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# ARE PENSION FUNDS A STABILISING FACTOR IN FINANCIAL MARKETS? EVIDENCE FROM FOUR COUNTRIES

**Taejin Han, Kyoung Gook Park, Dariusz Stańko**

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# ARE PENSION FUNDS A STABILISING FACTOR IN FINANCIAL MARKETS? EVIDENCE FROM FOUR COUNTRIES

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## ABSTRACT

The paper analyses qualitatively and quantitatively the investment behaviour of pension fund sector during and after the 2008-09 financial crisis until 2014-2016 in Chile, Mexico, Poland, and Italy. Four methods were used: an analysis of average quarterly transactions, a scatter plot analysis of the relation between average quarterly net purchases and quarterly changes in asset value, a correlation analysis of average quarterly transactions in equity market and its index values, and a regression analysis of average quarterly transactions in equity market and its index values.

All these methods suggest that Polish and Italian pension funds were, counter-cyclical in, respectively, domestic and foreign equity markets. 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. In case of Mexican pension funds we were not able to arrive at any statistically significant conclusions.

During the recent financial crisis pension funds in Poland, Chile and Italy increased their net average purchases of risky assets (equities and private bonds). This seemed to be helpful to the credit market that suffered from credit crunch and liquidity shortage during the crisis.

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 in. These can be strategic asset allocation benchmark (Italy), performance system (Poland), investment portfolios chosen by members (potentially Chile). 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.

Pro-cyclicality or counter-cyclicality of pension funds should not be subject to valuation. The paper found that the presence of some strategic asset allocation index may help stabilise financial markets. Counter-cyclical behaviour by institutional investors seems to be good for the stability of financial markets and the economy in long-run. However, it is difficult to conclude, at least ex-ante, that a particular benchmark or investment behaviour is beneficial for pension fund members, and thus should be promoted by supervisors or policy makers. Investment decisions by pension funds should be governed solely by the interest of members and correspond to the local circumstances.

**Keywords:** investment, pension funds, pro-cyclicality, pension supervision, private pensions, financial stability

**JEL codes:** E-22, G-23, G-28

* International Organisation of Pension Supervisors (IOPS). We kindly thank IOPS Members for their support and, in particular, pension supervisory authorities of Chile, Italy, Mexico and Poland for providing the data and useful comments.

# Contents

## EXECUTIVE SUMMARY

The paper analyses qualitatively and quantitatively the investment behaviour of the 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.

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 relationship between average quarterly net purchases and quarterly changes in asset value (domestic equities, domestic private bonds, 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.

We find that during the 2008-09 Financial Crisis, pension funds in Mexico and 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 the time. On the other hand, Chilean funds' net purchases became sizeable during the crisis and afterwards. Italian funds lowered their percentage of net new investments in public bonds during the crisis and increased the percentage of public bonds as the economy recovered.

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

The analysis of transactions suggests that in the 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 the case of Chile and Italy (with Poland following the 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 that use the average transactions for individual quarters.

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

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 significant only at 8% level.

The regression analysis indicates that during the whole period Polish funds acted counter-cyclically in domestic equities, and Italian funds in foreign equities. There is also some weak evidence that Chilean may have acted pro-cyclically in the domestic equity market and stronger evidence of pro-cyclicality in foreign equities. When analysing the most aggressive type of pension funds in Chile and Mexico (see Annex), we obtained statistically significant evidence of pro-cyclical behaviour by such

funds in Chile. However, we were not able to reveal any meaningful results for Mexico's aggressive funds.

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 in which 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 study may be explained 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).

**ARE PENSION FUNDS STABILISING FACTOR IN FINANCIAL MARKETS?**
**EVIDENCE FROM FOUR COUNTRIES**

## Introduction

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 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 volatility (see Table 1 in IOPS, 2017: 40). However, the existing quantitative research is fragmented in terms of data coverage and methodology.

The evidence produced by the Italian Pension Regulator (COVIP) (see COVIP 2008, 2009) confirmed clear counter-cyclical behaviour by 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 characterised by a different strategic asset allocation (SAA), must be established by the pension fund managing companies[1].

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 stability to financial markets, in particular during the last Financial Crisis.

In Section 1 we analyse historical pension fund transactions and asset allocation. In Section 2 we track historical movements of risky assets to define when the global crisis occurred and when it passed. 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 market performance 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*

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).

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. Funds may change their **propensity for buying (selling)** to adjust to the changing market conditions and to allow for rebalancing of their asset holdings. For example, in a rising market a fund may continue purchasing a particular class of assets but 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.

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

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.

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

***Scope, data and method***

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 on purchases and sales by asset classes is very rare and helps in understanding the nature of pension funds' investment behaviour and their impact on financial markets.

The data classify investments by pension funds into five asset classes: cash and deposits, public bonds, private bonds, equity, and others. The data track values of purchases and sales on a quarterly basis. Unfortunately, more frequent data were not available. The data also describe cashflows 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.

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.

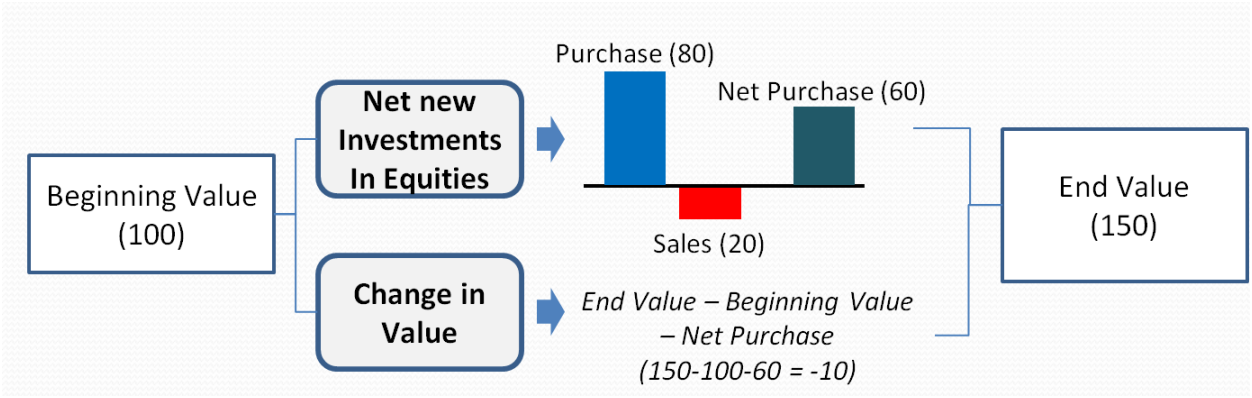
This paper focuses on the investment behaviour of pension funds with regard to domestic equities. This is because such data are more available and also because the impact of pension funds' investments on a local market is more important, especially in the supervisors' context. Only for Italy did we use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

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 investment manager. Usually, the final result is due 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.

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.

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

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




Source: Authors

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.

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 during the analysed period (one 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 quantify 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

The four jurisdictions reveal different profiles of investment by asset class. 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.

Pension funds in Mexico invested mainly in domestic public bills and bonds (recently 51.2%), while allocation to equity was around 20%. 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 rose to 20% in 2013, mainly due to large investments in foreign equity markets.

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 profoundly changed asset allocation, making domestic equity the single major asset class.[3] As this can be regarded a structural change to the Polish pension sector, we excluded the period of 2014-2015 from the sample period used for the quantitative analysis.

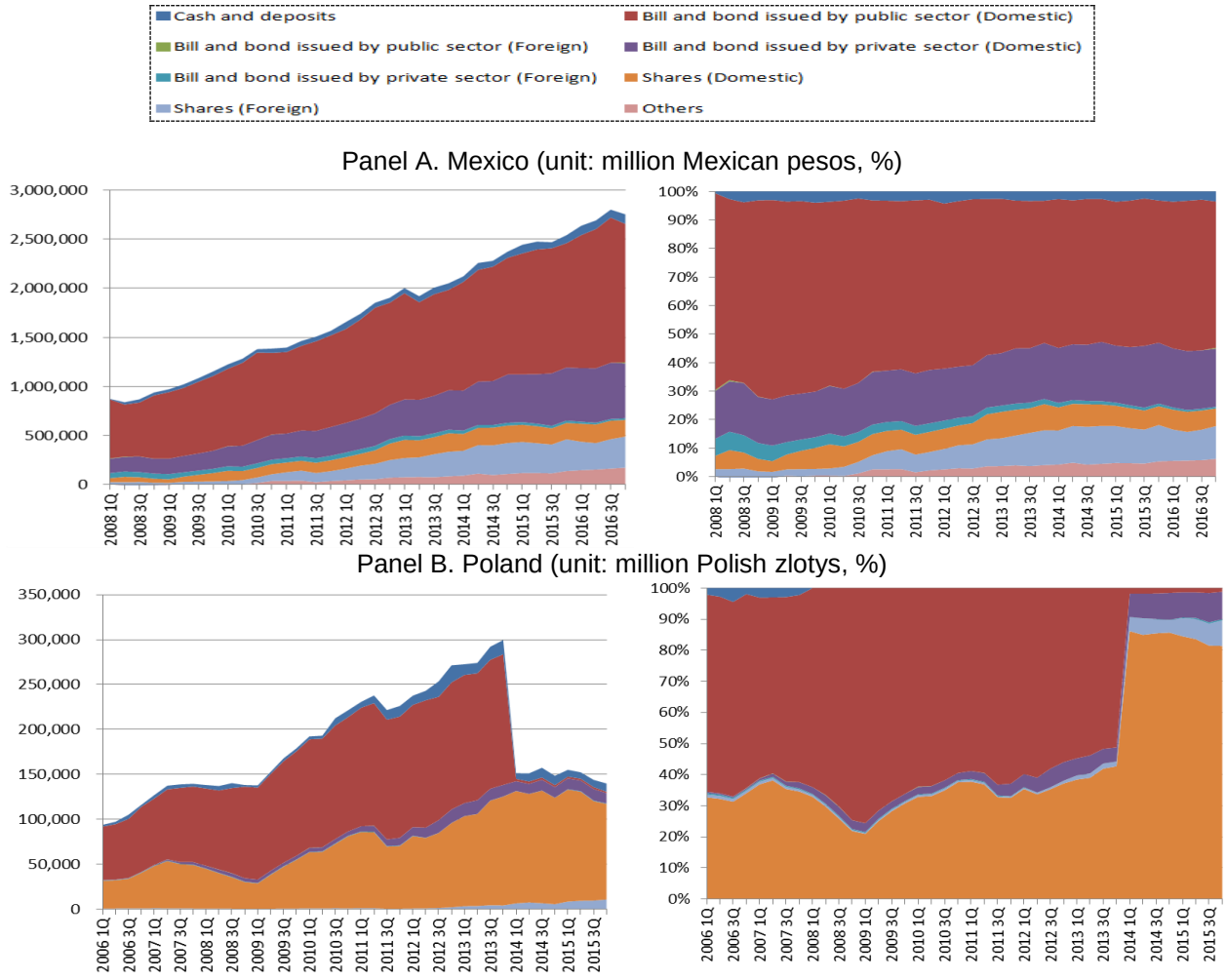
Unlike Mexico and Poland, Chilean pension funds have maintained a highly diversified portfolio in terms of asset classes. After the global financial turmoil in 2008, there has been a trend of decreasing

[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.

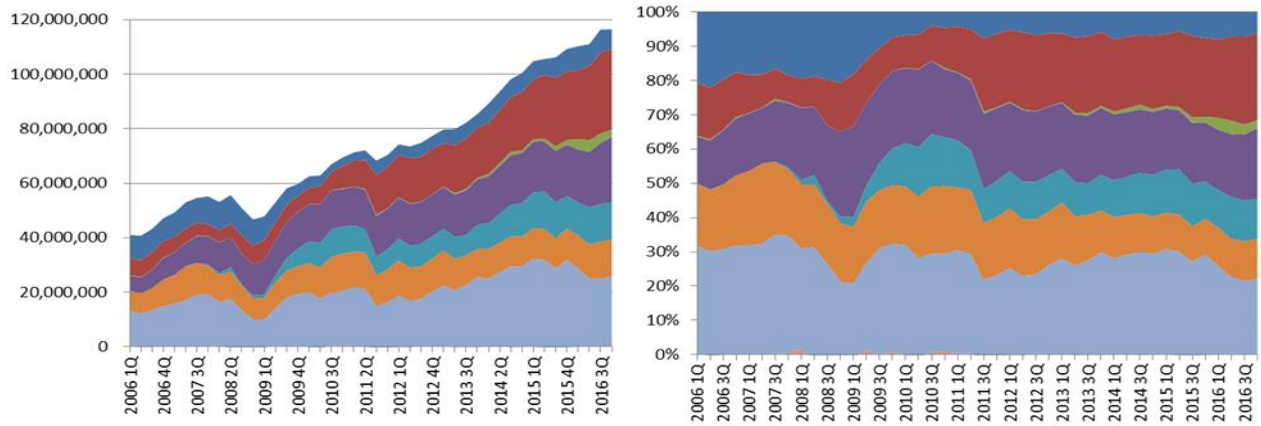
allocation to cash and deposits (towards 5%) and domestic equity (towards 10%); while increasing allocation to domestic public sector bills and bonds (25%). More than other countries in the study, a high proportion of foreign equity (20-35%) is noticeable.

Pension funds in Italy invested mainly in public bills and bonds (approximately 60%), while the combined allocation to private bills and bonds (25%) and equity (15%) was less than half of total investments. Unfortunately, the distinction between 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 were foreign.

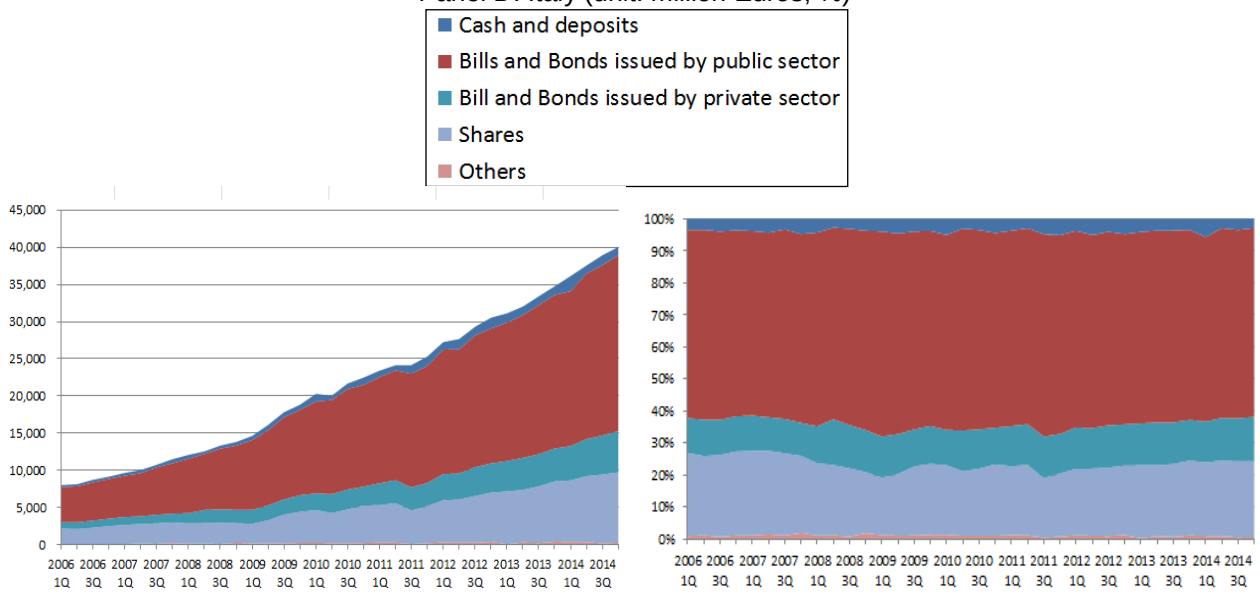
**Figure 2. Trends in pension funds' investment amounts and asset allocation**



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




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




Source: IOPS

## 2. Definition of Financial Crisis period

### *2.1 Equity markets*

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 conditions (see Figures 3 and 4).

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

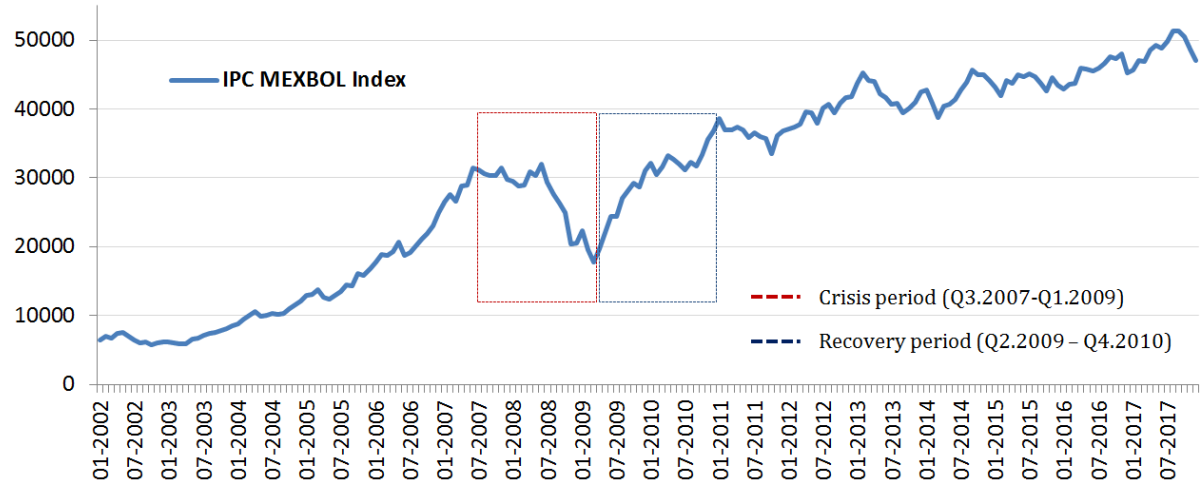
In Figure 4, one can notice that domestic stock prices in all four countries also dropped sharply between Q3.2007 and Q1.2009 then recovered in the period of Q2.2009 to Q4.2010. This indicates that the movements of domestic equity prices were very similar to the movements of the global stock price during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

Based upon the analysis above, in order to compare pension funds' behaviour in more detail, 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).

The magnitude of domestic stock price decline varied depending on the 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%). Moreover, 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 a greater impact in Europe. As we develop our analysis, we can also observe clearer counter-cyclical behaviour by Italian and Polish pension funds, which might be explained by the very magnitude of the Crisis.

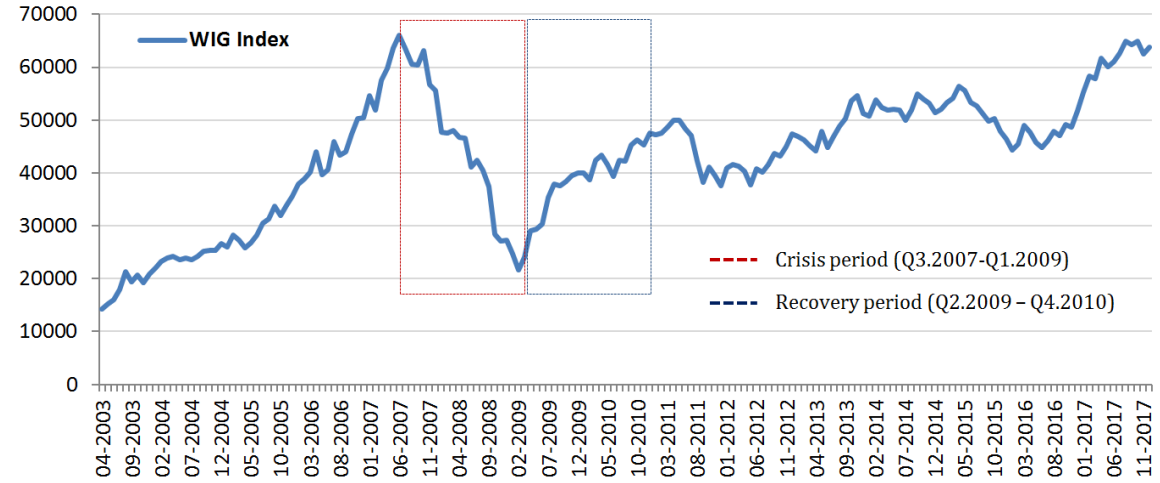
**Figure 4. Movements of domestic stock prices**

Panel A. Mexico (IPC MEXBOL index)

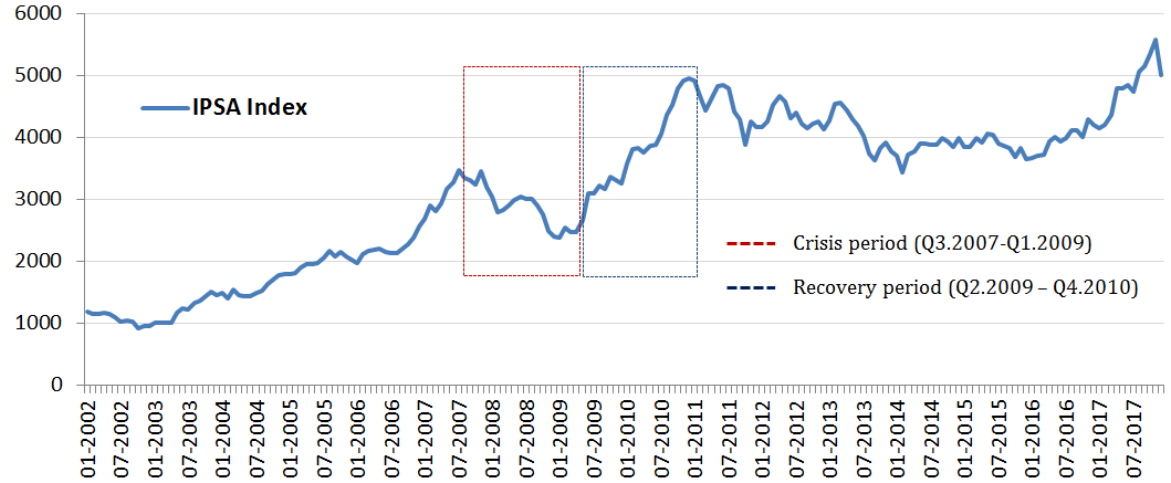



[4] https://markets.ft.com/data/indices/tearsheet/charts?s=MS-WX:MSI

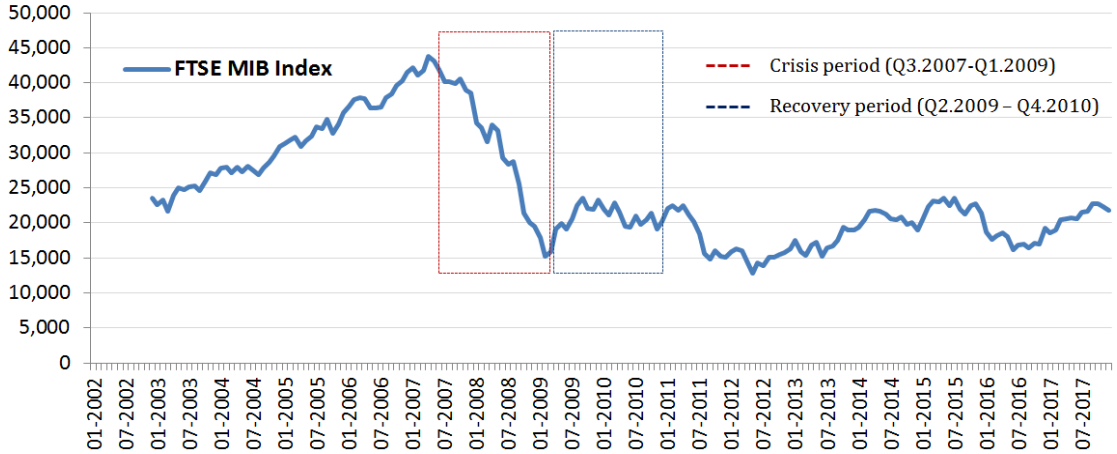
Panel B. Poland (WIG index)




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*

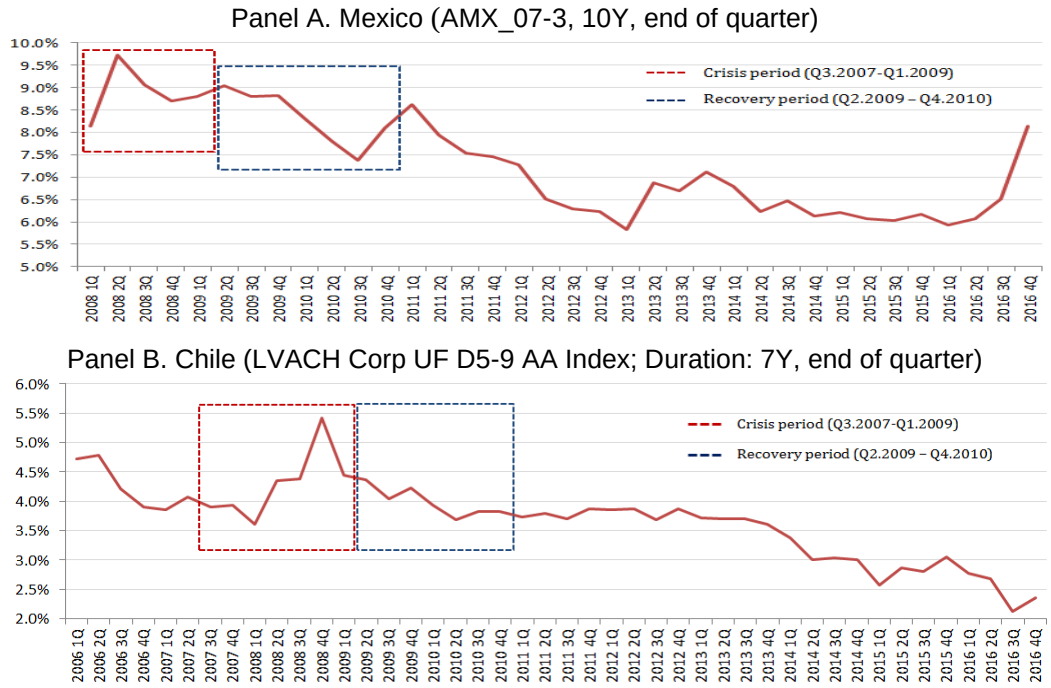
The second asset class which can be regarded as "risky" is private-sector bonds. During the 2008-09 Financial Crisis many jurisdictions experienced "a flight to quality", which led to the credit crunch and sky-rocketing credit spreads of private-sector bonds (see Figure 5). This result is in line with 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]

Figure 6 shows the changes in representative private bond 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 bond yields (i.e. falling bond prices) during the Crisis followed by a gradual decrease (i.e. increasing bond prices) during the recovery.

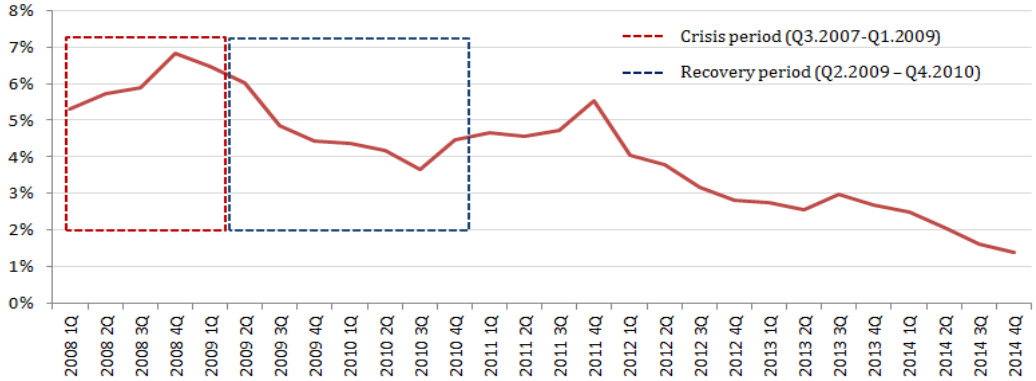
**Figure 6. Movements of domestic private bond yields**




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




Source: IOPS

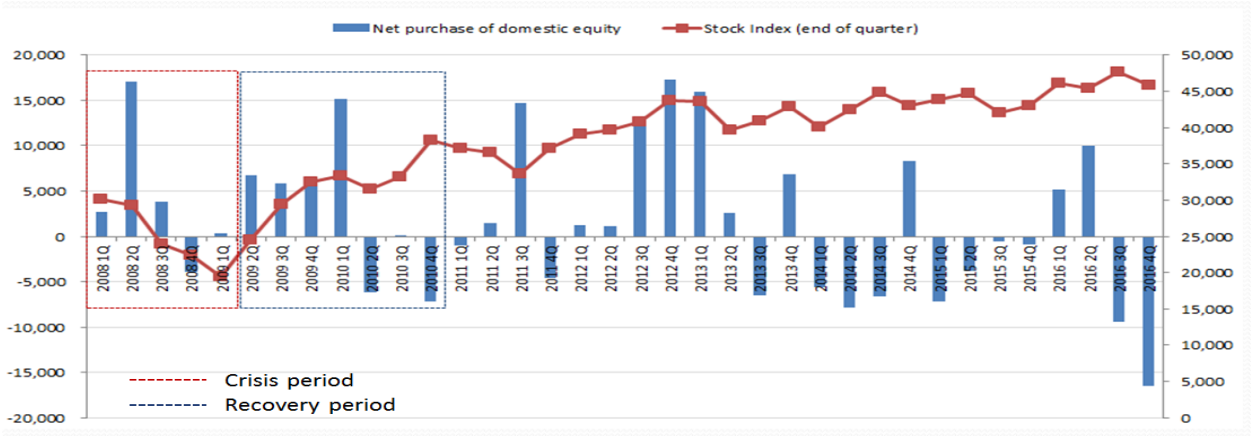
## 3. Characteristics of pension funds' transactions

### *3.1 Equities*

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.

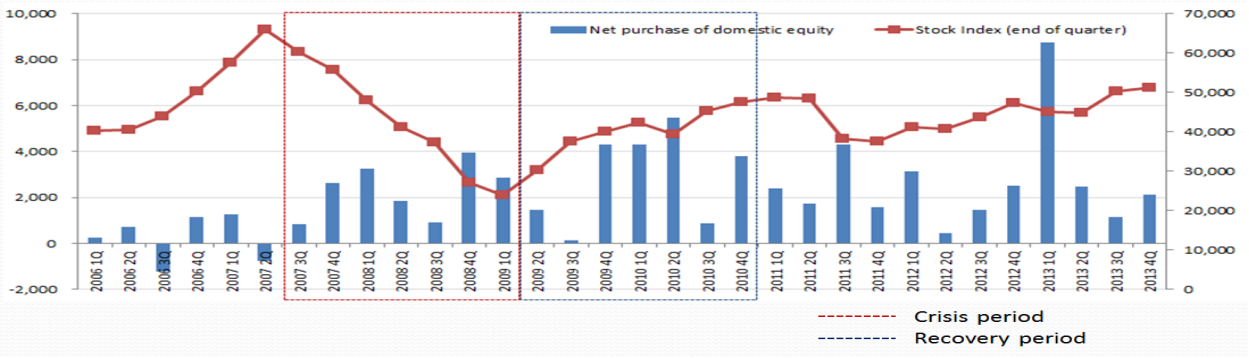
**Figure 7. Net purchases of domestic equity vs stock indices**

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

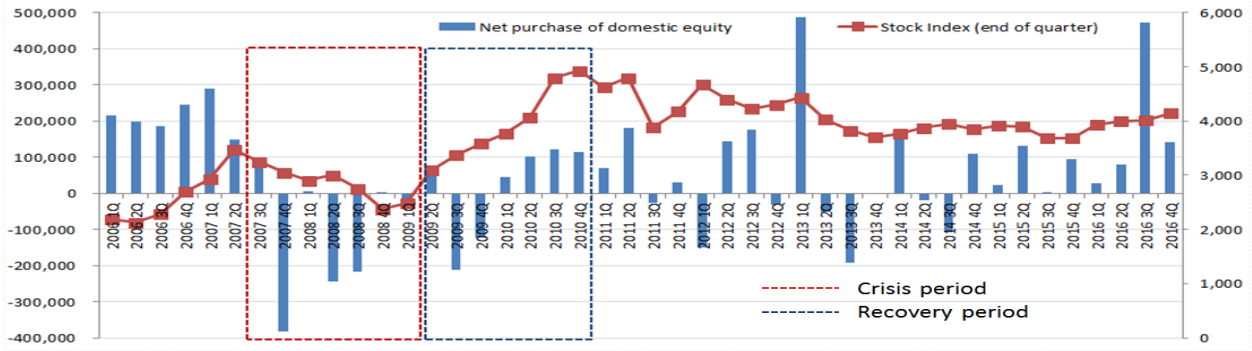



[8] The MSCI World Index is a broad global equity benchmark that represents large and mid-cap equity performance across 23 developed markets countries.

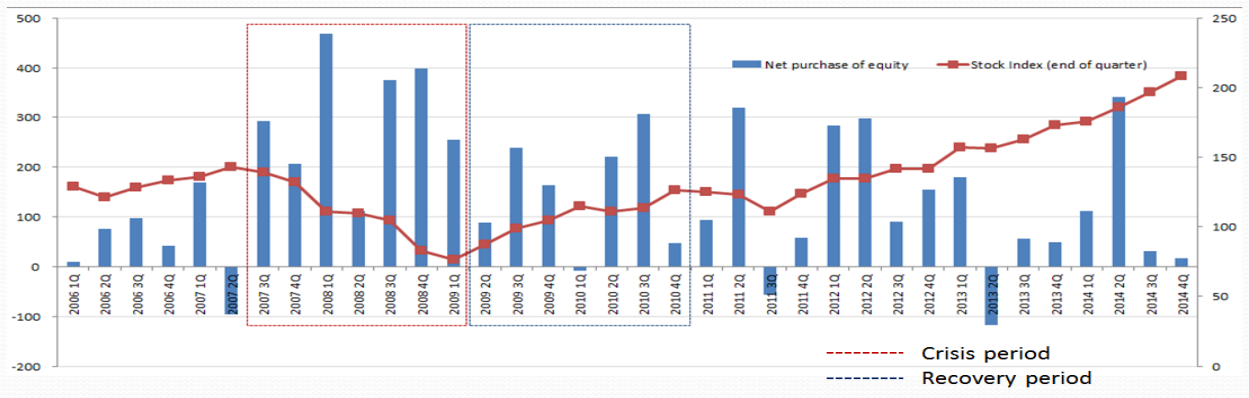
Panel B. Poland (left axis: million Polish Zloty, right axis: WIG index)




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

Table 1 contains a summary of the average and total quarterly net purchases of equity 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.

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

**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 (Q3.2007-Q1.2009) | 2,329 | 16,302 | 31 | 215 | 2,360 | 16,517 | 7,540 | 52,779 |
| | | (30.9%) | | (0.4%) | | (31.3%) | | (100%) | |
| | Recovery (Q2.2009-Q4.2010) | 2,912 | 20,382 | 52 | 362 | 2,963 | 20,744 | 5,834 | 40,841 |
| | | (49.9%) | | (0.9%) | | (50.8%) | | (100%) | |
| | Post-Crisis (2011-2013)[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%) | |

[10] No data were available for the pre-Crisis period in Mexico.

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

[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.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **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

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%).

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 (MXN 96 bln vs MXN 66.5 bln). Also, from the perspective of net purchases of equities as an asset class, Mexican funds were net buyers during the whole analysed period.

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 at that time at 5%) and partly due to accounting disincentives contained in the pension law.

Average quarterly purchases of domestic equities increased ten times from PLN 241 mln (Polish zlotys) before the Crisis to levels of PLN 2 300 mln and 2 900 mln during the Crisis and the recovery. What is interesting, after the Crisis funds were still quite intensively buying domestic equities (approximately PLN 2 700 mln 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). As in Mexico, pension funds in Poland were net buyers of equities (domestic and foreign) during the whole period.

Unlike Mexico and Poland, Chile experienced 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 an even lower ratio (1.8%) in foreign equities. At the onset of the Financial Crisis, funds moved to selling domestic equities holdings (negative ratio of -4.8% during the Crisis), while increasing foreign equity

net purchases (11.3% of net new investments)[13]. During the recovery, funds had almost no appetite for increasing domestic equity positions (0.6% of net new investment) and after the Crisis purchases continued to be very low (1.4%). In foreign equities, funds kept on buying at a similar level (10.5%) during the recovery but interestingly, they became net sellers of foreign equities in the period after the Crisis (-2.5%).

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 (circa MXN 110 000 mln per quarter). They also quintupled purchases of foreign equities (MXN 259 000 mln). During the recovery, funds became net buyers of domestic equities again, albeit at a very low level (over MXN 16 000 mln per quarter) and increased even further the amount of foreign equities bought per quarter (to over 280 000 mln). After the Crisis funds increased their average purchases of domestic equities over four times (to more than MXN 73 000 mln) but became quite intense net sellers of foreign equities (over MXN 136 000 mln per quarter). In contrast 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.

In Italy, one can see clearer signs of counter-cyclical behaviour as pension funds increased their investments to equities when stock prices dropped. Before the Crisis, funds invested in equities around 12% of their net new capital, 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.

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

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[14]. 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 suffered bigger impact from the Financial Crisis, increased their investments in equity heavily during the Crisis. Funds in all four countries were net buyers during the recovery period.

Considering that pension funds were net buyers in most of the periods, we should examine the propensity for buying equities more precisely. Pension funds in Poland and Italy both increased their 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 domestic equities decreased during the Crisis and increased during the recovery, whereas they acquired greater exposure to foreign shares during the Crisis then decreased during the recovery. For Mexico, the analysis was limited since we do not have the data before the Crisis.

[13] This can be explained by the rising path of the exchange rate during 2008 that encourages investment in foreign equity. In addition, thanks to the investment regime in place at the time it was possible to increase foreign equity and to reduce domestic equity. (Information from the Superintendence of Pensions, Chile).

[14] Information from the Pension Funds Supervision Commission (COVIP).

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 being 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 different behaviour. In the next section we use each individual quarterly data for scatter plot, correlation and regression analyses.

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 for domestic equity markets and Mexico for foreign markets. The 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, dealings in Mexican domestic equity, Chilean and Italian foreign equities are rather counter-cyclical.

**Table 2. Nature of 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 because of negligible average quarterly net investments (< 1% of total quarterly new investments), [ ]: weak effect because of similar propensity (< 5% percentage of net purchases in total new investments),
n/a: no data on pre-Crisis period for Mexico or domestic equities for Italy,
*: most equity investment in Italy related to foreign equities

Source IOPS

### *3.2 Private bonds*

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 the total investment in private bonds was available as it was not possible to differentiate between domestic and foreign investments. Mexico was not included in the table due to incomplete data on private bond investments.

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.

**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.

In terms of volume, Polish funds doubled the net quarterly average amounts of private bonds purchased during the Crisis (PLN 342 mln) compared to the pre-Crisis period (PLN 173 mln), and then purchased similar amounts during the recovery (PLN 372 mln). After the Crisis, funds were intensively

buying private bonds (over PLN 1 700 mln per quarter on average). In keeping with their behaviour in foreign equity markets, Polish funds' trading in foreign private bonds was minimal during all periods.

In Chile, unlike for equity, net quarterly average purchases of private bonds increased during the Crisis. Before the Crisis, almost one-quarter of net new investment was allocated to private domestic or foreign bonds, but this fraction increased to almost one-third 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% during the recovery.[15] However, after the Crisis funds lowered their appetite for private bonds to 9.2% of net new investment, far 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%).

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 CLP 700 000 mln per quarter decreased to CLP 550 000 mln during the Crisis and to CLP 370 000 mln at the recovery. Funds started buying more domestic bonds afterwards – the average increased to over CLP 540 000 mln. 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 CLP -203 mln pesos at the pre-Crisis period to over CLP 170 000 mln during the Crisis and to record-high CLP 1 135 bln during the recovery. Subsequently, funds began selling foreign bonds at an average rate of CLP 49 000 mln per quarter.

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

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

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 a pro-cyclical or counter-cyclical character based on the above analysis.

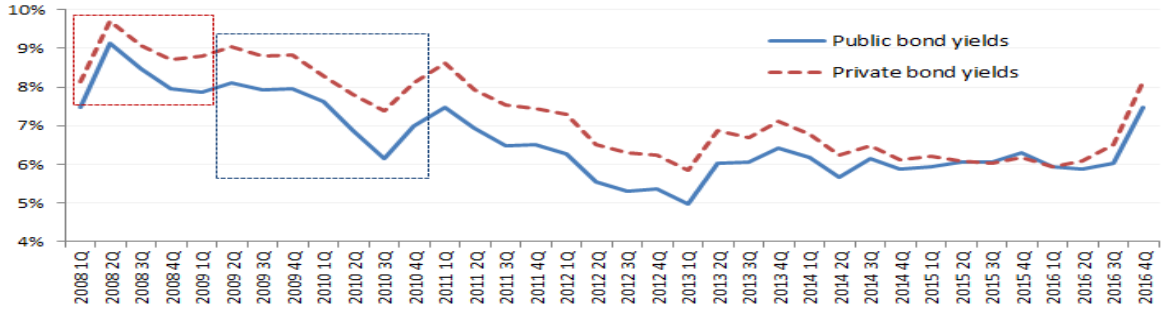
### *3.3 Public bonds*

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. Figure 8 shows the development of public and private bond yields in each jurisdiction (data for Polish private bond yields were not available). Public bond yields in Poland, Chile and Italy remained relatively stable during the Crisis compared to private bond yields. The only exception was public bond yields in Mexico as they increased at a similar rate to private bond yields. However, for Mexico one can assume public bonds as a secure asset, since there were few alternative assets to invest in during the crisis and public bond yields were still lower than private bond yields.

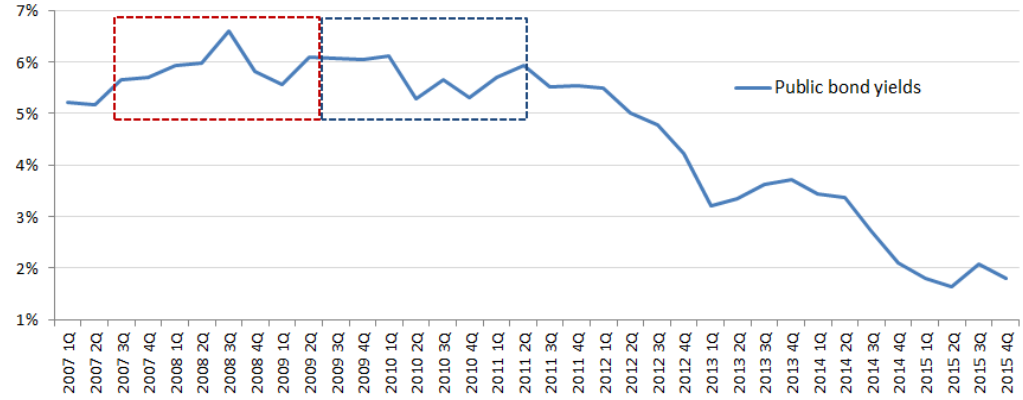
[15] This is due the pension reform of 2008 that increased both the global limit of foreign investment (all funds added together) and for each fund individually. (Information from the Superintendence of Pensions, Chile).

**Figure 8. Movement of domestic public bond yields vs. private bond yields**

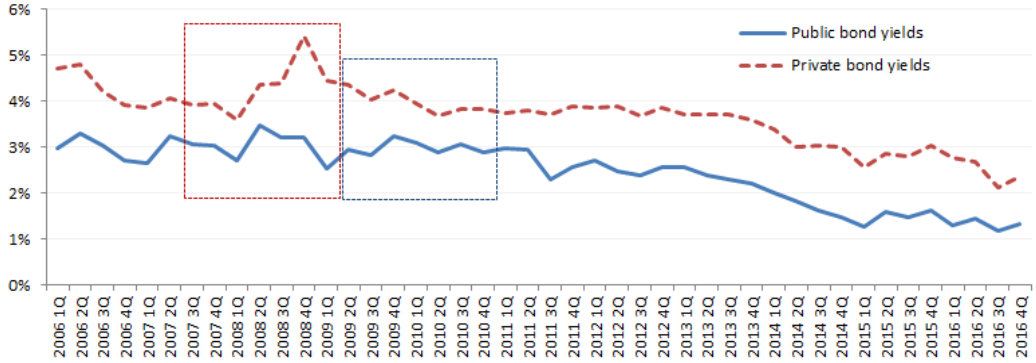
Panel A. Mexico (MEX BONOS DESARR FIX RT(10Y) & AMX_07-3(10Y) end of quarter)



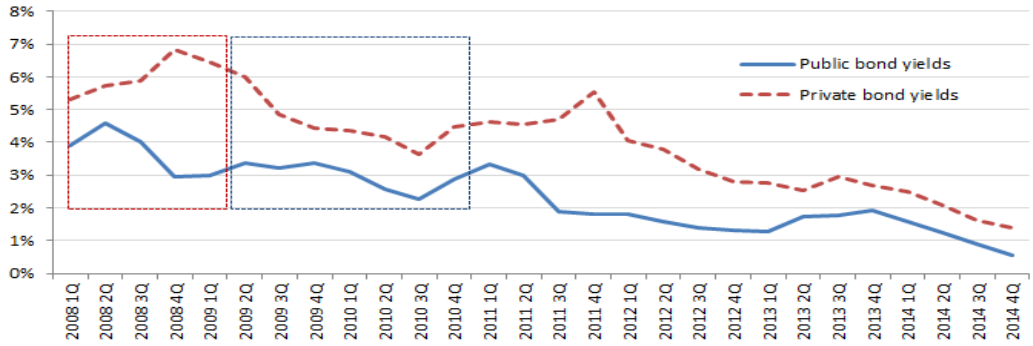

Panel B. Poland (PL0000104543 (10Y), end of quarter)




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

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 the 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.

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, the share of net investments in public bonds decreased even further to 29.6% as Polish funds began to invest more money in private bonds.

The average amounts of new purchases of public bonds by pension funds in Poland changed from the pre-crisis level of PLN 5 040 mln per quarter to PLN 4 800 mln per quarter during the crisis and fell to PLN 2 500 mln per quarter as the situation in financial markets was improving. This may suggest some counter-cyclical behaviour in the recovery period. After the crisis, average purchases of public bonds amounted to almost PLN 2 000 mln 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.

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 slimmed their investments in cash & deposits (42% of net new investments) and used new money to invest more in public bonds (20%) as well as private bonds (c.f. Table 3), which should have helped bond markets to stabilise. This could be viewed as counter-cyclical behaviour but, again, this behaviour may be influenced by the 2008 reform, where the limit on equities and foreign investment increased. 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 – net investment jumped to 92.0% (56% for cash and deposits and 36% for public bonds).

The average quarterly net purchases of cash and deposits in Chile were very high before the crisis (almost CLP 2 040 bln). At the same time, funds were buying public bonds but at a much lower speed – with the quarterly average of only CLP 14 000 mln, the majority of which were foreign bonds (over CLP 11 500 mln per quarter). Funds kept lowering their net purchases of cash and deposit (less than CLP 1,000 bln per quarter during the crisis and less than CLP 247 000 mln per quarter during the recovery). However, they became intensive net buyers of public bonds (over CLP 451 000 mln per quarter) during the crisis and the recovery period (almost CLP 650 000 mln). 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 CLP 400 000 mln per quarter and only CLP 52 000 mln of foreign bonds. This trend continued in the recovery period as funds enlarged their net purchases of domestic bonds to almost CLP 603 000 mln per quarter, while net purchases of foreign bonds stayed around CLP 45 000 mln. 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 CLP 3 000 000 mln per quarter) and public bonds (almost CLP 2 000 000 mln). 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 risky assets' improving valuations. The structure of purchases of domestic vs foreign public bonds after the Crisis remained similar: funds were buying around eight times more domestic bonds (over CLP 1 730 000 mln per quarter) than foreign ones (less than CLP 192 000 mln).

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.

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, the percentage of new purchases of public bonds was 68%, but it fell to 53% during the Crisis, suggesting that Italian pension funds acted somehow counter-cyclically. As the economy recovered, this percentage rose to 69% (the recovery period) and 67.1% (post-Crisis period) - noticeably similar to the 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% compared to 8% pre-Crisis and 6.2% during the recovery.

**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 the 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.

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 EUR 296 mln; subsequently they increased to EUR 525 mln (the crisis), EUR 669 mln (the recovery), and EUR 674 mln (the post-crisis).

As with 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.

In Table 6 we summarised 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 and equities) during the crisis with the exception of the period after the crisis when Chilean funds were selling (foreign) equities. Also, funds in Poland, Chile and Italy raised their new purchases of risky assets during the crisis and lowered investments in secure assets in contrast to the period before the crisis. The difference is that during the recovery period, Polish funds invested more intensively in equities and slowed investments in public bonds. Chilean funds kept similar levels of transactions in public bonds and increased investments in equities, whereas Italian funds strongly upped their new investments in public bonds and also strongly reduced their new allocation to 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 lowered such investments whereas Italian funds increased them. Among three jurisdictions, Italy shows the clearest sign of counter-cyclical behaviour as they reverted 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 a percentage 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 (Q3.2007 -Q1.2009) | 0.0% (0.0%) | 64.2% (65.9%) | 64.2% (65.9%) | 4.5% (2.7%) | 31.3% (28.7%) | 35.8% (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 the difference between purchased amount and sold amount during the quarter, and *net new investments* is the 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*

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 [16] to obtain standardised results.

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 first and second quadrants[17] indicate that funds were net buyers during a particular period, and data points on the third and fourth quadrants suggest that funds were net sellers at that time. Also, data located in the first and fourth quadrants point to a rising market at that time; data in the second and third quadrants indicate a falling market during a particular period.

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

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

[17] See Figure 9. The convention is that the first quadrant is located at the upper right part of the graph, the second quadrant at the upper left, the third quadrant at the bottom left and the fourth quadrant at the bottom right.

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

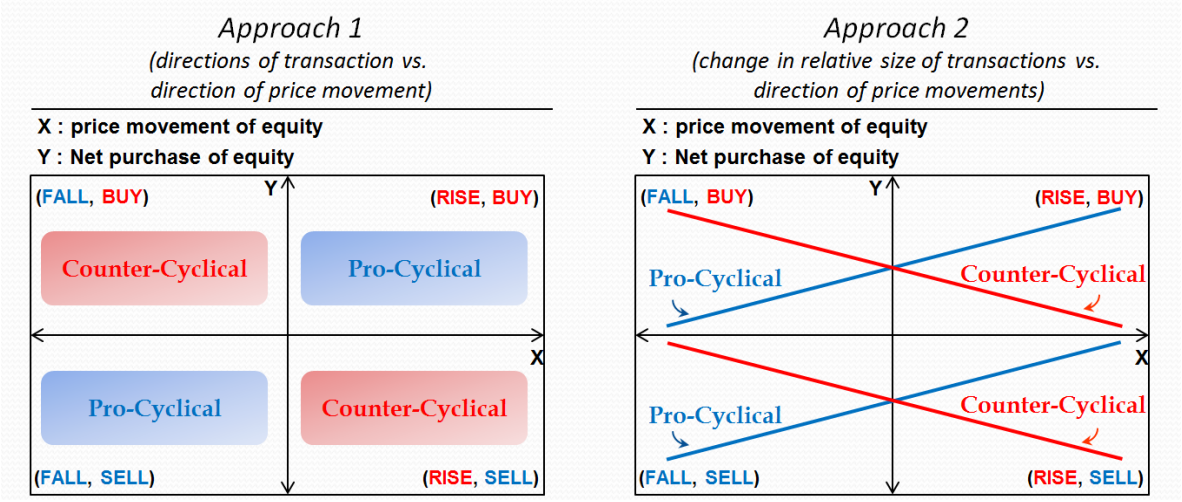
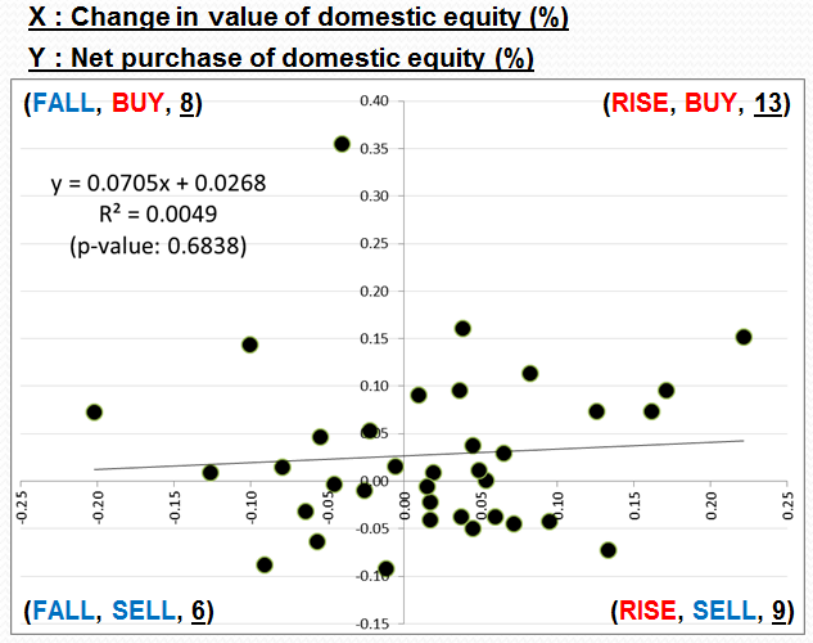


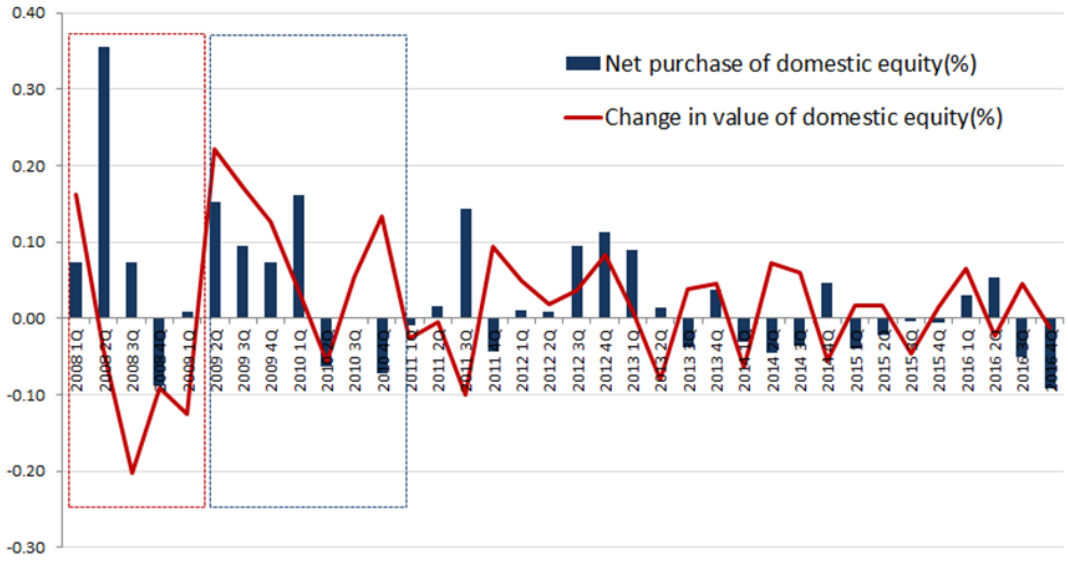

Figure 10. depicts a scatter plot of the imputed Change in value of domestic equity (%) and reported Net purchase of domestic equity (%). Since the scatter plot does not show the passage of time, we also present, as a complementary measure, a bar graph that indicates temporal changes of these two variables. As we were unable to break down Italian pension funds' net purchases 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; the conclusions are similar.[18]

[18] Results are not presented here but are available on request.

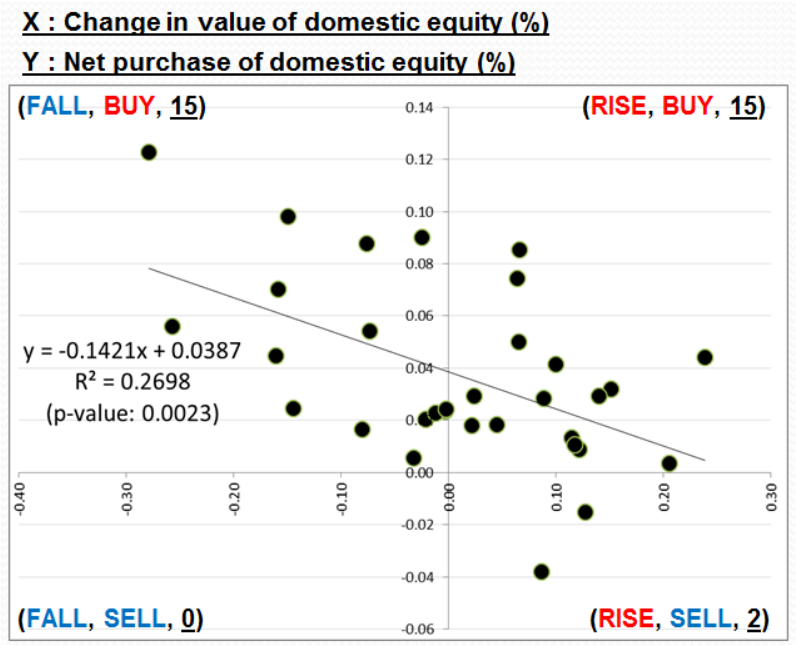
**Figure 10. Scatter plot analysis for domestic equity**

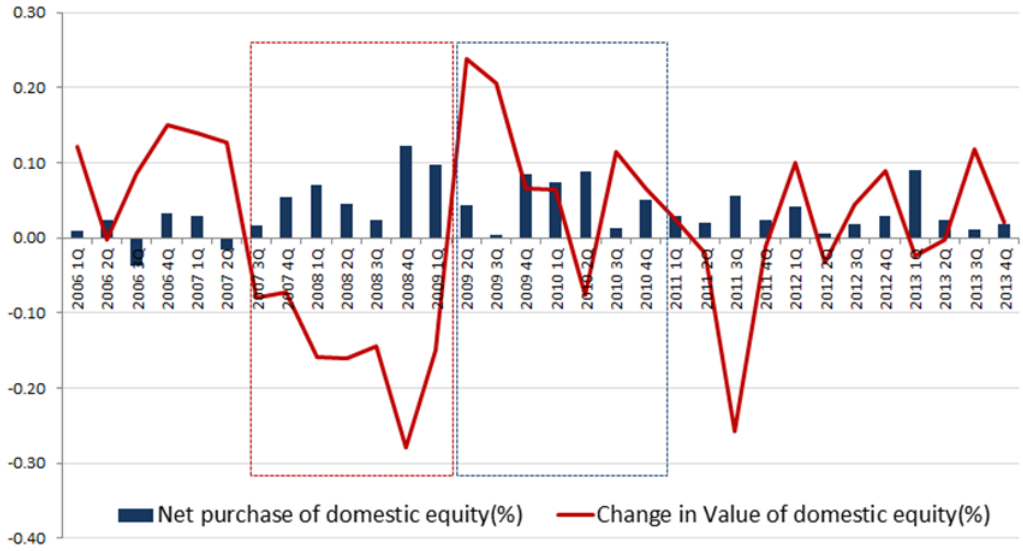
Panel A. Mexico



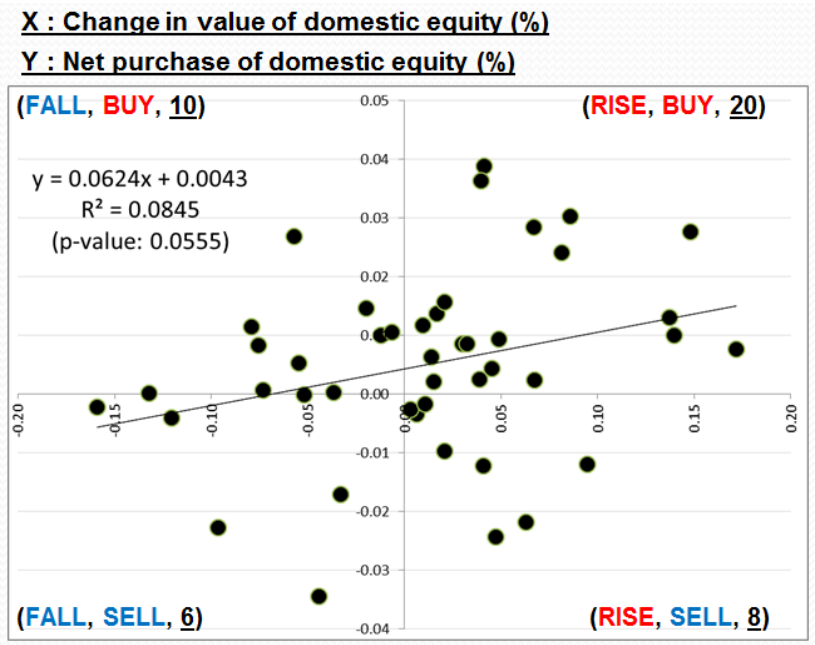



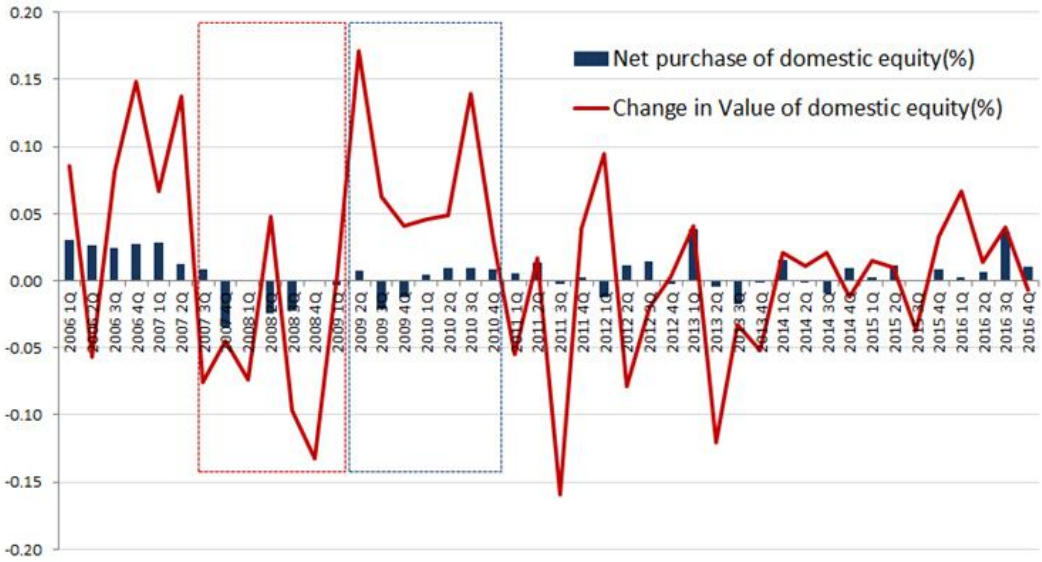
Panel B. Poland



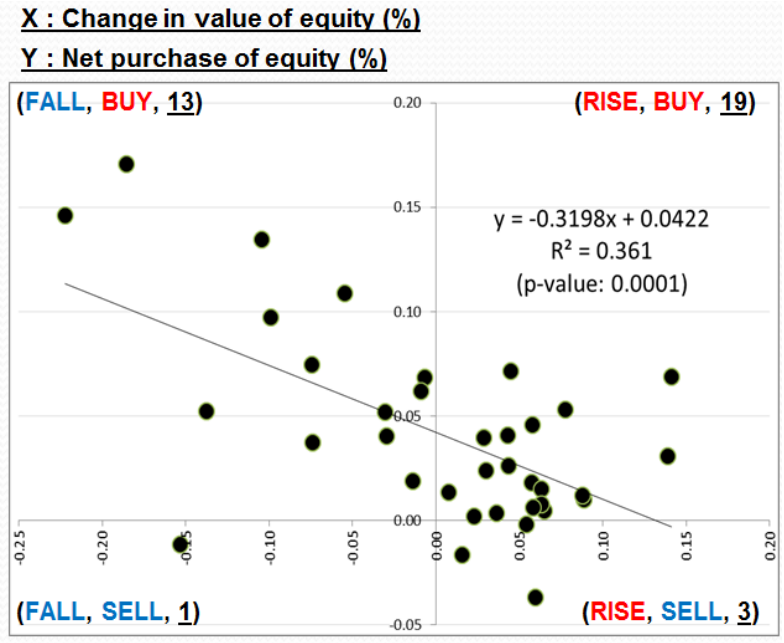



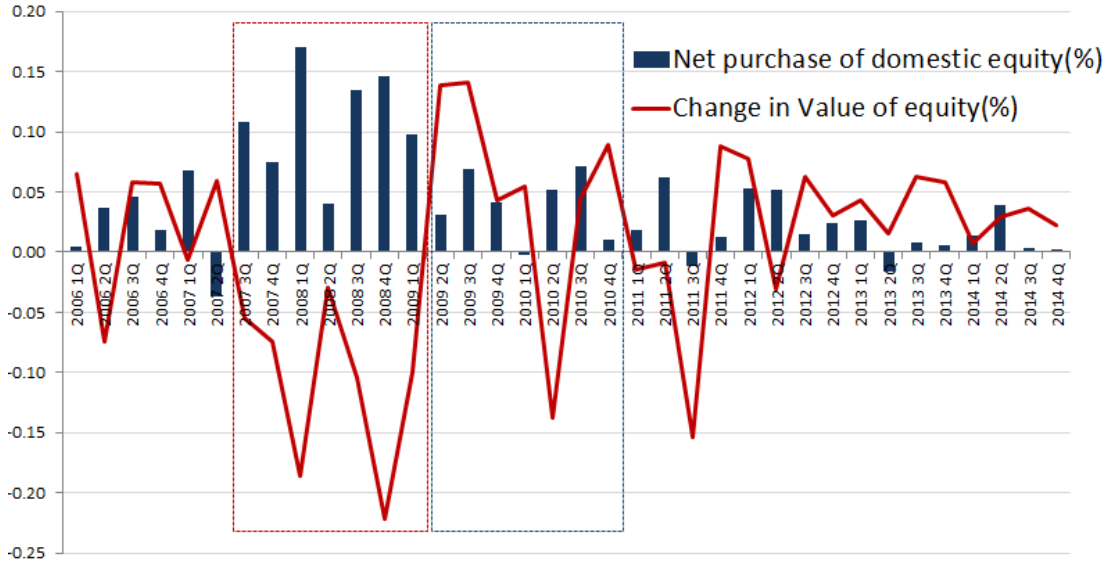
Panel C. Chile



Panel D. Italy




Source: IOPS

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 first and fourth quadrants) during 21 out of 36 quarters in the sample (58%), and net sellers (the second and third 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 the institutional framework of regulation and culture as funds reduced net purchases in equity recently regardless of local stock price movements.

In Poland, one can easily notice that the data points are more concentrated in the first and fourth 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 Polish 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.

In Chile, one can see that the largest group (45% or 20 quarters) of data points is concentrated in the first 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 an even stronger positive trend line (0.1588x, p-value: 0.0334).

The results for Italy are very similar to Poland. The data points are mostly concentrated in first and fourth 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.

The scatter plot results for private bonds, the second asset class analysed in this paper, are shown in Figure 11[19]. 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.

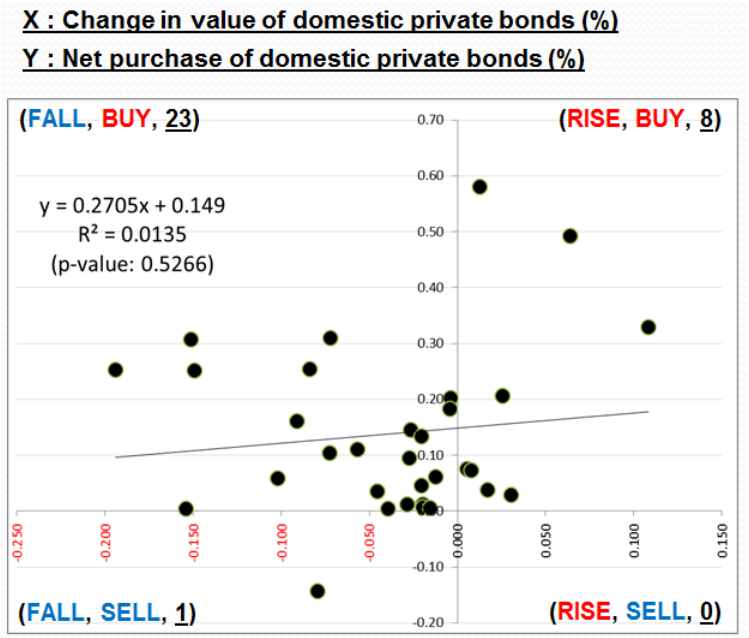
In all three countries, the great majority of data points are located in the first and second quadrants (Poland 97%, Chile 98%, Italy 97%). This means that funds were net buyers of private bonds most of the time regardless of the price movements. No strong sign of pro- or counter-cyclicality is observed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

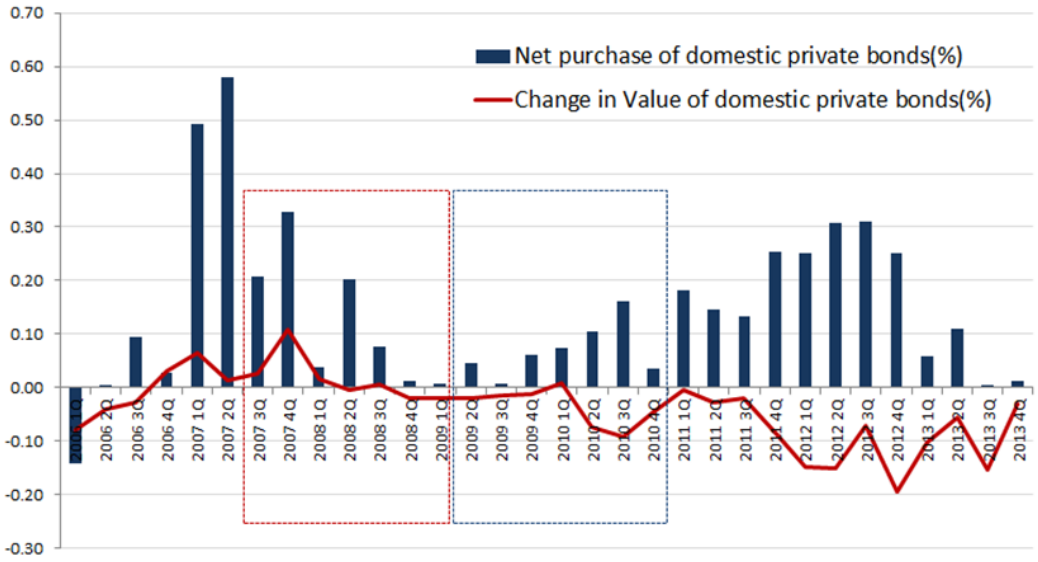
One interesting observation is that the Crisis and recovery periods do not correspond much to value changes of private bonds. Compared with Figure 10, changes in value of equities are mostly negative (-) during the Crisis and positive (+) during the recovery, whereas the signs of changes in value of private bonds are more randomly distributed during the same period. This may suggest that prices of private bonds were less affected than 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.

[19] The results for foreign private bonds for Poland and Chile are available on request.

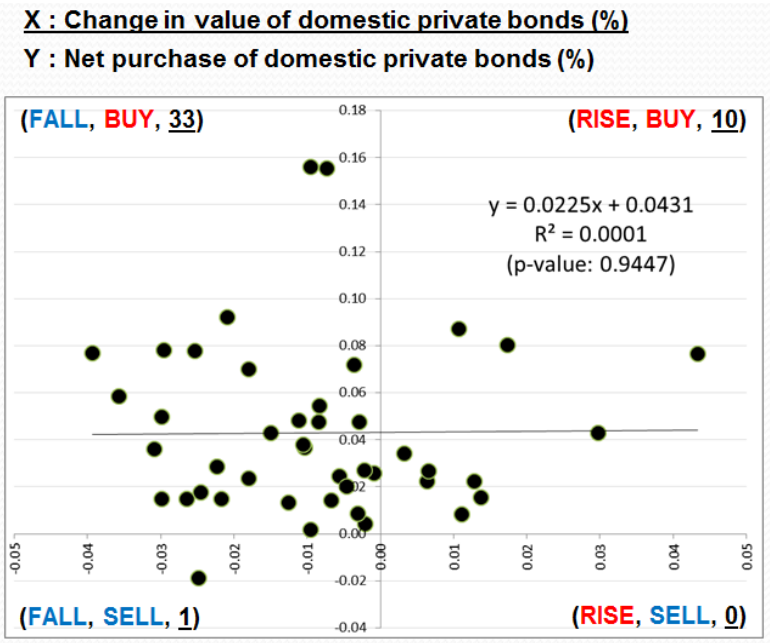
**Figure 11. Scatter plot analysis for domestic private bonds**

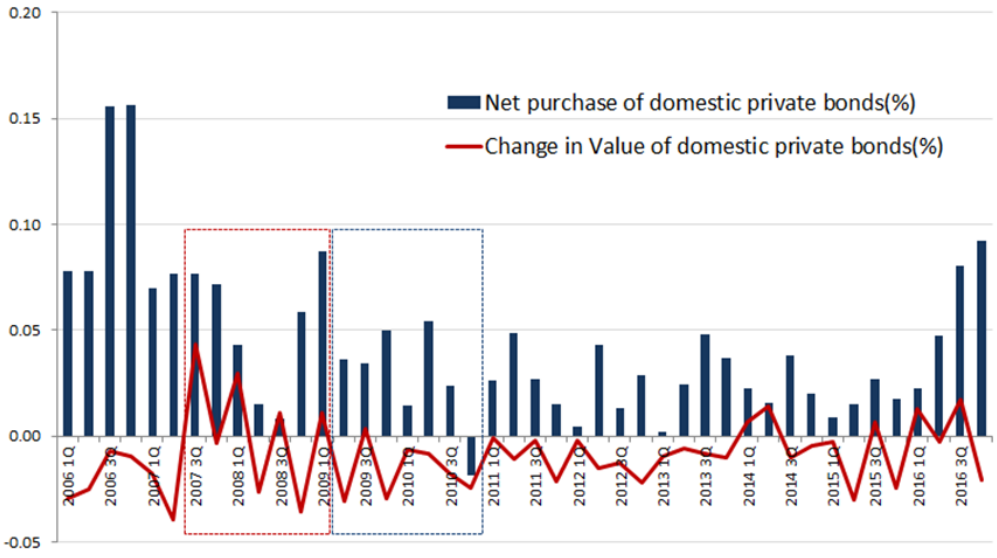
Panel A. Poland



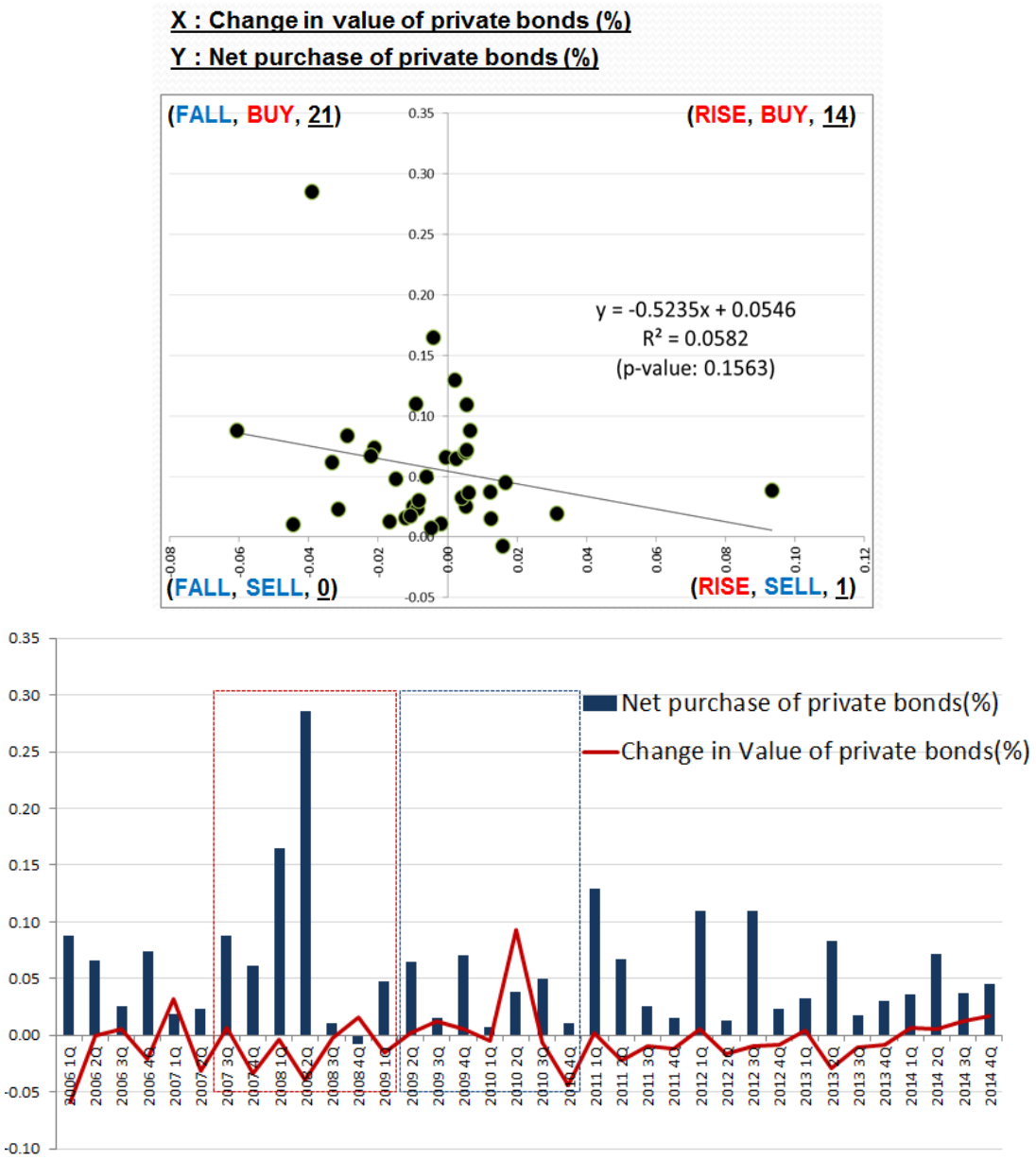



Panel B. Chile



Panel C. Italy




Source: IOPS

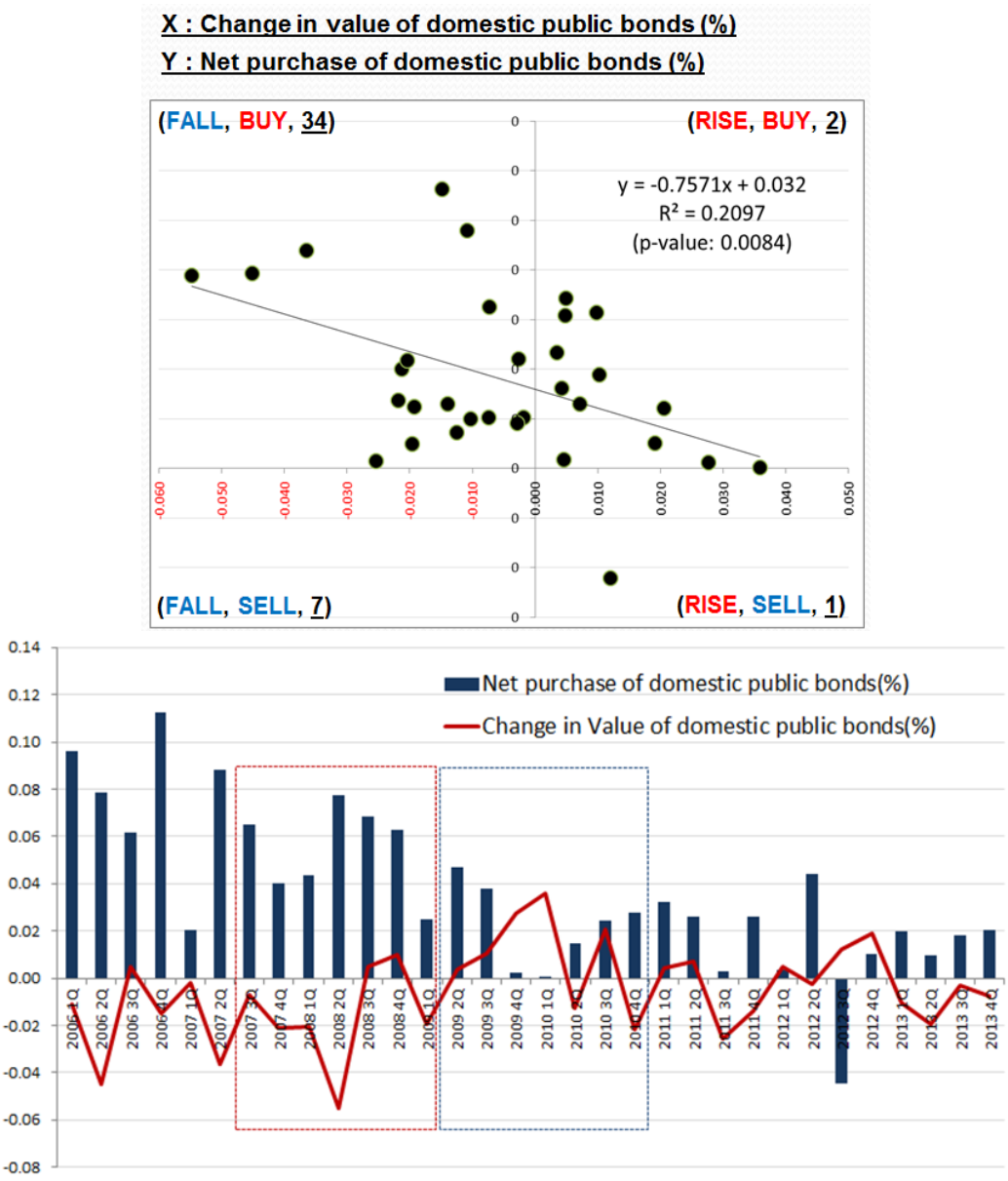
Lastly, the scatter plot results of domestic public bonds are shown in Figure 12 (total public bonds were used instead of domestic public bonds in Italy)[20]. As for private bonds, the Financial Crisis did not influence much the value of public bonds. In all three countries, pension funds were net buyers most of the time, and negative trend lines[21] 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 default risk is (usually) very low.

[20] The results for foreign private bonds for Poland and Chile are available on request.

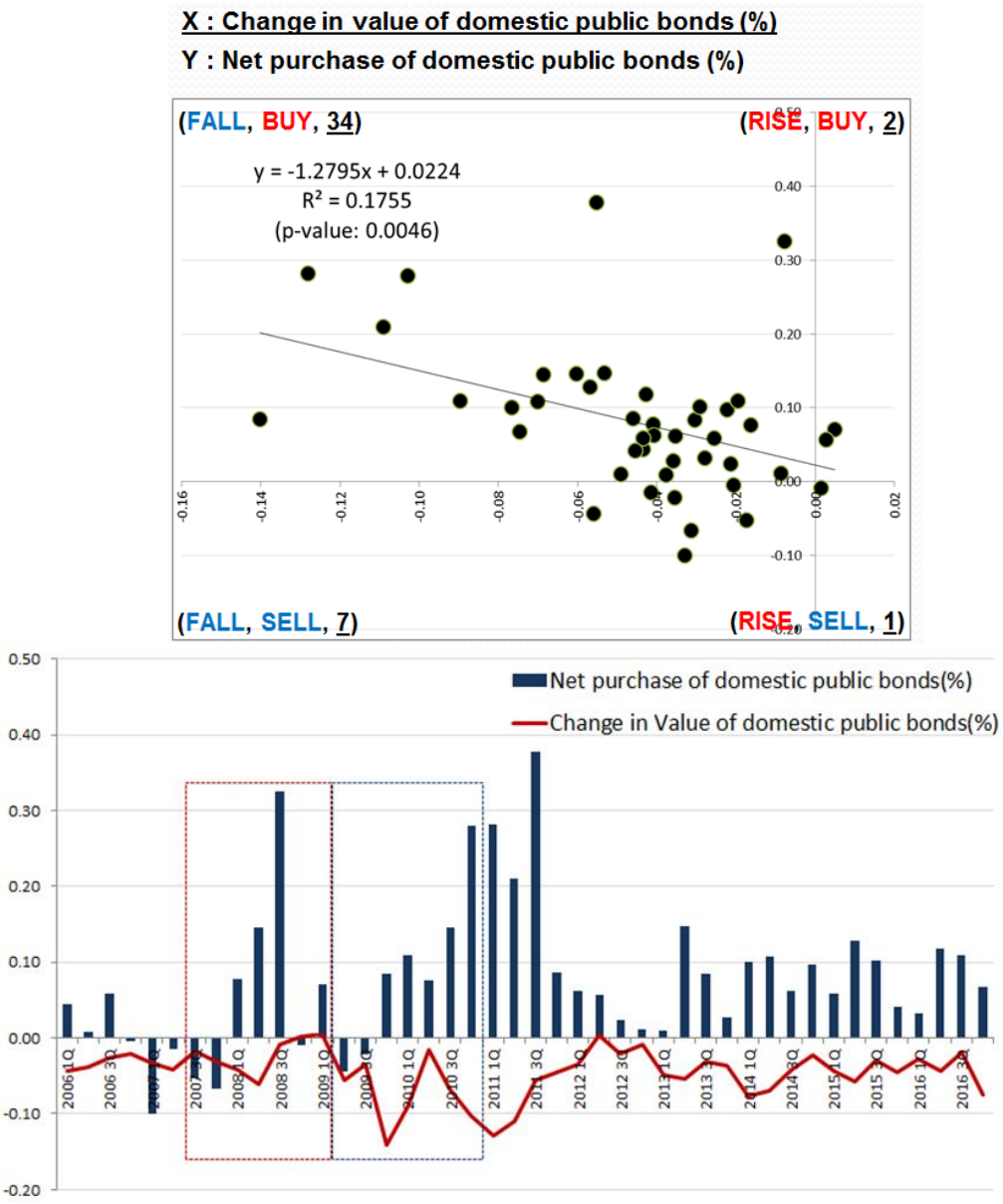
[21] In the cases of Chile and Poland, the trend line was statistically significant at 1% and for Italy insignificant at 10% level.

**Figure 12. Scatter plot analysis for domestic public bonds**

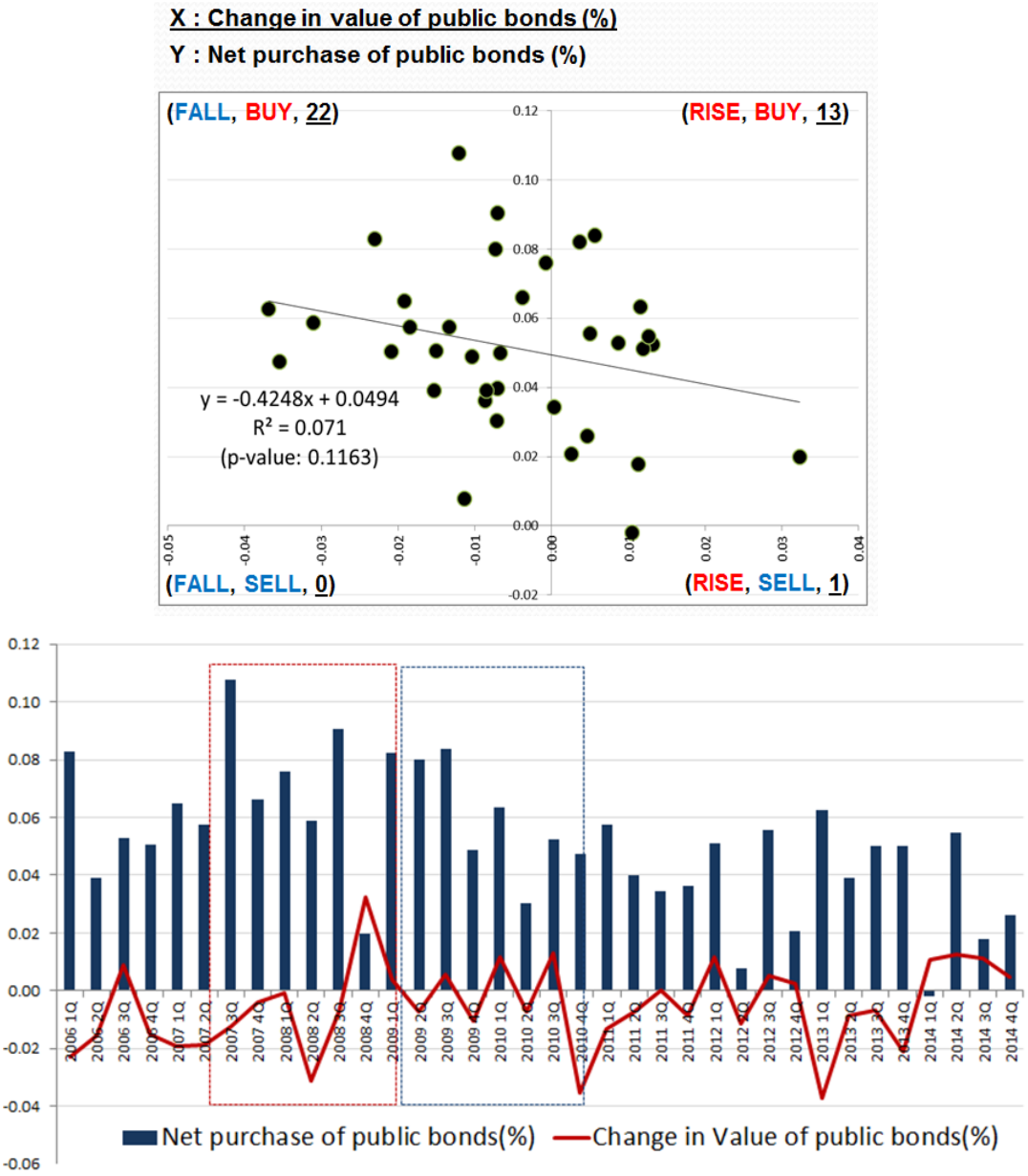
Panel A. Poland



Panel B. Chile



Panel C. Italy




Source: IOPS

Table 7 provides a summary of pension funds' investment behaviour in terms of net transactions versus price changes. 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 private bond market, but stronger counter-cyclical behaviour was observed in public bond 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*

A correlation co-efficient is a useful tool to summarise a set of data into a single number that depicts the strength of the linear relationship between two variables. Table 8 shows correlations between domestic stock market returns and net purchases of domestic equity. Net purchases are expressed in two different ways: as net purchases of domestic equity versus total net new investments or as absolute values of net purchases of domestic equity. Considering the importance of funds' impact on local markets, we present results for domestic equity investments[22] (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.

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

The above two findings support conclusions from Table 2 with regard to counter-cyclical behaviour by Polish funds in their domestic equity market and by Italian funds in foreign equity markets during the Crisis period. However, negative correlations question any pro-cyclical behaviour of funds in these two countries during the recovery period. Table 1 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. In addition, correlation results (cf. Table 8) are in line with the results obtained from scatter plot analysis that also indicates counter-cyclical behaviour by Polish funds in domestic, and Italian funds in foreign equity markets.

[22] The correlation analysis results for foreign equities are available on request.

**Table 8. Correlation co-efficients 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%<br>(0.7329) | 2.1%<br>(0.9021) |
| - Pre-crisis | N/A | N/A |
| - Crisis<br>(Q1.2008 – Q1.2009) | 35.3%<br>(0.5602) | 26.2%<br>(0.6708) |
| - Recovery<br>(Q2.2009 - Q4.2010) | 43.6%<br>(0.3284) | 21.3%<br>(0.6458) |
| - Post-Crisis<br>(Q1.2011- Q4.2016) | -5.0%<br>(0.8179) | -8.9%<br>(0.6791) |
| **Poland** (Q1.2006- Q4.2013) | -22.8%<br>(0.2094) | **-43.6%***<br>(0.0125) |
| - Pre-Crisis<br>(Q1.2006 – Q2.2007) | 16.0%<br>(0.7617) | 5.3%<br>(0.9204) |
| - Crisis<br>(Q3.2007 – Q1.2009) | -30.3%<br>(0.5082) | -70.1%<br>(0.0793) |
| - Recovery<br>(Q2.2009 - Q4.2010) | **-77.5%***<br>(0.0407) | **-90.5%***<br>(0.0051) |
| - Post-Crisis<br>(Q1.2011- Q4.2013) | -33.6%<br>(0.2862) | -40.8%<br>(0.1875) |
| **Chile** (Q1.2006- Q4.2016) | 28.8%<br>(0.0581) | 22.9%<br>(0.1356) |
| - Pre-Crisis<br>(Q1.2006 – Q2.2007) | 10.6%<br>(0.8416) | -6.1%<br>(0.9080) |
| - Crisis<br>(Q3.2007 – Q1.2009) | -13.7%<br>(0.7691) | -14.2%<br>(0.7608) |
| - Recovery<br>(Q2.2009 - Q4.2010) | 29.7%<br>(0.5179) | 20.6%<br>(0.6578) |
| - Post-Crisis<br>(Q1.2011- Q4.2016) | 5.2%<br>(0.8108) | 10.0%<br>(0.6432) |
| **Italy** (Q1.2006- Q4.2014)[23] | **-40.6%***<br>(0.0141) | **-42.8%***<br>(0.0091) |
| - Pre-Crisis<br>(Q1.2006 – Q2.2007) | -47.1%<br>(0.3455) | -33.7%<br>(0.5134) |
| - Crisis<br>(Q3.2007 – Q1.2009) | **-85.9%***<br>(0.0132) | -74.7%<br>(0.0537) |
| - Recovery<br>(Q2.2009 - Q4.2010) | -81.2%*<br>(0.0266) | -52.6%<br>(0.2255) |
| - Post-Crisis<br>(Q1.2011- Q4.2016) | 17.0%<br>(0.5290) | 20.5%<br>(0.4456) |

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

Source: Authors' analysis.

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

### *4.3 Regression analysis*

Multiple regression method was employed to investigate what determines pension funds' investment in equity, the most representative asset class of risky investment. As for the correlation analysis, we present results on domestic equity investments[24]. In Italy, total equity investments were analysed to cover foreign equity, which represented the majority of equity holdings. Two measures of risky investment were used. The first is net purchases of domestic equity relative to total net new investment (Model 1). The second is the absolute value of net purchases of domestic equities (Model 2)[25]. Explanatory variables include: domestic stock index returns, MSCI returns, a change in the risk-free rate, a change in term premium (calculated as the difference between the representative domestic government bond yield and short-term risk-free rate), a change in credit spread (calculated as the difference between the 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 the dependant variable using standardisation method[26] to scale down its values.

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.

The results (Table 9) vary by jurisdictions possibly due to differences in financial market characteristics and pension sectors' institutional structure. Model 2 demonstrates a 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 the 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. the yield of government bonds net of the risk-free rate) and the absolute value of net equity purchases.

**Table 9. 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 |
| | Co-efficient (p-value) | Co-efficient (p-value) | Co-efficient (p-value) | Co-efficient (p-value) | Co-efficient (p-value) | Co-efficient (p-value) | Co-efficient (p-value) | Co-efficient (p-value) |
| Intercept for positive stock index returns | 0.0526 (0.6207) | -0.0856 (0.7871) | 0.08084 (0.8599) | 0.6077 (0.1760) | 0.0008 (0.9624) | 0.0922 (0.7901) | 0.1153 (0.1110) | **-0.7118*** (0.0310) |
| Intercept for negative stock index returns | 0.2889 (0.0943) | 0.6257 (0.1816) | 0.1613 (0.5260) | 0.4850 (0.3000) | 0.0238 (0.2395) | 0.2741 (0.4705) | **0.4030*** (0.0002) | 0.5224 (0.0597) |
| Positive stock index returns | 0.6679 (0.5303) | 1.7824 (0.5586) | -0.6895 (0.6053) | **-8.0682*** (0.0065) | 0.3361 (0.0763) | 2.1427 (0.5495) | -4.5729 (0.2344) | -4.8501 (0.7734) |

[24] The regression analysis results for foreign equities are available on request.

[25] 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.

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Negative stock index returns | 2.4148<br>(0.2407) | 7.4582<br>(0.1403) | -1.2208<br>(0.3028) | -6.1446<br>(0.1417) | 0.5608<br>(0.1315) | 9.3214<br>(0.1524) | -3.4731<br>(0.1955) | -8.4846<br>(0.5364) |
| MSCI returns | -1.0594<br>(0.5297) | -5.304<br>(0.2106) | 1.7708<br>(0.1954) | 7.2500<br>(0.1563) | -0.0263<br>(0.8866) | 0.0444<br>(0.9860) | 4.3680<br>(0.1490) | 10.3031<br>(0.5078) |
| Change in risk-free rate | -26.2632<br>(0.2254) | -87.29<br>(0.1403) | 9.6434<br>(0.4735) | 3.8223<br>(0.3645) | -2.3869<br>(0.4259) | -6.3823<br>(0.8988) | **-30.214***<br>(0.0053) | **-143.10***<br>(0.0123) |
| Change in term premium[27] | -9.2222<br>(0.4930) | -30.2809<br>(0.4017) | n/a | n/a | **-5.1664***<br>(0.0723) | **-90.6955***<br>(0.0386) | -18.4579<br>(0.0676) | **-131.32***<br>(0.0044) |
| Change in credit premium[28] | 15.8021<br>(0.7320) | 92.0297<br>(0.4704) | n/a | n/a | -3.3282<br>(0.4228) | -131.4061<br>(0.1278) | -2.6642<br>(0.0756) | -18.0713<br>(0.1024) |
| Change in foreign exchange rate | -1.6629<br>(0.3858) | -8.3034<br>(0.0826) | 2.2540<br>(0.1497) | 3.8223<br>(0.3645) | 0.1213<br>(0.3033) | 1.3391<br>(0.5124) | -5.1451<br>(0.1741) | -2.1723<br>(0.8943) |
| GDP growth rate | 1.0427<br>(0.6567) | 5.8077<br>(0.3744) | 5.4139<br>(0.5837) | **-28.3704***<br>(0.0209) | -0.1206<br>(0.5531) | -3.6395<br>(0.3111) | 10.5300<br>(0.2112) | -18.9323<br>(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.

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[29]. Results that are significant at 5% critical level (Table 10) 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 the case of Chile, managers of pension funds were decreasing (increasing) their absolute net equity purchases in response to increasing (decreasing) term or credit premiums. This suggests some substitutional effects between domestic equities and treasury bonds. In Italy, pension funds were decreasing (increasing) their absolute net equity purchases in response to increasing (decreasing) risk-free rate or term premiums, which also suggests substitutional effects between foreign equities and domestic treasury bonds.

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

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

[29] The same exercise was performed for Model 1; however, no improved results were obtained.

**Table 10. Determinants of pension funds' domestic equity investment**
(simple regression, no asymmetric variables)

| Explanatory variables | Mexico | | Poland | | Chile | | Italy[30] | |
|---|---|---|---|---|---|---|---|---|
| | Model 2 | | Model 2 | | Model 2 | | Model2 | |
| | Co-efficient | p-value | Co-efficient | p-value | Co-efficient | p-value | Co-efficient | 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.

Table 11 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 9 and 10). The results basically remain the same as in Table 10.

**Table 11. 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 | |
| | Co-efficient | p-value | Co-efficient | p-value | Co-efficient | p-value | Co-efficient | 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 | | | | | | |

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| GDP growth rate | | | **-31.9645*** | 0.0288 | | | | |
| R-squared | 0.0415 | | 0.3575 | | 0.1683 | | 0.2693 | |
| Adjusted R-squared | 0.0133 | | 0.2887 | | 0.1277 | | 0.2008 | |
| #observations | 36 | | 32 | | 44 | | 36 | |

Notes:

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

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

Source: Authors' analysis.

To investigate solely whether pension funds revealed pro- or counter-cyclical investment behaviour in domestic equity markets, we run a single regression model where stock index returns was the only explanatory variable (Table 12). The results signal a counter-cyclical behaviour for Poland (domestic equities) and Italy (foreign equities). In Chile, one may speculate that the funds acted pro-cyclically; however, this finding (for model 1) is statistically significant at 7% level[31].

**Table 12. 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** |
| | **Co-efficient (p-value)** | | **Co-efficient (p-value)** | | **Co-efficient (p-value)** | | **Co-efficient (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

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 an anti-cyclical pattern of their transactions, there may be 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 a framework can consist, for example, of *benchmarks* (as in Italy) which can be combined with *investment penalties* for underperformance (Chile and until recently Poland) or *freedom of members to switch* between different pension providers and investment portfolios (Chile and Mexico). Below we provide a short discussion

[31] The statistical significance may be weak because of the existence of multifunds, given that since 2008 Funds E have been allowed to invest in equities. (Information from the Superintendence of Pensions, Chile).

of the institutional arrangements that exist in the investigated countries and the potential role these arrangements could have on the way pension funds invest.

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. Other things being equal, 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. This finding can be confirmed by Table 13 where one can observe that asset allocation in Italy was very stable regardless of the situation in the markets. When comparing the standard deviation of asset allocation in shares, Italian pension funds' variation (2.2%) was only half that of peers in other jurisdictions (Mexico: 4.8%, Poland: 5.0%, Chile: 5.9%).

**Table 13. Asset allocation movements within the sub periods**

| Jurisdiction | Asset classes | Sub-Periods | | | | Standard deviation* |
|---|---|---|---|---|---|---|
| | | Before Crisis | Crisis | Recovery | After Crisis | |
| Mexico | Cash and deposits | - | 2.7% | 3.3% | 3.1% | **0.6%** |
| | Public bonds | - | 67.1% | 65.3% | 53.8% | **6.8%** |
| | Private bonds | - | 22.9% | 20.5% | 21.2% | **1.0%** |
| | Shares | - | 8.1% | 10.1% | 17.8% | **4.8%** |
| Poland | Cash and deposits | 2.9% | 0.7% | 0.0% | 0.0% | **1.3%** |
| | Public bonds | 61.1% | 65.9% | 63.6% | 54.8% | **6.3%** |
| | Private bonds | 1.0% | 2.7% | 2.6% | 4.4% | **1.5%** |
| | Shares | 35.1% | 28.7% | 31.5% | 35.9% | **5.0%** |
| Chile | Cash and deposits | 19.5% | 18.8% | 7.7% | 6.6% | **5.9%** |
| | Public bonds | 13.4% | 11.1% | 10.7% | 22.5% | **6.3%** |
| | Private bonds | 15.7% | 23.1% | 33.6% | 30.6% | **6.2%** |
| | Shares | 51.5% | 47.8% | 47.6% | 40.3% | **5.9%** |
| Italy | Cash and deposits | 3.7% | 3.6% | 4.0% | 4.0% | **0.7%** |
| | Public bonds | 58.4% | 60.9% | 61.8% | 60.2% | **1.7%** |
| | Private bonds | 10.9% | 12.3% | 11.9% | 13.0% | **1.0%** |
| | Shares | 25.9% | 21.8% | 21.2% | 22.0% | **2.2%** |

* Note: Standard deviation is calculated based on the quarterly data in each jurisdiction

Source: Authors' analysis.

Pension providers (AFPs) in the 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[32]. Members may allocate their mandatory savings to two funds at most. Men aged 56 or older

[32] However, these limits were not constant for the periods analysed in this study. The reform of 2008 increased both the global as well each funds' limits.

and women aged 51 or older are not permitted to choose Fund A. The same applies for pensioners[33], who are further not permitted to choose Fund B to invest their savings.

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.

In Mexico there are currently five types of investment portfolios (SIEFOREs Básicas 0 – 4). As in the Chilean pension system, each fund is invested in portfolios with different level of risk exposure, SIEFOREs Básicas (SB) 4 being the riskiest fund, and SB0 being the safest fund. Members 36 years old or younger are allocated to SB4, members between 37 and 45 years old are assigned to SB3, members between 46 and 59 years old are assigned to SB2, and members older than 60 years old are allocated to SB1 by default. SB0 is for people older than 60 years old that can retire at any time, but with some considerations that require capital preservation in their accounts through a highly conservative investment regime.

Another institutional stricture 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

- half of the mean of the annual real return over the past 36 months minus the absolute value of 50 per cent.

In Poland there was the obligation of a minimum rate of return, calculated twice a year at the end of the first and third quarter, and 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

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

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 manifested itself as increased herding.

[33] 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**

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.

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 per cent.

- 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.

- Italy invested mainly in public bills and bonds (approximately 60%), while the combined allocation to private bills and bonds (25%) and equity (15%) was less than half of the total investments. Bonds tended to be domestic while the majority of equities were foreign.

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.

During the 2008-09 Financial Crisis, pension funds in Mexico and 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 bear market, 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.

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 sizeable 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 the recovery, followed by their selling afterwards. Italian pension funds bought more private bonds during the Crisis than the previous period, 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.

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.

Did pension funds buy more aggregated risky assets during the Crisis, therefore playing role of liquidity providers to the market during a fire sale? The answer for three jurisdictions where 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 equities, 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 than normal times. This seemed to be helpful to the credit market, which suffered a liquidity shortage during the Crisis.

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 in this type of asset were of pro-cyclical or counter-cyclical character based on the above analysis.

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

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 significant only at 8% level. Why are results from correlation analysis different from results from transactions analysis? A possible explanation is that for the analysis of transactions we analysed average values calculated for four sub-periods while for correlations we used quarterly data. Therefore, the conclusions based on correlations are likely to be more robust.

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 Italian pension funds too behaved counter-cyclically and suggests that Chilean funds acted pro-cyclically. The statistical significance of this last finding, however, is somehow weaker at 7%.

Tables 14 and 15 provide a summary of findings with regard to investment behaviour in domestic and foreign equity markets:-

**Table 14. 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 15. 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.

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 in which they operate. It seems that Italian and Polish pension funds were influenced in their decisions by the regulatory obligations of strategic asset allocation (Italy) and peer-based (Poland) benchmarks. The other possible factor is the presence of different types of investment portfolios (multifunds).

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. The investment behaviour under study may therefore 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).

For this purpose, we performed the same analysis for the most aggressive funds in Chile and Mexico (see Annex for more details). From Chile we obtained strong statistically significant evidence that these funds acted pro-cyclically both in domestic and foreign equity markets. In the case of Mexico, we were not able to arrive at any additional conclusions.

In general, we may therefore conclude that:-

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

- there is some weak evidence showing that Chilean funds in general may have acted pro-cyclically in the domestic equity market. A separate analysis of the most aggressive funds (type A) in the Annex to this paper revealed that this type of fund indeed behaved pro-cyclically during the whole period;

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

Finally, it is important to stress that pro-cyclicality or counter-cyclicality of pension funds should not be subject to valuation. The paper found that the presence of some strategic asset allocation index (such as in Italy) may help stabilising financial markets. The same can be said about pension funds being counter-cyclical in their investment decisions. Counter-cyclical behaviour by institutional investors seems to be good for the stability of financial markets and the economy in the long run. However, it is difficult to conclude that a particular benchmark or investment behaviour is beneficial for pension fund members, at least ex ante, and thus should be promoted by supervisors or policy makers. Investment decisions by pension funds should be governed solely by the interest of members and correspond to the local circumstances[34].

[34] For instance, when a structural vulnerability of the market occurs, the governing body of a pension fund may become pro-cyclical to prevent losses to pension fund members in line with its legal mandate.

**Annex: Analysis of multifunds in Mexico and Chile**

In Mexico, there are five types of pension funds which correspond to the SIEFOREs Básicas (investment companies specialised in pension funds)[35]. In the past, there was an additional pension fund, the SIEFORE Básica 5 (SB5), dedicated for savers aged 26 years old and younger. The fund was merged with the SB4 in November 2012.

Table 16 depicts risk appetites for each type of pension fund. Funds for older people (SB1~SB2) followed a more conservative investment regime induced by their statutory investment limits. For instance, quarterly average asset allocations in shares increased from 0% in SB1 to 6.6% (SB2), 8.9% (SB3), 10.6% (SB4), and 12.6% (SB5), respectively during the crisis period. We separated the post-crisis period into two parts (A: Q1.2011- Q3.2012, B: Q4.2012- Q3.2012) to investigate the influence of the merger between SB4 and SB5.

**Table 16. Asset allocations of multifunds in Mexico (end of quarter)**

| Period | Asset classes | SB1 | SB2 | SB3 | SB4 | SB5 |
|---|---|---|---|---|---|---|
| Average during the Crisis period (Q2.2008-Q1.2009[1)]) | **Cash and deposits** | **2.2%** | **3.1%** | **3.1%** | **2.9%** | **3.4%** |
| | **Public bonds** | **83.1%** | **71.1%** | **66.4%** | **63.9%** | **60.3%** |
| | *Domestic* | *83.0%* | *70.8%* | *66.2%* | *63.7%* | *60.2%* |
| | *Foreign* | *0.1%* | *0.2%* | *0.2%* | *0.1%* | *0.1%* |
| | **Private bonds** | **23.3%** | **22.7%** | **22.9%** | **24.0%** | **24.8%** |
| | *Domestic* | *17.7%* | *17.7%* | *17.8%* | *18.6%* | *19.2%* |
| | *Foreign* | *5.6%* | *4.9%* | *5.1%* | *5.5%* | *5.6%* |
| | **Shares** | **0.0%** | **6.6%** | **8.9%** | **10.6%** | **12.6%** |
| | *Domestic* | *0.0%* | *4.1%* | *5.5%* | *6.4%* | *7.9%* |
| | *Foreign* | *0.0%* | *2.5%* | *3.4%* | *4.2%* | *4.7%* |
| Average during the recovery period (Q2.2009-Q4.2010) | **Cash and deposits** | **2.3%** | **3.6%** | **3.2%** | **3.3%** | **3.8%** |
| | **Public bonds** | **74.0%** | **66.7%** | **64.7%** | **62.2%** | **60.6%** |
| | *Domestic* | *74.1%* | *66.7%* | *64.7%* | *62.1%* | *60.6%* |
| | *Foreign* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.1%* |
| | **Private bonds** | **23.6%** | **21.0%** | **20.3%** | **20.1%** | **19.2%** |
| | *Domestic* | *20.1%* | *17.7%* | *16.6%* | *16.1%* | *15.5%* |
| | *Foreign* | *3.5%* | *3.4%* | *3.6%* | *4.0%* | *3.6%* |
| | **Shares** | **0.1%** | **8.4%** | **10.8%** | **13.5%** | **15.5%** |
| | *Domestic* | *0.1%* | *5.9%* | *7.4%* | *9.2%* | *10.9%* |
| | *Foreign* | *0.0%* | *2.4%* | *3.4%* | *4.2%* | *4.6%* |
| Average during the post-Crisis period A (Q1.2011-Q3.2012[2)]) | **Cash and deposits** | **2.4%** | **3.7%** | **3.2%** | **3.1%** | **4.1%** |
| | **Public bonds** | **68.9%** | **60.2%** | **58.0%** | **55.1%** | **58.0%** |
| | *Domestic* | *68.9%* | *60.2%* | *58.0%* | *55.1%* | *58.0%* |
| | *Foreign* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* |
| | **Private bonds** | **27.3%** | **21.4%** | **20.8%** | **20.0%** | **16.6%** |
| | *Domestic* | *24.0%* | *18.6%* | *17.9%* | *16.9%* | *14.4%* |
| | *Foreign* | *3.3%* | *2.7%* | *3.0%* | *3.1%* | *2.2%* |
| | **Shares** | **1.5%** | **12.8%** | **14.6%** | **18.6%** | **19.2%** |
| | *Domestic* | *0.8%* | *6.4%* | *7.0%* | *9.5%* | *10.0%* |
| | *Foreign* | *0.7%* | *6.4%* | *7.5%* | *9.2%* | *9.2%* |

[35] There are other SIEFOREs that invest voluntary savings and resources of private pension plans. Such funds can decide on their own investment policy and represent 2.2% of the AUM of the pension funds supervised by CONSAR.

| | | | | | |
|---|---|---|---|---|---|
| Average during the post-Crisis period B (Q4.2012-Q3.2012[2)]) | **Cash and deposits** | **3.3%** | **3.2%** | **2.8%** | **3.1%** |
| | **Public bonds** | **62.9%** | **53.4%** | **50.5%** | **47.6%** |
| | *Domestic* | *62.9%* | *53.4%* | *50.5%* | *47.6%* |
| | *Foreign* | *0.0%* | *0.0%* | *0.0%* | *0.0%* |
| | **Private bonds** | **29.9%** | **21.7%** | **21.3%** | **19.6%** |
| | *Domestic* | *27.4%* | *20.4%* | *19.9%* | *18.5%* |
| | *Foreign* | *2.5%* | *1.3%* | *1.4%* | *1.1%* |
| | **Shares** | **3.6%** | **17.4%** | **19.8%** | **24.5%** |
| | *Domestic* | *1.3%* | *6.5%* | *7.7%* | *10.4%* |
| | *Foreign* | *2.3%* | *10.9%* | *12.1%* | *14.1%* |

1) Crisis period was defined as the period Q2.2008-Q1.2009 because SB3, SB4 and SB5 started their operation in March 2008

2) Post-Crisis period was set as Q1.2011-Q3.2012 since Mexican pension funds merged SB4 and SB5 in November 2012.

Source: Authors' analysis

In Chile, pension providers (AFPs) offer four types of pension funds (known as funds B, C, D and E) and may offer an additional fund (known as fund A). 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.

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.

Table 17 shows the asset allocation of each multifund in Chile. As in Mexico, pension funds for older people (Fund C - E) followed a more conservative investment than the funds for younger people (Fund A - B). But as a whole, Chilean funds invested in equity more aggressively than Mexican funds: their quarterly average asset allocations in shares during the Crisis ranged from 0% in Fund E to 20.9% (Fund D), 41.1% (Fund C), 58.3% (Fund B), and 75.8% (Fund A) respectively. The riskiest funds in Chile invested nearly 80% of investments in equity, while their Mexican peer average was around 20%.

**Table 17. Asset allocations of multifunds in Chile (end of quarter)**

| Period | Asset classes | Fund A | Fund B | Fund C | Fund D | Fund E |
|---|---|---|---|---|---|---|
| Average before the Crisis period (Q1.2006-Q2.2007) | **Cash and deposits** | **16.6%** | **19.8%** | **19.2%** | **24.7%** | **14.9%** |
| | **Public bonds** | **3.6%** | **8.6%** | **15.9%** | **24.8%** | **34.6%** |
| | *Domestic* | *3.3%* | *8.3%* | *15.7%* | *24.6%* | *34.1%* |
| | *Foreign* | *0.3%* | *0.2%* | *0.2%* | *0.2%* | *0.5%* |
| | **Private bonds** | **4.9%** | **10.1%** | **19.3%** | **24.7%** | **50.4%** |
| | *Domestic* | *4.9%* | *10.1%* | *19.3%* | *24.2%* | *50.2%* |
| | *Foreign* | *0.0%* | *0.0%* | *0.0%* | *0.5%* | *0.2%* |
| | **Shares** | **74.9%** | **61.5%** | **45.5%** | **25.8%** | **0.0%** |
| | *Domestic* | *21.5%* | *22.1%* | *20.6%* | *14.3%* | *0.0%* |
| | *Foreign* | *53.4%* | *39.4%* | *25.0%* | *11.5%* | *0.0%* |
| Average during the Crisis period (Q3.2007-Q1.2009) | **Cash and deposits** | **13.3%** | **19.3%** | **18.4%** | **24.9%** | **27.7%** |
| | **Public bonds** | **2.4%** | **7.0%** | **13.3%** | **19.0%** | **24.0%** |
| | *Domestic* | *2.2%* | *6.8%* | *13.3%* | *18.8%* | *23.5%* |
| | *Foreign* | *0.2%* | *0.2%* | *0.1%* | *0.1%* | *0.4%* |
| | **Private bonds** | **10.3%** | **16.4%** | **27.8%** | **35.5%** | **48.3%** |
| | *Domestic* | *8.8%* | *15.3%* | *26.4%* | *32.9%* | *47.6%* |
| | *Foreign* | *1.5%* | *1.1%* | *1.4%* | *2.6%* | *0.7%* |
| | **Shares** | **75.8%** | **58.3%** | **41.1%** | **20.9%** | **0.0%** |
| | *Domestic* | *22.9%* | *20.6%* | *19.0%* | *11.3%* | *0.0%* |
| | *Foreign* | *53.0%* | *37.8%* | *22.0%* | *9.5%* | *0.0%* |
| Average during the recovery period (Q2.2009-Q4.2010) | **Cash and deposits** | **3.2%** | **7.7%** | **7.5%** | **13.8%** | **13.5%** |
| | **Public bonds** | **2.9%** | **7.8%** | **12.8%** | **16.2%** | **27.2%** |
| | *Domestic* | *2.7%* | *7.7%* | *12.8%* | *16.1%* | *26.7%* |
| | *Foreign* | *0.2%* | *0.1%* | *0.0%* | *0.1%* | *0.4%* |
| | **Private bonds** | **15.1%** | **24.9%** | **40.0%** | **50.5%** | **57.2%** |
| | *Domestic* | *6.0%* | *13.6%* | *27.3%* | *36.4%* | *55.5%* |
| | *Foreign* | *9.1%* | *11.3%* | *12.7%* | *14.1%* | *2.3%* |
| | **Shares** | **78.1%** | **59.1%** | **39.4%** | **19.3%** | **2.0%** |
| | *Domestic* | *21.2%* | *21.4%* | *18.9%* | *10.2%* | *0.3%* |
| | *Foreign* | *56.9%* | *37.7%* | *20.5%* | *9.2%* | *1.7%* |
| Average during the post-Crisis period A (Q1.2011-Q4.2016) | **Cash and deposits** | **2.5%** | **4.5%** | **4.0%** | **9.9%** | **17.8%** |
| | **Public bonds** | **3.7%** | **13.4%** | **22.2%** | **33.9%** | **47.6%** |
| | *Domestic* | *2.9%* | *12.5%* | *21.1%* | *32.7%* | *46.0%* |
| | *Foreign* | *0.8%* | *0.9%* | *1.0%* | *1.2%* | *1.6%* |
| | **Private bonds** | **16.0%** | **24.5%** | **36.6%** | **39.0%** | **31.4%** |
| | *Domestic* | *4.5%* | *11.9%* | *22.9%* | *27.3%* | *30.2%* |
| | *Foreign* | *11.6%* | *12.6%* | *13.7%* | *11.7%* | *1.2%* |
| | **Shares** | **77.8%** | **57.7%** | **37.2%** | **17.2%** | **3.2%** |
| | *Domestic* | *19.5%* | *19.2%* | *15.3%* | *6.5%* | *0.9%* |
| | *Foreign* | *58.4%* | *38.5%* | *21.9%* | *10.7%* | *2.3%* |

Source: Authors' analysis

Our goal was to analyse pension funds' behaviour during the crisis, in particular whether funds invested in risky assets and acted counter-cyclically. We therefore investigated aggressive funds ("SB4 / SB5"[36] in Mexico and "Fund A" in Chile; Table 18).

First, we analysed their average transactions. For Mexico, we changed the length of the crisis period to Q3.2008-Q1.2009 since equities were heavily purchased in Q2.2008 (SB4: MXN 13 735 mln;

[36] Since asset allocations for SB4 and SB5 are similar, we used aggregated data of SB4 and SB5 ("SB4 / SB5") in the analysis to increase sample size and observation period.

SB5: MXN 5 862 mln) when this type of fund was introduced to meet a new target asset allocation. This is a structural change so we dropped earlier quarters when investigating investment behaviour.

One can see that aggressive funds in both countries were net sellers of domestic equities during the crisis (Mexico: -4.1%, Chile: -5.7%). However, the funds increased their investments in domestic equity after the crisis. Their investment behaviour was different in foreign markets as Mexican funds sold foreign equities during the crisis while Chilean funds increased their purchases in foreign equities at this time.

**Table 18. Net purchases of equities in aggressive funds in Mexico and Chile (millions in national currency, %)**

| Jurisdiction | Funds | 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 | (% in investment) | Average per quarter | (% in investment) | Average per quarter | (% in investment) | Average per quarter | (% in investment) |
| Mexico | SB4 / SB5 | Crisis[1)] | -230 | (-4.1%) | -413 | (-7.4%) | -642 | (-11.6%) | 5,557 | (100%) |
| | | Recovery[2)] | 1,607 | (172.4%) | 2,696 | (289.2%) | 4,303 | (461.6%) | 2,381 | (100%) |
| | | Post-crisis[3)] | 909 | (144.4%) | 1,879 | (298.4%) | 2,788 | (442.8%) | 630 | (100%) |
| | Total (All funds) | Crisis[1)] | 65 | (0.2%) | -1,045 | (-3.0%) | -980 | (-2.8%) | 35,280 | (100%) |
| | | Recovery[2)] | 2,865 | (12.4%) | 5,067 | (22.0%) | 7,933 | (34.4%) | 23,051 | (100%) |
| | | Post-Crisis[3)] | 1,105 | (3.8%) | 2,737 | (9.4%) | 3,842 | (13.1%) | 29,274 | (100%) |
| Chile | Fund A | Before Crisis[4)] | 174,320 | (18.0%) | 121,830 | (12.6%) | 296,150 | (30.7%) | 965,993 | (100%) |
| | | Crisis[5)] | -15,961 | (-5.7%) | 170,011 | (60.6%) | 154,050 | (54.9%) | 280,754 | (100%) |
| | | Recovery[6)] | 22,882 | (3.1%) | 287,002 | (38.6%) | 309,884 | (41.7%) | 743,115 | (100%) |
| | | Post-Crisis[7)] | 12,071 | (3.1%) | -150,076 | (-38.8%) | -138,004 | (-35.7%) | 386,310 | (100%) |
| | Total (All funds) | Before Crisis[4)] | 213,241 | (7.1%) | 53,907 | (1.8%) | 267,148 | (8.8%) | 3,020,821 | (100%) |
| | | Crisis[5)] | -109,626 | (-4.8%) | 259,313 | (11.3%) | 149,688 | (6.5%) | 2,105,051 | (100%) |
| | | Recovery[6)] | 16,235 | (0.6%) | 282,843 | (10.5%) | 299,079 | (11.1%) | 2,698,680 | (100%) |
| | | Post-Crisis[7)] | 73,115 | (1.4%) | -136,165 | (-2.5%) | -63,050 | (-1.2%) | 5,347,519 | (100%) |

Note: *Net purchases* is the difference between the amounts purchased and sold during the quarter, while *net new investments* is the 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.

1) Crisis (Mexico): Q3.2008-Q1.2009
2) Recovery (Mexico): Q2.2009-Q4.2010
3) Post-crisis (Mexico): Q1.2011-Q4.2016
4) Crisis (Chile): Q1.2006-Q2.2007
5) Crisis (Chile): Q3.2007-Q1.2009
6) Recovery (Chile): Q2.2009-Q4.2010
7) Post-crisis (Chile): Q1.2011-Q4.2016

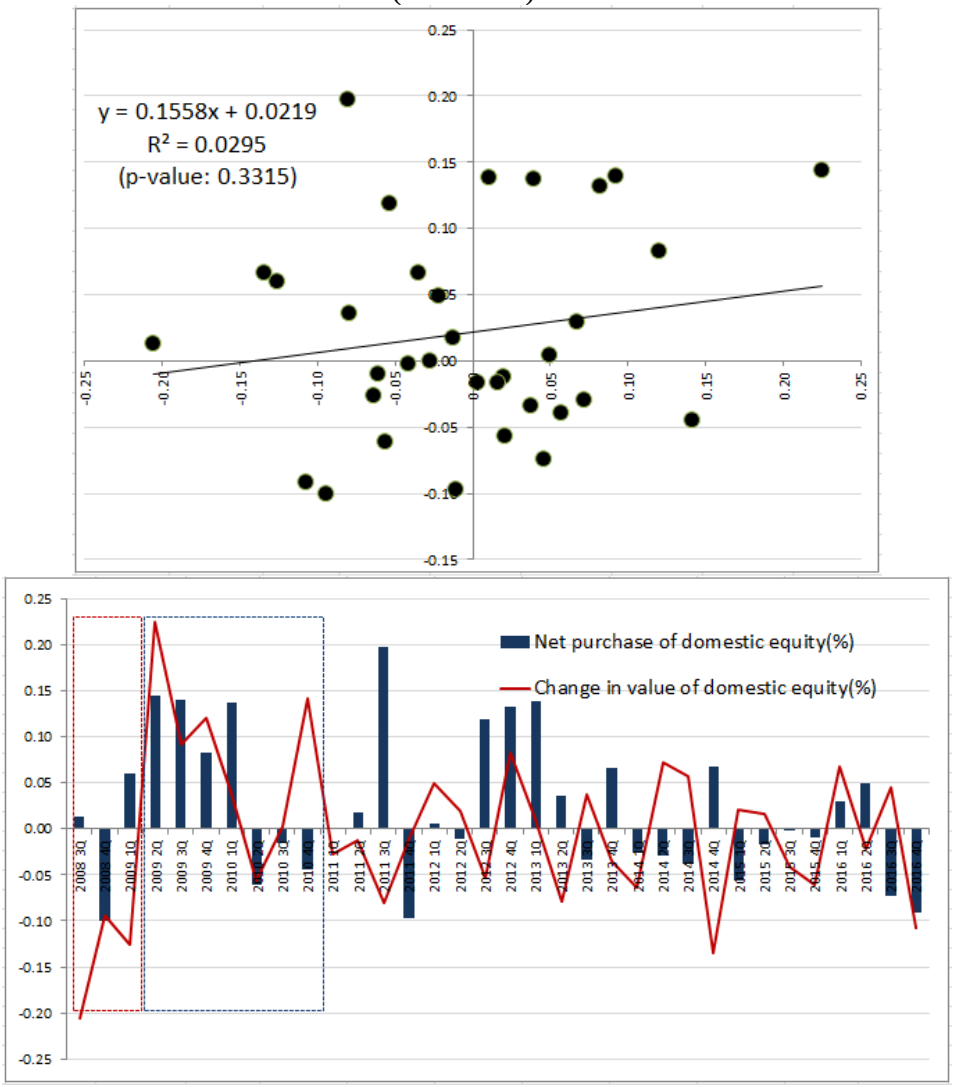
Source: IOPS

Next, we performed scatter plot analysis (Figure 13) with variables of the change in value of domestic equity (%) and net purchase of domestic equity (%). Mexico's aggressive funds showed a

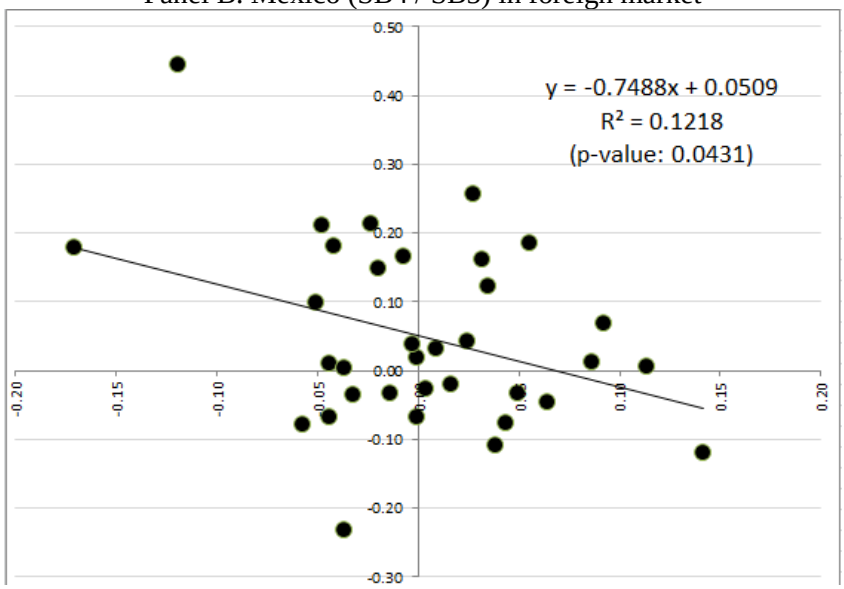
positive trend line (0.1558x) in the domestic market, but the result is not statistically significant (p-value: 0.3315). Interestingly, Mexican funds revealed a very strong negative trend line in foreign equity markets with p-value under the significance level of 5% (-0.7488x, p-value: 0.0431). This is mainly due to the large net purchases in 2010 2Q during the recovery period when the values of foreign equity dropped more than 10%. Meanwhile, aggressive funds in Chile showed a strong positive trend line in both domestic (0.2394x, p-value: 0.0037) and foreign (0.3196x, p-value: 0.0030) stock markets, which indicate a strong pro-cyclicality.

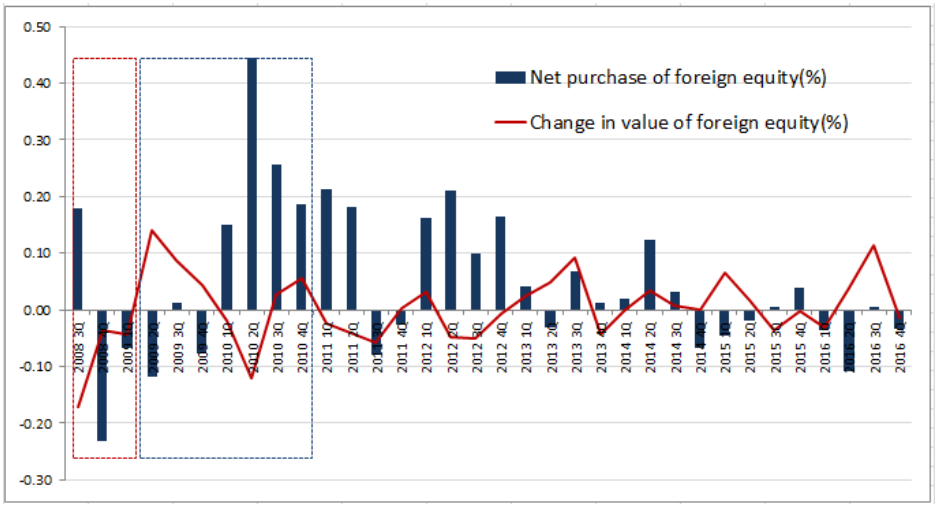
**Figure 13. Scatter plot analysis of aggressive funds in Mexico and Chile**

Panel A. Mexico (SB4 / SB5) in domestic market

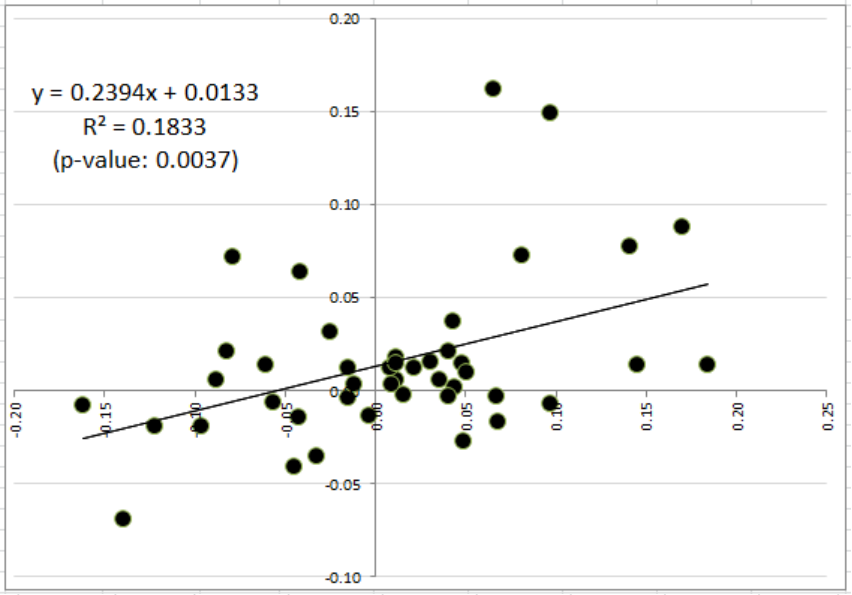


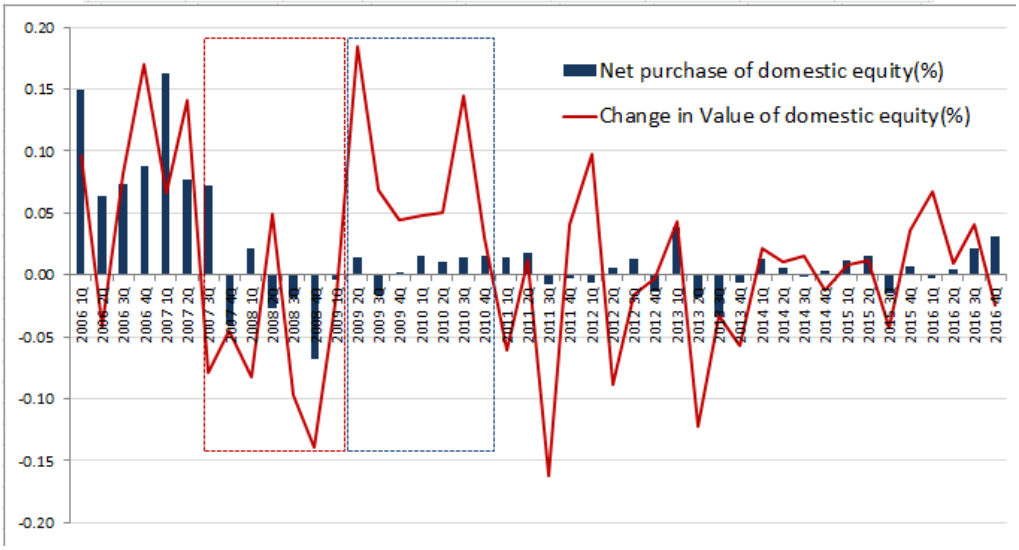
Panel B. Mexico (SB4 / SB5) in foreign market



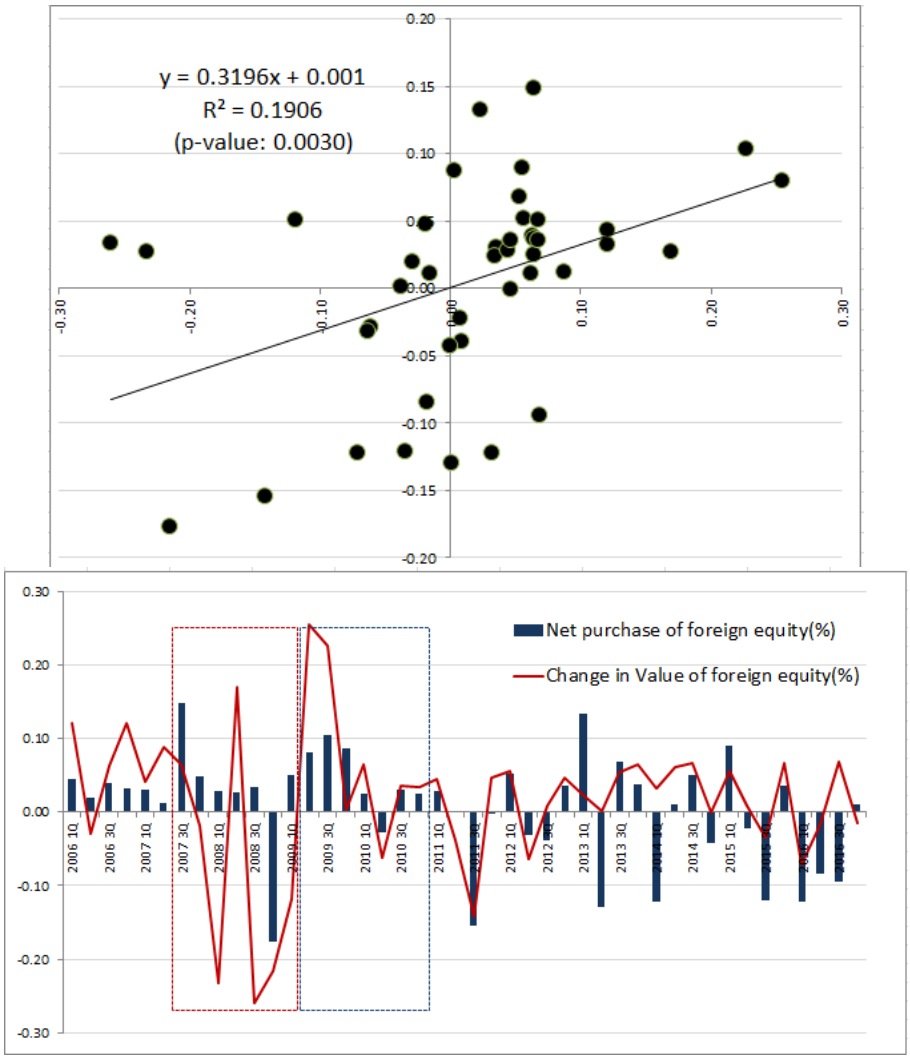



Panel C. Chile (Fund A) in domestic market



Panel D. Chile (Fund A) in foreign market




Source: Authors' analysis.

Chilean funds' pro-cyclical behaviour was also observed in correlation analysis (Table 19). Correlation co-efficients were strong and positive in both domestic (41.7%, p-value 0.0049) and foreign (44.7%, p-value 0.0023) equity markets during the whole period. In Mexico, all the analysis was statically insignificant, except for the recovery period of foreign market (-75.8%, p-value: 0.0491), which is in line with the evidence we observed in the scatter plot analysis. Single regression results were similar as well (Table 20). Chilean pension funds had a strong negative co-efficient between stock index returns and their net purchase of equities (domestic: +4.8454x, p-value: 0.0135, foreign: +5.1186x, p-value: 0.0019).

**Table 19. Correlation co-efficients between stock index returns and net purchases of equity by aggressive funds in Mexico and Chile**

| | Domestic stock index return and | | Foreign stock index return and | |
|---|---|---|---|---|
| | net purchases of domestic equity relative to total net new investment | absolute value of net purchases of domestic equity | net purchases of foreign equity relative to total net new investment | absolute value of net purchases of foreign equity |
| **Mexico (SB4 / SB5)** (Q3.2008- Q4.2012) | -2.5% (0.8883) | 2.8% (0.8749) | 27.0% (0.1228) | 15.2% (0.3909) |
| - Crisis (Q3.2008 – Q1.2009) | -27.2% (0.8247) | -76.7% (0.4438) | 21.5% (0.8618) | 39.8% (0.7391) |
| - Recovery (Q3.2009 - Q4.2010) | -2.7% (0.9544) | 36.8% (0.4165) | -75.6%* (0.0491) | -57.4% (0.1783) |
| - Post-Crisis (Q1.2011- Q4.2016) | -19.7% (0.3553) | -22.7% (0.2869) | 30.0% (0.1539) | 25.9% (0.2210) |
| **Chile (Fund A)** (Q1.2006- Q4.2016) | -0.6% (0.9671) | **41.7%*** (0.0049) | 19.3% (0.2087) | **44.7%*** (0.0023) |
| - Before Crisis (Q1.2006 – Q2.2007) | 17.8% (0.7353) | 32.8% (0.5252) | 29.3% (0.5729) | 29.8% (0.5660) |
| - Crisis (Q3.2007 – Q1.2009) | 25.1% (0.5866) | 14.0% (0.7643) | 12.0% (0.7972) | **83.9%*** (0.0183) |
| - Recovery (Q3.2009 - Q4.2010) | 6.6% (0.8890) | 3.0% (0.9495) | 85.8%* (0.0134) | 67.0% (0.0997) |
| - Post-Crisis (Q1.2011- Q3.2012) | -30.5% (0.1473) | 28.1% (0.1830) | -8.7% (0.6877) | **58.0%*** (0.0030) |

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

Source: Authors' analysis.

**Table 20. Single regression: equity investment by aggressive pension funds in Mexico and Chile**

| Jurisdiction | Explanatory variables | Domestic market | | Foreign Market | |
|---|---|---|---|---|---|
| | | Model 1 | Model2 | Model 1 | Model 2 |
| | | Co-efficient (p-value) | | Co-efficient (p-value) | |
| Mexico (SB4 / SB5) | Intercept | 0.0622 (0.2429) | 0.4162 (0.2995) | -0.1732 (0.2241) | 0.0762 (0.3156) |
| | Stock index returns | -0.0783 (0.8357) | 2.1281 (0.2746) | 0.4541 (0.7887) | 1.0621 (0.1653) |
| | R-squared | 0.0006 | 0.0141 | 0.0032 | 0.0728 |
| | Adjusted R-squared | -0.0306 | -0.0167 | -0.0280 | 0.0438 |
| | #observations | 34 | | 34 | |
| Chile (Fund A) | Intercept | 0.0796 (0.0152) | -0.1001 (0.5576) | -0.2260 (0.7380) | -0.0559 (0.7305) |
| | Stock index returns | -0.0143 (0.9614) | **4.8454*** (0.0135) | 9.2015 (0.2171) | **5.1186*** (0.0019) |
| | R-squared | 0.0000 | 0.1735 | 0.0374 | 0.2000 |
| | Adjusted R-squared | -0.0238 | 0.1538 | 0.0144 | 0.1810 |
| | #observations | 44 | | 44 | |

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.

Table 21 summarises the analysis of aggressive funds in Mexico and Chile. Mexican funds show mixed results depending on type of analysis and are mostly statistically insignificant. These findings are in line with the results for the aggregated fund level in Mexico. As a result, we cannot conclude whether Mexican funds acted pro-cyclically or counter-cyclically based on this additional analysis. Otherwise, Chilean aggressive funds showed pro-cyclical behaviour in most of the analyses with a strong statistical significance. The results are statistically stronger when comparing the results for the aggregated fund level in Chile. We can then conclude that Chilean pension funds, especially aggressive funds, acted pro-cyclically during the observed periods.

**Table 21. Summary: investment behaviour of aggressive funds in Mexico and Chile**

| **Jurisdiction** | **Market** | **Transaction analysis (crisis)** | **Scatter plot Analysis** | **Correlation analysis** | **Single regression analysis** |
|---|---|---|---|---|---|
| | | | **(whole period)** | | |
| Mexico | Domestic | sell **pro-cyclical** | ? | ? | ? |
| | Foreign | sell **pro-cyclical** | negative trend line **counter-cyclical** | ? | ? |
| Chile | Domestic | sell **pro-cyclical** | positive trend line **pro-cyclical** | positive trend line **pro-cyclical** | positive trend line **pro-cyclical** |
| | Foreign | Increase buying **counter-cyclical** | positive trend line **pro-cyclical** | positive trend line **pro-cyclical** | positive trend line **pro-cyclical** |

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

Source: Authors' analysis.

**Related publications**

Blake, D., L. Sarno, and G. 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.

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.