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Marcin Brycz
University of Gdańsk

Daniel Sonnet
Hochschule Fresenius Hamburg

Pension efficiency in European Union countries after the 2008 financial crisis – lessons for the next turmoil

The pension system is one of the most challenging parts of a country's social security system, as demographic change hits many macroeconomic stability concerns – public debt in particular. The 2008 financial crisis revealed fiscal imbalances in many European countries, which made their governments reform the pension systems. Demographic change is the primary determinant of pension system performance, but not the only one. Its efficiency is measured in three dimensions: sustainability (impact on labor market, pension expenditures), adequacy (reduction of old-age income poverty), and modernization (gender inequality). Since the 2008 crisis, many European countries have lost macroeconomic soundness (Greece is a notable example). This, in turn, interferes with pension system efficiency. This paper aims to investigate the link between the 2008 crisis and pension system efficiency in the three mentioned dimensions. We hypothesize that the former has had a negative impact on all three of them. In order to evaluate our hypothesis, we use data on pension system efficiency provided by Chybalski and Gumola as our dependent variables and crisis factors provided by Bernanke as our independent variables. To ensure that the set of macroeconomic variables is consistent with Bernanke's, we apply principal component analysis to real economic data and compare it with Bernanke's using multi-information. We found that the 2008 crisis reduced the sustainability and modernization level of European pension systems but, surprisingly, enhanced their adequacy.

Keywords: pension system efficiency, financial crisis, principal component analysis, multi-information

JEL classification: G19, H55

Introduction

Pension system efficiency, or simply pension efficiency, is a relatively new branch of economic studies concerned with the longevity, consumption smoothing, poverty reduction, and equality of pension systems. The idea originated in

the so-called Open Method of Coordination, a policy introduced by the European Commission at the Lisbon Summit in 2000. To challenge the issues of an aging society, three goals of the pension system were defined: adequacy, financial sustainability, and modernization. The first one refers to poverty and social exclusion among the elderly; the second – to financial soundness of the pension system and public finances (in other words, employment in the pre-retirement age group); the third – to equality among retirement subpopulations, in particular in terms of gender [EC, 2001; Chybalski, Gumola, 2018].

The three goals of pension system efficiency can be measured by numerous indicators [Chybalski, 2012; 2016]. However, as some of them are highly correlated, there is a need for careful selection. Those indicators are commonly used to annually investigate similarities within a group of countries, e.g. EU or OECD; on the whole, these groups were not stable in the years 2007–2015 [Chybalski, 2016; Chybalski, Gumola, 2018], although some countries created fairer clusters than others.

The 2005–2015 period was characterized by turbulence which influenced many pension system efficiency variables and forced governments to reform social security systems due to longevity risk and a rise in government deficit followed by a public debt spike. The 2008 financial crisis was the breaking point in the European economy; the first drop in the banking sector and financial markets was followed by persistent public debt rise and a sharp decrease in GDP growth.

We hypothesize that the 2008 crisis affected pension system efficiency in terms of adequacy, financial stability, and modernization. To verify this, we test for correlation between real economy data and financial variables provided by Bernanke [2018] on the one side and Chybalski and Gomola's [2018] pension system efficiency indicators on the other. We use multi-information in order to reveal the dependencies between both datasets, which we then exmine by panel regression.

1. Pension system efficiency indicators

A holistic pension approach – as postulated by OMC – is a powerful tool for analysing a country's pension system efficiency. Of interest to us are three indicators elaborated by Chybalski and Gumola [2018]:

adequacy: $$A_{j,t} = \frac{1}{4}\left(ARP_{j,t} + MRI_{j,t} + ARR_{j,t} + SBO/20_{j,t} \right) \quad [1]$$

sustainability: $$S_{j,t} = \frac{1}{3}\left(PE_{j,t} + EMP(55-64)_{j,t} + DWL_{j,t} \right) \quad [2]$$

modernization: $$M_{j,t} = \frac{1}{3}\left(dARP_{j,t} + dMRI_{j,t} + dARR_{j,t} \right) \quad [3]$$

where:

j – country,

t – time.

All of the measures are simply averages of aspect indices. The adequacy indicator ($A_{j,t}$) describes the overall condition of the pension efficiency of a given country in a given year. It consists of at-risk-of-poverty ratio among pensioners (ARP), median relative income ratio for people aged 65+ (MRI), aggregate replacement ratio (ARR), and inequality of income distribution for people aged 65+ (S80/20). It shows how the pension system fulfills its role in providing a safe and financially secure living in advanced age. It does not indicate the cost for the rest of society or the link to a previous working career. Sustainability ($S_{j,t}$) is an average of total pension expenditure to GDP ($PE_{j,t}$), the employment rate for people aged 55–64 (EMP55–64), and duration of working life (DWL). Sustainable pension systems ensure reasonable pension expenditure to GDP ratio, prevent earlier retirement, and increase overall working life duration. Modernization ($M_{j,t}$) is the gender equality of adequacy components. The lower the gender differences, the higher the level of modernization. The optimal pension system should provide sufficient funds for pensioners without bias and not burden public finances nor give incentives to leave the labor market.

2. Crisis theory

A wide range of crisis theories sprang up after the 1930s crisis, some of which are still being elaborated or have been rediscovered after 2008. A reasonable crisis theory should link financial distress to the real economy. Keeping in mind our hypothesis, a link between financial turmoil and the real economy and between the real economy and variables reflecting pension system efficiency should be indicated.

Signs of the coming crisis were visible in mid-2007 when two Bear Stearn's funds filed for bankruptcy and BNP Paribas halted calculation and withdrawals of its investment funds. A year later, Lehman Brothers defaulted, which sparked the crisis across the whole financial industry [Kacperczyk, Schnabl, 2010]. In the fourth quarter of 2008, most European countries experienced severe negative GDP growth. In December 2008, the Federal Reserve cut interests rates to virtually 0%. As conventional monetary policy ammunition ran out, quantitative easing was introduced by chairman Ben Bernanke [Blinder, 2010]. The policy helped financial markets recover in the US, but problems in the EU were still to come.

Filoso et al. [2017] present the financial crisis in Europe from two perspectives: macroeconomic imbalances and institutional failures. The former concerns eco-

nomic fundamentals diversity in the EU countries, i.e., labor unit costs pushed by unions. Prior to the debt crisis, financial markets did not distinguish countries, so debt yields were similar. The latter concerns the failure of various institutions to step in and counter the crisis (this perspective being more appropriately applied to the Greek, Spanish, and Italian crises).

Excessive sovereign debt in EU countries made their governments' reform the pension system as the public debt burden increased. The pension system, in many cases, produces excess debt and retains massive savings. On the other hand, the latter may be used to cover extra expenses in turbulent years. A notable example are the so-called PIIGS countries, where the reforms aimed to strengthen public finances now and in the future. In Portugal, pension contribution for an elderly employee was reduced, tax allowance for pension contribution solidarity tax was reduced, solidarity tax was raised, and retirement age was tied to life expectancy. In Ireland, just after the crisis began, private pension funds were taxed, and thus some pension savings were transferred to the government budget directly, the demographic reserve was used to raise capital for failing banks, raise pension age, and provide an allowance for the poorest pensioners. In Italy, employer contribution and pension age were raised, and pension system finance parameters were tied to life expectancy. In Greece, privileged working groups were also included in the universal pension system. In Spain, likewise, pension age was raised and pension system finance parameters were tied to life expectancy, and households were allowed to withdraw some of their pension savings [Symeonidis, 2016; EC, 2018; OECD, 2012; 2014].

3. Cost of credit intermediation

The cost of credit intermediation theory, stemming from Milton Friedman's breakdown of the monetary effects of the great depression [Friedman, Schwartz, 1963], was later popularized by Bernanke in numerous publications. Money contraction leads to a decrease in production. Bernanke [1983] gave additional variables to money aggregates and output regression, such as the first difference of deposits in failing banks and the first difference of liabilities of the failing business. Both regressors indicate non-monetary effects of the financial crisis; their significance proves the existence of additional effects – the condition of banks and business matters for output, the processing of information by banks is therefore destabilized, so the cost of credit intermediation rises. Finally, Bernanke [1990] describes the link between interest rates and spreads and the real economy, stating that different spreads predict different real economic variables (e.g. inflation can be predicted based on the spread between highest-quality commercial paper

of 6-month maturity and treasury bills of 6-month maturity, while employment based on the spread between 1- and 10-year government bonds).

Bernanke [2018] discussed the link between the stages of the 2008 crisis and financial data representation. The financial data – particularly interest, spreads, prices, and indices – can be grouped into four areas and their robustness checked using factor analysis: 1) housing and mortgages, 2) non-mortgage credit, 3) short-term funding, and 4) bank solvency. Over the years 2006–2012 in the US, the housing factor dominated (until BNP rescue); then the funding factor, peaking in the time of Lehman Brothers collapse; next, until the stress tests, the credit factor; and lastly, when the European sovereign debt crisis began, the solvency factor. The crisis factors are linked to segments of the real economy, measured by correlation of forecasted variables and simulated values.

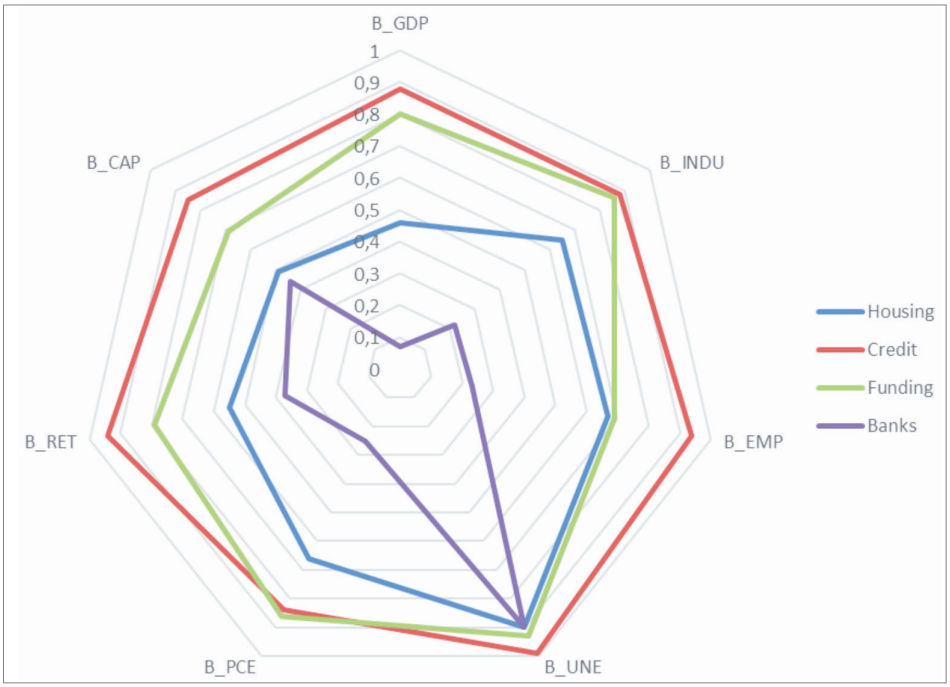

Figure 1. Correlation of actual and forecasted variables with simulated values

Notes: Macroeconomic indicators shown in the radar graph are: Gross Domestic Product Growth (GDP), Industrial production (INDU), Employment (EMP), Unemployment (UNE), Consumption Price Index (PCI), Retail Sales (RET), Capacity Utilization (CAP).

Source: [Bernanke, 2018].

The housing and funding factors affect all of the macroeconomic variables similarly. On the other hand, the solvency factor is highly correlated with unem-

ployment, while the housing factor with unemployment, employment, and, to a lesser extent, inflation.

4. Methodology

In this study, we hypothesize that particular financial crisis factors affect particular pension system efficiency indicators (e.g. the solvency factor affects sustainability). To test our hypothesis, we use the database provided by Chybalski and Gumola [2018], taking adequacy (A), sustainability (S), and modernization (M) indicators for 27 countries in the years 2005, 2010, and 2015 as dependent variables.

Our independent variables are crisis factors obtained from real economy data[1]. First, we calculate the values of the principal components based on macroeconomic data and country dummies, using only the first 7 out of 34 components[2]. Then, we construct a mutual-information matrix to determine which principal components provide relatively much information about other principal components and crisis factors. The factor analysis performed by Bernanke resolved four financial crisis factors from many financial time series. The factors are used to obtain macro variables in dynamic simulation. Bernanke's correlations are interpreted as to how close the factors are to particular macro variables. We compute principal components based on a dataset consisting of the macro variables used by Bernanke, but for EU-27. Next, we resolve the similarity of our components and Bernanke's factors using a multi-information matrix, thus identifying which Principle Component represents Bernanke's factor.

We built our analysis by calculating the determination coefficient of all variables to obtain a common interpretation. In the next step, the multi-information matrix is calculated.

The housing factor shares the highest portion of information with Principal Component 2 (1.974 bit). The funding factor shares information with PC4 (1.678 bit). Crisis factors are correlated with each other in different ways than in Bernanke's [2018] example. In the EU data, the housing factor shares much information with the funding factor (1.414 bit), the solvency factor, and other crisis factors (1.193 bit).

[1] Real GDP growth, industrial production, total employment, unemployment (percentage of the active population), price index (final consumption), retail trade, employment in industry. Data come from the Eurostat database.

[2] The first seven components are correlated with seven macroeconomic variables and country dummy, the remaining components with country dummy only.

Table 1. Multi-information matrix for principal components and crisis factors

	Housing	Credit	Funding	Solvency
PC1	0.981	0.693	0.827	0.981
PC2	1.386	0.693	0.981	0.827
PC3	1.163	0.539	0.827	0.981
PC4	0.981	0.539	1.163	0.981
PC5	0.827	0.693	0.981	0.827
PC6	1.163	0.693	0.827	0.981
PC7	0.827	0.539	0.981	0.827
Housing	1.386	0.693	0.981	0.827
Credit	0.693	1.099	0.539	0.875
Funding	0.981	0.539	1.386	0.827
Solvency	0.827	0.875	0.827	1.386

Notes: The outcome in nats (to convert into bit, multiply by $\log_2 e = \sim 1.4427$). Shrinkage estimation was used to improve reliability [Meyer, 2008]. The whole sample is split into four nodes in the process of discretization.

Source: Own elaboration.

In the next stage, we indicate which crisis factor affects a particular pension system efficiency (adequacy, sustainability, and modernization). For this, we employ a panel regression with fixed effects.

Principal components (PC2 and PC3) explain pension system efficiency of Adequacy, Sustainability, and Modernization well; in all cases, parameters are significant with high t-ratio and models to characterize reasonable within R-squared for Adequacy and Sustainability.

The parameter's sign for adequacy is positive, which implies both crisis factors (PC2 and PC4 for European economies; reflecting the housing and funding factors) rise that type of pension efficiency in the European countries. Sustainability and Modernization of pension systems are negatively tied to the housing and funding factors.

The difference in signs between adequacy and the rest of the pension system indicators must be explained. The EC [2012] stated that many EU countries decided to put pressure on sustainability, trading off adequacy and security, the indicated deterioration adequacy component, when crisis eased (that is when sustainability improvement took effect). The issue needs further explanation after controlling for EU countries' reforms. Moreover, Adequacy and Sustainability are negatively correlated with components in EU countries.

Table 2. Panel regression of adequacy, sustainability, and modernization for pension system efficiency, 2005–2015

Adequacy				
	coefficient	std. error	t-ratio	p-value
const	0.5578	0.0000	7.94E+15	0.0000
PC2	0.0925	0.0166	5.5780	0.0000
PC4	0.0949	0.0233	4.0780	0.0004
LSDV	R-squared	0.8691		
Within	R-squared	0.4351		
DW		1.7399		
Joint test on named regressors:				
F(2, 26) = 15.6308, P(F(2, 26) 15.6308) = 3.48e-005				
Sustainability				
	coefficient	Std. error	t-ratio	p-value
const	0.4089	0.0000	1.09E+16	0.0000
PC2	–0.0612	0.0076	–8.025	0.0000
PC4	–0.0463	0.0086	–5.382	0.0000
LSDV	R-squared	0.9797		
Within	R-squared	0.6538		
DW		1.8918		
Joint test on named regressors:				
F(2, 26) = 32.6912, P(F(2, 26) 32.6912) = 8.00e-012				
Modernization				
	coefficient	std. error	t-ratio	p-value
const	0.6615	0.0000	1.03E+16	0.0000
PC2	–0.0641	0.0230	–2.791	0.0097
PC4	–0.1031	0.0320	–3.218	0.0034
LSDV	R-squared	0.7432		
Within	R-squared	0.2071		
DW		1.7318		
Joint test on named regressors:				
F(2, 26) = 5.0835, P(F(2, 26) 5.0835) = 0.0082				

Notes: Robust standard errors: [Arellano, 2003].

Source: Own elaboration.

The Modernization pension system indicator is negatively tied to crisis factors; the more severe crisis is that the difference between men and women narrows. It can also be somewhat explained by reforms, which in most cases were to lower the pension amount of those with higher pensions (male pensioners).

Conclusions

This study questions the link between the financial crisis and pension system efficiency regarding the three main aspects: adequacy, sustainability, and modernization. In Europe, the most visible are the housing, funding, and solvency factors, with the last one being correlated with the two others, which therefore have significant effect on the pension system.

Further study can concentrate on a deeper explanation of why financial crisis affects adequacy and sustainability in the opposite direction. On the one hand, adequacy and sustainability are ambitious goals, but logic suggests that financial crisis should affect these variables negatively. Further research of the subject could focus on the role of pension system efficiency reform after the crisis.

The housing, funding, and solvency factors affect adequacy, and sustainability can serve as a prognosis for the next crisis. In 2020, the pandemic caused a new kind of economic crisis. Although different from the 2008 financial crisis, some elements are common. It can be described as a triple threat: a demand shock, a supply shock, and a financial shock [Triggs, Kharas, 2020]. The first and the second component came from the lockdown policy which aimed to decrease the number of infected people and prevent the public health system from collapsing. Businesses that depend on large gatherings of people, such as tourism, hospitality, or open-air entertainment, are affected the most. Supply shock was a result of logistic chain problems. The third one was caused by a decreased ability to pay debts by closed businesses. Central banks worldwide had to step in and increase quantitative easing policies introduced after the 2008 crisis. Since lowering interest rates and raising the quantity of money was not enough to counter the economic turmoil, another policy was introduced – the so-called "helicopter drop" – to direct new money to closed businesses to prevent a spike in unemployment. All in all, a massive amount of new money entered the market.

This last kind of shock is similar to the 2008 crisis. On the other hand, its magnitude and volatility are different, as crisis performance in 2008 and 2020 is not the same. In previous crises, the shock occurred once, when Lehman Brothers collapsed, and was propagated through the economy. At present, the magnitude of the crisis is alternating with high volatility, as it depends on the number of infected people. The number of infected people varies as described in the SIR model. Lockdown policy and easing alternately with excess money generates high consumption, investment, and housing market volatility. According to our research of the pandemic crisis, as more money circulates in the market, interest is lower, high bank soundness and new investment in the housing market and higher fatality

among pensioners should enhance the sustainability of the pension system significantly. As sustainability and adequacy run oppositely, one can assume that adequacy should decrease (mainly due to higher inflation and unfavorable relative prices).

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M. Brycz, (✉) marcin.brycz@ug.edu.pl
Uniwersytet Gdański, Wydział Ekonomiczny, ul. Armii Krajowej 119/121, 81-824 Sopot, Poland

D. Sonnet, (✉) daniel.sonnet@hs-fresenius.de
Hochschule Fresenius Hamburg, Alte Rabenstraße 1, 20148, Hamburg, Germany