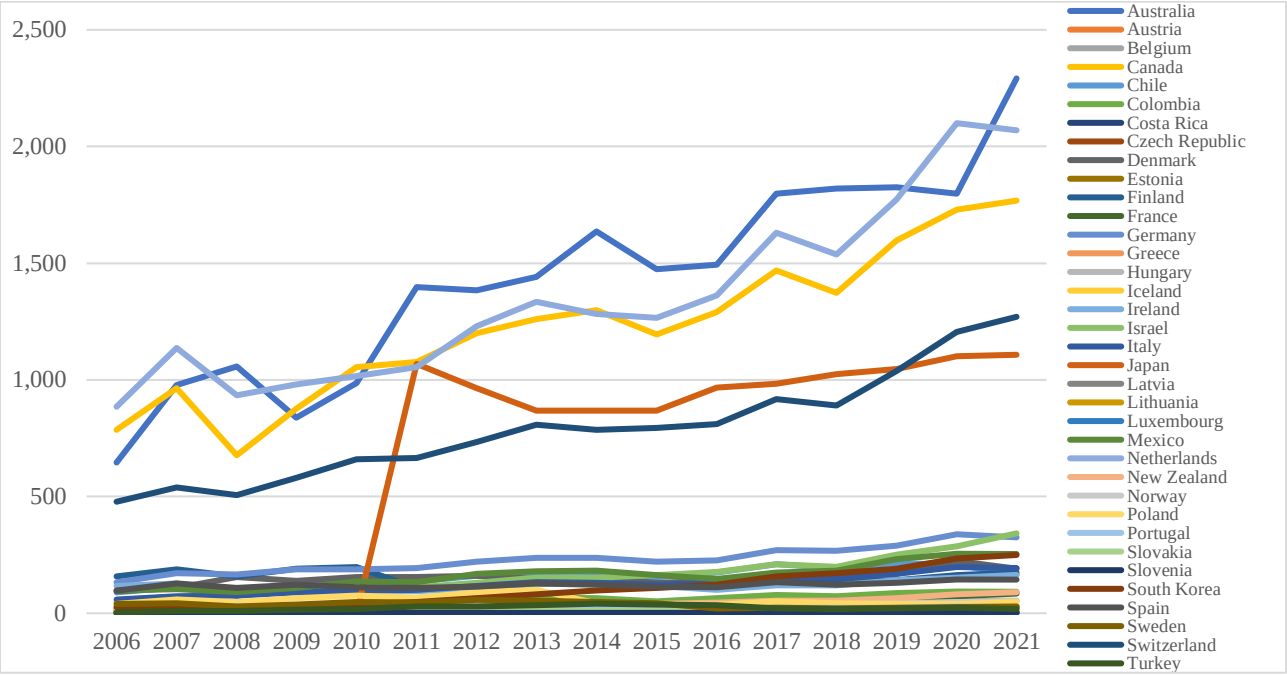


Chart 3.2.2 Pension Assets in billions USD (ex-USA&UK)



When excluding the pension assets of the United States and United Kingdom, which maintain a clear dominance among the country members, we observe that countries such as Australia, Netherlands, Canada, Switzerland and Japan maintain a significant lead. In the graph below, we are going to further exclude the countries above in order to observe how PA of the rest of the countries shape.

Chart 3.2.3 Pension Assets in billions USD (ex-mentioned countries)

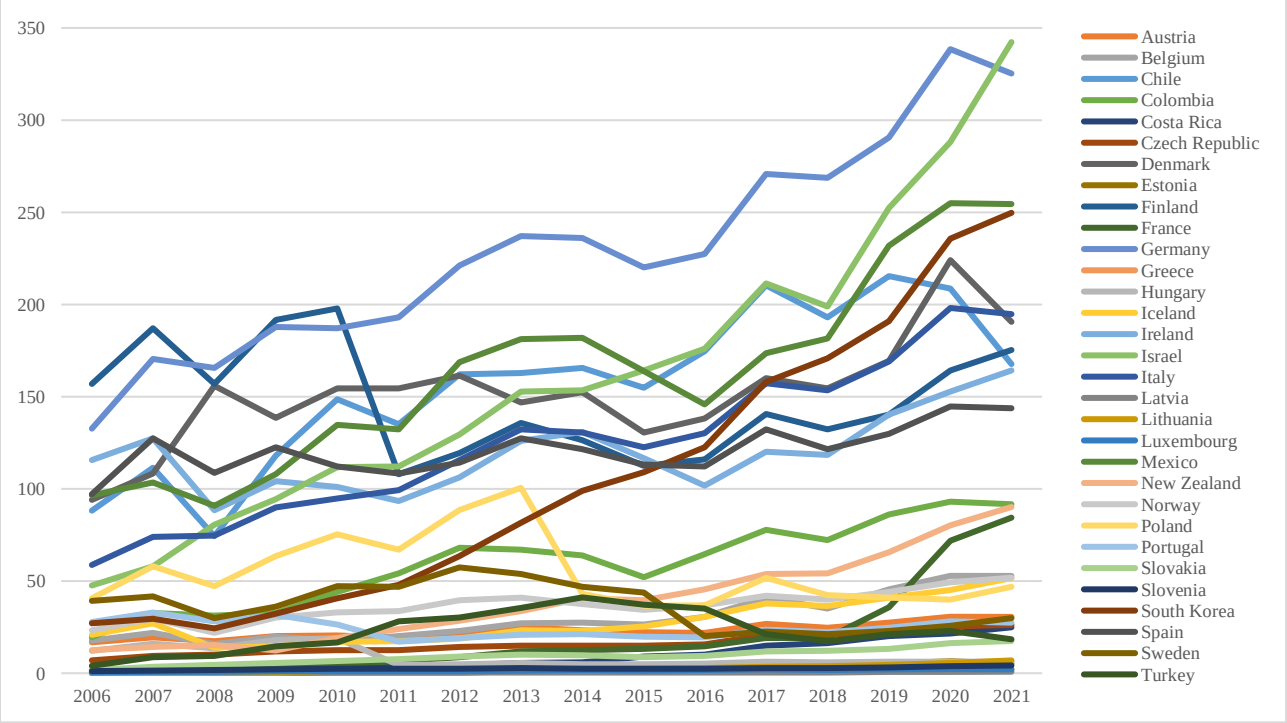


Table 3.2 Pension assets in billions USD

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Australia	646	978	1,058	839	987	1,397	1,383	1,441	1,635	1,475	1,492	1,797	1,819	1,826	1,797	2,292
Austria	17	19	17	20	20	19	22	25	23	22	22	27	25	27	31	31
Belgium	18	22	16	20	18	20	23	27	28	26	31	41	35	45	53	53
Canada	786	963	677	876	1,054	1,076	1,200	1,261	1,298	1,196	1,289	1,470	1,373	1,597	1,729	1,768
Chile	88	111	74	118	148	135	162	163	165	155	174	211	193	215	208	168
Colombia	19	33	31	33	44	54	68	67	64	52	65	78	72	86	93	92
Costa Rica	1	2	2	2	3	4	4	5	6	9	10	15	16	20	22	25
Czech Republic	7	9	10	12	12	12	14	15	15	15	16	21	21	22	25	26
Denmark	94	108	156	138	155	155	161	147	152	130	138	160	154	169	224	190
Estonia	1	1	1	1	1	1	2	2	3	3	3	4	5	5	7	5
Finland	157	187	157	192	198	108	120	136	126	113	116	141	132	140	164	175
France	1	2	3	4	5	6	9	12	13	13	15	19	19	36	72	84
Germany	133	170	166	188	187	193	221	237	236	220	227	271	269	291	338	325
Greece	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	2
Hungary	12	16	14	18	19	4	5	6	5	5	5	6	6	6	6	6
Iceland	21	27	14	15	17	18	19	23	23	25	31	38	36	41	45	52
Ireland	116	127	88	104	101	94	106	126	131	117	102	120	119	140	153	164
Israel	48	58	81	94	112	112	129	153	154	164	176	211	199	252	288	342
Italy	59	74	75	90	95	99	116	132	131	122	130	157	153	169	198	195
Japan	0	0	0	0	0	1,069	965	868	869	869	968	983	1,025	1,045	1,101	1,108
Latvia	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Lithuania	0	0	0	0	2	2	2	2	2	2	3	4	4	5	6	7
Luxembourg	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Mexico	97	104	91	108	135	132	169	181	182	164	146	174	182	232	255	254
Netherlands	885	1,137	933	979	1,016	1,056	1,229	1,335	1,282	1,266	1,361	1,631	1,539	1,774	2,100	2,069
New Zealand	12	14	15	12	19	24	28	34	40	40	45	54	54	66	80	90
Norway	23	30	22	30	33	34	39	41	37	34	37	42	40	44	49	52
Poland	40	58	47	64	75	67	88	101	43	37	37	52	42	41	40	47
Portugal	28	33	28	32	26	17	19	21	21	20	19	24	22	25	28	27
Slovakia	2	3	4	6	7	8	9	10	10	9	10	12	12	13	16	17
Slovenia	1	2	2	2	2	2	2	3	3	2	2	3	3	3	4	4
South Korea	27	30	24	32	41	48	64	82	99	109	123	158	171	191	236	250
Spain	97	127	109	123	112	108	114	127	122	113	112	132	121	130	145	144
Sweden	39	42	30	36	47	47	57	54	47	44	20	23	21	23	26	30
Switzerland	478	538	506	581	661	665	734	808	786	794	811	917	889	1,038	1,206	1,270
Turkey	4	9	9	15	17	28	30	36	41	37	35	21	18	21	23	18
United Kingdom	2,079	2,120	1,310	1,631	1,794	1,886	2,146	2,365	2,301	2,279	2,205	2,653	2,639	3,143	3,508	3,752
United States	10,524	11,173	8,688	10,031	11,064	11,113	12,166	13,708	14,345	14,174	14,873	16,734	15,996	18,349	20,397	22,886

Source: (OECD, 2023)

Table 3.3

Average Pension Assets per Country as a (%) of Total Pension OECD Assets	
United States	59.195%
United Kingdom	9.894%
Australia	5.983%
Netherlands	5.650%
Canada	5.132%
Switzerland	3.319%
Japan	2.844%
Germany	0.961%
Mexico	0.681%
Israel	0.673%
Chile	0.652%
Denmark	0.637%
Finland	0.618%
Italy	0.522%
Spain	0.507%
Ireland	0.499%
South Korea	0.440%
Colombia	0.249%
Poland	0.230%
New Zealand	0.165%
Norway	0.154%
Sweden	0.153%
Belgium	0.124%
Iceland	0.116%
Portugal	0.102%
Austria	0.096%
Turkey	0.095%
France	0.082%
Czech Republic	0.066%
Slovakia	0.038%
Costa Rica	0.038%
Hungary	0.037%
Lithuania	0.014%
Estonia	0.012%
Slovenia	0.011%
Luxembourg	0.006%
Greece	0.004%
Latvia	0.002%

Source: (OECD, 2023)

It is once again clear according to Table 3.3, the worldwide dominance in nominal terms is held by the United States, reaching the impressive percentage of 59.195% as an average percentage of the total pension assets over the examined period of time. The United Kingdom follows with a much smaller percent of 9.894%. Similar to nominal amounts, Latvia, Greece, and Luxembourg are the biggest laggards also in this metric.

As mentioned earlier, it would be necessary to introduce a relative indicator in which we can export more comparable statistical findings regarding pension assets concentration over the countries we examine. A ratio that could sufficiently service this measurement would be total pension assets over gross domestic product, with which we succeed achievable comparisons between the countries of our sample. Similar to table 3.2, we designed table 3.8 in which we observe the percentages of these ratios overtime for every country. Furthermore, we created table 3.4 in which we took the simple moving average of PA/GDP for all countries over the examined period in order to compare their performances on a relative basis.

Table 3.4 Moving Average of PA/GDP

Country	*PA (Average)*	*PA/GDP*
Iceland	0.277468529	167.2%
Netherlands	13.49428346	154.6%
Switzerland	7.926707139	154.1%
Australia	14.28957895	126.3%
United Kingdom	23.631604	87.7%
United States	141.3870023	79.1%
Canada	12.25784321	76.8%
Finland	1.475796861	63.9%
Denmark	1.520797291	55.2%
Israel	1.608583555	53.1%
Ireland	1.192148199	43.9%
Chile	1.556249828	40.1%
New Zealand	0.393515006	21.2%
Japan	6.793529665	13.3%
Norway	0.367649815	11.2%
Costa Rica	0.091602861	9.7%
Colombia	0.59419945	9.6%
Sweden	0.365314286	8.3%
Portugal	0.244187833	8.0%
Mexico	1.627591907	7.7%
Spain	1.210377068	7.4%
Estonia	0.028717906	6.8%
Poland	0.549621837	6.1%
Germany	2.295057731	6.0%
Slovakia	0.091930737	5.8%
Belgium	0.29659037	5.6%
Austria	0.229635009	5.5%
Italy	1.247232197	5.3%
South Korea	1.051625128	5.2%
Czech Republic	0.158370978	4.4%
Hungary	0.087306673	3.8%

Slovenia	0.025493813	3.7%
Lithuania	0.032618276	2.6%
Luxembourg	0.014192601	2.4%
Turkey	0.226522378	1.3%
Latvia	0.003705999	0.7%
France	0.195729769	0.6%
Greece	0.009142529	0.3%

Source: (OECD, 2023)

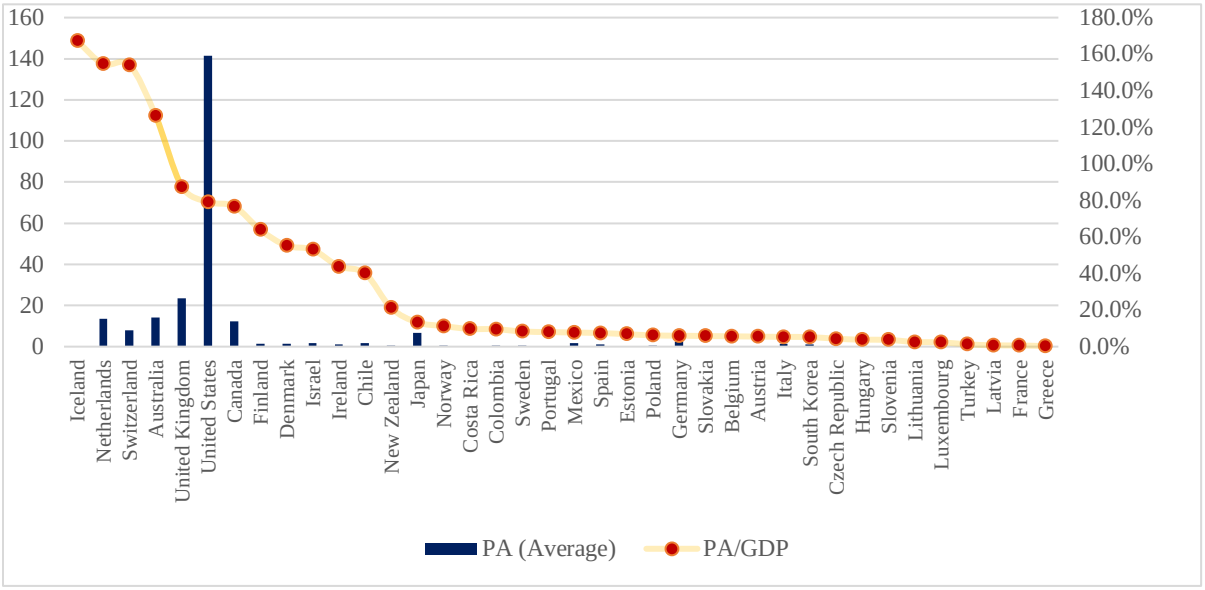
Analysing Table 3.4, we can easily export some preliminary findings. The leader is Iceland with an average ratio of 167.2%, indicating a very rich mix of pension assets over GDP on the examined period. Although, despite the impressive performance, Iceland observation is lacked significance due to the small population of the country - 372,520 citizens in 2021, according to World Bank -. The leadership after Iceland is held by Netherlands (154.6%), Switzerland (154.1%) and Australia (126.3%), indicating very well-developed and capitalised pension systems. Comparing these figures with the sample mean and median of 33.28% and 7.84% respectively, as shown in table 3.5 we can easily claim that these countries have made a significant effort on successfully transforming their pension systems and maintaining it vital and sustainable.

According to (European Commission, 2019), the Dutch pension funds market on net cash flow terms is ranked first among the other European countries due the strong occupational pension schemes the country has implemented. Similar to the Dutch and according to (International Monetary Fund. European Dept, 2021), Swiss pension system is one of the most-well capitalized system among OECD countries and even though it maintains this position, local regulators are emphasizing on the ongoing demographic challenges, proposing reforms on further reducing the funding gap and enforcing the long term sustainability of the system.

Table 3.5

Descriptive Statistics of Table 3.4	
Mean	33.28%
Standard Error	7.74%
Median	7.84%
Standard Deviation	48%
Minimum	0.30%
Maximum	167.23%
Count	38

Chart 3.3 Average Pension Assets and PA/GDP by country



Source: (OECD, 2023)

Further analysing Table 3.4, we observe that countries such as Greece, France and Latvia maintain on average percentages less than 1% of their total pensions assets over their GDP, indicating a pretty poor capitalized system overtime, albeit as shown below in Table 3.6, the countries have taken radical measures by implementing policies for their pension system transformation. As we may see countries that lag over time, also maintain the fastest average growth, but still with poor ratios relative to their peers. Greece, France, Latvia, and Turkey as of 2021 maintained their PA/GDP at 0.6%, 2.4%, 1.3%, 0.7% respectively.

Table 3.6 – Double Digit PA Average Growth % (2006-2021)

Country	***Average***
Greece	26.8%
France	26.1%
Costa Rica	12.8%
Slovakia	11.3%
South Korea	10.6%
Latvia	10.2%

Source: (OECD, 2023)

On our attempt to reach similarities in factors that drive the laggings between these countries we recognised that the common factor in terms of pension systems is that all of these countries maintain non-diversified public, defined-benefit (DB) or NDC plans as their mandatory public pension scheme (OECD, 2007). What we also find worth citing is that according to (Peksevim & Akgiray , 2019) Greece and Turkey have one of the highest levels of self-employment rates worldwide (over 30% of the workforce). Informal sector workers have limited coverage by their private pension plans and those enrolled into pension schemes do not have regular payments. As a result, the non-stability of contributions made by the self-employed workforce, further disrupts the implementation of a sustainable alternative pension scheme. In the same report, we noticed that all of the lagging countries that we examine, present lack of legislation regarding financial-tax incentives for workers that wish to participate in an alternative pension scheme, as other OECD countries have implied. Finally, over the years we observe that all of these countries have implemented pension reforms to address sustainability issues, demographic changes, and financial constraints, in line with the international widely accepted practices, but still there is a long way to go in order for their figures to reach the global averages.

Greece for example as of 2021, have passed a new law (Law 4826/2021), legislating the transformation of the NDC pillar into a mandatory fully-funded defined-contribution (DC) scheme from January 2022, in which contribution of workers will be recorded in individual accounts and invested according to the risk-profile of the contributor, in the financial markets. In this particular legislation tax incentives are also included, as we noticed on other OECD countries.

As the ageing issue elevates in Europe, we believe that the majority of the countries will follow this kind of legislation. Presently, Italy and Germany maintain the highest share of elderly people in Europe, but studies show that by the middle of this century when the aging process reaches its climax, Greece, Spain and Portugal will be ranked first among the other European country members.

European Union have addressed this issue and recently introduced the Pan-European Personal Pension Product (PEPP. The pan-European personal pension product (PEPP) is a voluntary personal pension scheme that will offer consumers a new pan-European option to save for retirement. This new type of product is designed to give savers more choice and provide them with more competitive products, while enjoying strong consumer protection. It could be offered by a broad range of financial providers such as insurance companies, asset managers, banks, certain investment firms and certain occupational pension funds. PEPP main objectives. PEPP aims to help addressing demographic challenges due to the aging of the population and close the pensions' gap in the EU. Currently, less than a third of Europeans between 25 and 59 years old have enrolled themselves in a pension product. PEPP will offer to all EU citizens an additional opportunity to save for their retirement. Moreover, a more developed market for personal pensions in the EU will channel more savings into long-term investments and increase the depth, liquidity and efficiency of capital markets (European Parliament, 2019).

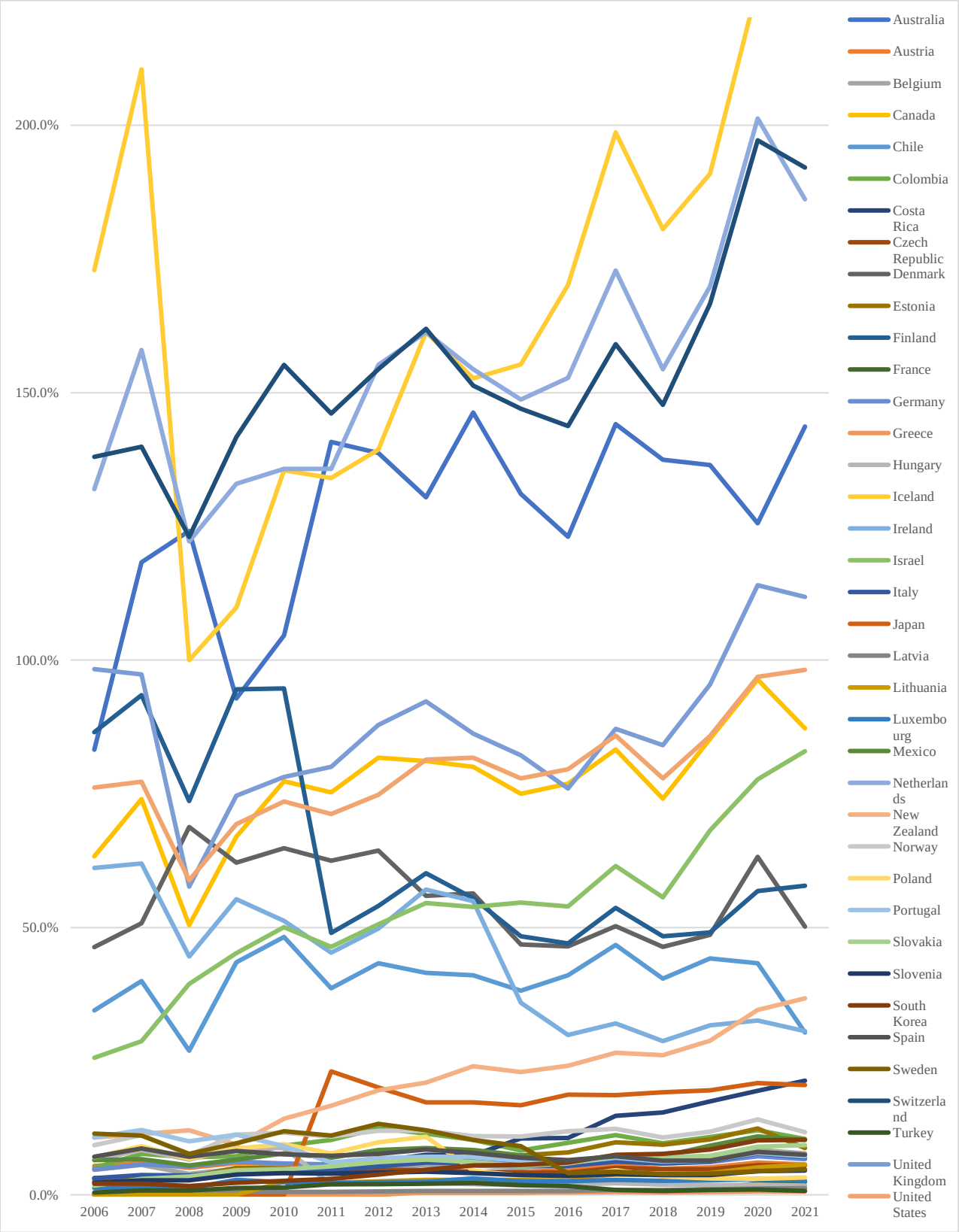
Table 3.7 First Pillar - Pension Schemes

Country	***Pension Scheme***
Australia	DC
Austria	DB
Belgium	DB
Canada	DB
Chile	DB+DC
Colombia	DB+DC
Costa Rica	DB+DC
Czech Republic	DB
Denmark	DC
Estonia	DB/Points + DC
Finland	DB
France	DB + Points
Germany	Points
Greece	DB+NDC
Hungary	DB
Iceland	DC
Ireland	-
Israel	DC
Italy	DB+NDC
Japan	DB
Latvia	DB/DC+NDC
Lithuania	Points
Luxembourg	DB
Mexico	DC
Netherlands	DB
New Zealand	-
Norway	NDC+DC
Poland	NDC
Portugal	NDC
Slovakia	Points
Slovenia	DB
South Korea	DB
Spain	DB
Sweden	NDC+DC
Switzerland	DB
Turkey	DB
United Kingdom	DC
United States	DB

Source: (OECD, 2021)

We present table 3.7 above, from the latest publication of "Pensions at a Glance" (OECD, 2021), so that we can study which of the countries of our research have already implemented funded pension schemes and which have not. As we may notice, the vast majority of the countries have DB and NDC as their core pension schemes which are not fully funded. Hence, under the challenges that we mentioned, we believe that a lot of upcoming transformations in the pension policies will be implied.

Chart 3.4 Pension assets / GDP (%)



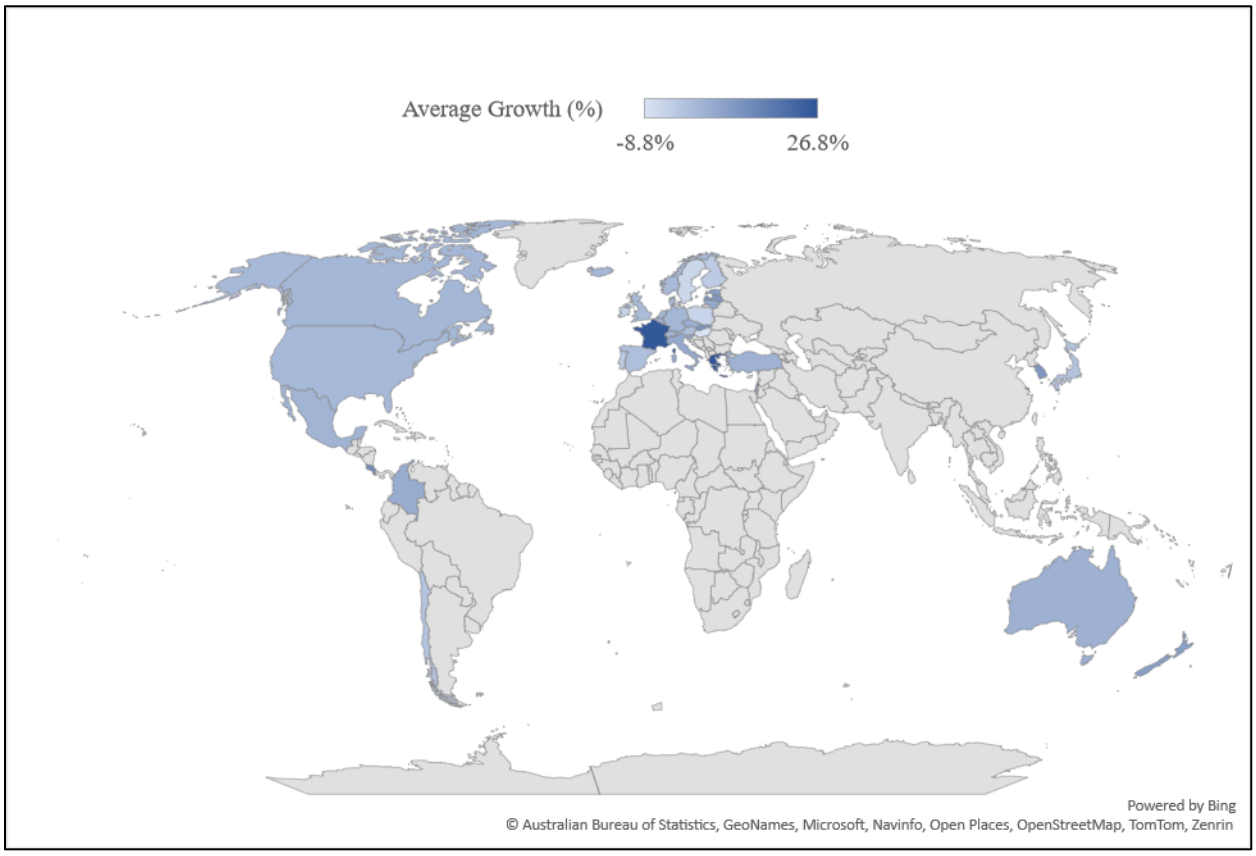
Source: (OECD, 2023)

Table 3.8 Pension assets / GDP (%)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Australia	83.2%	118.3%	124.1%	92.8%	104.6%	140.8%	138.7%	130.4%	146.3%	131.1%	123.0%	144.1%	137.4%	136.5%	125.6%	143.7%
Austria	5.4%	5.9%	5.1%	5.9%	5.8%	5.1%	5.5%	6.2%	5.6%	5.2%	4.8%	5.6%	4.9%	5.1%	6.0%	5.7%
Belgium	4.7%	5.6%	3.9%	4.9%	4.1%	4.5%	4.8%	5.6%	5.5%	5.1%	5.6%	7.1%	5.9%	7.1%	8.4%	7.7%
Canada	63.3%	74.0%	50.4%	67.0%	77.3%	75.2%	81.7%	81.1%	80.0%	75.0%	76.8%	83.2%	74.1%	85.2%	96.4%	87.2%
Chile	34.5%	40.0%	26.9%	43.5%	48.2%	38.7%	43.3%	41.5%	41.1%	38.2%	41.1%	46.7%	40.4%	44.2%	43.3%	30.3%
Colombia	5.0%	7.7%	7.0%	7.2%	9.2%	10.3%	12.4%	11.4%	10.3%	8.3%	9.7%	11.2%	9.7%	10.8%	12.1%	10.4%
Costa Rica	3.1%	3.2%	3.5%	4.2%	4.7%	5.4%	6.3%	7.4%	7.4%	10.6%	10.6%	14.8%	15.4%	17.5%	19.5%	21.3%
Czech Republic	2.9%	3.4%	3.4%	4.1%	4.2%	4.1%	4.7%	4.6%	4.3%	4.2%	4.1%	5.1%	4.8%	4.8%	5.5%	5.5%
Denmark	46.3%	50.8%	68.8%	62.1%	64.8%	62.5%	64.4%	55.9%	56.4%	46.8%	46.5%	50.2%	46.4%	48.6%	63.2%	50.1%
Estonia	2.4%	3.5%	3.4%	5.0%	5.0%	4.5%	5.7%	6.7%	7.0%	7.4%	7.9%	9.8%	9.4%	10.3%	12.4%	8.8%
Finland	86.5%	93.4%	73.7%	94.6%	94.7%	49.0%	54.0%	60.1%	55.4%	48.3%	47.0%	53.7%	48.3%	49.1%	56.8%	57.8%
France	0.0%	0.1%	0.1%	0.2%	0.2%	0.3%	0.4%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	1.0%	2.2%	2.4%
Germany	4.7%	5.7%	5.3%	6.2%	5.9%	5.6%	6.3%	6.5%	6.2%	5.7%	5.5%	6.2%	5.9%	6.1%	7.2%	6.6%
Greece	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.5%	0.4%	0.4%	0.5%	0.5%	0.5%	0.7%	0.6%
Hungary	6.5%	8.3%	6.6%	8.7%	8.7%	1.9%	2.2%	2.3%	2.0%	1.8%	1.9%	2.2%	1.9%	1.8%	1.9%	1.7%
Iceland	172.9%	210.5%	100.0%	109.8%	135.4%	134.1%	139.4%	161.3%	152.6%	155.3%	170.2%	198.7%	180.6%	191.0%	226.1%	237.8%
Ireland	61.1%	62.0%	44.6%	55.3%	51.2%	45.3%	49.8%	57.0%	54.9%	35.9%	29.9%	32.1%	28.7%	31.7%	32.6%	30.6%
Israel	25.6%	28.7%	39.4%	45.2%	50.1%	46.4%	50.6%	54.5%	53.8%	54.6%	53.9%	61.5%	55.7%	68.1%	77.7%	83.0%
Italy	3.1%	3.7%	3.6%	4.4%	4.5%	4.6%	5.3%	6.0%	5.9%	5.5%	5.4%	6.3%	5.9%	6.2%	7.7%	7.1%
Japan	0.0%	0.0%	0.0%	0.0%	0.0%	23.1%	20.1%	17.3%	17.3%	16.7%	18.8%	18.7%	19.2%	19.5%	20.9%	20.6%
Latvia	0.3%	0.3%	0.3%	0.5%	0.6%	0.5%	0.6%	0.7%	0.7%	0.7%	0.8%	0.9%	0.9%	1.0%	1.2%	1.3%
Lithuania	0.0%	0.0%	0.0%	0.0%	2.4%	2.3%	2.6%	2.8%	2.8%	2.8%	3.1%	3.8%	3.7%	4.0%	5.1%	5.7%
Luxembourg	1.3%	1.3%	1.2%	2.8%	2.3%	2.2%	2.3%	2.4%	3.1%	2.6%	2.5%	2.8%	2.6%	2.7%	3.0%	2.6%
Mexico	6.5%	6.6%	5.5%	6.6%	7.7%	6.9%	8.4%	8.8%	8.4%	7.4%	6.1%	7.1%	7.2%	9.2%	10.9%	10.3%
Netherlands	132.0%	158.0%	122.2%	133.0%	135.7%	135.7%	155.2%	161.3%	154.4%	148.7%	152.8%	172.8%	154.4%	169.8%	201.3%	186.2%
New Zealand	10.7%	11.4%	12.1%	9.4%	14.2%	16.7%	19.5%	21.0%	24.0%	23.0%	24.1%	26.6%	26.1%	28.8%	34.6%	36.7%
Norway	9.3%	11.2%	7.4%	11.3%	11.6%	10.9%	12.0%	12.0%	11.0%	10.9%	11.9%	12.4%	10.7%	11.8%	14.1%	11.7%
Poland	7.0%	9.1%	6.8%	8.7%	9.5%	7.8%	9.9%	10.9%	4.5%	3.6%	3.5%	4.6%	3.5%	3.1%	3.0%	3.3%
Portugal	10.7%	12.1%	10.0%	11.3%	9.1%	6.1%	6.9%	7.2%	7.1%	6.4%	6.0%	7.0%	6.2%	6.4%	7.9%	7.2%
Slovakia	1.7%	3.0%	3.5%	4.6%	4.8%	5.3%	6.2%	6.5%	6.1%	5.4%	5.9%	7.3%	7.0%	7.3%	9.0%	9.3%
Slovenia	2.3%	2.7%	2.7%	3.8%	4.1%	4.0%	4.1%	4.3%	4.0%	3.7%	3.5%	3.9%	3.7%	3.7%	4.4%	4.5%
South Korea	2.1%	2.1%	1.7%	2.2%	2.6%	2.9%	3.8%	4.7%	5.5%	5.6%	6.0%	7.5%	7.7%	8.5%	10.2%	10.3%
Spain	7.1%	8.7%	7.1%	8.2%	7.6%	7.3%	7.7%	8.4%	7.8%	7.0%	6.5%	7.2%	6.4%	6.4%	8.0%	7.5%
Sweden	11.4%	11.1%	7.7%	9.6%	11.9%	11.1%	13.3%	12.1%	10.3%	9.1%	4.0%	4.3%	3.9%	3.9%	4.4%	4.8%
Switzerland	138.0%	139.9%	123.0%	141.7%	155.2%	146.1%	154.4%	162.0%	151.3%	147.0%	143.8%	159.1%	147.7%	166.6%	197.2%	192.1%
Turkey	0.4%	0.8%	0.8%	1.3%	1.3%	1.9%	1.9%	2.1%	2.2%	1.8%	1.7%	0.9%	0.8%	0.9%	1.0%	0.7%
United Kingdom	98.3%	97.3%	57.6%	74.6%	78.1%	80.0%	87.9%	92.3%	86.3%	82.2%	75.9%	87.1%	84.1%	95.4%	114.0%	111.8%
United States	76.2%	77.2%	58.8%	69.3%	73.5%	71.2%	74.8%	81.4%	81.7%	77.9%	79.6%	85.9%	77.9%	85.8%	96.8%	98.2%

Below we observe a heatmap containing the average growth rate of pension assets to gdp per country member during the period we conduct the examination.

Heatmap 3.1 PA/GDP Average Growth % (2006-2021)



Source: (OECD, 2023)

As we also noticed earlier, countries with excessive lags versus their peers maintain the largest average growth rates on this particular ratio for the examined period. This fact implies that these countries addressed this issue by legislating transformations in their pension systems or by creating incentives for their citizens into saving through private voluntary pension plans.

Overall as you might see below in table 3.9, we gathered the average pensions assets per capita for each of the countries we study. With this particular ratio we further achieve comparisons between the countries on a relative basis. We observe that no surprises are shaping with the rankings of these countries for this particular ratio. The same countries that leaded the rankings in the previous ratios also maintain the lead in this one. As for those lagging, we also notice that these countries maintain the same low rankings as with the previous ratios.

Table 3.9

Average Pension Assets per Capita for the OECD country members (2006-2021) in $	
Switzerland	96547.67
Iceland	81938.09
Netherlands	79531.85
Australia	60476.95
United States	44328.53
United Kingdom	36516.30
Canada	34368.52
Finland	27225.12
Denmark	26878.27
Ireland	25506.20
Israel	19004.55
Chile	8649.15
New Zealand	8301.86
Norway	7193.32
Japan	5358.26
Sweden	3799.34
Germany	2796.07
Austria	2668.70
Belgium	2645.63
Spain	2604.53
Luxembourg	2495.02
Portugal	2340.86
Estonia	2168.12
Italy	2087.57
South Korea	2056.78
Costa Rica	1854.51
Slovakia	1692.59
Czech Republic	1501.74
Poland	1432.28
Mexico	1353.03
Slovenia	1234.22
Colombia	1233.54
Hungary	878.42
Lithuania	856.68
Turkey	292.46
France	292.05
Latvia	188.39
Greece	84.85

Source: (OECD, 2023)

Table 3.10 Pension assets per Capita

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Australia	31581	46955	49808	38691	44792	62552	60855	62301	69639	61914	61690	73045	72826	71984	69951	89048
Austria	2030	2334	2098	2429	2432	2277	2553	2969	2724	2595	2515	3044	2776	3074	3436	3413
Belgium	1669	2049	1482	1841	1632	1840	2056	2446	2465	2343	2710	3602	3088	3959	4590	4557
Canada	24140	29280	20362	26040	31000	31342	34555	35933	36614	33490	35707	40221	37038	42472	45468	46234
Chile	5401	6737	4450	6993	8699	7822	9288	9254	9300	8609	9604	11429	10298	11272	10714	8515
Colombia	449	743	706	729	971	1173	1465	1420	1337	1078	1325	1575	1449	1709	1828	1780
Costa Rica	350	390	458	530	625	764	936	1157	1225	1866	2035	3010	3288	3978	4237	4824
Czech Republic	681	896	950	1120	1179	1183	1364	1422	1411	1425	1484	1976	1970	2104	2369	2493
Denmark	17301	19820	28413	25066	27889	27760	28881	26155	27013	22963	24167	27805	26662	29140	38462	32554
Estonia	469	778	765	1028	1075	1105	1477	1853	2036	2164	2480	3313	3412	4026	4893	3814
Finland	29797	35350	29528	35907	36886	20032	22091	24941	23152	20533	21123	25529	23966	25420	29710	31637
France	16	32	40	67	83	99	135	180	190	199	221	286	283	530	1063	1246
Germany	1610	2071	2017	2295	2290	2403	2749	2938	2917	2695	2760	3278	3239	3496	4070	3908
Greece	0	3	4	6	6	9	10	123	121	114	116	149	148	163	188	195
Hungary	1197	1594	1361	1810	1900	442	507	557	511	490	520	650	601	624	656	635
Iceland	68636	87289	43720	45982	53867	54878	58533	71646	70210	76409	90999	110548	103303	113825	122755	138410
Ireland	27300	29134	19710	22943	22149	20448	23121	27345	28174	24884	21454	25075	24399	28533	30659	32770
Israel	6749	8092	10993	12614	14671	14452	16360	18944	18690	19598	20590	24265	22391	27884	31254	36527
Italy	1006	1256	1262	1512	1582	1657	1921	2191	2166	2033	2168	2623	2563	2832	3333	3296
Japan	0	0	0	0	0	8359	7564	6812	6830	6838	7624	7760	8105	8287	8729	8825
Latvia	43	62	68	88	99	101	128	162	172	182	206	268	274	329	394	439
Lithuania	0	0	0	0	489	516	631	751	794	818	946	1277	1335	1617	2047	2484
Luxembourg	987	1147	1109	2441	2105	2076	2240	2434	3238	2759	2843	3255	3047	3258	3562	3416
Mexico	902	953	822	962	1185	1147	1442	1530	1516	1351	1188	1400	1450	1833	1995	1972
Netherlands	54133	69414	56719	59248	61128	63239	73355	79449	76016	74760	79894	95219	89288	102263	120404	117979
New Zealand	2965	3338	3612	2875	4430	5458	6444	7616	8966	8619	9624	11213	11086	13209	15738	17636
Norway	5029	6297	4600	6277	6777	6789	7862	8053	7276	6592	7047	7979	7533	8224	9183	9576
Poland	1061	1523	1237	1668	1953	1740	2296	2612	1121	952	961	1350	1099	1069	1043	1233
Portugal	2652	3122	2673	2988	2493	1622	1816	1999	2043	1909	1885	2300	2167	2384	2746	2653
Slovakia	323	624	817	1054	1201	1390	1663	1834	1780	1613	1753	2200	2210	2443	2966	3210
Slovenia	579	749	807	1032	1131	1156	1203	1293	1245	1172	1180	1425	1427	1548	1801	1999
South Korea	563	606	496	656	822	956	1267	1617	1947	2135	2393	3079	3310	3691	4544	4826
Spain	2189	2814	2365	2643	2410	2316	2443	2736	2617	2439	2412	2839	2599	2759	3055	3037
Sweden	4305	4544	3235	3867	5025	4944	6030	5601	4851	4459	2029	2248	2075	2222	2493	2862
Switzerland	63866	71241	66200	75054	84495	83991	91786	99871	95975	95909	96851	108476	104434	121057	139628	145928
Turkey	58	125	131	202	229	381	402	467	533	476	444	262	215	258	277	219
United Kingdom	34180	34577	21189	26202	28581	29805	33689	36891	35618	35001	33593	40173	39720	47049	52289	55704
United States	35270	37093	28570	32698	35769	35665	38760	43373	45054	44191	46035	51469	48941	55886	61528	68955

4. Research Methodology and Model Specification

For the econometrical purposes of this study as mentioned in the previous section, we selected yearly observations of the 38 OECD countries for a time period of 16 years, between 2006 and 2021. In order to examine the effect between the increasing pension fund investments and economic growth, we decided to take into account some additional variables in which we discover statistical significance between these variables and the dependent variable, as we will present further on. For each of these variables, 608 observations have been collected through panel time series data (38 countries * 16 years) in order to proceed with the statistical tests and comparative analysis between those variables and the dependent one. To achieve robust statistical conclusions, we applied several methods introduced by the scientific literature. We strongly believe that by applying multiple statistical methods we will achieve safer predictions for the future trends and at the same time, far more accurate conclusions for the past. To perform our empirical analysis for our time-series panel data, we mainly used Microsoft Excel software in which we applied several data analysis functions. For the most complex statistical findings we coded our sample in R statistical software in order to apply more sophisticated econometrical experiments, which we are going to represent in the following chapters of this study.

Regarding our variables, we decided mainly influenced from (Morina & Grima, 2022) study, to import some additional parameters in our research which is: gross fixed capital formation, domestic credit to private sector, inflation rate, general government debt and population. As a result, we now hold seven variables of which gross domestic product is our dependent variable or endogenous variable that depends on the impact of other independent variables such as pension fund assets, gross fixed capital formation, domestic credit to private sector, inflation, general government debt and inflation.

On a mathematical approach of the above statement, we may export the following function as our first model:

$$\text{GDP} = f\,(PFA, GFCF, DCPS, INFL, PD, POP)$$

Thus, according to the main objective of this study which is to examine whether the increasing trend of pension assets stimulates economic growth, we are now called to explore the result of the following hypothesis testing.

H_0: *There is not a positive relationship between pension funds' assets and GDP growth.*

H_1: *There is positive relationship between pension funds' assets and GDP growth.*

However, before further proceeding with econometric measurements, it would be helpful to provide a definition on the independent variables we chose to imply on our models. Finally, we will present with logical arguments, the correlation each variable is expected to show in relationship with our model's dependent variables.

Table 4.1 Variables Description

Variables	*Description of Variable*	*Source*
Dependent Variable	Gross Domestic Product (GDP)	OECD and World Bank Database (2006-2021)
Independent Variable	Pension Fund Assets (PFA)	OECD Database (2006-2021)
Independent Variable	Gross fixed capital formation (GFCF)	OECD Database (2006-2021)
Independent Variable	Domestic credit to private sector (DCPS)	OECD Database (2006-2021)
Independent Variable	Inflation (INFL)	OECD Database (2006-2021)
Independent Variable	Public Debt (PD)	OECD and World Bank Database (2006-2021)
Independent Variable	Population (POP)	OECD Database (2006-2021)

Beginning with the dependent variable, Gross domestic product, or **GDP**. According to (OECD, 2023) is defined as the standard measure of the value added created through the production of goods and services in a country during a certain period. As such, it also measures the income earned from that production, or the total amount spent on final goods and services (less imports). In our case this indicator is based on nominal GDP in USD terms.

Our first independent variable in which we are mainly going to focus is pension funds' assets. According to (OECD, 2023) pension funds' assets or **PFA**, are defined as assets bought from the contributions to a pension plan for the exclusive purpose of financing pension plan benefits. The pension fund is a pool of assets forming an independent legal entity. According to OECD statistics, the 300 largest pension funds globally own approximately $6 trillion in assets, indicating the importance these investments represent in terms of scale, on the world economy. At a first glance, we might assume that investments of this significance in the public or private markets of an economy would provide a buy-side support on the valuations of the domestic assets, thus creating a wealth effect. Under these assumptions and before making any quantitative test, we assume that the correlation between this variable and the GDP will be positive, as we want to examine in this study.

The next independent variable we propose for our model will be gross fixed capital formation or **GFCF**. According to (OECD, 2023) GFCF is defined as the acquisition of produced assets (including purchases of second-hand assets), including the production of such assets by producers for their own use, minus disposals. The relevant assets relate to assets that are intended for use in the production of other goods and services for a period of more than a year. The term produced assets means that only those assets that result from a production process are included. Hence, the purchase of land and natural resources is not included in the formation of gross fixed capital. Regarding this

variable which by definition represents economic activity, we expect it to have positive corelation with the gross domestic product.

Domestic credit to private sector or **DCPS** refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment (World Bank, 2023). In some countries these claims include credit to public enterprises. This variable represents the third independent variable of this study. We can also expect this variable to have positive corelation with the gross domestic product, since greater access to credit creates leverage and thus stimulates the economic activity.

Inflation measured by consumer price index (CPI) or **INFL** is defined as the change in the prices of a basket of goods and services that are typically purchased by specific groups of households. The consumer price index is estimated as a series of summary measures of the period-to-period proportional change in the prices of a fixed set of consumer goods and services of constant quantity and characteristics, acquired, used or paid for by the reference population (OECD, 2023). Regarding our fourth independent variable, we may assume that there is a negative correlation between inflation and the gross domestic product within an economy, which mainly originates from the fact that inflation is responsible of decreasing households' disposable income, leading consumer demand lower.

General government debt-to-GDP ratio or **PD** measures the gross debt of the general government as a percentage of GDP. It is a key indicator for the sustainability of government finance. Debt is calculated as the sum of the following liability categories (as applicable): currency and deposits, debt securities, loans, insurance, pensions and standardised guarantee schemes, and other accounts payable (OECD, 2023). We maintain a cautious approach on exporting reasonable conclusions regarding our fifth independent variable corelation with GDP, since this particular factor remains controversial along the scientific literature. Albeit, according to (Caner, Grennes, & Koehler-Geib, 2010), they examined 99 countries between 1980 and 2008 and found that the threshold level of the average debt ratio on GDP growth is 77 percent. If debt is above this threshold, each additional percentage point of debt costs 0.017 percentage point of annual real growth.

Last, population or **POP** is defined as all nationals present in, or temporarily absent from a country, and aliens permanently settled in a country according to the (OECD, 2023). This variable clearly reflects positively on economic growth since the larger the number of people a country has, the larger the output of goods and services produced will be. Therefore, we expect a positive corelation between population and economic growth.

Finally, after we have successfully represented all variables that we are going to include in our model, it is now to time to introduce the quantitative form of our model in which we are going implement the statistical studies in the next chapter of this paper.

In a relevant study which explores the relationship between growing pension assets and economic growth, (Hu, 2005) introduced the following econometric model:

$$LOG(EG)_{it} = \alpha + \beta_1 LOG(PFAGDP)_{it} + \beta_2 LOG(INFL)_{it} + \beta_3 LOG(INT)_{it} + \beta_4 LOG(LIQUID)_{it} + \beta_5 LOG(CREDIT)_{it} + \beta_6 LOG(STKCAP)_{it} + \beta_7 LOG(STKTNV)_{it} + \beta_8 LOG(GOVEXP)_{it} + \beta_9 LOG(URBAN)_{it} + \beta_{10} LOG(EXIMGDP)_{it} + \beta_{11} LOG(I\_GDPPC)_{it} + \varepsilon_i + \upsilon_{it}$$

EG: vector of economic growth indicators, including TFPGR, GFCFGR and GDPGR.

Source: (Hu, 2005)

For simplicity and influenced by the model that (Morina & Grima, 2022) specified that also examined the impact of the investments of pension assets on the economic growth for another sample and timeframe, we decided only to take into account some of the variables that we believe provide the greater significance for our purposes. As a result, we introduce the following model:

$$GDP_{i,t} = \beta_0 + \beta_1 PFA_{it} + \beta_2 GFCF_{it} + \beta_3 DCPS_{it} + \beta_4 INFL_{it} + \beta_5 PD_{it} + \beta_6 POP_{it} + \gamma_{it}$$

Where: β_0 — presents the constant or value of the variable Y when all values of X are zero; $\beta_{1\text{-}6}$ - regression coefficients for independent variables; γ—stochastic variables (other factors not taken into account in the model); i— country; the t—time period (2006–2021).

5. Linear Trend Analysis

In this section of this study, we are going to analyse how the independent variables which we adopted in our model, perform in comparison with our dependent variable (GDP), by examining how linear trends are shaping during the selected timeframe. As presented below, Table 5.1 maintains values of these variables of all 38-OECD countries for the period 2006–2021. In this table, some variables such as GDP, PFA,GFCF and POP are expressed in total nominal terms, by summarizing the values from all countries per year. Whereas variables such as DCPS, INFL and PD are expressed in average terms, by calculating a simple mean of these values for all countries per year. GDP and PA and GFCF are presented in nominal USD terms, while DCPS and PD are presented as a percentage of GDP. Finally, inflation is presented as percentage by definition and POP is presented in nominal terms, since it represents a number of people. Microsoft Excel features were used for the analysis and edits of the data for the purposes of this chapter.

Table 5.1 Variables included in the econometric model.

Year	GDP ($)	PA ($)	GFCF ($)	DCPS/GDP (%)	INFL (%)	PD/GDP (%)	POP
2006	3.99×10^{13}	1.7×10^{13}	9.34×10^{12}	100.730	3.20	58.27	1.26×10^{9}
2007	4.21×10^{13}	1.8×10^{13}	9.85×10^{12}	104.016	3.39	55.39	1.27×10^{9}
2008	4.36×10^{13}	1.4×10^{13}	9.98×10^{12}	104.352	5.37	60.05	1.28×10^{9}
2009	4.26×10^{13}	1.6×10^{13}	8.96×10^{12}	106.070	1.76	69.10	1.28×10^{9}
2010	4.46×10^{13}	1.8×10^{13}	9.18×10^{12}	102.035	2.23	72.24	1.29×10^{9}
2011	4.67×10^{13}	2.0×10^{13}	9.80×10^{12}	99.400	3.22	74.60	1.30×10^{9}
2012	4.82×10^{13}	2.2×10^{13}	1.02×10^{12}	97.493	2.68	81.71	1.31×10^{9}
2013	5.02×10^{13}	2.4×10^{13}	1.06×10^{12}	96.048	1.66	82.61	1.32×10^{9}
2014	5.20×10^{13}	2.4×10^{13}	1.11×10^{13}	94.982	1.27	85.14	1.32×10^{9}
2015	5.38×10^{13}	2.4×10^{13}	1.17×10^{13}	93.722	0.69	84.03	1.33×10^{9}
2016	5.61×10^{13}	2.5×10^{13}	1.21×10^{13}	94.141	1.02	84.39	1.34×10^{9}
2017	5.85×10^{13}	2.8×10^{13}	1.28×10^{13}	91.610	2.14	81.94	1.35×10^{9}
2018	6.12×10^{13}	2.7×10^{13}	1.35×10^{13}	90.667	2.33	80.45	1.36×10^{9}
2019	6.36×10^{13}	3.1×10^{13}	1.41×10^{13}	90.824	2.09	81.20	1.36×10^{9}
2020	6.21×10^{13}	3.5×10^{13}	1.38×10^{13}	97.241	1.25	95.83	1.37×10^{9}
2021	6.73×10^{13}	3.8×10^{13}	1.51×10^{13}	91.788	3.36	91.64	1.37×10^{9}

As represented in the chart 5.1.1 below, we can know reach some conclusions regarding the relationship between pension assets and economic growth. First, we can graphically observe the similar positive movement these two variables shape over time. Also, from table 5.1.2 based on the linear regression of the two variables we observe a high value of the correlation coefficient shaping at ρ=0.9590, indicating a similarity on how these values shape overtime on an aggregate level. According to this figure, the equation which represents the following relationship is:

$$Y = 1.2257*X + 22.765, \textit{ where Y: GDP, X: PA}$$

Assuming now that PA=10 (trillion $), according to the above equation that equals to 35.315 (trillion $) of GDP, expressing a positive linear relationship between pension assets and economic growth, which is the main objective of this study.

Chart 5.1.1 Linear trend between GDP and pension assets (in trillion $).

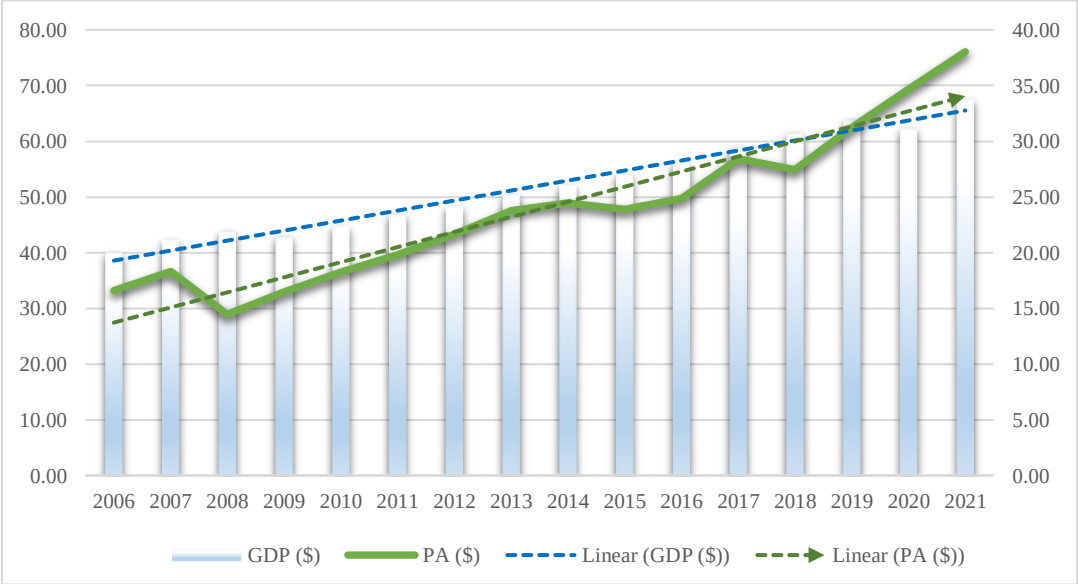
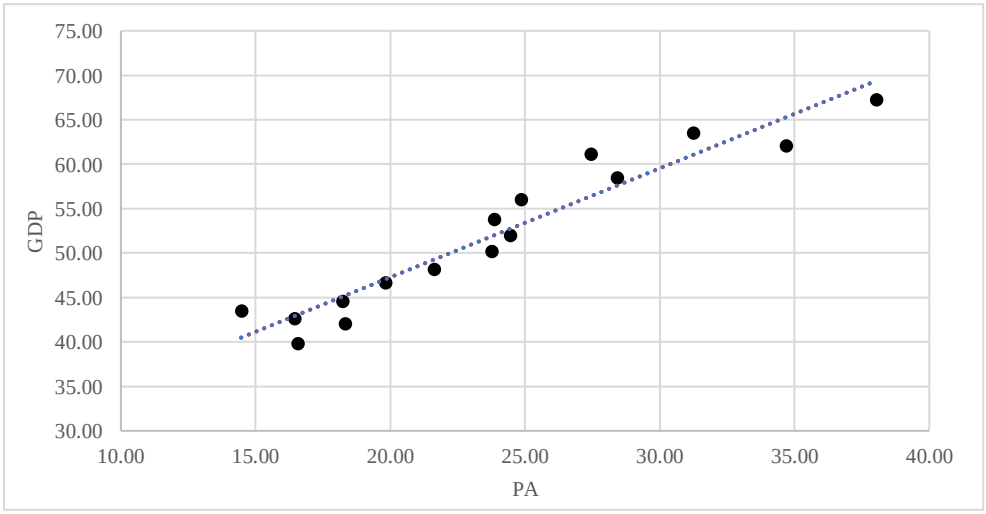


Chart 5.1.2 Linear regression of GDP and pension assets



The next variable of this study in which we are about to examine whether a linear trend exists is gross fixed capital formation GFCF and its relationship with the GDP. As shown in chart 5.2.1 below, we graphically observe a similar shaping as with the pension assets. We notice that GFCF as a nominal value on an aggregate basis (summing all GFCF values for all countries for each year) maintains a very positive relationship with GDP. It is an extremely reasonable conclusion since GFCF or alternatively, domestic investments is one of the most significant components of the GDP measurement. Since by origination this relationship exists, we were expecting from the beginning these two values to maintain a significant positive relation overtime. We also calculated the corelation coefficient which once again presents an outstanding coexistence ρ=0.9812.

In the macroeconomic standpoint, it is always preferred that the slope of the GFCF curve to remain positive since it represents a very important component of economic growth. For the purposes of this section, we only want to review on a comparative basis how this trend forms through the given period of time relative to the GDP.

Chart 5.2.1 Linear trend between GDP and GFCF (both in trillion $).

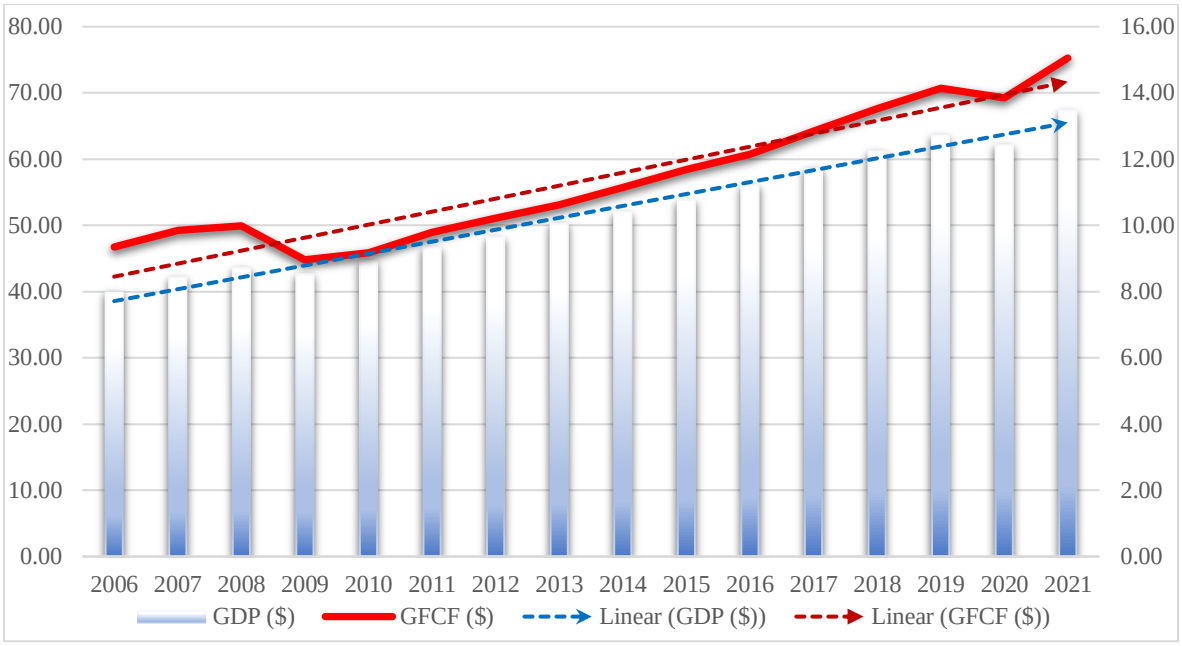
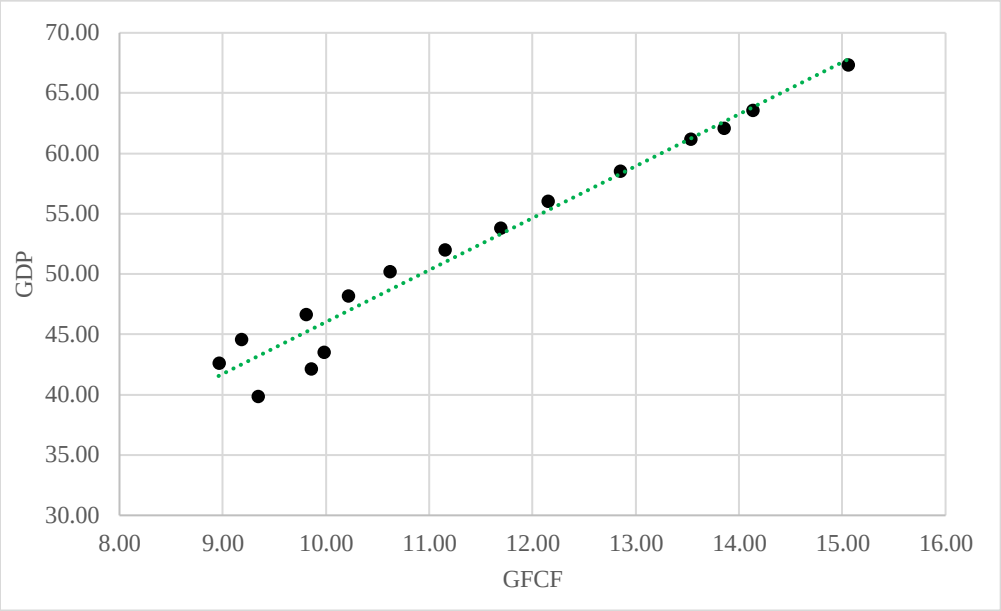


Chart 5.2.2 Linear regression of GDP and GFCF (both in trillion $).



The next variable of this study in which, we are going to examine its trend is DCPS/GDP. In Chart 5.3.1, we observe that there is a clear downward trend regarding this specific variable, compared with GDP. In 2006, DCPS as percentage over GDP, was shaping at 100.73% on average. The same ratio in 2021 had shaped on average at 91.74% indicating a rapid deleveraging of private sector through these years. The decrease in percentage terms is 8.92%. Generally, credit is a very important aspect of the economy which has the ability to multiply financial results, but only in sustainable levels. Since leverage maintain such an important role on shaping the dynamics of an economy, we are strongly determined that this particular variable will offer added value and significant information to our final model.

Chart 5.3.1 Linear trend between GDP and DCPS (GDP in trillion $).

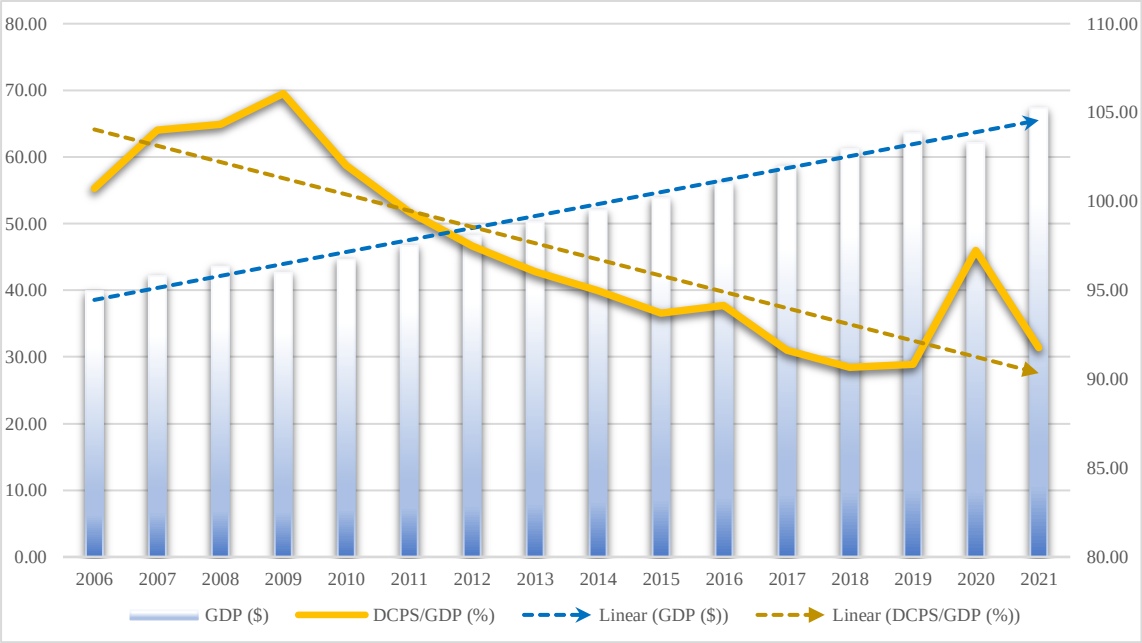
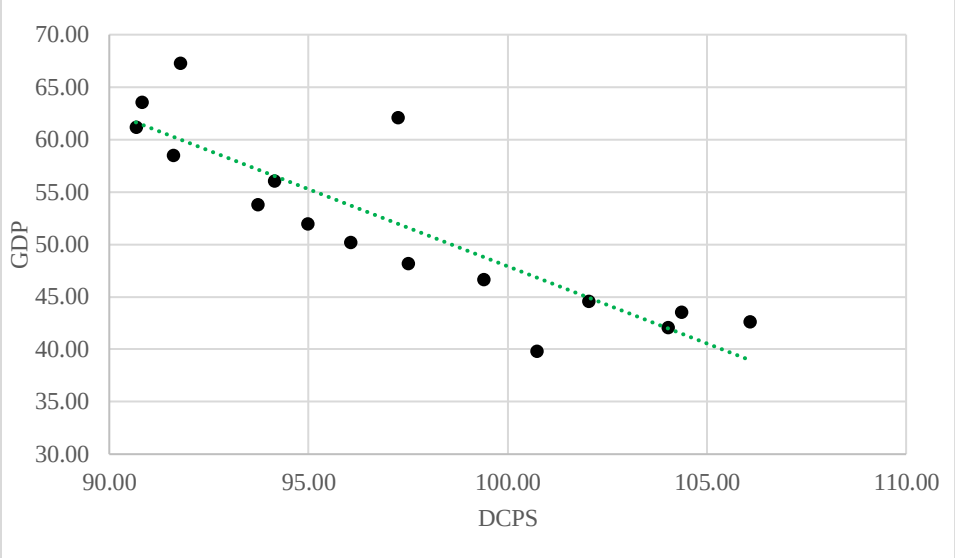


Chart 5.3.2 Linear regression of GDP and GFCF (GDP in trillion $).



The fourth variable of this study is inflation. As shown in chart 5.4.1, we notice that inflation also maintains a downward trend, which is a positive signal considering the harmful effects of this particular variable. As in DCPS, since inflation represent one of the most important factors that shape the dynamics of an economy, it is essential to account it for our final modelling purposes.

Chart 5.4.1 Linear trend between GDP and inflation (GDP in trillion $).

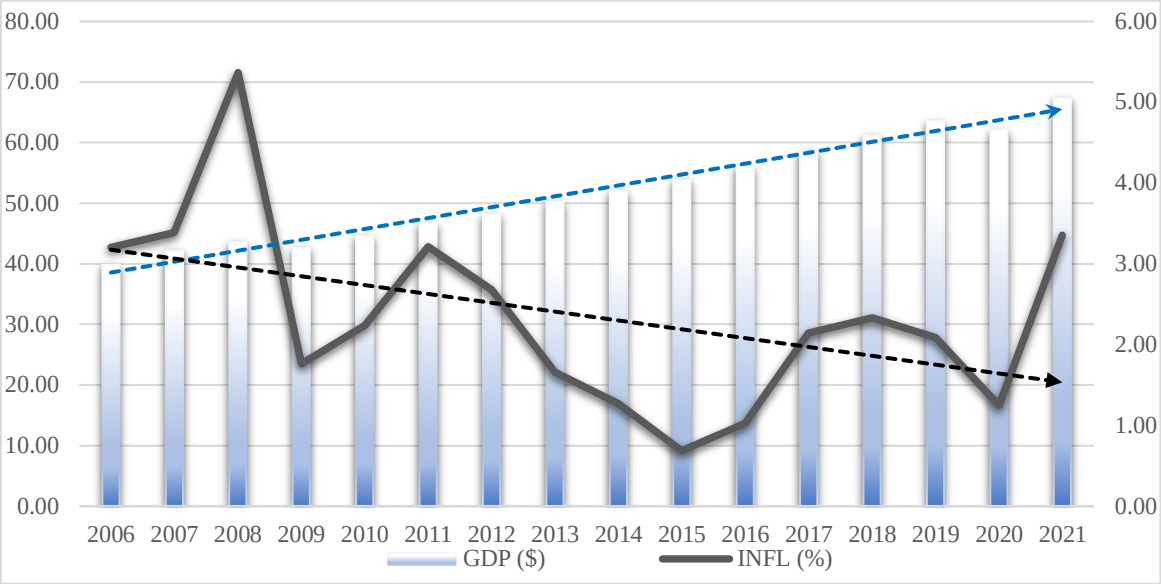
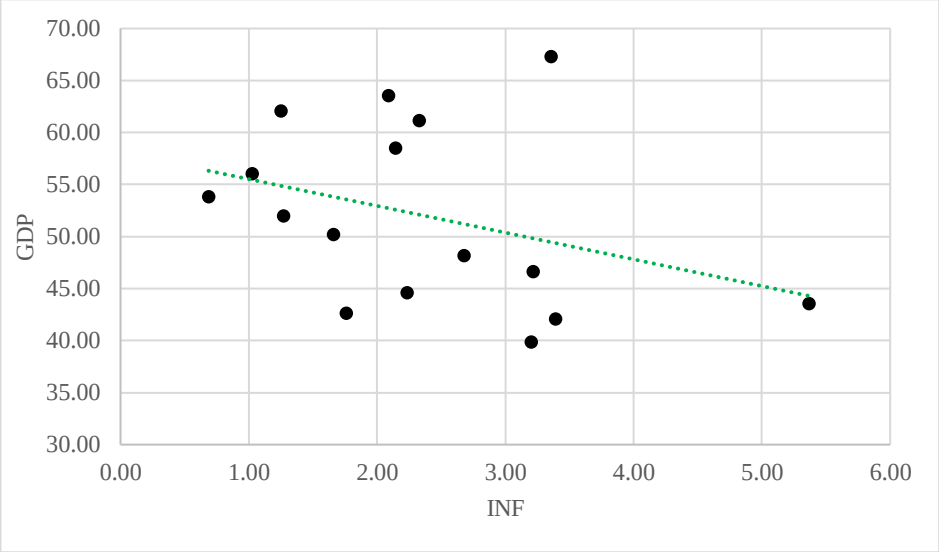


Chart 5.4.2 Linear regression of GDP and inflation (GDP in trillion $)



The fifth variable of this study is public debt, calculated once again as a percent of GDP. As represented in chart 5.5.1, we observe a positive linear trend between our variables once again. It is obvious that from the economic perspective, this is not an optimistic signal since increasing public debt may occur decreases in budget costs, increase in tax rates, decrease in public investments and many more harmful events for the economy. On the other hand, it indicates increasing spending or public investment that provide additional support on shaping the gross domestic product.

Chart 5.5.1 Linear trend between GDP and public debt (GDP in trillion $).

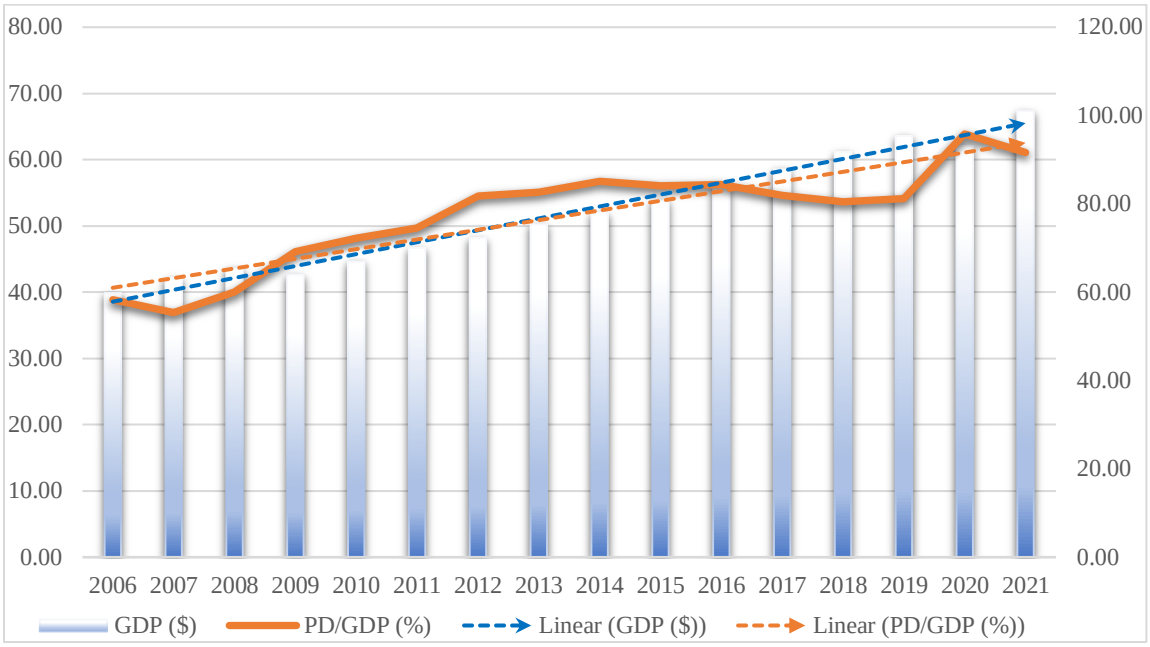
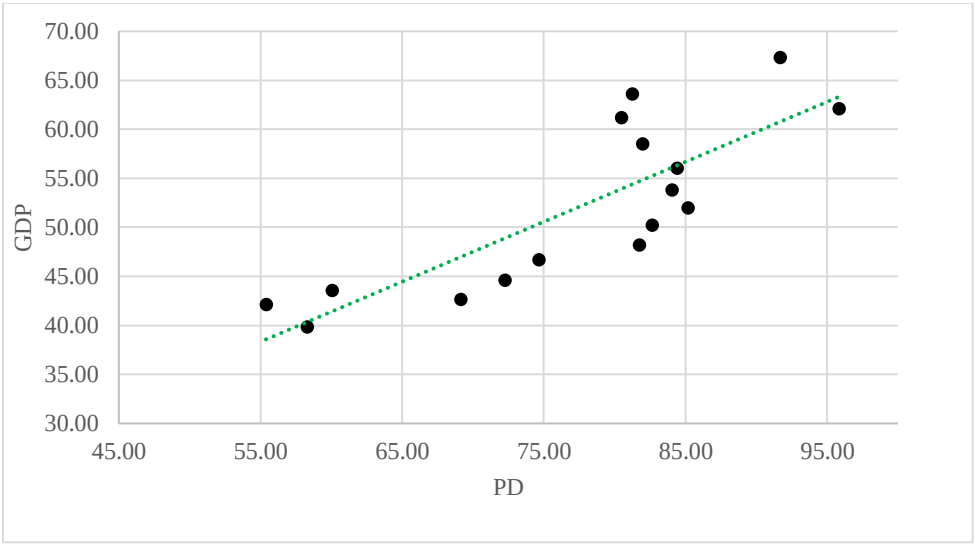


Chart 5.5.2 Linear regression of GDP and public debt (GDP in trillion $)



The last independent variable of this study that will be analysed for the trends that might shape over our sample period is population. According to the data presented in chart 5.6.1, we notice that there is a strong positive linear trend between population and GDP, with the corelation coefficient shaping at ρ=0.982. It is obvious that the population metric is a vital catalyst for both GDP and PA.

An increase in population will offer increased tax revenues for the governments and increased contribution from the available labour force. As a result, the increased available volume of pension contributions, will increase the available assets for pension funds to manage and invest.

Chart 5.6.1 Linear trend between GDP and Population (GDP in trillion $, population in hundred million)

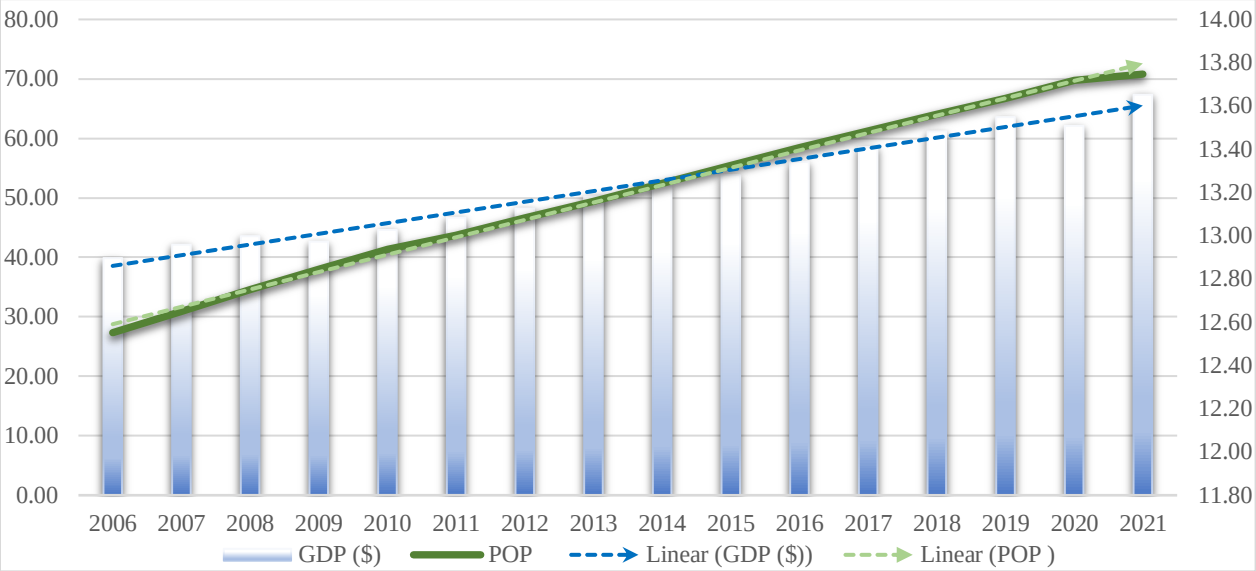
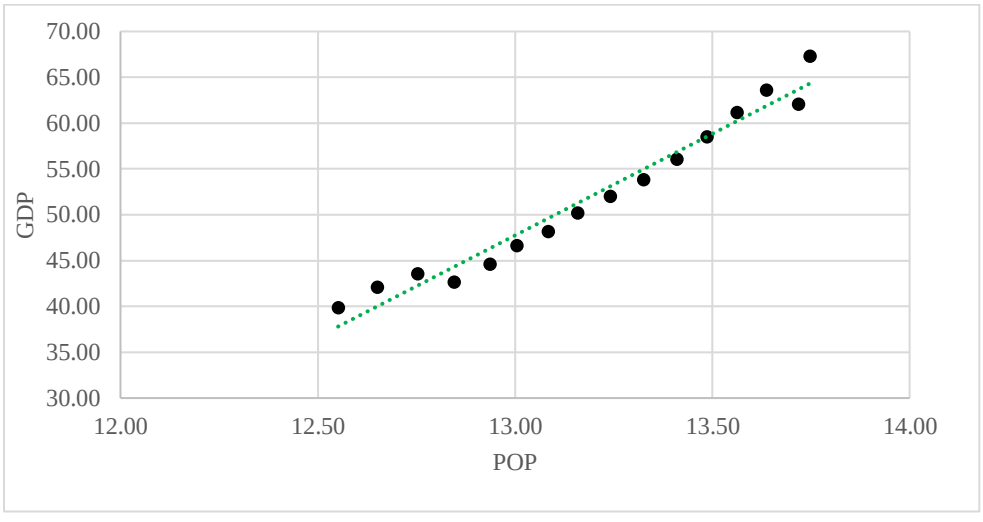


Chart 5.5.2 Linear regression between GDP and Population (GDP in trillion $, population in hundred million)



Summarizing all of the above, we observe that not all of the selected variables maintain a positive linear relationship with the gross domestic product (at least on aggregate basis), but it would be extremely harmful for our model to omit one of those important variables since we would violate the principle of omitted variables and offer excessive bias on the specified model. As we will investigate on the next chapter all variables contribute so that we get a trustworthy conclusion regarding the main objective of this study. On an early view though, the findings from this chapter indicate a very strong relationship between the pension assets and GDP on a non-cross-country level. The main purpose of this thesis is to examine whether a positive relationship between pension assets growth and gross domestic product exists. At least on cumulative basis it appears that this fact holds. As we advocated in the literature section of this paper, catalysts such us the increasing saving rates, the financial market liquidity and development, the prudent corporate governance and the wealth effect of the citizens provide additional support in shaping the gross domestic product.

In the next chapter we are going to investigate whether this condition holds on a cross-country study through various statistical techniques and prove whether this effect can be reliably claimed. All of the techniques will be implemented on our core model which all of the study variables are included in the analysis. The purpose of this chapter was only to observe the dynamics these variables shape overtime for the timeframe of our sample.

6. Econometric analysis

In this part of the study, we are going to present the results of econometric models and statistical test, edited with R statistical software. Before proceeding to panel regression analysis, the first step is to examine whether our data present stationarity or not, for all of our model variables. The validity of panel data regression models require that the underlying data are stationary. As a result, unit root testing is an important step in order to export reliable conclusions for the time series panel data we will analyse.

Among academic literature there are several ways to test panel data stationarity. For the purposes of this study, we are going to use three methods in order to achieve robust statistical conclusions. The first method is proposed by (Levin, Lin, & Chu, 2002), quoted as LLC. The second method is presented by (Maddala & Wu, 1999), quoted as MW and finally the last method is presented by (Shin , Pesaran, & Im, 2003), quoted as IPS. These three tests are extended versions of the traditional Augmented Dickey–Fuller test (ADF), to account for the presence of both cross-sectional and time-series dimensions in the data. To investigate whether stationarity exists, these three tests perform the following hypothesis testing, similar with the Augmented Dickey-Fuller (ADF) unit root test.

Null hypothesis (H_0): *The time series has a unit root (non-stationary).*

Alternate hypothesis (H_1): *The time series doesn't have a unit root (stationary).*

To reject the null hypothesis, the p-value produced by these specific tests should be less than the significance level. For our purposes we choose 5%.

Studies with similar characteristics as this one, for unit root testing procedures implement the Maddala-Wu test which is widely used in econometrics and is especially suitable for panels with a small number of time periods and for a large number of cross-sectional units. It takes into consideration both the individual heterogeneity and the potential cross-sectional dependence that can arise in panel data. However, there have been further developments in panel unit root testing since Maddala and Wu's paper. Academic literature more commonly refer to alternative tests, such as the Levin-Lin-Chu (LLC) test and the Im-Pesaran-Shin (IPS), which offer improved power and control for various forms of heterogeneity and cross-sectional dependence and correlation, which are common characteristics in panel datasets.

After performing all cited unit root tests for our cross-country timeseries panel data, we reached into mixed results regarding our variables stationarity. As we observe in Table 6.1 below, variables such as gross domestic product, pension fund assets and gross fixed capital formation present not stationarity, whereas domestic credit to private sector, inflation, public debt data maintain stationarity. On the other hand, population receives mixed results, as LLC and MW tests determine that the data are stationary, whereas IPS present quite the opposite. For simplicity and since a single test perceived that the data for population are not stationary, we are going to handle population data as not stationary and as a result we are going to proceed with all appropriate modifications as we will do with all the not-stationary variables.

Table 6.1

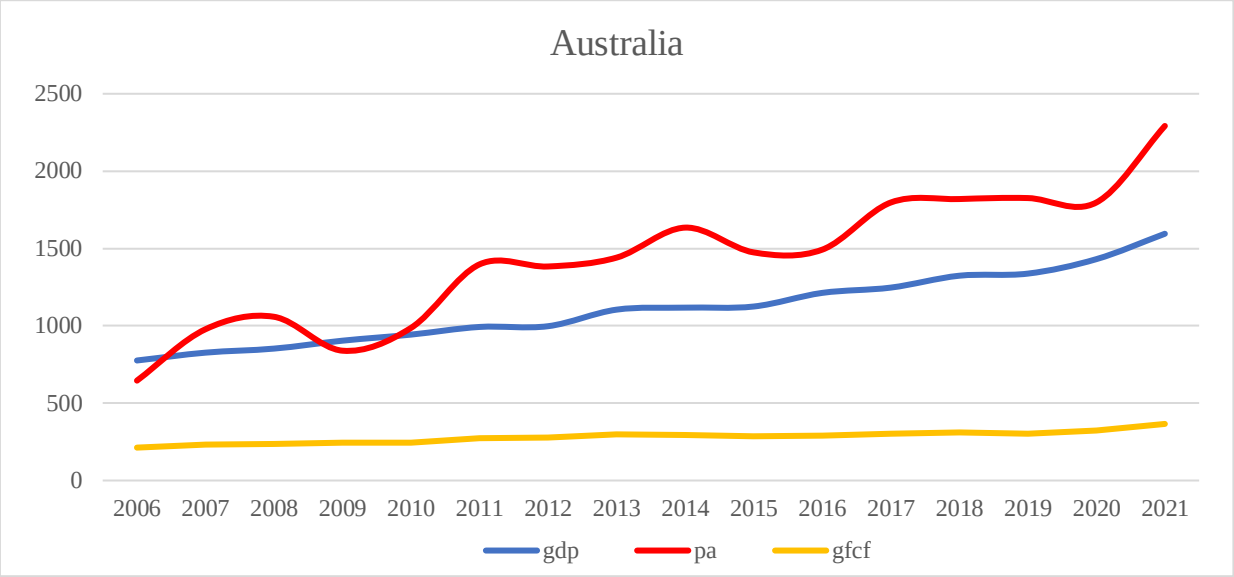
Panel Data Unit Root Test *(38 Countries, 16years) - Maximum Lag Length = 2 years*			
Variables	*LLC (2002)*	*MW (1999)*	*IPS (2003)*
Gross Domestic Product (GDP)	not stationary	not stationary	not stationary
p-value	*0.999*	*0.999*	*0.999*
Pension Fund Assets (PFA)	not stationary	not stationary	not stationary
p-value	*0.999*	*0.999*	*0.99*
Gross fixed capital formation (GFCF)	not stationary	not stationary	not stationary
p-value	*0.999*	*0.977*	*0.999*
Domestic credit to private sector (DCPS)	stationary	stationary	stationary
p-value	$2.75*10^{-20}$	$3.82*10^{-22}$	*0.003169*
Inflation (INFL)	stationary	Stationary	stationary
p-value	$9.22*10^{-33}$	$1.83*10^{-48}$	$9.86*10^{-30}$
Public Debt (PD)	stationary	stationary	stationary
p-value	$1.64*10^{-7}$	$1.75*10^{6}$	*0.004985714*
Population (POP)	stationary	stationary	not stationary
p-value	*0.002591794*	$1.64*10^{-13}$	*0.5074913*

Source: Author Calculations

Not stationary data will lead us to unreliable and spurious results and drive us to poor understanding in order to further proceed towards our next step, the multiple regression analysis. For this reason, we will modify out data by taking the logarithmic differences of these values for a specific year and the previous one. After implementing logarithmic differences into the data of the variables containing a unit root, we will once again perform all three tests in order to verify that not-stationarity has been eliminated.

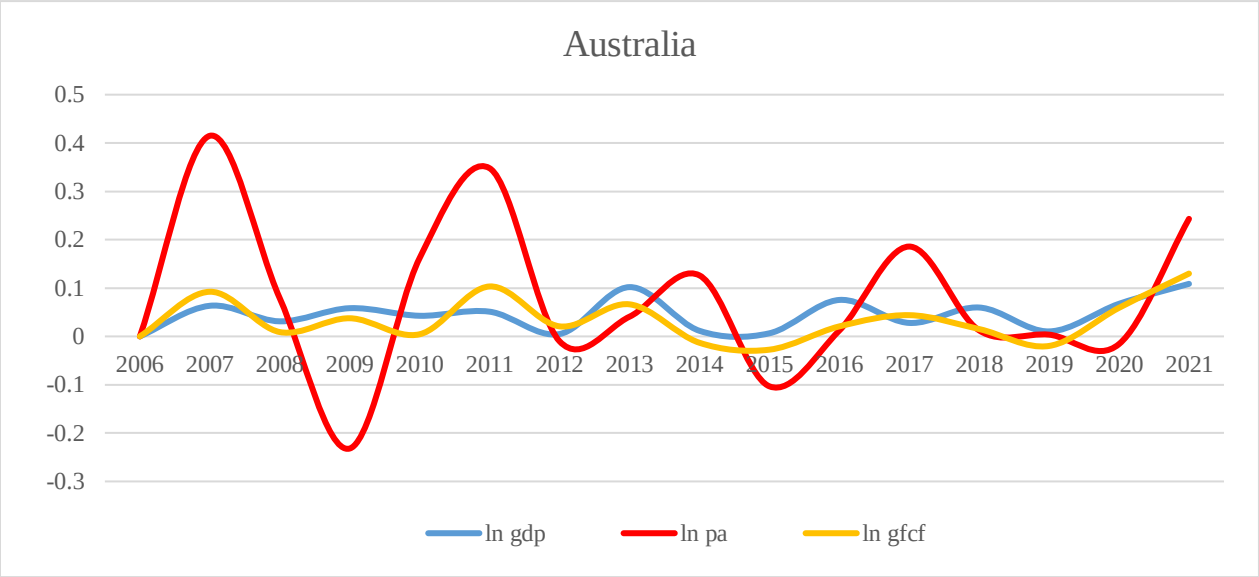
After performing the relevant tests, we wish to observe how these values that maintain a unit root, graphicly perform over our time series in both scenarios for a specific country. For example, we might see how the values of all GDP, PA and GFCF fluctuate over the given time frame for a country such as Australia for both nominal values and their logarithmic differences, as shown below in chart 6.1 and chart 6.2.

Chart 6.1 GDP, PA & GFCF before adjustments



After carefully observing graph 6.1, we can notice that all variables maintain a trend overtime, which is not optimal for our modelling purposes - as the unit root test we implied also indicated -. In this case, it is also graphically justified that this particular pattern that these variables follow lead to the conclusions that these timeseries data hold a unit root, for certainty.

Chart 6.2 GDP, PA & GFCF after adjustments



In contrast, it is clear now in graph 6.2 that by taking the logarithm differences for all the non-stationary variables -for our example Australia- all trend patterns have been successfully eliminated, which was our goal from the beginning. Of course, we will prove this particular effect by implementing once again the unit root tests for these specific variables.

As we notice in Table 6.2 below, we summarize the results from all tests for all variables, including the four variables such as GDP, PFA, GFCF and POP that we proceeded with the relevant modifications.

Table 6.2

Panel Data Unit Root Test *(38 Countries, 16years) - Maximum Lag Length = 2 years*			
Variables	**LLC (2002)**	**MW (1999)**	**IPS (2003)**
Log (Gross Domestic Product (GDP))	stationary	stationary	stationary
p-value	$2.06*10^{-111}$	$6.03*10^{-137}$	$9.73*10^{-110}$
Log (Pension Fund Assets (PFA))	stationary	stationary	stationary
p-value	$7.15*10^{-134}$	$3.50*10^{-139}$	$6.67*10^{-113}$
Log (Gross fixed capital formation (GFCF))	stationary	stationary	stationary
p-value	$3.10*10^{-63}$	$6.09*10^{-97}$	$8.71*10^{-67}$
Domestic credit to private sector (DCPS)	stationary	stationary	stationary
p-value	$2.75*10^{-20}$	$3.82*10^{-22}$	*0.003169*
Inflation (INFL)	stationary	Stationary	stationary
p-value	$9.22*10^{-33}$	$1.83*10^{-48}$	$9.86*10^{-30}$
Public Debt (PD)	stationary	stationary	stationary
p-value	$1.64*10^{-7}$	$1.75*10^{6}$	*0.004985714*
Log (Population (POP))	stationary	stationary	stationary
p-value	$3.19*10^{-8}$	$5.88*10^{-78}$	$1.37*10^{-33}$

Source: Author Calculations

At this point, since all of our variables do not contain a unit root, we may now proceed with the core part of this study and reach conclusions regarding the statistical findings of our model.

First, since we adjusted some of the parameters, we should present the updated form of our model by adding the log differences to the variables we determined earlier.

Below we present our new modified model,

$$\mathbf{logGDP_{i,t}=\beta_0 + \beta_1\, logPFA_{it} + \beta_2\, logGFCF_{it} + \beta_3\, DCPS_{it} + \beta_4\, INFL_{it} + \beta_5\, PD_{it} + \beta_6\, logPOP_{it} + \gamma_{it}}$$

Where: β_0 — presents the constant or value of the variable Y when all values of X are zero; $\beta_{1\text{-}6}$ - regression coefficients for independent variables; γ—stochastic variables (other factors not taken into account in the model); i— country; the t—time period (2006–2021). Log refers to logarithmic differences.

In line with the widely accepted research practises, we decided to use several types of regression analysis for our model in order to reach safer conclusions. First by applying multiple regression models, we achieve to include all the unique advantages of each technique and as a result obtain

more accurate and reliable results. Also, by employing multiple regression models we improve the validity of our findings by reducing the likelihood of false results, since we have the ability to compare the results of each method. As a result, by employing multiple regression models, we achieve to obtain more robust findings and strengthen the overall credibility of our analysis. For this reason, we managed to imply the following techniques regarding our model analysis such as, linear regression (quoted as LR), fixed effects regression (quoted as FE), random effects regression (quoted as RE) and fixed effects with time effects regression (quoted as FTE).

In table 6.3 below, we observe all the empirical results we retrieved for each of these techniques. For each of our variables, we notice that we get an estimation of their coefficients and the statistical significance each variable provides to our model in p-value terms.

Table 6.3 Empirical results for the econometric panel models

Variables	*Linear Regression*	*Fixed Effects Regression*	*Random Effects Regression*	*Fixed Effects with Time Effects Regression*
log (PFA)	0.0023	0.004	0.002	0.006
p-value	*72.4918%*	*58.8907%*	*72.4779%*	*35.3256%*
log (GFCF)	0.2585***	0.24994***	0.25845***	0.18314***
p-value	*0.0000%*	*0.0000%*	*0.0000%*	*0.0000%*
DCPS	-0.0001**	-0.0002**	-0.0001**	-0.0001***
p-value	*4.5083%*	*2.1186%*	*4.4580%*	*0.4007%*
INFL	0.0017***	0.0028***	0.0017***	0.0000
p-value	*0.8965%*	*0.3018%*	*0.8716%*	*99.7355%*
PD	-0.0001***	-0.0001	-0.0001***	-0.0001***
p-value	*0.6052%*	*44.0039%*	*0.5852%*	*0.0011%*
log (POP)	0.3426 *	0.6584**	0.3426*	0.3474**
p-value	*6.3409%*	*4.1708%*	*6.2860%*	*2.9627%*
Intercept *(βo)*	0.0377 ***	-	0.0377 ***	-
p-value	*0.0000%*	-	*0.0000%*	-
R-squared	**0.4362**	**0.4063**	**0.4362**	**0.344**
Adjusted R-squared	**0.4298**	**0.3563**	**0.4298**	**0.3175**

Note: *** indicates statistical significance at the level of 1%; ** indicates statistical significance at the 5% level, and * indicates statistical significance at 10%.
Source: Author Calculations

According to Table 6.3 we observe that R-squared and adjusted R^2, fluctuates at 40% levels for all of the regressions, indicating a satisfactory level of explanation for the model specified by this study. We also advocate that Linear Regression and Random Effects Regression maintain the highest levels of explanation, whereas the other techniques show poorer results. Furthermore, we note that many of the variables hold pretty low p-values, indicating that they offer rich statistical significance in our model for all of the techniques, such as GFCF and POP, whereas other do not offer significance at all. We also observe that some variables offer significance for a portion of techniques, while in other techniques don't. GFCF as we observe, maintains the highest significance among the other variables for all of the techniques. It is a reasonable conclusion since according to World Bank (World Bank national accounts data, and OECD National Accounts data files), for the OECD country members we examine, gross fixed capital formation as a percentage of GDP for the past 50 years of data retained from the organizations, maintain values from 21% to 26% overtime. Thus, it is obvious that this specific variable as we also proved in our analysis would shape a vital role when modelling gross domestic products projections.

Most notable though for the causes of this study, we observe that for all of these techniques pension fund assets do not offer statistical significance on shaping the Gross Domestic Product. This fact raises concerns regarding our research since the sole purpose of this study is to investigate whether there is a connection between gross domestic product and pension assets growth. Of course, it would be extremely naïve to expect that pension assets growth maintain one of the biggest dynamics in shaping the gross domestic product, since by definition other factors such as the other variables we have introduced maintain the biggest role on shaping the domestic output annually. Furthermore, as we modified some variables of the model into logarithmic differences from one period to the other, we were expecting not to see a direct connection between the values at least on their growth rate for a year over year basis. For this reason, we are going to further investigate what outcome we obtain by lagging the growth rate of pension assets for numerous periods of time and then select the model that provides the highest coefficient of determination - R-squared - combined with the greater statistical significance between the independent variable and the dependent one. This also services a reasonable argument that the pension assets growth might have a lagging effect on the gross domestic product of a single country since all the positive drivers we specified in the literature section of this paper, such as the wealth effect, the market efficiency, the improved market capitalization effect, and the enhanced savings rates by definition maintain a lagging effect.

At this point, we will further investigate how our findings perform under the assumption that the pension assets values maintain a lagging effect. As we may notice on Table 6.4, we only exploited significant evidence for t=1 year lag. When we perform stimulation with lags greater than a year we failed to expose improved R^2 in our models. Therefore, we only going to examine what statistical findings we obtain with 1 year lag.

Table 6.4 Empirical results for the econometric panel models

Variables	*Linear Regression*	*Fixed Effects Regression*	*Random Effects Regression*	*Fixed Effects with Time Effects Regression*
lag (log (PFA))	0.014996**	0.018325***	0.014996**	0.008458
p-value	*2.27%*	*0.83%*	*2.22%*	*19.09%*
log (GFCF)	0.25007***	0.24012***	0.25007***	0.18181***
p-value	*0.00%*	*0.00%*	*0.00%*	*0.00%*
DCPS	-0.000045493	-0.00026767***	-0.000045493	-0.000084056***
p-value	*16.88%*	*0.50%*	*16.82%*	*0.39%*
INFL	0.0018052***	0.0027058***	0.0018052***	-0.000015147
p-value	*0.42%*	*0.32%*	*0.40%*	*98.02%*
PD	-0.00012798***	-0.00033091***	-0.00012798***	-0.00012959***
p-value	*0.02%*	*0.08%*	*0.02%*	*0.00%*
log (POP)	0.10142	-0.39648	0.10142	0.34118**
p-value	*59.07%*	*28.89%*	*59.05%*	*3.90%*
Intercept *(βo)*	0.041063***	-	0.041063***	-
p-value	*0.00%*	-	*0.00%*	-
R-squared	**0.4479**	**0.4292**	**0.4479**	**0.3481**
Adjusted R-squared	**0.4413**	**0.3779**	**0.4413**	**0.3214**

Note: *** indicates statistical significance at the level of 1%; ** indicates statistical significance at the 5% level, and * indicates statistical significance at 10%.
Source: Author Calculations

After observing Table 6.4 above, we can exploit some interesting statistical conclusions. Regarding the R^2 and the adjusted R^2, we notice that for all of the regression techniques, by lagging pension assets values for one year, we achieved greater levels of explanation, since all R^2 and the adjusted R^2 values maintain greater values than the previous regressions. Regarding the statistical significance of pension assets and gross domestic product, we now exploit that these variables maintain a strong relationship for all of the introduced techniques when lagging pension assets variable for one period. This fact reveals that there is a positive coexistence between the two variables we mainly study in this paper. Since linear regression and random effects regression provide the greater level of R^2, we may also introduce a quantitative relation between our variables. However, we also notice that for both methodologies we observe that not all variables provide for every occasion statistical significance and as a result it would be inappropriate to introduce a model in which variables with

low statistical significance would exist. For simplicity we will introduce a model with this kind of characteristics but only for the purposes of the main objective of this paper. In the analysis that follows we will further investigate methods to solve this particular issue and as a result all variables would potentially provide statistical significance (p-value<10%).

Below we observe the relevant equation, exported from linear regression or OLS estimation method (which contains the higher R^2) results. As you may notice, PFA variable is lagged (t-1).

Equation 6.1 Linear Regression Estimators

$$logGDP_{i,t}=0.041063+ 0.014996 * logPFA_{it-1} + 0.25007 * logGFCF_{it} - 0.000045493*DCPS_{it} + 0.0018052* INFL_{it} - 0.00012798*PD_{it} + 0.10142* logPOP_{it}$$

Variables such as DCPS, INFL and PD, maintain small values as their coefficients, due to the fact that these variables are nominated in nominal values and the nominal values refer to millions of dollars, whereas PFA, GFCF and POP maintain bigger coefficients since they refer to logarithmic differences which are percentages.

At this point we may conclude that if all other variables of our model remain constant, an x% increase in pension assets for the previous year, would occur according to our estimates a 1.499% increase for current year gross domestic product as noted to equation 6.1, implied from our linear regression model. Finally, we may now answer the main question of this paper. According to our estimates, we may conclude that **the increasing pension fund assets of the previous year have a significant positive relation with the economic growth of the current year, for the data sample of 38 OECD countries for the period of 2006-2021.**

In a similar analysis by (Bijlsma, Bonekamp, & Van Ewijk, 2018), the authors studied the impact of increasing pension assets on economic growth by using data from 69 manufacturing industry sectors in 34 OECD countries for the period 2001–2010. The authors once again found that increased pension savings are associated with higher growth for specific industries. Once again, the variable which refers to the pension assets is used as with a lagged effect in their model, as the authors found evidence that it takes time for additional pension savings to lead to higher investment and growth.

Further proceeding with analysing the relationship between pension assets and gross domestic product, we imply an additional technique which is highly recommended from the academic community, introduced by (Wooldridge, 2002) for cross-section panel data analysis which is the first-differenced (FD) estimator. FD is an approach that is used to address the problem of omitted variables in econometrics and statistics when using panel data. The estimator is obtained by running a pooled OLS estimation for a regression of the differenced variables. With this technique, we once again exploit whether a connection exists between PA and GDP, but with no lag effect, since we didn't accomplish statistical significance with this effect. Goal of the additional technique of course is to exam whether we accomplish additional information regarding the model we implemented. Finally, this technique also allows us to procced with safer results since by origination first

differences eliminate any potential not stationarity effects that our data may obtain, as we examined earlier. Thus, no modifications were made on our data in order to procced with the analysis.

Above we will find Table 6.5 in which we observe the statistical findings, regarding this specific methodology we introduced above. At a first glance, we observe that we achieve greater levels of explanation R^2 from every other method we used previously, 0.7642 from approximately 0.40 to 0.50 earlier.

Table 6.5 Empirical results for the econometric panel models

Variables	***FD Estimator***
PFA	0.072879***
p-value	*0.00%*
GFCF	2.560835***
p-value	*0.00%*
DCPS	-1.80115***
p-value	*0.01%*
INFL	0.044917
p-value	*98.16%*
PD	-0.535305
p-value	*23.29%*
POP	67.457794***
p-value	*0.00%*
Intercept *(βo)*	7.609913**
p-value	*4.82%*
R-squared	**0.7642**
Adjusted R-squared	**0.7614**

Note: *** indicates statistical significance at the level of 1%; ** indicates statistical significance at the 5% level, and * indicates statistical significance at 10%.
Source: Author Calculations

What we also observe is that with this specific methodology, which is introduced to avoid bias, we obtain much greater statistical significance for a part of our variables, especially for the one we are interested, the pension assets. Values such as PD and POP in this case offer less significance, whereas all other independent values maintained a strong presence of explanation.

At this point we introduce a new model specifying the relationship between our dependent and independent values regarding their first-time differences.

Equation 6.2 First Differences OLS Estimators

$$GDP_{i,t} - GDP_{i,t-1} = 7.6099 + 0.0728 * (PFA_{it} - PPFA_{it-1}) + 2.56 * (GFCF_{it} - GFCF_{it-1}) - 1.80 * (DCPS_{it} - DCPS_{it-1}) + 0.044 * (INFL_{it} - INFL_{it-1}) - 0.535 * (PD_{it} - PD_{it-1}) + 67.45 * (POP_{it} - POP_{it-1})$$

Once again, we may assume that if we exclude all other variables of our model, a one billion $ increase in pension assets on a year over year period, would occur according to our estimates a 7.28 million $ increase for the gross domestic product as noted to equation 6.2, implied from the First Differences OLS Estimation. Of course, this statement only satisfies the theoretical approach of this paper, which is to investigate the relationship between these two values and as we also noticed with this technique the relationship is extremely positive. In order to proceed with estimation for the GDP growth, all other variables will need to be included in case we are willing to proceed with quantified estimations. Thus, we may come to similar conclusions as we did in the previous techniques, that **the increasing pension fund assets have a significant positive relation with the economic growth for the data sample of 38 OECD countries for the period of 2006-2021.** *Albeit we maintain our preferences on the model described by Equation 6.1, as we believe the lagging factor of pension assets variable provides more reasonable explanation regarding the topic we introduce.*

Furthermore, it would also be appropriate to investigate whether the raw panel data of the variables we are interested - pension assets and gross domestic product - shape cointegration relationship through the given period we examine. Generally, researchers perform cointegration tests when time series are nonstationary in order to determine whether the variables maintain a stable, long-run relationship. Both of the variables contain non-stationarity, as we exploited earlier with the relevant tests. For this purpose we are going to use a cointegration test technique which is an extension of the traditional (Engle & Granger, 1987), for the test of the null of no cointegration for cross-sectional time-series panel data, presented by (Pedroni, 1999). In his paper Peter Pedroni describes a method for testing the null hypothesis of no cointegration with several tests, in dynamic panels with multiple regressors. With this specific technique seven different statistics are introduced. According to (Pedroni, 1999) of these seven statistics, four are based on what is commonly referred to as the within-dimension, and the rest three as the between-dimension. Panel statistics, defined as within-dimension-based statistics include a variance ratio statistic, a non-parametric Phillips and Perron type r-statistic, a non-parametric Phillips and Perron type t-statistic and a Dickey–Fuller type t-statistic. Group-mean statistics is defined as between-dimension-based statistics and is based on a group mean approach. The set includes, in this case, a Phillips and Perron type r-statistic, a Phillips and Perron type t-statistic and finally an Augmented Dickey–Fuller type t-statistic (Gutierrez, 2003).

The following specification of null and alternative hypotheses is used,

H_0: *No cointegration*

H_1: *Cointegration*

In Table 6.6 below we observe the results of all seven hypothesis tests we conducted based on Pedroni methodology. For all these tests both *Empirical* and *Standardized* statistics were exploited through this specific methodology. Empirical results refer to the actual outcomes of a statistical test when applied to a specific dataset. While standardized results refer to a transformed version of the empirical test statistic that is scaled in a way that makes it easier to interpret and compare across different studies or scenarios. The standardized test statistic is calculated by dividing the empirical test statistic by its estimated standard error.

Table 6.6 Pedroni panel data cointegration test statistics

Statistics	*Empirical*	*Standardized*
panel v	31049830.00***	3446895.00***
panel ρ	-92.58***	-8.36***
panel t	-16.49***	-7.88***
panel ADF	-0.00004	5.32***
group ρ	-92.71***	-8.21***
group t	-16.50***	-10.59***
group ADF	-16.67***	-10.80***

Note: *** indicates rejection of H_0 at the level of 1%; ** indicates rejection of H_0 at the 5% level, and * indicates rejection of H_0 at 10%.
Source: Author Calculations

According to the study, for the panel variance statistic, large positive values imply that the null of no cointegration is rejected. For each of the other six test statistics, these diverge to negative infinity under the alternative hypothesis, and consequently the left tail of the normal distribution is used to reject the null hypothesis. Thus, for any of these latter tests, large negative values imply that the null of no cointegration is rejected. Furthermore, (Baltagi, 2013) provides a formal interpretation of a rejection of the null: "Rejection of the null hypothesis means that enough of the individual cross-sections have statistics 'far away' from the means predicted by theory were they to be generated under the null." As we may advocate on both Empirical and Standardized approaches, the vast majority of the test statistics maintain far greater absolute values than the 2.576, which is the statistic that represent a 99% confidence interval, except for the paned ADF test of the Empirical approach, where we fail to reject the null hypothesis. Under these assumptions, we may exploit that all of the above statistics indicate that the null hypothesis is strongly rejected. Therefore, our examined variables maintain a cointegration relationship. This procedure once again acknowledges the

conclusions that we exploited previously in this chapter, that these two variables hold a strong positive relation overtime, which of course is the main purpose of this study. Finally, we are going to present graphicly how these values shape overtime and examine whether we can exploit the cointegration effect visually. We randomly chose to study the examples of United Kingdom and Israel, in order to present the shaping of both gross domestic product and pension assets in usd terms over the examined period.

Chart 6.3 United Kingdom GDP& PA in nominal USD terms

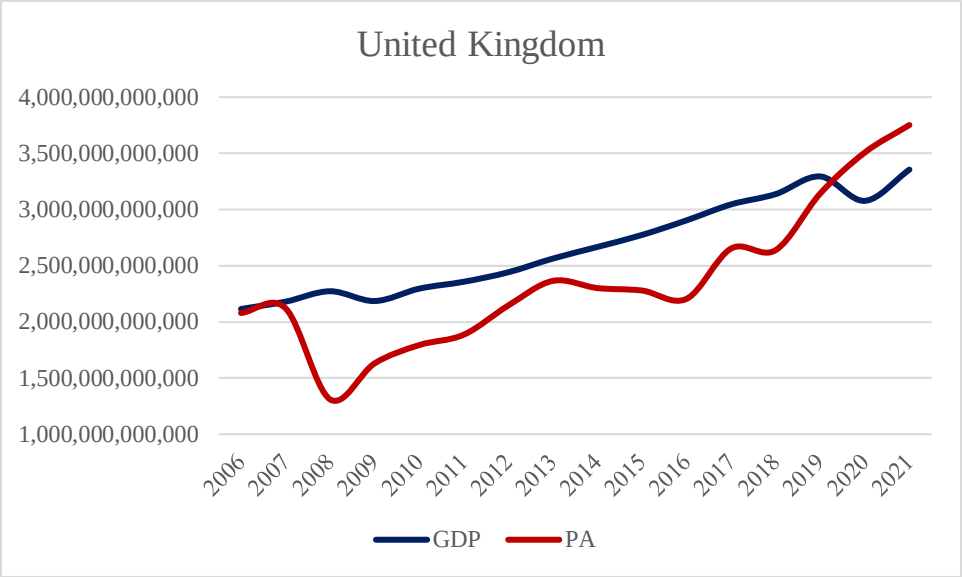
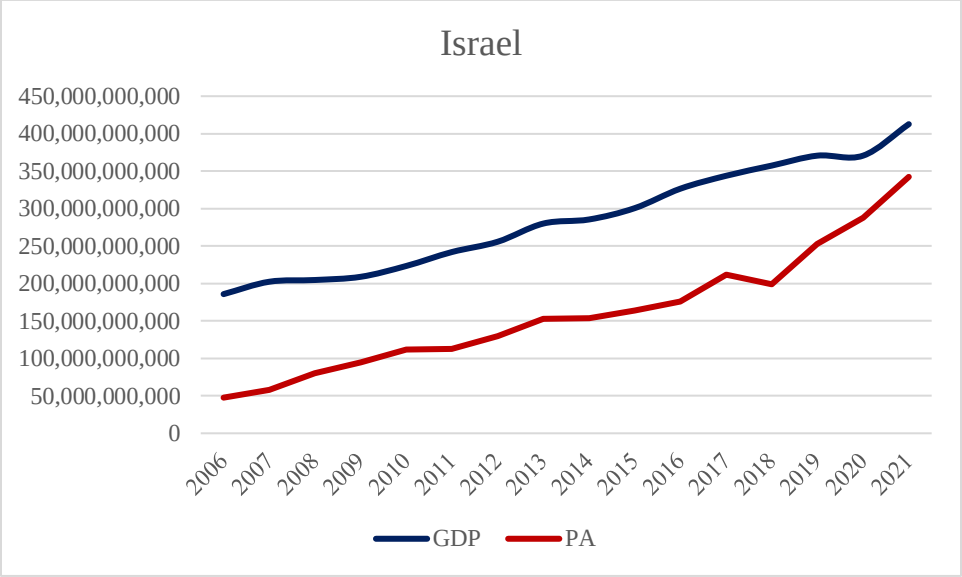


Chart 6.4 Israel GDP& PA in nominal USD terms



What we notice for both countries is that, visually the dynamics of GDP and PA present similar characteristics and a positive relationship overtime. This visual effect actually confirms what we exploit earlier via the pedroni cointegration tests. Consequently, we may once again assume that these two values maintain a strong positive relationship, which is the main purpose of this paper.

7. Conclusions and Proposals

After summarizing all the findings we exploited from all previous chapters, we are now standing in a position to verify the existence of a positive relationship between pension assets growth of the (primarily with one year lagging effect) and the gross domestic product for the OECD country members for the period of 2006-2021. Catalysts such as the increasing saving rates, the financial market liquidity and development, the improved foreign direct investments, the prudent corporate governance that pension funds offer by influencing managements and the wealth effect of the citizens, seem to provide additional support when the gross domestic product dynamics are shaping. Pension assets growth is achieved by transitioning from traditional pension systems to funded. As we noticed from the presented data, governments already implement this transformation to achieve sustainability and efficiency for their pension systems, but further initiatives need to be taken. Governments have considered the long-term sustainability these pension systems can offer in the long run since funds are accumulated and invested over time, potentially generating returns that can help cover future pension obligations. In addition, these schemes provide more justice in a sense that every participant is contributing individually. Therefore, every participant will enjoy the future pension income relied on his contributions during his working life. As a result, the beneficiary will be less exposed to demographic challenges and the potential fiscal difficulties an economy might have on his retirement age. Finally, the funded pension funds can be invested in various assets, potentially leading to higher returns than traditional pay-as-you-go pension systems. Under these assumptions we may introduce several proposals regarding potential policy reforms that the governments might need to implement under the today challenges.

First of all, we propose policy makers to legislate frameworks targeting the easy and flexible establishment of occupational funds, so that all businesses and their employees will gain access to participate in this transformation effort. Limited bureaucracy and relaxation of excessive regulation will incentivize even the small-medium enterprises to enter these kinds of schemes, which now have limited access to this service due to their size disadvantage. If this market opens its barriers, more participants will have the opportunity to join and as a result provide additional contributions into supplementing pension schemes (public or private).

Furthermore, we propose policies to encourage and support the use of Pillar 2 and 3. To achieve this additional tax incentives or other benefits should be considered from the policy makers in order to convince the citizens to voluntarily participate in these kinds of schemes. An additional solution that we do not support in the first phase of transformation due to its moral concerns regarding the freedom of financial choices, it would be to further extend the mandatory participation in these capitalized schemes even in the first pillar of the pension system.

Additional efforts should also be devoted into improve the financial education of citizens. Citizens should be provided from the state information regarding the advantages and disadvantages of this option and be provided with proper guidance in order to consider the opportunities this transition has to offer on their future pension income.

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