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Dobromił Serwa, PhD

Warsaw School of Economics

Report on scientific achievements
Dobromił Serwa

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1. Academic and professional experience

I have graduated at Warsaw School of Economics in 2001 (major: finance and banking, grade: very good). My academic work has begun in the Institute of Econometrics at the same school during my master's studies. Since then I have been continuing my work at Warsaw School of Economics as a lecturer.

In the years 2001 – 2004, I also participated in the scientific program "Capital Markets and Finance in the Enlarged Europe" at the European University Viadrina in Frankfurt (Oder). After completing the program, I was employed at the National Bank of Poland in Warsaw in the Financial System Department, and now I am an economic expert in this department. In 2011, I had a five-month research internship at the European Central Bank in Frankfurt.

2. Pre-doctoral research work, doctoral thesis

My initial research has focused on modeling the foreign exchange and capital markets with the help of econometric nonlinear models. The paper, written jointly with Michał Rubaszek analyzed changes in the risk premium on the Polish currency market using regression models with GARCH-M effects (Rubaszek, Serwa, 2001). We have noticed that the risk premium is correlated with the rate of growth of stock indices, interest rates and the volatility of the exchange rate. In two studies written with Wanda Marcinkowska-Lewandowska we have used threshold autoregressive models to explain changes in stock indices and in exchange rates (Marcinkowska-Lewandowska, Serwa, 2001 and 2002). In both works have revealed the usefulness of the threshold regression models to explain financial variables. In another study, I have analyzed changes in the forward discount of exchange rates for selected countries in Central Europe with the help of state-space model (Serwa, 2002). In this study, I have generated estimates of the time-varying risk premium in the foreign exchange market using the quotes of spot exchange rates.

While working at the National Bank of Poland I have built a early warning model for the currency crises in Poland (Serwa, 2005). This model has been used in analyses of the stability of the financial system. I am also a co-author of the work examining the effects of shocks to monetary policy pursued by the National Bank of Poland on short-term changes in the exchange rate of the zloty against other currencies (Serwa, Smolińska-Skarżyńska, 2004; Serwa, Szymanska, 2004). The results have indicated a statistically significant effect of

unexpected changes in interest rates to changes in the exchange rate during the first two days after the shock. Moreover, the the derivative instruments like the FX futures have reacted most strongly to monetary shocks. I have extened this study by considering the response of stocks and treasury bonds to monetary shocks (Serwa, 2006). However, neither stock indices or long-term interest rates in Poland have reacted to unexpected monetary policy changes. The article of Serwa (2006) has been published in the journal Applied Financial Economics (Taylor & Francis).

I have earned a doctoral degree in economics on May 27, 2008 from the Collegium of Economic Analyses at Warsaw School of Economics. My doctoral thesis titled "Econometric analysis of changes in the foreign exchange rate: the case of the Polish financial market" has been written under the supervision of prof. Wanda Marcinkowska-Lewandowska. This thesis has been related to modeling short-term fluctuations in the foreign exchange rate. I have presented applications of advanced econometric methods (e.g., event studies, identification through heteroscedasticity, state-space models with ARCH effects, threshold regression models) to explain changes in the foreign exchange rate of the zloty and to estimate the risk premium on the currency market. I have examined whether the risk premium is an important element determining the direction and magnitude of changes in the foreign exchange rate. I have verified the relationship between changes of interest rates and fluctuations in the foreign exchange rate. Finally, I have analyzed the foreign exchange rate fluctuations in various states of financial markets (e.g., during periods of prosperity and periods of turbulence in the financial markets). In my dissertation, I have also described the functioning of the Polish currency market and have presented economic theories explaining the short-run changes of the foreign exchange rates. Selected parts of my dissertation and the dissertation of Michał Rubaszek have been used to write the book "Analysis of the exchange rate" (Wanda Marcinkowska-Lewandowska was the scientific editor of this book) and published by C.H. Beck publishing house (Marcinkowska-Lewandowska, Rubaszek and Serwa, 2009).

During my participation in the research program at the European University Viadrina, I have analyzed the flows of information and capital between capital markets around the world. The work, written together with Jędrzej Białkowski, has proposed a new method for testing causality between the rates of return on stock market indices for the two stock markets (Bialkowski and Serwa, 2005). We have checked whether the information and capital shocks have spilled over from the stocks exchange in Hong Kong to Japan and in the opposite direction during the Asian crisis in 1997. We have used this econometric method in our further analyses of the relationship between major stock markets in the world (Białkowski,

Bohl and Serwa, 2006). We have also developed an algorithm to test different types of interdependencies between markets using econometric Markov switching models. Our results indicate that none of the market has been independent from other markets. The relationship between the markets does not rely exclusively on one market imitating the second market, but it is rather a bidirectional exchange of information and capital in times of calm and crisis.

In another article prepared together with Martin Bohl, we have studied contagion effects of financial crises in selected stock exchanges in Western Europe and Central and Eastern Europe (Serwa and Bohl, 2005). The stock exchanges in Central and Eastern Europe have proved to be at least as resistant to external financial crises as the stock exchanges in Western Europe. Contagion effects, defined as an increase in correlation between markets during crises, have been observed only sporadically in the analyzed countries. In a similar study written together with Bartosz Gębka, we have verified whether there was any contagion effect between the Asian stock markets and the stock market in the United States during the Asian crisis of 1997 (Gębka and Serwa, 2006). We have revealed increased information flow between the markets. The U.S. investors paid greater attention to developments in the Asian stock markets during the Asian crisis.

In another study conducted jointly with Bartosz Gębka we have noticed that information flows take place not only between developed markets, but also between emerging markets around the world (Gębka and Serwa, 2007). We have also confirmed the existence of links between other regional and interregional stock markets located in Central Europe.

Papers written during my participation in the scientific program at the European University Viadrina have been published in the journals "Quantitative Finance", "Quarterly Review of Economics and Finance", "Economic Systems", "Journal of International Financial Markets, Institutions and Money", "Research in International Business and Finance". All of these journals are published either by Elsevier or Taylor & Francis. The journal "Quantitative Finance" was listed in the Journal of Citation Reports at the time of our publication, and the journals "Economic Systems" and "Journal of International Financial Markets, Institutions and Money" joined the list after our publications.

3. **Single-topic list of publications "Econometric modeling of the processes taking place in the banking sector in times of credit booms and banking crises."**

Since writing the doctoral dissertation my research interests have evolved in the direction of analyzing stability of the financial system, in particular stability of the banking

sector. My first study on this subject was the work titled "The costs of banking sector restructuring in Poland" written jointly with Adam Pawlikowski. In this work, we have estimated the costs of restructuring the Polish banking sector incurred by the government and the central bank in 1993-2006.[1] We have focused our attention on those support activities targeted at Polish banks which had generated direct fiscal costs. According to our estimates, the aggregate cost of restructuring the banking sector had amounted to 2.6% of annual gross domestic product and had been not high compared with the corresponding costs of restructurings in other transition countries. Our achievement has been the inclusion of all major support instruments for the first time in the studies of the Polish banking sector to accurately estimate the costs of restructuring. We have taken into account the discount rate and the large price changes during the analyzed period.

My further research has focused on the analyses of the functioning of banking sectors in different countries and the link between banks and the real economy. I have been interested in the various states (regimes) of the banking sector, in particular credit booms and periods of banking crises. Credit booms affect the growth of economic activity in the real sector, but they also increase the risk of instability in the financial system. Banking crises are an extreme form of this instability. They are most commonly associated with the slowdown in lending and financial problems of banks. Banking crises generate severe costs to the real economy. Therefore, stability of the banking sector is an important issue from the perspective of regulators and supervisors of the credit market. The stability of the banking sector is also essential for households and corporates that utilize financial services.

Modelling the processes taking place in the banking sector has necessitated the use of sophisticated and often innovative econometric methods. In particular, we have made estimates using the non-linear econometric models and the appropriate methods of estimation. We have also proposed some new algorithms for testing hypotheses related to functioning of the credit market.

Three main problems addressed in my research were the following:

1) The causality between economic recessions and banking crises around the world.

2) Identifying the state of equilibrium, credit booms and crashes in the credit market.

3) Methods to analyze risk of instability in the banking sector in Poland.

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[1] It is worth noting that the period 1993-1996 is often identified in the international economic literature as the period of the banking crisis in Poland. The described work has not been formally incorporated into the list of single-topic publications because it was published in the journal "Bank & Credit" in 2007, a few months before the defense of my dissertation. I have participated in the creation of this article by finding a method of calculating the cumulative cost of all support instruments used by economic authorities to rescue banks and to carry out calculations and to interpret results.

The outcome of these studies is the list of six single-topic publications as envisaged in article 16, paragraph 2 of the act on academic degrees and titles and degrees and titles in art from 14 March 2003. The title of my scientific achievement is "Econometric modeling of the processes taking place in the banking sector in times of credit booms and banking crises."

The scientific articles included in my list of single-topic publications are the following:

1) Serwa (2010): "Larger crises cost more: Impact of banking sector instability on output growth". Article published in the journal *Journal of International Money and Finance* (detailed bibliographic information in section 6).

2) Serwa (2012): "Banking crises and nonlinear linkages between credit and output". Article published in the journal *Applied Economics*.

3) Serwa (2013a): "Identifying multiple regimes in the model of credit to housholds", Article published in the journal *International Review of Economics and Finance* and in the working paper series of the National Bank of Poland (Serwa, 2011).

4) Rubaszek, Serwa (2012): "Determinants of credit to households in a life-cycle model". Article published in the working paper series of the European Central Bank and the working paper series of the National Bank of Poland (Rubaszek, Serwa, 2011). Most recent version of the paper accepted for publication in the journal *Economic Systems* (Rubaszek, Serwa, 2014).

5) Serwa (2013b): "Measuring non-performing loans during (and after) credit booms". Research published in the journal *Central European Journal of Economic Modelling and Econometrics*.

6) Pawłowska, Serwa, Zajączkowski (2014): "Transmission of liquidity shocks between parent banks and foreign affiliates: Evidence from the host country". Research published in the working paper series of the National Bank of Poland.

I am the single author of the three articles from this list that have been published in in the Journal of Citation Reports (JCR). One co-authored paper has also been accepted for publication in the journal listed in the JCR (Rubaszek, Serwa, 2014). I have presented each of the six articles at international scientific conferences.

I have presented the most important results from these six publications in the following three subsections. These results are related directly to the three problems addressed in my research.

3.1. Causality between economic recessions and banking crises around the world.

In the paper titled "Larger crises cost more: Impact of banking sector instability on output growth" I have presented a new method of calculating the macroeconomic costs of banking crises. This method, in contrast to methods previously applied in practice, takes into account the fact that economic downturns often occur in times of crises and they affect the size of banking crises. In this way economic recessions increase the costs of crises. Earlier studies have suggested that costs of banking crises are very large and sometimes even reach 100% of the country's GDP. The costs calculated using my method are much lower and they depend on the size of the crisis, as measured, for example, by the decrease in lending, deposit outflows, or a slowdown in the growth rate of the money supply. Nevertheless banking crises generate macroeconomic costs, even in countries with poorly developed banking system.

The procedure presented in my article consists of using an event study approach and the econometric method called 'identification through heteroscedasticity' to estimate parameters in the in the multi-equation model. This method was proposed Roberto Rigobon and Brian Sack (2004) for modeling financial markets. In my study, I have extended this method by taking into account the changes in the expected values of random variables in the sample, and by using the method for the analysis of panel data. This is the first time, when this method has been used to analyze the banking sector and (more importantly) to analyze the low frequency (e.g. annual) data. My article has been listed in the Journal of Citation Reports, and has been cited Lagoarde-Segot, Leoni (2013), Fernández, González, Suárez (2013), and Aizenman, Noy (2013), among others.

The study "Banking crises and nonlinear linkages between credit and output" has analyzed the relationship between credit growth and economic growth in different countries around the world. In particular, I have been interested in periods of severe banking crises (the so-called systemic crises) in the years 1970-2003. The sample has contained 103 cases of crises in individual countries. I have checked whether the periods of economic recession were on average preceded by banking crises or banking crises have led to a decline in economic growth. In the empirical study I have applied a method for testing causality (Granger-causality) between macroeconomic variables using a Markov switching model.[2]

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[2] This method was proposed by Jędrzej Bialkowski and me in 2005. We have used this method to analyze the stock returns on capital markets. The article of Bialkowski and Serwa (2005) was published in the journal "Quantitative Finance" listed in the Journal of Citation Reports.

My achievement here is the application of this testing method for the first time in the analysis of panel data (this approach requires appropriate adjustments to the estimation method of Markov switching models), and to develop a methodology for testing "asymmetric" causality between economic variables. The existence of asymmetric causation means that one economic variable leads the other variable only in some specific regimes, such as banking crises or credit booms. The algorithm presented in my work enables testing hypotheses about the independence of two economic variables, about of the causality between these variables, and the "asymmetric" causality between these variables.

In the empirical study, I have found that banking crises do not generally precede a recession in the real sector, nor are they usually caused by the economic downturn. Most recessions and crises occur simultaneously and are mutually reinforcing. In addition, I have noticed that the relationship between the real and financial sectors is non-linear, i.e. it changes between times of calm and turbulence. In this way, I have confirmed my earlier result showing that the banking crises contribute to (but not necessarily precede) economic recessions. My work has been published in a journal listed in the JCR list and it has been quoted by such economists as Joshua Aizenman, Ilan Noy (2013), Michal Franta (2013), and Stefano Puddu (2013).

3.2. Identifying the state of equilibrium, credit booms and crashes in the credit market

Two further related research papers focused on the modeling of the level and the rate of growth of credit in various states of the economy. Since both the demand and supply of credit by banks varies significantly depending on the type of loan, the research focuses on one type of credit (the most important in terms of its aggregate size in the banking sector), namely loans to households. The first study titled "Determinants of credit to households in a life-cycle model" , co-authored with Michał Rubaszek, concerned calculation of the optimal level of credit to households in a single economy. [3] In this work, we have used panel data from OECD countries, and cross-sectional data from the countries of the European Union to estimate the long-run dependence between the loans to households and important macroeconomic factors

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[3] Another version of our work is likely to be published in the international journal "Economic Systems" published by Elsevier (status: "revise & resubmit") and listed in the Journal of Citation Reports. The work was previously reviewed by editors and anonymous reviewers, and it was presented at important international conferences such as the European Economic Association conference in Oslo, INFINITI conference in Dublin, or MARS Network conference in Frankfurt. In this work, I was responsible for preparing the estimated models (analysis of data, selection of variables for econometric models to estimate regression models, interpretation of results), and the co-author Michał Rubaszek was responsible for the construction of a theoretical model, calibration of the model and the simulations carried out on our theoretical model.

such as the level of income of the population, the spread between the interest rates on loans and deposits in the banking system, unemployment and diversification of income in the population. Parameters of regression models have been estimated using sophisticated econometric methods that have not been previously used in the analyses of credit markets. These methods take into account the nonstationary panel data and a strong correlation between specific panels, so that our estimates are accurate.

Our work was also important due to the following reason. In earlier studies the equilibrium level for credit had been determined by means of simple statistical rules (e.g., trend models or the Hodrick-Prescott filter), or by using regression models with explanatory variables selected ad hoc. We have proposed a method for modeling and estimating credit in equilibrium in such a way that the equilibrium has resulted from the theoretical economic model presented in our work. This model has described the optimal level of credit in the economy where households maximize their utility from consumption. Thanks to our approach a more effective assessment of deviations of credit from the economic equilibrium is now possible. The newest version of our article (titled "Determinants of credit to households: An approach using the life-cycle model") has also been accepted for publication in the journal Economic Systems and has already been cited, among others, in Brissimis, Garganas, Hall (2014).

My second study titled "Identifying multiple regimes in the model of credit to housholds" has been related to modeling the credit market for households in different states of the economy. I have analyzed the differences in the dynamics of credit in periods of "normal" growth of credit, in periods of credit booms, and in periods of credit busts (a rapid return of credit to the long-run equilibrium credit). To this end, I have built a dynamic pane data regression model, which has controlled for the various regimes of the credit market. Changes of regimes in the credit market have been modeled using a threshold effect in a regression model. With the help of threshold effects, I have been able to identify three different regimes occurring in the credit market for households in OECD countries. The method of estimating the threshold dynamic panel data models uses a bootstrap method to remove the bias generated by the standard LSDV estimator in finite samples. My study has been the first case when this method has been used to model credit markets, and to my best knowledge this has been the second application of this method ever. [4] I have also proposed a method of testing the number of regimes in the dynamic threshold model using based on the testing method

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[4] This method has also been applied by Shin and Kim (2011) to model corporate investments. In my study I have described differences between my model and their model.

invented by Bruce Hansen (1999). My work has been published in the journal listed in the Journal of Citation Reports.

The results of both studies presented in this subsection have already been used in practice. Namely, in the "Financial Stability Report", a cyclical publication of the National Bank of Poland, we have presented the calculation of the optimal level of credit to households for Poland and we have evaluated the deviation of the current level of credit from the long-run equilibrium (National Bank of Poland, 2011).

3.3. Analyzing the risk of instability in the banking sector in Poland

The problem of measuring deviations of credit from its equilibrium level is strongly associated with other methods of measuring the fragility of the banking sector, namely credit risk measurement and evaluation of the funding risk in banks. The most important threats to the stability of Polish banks (and banks around the world) have been related to the incorrect assessment of credit risk in banks and the existence of the funding risk in banks. A good example has been the recent global financial crisis that has caused financial problems or even bankruptcies of many banks in the world. Problems of crisis banks have been associated, among other factors, with the wrong risk assessment of the loan portfolio and the loss of funding sources to finance lending activities of banks. The analysis of these threats to the stability of the Polish banking sector is the topic of my two following studies.

Realized credit risk borne by banks is often evaluated on the basis of the NPL ratio (non-performing loan ratio), measured for individual banks or various loan portfolios. The high value and rapid growth rate of this ratio may suggest that the bank conducted risky lending activity recently, while low values and the slow growth rate of the NPL ratio may suggest an improvement of the quality of the loan portfolio in banks. In the study, entitled "Measuring non-performing loans during (and after) credit booms" I have analyzed the quality of bank loan portfolios. On the basis of simulations of a theoretical model, I have noticed that the NPL ratio falls quickly and takes low values during credit booms or during periods of increased growth of credit in the economy, even when the economic situation of the borrowers does not change. In times of crisis or a credit slowdown the NPL ratio usually increases, despite the fact that the economic situation of households remains at the same level. Both of these effects pose a serious threat to the financial stability of banks, in a situation

where analysts do not take into account the increasing credit risk in times of credit boom and the risk materializes in times of economic stagnation.

So far, the problem of the downward-biased NPL ratio has been repeatedly discussed, but the value of this bias has never been estimated.

My first achievement here has been to show the method to calculate bias in the NPL ratio during credit booms and to present an example calculation for the housing loans in Poland.

Another achievement in this work has been to propose the NPL ratio unaffected by changes in the dynamics of lending. As an example, I have presented such an indicator for the aggregate housing loans in Poland.

The results of this study have also been used in the "Financial Stability Report" to analyze the financial stability of Polish banks (National Bank of Poland, 2012).

The most recent study entitled "Transmission of liquidity shocks between parent banks and foreign affiliates: Evidence from the host country", has been written in collaboration with Małgorzata Pawłowska and Sławomir Zajączkowski as a result of our participation within the International Banking Research Network (IBRN).[5] This study concerns the analysis of liquidity shocks in foreign "parent banks" of Polish banks (i.e., foreign banks owing majority stakes in Polish banks). Liquidity shocks affect lending policies of parent banks and may result in a reduction of funding to Polish banking subsidiaries from their parent institutions. Limited foreign financing may in turn lead to a reduction in lending by Polish banks.

The analysis carried out for the years 2007-2013 has found that Polish banks have received increased support from their foreign owners in the first phase of the global financial crisis in 2008-2009, while in the later stages of the crisis the outflow of foreign funds from Polish banks has taken place. During the crisis, Polish banks reduced the supply of credit to households and businesses. However, banks more dependent on foreign financing were able to supply more loans to their customers in times of crisis than the banks dependent on funding from the domestic market. We have also examined various measures of shocks in the banking sector and our analysis has confirmed that the banks responded significantly primarily to liquidity shocks .

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[5] My participation in this research consisted of providing arguments in favor of significance of our study, preparing the literature review (together with Małgorzata Pawłowska), collecting data (together with Małgorzata Pawłowska and Sławomir Zajączkowski), refining the method to analyze Polish banking sector, describing and interpreting the results. This research has been initiated by the proposal of prof. Linda Goldberg from the Federal Reserve Bank of New York and prof. Claudia Buch from the Halle Institute for Economic Research. I have presented our preliminary results during the IBRN seminar in Potsdam in July 2013 (Pawłowska, Serwa, Zajączkowski, 2014).

Our study is important for identifying and understanding the channels for transmission of shocks between international financial institutions. Our results show that the existing links between institutions within banking groups may be a significant channel to transfer liquidity shocks between banks, but these links can also act as an important emergency channel for banks urgently needing liquidity support.

My achievement in this work has been to note that the policies of foreign banks to provide funding to Polish banks have changed during the debt crisis in the euro zone in 2011-2012. In the initial phase of the global financial crisis, parent banks significantly increased funding to Polish banks, which allowed Polish banks to keep at least partially the pace of lending activity. However, in subsequent years, Polish banks reduced significantly the supply of housing loans (especially loans denominated in foreign currencies) and the foreign banks have reduced funding to their subsidiary banks in Poland. In our work we have decided to perform our calculations separately in the two sub-samples in order to take account of the behavior of Polish and foreign banks. Our results have already been quoted in the work of Claudia Buch and Linda Goldberg (2014).

4. Other research beyond the single-topic list of publications

My research in recent years has focused on the use of advanced econometric methods to analyze the risk of debt crises in some countries, to calculate the costs of the global financial crisis of 2008-2009, and to analyze changes in stock returns in international capital markets.

Two related studies have focused on the analysis of financial crises, in particular the measurement of the risk of debt crises in individual countries and the potential costs of these crises for investors. In a co-authored work, written together with Gonzalo Camba-Mendez, we have built a model to price financial instruments called *sovereign Credit Default Swaps* (CDS). These instruments have been developed to protect investors against the risk of insolvency of sovereigns.

Our major achievement was to construct the model that enables the simultaneous identification of a time-varying probability of a crisis, the so-called Probability of Default (PD), and the time-varying estimates of potential losses to investors given the crisis, namely the Loss Given Default (LGD), on the basis of CDS quotations. We have formulated the arbitrage pricing CDS model as a nonlinear state-space model. Estimation of the model parameters has required the use of the non-linear least squares method, and the identification

of PD and LGD has been made possible thanks to the use of the non-linear Kalman filter (namely *the unscented Kalman filter*) and an iterative method to determine the value of the CDS premium.

In our first paper, we have analyzed the risk of sovereign default in seven euro area countries (Greece, Portugal, Spain, Ireland, Italy, France and Germany) during the crisis in the euro area. For most countries, it has been possible to calculate the PD and LGD, but not for the entire period of the crisis. We have examined the macroeconomic and institutional factors that influence the risk of the crisis. It has turned out that these factors had affected changes in PD and LGD only to a small extent. We have also examined the transmission of shocks between major markets (the so-called contagion effect) and we have noticed that this effect had occurred at different times of the crisis and had not resulted only from the financial problems of Greece.

In the second paper "Pricing sovereign credit risk of an emerging market", written together with Gonzalo Camba-Mendez, Konrad Kostrzewa and Anna Mospan, we have used analogous CDS pricing model to analyze the risk of sovereign debt crisis in Poland. We have analyzed the specifications of models with constant and time-varying levels of LGD and we have received similar results in both cases. It has turned out that any losses of investors caused by the potential crisis would be low. Our result can be interpreted in such a way that investors expect only short-term liquidity problems of the Polish government rather than a serious debt crisis, as was the case in Greece in 2011-2012. The highest probability of a crisis in Poland has been estimated for the months following the collapse of Lehman Brothers, and the biggest increase in LGD took place during the crisis in the eurozone. In addition, we have observed that CDS premiums are highly correlated with estimated probabilities of the crisis, but only for the short-term CDS contracts (from one-year to three-year contracts). For the CDS contracts with longer maturities the spreads are more strongly correlated with expected conditional losses (LGD).

I am also the co-author, together with Agnieszka Domańska, of a series of studies on the effects of macroeconomic openness and synchronization of economies on the costs incurred by the respective economies during the global financial crisis of 2008-2009. Studies have been financed by the grant from the Ministry of Science and Higher Education (No. 3779/B/H03/2011/40) directed by Agnieszka Domańska.

Our preliminary study titled "Koszty kryzysu gospodarczego w Europie na tle innych regionów świata – analiza przekrojowa" has investigated the construction of measures to calculate costs of the global economic crisis of 2008-2009 in different countries (Domańska,

Serwa, 2014). In this work, we have compared the costs of the crisis of 2008-2009 in various countries and regions of the world with particular emphasis on Poland. We have measured the costs using the basic macroeconomic variables such as gross domestic product (also per capita), value added, gross national income, as well as the volume of production in various branches of the economy. We have also examined the relationship between the costs of the crisis in different countries and the wealth of these countries and their economic growth before the crisis. The crisis affected particularly strongly the production of the European economies. In turn, exports were most affected in Asian economies, such as China and Japan. Among the various sectors and economies in Europe, the construction and transport in the Baltic countries suffered most. In the whole group of European Union countries the most affected branches were manufacturing, mining, and construction.

In the second study entitled "Factors of the European economies' vulnerability to external shocks - an empirical analysis. The example of 2008-2009 crisis costs", we have analyzed the factors affecting vulnerability of economies to external macroeconomic factors (Domańska and Serwa, 2013a). In particular, we have checked what factors are important in explaining the costs incurred by individual European economies during the global financial crisis of 2008-2009. In this study, we have measured the costs of the crisis as the cumulative deviation of real GDP growth in the crisis years from the long-term trend. We have used modern econometric methods to assess the impact of various macroeconomic and structural factors on the size of the crisis, including the methods of averaging parameter estimates in the regression models. This methods have allowed us to minimize the risk of selecting an incorrect specifications of econometric models. As the results of our calculations, the factors limiting the effects of the crisis were the following: a high level of economic development and a small concentration of industries, poor development of the financial sector, as well as good quality of law in the analyzed countries.

A similar research paper in this cycle has been titled "Vulnerability to foreign macroeconomic shocks - an empirical study in cross-industry perspective. Example of 2008-2009 global crisis in Europe". It has been written in collaboration with Agnieszka Domańska. This paper is related to research on the impact of the recent global crisis on different sectors of European economies (Domańska and Serwa, 2013b). Among the factors that contributed to the decrease in sales (and production) of individual sectors of the economy were the high degree of openness of these industries, a large concentration of production and exports of different sectors of the economy, and a high level of intra-sectoral trade. However, the

openness of the whole economy had no significant effect on the costs of the crisis according to the results of our study.

Another study written in collaboration with Agnieszka Domanska, entitled "Międzynarodowa transmisja szoków a podatność gospodarek krajów Europy na skutki globalnego kryzysu gospodarczego 2007-2009. Rola synchronizacji cykli koniunkturalnych w tłumaczeniu kosztów kryzysu 2008-2009" refers to measuring the degree of synchronization of business cycles of countries in Europe (Domańska and Serwa, 2013c). In this study, we have analyzed the impact of synchronization of individual economies on the macroeconomic costs incurred by these countries during the global crisis of 2008-2009. The aim of the study was to investigate the vulnerability of European economies to external economic shocks in the context of the effects of the global economic slowdown that had begun with the financial market collapse in the United States in mid-2007.

In this paper, we have noted that the degree of convergence of economic cycles in different countries can be an important characteristic that affects the transmission of shocks between countries. Therefore, we have measured the synchronization of individual economies and then constructed an econometric model in which the measure of synchronization is one of the variables to explain economic slowdown in individual countries during the global financial crisis. We have verified the hypothesis that the magnitude of the crisis in different European economies in 2008-2009 depended on the degree of synchronization of business cycles in these economies with other economies in Europe. The results of our calculations have shown that a strong synchronization and openness of the economies increased somewhat the costs of the crisis in different countries, but this effect was not statistically significant. Other macroeconomic factors were responsible for the magnitude of the crisis to a much greater extent.

Two further studies are related to the analysis of capital markets. In the paper written jointly with Bartosz Gębka "Liquidity needs, private information, feedback trading: verifying motives to trade" we have examined the dominant motives of investors to make investment decisions on the international stock markets (Gębka and Serwa, 2012). We have also checked whether the results of previous research on the investment motives will be confirmed if the estimates will be performed in a more precise way than they have been done so far. In particular, we have built a theoretical model describing the dependence of stock returns on global factors and the individual investment decisions of investors. Then, we have presented empirical regression models taking into account the combined effects of regime switching and GARCH effects (namely Markov Switching - GARCH models) affecting the stock returns.

The results of our calculations show that the dominance of liquidity needs or private information as main trading motives cannot be confirmed in any market. Instead we have noted the presence of investors using technical-analysis based strategies, such as "feedback trading".

In a study prepared jointly with Janusz Brzeszczyńskim and Martin Bohl under the title "Large capital inflows and stock returns in a thin market" we have verified the impact of investments made by Polish open pension funds (OFE) on the returns of stocks traded in the Warsaw Stock Exchange (Brzeszczyński, Bohl and Serwa, 2012). We have performed calculations using a unique database of daily capital flows from Zakład Ubezpieczeń Społecznych (ZUS, Social Insurance Institution in Poland) to pension funds. Our results indicate that the impact of investments of the funds in the stock market is statistically significant only in the short term (within one week from the date of transfers of capital from ZUS to OFEs), whereas the long-term effect is negligible. We have also noticed that the investment strategy of buying the stocks during the periods of capital inflows to pension funds would be profitable for potential investors. The results of our study are also important in the context of the Polish pension system reforms that have taken place in recent years.

I have also conducted one purely econometric study titled "Metoda Hellwiga jako kryterium doboru zmiennych do modeli szeregów czasowych" (Serwa, 2011). The aim of this study has been to check whether the method of optimal predictors (the so-called Hellwig method, see Hellwig, 1985) is useful in constructing time series models and to what extent this method is competitive with other methods (e.g. methods employing the Schwarz and Akaike information criteria). As a result of my theoretical analysis and simple empirical simulations, I have shown that the Hellwig method will often lead to the selection of wrong (non-optimal) econometric models. Importantly, this result applies to any dynamic time series models. Therefore, in practical applications, we recommend to use information criteria such as the Schwarz criterion and the Akaike criterion, or some methods to sequentially select statistically significant variables in a model (e.g. the general-to-specific approach) instead of using the Hellwig method to select optimal explanatory variables in a model. My research has been cited and extended by subsequent authors (see e.g., Bednarski and Borowicz, 2009, and Rosienkiewicz, 2012).

My current research is related to forecasting the credit risk of companies from different sectors of the economy. In a joint study with Zuzanna Wośko, we use advanced methods to estimate and forecast the quality of corporate loans. We employ dynamic panel data regressions. The precision of estimates is strengthened with the use of Bayesian

averaging of econometric models and forecast averaging methods. The aim of this study is to compare the predictions obtained from individual regression models, benchmark random-walk models, and the models averaged with the use of different averaging techniques.

5. Other achievements

In the following subsections, I have presented my other important achievements in research and teaching. In particular, I have mentioned my presentations during more important scientific conferences, reviewing activity, citations of my work, and received scientific grants. Finally, I have presented my teaching achievements.

5.1. Scientific work

I have presented my papers at more than 20 conferences and seminars aborad and at a similar number of conferences in Poland (details in Appendix 5).

I have been a member of the editorial board of the scientific journal "Bank & Credit" (Bank i Kredyt) since 2011 and have participated in the enhancement of this journal and its promotion in the country and abroad.

I have reviewed 47 papers submitted to the following journals: Economic Systems, Applied Economics, Argumenta Oeconomica, Central European Journal of Economic Modeling and Econometrics, Journal of Multinational Financial Management, Emerging Markets Finance and Trade, Eastern European Economics, Journal of International Money and Finance, Emerging Markets Finance and Trade, Empirical Economics, Bank & Credit, NBP Working Paper Series, Materiały i Studia NBP, and several papers submitted to international conferences.

I have reviewed 8 economic research projects (grants) in cooperation with the Romanian Ministry of Education, Research, Youth and Sport (currently the Ministry of National Education in Romania).

I'm the leader of the OPUS grant awarded by the National Science Centre (NCN/2012/07/B/HS4/00361). In the project titled „Nowe metody badania stabilności finansowej sektora bankowego" ("New methods to analyze financial stability of the banking sector", lasting from July 2013 to December 2015), I have already published one scientific paper in the Central European Journal of Economic Modelling and Econometrics (Serwa, 2013b).

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I have also participated in the project led by Agnieszka Domańska and related to measuring costs of the global financial crisis of 2008-2009. This project has received the grant from the Ministry of Science and Higher Education (3779/B/H03/2011/40) and it has lasted in the years 2011-2013. In this project, we have published at least four papers in local and international journals (Domańska i Serwa, 2013a, 2013b, 2013c, 2014).

In the years 2001-2004 I have been receiving the scholarship in the scientific research programme "Capital Markets and Finance in the Enlarged Europe" at the European University Viadrina in Frankfurt (Oder). I have received twice the scholarship from the Foundation for Polish Science in 2005 and 2006. In recent years, I also received prizes from the President of the National Bank of Poland and from the Rector of Warsaw School of Economics for my scientific achievements.

My research studies have been quoted multiple times in local as well as international scientific articles. The list of citations of my work includes 195 citations (153 citations since 2009) according to the Google Scholar service. The h-index coefficient (the number of publications h that were cited at least h times) is currently equal 8. According to the Ideas/Repec scientific research service, which registers only citations from its internal database the numer of citations of my works equals 78 (the list of citations of my studies is presnted at http://ideas.repec.org/e/c/pse187.html). The number of citations listed in the JCR of my publications listed in the JCR is equal to 5 according to the Web of Knowledge service.

On the basis of my publications, their quality, the number of downloads of my works, and the number of citations of my papers, I have been classified in the 18th place in the Ideas/Repec ranking for Polish economists (as of April 2014, the current rankings can be found at: http://ideas.repec.org/top/top.poland.html).

5.2. Educational activities

I have taught "Econometrics", "Financial Econometrics", "Financial Econometrics for PhD Students", "Econometric Nonlinear Models" at Warsaw School of Economics. I have also taught "Asset Pricing" and "Financial Contagion (for PhD students)" classes at the European University Viadrina in Frankfurt (Oder).

I am the author of the teaching programme for the "Econometric Nonlinear Models" class (teaching & student materials – lecture slides, computer programs, problems and literature are available at http://akson.sgh.waw.pl/~dserwa/emn.htm). I have been lecturing this class for about 10 years at Warsaw School of Economics.

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I have co-authored the programs for the following classes: "Financial Econometrics 1", "Financial Econometrics 2", "Financial Econometrics for PhD Students".

In the international educational programme, I have co-authored two lectures "Econometrics" and "Financial Econometrics" (teaching & student materials are available at http://akson.sgh.waw.pl/~dserwa/ex.htm and http://akson.sgh.waw.pl/~dserwa/fe.htm).

During the academic year 2010/2011, I have coordinated the "Econometrics" class for all lecturers at Warsaw School of Economics. I have also co-authored one chapter in the text book for our students of the "Econometrics" class (Rubaszek and Serwa, 2010). I have prepared one exercise class for the e-learning service www.e-sgh.pl.

I have been a thesis supervisor for six bachelor and two master's students at Warsaw School of Economics (information available at http://akson.sgh.waw.pl/~dserwa/nowe/dyplomy.html).

I have also prepared some students to conduct scientific research. For example, I have prepared a project to develop a statistical test for Markov switching models together with my former student. I also preparing a paper on pension fund investments together with my two former students. We have already presented our results during the seminar in the National Bank of Poland.

6. Literature cited in the report on scientific achievements

6.1. My publications in the journals currently listed in the JCR[6]

Rubaszek M., Serwa D. (2014) Determinants of credit to households: application of a life-cycle model, Economic systems, forthcoming. Earlier versions of the paper published as:

Rubaszek M., Serwa D. (2012) Determinants of credit to households in a life-cycle model, European Central Bank Working Paper 1420.

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Serwa D. (2013) Identifying multiple regimes in the model of credit to households, International Review of Economics and Finance 27, 198 – 208.

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[6] The journals "Economic Systems" and "Journal of International Financial Markets, Institutions and Money" entered the JCR list only in 2013. At the time when I wrote my earlier articles the JCR list was not as significant as it is today, especially in finance. The status of the publisher of the journal (here: Elsevier and Taylor & Francis) was much more important.

Serwa D. (2012) Banking crises and nonlinear linkages between credit and output, Applied Economics 44, 1025 – 1040.

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Białkowski J., Serwa D. (2005) Financial Contagion, Spillovers, and Causality in the Markov Switching Framework, Quantitative Finance 5, 123 – 131.

Serwa D., Bohl M. (2005) Financial Contagion and Resistance: Empirical Evidence on Emerging European Capital Markets, Economic Systems 29, 344 – 362.

6.2. My publications in well-known journals not listed in the JCR

Gębka B., Serwa D. (2007) Intra- and Inter-regional Spillovers between Emerging Capital Markets around the World, Research in International Business and Finance 21, 203 – 221.

Białkowski J., Bohl M., Serwa D. (2006) Testing for Financial Spillovers in Calm and Turbulent Periods, Quarterly Review of Economics and Finance 46, 2006, 397 – 412.

Serwa D. (2006) Do Emerging Financial Markets React to Monetary Policy Announcements? Evidence from Poland, Applied Financial Economics 16, 513 – 523.

Serwa D. (2013) Measuring non-performing loans during (and after) credit booms, Central European Journal of Economic Modelling and Econometrics 5, 163 – 183.

6.3. My other publications

Brzeszczyński J., Bohl M., Serwa D. (2012) Large capital inflows and stock returns in a thin market, National Bank of Poland Working Paper 120.

Domańska A., Serwa D. (2013a) Factors of the European economies' vulnerability to external shocks – an empirical analysis. The example of 2008–2009 crisis costs, International Journal of Management and Economics 40, 72 – 95.

Domańska A., Serwa D. (2013b) Vulnerability to foreign macroeconomic shocks - an empirical study in cross-industry perspective. Example of 2008-2009 global crisis in Europe, Folia Oeconomica Stetinensia 3, 150 – 173.

Domańska A., Serwa D. (2013c) Międzynarodowa transmisja szoków a podatność gospodarek krajów Europy na skutki globalnego kryzysu gospodarczego 2007-2009.

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Domańska A., Serwa D. (2014) Koszty kryzysu gospodarczego w Europie na tle innych regionów świata – analiza przekrojowa, Optimum Studia Ekonomiczne, in press.

Gębka B., Serwa D. (2012) Liquidity needs, private information, feedback trading: verifying motives to trade, National Bank of Poland Working Paper 199.

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