THE IMPACT OF MONETARY UNION MEMBERSHIP ON GOVERNMENT FINANCIAL STABILITY

by

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Abstract

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This study investigates the impact of entrance to monetary union on the government financial stability of the union members. In order to do the analysis the general equilibrium model was constructed. It describes relations between utility maximizing, governments, central bank and private agents of the union. Comparison of model solutions for financial stability in autarky case and union membership reveals deterioration of financial stability after the union entrance. While simulating dynamic solutions it was found that in case without size disparity between union members, countries demonstrate healthy financial state with budget surplus, but with arising size disparity financial stability of large countries deteriorates, whereas small countries have improvement. Obtained conclusions were tested using the dataset for European Monetary Union countries. Estimates of empirical model show that there is no evidence of entrance effect on large countries' stability, whereas for small countries theoretical conclusion about increase in stability is not confirmed. Moreover, from empirical analysis it was found that relation between country size and financial stability is rather strong, indicating that large countries tend to be more stable, which is opposite to results of theoretical model.

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GLOSSARY

EMU –European Monetary Union

EUROSTAT – European Statistical agency

EU **-** European Union

FE – Fixed Effect

GDP – Gross Domestic Product

LSDV – Least Square Dummy Variable

OCA – Optimal Currency Area

OECD – Organization of Economic Cooperation and Development

OLS – Ordinary Least Squares

RE - Random Effect

WDI – World Development Indicators

Chapter 1

INTRODUCTION

The problem of economic cooperation has become very popular recently in the context of globalization and trade liberalization. There are several forms of economic cooperation ranging from the simplest agreement on free trade areas and up to the one of the most complex - monetary union. Costs and benefits for potential member countries of these agreements (unions) are a subject of some controversy in economic literature.

Originally costs and benefits that arise as a result of economic cooperation were analyzed by Mundell (1961). In his analysis, Mundell focused on optimality conditions for common currency area in a simple two-country model. He concluded that perfect mobility of factors of production and symmetric patterns of shocks were important conditions for macroeconomic stability within a union. Later Alesina and Barro (2002) in their analysis of co-movements of macroeconomic variables of a union's member countries showed that a loss of independent monetary policy was less costly for the union member countries if a higher correlation between their output fluctuations was observed. They accounted this to a common stabilizing monetary policy, which was completely in accord with the Mundell's arguments.

A number of benefits to producers and consumers that arise as a result of a monetary union were cited in the literature. These benefits are mainly associated with liberalization of international trade (Alesina and Barro, 2002), freedom of labor movement across the union, and reduction in transactions costs (Fink,1999). However, differences in economic development of the potential member countries create some uncertainty about positive outcomes of integration. In order to overcome these differences, some pre-entry conditions should be set. In the case of the European Monetary Union, such conditions were specified in the Maastrich Treaty (De Grauwe,2003). Among other things, the Treaty formulated convergence criteria

that should be met by potential member countries. In addition, government financial stability criteria such as ceilings on the debt to GDP and deficit to GDP ratios were mentioned. Despite the widespread critique of the ceilings (see, for example, Begg et al.(1991) and Buiter et al. (1993)), the very fact of their presence in the Treaty shows the importance of the issue.

However, despite the wide number of aspects specified in the Treaty it could not foresee all the consequences of the monetary union. The impact of heterogeneity within a monetary union is one of them. Since usually monetary policy within a union is aimed at the increase in aggregate utility of the union, interests of large countries versus smaller member countries were not taken into consideration. Size heterogeneity within a monetary union is the main focus of this study.

In general, the subject matter of this study is to analyze the impact of a monetary union membership on financial stability of a member country under assumption of size heterogeneity of the union members. It appears to be that the concept of financial stability is not well-defined in the literature, and is usually interpreted through the opposite term – "instability", implying high variation of some economic variable. In this study, financial stability is seen through the government debt to GDP ratio. It means that a country with a low value of the debt to GDP ratio is considered more financially stable. Some authors (Wyplosz, 1997) call this ratio fiscal stability because government debt is an instrument of fiscal policy. Since members of monetary union loose their monetary independence, fiscal policy remains the only macroeconomic tool to cope with endogenous and exogenous shocks.

In order to address the issue, analysis is concentrated on two questions: (i) Is there evidence of a change in the debt to GDP ratio after the entrance into a monetary union?, and (ii) if the change is significant, is it different for "large" and "small" member countries?

Theoretically these questions are addressed in the framework of a general equilibrium model similar to the ones used in works of Baxter and Cricini (1993) and Beetsma and Bovenberg (1995). The analysis is done on the basis of comparison of the outcomes obtained from the model under the autarky and union situations.

In the autarky case, the model is solved for general equilibrium between society, monetary authority and fiscal authority. The solution produces the time–path of government debt accumulation.

In the monetary union case, the model is extended to describe a union between two countries. Therefore in this case, the model involves decisions of two fiscal authorities, two societies and common monetary authority. Size heterogeneity of the union members is introduced into the model through different number of homogeneous private agents in society of every country.

The model is tested in two ways. First, simulation of the time path of debt/GDP is performed to show that cycles of productivity shocks have different effects on debt accumulation in heterogeneous union members. Second, the results of simulation are confirmed by empirical analysis. In the latter case, the data from the European Monetary Union are used. Most data are obtained from the official databases of European Statistical Agency, which are available publicly from the official Internet web-site.[1] In addition, some data were gathered from OECD databases. The data used are panel data.

The study is organized as follows. Section 2 discusses the literature related to the field. In section 3, a general equilibrium dynamic model is developed and solved. Section 4 presents computer simulation of the solutions under autarky case and monetary union membership. Empirical model and data description, with results of econometric analysis are presented in Section 5. Finally, section 6 summarizes the main findings of the study.

[1] http://epp.eurostat.cec.eu.int

Chapter 2

LITERATURE REVIEW.

In order to critically review studies dedicated to the issues of government debt of monetary union members, general analysis of main aspects of a monetary union should be done. Literature on monetary unions can be divided into two categories. First one is related to theoretical questions of monetary and fiscal policy within hypothetical unions. The second one is devoted to the analysis of different theoretical issues in real unions, examples of which are European Monetary Union, Frank Zone in Africa, etc.

Review of theoretical studies should be done as overview of fundamental studies in the field. Significant contribution to the development of the theory of optimal currency areas (OCA) was done by Mundell (1961) in his seminal work. In order to detect the main effects arising within a single currency area he uses an example of two countries involved into trade. Making assumptions about full employment and similar inflation rates of the countries in initial state, he shows that as a result of supply/demand shocks in one of the countries there is an increase in unemployment in a country facing negative shock or no shock and an inflationary pressure in the other country with positive shock. These disparities may be captured by fluctuations of the exchange rate under flexible regime, and changes in balance of payments (disequilibria) in the case of fixed rate regime.

Mundell emphasizes the importance of independent monetary policy for a country to smooth these disparities in the case when shocks arise within the borders of one country. Considering the situation of two regions with common currency, he shows that impact of regional shocks is similar to the one described for two country case. However, there is no policy instrument to decrease the burden of the shock in a form of inflationary pressure in one region and increase in unemployment in the other region except for endogenous regulations through capital and labor mobility. Therefore, division of the countries into separate regions with flexible exchange rates may localize shock effects within region and bring better outcomes to individual

countries, thus emphasizing the difference between interregional and international adjustments. However, in the case of a country with one currency circulating over several regions, some redistributive policy rule should be introduced to smooth the disturbances in inflation and unemployment over the country. Mundell concludes that it is necessary to find a balance between the creation of many regions with own local currencies in order to localize shock effects and minimization of costs related to circulation of many currencies.

McKinnon (1963) approached optimality of OCA from a viewpoint of openness of an economy. Measuring openness as tradable output to non-tradable output ratio he states that more open economy would better suit OCA.

McKenen (1969) emphasized the importance of diversified economies, where intra-industry trade accounts for large part of total trade, in order to have more symmetric shocks across regions of OCA. Moreover, author notes a possibility of coordination between fiscal policies of the OCA regions, which may decrease the need for high labor mobility level.

As an extension of theoretical studies, a theory of optimal currency area developed into a number of studies devoted to pre-requisites for stable and beneficial OCA. Demopoulos and Yannacopoulos (1999) consider two approaches to the analysis of the problem. The marginalistic approach to the OCA implies that there is optimal size of OCA defined from condition of equality between marginal costs and benefits of further expansion of the OCA. A decrease in transaction costs within the OCA is considered as marginal benefit, whereas a decrease in speed of terms of trade adjustment represents marginal cost of expansion. Under this approach, optimal outcome can be reached if some specific part of OCA's trade is localized within a union. Therefore, in order to define degree of integration into union a country, maximizing its own welfare, compares marginal benefits with losses. Another approach to the analysis of the OCA considers conditions under which the area is optimal, which means Pareto improvement for all members of union.

Following Mundell's approach, Frankel and Rose (1996) consider a problem of optimality from a viewpoint of the integration level. They emphasize that four criteria are necessary for successful integration and macroeconomic stability between

countries of a union. They are: *(i)* level of production factor mobility should be large enough, *(ii)* business-cycles and shocks patterns are to be comparable in size and time variability for the union members, *(iii)* trade volumes between members of union should be comparable, and *(iv)* the system of fiscal transfers is to be created. Authors outline drastic changes of countries' macroeconomic indicators after the entrance into a union explaining it by transition to a common stabilization policy. However, different levels of integration lead to different stabilization policies. Frankel and Rose empirically evaluate price and trade integration as well as business cycle synchronization. Their findings show that greater integration is directly related to the volume of economic activity between the countries. On the other hand, they conclude that even if integration between union members is much higher then with other countries, it is still far away from interregional integration existing within boundaries of one country.

In theoretical analysis of monetary unions, the most attention has been devoted to policy analysis. Its importance stems from the presence of a common monetary policy as well as spillover effects caused by fiscal policies of union members, which is less typical for a stand-alone country. The following papers will briefly discuss these effects in order to identify main aspects that may influence government debt accumulation once a union is created.

A problem of welfare allocation usually arises in situation when several economic agents cooperate. The case of the countries in a monetary union is very similar. In the union, the conflict of interests may arise because of common monetary policy being undesired by some members of the union. Analyzing interest rates in asymmetric monetary union, Egil Matsen and Øistein Røisland (2003) focus on four different types of decision making. They construct theoretical model with *n*-countries and evaluate welfare effects of national divergences from optimal interest rates. They find that in the case of full symmetry of economies, the outcomes of different mechanisms are the same, and in the case of asymmetry, the conflict of interests arises due to differences in monetary transmission mechanisms.

The conflict of interests and adverse selection problems are also considered by Bottazzi and Manasse (2005). They evaluate a common monetary policy, which is

based on information about economic situation in the union. The authors state that asymmetric information about real economic conditions eventually leads to additional welfare losses for the union as a whole.

Another direction of research in the field is associated with the analysis of optimal combination of fiscal and monetary policies within a union, which is more related to the subject matter of this thesis. The following study serves as a good example of the idea that even in the case of a monetary union where only fiscal policy instruments are left to governments, greater performance may be achieved if fiscal policy is coupled with decisions of central bank. Beetsma and Jensen (2002) used a two-country model with micro-foundations to explore the role of a single fiscal policy as well as interaction of fiscal and monetary policies in a multiple countries case, where a stabilizing fiscal policy is defined by the choice of optimal level of government spending. Assumption of slow-moving prices in the model is a distinguishing feature of their work compared to the previous study by Taylor (1999). Solving the problem of union welfare maximization under different assumptions, they find that fiscal policy may be effective stabilizing tool. However, since it was mostly used to serve own interests of the country, the efficiency of this tool could be increased by its "strategic" use, implying centralized planning. In conclusion, the authors also propose to increase flexibility of fiscal policy by extending the number of available fiscal instruments with public debt, which may serve as effective fiscal stabilizer.

In a similar model with a policymaker maximizing the welfare of the union members, the question of simultaneous stabilization monetary and fiscal policies was addressed by Ferrero (2005). Assuming different fiscal regimes, the author analyses potential losses of welfare from the use of fiscal policy as a stabilization mechanism for different types of shocks. He states that efficiency of stabilization policy increases if monetary and fiscal policies are combined to smooth aggregate shocks.

The following study slightly touches on the subject matter of this thesis analyzing the impact of size heterogeneity. Schalck (2003) investigates the efficiency of stabilizing fiscal policy under the assumption of heterogeneity of member

countries. The author considers a static model of a monetary union of ***n*** countries, facing asymmetric demand shocks. Analyzing cooperative and non-cooperative equilibria, he concludes that size matters in coordination of fiscal policy. Although the impact of size heterogeneity on debt accumulation is not analyzed, the author shows that small countries gain more from fiscal externalities within the union. Moreover, using an example of EMU, Shalck finds a threshold ratio of a country size relative to the size of the union under which the country is considered as small enough to gain more.

A number of studies are dedicated to different aspects of policy-making within a union, however, according to the subject matter of this study, a greater attention should be paid to studies devoted to the government stability issues. Only a few studies consider a problem of financial stability in a monetary union using the concept of the debt to GDP ratio. However, some of them touch on the question of debt accumulation as one of the most important.

Beetsma and Bovenberg (1995) examine how indebtness of the countries changes after entering a union. Using usual Barro-Gordon(1983) approach, incorporating commitment problems, they consider a two-period dynamic model of union involving common central bank and ***n*** equal size countries deciding on their own fiscal policies. The model captures a spillover effect of a national fiscal policy on the other union members through the impact of a central bank's decision regarding the level of inflation rate. The authors conclude that presence of inflationary bias leads to higher debt accumulation in countries of the union. Moreover, they show that if governments are myopic, the debt accumulation is excessive and has adverse impact on welfare. Therefore, two kinds of imperfections - monetary and fiscal - are responsible for such an outcome. The authors do not touch directly on the effect of the size heterogeneity in their model considering ***n*** equal size countries, but indirectly they conclude that when ***n*** approaches infinity, debt accumulation increases, whereas with increasing n relative size of the single country decreases.

Quite opposite result about debt accumulation after the monetary union entrance is obtained by the Jahjar (2000) in IMF working paper. The author develops a theoretical model to capture a trade-off between price stability within a union and

financial crisis prevention faced by the central banker, where financial crisis is represented by government default on its debts. The author compares a monetary union with n countries setting its fiscal policies based on the previously chosen monetary policy of the central bank with outcomes of a single country. In the model, government debt, which is present in every country, may be defaulted with the costs related to the future loss of credibility. Inclusion of such costs into the central bank's utility function, which reflects the central bank's concerns about financial stability, leads to a necessity for the union's central bank to react by conducting a corresponding monetary policy. Outcomes of the model show that a single country accumulates more debt compared to countries in the union. However, there is significant influence of the union's bank preferences on the fiscal discipline of union members, indicating importance of institutional framework.

Empirical studies in the field are mostly devoted to the tests of optimality criteria and analysis of real effects from specific policy application. Therefore, looking at debt dynamics of a sample of OECD countries, including members of Eurozone, Balassone and Francese (2004) investigate presence of asymmetry of fiscal policy reaction to positive and negative parts of economical cyclical development. The conclusion about significant asymmetry of fiscal policy and persistent debt accumulation as a consequence is made by the authors.

Canzoneri, Cumby, and Diba (2005) consider questions of coordination of monetary and fiscal policies within a monetary union with heterogeneities. The attention is paid to the following question: What rules should be imposed in order to restrict the deficit to GDP ratio? The authors suggest that common monetary policy will have different effects on countries, which have different amounts of debt or are different in size. Applying the so-called New Neoclassical Synthesis, the authors show that a common monetary policy within the union with heterogeneities has asymmetric effects. As a consequence, the following conclusions are drawn: most volatility in deficit to GDP ratio is explained by the productivity shocks, whereas they are the main source of inflation differentials between countries; change is government purchases as a regulator of budget deficit may have advantage over the tax rate variation if measured in terms of welfare reduction. The last conclusion states that large countries

have more gains from common monetary policy, because its inflation has higher correlation with average inflation over the union. The approach used in the work is very similar to the one used in this study, but attention is mostly directed to the welfare effects of monetary and fiscal policies, which makes it differ from this study.

In support of the previous conclusion about significance of supply shocks within a union, Chernookij (2005) creates an empirical model to analyze structural differences in economies in a would-be monetary union between Belarus and Russia. The author concludes that such asymmetry will create asymmetric productivity shocks that should be tackled with some fiscal stabilizing mechanism.

Despite economic determinants of the debt accumulation, there are a number of political factors contributing to the issue. In this way, Sapir and Sekkat (2002) investigate the effect of political cycles within the European Union on the budget deficit during the period from 1973 till 1994. The hypothesis that monetary and fiscal policy may be manipulated in order to achieve some political goals is tested. Using results of its empirical model, the authors derive conclusions that political events and preferences are likely to add to debt accumulation. Introduction of economic variables in the model and running estimation for different periods allow us to state that on average European countries run counter–cyclical budgetary strategy and implementation of Maastrich criteria may decrease the debt accumulation tendency.

A number of studies are devoted to the test of convergence between union members. Among them are the following: Alesina and Barro (2002) investigate co-movements of prices and output in countries that are members of a union. Because of a high level of the intra-industry trade between union members, it is expected that the co-movement will be significant. Based on the results they assert that dollar and euro currency area countries have patterns of co-movements in historical data on inflation, prices and outputs, and therefore, there is a place for a union.

As a summary of the reviewed literature, some stylized facts should be outlined. There are a number of pre-requisites to be satisfied by potential member countries in order for common policy to be stable. The intuitive conclusion is that fiscal and monetary policies should be coordinated in a monetary union in order to increase

efficiency of the after shock stabilization and to decrease welfare losses. This conclusion and a number of additional effects arising in a monetary union such as, for example, a conflict of interests should be taken into account while constructing a model to study financial stability.

Chapter 3

MODEL DESCRIPTION.

In order to do the analysis of financial stability, a general equilibrium model is constructed. In equilibrium, all economic agents - central bank, private agents and government representing the fiscal authority - maximize their respective utilities.

The structure of this chapter is as follows: initially a maximization problem of each agent is solved separately; then these solutions are combined in order to construct a general model, representing solutions in the separate countries case and in the union case. Eventually, using log–linearization, the model is solved for coefficients of policy functions.

In order to make a conclusion regarding change in debt accumulation of a country after joining a monetary union, the following two situations are analyzed: (1) the case of stand-alone countries with independent monetary policies, and (2) the case of a monetary union with a common central bank. To analyze these cases the same solutions are used. The difference between the cases is associated with the form of the central bank's response function and allocation of seigniorage revenues. In the autarky case, only each country's own output is taken into account and seigniorage revenues are allocated to the respective governments, whereas in the union case, sum of the countries' output is internalized by the central bank and total seigniorage revenue is distributed according to the shares of the countries' GDP in total union production.

In general, basic assumptions of the model are:

- Each agent has its own decision making function (derived from the FOCs and constraints);
- Private agents respond to shocks by choosing future capital allocations;
- Governments issue debt, which is bought by private agents of the respective country.
- Central banks of the countries target inflation levels.

- Free capital mobility, which satisfies the equality of marginal productivities between countries condition;

The deterministic dynamic model is constructed over infinite horizon with discrete time $t \in T, T = \{0,1,..\infty\}$. The framework of the model is similar to the one proposed by Baxter and Crucini (1993), allowing for some simplifications: instead of two factors of production, only one factor, capital is used. Moreover, in order to focus on the countries' public debt/GDP ratios, the governments are considered as separate agents. In addition, a monetary authority is introduced to show the effect of monetary policy within the union on separate countries' financial situations.

3.1 Fiscal authority.

In the following analysis it is assumed that government maximizes social utility $U(G_t)$ over its lifetime, where G_t is total government expenditures in time period ***t***. So, the government's problem is:

$$\max_{\{G_t, D_t\}} E_0 \left(\sum_{t=0}^{\infty} \beta^t \cdot U_i(G_{it})\right)$$

$$G_{it} + (1 + r_{t-1}) \cdot D_{it-1} = \tau \cdot y_{it}(a_t) + D_{it} + \alpha_i \cdot \frac{\Delta M_t}{P_t}; \frac{\Delta M_t}{P_t}, D_0 \text{ -given.} \qquad (3.1)$$

Where D_t - stock of public debt allocated over population of the society

τ - tax rate in a country;

a_t -relative productivity parameter;

α_i - share of total seigniorage revenues ΔM_t raised by government of country *i* (in case of stand-alone country $\alpha = 1$);

β – social discounting factor.

The following form of social utility function is chosen.

$U_i(G_{it}) = \ln(G_{it})$

- The function is concave, which reflects fundamental property of the government policy - larger government expenditures lead to a higher social utility.

Solution to the problem under certainty is presented in Appendix 1. The resulting policy functions are:

$$G_{it} = \beta \cdot (1 + r_{t-1}) \cdot G_{it-1}$$

$$D_{it} = G_{it} + (1 + r_{t-1}) \cdot D_{i(t-1)} - \tau_i \cdot y_{it} - \alpha_i \cdot \frac{\Delta M_t}{P_t}, \qquad (3.2)$$

These functions provide governments with policy rules indicating what levels of government expenditures and debt to choose in specific period, given state variables. Due to similar form of utility functions, policy rules for both governments of the union model are the same.

Solution to these problems is similar for the union and separate countries cases. The only difference is presence of the coefficient α_i in the union's solution, whereas in case of autarky $\alpha_i = 1$.

3.2 Private agents.

Society consists of homogeneous agents who solve their own utility maximization problems. For simplicity it is assumed that private agents' utility depends on consumption only. Agents own firms that use capital in order to produce goods, which then can be consumed, re-invested into production or invested into governments bonds. During the production process, capital depreciates at rate d. Therefore, the problem of the lifetime utility maximization of a representative private agent can be written as

$$\max_{\{c_t, k_{t+1}\}} E_0 \left(\sum_{t=0}^{\infty} \beta^t \cdot U^p(C_t)\right), \text{ s.t.}$$

$$\begin{aligned} C_t + D_t + K_{t+1} &= K_t \cdot (1-d) + (1-\tau) \cdot y_t + D_{t-1} \cdot (1 + r_{t-1}) \\ y_t &= a_t \cdot [K_t]^{\gamma} \end{aligned}, \qquad (3.3)$$

where K_t -capital stock used in production in period t by one firm;

a_t - relative productivity parameter;

Interest rate on bonds is a state variable in the private agent problem and it is defined by a monetary authority.

Derivation of the problem's solution for utility function $U^p(C_t) = \ln(C_t)$ under certainty is presented in appendix 1. The solution is

$$K_{t+1} = \left[\frac{r_t + d}{l \cdot (1-\tau_i) \cdot a_{t+1}} \right]^{\frac{1}{l-1}}$$
$$C_{t+1} = \beta \cdot C_t((1-d) + l \cdot (1-\tau_i) \cdot a_{t+1} \cdot [K_{t+1}]^{l-1}) \quad (3.4)$$
$$D_t = K_t \cdot (1-d) + (1-\tau_i) \cdot a_t \cdot [K_t]^l + D_{t-1} \cdot (1+r_{t-1}) - C_t - K_{t+1}$$

So given the values of external shocks and other parameters like tax rate and technology agents decide on their allocations using these policy functions. All private agents across the union face the same form of policy functions.

3.3 Central Bank

The central bank of a country (or union as a whole) is responsible for maintaining price stability (actually inflation targeting means stability of the growth rate of prices) within the country (union). Central bank reacts to price variation in order to minimize its losses, which are represented by the following function $L_t = (\left[\frac{\Delta P}{P}\right]_t - \left[\frac{\Delta P}{P}\right]^*)^2$,

where P_t is the price level , $\left[\frac{\Delta P}{P}\right]_t$ is the current inflation, $\left[\frac{\Delta P}{P}\right]^*$ is the target level of inflation.

In this model, inflation targeting is achieved by the change in nominal money supply. Since the loss function is represented by simple parabola, the solution to the following loss minimization problem

$$\min \{M^s\}\ L_t = (\left[\frac{\Delta P}{P}\right]_t - \left[\frac{\Delta P}{P}\right]^*)^2$$

is such a value of M^s when $\left[\frac{\Delta P}{P}\right]_t - \left[\frac{\Delta P}{P}\right]^* = 0$. Hence, according to derivation presented in appendix 1, the following central bank response function may be obtained

$$\frac{\Delta M_t}{P_t} = \frac{M_{t-1}}{P_{t-1}} \cdot \frac{1}{\left[\frac{\Delta P}{P}\right]^* + 1} \cdot \left(\left[\frac{\Delta P}{P}\right]^* + \left[\frac{L_Y}{L}\right]_{t-1} \cdot \Delta y_t + \left[\frac{L_r}{L}\right]_{t-1} \cdot \Delta r_t \right), \qquad (3.5)$$

where $\Delta x_t = x_t - x_{t-1}$.

The central bank's solution has the same form in both cases, in the union case and in the autarky case. The only difference is that in the union case, Δy_t represents change of output of the entire union, whereas in a stand-alone country case, Δy_t is change of a single country output.

3.4 General competitive equilibrium.

Competitive equilibrium is presented by time series of the prices and interest rates such that debt, consumption and capital allocations satisfy the maximization problems of the government, the central bank and private agents. Below general representation of the model is given. Imposing specific assumption on the decision-making process of the central bank, specific models for the union and stand-alone countries can be derived.

Central Bank-

$$\frac{\Delta M_t}{P_t} = \frac{M_{t-1}}{P_{t-1}} \cdot \frac{1}{\left[\frac{\Delta P}{P}\right]^* + 1} \cdot \left(\left[\frac{\Delta P}{P}\right]^* + \left[\frac{L_Y}{L}\right]_{t-1} \cdot \Delta y_t + \left[\frac{L_r}{L}\right]_{t-1} \cdot \Delta r_t \right),$$

Private agent - $K_{i(t+1)} = \left[\frac{r_t + d}{l \cdot (1-\tau) \cdot a_{it+1}} \right]^{\frac{1}{l-1}}$

$$C_{it} = \beta \cdot C_{i(t-1)} \cdot (1 - d + l \cdot (1-\tau) \cdot a_{it} \cdot \left[K_{it}\right]^{l-1})$$

$$D_{it} = K_{it} \cdot (1-d) + (1-\tau) \cdot a_{it} \cdot \left[K_{it}\right]^l + D_{i(t-1)} \cdot (1 + r_{t-1}) - C_{it} - K_{i(t+1)}$$

Government 1: $G_{1t} = \beta \cdot (1 + r_{t-1}) \cdot G_{1(t-1)}$ (3.6a)

$$D_{1t} = G_{1t} + (1 + r_{t-1}) \cdot D_{1(t-1)} - \tau \cdot y_{1t} - \alpha_1 \cdot \frac{\Delta M_t}{P_t} \qquad (3.6b)$$

Government 2: $G_{2t} = \beta \cdot (1 + r_{t-1}) \cdot G_{2(t-1)}$

$$D_{2t} = G_{2t} + (1 + r_{t-1}) \cdot D_{2(t-1)} - \tau \cdot y_{2t} - (1 - \alpha_1) \cdot \frac{\Delta M_t}{P_t}$$

Because of inflation targeting, the price series $\{p_t\}_{t=0}^{\infty}$ is determined exogenously, whereas the interest rate series is determined endogenously. Therefore, competitive equilibrium is characterized by a series of capital prices $\{r_t\}_{t=0}^{\infty}$ when allocations of private agents $\{C_t, D_t, K_{t+1}\}_{t=0}^{\infty}$ and government $\{G_t, D_t\}_{t=0}^{\infty}$ maximize corresponding utilities while the central bank minimizes its loss function by $\{\Delta M_t\}_{t=0}^{\infty}$.

3.5 Autarky.

The goal of this paragraph is to give some intuition regarding major differences between the union and the autarky cases. A detailed analysis of the autarky case will be done after the model is solved for the union case.

The solution for stand-alone country is similar to the union's solution. Difference is associated with the following: (1) in the autarky case, there is separate central bank for each country, which decides on monetary policy based on output of its own country; (2) all seigniorage revenues are a part of the government revenues. In the autarky case, only monetary policy is independent. There is no restriction on capital mobility between separate countries, which means that private agents decide over their capital allocations taking into account productivities in both countries. Regional productivity shocks lead to a change in output of the region, which puts pressure on prices leading to monetary policy response. Therefore, the variability of the debt of a single country *i* is a result of productivity shocks arising in both independent

countries[2]. Decision of the monetary authority of country *i* influences the financial position of its government. Increased money supply creates possibility of seigniorage for the government making additional expenditures from the budget possible.

3.6 Monetary union case.

In order to evaluate the effect in the case of a monetary union, the model of two countries with different sizes of economies is considered. Under different sizes different quantities of producing firms in both countries is meant. Since every firm owns some amount of capital, the difference in size automatically means the difference in stock of country's capital. This fact is reflected in the government budget constraint, when the government of a large country 1 collects tax revenues from *s* firms, whereas tax revenues of government 2 are collected from 1 firm. Fiscal authorities (governments) maximize their own social utility functions with respect to the corresponding budget constraints. Solutions were already found before:

Government 1: $G_{1t} = G_1 * + \beta \cdot \gamma \cdot (1 + r_{t-1}) \cdot (G_{1t-1} - G_1 *)$

$$D_{1t} = G_{1t} + (1 + r_{t-1}) \cdot D_{1(t-1)} - s \cdot \tau \cdot y_{1t} - \alpha_{1t} \cdot \frac{\Delta M_t}{P_t}$$

Government 2: $G_{2t} = G_2 * + \beta \cdot \gamma \cdot (1 + r_{t-1}) \cdot (G_{2t-1} - G_2 *)$

$$D_{2t} = G_{2t} + (1 + r_{t-1}) \cdot D_{2(t-1)} - \tau \cdot y_{2t} - \alpha_{2t} \cdot \frac{\Delta M_t}{P_t},$$

$$\alpha_{1t} = \frac{y_{1t}}{y_{1t} + y_{2t}} = \frac{s \cdot a_t \cdot K_{1t}^l}{s \cdot a_t \cdot K_{1t}^l + K_{2t}^l} = \frac{s \cdot a_t \cdot K_{1t}^l}{s \cdot a_t \cdot K_{1t}^l + K_{1t}^l \cdot a_t^{\frac{l}{1-l}}} = \frac{s \cdot a_t}{s \cdot a_{1t} + a_{1t}^{\frac{l}{1-l}}}$$

Where α_{it} - share of seigniorage revenues gathered by country i,

s- the scale parameter, indicating difference in outputs and sizes of two countries.

[2] Independent country = a country with an independent monetary policy.

Monetary policy of the union is total responsibility of a common central bank, which chooses policy of inflation targeting taking into account total union's output and interest rate levels. Its response function is:

$$\frac{\Delta M_t}{P_t} = \frac{M_{t-1}}{P_{t-1}} \cdot \frac{1}{\left[\frac{\Delta P}{P}\right]^* + 1} \cdot \left(\left[\frac{\Delta P}{P}\right]^* + \left[\frac{L_Y}{L}\right]_{t-1} \cdot \Delta Y_t + \left[\frac{L_r}{L}\right]_{t-1} \cdot \Delta r_t\right)$$

Where ΔY_t - is change of total union output,

Δr_t -change of real interest rate over the union.

Solution to the central bank's problem is incorporated into budget constraint of each government.

Ideally the dynamic model should be solved over the whole life span $t = 0, \infty$. However, taking into account recursiveness of the decisions, it can be represented as a repeating problem over any two periods. In the first period (t), there is a shock to relative productivity parameter. The shock leads to a change in relative productivity of the union's firms, as well as to the corresponding reallocation of the factors of production by private agents, which eventually changes the total outputs in both economies in this period. In addition, in period (t) private agents decide on the amount of capital used in production in the next period. In every period the union's central bank applies appropriate monetary policy based on output and real interest rate levels. Also governments of the union countries incorporate both, the effect of the shock and the central bank's response into their budgets to decide on the need for public debt issuance to cover government expenditures in every period.

As mentioned previously, difference in sizes is captured by the fact that output of country 1 is larger than output of small country 2. It is assumed that GDP in each country is a result of total production of all firms located within the country. Since in this model only size heterogeneity between countries is emphasized, the technology in both countries is assumed to be identical in the no shock state ($a_t = 1$), which corresponds to similar aggregate production functions for both countries. Capital is

taken to be the only production factor, which is used in the union[3]. This can be justified by the statement that in the case of a developed financial system within a country (union) financial capital has higher flexibility in the very short run compared to labor. This assumption becomes stronger if a longer run is taken into account because of large population migration. In order to incorporate changes in both factors, labor and capital, a relative production factor can be used, i.e the ratio of capital per unit of labor. However, for the sake of simplicity, one production factor will be analyzed. Since business cycles are relatively short-run fluctuations, capital mobility is taken into account since it is the only mobile factor in the short-run in this model. Production functions of both economies have the usual Cobb-Douglas forms, which were used in (3.3):

$$y_{1t} = s \cdot a_t \cdot K_{1t}^{\ l} \qquad s = \frac{N_1}{N_2}$$
$$y_{2t} = K_{2t}^{\ l} \qquad K_t = s \cdot K_{1t} + K_{2t}$$

Where y_{1t}, y_{2t} - normalized aggregate production of country 1 and 2 respectively;

N_1, N_2 - number of firms in country 1 and 2 respectively;

s – the scale parameter, indicating difference in outputs and sizes of the two countries. It can be interpreted as the ratio of the number of firms located in country 1 to the number of firms located in country 2, s>1;

K_{1t}, K_{2t} – amounts of capital of one firm in countries 1 and 2 respectively;

K_t – total amount of capital within the union in period t;

a_t – parameter indicating relative productivity between countries at time t.

Using assumptions about flexibility of capital prices, perfect mobility and rationality of agents, we can define allocation of capital over the countries. Relocation of capital between the countries continues until marginal products of capital of every single firm in both countries are equal. As already mentioned, total output consists of

[3] But this only factor can be also interpreted as a ratio of labor to capital, which is also important production factor.

aggregate output of all domestic firms. Applying the equi-marginal principle at the firm's level, the following relationship arises:

$$l \cdot K_{2t}^{\,l-1} = a_t \cdot l \cdot K_{1t}^{\,l-1} \rightarrow \left[\frac{K_{2t}}{K_{1t}}\right]^{l-1} = a_t \rightarrow \begin{cases} K_{2t} = K_{1t} \cdot a_t^{\frac{1}{l-1}} \\ s \cdot K_{1t} + K_{2t} = K_t \end{cases} \rightarrow \begin{array}{l} K_{1t} = \dfrac{K_t}{s + a_t^{\frac{1}{l-1}}} \\ K_{2t} = \dfrac{K_t \cdot a_t^{\frac{1}{l-1}}}{s + a_t^{\frac{1}{l-1}}} \end{array} \quad (3.7)$$

Value of productivity shock parameter a_t varies to introduce supply shock impact on capital allocation between firms of country 1 and 2. Case of $a_t = 1$ leads to equal amount of capital of firms in both countries, which corresponds to the situation with the absence of productivity shock and correspondingly to the same level of productivity of firms in both countries. Whenever productivity shock in one country occurs this equality is violated except for the case when both countries face the same magnitude and type of the shock.

In order to present general framework in the union case, the following simplifications are assumed. Private agents of each country allocate their revenues over government bonds, consumption and capital. It is also assumed that while buying governments bonds agents buy bonds of their own country only, while capital can be freely allocated over the countries. This simplification is due to some evidence that usually investors are more likely to invest into domestic securities rather than foreign, which is the so-called "home bias effect" for equity investment. There may be several reasons for that: investors are patriotic; investors have higher awareness of the situation in domestic country, therefore, they can better forecast the risk. Under such assumptions the problem of private agents in the union case will not change. Therefore using (3.4) policy rules for private agents of the union are:

$$C_{1t+1} = \beta \cdot (1 + r_t) \cdot C_{1t} = \beta \cdot C_{1t} \cdot ((1 + d) + l \cdot (1 - \tau_1) \cdot a_t \cdot \left[K_{1t+1}\right]^{l-1} \quad (3.8a)$$

$$C_{2t+1} = \beta \cdot (1 + r_t) \cdot C_{2t} = \beta \cdot C_{2t} \cdot ((1 + d) + l \cdot (1 - \tau_2) \cdot \left[K_{2t+1}\right]^{l-1} \quad (3.8b)$$

$$D_{1t} = K_{1t} \cdot (1 - d) + (1 - \tau_i) \cdot a_t \cdot \left[K_{1t}\right]^{l} + D_{1t-1} \cdot (1 + r_{t-1}) - C_{1t} - K_{1t+1} \quad (3.8c)$$

$$D_{2t} = K_{2t} \cdot (1 - d) + (1 - \tau_i) \cdot \left[K_{2t}\right]^{l} + D_{2t-1} \cdot (1 + r_{t-1}) - C_{2t} - K_{2t+1}$$

$$K_{t+1} = \left[\frac{r_t - d}{l \cdot (1 - \tau_i) \cdot a_{t+1}} \right]^{\frac{1}{l-1}} \tag{3.8d}$$

$$K_{1t+1} = a_{t+1}^{\frac{1}{l-1}} \cdot K_{2t+1}$$

The model is deterministic, implying that agents have perfect information about the relative productivity in both countries while doing capital allocations.

Chapter 4

NUMERICAL ANALYSIS.

4.1 Calibration.

Calibration of the parameters should be done before the model will be solved. Moreover, the functional form of real money demand function should also be specified in the model. The typical form of real money demand function (Bosker, 2003) is chosen. It is

$$L_t = c_0 \cdot Y_t^{ey} \cdot r_t^{er},$$

where ey – elasticity of money demand with respect to output Y;

er – elasticity of money demand with respect to real interest rate r;

c_0 - constant parameter, will be taken as 1.

Values of the model parameters are chosen based on the results previously obtained by a number of authors.

Values of the elasticities *ey* and *er* were evaluated by Bosker (2003). Using two methods for creating the aggregate data author estimates money demand elasticities, which are presented in a table 4.1.

Table. 4.1 Estimates of the real money demand function.

	Method of fixed coefficients of Eurozone data aggregation	Method of variable coefficients of Eurozone data aggregation
Estimate of *ey* and its P-value	1.52, (p=0.04)	1.27, (p=0.05)
Estimate of *er* and its P-value	0.3, (p=0.21)	-0.84, (p=0.31)

Values obtained by the method of variable coefficients will be used, because according to quantitative theory used in theoretical model the sign of *er* is expected to be negative. Even though the estimates for *er* are insignificant at level of 25% this value is used because of (1) usual instability typical for this parameter (Knell, Stix, 2004); (2) coefficient's sign reflect expected negative relation between real money demand and real interest rates; (3) in case of absent precise estimators for Eurozone, which is

related to the fact that money demand is different across all monetary union members (Bosker, 2003); (4) the sensitivity analysis may be done to check robustness of results.

Denis and others (2002) do estimates of Cobb Douglas production function using data of EMU. With data for EU15 over 1960-2000 they obtain that elasticity of output with respect to capital is ***l*=0.37**.

Following the Kydland and Prescot (1982), the depreciation rate of capital is set at 10% level annually. They found it to be a good estimate for US economy for different types of capital. Due to similar level of technology both in EMU and in US the depreciation rate for Eurozone is taken the same, **d=0.1**.

Value of discount factor is calibrated using Euler equation with steady state values:

$$1 = \beta \cdot (1 - d + l \cdot (1 - \tau) \cdot \left[K_{ss}\right]^{l-1}) \Rightarrow \beta = \frac{1}{(1 - d + l \cdot (1 - \tau) \cdot \left[K_{ss}\right]^{l-1})} =$$

$$= \frac{1}{(1 - d + l \cdot (1 - \tau) \cdot \left[{}^{y}\!/\!_{K} \right]_{ss})}$$

Following the Kydland and Prescott $\beta = 0.99$ is found.

4.2 Dynamic solution of the problem.

To solve obtained model for dynamic solution the log-linearization around steady state will be used. Using Taylor first order approximation linear functions of log deviations of variables K, C, D, G are found. In the process of log-linearization the following assumption on a form of policy functions are imposed:

$$\begin{array}{llll} \tilde{K}_{1t+1} = F_{1KK} \cdot \tilde{K}_{1t} & \tilde{D}_{1t} = F_{1KD} \cdot \tilde{K}_{1t} & \tilde{G}_{1t} = F_{1KG} \cdot \tilde{K}_{1t} & \tilde{C}_{1t} = F_{1KC} \cdot \tilde{K}_{1t} \\ \tilde{K}_{2t+1} = F_{2KK} \cdot \tilde{K}_{2t} & \tilde{D}_{2t} = F_{2KD} \cdot \tilde{K}_{2t} & \tilde{G}_{2t} = F_{2KG} \cdot \tilde{K}_{2t} & \tilde{C}_{2t} = F_{2KC} \cdot \tilde{K}_{2t} \\ \tilde{r}_t = F_{KR} \cdot \tilde{K}_t & & & \end{array} \qquad (3.9)$$

Where $F_{KC}, F_{KD}, F_{KG}, F_{KK}, F_{KR}$ are unknown elasticities that are to be found during linearization of FOCs and budget constraints;

$\tilde{x}_t = \dfrac{x_t - x}{x}$, where x is a steady state of x_t.

Model may be solved for steady state. Steady state values are presented below.

From (3.8a) $r_{ss} = \frac{1}{\beta} - 1$

From (3.8d) $K_{1ss} = \left[\frac{r_{ss} + d}{l \cdot (1 - \tau_i)} \right]^{\frac{1}{l-1}} \Rightarrow y_{1ss} = K_{1ss}^{l}$

From (3.8c) and $r_{ss} \cdot D_{1ss} = \tau \cdot y_{1t} + \alpha_1 \cdot \left[\frac{\Delta M}{P} \right]_{ss} - G_{1ss}$

$$r_{ss} \cdot D_{1ss} - C_{1ss} = K_{1ss} \cdot d - (1 - \tau) \cdot y_{1ss}$$

From (3.5) $\left[\frac{\Delta M}{P} \right]_{ss} = L_{ss} \cdot \frac{\left[\frac{\Delta P}{P} \right]^{*}}{\left[\frac{\Delta P}{P} \right]^{*} + 1}$

It can be seen that the solution of the model gives a set of steady states depending on target value of government expenditures. In order to do analysis of the change in debt accumulation after the union entrance it is assumed that government after the entrance to union does not change its optimal level of expenditures, which is achieved in steady state , $G_{ss} = G_{opt} = 0.5 \cdot K_{ss}$. Therefore solution for steady state consumption and amount of debt is as follows.

$$D_{1ss} = \frac{s \cdot \tau \cdot y_{1t} + \alpha_1 \cdot \left[\frac{\Delta M}{P} \right]_{ss} - G_{opt}}{r_{ss}}$$

$$C_{1ss} = (1 - \tau) \cdot y_{1ss} - K_{1ss} \cdot d + D_{1ss} \cdot r_{ss} \quad ,$$

$$\alpha_{1ss} = \frac{y_{1ss}}{y_{1ss} + y_{2ss}} = \frac{s \cdot K_{1ss}^{l}}{s \cdot K_{1ss}^{l} + K_{2ss}^{l}} = \frac{s \cdot K_{1ss}^{l}}{s \cdot K_{1ss}^{l} + K_{1ss}^{l}} = \frac{s}{s+1}$$

Corresponding solution for separate country will be:

$$D_{1ss} = \frac{s \cdot \tau \cdot y_{1t} + \left[\frac{\Delta M}{P} \right]_{ss} - G_{opt}}{r_{ss}}$$

$$C_{1ss} = (1 - \tau) \cdot y_{1ss} - K_{1ss} \cdot d + D_{1ss} \cdot r_{ss}$$

Log-linearization of the dynamic solution is done in Appendix 1.. Following tables present the obtained solutions of the model for cases of union and autarky, under different sizes o country.

Table 4.2 The Values of Decision Function's Coefficients For Union problem.

Size disparity, s	F_{KK}	F_{KC}	F_{KD}	F_{KG}	F_{RK}
S=0.5	0.2859	-0.0928	0.1004	-0.0928	-0.0527
S=0.9	0.2822	-0.0912	0.1451	-0.0912	-0.0520
S=1	0.2814	-0.090877	0.15596	-0.090877	-0.051868
S=1.1	0.7076	-0.45986	0.65433	-0.45986	-0.13042
S=2	0.6788	-0.4128	1.189	-0.4128	-0.1251
S=1.5	0.6917	-0.4332	0.9045	-0.4332	-0.1275

Table 4.3 The Values of Decision Function's Coefficients For Autarky problem.

Size disparity, s	F_{KK}	F_{KC}	F_{KD}	F_{KG}	F_{RK}
S=1	0.0242	-0.0928	0.0242	-0.0928	-0.1786

Simulations for dynamic paths of union members' macrovariables are presented in appendix. In order to investigate the question of financial stability within union the following results of simulations should be considered. On the figures 3.1 and 3.2 the debt to GDP ratios are presented for different cases of size heterogeneity between union members.

Figure 4.1: Simulated Transaction Path for Debt to GDP ratio for monetary union member under its different values of its economy size. (s< 1 – country is smaller member of union, s>1 = country is larger member of union).Inflation target =0.1

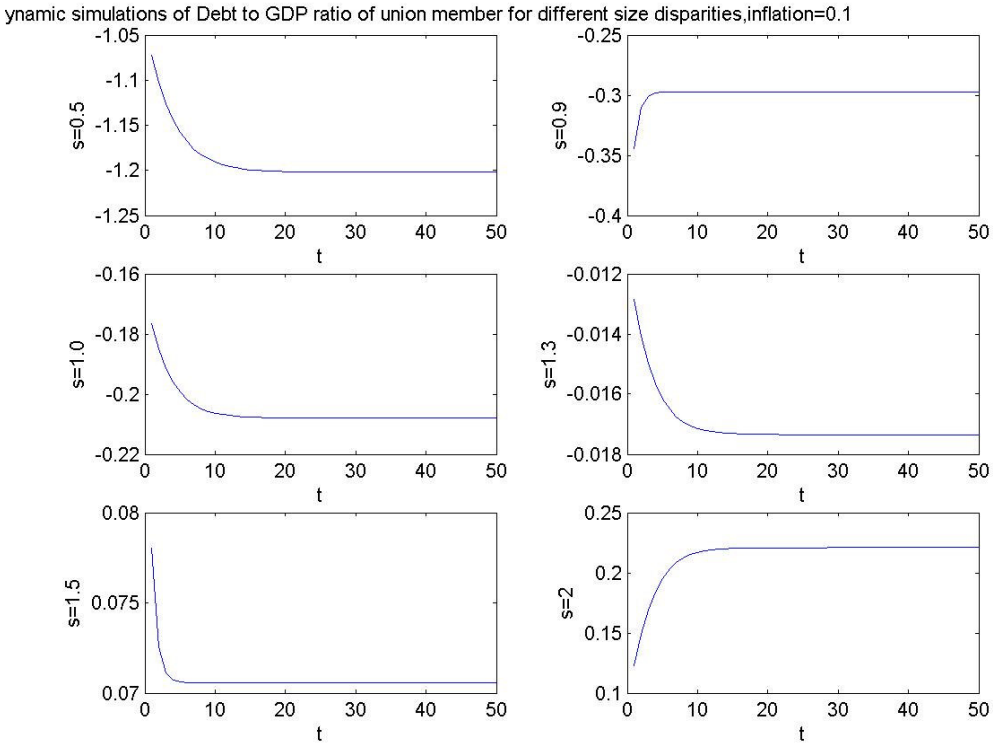
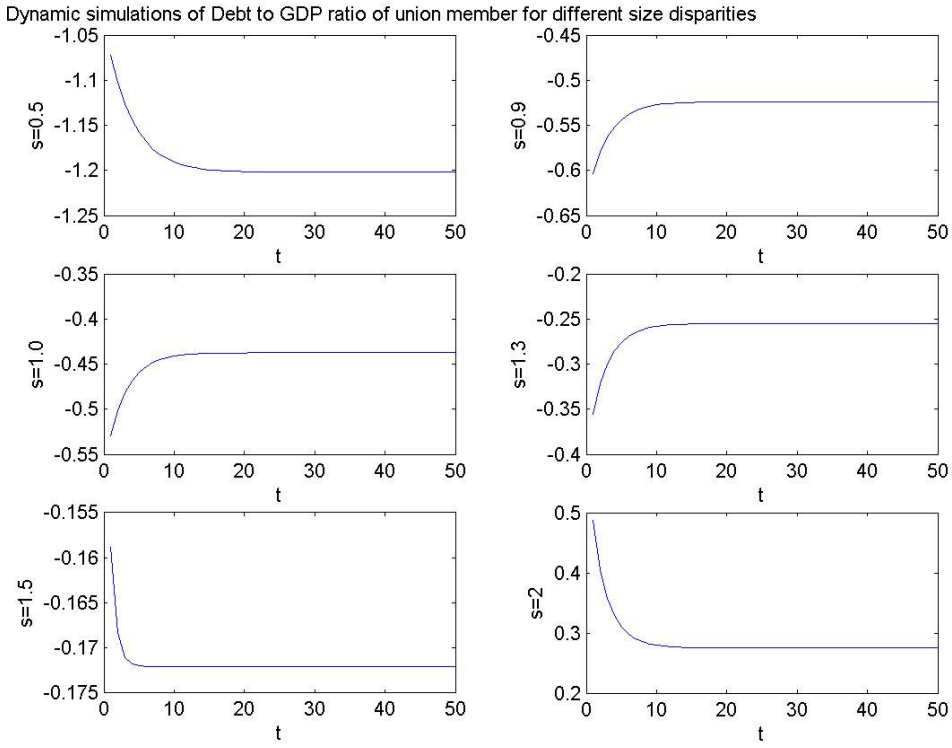


Figure 3.2: Simulated Transaction Path for Debt to GDP ratio for monetary union member under its different values of its economy size. (s< 1 – country is smaller member of union, s>1 = country is larger member of union). Inflation target =0.05

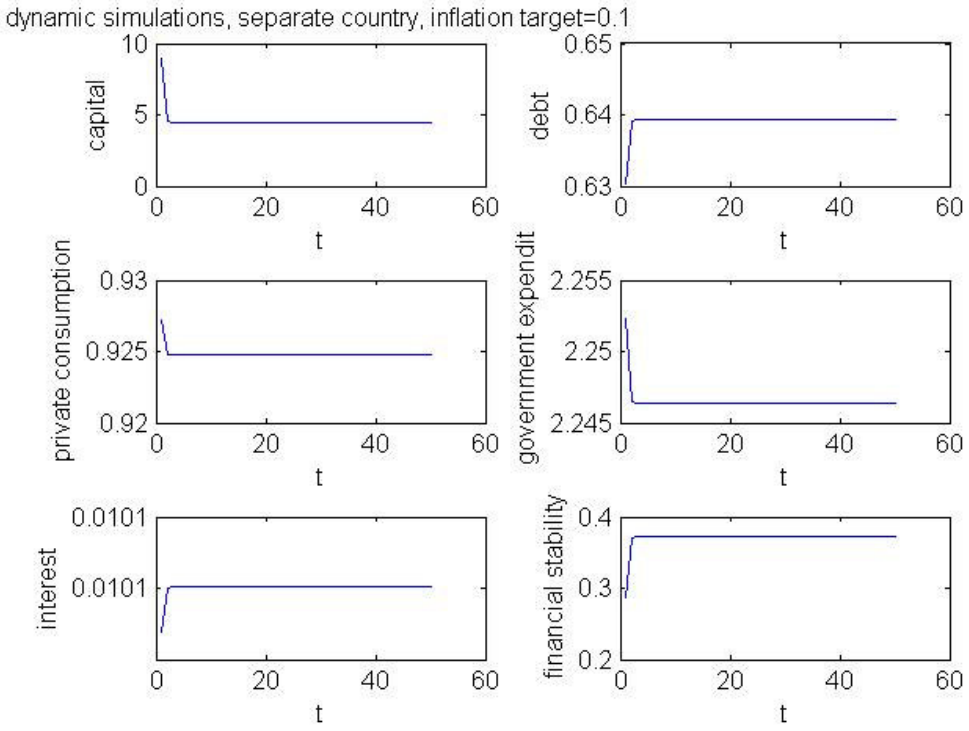


Several conclusions may be drawn from the results of simulations. With no size heterogeneity present within union both countries end up with positive budget surplus indicating the pattern of the complete financial stability in the steady state.

Moreover, results of the simulation show that with increasing size disparity between countries financial stability of large country deteriorates, whereas smaller country becomes more financially stable.

Another conclusion may be drawn about relation of financial stability to monetary policy. In case union central bank keeps lower target, the higher patterns of financial stability are observed. It may be explained by the fact that under lower target lower the seigniorage constitutes lower part of total government revenues; therefore there is lower effect of monetary policy on governmental budget.

Figure 3.3: Simulated Transaction Path for Debt to GDP ratio for monetary union member under its different values of its economy size. (s< 1 – country is smaller member of union, s>1 = country is larger member of union). Inflation target =0.05



Comparing results of separate country simulation with the dynamic path of union members the result of lower elasticity of debt convergence to steady state should be noted. Even although level of steady state financial stability is lower for union country, nothing may be concluded from this fact, because of non-comparability. There a lot of other parameters influencing the financial stability level, which are not controlled, f.e. parameters of other union member. Financial stability of country before and after union entrance may be compared using levels of elasticities defining speed of debt and financial stability convergence. They are presented in tables 4.3 and 4.2. It can be seen that F_{KD} is much lower for independent country, which means higher elasticity for small country. This fact may prove that accumulated over time debt is larger for a member of a union if compared to the separate country.

Chapter 5

METHODOLOGY AND DATA.

5.1 Data description.

The main issues investigated in this study are related to the effects, which arise within monetary unions. There are several examples of real monetary unions, whose data may be taken into account in order to do empirical estimation of the main conclusions of the model.

Economic Community of West African States (ECOWAS) created the monetary union with a goal to achieve a system of commitment to social planer decisions. It was expected that such an organization will let to create gain at least to one of the union members as a result of any policy. Under such scheme the members were required to announce its intentions in future policy before implementing it, which indicate lack of government independency.

In 1865 the Latin Monetary Union (LMU) was formed. It included Belgium, Italy, France and Switzerland. Each state adopted its currency value according to the French franc, whereas every state's currency was legal tender throughout the union. Despite the reciprocal agreement between country's banks to accept each other currency the monetary policy was run independently by each state.

Scandinavian Monetary Union (SMU) was formed by Sweden and Denmark with Norway joined later. As well as LMU the SMU was exchange rate union created to facilitate circulating of member's currencies over the area of union. There was one currency established as uniform unit, but all other currencies were not prohibited from circulation. Full acceptability of the state's currencies over the union created three common currencies. The union was disrupted with the start of the World War I, which created excess floating of union currencies.

Belgium Luxemburg Economic Union set the Belgian franc as a legal tender over the union. Belgium and Luxemburg had central banks, but central bank of Luxemburg had limited capacity of money supply. It could issue Luxemburg francs, which were circulating over the Luxemburg only.

There are many examples of state's colonies, which may be considered as monetary unions too, because of some country's currency circulating as a legal tender over the area but such colonies like British colonies, East Caribbean, CFA Frank zone in Africa are not taken into account by monetary authority issuing that currency. Therefore, colony just agrees to take on the risk of some country in order to gain benefits from well convertibility of the chosen currency[4].

Common currency in the European Monetary union was introduced in circulation on 1 January of 1999 year initially in electronic form and later in 2002 with coins and notes. The Union represents voluntarily agreement on replacing the local currencies and delegating the monetary policy to common monetary authority the European Central Bank. At the same time each country keeps its fiscal policy independence within the limits of some rules established in the common agreement between union members.

In order to choose a union for estimation of empirical model two factors were taken into account. At first the model presented in this study should be consistent with the principles of the union, chosen for empirical testing. Another issue, which should not be disregarded, is data availability.

The theoretical model presented in this study is based on the following principles:

- there is common monetary authority, deciding upon the monetary policy over the union area;
- free movement of production factors, which is facilitated by the circulation of single currency over the union area and absence of the legal restrictions;
- fiscal policy within union's countries is delegated to governments, which are independent in its policy making.

Taking into consideration the above principles and the fact of relatively easy access to data about the union members before and after the union formation, the European Monetary Union is chosen for empirical investigation. Twelve countries are members of the EMU (Eurozone). Initially only 11 countries adopted euro as its currency. These countries are Austria, Belgium, Finland, France, Germany, Ireland, Italy,

[4] (http://www.singleglobalcurrency.org/monetary_unions.html)

Luxemburg, the Netherlands, Portugal and Spain. Greece joined the Eurozone on 1 January of 2001.

Following to the specification of the model I use time series of the corresponding variables. Their brief description is presented in the table below.

Table 5.1 Data description.

Variable	Number of observations (Annual)	Mean	Std. Dev.	Min	Max	Source
GDP at market prices, mil USD	541	289622.4	491526.1	599.56	2811406	WDI2004
GDP deflator for US, at prices of 1995	552	0.6649	0.335065	0.221062	1.240659	WDI2004
Stock of government debt at market prices, mil USD	276	264966.3	372595.7	192.108	1924227	Eurostat
Budget surplus, mil USD	274	-17587	30276.07	-221708	28900.74	Eurostat, WDI2004
Gross Capital formation, current prices, mil USD	456.00	72700.00	108000.00	0.03	557000.0	WDI2004
Capital stock, (at 1995 prices), mil USD	428	761376.8	1039154	7437.1	4240000	Self-constructed using data from WDI2004
Monetary aggregate over the country (before the entrance), M1, mil USD	552	6864.7	33118.4	0	311637.1	Eurostat, WDI2004
Monetary aggregate over the monetary union, M1, bln USD	552	399.962	993.0605	0	3985.744	Eurostat
Quantity of employed workers, thsnds workers	217	12766.58	10976.12	215.5	39315	WDI2004

Dataset is unbalanced because time series of variables are available starting from different points in time but on average all time series include data starting from 1985.

In the process of regressional analysis statistical software will automatically chose the interval with all data available.

Despite the fact that some variables are available on quarterly basis, data were converted into annual terms because of the two reasons: on the one hand - data on some series are reported annually, on the other hand - decision about government debt is usually made annually, while planning the government budget.

Since data for EMU countries are presented both in values of local currencies before the unification and in euro after the unification, all of the monetary variables were converted to USD values, using central bank's exchange rates. As a result data are presented in USD terms in markets prices. In order to transform these series in real values they were adjusted by the GDP deflator for US economy with 1995 as a base year.

Capital stock series is not reported, therefore it was constructed using the perpetual inventory method presented by Summers and Heston (1991). According to this method capital stock is calculated as a summation of investment in capital and all non-depreciated capital from the previous periods. Formally this methodology may be described by the following formula:

$$K_t = (1-d)^t \cdot \frac{I_0}{g+d} + \sum_{k=1}^{t} I_k \cdot (1-d)^{t-k} \text{ , t>0} \qquad (5.1)$$

Where K_t - capital stock at moment t,

I_t - investment in capital at t,

d - depreciation rate,

$g = \left[\prod_{t=1}^{T} \frac{I_t}{I_{t-1}} \right]^{\frac{1}{T}}$ – average geometric growth rate of investment in capital stock, calculated based on historical data.

It should be noted that annual basis of data creates the problem of low number of observations. Annual periodicity of data means that there are at most six observations are available for each country in a period after the entrance to EMU, if counted from

the 1999 when electronic euro was introduced (from 1999 to 2005), which is very small to analyze debt accumulation in a separate country. But if aggregated, these panel data may be used to run least square dummy variable regressional analysis.

5.2 Model specification.

The questions that are investigated in this study may be reformulated as followings:

- is there evidence of change in debt/GDP ratio once the country becomes a member of the monetary union;
- is there relation between value of the debt/GDP ratio and size of the economy for members of the monetary union.

In order to answer the questions of this study the theoretical approach to government debt is used. It states that debt is defined from the governmental budget equation (3.6b)

$$D_t = G_t + r_{t-1} \cdot D_{t-1} + D_{t-1} - \alpha \cdot \frac{\Delta M_t}{P_t} - \tau \cdot y_t \qquad (5.2)$$

According to the theoretical model size of economy is related to the debt accumulation and correspondingly the financial stability. Therefore, including size variable the simplified form of the empirical model is received:

$$D_t = G_t + r_{t-1} \cdot D_{t-1} + D_{t-1} - \alpha \cdot \frac{\Delta M_t}{P_t} - \tau \cdot y_t + c_t \cdot size_t, \qquad (5.3)$$

where c_t - coefficient to be estimated.

According to definition of financial stability the model is transformed to GDP ratios

$$\left[\frac{D}{GDP}\right]_t = \frac{G_t + r_{t-1} \cdot D_{t-1} + D_{t-1}}{GDP_t} - \left[\frac{\alpha \cdot \Delta M / P}{GDP}\right]_t - \left[\frac{\text{Revenues}}{GDP}\right]_t + c_t \cdot \left[\frac{size}{GDP}\right]_t \qquad (5.4)$$

According to assumptions of the model about full repayment of the debt accumulated from previous period the equation (5.4) may be intuitively represented as:

$$\frac{D_t}{GDP_t} = \left[\frac{GovernmentExpendit}{GDP}\right]_t - \left[\frac{Government\,\mathrm{Re}venues}{GDP}\right]_t + c_t \cdot \left[\frac{size}{GDP}\right]_t \quad (5.5)$$

But it is very strong assumption on full repayment of debt every period. Since in reality debt is not repaid after one period the problem of autocorrelation may appear, which will lead to uncertainty in interpretation of estimates. In the table 5.2 correlations between lags of $\frac{D_t}{GDP_t}$ are presented.

Table 5.2 Correlation between lags of the Debt to GDP ratio.

		DtoY	L1.DtoY	L3.DtoY	L3.DtoY	L4.DtoY	L5.DtoY
DtoY	**--**	1					
	L1	0.9802	1				
	L2	0.9637	0.9798	1			
	L3	0.9385	0.9654	0.9816	1		
	L4	0.9184	0.9385	0.9672	0.9815	1	
	L5	0.8872	0.9177	0.9392	0.9663	0.9814	1

The correlations are very high, which indicates the need for structural change of the empirical model. Therefore, the following modification of the (5.3) is proposed:

$$D_t = G_t + r_{t-1} \cdot D_{t-1} + D_{t-1} - \alpha \cdot \frac{\Delta M_t}{P_t} - \tau \cdot y_t + c_t \cdot size_t \Rightarrow$$
$$\frac{D_t - D_{t-1}}{GDP_t} = \frac{G_t + r_{t-1} \cdot D_{t-1}}{GDP_t} - \frac{\alpha \cdot \Delta M_t / P_t}{GDP_t} - \tau + c_t \cdot \left[\frac{size}{GDP}\right]_t \quad (5.6)$$

The endogeneity problem is eased in this model, since interest payments constitute very low part if compared to debt value. Moreover, this approach is more realistic, because it requires that only interests, which are part of total government expenditures, are repaid each period. But the interpretation of the estimation would change because $\frac{D_t - D_{t-1}}{GDP_t}$ is not just a change in financial stability.

$$\frac{D_t - D_{t-1}}{GDP_t} = \frac{D_t}{GDP_t} - \frac{D_{t-1}}{GDP_{t-1}} \cdot \frac{GDP_{t-1}}{GDP_t} \tag{5.7}$$

The term will precisely reflect the change in financial stability issue only in case of no growth, which corresponds to the steady state, whereas in opposite situation the interpretation error is present. Information from Table 5.3 indicates that on average there is small positive growth, therefore, term (5.7) will on average overestimate the change in financial stability, but still is appropriate for investigation of size and entrance impacts on financial stability.

Table 5.3 Description of gross growth rates for countries of EMU.

	Mean	**Std. Dev.**	**Min**	**Max**
Austria	1.053846	0.107353	0.791292	1.392619
Belgium	1.045455	0.109022	0.755503	1.357117
Finland	1.049144	0.110454	0.775427	1.273454
France	1.045645	0.104022	0.801088	1.357556
Germany	1.040424	0.127396	0.767501	1.402315
Greece	1.055312	0.089379	0.842057	1.258987
Ireland	1.0708	0.093464	0.868842	1.32059
Italy	1.051993	0.10326	0.788031	1.385262
Luxemburg	1.0586	0.114909	0.767429	1.428782
Netherlands	1.055087	0.10513	0.764879	1.365005
Portugal	1.056689	0.108236	0.858354	1.397714
Spain	1.07144	0.12083	0.797536	1.358863

There are several problems with such an econometric model. First, the problem of omitted variables may be present since a number of factors influencing the change in debt/GDP ratio are not included into the specification (5.6). It mostly deals with economic factors, whereas some political factors are important. For example, during election year total spending may increase leading to increase of government debt, or necessity to comply pre-entry Maastrich criteria may influence the fiscal behavior.

(Sapir and Sekkat, 2002). In order to tackle this problem dummies for specific periods may be included.

One of the assumptions of the model is a single productive factor - capital, whereas in reality human capital migration is also important shock stabilizing factor. But taking into account that labor mobility within Europe countries is small (Neu, 1999) then its effect may be considered as fixed effect for specific country. It will be captured by the country's dummy. Moreover the number of employed workers may be included into the model as a control variable but problem of possible correlation with size variable should be noted.

Theoretical model does not take into account possible spillover effects between members of the union, which may lead to some estimation mistakes also. It is assumed that production factor only is transferred between countries, whereas in reality the consumption goods are traded too.

Another possible problem is associated with the data set. Since countries of the EMU are different in its technology level and overall economical institutional performance it is expected that assumption on similar technology level in case of no shocks may be violated. However, it still may be valid for EMU, because of compulsory prerequisite convergence criteria, which allow union access only for similar in development countries. In order to tackle this problem the dataset will be divided into several groups based on the economic performance, size and productivity. Dummies for groups will be included in order to take into account mentioned difference between countries.

Other questions are about the effect of size heterogeneity on debt/GDP ratio. In the theoretical model this heterogeneity was introduced as a difference in quantity of equal sized firms, which correspondingly coincides with difference in countries' GDP or in quantity of production factor. In the reality those different measures of size heterogeneity may give contradictory results. That is why here several model specifications are possible. In this analysis the following measures of the size heterogeneity will be used: (1) quantity of employed, (2) GDP, (3) capital stock. According to the means of this variables the groups of large and small countries will be formed.

Eventually, even if the evidence of relation between the entrance to union and change in financial stability will be revealed, still the problem of causality remains. There is uncertainty whether the participation in union lead to change in financial stability or Maastrich requirements force countries to change its behavior with respect to debt accumulation. Since the Maastrich criteria refer to the period before the entrance to union the problem will be investigated with a help of time dummy.

Taking into account correction of described drawbacks the following specification of empirical model is proposed:

$$\left(\frac{Debt_t - Debt_{t-1}}{GDP}\right)_{it} = c_{0i} + \sum_{i=1}^{N-2} c_{1i} \cdot CountryDummy_{it} + c_{2i} \cdot entrance_{it} + ..$$
$$.. + c_{3i} \cdot (PeriodBeforeEntrance) + c_{4i} \cdot (\frac{entrance \cdot ChangeInSize}{GDP})_{it} + ...$$
$$... + c_{5i} \cdot \left[\frac{(1 - entrance) \cdot ChangeInSize}{GDP}\right]_{it} + c_{6i} \cdot \left[\frac{entrance \cdot ChangeInMonetaryAggregate}{GDP}\right]_{it} + . \quad (5.8)$$
$$.. + c_{7i} \cdot \left[\frac{(1 - entrance) \cdot ChangeInMonetaryAggregate}{GDP}\right]_{it} + c_{8i} \cdot \left(\frac{Surplus}{GDP}\right)_{it} + ...$$
$$... + c_{9i} \cdot SizeGroupDummy + \varepsilon_{it}$$

Set of variables included into the model is defined from the theoretical approach to the union's problem (5.6). The revenues are highly correlated with government expenditures, which may lead to the biasness of estimates. Therefore budget surplus to GDP variable is included into model instead of government revenues and expenditures.

Additionally model is extended by the following variables:

- Dummies for "each" country $\boldsymbol{D}$ are introduced to eliminate fixed effects. To avoid multicollinearity between $\boldsymbol{D}$ and *SizeGroupDummy*, two dummies should be excluded from the model. Effect of these dummies will be captured by the constant of the model and dummy *SizeGroupDummy*.

- *entrance* dummy. Its coefficient will be used to conclude over the evidence on change of financial stability of the governments after the union entrance.

- *PeriodBeforeEntrance* variable is included to investigate causality problem, which may arise in interpretation of the results. This dummy is equal to 1 during 2 years before the entrance to monetary union. Such an interval was chosen because, according to Maastrich treaty, potential union members are required to demonstrate convergence during at least 2 years before the entrance. Union authorities compare performance of countries in keeping of price and exchange stability, fiscal discipline over the last two years, therefore it is expected that countries could have been increasing its financial stability starting yet before the entrance to union.

- *ChangeInSize* -variable indicating on change of economy size over time. Coefficient near this variable will show relation between change of financial stability and change of economy size. Amount of capital stock within economy is chosen to represent its size.

- *ChangeInMonetaryAggreate* variable is introduced to see the effect of monetary policy on the change in financial stability. Change of M1 aggregate is taken into account in the estimation process. Before the entrance the M1 aggregate of separate country is used, whereas to see effect within union the M1 aggregate for the whole union is taken.

Table. 5.4 Grouping of countries by size.

Group of small countries (*SizeGroupDummy=0)*	**Group of large countries** (*SizeGroupDummy=1)*
Austria	France
Belgium	Germany
Finland	Italy
Greece	Netherlands
Ireland	Spain
Luxemburg	
Portugal	

- *SizeGroupDummy*. In order to investigate size effect on financial stability countries of the monetary union are ranked according to the following size criteria: output of the country, quantity of employed people, real capital stock and real GDP. Ranking by

each criterion was done using mean values over the time period available. Results of the ranking are presented in Table 5.4. Complete data on countries' ranking according to each of criterion are presented in Appendix 2. Using different measure the same conclusion may be drawn about composition of the large group of countries. Despite some variability between rankings of small countries they are referred to one group.

Available dataset is presented in a form of panel data. Therefore the following econometrical issues should not be disregarded in the process of estimation.

At first, the test in order to detect presence of fixed or random effects should be done. It is expected that despite the convergence between countries' performance each country has its peculiarities of economy structure, which are reflected in fixed effect values. Above specification (5.8) corresponds to least square dummy variable regression representation, which is basically the same as fixed effect model. On the other hand the random effect for each country may be revealed in the data too; in that case dummies for each country will be excluded.

Second, the presence of autocorrelation and heteroscedasticity should be checked. In case of its presence the conclusions on significance of estimates may be deceptive. Under both problems estimates of OLS empirical model are unbiased but not having minimum variance (Gujarati, 1995). Therefore, some econometric techniques should be used to eliminate the problem.

Chapter 6

EMPIRICAL FINDINGS.

6.1 Model estimation.

Regressional analysis of the econometric model was performed using statistical package STATA 8.2. Initially a general model (5.8) was analyzed in order to define its econometric specification. Detailed description of all tests and the results are given in Appendix 3. Results of these tests indicate on significance of autocorrelation and heteroscedasticity. Moreover, there is no clear evidence about type of effect present in data: fixed versus random. Since used software does not give possibility to tackle both problems simultaneously no certain conclusion about model specification can be drawn. Therefore, two sets of estimates will be analyzed: one obtained from the pooled OLS model with variances corrected for heteroscedasticity, and the other one obtained from the model, which copes with autocorrelation and random effect model.

The analysis of the data will be done in a following way. According to formed size categories, the models will be estimated using three different datasets:

1 – dataset for small countries;

2 – dataset for large countries;

3 – dataset for all countries;

Results of the estimation are presented in the following tables.

Table. 6.1 Estimates of the pooled OLS model with heteroscedasticity corrected variances

	Small (S)[5]		**Large (L)**		**Total (T)**	
Stock of Debt / GDP	Coefficient (t-value)	P-value	Coefficient (t-value)	P-value	Coefficient (t-value)	P-value
SURPLUS / GDP	-0.76097 (-4)	0	-0.80616 (-2.31)	0.023	-0.76306 (-4.67)	0
Change of M1*(1-entrance)/GDP	0.609927 (1.45)	0.148	0.269666 (0.93)	0.354	0.43673 (2.42)	0.016
Change of M1*entrance/ GDP	-0.42325 (-0.84)	0.402	-8.84577 (-0.66)	0.508	-0.59416 (-1.07)	0.287
(Change of capital stock)*entrance/ GDP	-7.61795 (-2.06)	0.041	-2.03265 (-0.49)	0.623	-5.73773 (-2.1)	0.037
(Change of capital stock)*(1-entrance)/ GDP	-1.14959 (-1.52)	0.131	-1.53975 (-0.87)	0.384	-1.1579 (-1.7)	0.09
large	(dropped) ()	0	(dropped) ()	0	-0.01722 (-1.48)	0.141
entrance	0.031488 (1.1)	0.274	0.023393 (0.8)	0.428	0.029545 (1.48)	0.139
PeriodBeforeEntrance	-0.05399 (-2.34)	0.021	-0.02877 (-1.09)	0.28	-0.04324 (-2.51)	0.013
constant	0.031578 (2.27)	0.025	0.008786 (0.47)	0.64	0.028819 (2.4)	0.017
Number of obs	148		99		247	
R-squared	0.2232		0.1502		0.1901	

[5] Notations (x) are introduced for convenience of reference to model estimates, f.e. OLS(T) means reference to pooled OLS model estimated with all country dataset.

Table.6.2 Estimates of the random effect model corrected for autocorrelation.

	Small (S)		**Large (L)**		**Total (T)**	
Stock of Debt / GDP	Coefficient (t-value)	P-value	Coefficient (t-value)	P-value	Coefficient (t-value)	P-value
SURPLUS / GDP	-0.77815 (-3.8)	0	-0.76747 (-2.4)	0.016	-0.76606 (-4.61)	0
Change of M1*(1-entrance)/GDP	0.547634 (1.35)	0.179	0.202861 (0.62)	0.536	0.413552 (1.74)	0.081
Change of M1*entrance/ GDP	-0.53132 (-0.67)	0.503	-12.7247 (-0.85)	0.398	-0.65229 (-0.88)	0.378
(Change of capital stock)*entrance/ GDP	-7.96198 (-2.16)	0.031	-0.62594 (-0.17)	0.867	-5.11094 (-1.98)	0.048
(Change of capital stock)*(1-entrance)/ GDP	-1.16004 (-1.28)	0.2	-2.20816 (-1.3)	0.192	-1.32468 (-1.72)	0.085
large	(dropped) ()	0	(dropped) ()	0	-0.01847 (-1.36)	0.175
entrance	0.031586 (1.04)	0.298	0.001747 (0.05)	0.959	0.020498 (0.93)	0.353
PeriodBeforeEntrance	-0.03831 (-1.39)	0.163	-0.02608 (-0.83)	0.404	-0.03202 (-1.57)	0.116
constant	0.030689 (1.6)	0.11	0.020131 (0.76)	0.447	0.031467 (1.99)	0.047
R-sq within	0.2169		0.1349		0.1841	
R-sq between	0.9419		0.9648		0.9527	
R-sq overall	0.2203		0.143		0.1872	
Number of obs	148		99		247	
Number of groups	7		5		12	
Obs per group: min	12		11		11	

As can be seen from the tables, estimates obtained from two models are very similar, which may serve as a support for the robustness of the results.

6.2 Interpretation of the results.

Models demonstrate low explanatory power of the variability in the change of financial stability variable, which may be concluded from the low values of R-squared. However, the aim of this empirical analysis is to investigate presence of specific effects, therefore the high explanatory power is not the main focus and most of

attention should be paid to statistical significance of coefficients and their interpretations. On the other hand low explanatory power may indicate missing variables, which can cause the biasness, but according to theoretical model and corrections of econometric specification is complete.

In general results of the estimation are in line with expectations from the theory:

- Budget surplus is expected to have positive impact on financial stability. Negative coefficient of the surplus to GDP ratio shows that its increase leads to a decrease in the change of debt to GDP ratio, which means improvement of financial stability over time. Both OLS and RE model estimates give significant and similar values of coefficients for large and small countries, indicating the same influence of the surplus/GDP ratio for countries of different size categories.

- Variables *Change of M1*(1-entrance)/GDP* and *Change of M1*entrance/GDP* were included in the model to represent the effect of monetary policy. Several facts should be noted about estimates of the coefficients of these variables: (1) On average, for all countries the coefficient of the *Change of M1*entrance/GDP* variable is insignificant whereas the coefficient of the *Change of M1*(1-entrance)/GDP* variable is highly significant in RE(T) and OLS(T) models. This fact may confirm the evidence that before the union entrance monetary policy was conducted in coordination with fiscal policy or central bank of independent country misused its monetary policy in order to decrease pressure of interest payments borne by government. In turn, insignificance of the coefficient in the case of a union confirms independence between local fiscal policy and monetary policy conducted by a common central bank. It should be noted that lower significance of estimates near *Change of M1*(1-entrance)/GDP* for RE(S,L) and OLS (S,L) models may be explained by small samples. Indeed, small countries dataset estimates of in RE(S) and OLS (S) have both higher significance and larger sample if compared results obtained from dataset of large countries. (2) All coefficients of the *Change of M1*entrance/GDP* variable are negative, which would indicate a counter cyclical relationship between governmental fiscal policy and monetary policies once in a union – debt increases whenever monetary base decreases. But because coefficients are insignificantly different from zero such an interpretation

may be illusory and no strong conclusions can be drawn. The coefficients of the *of M1*(1-entrance)/GDP* variable in the models are positive, which means that on average, for all countries monetary and fiscal polices are coherent, which gives one more argument in favor of significant relationship between monetary policy and financial stability for independent country. Thus, interpretation may be as follows – whenever the government becomes less financially stable the central bank issues money in order to create additional seigniorage revenues for government and to devalue the debt. But the question of causality may prejudice this logic, proposing alternative scenario, where fiscal authority issues debts in period of monetary contraction because of lower interest rates and corresponding interest payments. Therefore, it is not clear whether financial stability decreases with an increase in stock of monetary aggregate or the opposite is true.

- The coefficient of the dummy *entrance* was supposed to show the effect of a change in financial stability after the entrance into the monetary union. Results of the model are slightly controversial. The pooled OLS (T) model tells us about significance of the entrance effect for the whole countries dataset at 15% level, whereas result is highly insignificant for random effect model. Significant and positive value of the coefficient from pooled OLS (T) means that on average for all countries financial stability is decreased (change of financial stability over time is positive) once they are in the union. When the coefficient is not statistically different from zero as in random effect model, value of constant in the model RE(T) 0.031467 (p=0.047) capture value of change in financial stability on average for all countries. Its significant value may serve as a proof of persistent loss of financial stability (f.e., debt accumulation with higher rate then growth of output), which is unchanged after the entrance into monetary union. In order to tackle the problem of causality, the dummy *PeriodBeforeEntrance* was introduced into the models. Both models OLS(T) and RE(T) produce significant and negative coefficient of the *PeriodBeforeEntrance* dummy, which on average indicates the presence of improvement in financial stability before the union membership. Fact that estimates of coefficients for dataset of large countries OLS (L) , RE(L) are insignificant, may indicate that only small countries had

improvement of stability before the entrance. But positive values of coefficients near *entrance* support the evidence of the reversal in improving tendency of financial stability after the entrance to the monetary union. Possible explanation of such a situation may come from the difference in ex-post and ex-ante behavior of the countries. Ex-ante, a government is willing to take all the measures in order to get membership in the union, whereas once the goal is achieved, the incentives to keep the standards become lower. Assuming that credibility of the union authorities is very high, and taking into account prescribed no bail-out rule for the union countries in the case of crisis, the underlying ambiguity over the *entrance* effect may be resolved in favor of the economic effects proposed in this study. But regarding the controversy about significance of the coefficients near *entrance* estimated for the whole countries dataset – significant at 15% in a pooled OLS (T) and insignificant in random effect model RE(T) - this conclusion should be taken with precaution.

Table 6.3 Test on equality in absolute values of coefficients near large and entrance variables.

	Random effect:	**Pooled model**
(1) - Null hypothesis of the test *Test statistics,* *P-value*	*(1) large + entrance = 0* *chi2(1) = 0.30* *Prob > chi2 = 0.5812*	*(1) large + entrance = 0* *F(1, 238) = 0.29* *Prob > F = 0.5927*

Both models indicate that on average larger countries have tendency to increase its financial stability, which may be interpreted from negative coefficient of the dummy *large*. Coefficient is significant at 18% level in both models. Taking into account a low number of observations, such a significance level still may be appropriate. In order to make conclusion about entrance impact on change in financial stability of large and small countries joint effect of the *entrance* and *large* variables should be analyzed. Analysis in the Table 6.3 may be of use. It shows that there is no entrance impact on financial stability for large countries, whereas based on all countries dataset OLS(T)estimate of coefficient near *entrance* (0.029545, p=0.139) conclusion about evidence of a smaller financial stability once in the union for small

countries may be drawn, whereas random effect RE(T) model says about absence of significant effect.

Another approach to analyze the size effect is to use the coefficients of the *(Change of capital stock)*(1-entrance)/GDP* and *(Change of capital stock)*entrance/GDP* variables. These variables were constructed in order to reflect influence of amount of capital in the economy during periods before and after the entrance to the union in the following way:

$$\frac{(\text{Change of capital stock})*(1-\text{entrance})}{\text{GDP}} = \frac{\text{CapitalStock}_t - \text{CapitalStock}_{t-1}}{\text{GDP}_t} \cdot (1-\text{entrance})$$

$$\frac{(\text{Change of capital stock})*\text{entrance}}{\text{GDP}} = \frac{\text{CapitalStock}_t - \text{CapitalStock}_{t-1}}{\text{GDP}_t} \cdot \text{entrance}$$

Several interpretations of coefficients near these variables are possible. Coefficients may serve to indicate impact of a change in relative to GDP size of economy on the change in financial stability. On the other hand according to the following correspondence between regressor and regressand (6.1) the coefficient may indicate on change of public debt in response to change of size measure. But nothing is said about change in GDP, therefore financial stability effects may not be inferred.

$$\frac{D_t - D_{t-1}}{GDP_t} \approx \frac{\text{CapitalStock}_t - \text{CapitalStock}_{t-1}}{\text{GDP}_t} \qquad (6.1)$$

Additionally, since both regressor and regressand variables represent differences weighted by GDP, the interpretation can be applied to levels too, giving the impact of a relative size of the economy on financial stability. But this last interpretation has the already mentioned effect of measure overestimation, which should be taken into account. It should be noted that the ratio of capital stock to GDP may also indicate the efficiency of capital utilization. Hence, if the ratio is low then country is more efficient in production, whereas if the ratio is high, the country is less efficient. This ambiguity in interpretations arises because of the assumption of equality of country's marginal productivities of capital in a steady state, which leads to the same level of efficiency of production in both countries. As mentioned before, there is some

evidence in support of this assumption: (1) EMU was created on the basis of the long-lasting relations between countries, which led to process of reallocation of resources and technology levels in such a way that productivity of all regions became similar on average; (2) all of EMU members are developed countries; (3) although the Maastrich Treaty does not set the productivity criteria, established stability requirements may be more likely met only when countries have similar production characteristics.

I will stick to relative size measure interpretation. Estimates of the coefficient of the *(Change of capital stock)*entrance/GDP* variable are significant for small countries dataset and for general datasets (OLS(S,T) and RE(S,T)). Its negative sign indicates that with increasing relative size of an economy, financial stability improves. The conclusion is in line with the one obtained from interpretation of the negative coefficient of the dummy *large*. On the other hand, the coefficient of the *(Change of capital stock)*(1-entrance)/GDP* variable has lower significance in the model estimated with all countries dataset (T) if compared to the *(Change of capital stock)*entrance/GDP*. Moreover, lower absolute value of the coefficient near *(Change of capital stock)*(1-entrance)/GDP* [-5.11094, (p=0.048)] after the entrance versus [-1.32468, (p=0.085)] indicates that on average relative size of economy has lower impact on financial stability before the entrance into the monetary union: particularly models estimated on datasets for small and large countries (OLS(S,L) and RE(S,L)) separately show insignificance (under 18%) of *(Change of capital stock)*(1-entrance)/GDP*. Therefore, the conclusion may be drawn that relative size of economy has higher impact on financial stability of a union members if compared to separate countries case, which indicates the importance of size heterogeneities within monetary union for policy analysis.

Summarizing, the empirical results it should be outlined that no clear evidence of change in financial stability for large countries after the union entrance is observed, whereas stability of small countries deteriorates. This inference contradicts to the theoretical approach which concludes about higher stability for small countries. An interesting finding was revealed about improvement of stability right before the entrance with following decrease of financial stability after the unification. Analysis also confirms the relation between economy size and financial stability for union

members, whereas the relation for separate countries is much lower. Thus with increasing relative size of economy financial stability improves for the union members. Once again the problem of causality should be addressed in order to mention possible uncertainty in interpretations.

Chapter 7

SUMMARY AND CONCLUSIONS.

The focus of this study was turned to the questions governmental financial stability of union members before and after the unification. The problem of relation between financial stability and union membership is broken into two issues. Initially, the effect of entrance to monetary union on financial stability was discussed, with later extension to intra-union impacts, arising from the common monetary policy within monetary union.

The issues are initially analyzed with a help of theoretical general equilibrium model, incorporating the decision-making of governments, monetary authority and private agents. Using the log-linearization, model was solved for dynamic solution, which was used for further simulations of macrovariables of separate country and union members. The results of simulations show that size asymmetry leads to asymmetric patterns of financial stability time path. Thus in case of no size disparities all union members gain improvement of stability, whereas with rising size disparity large stability of large countries deteriorates. Simulations of the financial stability patterns show that separate countries face higher rate of steady state convergence if compared convergence for union member. This result may give intuition about negative impact of union entrance on financial stability, but the conclusion should be taken with cautions since the final result is dependent on parameters of the other union members.

In order to test conclusions obtained from theoretical model and simulations, the dataset for 12 countries of European Monetary Union over period from 1985-2005 was used. Econometric model was based on the solution of theoretical approach to the union problem. It was extended with additional variables needed for correction of potential problems with proposed econometric specification. Results of the econometric specification tests indicate that estimates of both fixed effect and random effect model should be estimated in order to check for robustness of estimates.

Moreover data showed the need for autocorrelation and heteroscedastcity correction which was done by the chosen econometric specification.

As a result of estimation, similar estimates were obtained from different specification, which proves robustness of model. Estimates were found separately for the large and small counties groups and for the whole dataset. Size groups were created based on the mean values of the GDP, quantity of employed people and capital stock within economy.

Results of the estimation show the following evidence. There is support of positive relation between surplus to GDP ratio and financial stability. Data indicate on strong negative relation between change of monetary aggregates and financial stability in separate economy, whereas for union members the relation is absent.

Some findings contradict to results obtained from simulations. Thus, despite the expected higher stability for smaller countries data reveal that smaller countries are on average less financially stable. Moreover, data shows that if relative size of union-member increases its financial stability improves. Theoretical model does not clearly states about entrance impact on financial stability, whereas empirical findings show adverse effect for small countries.

A number of drawbacks of the proposed theoretical approach may be used to explain the divergence between empirical and theoretical results. Such assumptions of theoretical model like "coercion" to buy public debt by private agents, form of utility functions contradict to reality. Moreover, single production factor in economy and free capital mobility may be violated. But nevertheless, the theoretical approach may be extended in order to incorporate possible correction to achieve better fit to reality, which provides idea for further research in a field.

On the one hand simplifications involved into model give a possibility to investigate the economic effects on the issue in contrast to political economy approaches, which are previously used by some authors.(Beetsma, Bovenberg,1995, Jahjar,2001). On the other hand, it creates stimulus for more deep analysis of the questions in order to get better compliance with empirical findings.

In general, although different approach was used the obtained results agree with Shalk's (2003) conclusions about beneficial position of small union members.

As summary of the research it should be outlined that financial stability of monetary union members is subject to size disparities between union members, which indicates importance of the issue in order to continue the further work over the topic, using following extensions: (1) extension of the theoretical model to incorporate stochastic process of change in relative productivity between union countries may introduce the conflict of interests problem, which is known to arise within union members; (2) restructuring of the empirical model in order to have more clear interpretations of relation between variables and financial stability; (3) investigation of impact from introduction of different policy restriction.

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