IOPS Technical Committee

Investment behaviour of pension funds in Chile, Italy, Mexico and Poland

4-5 June 2018
Paris, France

In this version:

- a new, more clarified, title is proposed (prev. investment behaviour of pension funds and its impact on financial markets)
- the text structure has been revised
- scatter plot analysis (section 4.1) has been introduced
- executive summary has been created
- conclusions section has been streamlined

INTERNATIONAL ORGANISATION OF PENSION SUPERVISORS

Contents

EXECUTIVE SUMMARY

1. The paper analyses qualitatively and quantitatively the investment behaviour pension fund sector during and after the 2008-09 financial crisis until 2014-2016 in Chile, Mexico, Poland, and Italy. Since only four countries were covered in the study, the applicability of its findings to other pension systems may be limited.

2. Four methods were used: an analysis of average quarterly transactions for four sub-periods (pre-crisis, crisis, recovery, post-crisis) for five asset classes (equities, private bonds, public bonds, cash and deposits, and others); a scatter plot analysis of the relation between average quarterly net purchases and quarterly changes in asset value (domestic equities, domestic private bond, domestic public bonds), a correlation analysis of average quarterly transactions in equity market and its index values, as well as, a regression analysis of average quarterly transactions in equity market and its index values.

3. We find that during the 2008-09 financial crisis pension funds in Mexico, Poland continued buying domestic equities, whereas Chilean funds were selling. With regard to foreign equities, Mexican funds became net sellers, while Chilean and Italian funds increased their net purchases. Pension funds in Poland, Chile, and Italy remained net buyers of private sector bonds during the periods of crisis and recovery in 2008 and 2009. For public bonds, Polish funds were actively buying them before the crisis and then consequently lowered their average quarterly net purchases over time, Chilean funds' net purchases became sizeable during the crisis and afterwards. Italian funds lowered the percentage of net new investments in public bonds during the crisis and increased the percentage of public bonds as the economy recovered.

4. Pension funds in Poland, Chile and Italy bought more aggregated risky assets during the crisis, therefore playing role of liquidity provider to the market during fire sale. Polish and Italian funds invested heavily in equity market, whereas Chilean funds invested more in private bonds.

5. The analysis of transactions suggests that in case of domestic equities pension funds in Mexico and Poland acted counter-cyclically during the crisis whereas Chilean funds seemed to be pro-cyclical. Regarding foreign equities, pension funds tended to be counter-cyclical during the crisis in case of Chile and Italy (with Poland having same pattern but of negligible scale) and pro-cyclical in Mexico. We were not able to judge whether funds' transactions for bonds were pro-cyclical or not. The analysis of transactions is based on average transactions during the sub-periods and therefore seems to be less credible than the other methods based on average transactions for individual quarters.

6. The scatter plot analysis reveals that pension funds showed counter-cyclical behaviour in Poland (mainly in domestic market) and Italy (mainly in foreign market). On the other hand, Chilean funds' showed pro-cyclical behaviour in both domestic and foreign equity markets. No strong evidence was observed in case of Mexico.

7. The correlation analysis of domestic equity transactions suggests, 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.

8. The regression analysis indicates that during the whole period Polish funds acted counter-cyclically in case of domestic equities, and Italian - foreign equities. There is also some weak evidence that Chilean may have acted pro-cyclically in domestic equity market and stronger evidence of pro-cyclicality in case of foreign equity market.

9. Investment behaviour by pension funds 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). As result, the investment behaviour under the study may be triggered by the combined behaviour of 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).

10. 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.

INVESTMENT BEHAVIOUR OF PENSION FUNDS IN CHILE, ITALY, MEXICO AND POLAND

Project Background

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

Introduction

12. 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.

13. The evidence produced by the Italian Pension Regulator (COVIP) in its past research (see COVIP 2008, 2009) confirmed a clear counter-cyclical behaviour of 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].

14. This report uses the methodology developed by the COVIP in its past research and the data provided by pension supervisors from Chile, Mexico, Italy and Poland. The main purpose of the report is to investigate whether pension funds from these jurisdictions contributed to stability of financial markets, in particular during the past financial crisis.

15. In Section 1 we analyse historical pension funds' transactions and asset allocation. In Section 2 we track historical movements of risky assets to define when the global crisis occurred and when it recovered. Section 3 investigates characteristics of pension funds' transactions during and after the global crisis. Section 4 analyses how pension funds' purchases of risky assets were related to the market performances and investigates whether pension funds behaved pro-cyclically or counter-cyclically during all periods but with a particular focus on the crisis. In section 5 we search for institutional determinants of pension funds' investment behaviour. Section 6 concludes.

Definitions

16. For the use of this paper we apply the following definitions (see also Figure 9). The first approach is to compare the direction of funds' transactions with the direction of price changes. We define that 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).

[1] See more in the section 5. *Institutional determinants of pension funds' investment behaviour.*

17. The second approach compares the relative size of pension funds' transactions during a particular period with the relative size of transactions in the previous period. Over the time, funds may 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 market a fund may continue purchasing a particular class of assets, however may decide, as compared to the previous periods, to decrease (i.e. be somehow **counter-cyclical**) or to increase (be **pro-cyclical**) the relative size of its net purchases 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.

18. We also define **net purchase of equities** as the difference between the amount of purchased equity and the amount of sold equity during each quarter, while **net new investments** as a sum of net purchases of all asset classes during each quarter. Relevant definitions for other types of assets apply.

19. Net new investments can also be viewed as the net cash flow to a pension fund during the particular period. This is therefore a difference between all inflows (contributions of existing members and assets of new members) and all outflows (retirement benefits to existing members and transfer of assets of departing members).

Scope, data and method

20. 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]. We use full or partial data, depending on availability, submitted by the 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.

21. The data classify investments by pension funds 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. Unfortunately, more frequent data was not available. The data also describes cash flows calculated at the level of the whole pension sector 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.

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

23. This paper focuses on investment behaviour of pension funds with regard to domestic equities. This is because such data is more available and also because an impact of pension funds' investments on a local market is more important, especially in the supervisors' context. Only for Italy we used total equities instead as classification into domestic and foreign investment was not possible.

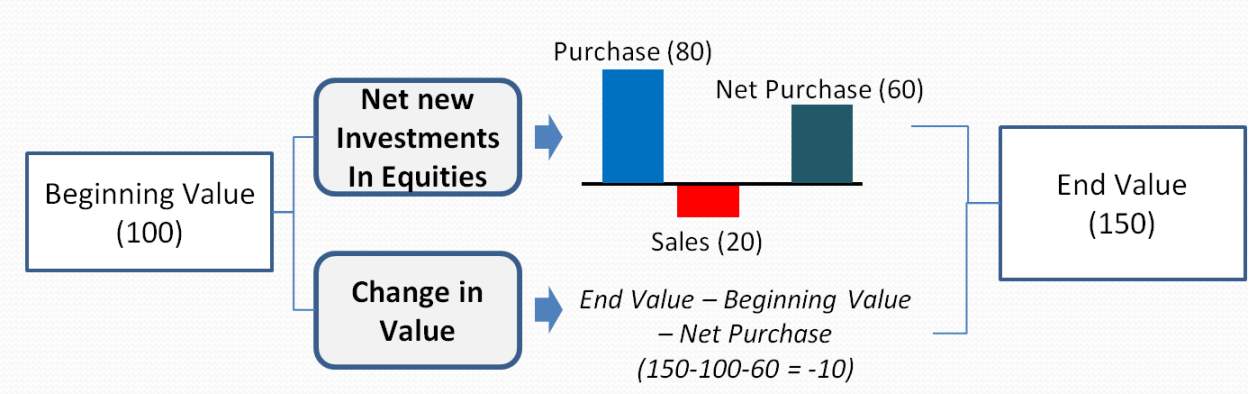
24. When analysing the investment position in a particular asset class one needs to take into account two effects. The value of such a position can change due to *price changes* in the financial market or due to *transactions* concluded by the pension fund manager. Usually, the final result is due

[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.

to both effects at the same time. Therefore, when analysing the investment behaviour with the available data, one needs to disentangle the price and the transaction effects.

25. Below we present a simple example (Figure 1) to explain the methodology used. Let us assume that a pension fund A invests in equity and that at the beginning of the quarter it 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) the fact that some equity is bought and sold ('net new investments in equities'), and/or 2) 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 investments in equities (net purchase) will amount to 60 euros (+80-20) which in result makes the imputed change in value position to be minus 10 euros.

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



Source: Authors.

26. By finding the new net investments 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.

27. One needs to note the important simplification that – due to data granularity – must be made here. When calculating the net purchases, the final value is based on the series of individual transactions that took place over the analysed period (a 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.

1. Trends in pension funds' asset allocations

28. 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 5.), 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.

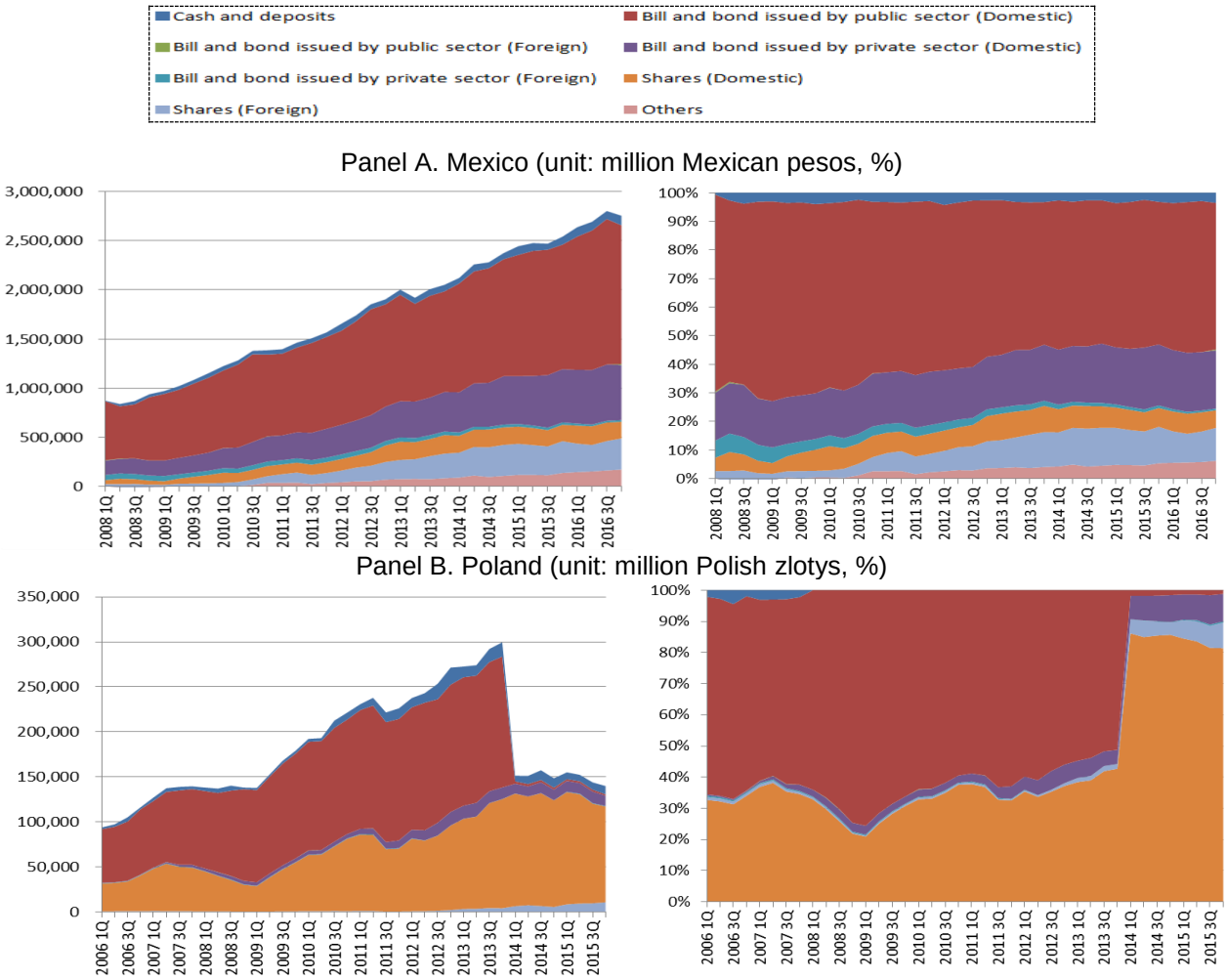
29. Pension funds in Mexico invested mainly in domestic public bills and bonds (recently 51.2%), while allocation to equity was around 20 percent. However, a slow but consequent trend of increased exposure to equities is also observable. In 2008, only 7% of invested assets were allocated to equities but pension funds' investments in equities increased up to 20% in 2013, mainly due to large investments in foreign equity markets.

30. Pension funds in Poland, until the second quarter of 2014, mainly invested in two asset classes, domestic public bills and bonds (jointly around 50-75%) and domestic equity (around 20-40%). The reform of the pension sector in early 2014 seriously changed asset allocation making the domestic equity the single major asset class.[3] 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.

31. 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.

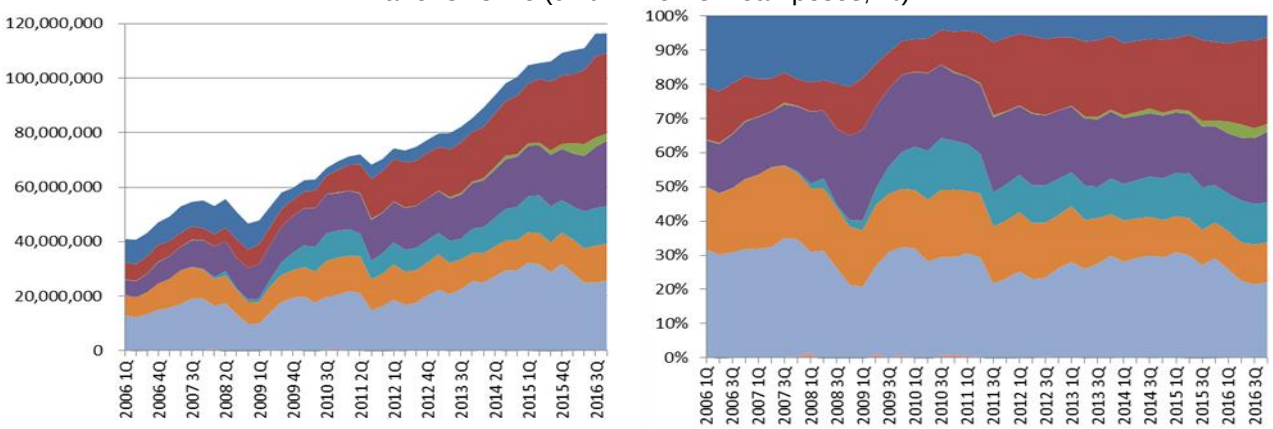
32. Pension funds in Italy invested mainly in public bills and bonds (approx. 60%), while the combined allocation to private bills and bonds (25%) and equity (15%) was less than half of the total investments. Unfortunately, the classification into domestic and foreign investments was not available. However,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

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

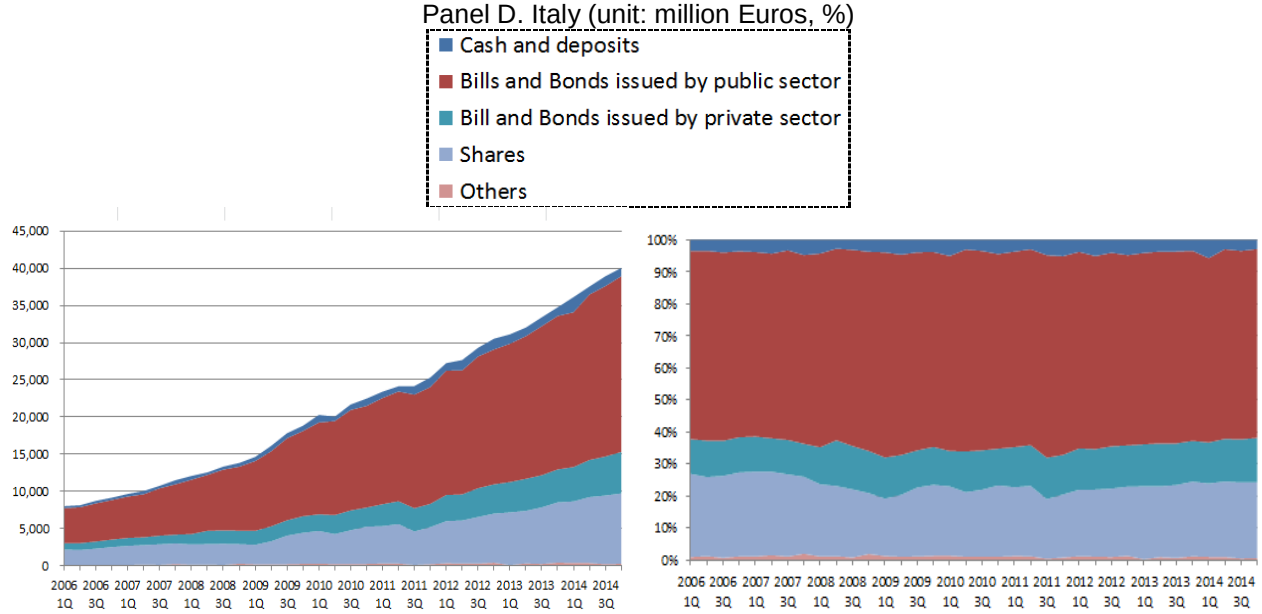


[3] All bonds issued or guaranteed by the governments were transferred to the public security system and subsequently retired. This action was undertaken on the 3rd of February 2014 on the basis of amended pension law.

Panel C. Chile (unit: million Chilean pesos, %)



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



Source: IOPS.

2. Definition of 'crisis' period

2.1 Equity markets

33. 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).

34. 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[4], delimitation of the periods by authors.

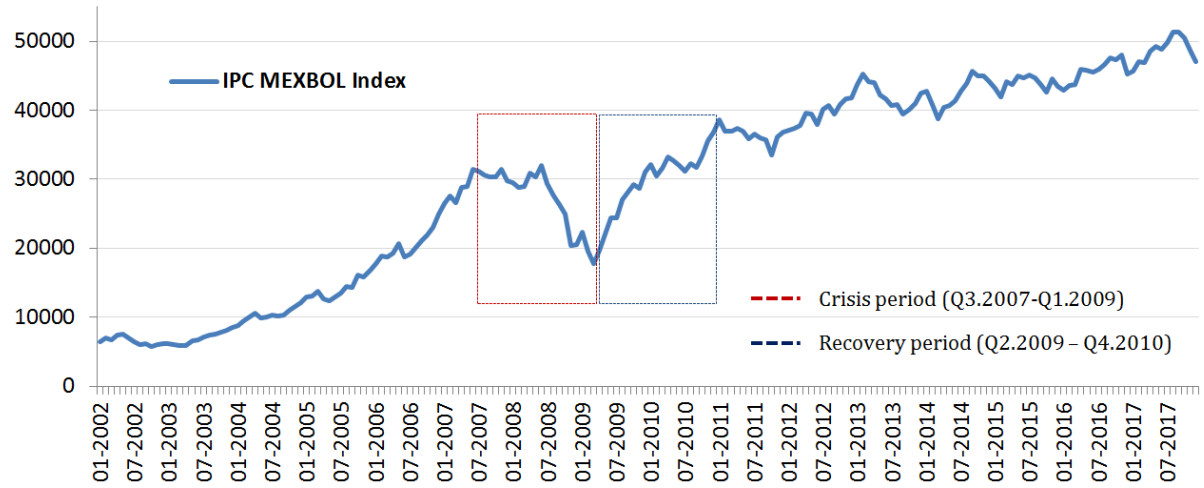
35. In Figure 4, one can notice that domestic stock price in all four countries dropped sharply also between Q3.2007 and Q1.2009 and then recovered in the period of Q2.2009 to Q4.2010. This indicates that the movements of domestic equity prices were very similar to the movements of the global stock price during the 2008-09 financial crisis, which is the reason why it is called 'global'.

36. 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).

37. The scale of domestic stock prices decline varied depending on continent of the participating jurisdiction. During the crisis, the depreciation of stock prices in European jurisdictions (Poland: -54%, Italy: -52%) was relatively higher than in Latin American countries (Mexico: -37%, Chile: -29%). Whereas, the appreciation during the recovery was higher in Latin America (Mexico: 96%, Chile: 99%) than in Europe (Poland: 63%, Italy: 15%). 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 of Italian and Polish pension funds, which might be explained by the very magnitude of the crisis.

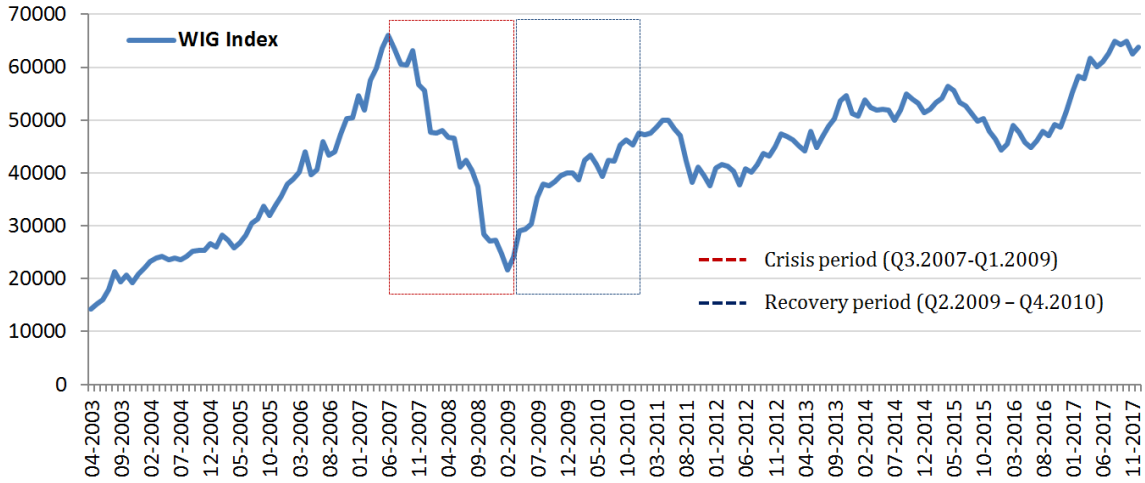
Figure 4. Movements of domestic stock prices

Panel A. Mexico (IPC MEXBOL index)

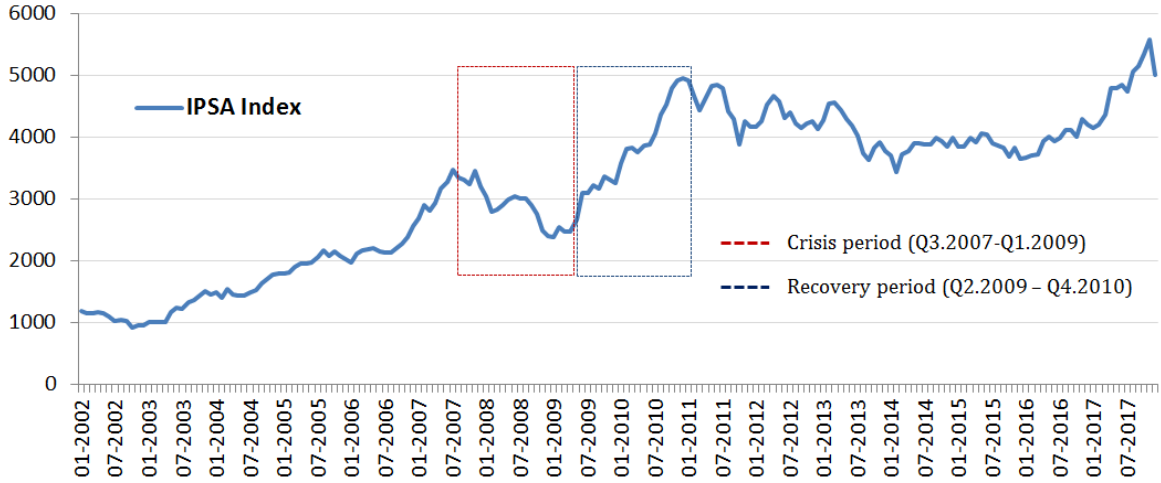


[4] https://markets.ft.com/data/indices/tearsheet/charts?s=MS-WX:MSI

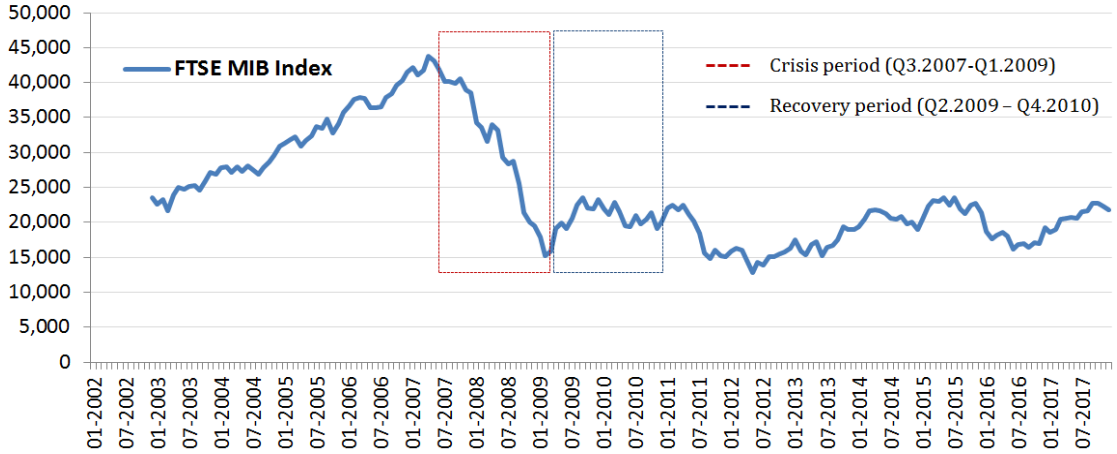
Panel B. Poland (WIG index)



Panel C. Chile (IPSA index)



Panel D. Italy (FTSE MIB index)



Source: Markets Data[5], delimitation of the periods by authors.

[5] Mexico (https://finance.yahoo.com/quote/%5EMXX/history?p=%5EMXX),
Poland (https://www.investing.com/indices/wig-historical-data),
Chile (https://finance.yahoo.com/quote/%5EIPSA/history/),
Italy (https://www.investing.com/indices/it-mib-40-historical-data)

2.2 Bond markets

38. The second asset class which can be regarded as 'risky' investment 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 5). 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.

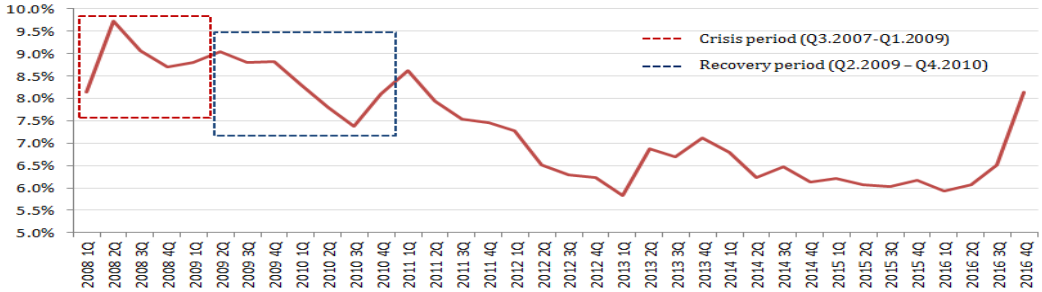
Figure 5. 10-Year High Quality Market (HQM) Corporate Spot Rate[6]

Source: U.S. Department of the Treasury retrieved from FRED, Federal Reserve Bank of St. Louis[7]

39. Figure 6 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 6. Movements of domestic private bond yields

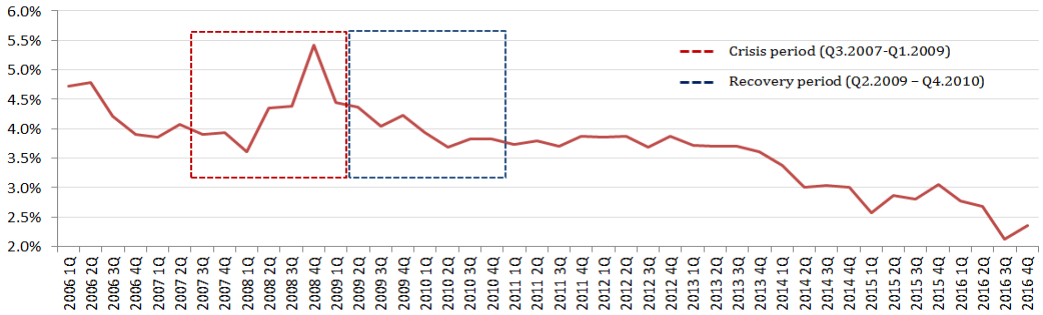
Panel A. Mexico (AMX_07-3, 10Y, end of quarter)



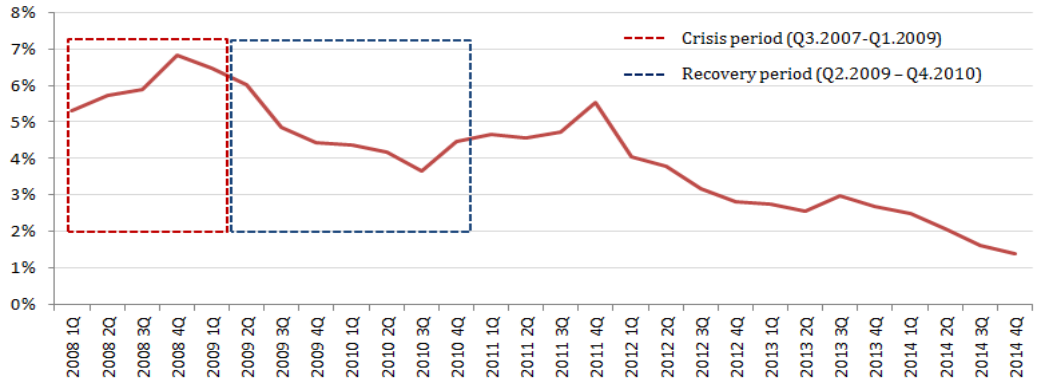
[6] *The spot rate* for any maturity is defined as the yield on a bond that gives a single payment at that maturity. This is called a zero coupon bond. As high quality zero coupon bonds are not generally available, the High Quality Market (HQM) methodology computes the spot rates to make them consistent 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).

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

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)



Source: IOPS.

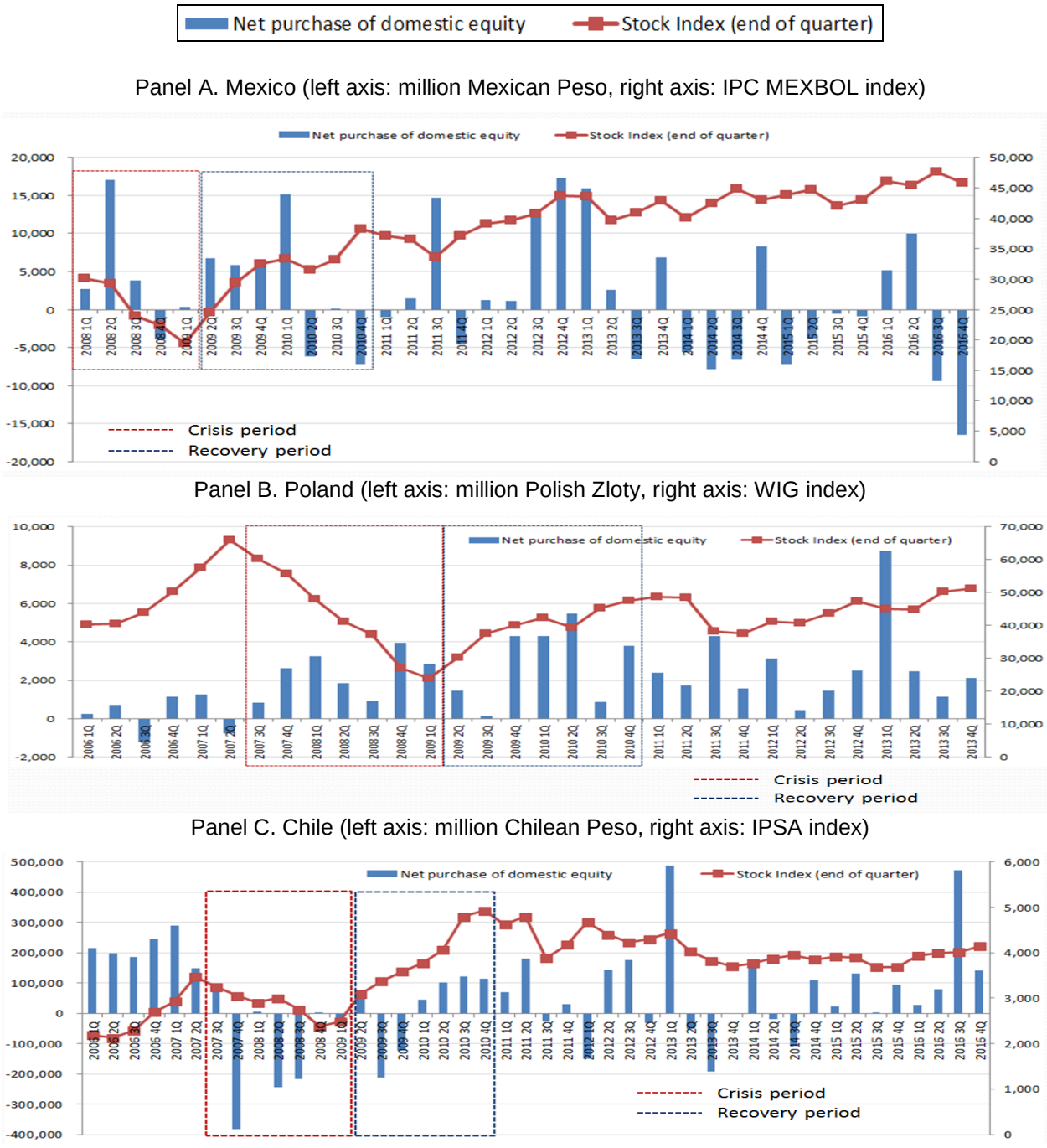
3. Characteristics of pension funds' transactions

3.1 Equities

40. Figure 7 shows pension funds' net purchases of domestic equities compared with the representative stock indices in Mexico, Poland, and Chile. For Italy, due to data limitation we compared funds' net purchases of total equities and the representative international MSCI World Equity stock index[8]. 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.

[8] The MSCI World Index is a broad global equity benchmark that represents large and mid-cap equity performance across 23 developed markets countries

Figure 7. Net purchases of domestic equity vs stock indices

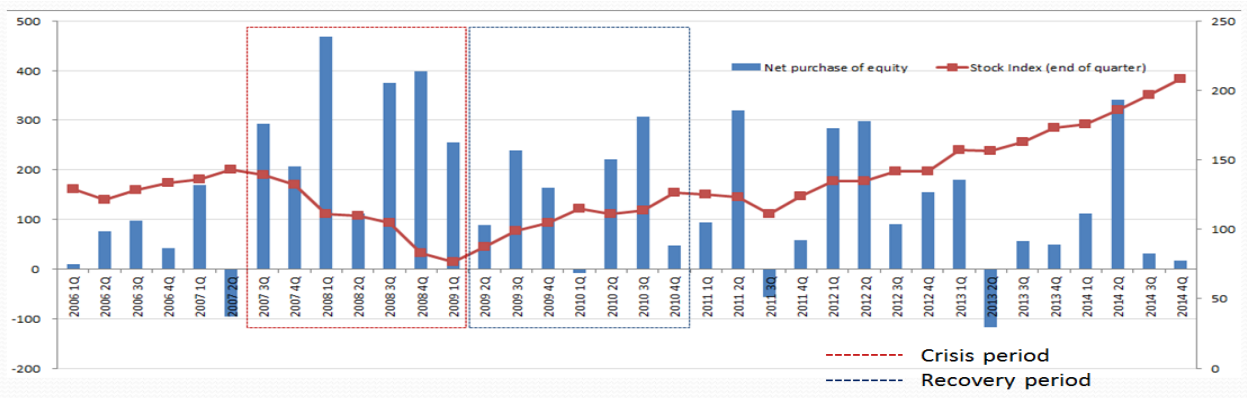


Panel A. Mexico (left axis: million Mexican Peso, right axis: IPC MEXBOL index)

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 Index (Total return, EUR))



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

41. Table 1. contains summary of the average and total quarterly net purchases of equity made by Mexican, Polish, Chilean and Italian funds[9]. The values are expressed in national currencies and relate to four sub-periods. The numbers in parenthesis represent shares of net purchases 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 purchases of domestic equities (a)		Net purchases of foreign equities (b)		Net purchases 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[10]	N/A		N/A		N/A		N/A	
	Crisis (Q1.2008-Q1.2009[11])	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	2,329	16,302	31	215	2,360	16,517	7,540	52,779

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

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

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

	(Q3.2007-Q1.2009)	(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)[12]	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%)	
	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 purchases* is a difference between the amounts purchased and sold during the quarter, while *net new investments* is a sum of net purchases by all five asset classes during each quarter. The numbers in parenthesis show the participation of equity net purchases in total new investments.

Source: IOPS.

42. 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 investments. 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 investments. Meanwhile, funds were mildly selling foreign equity (net purchases being negative and equal to -3.5% of net new investments) 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%).

43. 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).

[12] 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.

Also, from the perspective of net purchases of equities as a whole asset class, Mexican funds were net buyers during the whole analysed period.

44. 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 partly resulted from low foreign investment limit (set up at that time at 5%) and partly due to accounting disincentives present in the pension law.

45. 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 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 7. Panel B, 3Q 2011–1Q 2013). Similarly to Mexico, pension funds in Poland were net buyers of equities (domestic and foreign) during the whole period.

46. Differently from Mexico and Poland, Chile observed its net selling of domestic equities by pension funds 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 investments, 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 investments). 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%).

47. 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 a 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 reduced their domestic equity holdings and after the crisis they decreased their foreign equity holdings.

48. 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, 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, funds lowered their propensity to buy stocks to 15% during the recovery and to 12% after the crisis, i.e. a similar level as during the pre-crisis period.

49. 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.

50. 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 being net buyers of domestic equity. On the other hand, Chilean pension funds were net sellers of domestic and net buyers of foreign equity. Pension funds in Poland and Italy, who experienced bigger impact of the financial crisis increased their investments in equity heavily during the crisis. Funds in all four countries were net buyers during the recovery period when the equity prices regained following a sharp drop during the crisis.

51. Considering that pension funds were net buyers in most of the periods, we should examine the propensity for buying equities to investigate funds' investment behaviour more precisely. Pension funds in Poland and Italy both increased net purchases of domestic equity during the crisis period, but they acted differently thereafter; Polish funds increased net purchases even more during the recovery period, whereas Italian funds invested in the other direction. Chilean pension funds behaved differently in domestic and foreign markets. Their net purchases of equities decreased during the crisis and increased during the recovery on domestic market, whereas they increased during the crisis and decreased during the recovery on foreign markets. In case of Mexico, the analysis was limited since we do not have the data before the crisis.

52. To summarise the above discussion, Table 2 provides some conjectures on the investment behaviour by pension funds in equity markets during and immediately after the crisis of 2008. It must be emphasized that these conjectures are based on the average values each calculated for a particular sub-period (e.g. crisis, recovery) where the values themselves are based on the average volumes of transactions for several quarters that make up each sub-period. Therefore, it may be the case that within each quarter under the analysis pension funds actually had revealed different behaviour. In the next section we use each individual quarterly data for scatter plot, correlation and regression analyses.

53. A counter-cyclical behaviour during the crisis can be found in domestic equity markets for Mexican and Polish pension funds and in foreign markets for Chilean and Italian funds. Pro-cyclical behaviour during the crisis can be noted in Chile in case of domestic equity markets and Mexico in case of foreign markets. Investment behaviour of pension funds during the recovery period differs depending on the approach we apply (see Introduction). All jurisdictions revealed pro-cyclical behaviour with '*approach 1'* analysing the direction of transactions, but according to *'approach 2'* which looks at the relative size of transactions, Mexican domestic equity, Chilean and Italian foreign equities are rather counter-cyclical.

Table 2. Transactions of pension funds in equity markets

Jurisdiction	Approach 1 (direction of transactions)				Approach 2 (relative size of transactions)			
	Domestic equities		Foreign equities		Domestic equities		Foreign equities	
	crisis	recovery	crisis	recovery	crisis	recovery	crisis	recovery
Mexico	–	+	+	+	n/a	[–]	n/a	+
Poland	–	+	(–)	(+)	–	+	[+]	[+]
Chile	+	(+)	–	+	+	+	–	(–)
Italy*	n/a	n/a	–	+	n/a	n/a	–	–

Notes: **+:** pro-cyclical investment behaviour, **–:** counter-cyclical investment behaviour,
( ): weak effect with negligible average quarterly net investments (< 1% of total quarterly new investments), [ ]: weak effect with similar propensity (< 5% percentage of net purchases in total new investments),
n/a: no data on before crisis period for Mexico and domestic equities for Italy,
*: most equity investment in Italy related to foreign equities

Source IOPS.

3.2 Private bonds

54. The second asset class of risky assets analysed in this section are private sector bonds. Table 3 displays statistics on net purchases of private sector bonds made by pension funds (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 purchases of domestic private bonds (a)		Net purchases of foreign private bonds (b)		Net purchases of private bonds (c)= (a)+(b)		Net new investments (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 purchases* is a difference between purchased amount and sold amount during the quarter, and *net new investments* is a sum of net purchases by asset classes during the quarter. The numbers in parenthesis show the participation of private bonds net purchases in total new investments.

Source: Authors' analysis.

55. In Poland, net purchases of all private bonds before the crisis were equal to 3.1% of net new investments, 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 percentages of net new investments allocated to private sector bonds were not large but funds started to invest much more (26.1%) in private bonds 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.

56. 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 behaviour of Polish funds with regard to foreign equity markets, their trading in foreign private bonds was minimal during all periods.

57. 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 56% in the recovery period. This was mainly due to a huge increase of net investments 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 funds lowered their appetite for private bonds to 9.2% of net new investment which was much lower than the pre-crisis level (23.2%). The funds were even mildly selling foreign private bonds (-0.9% of net new investments) during 2011-2016. Purchases of private bonds during the total period represented 17.5% of net new investments, which is much larger than percentage of net purchases of equity (1.8%).

58. 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 decreased to 550 000 m during the crisis and to 370 000 at the recovery. Funds started buying more domestic bonds afterwards – the average increased to over 540 000 m. Allocation to foreign bonds changed 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 to record-high 1 135 000 m during the recovery. Subsequently, funds began selling foreign bonds with an average speed of 49 000 m pesos per quarter.

59. Also in Italy, net average quarterly purchases of private bonds slightly increased (from 10.5% to 13.5%) during the crisis. 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%)

60. 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.

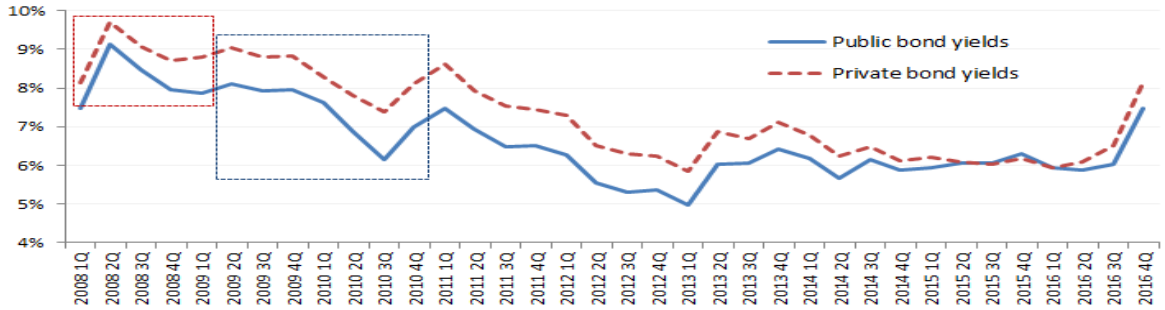
61. Due to lack of information about the price movements of (at least representative) private bonds, we were not able to judge whether funds' transactions were of pro-cyclical or counter-cyclical character based on the above analysis.

3.3 Public bonds

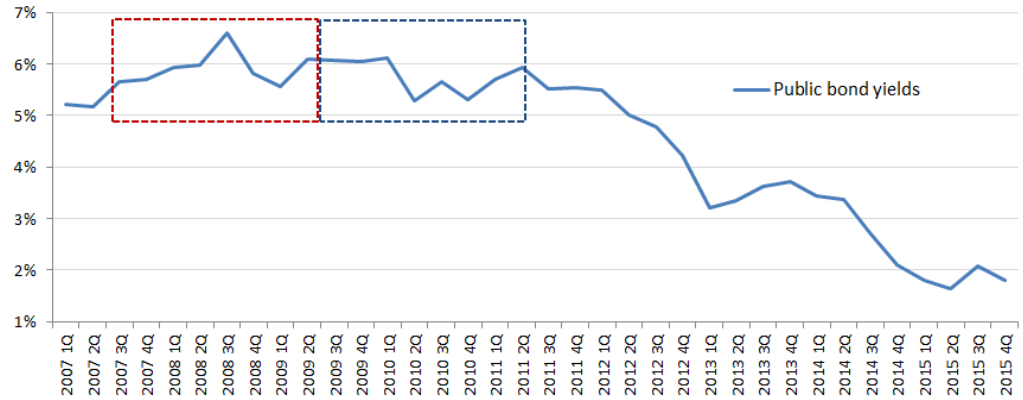
62. We also analysed the transactions of pension funds with regard to cash, deposits, and public bonds during the crisis. These asset classes are considered the most secure ones. Figure 8 shows the development of public and private bond yields in each jurisdictions (data for Polish private bond yields 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 was 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

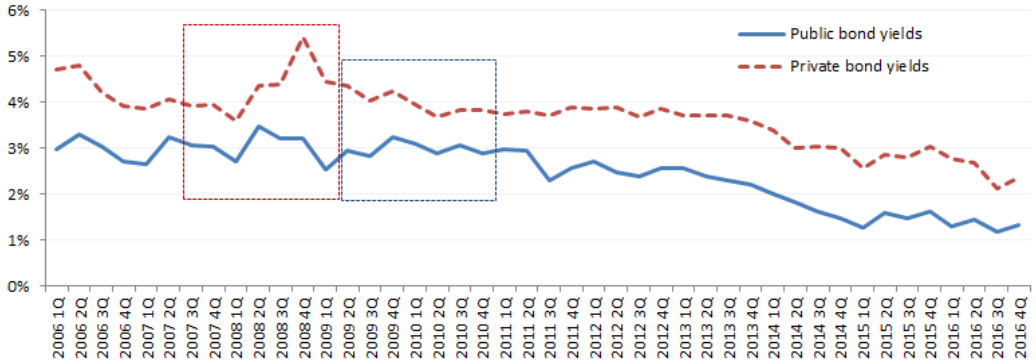
Panel A. Mexico (MEX BONOS DESARR FIX RT(10Y) & AMX_07-3(10Y) end of quarter)



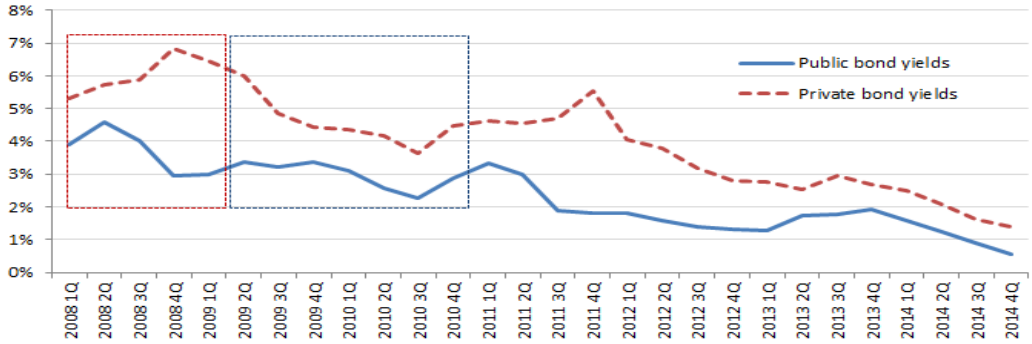
Panel B. Poland (PL0000104543(10Y), end of quarter)



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 were available for Poland.

Source: IOPS.

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

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

Jurisdiction	Periods	Net purchases of cash and deposits (a)		Net purchases of public bonds (b)		Net purchases of secure assets (c)= (a)+(b)		Net new investments (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 purchases* is a difference between purchased amount and sold amount during the quarter, and *net new investments* 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.

64. 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 the majority of total net investments were public bonds: before the crisis they represented almost all (91.6%) of net new investments but this ratio dropped to 64.2% during the crisis and to 42.8% in the recovery period. After the crisis, share of net investments in public bonds decreased even deeper to 29.6% as Polish funds began to invest more money in private bonds.

65. The average amounts of new purchases of public bonds by pension funds in Poland 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.

66. 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 net investment in public bonds (0.5%). During the crisis, the funds decreased portion of their investments in cash & deposits (42% of net new investments) and used new money to invest more in public bonds (20%) as well as in 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 the continued decrease of net new investments in cash & deposits (9.1%). 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).

67. 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 funds were buying public bonds but at a much lower speed – with the quarterly average of only 14 000 m pesos, majority of which 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 fund 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 of the incoming money was put into safe assets meant 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).

68. 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.

69. 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, this percentage increased back to 69% (the recovery period) and 67.1% (post-crisis period) being similar to pre- crisis period. Net investment in cash and deposits was minimal and amounted to less than 3% of net new investment during the all observed periods. However, it can be noted that 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%).

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

Jurisdiction	Periods	Net purchases of domestic public bonds (a)		Net purchases of foreign public bonds (b)		Net purchases of public bonds (c)= (a)+(b)		Net new investments (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 purchases* is a difference between purchased amount and sold amount during the quarter, and *net new investments* 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.

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

71. Similarly to private bonds, due to lack of information about the price movements of public bonds in the analysed countries we were not able to judge whether transactions by pension funds were of pro-cyclical or counter-cyclical character.

72. In table 6 we summarized the results from Tables 3-5, by grouping asset classes either as secure or risky ones. 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 invested more intensively in equities and decreased investments 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 also 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 (2.8%)	N/A (67.2%)	N/A (70.1%)	N/A (22.6%)	10.4% (7.9%)	N/A (30.5%)
	Recovery (Q2.2009-Q4.2010)	N/A (3.3%)	N/A (64.9%)	N/A (68.2%)	N/A (20.5%)	34.4% (10.6%)	N/A (31.0%)
	Post-crisis (2011-2016)	N/A (3.1%)	N/A (53.8%)	N/A (56.9%)	N/A (21.2%)	13.1% (17.8%)	N/A (39.1%)
	Total (2008-2016)	**N/A (3.1%)**	**N/A (57.9%)**	N/A **(61.0%)**	**N/A (21.3%)**	**16.1% (15.0%)**	N/A **(36.3%)**
Poland	Pre-crisis (2006-Q2.2007)	0.0% (0.0%)	91.6% (61.1%)	91.6% (61.1%)	3.1% (1.0%)	5.2% (35.1%)	8.4% (36.0%)
	Crisis	0.0%	64.2%	64.2%	4.5%	31.3%	35.8%

	(Q3.2007 -Q1.2009)	(0.0%)	(65.9%)	(65.9%)	(2.7%)	(28.7%)	(31.4%)
	Recovery (Q2.2009-Q4.2010)	0.0% (0.0%)	42.8% (63.6%)	42.8% (63.6%)	6.4% (2.6%)	50.8% (31.5%)	57.2% (34.1%)
	Post-crisis (2011-2013)	0.0% (0.0%)	32.6% (54.8%)	32.6% (54.8%)	26.1% (4.4%)	44.3% (35.9%)	70.4% (40.4%)
	Total (2006-2013)	**0.0% (0.0%)**	**51.1% (60.3%)**	**51.1% (60.3%)**	**12.9% (3.0%)**	**36.0% (33.2%)**	**48.9% (36.2%)**
Chile	Pre-crisis (2006-Q2.2007)	67.5% (19.5%)	0.5% (13.4%)	67.9% (32.8%)	23.2% (15.7%)	8.8% (51.5%)	32.1% (67.2%)
	Crisis (Q3.2007 -Q1.2009)	41.9% (18.8%)	19.7% (11.1%)	61.6% (29.9%)	31.8% (23.1%)	6.5% (47.8%)	38.4% (70.9%)
	Recovery (Q2.2009-Q4.2010)	9.1% (7.7%)	24.0% (10.7%)	33.1% (18.4%)	55.8% (33.6%)	11.1% (47.6%)	66.9% (81.2%)
	Post-crisis (2011-2016)	56.0% (6.6%)	36.0% (22.5%)	92.0% (29.1%)	9.2% (30.6%)	-1.2% (40.3%)	8.0% (70.9%)
	Total (2006-2016)	**51.0% (10.5%)**	**29.7% (17.6%)**	**80.8% (28.0%)**	**17.5% (27.8%)**	**1.8% (44.2%)**	**19.2% (72.0%)**
Italy	Pre-crisis (2006-Q2.2007)	8.0% (3.7%)	68.0% (58.4%)	76.0% (62.1%)	10.5% (10.9%)	11.5% (25.9%)	22.0% (36.8%)
	Crisis (Q3.2007-Q1.2009)	2.0% (3.6%)	53.4% (60.9%)	55.4% (64.5%)	13.5% (12.3%)	30.6% (21.8%)	44.2% (34.1%)
	Recovery (Q2.2009-Q4.2010)	6.2% (4.0%)	69.0% (61.8%)	75.2% (65.8%)	8.4% (11.9%)	15.6% (21.2%)	24.0% (33.1%)
	Post-crisis (2011-2016)	0.8% (4.0%)	67.1% (60.2%)	67.9% (64.1%)	20.1% (13.0%)	11.9% (22.0%)	31.9% (35.0%)
	Total (2006-2016)	**2.8% (3.9%)**	**64.7% (60.3%)**	**67.4% (64.2%)**	**15.5% (12.3%)**	**16.6% (22.4%)**	**32.1% (34.7%)**

Note: *Net purchases* is a difference between purchased amount and sold amount during the quarter, and *net new investments* is a sum of net purchases by asset classes during the quarter. The numbers in parenthesis show average asset allocations of end of quarter (as % of total assets) for each of these four periods.

Source: Authors' analysis.

4. Pension funds' purchases of risky assets and market performance

4.1 Scatter plot analysis

73. As we stated previously, the results of section 3 are based on the averages calculated for each particular sub-period (e.g. crisis, recovery) whereas the values themselves are based on the average transaction volumes for several quarters. In order to address this limitation, scatter plot analysis was performed to directly compare pension funds' net purchases of equity and price movements on a quarterly basis. Since the direct data on equity price movements were not available, an imputed change in value of equities, derived using the method introduced in Figure 1 was used as a proxy. Net purchases of equity and absolute changes in equity value were transformed to relative figures[13] to obtain standardised results.

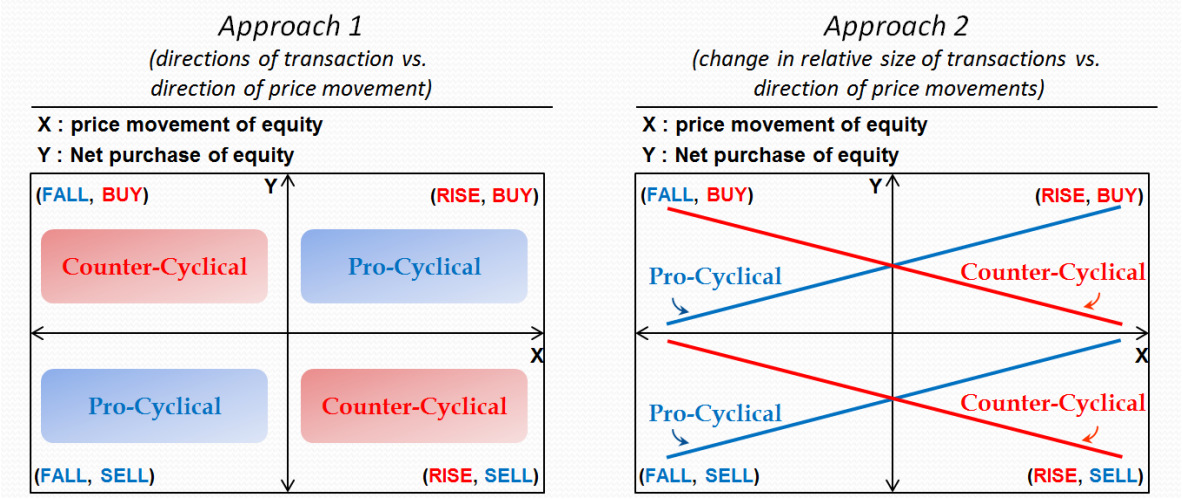
74. Data points for each quarter were plotted in four quadrants with the X-axis representing changes in equity value, and the Y-axis –net purchases of equity. The data points located in the 1st and 2nd quadrants[14] indicate that funds were net buyers during a particular period, and data points on the 3rd and 4th quadrants, suggest that funds were net sellers at that time. Also, data located in the 1st and 4th quadrants point to a rising market at that time, and in the case of the 2nd and 3rd quadrants - a falling market during a particular period.

[13] Net purchases (%) = Net purchases ÷ {(Beginning amount + Ending amount) ÷ 2}
Change in value (%) = Change in value ÷ {(Beginning amount + Ending amount) ÷ 2}

[14] See Figure 9. The convention is that the 1st quadrant is located at the upper right part of the graph, the 2nd quadrant – at the upper left, the 3rd quadrant at the bottom left and the 4th quadrant at the bottom right.

75. Combining these two aspects in the scatter plot we can intuitively interpret pension funds' investment behavior during price movements (Figure 9). Applying the first approach of analyzing the direction of price changes and transactions, we can conclude that if data points are located mostly in the 1st and 3rd quadrants, pension funds are pro-cyclical (and counter-cyclical if data are located mostly in the 2nd and 4th quadrants). The second approach is to compare relative size of transactions during and before the analyzed period. If data points are moving with a positive trend line from the 2nd quadrant to the 1st quadrant or from the 3rd quadrant to 4th quadrant, then pension funds are considered pro-cyclical. They are counter-cyclical if data are moving with a negative trend line from the 2nd quadrant to the 1st quadrant or from the 3rd quadrant to the 4th quadrant).

Figure 9. Illustration of how pension funds' investment behavior could be defined

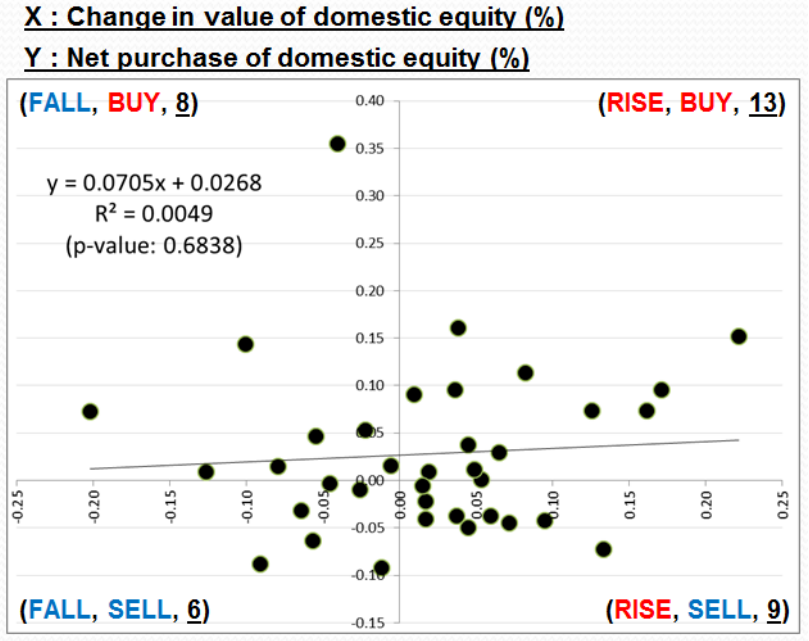


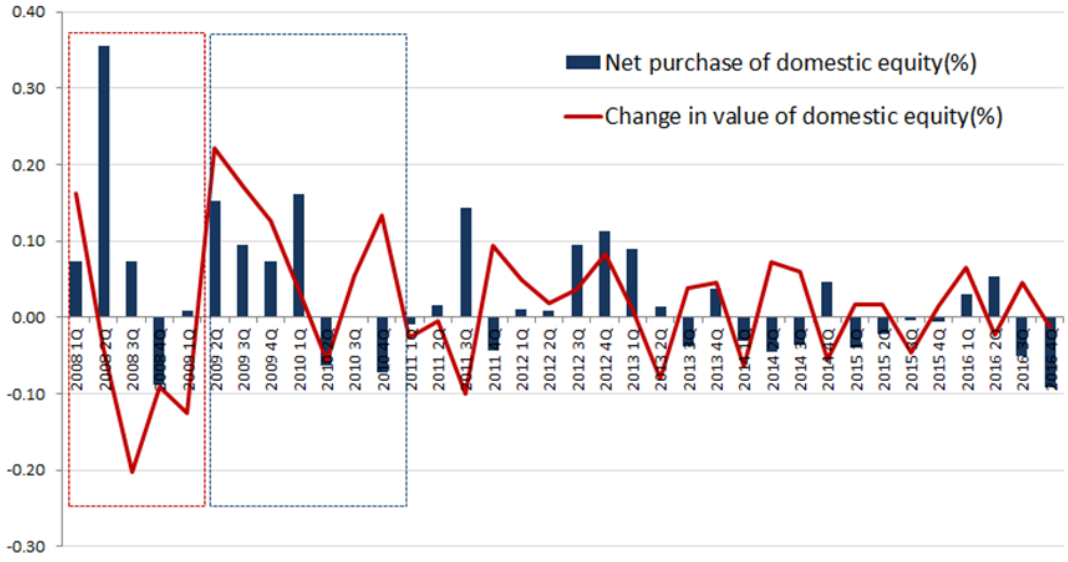
76. Figure 10. depicts a scatter plot of the imputed 'Change in value of domestic equity (%)' and reported 'Net purchase of domestic equity (%)'. Since the scatter plot does not show passage of time, we also present, as a complementary measure, a bar graph that indicates changes of these two variables over the time. As we were unable to break down Italian pension funds' net purchase into domestic and foreign equities, the variable 'total equity' was used instead of 'domestic equity' in the case of Italy. For Mexico, Poland, and Chile, the same analysis was performed for foreign equity as well; however the conclusions are similar.[15]

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

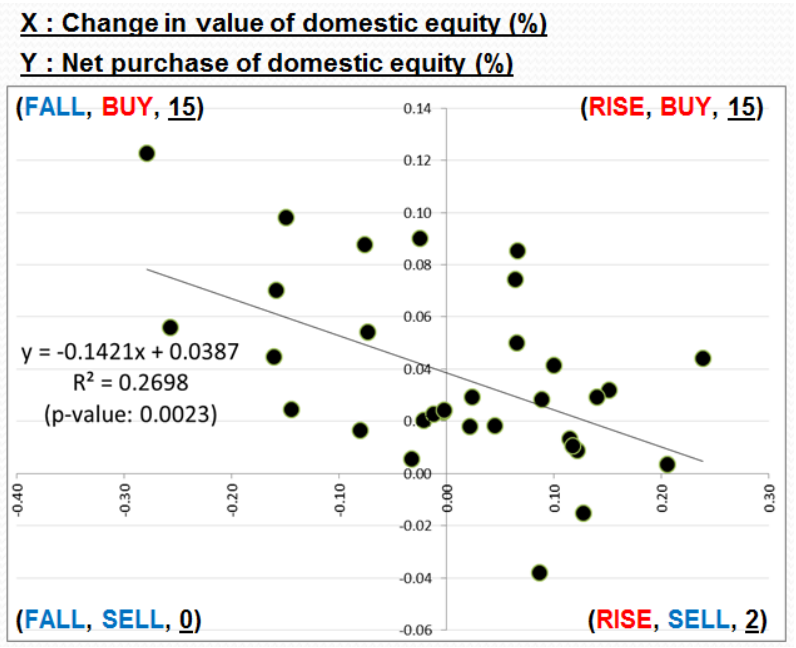
Figure 10. Scatter plot analysis for domestic equity

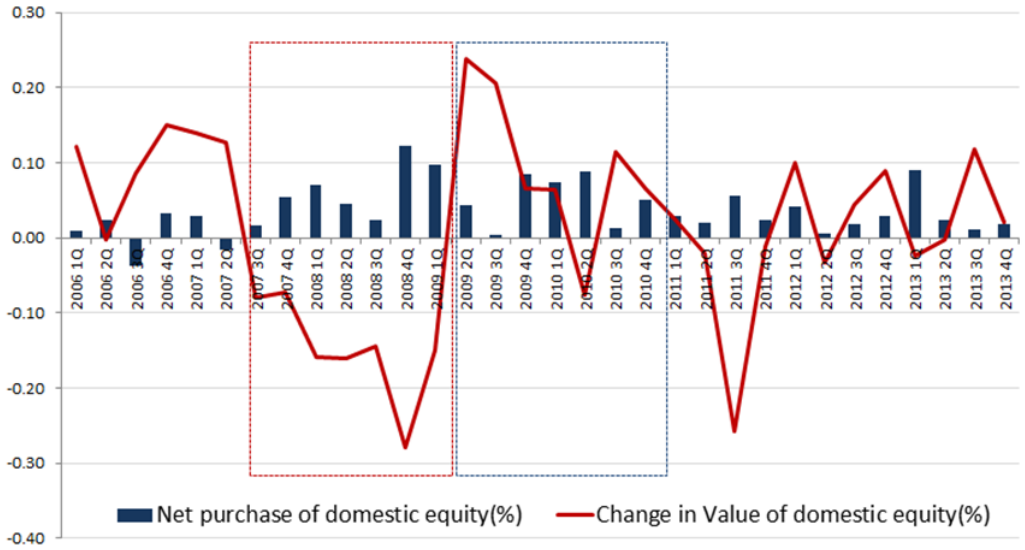
Panel A. Mexico



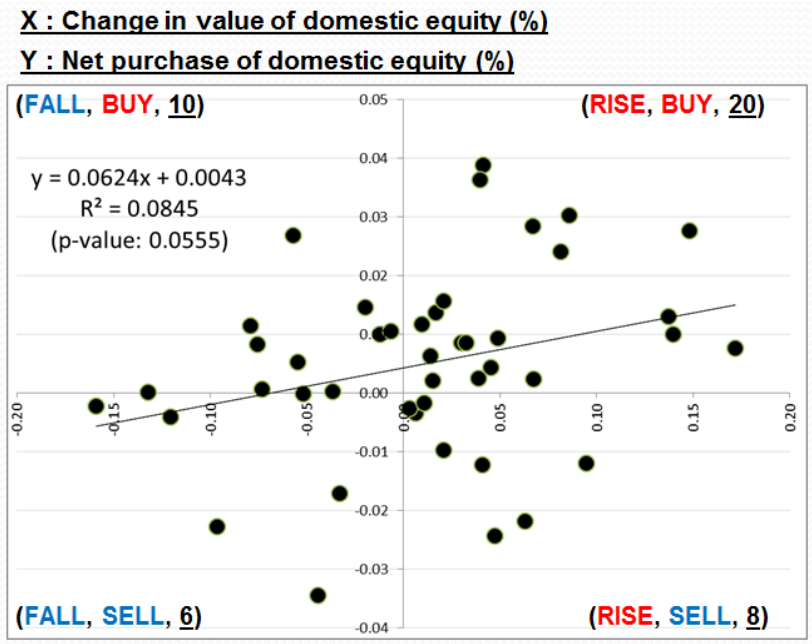


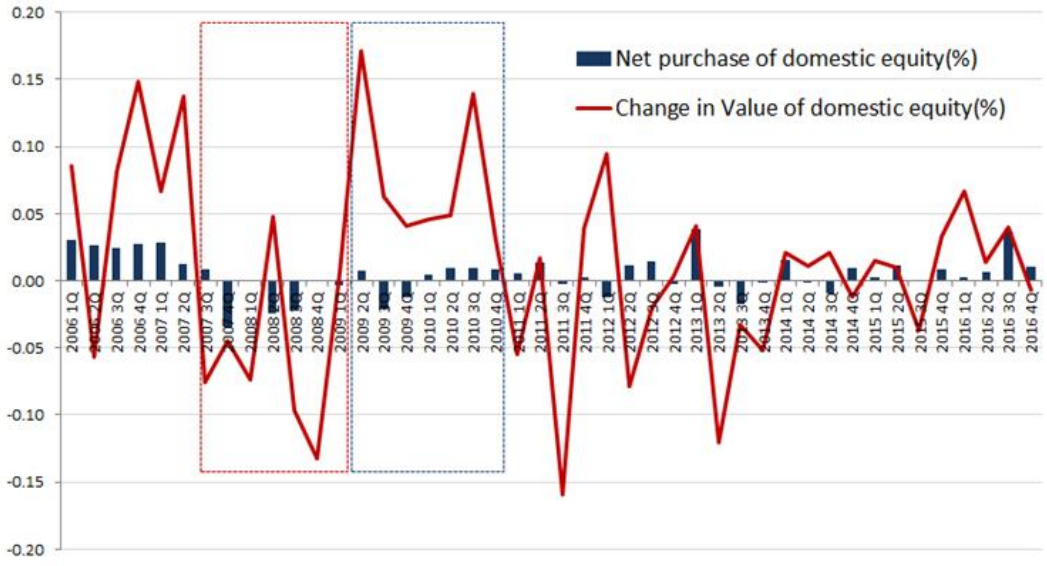
Panel B. Poland



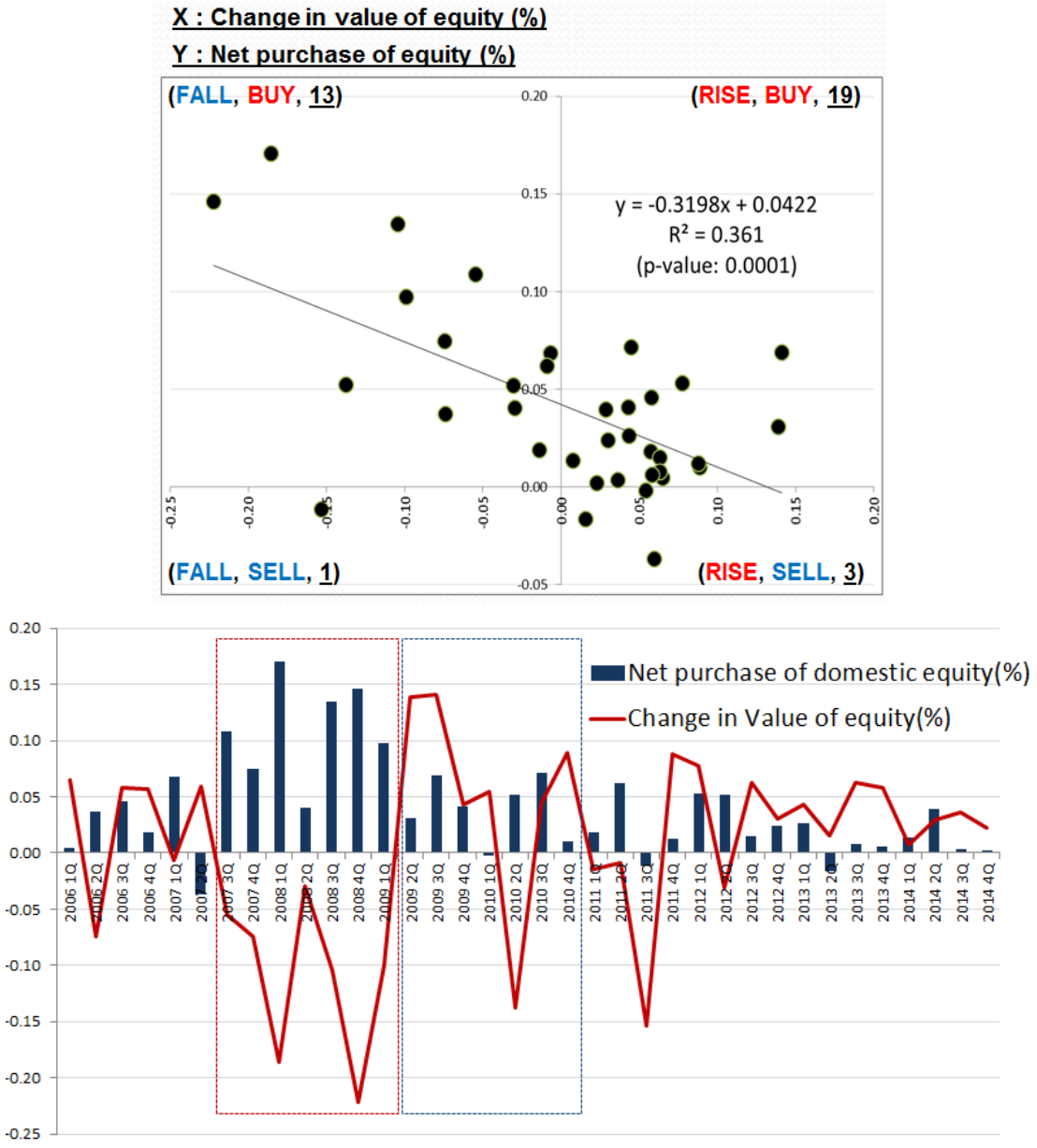


Panel C. Chile





Panel D. Italy



Source: IOPS.

77. In Mexico, data points are spread over all quadrants, with a weak and statistically insignificant positive trend line (+0.0705x, p-value: 0.6838). Funds were net buyers (e.g. observations located in the 1st and 4th quadrants) during 21 out of 36 quarters in the sample (58%), and net sellers (the 2nd and 3rd quadrants) during 15 quarters (42%). Also, a bar graph reveals no strong relation between net purchases and changes in value. One interesting observation is that funds were mostly net buyers in the first half (from 2008 1Q to 2011 4Q) of the sample (15 out of 18 quarters), and then they reverted to being net sellers afterwards (12 out of 18 quarters). As result, Mexican pension funds' investment in equity seems more likely to be influenced by other factors such as institutional framework as funds reduced net purchase in equity recently regardless of local stock price movements.

78. In Poland, one can easily notice that the data points are more concentrated in the 1st and 4th quadrants (for 30 out of 32 observations) which mean that funds were net buyers most of the time. The corresponding bar graph confirms that they were net buyers not only when prices were falling but also when rising. Therefore, we need to apply the second approach to pinpoint whether pension funds

acted pro-cyclically or counter-cyclically. With this, we can observe a stronger negative and statistically significant trend line (-0.1421x, p-value: 0.0023) which suggests that funds lowered their propensity for net purchases when equity prices were rising. This is a sign of counter-cyclicality according to the description explained in Figure 9.

79. In Chile, one can see that the majority (45% or 20 quarters) of data points are concentrated in 1st quadrant which means funds were buying equities when equity prices were rising. As a result, quite a clear positive and trend line statistically significant only at 10% level (+0.0624x, p-value: 0.0555) is observed. This suggests a pro-cyclicality according to the description explained in Figure 6. One should also note that similar results are shown for foreign equities with even stronger positive trend line (0.1588x, p-value: 0.0334).

80. The results for Italy are very similar to Poland. The data points are mostly concentrated in 1st and 4th quadrants (32 out of 36) and reveal a strong, statistically significant, negative trend line (-0.3198x, p-value: 0.0001). This suggests that Italian pension funds acted counter-cyclically.

81. The scatter plot results for private bonds, the second asset class analysed in this paper are shown in Figure 11[16]. In the case of Italy, due to data limitations 'total private bonds' were used instead of 'domestic private bonds'. Mexico was not included due to incomplete data on private bond investments.

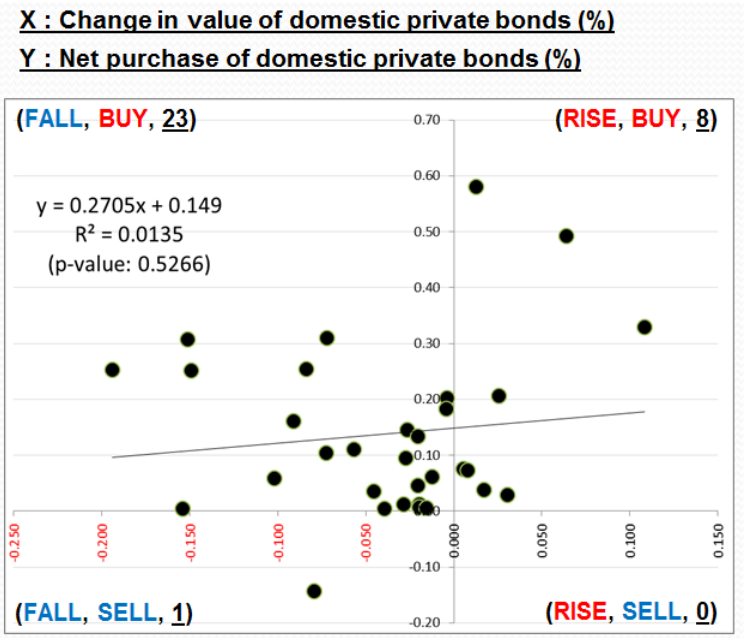
82. In all three countries, the majority of data points are located in the 1st and 2nd quadrants (Poland 97%, Chile 98%, Italy 97%). This means that funds were net buyers of private bonds most of the time regardless of the price movements. No strong sign of pro- or counter-cyclicality is observed in these countries for private bonds.

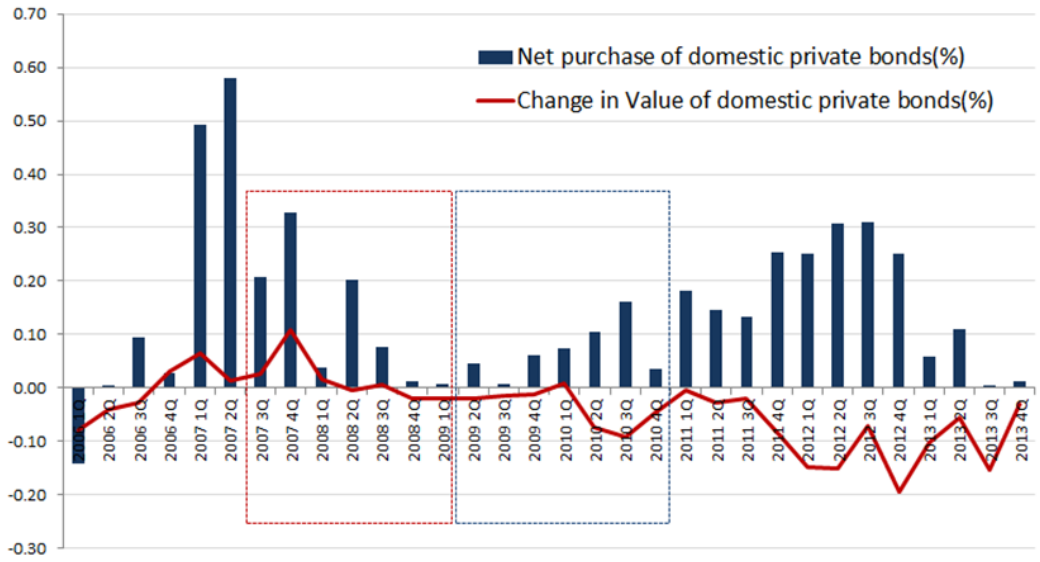
83. One interesting observation is that the 'crisis' and 'recovery' periods do not correspond much to value changes of private bonds. When comparing with Figure 10, changes in value of equities are mostly negative (-) during the crisis and positive (+) during the recovery, whereas the signs of changes in value of private bonds are more randomly distributed during the same period. This may suggest that prices of private bonds were less affected as compared to equity prices during the financial crisis. This in turn indicates that we should focus more on pension funds' behaviour with regard to equities to better verify whether pension funds contribute to markets' stability or destabilise them.

[16] The results for foreign private bonds for Poland and Chile are available at request.

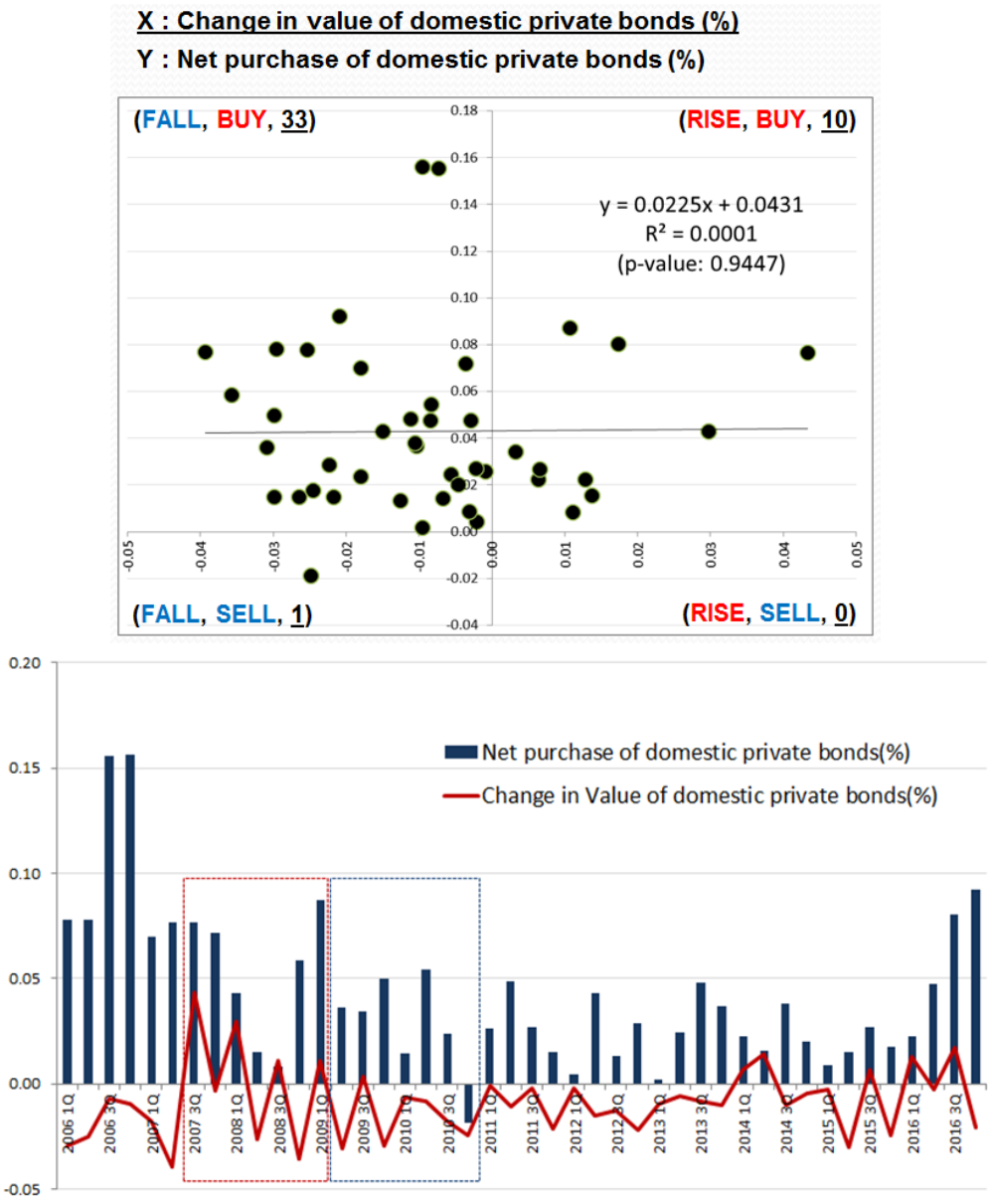
Figure 11. Scatter plot analysis for domestic private bonds

Panel A. Poland

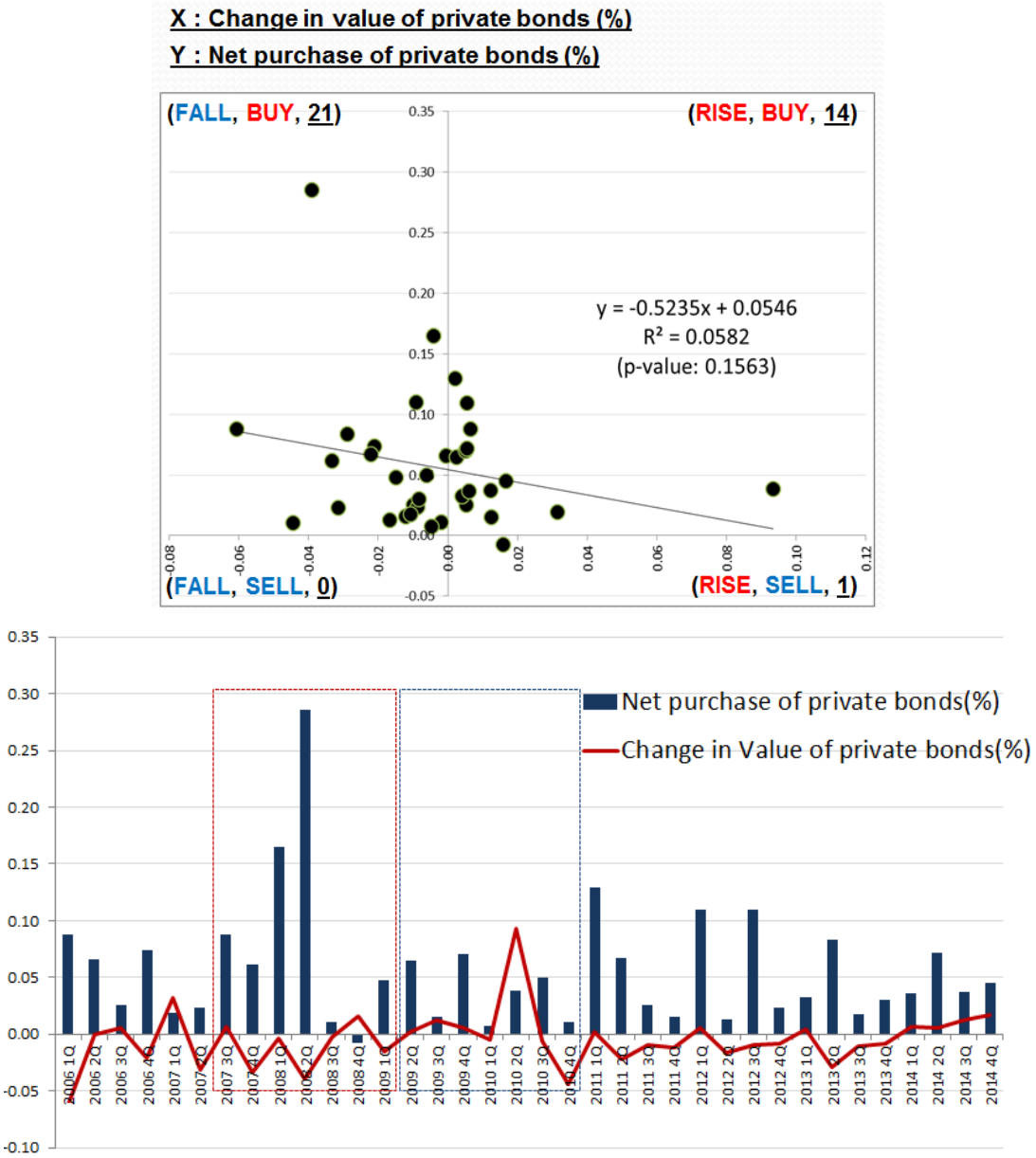




Panel B. Chile



Panel C. Italy



Source: IOPS.

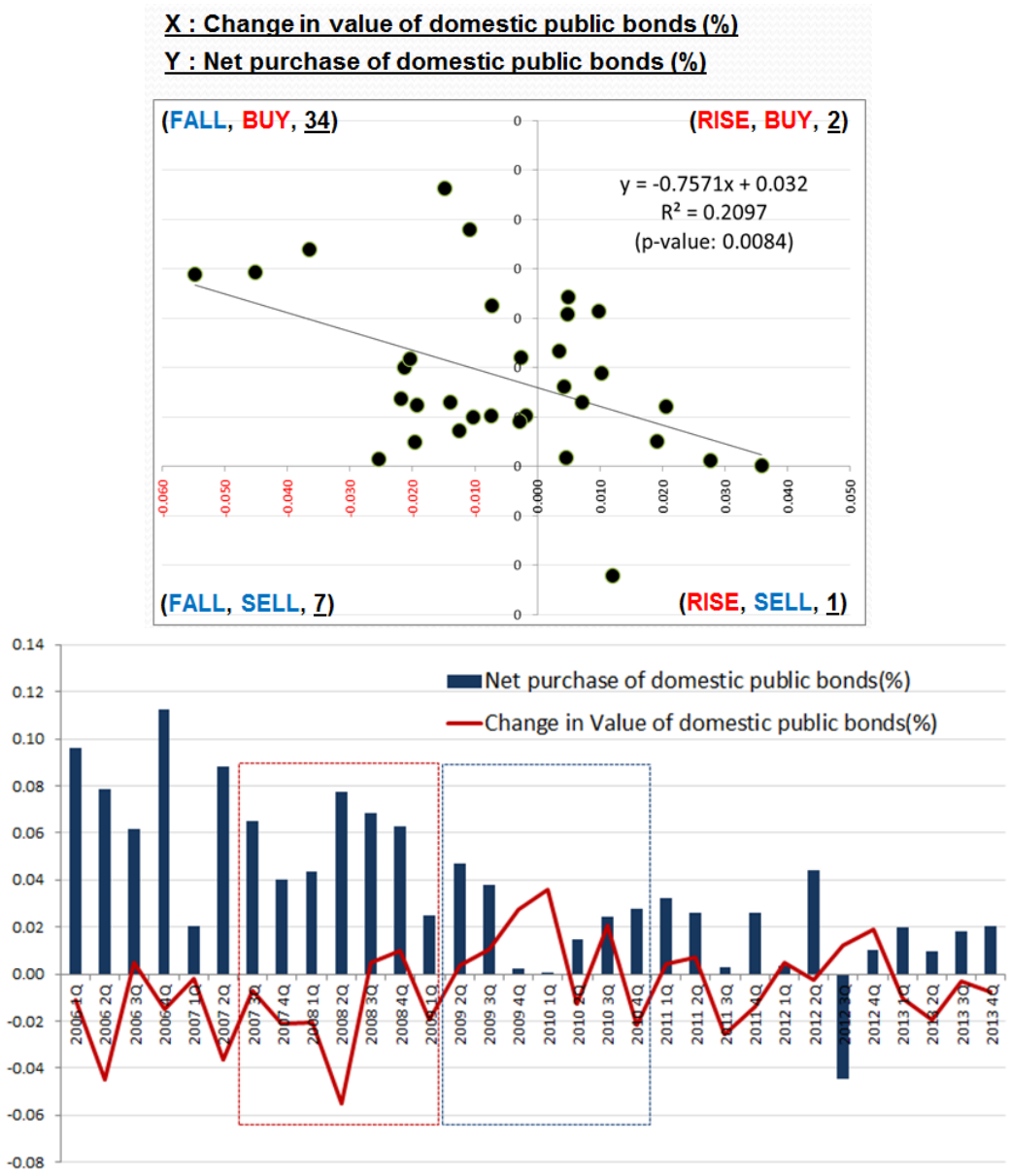
84. Lastly, the scatter plot results of domestic public bonds are shown in Figure 12 ('total public bonds' were used instead of 'domestic public bonds' in Italy)[17]. Similarly to the case with private bonds, financial crisis did not influence much the value of public bonds. In all three countries, pension funds were net buyers most of the time, and negative trend lines[18] were observed indicating that pension funds acted counter-cyclically by buying relatively more public bonds when the prices were falling. Considering that domestic public bonds are one of the most secure assets, it seems logical for funds to buy them at a lower price since their credit risk is (usually) very low.

[17] The results for foreign private bonds for Poland and Chile are available at request.

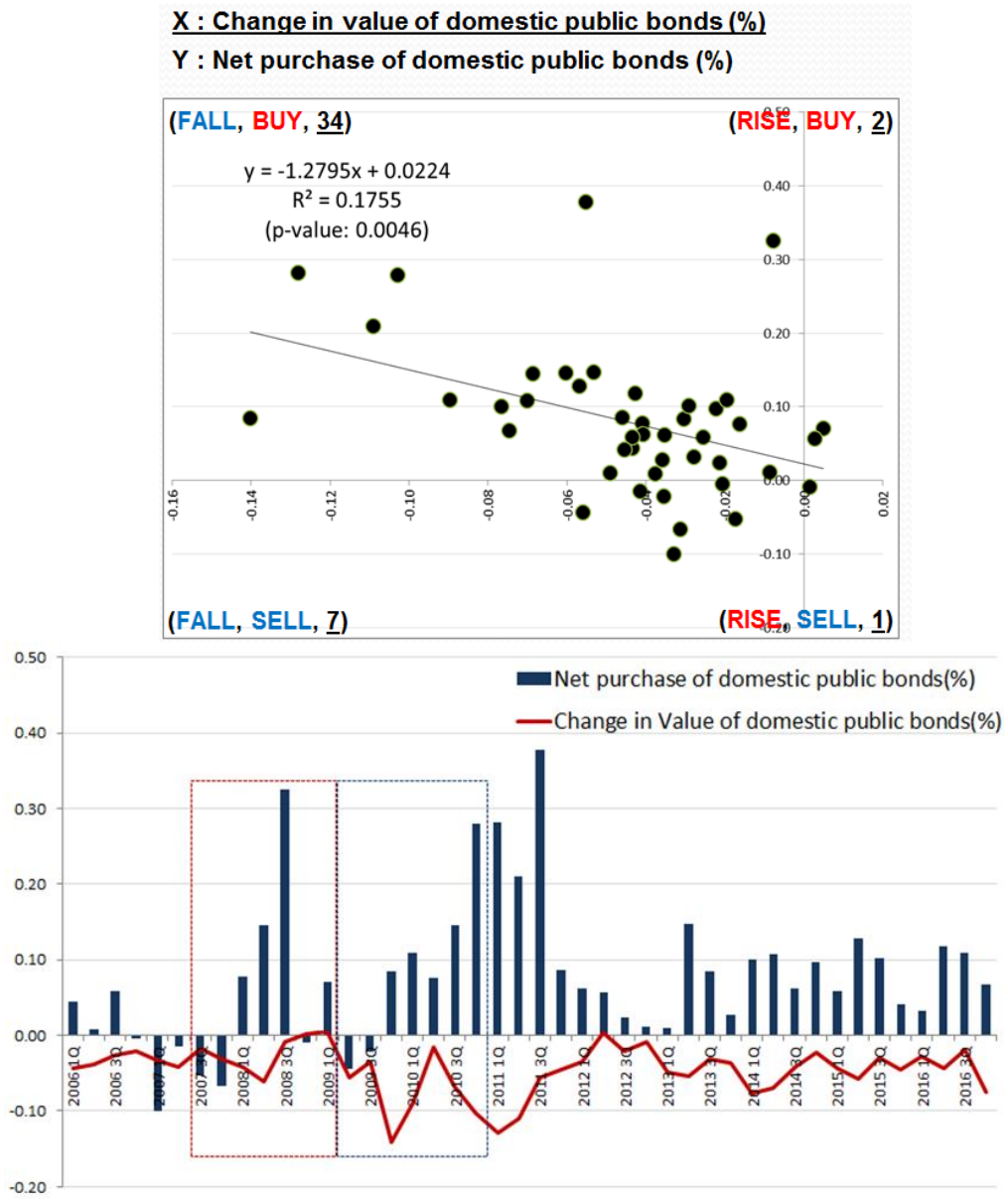
[18] In case of Chile and Poland, the trend line was statistically significant at 1% and in case of Italy insignificant at 10% level.

Figure 12. Scatter plot analysis for domestic public bonds

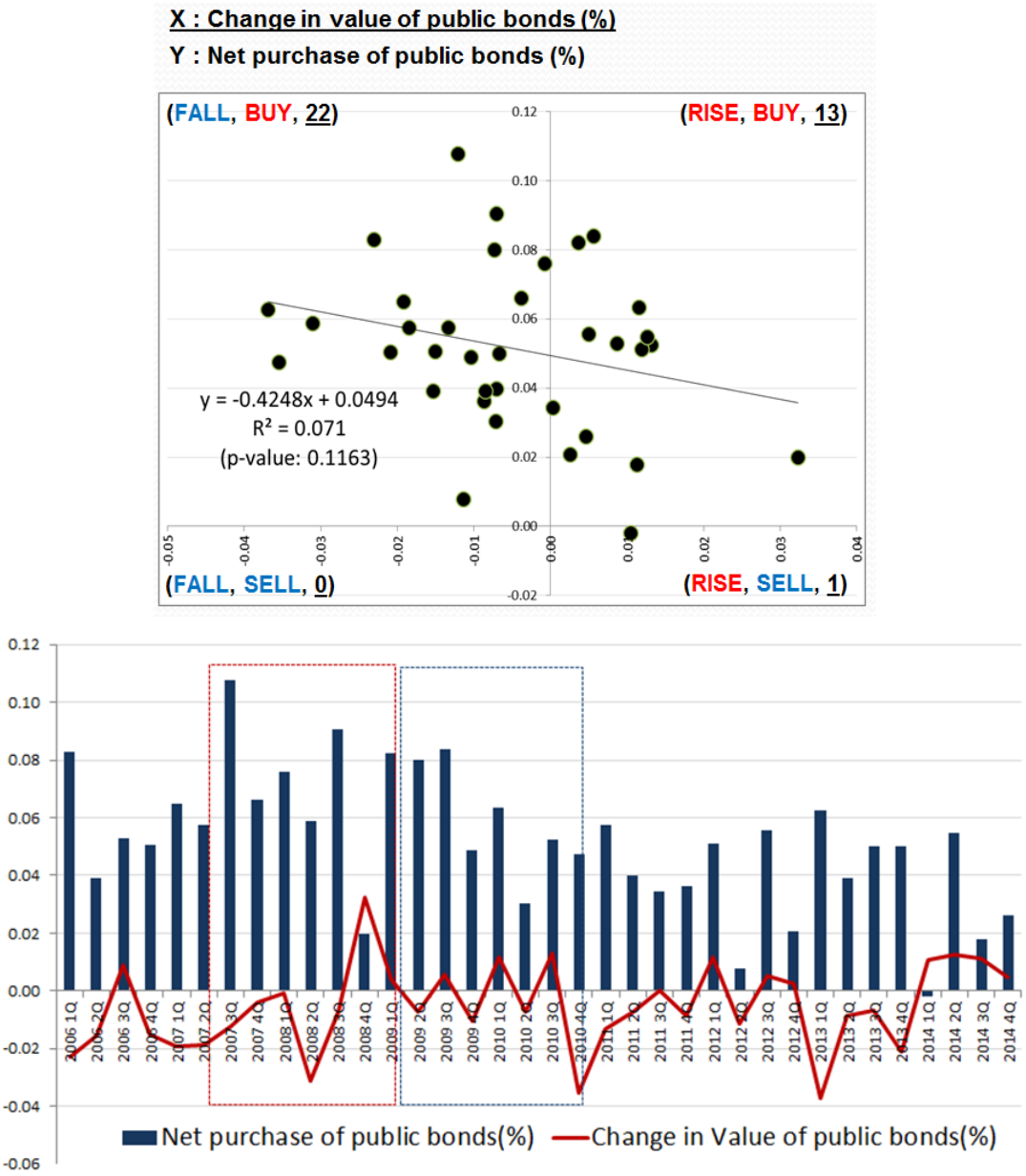
Panel A. Poland



Panel B. Chile



Panel C. Italy



Source: IOPS.

85. We summarized pension funds' investment behaviour in relation to analysis of net transactions vs price changes in Table 7. Since in most cases funds were net buyers, we make conclusions mainly on the basis of the second approach, i.e. the sign and significance of the established trend line. In Poland and Italy, pension funds showed very strong counter-cyclical behaviour in equity markets, whereas funds showed weak counter-cyclical behaviour in Mexico, and weak pro-cyclical behaviour in Chile. Among Poland, Chile, and Italy, no strong pro- or counter-cyclical behaviour was observed in in private bond market, but stronger counter-cyclical behaviour was observed in public markets.

Table 7. Summary of investment behaviour by pension funds in relation to changes in value

Jurisdiction	Equities		Private bonds		Public bonds	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
Mexico	(–)	(–)	n/a	n/a	n/a	n/a
Poland	–	n/a	net buyers		–	n/a
Chile	**(+)**	+	net buyers		–	–
Italy*	n/a	–	(–) net buyers	n/a	(–)	n/a

Notes: **+:** pro-cyclical investment behaviour (a negative trend line statistically significant at 5% or less),
–: counter-cyclical investment behaviour (a positive trend line statistically significant at 5% or less),
(): weak effect with a trend line statistically insignificant (in a range 5%-15%)
n/a: not applicable or negligible
empty cell: no conclusion can be drawn
* Italian funds mostly invest in domestic bonds and foreign equities

Source IOPS.

4.2 Correlation analysis

86. A correlation coefficient is a useful tool to summarise a set of data into single number that depicts strength of the linear relationship between two variables. Table 7. shows correlations between domestic stock market returns and net purchases of domestic equity expressed in two different ways: net purchases of domestic equity versus total net new investments or absolute values of net purchases of domestic equity. Considering the importance of funds' impact on local markets, we present results for domestic equity investments[19] (In Italy, total equity investments were analysed to cover foreign equity which was the majority of equity investments). Unfortunately, more frequent (such as monthly) data that would help achieve more granular conclusions were not available.

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

88. The above two findings support conclusions from Table 2 with regard to counter-cyclical behaviour by Polish funds in domestic equity market and by Italian funds in foreign equity market during the crisis period. However, negative correlations question pro-cyclical behaviour of funds in these two countries during 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. Moreover, correlation results are in line with the results obtained from scatter plot analysis (cf. Table 7) that also indicates counter-cyclical behaviour by Polish funds in domestic, and Italian funds in foreign equity markets.

[19] The correlation analysis results for foreign equities are available at request.

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)[20]	**-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.

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

4.3 Regression analysis

89. Multiple regression method was employed to investigate what determines pension funds' investment in equity, the most representative asset class of risky investment. Similarly to the correlation analysis, we present results on domestic equity investments[21]; in Italy, total equity investments were analysed to cover foreign equity which represented the majority of equity investments. 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)[22]. 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[23] to scale down its values.

90. 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.

91. The results (Table 8) vary by jurisdictions possibly due to differences in financial market characteristics and pension sectors' institutional structure. Model 2 shows better fit than Model 1 in terms of R-squared and Adjusted R-squared metrics. Notwithstanding, the results do not show any relation between investment decisions by pension funds and stock returns. The only exception is Poland (Model 2) where positive stock returns variable is statistically significant. 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)

[21] The regression analysis results for foreign equities are available at request.

[22] Models with lagged (by one quarter) returns were also tested. However, they provide no significant results. Moreover, with quarterly data it seems very unlikely that pension fund managers would be reacting to stock market changes with such a delay.

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

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[24]	-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[25]	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.

92. As the time series is rather short, we made an attempt to simplify Model 2 by deleting asymmetric variables for the intercept and local stock index returns[26]. Results that are significant at 5% critical level (Table 9) suggest 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 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 foreign equities and domestic treasury bonds.

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

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

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

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

Explanatory variables	Mexico		Poland		Chile		Italy[27]	
	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.

93. 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
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	

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

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.

94. 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 was the only explanatory variable (Table 11). The results signal a counter-cyclical behaviour for Poland (domestic equities) 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.

5. Institutional determinants of pension funds' investment behaviour

95. 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 pattern 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.

96. 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. These boundaries 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 changes in portfolios' asset prices. This reduces the degree of divergence from the SAA. Ceteris paribus, pension funds buy asset classes which experience falls in prices, and sell asset classes whose prices increase. In other words, there is a counter-cyclical mechanism built-in in the institutional setting of Italian pension plans with respect to the behaviour of asset prices.

97. 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 an 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 its assets invested in stocks, and fund E is the safest fund with up to 5% of its assets 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[28], who are further not permitted to choose Fund B to invest their savings.

98. There is a default allocation for members who do not choose an investment portfolio. 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 assigned to fund C. Finally, men older than 55 and women older than 56 are allocated to fund D by default.

99. In Mexico there are currently five types of investment portfolios (Bàsicas 0 – 4) with different level of risk exposure [to develop or merge with the previous paragraphs]

100. 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
- ½ of the mean of the annual real return over the past 36 months minus the absolute value of 50 percent.

101. 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

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

[28] 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.

Conclusions

103. The purpose of this paper was to qualitatively and quantitatively analyse the investment behaviour pension fund sector during and after the 2008-09 financial crisis until 2014-2016 in Chile, Mexico, Poland, and Italy. Since only four countries were covered in the study, the applicability of its findings to other pension systems may be limited.

104. The four jurisdictions reveal different profiles of investment by asset classes. Pension funds in

- Mexico invested mainly in domestic public bills and bonds (recently 51.2%), while allocation to equity was around 20 percent.

- Poland, until the second quarter of 2014, invested mainly in two asset classes, domestic public bills and bonds (jointly around 50-75%) and domestic equity (around 20-40%). The early 2014 reform seriously changed asset allocation making the domestic equity the single major asset class.

- Chile maintained a highly diversified portfolio. 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%). A high proportion of foreign equity (20-35%) is noticeable.

- 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. Investments in bonds tended to be domestic ones and in equities - foreign.

105. We used four methods to investigate the investment behaviour of pension funds:

- an analysis of average quarterly transactions for four sub-periods (pre-crisis, crisis, recovery, post-crisis) for five asset classes (equities, private bonds, public bonds, cash and deposits, and others);

- a scatter plot analysis of the relation between average quarterly net purchases and quarterly changes in asset value (domestic equities, domestic private bond, domestic public bonds),

- a correlation analysis of average quarterly transactions in equity market and its index values, as well as,

- a regression analysis of average quarterly transactions in equity market and its index values.

106. During the 2008-09 financial crisis, pension funds in Mexico, Poland continued buying *domestic equities*, 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. Mexican pension funds became net sellers of *foreign equities* during the crisis and then relatively strong buyers at the recovery. Chilean funds kept buying foreign equities before and even increased net purchases during the crisis but became net sellers afterwards. Pension funds in Italy increased their net purchases of (mostly foreign) 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. Net positive investment of Polish funds in foreign equities was of negligible scale through the whole period.

107. Pension funds in Poland, Chile, and Italy remained net buyers of *private sector bonds* 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 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. They 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, they doubled their allocation of new money to private bonds as compared to the pre-crisis.

108. With regard to *public bonds*, Polish funds were actively buying them before the crisis and then consequently lowered their average quarterly net purchases over time. 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.

109. Did pension funds buy more aggregated risky assets during the crisis, therefore playing role of liquidity provider to the market during fire sale? The answer to this question for three jurisdictions we have the data (Poland, Chile, and Italy) is positive. These funds increased their net average purchases of risky assets (equities and private bonds) during the time of the crisis. The difference is that Polish 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 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.

110. The overview of transactions in domestic equities suggests that pension funds in Mexico and Poland acted counter-cyclically during the crisis whereas Chilean funds seemed to be pro-cyclical. Regarding foreign equities, pension funds tended to be counter-cyclical during the crisis in case of Chile and Italy (with Poland having same pattern but of negligible scale) and pro-cyclical in Mexico. Due to lack of information about price movements of bonds, we were not able to judge whether funds' transactions were of pro-cyclical or counter-cyclical character based on the above analysis.

111. The scatter plot analysis reveals that pension funds showed counter-cyclical behaviour in Poland (mainly in domestic market) and Italy (mainly in foreign market). On the other hand, Chilean funds' showed pro-cyclical behaviour in both domestic and foreign equity markets. No strong evidence was observed in case of Mexico.

112. The correlation analysis of domestic equity transactions suggests, 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.

113. The findings of the correlation analysis are corroborated by the regression analysis. The regression 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%.

114. Tables 12 and 13 provide a summary of findings with regard to investment behaviour in domestic and foreign equity markets:

Table 12. Summary – investment behaviour with regards to domestic equities

Jurisdiction / Method	Transaction analysis (crisis)	Scatter plot analysis	Correlation analysis	Single regression analysis
		(whole period)		
Mexico	continue buying **counter-cyclical**	?	?	?
Poland	continue buying **counter-cyclical**	negative trend line **counter-cyclical**	negative sign **counter-cyclical**	negative sign **counter-cyclical**
Chile	sell **pro-cyclical**	weak positive trend line (at 9%) **pro-cyclical (?)**	weak positive sign (at 6%) **pro-cyclical (?)**	weak positive sign (at 7%) **pro-cyclical (?)**
Italy	not applicable	not applicable	not applicable	not applicable

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

Table 13. Summary - investment behaviour with regards to foreign equities

Jurisdiction / Method	Transaction analysis (crisis)	Scatter plot analysis	Correlation analysis	Single regression analysis
		(whole period)		
Mexico	sell **pro-cyclical**	?	?	?
Poland	continue buying **counter-cyclical** (negligible amounts)	?	?	?
Chile	continue buying **counter-cyclical**	positive trend line **pro-cyclical**	positive sign **pro-cyclical**	positive sign **pro-cyclical**
Italy	continue buying **counter-cyclical**	negative trend line **counter-cyclical**	negative sign **counter-cyclical**	negative sign **counter-cyclical**

Source: Authors' analysis.

115. In general, we may therefore conclude that

- Polish and Italian funds tended to act counter-cyclically in equity market (Poland - domestic, Italy - foreign) during the whole period, including the time of crisis;

- there is some weak evidence showing that Chilean funds may have acted pro-cyclically in domestic equity market. However to obtain statistically significant results one would need 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;

- Chilean pension funds tended to act pro-cyclical in foreign equity market according to three methods and counter-cyclically according to analysis of quarterly average transactions during the crisis.

116. 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).

117. 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.

118. 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)[29] 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.

119. For the final 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.

[29] 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