IOPS Technical Committee

Investment behaviour of pension funds and its impact on financial markets

22 February 2018
Dublin, Ireland

This version:

- includes comments received during and after the Technical Committee meeting in Bella Mare, October 2017
- incorporates data from Italy
- streamlines the text (deletes part of the introduction and the section on Granger test, changes order of sections)
- adds a section 6 on institutional framework
- modifies and extends the conclusion section

Contents

INVESTMENT BEHAVIOUR OF PENSION FUNDS AND ITS IMPACT ON FINANCIAL MARKETS

Project Background

1. While working on the project on 'Macro and micro dimensions of supervision of large pension funds', a consensus amongst the IOPS Members has emerged to undertake a follow-up quantitative analysis on the investment behaviour of pension funds and their impact on financial markets.

Introduction

2. The previous IOPS work on large pension funds (IOPS, 2017) discussed some existing empirical research that focused on pension funds' investment behaviour and their role in financial market stability. These studies seem to indicate that pension funds tend to have a counter-cyclical investment behaviour rather than a pro-cyclical one; therefore contributing to more stable prices in the market during substantial price changes (see Table 1 in IOPS, 2017: 40). However, the existing quantitative research is fragmented in terms of data coverage and methodology.

3. The evidence produced by the Italian Pension Regulator (COVIP) in its past research (see COVIP 2008, 2009) confirmed a clear counter-cyclical behaviour in the large Italian pension funds during the 2008-09 financial crisis. This finding should be predominantly linked to the Italian law which requires that a limited number of investment choices, each characterized by a different strategic asset allocation (SAA), must be established by the pension fund managing companies[1].

4. This report investigates whether the findings from the COVIP study could applicable to other selected jurisdictions. Therefore, the aim of this report is to study the impact of the pension fund sector as a whole on financial markets with the use of the data provided by pension supervisors and methodology developed by the Italian pension supervisor through its past research. In particular, we would like to answer questions such as: 'Are pension funds net buyers of risky assets during crisis?', and: 'Do they buy more risky assets during the crisis than during the normal times?' The study attempts to investigate whether pension funds contribute to financial stability or destabilise the market.

Definitions

5. For the use of this paper we apply the following definitions. Funds act **pro-cyclically** when they are buying assets in a rising market and selling in a falling market. Such strategies could exacerbate price movements in financial markets. Funds act **counter-cyclically** when they are selling assets in a rising market and buying in a falling market. Such strategies could stabilise price movements in financial markets. (c.f. Blake et al., 2015: 20).

6. Over the time, funds may also change their **propensity for buying (selling)** so that to adjust to the changing market conditions and to allow for rebalancing their asset holdings. For example, in a rising

[1] See more in the section *Institutional determinants of pension funds' investment behaviour*.

market a fund may continue purchasing (selling) a particular class of assets, however may decide, as compared to the previous periods, to decrease or to increase the relative size of its net purchases (sales) of the asset compared to total investments in all assets during the period. Alternatively, pension funds may rebalance their asset allocation by simply refraining from taking any action, i.e. they may hold on their position without making additional investment or disinvestment.

7. **Net purchase of equities** is the difference between the amount of purchased equity and the amount of sold equity during each quarter, while **net new investment** is a sum of net purchases of all asset classes during each quarter. Relevant definitions for other types of assets apply.

Scope, data and method

8. This report looks into the investment behaviour of pension funds during and after the 2008-09 financial crisis until 2014-2016 in four IOPS jurisdictions: Chile, Italy, Mexico, and Poland[2]. It uses full or partial data, depending on availability, submitted by their pension supervisors. Although the number of participating jurisdictions is small, such detailed information set on purchase and selling by asset classes is very rare and helps in understanding the nature of pension funds investment behaviour and their impact on financial markets.

9. The data classify pension funds' investments into five asset classes: cash and deposits, public bonds, private bonds, equity, and others. The data tracks values of purchases and sales on a quarterly basis. It also describes cash flows calculated at the level of the whole pension sector supervised by the submitting supervisory authorities as well as the information on the macroeconomic situation. The sample periods vary depending on the data availability and cover the spans: 2008.Q1-2016.Q4 for Mexico, 2006.Q1-2014.Q4 for Italy, 2006.Q1-2015.Q4 for Poland, and 2006.Q1-2016.Q4 for Chile.

10. Data on equity transactions and equity market variables are exhaustive, while some information on bond transaction and bond market variables proved to be rather limited. This imperfection imposed a limitation on relevant analyses. Bearing in mind that the most important risky asset class of pension funds' investment is equity, the data can be well utilised in analysing pension funds' investment behaviour and their interaction with financial markets.

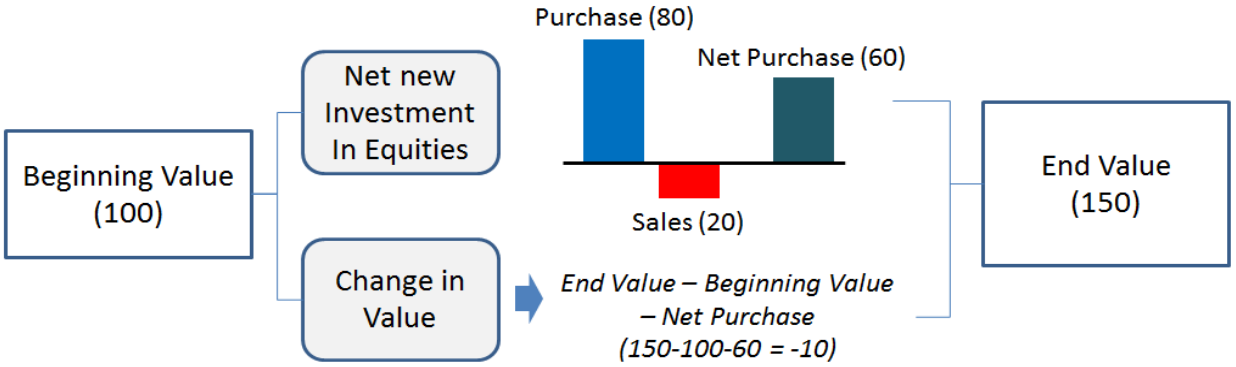
11. When analysing the investment position in a particular asset class one needs to take into account two effects. The value of such a position can change due to *price changes* in the financial market or due to *transactions* concluded by the pension fund manager. Usually, the final result is the result of both effects at the same time. Therefore, when analysing the investment behaviour with the available data, one needs to disentangle the price effect and the transaction effect.

12. Below we present a simple example (Figure 1) to explain the methodology which is used. Let us assume that a pension fund A invests in equity and at the beginning of the quarter has 100 euros invested. If at the end of the quarter the value of the position increases to 150 euros, this can be attributed to different factors: 1) due to the fact that some equity is bought and sold ('net new investment in equities'), and/or 2) due to the changes in equity prices ('change in value'). In our example, if the fund A purchased new equity for 80 euros and sold the other for 20, the new investment in equities (net purchase) will amount to 60 euros (+80-20) which in result makes the change in value position to be minus 10 euros.[3]

[2] We appreciate receiving the data from Russian Federation. However, the data were not included in this analysis due to their short time span and limited coverage.

[3] One needs to note the important simplification that – due to data granularity – needs to be made here. When calculating the net purchases, the final value is based on the series of individual transactions that took place over the

Figure 1. Transaction effect (net new investment) vs price effect (change in value): an illustration



13. By finding the new net investment of pension funds in each sample period, we can identify the investment behaviour of pension funds, i.e. to what extent the changes in the portfolio are related to exogenous price changes and to what extent to pension fund managers' investment decisions. More specifically, by comparing their investments in risky assets during and after the crisis, we can see whether pension funds stabilise or destabilise the market.

Main findings

1. Trends in pension funds' investment amounts and asset allocations

14. The four jurisdictions reveal different profiles of investment by asset classes. This diversity can be attributed to many factors such as institutional framework (see section 6), risk appetite, investment horizon, liability features, structure of incentives for relevant parties, investment experience, and degree of home bias. Figure 2. shows amounts invested and asset allocation.

15. Pension funds in Mexico invested mainly in domestic public bills and bonds (recently 51.2%), while allocation to equity was hovering around 20 percent. However, a slow but consequent trend of increased exposure to equities is also observable since 2009 due to a steady growth of total investments.

16. Pension funds in Poland, until the second quarter of 2014, mainly invested in two asset classes, domestic public bills and bonds (around 50-75%) and domestic equity (around 20-40%). The reform of the pension sector in early 2014 has seriously changed asset allocation making the domestic equity the single major asset class.[4] As this can be regarded the structural change to the Polish pension sector, we excluded the period of 2014-2015 from the sample period used for the quantitative analysis.

17. Differently from Mexico and Poland, Chilean pension funds have maintained a highly diversified portfolio in terms of asset classes. After the global financial turmoil in 2008, there has been a trend of decrease in allocation to cash and deposits (towards 5%) and domestic equity (towards 10%) and an increase in allocation to domestic public sector bills and bonds (25%). More than others, a high proportion of foreign equity (20-35%) is noticeable.

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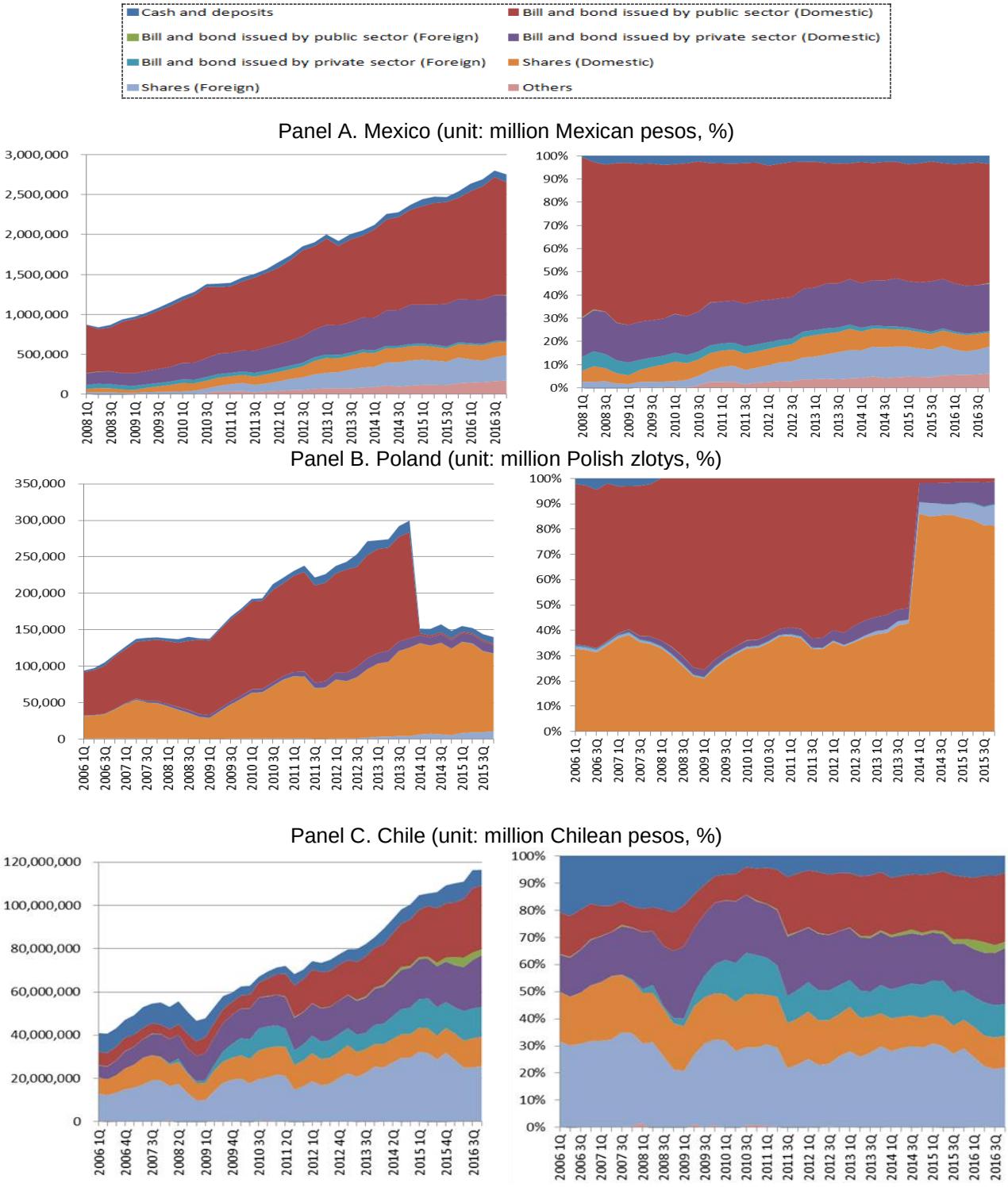
analysed period (quarter). Therefore, the net purchases value does incorporate – to some unknown yet likely minor extent – the price effect. As we do not have daily data, we are not able to fully address this effect. Another simplification is that the 'Change in value' is calculated on a quarterly basis, so it represents the average movement of prices within the quarter. Therefore, it does not precisely take into account the daily fluctuation of equity prices.

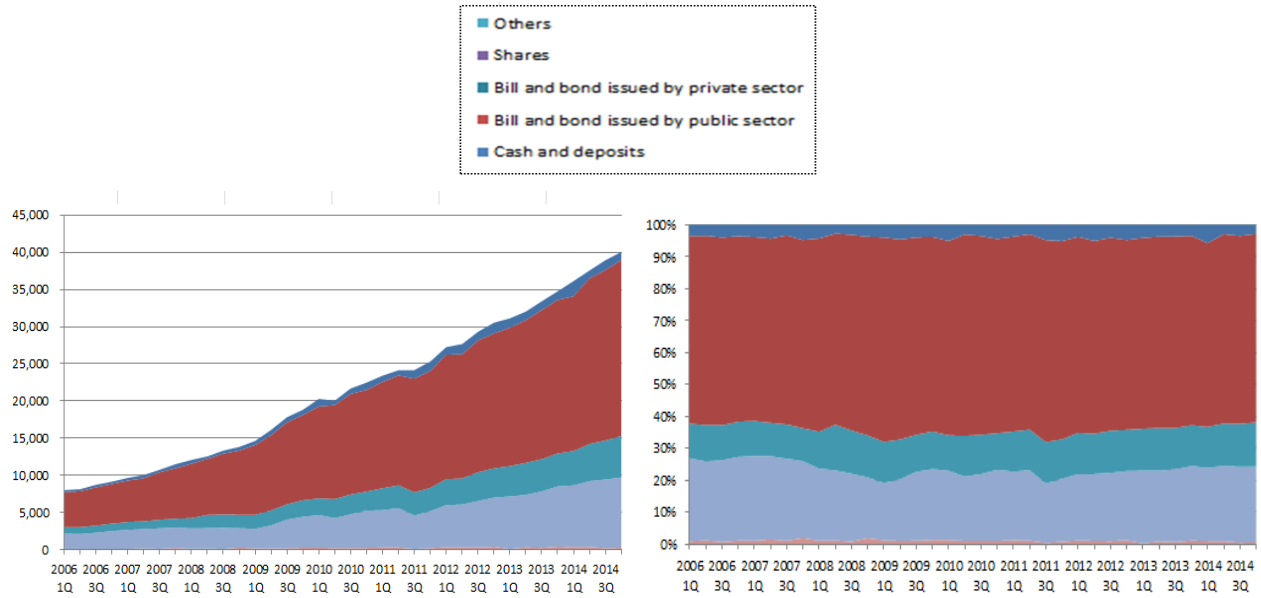
[4] All bonds issued or guaranteed by the governments were transferred to the public security system and subsequently retired. The action was done on the 3rd of February 2014 on the basis of amended pension law.

18. Pension funds in Italy invested mainly in public bills and bonds (approx. 60%), while the combined allocation to private bills and bonds (25%) and equity (15%) was less than half of the total investments. Unfortunately, classification into domestic and foreign investments was not possible due to data limitation. However the information obtained from the pension supervisor indicates that Italian funds investment in bonds tended to be domestic whereas equity investment - foreign.

Figure 2. Trends in pension funds' investment amounts and asset allocation



Panel D. Italy (unit: million Euros, %)



Source: IOPS.

2. Are pension funds net buyers of risky assets during crisis?

19. Do pension funds buy or sell risky assets when the market is falling? Among the various asset classes in which pension funds typically invest, equity can be regarded as the most representative 'risky' investment due to its high volatility and sensitivity to market situations (see Figure 3 and Figure 4.).

20. We analysed movements of the indices representative for global and domestic stock markets. Figure 3 shows the MSCI International World Index Price. One can recognise a sharp drop (-58%, from 1,650 to 700) of stock prices between Q3.2007 to Q1.2009 followed by an initial recovery (85%, from 700 to 1,300) between Q2.2009-Q4.2010..

Figure 3. Movement of MSCI International World Index Price

Source: Markets Data, Financial Times[5].

[5] https://markets.ft.com/data/indices/tearsheet/charts?s=MS-WX:MSI

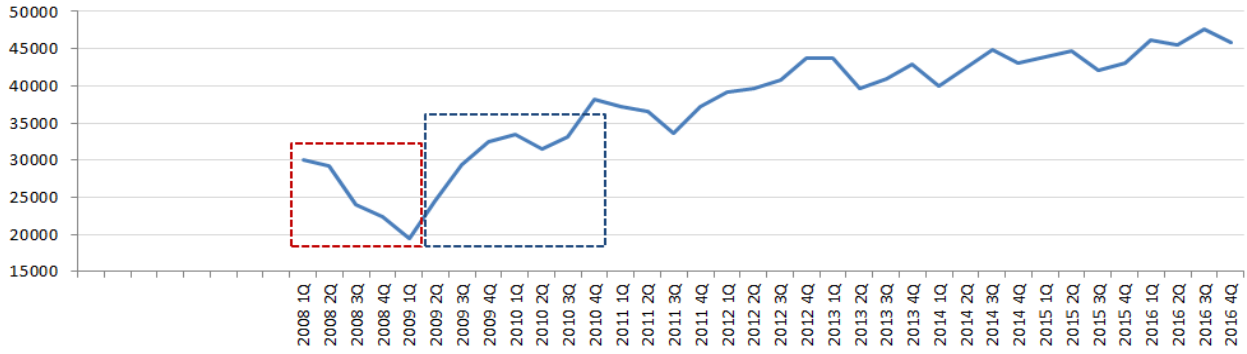
21. In Figure 4, one can notice that domestic stock price in all four countries dropped sharply also between 3Q.2007 and 1Q.2009 and then recovered in the period of 2Q.2009 to 4Q.2010. This indicates that the movements of domestic equity prices were very similar to the movements of the global stock price during the 2008-09 financial crisis, which is the reason why it is called 'global'.

22. Based upon the analysis above, to compare pension fund's behaviour in more details, we identified four sub-periods: 'pre-crisis' (until Q2.2007), 'crisis' (Q3.2007–Q1.2009), 'recovery' (Q2.2009–Q4.2009), and 'post-crisis' (2010-2016).

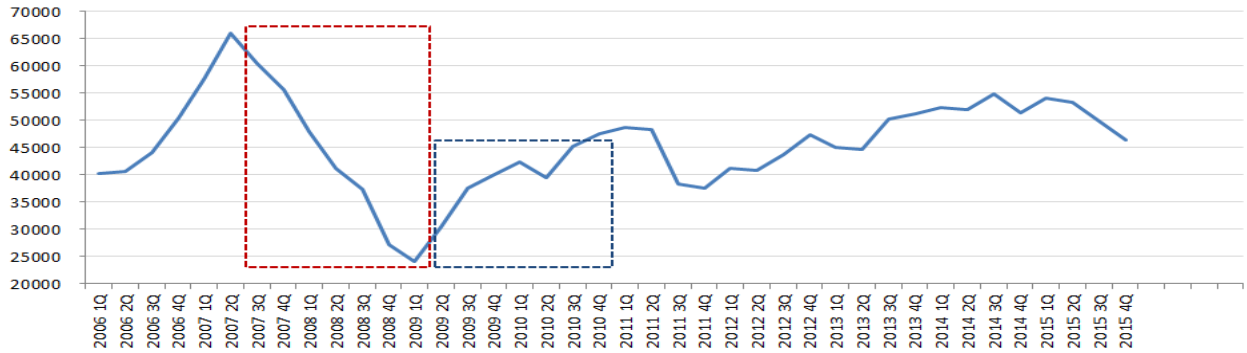
23. An interesting result is that the scale of domestic stock prices decline varied depending on continent. During the crisis, the depreciation of stock prices in European jurisdictions (Poland: -64%, Italy: -46%) was relatively higher than in Latin American countries (Mexico: -34%, Chile: -29%). Whereas, the appreciation during the recovery was higher in Latin America (Mexico: 96%, Chile: 99%) than in Europe (Poland: 98%, Italy: 65%). This difference suggests that the 2008-09 financial crisis had bigger impact in Europe. As we develop our analysis, we can also observe clearer counter-cyclical behaviour in European pension funds, which might be explained by the very magnitude of the crisis.

Figure 4. Movements of domestic stock prices

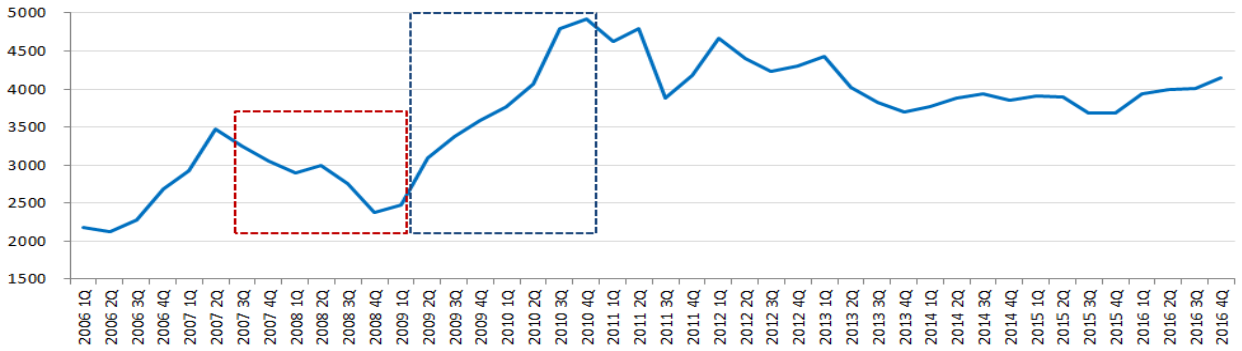
Panel A. Mexico (IPC MEXBOL index, end of quarter)



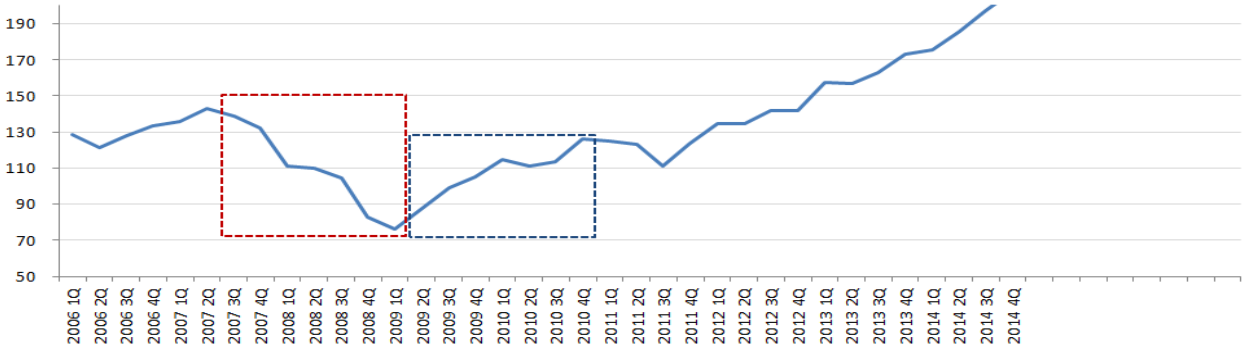
Panel B. Poland (WIG index, end of quarter)



Panel C. Chile (IPSA index, end of quarter)



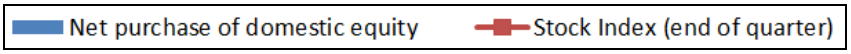
Panel D. Italy (MSCI WORLD E - TOT RETURN Index, end of quarter)



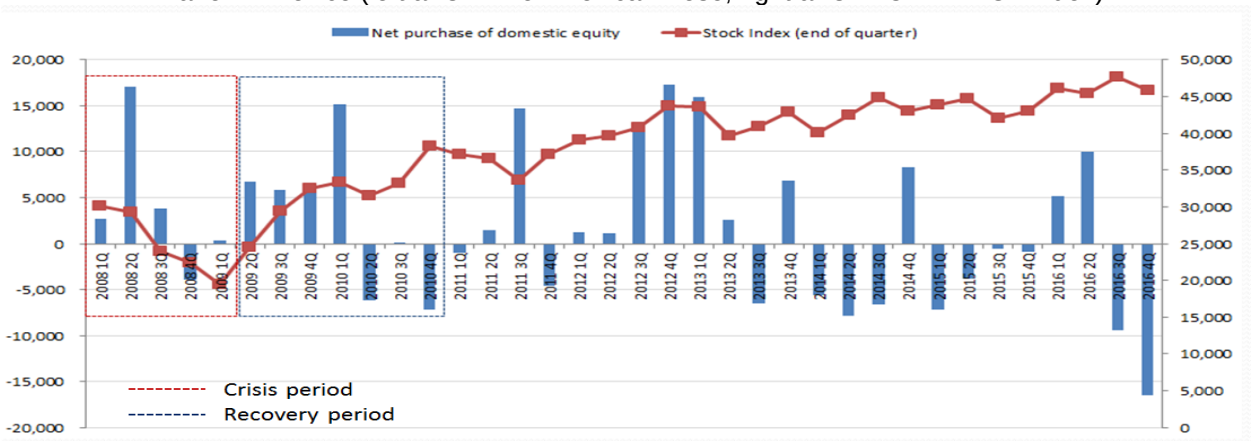
Source: IOPS.

24. Figure 5. shows pension funds' net purchases of domestic equities compared with the representative stock indices in Mexico, Poland, and Chile. For Italy, we compared funds' net purchases of equities and the representative international MSCI World Equity stock index since it was not possible to break down Italian pension funds' net equity purchases into domestic and foreign categories. In three countries it is not easy to find any noticeable graphical relationship between the market performance and funds' purchases. Only in Chile, one can observe consecutive negative net purchases of domestic equities during 2008.

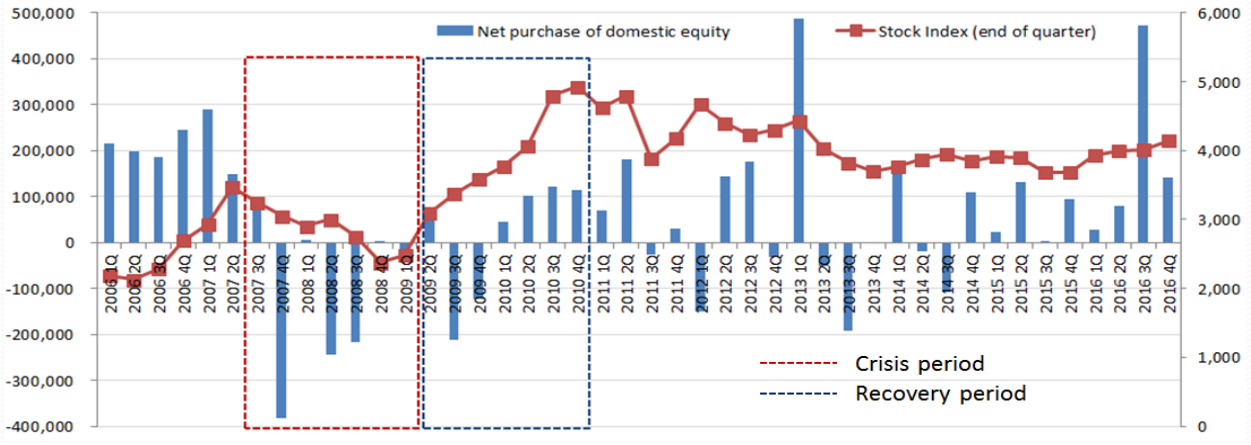
Figure 5. Net purchases of domestic equity vs stock indices



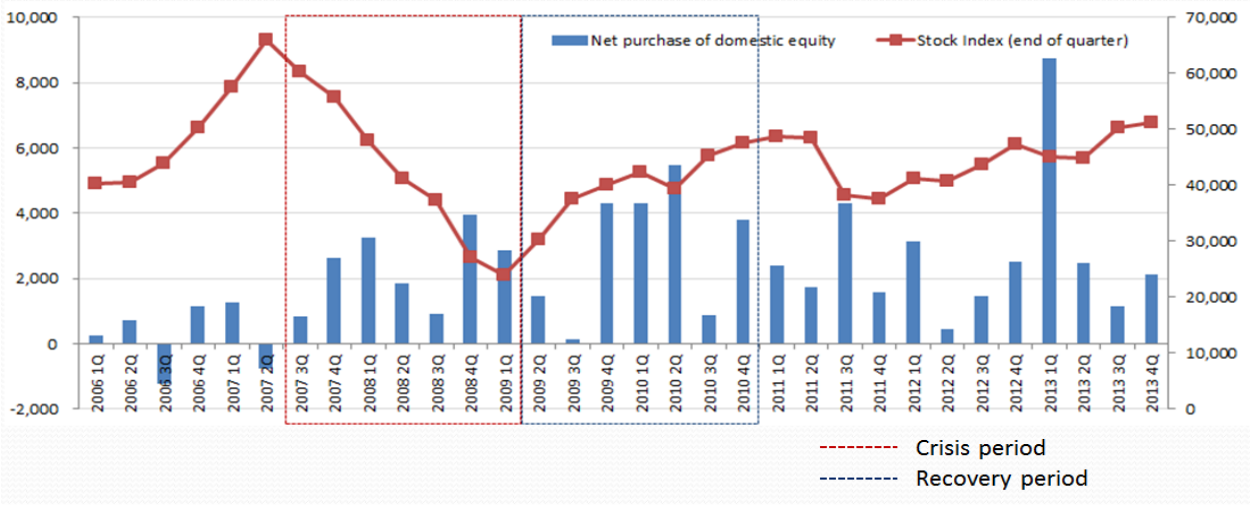
Panel A. Mexico (left axis: million Mexican Peso, right axis: IPC MEXBOL index)



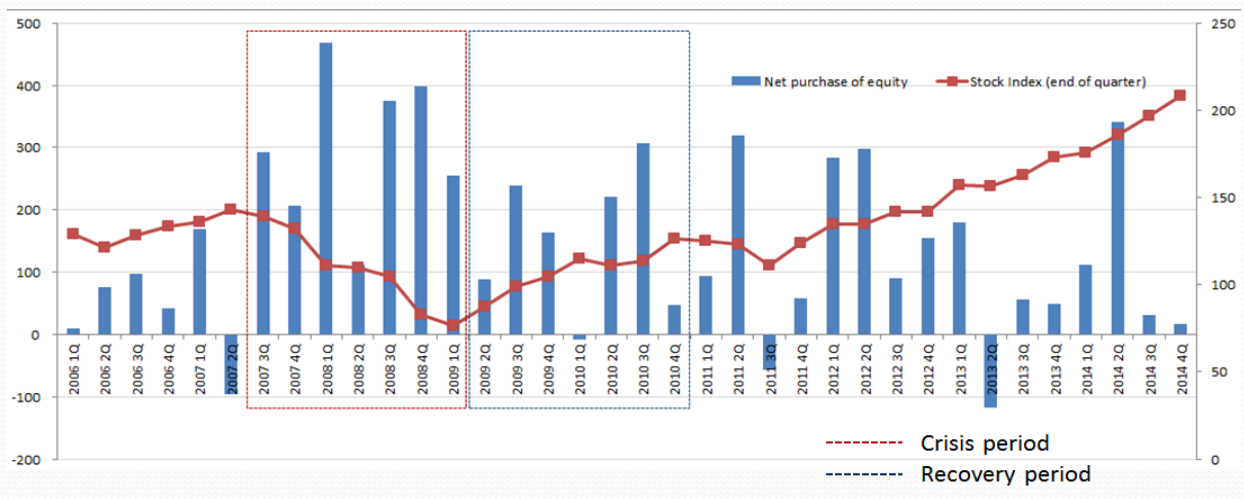
Panel B. Poland (left axis: million Polish Zloty, right axis: WIG index)



Panel C. Chile (left axis: million Chilean Peso, right axis: IPSA index)



Panel D. Italy (left axis: million Euro, right axis: MSCI WORLD E - TOT RETURN Index)



Note: The graph for Poland does not show transactions after 2013 when a structural change in the system occurred.
Source: IOPS.

25. Table 1. contains information on the average and total quarterly net purchases of equity made by Mexican, Polish, Chilean and Italian funds[7]. The values are expressed in national currencies and relate to four sub-periods. The numbers in parenthesis represent shares of net purchase of equity in the total new investments. Although pension funds cannot control the total amount of net new investments, they can decide on how to allocate incoming money among asset classes. Therefore, the share of net purchases of equity can be interpreted as funds' willingness (propensity) to invest in this particular asset class.

Table 1. Net purchases of equities vs net new investments (millions in national currency, %)

Jurisdiction	Periods	Net purchase of domestic equities (a)		Net purchase of foreign equities (b)		Net purchase of equities (c)= (a)+(b)		Net new investment (d)	
		Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period
Mexico	Pre-crisis[8]	N/A		N/A		N/A		N/A	
	Crisis (Q1.2008-Q1.2009[9])	3,988	19,940	-999	-4,993	2,989	14,947	28,732	143,662
		(13.9%)		(-3.5%)		(10.4%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	2,865	20,058	5,067	35,470	7,933	55,528	23,051	161,355
		(12.4%)		(22.0%)		(34.4%)		(100%)	
	Post-crisis (2011-2016)	1,105	26,515	2,737	65,699	3,842	92,214	29,274	702,578
		(3.8%)		(9.4%)		(13.1%)		(100%)	
	Total (2008-2016)	1,848	66,512	2,672	96,177	4,519	162,689	27,989	1,007,595
		(6.6%)		(9.5%)		(16.1%)		(100%)	
Poland	Pre-crisis (2006-Q2.2007)	241	1,444	46	276	287	1,721	5,495	32,970
		(4.4%)		(0.8%)		(5.2%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	2,329	16,302	31	215	2,360	16,517	7,540	52,779
		(30.9%)		(0.4%)		(31.3%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	2,912	20,382	52	362	2,963	20,744	5,834	40,841
		(49.9%)		(0.9%)		(50.8%)		(100%)	
	Post-crisis (2011-2013)[10]	2,673	32,074	222	2,658	2,894	34,732	6,537	78,448
		(40.9%)		(3.4%)		(44.3%)		(100%)	
	Total (2006-2013)	2,194	70,202	110	3,511	2,304	73,713	6,407	205,038
		(34.2%)		(1.7%)		(36.0%)		(100%)	
Chile	Pre-crisis (2006-Q2.2007)	213,241	1,279,449	53,907	323,441	267,148	1,602,890	3,020,821	23,644,128
		(7.1%)		(1.8%)		(8.8%)		(100%)	

[7] We were unable to break down Italian pension funds' net purchase into of domestic and foreign equities.

[8] No data were available for 'before crisis' period in Mexico.

[9] In Mexico, 'Crisis' period is defined as Q1.2008 - Q1.2009 due to lack of earlier data.

[10] Since the pension reform in 2014 can be regarded as a structural change, the 'after crisis' period in Poland is analysed only until the end of 2013.

	Crisis (Q3.2007-Q1.2009)	-109,626	-767,381	259,313	1,815,194	149,688	1,047,813	2,105,051	10,525,253
		(-4.8%)		(11.3%)		(6.5%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	16,235	113,648	282,843	1,979,904	299,079	2,093,552	2,698,680	18,890,763
		(0.6%)		(10.5%)		(11.1%)		(100%)	
	Post-crisis (2011-2016)	73,115	1,754,762	-136,165	-3,267,966	-63,050	-1,513,203	5,347,519	128,340,462
		(1.4%)		(-2.5%)		(-1.2%)		(100%)	
	Total (2006-2016)	54,102	2,380,479	19,331	850,573	73,433	3,231,052	4,122,741	181,400,606
		(1.3%)		(0.5%)		(1.8%)		(100%)	
Italy	Pre-crisis (2006-Q2.2007)	N/A		N/A		50	300	435	2,607
		N/A		N/A		(11.5%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	N/A		N/A		301	2,108	983	6,881
		N/A		N/A		(30.6%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	N/A		N/A		151	1,058	969	6,783
		N/A		N/A		(15.6%)		(100%)	
	Post-crisis (2011-2016)	N/A		N/A		119	1,906	1,004	16,071
		N/A		N/A		(11.9%)		(100%)	
	Total (2006-2016)	N/A		N/A		163	5,373	898	32,342
		N/A		N/A		(16.5%)		(100%)	

Note: *Net purchase* is a difference between amount purchased and amount sold during the quarter, and *net new investment* is a sum of net purchases by asset classes during each quarter. The numbers in parenthesis show the participation of net purchases of equity in total new investments.

Source: IOPS.

26. In Mexico, pension funds' net purchases of domestic equity during the crisis and the recovery periods were quite similar in relative terms - both around 13% of net new investment. Mexican pension funds were therefore stable, but quite moderate, net buyers of domestic equities during the crisis. However, after the crisis, net purchases of domestic equity dropped significantly to 3.8% of net new investment. Meanwhile, funds were mildly selling foreign equity (net purchases being negative and equal to -3.5% of net new investment) during the crisis, and then quite intensively buying foreign stock (net purchase 22.0%) at the recovery. After the crisis, these purchases decreased to 9.4% but they still represented a larger buying propensity than the domestic equity (3.8%).

27. When analysing the average quarterly net purchases, one can notice that during all periods, Mexican funds bought more foreign equities on a net basis than domestic ones (96 bn vs 66.5 bn). Also, from the perspective of net purchases of equities as a whole asset class, Mexican funds were net buyers during the whole analysed period.

28. In spite of the crisis, Polish pension funds made large net purchases of domestic equity. Before the crisis, such purchases amounted to merely around 4% of net new investment, but this ratio increased to almost 31% during the crisis, and to almost 50% during recovery. Apparently, managers were buying depreciating stock during the bear market but they were buying even more when the market reversed. After the crisis, new net investments slightly decreased to some 40%. On the other hand, trading in foreign

equities was minimal during all periods. This lack of interest in foreign assets was partly resulting from low foreign investment limit (set up at that time at 5%) and partly due to accounting disincentives present in the pension law.

29. Average quarterly purchases of domestic equities increased ten times from 241 m PLN before the crisis to levels of 2 300 m and 2 900 m during the crisis and the recovery. What is interesting, after the crisis the funds were still quite intensively buying domestic equities (approx. 2 700 m PLN per quarter) but they tended to invested more when the prices were dropping (see the transactions indicated in Figure 5. Panel B, 3Q 2011–1Q 2013). Similarly to Mexico, the pension funds in Poland were net buyers of equities (domestic and foreign) during the whole period.

30. Differently from Mexico and Poland, Chile observed its pension funds' net selling of domestic equities during the crisis and limited net purchases at the recovery. In Chile, before the crisis, the propensity of buying domestic equities was quite low and accounted for 7.1% of net new investment, with even much lower ratio (1.8%) in case of foreign equities. At the onset of the financial crisis the funds moved to selling their domestic equities holdings (negative ratio of -4.8% during the crisis) while increasing level of foreign equity net purchases (11.3% of net new investment). During the recovery funds had almost no appetite for increasing their domestic equity positions (0.6% of net new investment) and after the crisis purchases continued to be very low (1.4%). For foreign equities, funds kept on buying foreign equities at similar level (10.5%) during the recovery but interestingly, they became a net seller of foreign equities in the period after the crisis (-2.5%).

31. When looking at quarterly average data one can see that during the crisis, Chilean funds were disposing of domestic equities at almost half the speed at which they were buying them before (approx. 110 000 m pesos per quarter) with quintupled purchases of foreign equities (259 000 m). During the recovery funds became net buyers of domestic equities again, however at very low level (over 16 000 m pesos per quarter) and increased even further the amount of foreign equities bought per quarter (to over 280 000 m). After the crisis funds increased their average purchases of domestic equities over four times (to more than 73 000 m pesos) but became quite intense net sellers of foreign equities (over 136 000 m pesos per quarter). Contrary to Poland and Mexico, pension funds in Chile acted twice as net sellers of equities: during the crisis they were reducing their domestic equity holdings and after the crisis they were reducing their foreign equity holdings.

32. In Italy, one can see clearer signs of counter cyclical behaviour as pension funds increased their investments to equities when the stock price dropped. Before the crisis, pension funds invested in equities around 12% of their new investments, but during the crisis increased purchases to over 30%. As the stock price started to rise, Italian pension funds lowered their propensity to buy stocks to 15% during recovery and to 12% after the crisis, i.e. a similar level as during the pre-crisis period.

33. The results are similar for the quarterly average data. Italian pension funds were buying around 50 m euros of equities before the crisis, but the average quarterly purchases increased six times to 301 m euros during the crisis. Afterwards purchases halved to 151 m euros during the recovery and decreased to 119 m euros after the crisis. Funds were net buyers of equities during all the periods.

34. The above findings indicate that pension funds in Mexico and Poland kept buying domestic equity during the crisis when a sharp drop in equity markets was experienced, while funds in Chile were net sellers at this period. Italian funds did invest mainly in foreign equities. Interestingly, Mexican and Chilean pension funds showed asymmetric behaviour for domestic and foreign equity. During the crisis, Mexican pension funds became net sellers of foreign equity while they were net buyers of domestic equity. On the other hand, Chilean pension funds were net sellers of domestic equity and net buyers of foreign equity. Pension funds in Poland and Italy, who experienced bigger impact of the financial crisis performed

a counter-cyclical behaviour during the crisis as they increased their investment on equity heavily. Reaction of those two countries differed after the crisis. Italian funds lowered their propensity for buying foreign equities after the crisis whereas Polish funds even increased it, therefore acting pro-cyclically for the recovering domestic stock market.

35. To summarise the above discussion, Table 2 provides some conjectures on pension funds' investment behaviour in equity markets during and immediately after the crisis of 2008. It must be emphasized that these conjectures are based on the average value calculated for a particular sub-period (e.g. crisis, recovery) where the value itself is based on the average volumes of transactions for several quarters. Therefore, it may be the case that within each quarter under the analysis pension funds actually had revealed different behaviour. Later in the paper we use each individual quarterly data in the correlation analysis (see analysis from the Table 7).

36. Counter-cyclical behaviour during the crises can be found in domestic equity markets for Mexican and Polish pension funds and in foreign equity markets for Chilean and Italian funds. Pro-cyclical behaviour during the crisis can be noted in Chile in case of domestic equity market and Mexico in case of foreign equity markets. During the recovery period all jurisdictions revealed pro-cyclical behaviour; with Chile and Poland being rather negligibly pro-cyclical in case of, respectively, domestic and foreign equities.

Table 2. Pension funds' investment behaviour in equity markets

Jurisdiction	**Domestic equities**		**Foreign equities**		**Behaviour during all four periods (pre-crisis, crisis, recover, post-crisis)**
	crisis	**recovery**	**crisis**	**recovery**	
Mexico	–	+	+	+	net buyers of domestic equities*
Poland	–	+	(–)	(+)	net buyers of domestic and foreign equities
Chile	+	(+)	–	+	
Italy	n/a	n/a	–	+	net buyers of foreign equities**

Notes: **+:** pro-cyclical investment behaviour, **-:** counter-cyclical investment behaviour, (): weak effect with negligible average quarterly net investments (< 1% of total quarterly new investments), n/a: no data on domestic equities for Italy, *: no data on pre-crisis period for Mexico, **: most equity investment in Italy related to foreign equities

Source IOPS.

37. The second asset class of risky assets analysed here are private sector bonds. During the 2008-09 financial crisis, many jurisdictions experienced 'a flight to quality' phenomenon, which led to the credit crunch and sky-rocketing credit spreads of private sector bonds (see Figure 6.). This result is in line with our definition of crisis period, as one can observe a steep rise of bond yields from Q3 2007 to Q1 2009, followed by a gradual decrease from Q2 2009 to Q4 2010.

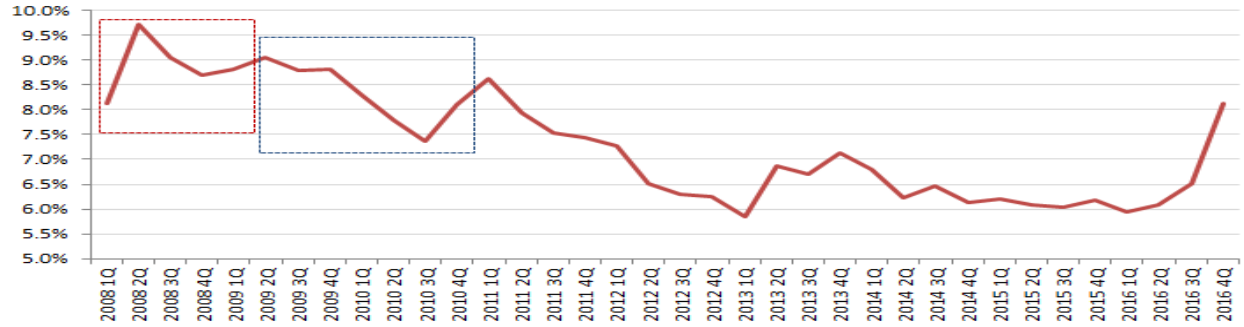
Figure 6. 10-Year High Quality Market (HQM) Corporate Spot Rate[13]

Source: U.S. Department of the Treasury retrieved from FRED, Federal Reserve Bank of St. Louis[14]

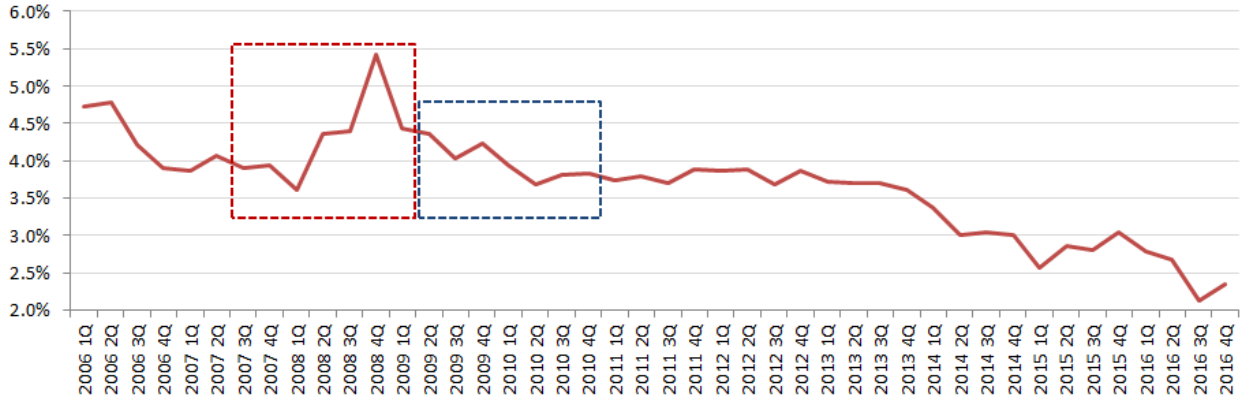
38. Figure 7. shows the changes in representative private bond's yields for Mexico, Chile and Italy. The data was provided by pension supervisors. Unfortunately, yields for Poland were not available. In these three jurisdictions, one can observe a steep rise of corporate bonds yield (i.e. falling bond prices) during the crisis followed by a gradual decrease (i.e. increasing bond prices) during the recovery.

Figure 7. Movements of domestic private bond yields

Panel A. Mexico (AMX_07-3, 10Y, end of quarter)



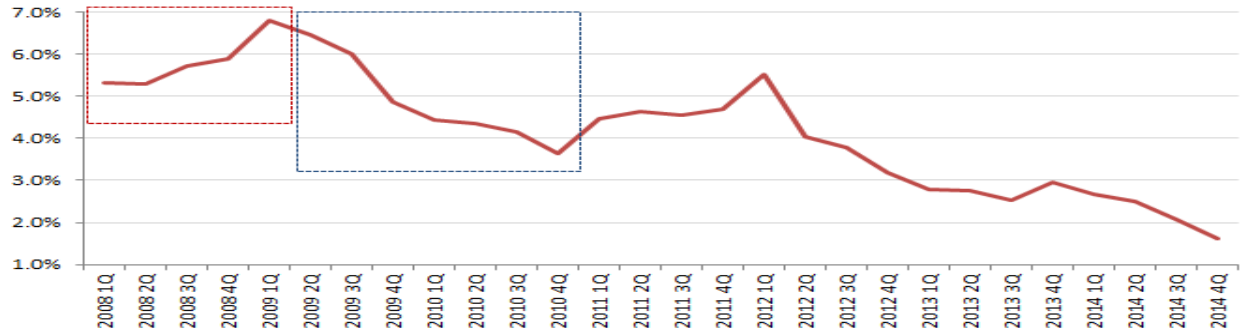
Panel B. Chile (LVACH Corp UF D5-9 AA Index; Duration: 7Y, end of quarter)



Panel C. Italy (Citi EuroBIG Corporate Index 7-10Y - Redemption Yield, end of quarter)

[13] *The spot rate* for any maturity is defined as the yield on a bond that gives a single payment at that maturity. This is called a zero coupon bond. As high quality zero coupon bonds are not generally available, the High Quality Market (HQM) methodology computes the spot rates to make them consistent with the yields on other high quality bonds. The HQM yield curve uses data from a set of high quality corporate bonds rated AAA, AA, or A that accurately represent the high quality corporate bond market (Federal Reserve Bank of St. Louis).

[14] https://fred.stlouisfed.org/series/HQMCB10YR



Source: IOPS.

39. Table 3. shows net purchases of private sector bonds made by pension funds in the researched jurisdictions (in national currency). For Italy only total investment in private bonds was available as it was not possible to differentiate between the domestic and foreign investments. Mexico was not included in the table due to incomplete data on private bond investments.

Table 3. Net purchases of private sector bonds vs net new investments (millions in national currency, %)

Jurisdiction	Periods	Net purchase of domestic private bonds (a)		Net purchase of foreign private bonds (b)		Net purchase of private bonds (c)= (a)+(b)		Net new investment (d)	
		Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period
Poland	Pre-crisis (2006-Q2.2007)	152	913	21	124	173	1,037	5,495	32,970
		(2.8%)		(0.4%)		(3.1%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	314	2,199	28	194	342	2,393	7,540	52,779
		(4.2%)		(0.4%)		(4.5%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	307	2,151	65	452	372	2,603	5,834	40,841
		(5.3%)		(1.1%)		(6.4%)		(100%)	
	Post-crisis (2011-2013)	1,719	20,626	-11	-137	1,707	20,489	6,537	78,448
		(26.3%)		(-0.2%)		(26.1%)		(100%)	
	Total (2006-2013)	809	25,889	20	634	829	26,523	6,407	205,038
		(12.6%)		(0.3%)		(12.9%)		(100%)	
Chile	Pre-crisis (2006-Q2.2007)	702,221	4,213,324	-203	-1,217	702,018	4,213,107	3,020,821	18,124,923
		(23.2%)		(-0.01%)		(23.2%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	552,713	3,868,988	177,031	1,239,216	729,743	5,108,204	2,292,065	10,525,253
		(24.1%)		(7.7%)		(31.8%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	370,476	2,593,330	1,134,572	7,942,004	1,505,048	10,535,334	2,698,680	18,890,763
		(13.7%)		(42.0%)		(55.8%)		(100%)	
	Post-crisis (2011-2016)	541,210	12,989,032	-48,888	-1,173,310	492,322	11,815,722	5,347,519	128,340,462
		(10.1%)		(-0.9%)		(9.2%)		(100%)	

	Total (2006-2016)	537,833	23,664,674	181,970	8,006,693	719,804	31,671,367	4,122,741	181,400,606
		(13.0%)		(4.4%)		(17.5%)		(100%)	
Italy	Pre-crisis (2006-Q2.2007)	N/A		N/A		46	275	435	2,607
		N/A		N/A		(10.5%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	N/A		N/A		133	931	983	6,881
		N/A		N/A		(13.5%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	N/A		N/A		82	573	969	6,783
		N/A		N/A		(8.4%)		(100%)	
	Post-crisis (2011-2014)	N/A		N/A		201	3,223	1,004	16,071
		N/A		N/A		(20.1%)		(100%)	
	Total (2006-2014)	N/A		N/A		139	5,002	898	32,342
		N/A		N/A		(15.5%)		(100%)	

Note: *Net purchase* is a difference between purchased amount and sold amount during the quarter, and *net new investment* is a sum of net purchases by asset classes during the quarter. The numbers in parenthesis show the participation of net purchases of private bonds in total new investments.

Source: Authors' analysis.

40. In Poland, net purchases of all private bonds before the crisis were equal to 3.1% of net new investment, then increased to 4.5% during the crisis and rose to 6.4% in the recovery. This indicates that pension funds were still buying private sector bonds even during the most severe credit crunch period. The absolute percentages of net new investment allocated to private sector bonds were not large but still represented not a negligible share, bearing in mind the small portion of private sector bonds in the portfolio. However, Polish pension funds started to invest more in private bonds afterwards as the share of new money allocated to this asset class increased to 26.1% after the crisis. During the crisis funds increased slightly their purchases of domestic private bonds (from 2.8% before the crisis to 4.2% of net new investment in the crisis) and increased them again (to 5.3%) in the recovery.

41. In volume terms, Polish funds doubled the net quarterly average amounts of private bonds purchased during the crisis (342 m PLN) as compared to the pre-crisis period (173 m PLN), and then purchased similar amounts during the recovery (372 m PLN). After the crisis the funds were intensively buying private bonds (over 1 700 m PLN per quarter on average). Similarly to Polish funds' behaviour for equity markets, the trading in foreign private bonds was minimal during all periods.

42. In Chile, differently than for equity, net quarterly average purchases of private bonds increased during the crisis. Before the crisis, almost 1/4 of net new investment was allocated to private domestic or foreign bonds, but this ratio increased to almost 1/3 during the crisis, and 55.8% in the recovery period. This was mainly due to a huge increase of net investment in foreign private bonds (which jumped from -0.01% before the crisis to 7.7% during the crisis and 42.0% during the recovery). However, after the crisis Chilean pension funds lowered their appetite for private bonds to 9.2% of net new investment which is much lower than the pre-crisis level (23.2%). The funds were even mildly selling foreign private bonds (-0.9% of net new investment) during 2011-2016. Purchases of private bonds during the total period represented 17.5% of net new investment, which is much larger than percentage of net purchases of equity (1.8%).

43. When analysing quarterly average amounts of purchases, the change in investment behaviour of Chilean funds is quite clear. Initial purchases of domestic private bonds of over 700 000 m pesos per quarter were reduced to 550 000 m during the crisis and to 370 000 during the recovery. Funds started buying more domestic bonds afterwards – the average increased to over 540 000 m. Allocation to foreign bonds was changing even more substantially, but in the opposite direction. One can thus observe a huge increase of average quarterly purchases during the crisis – the values increased from -203 m pesos at the pre-crisis period to over 170 000 during the crisis and record-high 1 135 000 m during the recovery. Then pension funds began selling foreign bonds with an average speed of 49 000 m pesos per quarter.

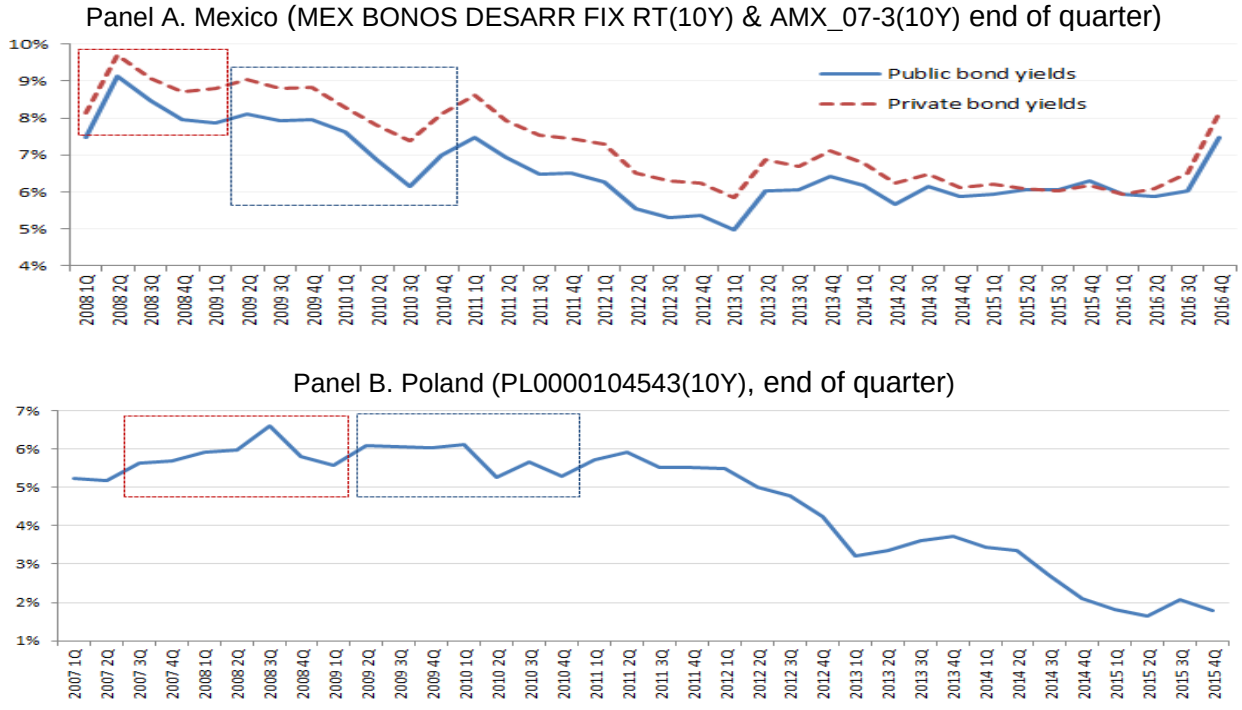
44. Also in Italy, net average quarterly purchases of private bonds slightly increased during the crisis (from 10.5% to 13.5%). But unlike Chile, net purchases of private bonds decreased during the recovery (8.4%) followed by a huge increase of net purchase after the crisis (20.1%)

45. The average quarterly net purchases tripled during the crisis (133 m) as compared to pre-crisis period (46 m), and then almost halved during the recovery (82 m). After the crisis, Italian pension funds increased their average purchases of private bonds up to 201 m which is even higher than during the crisis.

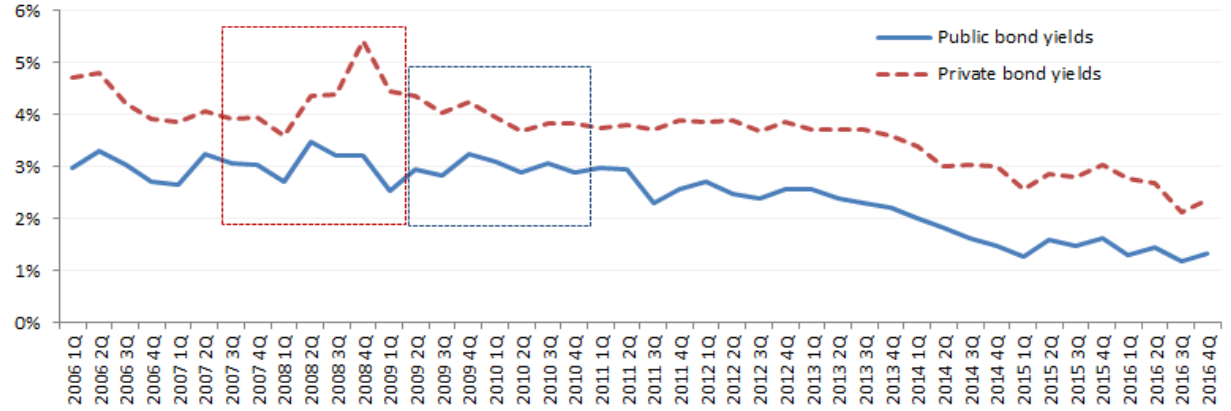
46. Due to lack of information about the price behaviour of (at least representative) private bonds we were not able to judge whether funds' transactions were of pro-cyclical or counter-cyclical character.

47. In the next step we analysed the investment behaviour of pension funds with regard to cash, deposits, and public bonds during the crisis. These asset classes are considered the most secure assets. Figure 8. shows the development of public and private bond yields in each jurisdictions (data for Polish private bond yields was not available). Public bond yields in Poland, Chile and Italy remained relatively stable during the crisis as compared to private bond yields. The only exception is public bond yields in Mexico as they increased at a similar level to private bond yields. However, for Mexico one can assume public bonds as a secure asset, since there were few alternative assets to invest during the crisis and public bond yields were still lower than private bond yields.

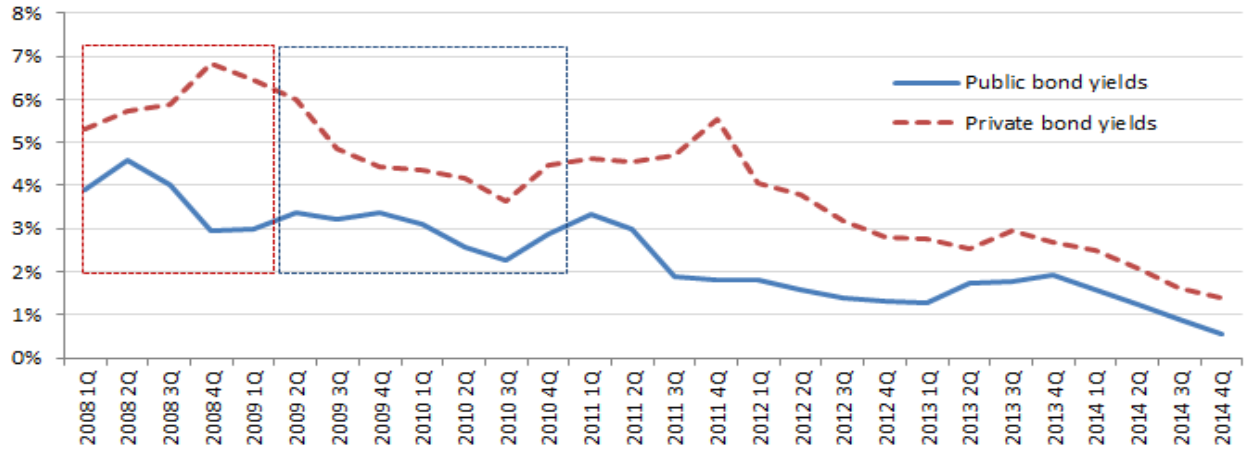
Figure 8. Movements of domestic public bond yields vs. private bond yields



Panel C. Chile (LVACH Gob UF D7-9 Index(7.5Y) & LVACH Corp UF D5-9 AA Index(7Y) end of quarter)



Panel D. Italy (EMU BENCHMARK DS GOVT. Index(10Y) & Citi EuroBIG Corporate Index(7-10Y), end of quarter)



Note: No private bond yields available for Poland.

Source: IOPS.

48. The investment behaviour of pension funds with regard to cash, deposits, and public bonds is presented in Tables 4 and 5.

49. In Poland, there were no net purchases of cash and deposits, so public bonds were the only secure assets bought. It can be noted that majority of total net investments by Polish pension funds were public bonds: before the crisis such bonds almost all (91.6%) of net new investment but this ratio dropped to 64.2% during the crisis, and 42.8% in the recovery period. After the crisis, it decreased even deeper to 29.6% as Polish pension began to invest more money in private bonds.

50. The average amounts of new purchases of public bonds by Polish funds changed from the pre-crisis level of 5 040 m PLN per quarter to 4 800 m PLN per quarter during the crisis and decreased to 2 500 PLN per quarter as the situation in the financial markets was improving. This may suggests some counter-cyclical behaviour in the recovery period. After the crisis their average purchases of public bonds amounted to almost 2 000 m PLN per quarter. During all periods, the share of foreign bonds in the bonds trade was very low and represented less than 0.1% of net new investments.

51. In Chile, before the financial crisis pension funds heavily increased their positions in cash and deposits (68% of new net investments) with a very small investment in public bonds (0.5%). During the crisis, Chilean pension funds decreased portion of investments in cash & deposits (42% of net new investments) and used new money to invest more in public bonds (20%) as well as private bonds (c.f. Table 3), which should have helped bond markets to stabilise. This could be viewed as a counter cyclical behaviour During the recovery, net purchases of all secure assets dropped by half to 33% of net new investments, mainly due to continued decrease of net new investment in cash & deposits (9.1%). But after the crisis, Chilean pension funds reverted to secure assets – the net investment jumped to 92.0% (56% for cash and deposits and 36% for public bonds).

52. The average quarterly net purchases of cash and deposits in Chile were at record high before the crisis (almost 2 040 000 m pesos). At the same time Chilean funds were buying public bonds but at a much lower speed – with the quarterly average of only 14 000 m pesos, of which majority were foreign bonds (over 11 500 m per quarter). Funds kept lowering their net purchases of cash and deposit (over 960 000 m pesos per quarter during the crisis and over 246 000 m per quarter during the recovery. However they became intensive net buyers of public bonds (over 451 000 m pesos per quarter) during the crisis and the recovery period (almost 650 000 m). Both domestic and foreign bonds net purchases were positive during the crisis and the recovery. However, Chilean pension funds were buying more domestic bonds than foreign ones: during the crisis the average purchases of domestic bonds reached almost 400 000 m pesos per quarter and only 52 000 m pesos of foreign bonds. This trend continued in the recovery period as funds enlarged their net purchases of domestic bonds to almost 603 000 m per quarter, while net purchases of foreign bonds stayed around 45 000 m. After the crisis managers in Chile moved towards safe assets again. They intensively increased their cash and deposit holdings (with average net purchases of almost 3 000 000 m pesos per quarter) and public bonds (almost 2 000 000 m pesos). This may signal that the transactions were motivated by rebalancing purposes, i.e. more incoming money put into safe assets were used to offset the effect of improving valuation of risky assets. The structure of purchases of domestic vs foreign public bonds after the crisis remained similar: funds were buying around 8 times more domestic bonds (over 1 730 000 m pesos per quarter) than foreign ones (over 191 000 m pesos).

53. It can therefore be concluded that during all periods both in Poland, and Chile, pension funds were buying much more domestic public bonds than foreign ones.

54. In Italy, during the total observed period (2006–2016) pension funds invested mainly in public bonds (65% of their net new investment). Before the crisis, percentage of new purchases of public bonds was 68%, but it decreased to 53% during the crisis which suggests that Italian pension funds acted somehow counter-cyclically. As the economy recovered, percentage of new purchases of public bonds increased back to 69% (the recovery period) and 67.1% (post-crisis period) being similar to pre- crisis period. Net investment in cash and deposit was minimal and amounted to less than 3% of net new investment during the all observed periods. However it can be noted that Italian funds during the crisis lowered their net new investments in cash and deposits to 2% as compared to pre-crisis period (8%), and increased them again in during the recovery (6.2%).

55. The average quarterly net purchases of public bonds in Italy increased as total net new investments increased. Before the crisis net purchases were 296 m euros; subsequently they increased to 525 m euros (the crisis), 669 m euros (the recovery), and 674 m euros (after post-crisis).

Table 4. Net purchases of secure assets vs net new investments (millions in national currency, %)

Jurisdiction	Periods	Net purchase of cash and deposits (a)		Net purchase of public bonds (b)		Net purchase of secure assets (c)= (a)+(b)		Net new investment (d)	
		Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period
Poland	Pre-crisis (2006-Q2.2007)	0	0	5,035	30,213	5,035	30,213	5,495	32,970
		(0.0%)		(91.6%)		(91.6%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	0	0	4,838	33,869	4,838	33,869	7,540	52,779
		(0.0%)		(64.2%)		(64.2%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	0	0	2,499	17,494	2,499	17,494	5,834	40,841
		(0.0%)		(42.8%)		(42.8%)		(100%)	
	Post-crisis (2011-2013)	0	0	1,936	23,227	1,936	23,227	6,537	78,448
		(0.0%)		(29.6%)		(29.6%)		(100%)	
	Total (2006-2013)	0	0	3,275	104,802	3,275	26,523	6,407	205,038
		(0.0%)		(51.1%)		(51.1%)		(100%)	
Chile	Pre-crisis (2006-Q2.2007)	2,037,733	12,226,398	13,921	83,528	2,051,654	12,309,926	3,020,821	18,124,923
		(67.5%)		(0.5%)		(67.9%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	961,206	6,728,445	451,428	3,159,996	1,412,634	9,888,441	2,292,065	16,044,458
		(41.9%)		(19.7%)		(61.6%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	246,280	1,723,958	648,274	4,537,918	894,554	6,261,876	2,698,680	18,890,763
		(9.1%)		(24.0%)		(33.1%)		(100%)	
	Post-crisis (2011-2016)	2,995,597	71,894,324	1,922,651	46,143,619	4,918,248	118,037,943	5,347,519	128,340,462
		(56.0%)		(36.0%)		(92.0%)		(100%)	
	Total (2006-2016)	2,103,935	92,573,125	1,225,570	53,925,061	3,329,504	146,498,187	4,122,741	181,400,606
		(51.0%)		(29.7%)		(80.8%)		(100%)	
Italy	Pre-crisis (2006-Q2.2007)	35	208	296	1,773	330	1,981	435	2,607
		(8.0%)		(68.0%)		(76.0%)		(100%)	
	Crisis (Q3.2007-Q1.2009)	19	134	525	3,675	544	3,809	983	6,881
		(2.0%)		(53.4%)		(55.4%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	60	422	669	4,682	729	5,104	969	6,783
		(6.2%)		(69.0%)		(75.2%)		(100%)	
	Post-crisis (2011-2014)	8	132	674	10,786	682	10,918	1,004	16,071
		(0.8%)		(67.1%)		(67.9%)		(100%)	
	Total (2006-2014)	25	896	581	20,915	606	21,811	898	32,342
		(2.8%)		(64.7%)		(67.4%)		(100%)	

Note: *Net purchase* is a difference between purchased amount and sold amount during the quarter, and *net new investment* is sum of net purchases by asset classes during the quarter. The numbers in parenthesis are the shares of net purchase of a particular type of safe assets in total new investments.

Source: Authors' analysis.

Table 5. Net purchases of public sector bonds vs net new investments (millions in national currency, %)

Jurisdiction	Periods	Net purchase of domestic public bonds (a)		Net purchase of foreign public bonds (b)		Net purchase of public bonds (c)= (a)+(b)		Net new investment (d)	
		Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period	Average per quarter	Total per period
Poland	Pre-crisis (2006-Q2.2007)	5,020	30,117	16	95	5,035	30,213	5,495	32,970
		(91.3%)		(0.3%)		(91.6%)		(100%)	
	Crisis (Q3.2008-Q1.2009)	4,849	33,946	-11	-77	4,838	33,869	7,540	52,779
		(64.3%)		(-0.1%)		(64.2%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	2,518	17,623	-18	-129	2,499	17,494	5,834	40,841
		(43.1%)		(-0.3%)		(42.8%)		(100%)	
	Post-crisis (2011-2013)	1,929	23,149	6	77	1,936	23,227	6,537	78,448
		(29.5%)		(0.1%)		(29.6%)		(100%)	
	Total (2006-2013)	3,276	104,835	-1	-33	829	104,802	6,407	205,038
		(51.1%)		(-0.0%)		(51.1%)		(100%)	
Chile	Pre-crisis (2006-Q2.2007)	2,355	14,128	11,567	69,400	13,921	83,528	3,020,821	18,124,923
		(0.1%)		(0.4%)		(0.5%)		(100%)	
	Crisis (Q3.2008-Q1.2009)	398,789	2,791,524	52,639	368,472	451,428	3,159,996	2,292,065	16,044,458
		(17.4%)		(2.3%)		(19.7%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	602,899	4,220,293	45,375	317,625	648,274	4,537,918	2,698,680	18,890,763
		(22.3%)		(1.7%)		(24.0%)		(100%)	
	Post-crisis (2011-2016)	1,731,525	41,556,603	191,126	4,587,016	1,922,651	46,143,619	5,347,519	128,340,462
		(32.4%)		(3.6%)		(36.0%)		(100%)	
	Total (2006-2016)	1,104,149	48,582,548	121,421	5,342,513	1,225,570	53,925,061	4,122,741	181,400,606
		(26.8%)		(2.9%)		(29.7%)		(100%)	
Italy	Pre-crisis (2006-2007)	N/A		N/A		296	1,773	435	2,607
		N/A		N/A		(68.0%)		(100%)	
	Crisis (Q1.2008-Q1.2009)	N/A		N/A		525	3,675	983	6,881
		N/A		N/A		(53.4%)		(100%)	
	Recovery (Q2.2009-Q4.2010)	N/A		N/A		669	4,682	969	6,783
		N/A		N/A		(69.0%)		(100%)	
	Post-crisis (2011-2016)	N/A		N/A		674	10,786	1,004	16,071
		N/A		N/A		(67.1%)		(100%)	
	Total (2006-2016)	N/A		N/A		581	20,915	898	32,342
		N/A		N/A		(64.7%)		(100%)	

Note: *Net purchase* is a difference between purchased amount and sold amount during the quarter, and *net new investment* is a sum of net purchases by asset classes during the quarter. The numbers in parenthesis show the participation of net purchases of public bonds in total new investments.

Source: Authors' analysis.

56. Due to lack of information about the price behaviour of public bonds in analysed countries we were not able to judge whether funds' transactions were of pro-cyclical or counter-cyclical character. [For purposes of the next draft we will make an attempt to identify a representative public bond holding for each jurisdiction].

57. In table 6 we summarized the results from Tables 3-5, by grouping asset classes either as secure or risky. In all four jurisdictions, pension funds were net buyers of risky assets (defined as private bonds + equities) during the crisis with the exception of time after the crisis where Chilean funds were selling (foreign) equities. Also, funds in Poland, Chile and Italy increased their new purchases of risky assets during the crisis and lowered investments in secure assets as compared to the period before the crisis. The difference is that during the recovery period, Polish funds were investing more intensively in equities and decreasing investment in public bonds, Chilean funds kept similar level of transactions in public bonds and increased investments in equities, whereas Italian funds strongly increased their new investments in public bonds and strongly lowered their new investment in equities (see Table 5). With regard to cash, both Chilean and Italian funds decreased the proportion of new net investments in this asset class during the crisis. During the recovery Chilean funds further decreased such investments whereas Italian funds increased them. Among three jurisdictions, Italy shows the clearest sign of counter-cyclical behaviour as they reverted back to increasing investments in secure assets and lowering investments in risky assets after the crisis as the economy was recovering.

Table 6. Average quarterly size of transactions in asset classes as % of total new investments

Jurisdictions	Period	Secure Assets			Risky Assets		
		Cash & Deposits	Public bonds	Total	Private bonds	Equity	Total
Mexico	Pre-crisis	N/A	N/A	N/A	N/A	N/A	N/A
	Crisis (Q1.2008-Q1.2009)	N/A	N/A	N/A	N/A	10.4%	N/A
	Recovery (Q2.2009-Q4.2010)	N/A	N/A	N/A	N/A	34.4%	N/A
	Post-crisis (2011-2016)	N/A	N/A	N/A	N/A	13.1%	N/A
	Total (2008-2016)	**N/A**	**N/A**	N/A	**N/A**	**16.1%**	N/A
Poland	Pre-crisis (2006-Q2.2007)	0.0%	91.6%	91.6%	3.1%	5.2%	8.4%
	Crisis (Q3.2007 -Q1.2009)	0.0%	64.2%	64.2%	4.5%	31.3%	35.8%
	Recovery (Q2.2009-Q4.2010)	0.0%	42.8%	42.8%	6.4%	50.8%	57.2%
	Post-crisis (2011-2013)	0.0%	32.6%	32.6%	26.1%	44.3%	70.4%
	Total (2006-2013)	**0.0%**	**51.1%**	**51.1%**	**12.9%**	**36.0%**	**48.9%**
Chile	Pre-crisis (2006-Q2.2007)	67.5%	0.5%	67.9%	23.2%	8.8%	32.1%
	Crisis (Q3.2007 -Q1.2009)	41.9%	19.7%	61.6%	31.8%	6.5%	38.4%
	Recovery (Q2.2009-Q4.2010)	9.1%	24.0%	33.1%	55.8%	11.1%	66.9%
	Post-crisis (2011-2016)	56.0%	36.0%	92.0%	9.2%	-1.2%	8.0%
	Total (2006-2016)	**51.0%**	**29.7%**	**80.8%**	**17.5%**	**1.8%**	**19.2%**

Italy	Pre-crisis (2006-Q2.2007)	8.0%	68.0%	76.0%	10.5%	11.5%	22.0%
	Crisis (Q3.2007-Q1.2009)	2.0%	53.4%	55.4%	13.5%	30.6%	44.2%
	Recovery (Q2.2009-Q4.2010)	6.2%	69.0%	75.2%	8.4%	15.6%	24.0%
	Post-crisis (2011-2016)	0.8%	67.1%	67.9%	20.1%	11.9%	31.9%
	Total (2006-2016)	**2.8%**	**64.7%**	**67.4%**	**15.5%**	**16.6%**	**32.1%**

Note: *Net purchase* is a difference between purchased amount and sold amount during the quarter, and *net new investment* is a sum of net purchases by asset classes during the quarter.

Source: Authors' analysis.

3. Correlation between pension funds' purchase of risky assets and market performance

58. A correlation coefficient is a useful tool to summarise a set of data into single number that depicts the strength of the linear relationship between two variables. Contrary to the analysis of transactions conducted in section 2. where we analysed average values calculated for four sub-periods, here we use all quarterly data on pension funds' transactions. This should help us developing more robust conclusions. Table 7. shows correlations between domestic stock market returns and net purchases of domestic equity expressed in two different ways (as net purchases of domestic equity relative to total net new investment and as absolute value of net purchases of domestic equity). Unfortunately, more frequent (such as monthly) data was not available that would help achieve more granular conclusions.

59. In all four jurisdictions, correlation coefficients are rather strong ranging from -43.6% to 28.8% for the whole available sample periods. However only correlation coefficients in Poland and Italy were statistically significant and negative, indicating somehow counter-cyclical investment behaviour in stock market. In case of Poland these are negative values for total period and the recovery and Italy – for total period and for the crisis and the recovery periods (the last two are significant in the model that uses relative purchases).

60. The above two findings seem to support conclusions from Table 2 with regard to the crisis period (i.e. counter-cyclical behaviour) but question pro-cyclical character of the recovery period. Table 2 shows that during the recovery period funds in these countries were net buyers of equities but lowered their average quarterly purchases both in Poland (from 50.8% to 44.3%) and Italy (from 15.6% to 11.9%). Moreover, the analysis of average values for periods (e.g. crisis, recovery) is based on fewer, "smoothed" values and as such does not take into account individual quarterly values. From this perspective, the analysis based on correlations offers more robust results.

Table 7. Correlation coefficients between domestic stock index returns and net purchases of domestic equity

	Domestic stock index return and	
	net purchases of domestic equity relative to total net new investment	**absolute value of net purchases of domestic equity**
Mexico (Q1.2008- Q4.2016)	5.9% (0.7329)	2.1% (0.9021)
- Pre-crisis	N/A	N/A
- Crisis (Q1.2008 – Q2.2009)	35.3% (0.5602)	26.2% (0.6708)

- Recovery (Q3.2009 - Q4.2010)	43.6% (0.3284)	21.3% (0.6458)
- Post-crisis (Q1.2011- Q4.2016)	-5.0% (0.8179)	-8.9% (0.6791)
Poland (Q1.2006- Q4.2013)	-22.8% (0.2094)	-43.6%* (0.0125)
- Pre-crisis (Q1.2006 – Q2.2007)	16.0% (0.7617)	5.3% (0.9204)
- Crisis (Q3.2007 – Q1.2009)	-30.3% (0.5082)	-70.1% (0.0793)
- Recovery (Q2.2009 - Q4.2010)	-77.5%* (0.0407)	-90.5%* (0.0051)
- Post-crisis (Q1.2011- Q4.2013)	-33.6% (0.2862)	-40.8% (0.1875)
Chile (Q1.2006- Q4.2016)	28.8% (0.0581)	22.9% (0.1356)
- Pre-crisis (Q1.2006 – Q2.2007)	10.6% (0.8416)	-6.1% (0.9080)
- Crisis (Q3.2007 – Q1.2009)	-13.7% (0.7691)	-14.2% (0.7608)
- Recovery (Q2.2009 - Q4.2010)	29.7% (0.5179)	20.6% (0.6578)
- Post-crisis (Q1.2011- Q4.2016)	5.2% (0.8108)	10.0% (0.6432)
Italy (Q1.2006- Q4.2014)[15]	-40.6%* (0.0141)	-42.8%* (0.0091)
- Pre-crisis (Q1.2006 – Q2.2007)	-47.1% (0.3455)	-33.7% (0.5134)
- Crisis (Q3.2007 – Q1.2009)	-85.9%* (0.0132)	-74.7% (0.0537)
- Recovery (Q2.2009 - Q4.2010)	-81.2%* (0.0266)	-52.6% (0.2255)
- Post-crisis (Q1.2011- Q4.2016)	17.0% (0.5290)	20.5% (0.4456)

Note: * denotes statistical significance at 5% critical level.

Source: Authors' analysis.

4. Does pension funds' risky investment affect market performance, or vice versa?

61. In the perspective of financial stability and pro/counter-cyclicality of pension funds' investment behaviour, the question of interest is whether funds' investment behaviour 'causes' changes in financial markets or whether it is the market performance that 'causes' changes in funds' investment behaviour.

[15] Due to lack of data, we used total equity investments instead of domestic equity investments for Italy.

However, it is not easy to test such a real 'causal relationship' quantitatively. Instead, one can test it with the 'Granger causality'.

62. The tests applied used different lengths of lags between variables to investigate causality between domestic stock index performance and pension funds' net purchase of domestic equity We tested two null hypotheses stating respectively that "Domestic stock index returns does not Granger cause pension funds' net purchase of domestic equity relative to total net new investment" (H01) and "Pension funds' net purchase of domestic equity relative to total net new investment does not Granger cause domestic stock index returns" (H02). The results suggest that these null hypotheses could not be rejected. Therefore there is no quantitative evidence for the existence of Granger causality between market situation and pension funds' risky investment[16]. We also tested potential causality between fund net purchases of domestic equity relative to the total investment at the beginning of the quarter.

63. Could any different measure for pension funds' risky investment be used instead of 'net purchase of equity relative to total net new investment'? Indeed, the currently applied measure can be less stable if the amount of total net new investment is too small. To tackle this problem, another measure was used: 'net purchase of domestic equity relative to the total investment at the beginning of the quarter'. A new Granger causality test was conducted[17]. Again, the conclusion is that the two null hypotheses could not be rejected, which suggests again that there is no quantitative evidence for existence of Granger causality between market situation and pension funds' risky investment.

5. Regression analysis of pension funds investment behaviour in equities

64. Multiple regression method was employed to investigate what determines pension funds' investment in equity, the most representative asset class of risky investment. Two measures of risky investment were used. The first is net purchases of domestic equity relative to total net new investment (Model 1), and the second is the absolute value of net purchases of domestic equities (Model 2)[18]. Explanatory variables include domestic stock index returns, MSCI returns, a change in risk-free rate, a change in term premium (where term premium is calculated as the difference of representative domestic government bond yield and short term risk-free rate), a change in credit spread (where credit spread is calculated as the difference between representative domestic corporate bond yield and representative government bond yield), a change in foreign exchange rate, and GDP growth rate. For Model 2, we transformed dependant variable using standardization method[19] to scale down the value of a variable.

65. Domestic stock index returns were split into two variables based on their signs to capture potential asymmetry of pension funds' investment behaviour during positive and negative stock market returns. The choice of representative government bond and corporate bond was left to the submitting jurisdiction as financial markets in each jurisdiction may have different characteristics. These two models were run for each jurisdiction using HAC (heteroscedasticity and autocorrelation consistent) standard errors and covariance to address potential heteroscedasticity and autocorrelation issues.

[16] Granger causality between domestic stock index performance and absolute value of pension funds' net purchase of domestic equity was performed as well with similar results obtained.

[17] Results are not presented here but are available at request.

[18] Models with lagged returns (by one quarter) were also tested. However they did not provide significant results. Moreover, due to the data frequency, it seems very unlikely that pension fund managers would be reacting to stock market changes with such a delay.

[19] $x_{new} = \frac{x - \mu}{\sigma}$

66. Results (Table 8) vary by jurisdictions representing differences in financial market characteristics and their institutional structure. Notwithstanding, the results are not significant therefore do not prove any relation between investment decisions and the current equity market situation. In general, Model 2 shows better fit than Model 1. Model 2 for Poland suggests that pension managers are lowering the amount of net equity purchases when stock index increases. It shows also a negative relationship between absolute net purchases and GDP growth. The same model for Chile and Italy indicates a reverse relationship between changes in term premium (i.e. yield of government bonds net of risk free rate) and absolute value of net equity purchases.

Table 8. Determinants of pension funds domestic equity investment

Explanatory variables	Mexico		Poland		Chile		Italy	
	Model 1	Model2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
Intercept for positive stock index returns	0.0526 (0.6207)	-0.0856 (0.7871)	0.08084 (0.8599)	0.6077 (0.1760)	0.0008 (0.9624)	0.0922 (0.7901)	0.1153 (0.1110)	-0.7118* (0.0310)
Intercept for negative stock index returns	0.2889 (0.0943)	0.6257 (0.1816)	0.1613 (0.5260)	0.4850 (0.3000)	0.0238 (0.2395)	0.2741 (0.4705)	0.4030* (0.0002)	0.5224 (0.0597)
Positive stock index returns	0.6679 (0.5303)	1.7824 (0.5586)	-0.6895 (0.6053)	-8.0682* (0.0065)	0.3361 (0.0763)	2.1427 (0.5495)	-4.5729 (0.2344)	-4.8501 (0.7734)
Negative stock index returns	2.4148 (0.2407)	7.4582 (0.1403)	-1.2208 (0.3028)	-6.1446 (0.1417)	0.5608 (0.1315)	9.3214 (0.1524)	-3.4731 (0.1955)	-8.4846 (0.5364)
MSCI returns	-1.0594 (0.5297)	-5.304 (0.2106)	1.7708 (0.1954)	7.2500 (0.1563)	-0.0263 (0.8866)	0.0444 (0.9860)	4.3680 (0.1490)	10.3031 (0.5078)
Change in risk-free rate	-26.2632 (0.2254)	-87.29 (0.1403)	9.6434 (0.4735)	3.8223 (0.3645)	-2.3869 (0.4259)	-6.3823 (0.8988)	-30.214* (0.0053)	-143.10* (0.0123)
Change in term premium[20]	-9.2222 (0.4930)	-30.2809 (0.4017)	n/a	n/a	-5.1664* (0.0723)	-90.6955* (0.0386)	-18.4579 (0.0676)	-131.32* (0.0044)
Change in credit premium[21]	15.8021 (0.7320)	92.0297 (0.4704)	n/a	n/a	-3.3282 (0.4228)	-131.4061 (0.1278)	-2.6642 (0.0756)	-18.0713 (0.1024)
Change in foreign exchange rate	-1.6629 (0.3858)	-8.3034 (0.0826)	2.2540 (0.1497)	3.8223 (0.3645)	0.1213 (0.3033)	1.3391 (0.5124)	-5.1451 (0.1741)	-2.1723 (0.8943)
GDP growth rate	1.0427 (0.6567)	5.8077 (0.3744)	5.4139 (0.5837)	-28.3704* (0.0209)	-0.1206 (0.5531)	-3.6395 (0.3111)	10.5300 (0.2112)	-18.9323 (0.4082)
R-squared	0.1357	0.2099	0.0986	0.4440	0.1854	0.2489	0.5007	0.5017
Adjusted R-squared	-0.1635	-0.0637	-0.1643	0.2818	-0.0302	0.0501	0.3279	0.3292
#observations	36		32		44		36	

Notes:

1. HAC (heteroscedasticity and autocorrelation consistent) standard errors and covariance method was applied.

2. * denotes statistical significance at 5% critical level.

Source: Authors' analysis.

[20] No data were available for 'Change in term premium' in Poland.

[21] No data were available for 'Change in credit premium' in Poland.

67. As the time series is rather short, we made an attempt to simplify Model 2 by deleting asymmetric variables for intercept and local stock index returns[22]. The results are significant at 5% critical level (Table 9). suggesting that Polish funds tended to lower (increase) their absolute net equity purchases when the local market was improving (deteriorating) or when current GDP growth rate was increasing (decreasing) This may imply some counter-cyclical investment in the area of domestic equities. In the case of Chile, managers of pension funds were decreasing (increasing) their absolute net equity purchases in response to increasing (decreasing) term or credit premiums. This suggests some substitutional effects between domestic equities and treasury bonds. In Italy, pension funds were decreasing (increasing) their absolute net equity purchases in response to increasing (decreasing) risk-free rate or term premiums, which also suggests substitutional effects between equities and treasury bonds.

Table 9. Determinants of pension funds domestic equity investment (simple regression, no asymmetric variables)

Explanatory variables	Mexico		Poland		Chile		Italy[23]	
	Model 2		Model 2		Model 2		Model2	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Intercept	0.0694	0.7640	0.4521	0.0904	-0.0501	0.7949	0.0555	0.7481
Stock index returns	0.2680	0.9005	-6.8601*	0.0270	3.0357	0.1499	-19.3625	0.2381
MSCI returns	-4.5446	0.2733	7.3074	0.1502	0.2544	0.9066	16.5438	0.3406
Change in risk-free rate	-75.8880	0.1807	-31.1081	0.3605	-4.0468	0.9361	-103.080*	0.0121
Change in term premium	-24.0795	0.5110	n/a	n/a	-88.981*	0.0457	-110.168*	0.0188
Change in credit premium	89.5588	0.4794	n/a	n/a	-181.896*	0.0333	-12.0642	0.4198
Change in foreign exchange rate	-7.9334	0.0741	3.6724	0.3572	1.8348	0.3792	-10.4234	0.5709
GDP growth rate	6.7161	0.3245	-28.378*	0.0169	-2.9165	0.3901	-24.9259	0.2509
R-squared	0.1583		0.4382		0.2270		0.3730	
Adjusted R-squared	-0.0521		0.3302		0.0767		0.2163	
#observations	36		32		44		36	

Notes:

1. HAC (heteroscedasticity and autocorrelation consistent) standard errors and covariance method was applied.

2. * denotes statistical significance at 5% critical level.

Source: Authors' analysis.

68. Table 10 presents the results for Model 2 with some variables deleted so as to achieve the best fit (improved in comparison to models presented in Tables 8 and 9). The results basically remain the same as in Table 9.

Table 10. Determinants of pension funds domestic equity investment (simple regression – best fit)

Explanatory variables	Mexico		Poland		Chile		Italy	
	Model 2		Model 2		Model 2		Model 2	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value

[22] Same exercise was done for Model 1; however no improved results were obtained.

[23] Due to lack of data, we used total equity investments instead of domestic equity investments for Italy.

Intercept	0.0619	0.7563	0.5440	0.0951	-0.036684	0.7962	-0.0055	0.9740
Stock index returns			-3.5397*	0.0054			-3.4427	0.1661
Change in risk-free rate			-44.3542*	0.0220			-88.6751*	0.0383
Change in term premium			n/a	n/a	-76.3050*	0.0059	-66.4509	0.2029
Change in credit premium			n/a	n/a	-218.188*	0.0072		
Change in foreign exchange rate	-3.0976	0.2894						
GDP growth rate			-31.9645*	0.0288				
R-squared	0.0415		0.3575		0.1683		0.2693	
Adjusted R-squared	0.0133		0.2887		0.1277		0.2008	
#observations	36		32		44		36	

Notes:

1. HAC (heteroscedasticity and autocorrelation consistent) standard errors and covariance method was applied.

2. * denotes statistical significance at 5% critical level.

Source: Authors' analysis.

69. To investigate solely whether pension funds revealed pro- or counter-cyclical investment behaviour in domestic equity markets we run a single regression model where the stock index returns is the only explanatory variable (Table 11). The results indicate a counter-cyclical behaviour for Poland and Italy (foreign equities). In case of Chile, one may speculate that the funds acted pro-cyclically; however this finding (for model 1) is statistically significant at 7% level.

Table 11. Single regression; pension funds domestic equity investment

Explanatory variables	**Mexico**		**Poland**		**Chile**		**Italy**	
	Model 1	**Model2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
	Coefficient (p-value)		**Coefficient (p-value)**		**Coefficient (p-value)**		**Coefficient (p-value)**	
Intercept	0.0962 (0.1317)	-0.0039 (0.9831)	0.2528* (0.0199)	0.0671 (0.7463)	0.0072 (0.4761)	-0.0549 (0.7564)	0.2002* (0.0000)	0.0974 (0.5475)
Stock index returns	0.2374 (0.7043)	0.2474 (0.8822)	-1.0987* (0.0190)	-3.5341* (0.0009)	0.1924 (0.0656)	2.6585 (0.1027)	-1.1374* (0.0024)	-5.5670* (0.0222)
R-squared	0.0035	0.0005	0.0520	0.1904	0.0829	0.0522	0.1645	0.1835
Adjusted R-squared	-0.0258	-0.0289	0.0204	0.1635	0.0611	0.0297	0.1399	0.1595
#observations	36		32		44		36	

Notes:

1. HAC (heteroscedasticity and autocorrelation consistent) standard errors and covariance method was applied.

2. * denotes statistical significance at 5% critical level.

Source: Authors' analysis.

6. Institutional determinants of pension funds' investment behaviour

70. While pension funds may follow general strategic asset allocation policies (e.g. to maintain a fixed percentage of assets in equities) which may result in anti-cyclical patter of their transactions, there may be some other factors that also influence their decisions. The institutional framework in a jurisdiction can have a significant impact on the way pension funds invest. Such framework can consist, for example, of *benchmarks* (case of Italy and until recently Poland) which can be combined with *investment penalties* for underperformance (case of Chile and until recently Poland) or *freedom of members to switch* between different pension providers and investment portfolios (case of Chile and Mexico). Below we provide a short discussion of the institutional arrangements that exist in the investigated countries and the potential role these arrangements can have on the way pension funds invest.

71. In Italy, the actual asset allocation of pension funds is expected to diverge from the strategic asset allocation (SAA) determined by the benchmark only up to a certain point. The deviation boundaries, usually defined in terms of tracking error volatility with respect to the benchmark portfolio, are set consistently with the SAA, and are defined in the pension fund internal rules and described in the Statement of Investment Policy Principles. Therefore, in the Italian context the strategic asset allocation benchmarks act as a binding commitment for pension funds and imply almost mechanical rebalancing of their investments in response to the changes in portfolios' asset prices. This reduces the degree of divergence from the SAA. Ceteris paribus, pension funds buy these asset classes which experience falls in prices, and sell asset classes whose prices increase. In other words, there is a built-in counter-cyclical mechanism in the institutional setting of Italian pension plans with respect to the behaviour of asset prices.

72. Pension providers (AFPs) in Chilean pension system are required to offer four types of pension funds (known as funds B, C, D and E) and may offer one additional fund (known as fund A). Currently, administrators offer all five types of funds. Different investment restrictions apply to each fund and each fund is invested in portfolios with different risk levels. Fund A is the riskiest fund with a maximum of 80% of the fund invested in stocks, and fund E is the safest fund with up to 5% of the fund invested in stocks. Members may allocate their mandatory savings in two funds at most. Men aged 56 or older and women aged 51 or older, are not permitted to choose Fund A. The same applies for pensioners[27], who are not further permitted to choose Fund B to invest their savings.

73. There is a default allocation for members who do not choose a fund. Members being 35 or younger are allocated to fund B. Men between 36 and 55 years old and women between 36 and 51 years old are allocated to fund C. Finally, men older than 55 and women older than 56 are allocated to fund D by default.

74. In Mexico there are currently types of investment portfolios with different level of risk exposure [to develop or merge with the previous paragraphs]

75. Another institution is the minimum required rate of return, present in Chile, and until September 2013 in Poland. The minimum monthly return is relative and depends on the average return of all funds of the same type. In Chile, the minimum is defined as the lowest between

- the mean of the annual real return over the past 36 months minus 4 percentage points (in case of funds A and B) or minus 2 percentage points (in case of funds C, D, and E) and

[27] This applies for pensioners who take a programmed withdrawal and maintain their savings in the AFP. Pensioners who buy an annuity transfer their savings to an insurance company and do not choose funds.

- ½ of the mean of the annual real return over the past 36 months minus the absolute value of 50 percent.

76. In Poland the minimum rate of return, calculated twice a year at the end of 1st and 3rd quarter, was defined as the lowest between:

- the weighted average of all open pension funds' rates of return for the past 36 months minus 4 percentage points and

- ½ of the weighted average of all open pension funds' rates of return for the past 36 months

77. Both in Chile and Poland, administrator of the fund with a rate of return lower than the minimum is/was obliged to cover the difference. Obviously, this arrangement has influence on the investment behaviour of pension fund managers, which manifested itself in enhanced herding.

Conclusions [This section will be further streamlined, including additional summary tables]

78. The purpose of this paper was to qualitatively and quantitatively analyse the impact of the pension fund sector as a whole on financial markets in the cases of Chile, Mexico, Poland, and Italy. Since only four countries are covered in the study, the applicability of its findings to other pension systems may be limited.

79. We used three methods: an analysis of average quarterly transactions for four sub-periods (pre-crisis, crisis, recovery, post-crisis), a correlation analysis of average quarterly transactions in domestic equity market and its index values as well as a regression analysis of quarterly transactions in domestic equity market and its index values. Bearing in mind the importance of this asset class, the last two methods were used to analyse only domestic equity investments (In Italy, total equity investments were analysed to cover foreign equity which was the majority of equity investments).

80. The tables below provide some summary of the results which are discussed further in this section.

Table 12. Summary - Domestic equity, time of crisis

Jurisdiction/Method	Transaction analysis	Correlation analysis	Single regression analysis
Mexico	continue buying counter-cyclical	?	?
Poland	continue buying **counter-cyclical**	weak negative sign (at 8%) **counter-cyclical (?)**	negative sign **counter-cyclical**
Chile	selling pro-cyclical	?	?
Italy	not applicable	not applicable	not applicable

* ? : not statistically significant (more than 5%)

Table 13. Summary - Foreign equity, time of crisis

Jurisdiction/Method	Transaction analysis	Correlation analysis	Single regression analysis
Mexico	selling pro-cyclical	no analysis yet	no analysis yet

Poland	continue buying but still negligible amounts counter-cyclical but negligible amounts	no analysis yet	no analysis yet
Chile	continue buying counter-cyclical	no analysis yet	no analysis yet
Italy	continue buying **counter-cyclical**	negative sign **counter-cyclical**	negative sign **counter-cyclical**

81. Regarding the investments in risky assets during the 2008-09 financial crisis, pension funds in Mexico, Poland, and Italy[28] continued buying domestic equity even during the period of sharp drop in equity markets. On the contrary, Chilean funds were selling domestic equity during the crisis and acted cautiously during the recovery. Having said that, the data shows that pension funds in Mexico decreased their net purchases of domestic equity over time, and that Polish pension funds' purchases increased over the turbulent period and were higher than before and after the crisis. Interestingly, Mexican pension funds showed asymmetric behaviour between domestic equity and foreign equity by becoming net sellers of foreign equity during the crisis and then relatively strong buyers at the recovery. Chilean funds kept buying foreign equities before and during the crisis but became net sellers afterwards. Net positive investment of Polish funds in foreign equities was of negligible scale through the whole period. Pension funds in Italy increased their net purchases of equity during the period of sharp drop, and then lowered the speed of purchase during the recovery, which shows the clearest sign of counter-cyclical behaviour.

82. On the other hand, pension funds in Poland, Chile, and Italy remained net buyers of private sector bonds, another important risky investment of pension funds, during the periods of crisis and recovery in 2008 and 2009. In the case of Poland one can even notice a sizable movement towards domestic pension bonds after the crisis. Chilean pension funds were strong buyers of domestic private bonds before and during the crisis and continued to be net purchasers, although somewhat weaker ones during the recovery and afterwards. Funds in Chile were buying more and more foreign private bonds as the crisis developed, with a very noticeable run for foreign private bonds during recovery, followed by their selling afterwards. Italian pension funds bought more private bonds during the crisis as compared to the previous stage, and then lowered their purchase during the recovery. After the crisis, Italy doubled their allocation of new money to private bonds as compared to the pre-crisis.

83. With regard to public bonds, Polish funds were actively buying them before the crisis and then consequently lowering their average quarterly net purchases over time. The Chilean funds behaved differently – with little purchases before the crisis and then quite sizeable net purchases during the crisis and afterwards. Both their domestic and foreign bonds net purchases were positive during the crisis, however funds were buying considerably more domestic bonds that foreign ones. Italian funds seemed to act counter-cyclically as they lowered the percentage of net new investments in public bonds during the crisis and increased the percentage of public bonds as the economy recovered.

84. Did pension funds buy more aggregated risky assets during the crisis, therefore playing role of liquidity provider to the market of fire sale? In three jurisdictions we have the data (Poland, Chile, and Italy), private funds increased their net average purchases of risky assets (equities and private bonds) during the time of the crisis. The difference is that Polish funds and Italian funds invested heavily in equity market, whereas Chilean funds invested more in private bonds. In Chile, net new investment allocated to bonds (private and public) as a percentage of total net new investments was much higher in the period of

[28] In case of Italy most of investments in equity are related to foreign ones.

crisis compared to period of normal times. This seemed to be helpful to the credit market that suffered from credit crunch and liquidity shortage during the crisis.

85. Granger causality tests were performed to see whether pension funds' investment behaviour affects changes in financial markets or whether the relationship is opposite. The results suggest that there is no quantitative evidence for existence of such causality between these variables.

86. The overview of transactions in domestic equities suggests that pension funds in Mexico and Poland acted counter-cyclically during the crisis and pro-cyclically during the recovery period. Chilean funds seemed to be pro-cyclical during the crisis and mildly pro-cyclical during the recovery (their average new investments during this period were below 1% of total new net investments). Regarding foreign equities, pension funds tended to be countercyclical during the crisis in case of Chile and Italy (with Poland having same pattern but of negligible scale) and pro-cyclical during the recovery in all four jurisdictions (with Poland, again, having a negligible scale of funds' investment activity in this market).

87. The correlation analysis of domestic equity transactions suggests, however, that pension funds in Poland and Italy revealed a counter-cyclical behaviour during the whole horizon for which the data was available as well as during the recovery period. Pension funds in Italy were also counter-cyclical during the crisis, whereas for Poland this finding was s significant only at 8% level. Why are results from correlation analysis different from results coming from the analysis of transactions? A possible explanation is that for the analysis of transactions we analysed average values calculated for four sub-periods, here we use all quarterly data on pension funds' transactions. Therefore, the conclusions based on correlations are likely to be more robust.

88. The regression analysis of domestic equity transactions indicates that Polish funds acted counter-cyclically. The reduced regression model (with domestic stock index as the only explanatory variable) shows that also Italian pension funds behaved counter-cyclically and suggests that Chilean funds acted pro-cyclically - however, the statistical significance of this last finding is somehow weaker – 7%.

89. Overall, we may conject that Polish and Italian funds tended to act counter-cyclically when purchasing equities (domestic Poland, foreign Italy). There is some evidence showing that Chilean funds may have acted pro-cyclically in domestic equity market. However to obtain statistically significant results it seems advisable to disentangle the transaction information into different types of multifunds and analyse the data for at least for two types of portfolios: most aggressive (equity) and most conservative.

90. According to multiple regression analysis the following variables explain pension funds' investment decisions with regard to investment in domestic stock: stock index returns (a negative sign for Poland), change in risk-free rate (negative signs Poland and Italy for foreign equities), change in term and credit premia (negative signs for Chile), and GDP growth rate (a negative sign for Poland).

91. Pension funds investment behaviour might be influenced not only by their strategic decisions but also by other factors that are related to the institutional framework they operate. It seems that Italian and Polish pension funds were influenced in their decisions by the presence of strategic asset allocation benchmarks. The other possible factor is the presence of different types of investment portfolios (multifunds).

92. The data available for Chile and Mexico cover the behaviour of all types of investment portfolios (so-called multifundos). Therefore, there might have been some allocation changes between these investment vehicles over time as a result of pension fund members' reactions to price changes. As result the investment behaviour under the study may be triggered by the combined behaviour of both pension fund managers and pension fund members. Moreover, the overall demand for risky and safe assets may be

driven by the gradual maturing of these pension systems (with some members being moved towards more conservative portfolios as they approach their retirement age). In the next draft of this report we therefore intend to investigate the behaviour of the most aggressive investment funds in Chile and Mexico.

93. From the perspective of stability of financial markets and individual pension fund members, it may seem desirable that some strategic asset allocation benchmarks are set up in the pension system and requirements for managing tracking errors are imposed. These should prevent pension fund managers from assuming too much investment risk that occurs when deviating too far from the long-term investment policy when not reacting to continued and substantial asset changes. The literature suggests that the level of total return is basically the result of funds' policy return (Ibbotson and Kaplan, 2000:32)[30] and therefore such a proposal may help induce managers to sell (buy) highly appreciating (depreciating) assets when the current investment allocation deviates too far from the assumed long-term one.

94. In the next draft we therefore intend to

- analyse the data for multifunds (most aggressive and most conservative) in Chile and Mexico; this could be helpful especially for the correlation and regression analyses
- undertake additional analysis of the situation in bonds' markets (credit spread)
- provide more discussion on institutional framework and its possible impact on pension funds investment behaviour

[30] Ibbotson and Kaplan (2000) state that "On average, the pension funds and balanced mutual funds are not adding value above their policy benchmarks because of a combination of timing, security selection, management fees, and expenses."

Related publications

Blake, David, Lucio Sarno, and Gabriele Zinna (2015), "The Market for Lemmings: The Investment Behavior of Pension Funds", Pension Institution Discussion Paper.

COVIP (2008 and 2009), Commissione Di Vigilanza Sui Fondi Pensione, Relazione Per L'Anno 2008 and 2009, http://www.covip.it/?cat=35.

Franklin R. Edwards, and X. Zhang (1998), "Mutual Funds and Stock and Bond Market Stability", Journal of Financial Services Research, Vol. 13(3): 257-282.

Ibbotson, R., and P. Kaplan P. (2000). Does Asset Allocation Policy Explain 40, 90, or 100 Percent of Performance? Financial Analysts Journal, 56(1), 26-33. Retrieved from http://www.jstor.org/stable/4480220

IOPS (2017), "Macro- and Micro Dimensions of Supervision of Large Pension Funds", K.G. Park and D. Stańko, IOPS Working Papers on Effective Pension Supervision No. 30, International Organisation of Pension Supervisors