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The paper provides new empirical evidence for the connection between pension reform and capital market development using a sample of ten Central and Eastern European countries. Using a single equation Error Correction Model, the results confirm the existence of a strong positive short-term effect, as well as a lower magnitude positive long-term effect of the pension funds' assets on the market capitalisation.

Keywords: pension reform; stock market; development; CEE; pension funds

JEL classification: G23, G20, G10

1. Introduction

Beginning in the 1990s, and led by unfavourable demographic dynamics, many Central and Eastern European (CEE) countries changed the architecture of their pension systems, in a way similar to that of other European Union developed countries. Their efforts were focused on diminishing the reliance on the pay-as-you-go public pensions, by encouraging complementary pension schemes (occupational and personal) to alleviate the public budget.

This process raised questions among researchers, the main debate being the effect of this upon the financial markets and the economic growth. More precisely, the main debate was whether the growth of contractual savings could become a trigger for shifting the financial markets from these countries towards a 'capital market oriented' stage of financial development. It has been argued that the private pension funds assets' growth is contributing to the financial innovation, to the increase of market liquidity and to a deepening of the financial market.

There is a wide literature that supports the assumption that institutional investors, including private pension funds, can foster the development of the domestic capital markets. This is because such markets, as they are sophisticated investors and possess important financial knowledge, are the biggest participants in securities transactions, and aim at finding long-term investments (Catalán, Impavido, & Musalem, 2000; Raddatz & Schmuckler, 2008; Walker & Lefort, 2002). Moreover, the legislation of each country stipulates that the private pension funds must allocate, at least in the first operating years, a

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part of their financial assets in securities traded on the local capital markets. Consequently, the pension funds become strategic investors for the domestic capital markets, especially for those in a less developed stage. Therefore, given the increase of the private pension fund industry, the role of the pension funds in fostering the development of local capital markets becomes more important, contributing to the economic growth and financing of the real economy. The mainstream theoretical and empirical literature has focused though on the case of Latin countries or developed OECD countries, the CEE countries being somehow left out (Catalán et al., 2000; Niggemann & Rocholl, 2010; Raddatz & Schmuckler, 2008; Walker & Lefort, 2002). The main contribution of the paper is to bring a new perspective on these issues, using a sample of ten CEE countries.

The rest of the paper is organised as follows. Section 2 makes a short review of the main theoretical and empirical background; Section 3 presents the methodological framework, the data used in the empirical approach and presents the obtained results; Section 5 draws the conclusions.

2.   Theoretical and empirical background

What does the literature state about the connection between pension funds and capital markets? Within institutional investors, private pension funds have an important role, being long-term investors and assuming much more risks than other investors in terms of portfolio allocation. In the economic literature, the very important functions of institutional investors have been mentioned. These functions are accumulation of institutional capital, transferring financial resources, risk control, reducing the price volatility, integrating the capital market at international level, diversifying the financial instruments existing on the market, intensifying the competition. These functions lead further to a more liquid and developed stock market and to a general improvement of the financial stability (Blommestein, 2000; Davis, 1996; Vittas, 1998). Impavido and Musalem (2000) also state that pension funds increase financial innovation and foster the efficiency and competition on the domestic capital markets. Hansen and Torregrosa (1992) and Hansen and Pinkerton (1982) also mention the reduction of the trading and issuing costs on the markets which the pension funds activate. Some authors refer to the positive impact of the pension funds on the domestic capital markets, both for the economies with developed financial systems and for those that have less developed financial systems, the influence being somewhat diminished for the latter (Dayoub & Lasagabaster, 2008). Other papers outline the effect of deepening of bond and equity markets produced by the development of the activity pension funds (Catalán, 2004; Corbo & Schmidt-Hebbel, 2003; Davis, 1996; Vittas, 1999).

A growing body of empirical literature, beginning in 2000, has had, as objective testing, the theoretical connection between the growth of the pension fund industry and the development of the domestic capital market (Table 1). Reviewing the main papers, we can see that the majority have focused on the case of more developed countries or Latin countries, these being the first to implement pension reform, rather than on CEE countries, which have shifted only recently to a third pillar functional pension system.

The majority of these papers, quite different from the point of view of the methodological framework, reach the same conclusion – that pension funds positively influence capital market development. There are still some differences in the results as far as the intensity of this connection is concerned, which, in opinion of these papers, could be related to the level of financial development of the country and of the stock market, the indicator taken into consideration when considering the stock market (if it applies to both equity and bond market or considers just one of them), the legislative restrictions

Table 1. Review of the main empirical literature.

Author/s	Sample	Methodology	Main results: Pension fund assets
Catalán et al. (2000)	14 OECD countries plus 5 developing countries (Chile, Malaysia, Singapore, South Africa, Thailand)	Granger causality test	Granger cause market capitalisation
Impavido and Musalem (2000)	26 countries, from which 5 developing ones	OLS, Error Component (EC), TSLS	Strong and positive impact on market capitalisation
Walker and Lefort (2002)	Chile, Argentina, Peru, 33 emerging economies	GLS	Positive impact on the development of capital markets
Impavido, Musalem, and Tressel (2003)	32 developed and developing countries	GMM	Positive impact on the market depth
Aras and Müslümov (2005)	23 OECD countries	Granger causality test	Granger cause market capitalisation
Raddatz and Schmuckler (2008)	Chile	Lakonishok et al. (1992) herding statistic	No consistent impact on financial market
Hryckiewicz (2009)	8 CEE countries	GMM	Positive impact on market capitalisation
Meng and Pfau (2010)	32 developed and emerging countries	GMM LSDV	positive impact on stock market depth and liquidity
Niggemann and Rocholl (2010)	30 OECD member states and 42 non-member states (developed and emerging economies)	GLS	Positive impact on market capitalisation
Liang and Bing (2010)	UK	Granger causality	Positive impact on market capitalisation; Reverse causality also significant
Kim (2010)	21 OECD countries	GMM	Positive long-term impact on market capitalisation Positive, but volatile short-term impact on market capitalisation

Source: authors' compilation.

concerning the investment strategies of the private pension funds, and the herding behaviour of the pension funds that often align their investment strategies, leading to the development of only certain parts of the capital market.

Summarising, there are both theoretical grounds and empirical support for the positive impact of private pension funds on financial market capitalisation. However, most of the empirical studies realised so far are focused on developed countries or the developing countries from Latin America, or are using mixed samples of developed and emerging economies. In this context, we are trying to fill a gap in the literature by analysing the case of 10 Central and Eastern European countries that experienced pension reforms in the last decades and were trying to establish and develop their capital markets. More precisely, our research hypothesis is that the accumulation of pension fund assets in these countries triggered by the pension reform is associated with an increase in the market capitalisation, both in the short-run and in the long-run.

3.   Data, methodology and results

Our empirical analysis focused on a sample of ten Central and Eastern European countries (Bulgaria, Czech Republic, Hungary, Estonia, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia) for the period 2001–2010.

As a proxy indicator for the capital market development, we used the market capitalisation of listed companies as a percentage of GDP (MC). Data for the 2001–2010 period were extracted from the World Bank Database. To account for pension reform, we used as a proxy pension funds' assets as a percentage of GDP (PFA). This choice was made having in mind the design of the second pillar of Central and Eastern European pension systems reform (especially the restriction imposed by legislation on recipient pension funds to invest in a certain measure on the domestic capital market). Data for the 2001–2010 period were extracted from the OECD Statistical Database and the official web pages of the national capital markets. Data were grouped in a panel ($N = 10$, $T = 10$).

Examining our variables of interest, we found evidence of autocorrelation. The correlograms for both market capitalisation (MC) and pension fund assets (PFA) indicate strong autocorrelation and partial correlation of order one (see correlograms below – Tables 2 and 3).

In addition, both our variables of interest proved to be non-stationary in levels, but became stationary after first-differencing. We used the LLC unit root test (Levin, Lin, & Chu, 2002) which uses the null hypothesis of a common unit root for all the cross-section

Table 2.   Correlogram of market capitalisation (MC).

Lag	AC	PAC	Q-Stat	Prob
1	0.58	0.58	35.13	0.00
2	0.34	−0.01	46.88	0.00
3	0.21	0.02	51.34	0.00
4	0.05	−0.11	51.65	0.00
5	0.01	0.03	51.67	0.00
6	0.01	0.02	51.69	0.00
7	0.09	0.14	52.65	0.00
8	0.05	−0.10	52.94	0.00
9	0.03	0.00	53.01	0.00

Source: authors' calculation.

Table 3.   Correlogram of pension fund assets (PFA).

Lag	AC	PAC	Q-Stat	Prob
1	0.82	0.82	68.59	0.00
2	0.64	−0.06	111.87	0.00
3	0.52	0.04	140.48	0.00
4	0.36	−0.18	154.48	0.00
5	0.22	−0.05	159.68	0.00
6	0.11	−0.03	161.03	0.00
7	0.04	0.03	161.20	0.00
8	−0.01	0.01	161.21	0.00
9	−0.02	0.06	161.25	0.00

Source: authors' calculation.

Table 4. Unit root tests.

Variable	Hypothesis	Common unit root LLC	Individual unit root	
			ADF-Fisher	PP-Fisher
MC	Level	−1.19	13.78	13.51
	First difference	−6.81***	59.38***	107.13***
PFA	Level	2.65	4.65	3.23
	First difference	−8.91***	46.32***	74.66***

(***), (**) and (*) denote rejection of the unit root hypothesis at the 1, 5 and 10% levels, respectively.
Source: authors' calculation.

Table 5. Johansen Fisher cointegration test.

Type of the cointegration equation	Number of cointegration equations	Trace test	Max-Eigen test
No constant and no trend in CE or in VAR	None	83.92***	69.45***
	At least one	42.11***	42.11***
With constant only in CE	None	88.80***	69.58***
	At least one	43.54***	43.54***
With constant in CE and in VAR	None	61.83***	54.40***
	At least one	35.07**	35.07**
With constant and linear trend in CE and no	None	185.3***	156.7***
trend in VAR	At least one	30.58*	30.58*
With constant and quadratic trend CE and	None	163.4***	168.2***
linear trend in VAR	At least one	56.98***	56.98***

(***), (**) and (*) denote rejection of the no cointegration hypothesis at the 1%, 5% and 10% levels, respectively.
Source: authors' calculation.

of the panel. However, since this hypothesis is somehow restrictive we run ADF-Fisher and PP-Fisher panel unit root tests (Maddala & Wu, 1999), which drop this homogeneity hypothesis. For market capitalisation variable, we used a baseline equation without any individual intercept or trend. For the pension funds' assets variable, an equation with an individual intercept was used (Table 4).

To check if there is a log-run equilibrium relation between the two variables, a panel Johansen Fisher Test was employed. The test uses the Maddala and Wu (1999) procedure, combining tests from individual cross-sections to obtain a test statistic for the full panel. The results confirm the existence of at least one cointegration equation between the two variables (Table 5).

Given the fact that both variables of interest are I(1) processes, showing strong first-order autocorrelation and are cointegrated, the use of an Error Correction Model is straightforward. In this framework, the two cointegrated variables share a stochastic component and a long-term equilibrium relationship. Any deviations from this equilibrium relationship as a result of shocks will be corrected over time.

Instead of using a traditional Engle and Granger two-step ECM, which does not clearly distinguish dependent variables from independent variables, we chose to use a Single Equation ECM, our interest being to highlight the impact of pension reform (proxied by the pension funds' assets variable) on capital market development (proxied by the market capitalisation variable). The structural form of the model is the following:

$$\Delta MC_{it} = \alpha + \beta_1 \Delta PFA_{it} - \beta_2(MC_{it-1} - \beta_3 PFA_{it-1}) + \varepsilon_{it} \tag{1}$$

The error correction mechanism in equation (1) is given by $MC_{it-1} - \beta_3 PFA_{it-1}$. When the two variables are in their equilibrium state, the portion of the equation in parentheses will be equal to zero. If the ECM approach is appropriate, then $-1 < \beta_2 < 0$. Such model specification allows us to distinguish between short-term and long-term effects of pension funds' assets on market capitalisation.

The short-term effect of an increase in pension funds' assets on market capitalisation will be estimated by β_1. After a shock that displaces the equilibrium between two values, given the correction mechanism, the return to equilibrium will be done at a speed equal to $-\beta_2$.

The long-term effect that a one unit increase in pension funds' assets has on market capitalisation is estimated by β_3. This long-term effect will be distributed over future time periods according to the rate of error correction $-\beta_2$.

In order to estimate the model, we rearranged the terms in equation (1) as follows:

$$\Delta MC_{it} = \alpha + \gamma_1 MC_{it-1} + \gamma_2 \Delta PFA_{it} + \gamma_3 PFA_{it-1} + \varepsilon_{it} \tag{2}$$

where $\gamma_1 = -\beta_2$; $\gamma_2 = \beta_1$; $\gamma_3 = \beta_2\beta_3$

In this specification, the short-term effect is captured by γ_2, the log-term effect is given by $\frac{\gamma_3}{-\gamma_1}$ and the speed of adjustment in the event of a shock is given by $-\gamma_1$.

Given the common features of the sample's countries, it was intuitive to start the estimation with a model with individual effects. $\varepsilon_{it} = \lambda_i + u_{it}$, where λ_i is the individual country effect and u_{it} is an idiosyncratic error component.

First, we assumed that there is some correlation between our regressors and the individual effects and we ran a one-way cross-section fixed effects estimation. We removed the cross-section mean from both the dependent variable and the independent variables and then performed the regression with the demeaned values. The estimation results are given in column 1 of Table 6.

As expected, the coefficient for the lagged dependent variable is significant and lies between –1 and 0, confirming our choice in using an Error Correction Model. Also, the coefficient of our first-differenced independent variable is significant and positive. Only the coefficient for our lagged independent variable proved to be insignificant.

Table 6. Single equation ECM estimation.

Variable	(1) OLS fixed-effects	(2) OLS random effects	(3) FGLS fixed-effects
MC(−1)	−0.49***	−0.32***	−0.46**
	(0.10)	(0.08)	(0.23)
D(PFA)	4.50***	5.09***	3.14***
	(1.59)	(1.43)	(0.95)
PFA(−1)	−0.60	−0.38	0.27**
	(0.51)	(0.35)	(−2.34)
C	9.85***	5.14**	10.14**
	(2.83)	(2.03)	(4.13)
N	90	90	90
Adjusted R^2	0.30	0.27	0.33
F-statistic	4.20***	12.03***	4.65***
Durbin-Watson stat	2.17	2.17	2.16
Hausman test		11.51***	

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: authors' calculation.

Second, we considered full independence between our regressors and the individual effects and ran a one-way (cross-section) random effects estimation. The estimation results are given in column 2 of Table 6.

The results are very similar to the ones from the previous estimation. The coefficient for a lagged dependent variable is significant and lies between –1 and 0, the coefficient of our first-differenced independent variable is significant and positive, and the coefficient for our lagged independent variable is negative and insignificant.

In order to choose between fixed or random effects, a Hausman test was employed. The null hypothesis of the Hausman test is that both estimators are efficient, and the alternative is that only the fixed effects estimator is efficient. The high value obtained for the Hausman test led to the rejection of the null, indicating that the fixed effects estimator is more efficient than the random effects estimator.

Next, specific panel data issues such as residual autocorrelation and cross-section heteroscedasticity were addressed. The obtained value of the Durbin-Watson statistic, exceeding 2, could be an indicator of first-order serial correlation. Also, heteroscedasticity is, usually, present in panels with macro data. Given that in the presence of heteroscedasticity and serial correlation ordinary least squares results are biased, we employed 'feasible' generalised least squares (FGLS) to obtain more reliable estimates. Results are shown in column 3 of Table 6.

The coefficient for a lagged dependent variable is significant and lies between –1 and 0 ($\gamma_1 = -00.46$), as expected. The coefficient value gives the speed of adjustment towards equilibrium in the event of a shock.

The short-term effect of pension funds' assets on market capitalisation is given by the coefficient of our first-differenced independent variable, which is significant and positive ($\gamma_2 = 30.14$). This result confirms our assumption that pension reform (proxied by pension funds' assets) has a positive impact on financial development in the short-term.

In addition, the coefficient for our lagged independent variable is positive and significant. This result allows us to identify the long-term effect of pension funds' assets on market capitalisation, given by $\beta_3 = \frac{\gamma_3}{-\gamma_1} = +0.60$.

Summarising, a 1% of GDP increase in pension funds' assets will produce a short-term increase in market capitalisation equal to 3.14% of GDP. Also, such a shock will disrupt the long-term equilibrium relationship between these two variables. However, given the correction mechanism, market capitalisation will respond to such a shock by increasing by a total of 0.60% of GDP, spread over future years at a rate of 45.98% per year. This implies that market capitalisation will increase with 0.28% of GDP in year t, with 0.15% of GDP in year $t + 1$, with 0.08% of GDP in year $t + 2$, with 0.04% of GDP in year $t + 3$ and so on, until the change in pension funds' assets at $t - 1$ has virtually no effect on market capitalisation.

These results confirm our starting hypothesis that the accumulation of pension fund assets is beneficial for the development of the financial market, increasing its capitalisation, and also it is in line with other empirical results from the literature (see Hryckiewicz, 2009; Impavido & Musalem, 2000; Kim, 2010; Meng & Pfau, 2010; Niggemann & Rocholl, 2010). Moreover, according to our results, policymakers should consider future public pension reforms as an effective tool for pursuing the capital market development objective.

However, the magnitude of the effect should be carefully considered. Our estimate lies somewhere between other estimates in the literature. For instance, using a mixed sample of developed and developing countries, Impavido and Musalem (2000) and

Meng and Pfau (2010) estimated a coefficient for the impact of pension fund assets on market capitalisation around 0.33, while Niggemann and Rocholl (2010) and Kim (2010) estimated a coefficient around unity. These different estimates point out that the sample heterogeneity could have a significant influence on the obtained results. For eight out of ten countries of our sample, Hryckiewicz (2009) used stock market capitalisation and bond market capitalisation as dependent variables and estimated higher coefficients for pension fund assets (+1.39 and +4.02, respectively). However, the methodology used in Hryckiewicz (2009) did not permit us to disentangle the short-run effect from the long-run effect.

Moreover, one could argue, based on our results, that in countries with a low level of financial development (such as the countries in our sample), the accumulation of pension fund assets triggered by pension reforms is a significant determinant of financial market development. However, it should be mentioned that Meng and Pfau (2010), using a sub-sample of low financial development countries, estimated a positive coefficient for pension fund assets (+0.30), but it was statistically insignificant.

4.   Conclusions

The recent growth experienced by the private pension funds from the CEE countries, due to the pension reform, has led us to question the positive effect that this might have on the development of local capital markets.

Our empirical results confirm both short-term and long-term significant and positive effects of pension funds' assets on market capitalisation for the Central and Eastern European countries under consideration (Bulgaria, Czech Republic, Hungary, Estonia, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia) and are consistent with other empirical papers.

An increase in pension funds' assets proved to have a strong positive short-term effect on market capitalisation. Our estimates highlight a magnitude of 3.14 for this short-term effect. This result confirms that the implementation of the second pillar of pension system reform in the considered CEE countries, strengthened with mandatory investments in local financial market requirements for recipient pension funds could immediately boost local financial development.

Another finding of our paper is that the positive effect of a shock in pension funds' assets on market capitalisation does not fade in the long-term. Our estimates point out that the positive effect persists in the long-term, but lowers its magnitude to 0.60. In addition, given a long-term equilibrium between market capitalisation and pension funds' assets, any deviation will be corrected with a speed of adjustment of 45.98% per year.

Having in mind the institutional design of the pension system reform in Central and Eastern European countries, the obtained results prove the beneficial impact of pensions reform on the development of domestic capital markets. In addition, we consider that this effect is likely to be more significant in the future, with a larger accumulation in assets by the private pension funds and with a change in their investment strategies towards more risk-oriented portfolios, where equity holdings are not so restrictive.

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