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Factors of the European economies' vulnerability to external shocks – an empirical analysis. The example of 2008–2009 crisis costs[1]

Abstract

The article analyses the factors determining the vulnerability of the European countries to external shocks taking the example of the global 2008–2009 economic slowdown (also called the *subprime* crisis[2]) and its impact on economies in Europe. The particular attention is attached to factors related to the fundamentals of the economy, i.e. the GDP growth, fiscal and monetary stability and external stability. Attempting to level off the gap existing in the Polish literature in the empirical research on that problem, the hereby article also refers to wider problems of the macroeconomic factors enhancing economies' capabilities to meet the challenges of global crises and strengthening their competitiveness afterwards. The special attention in the paper was attached to the role of financial and trade openness.

In the empirical study we have assessed the macroeconomic "costs" of the crisis in the European economies and then we have run the regression model process to estimate the factors determining the exposure to those costs in cross-country perspective. The above mentioned macroeconomic costs are the relative falls ("gaps") in GDP, i.e. the difference between the hypothetical GDP (resulting from the average mid-term trend) in 2008–2009 and actual GDP incurred in those two "crisis years". In the regression model (crisis costs as the explained variable) we used the chosen data and indicators denoting the potential factors of the European countries' exposure to 2007–2009 crisis shock as explanatory variables.

As the calculation results show, the variables that contributed to higher 2008–2009 crisis effects in the European countries were among others: high unemployment and

high real interest rates, considerable government sector debt before the crisis, high economic development level, high share of nonperforming credit portfolio and high share of equity in the banking sector's assets (signifying a relatively poorly developed banking system), as well as good quality of law. Greater costs of the 2007–2009 crisis were (on average) incurred by countries experiencing high inflation, rapid GDP growth (as compared to the other sample countries), and considerable share of investment in GDP before crisis, and the economies which were characterized by above-average industry concentration and high development of stock exchange and bank market. The study leads to a general conclusion that in case of the European countries, the recession only highlighted and enhanced many problems and unfavorable tendencies which had existed before.

Keywords: globalization, global crisis, international macroeconomic shocks
JEL: F15, F41, F62

Introduction

Nowadays, when globalization of the world economy is gathering pace dynamically, the issues of international transmission of economic shocks and mutual economic impact of countries and markets often located at far distances from each other constitute the area of interest for one of the major open-economy macroeconomics research trend. A new aspect of these issues arose after the phenomenon of transmitting economic impulses between most of the countries in the world, observed during the unprecedented range and strength of the recent global crisis (2008–2009). Reports and numerous analyses concerning the crisis effects (incl. World Economic Outlook, World Financial Stability Report, other reports and analyses from World Bank, IMF, OECD, etc.) indicate though that recession consequences in their broad sense (such as financial and real capital outflow, collapse of international trade, overall business slowdown etc.) influenced particular regions and countries to different extent. What are then the reasons for different levels of national economies' sensitivity (vulnerability, or as defined in literature – exposure) to the negative influences of the crisis and slowdowns originating abroad?

The abundant literature on the issue with numerous empirical studies presented by other researchers provided different and sometimes counteractive results. It can be thus concluded that the literature has not given so far one universal and comprehensive answer explaining what factors (among them those connected with the fundamentals, i.e. structural features of the economy) can be responsible for the specific vulnerability of the economies to the shocks coming from the rest of the world. That is why it is worth to analyze this important issue in the context of the recent global crisis, especially

considering its vital importance for the Polish economy in Europe. To the authors' knowledge this issue has not been studied empirically in the Polish literature, what gives another reason to take and advance the problem in this article.

In line with the properties of international transmission mechanisms as regards negative shocks, a recession spreads from the financial to real economy and attacks subsequent groups of key economic equities, what results in worsening the situation on all mutually tied markets and sectors and deteriorating the overall stability of the economies touched by crisis. Hence, a substantial literature focuses on the country-specific vulnerabilities to transmission mechanisms (especially negative ones) in the context of the country-specific features, so called fundamentals, i.e. some general categories reflecting the economies' performance such as, e.g., the economy size, domestic demand stability, fiscal stability, international competitiveness and country's general significance in the global economy, trade and financial account balance, external debt level, banking system stability, etc. It is also worth to note that, as can be concluded from the overview of the literature, the studies focusing on economies' fundamentals as determining the exposure to international shocks (global or regional) often examine the factors (indicators) related to the internal stability (manifested mainly by budget balance and public debt level), together with the indicators of the external stability (like balance of payments, external debt level, exchange rate fluctuations, foreign reserves, etc.) [See Domańska, 2011a, Domańska, Serwa 2013].

Considering all the above, the herewith article analyses the factors determining the vulnerability of the European economies to the effects of the global economic slowdown also called the *subprime* crisis, noted since mid 2007 with particular attention to the factors related to the fundamentals of the economy, i.e. the GDP growth, fiscal and monetary stability and external stability. The selected macroeconomic indicators are used to denote the level of the macroeconomic stability and its general performance before the strike of the crisis (marking the "entry" situation of the analyzed economies, i.e. at the very beginning of the crisis). The study presented herein attempts to define to what extent the considered macroeconomic fundamental features of the analyzed European countries caused lower or higher exposure of their economies to the 2008–2009 world economic slowdown.

That is why the hereby article is an attempt to level off the gap existing in the Polish literature in the empirical research on that problem. Moreover, it refers to wider problem of the macroeconomic country-specific factors enhancing economies' capability to meet the challenges of global recessions at all and strengthening their competitiveness afterwards. Thus, the article is a contribution to potential further discussion on the determinants of countries' exposure to the global slowdowns' effects in general.

1. The article advances the following arguments concerning the tackled issue.The financial and trade openness of the European countries contribution to strengthening the negative consequences of the 2007–2009 crisis.

2. The weak stability of the European economies observed before the crisis struck as another important factor which deepened the general economic slowdown during the crisis period.

The paper consists of two parts: a theoretical and empirical one. The first part comprises a literature review and provides the most significant postulates of other authors as regards the title issues. Several specifications of the general model presented in the methodology description were estimated in the second, i.e. empirical part.

The literature review

According to Ch. Rosenberg et al. [2005, pp. 4–6], the real economy shocks are especially dangerous if they accompany high vulnerability of the financial economy. It is because production collapse is usually strongly correlated with a reduction of access to financial market (loans, etc.). Thus, internal (state budget) and external stability make the economy resistant to shocks, both those resulting from turbulences and collapses in the international financial markets and those coming out of the real economy (e.g. decrease in the world demand). Hence, two kinds of balance determine the economy's resistance to crises jointly and, e.g., budget instability should not arouse anxiety as long as the good condition of the balance of payments is sustained. The countries suffering from the instability of public finances combined with the bad situation in the balance of payments are exposed to sudden capital outflows or other consequences of changes in market equities' confidence. So it should be stated that crisis episodes and recessions in general reveals weak fundamentals of a particular economy because players take their decisions basing on some selected indicators which may not give a perfect picture of the country's real vulnerability to a crisis or a longer-lasting recession [Calvo, 2000; Rosenberg et al., 2005].

The review of approaches and methods applied in literature [Domańska, 2011a, Domańska 2011b, Domańska and Serwa 2013] focus on linkages between turbulence and downturns in international financial markets and the aforementioned structural characteristics of economies. So we can draw the conclusion that factors "originating" in the real and in the financial economy should be treated and analyzed together. That is why, basing on the approach presented in the literature, in the herein article we analyze the factors concerning both real and financial economy, as well as concerning both internal and external stability put in the cross-country analysis. Thus, the following potential determinants of the European countries' exposure to 2007–2009 crisis shock were taken into consideration, among others economic development before crisis, financial system quality, the economy's trade and financial openness, diversification of the economy's sectors, legal system quality, financial system stability and resistance, stability of the government sector, propensity to invest by the private sector, inflation and unemployment level before the crisis, etc.

Macroeconomics of the open economies became interested in the determinants of national economies' exposure to external influences a relatively short time ago: empirical research on the matter flourished mainly in the 1990s and later on. Many studies focus on general factors of countries' vulnerability to global shocks in the broad sense (more detailed analyses concentrate on vulnerability factors of particular sectors/industries, i.e. studies the problem in the cross-sectional or cross-industry perspective). In their empirical research on fundamentals in the context of countries' exposure to external shocks, the authors consider different "categories" (e.g. regional and global crises) such as: the income of the economy, the economy's sector and branch structure, production specialization vs. diversification level, monetary and fiscal policy, income distribution, financial and trade openness, propensity to invest/consume, strength of the domestic market, general stability of the economy, quality of institutions, etc.

Selected studies are worth quoting here, with a special focus on what categories (usually presented dynamically as tendencies of changes) are treated empirically as factors of vulnerability (variables in the models). L. Goldberg [1996, pp. 413–430] for example in his research, considered aggregate credit in the internal market, foreign exchange rate volatility, relative prices, the level of external credit and money demand as factors of fundamental vulnerability to crisis attack. C. Pazarbasioglu and I. Otker [1997, pp. 837–845] focused on the real income growth rate, domestic credit creation, real exchange rate, foreign exchange reserves, indicators of expansive fiscal and monetary policy, and in their further studies they added information on budget deficits and unemployment rate. In his analysis of Brazil's vulnerability to currency crisis, O.F. Saquib [1999, pp. 193–206] referred to the data on government expenditure, foreign reserves, real exchange rate, net export dynamics and he added variables describing the political scene.

Parallel to the aforementioned studies, a new current in the literature was initiated by the research of J. Frankel and A.K. Rose [1996, pp. 351–366], who introduced so called "new generation models" based on general equilibrium approach and concentrated on mutual relations within multiple-equilibrium. In their analysis of a sample of over 100 countries in the period between 1971 and 1992, the authors utilized a number of statistical data on public debt structure broken down by entities public sector, private sector and banks, variables defining the external situation, that is the relation of foreign exchange reserves to imports, external debt, current account balance, real foreign exchange rate as well as variables concerning domestic budget balance, dynamics of domestic credit growth and real income *per capita*, etc. M. Klein and N. Marion [1997] listed the level of the economies' openness and trade geographic concentration (as well as variables characterizing political situation) among structural factors defining proneness to a crisis. Whereas G. Kaminsky, S. Linzodo and C. Reinhard [1998] focused on the information concerning foreign exchange reserves, domestic credit dynamics, inflation rate, budget deficit and public sector debt as well as balance of trade.

Studies from the 1970s and 1980s, e.g. Krugman's [Krugman, 1979, pp. 311–325] or R. Flood and P. Garber's [Flood, Garber, 1984, pp. 1–13] already proved that crises and especially the collapse of fixed exchange rate regimes are mainly related to inadequate monetary policy and fiscal policy, notably budget deficit monetization and loss of foreign exchange reserves. The early literature on the subject states that directly before a crisis, there are often substantial fiscal weaknesses (considerable budget deficits and high public debt) which burden the financial balance of the economy (as well as the external one, which creates pressure, e.g., on the change in exchange rate). As emphasized by S.U. Khan and O.F. Saquib [2008], despite certain differences in the attitude and a variety of models applied by different authors to research on crisis exposure determinants, all of them, in fact, refer to reasons underlying fundamentals (i.e. structural features) of the economies (fundamentals-driven crisis).

Other authors who tackled factors of economies' vulnerability to external shocks include: S. Edwards [1998], J. di Giovanni and A.A. Levchenko et al. [2008], C. Raddatz [2007], D. Rodrik [2007], C. Calderon et al. [2005], C. Artreta et al. [2001]. The studies on trade openness influence on output and income include: e.g. D.A. Irvin and M. Tervio [2002], M.A. Kose et al. [2002], D. Ben-David [1993], T. Brodzicki [2006]. The issue of how liberalization in regard to capital markets and financial openness influences economic growth and business cycles was examined, i.a., by H.J. Edison et al. [2002], M.A. Kose [2002], A. Razin and Y. Rubinstein [2004], as well as G. Bekaert et al. [2004]. Other shock factors were analyzed by, e.g., Mendoza [1991], S. Schmidt-Grohe [1998] or A. Malik and J. Temple [2006]. Whereas terms of trade in the context considered herein were addressed by, e.g., R. Hausman and M. Gavin [1996] and later by C. Broda [2004].

Models applied in empirical research (presented by the aforementioned and other authors) are to describe quantitatively the dependency of business cycles (in most cases, defined by changes or fluctuations of GDP, GDP *per capita,* etc.) in the analyzed countries on their economies' features (which are explanatory variables of the models). However, in some cases data representing external shocks are explanatory variables whereas macroeconomic indicators (features or economies' endogenous conditions) become control variables.

Outcomes of various analyses on the subject, especially those based on different specifications of regression models, contribute to a typical literature discussion on technical and factual aspects of the estimation process. The discussion focuses on justifiability of applying particular categories and macroeconomic factors as explanatory variables, dependency of quality of results on the parameters used in the models, sample selection (data broken down by countries, chosen groups of countries, types, e.g. divided into developed, developing and emerging markets, etc.). Depending on analysis assumptions, statistical data of different aggregation levels in international statistics, e.g. country-level, regional-level, industry level (i.e. broken down by industry branches such as ISIC two-digit, four-digit classification, data aggregated at the level of product, etc.)

may be also used. The authors dispute about the selection of desirable control variables, the fact of existing additional (imperceptible in certain model specifications) so called country-specific conditions that may influence estimation outcomes, and especially about the existence of hidden correlations or autocorrelations that may undermine the appropriateness of estimation results. The most often used categories (indicators) denoting particular specific determinants include: the level of income at the beginning of the period (or some average quantities describing the economy development long-term tendencies), data referring to human and real capital accumulation (e.g. investment value in relation to GDP), an average period of education, reflecting the society education level and quality of human capital, data concerning the internal market and demand dynamics, income distribution (significant due to the fact that, as it was proved, the poorest households are the most affected ones by the national income slowdowns). The control variables used in models include also various indicators of the main balance sheets reflecting the macroeconomic internal and external stability (budget balance, current account balance, the level of foreign exchange reserves, the level of assets, international investment position, etc.) as well as fiscal and monetary policy (government expenditure, public debt level, monetary base, central bank interest rates – their average level or fluctuations, etc.) in a form that shows the state of /change in their values, fluctuations (e.g. variance, standard deviation) [see in Domańska, 2011a, Domańska 2011b, Domańska and Serwa 2013] some variables is another often mentioned problem.

Basing on the overview of the literature we can conclude that while the researchers generally agree that the very mechanisms of crisis extension in general depend on specific country features (group of countries, regional integration group, etc.), the studies differ in assessing the role (and even the impact direction) of those features (as factors) in creating countries' vulnerability to external shocks. Thus the results concerning such factors (variables in estimated models) as the economy size and its significance in the global economic turnover, income level, unemployment and inflation, specialization versus diversification of domestic production and trade, level of the financial stability, fiscal policy (defined by internal, public debt or external debt level), monetary policy (interest rate level, capital turnover liberalization, etc.) are diverse. This proves that despite relatively numerous studies on the subject and a variety of attitudes presented (especially in terms of research methodology), there are no unequivocal, "absolute" outcomes concerning the set of factors significant to creating countries' vulnerability to external shocks (and even directions of their impact on this vulnerability). Thus transmission of impulses and the economies' exposure to a crisis should be analyzed each time in relation to a certain group of countries and a given economic situation, which makes the analysis presented herein additionally justified[3].

Moreover, as can be concluded from the above presented literature's review, numerous studies focus on vulnerability to transmission mechanisms (especially negative ones) in the context of the country-specific features, so called "fundamentals", and in search

for the importance of those fundamentals in determining the exposure to international shocks they often examines the indicators of internal and external stability together. That is why the authors of the hereby article took the same approach. Namely, we have used many factors in our analysis combining them in extended regression models. Among the indicators potentially explaining the macroeconomic vulnerability of analyzed countries to the global crisis consequences (understood here as "our" crisis costs) we used (in the cross-country regression): the average economic growth before the crisis, financial system openness, trade openness, level of diversification vs. specialization of the economy (sectors), legal system quality, financial system stability, government sector liquidity and stability, propensity to invest in the private sector, inflation and unemployment level before the crisis and other indicators (see below).

The special attention in this article was attached to the role of financial and trade openness since the openness itself plays an ambiguous and multifaceted role in the problem tackled here. Openness is connected not only to the simple relation of particular producers and whole industries to the volatile demand in foreign markets. Tight international linkages additionally loosen particular industries' relations to the rest of the national economy and change the features of the common course of highly international branches or industries' output fluctuations and country's business cycle[4]. International trade can provide some buffer against the fall in demand on the national markets since it helps to redirect the sales from the national to the foreign markets. On the other hand it may contribute to deepening the problems of the economy when also foreign markets suffer from the collapse. Taking into account the dubious role of openness as a determinant of economies' reactions to a global shock as well as different (often even contradictory) research results (broken down into various groups and periods), the general influence of this factor on GDP level and fluctuations remains an open empirical question, which should be answered here in the context of 2008–2009 crisis in Europe.

Research methodology and data

The empirical analysis of particular European economies' sensitivity to the world economic slowdown in 2007–2009 presented herein is divided into two parts. In the first one we calculate the level of macroeconomic costs[5] incurred by particular countries during 2008–2009 crisis. In the second one, we use a regression model to detect how strongly the given factors (among them the *fundamental* ones) affected the macroeconomic costs in Europe in the cross-country perspective.

To accomplish the analysis there were the data from IMF World Economic Outlook (WEO) and International Financial Statistics (IFS) as well as from the UNCTAD databases, gathered and aggregated. The data concerning fundamental variables, i.e. on GDP, unemployment, inflation and debt come from WEO databases, the data on

financial variables and capital markets used for accounting the capitalization, data on interest rate and credit originate mainly from IFS statistics. The rest of the data, i.e. those used for accounting openness and concentration index come from UNCTAD 2-digit level database since they are aggregated in cross-sectional and in cross-country perspective (37 industries for all European countries except from Moldova, Belarus, and Montenegro due to the lack of comparable data).

Crisis costs in Europe and in the rest of the world

Macroeconomic costs of the global financial crisis are estimated with the use of data on gross domestic product's rate of decrease (in the real terms) compared to the average GDP growth rate from the period before crisis. To be more precise, so called crisis "costs" were calculated by means of two methods and in both of them the "loss" or "gap" in the GDP due to the crisis is, most simply saying, the difference between the economic growth during the slowdown and the hypothetical one (i.e. the growth that could have been achieved if the crisis had not struck)[6]. According to the first method (that is *cost 1*, the results presented in table 1), a theoretical income level (or other variable level) was calculated for each of the years: 2008 and 2009 by multiplying the real production in 2007 and 2008 respectively by an average annual growth from the last 10 years.

In line with Domańska and Serwa [2013] a theoretical long-term production level was calculated by means of the following equation:

$$Y_{it}^{*} = \begin{cases} Y_{it} & \text{dla } t < 2008 \\ Y_{it}^{*} = \left(\dfrac{Y_{i,\,2007}}{Y_{i,\,1998}} \right)^{\frac{1}{10}} & \text{dla } t < 2008. \end{cases}$$

The cost of crisis is a percentage deviation of theoretical production, calculated as it was presented above, from the real production in 2008 and 2009 respectively, and the accumulated cost is the sum of costs for those two years.

To calculate production decrease in country *i,* the output (or other variable) Y_{it} in country i in period t of the crisis was compared to the theoretical production level Y_{it}^{*} computed on the basis of a long-term production tendency before crisis; the calculation was made by means of the following formula (production decrease is measured in a percentage terms):

$$\Delta y_{it} = \frac{Y_{it} - Y_{it}^{*}}{Y_{it}^{*}} \cdot 100\%. \qquad \text{for } t = 2008, 2009.$$

The production decrease accumulated within the whole crisis period was calculated by adding up the decreases from subsequent periods of the crisis. For example the accumulated decrease of production in the economy's branch i in 2008 and 2009 amounts to:

$$S_i = \sum_{t=2009}^{2009} \Delta y_{it}.$$

In the second method, the theoretical level (marked as *cost 2*, table 2) of production (or any other variable, notably: consumption level, government expenditure) for the year 2008 was calculated in the same way as in method 1; however, the values for 2009 were obtained by multiplying the theoretical production (and not the real one as in method 1) in 2008. As it was in method 1, the crisis cost for 2008 is a percentage deviation of theoretical production from the real production in 2008. Whereas the crisis cost for 2008–2009 is a percentage deviation of theoretical production in 2009 from the real production in 2009, which is an accumulated deviation for two years. The crisis costs calculated according to both methods are very similar. On the basis of the above described methods we estimated the crisis costs using the data on GDP *per capita* for Europe (and EU) and compared them with the results for another regional economies (i.e. South America, South-East Asia, Central America) and the countries important for the global economy (USA, China and Japan). The aim of this study was to show the performance of the European economy in the wider context of another region's (and countries' economies) situation in times of the global downturn.

Factors of vulnerability to the crisis shock

After calculating the crisis costs, in the second part of the empirical research we use the regression model to explain the influence of the chosen macroeconomic factors (mainly those connected with the *fundamentals*) on crisis costs in Europe calculated above (as reflecting the downturns in the economic growth). In these estimations we refer only to Europe, according to the problem stated in the title. In this way, we estimate, using great variety of measures and indicators, the factors of the vulnerability of the economies to the crisis shocks.

The following measures were used as potential explanatory variables: average economic growth before the crisis, financial system openness, trade openness, level of diversification vs. specialization of the economy (sectors), legal system quality, financial system stability, government sector liquidity and stability, propensity to invest in the private sector, inflation and unemployment level before the crisis and other.

As presented in Domańska and Serwa [2013], the regression model explaining crisis macroeconomic costs is as follows:

$$cost_{i,j} = \alpha_0 + \alpha_1 unemployment_j + \alpha_2 investments_j + \alpha_3 debt_j + \alpha_4 inflation_j + \\ + \alpha_5 concentration_j + \alpha_6 openness_j + \alpha_7 development_j + \alpha_8 capitalization_j + \alpha_9 NPL_j + \\ + \alpha_{10}(cap/ass)_j + \alpha_{11} percentage_j + \alpha_{12} credit_j + \alpha_{13} law_j + \alpha_{14} growth_j + \varepsilon_j,$$

where:

- (the explained) variable *cost* denotes the crisis macroeconomic costs (measured with the method presented above),
- index $i = 1, 2$ represents the method of calculating costs, index $j = 1, 2, ..., N$ denotes a country number,

– variable *unemployment* measures unemployment level (percentage of the whole labor force) before the crisis started, variable *investments* denotes investment level in relation to GDP, *debt* denotes the level of state government and local government sector debt in relation to GDP, *inflation* measures inflation level, *concentration* measures the concentration level of the economy's sectors, *openness* measures the economy's openness by means of the relation of aggregate exports and imports to GDP, variable *development* represents economic development level measured as GDP *per capita* in USD, variable *capitalization* denotes the capitalization level of companies listed in a particular country in relation to GDP, *NPL* measures the share of nonperforming loans in banking sector, variable (*cap*/*ass*) measures the financial leverage of banks, that is the relation of banks' equity to their assets, variable *interest rates* denotes the level of market interest rates, *credit* is the level of banking sector development as the relation of bank loans to GDP, variable *law* measures the quality of business law according to the World Bank indicator, whereas variable *growth* measures the economic growth rate. The random component was marked as ε. All explanatory variables are measured for the year preceding the start of the global financial crisis, whereas crisis costs are measured for the years 2008–2009.

The following methods were used to select explanatory variables for the model. General-to-specific approach was applied firstly, which means that the least statistically significant explanatory variables were removed at subsequent stages. Only statistically significant variables and the variable measuring the economy's openness as well as the absolute term were included in the model. The algorithm used for selecting model specifications is not perfect for at least two reasons. Firstly, while eliminating subsequent insignificant variables from the model, it is possible to omit specifications which best describe the selected dependent variable. Secondly, probably each proposed model specification is only an approximation of the "real" relationship between the financial crisis costs and the examined economic factors. In such a situation, it is better to take into account the results from good enough multiple models than to select a single model.

Therefore, models in which the values of Akaike, Schwarz and Mallows' information criteria are the lowest were selected as alternative model specifications. Additionally, three methods of averaging models were applied and average estimates of parameters defined after all the combinations of variables used in these models were taken into account. As the potential influence of the economy's openness on the cost level of 2008–2009 financial crisis is the most significant element in the study, the distribution of parameter estimates for the variable measuring the economy's openness was also tested for all the possible model specifications.

Empirical research results

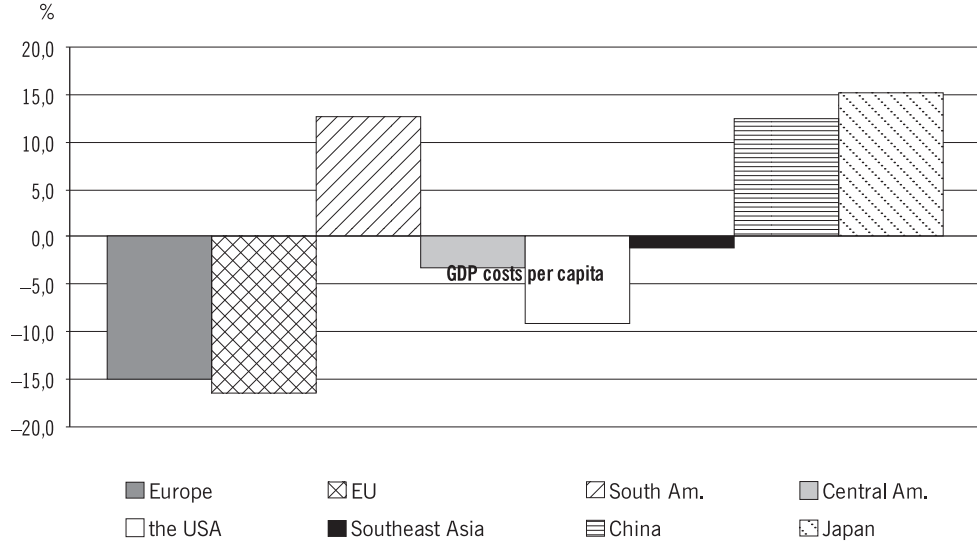
As regards the crisis costs, the authors focused on the general distribution of these costs in the global economy by comparing the data for Europe and other regions of the world. Secondly, the authors calculated costs for international trade net exports and compared them between groups of countries (in EU and Europe versus the rest of the world). Special attention was given to the declines in foreign trade. This preliminary analysis covers 81 developed and developing countries. Data concerning GDP and GDP *per capita* was gathered and costs were estimated in line with the methods presented above for all the 81 countries from the given regions and for individual countries (i.e. those having the special importance for the world economy). Subsequently the results were aggregated for the world regions. Due to the size of this study, detailed results for all the analyzed countries will not be presented herein. Only the results for Europe and other regions with indicating the most important conclusions in the context of further research stages will be charted and discussed.

As the cost comparison revealed, the European countries as a group incurred on average higher costs (calculated as GDP and GDP *per capita*) than the countries from outside Europe. For example, accumulated growth deviation from the growth rate obtained on the basis of the long-term development tendency accounted for 20% for Argentina, about 20% for Bolivia, 7% for Brazil, almost 12.5% for China, 9.2% for India, 11% for Indonesia, about 15% for Japan. On the other hand, only three European countries did not bear costs of the crisis, notably Switzerland, Moldova and the former Yugoslavia (i.e. Serbia and Montenegro). The rest of the countries incurred costs with the deviation values starting over ten per cent and finishing at -62% in Iceland's economy (-38% in Estonia).

Chart 1 presents costs for Europe in comparison to other world regions. Average costs of GDP *per capita* for Europe and EU were collated here with the results for South America, Central America, the USA, Southeast Asia (calculated as averages out of the data for appropriate countries) as well as for China and Japan separately. The chart shows that the negative GDP deviation during the crisis from 10 years' tendency was especially high in Europe (including EU). On average, it amounted to -16.6% for EU member states whereas it was positive for South America (12.6%), negative for the USA (-9.3%), slightly negative for Southeast Asia (-1.2%) and positive for China and Japan (12.4% and 15.2% respectively).

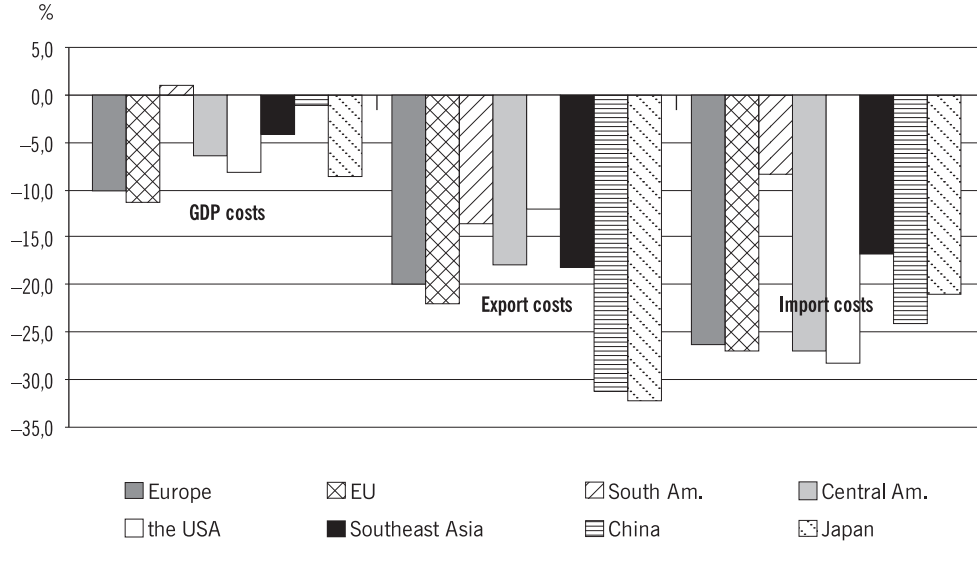
As regards the results for individual GDP elements, the general outcomes indicate that the greatest costs in the whole world economy were registered in relation to net exports. The whole foreign trade dropped sharply in 2008–2009. All world regions were affected by the decrease of exports and imports and in this respect the differences between Europe and the rest of the world were less significant. Chart 2 presents costs of GDP, exports and imports for Europe and other regions (accumulated value for

CHART 1. **GDP costs *per capita*: Europe versus other world regions**



S o u r c e: own elaboration.

CHART 2. **The costs of GDP, exports and imports for Europe in comparison to other world regions**



S o u r c e: own elaboration.

2008–2009 calculated in line with method 1). GDP deviation appeared to be positive only in the countries of South America (1.14%), slightly negative in China and Southeast Asia. For a change, the declines in foreign trade were especially significant for China and Southeast Asia. The decrease in exports was due to the lower demand of purchasers – the western countries: imports dropped considerably especially in Europe, with the deviation of below -26%. The lowest foreign trade costs were also incurred by South America. The comparison of Europe with the USA reveals that the crisis effects were greater in Europe than in the USA as regards costs of both GDP and exports (GDP costs in the USA: -8%, in EU: -11.5%, costs of exports: -12.3% and -22% respectively). The results indicate that decrease determinants with reference to exports will be worth looking into more deeply at further stages.

The substantial part of the research, presented below, consists of the results of the regression model which defines the level of crisis costs with reference to particular macroeconomic factors, taken into account herein because they were considered to be significant based on the literature review. The regression results follow discussion in Domańska and Serwa [2013].

The first observation concerns the correlations among the variables. The calculations showed mainly that some explanatory variables are strongly correlated with each other – suggesting the existence of multicollinearity – and that is why the regressions utilize those variables interchangeably.

For example:

- the inflation in 2007 was strongly positively correlated with the level of investment,
- the state government and local government sector debt was negatively correlated with the economic growth in 2007,
- the capitalization of listed companies in relation to GDP was strongly positively correlated with the level of economic development (GDP *per capita*) and with the level of credit in the economy,
- there is a strong positive dependency between the shares of nonperforming loans in total credit portfolio and the relation of banks' equity to their assets and unemployment level, as well as a negative dependency between nonperforming loans and the amount of total credit portfolio, and the economic development level.

Table 1 presents estimation results for different specifications of the 2008 and 2009 financial crisis cost model for the explained variable $cost_1$, as caltulated in Domańska and Serwa [2013]. In the first model, which contains all the explained variables ("big model"), it was examined how particular economic factors in individual countries before crisis contributed to the crisis in those countries. In this model, the variables that contributed to the deepening the crisis consequences (i.e. higher crisis costs) scale included: high unemployment and high real interest rates, high government sector debt before the crisis, high economic development level, high share of nonperforming loans and high share of equity in the banking sector's assets

TABLE 1. Estimations of the parameters in the 2008–2009 crisis costs' models (explained

	Constant	Unemployment	Investment	Debt	Inflation	Concentration
Big model	1,957	-0,118	0,356	-0,006	1,172	31,942
	(18,271)	(0,278)	(0,385)	(0,086)	(0,660)	(30,846)
Small model	-5,127		0,532		1,150	33,559
	(5,778)		(0,214)		(0,506)	(19,577)
Optimal AIC	4,563				2,026	
	(3,050)				(0,368)	
Optimal BIC	4,563				2,026	
	(3,050)				(0,368)	
Optimal MIC	4,563				2,026	
	(3,050)				(0,368)	
Averaged	1,504	-0,025	0,083	-0,001	1,810	0,262
BMA[1]	(6,689)	(0,102)	(0,243)	(0,010)	(0,679)	(3,713)
Averaged	1,002	-0,050	0,184	-0,003	1,652	3,402
BMA[5]	(8,401)	(0,141)	(0,293)	(0,022)	(0,694)	(12,429)
Average AIC	0,215	-0,093	0,251	-0,009	1,293	6,605
Average BIC	0,272	-0,098	0,261	-0,010	1,284	8,061

Notes: standard errors of estimations were presented in brackets. The "big model" is a model with all explanatory variables, "optimal BIC" and "optimal MIC" are models that are optimal as regards the value of information criteria of Akaike, Schwarz all possible combinations of explanatory variables (the number of combinations is 2^{14}=16384). In case of "averaged BMA[1]" al., pp. 25–58] was applied for classic estimations with the assumption that the *a priori* expected number of parameters in the by means of weights calculated on the basis of Akaike and Schwarz's information criteria was used. (cf. Hansen, 2007).

S o u r c e: own elaboration presented in Domańska and Serwa [2013].

variable: *costs*$_1$)

Openness	Development	Capitalization	NPL	Cap/ass	Interest rate	Credit	Law	Growth
0,994	-0,017	0,000	-0,466	-0,584	-0,605	0,001	-0,372	0,191
(2,804)	(0,095)	(0,028)	(1,035)	(0,714)	(0,356)	(0,033)	(0,773)	(0,741)
1,419				-0,893	-0,662			
(1,864)				(0,305)	(0,284)			
1,506			-1,372					
(2,007)			(0,439)					
1,506			-1,372					
(2,007)			(0,439)					
1,506			-1,372					
(2,007)			(0,439)					
2,023	0,001	0,000	-0,606	-0,080	-0,045	0,001	-0,004	0,008
(2,197)	(0,011)	(0,002)	(0,740)	(0,270)	(0,184)	(0,005)	(0,085)	(0,096)
1,642	0,002	0,000	-0,711	-0,191	-0,177	0,002	-0,035	0,052
(2,148)	(0,023)	(0,006)	(0,746)	(0,401)	(0,317)	(0,010)	(0,227)	(0,240)
1,641	0,002	-0,001	-0,467	-0,197	-0,278	0,004	-0,068	0,105
1,567	0,002	-0,002	-0,481	-0,220	-0,308	0,004	-0,085	0,118

the "small model" is a model with explanatory variables selected by means of "general-to-specific" algorithm; "optimal AIC", and Mallows respectively. "Averaged (...)" correspond to models built as weighted averages of a group of linear models with and "averaged BMA[5]", the Bayesian Model Averaging method [Sala-i-Martin X. et al., 2004, pp. 813–835], [M. Próchniak et model amounts to one and five respectively. In case of "averaged AIC" and "averaged BIC", a method of averaging estimations

TABLE 2. Estimations of the parameters in the 2008–2009 crisis costs' models (explained

	Constant	Unemployment	Investment	Debt	Inflation	Concentration
Big model	4,383	-0,141	0,286	-0,009	1,135	29,846
	(17,159)	(0,261)	(0,362)	(0,081)	(0,620)	(28,969)
Small model	-4,244		0,483		1,122	30,434
	(5,461)		(0,202)		(0,478)	(18,502)
Optimal AIC	4,572				1,905	
	(2,844)				(0,344)	
Optimal BIC	4,572				1,905	
	(2,844)				(0,344)	
Optimal MIC	4,572				1,905	
	(2,844)				(0,344)	
Averaged	2,035	-0,027	0,062	-0,001	1,739	0,203
BMA[1]	(5,847)	(0,102)	(0,203)	(0,010)	(0,594)	(3,180)
Averaged	1,943	-0,054	0,142	-0,003	1,617	2,536
BMA[5]	(7,466)	(0,140)	(0,252)	(0,021)	(0,607)	(10,420)
Averaged AIC	1,117	-0,095	0,213	-0,009	1,264	5,707
Averaged BIC	1,239	-0,100	0,221	-0,009	1,256	6,991

Remarks: see Tab. 1.

S o u r c e: own elaboration presented in Domańska and Serwa [2013].

variable: *costs*$_2$)

Openness	Development	Capitalization	NPL	Cap/ass	Interest rate	Credit	Law	Growth
0,783	-0,020	0,001	-0,454	-0,541	-0,531	-0,002	-0,421	0,221
(2,634)	(0,089)	(0,026)	(0,972)	(0,671)	(0,334)	(0,031)	(0,726)	(0,696)
1,363				-0,829	-0,592			
(1,762)				(0,288)	(0,269)			
1,428			-1,277					
(1,871)			(0,410)					
1,428			-1,277					
(1,871)			(0,410)					
1,428			-1,277					
(1,871)			(0,410)					
1,900	0,001	0,000	-0,570	-0,073	-0,031	0,000	-0,005	0,008
(2,046)	(0,010)	(0,002)	(0,690)	(0,248)	(0,148)	(0,004)	(0,083)	(0,093)
1,534	0,001	0,000	-0,685	-0,167	-0,131	0,001	-0,040	0,056
(2,010)	(0,021)	(0,005)	(0,699)	(0,367)	(0,265)	(0,008)	(0,224)	(0,235)
1,524	0,001	-0,001	-0,443	-0,181	-0,233	0,003	-0,076	0,109
1,448	0,001	-0,001	-0,457	-0,200	-0,258	0,003	-0,095	0,124

(signifying a relatively poorly developed banking system), as well as good quality of law. In the big model, the parameter for unemployment variable amounted to -0.118, (signifying a relatively poorly developed banking system), as well as good quality of law. In the big model, the parameter for unemployment variable amounted to -0.118, 0.356 for investment, 1.177 for inflation and 31.942 for concentration indicator, with the costs calculated according to method 1. It is worth noting that greater crisis costs were incurred by countries which experienced high inflation, rapid GDP growth and considerable share of investment in GDP before crisis, and when the economy was characterized by above-average industry concentration and high development of stock exchange and bank market. The economies which were more open before crisis incurred on average higher costs of crisis.

It must be borne in mind that hardly any of the estimated parameters in the first model is statistically significantly different from zero, which might indicate a poor model adjustment to the data. This is due to high correlations between individual explanatory variables in the model. While the "small model" with a limited number of explanatory variables was created by means of general-to-specific algorithm of selecting an optimal model specification, then the impact direction of particular economic indicators on crisis costs is identical to the one obtained in the "big model". Most explanatory variables are statistically significant, but the parameter for the variable measuring the economy's openness is not significantly different from zero. This may signify that openness of individual economies was not a significant factor contributing to the scale of crisis costs.

Similar outcomes were obtained by means of optimal model selection methods utilizing estimation of Akaike, Schwarz and Mallows' information criteria. These methods of selecting an appropriate model specification are preferred by most authors because they allow to choose models bearing the most information while consisting of a moderate number of explanatory variables. Here, it turns out that the inflation level and the share of nonperforming loans in banking sector had a decisive effect on the scale of crises in the European countries. Again, the positive influence of the economy's openness is not statistically significant.

Finally, methods of averaging parameter estimates were applied on the basis of numerous model specifications. Such approach to model analysis is becoming more and more popular in the econometric literature as it allows to take into account the risk related to optimal model selection [Sala-i-Martin et al., 2004], [Próchniak et al., 2012]. A single model may not explain the analyzed phenomenon appropriately (e.g. precisely), but a combination of multiple models allows to limit the risk of selecting unsuitable model and to avoid a variables selection bias as well so it raises the goodness of estimates.

Most variables in the averaged estimates of the crisis cost model influence the dependent variables in a similar way as in the "big model". The variables "economic development" and „capitalization" are exceptions: their parameters in different specifications are of positive and negative values.

Analogical outcomes were obtained during the analysis of the second potential variable measuring the scale of crisis, that was the variable $costs_2$. The results were presented in Table 2 in line with Domańska and Serwa [2013]. Since both explanatory variables measuring crisis costs are almost perfectly correlated, the results in Table 2 differ from those in Table 1 only in parameter values – the signs of corresponding variables remain the same (with the exception of one case). For example, for the variable *unemployment*, the parameter amounted to -0.141, for the var. *investments*: 0.286, *debt*: -0.009, *inflation*: 1.135, *concentration*: 29.846, *openness:* 0.78, *economic development*: -0,02, and *capitalization*: 0.001 (averaged values are respectively as follows: 2.035, -0.027, 0.062, -0.001, 1.739, 0.203, 1.9 and 0.001).

Summary and suggestions as to the future research

As indicated in the literature, a number of macroeconomic factors determine the differences in vulnerability to economic crises. Those factors include: the situation in internal markets (demand), general GDP growth rate before crisis, the level of internal stability (budget deficit and public debt level) and external stability (trade balance, external debt, international investment position, foreign reserves) of the economies. As a rule, countries and world regions whose weaknesses include low domestic demand dynamics, considerable imbalances and deficits, weak bank system and legal system, etc. are less resistant to a downturn, but the pace of their recovery is also much slower.

Referring to the results of the empirical study presented in this article, the impact directions of particular variables seem to correspond to the intuitive understanding of how a crisis is deepening and are consistent with the results obtained by another authors.

As the calculation results show, the variables that contributed to 2007–2009 crisis effects in the European countries were among others: high unemployment and high real interest rates, considerable government sector debt before the crisis, high economic development level, high share of nonperforming credit portfolio and high share of equity in the banking sector's assets (signifying a relatively poorly developed banking system), as well as good quality of law. Greater costs of crisis were (on average) incurred by countries which experienced high inflation, rapid GDP growth (as compared to the other sample countries) and considerable share of investment in GDP before crisis, and the economies which were characterized by above-average industry concentration and high development of stock exchange and bank market. These outcomes correspond to the economic intuition and the findings of analysis performed by other authors. Higher unemployment and inflation rates show the economy's weakness and high interest rates, constraining economic activity and slowing down the pace of growth make the European countries relatively prone to the negative influence of an economic downturn in the rest of the world in 2008–2009 period. Developed bank and stock exchange systems, being more

open to international flow of capital, were significant crisis transmission channels in the examined countries (the conclusion corresponds to the research results obtained by other authors). Similarly, as the computations herein showed, a relatively higher vulnerability to a crisis is related to weak bank and legal systems. The European countries in which the growth rate was relatively fast (in comparison to others) experienced a sharper drop of it. It is worth noting that considerable industrial concentration (poor branch diversification of production) had an overwhelming negative impact on the economy's resistance to a crisis shock. As regards the economies' openness, a slightly positive influence of this factor on the increase of crisis costs was observed (the fact is that the parameter for the variable "the economy's openness" is positive regardless of a model specification).

The study leads to a general conclusion that in case of the European countries, the recession only highlighted and enhanced many problems and unfavorable tendencies which had existed before the crisis. It concerns mainly the weak stability of the European economies observed before the crisis struck and that was probably an important factor which deepened the general economic slowdown during the crisis period. The empirical results have also proved the argument that financial and trade openness of the European countries highly contributed to strengthening the negative consequences of the 2007–2009 crisis. We also emphasize that favorable conditions for crises (especially currency ones) to spread are created firstly by conditions making the economies more prone to the trap of indebtedness or bank panic to occur (coming out of financial markets), secondly by fundamental weaknesses.

The results obtained in the analysis allow to draw some interesting conclusions as to the economic policy. It seems it should be concentrated on strengthening the financial system and – in the real economy – on stimulating the domestic markets' demand (boosting the investments and creating favorable conditions for intra-regional trade in Europe).

As the results obtained within this research (as well as results by other authors tackling the issues of the 2008–2009 crisis) show, the crisis put the substantial negative pressure particularly on the international trade. That is why in the future research concerning the factors of the vulnerability to crisis shock, it will be worth to attach the special importance to the factors connected with international trade. Within this problem (analyzed in relation to 2008–2009 crisis) it should be studied the role and importance (in relation to another factors like financial openness) of trade links in the broad context of the mechanisms through which trade contributes to international transmission of shocks. Since the herewith study relates to more general country-specific factors it is desired to shift the attention to the less aggregated data, for example data on industries and their international trade (cross-industry rather than cross-country perspective) taking into consideration the factors like patterns of specialization (relationship between commodity diversification/concentration and export volatility and dynamics which indirectly affect income), the role of demand shocks in the partner countries for economic volatility and development in exporting countries, the role of terms of trade, the possible role of geographical concentration of exports and imports in exposure to demand shocks, etc.

Notes

[1] The article was accomplished in the framework of the project no. N N112 377940 financed by the Polish National Science Centre.

[2] The crisis started in fact in the year 2007 but since its effects revealed in most of countries in 2008 and 2009 it is frequently referred to as 2008–2009 global crisis.

[3] What is more, so far the world literature has not provided many studies analyzing the issue of shock transmission in the context of 2007-2009 economic crisis.

[4] Similarly, financial openness may cushion the negative influence of endogenous shocks on the economy and counteract cycles thanks to wider access to foreign loans and generally thanks to greater chances to finance investments with foreign capital as well as domestic companies' portfolio diversification. On the other hand, if domestic sources are too strongly tied to the international financial system, they are exposed to its shocks, which may cause a recession.

[5] Understanding of crisis "macroeconomic costs" corresponds to this notion definition in specialized literature. The studies analyzing macroeconomic costs of financial crises often compare the level of gross domestic product (usually real GDP calculated *per capita*) during the crisis to the GDP level that would have been reached but for the crisis. An analogical way of calculating costs was to compare GDP growth rate during a crisis to the hypothetical GDP growth rate that would have occurred but for the crisis. GDP growth rate analyses were carried out, among others, by: IMF [1998, 1999], Azis, Caramazza and Salgado [2000], Barro [2001], Hutchison and Noy [2005], while output levels were compared among others by Hoggarth, Reis and Sapporta [2002], Boyd, Kwak and Smith [2005], Laeven and Palencia [2010]. IMF [1998, 1999], Azis, Caramazza and Salgado [2000] as well as other researchers additionally aggregated costs of crises that occurred in particular years to calculate overall crisis costs. They added up differences between the real level (or dynamics) of output and hypothetical level (or dynamics) of output from each year during the crisis or from each year after the crisis occurred when the differences were negative.

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