Marketta Henriksson

ESSAYS ON EURO AREA ENLARGEMENT

HELSINKI SCHOOL OF ECONOMICS

ACTA UNIVERSITATIS OECONOMICAE HELSINGIENSIS

A-266

Marketta Henriksson

ESSAYS ON EURO AREA ENLARGEMENT

HELSINKI SCHOOL OF ECONOMICS

ACTA UNIVERSITATIS OECONOMICAE HELSINGIENSIS

A-266

ISSN 1237-556X
ISBN 951-791-988-3
ISBN 951-791-989-1 (e-version)

Helsinki School of Economics -
HSE Print 2006

To My Father

Acknowledgements

I started my doctoral studies in the fall of 1999, in the middle of the first Finnish EU Presidency. My choice of topic was quite clear from the beginning, as already my Master's Thesis dealt with the European Monetary System. Moreover, topics related to the functioning of the euro area and its enlargement have been an essential part of my duties since I started working at the Ministry of Finance in 1998. Indeed, the interaction between my academic and non-academic work has proved fruitful. Now, more than 6 years after the start of my doctoral studies, with the next Finnish EU Presidency approaching, I am happy to see this academic project concluded before the first new Member States are - hopefully - accepted into the euro area next summer.

It would not have been possible to complete this academic project, and balance it with work, without the help and support of a number of people. I am especially grateful to Professor Pertti Haaparanta, who was my supervisor already during my Master's Thesis and encouraged me to continue with doctoral studies. Pertti has been a constant source of advice and has had understanding for the challenges of working while writing a dissertation. I am equally indebted to Professor Jouko Vilmunen, who first, provided valuable comments to my Licenciate Thesis as one of its pre-examiners and second, offered ideas and advice, as I continued onto a doctoral dissertation. Jouko always had time for my questions, especially when I struggled with numerical methods.

I would also like to thank my pre-examiners, Professor Mikko Puhakka and Dr., Docent Juha Kilponen. Mikko was the other pre-examiner of my Licenciate Thesis and provided helpful suggestions and corrections to both works. Juha's comments to my dissertation improved the quality of the work considerably and he has also been kind enough to give me some technical advice. During my doctoral studies I have also benefited from the help and support of fellow students, especially Kirsti Kuisma and Tuuli Juurikkala, with whom I have shared experiences of economics studies since 1993, and Iikka Korhonen, who has provided valuable comments to all of my papers.

I would also like to express my gratitude to the Ministry of Finance for allowing me to take on this project. There are several people in the Ministry, who deserve thanks. Two people, however, require a special mention, Martti Hetemäki and Ilkka Kajaste. Martti has encouraged me from the start of this project and has shown constant interest in its progress, which has provided needed support for my motivation, especially in bringing this project to an end. Ilkka was the one, who originally hired me to the Ministry and has since

provided encouragement with regard to my work as well as my studies. He was also the one, who allowed me to use worktime for attending classes, a decision that has benefited a number of people, who have later taken up doctoral studies in the Ministry.

I have benefited from financial support from the Yrjö Jahnsson Foundation, which I am very grateful for. I would also like to express my appreciation to the Bank of Finland for the time I spent at their Research Department and for publishing some of my work. In addition, I thank Liisa Roponen for checking the language of this dissertation.

Family and friends naturally form the basis that enables one to take on such projects and balance them with the rest of life. I would first like to thank my parents, who installed in me a faith in myself that allowed me to start this project and the "sisu" to finish it. My only wish is that my father would have been here today to see me finish this project, and therefore, I have dedicated this dissertation to him. Many friends ought to mentioned. I would like to thank Eija and Ulla, who have been a source of support and friendship for a number of years and last but not least Kirsti, whose contribution has not been limited to helping me through the micro and macro courses but to many aspects of my life. Finally, this day would not be the same without Tom, who has always been able to help me put things in perspective and whose love and support in the last five years have had a huge impact on my life.

Helsinki, December 2005
Marketta Henriksson

Abstract

This dissertation examines issues related to the adoption of the euro by the new Central and Eastern European EU Member States.

The first essay studies the interaction between fiscal policy and the price level in different exchange rate regimes. The theoretical framework is based on the Fiscal Theory of the Price Level (FTPL). The results show that a credibly fixed exchange rate is inconsistent with fiscal irresponsibility, which implies that fiscal discipline is a prerequisite for successful participation in the exchange rate mechanism ERM II, while countries unable to commit to sound fiscal policies, probably should not commit to a fixed exchange rate either. Paradoxically, adoption of the common currency enables a country to conduct irresponsible policies, with the result that a rise in the debt level of one country raises the common price level of the monetary union.

In the second essay, a small open economy model is constructed, which allows the examination of the effects of Balassa-Samuelson-type growth - i.e. faster productivity growth in the traded goods sector than in the non-traded goods sector - in an intertemporal fixed exchange rate framework with a focus on the external balance, which has gained less attention in earlier research. The numerical simulations imply that the Balassa-Samuelson effect may increase the vulnerability of the economy. However, trade account deficits would appear to be a temporary phenomenon, as the deficits are decreased by the natural shift in the composition of consumption towards non-traded goods that is characteristic of catch-up.

The focus of the third essay is the effects of the EU fiscal policy rules on the fiscal variables, namely deficit and debt, and the external balance in the new Member States participating in ERM II. The numerical simulations show that a fiscal rule based on debt may be better at providing stability into the economy, while a deficit rule implies a smoother response to a transitory increase in output. External imbalances appear to be a natural part of the convergence process, which cannot be eliminated through the use of fiscal rules alone.

Key words: ERM II, Fiscal Theory of the Price Level, Balassa-Samuelson effect, small open economy, external balance, fiscal rules

Contents

1 Introduction

1.1 Background

This dissertation tackles issues related to the adoption of the euro by the Central and Eastern European Countries (CEECs) - the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Slovakia and Slovenia. All of these new EU Member States are expected to join the euro area by the end of the decade when the readiness of these countries to adopt the euro will be measured by their performance with regard to the Maastricht convergence criteria on price and exchange rate stability, sustainability of the government financial position and long-term interest rates. As the convergence process - which entails fast growth and inflation - is still on-going, the criteria may prove quite demanding for these countries. The external balance as such is not included in the convergence criteria but is likely to factor in the decision making, especially as persistent external imbalances have emerged in several of the new Member States.

Since the beginning of transition, the discussion on the different exchange rate regime possibilities for the CEECs has been lively. Early in transition, the advice usually was to peg the exchange rate, since a fixed peg can serve as a policy anchor for macroeconomic stabilization, while the necessary institutional framework, including market-based hard budget constraints, is being developed. According to an alternative view, a flexible rate could be useful for maintaining external competitiveness and could serve as a more immediate cauge for macroeconomic discipline, without constraining the transformation of the economy. However, it has also been pointed out that the debated role of exchange rate policies has not turned out to be a crucial determinant of success or failure of the transition (IMF 2000, Wyplosz 2000).

As transition has progressed, the aspect of future participation in the euro area has gained more attention in the exchange rate regime discussion. The Ecofin Council (2000) has indicated that before joining the exchange rate mechanism ERM II - a requirement for adoption of the euro - there are no restrictions on the choice of the exchange rate regime, with the exception that unilateral adoption of the euro, euroization, has been ruled out. Indeed, varying suggestions for the appropriate way to proceed to the single currency have been proposed. Some have suggested a specific solution for all, such as crawling parities (Begg 1998), euroization (Begg et al. 2003, Buiter and Grafe 2002) or that some weight should be given to an exchange rate target and some to an

inflation target (Masson 1999, Bofinger and Wollmerschaeuser 2000, Corker et al. 2000), while others have preferred the outcome that several regimes, both fixed or flexible, are suitable for the transition countries (Backé 1999, Hochreiter 2000). Based on the countries' experience so far, one would tend to agree with this last conclusion, which is in line with Frankel (1999), that no single currency regime is right for all countries at all times. Switching to a single regime - ERM II and eventually, adoption of the euro - is, however, becoming a reality.

Most of the new Member States have already joined the ERM II: Estonia, Lithuania and Slovenia joined in June 2004, Latvia, together with the non-transition new Member States, Cyprus and Malta, in May 2005 and Slovakia in November 2005. Three CEECs still remain outside the mechanism with plans to join in a few years time. The ERM II, being a fixed exchange rate regime, is likely to set its own requirements to the conduct of economic policy. The open economy trilemma indicates that of the three objectives - fixed exchange rate, monetary policy independence and open capital markets - only two can be mutually consistent (Obstfeld et al. 2004). In the ERM II framework, this implies the transfer of monetary policy authority to the European Central Bank (ECB).

The loss of monetary policy independence underlines the importance of fiscal policy as a domestic policy instrument. Room for manoeuvre of fiscal policy may, however, also be limited. According to the Fiscal Theory of the Price Level (FTPL) - which states that fiscal policy, not the money supply, is a key determinant of the price level - meeting the criteria on price level and exchange rate stability may set requirements for fiscal policy.[1] In the FTPL terminology, what is required is a Ricardian regime, where fiscal policy is assumed to adjust to ensure that the government intertemporal budget is always in balance. Coincidentally, it has been shown that the Maastricht fiscal criteria are sufficient to force a country into a Ricardian regime. As a matter of fact, some new Member States have already announced that they do not plan to participate in the ERM II until the public finances deficit has been brought to less than 3 per cent of GDP. Hence, it appears that fiscal policy affects the choice of the exchange rate regime and the timing of ERM II entry.

Moreover, the ERM II stage coincides with striving to meet the Maastricht criteria. Meeting the Maastricht criteria posed a challenge already for the current euro area countries. The new Member States will strive to meet these criteria in an environment of real convergence, which can be described as

[1] The FTPL has been examined by e.g. Leeper (1991), Sims (1994), Woodford (1994, 1995, 1996, 2001, 2003), Canzoneri et al. (1998, 2001a, b), Walsh (2003).

convergence in standards of living as well as in productivity and price levels. Hence, in the future enlarged monetary union, growth differentials are going to be pronounced. Moreover, price levels rise with GDP per capita, as stated by the Balassa-Samuelson proposition, which implies that inflation differentials are going to be a prominent feature in the euro area.[2] Indeed, due to the Balassa-Samuelson effect, the new Member States may experience difficulties in meeting the exchange rate or inflation criteria but the effects from such convergence may not be limited to these two variables.

Besides meeting the Maastricht criteria, the new Member States must adopt the EU rules, which include the EU fiscal framework. According to the Treaty, the Member States are obligated to avoid excessive government deficits, with reference values defined at 3% for general government deficit as a share of GDP and at 60% of GDP for public debt, while the Stability and Growth Pact (SGP) stipulates that the Member States should aim for budgetary positions close to balance or in surplus in the medium term. Will the implementation of these rules constrain the development of these countries or will it provide support in attaining fiscal and external sustainability in an environment of real convergence?

This dissertation aims to provide a broad picture of the challenges that lay ahead of the new Member States that are still engaged in convergence with the current euro area. The objective is to determine whether the EU requirements, such as participation in the ERM II or the fiscal rules, could provide support for the new Member States in the preparations for participation in the euro area and in the convergence process in general or whether for example the ERM II is "an interim stage of some danger on the road to full integration" as claimed by Begg et al. (2003).

1.2 Overview of the essays

The three essays in this dissertation deal with the various issues related to the adoption of the euro by the new Central and Eastern European Member States.[3] There are linkages between the different convergence criteria as such,

[2] The Balassa-Samuelson hypothesis - which originates from Balassa (1964) and Samuelson (1964) - asserts that faster productivity growth in the traded than in the non-traded goods sector results in a rise of the price of the non-traded good and a trend appreciation of the real exchange rate, which in fixed exchange rate regimes is visible as higher inflation. The size of the Balassa-Samuelson effect has been estimated in different studies to be 0-2 percent per year. (See e.g. European Commission (2004) and Mihaljek and Klau (2003)).

[3] In the statements published in conjunction with the ERM II entries of the new Member States, inflation, current account deficits and the fiscal policy stance were highlighted as

e.g. between price level and exchange rate stability and fiscal discipline, which form the topic of the first essay. Moreover, the fast output growth, an inherent part of the convergence process, is likely to bring its own complications, e.g. pressures on inflation or the exchange rate or the increased vulnerability of the economy. These issues are examined in the second essay. The central role of fiscal policy surfaces in the first two essays, so the third essay examines the effects of the EU fiscal policy rules on external and fiscal sustainability in an environment of real convergence.

Fiscal Policy and the Exchange Rate Regime Choice

The first essay "Fiscal Policy and the Exchange Rate Regime Choice" attempts to answer the following questions: What exchange rate regime should the new Member States adopt prior to ERM II participation; what is required for successful ERM II participation and fulfilment of the Maastricht criteria; and finally, what happens after the adoption of the euro. Specifically, this essay examines the interaction of fiscal policy and the price level in different exchange rate regimes - i.e. the range of regimes between fixed and flexible that are or have been in place in the new Member States or that have been suggested by e.g. academic research.

The analysis employs a theoretical framework based on the Fiscal Theory of the Price Level (FTPL). The FTPL combines monetary and fiscal policies and provides, as noted by Ballabriga and Martinez-Mongay (2002), a holistic approach to macroeconomic analysis. The theory originates from Leeper (1991), Sims (1994) and Woodford (1994) and views the price levels as being determined by the budgetary policies of the fiscal authority. Following Woodford (1995), the FTPL differentiates between Ricardian (money dominant) and non-Ricardian (fiscal dominant) regimes. In a Ricardian policy, primary surpluses adjust to guarantee fiscal solvency for any sequence of prices, in contrast to a non-Ricardian policy, where primary surpluses are not affected by government debt. However, as has been noted by Christiano and Fitzgerald (2000), the non-Ricardian assumption is probably not a good characterization of policy at all times and places. Nevertheless, just recognizing that the possibility for such policies exists, may help to avoid them.

This essay provides a formal analysis of the FTPL in different exchange rate regimes. In earlier work, only Canzoneri et al. (1998, 2001a) have examined the FTPL in different exchange rate regimes but their analysis was not based on a thorough formal model. Moreover, the purpose is to use this analysis

special policy challenges (European Union 2004, 2005a, b).

to discuss the choice of exchange rate regime in the new Member States and the level of commitment in fiscal policy The countries aiming to adopt the euro vary in their choice of the exchange rate regime as well as their level of fiscal commitment. The aim is to analyse the interaction between fiscal policy and the price level in the ERM II, a fixed exchange rate regime and a variety of other regimes in place in the countries planning to adopt the euro. The model in this essay is adapted from Bergin (2000), who examined the FTPL in a monetary union framework. Here, this model is extended to different exchange rate regimes, which include both fixed and flexible arrangements.

The results show that if fiscal policy is responsible, the price level is determined in the traditional way and the fiscal variables have no effect. On the other hand, no exchange rate regime as such can impose responsible fiscal policy. Responsible (Ricardian) fiscal policy is defined as a policy, where the government always guarantees its own solvency, while irresponsible (non-Ricardian) fiscal policy is such that the government does not pay attention to the development of public debt.

For fixed exchange rate regimes, it is found that irresponsible fiscal policy is inconsistent with a credibly fixed exchange rate. Thus, if the exchange rate is to be credibly fixed within ERM II, the participating country is forced to conduct responsible fiscal policy, or otherwise exit the regime. This requirement for responsible fiscal policy is naturally strengthened by the requirements set by the Maastricht criteria on public finances, especially as it has been shown that the Maastricht fiscal criteria force a country to conduct a Ricardian policy.[4] Due to the high costs of abandoning a currency board, it is concluded that a currency board is best at forcing fiscal discipline. Dollarization, or euroization, does not set the same kind of constraints on fiscal policy as other fixed exchange rate regimes and furthermore it may not be beneficial from the point of view of the country whose currency is being used, as it may experience some effects on its price level.

With a flexible exchange rate regime, on the other hand, the effects of irresponsible fiscal policy are visible as fluctuations in the nominal exchange rate, which can then have nominal and real consequences. Responsible fiscal policy is a requirement for a stable nominal exchange rate also in a flexible exchange rate regime.

In a monetary union, irresponsible fiscal policy by one country raises the price level of the whole union, which suggests that responsible fiscal policies

[4]Canzoneri and Diba (1996) find that limiting the government's total deficit (primary deficit plus interest payments) to 3% of GDP achieves this, as does a Maastricht-type debt limit, as shown by Woodford (1996).

are essential for the functioning of the euro area. Indeed, the FTPL could be seen to provide some rationale to the EU fiscal framework. Nevertheless, as noted by Canzoneri and Diba (2001), it is clear that the policymakers did not have this theory in mind when they drafted the Stability and Growth Pact. A recent Commission paper (Ballabriga and Martinez-Mongay 2002) shows that the SGP is actually working, as EMU operates in a monetary dominant regime.

What exchange rate regime should a country aspiring to join the euro area then, according to this analysis, choose before it joins the ERM II? Countries aiming for a stable nominal exchange rate need to conduct responsible fiscal policy, while countries unable to commit to responsible fiscal policy probably should not commit to a fixed exchange rate either. Indeed, Woodford (2003) emphasizes that a suitable fiscal policy commitment is an essential part of a policy framework to achieve macroeconomic stability, in addition to a suitable monetary policy commitment. On the one hand, abandoning a fixed regime may be costly but nominal exchange rate adjustment on the other hand, will also involve adverse consequences. Countries with responsible fiscal policies may enhance the credibility of their policies by committing to a fixed regime. Nevertheless, it should not be forgotten that fiscal policy responsibility or irresponsibility is only one factor in the determination of the appropriate exchange rate regime.

Productivity Differentials and the External Balance in ERM II

In the second essay "Productivity Differentials and the External Balance in ERM II", a model that is suited for analyzing convergence and growth related questions in small open economies participating in the ERM II is constructed. The convergence process is depicted by the Balassa-Samuelson framework, which implies that growth differentials are assumed to stem from differences in productivity growth, i.e. the home economy will experience faster productivity growth in its traded than its non-traded goods sector.

As a matter of fact, much research on the euro area enlargement has focused on the Balassa-Samuelson effect, with the effects on the equilibrium real exchange rate gaining special attention while in general the implications of the Balassa-Samuelson effect in an intertemporal framework appear to have gained less attention. Here, the focus will be on the effects on the external balance.

In the model, both the home economy as well as the monetary union produce a traded good and a non-traded good using labour as the only input. The model is set in a fixed exchange rate framework, which entails that the small

open economy takes the interest rate as exogenously given by the central bank of the monetary union.

The numerical analysis in this essay focuses on the Baltic states that are first, small open economies; second, have a tradition with fixed exchange rates and third, can be considered as front-runners in euro adoption. Moreover, the sustainability of the external balance has been questioned particularly in the case of the Baltic states. The issue was for example taken up for all three countries in the statements published in connection with the entry into ERM II (European Union 2004, 2005a).

The simulations in the essay provide support for the Balassa-Samuelson effect, i.e. faster productivity growth in the traded than in the non-traded good's sector shows up as an increase in the price of the non-traded good and an appreciation of the real exchange rate – and therefore as inflation, because in fixed exchange rate regimes the Balassa-Samuelson effect is visible as higher inflation. However, the focus in this essay goes beyond this supply-side effect to the implications on the external balance.

The simulations show that permanent shocks to productivity, i.e. convergence of productivity and output levels, can have effects on the trade account and the net foreign asset position of a small open economy. Trade account deficits (surpluses) grow easily when the country experiences a permanent productivity shock in its traded goods sector, which leads to the accumulation of negative (positive) net foreign assets. This implies an increased vulnerability of the economy. Also transitory shocks appear to have longer-term consequences, especially for net foreign assets.

Convergence is, however, often related to a shift in consumption preferences. Typically, as an economy catches up, the share of non-traded goods, i.e. services, in total consumption tends to increase. This reinforces the supply side Balassa-Samuelson effect, i.e. the relative price and the real exchange rate rise more strongly, but reduces the effects on the external balance. As the share of non-traded goods in consumption increases, the trade balance deficit improves. Hence, trade account deficits would appear to be a temporary phenomenon in countries that are still catching-up.

The Baltic states, used as reference countries here, all have significant trade and current account deficits. Nevertheless, based on the findings in this essay, it would appear that the large trade and current account deficits may not be such a serious cause of concern after all. Changes in the composition of consumption that are characteristic to the transition process may provide a natural correction in the course of catching-up. Yet, a careful monitoring of the development of the net foreign asset position should not be neglected.

The Balassa-Samuelson effect, and fast growth in general, increase the vulnerability of the small open economy. To counter these problems, the policy advice most often centers on fiscal policy. First, fiscal policy has a crucial part in keeping the trade and current account deficits in check. Second, fiscal policy also helps bring down inflation that is also influenced to some extent by the Balassa-Samuelson effect. Third, fiscal policy is key in containing pressures for over-heating that may appear in fast growing economies and finally, prudent fiscal policy is a requirement for meeting the Maastricht fiscal criteria.

Growth and Fiscal Rules in ERM II

The third essay "Growth and Fiscal Rules in ERM II" builds from the model of the second essay and examines the effects of EU fiscal policy rules on the fiscal variables and external balance in the new Member States. In contrast to the model of the second essay, the Balassa-Samuelson assumption is dropped, capital added and taxes made distortionary. The small open economy again has a fixed exchange rate and takes the interest rate as given.

The fiscal rules are formulated to resemble those of the EU, i.e. they include limits on the government deficit or debt. In most studies on fiscal policy rules, the focus has been on the interaction between the fiscal and monetary authorities and on the effects on price level determination. This focus coincides with the analysis in the first essay. The findings indicate that in general, fiscal policy - and fiscal rules - matter for price level determination. In this essay, attention is centered on the effects on fiscal and external sustainability in an environment of convergence of output levels via productivity shocks. Moreover, while these papers for the most part have studied an active monetary policy, e.g. based on the Taylor rule, monetary policy in this essay, does not play a role, as the small open economy takes the interest rate as exogenous.

The simulations show that the debt rule ensures a stable debt-output-ratio and a zero deficit at all times, while the deficit rule guarantees only the latter. When the economy is hit by a transitory increase in output due to a productivity shock, the reactions with the two rules differ. A government employing a debt rule will lower taxes much more than a government using a deficit rule that cuts taxes more gradually, while there is a surplus in public finances and decreasing government debt. This implies that the government employing a debt rule is also forced to raise the tax rate much faster due to increases in the debt level. Adjustment with the deficit rule is smoother. Hence, based on the results from a transitory productivity shock, the deficit rule appears perhaps more suitable and could provide a suitable anchor for

public finances, at least in the short term. In the long term, an increased focus on debt is likely to be needed.

The recent change of the Stability and Growth Pact has placed greater attention to debt. A further improvement to the EU framework would be increased attention on debt levels, especially the growth of debt levels. As can be seen from the results here, a debt-output target keeps the debt ratio stable, even when output growth is very fast. Thus, also debt levels rise rapidly. Indeed, debt growth is a factor that should be taken into consideration in the analysis of Member States' public finances, especially those of the countries experiencing significant output growth.

With regard to external sustainability, the debt rule cannot constrain the accumulation of negative net foreign assets in case of a permanent shock to productivity, while the properties of the deficit rule do not allow an examination of a permanent shock, and hence a comparison between the two rules. It would appear that external imbalances and the accumulation of net foreign assets might be an unavoidable consequence of the convergence process. As fiscal rules prove not to be a panacea in this respect, it appears that attention needs to be paid also to the growth of private sector indebtedness. Finally, external imbalances might have to be accepted as a fairly permanent phenomenon in these countries, as long as they are catching up to the old Member States. Regardless, their development needs to be carefully monitored.

To conclude, the choice of the appropriate fiscal policy rule depends on the policymakers' preferences as well as on the nature of the most prevalent shock. On the one hand, use of the debt rule appears to achieve better results with regard to output growth by restricting excessive debt growth, which is important for the countries that are still catching-up. On the other hand, following a deficit rule seems to ensure a smoother adjustment when there is a transitory productivity shock, a fact which points to the usefulness of deficit rules, especially for the new Member States, who are aiming to meet the Maastricht criteria.

1.3 Concluding Comments

The first new Member States should, hopefully, be accepted into the the euro area in 2006. Before any decisions are taken, the fulfilment of the convergence criteria will be assessed and this moment will also provide an opportunity to evaluate the functioning of the exchange rate mechanism ERM II for these

countries that are still catching up to the current euro area. Currently, it appears that the ERM II has functioned well, and meeting the exchange rate criterion should not pose problems. The inflation criterion appears, at the moment, the most challenging of the convergence criteria for the three countries - Estonia, Lithuania and Slovenia - planning a changeover into the euro at the start of 2007.

In this dissertation, the different aspects of the upcoming euro adoption in the new EU Member States are discussed. The aim is to go beyond the conventional discussion on whether the new Member States should join the ERM II or adopt the euro. The essays in this dissertation hope to combine in a new manner the different topics raised in the debate and thus, contribute to the discussion.

To begin with, choice of exchange rate regime was looked at from the point of view of fiscal policy with the effects of fiscal policy on the price level playing a central role. In the last two essays, the new Member States were assumed to be already participating in the exchange rate mechanism ERM II. The focus was moved to coping in an environment of fast growth with external imbalances gaining special attention. Finally, fiscal considerations were again brought to the fore: this time to examine their role in containing the effects of fast growth.

The findings underline the importance of fiscal policy as a central policy instrument. Fiscal discipline is not important solely for the fulfilment of the Maastricht fiscal criteria but, as it turns out, also for the criteria on exchange rate and price level stability. Moreover, sound fiscal policy supports the containment of external imbalances. External imbalances, which have troubled the EU at least when the Baltic States entered the exchange rate mechanism ERM II, should not, however, be such a cause of concern, as these can be considered a normal part of the convergence process and should be reversed as the countries continue to catch-up. The new Member States are obliged to adopt the EU fiscal rules. Adoption of these rules can be beneficial and support fiscal discipline.

The lack of detailed numerical country analysis can be considered a shortcoming in this dissertation. As the availability and reliability of the statistical data in these countries improve, work can be continued in this area. Also the theoretical set-up can be improved upon, e.g. by supplementing the models with price and wage rigidities. Further research is also clearly needed on the causes of external imbalances in these countries.

To conclude, this dissertation intends to provide new lines of thinking to the discussion on euro adoption in the new Member States, which will be one of the most important topics in the EU economic discussion in 2006 and beyond.

References

Backé, P., 1999. Exchange Rate Regimes in Central and Eastern Europe: A Brief Review of Recent Changes, Current issues and Future Challenges. Focus on Transition, 2/1999, Österreichische National Bank, 47–67.

Balassa, B., 1964. The Purchasing-Power Parity Doctrine: A Reappraisal. The Journal of Political Economy, LXXII: 6, 584-596.

Ballabriga, F., Martinez-Mongay, C., 2002. Has EMU shifted policy?. Economic Papers No. 166, European Commission, Directorate-general for Economic and Financial Affairs.

Begg, D., 1998. Exchange Rate and Monetary Policies in Central and Eastern Europe: Coping with Accession in a World After EMU. CEPR/EWI Economic Policy Initiative Forum, Brussels, 20-22 November 1998.

Begg, D., Eichengreen, B., Halpern, L., von Hagen, J., Wyplosz, C., 2003. Sustainable Regimes of Capital Movements in Accession Countries. CEPR Policy Paper No. 10.

Bofinger, P., Wollmershaeuser, T., 2000. Options for the Exchange Rate Policies of the EU Accessions Countries (and Other Emerging Market Economies). CEPR Discussion Paper No. 2379.

Bergin, P., 2000. Fiscal solvency and price level determination in a monetary union. Journal of Monetary Economics, 45:1, 37-53.

Buiter, W.H., Grafe, C., 2002. Anchor, Float or Abandon Ship: Exchange Rate Regimes for Accession Countries. CEPR Discussion Paper No. 3184.

Canzoneri, M.B., Diba, B.T., 1996. Fiscal Constraints on Central Bank Independence and Price Stability. CEPR Discussion Paper No. 1463.

Canzoneri, M.B., Diba, B.T., 2001. The SGP: Delicate Balance or Albatross? in Brunila, A., Buti, M., Franco, D. (eds.), The Stability and Growth Pact The Architecture of Fiscal Policy in EMU, Palgrave, New York.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 1998. Fiscal Discipline and Exchange Rate Regimes. CEPR Discussion Paper No. 1899.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 2001a. Fiscal Discipline and Exchange Rate Systems. Economic Journal, 111:474, 667-690.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 2001b. Is the Price Level Determined by the Needs of Fiscal Solvency?. The American Economic Review, 91:5, 1221-1238.

Christiano, L.J., Fitzgerald T.J., 2000. Understanding the Fiscal Theory of the Price Level. NBER Working Paper No. 7668.

Corker, R., Beaumont, C., van Elkan, R., Iakova, D., 2000. Exchange Rate Regimes in Selected Advanced Transition Economies - Coping with Transition, Capital Inflows, and EU accession. IMF Policy Discussion Paper, PDP/00/3.

Council (Ecofin), 2000. 2301st Council meeting, Brussels, 7 November 2000, press release. http://ue.eu.int/Newsroom

European Commission, 2004. Convergence Report 2004. European Economy, 6/2004.

European Union, 2004. ERM II Exchange Rate Procedure, press release 27.6.2004. http://www.eu2004.ie/templates/news.asp?sNavlocator=66&list_id=894

European Union, 2005a. Latvian lats included in the Exchange Rate Mechanism II (ERM II), press release 29.4.2005. http://www.ecb.int/press/pr/date/2005/html/index.en.html

European Union, 2005b. Slovak koruna included in the Exchange Rate Mechanism II (ERM II), press release 25.11.2005. http://www.ecb.int/press/pr/date/2005/html/index.en.html

Frankel, J.A., 1999. No Single Currency Regime is Right for All Countries or at All Times. NBER Working Paper No. 7338.

Hochreiter, E., 2000. Exchange rate regimes and capital: Issues and some lessons from central and eastern European applicant countries. North American Journal of Economics and Finance, 11:2, 155-171.

IMF, 2000. World Economic Outlook October 2000.

Leeper, E., 1991. Equilibria under 'active' and 'passive' monetary and fiscal policies. Journal of Monetary Economics, 36:27, 129-147.

Masson, P.R., 1999. Monetary and Exchange Rate Policy of Transition Econo-mies of Central and Eastern Europe after the Launch of EMU. IMF Policy Discussion Paper, 99:5.

Mihaljek, D., Klau, M., 2003. The Balassa-Samuelson effect in central Europe: a disaggregated analysis. BIS Working Papers No 143.

Obstfeld, M., Shambaugh, J.C., Taylor, A.M., 2004. The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies, and Capital Mobility. NBER Working Paper No. 10396.

Samuelson, P., 1964. Theoretical notes on trade problems. The Review of Economics and Statistics, XLVI:2, 145—154.

Sims, C.A., 1994. A simple model for the study of the determination of the price level and the interac-tion of monetary and fiscal policy. Economic Theory, 4, 381-399.

Walsh, C.E., 2003. Monetary Theory and Policy: Second edition. The MIT Press, Cambridge, Massachusetts.

Woodford, M., 1994. Monetary policy and price level determinacy in a cash-in-advance economy. Economic Theory, 4:3, 345-380.

Woodford, M., 1995. Price-level determinacy without control of a monetary aggregate. Carnegie-Rochester Conference Series on Public Policy, 43, 1-46.

Woodford, M., 1996. Control of the Public Debt: A Requirement for Price Stability. NBER Working Paper No. 5684.

Woodford, M., 2001. Fiscal Requirements for Price Stability. NBER Working Paper No. 8072.

Woodford, M., 2003. Interest and Prices: Foundations of a Theory of Monetary Policy. Princeton Uni-versity Press, Princeton, New Jersey.

Wyplosz, C., 2000. Ten Years of Transformation: Macroeconomic Lessons. World Bank Policy Research Working Paper No. 2288.

2 Fiscal Policy and the Exchange Rate Regime Choice

2.1 Introduction

Seven of the ten new Member States have already joined the exchange rate mechanism ERM II, while three Central and Eastern European Countries (CEECs) still remain outside the mechanism with plans to join in a few years. There are no restrictions on the choice of the exchange rate regime before participation in the ERM II, except for euroization, which the Ecofin Council (2000) has deemed to be inconsistent with the economic reasoning of EMU. The question of the most appropriate exchange rate regime for these countries as they converge to the current euro area has been widely discussed. While inflation has ceased to be a major macroeconomic problem in most countries, the soundness and sustainability of public finances have gained more attention. The performance of the new Member States in these areas will be measured by the Maastricht criteria.[5] The countries both inside and outside the ERM II have yet to prove that they have sustainably fulfilled these criteria.

This study attempts to answer the following questions: What exchange rate regime should the new Member States adopt prior to ERM II participation; what is required for successful ERM II participation and fulfilment of the Maastricht criteria; and finally, what happens after adoption of the euro. Specifically, this study examines the interaction of fiscal policy and the price level in different exchange rate regimes - i.e. the range of regimes between fixed and flexible that are or have been in place in the new Member States or that have been suggested by e.g. academic research.

The theoretical framework employed in the analysis is based on the Fiscal

[5] The convergence criteria are defined as follows (according to Art. 121, Art. 104 and the Protocols on the excessive deficit procedure and on the convergence criteria):

- the achievement of a high degree of price stability; this will be apparent from a rate of inflation which is close to (i.e. that does not exceed by more than $1\frac{1}{2}$ percentage points) that of, at most, the three best performing Member States in terms of price stability;
- the sustainability of the government financial position; this will be apparent from having achieved a government budgetary position without a deficit that is excessive (the existence of an excessive deficit is judged based on the following reference values: 3% for the ratio of planned or actual government deficit to GDP and 60% for the ratio of government debt to GDP);
- the observance of the normal fluctuation margins provided for by the exchange rate mechanism of the European Monetary System, for at least two years, without devaluing against the currency of any other Member State;
- the durability of convergence achieved by the Member State and of its participation in the exchange rate mechanism of the European Monetary System being reflected in the long-term interest rate levels (i.e. average nominal long-term interest rate that does not exceed by more than 2 percentage points that of, at most, the three best performing Member States in terms of price stability).

Theory of the Price Level (FTPL). The FTPL combines monetary and fiscal policies and provides, as noted by Ballabriga and Martinez-Mongay (2002), a holistic approach to macroeconomic analysis. The theory originates from Leeper (1991), Sims (1994) and Woodford (1994) and views the price level as determined by the budgetary policies of the fiscal authority. According to Woodford (1995), fiscal policy can be either Ricardian (monetary dominant), where primary surpluses adjust to guarantee fiscal solvency for any sequence of prices, or non-Ricardian (fiscal dominant), i.e. the government's intertemporal budget constraint is satisfied for some but not all price paths.

This work provides a formal analysis of the FTPL in different exchange rate regimes. In earlier work, only Canzoneri et al. (1998a, 2001a) have examined the FTPL in different exchange rate regimes but their analysis was not based on a thorough formal model. Moreover, the purpose is to use this analysis to discuss the choice of exchange rate regime and the level of commitment in fiscal policy in the new Member States. The countries aiming to adopt the euro vary in their choice of the exchange rate regime as well as in their level of fiscal commitment. The aim is to analyse the interaction between fiscal policy and the price level in the ERM II, a fixed exchange rate regime and a variety of other regimes in place in the countries planning to adopt the euro. The model in this study is adapted from Bergin (2000), who examined the FTPL in a monetary union framework. This model is extended here to different exchange rate regimes, which include both fixed - such as a currency board - and flexible, e.g. a managed float, arrangements.

Applying the FTPL in different exchange rate regimes shows that if fiscal policy is responsible, the price level is determined in the traditional way and the fiscal variables have no effect. On the other hand, no exchange rate regime as such can impose responsible (Ricardian) fiscal policy.

In a monetary union, irresponsible (non-Ricardian) fiscal policy by one country raises the price level of the whole union, which suggests that responsible fiscal policies are essential for the functioning of EMU. Indeed, the FTPL could be seen to provide some rationale to the EU fiscal framework. Nevertheless, as noted by Canzoneri and Diba (2001), it is clear that the policymakers did not have this theory in mind when they drafted the Stability and Growth Pact (SGP), where the Member States commit themselves to respect the medium-term objective of budgetary positions close to balance or in surplus. It has been shown that the SGP is actually working, as EMU operates in a monetary dominant regime (Ballabriga and Martinez-Mongay 2002).

For fixed exchange rate regimes, it is found that irresponsible fiscal policy is inconsistent with a credibly fixed exchange rate. Thus, if the exchange rate is to

be credibly fixed within ERM II, the participating country is forced to conduct responsible fiscal policy, or otherwise exit the regime. This requirement for responsible fiscal policy is naturally strengthened by the requirements of, first, the Maastricht criteria on public finances and later of the SGP. Due to the high costs of abandoning a currency board, it is concluded that a currency board is best at forcing fiscal discipline. Dollarization, or euroization, does not set the same kind of constraints on fiscal policy as other fixed exchange rate regimes and furthermore it may not be beneficial from the point of view of the country whose currency is being used, as there may be impacts on its price level, if the dollarizing/euroisizing country is large enough.

With a flexible exchange rate regime, on the other hand, the effects of irresponsible fiscal policy are visible as fluctuations in the nominal exchange rate, which can then have nominal and real consequences. Responsible fiscal policy is a requirement for a stable nominal exchange rate also in a flexible exchange rate regime.

For the pre-ERM II period, it can be concluded that countries wishing to maintain a stable nominal exchange rate, or a fixed exchange rate regime, should conduct responsible fiscal policy. Furthermore, the credibility of responsible policies may be enhanced by commitment to a fixed exchange rate regime.

Section 2 presents the Fiscal Theory of the Price Level. A theoretical model on the interaction between fiscal policy and the price level in different exchange rate regimes is studied in Section 3, while conclusions are presented in the last Section.

2.2 The Fiscal Theory of the Price Level

Traditional analysis views the price level as being determined solely by monetary policy. Walsh (2003) identifies three ways how fiscal policy and monetary policy interact in price level determination.[6] In the first one, if fiscal policy affects the real rate of interest, then the price level is not independent of fiscal policy. A balanced budget increase in expenditures that raises the real interest rate brings up the nominal interest rate and lowers the real demand for money. Given an exogenous path for the nominal money supply, the price level must

[6] Sargent and Wallace's (1981) unpleasant monetarist arithmetic pointed out that monetary policy and fiscal policy are linked. The central question in their paper is which authority, the fiscal or the monetary, moves first, i.e. who imposes discipline on whom. If the fiscal authority moves first, monetary policy must be determined in a way that is consistent with it.

jump up to reduce the real supply of money. In the second one, the fiscal authority sets its expenditures and taxes without regard to any requirement of intertemporal budget balance. If the present discounted value of these taxes is not sufficient to finance expenditures, seigniorage must adjust to ensure that the government's intertemporal budget constraint is met. This has effects for prices and inflation. The third option is the Fiscal Theory of the Price Level (FTPL), which asserts that the price level is determined by the budgetary policies of the fiscal authority.

The major difference between the traditional view and the FTPL concerns the government intertemporal budget constraint, which implies that the real value of existing public sector liabilities must equal the present value of current and future primary surpluses (inclusive of central bank transfers). In the traditional analysis, fiscal policy is assumed to adjust to ensure that the government's intertemporal budget is always in balance, leaving monetary policy free to set the nominal money stock or the nominal interest rate, while under the FTPL, the government's present value budget constraint is treated as an equilibrium condition.

Key contributions

The FTPL is generally considered to originate from Leeper, Sims and Woodford. Leeper (1991) defines policies as either active, whereby the authority pays no attention to the state of government debt and is free to set its control variable as it sees fit, or passive, whereby the authority responds to government debt shocks, while its behaviour is constrained by private optimization and the active authority's actions. Equilibrium policies can be divided into those where future direct lump-sum taxes back debt shocks entirely, i.e. monetary policy is active and fiscal policy is passive, and those where fluctuations in real debt generate current or future money creation, i.e. fiscal policy is active and monetary policy is passive. A unique pricing function requires that at least one authority sets its control variable actively, while an intertemporally balanced government budget requires that at least one authority sets its control variable passively.[7]

[7]Similarly, Carlstrom and Fuerst (2000) also divide the FTPL into two parts – weak-form FTPL and strong-form FTPL – according to which policymaker moves first. Under the weak-form version, it is assumed that the fiscal authority moves first by committing to a path for primary budget surpluses or deficits, forcing the monetary authority to generate the seigniorage needed to maintain solvency. If both authorities refuse to generate the needed seigniorage, then the nation's debt-to-GDP ratio will grow at an unsustainable rate until one of the authorities alters its behavior. In the strong-form version, fiscal policy determines future inflation but is independent of future monetary growth. Carlstrom and Fuerst argue that this version, as in many monetary models, is possible as the initial price level is not

Sims (1994) proves that a monetary policy that fixes the money stock may - depending on the transaction technology - be consistent with indeterminacy of the price level, and indeed, with stochastically fluctuating explosive inflation. In contrast, a monetary policy that fixes the nominal interest rate, even if it holds the interest rate constant regardless of the observed rate of inflation or money growth rate, may deliver a uniquely determined price level. The determinacy of the price level under any policy depends on the public's belief as to what the policy authority would do under conditions never observed in equilibrium. Similarly, Woodford (1994) finds that the price level is uniquely determined under a nominal interest rate peg, while constant money growth rates can lead to indeterminacy of the perfect foresight equilibrium and existence of sunspot equilibria.

An important contribution to the FTPL was made by Woodford (1995), who identifies two types of policy regimes. A fiscal policy is Ricardian if the primary surpluses adjust to guarantee fiscal solvency for any sequence of prices. In a non-Ricardian policy, the government's intertemporal budget constraint is satisfied for some, but not all, price paths.[8] [9] According to Canzoneri et al. (2001b), all that is required for a Ricardian regime is that primary surpluses respond to the level of debt "infinitely often", while a fiscal policy that sets the primary surplus at a fixed level for example can be characterized as a non-Ricardian policy (2001b, 1233-1234).[10]

pinned down. Different initial price levels are consistent with different paths for future inflation. Hence, it is assumed that the fiscal budget constraint pins down the initial price level. The strong-form version assumes that both fiscal and monetary policies are given exogenously and that prices adjust to ensure solvency.

[8] Fiscal policy is argued not to have an effect on the price level due to the Ricardian equivalence proposition, which implies that if consumers have rational expectations, fiscal policy should have no effect upon aggregate demand, and hence, no effect upon inflation.

[9] Woodford (2003) distinguishes between globally and locally Ricardian and non-Ricardian policies. A locally Ricardian fiscal rule is defined as a rule that when substituted into the government flow budget constraint implies that the maturity value of real public debt remains forever within a bounded neighborhood of the steady state value of government liabilities, for all paths of the endogenous variables that remain forever within some sufficiently small neighborhoods of their steady state values and all small enough values of the exogenous disturbances. This is, however, not the case with a locally non-Ricardian fiscal rule (e.g. one in which tax collections are not affected by the size of the existing public debt), where the requirement that the maturity value of real public debt remains bounded places a linear restriction on the possible evolution of inflation, output and interest rates. In the generic case, this additional linear restriction suffices to determine the equilibrium evolution of those variables in the case that the other log-linear structural relation fail to uniquely determine an equilibrium. In this case, equilibrium is determinate and the evolution of inflation depends on fiscal variables. (Woodford 2003, 312-315).

[10] Canzoneri et al. (1998a,b) define policies according to whether fiscal or monetary policy provides the nominal anchor for the economy. In the fiscal dominant regime (FD), primary surpluses are determined independently of the debt level. The path of the money supply and the price level must also satisfy the needs of fiscal solvency (monetary policy has to work through seigniorage to control the price level), whereas in the money dominant regime

Woodford (1998) shows further that fiscal policy and the price level are connected through the wealth effect of variations in the value of public debt. He finds that if fiscal policy is non-Ricardian, the time path and composition of government debt (like maturity and degree of indexation) have consequences for inflation determination.[11] Moreover, Woodford (2001) shows that a commitment by the central bank to conduct monetary policy according to a rule (e.g. Taylor rule) is insufficient to guarantee a stable, low equilibrium inflation rate. Indeed, the combination of a Taylor rule with certain fiscal policies may result in an inflationary or deflationary spiral. Hence, a Taylor rule should be accompanied with targets for the size of government budget deficit.[12]

Empirical findings on the FTPL

The FTPL has not been empirically tested widely. Kocherlakota and Phelan (1999) point out that the only way to determine if a government is using a non-Ricardian policy is to know whether the government's budget constraint is satisfied for unobserved prices, which is impossible. In their empirical examination, Canzoneri et al. (2000, 2001b) find no evidence of a fiscal dominant regime for the US or the 16 OECD countries, which would indicate the prevalence of traditional views of price-level setting.[13] Ballabriga and Martinez-Mongay (2002) look jointly at fiscal and monetary policy behaviour for EU Member States both in the pre-EMU and EMU periods. They show that both periods can be characterized as being in a monetary dominant regime. However, they also find that

(MD), primary surpluses respond to the level of debt in a way that assures fiscal solvency, and money and prices can be determined by the supply and demand for money.

[11] Cochrane (2001) finds the maturity structure of debt matters. Long-term debt may help stabilize inflation in some cases.

[12] Schmitt-Grohé and Uribe (2000) examine balanced budget rules in three different monetary policy regimes: a nominal interest rate peg, a money growth rate peg ad a feedback rule whereby the nominal interest rate is set as a non-negative and non-decreasing function of the inflation rate. They find that when the primary balance equals interest payments on the government debt or when the secondary surplus/deficit is an exogenous, non-zero path, an interest rate peg leads to an indeterminacy of the price level, while a money growth rate peg results in price level de-terminacy. A feedback rule results in determinacy, when the nominal interest rate is moderately sensitive to the inflation rate and indeterminacy when the interest rate is either very sensitive or very little sensitive. Hence, they conclude that what matters for price level determination under an interest rate peg is whether fiscal policy is specified as an exogenous sequence of primary or secondary surpluses/deficits.

[13] Canzoneri et al. (1998b) develop restrictions that enable the differentiation between MD and FD regimes. In a MD regime, the fiscal surplus in period t pays off some period t+1 debt, whereas in a FD regime, there are several possibilities depending on the correlation between the current surplus and future surpluses and discount factors. In case of no-correlation, the period t+1 debt is not affected by the period t surplus, while in case of positive correlation, debt in period t+1 rises. In both cases, the regimes can be differentiated. If the correlation is negative, period t+1 debt will fall in both regimes, resulting in a differentiation problem.

- fiscal solvency is ensured differently in the two periods: While in the past fiscal authorities responded systematically to debt accumulation, now the SGP limits debt accumulation by limiting the variability of the deficit;

- in the pre-EMU period, close-to-balance positions were not ensured in the medium term and deficits of over 3% were common;

- close-to-balance positions in the medium term might be reached faster with a stronger response to debt in EMU (Ballabriga and Martinez-Mongay 2002, 35-36).

Criticism of the FTPL

Buiter (1999), one of FTPL critics, argues that the FTPL has an economic misspecification when it stipulates that the government's intertemporal budget constraint be satisfied only in equilibrium. He also questions the absence of the possibility for government default, as a fiscal regime results in overdetermination of the price level without an endogenous default discount factor on government debt. He concludes that the FTPL may lead to harmful policies. Cochrane (2000) counters some of this critique, finding that the intertemporal budget constraint should be taken as a value equation (like a stock valuation equation) instead of as a constraint. Thus, the government is not forced by the budget constraint to raise future taxes in response to an out-of-equilibrium deflation and a determinate finite price level can be achieved.

Niepelt (2004) points out that the fundamental problem of the FTPL is that non-Ricardian policies rely on the assumption of non-zero initial government liabilities. According to Niepelt, this is not well-founded, as a household with rational expectations would anticipate the possibility of a surprise asset revaluation and should thus not be willing to hold nominal government debt in the first place (Niepelt 2004, 279).

Although it is clear that the non-Ricardian assumption may not be a good characterization of policy at all times and places, recognizing that the possibility for such policies exists may help to avoid them, as is pointed out by Christiano and Fitzgerald (2000). Examples of governments adjusting fiscal policy as debt becomes too large are numerous, including the US in the 1980s and 1990s. Other examples provided by Christiano and Fitzgerald include the Maastricht criteria, which are designed to prevent excessive indebtedness, and IMF programs, which often guide countries toward debt reduction.[14]

[14] One case against the FTPL could be considered to be Japan, where fiscal policy is clearly unsustainable but there are no effects on inflation or the exchange rate.

Indeed, it has been shown that the Maastricht criteria are sufficient to force a country into a Ricardian regime. Canzoneri and Diba (1996) show that limiting the government's total deficit (primary deficit plus interest payments) to 3% of GDP is sufficient. In addition, Woodford (1996) finds that in the presence of a Maastricht-type debt limit, Ricardian equivalence holds and fiscal shocks have no effect upon real or nominal variables. He notes that the debt limit serves as a pre-condition for the common central bank in a monetary union to be charged with the responsibility for maintaining a stable value for the common currency. On the other hand, Canzoneri et al. (2001b) view the EU deficit rules as being stronger than necessary.

The FTPL and exchange rate policy

The analyses of most studies concentrate on one-country/one-currency frameworks. Dupor (2000) shows that the Sims-Leeper-Woodford results do not hold in a two-country/two-currency setting. Indeed, if both countries peg the nominal interest rate on domestic bonds, then the price level and the exchange rate are indeterminate. Canzoneri et al. (1998a, 2001a) examine the implications of the FTPL for the maintenance of various exchange rate regimes. Their key finding is that tighter monetary integration requires greater fiscal discipline. Furthermore, they find that in a monetary union when one country conducts a non-Ricardian regime, then the union as a whole will operate in that fiscal-dominant regime. Similarly, Bergin (2000) finds that the implications of FTPL for a monetary union are that a rise in debt not backed by future taxes of one member country can raise the price level of the entire union. [15]

Hence, it would appear that the only studies, although not very formal, on the implications of the FTPL for different exchange rate regimes have been Canzoneri et al. (1998a, 2001a). The theoretical framework used by Bergin (2000) for the monetary union case - with a single central bank and multiple fiscal authorities - seems suitable for extension to other exchange rate regimes and for solving formally the consequences of a non-Ricardian policy. In conclusion, the FTPL seems to provide an interesting framework for studying the proper path to membership in a monetary union where the upcoming euro area membership of the CEECs offers an interesting perspective. These countries face challenges on meeting the criteria on exchange rate and price level stability and sustainability of the government's financial position. Moreover, fiscal policy is at the center of the policy debate in the current euro area. Indeed, fiscal

[15] Dupor (2000) uses a single government present value budget constraint, while in Canzoneri et al. (1998a, 2001a), as well as in Bergin (2000) each government faces its own PVBC.

policy, specifically the Maastricht criteria on public finances and the Stability and Growth Pact, are at the core of EMU, as fiscal discipline contributes to maintaining an economic environment in which monetary policy can effectively pursue price stability (Brunila et al. 2001, 1).

2.3 The Model

There are two countries in the model: a euro area accession country and a monetary union (euro area). In the first case, both countries belong to the monetary union and then the model is extended to two currencies, and thus to different exchange rate regimes, which include fixed (peg, currency board and dollarization) and flexible (free float, managed float, crawling peg) regimes.

The infinitely-lived representative household chooses consumption of the two goods (Bergin uses a single consumption good), nominal holdings of money and nominal bond holdings. The government determines lump-sum taxes and issues nominal government debt. It is further assumed that the government does not purchase the other government's debt. The central bank is independent of the government and issues money through open-market purchases of bonds. The interest income of the central bank is returned to the national government, or in the case of monetary union, is divided among the governments.

A price stability target is the cornerstone of monetary policy in EMU. Therefore, the central bank's monetary policy is defined to reflect this goal. EMU fiscal policy is assumed to be "responsible" (Ricardian), i.e. the government present-value budget constraint is satisfied at all times. The accession country's monetary policy depends on its exchange rate regime. In general, a fixed regime (e.g. ERM II) is described by an exchange rate target, while the monetary policy of a flexible exchange rate regime is characterized by a price stability target. Fiscal policy of the accession country can be either "responsible" or "irresponsible" (non-Ricardian) where the primary surplus is set at a fixed level.

The model's timeline begins with a first stage, in period t, when the accession country announces its plans to join the ERM II arrangement in period T (stage 2) and adoption of the euro in T+2 (stage 3). During the first stage, the accession country may have one of several exchange rate regimes while in the second stage, the exchange rate is assumed to be credibly fixed within the ERM II arrangement.

The major differences with regard to Bergin's (2000) framework are first,

changing the monetary union's monetary policy to better describe that of the euro area, i.e. to having a target for the change of the price level, and second, the use of a two good model, instead of the single consumption good model employed by Bergin.[16] We first solve the model in the monetary union framework in a similar manner to Bergin (2000), then we extend it to different exchange rate regimes not covered by Bergin. Finally, the solution for the monetary union, stage 3, is imposed on the first stage.

2.3.1 Monetary union

The infinitely-lived representative household in country 1 receives a stochastic endowment of the domestic consumption good (y_{1t}), whose price is (p_t^1) and chooses consumption (c_{1t}) of the domestic (c_{1t}^1) and foreign goods (c_{1t}^2), nominal holdings of money (M_{1t}) and nominal bond holdings (B_{1t}) that have a nominal gross return (R_t). Real money balances (m_{1t}) are defined as the ratio of nominal money holdings to the common price level (P_t), i.e. $m_{1t} \equiv M_{1t}/P_t$. The household pays lump-sum taxes (τ_{1t}) to the domestic government. Utility is discounted at a rate β. The infinitely-lived household in country 1 maximizes

$$MaxE_0 \sum_{t=0}^{\infty} \beta^t \left[\left(c_{1t}^1\right)^a \left(c_{1t}^2\right)^{1-a} \right]^d (m_{1t})^{1-d} \tag{2.1}$$

to choose B_{1t} and m_{1t} subject to the following budget constraint

$$c_{1t} + \frac{M_{1t}}{P_t} + \frac{B_{1t}}{P_t} + \tau_{1t} = \frac{p_t^1}{P_t} y_{1t} + \frac{M_{1t-1}}{P_t} + R_{t-1} \frac{B_{1t-1}}{P_t}, \tag{2.2}$$

where $M_{1t} \geq 0$ and $c_{1t} \geq 0$. The household's holdings of bonds can be either positive or negative. This Cobb-Douglas form of the utility function where the elasticity of substitution between domestic and foreign goods equals one has been chosen for analytical convenience.

The first-order conditions of the household's problem are

$$\left(\frac{m_{1t}}{c_{1t}}\right)^{1-d} = \beta R_t E_t \left[\left(\frac{m_{1t+1}}{c_{1t+1}}\right)^{1-d} \left(\frac{P_t}{P_{t+1}}\right) \right] \tag{2.3}$$

$$m_{1t} = \left(\frac{1-d}{d}\right) \left(\frac{R_t}{R_t - 1}\right) c_{1t}. \tag{2.4}$$

[16] Bergin (2000) characterizes monetary policy in the first case by a nominal interest rate peg and in the second case by a price stability target, where the central bank does not tolerate deviations from the steady state price level.

To solve the price index P_t, we maximize consumption $c_{1t} = \left(c_{1t}^1\right)^a \left(c_{1t}^2\right)^{1-a}$ subject to total expenditure $P_t c_{1t} = p_t^1 c_{1t}^1 + p_t^2 c_{1t}^2 = Z_1$, which produces

$$\left(\frac{a}{1-a}\right)\left(\frac{c_{1t}^2}{c_{1t}^1}\right) = \frac{p_t^1}{p_t^2}, \tag{2.5}$$

from where it can be calculated that $c_{1t}^1 = a\frac{P_t}{p_t^1}c_{1t}$ and $c_{1t}^2 = (1-a)\frac{P_t}{p_t^2}c_{1t}$. Substituting these back into the consumption equation, we can solve for the price level

$$P_t = \left(p_t^1\right)^a \left(p_t^2\right)^{1-a}. \tag{2.6}$$

The transversality condition implies that households fully use their lifetime wealth, i.e.

$$\lim_{T\to\infty}\left(\prod_{j=t}^{T-1} R_j^{-1}\right) W_{1T} = 0, \tag{2.7}$$

where $W_{1t} = R_{t-1}B_{1t-1} + M_{1t-1}$ is the nominal beginning of period household wealth. Thus, the household intertemporal budget constraint can be written as

$$\frac{W_{1t}}{P_t} = \sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1} r_j^{-1}\right)\left(c_{1s} + \tau_{1s} + \frac{R_s - 1}{R_s}m_{1s} - \frac{p_s^1}{P_s}y_{1s}\right), \tag{2.8}$$

where the gross real rate of return on bonds is defined as $1 + r_t = \frac{R_t P_t}{P_{t+1}}$. The household's problem is solved analogously for country 2.

Each government determines lump-sum taxes (τ_1) and issues nominal government debt (D_{1t}), which together with the real transfers from the central bank to government of country 1 (v_{1t}) finance the constant government purchases ($\overline{g}_1$). The flow government budget constraint in country 1 can be written as

$$\overline{g}_1 + R_{t-1}\left(\frac{D_{1t-1}}{P_t}\right) = \tau_{1t} + v_{1t} + \frac{D_{1t}}{P_t}, \tag{2.9}$$

where $P_t\overline{g}_1 = p_t^1\overline{g}_1^1 + p_t^2\overline{g}_1^2$. The solvency condition for the government indicates that the present value of real outstanding government debt goes to zero in the limit, i.e.

$$\lim_{T\to\infty}\left(\prod_{j=t}^{T-1} R_j^{-1}\right) D_{1T} = 0. \tag{2.10}$$

Therefore, the intertemporal budget constraint for government 1, which requires that the present discounted value of future tax and seigniorage revenues covers expenditures and allows the government to pay back its outstanding debt, is

$$R_{t-1}\left(\frac{D_{1t-1}}{P_t}\right)=\sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1}r_j^{-1}\right)\left(\tau_{1s}-\overline{g}_1+v_{1s}\right). \tag{2.11}$$

The central bank is independent of the government. It issues money (M_t) through open market purchases of bonds (B_{mt}), but does not itself issue debt or levy taxes. The period budget constraint of the common central bank is

$$\frac{B_{mt}}{P_t}+v_{1t}+v_{2t}=R_{t-1}\left(\frac{B_{mt-1}}{P_t}\right)+\frac{M_t-M_{t-1}}{P_t}, \tag{2.12}$$

where v_{2t} is the real transfers from the central bank to the government of country 2. The interest income of the central bank is returned to the governments according to exogenously determined division rules ω_1 and ω_2 so that

$$v_{1t}=\omega_1\left[\left(R_{t-1}-1\right)\frac{B_{mt-1}}{P_t}\right]=\omega_1 v_t; \tag{2.13}$$

$$v_{2t}=\omega_2 v_t, \tag{2.14}$$

where $\omega_1+\ \omega_2=1$. This allows for a differentiation in country size, whereas Bergin (2000) assumes that the countries are of the same size, i.e. $\omega_1=\omega_2=\frac{1}{2}$. The intertemporal budget constraint of the common central bank can be written as

$$\frac{M_{t-1}-R_{t-1}B_{mt-1}}{P_t}=\sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1}r_j^{-1}\right)\left(\frac{R_s-1}{R_s}m_s-v_{1s}-v_{2s}\right). \tag{2.15}$$

The central bank's monetary policy is assumed to be characterized by a price stability target, where $\frac{P_{t+1}}{P_t}=1+\mu$. This implies an interest rate of the form $R_t=\frac{P_{t+1}}{\beta P_t}=\frac{1+\mu}{\beta}=\overline{R}$. Furthermore, the money supply becomes endogenous with $\frac{M_{t+1}}{M_t}=1+\mu$.

The market clearing conditions in the goods, money and bond markets are

$$c_{1t}^1+c_{2t}^1+\overline{g}_1^1+\overline{g}_2^1=y_{1t}\text{ and }c_{1t}^2+c_{2t}^2+\overline{g}_1^2+\overline{g}_2^2=y_{2t} \tag{2.16}$$

$$M_{1t}+M_{2t}=M_t \tag{2.17}$$

$$B_{1t}+B_{2t}+B_{mt}=D_{1t}+D_{2t}. \tag{2.18}$$

As in Bergin's (2000) model, there are transitory asymmetric output shocks. These are considered to be offsetting across countries, so there are no shocks to aggregate output, i.e.

$$\begin{aligned} y_{1s} &= \overline{y}_1 + \varepsilon_s \\ y_{2s} &= \overline{y}_2 - \varepsilon_s \\ \varepsilon_s &\sim N\left(0, \sigma^2\right). \end{aligned} \tag{2.19}$$

The equilibrium is defined as those paths for the price level, consumption, nominal bond holdings, nominal debt, nominal money holdings, taxes, rebates and output that are consistent with the 19 necessary conditions for equilibrium. For both countries these include the household intertemporal budget constraint (2.8), first-order conditions (2.3), (2.4) and (2.5), the exogenous sequence for outputs (2.19), government flow budget constraint (2.9) and fiscal policy, the common central bank's budget constraint (2.12), monetary policy and rebate allocations (2.13) and (2.14), as well as the market-clearing conditions for the goods and money markets (2.16) and (2.17). It should be noted that neither the government intertemporal budget constraint nor the solvency condition are necessary conditions for equilibrium but they are implied in the consolidated form. It is shown in the Appendix that a steady state exists for this system.

To solve the model we linearize around a deterministic steady state with $\omega_1 + \omega_2 = 1$, where $\frac{P_{t+1}}{P_t} = 1 + \mu$, and similarly for other nominal variables, the household intertemporal budget constraint can be written as

$$\begin{aligned} &\frac{\widetilde{W}_{1t}}{\overline{P}} - \left(\frac{\overline{W}_1}{\overline{P}}\right)\left(\frac{\widetilde{P}}{\overline{P}}\right) = \sum_{s=t}^{\infty} \beta^{s-t}[\{\widetilde{c}_{1s} + \widetilde{\tau}_{1s} + \frac{\overline{R}-1}{\overline{R}}\widetilde{m}_{1s} + \frac{\overline{p}^1}{\overline{P}}\widetilde{y}_{1s} \\ &- \left[\frac{\widetilde{p}_s^1}{\overline{P}} - \left(\frac{\overline{p}^1}{\overline{P}}\right)\left(\frac{\widetilde{P}_s}{\overline{P}}\right)\right]\overline{y}\} + (1-\beta)\left(\frac{\overline{W}_1}{\overline{P}}\right)\sum_{j=t}^{s-1}\left(\frac{\overline{P}_{j+1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_{j+1}}{\overline{P}_{j+1}} - \frac{\widetilde{P}_j}{\overline{P}}\right)], \end{aligned} \tag{2.20}$$

where the bars indicate steady state values in period t (for steady states that differ from those of period t, the period is noted), and tildes denote deviations from the steady state. Using the linearized first-order conditions (2.3) and (2.4), as well as the goods-market-clearing conditions (see the Appendix), we solve for current consumption

$$\widetilde{c}_{1t} = d\,(1-\beta)\left[\left(\frac{\overline{W}_1}{\overline{P}}\right)\left(\frac{\widetilde{W}_{1t}}{\overline{W}_1} - \frac{\widetilde{P}_t}{\overline{P}}\right) + E_t\sum_{s=t}^{\infty}\beta^{s-t}\left(\frac{\overline{p}^1}{\overline{P}}\widetilde{y}_{1s} - \widetilde{\tau}_{1s}\right)\right]. \tag{2.21}$$

As can be seen from equation (2.21), changes in consumption are a function

of changes in the household's intertemporal wealth, i.e. the initial asset holdings and the present value of output net of taxes. Summing the consumption function with its foreign counterpart, and imposing the goods-market-clearing condition so that joint consumption is constant, produces

$$\frac{\widetilde{P}_t}{\overline{P}} = \left(\frac{\overline{W}}{\overline{P}}\right)^{-1} \left[\left(\frac{\widetilde{W}_t}{\overline{P}}\right) - E_t \sum_{s=t}^{\infty} \beta^{s-t} \left(\widetilde{\tau}_{1s} + \widetilde{\tau}_{2s}\right)\right], \tag{2.22}$$

where $W_t = W_{1t} + W_{2t}$ and analogously for steady state values.

Next, the fiscal rules of both countries, rules for the determination of $\widetilde{\tau}_{1s}$ and $\widetilde{\tau}_{2s}$ respectively, are entered into equation (2.22). Moreover, it is assumed that the economy starts in a steady state in period t-1. If both countries have a "responsible" fiscal policy, i.e. they choose τ_{1s} and τ_{2s} so that they ensure their own solvency at all times (satisfy equation (2.11)), then the price level is unaffected by the fiscal variables. IHowever, if it is assumed that country 1 has an "irresponsible" fiscal policy, where it pegs its taxes at a given level $\tau_{1s} = \overline{\tau}_1$, while the fiscal policy of country 2 is "responsible", it can be shown that (also see Appendix)

$$\frac{\widetilde{P}_t}{\overline{P}} = -\left(\frac{\overline{W}_1}{\overline{P}}\right)^{-1} \widetilde{\tau}_{1t}. \tag{2.23}$$

Bergin interprets equation (2.23) as follows: If the government in country 1 temporarily cuts taxes in period t, after which they would be held fixed again, equation (2.23) implies that the price level would rise proportionally to the tax cut, the proportion depending on the initial wealth of country 1. The consumption equation (2.21) suggests that without a price level rise, household wealth would rise in country 1, while consumption in country 2 would not fall, leading to excess demand in the goods market. Thus, a rise in the price level is needed to lower the real value of wealth to be consistent with goods-market equilibrium. (Bergin 2000, 46-47).

Equation (2.23) can also be written as (see Appendix)

$$\frac{\widetilde{P}_t}{\overline{P}} = \frac{\widetilde{D}_{1t}}{\overline{D}_1}. \tag{2.24}$$

Equation (2.24) implies that a percentage rise in the debt level of country 1 will equal a percentage rise in the common price level. Therefore, it appears that the central bank cannot achieve its price stability target without help from the fiscal authorities. However, as noted by Bergin (2000), the price stability target could be achieved if one country absorbed the increased debt of the

other. Here that possibility is not analyzed, as it is considered unlikely that one government would be willing to lend indefinitely to another.

The results for the monetary union case are thus in line with Bergin (2000) and also the conclusions of Canzoneri et al. (1998a, 2001a). Next, Bergin's model is extended to a two-currency setting and different exchange rate regimes.

2.3.2 Two currencies

When there are two currencies and two central banks, the household of country 1 chooses B^1_{1t}, B^2_{1t} and m_{1t} to maximize (2.1) subject to the following budget constraint

$$\begin{aligned} & c_{1t} + \frac{M_{1t}}{P_{1t}} + \frac{B^1_{1t}}{P_{1t}} + e_t \frac{B^2_{1t}}{P_{1t}} + \tau_{1t} \\ & = \frac{p^1_{1t}}{P_{1t}} y_{1t} + \frac{M_{1t-1}}{P_{1t}} + R_{1t-1} \frac{B^1_{1t-1}}{P_{1t}} + e_t R_{2t-1} \frac{B^2_{1t-1}}{P_{1t}}, \end{aligned} \tag{2.25}$$

where $M_{1t} \geq 0$ and $c_{1t} \geq 0$. The exchange rate e_t is defined as the price of one unit of the currency of country 2 in terms of the currency of country 1. The household's holdings of bonds, domestic (B^1_{1t}) and foreign (B^2_{1t}) with nominal gross returns (R_{1t}) for domestic and (R_{2t}) for foreign bonds, can be either positive or negative. The first-order condition (2.3) for country 1 is now written as

$$\begin{aligned} \left(\frac{m_{1t}}{c_{1t}}\right)^{1-d} &= \beta R_{1t} E_t \left[\left(\frac{m_{1t+1}}{c_{1t+1}}\right)^{1-d} \left(\frac{P_{1t}}{P_{1t+1}}\right) \right] \\ \left(\frac{m_{1t}}{c_{1t}}\right)^{1-d} &= \beta R_{2t} E_t \left[\left(\frac{m_{1t+1}}{c_{1t+1}}\right)^{1-d} \left(\frac{P_{1t}}{P_{1t+1}}\right) \left(\frac{e_{t+1}}{e_t}\right) \right], \end{aligned} \tag{2.26}$$

while condition (2.4) still applies. Condition (2.26) implies the uncovered interest rate parity

$$R_{1t} = R_{2t} E_t \left(\frac{e_{t+1}}{e_t}\right). \tag{2.27}$$

To solve the price index P_{1t}, we again maximize consumption $c_{1t} = \left(c^1_{1t}\right)^a \left(c^2_{1t}\right)^{1-a}$ subject to total expenditure $P_{1t}c_{1t} = p^1_{1t}c^1_{1t} + e_t p^2_{2t} c^2_{1t} = Z_1$, which

produces

$$\left(\frac{a}{1-a}\right)\left(\frac{c_{1t}^2}{c_{1t}^1}\right)=\frac{p_{1t}^1}{e_t p_{1t}^2}. \tag{2.28}$$

From condition (2.28) and the respective condition for country 2, we get that $c_{1t}^1 = a\frac{P_{1t}}{p_{1t}^1}c_{1t}$, $c_{1t}^2 = a\frac{P_{1t}}{e_t p_{2t}^2}c_{1t}$, $c_{2t}^1 = a\frac{e_t P_{2t}}{p_{1t}^1}c_{2t}$ and $c_{2t}^2 = a\frac{P_{2t}}{p_{2t}^2}c_{2t}$. Substituting these into the consumption equations produces the domestic and foreign price levels

$$P_{1t}=\left(p_{1t}^1\right)^a\left(e_t p_{2t}^2\right)^{1-a}, \tag{2.29}$$

and

$$P_{2t}=\left(\frac{1}{e_t}p_{1t}^1\right)^a\left(p_{2t}^2\right)^{1-a}, \tag{2.30}$$

respectively. Thus, the exchange rate is defined as

$$\frac{P_{1t}}{P_{2t}}=e_t. \tag{2.31}$$

The budget constraint of the central bank in country 1 changes from (2.12) to

$$\frac{B_{1mt}}{P_{1t}}+v_{1t}=R_{1t-1}\left(\frac{B_{1mt-1}}{P_{1t}}\right)+\frac{M_{1t}-M_{1t-1}}{P_{1t}} \tag{2.32}$$

with the rebates paid to the domestic government defined as

$$v_{1t}=\left(R_{1t-1}-1\right)\frac{B_{1mt-1}}{P_{1t}}. \tag{2.33}$$

The intertemporal budget constraint for the central bank of country 1 is now written as

$$\frac{M_{1t-1}-R_{1t-1}B_{1mt-1}}{P_{1t}}=\sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1}r_{1j}^{-1}\right)\left(\frac{R_{1s}-1}{R_{1s}}m_{1s}-v_{1s}\right). \tag{2.34}$$

Analogous conditions apply to the central bank of country 2, while the government budget constraints are unaltered. Furthermore, the goods-market-clearing conditions (2.16) do not change and the money-market condition (2.17) disappears with the common central bank, whereas the bond-market

condition (2.18) is divided into

$$B^1_{1t} + B^1_{2t} + B_{1mt} = D_{1t} \text{ and } B^2_{1t} + B^2_{2t} + B_{2mt} = D_{2t}. \tag{2.35}$$

There are no changes to other equations. The linearized household intertemporal budget constraint (2.20), and therefore the solution for the change in consumption (2.21) for the monetary union, still applies, but with household wealth now written as $W_{1t} = R_{1t-1}B^1_{1t-1} + e_t R_{2t-1}B^2_{1t-1} + M_{1t-1}$. We next solve for the price level change for fixed exchange rate regimes, including a regular peg, a currency board and dollarization, and for more flexible exchange rate regimes that incorporate a pure float, a crawling peg, or a managed float.

Fixed exchange rate regimes

ERM II here is considered as an arrangement where the exchange rate is credibly fixed. The solutions for fixed exchange rate regimes naturally also apply to countries which have a fixed rate regime during stage 1. A fixed exchange rate, i.e. $e_t = e_{t+1} = \overline{e}$, implies that the price level changes of the two countries cannot differ, i.e. $\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{P}_{2t}}{\overline{P}_2}$, as linearizing the exchange rate around the steady state yields $\frac{\widetilde{e}_t}{\overline{e}} = \frac{\widetilde{P}_{1t}}{\overline{P}_1} - \frac{\widetilde{P}_{2t}}{\overline{P}_2}$. If country 2 (euro area) is engaged in inflation targeting with $\frac{\overline{P}_{2t+1}}{\overline{P}_2} = 1 + \mu_2$, then the steady state price level change of country 1 (the accession country which now is a new Member State) must also be $\frac{\overline{P}_{1t+1}}{\overline{P}_1} = 1 + \mu_2$. Furthermore, the interest rate parity condition (2.27) implies that with a credibly fixed exchange rate, the interest rates of the two countries cannot differ, i.e. $R_{1t} = R_{2t} = \frac{1+\mu_2}{\beta}$.

Assuming that fiscal policy is responsible in both countries, the procedure applied in the previous sections produces (see Appendix)

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{P}_{2t}}{\overline{P}_2} \Rightarrow \frac{\widetilde{e}_t}{\overline{e}} = 0, \tag{2.36}$$

which implies that the exchange rate is indeed credibly fixed when both conduct responsible fiscal policies. If fiscal policy is irresponsible in the accession country and responsible in EMU, and assuming that the EMU price level is at the steady state level, we get

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = -\left(\frac{\overline{W}_1}{\overline{P}_1}\right)\widetilde{\tau}_{1t}, \tag{2.37}$$

which can also be written as

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = \left[\overline{R}_2\left(\overline{e}\overline{B}^2_{1t-1} - \overline{B}^1_{2t-1}\right) + \overline{D}_1\right]^{-1} \widetilde{D}_{1t} \tag{2.38}$$

(see Appendix). Both equation (2.37) and (2.38) must equal zero for the exchange rate to be credibly fixed. If not, the accession country may be forced to exit the peg. In other words, irresponsible fiscal policy is inconsistent with a fixed exchange rate, which is in line with Canzoneri et al. (2001a), who note that to be able to maintain a fixed peg, the central bank needs help from the fiscal authorities.[17] [18]

All in all, there appears to be a paradox between the findings for the ERM II and the common currency stages. If the exchange rate is credibly fixed within the ERM II arrangement, the accession country is essentially barred from having an irresponsible fiscal policy. However, it may engage in an irresponsible fiscal policy once it adopts the common currency!

Tighter forms of a peg include the currency board arrangement and dollarization. Instead of equation (2.32), the central bank's budget constraint for the CBA country can be written as

$$\overline{e}\frac{B^2_{1mt}}{P_{1t}} + v_{1t} = \overline{e}R_{2t-1}\left(\frac{B^2_{1mt-1}}{P_{1t}}\right) + \frac{M_{1t} - M_{1t-1}}{P_{1t}}, \tag{2.39}$$

where $v_{1t} = (R_{2t-1} - 1)\overline{e}\frac{B^2_{1mt-1}}{P_{1t}}$. Equation (2.39) reflects the fact that the domestic money supply has to be backed by foreign reserves, i.e. $\frac{M_{1t}-M_{1t-1}}{P_{1t}} = \overline{e}\frac{B^2_{1mt}-B^2_{1mt-1}}{P_{1t}}$. Consequently, the bond-market equilibrium conditions (2.34) become

$$B^1_{1t} + B^1_{2t} = D_{1t} \text{ and } B^2_{1t} + B^2_{2t} + B_{1mt} + B_{2mt} = D_{2t}. \tag{2.40}$$

If both countries conduct responsible fiscal policies, the answer is again equation (2.36). Assuming that fiscal policy in country 1 would be irresponsible, while country 2 would be at the steady state price level, again produces equa-

[17] Aghevli et al. (1991) also find that a fixed exchange rate requires that a country be able to maintain fiscal discipline.

[18] The literature on currency crises supports this result. Krugman (1979) notes that in first-generation currency crises, irresponsible fiscal policy leads to increasing debt and finally to a currency crisis. Daniel (2001) argues that a currency crisis takes place when the fiscal authority lets the present value of primary surpluses, inclusive of seigniorage, differ from the value of government debt at the fixed exchange rate. Corsetti and Mackowiak (2001), in their study on size and timing of devaluations within the FTPL framework, find that real debt acts as leverage. Devaluations are smaller when nominal liabilities are a larger fraction of the total debt and long-term nominal debt helps the government delay the devaluation.

tion (2.37), as well as

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = \left[\overline{R}_2\left(\overline{e}\overline{B}^2_{1t-1} - \overline{B}^1_{2t-1} + \overline{e}\overline{B}^2_{1mt-1}\right) + \overline{D}_{1t}\right]^{-1}\widetilde{D}_{1t} \tag{2.41}$$

(details in Appendix). As changes in the exchange rate are impossible or at least very difficult in the CBA, equation (2.41) would have to equal zero. Irresponsible fiscal policies are thus inconsistent with the CBA arrangement. Increasing debt would result in the loss of reserves, which would eventually lead to the abandonment of the CBA. Hence, the CBA implies even tighter fiscal discipline on a country than a regular peg and irresponsible fiscal policy is likely to lead to a crisis faster in a CBA than in a regular peg. Indeed, authorities committed to the CBA are likely to be also committed to the responsible fiscal policies required.[19]

Dollarization means replacing a country's own currency fully with the currency of a foreign country, and thus abandoning the issue of domestic currency altogether.[20] The government budget constraints for both countries are affected. The seigniorage revenues for country 1 disappear and the government budget constraint for the dollarized country is thus written as

$$\overline{g}_1 + R_{1t-1}\left(\frac{D_{1t-1}}{P_{1t}}\right) = \tau_{1t} + \frac{D_{1t}}{P_{1t}}, \tag{2.42}$$

so that government 2 now benefits from increased seigniorage revenues. If we assume that arbitrage applies, there is only one price level.[21] Moreover, the country risk premium is ignored and the interest rate parity continues to apply, $R_{1t} = R_{2t}$, but we continue to separate bonds by countries. Thus, the bond-market equilibrium conditions are written as

$$B^1_{1t} + B^1_{2t} = D_{1t} \text{ and } B^2_{1t} + B^2_{2t} + B_{2mt} = D_{2t}. \tag{2.43}$$

and in addition there is a money market condition $M^2_{1t} + M^2_{2t} = M^2_t$. If both countries conduct responsible fiscal policies, then the common price level is not affected by the fiscal variables. However, if the dollarized country conducts an irresponsible fiscal policy, then the percentage change in the price level can be

[19] As noted by Edwards (2002) in relation to the Argentine case, the existence of a currency board does not "force" politicians to run a prudent fiscal policy and moreover, a super-fixed exchange rate regime is not on its own a solution to a country's macroeconomic problems.

[20] Specifically, this is official dollarization as opposed to unofficial dollarization, whereby domestic residents at least partly rely on a foreign currency in their domestic transactions. Unofficial dollarization is typically a reaction to high domestic inflation levels.

[21] In practice, the countries may not share the same price level.

defined as (see Appendix)

$$\frac{\widetilde{P}_t}{\overline{P}} = \frac{\widetilde{D}_{1t}}{\overline{D}_1}, \tag{2.44}$$

which is the same as equation (2.24) for the monetary union case. Hence, a rise in the level of debt of the dollarized country raises the common price level of both countries. From the viewpoint of the other countries using the dollar, dollarization of a country conducting irresponsible fiscal policies is thus not desirable.

As there is no exchange rate constraint, dollarization does not prevent irresponsible fiscal policies in the same manner as e.g. the currency board. Indeed, Fatás and Rose (2001) find in their empirical study that dollarization is associated with higher spending, while currency boards are characterized with fiscal restraint. However, in practice irresponsible fiscal policy may force a country to abandon dollarization eventually as debt simply becomes too large. Therefore, even though dollarization, as such, does not impose responsible fiscal policy, it promotes responsible policies by making it very difficult - not to mention costly - to reverse the dollarization. The price level rise caused by irresponsible fiscal policy in the dollarized country may also affect the exchange rate of the dollar, even though it is assumed that the dollarized country is small relative to the US, or in case of euroization, the euro area.

Floating exchange rate regimes

In a pure float, both central banks are assumed to conduct a monetary regime of inflation targeting. The inflation target for the accession country is determined as $\frac{P_{1t+1}}{P_{1t}} = 1+\mu_1$, while that of the monetary union is $\frac{P_{2t+1}}{P_{2t}} = 1+\mu_2$. The relative interest rates are thus $R_{1t} = \frac{1+\mu_1}{\beta}$ and $R_{2t} = \frac{1+\mu_2}{\beta}$. The uncovered interest rate parity implies that the steady state change in the exchange rate can be determined as

$$\frac{\overline{e}_{t+1}}{\overline{e}} = \frac{1+\mu_1}{1+\mu_2}, \tag{2.45}$$

which implies a trend appreciation or depreciation of the exchange rate, if $\mu_1 \neq \mu_2$.

Assuming that fiscal policy is responsible in both countries gives for the price level change in country 1 (see Appendix)

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{P}_{2t}}{\overline{P}_2} \Rightarrow \frac{\widetilde{e}_t}{\overline{e}} = 0. \tag{2.46}$$

Therefore, if both countries conduct responsible fiscal policies, there are no deviations from the steady state path of the exchange rate. When the accession country conducts irresponsible fiscal policy and assuming that the monetary union is in a steady state, we get (see Appendix)

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = \left(\overline{e}\overline{R}_2\overline{B}^2_{1t-1} - \overline{R}_1\overline{B}^1_{2t-1} + \overline{D}_1\right)^{-1} \widetilde{D}_{1t}, \tag{2.47}$$

i.e. the price level of country 1 would rise proportionally to the rise in the level of debt, the proportion depending on the steady state net foreign interest payments plus the steady state debt of country 1. The price level rise of country 1 implies a nominal exchange rate depreciation. Thus, a flexible exchange rate absorbs the price level rise and therefore sets no constraints on fiscal policy.

With a crawling peg regime, the central bank of the accession country targets a specific periodic rate of change for the exchange rate, defined here as $\frac{e_{t+1}}{e_t} = 1 + \lambda_1$, while the central bank of the monetary union still has inflation targeting. Thus, in the steady state

$$\left(\frac{\overline{P}_{1t+1}}{\overline{P}_1}\right) = (1 + \lambda_1)(1 + \mu_2). \tag{2.48}$$

Moreover, the uncovered interest rate parity implies

$$R_{1t} = \left(\frac{1 + \mu_2}{\beta}\right)(1 + \lambda_1). \tag{2.49}$$

The solution is the same as for the pure float with inflation targeting.

In a managed float, the central bank has a certain (often unannounced) target path for the exchange rate. As the other central bank is engaged in inflation targeting, the solution for a managed float is similar to that of a pure float with inflation targeting. Hence, the more flexible regimes are able to absorb the effects of irresponsible fiscal policy. Irresponsible fiscal policy implies only that the central bank may not meet its monetary policy targets.

2.3.3 Effect of EMU entry announcement

As the public has rational expectations, it can be assumed that the knowledge of the upcoming EMU entry already affects the price level. To determine the effects, the first-order conditions (2.4) and (2.26) are here linearized around

the common currency steady state

$$\frac{\widetilde{m}_{1t}}{\overline{m}_{EMU}} = \frac{\widetilde{c}_{1t}}{\overline{c}_{EMU}} \tag{2.50}$$

$$\begin{aligned}(1-d)\left(\frac{\widetilde{m}_{1t}}{\overline{m}_{EMU}} - \frac{\widetilde{c}_{1t}}{\overline{c}_{EMU}}\right) &= (1-d)\left(\frac{\widetilde{m}_{1t+1}}{\overline{m}_{EMU,t+1}} - \frac{\widetilde{c}_{1t+1}}{\overline{c}_{EMU,t+1}}\right) \\ &\quad + \frac{\widetilde{P}_{1t}}{\overline{P}_{EMU}} - \frac{\widetilde{P}_{1t+1}}{\overline{P}_{EMU,t+1}},\end{aligned} \tag{2.51}$$

where the overbars indicate EMU steady state values in period t (for steady states that differ from those of period t, the period is noted), and tildes denote deviations from the EMU steady state. Equations (2.50) and (2.51) imply that

$$\begin{aligned}\frac{\widetilde{P}_{1t}}{\overline{P}_{EMU}} &= \frac{\widetilde{P}_{t+1}}{\overline{P}_{EMU,t+1}} \Rightarrow \frac{P_{1t} - \overline{P}_{EMU}}{\overline{P}_{EMU}} = \frac{P_{1t+1} - \overline{P}_{EMU,t+1}}{\overline{P}_{EMU,t+1}} \\ &\Rightarrow \frac{P_{1t+1}}{P_{1t}} = \frac{\overline{P}_{EMU,t+1}}{\overline{P}_{EMU}} = 1 + \mu_{EMU}.\end{aligned} \tag{2.52}$$

Hence, the accession country's price level jumps at the time of the announcement and continues thereafter at the EMU steady state level. In other words, accession countries should align their monetary policies with those of the EMU. For example, an inflation-targeting accession country should set its inflation target similar to that of EMU when it announces its future intention to adopt the common currency. Furthermore, to achieve these targets, it should conduct responsible fiscal policies in accordance with the Maastricht criteria.

2.4 Conclusions

Several Central and Eastern European countries will adopt the euro in the near future. Their readiness for euro area membership will be tested based on the Maastricht criteria, which include a two year participation in the Exchange Rate Mechanism ERM II. Before that, no restrictions are placed on the choice of exchange rate regime. Besides the requirement of holding a fixed exchange rate for two years, the criteria on price level stability and public finances are considered to be the greatest challenges for these countries that are still catching-up to the current euro area. This study attempts to provide a picture of exchange rate strategies that would facilitate convergence in the new Member States in the run-up to EMU, and of the requirements for successful

participation in the ERM II and the euro area.

The Fiscal Theory of the Price Level, despite severe criticisms, seems an appropriate way to combine aspects of the exchange rate regime choice and nominal convergence. In fact, while no incontestable proof of the existence of the so-called fiscal dominant regimes has been presented, this may be attributable to several factors. In this study, it was shown that irresponsible fiscal policies are inconsistent with fixed exchange rate regimes, while in earlier literature it has been illustrated how irresponsible fiscal policy may lead to a currency crisis. On the other hand, governments appear to adjust their fiscal policy when debt becomes too large. Thus, it seems appropriate to conclude, as did Christiano and Fitzgerald (2000), that the fiscal dominance assumption is not a good characterization of policy at all times and places. Nevertheless, it may be a useful characterization of actual policies in certain contexts.

The analysis in this study shows that the price level is affected by irresponsible fiscal policy in all exchange rate regimes, while the price level is unaffected by fiscal variables when policy is responsible. Indeed, there is no exchange rate regime that would in itself impose fiscal policy responsibility. Thus, the choice of the exchange rate regime is closely linked to the general level of commitment of the authorities. The credibility of responsible policies may be enhanced by a commitment to a more fixed exchange rate regime, while the effects of irresponsible fiscal policy will be reflected in more flexible regimes as changes to the nominal exchange rate.

In a monetary union, the price level is affected by irresponsible fiscal policy because the rise in the debt of just one member country raises the common price level throughout the union. In other words, the central bank loses control over the price level and the inflation target will not be achieved without help from the fiscal authorities. This result is in line with Bergin (2000) and Canzoneri et al. (1998a, 2001a). In EMU this should however be prevented by the Stability and Growth Pact. Ballabriga and Martinez-Mongay (2002) have indeed shown that the first years of EMU have been characterized by a monetary dominant regime.

Paradoxically, irresponsible fiscal policy will not be possible during the ERM II stage if the exchange rate is credibly fixed within the arrangement. According to the results, ERM II should force the participating countries to conduct responsible fiscal policies and thus bring price level changes in line with those of the euro area, as irresponsible fiscal policy is inconsistent with a credibly fixed exchange rate. The results formally confirm the finding of Canzoneri et al. (1998a, 2001a) that a currency peg is simply not sustainable if fiscal policy is non-Ricardian. The central assumption for the ERM II is

thus that the exchange rate is credibly fixed within the ERM II, which may not be the case considering the current flexible arrangement.

Presently, there are several exchange rate regimes in place in the accession countries. In general, fixed exchange rate regimes imply more responsible fiscal policies, as exiting the regime is often very costly. In more flexible regimes, responsible policies are not a strict requirement, because the exchange rate can adjust. Here, irresponsible policies only mean that the central bank may not meet its goals. It could be assumed that regimes tighter than a standard peg, e.g. currency boards and dollarization (euroization), set even higher demands for fiscal policy to be responsible, as exiting these regimes is extremely difficult. The results however show this to be the case only for the currency board, as maintaining a currency board indeed requires responsible fiscal policies. Thus, the currency board seems appropriate to function within the ERM II arrangement. The case for euroization is less clear. The results show that irresponsible fiscal policy in the euroized country might raise the price level also in the euro area. In any case, the EU has ruled out the possibility.

What exchange rate regime should a euro area aspirant then choose according to this analysis? Countries aiming for a stable nominal exchange rate need to conduct responsible fiscal policy, while countries unable to commit to responsible fiscal policy should probably not commit to a fixed exchange rate either. Indeed, Woodford emphasizes that a suitable fiscal policy commitment is an essential part of a policy framework to achieve macroeconomic stability, in addition to a suitable monetary policy commitment (Woodford 2003, 317). On the one hand, abandoning a fixed regime may be costly but on the other hand, nominal exchange rate adjustment will also involve adverse consequences. Countries with responsible fiscal policies, moreover, may enhance the credibility of their policies by committing to a fixed regime. Nevertheless, it should not be forgotten that fiscal policy responsibility/irresponsibility is only one factor in the determination of an appropriate exchange rate regime.

In practice the CEECs have preferred a stable exchange rate in their policies, as in the beginning of the transition, several countries chose a fixed exchange rate regime, although with differing degrees of flexibility. When the exchange rate has not been technically pegged, it has still functioned as an implicit policy anchor. Moreover, floating may not be an option for small economies with small foreign exchange markets, as this could result in excessive volatility of the exchange rate. Changes in regimes have been numerous, which - according to Corker et al. (2000) - can be attributed to progress with disinflation and pressure from capital flows.

Fiscal responsibility should be enforced also by the Maastricht criteria,

which require besides fiscal responsibility also price stability from the countries aiming to adopt the euro. Undeniably, the Maastricht criteria are not officially on the table until the ERM II stage. Furthermore, it is important that real convergence advances so that the smooth functioning of EMU is ensured. Responsible fiscal, monetary and exchange rate policies should therefore not be viewed solely as methods to gain euro area membership, but rather as permanent policies.

Further research in the area of the fiscal determinants of inflation is clearly needed. One possible topic could be the empirical examination of the relationship between fiscal variables and crisis indicators. The amount of data available for CEECs is constantly increasing, which will facilitate empirical analyses in the future. Another line of research could focus on the relationship between the results from this research and other determinants in choosing an appropriate exchange rate regime.

References

Aghevli, B.B., Khan, M.S., Montiel, P., 1991. Exchange Rate Policy in Developing Countries: Some Analytical Issues. IMF Occasional Paper No. 78.

Ballabriga, F., Martinez-Mongay, C., 2002. Has EMU shifted policy?. Economic Papers No. 166, European Commission, Directorate-general for Economic and Financial Affairs.

Bergin, P., 2000. Fiscal solvency and price level determination in a monetary union. Journal of Monetary Economics, 45:1, 37-53.

Brunila, A., Buti, M., Franco, D., 2001. Introduction in Brunila, A., Buti, M., Franco, D. (eds.), The Stability and Growth Pact The Architecture of Fiscal Policy in EMU, Palgrave, New York.

Buiter, W.H., 1999. The Fallacy of Fiscal Theory of the Price Level. NBER Working Paper No. 7302.

Canzoneri, M.B., Diba, B.T., 1996. Fiscal Constraints on Central Bank Independence and Price Stability. CEPR Discussion Paper No. 1463.

Canzoneri, M.B., Diba, B.T., 2001. The SGP: Delicate Balance or Albatross? in Brunila, A., Buti, M., Franco, D. (eds.), The Stability and Growth Pact The Architecture of Fiscal Policy in EMU, Palgrave, New York.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 1998a. Fiscal Discipline and Exchange Rate Regimes. CEPR Discussion Paper No. 1899.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 1998b. Is the Price Level Determined by the Needs of Fiscal Solvency?. NBER Working Paper No. 6471.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 2000. Does Monetary or Fiscal Policy Provide a Nominal Anchor?: Evidence from OECD Countries. Unpublished, www.georgetown.edu/faculty/canzonem/canzoneri.htm

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 2001a. Fiscal Discipline and Exchange Rate Systems. Economic Journal, 111:474, 667-690.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 2001b. Is the Price Level Determined by the Needs of Fiscal Solvency?. The American Economic Review, 91:5, 1221-1238.

Carlstrom, C.T., Fuerst, T.S., 2000. The Fiscal Theory of the Price Level. Economic Review - Federal Reserve Bank of Cleveland, 36:1, 22-32.

Christiano, L.J., Fitzgerald, T.J., 2000. Understanding the Fiscal Theory of the Price Level. NBER Working Paper No. 7668.

Cochrane, J.H., 2000. Money as Stock: Price Level Determination with no Money Demand. NBER Working Paper No. 7498.

Cochrane, J.H., 2001. Long-term debt and optimal policy in the Fiscal Theory of the Price Level. Econometrica, 69:1, 69-116.

Corker, R., Beaumont, C., van Elkan, R., Iakova, D., 2000. Exchange Rate Regimes in Selected Advanced Transition Economies - Coping with Transition, Capital Inflows, and EU accession. IMF Policy Discussion Paper, PDP/00/3.

Corsetti, G., Mackowiak, B., 2001. Fiscal Imbalances and the Dynamics of Currency Crises. CEPR Discussion Paper No. 2929.

Council (Ecofin), 2000. 2301st Council meeting, Brussels, 7 November 2000. Press Release, http://ue.eu.int/Newsroom.

Daniel, B.C., 2001. A Fiscal Theory of Currency Crises. International Economic Review, 42:4, 969-988.

Dupor, B., 2000. Exchange rates and the fiscal theory of the price level. Journal of Monetary Economics, 45:3, 613-630.

Edwards, S., 2002. The Great Exchange Rate Debate After Argentina. NBER Working Paper No. 9257.

Fatás, A., Rose, A.K., 2001. Do Monetary Handcuffs Restrain Leviathan? Fiscal Policy in Extreme Exchange Rate Regimes. IMF Staff Papers, 47, 40-61.

Kocherlakota, N., Phelan, C., 1999. Explaining the Fiscal Theory of the Price Level. Quarterly Review - Federal Reserve Bank of Minneapolis, 23:4, 14-23.

Krugman, P., 1979. A Model of Balance-of-Payments Crises. Journal of Money, Credit and Banking, 11:3, 311-325.

Leeper, E., 1991. Equilibria under 'active' and 'passive' monetary and fiscal policies. Journal of Monetary Economics, 27:1, 129-147.

Niepelt, D., 2004. The Fiscal Myth of the Price Level. Quarterly Journal of Economics, 119:1, 277-300.

Obstfeld, M., Rogoff, K., 1998. Foundations of International Macroeconomics, The MIT Press, Cambridge, Massachusetts.

Sargent, T.J., Wallace, N., 1981. Some Unpleasant Monetarist Arithmetic. Federal Reserve Bank of Minneapolis Quarterly Review, 5:3, 1-17.

Schmitt-Grohé, S., Uribe, M., 2000. Prive level determinacy and monetary policy under a balanced budget requirement. Journal of Monetary Economics, 45:1, 211-246.

Sims, C.A., 1994. A simple model for the study of the determination of the price level and the interaction of monetary and fiscal policy. Economic Theory, 4:3, 381-399.

Walsh, C.E., 2003. Monetary Theory and Policy: Second edition. The MIT Press, Cambridge, Massachusetts.

Woodford, M., 1994. Monetary policy and price level determinacy in a cash-in-advance economy. Economic Theory, 4:3, 345-380.

Woodford, M., 1995. Price-level determinacy without control of a monetary aggregate. Carnegie-Rochester Conference Series on Public Policy, 43, 1-46.

Woodford, M., 1996. Control of the Public Debt: A Requirement for Price Stability. NBER Working Paper No. 5684.

Woodford, M., 1998. Public Debt and the Price Level. Unpublished, http://www.princeton.edu/~woodford/

Woodford, M., 2001. Fiscal Requirements for Price Stability. NBER Working Paper No. 8072.

Woodford, M., 2003. Interest & Prices: Foundations of a Theory of Monetary Policy. Princeton University Press, Princeton, New Jersey.

Appendix

Monetary union

The linearized first-order conditions (2.3), (2.4) and (2.5) are

$$\frac{\widetilde{c}_{1t}^2}{\overline{c}_1^2} - \frac{\widetilde{c}_{1t}^1}{\overline{c}_1^1} = \frac{\widetilde{p}_t^1}{\overline{p}^1} - \frac{\widetilde{p}_t^2}{\overline{p}^2} \tag{2.53}$$

$$(1-d)\left(\frac{\widetilde{m}_{1t}}{\overline{m}_1} - \frac{\widetilde{c}_{1t}}{\overline{c}_1}\right) = (1-d)\left(\frac{\widetilde{m}_{1t+1}}{\overline{m}_{1t+1}} - \frac{\widetilde{c}_{1t+1}}{\overline{c}_{1t+1}}\right) + \frac{\widetilde{P}_t}{\overline{P}_t} - \frac{\widetilde{P}_{t+1}}{\overline{P}_{t+1}} \tag{2.54}$$

$$\widetilde{m}_{1t} = \left(\frac{1-d}{d}\right)\left(\frac{R_t}{R_t - 1}\right)\widetilde{c}_{1t}. \tag{2.55}$$

From conditions (2.54) and (2.55) we get that $\frac{\widetilde{P}_t}{\overline{P}_t} = \frac{\widetilde{P}_{t+1}}{\overline{P}_{t+1}}$. Imposing this and condition (2.55) on equation (2.20), we can solve for current consumption (equation (2.21) in the text).

Two results used here (as well as later on) are the goods markets clearing condition that joint consumption is constant $\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$ and the condition stating that $\frac{\widetilde{p}_t^1}{\overline{p}^1} = \frac{\widetilde{p}_t^2}{\overline{p}^2} = \frac{\widetilde{P}_t}{\overline{P}}$.

Proof ($\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$):

$$c_{1t} = \frac{p_t^1}{P_t}c_{1t}^1 + \frac{p_t^2}{P_t}c_{1t}^2 \text{ and } c_{2t} = \frac{p_t^1}{P_t}c_{2t}^1 + \frac{p_t^2}{P_t}c_{2t}^2 \tag{2.56}$$

$$\begin{aligned}
\widetilde{c}_{1t} + \widetilde{c}_{2t} &= \left[\frac{\widetilde{p}_s^1}{\overline{P}} - \left(\frac{\overline{p}^1}{\overline{P}}\right)\left(\frac{\widetilde{P}_s}{\overline{P}}\right)\right]\left(\overline{c}_1^1 + \overline{c}_2^1\right) + \frac{\overline{p}^1}{\overline{P}}\left(\widetilde{c}_{1t}^1 + \widetilde{c}_{2t}^1\right) \\
&\quad + \left[\frac{\widetilde{p}_s^2}{\overline{P}} - \left(\frac{\overline{p}^2}{\overline{P}}\right)\left(\frac{\widetilde{P}_s}{\overline{P}}\right)\right]\left(\overline{c}_2^1 + \overline{c}_2^2\right) + \frac{\overline{p}^2}{\overline{P}}\left(\widetilde{c}_{1t}^2 + \widetilde{c}_{2t}^2\right) \\
&= \left[a\left(\frac{\widetilde{p}_t^1}{\overline{p}^1}\right) + (1-a)\left(\frac{\widetilde{p}_t^2}{\overline{p}^2}\right) - \frac{\widetilde{P}_t}{\overline{P}}\right](\overline{c}_1 + \overline{c}_2) \\
&= 0,
\end{aligned} \tag{2.57}$$

as linearizing equation (2.6) produces

$$\frac{\widetilde{P}_t}{\overline{P}} = a\left(\frac{\widetilde{p}_t^1}{\overline{p}^1}\right) + (1-a)\left(\frac{\widetilde{p}_t^2}{\overline{p}^2}\right). \tag{2.58}$$

Proof ($\frac{\widetilde{p}_t^1}{\overline{p}^1} = \frac{\widetilde{p}_t^2}{\overline{p}^2} = \frac{\widetilde{P}_t}{\overline{P}}$):

Imposing $c_{1t}^1 = a\frac{P_t}{p_t^1}c_{1t}$, $c_{1t}^2 = (1-a)\frac{P_t}{p_t^2}c_{1t}$, $c_{2t}^1 = a\frac{P_t}{p_t^1}c_{2t}$ and $c_{2t}^2 = (1-a)\frac{P_t}{p_t^2}c_{2t}$

on the goods market clearing conditions (2.16) and linearizing produces

$$a\left[\left(\frac{\widetilde{P}_t}{\overline{P}}-\frac{\widetilde{p}_t^1}{\overline{p}^1}\right)\left(\frac{\overline{P}}{\overline{p}^1}\right)(\overline{c}_1+\overline{c}_2)+\frac{\overline{P}}{\overline{p}^1}(\widetilde{c}_{1t}+\widetilde{c}_{2t})\right]=0 \tag{2.59}$$

and

$$(1-a)\left[\left(\frac{\widetilde{P}_t}{\overline{P}}-\frac{\widetilde{p}_t^2}{\overline{p}^2}\right)\left(\frac{\overline{P}}{\overline{p}^2}\right)(\overline{c}_1+\overline{c}_2)+\frac{\overline{P}}{\overline{p}^2}(\widetilde{c}_{1t}+\widetilde{c}_{2t})\right]=0, \tag{2.60}$$

which imply that

$$\frac{\widetilde{p}_t^1}{\overline{p}^1}=\frac{\widetilde{p}_t^2}{\overline{p}^2}=\frac{\widetilde{P}_t}{\overline{P}}. \tag{2.61}$$

The fiscal rule for country 1 implies that $E_t\sum_{s=t}^{\infty}\beta^{s-t}(\widetilde{\tau}_{1s})=\widetilde{\tau}_{1t}$, while for country 2

$$\sum_{s=t}^{\infty}\beta^{s-t}(\widetilde{\tau}_{2s})=\overline{R}\left[\frac{\widetilde{D}_{2t-1}}{\overline{P}}-\left(\frac{\overline{D}_{2t-1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)\right]+\sum_{s=t}^{\infty}\beta^{s-t}(\widetilde{v}_{2s}) \tag{2.62}$$

by definition of its fiscal policy and the linearized government intertemporal budget constraint (2.11), where the last term is solved from the linearized central bank intertemporal budget constraint (2.15)

$$\sum_{s=t}^{\infty}\beta^{s-t}(\widetilde{v}_{2s})=\omega_2\left[\overline{R}\frac{\widetilde{B}_{mt-1}}{\overline{P}}-\frac{\widetilde{M}_{t-1}}{\overline{P}}+\left(\frac{\overline{M}_{t-1}}{\overline{P}}-\overline{R}\frac{\overline{B}_{mt-1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)\right]. \tag{2.63}$$

Substituting these into equation (2.22) we arrive at equation (2.23) in the text. To get equation (2.24), we define

$$\begin{aligned}\sum_{s=t}^{\infty}\beta^{s-t}(\widetilde{\tau}_{1s}) \;&=\; \widetilde{\tau}_{1t}=\overline{R}\left[\frac{\widetilde{D}_{1t-1}}{\overline{P}}-\left(\frac{\overline{D}_{1t-1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)\right]-\frac{\widetilde{D}_{1t}}{\overline{P}}\\ &\quad+\left(\frac{\overline{D}_1}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)-(\widetilde{v}_{1t})\end{aligned} \tag{2.64}$$

by description of fiscal policy in country 1 and the government linearized flow budget constraint (2.9), where the rebates are defined according to equation (2.13).

Verifying that the steady state exists: The household intertemporal budget

constraint (2.8) in the steady state is

$$\frac{\overline{W}_1}{\overline{P}} = \frac{1}{1-\beta}\left(\overline{c}_1 + \overline{\tau}_1 + \frac{\overline{R}-1}{\overline{R}}\overline{m}_1 - \frac{\overline{p}^1}{\overline{P}}\overline{y}_1\right). \tag{2.65}$$

Together with the steady state first-order condition (2.4)

$$\overline{m}_1 = \left(\frac{1-d}{d}\right)\left(\frac{\overline{R}}{\overline{R}-1}\right)\overline{c}_1, \tag{2.66}$$

it allows us to solve consumption

$$\overline{c}_1 = d\left[(1-\beta)\frac{\overline{W}_1}{\overline{P}} + \frac{\overline{p}^1}{\overline{P}}\overline{y}_1 - \overline{\tau}_1\right]. \tag{2.67}$$

The steady state government budget constraint for both countries can be written as

$$\overline{\tau}_1 = \overline{\tau}_2 = \overline{g}_1 - \overline{v}_1 + \frac{(1-\beta)}{\beta}\frac{\overline{D}_1}{\overline{P}}, \tag{2.68}$$

which leads to the same equation for the flow budget constraint (2.9) and the intertemporal budget constraint (2.11) and thus for responsible and irresponsible policies alike. The central bank rebates are solved from the central bank equations (2.13) and (2.15), which give

$$\overline{v}_1 = \omega_1\left[\frac{\overline{R}-1}{\overline{R}}\overline{m} - (1-\beta)\left(\frac{\overline{M}_{t-1}}{\overline{P}} - \overline{R}\frac{\overline{B}_{mt-1}}{\overline{P}}\right)\right] = \omega_1\overline{v} \tag{2.69}$$

$$\overline{v}_2 = \omega_2\overline{v}. \tag{2.70}$$

Adding the consumption functions of both countries, substituting equations (2.68), (2.69) and (2.70) and imposing the goods-market-clearing conditions (2.16) gives

$$\begin{aligned}\overline{c}_1 + \overline{c}_2 &= \frac{\overline{p}^1}{\overline{P}}\left(\overline{c}_1^1 + \overline{c}_2^1\right) + \frac{\overline{p}^2}{\overline{P}}\left(\overline{c}_1^2 + \overline{c}_2^2\right) \\ &\quad + (1-\beta)\frac{\overline{W}}{\overline{P}} + \frac{(1-\beta)}{\beta}\frac{\overline{B}_m}{\overline{P}} - \frac{(1-\beta)}{\beta}\left(\frac{\overline{D}_1}{\overline{P}} + \frac{\overline{D}_2}{\overline{P}}\right) - \frac{(1-\beta)}{\beta}\frac{\overline{M}}{\overline{P}} \\ &= \frac{\overline{p}^1}{\overline{P}}\left(\overline{c}_1^1 + \overline{c}_2^1\right) + \frac{\overline{p}^2}{\overline{P}}\left(\overline{c}_1^2 + \overline{c}_2^2\right).\end{aligned} \tag{2.71}$$

Two currencies

Linearized first-order conditions (2.26) for country 1 are

$$(1-d)\left(\frac{\widetilde{m}_{1t}}{\overline{m}_1}-\frac{\widetilde{c}_{1t}}{\overline{c}_1}\right) = (1-d)\left(\frac{\widetilde{m}_{1t+1}}{\overline{m}_{1t+1}}-\frac{\widetilde{c}_{1t+1}}{\overline{c}_{1t+1}}\right) + \frac{\widetilde{P}_{1t}}{\overline{P}_1}-\frac{\widetilde{P}_{1t+1}}{\overline{P}_{1t+1}}+\frac{\widetilde{e}_{t+1}}{\overline{e}_{t+1}}-\frac{\widetilde{e}_t}{\overline{e}}, \tag{2.72}$$

which, together with the equation for country 2 and the definition of the exchange rate, give for all exchange rate regimes that $\frac{\widetilde{P}_{1t+1}}{\overline{P}_{1t+1}}=\frac{\widetilde{P}_{1t}}{\overline{P}_1}$.

Fixed exchange rate regimes

Regular peg: The consumption equation (2.21) still applies, because from the goods market clearing conditions we get that $\frac{\widetilde{p}^1_{1s}}{\overline{p}^1_1}=\frac{\widetilde{P}_{1s}}{\overline{P}_1}$ and $\frac{\widetilde{p}^2_{2s}}{\overline{p}^2_2}=\frac{\widetilde{P}_{2s}}{\overline{P}_2}$. Assuming that both countries have a responsible fiscal policy - substituting equation (2.62) and (2.63), where P_t now refers to each country's own price level, in the consumption equation of both countries - and imposing the goods market clearing condition $\widetilde{c}_{1t}+\widetilde{c}_{2t}=0$, produces

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)\left(\overline{e}\frac{\overline{B}^2_{1t-1}}{\overline{P}_1}-\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right)=\left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2}-\frac{1}{\overline{e}}\frac{\overline{B}^1_{2t-1}}{\overline{P}_2}\right), \tag{2.73}$$

which gives equation (2.36) in the text. Assuming that country 1 has an irresponsible fiscal policy and country 2 a responsible fiscal policy, equations (2.62) and (2.63) substituted in the consumption equation of country 2 produces, as joint consumption is constant,

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)d\left(\frac{\overline{W}_1}{\overline{P}_1}\right)=\left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2}-\frac{\overline{e}\overline{B}^1_{2t-1}}{\overline{P}_2}\right)-d\widetilde{\tau}_{1t} \tag{2.74}$$

and substituting further equation (2.64), where P_t now refers to the price level of country 1, here

$$\begin{aligned}&\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)d\left[\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2}-\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right)+\frac{\overline{D}_{1t}}{\overline{P}_1}\right] \\ =\ &\left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2}-\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right)+d\frac{\widetilde{D}_{1t}}{\overline{P}_1}.\end{aligned} \tag{2.75}$$

Then assuming that country 2 is in a steady state $\frac{\widetilde{P}_{2t}}{\overline{P}_2}=0$, we arrive at equations (2.37) and (2.38) in the text.

Currency board: Assuming that both countries have a responsible fiscal policy, substituting equations (2.62) and (2.63) in the consumption equations and imposing the goods-market-clearing condition $\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$, produces

$$\begin{aligned} & \left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)\left(\overline{e}\frac{\overline{B}^2_{1t-1}}{\overline{P}_1} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) \\ = & \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{1}{\overline{e}}\frac{\overline{B}^1_{2t-1}}{\overline{P}_2} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right), \end{aligned} \tag{2.76}$$

which gives again equation (2.36) in the text. Assuming that country 1 has an irresponsible and country 2 a responsible fiscal policy, equations (2.62) and (2.63) again substituted in the consumption equation of country 2 gives, as joint consumption is constant,

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left(\frac{\overline{W}_1}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{e}\overline{B}^1_{2t-1}}{\overline{P}_2} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) - d\widetilde{\tau}_{1t}, \tag{2.77}$$

which equals equation (2.37), when it is assumed that $\frac{\widetilde{P}_{2t}}{\overline{P}_2} = 0$. Substituting further equation (2.64) in equation (2.77) gives

$$\begin{aligned} & \left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left[\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) + \frac{\overline{D}_{1t}}{\overline{P}_1}\right] \\ = & \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) + d\frac{\widetilde{D}_{1t}}{\overline{P}_1}. \end{aligned} \tag{2.78}$$

If it is then assumed that $\frac{\widetilde{P}_{2t}}{\overline{P}_2} = 0$, we get

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \left[\overline{W}_1 - \overline{R}_2\overline{D}_{1t-1} + \overline{D}_1\right]^{-1}\widetilde{D}_{1t}, \tag{2.79}$$

which is the same as equation (2.41) in the text.

Dollarization: Households maximize (2.1) with regard to B^1_{1t}, B^2_{1t} and m_{2t} subject to

$$\begin{aligned} & c_{1t} + \frac{M^2_{1t}}{P_t} + \frac{B^1_{1t}}{P_t} + \frac{B^2_{1t}}{P_t} + \tau_{1t} \\ = & \frac{p^1_t}{P_t}y_{1t} + \frac{M^2_{1t-1}}{P_t} + R_{1t-1}\frac{B^1_{1t-1}}{P_t} + R_{2t-1}\frac{B^2_{1t-1}}{P_t}. \end{aligned} \tag{2.80}$$

Assuming that country 1 has an irresponsible fiscal policy and country 2 a responsible fiscal policy and substituting equations (2.62) and (2.63) in the

consumption equation of country 2 gives, as joint consumption is constant,

$$\left(\frac{\widetilde{P}_t}{\overline{P}}\right) = -\overline{R}_2 \left(\frac{\overline{D}_{1t-1}}{\overline{P}}\right) \widetilde{\tau}_{1t}. \tag{2.81}$$

Further substituting equation (2.64) here gives equation (2.44) in the text.

Floating exchange rate regimes

Assuming both countries have a responsible fiscal policy, substituting equations (2.62) and (2.63) in the consumption equations and imposing the goods-market-clearing condition $\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$ produces

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right),$$

which gives equation (2.46) in the text. Assuming that country 1 has an irresponsible fiscal policy and country 2 a responsible fiscal policy, equations (2.62) and (2.63) again substituted in the consumption equation of country 2 gives us (as joint consumption is constant)

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left(\frac{\overline{W}_1}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) - d\widetilde{\tau}_{1t}, \tag{2.82}$$

which gives equation (2.37), assuming that $\frac{\widetilde{P}_{2t}}{\overline{P}_2} = 0$. Further substituting equation (2.64) in equation (2.82) gives

$$\begin{aligned} &\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \frac{\overline{D}_{1t}}{\overline{P}_1}\right) \\ = &\left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) + d\frac{\widetilde{D}_{1t}}{\overline{P}_1}, \end{aligned} \tag{2.83}$$

which, assuming that $\frac{\widetilde{P}_{2t}}{\overline{P}_2} = 0$, yields equation (2.47) in the text.

3 Productivity Differentials and the External Balance in ERM II

3.1 Introduction

External imbalances are an often voiced concern when the economic development in the new EU Member States is discussed. E.g. in connection with the ERM II entry of Estonia and Lithuania in June 2004, the EU pointed to the reduction of the current account deficits as a major policy challenge (European Union 2004). Even though there are no convergence criteria relating to the external balance, this is still an essential part of the convergence process. Thus, the topic is likely to surface in the discussions preceding the adoption of the euro by the new Member States.

Convergence has always been a much discussed aspect of European unification, particularly in the monetary union context. There are both fast and slow growth countries already in the current EMU and in the future enlarged monetary union, growth differentials are likely to be even more pronounced, as the convergence process is still on-going in the new Member States. Moreover, the Balassa-Samuelson proposition - which originates from Balassa (1964) and Samuelson (1964) - stipulates that faster productivity growth in the traded than in the non-traded goods sector results in a rise of the price of the non-traded good and a trend appreciation of the real exchange rate which in fixed exchange rate regimes is visible as higher inflation.[22] This implies that inflation differentials are going to be a prominent feature of the future EMU.

Indeed, the Balassa-Samuelson framework forms a good basis for examining convergence related questions. Begg et al. (2003) have confirmed the presence of the Balassa-Samuelson premises among the five CEECs - the Czech Republic, Hungary, Poland, Slovenia and Estonia - namely that labour productivity is indeed growing faster in the traded (industry) than in the non-traded (services) sector, wages tend to be equalized between sectors and that prices of services have been rising faster than the producer price index. Nevertheless, they limit their research on the real exchange rate appreciation and the consequences for ERM II participation.

Much of the research on the euro area enlargement has indeed focused on the Balassa-Samuelson effect. The focus in these studies has, however, been on the implications for the use of a fixed exchange rate policy, meeting the Maas-

[22] The size of the Balassa-Samuelson effect has been estimated in different studies to be 0-2 percent per year. (See e.g. European Commission (2004) and Mihaljek and Klau (2003)).

tricht criteria or the estimation of equilibrium exchange rates. In general, the implications of the Balassa-Samuelson effect in an intertemporal framework appear to have gained less attention. The Balassa-Samuelson framework appears suitable also for examining the effects of continued fast growth on a country's external balance.

In the current study, the aim is to construct a framework that is suited for analyzing convergence and growth related questions in small open economies that have a fixed exchange rate regime with a monetary union. Both the home economy as well as the monetary union produce a traded and a non-traded good using labour as the only input. It will be assumed that growth differentials stem from differences in productivity growth, i.e. the home economy will experience faster productivity growth in its traded than its non-traded goods sector, consistent with the Balassa-Samuelson tradition.

The numerical analysis in this study focuses on the Baltic states that first, have a tradition with fixed exchange rates and second, can be considered as front-runners in euro adoption. Furthermore, questions of the sustainability of the external balance have been raised particularly with regard to the Baltic states. Recently concerns over sufficient fiscal discipline in Latvia and Lithuania have also been brought up.[23] For the Central European Countries, sound public finances pose a major challenge on the way to euro adoption. The focus of this paper will be on external sustainability, leaving fiscal sustainability questions for future work.

The remainder of the paper is divided into three Sections. Section 2 presents the theoretical model and its solution. Then in Section 3 numerical methods are employed to be followed by a discussion of the results, possible policy implications and directions for future work. Section 4 concludes.

3.2 The Model

The model is a fairly standard small open economy model where the home economy pegs its currency to the currency of a monetary union and thus takes the interest rate as exogenous. The construction of the production side follows Montiel (1999). There is a two-sector production structure with traded and non-traded sectors, which use labour as the only input.

The formulation of the household's problem to some extent follows Obstfeld

[23] E.g. the European Central Bank (ECB 2004) notes that implementation of a sound fiscal consolidation path is essential for achieving a high degree of sustainable convergence in Latvia and Lithuania.

and Rogoff (2000) and Benigno and Thoenissen (2003).[24] The household side of the model is described by a money-in-the-utility function formulation and an endogenous labour supply. The model employs an endogenous discount rate in line with Scmitt-Grohé and Uribe (2003) to induce stationarity into the small open economy model.

The first section explains the structure of the model starting with the production side, followed by the household's problem and finally the government and central bank formulations. In the second section, the model is solved analytically.

3.2.1 Structure of the Model

Production

The home economy has a two-sector production structure with traded and non-traded sectors. As the home economy is a small open economy, it takes the price of the traded good as given. There is no capital in the model. Output in the two sectors, Y_T and Y_N respectively, is produced using a fixed sector specific factor and labour, which is assumed to be internationally immobile but able to migrate between the two sectors. The Cobb-Douglas type production function has decreasing returns to scale in the variable factor, labour. The production functions for the traded and non-traded sectors are written as

$$Y_T = A_T L_T^{\alpha} \tag{3.1}$$

and

$$Y_N = A_N L_N^{\eta}, \tag{3.2}$$

where the subscript T denotes the traded sector and N the non-traded sector. A_T and A_N are the productivities in the traded and non-traded sectors respectively, while L_T and L_N denote labour employed in the two sectors. α and η are the labour elasticities in the production functions.

[24] The parameterization of the model would also allow the relative size of the country to be varied. The home economy produces a continuum of differentiated traded goods indexed on the interval $[0, n]$, where n is the relative measure of country size. The foreign economy's traded goods are indexed on the interval $(n, 1]$. In addition, each country produces a continuum of differentiated non-traded goods, indexed on the interval $[0, n]$ for home and on $(n, 1]$ for foreign. In each country, there is a continuum of households, with population size normalized to the range of traded goods.

Profit maximization gives the first-order conditions

$$A_T F'(L_T) = \alpha A_T L_T^{\alpha-1} = \frac{W}{P_T} \tag{3.3}$$

and

$$A_N G'(L_N) = \eta A_N L_N^{\eta-1} = \frac{W}{P_N}, \tag{3.4}$$

where W is the nominal wage common to both sectors and P_T and P_N are the prices of the traded and non-traded goods, respectively. (3.3) and (3.4) state that the marginal product of labour must equal the real wage, defined in terms of the respective price of both sectors.[25] This allows the sectoral labour demands to be written as a function of wage and the sector price:

$$L_T(P_T, W) = \left(\frac{W}{\alpha P_T A_T}\right)^{\frac{1}{\alpha-1}} = \left(\frac{w}{\alpha A_T}\right)^{\frac{1}{\alpha-1}} \tag{3.5}$$

for the traded sector and

$$L_N(P_N, W) = \left(\frac{W}{\eta P_N A_N}\right)^{\frac{1}{\eta-1}} = \left(\frac{w}{\eta p A_N}\right)^{\frac{1}{\eta-1}} \tag{3.6}$$

for the non-traded sector, where w is the real wage in terms of the price of the traded good and $p = \frac{P_N}{P_T}$ the relative price of the non-traded good.

Finally, it is assumed that the productivity in the traded sector follows the first-order autoregressive process:

$$A_{Tt} - \overline{A}_T = \rho\left(A_{Tt-1} - \overline{A}_T\right) + \epsilon_{A_T};\ \rho \in (0,1) \tag{3.7}$$

where $\overline{A}_T$ is the steady state level of productivity that A_{Tt} converges to - this could be assumed to be the monetary union level - and ϵ_{A_T} is distributed $NIID(0, \sigma^2)$. Thus, the rate at which the economy converges to the steady state, i.e. monetary union, level is $1-\rho$, i.e. $1-\rho$ of any difference between A_{Tt} and $\overline{A}_T$ tends to disappear in each period, absent any shocks.

Household

Households consume both the home and foreign traded goods as well as the domestic non-traded good. The households in the two countries have identical preferences and the representative household i maximizes the following utility

[25] (3.3) and (3.4) also give the shares of labour income in total production: $\frac{WL_T}{P_T Y_T} = \alpha$ in the traded sector and $\frac{WL_N}{P_N Y_N} = \eta$ in the non-traded sector.

function:

$$U_t^i = E_0 \sum_{t=0}^{\infty} \theta_t \left[\log C_t^i + \chi \log \frac{M_t^i}{P_t} - \kappa \frac{(L_t^i)^{1+\omega}}{1+\omega} \right] \tag{3.8}$$

$$\theta_0 = 1$$

$$\theta_{t+1} = \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) \theta_t,$$

where C_t^i denotes the level of consumption at period t for household i and $\frac{M_t^i}{P_t}$ the real money holdings. The household labour supply L_t^i is divided between labour supplied to the traded and non-traded goods sectors, where the household is indifferent between supplying labour to either sector. E_0 is the mathematical expectation operator, given information at time 0 and θ_t the discount factor. χ and κ are scale parameters, while ω is the inverse of the labour supply elasticity, i.e. $\frac{1}{\omega}$ is the Frisch elasticity of the labour supply.[26]

To induce stationarity into the small open economy model, an endogenous discount factor is used.[27] As pointed out by Obstfeld (1990) the use of an endogenous time preference avoids the 'sometimes troublesome non-convergence and hysteresis implied by constant time preference', while producing otherwise similar behaviour, at least in qualitative terms, to the standard model.[28] The discount factor employed in this analysis is a simplified specification of Uzawa preferences, the most common form of an endogenous discount factor. The simplified version induces stationarity in the same manner as the standard one but is computationally much simpler.[29] In line with Schmitt-Grohé and

[26] The Frisch elasticity is defined as the elasticity of labor supply with respect to wage, holding the marginal utility of consumption constant.

[27] As noted by Obstfeld (1990), a constant time preference rate results in either an indeterminate global distribution of wealth or in the economy with the lowest time-preference rate eventually owning all of the world's outside wealth. It is standard to eliminate this source of dynamics by assuming that the subjective discount rate equals the real rate of interest (Schmitt-Grohé and Uribe 2003, 164). The problems related to the standard model could also be avoided by assuming an overlapping-generations structure but as noted by Obstfeld (1990), this could unnecessarily complicate the analysis.

[28] Schmitt-Grohé and Uribe (2003) examine several techniques for inducing stationarity of the equilibrium dynamics in the small open economy model (two versions of endogenous discount factor, a debt-contingent interest rate premium, portfolio adjustment costs and complete asset markets) and examine the extent to which these stationarity-inducing techniques affect the equilibrium dynamics at business cycle frequencies. They find that once all models are made to share the same calibration, their quantitative predictions regarding the behavior of key macroeconomic variables are virtually identical.

[29] The Uzawa type preferences use a subjective discount factor assumed to be decreasing in consumption, i.e. agents become more impatient the more they consume. Obstfeld (1990) also shows that impatience to consume increases as actual consumption rises. If fact, the assumption is necessary for convergence of the infinite-horizon optimal saving plan to a constant long-run consumption level. If this assumption is not met, i.e. impatience to consume would decrease as actual consumption increases, individual optimum may not exist.

Uribe (2003), the discount factor is assumed to depend on the per capita levels of consumption $\widehat{C}_t$, real money balances $\widehat{m}_t$ and labour supply $\widehat{L}_t$, which the representative household takes as given.

The real consumption index C takes a Cobb-Douglas form defined as

$$C = \frac{C_T^{\gamma} C_N^{1-\gamma}}{\gamma^{\gamma} (1-\gamma)^{1-\gamma}}, \tag{3.9}$$

where C_T and C_N are the two consumption indices, which refer to the consumption of traded and non-traded goods, respectively. γ is the preference parameter, which indicates the weight that the household puts on traded goods, i.e. γ is also the share of total expenditure allocated to the consumption of traded goods. Money is deflated by a consumption-based price index that corresponds to the Cobb-Douglas consumption index specified above:

$$P = P_T^{\gamma} P_N^{1-\gamma}. \tag{3.10}$$

Consumption of traded goods is further divided into consumption of home and foreign traded goods with υ denoting the share of home-produced traded goods in traded goods consumption:

$$C_T = \frac{C_H^{\upsilon} C_F^{1-\upsilon}}{\upsilon^{\upsilon} (1-\upsilon)^{1-\upsilon}}, \tag{3.11}$$

which implies the price sub-index for traded goods

$$P_T = P_H^{\upsilon} P_F^{1-\upsilon}. \tag{3.12}$$

The law of one price is expected to hold for traded goods:

$$P_T = \varepsilon P_T^*, \tag{3.13}$$

i.e. $P_H = \varepsilon P_H^*$ and $P_F = \varepsilon P_F^*$, where ε is the nominal exchange rate (the home currency price of foreign currency).

The foreign utility function is analogous to the home one, except that home money is held only by home households and foreign money only by foreign households. The deflator for foreign money balances can be written as

$$P^* = (P_T^*)^{\gamma} (P_N^*)^{1-\gamma} \tag{3.14}$$

and the price sub-index for traded goods

$$P_T^* = \left(P_H^*\right)^{\upsilon} \left(P_F^*\right)^{1-\upsilon}. \tag{3.15}$$

Finally, the real exchange rate is defined as

$$\frac{P}{P^*} = \left(\frac{P_T}{\varepsilon P_T^*}\right)^{\gamma} \left(\frac{P_N}{\varepsilon P_N^*}\right)^{1-\gamma} = \frac{1}{\varepsilon}\left(\frac{P_N}{P_N^*}\right)^{1-\gamma}. \tag{3.16}$$

Maximizing equation (3.9) given total expenditure measured in traded goods $Z \equiv C_T + pC_N$, where $p = \frac{P_N}{P_T}$ is the relative price of the non-traded good, gives the household's demand for traded goods

$$C_T = \gamma P' C, \tag{3.17}$$

and for non-traded goods

$$C_N = (1-\gamma)\frac{P'}{p}C, \tag{3.18}$$

where P' is defined as the price index in terms of the price of the traded good $P' = \frac{P}{P_T} = p^{1-\gamma}$. The demand for traded goods can be decomposed into

$$C_H = \upsilon \frac{P_T}{P_H} C_T = \upsilon\gamma \frac{P}{P_H} C \tag{3.19}$$

$$C_F = (1-\upsilon)\frac{P_T}{P_F} C_T = (1-\upsilon)\gamma \frac{P}{P_F} C \tag{3.20}$$

using equation (3.11).

The period budget constraint of the home representative household i in terms of the price of the traded good is

$$\begin{aligned} & C_{Tt}^i + p_t C_{Nt} + \frac{M_t^i}{P_{Tt}} + \frac{B_{Ht}^i}{P_{Tt}} + \varepsilon_t \frac{B_{Ft}^i}{P_{Tt}} + P_t' \tau_t \\ = \; & \frac{W_t}{P_{Tt}} L_t^i + \frac{M_{t-1}^i}{P_{Tt}} + R_{t-1}\frac{B_{Ht-1}^i}{P_{Tt}} + f_{t-1} R_{t-1}^* \frac{B_{Ft-1}^i}{P_{Tt}} + \frac{\Pi_{Tt}}{P_{Tt}} + \frac{\Pi_{Nt}}{P_{Tt}} \end{aligned} \tag{3.21}$$

where τ_t is the taxes paid to the home government. B_{Ht}^i is the nominal holdings of the home government bond at the end of period t that pay a nominal gross interest R_t, which is defined by $R_t = 1 + i_t$, where i_t is the nominal interest rate of home currency loans between t and $t+1$. Similarly, B_{Ft}^i is the nominal holdings of the foreign government bond that pay a nominal gross interest R_t^*. f_{t-1} is the forward exchange rate determined in period $t-1$. Π_{Tt} and Π_{Nt} are

the profits paid to the household by the traded and non-traded sector firms, which are defined as

$$\Pi_T = P_T Y_T - W L_T \text{ and } \Pi_N = P_N Y_N - W L_N \,, \tag{3.22}$$

respectively.

The budget constraint can also be written in the more familiar form in terms of total consumption:

$$\begin{aligned} & P_t C_t^i + M_t^i + B_{Ht}^i + \varepsilon_t B_{Ft}^i + P_t \tau_t \\ = \;& W_t L_t^i + M_{t-1}^i + R_{t-1} B_{Ht-1}^i + f_{t-1} R_{t-1}^* B_{Ft-1}^i + \Pi_{Tt} + \Pi_{Nt} \end{aligned} \tag{3.23}$$

given the definition of the price level indicated by equation (3.10). In equilibrium, taking into consideration the definition of firm profits and rearranging, equation (3.21) can be written in intertemporal form as

$$\begin{aligned} & \frac{B_{Ht-1}^i + \varepsilon_{t-1} B_{Ft-1}^i + M_{t-1}^i}{P_{Tt-1}} = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} (1 + r_j)^{-1} \right) (C_{Ts}^i \\ & + p_s C_{Ns}^i + P_s' \tau_s + \frac{r_s}{P_{Ts}/P_{Ts-1}} \frac{M_{s-1}^i}{P_{T,s-1}} - Y_{Ts} - p_s Y_{Ns}), \end{aligned} \tag{3.24}$$

where $B_{Ht-1}^i + \varepsilon_{t-1} B_{Ft-1}^i + M_{t-1}^i$ is the nominal beginning of period household wealth and r_t is the real rate of return on bonds defined in terms of traded goods:

$$(1 + r_{t-1}) = R_{t-1} \frac{P_{Tt-1}}{P_{Tt}}. \tag{3.25}$$

As the households utilize fully their lifetime wealth, the transversality condition implies that

$$\lim_{T \to \infty} \left(\prod_{j=t}^{T} (1 + r_j)^{-1} \right) \left(\frac{B_{HT}^i + \varepsilon_T B_{FT}^i + M_T^i}{P_{TT}} \right) = 0. \tag{3.26}$$

Households maximize equation (3.8) subject to equation (3.23) taking the firm profits, Π_{Tt} and Π_{Nt}, as given. This produces the following first-order conditions for the household's problem with respect to consumption, real money balances and labour supply:

$$\frac{1}{C_t} = R_t \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) \frac{P_t}{P_{t+1}} E_t \frac{1}{C_{t+1}} \tag{3.27}$$

$$\frac{1}{C_t} = R_t^* \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) \frac{P_t}{P_{t+1}} \frac{f_t}{\varepsilon_t} E_t \frac{1}{C_{t+1}} \tag{3.28}$$

$$\frac{M_t}{P_t} = \chi \frac{R_t}{R_t - 1} C_t = \chi \frac{1 + i_t}{i_t} C_t \tag{3.29}$$

$$\kappa L_t^{\omega} = \left(\frac{W_t}{P_t} \right) \left(\frac{1}{C_t} \right). \tag{3.30}$$

Equation (3.27) is the standard first-order Euler condition for optimal intertemporal allocation of consumption. Together with equation (3.28) it implies the covered interest rate parity

$$(1 + i_t) = (1 + i_t^*) \frac{f_t}{\varepsilon_t}. \tag{3.31}$$

Equation (3.27) can also be written as follows:

$$\frac{1}{C_t} = \left(1 + r_t^C\right) \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) E_t \frac{1}{C_{t+1}}. \tag{3.32}$$

where r_t^C is the consumption-based real interest rate defined as

$$1 + r_{t-1}^C = R_{t-1} \frac{P_{t-1}}{P_t} = (1 + r_{t-1}) \frac{P'_{t-1}}{P'_t}. \tag{3.33}$$

As can be seen from equation (3.33), the higher the future price level compared to the present one, the lower the consumption based interest rate for any traded goods based interest rate. The importance of the total consumption based interest rate has been underlined by Dornbusch (1983):

> "In a small country with a non-traded goods sector the relevant interest rate is not the given world interest rate but the real interest rate stated in terms of the domestic consumption basket. To the extent that disturbances affect the relative price structure over time, they also affect the home real interest rate and therefore the optimal path of consumption and borrowing." (Dornbusch 1983, 142).

Condition (3.29) states that households must be indifferent between consuming a unit of the consumption good on date t or using the same funds to raise cash balances, enjoying the derived transactions utility in period t and then converting the extra cash balances back to consumption in period $t + 1$. Equation (3.30) is the leisure-consumption trade-off condition.

Government

The government determines taxes, defined as a fixed share of output, and issues nominal government debt, which together with the real transfers from the central bank finance government consumption. The government real consumption index G takes the same general form as that of the household, given by equation (3.9):

$$G = \frac{G_T^{\delta} G_N^{1-\delta}}{\delta^{\delta} (1-\delta)^{1-\delta}}, \tag{3.34}$$

where the share of traded goods in total government consumption is denoted by δ. This implies that the government's demand for the non-traded and traded goods, respectively, is also similar to those of the private sector:

$$G_N = (1-\delta) \frac{P'}{p} G \tag{3.35}$$

$$G_T = \delta P' G. \tag{3.36}$$

The period budget constraint of the government is

$$G_{Tt} + p_t G_{Nt} + R_{t-1} \frac{D_{t-1}}{P_{Tt}} = P' \tau_t + v_t + \frac{D_t}{P_{Tt}}, \tag{3.37}$$

where D_t is government end-period debt paying a nominal gross interest R_t, τ_t denotes taxes and v_t the real transfers from the central bank. Equation (3.37) can be written in intertemporal form as

$$\frac{D_{t-1}}{P_{Tt-1}} = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} (1+r_j)^{-1} \right) \left(P_s' \tau_s + v_s - G_{Ts} - p_s G_{Ns} \right). \tag{3.38}$$

with a transversality condition

$$\lim_{T \to \infty} \left(\prod_{j=t}^{T} (1+r_j)^{-1} \right) \frac{D_T}{P_{TT}} = 0. \tag{3.39}$$

Central bank

The monetary policy of the home central bank is defined by a fixed exchange rate regime, which implies that the home economy takes the interest rate as exogenous.

The central bank issues money M_t through open market purchases of bonds

B_{mt}. The period budget constraint is

$$\frac{B_{mt}}{P_{Tt}} + v_t = R_{t-1}\frac{B_{mt-1}}{P_{Tt}} + \frac{M_t - M_{t-1}}{P_{Tt}}, \tag{3.40}$$

which in intertemporal form can be written as

$$\frac{M_{t-1} - B_{mt-1}}{P_{Tt-1}} = \sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1}(1+r_j)^{-1}\right)\left[\frac{r_s}{P_{Ts}/P_{Ts-1}}\left(\frac{M_{s-1}}{P_{Ts-1}}\right) - v_s\right]. \tag{3.41}$$

3.2.2 Equilibrium

In solving the model, we assume that international capital markets exist, where the home economy can borrow and lend unlimited amounts. Combining the budget constraints of the household, the government and the central bank gives us the asset position of the whole economy in the end of period t:

$$\frac{F_t}{P_t} = (1+r)\frac{F_{t-1}}{P_t} + Y_t - C_t - G_t, \tag{3.42}$$

where $F_t = B_{Ht} + B_{Ft} + B_{mt} - D_t$ is the economy's net foreign assets.[30] In equilibrium, the intertemporal equation for the net foreign assets can be written as follows

$$\frac{F_{t-1}}{P_{Tt-1}} = \sum_{s=t}^{\infty}\left(\prod_{j=t}^{s}(1+r_j)^{-1}\right)(C_{Ts} + G_{Ts} - Y_{Ts}), \tag{3.43}$$

where the definition of equilibrium in the non-traded goods sector has been taken into account. It is defined as

$$C_N + G_N = Y_N, \tag{3.44}$$

i.e. the private and public consumption of the non-traded goods must equal its production. The money market clearing condition states that the domestic nominal money demand must equal the domestic nominal money supply in each country. The equilibrium in the non-traded goods sector is

$$L = L_T + L_N \tag{3.45}$$

[30] Therefore, the current account equation is

$$\frac{CA_t}{P_t} = r\frac{F_{t-1}}{P_t} + Y_t - C_t - G_t.$$

is the labour market resource constraint.

For the discount factor, we have in equilibrium that $\widehat{C}_t = C_t$, $\widehat{m}_t = m_t$ and $\widehat{L}_t = L_t$. The following functional form is assumed for the discount factor

$$\begin{aligned} \beta\left(C_t, m_t, L_t\right) &= \frac{\left[1+\lambda\left(C_t-\overline{C}\right)+\mu\left(m_t-\overline{m}\right)+\varphi\left(L_t-\overline{L}\right)\right]^{-\psi}}{1+r_t^C} \\ ;\psi &\geq 0, \end{aligned} \tag{3.46}$$

where $\overline{C}$, $\overline{m}$ and $\overline{L}$ are some positive constants and ψ the elasticity of the discount factor with respect to the aggregate $\left[1+\lambda\left(C_t-\overline{C}\right)+\mu\left(m_t-\overline{m}\right)+\varphi\left(L_t-\overline{L}\right)\right]$.[31] The Euler equation (3.27) can now be written as

$$\frac{1}{C_t} = \left[1+\lambda\left(C_t-\overline{C}\right)+\mu\left(m_t-\overline{m}\right)+\varphi\left(L_t-\overline{L}\right)\right]^{-\psi} E_t \frac{1}{C_{t+1}}. \tag{3.47}$$

To solve the model, we linearize it around a steady state, where $\widetilde{X}_t = X_t - \overline{X}$ defines a deviation from the steady state. In the steady state, the discount rate reduces to

$$\beta = \frac{1}{1+r}, \tag{3.48}$$

as can be seen from equation (3.46). Thus, the use of the endogenous discount factor does not affect the calculation of the steady state. The steady state model is presented in the first section of the Appendix.

To explicitly solve the model, several simplifications must be made and therefore, the following solution can only be considered as a special case of the model presented above. Assuming constant returns to scale, i.e. $\alpha = \eta = 1$ implies that the labour supply must be constant. Moreover, it is assumed that the discount factor depends solely on consumption, i.e. $\mu = \varphi = 0$ and $\lambda = 1$, and that non-traded sector productivity is fixed at $A_{Nt} \equiv \overline{A}_N$. Government consumption is assumed to be lump-sum. These changes give the following solution to the model

$$\widetilde{C}_t = \left(r + \psi\overline{C}\right)\left(\frac{\widetilde{F}_{t-1}}{\overline{P}}\right) + \zeta\widetilde{A}_{Tt}. \tag{3.49}$$

[31] If $\psi = 0$, the discount factor is constant and equal to $\frac{1}{1+r}$, which would imply that the long-run levels of foreign debt and consumption depend on the initial level of foreign debt and the initial realization of the endowment shock. In other words, the model is non-stationary. (Schmitt-Grohé and Uribe, 2003, 182).

$$\frac{\widetilde{F}_t}{\overline{P}} = \left(1 - \psi\overline{C}\right)\left(\frac{\widetilde{F}_{t-1}}{\overline{P}}\right) + \xi\widetilde{A}_{Tt} \tag{3.50}$$

where

$$\zeta = \frac{\left(r + \psi\overline{C}\right)}{(1 + r - \rho)}\left[\gamma\overline{L}\left(\frac{\overline{A}_T}{\overline{A}_N}\right)^{\gamma-1} - r\left(1 - \gamma\right)\frac{\overline{F}}{\overline{P}}\frac{1}{\overline{A}_N}\right] \tag{3.51}$$

and

$$\xi = \frac{\left(1 - \rho - \psi\overline{C}\right)}{(1 + r - \rho)}\left[\gamma\overline{L}\left(\frac{\overline{A}_T}{\overline{A}_N}\right)^{\gamma-1} - r\left(1 - \gamma\right)\frac{\overline{F}}{\overline{P}}\frac{1}{\overline{A}_N}\right] \tag{3.52}$$

(see the linearized model section in the Appendix for details).

Assuming that the economy starts in a steady state in period t, which implies that $\frac{\widetilde{F}_{t-1}}{\overline{P}} = 0$, the equations show that in response to a positive shock to traded sector productivity, consumption increases when the steady state net foreign assets are zero or negative. Otherwise, the direction of the effect is unclear. For net foreign assets, the direction of the effect depends, in addition to the value of steady state net foreign assets, on the value of steady state consumption $\overline{C}$. With $\frac{\overline{F}}{\overline{P}} \leq 0$, the response of a positive shock to traded sector productivity would be a positive deviation from the steady state net foreign assets, if steady state consumption was small enough $\left(\overline{C} < \frac{1-\rho}{\psi}\right)$ and negative otherwise.

These results imply that when an economy has steady state debt, the counterpart of which is a steady state trade balance surplus, a positive shock to productivity causes consumption to rise and the net foreign asset position to improve (assuming that $\overline{C} < \frac{1-\rho}{\psi}$). In other words, if the economy is consuming less than it is producing, it will increase its consumption and decrease the trade account surplus, in case of a positive shock to productivity. It should, however, be remembered that this result was achieved after several simplifications to the model presented earlier in this Section. These simplifications are not carried over to the numerical examination of the following Section.

3.3 Calibration and Simulation

To determine the steady state and its response to the different productivity shocks, numerical methods are employed. Here, two forms of the discount factor are employed, both of which abstract from the other variables besides consumption in the discount factor, thus setting $\lambda = 1$ and $\mu = \varphi = 0$.

In the first case, the household smooths consumption in terms of consumption/output, while in the second case, the smoothing takes place in terms of traded goods consumption/traded goods production.

In the first case, the discount factor and the first-order condition are written in terms of consumption per output, which makes sense as the ratio of consumption to output has remained relatively constant over time. Hence, the first-order condition (3.47) is written as follows

$$\frac{1}{C_t/Y_t} = \left\{1 + \lambda\left[(C_t/Y_t) - \overline{c}\right]\right\}^{-\psi} E_t \frac{1}{(C_{t+1}/Y_{t+1})} \left(\frac{Y_t}{Y_{t+1}}\right), \tag{3.53}$$

where $\overline{c} = \frac{\overline{C}}{\overline{Y}}$.

In the second case, the discount factor and the Euler equation are written in terms of consumption/output in terms of traded goods. This case gives the following form for the Euler equation

$$\frac{1}{C_{Tt}/Y_{Tt}} = \left[1 + \lambda\left[(C_{Tt}/Y_{Tt}) - \overline{c}_T\right]\right]^{-\psi} E_t \frac{1}{C_{Tt+1}/Y_{Tt+1}} \left(\frac{Y_{Tt}}{Y_{Tt+1}}\right), \tag{3.54}$$

where $\overline{c}_T = \frac{\overline{C}_T}{\overline{Y}_T}$.

3.3.1 Parameters

The parameter values were chosen in line with appropriate literature, and also available actual data were used as reference. Here, the Baltic states - particularly Estonia, where data availability was somewhat better - were used as reference countries, as they were considered to be a suitable benchmark for small open economies with fixed exchange rate regimes and the front-runners with regard to the adoption of the euro.

α and η represent labour's share of the income generated in the traded and non-traded sectors, respectively. As noted by Obstfeld and Rogoff (1998), empirically non-traded goods tend to be at least as labour-intensive as traded goods, which implies that $\eta \geq \alpha$. The numerical values of α and η were calculated to be 0.47 and 0.51.[32] The value for inverse of labour supply ω is set at 1.89 implying a Frisch labour supply elasticity with respect to wages of

[32] The values of α and η were calcualated based on Estonian data. The definitions $\frac{WL_T}{P_T Y_T} = \alpha$ and $\frac{WL_N}{P_N Y_N} = \eta$ deliver the above given values, as the share of non-traded goods in total output is 67% in Estonia (compared with 70.8% in Latvia and 60.5% in Lithuania), while the share of the non-traded sector (namely services) in total employment is 69% in Estonia (60% and 50% in Latvia and Lithuania, respectively) (CIA 2005). The share of wages in GDP is 50% of GDP (IMF 2003a, b and c).

0.53 in line with Siliverstovs and Koulikov (2003), who estimate this to be the labour elasticity with respect to wages in Estonia.[33] In line with Cooley and Prescott (1995), the value for the parameter κ is chosen so that the steady state labour supply is equal to approximately one-third. To calculate κ, we assume that the share of consumption and wages in GDP correspond to observed data.[34]

γ and δ are the shares of traded goods in the household and government consumption, respectively. In the beginning of transition, traded goods form the majority part of household consumption with the share of non-traded consumption increasing as transition progresses. Therefore, different values for γ are tried and the results reported. As a benchmark, the weights in the consumer price index are used, as they describe actual expenditure in a country, which would indicate a value of 0.65 for γ.[35] Public consumption as a share of output is set at 0.25.[36] As public consumption can be considered to be biased towards the consumption of non-traded goods, i.e. services, δ is set at 0.05. χ is the utility of money parameter, which typically is set very low in the literature. Here, a value of 0.005 is used.

ψ defines the minus elasticity of the discount factor, which determines the stationarity of the model and the speed of convergence to the steady state. In line with Scmitt-Grohé and Uribe (2003), this value is set at 0.01 but other values are also examined. The parameter $\overline{c}$ is set at 75%, while for the parameter $\overline{c}_T$ different values are examined.[37]

[33] A survey by Domeij and Flodén (2001) points out that the estimates for labour supply for males in general range between 0 and 0.5 but these estimates can be too low, especially in the presence of borrowing constraints. Moreover, Killingsworth and Heckman (1986) note that most estimates suggest that female labour supply elasticity is large both in absolute terms and relative to male elasticities. Indeed, Saget (2000) finds that the elasticity of female labour supply in Hungary is 1.82.

[34] Private consumption has been around 60% of GDP in Estonia, Latvia and Lithuania (IMF 2003a, b, c). As there is no investment in the model, a higher value of 0.75 is used. The share of wages in GDP is 50% in the Baltic states (IMF 2003a, b, c).

[35] The share of services is 35% in the consumer price index based on average consumer expenditure structure of the previous year, while in the harmonised index (HICP) which is computed from the expenditure of the last month of the year, it is 28.5% (Bank of Estonia 2004, 24).

[36] The share of public consumption is around 20% of GDP (e.g. IMF 2004a for Estonia) but as there is no investment in the model, the value of 0.25 is used.

[37] Traded goods consumption/traded goods production can be defined as follows

$$\overline{c}_T = \frac{\overline{C}_T}{\overline{Y}_T} = \frac{\overline{C}_T}{\overline{C}} \frac{\overline{Y}}{\overline{Y}_T} \frac{\overline{C}}{\overline{Y}} = \gamma \frac{\overline{C}}{\overline{Y}} \frac{\overline{PY}}{\overline{P}_T \overline{Y}_T},$$

where the share of the non-traded sector in total output is 67% in Estonia (IMF 2004a). The first value for $\overline{c}_T$ is, however, calculated from a formulation, where domestic consumption equals domestic production of traded goods, i.e. $\overline{c}_T = 1 - \frac{\overline{G}_T}{\overline{Y}_T} = 1.5\gamma$. The second value is derived from the above formula using $\frac{\overline{C}}{\overline{Y}} = 0.75$, as indicated in footnote 13, which gives

The real interest rate for the monetary union, i.e. the euro area, is 0.04, the standard one used in the literature. Cooley and Prescott (1995) set the quarterly value of ρ at 0.95, which implies an annual value of $\rho = 0.81$. The chosen parameter values are summarized in Table 1.

TABLE 1 Parameter values

α	η	ρ	γ	δ	χ	κ	ω	ψ	r
0.47	0.51	0.81	0.65	0.05	0.005	16	1.89	0.01	0.04

3.3.2 Steady state model

It is shown that the model converges to a unique steady state with both formulations of the discount factor. The steady state values of key variables for the four different cases of discount factor are presented in Table 2. The steady states for cases 1 and 2 are identical, so they are both presented in the first column.

TABLE 2 Steady state*

	Cases 1/2	**Case 3**	**Case 4**
Consumption/output	75%	97%	85%
Traded consumption/output	49%	63%	55%
Non-traded consumption/output	26%	34%	30%
Traded production/output	50%	42%	47%
Non-traded production/output	50%	58%	53%
Trade balance/output	0%	-22%	-10%
Wages/output	49%	49%	49%
Labour supply	0.33	0.30	0.32
- share of traded sector	48%	60%	45%
- share of non-traded sector	52%	55%	55%

* Case 1: Discount factor with $\overline{c} = 0.75$

Case 2: Discount factor with $\overline{c}_T = 1.5\gamma$

Case 3: Discount factor with $\overline{c}_T = 2.27\gamma$

Case 4: Discount factor with $\overline{c}_T = 1.82\gamma$

As can be seen from Table 2, there is no trade account deficit, and hence no net foreign assets in the steady state, when domestic consumption equals

$\overline{c}_T = 2.27\gamma$. As will be shown in the next Section, this value results in a rather large trade balance deficit. Thus, a lower value of $\overline{c}_T$ was examined, where $\frac{\overline{C}}{\overline{Y}}$ was set at the actual value 0.6, which produces $\overline{c}_T = 1.82\gamma$.

domestic output, as in cases 1 and 2. As trade balance deficits are a typical phenomenon in the Baltic states - particulary in Estonia - trade account balance does not appear as a sensible assumption.[38] Hence, other values for $\overline{c}_T$ are examined, which are also more in line with data, as noted in the previous Section. The two cases produce 10% and 22% trade account deficits, which are in the steady state combined with positive steady state net foreign assets of 241% and 540%, respectively. These are clearly at unsustainable levels.[39]

Finally, the sensitivity of the steady states with the two discount factors to changes in key parameter values was examined. The steady state with the first discount factor, where consumption smoothing takes place with regard to consumption/output, does not appear very sensitive to changes. For example, changes in r, κ and ρ have no effect on the steady state, while 10% increases in ω, α and η bring about a 3.3% augmentation in output and no change in the price level, a 3.9% reduction in output and a 1.3% fall in the price level and a 2.9% decrease in output and a 1.4% rise in the price level, respectively. Increases in γ and δ do not have an effect on output but change the composition of private and public consumption towards traded goods, which has effects on the price level. Whereas increasing γ by 10% results in a 4.7% drop in the price level, a rise of the same size in δ, only has a slight negative effect on the price level.

With the second discount factor, where consumption smoothing takes place with regard to consumption/output in traded goods, the results are quite similar. Changes in r and ρ again have no effect on the steady state, whereas 10% increases in κ, ω, α and η cause output to fall by 1,6%, 8.5%, 3.9% and 2.9%, respectively. While the price level drops slightly when ω and α are increased, it grows modestly when κ and η are augmented. Increasing γ brings about a small increase in output, a fall in the price level and a slight trade balance surplus, whereas raising δ causes minor drops in output and price level and a trade account deficit.

Hence, it would appear that the formulation of the discount factor, where consumption smoothing takes place with regard to consumption/output, is somewhat more robust with regard to changes in parameter values. However, the formulation keeps steady state domestic output equal to domestic con-

[38] According to IMF (2005), the trade deficit as a share of GDP in Estonia was 16.9% in 2003 and 17.5% in 2004, while it is estimated to be 15.3% in 2005.

[39] IMF (2002) sets the steady state level of net foreign assets to 70% of GDP for the Baltic countries. In general the rule is that the sustainable level of net foreign assets to GDP is 60% when exports to GDP are 20% and 60-80% when exports to GDP are between 20-40%. Sensitivity analysis with a ± 5 percentage point change in the net foreign assets to GDP ratio did not lead to substantially different results.

sumption, so it does not provide much information about the consequences of the Balassa-Samuelson effect on the external balance.

3.3.3 Permanent shock

We look at the effects of a permanent productivity shock, i.e. convergence, in the traded goods sector. The permanent shock is implemented by setting the end value in the simulation for the level of traded sector productivity higher than the original level of productivity by the amount of catching up needed to reach the monetary union level of productivity. Three productivity shocks are looked at. In the first one, traded sector productivity rises by 10%; in the second one, the traded sector productivity level in the home economy in the initial situation is assumed to be around two-thirds of the monetary union level, which implies a productivity increase of 50%, while in the last one, the initial level is assumed to be 60% of that in the monetary union, and thus the rise in productivity is 70%. Non-traded sector productivity is assumed to be at the same level as that of the monetary union, i.e. there is no convergence, i.e. shocks, in the non-traded sector. Productivity in the non-traded sector is assumed to be 80% of that in the traded sector.

As there is perfect foresight in the model, output and consumption immediately jump after a permanent shock to the new steady state levels, as do the relative price and the price level. The consumers and firms change their behaviour so that the economy begins to operate in the new steady state. The percentage changes from the relevant baseline steady states are presented in Table 3. There are no differences between the results for the different formulations and values of the discount factor.

TABLE 3 Permanent shock to traded sector productivity:
Changes in steady state variables

Traded sector productivity growth	**10%**	**50%**	**70%**
Real output	6.4%	30%	41%
Relative price	10%	50%	70%
Real exchange rate	3.4%	15.2%	20.4%

Real output and consumption rise in all cases by the same amount, while all nominal variables rise by the amount of the productivity shock as do the traded sector variables. The value given to $\overline{c}_T$ also does not have an effect on the new steady state. Although the output growth rates appear high with the

50% and 70% productivity shocks, the output level still does not reach that of the monetary union.[40]

As can be seen from Table 3, the Balassa-Samuelson effect is pronounced. Following the productivity shock, the real exchange rate appreciates by 3.4%, 15% and 20.4%, respectively, while the relative price rises by the amount of the productivity shock, 10%, 50% and 70%. This is in line with Begg et al. (2003), who show that a 10% increase in traded sector productivity raises the relative price by 3% in the short run.

Basically, the only difference with the different cases concerns the trade balance. If it is assumed that domestic consumption equals domestic output (cases 1 and 2), a balanced trade account is guaranteed by the formulation also in the new steady state. However, if one of the other two values for $\overline{c}_T$ is used (cases 3 and 4), the trade balance deficit rises at the same pace as the traded sector variables. Hence, the formulation of both discount factors ensures that trade balance/output stays constant, either at zero, as in cases 1 and 2, or at a negative ratio as in cases 3 and 4.

Yet, the trade account is not exactly zero even in cases 1 and 2 and a constant trade account deficit, however small, with the domestic demand of traded goods exceeding their supply implies that the economy accumulates negative net foreign assets, which are evident as a current account deficit. On the other hand, the same happens in the event that there is a slight trade account surplus - the economy accumulates positive net foreign assets. Both the negative as well as the positive net foreign assets can easily reach unsustainable levels. At the end of the period when traded sector productivity has reached the higher level of productivity, the imbalances are eliminated.

The Balassa-Samuelson effect is a supply side phenomenon. As pointed out by Begg et al. (2003), if demand growth for traded and non-traded goods is equal, demand is neutral and the supply side effect dominates. Nonetheless, if demand growth were higher in the traded goods, the supply side effect, at least partly, would be offset or completely cancelled. Usually, however, demand growth is biased towards non-traded goods, which enforces the supply side effect.

Hence, we now combine the productivity rise with a rise in the share of non-traded goods in consumption, i.e. an increase in $(1-\gamma)$. It is assumed that a 10% increase in traded sector productivity is linked with an 10% decrease in

[40] Even though the Baltic states grew by roughly half of their initial level over the period 1996-2003 (cumulative growth was 51% for Estonia, 59% for Latvia and 52% for Lithuania), all three countries are still below 50% of the GDP per capita (in PPS) of the 25 EU countries (World Bank 2005).

$(1-\gamma)$. The changes to key steady state variables are summarized in Table 4.

TABLE 4 Permanent shocks to productivity and the share of non-traded goods in consumption: Changes in steady state variables*

	Case 1	**Case 2**	**Case 3**	**Case 4**
Real output	5.9%	6.2%	6.1%	6.1%
Traded consumption	7%	3%	2.8%	2.7%
Non-traded consumption	24%	19.7%	19.5%	19.3%
Traded production	7.2%	8.8%	8.7%	8.5%
Non-traded production	19%	16.3%	16.6%	16.8%
Wage	13.3%	11.4%	11.5%	11.7%
Relative price	16%	13.8%	14%	14.2%
Real exchange rate	6.9%	6%	6.4%	6.8%

* Case 1: Discount factor with $\overline{c} = 0.75$

Case 2: Discount factor with $\overline{c}_T = 1.5\gamma$

Case 3: Discount factor with $\overline{c}_T = 2.27\gamma$

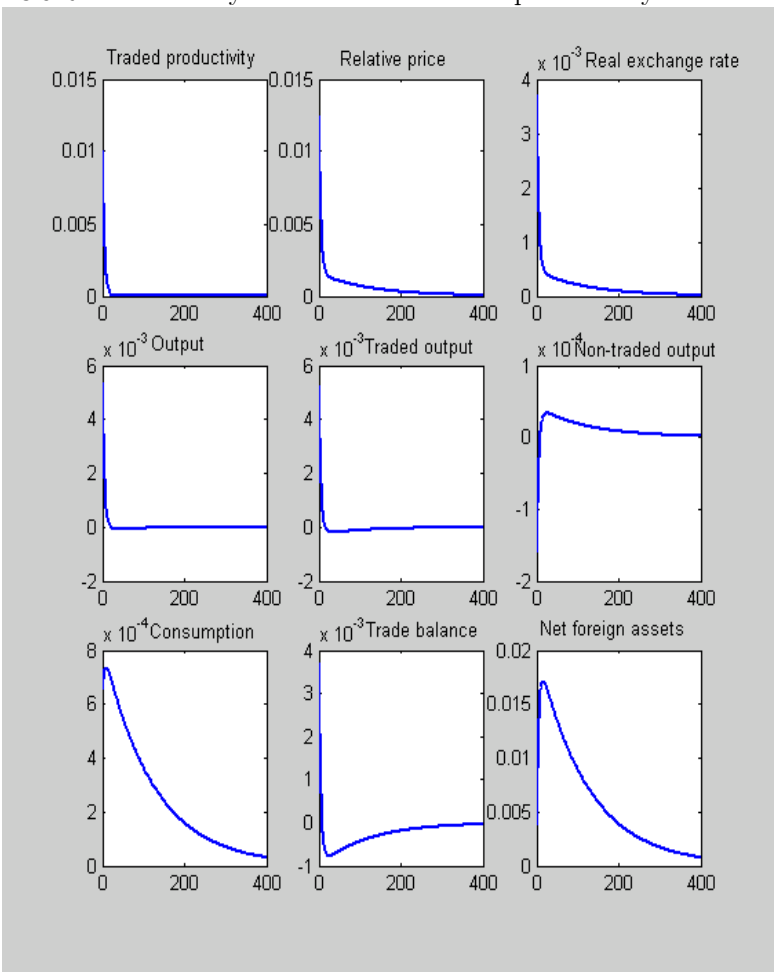
Case 4: Discount factor with $\overline{c}_T = 1.82\gamma$

The results show that the decrease in γ, indeed strengthens the Balassa-Samuelson effect, i.e. the relative price rises and the real exchange rate appreciates more than above. Real output growth, on the other hand, is not as strong. However, the effects on the trade account are positive: in case 2, a surplus of 2.5% of output appears; in case 3, the deficit drops from 10% to 6.6% of output, while in case 4, it decreases from 22% to 17.4% of output. Hence, it would appear that the catch-up related change in the composition of consumption might naturally help to correct external imbalances. However, at the same time, the effects on the price level might make meeting the Maastricht criterion on price stability harder.

3.3.4 Transitory shock

The transitory shock is a 1% stochastic shock to traded sector productivity. The deviations from the steady state in response to the shock are presented in Figure 1 for the case 1 discount factor where consumption smoothing takes place in terms of consumption/output. The direction of change is the same for the other formulations of the discount factor.

FIGURE 1 Transitory shock to traded sector productivity



Consistent with the Balassa-Samuelson proposition, the relative price, the real exchange rate and wage increase following the shock. Moreover, total output increases, as the output in the traded goods sector rises more than that in the non-traded goods sector falls.

Due to higher income, consumption rises but less than output which implies that trade balance surplus develops - and saving increases - causing positive net foreign assets to be created. As output quickly returns to the steady state level, the trade balance surplus is eliminated. After the initial rise, the relative price starts falling back to the steady state level. The falling relative price brings a rise to the consumption-based interest rate which implies a substitution from current to future consumption. Thus, consumption is lower but still above the steady state levels, and is financed by the interest income from the positive net foreign assets. This process continues until the net foreign assets have

evaporated and consumption and net foreign assets are again at the steady state levels. The Figures correspond largely to the linearization in Section 3.2.2, although several simplifications to the model were made to enable the linearization.

Examining the effects of different values of ψ gives results that are in line with Schmitt-Grohé and Uribe (2003). It was found that the speed of mean reversion increases with the value of ψ. Moreover, the response of net foreign assets to productivity shocks also decreases when the value of ψ increases.

3.4 Conclusions

Differences in growth, productivity and inflation levels are going to be a prominent feature of the future euro area, as the convergence process is still on-going in the new Member States. This convergence process can be described by the Balassa-Samuelson proposition, which has been discussed much in the context of the new Member States and their participation in ERM II and the euro area. Most research has, however, concentrated on the effects on the real exchange rate and its consequences for the exchange rate and inflation.

The aim in this study has been to build a framework that is suited for analyzing convergence and growth related questions in small open economies with fixed exchange rate regimes. The model presented here is a fairly standard intertemporal small open economy model, where the home economy pegs its currency to the currency of a monetary union and thus takes the interest rate as exogenous. The home economy produces a traded and a non-traded good using labour as the only input. It is assumed that growth differentials stem from differences in productivity growth, i.e. the home country will experience its traded sector faster productivity growth in than its non-traded sector, in line with the Balassa-Samuelson model.

To determine the existence of a steady state and the effects of different productivity shocks, numerical methods were employed. Parameter values were collected from the relevant literature and actual data were also consulted. The Baltic states were chosen as the reference group with regard to actual data, as they can be considered to be good examples of small open economies with fixed exchange rate regimes. Two main types of shocks were examined: a permanent shock, where the traded sector productivity level of the home economy converges to that of the monetary union, and a transitory stochastic shock to traded sector productivity.

The estimations in Section 3 provided support for the Balassa-Samuelson effect, i.e. faster productivity growth in the traded sector than in the non-traded goods sector shows up as an increase in the price of the non-traded good and an appreciation of the real exchange rate. However, the focus in this study goes beyond this much discussed supply-side effect to the implications on the external balance. The simulations showed that permanent shocks in productivity, i.e. convergence, can have effects on the net foreign asset position of the small open economy. The existence of the smallest trade account deficit (surplus) leads to the accumulation of negative (positive) net foreign assets. This implies increased vulnerability of the economy.

Convergence is, however, often related to a shift in consumption preferences. Typically, as an economy catches up, the share of non-traded goods, i.e. services, in total consumption tends to increase. This reinforces the supply side Balassa-Samuelson effect, i.e. the relative price and the real exchange rate rise more strongly, but reduces the effects on the external balance. It seems that as the share of non-traded goods in consumption increases, the trade balance deficit improves. Hence, trade account deficits would appear to be a temporary phenomenon in countries that are still catching-up.

The Baltic states, used as reference countries here, all have significant trade and current account deficits. Nevertheless, based on the findings in this Chapter, it would appear that the large trade and current account deficits may not be such a serious cause of concern after all. Changes in the composition of consumption that are characteristic to the transition process may provide a natural correction in the course of catch-up. Still, it should be kept in mind that the observed behaviour can also be due to factors other than those discussed here.

Yet, a careful monitoring of the development of the net foreign asset position should not be neglected. Indeed, strong private sector credit growth has been seen in the Baltic states, which underlines the need to ensure a proper functioning of the financial markets and an effective financial supervision. However, as pointed out by Cottarelli et al. (2003), the credit growth rates have not yet reached the excessive rates seen in some Asian countries in the 1990s.

The Balassa-Samuelson effect, and fast growth in general, increase the vulnerability of the small open economy. To counter these problems, the policy advice most often focuses on fiscal policy. First, fiscal policy has a crucial role in keeping the trade and current account deficits in check, which was the focus in this study. Second, fiscal policy also helps to bring down inflation that is also to some extent influenced by the Balassa-Samuelson effect. Third, fiscal

policy is the key in containing pressures for over-heating that may appear in fast growing economies and finally, prudent fiscal policy is a requirement for meeting the Maastricht fiscal criteria. The role of sound fiscal policy is also underlined by the ECB in its 2004 convergence report.

Based on these results, one can draw some guidelines for future research. As noted earlier, capital and investment could be added to the model to improve the description of the convergence process, particularly as they have been identified as a major cause behind external imbalances.[41] Moreover, numerical methods could be further developed and the group of reference countries widened to include the Central European countries, which are likely to join the ERM II in the next years. Most importantly, the study would benefit from an explicit formulation of the government side, as for example Chinn and Prasad (2000) point out government budget balance, together with the initial net foreign asset position, to be positively correlated with current account balances. Differences with regard to fiscal discipline are evident between the Baltic states but public sector deficits especially in the case of the Central European countries can be considered the largest obstacle on the way towards adoption of the euro. Hence, the integration of growth and fiscal sustainability should be a priority in future work.

[41] Schaedler et al. (2004) find that investment is higher in the Central European countries than the current euro area, as these countries are currently relatively labour-rich and capital-poor.

References

Balassa, B., 1964. The Purchasing-Power Parity Doctrine: A Reappraisal. The Journal of Political Economy, LXXII: 6, 584-596.

Bank of Estonia, 2004. Monetary Developments & Policy Survey, March 2004.

Begg, D., Eichengreen, B., Halpern, L., von Hagen, J., Wyplosz, C., 2003. Sustainable Regimes of Capital Movements in Accession Countries. CEPR Policy Paper No. 10.

Benigno, G., Thoenissen, C., 2003. Equilibrium exchange rates and supply-side performance. The Economic Journal, 113 (March), C103-C124.

Central Intelligence Agency (CIA), 2005. The World Factbook. http://www.cia.gov/cia/publications/factbook.

Chinn, M.D., Prasad, E.S., 2000. Medium-Term Determinants of Current Accounts in Industrial and Developing Countries: An Empirical Exploration. IMF Working Paper, WP/00/46.

Cooley, T.F., Prescott, E.C., 1995. Economic Growth and Business Cycles. In Cooley, T.F. (eds.), Frontiers of Business Cycle Research. Princeton University Press, Princeton, New Jersey. 1-38.

Cottarelli, C., Dell'Ariccia, G., Vladkova-Hollar, I., 2003. Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and the Balkans. IMF Working Paper, WP/03/213.

Domeij, D., Flodén, M., 2001. The labour-supply elasticity and borrowing constraints: Why estimates are biased. Stockholm School of Economics Economics and Finance Working Paper No. 480.

Dornbusch, R., 1983. Real Interest Rates, Home Goods, and Optimal External Borrowing. The Journal of Political Economy, 91:1, 141-153.

European Central Bank (ECB), 2004. Convergence Report 2004.

European Commission, 2004. Convergence Report 2004. European Economy, 6/2004.

European Union, 2004. ERM II Exchange Rate Procedure, press release 27.6.2004. http://www.eu2004.ie/templates/news.asp?sNavlocator=66&list_id=894.

IMF, 2002. Assessing Sustainability. http://www.imf.org/external/np/pdr/sus/2002/eng/052802.pdf

IMF, 2003a. Republic of Estonia: Selected issues and Statistical Appendix. Country Report No. 03/331.

IMF, 2003b. Republic of Latvia: Statistical Appendix. Country Report No. 03/112.

IMF, 2003c. Republic of Lithuania: Statistical Appendix. Country Report No. 03/294.

IMF, 2004. Republic of Estonia: Selected Issues. Country Report No. 04/357.

IMF, 2005. Republic of Estonia: 2005 Article IV Consultation - Staff Report; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for the Republic of Estonia. Country Report No. .

Killingsworth, M.R., Heckman, J.J., 1986. Female labour Supply: A Survey. In Ashenfelter, O.C., Layard, R. (eds.) Handbook of labour Economics Vol. 1. 103-204.

Mihaljek, D., Klau, M., 2003. The Balassa-Samuelson effect in central Europe: a disaggregated analysis. BIS Working Papers No 143.

Montiel, P.J., 1999. Determinants of the Long-Run Equilibrium Real Exchange Rate: An Analytical Model. In Hinkle, L.E., Montiel, P.J. (eds.), 1999. Exchange Rate Misalignment Concepts and Measurement for Developing Countries. World Bank, Oxford University Press.

Obstfeld, M., 1990. Intertemporal dependence, impatience, and dynamics. Journal of Monetary Economics, 26:1, 45-75.

Obstfeld, M., Rogoff, K., 1998. Foundations of International Macroeconomics. The MIT Press, Cambridge, Massachusetts.

Obstfeld, M., Rogoff, K., 2000. New directions for stochastic open economy models. Journal of International Economics, 50:1, 117-153.

Saget, C. 2000. The determinants of female labour supply in Hungary. Economics of Transition, 7:3, 575-591.

Samuelson, P., 1964. Theoretical notes on trade problems. The Review of Economics and Statistics, XLVI:2, 145—154.

Schadler, S., Drummond, P., Kuijs, L., Murgasova, Z., van Elkan, R., 2004. Euro Adoption in the Accession Countries: Vulnerabilities and Strategies. IMF, a Paper for Conference on Euro Adoption in the Accession Countries - Opportunities and Challenges, Czech National Bank, Prague, February 2-3, 2004.

Schmitt-Grohé, S., Uribe, M., 2003. Closing small open economy models. Journal of International Economics, 61:1, 163-185.

Siliverstovs, B., Koulikov, D., 2003. labour Supply of Married Females in Estonia. DIW Discussion Paper No. 321.

World Bank, 2005. Quarterly Economic Report, January 2005.

Appendix

Steady state model

In the steady state, the discount rate reduces to

$$\beta = \frac{1}{1+r}. \tag{3.55}$$

Now one can calculate the steady state consumption for the home economy using the steady state budget constraints for the household, government and central bank:

$$\overline{C}_T + p\overline{C}_N = \overline{r}\left(\frac{\overline{B}_H + \overline{B}_F + \overline{B}_m - \overline{D}}{\overline{P}_T}\right) + \overline{Y}_T + p\overline{Y}_N - \overline{G}_T - p\overline{G}_N. \tag{3.56}$$

Employing the non-traded goods market equilibrium condition $C_N + G_N = Y_N$ on equation (3.56) gives the current account equation for the home economy:

$$\overline{TB} = -\overline{r}\frac{\overline{F}}{\overline{P}_T}, \tag{3.57}$$

where $\overline{TB} = \overline{Y}_T - \overline{C}_T - \overline{G}_T$ is the steady state trade balance and $\overline{F} = \overline{B}_H + \overline{B}_F + \overline{B}_m - \overline{D}$ the steady state net foreign assets.

By substituting private and public demands for the non-traded good, (3.18) and (3.35), the supply of the non-traded good (3.2)as well as the demand for labour in the non-traded sector (3.6) into the equilibrium condition of the non-traded goods sector (3.44), we can solve the equilibrium value of p

$$p = A_N^{\frac{1}{\gamma\eta-\gamma-\eta}}\left(\frac{W}{\eta}\right)^{\frac{\eta}{\gamma+\eta-\gamma\eta}}\left[(1-\gamma)\,C + (1-\delta)\,G\right]^{\frac{\eta-1}{\gamma\eta-\gamma-\eta}} \tag{3.58}$$

and respectively for the foreign economy. Thus, the equilibrium real exchange rate can be written as

$$\frac{p}{p^*} = \frac{(A_N)^{\frac{1}{\gamma\eta-\gamma-\eta}}\left(\frac{W}{\eta}\right)^{\frac{\eta}{\gamma+\eta-\gamma\eta}}\left[(1-\gamma)\,C + (1-\delta)\,G\right]^{\frac{\eta-1}{\gamma\eta-\gamma-\eta}}}{(A_N^*)^{\frac{1}{\gamma\eta-\gamma-\eta}}\left(\frac{W^*}{\eta}\right)^{\frac{\eta}{\gamma+\eta-\gamma\eta}}\left[(1-\gamma)\,C^* + (1-\delta)\,G^*\right]^{\frac{\eta-1}{\gamma\eta-\gamma-\eta}}}. \tag{3.59}$$

Linearized model

The first-order conditions (3.47), (3.29) and (3.30) are written in linearized form as follows:

$$\begin{aligned} E_t\widetilde{C}_{t+1} &= \widetilde{C}_t - \psi\overline{C}\left(\lambda\widetilde{C}_t + \mu\widetilde{m}_t + \varphi\widetilde{L}_t\right) \\ &= \left(1-\psi\overline{C}\right)\widetilde{C}_t - \psi\overline{C}\left(\mu\widetilde{m}_t + \varphi\widetilde{L}_t\right) \end{aligned} \tag{3.60}$$

$$\widetilde{m}_t = \chi\left(\frac{R}{R-1}\right)\widetilde{C}_t \tag{3.61}$$

and

$$\omega\frac{\widetilde{L}_t}{\overline{L}} = \frac{\widetilde{W}_t}{\overline{W}} - \frac{\widetilde{P}_{Tt}}{\overline{P}_T} - \frac{\widetilde{C}_t}{\overline{C}}. \tag{3.62}$$

Combining the linearized household, government and central bank budget constraints and recalling that the exchange rate and the price of the traded good are fixed, gives the economy wide linearized budget constraint

$$\begin{aligned} \frac{\widetilde{F}_t}{\overline{P}} &= (1+r)\left(\frac{\widetilde{F}_{t-1}}{\overline{P}}\right) + \widetilde{Y}_{Tt} - \widetilde{C}_{Tt} - \widetilde{G}_{Tt} \\ &\quad + \overline{P}_N\left(\widetilde{Y}_{Tt} - \widetilde{C}_{Tt} - \widetilde{G}_{Tt}\right) \\ &\quad + \widetilde{P}_{Nt}\left(\overline{Y}_T - \overline{C}_T - \overline{G}_T\right), \end{aligned} \tag{3.63}$$

where $\frac{\widetilde{B}_{Ht}}{\overline{P}} + \frac{\widetilde{B}_{Ft}}{\overline{P}} + \frac{\widetilde{B}_{mt}}{\overline{P}} - \frac{\widetilde{D}_t}{\overline{P}} = \frac{\widetilde{F}_t}{\overline{P}}$ is the net foreign assets. Employing the non-traded goods market equilibrium produces

$$\frac{\widetilde{F}_t}{\overline{P}_T} = (1+r)\frac{\widetilde{F}_{t-1}}{\overline{P}_T} + \widetilde{Y}_{Tt} - \widetilde{C}_{Tt} - \widetilde{G}_{Tt}. \tag{3.64}$$

In terms of whole consumption, the linearized combined budget constraint can be written as follows

$$\frac{\widetilde{F}_t}{\overline{P}} = R\frac{\widetilde{F}_{t-1}}{\overline{P}} + \widetilde{Y}_t - \widetilde{C}_t - \widetilde{G}_t - (R-1)\frac{\overline{F}}{\overline{P}}\frac{\widetilde{P}_t}{\overline{P}} \tag{3.65}$$

Noting that $\widetilde{G}_t = 0$ and making the simplifications mentioned in the end of Section 3.2.2, namely, assuming constant returns to scale and a constant labour supply, $L_t = \overline{L}$, we get:

$$\frac{\widetilde{F}_t}{\overline{P}} = (1+r)\frac{\widetilde{F}_{t-1}}{\overline{P}} + \gamma\overline{L}\left(\frac{\overline{A}_T}{\overline{A}_N}\right)^{\gamma-1}\widetilde{A}_{Tt} - \widetilde{C}_t - r(1-\gamma)\frac{\overline{F}}{\overline{P}}\frac{\widetilde{A}_{Tt}}{\overline{A}_T} \tag{3.66}$$

Forward by one period, subtract $\left(1-\psi\overline{C}\right)\left(\frac{\widetilde{F}_t}{\overline{P}}\right)$ from both sides and assume that $\mu=\varphi=0$ and $\lambda=1$, which allows the previous equation to be written as follows:

$$\begin{aligned}&\frac{\widetilde{F}_{t+1}}{\overline{P}}-\left(1-\psi\overline{C}\right)\left(\frac{\widetilde{F}_t}{\overline{P}}\right)=(1+r)\left[\frac{\widetilde{F}_t}{\overline{P}}-\left(1-\psi\overline{C}\right)\left(\frac{\widetilde{F}_{t-1}}{\overline{P}}\right)\right] \qquad (3.67)\\ &+\gamma\overline{L}\left(\frac{\overline{A}_T}{\overline{A}_N}\right)^{\gamma-1}\left[\widetilde{A}_{Tt+1}-\left(1-\psi\overline{C}\right)\widetilde{A}_{Tt}\right]-\left[E_t\widetilde{C}_{t+1}-\left(1-\psi\overline{C}\right)\widetilde{C}_t\right]\\ &-r\left(1-\gamma\right)\frac{\overline{F}}{\overline{P}}\frac{1}{\overline{A}_N}\left[\widetilde{A}_{Tt+1}-\left(1-\psi\overline{C}\right)\widetilde{A}_{Tt}\right]\end{aligned}$$

which, taking into consideration the first-order-condition (3.60), the process for A_T and that government expenditure is exogenous, reduces to

$$\begin{aligned}&\left(1-\frac{L^{-1}}{(1+r)}\right)\left[\frac{\widetilde{F}_t}{\overline{P}}-(1-\psi\overline{c})\left(\frac{\widetilde{F}_{t-1}}{\overline{P}}\right)\right] \qquad (3.68)\\ =\;&\frac{1}{(1+r)}\left[\gamma\overline{L}\left(\frac{\overline{A}_T}{\overline{A}_N}\right)^{\gamma-1}-r\left(1-\gamma\right)\frac{\overline{F}}{\overline{P}}\frac{1}{\overline{A}_T}\right]\left(1-\rho-\psi\overline{C}\right)\widetilde{A}_{Tt}\end{aligned}$$

where the forward operator is defined as $L^{-k}X_t\equiv E_tX_{t+k}$. From here we get equations (3.49) and (3.50) in the text.

$$\widetilde{C}_t=\left(r+\psi\overline{C}\right)\left(\frac{\widetilde{F}_{t-1}}{\overline{P}}\right)+\frac{\left(r+\psi\overline{C}\right)}{(1+r-\rho)}\left[\gamma\overline{L}\left(\frac{\overline{A}_T}{\overline{A}_N}\right)^{\gamma-1}-r\left(1-\gamma\right)\frac{\overline{F}}{\overline{P}}\frac{1}{\overline{A}_N}\right]\widetilde{A}_{Tt}. \qquad (3.69)$$

$$\frac{\widetilde{F}_t}{\overline{P}}=\left(1-\psi\overline{C}\right)\left(\frac{\widetilde{F}_{t-1}}{\overline{P}}\right)+\frac{\left(1-\rho-\psi\overline{C}\right)}{(1+r-\rho)}\left[\gamma\overline{L}\left(\frac{\overline{A}_T}{\overline{A}_N}\right)^{\gamma-1}-r\left(1-\gamma\right)\frac{\overline{F}}{\overline{P}}\frac{1}{\overline{A}_N}\right]\widetilde{A}_{Tt} \qquad (3.70)$$

4 Growth and Fiscal Rules in ERM II

4.1 Introduction

Fiscal rules are gaining considerable popularity in the conduct of fiscal policy all over the world.[42] In the EU, such rules to eliminate or to contain budget deficits and to reduce public debt have manifested themselves in form of the Maastricht criteria as well as the Stability and Growth Pact (SGP). Indeed, the Maastricht fiscal criteria and the SGP are at the core of EMU, as fiscal discipline contributes to maintaining an economic environment in which monetary policy can effectively pursue price stability (Brunila et al. 2001, 1). The recent reform of the Stability and Growth Pact has underlined its central role in the EU framework.[43]

This line of reasoning has also been promoted by the Fiscal Theory of the Price Level (FTPL), which states that the price level is determined by the budgetary policies of the fiscal authority. The FTPL differentiates between Ricardian (money dominant) and non-Ricardian (fiscal dominant) regimes.[44] In a Ricardian policy, primary surpluses adjust to guarantee fiscal solvency for any sequence of prices, in contrast to a non-Ricardian policy, where primary surpluses are not affected by government debt. The recognition that the possibility for non-Ricardian policies exists may help to avoid them. Fiscal rules are considered one way to achieve this.

Indeed, it has been shown that the Maastricht fiscal criteria are sufficient to force a country into a Ricardian regime. Canzoneri and Diba (1996) find that limiting the government's total deficit (primary deficit plus interest payments) to 3% of GDP achieves this, as does a Maastricht-type debt limit, as is shown by Woodford (1996). As a matter of fact, Ballabriga and Martinez-Mongay (2002) confirm that the EU Member States's fiscal policy can be described by the money dominant regime in both the pre-EMU and EMU periods. However, they also find that fiscal solvency is ensured differently in the two periods: while in the past fiscal authorities responded systematically to debt accumulation,

[42] The interest in fiscal rules can be divided into three waves. In the first wave, subnational governments in some federal systems adopted autonomously the golden rule, i.e. the obligation to maintain the current balance. Examples of the first wave include most US states in the mid-19th century. The second wave started after the Second World War with several industrial countries, e.g. Germany, Italy, Japan and the Netherlands, introducing balanced budget rules, most of them the golden rule type. The New Zealand Fiscal Responsibility Act of 1994 began the third wave, which has witnessed several industrial and emerging markets adopting a wide range of fiscal rules. (Kopits 2001, 4-5).

[43] E.g. the governments of the Benelux countries (2005) assert that the reform confirmed the Pact as a strong instrument to foster budgetary discipline.

[44] See e.g. Woodford (1995, 2001, 2003) or Canzoneri et al. (1998b).

now the SGP limits debt accumulation by limiting the variability of the deficit.

Also the new Member States must adopt the EU rules, which first and foremost means meeting the Maastricht fiscal criteria. While many of the new Member States still exceed the deficit criterion, the debt to output ratios are comfortably below the 60% reference value in most new Member States. It is, however, noteworthy that debt ratios in some of the countries have increased which, considering the fast output growth rates, implies that debt levels have been rising relatively rapidly. For example in the Latvian 2004 Convergence Programme, it was estimated that gross debt would rise from 14.2% of GDP in 2004 to 15% of GDP in 2007, while GDP growth ranges between 6.5% and 8.1% (Ministry of Finance of the Republic of Latvia 2004).

In addition to the fiscal requirements, the Maastricht criteria include the two year participation in the exchange rate mechanism ERM II. It was shown in Chapter 2 in a FTPL framework, that maintaining a credibly fixed exchange rate necessitates a sound fiscal policy. Indeed, some new Member States have already announced that they do not plan to participate in the ERM II before bringing the deficit below 3 per cent. The role of sound fiscal policy was also underlined in the statements published in conjunction with the ERM II entries of Estonia, Lithuania and Slovenia in June 2004, Latvia in May 2005 and Slovakia in November 2005 (European Union 2004, 2005a, b).[45]

Besides the Maastricht deficit criterion, external imbalances have proved to be a problem for several new Member States. The external balance as such is not included in the Maastricht convergence criteria - only through its effects on other variables, e.g. the exchange rate - but it is likely to factor in the decision making, as can also be seen from the above-mentioned statements.

Fiscal policy rules have mostly been examined with the purpose of studying the relationship between monetary and fiscal policy and the determination of the price level. In the EU context, this has often meant a central bank that uses a Taylor type monetary policy rule. The findings have indicated that fiscal policy does matter for price level determination.

The aim in this Chapter is to examine the effects of EU fiscal policy rules on the fiscal variables and external balance, rather than on the price level, in the new Member States. The Member State is assumed to be engaged in a fixed exchange rate arrangement, such as the ERM II, which implies that the small

[45] E.g. for Estonia, it was noted that "The agreement on participation of the kroon in ERM II is based on a firm commitment by the Estonian authorities to continue with sound fiscal policies, which are essential for preserving macroeconomic stability, for supporting an orderly and substantial reduction of the current account deficit, and for ensuring the sustainability of the convergence process." and for Slovenia: "Fiscal policy will have to play a central role in controlling demand-induced inflationary pressures." (European Union 2004).

open economy takes the interest rate as given. The model is a fairly standard one-good small open economy model with capital, an endogenous labour supply and distortionary taxation. The country experiences fast growth, which is depicted by permanent and transitory shocks to its productivity. Two types of fiscal rules are examined: one based on debt and the other based on deficit. The numerical analysis in the Chapter is based on the economic characteristics of the Baltic states, which can be considered as good examples of small open economies with a long history of fixed exchange rates.

The results show that a fiscal rule, which is based on debt, guarantees balanced public finances and a stable debt to output ratio also in a environment of productivity convergence, while a deficit rule, aimed at balanced public finances, achieves favourable results with regard to debt and deficit when the economy is hit by a transitory productivity shock. The debt rule appears more robust in providing stability, especially in the long term. A shortcoming of the debt rule is that it keeps the debt to output ratio constant also in an environment of fast growth. Thus, more attention in the analysis of public finances needs to be given to growth of debt levels. External imbalances appear to be a natural part of the convergence process, which cannot be eliminated through the use of fiscal rules alone. Containing private sector credit growth is also important.

Section 2 explains the basic structure of the model and the fiscal rules used. Numerical methods are employed in Section 3 with policy implications and conclusions discussed in Section 4.

4.2 The Model

The study employs a one-good small open economy model, where the home economy pegs its currency to the currency of a monetary union and thus takes the interest rate as exogenous. The construction of the household's problem follows to some extent Obstfeld and Rogoff (2000), while the production side of the model is based on Obstfeld and Rogoff (1998).

The fiscal rules are formulated to resemble those of the EU, i.e. they include limits on the government deficit or debt.[46] Similar rules have been employed in for example Leeper (1991), Woodford (2001) and Railavo (2004a, b).[47] In these

[46] Hallerberg et al. (2004) note that even though all EU Member States face the same European policy framework, the application of fiscal rules and multi-annual target varies considerably at the national level.

[47] Leeper (1991) shows that whether simple interest rate and tax rules completely specify

studies the focus has been on the interaction between the fiscal and monetary authorities and on the effects on price level determination, whereas in this study, attention is centered on the effects on fiscal and external sustainability in an environment of convergence of output levels via productivity shocks. Moreover, while these papers for the most part have studied an active monetary policy, e.g. based on the Taylor rule, in this study, monetary policy does not play a role, as the small open economy takes the interest rate as exogenous.

The first section of this Chapter explains the structure of the model starting with the household's problem, followed by the construction of the production side and finally the formulation of the government equations, which are then combined to form the economy-level equilibrium. The second section describes the fiscal rules employed in the numerical analysis of Chapter 3.

4.2.1 Structure of the Model

Household

Households consume both home and foreign produced goods. The representative household i maximizes the following utility function:

$$U_t^i = E_0 \sum_{t=0}^{\infty} \theta_t \left[\log C_t^i + \eta \log \frac{M_t^i}{P_t} - \kappa \frac{\left(L_t^i\right)^{1+\omega}}{1+\omega} \right] \tag{4.1}$$

$$\theta_0 = 1$$

$$\theta_{t+1} = \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) \theta_t,$$

where C_t^i denotes the level of consumption at period t for household i and

policy depends on the mix of active and passive policies, where policies are defined as active, when the authority pays no attention to the state of government debt and is free to set its control variable as it sees fit, or passive, when the authority responds to government debt shocks, while its behaviour is constrained by private optimization and the active authority's actions.

Woodford (2001) argues that the mere commitment of a central bank to conduct monetary policy according to a Taylor rule is insufficient to guarantee a stable low equilibrium rate of inflation, which leads him to suggest that a Taylor rule for monetary policy should be accompanied by targets for the size of government budget deficit.

Railavo (2004a) examines the stabilising properties of different fiscal policy rules with a monetary policy based on the Taylor rule and finds that a rule based on debt appears to result in an unstable solution, while a rule based on deficit has stable solutions with a wide range of fiscal policy parameters.

Railavo (2004b) studies the monetary impact of fiscal rules based on debt or deficit with an optimising central bank. The results show that with discretionary monetary policy, the inflation bias depends on fiscal policy with both the debt and deficit rules and that under precommitment, output persistence increases in comparison to the discretionary case.

$\frac{M_t^i}{P_t} = m_t$ the real money holdings. L_t^i is the household's labour supply. E_0 is the mathematical expectation operator given information at time 0 and θ_t the discount factor. η is a scale parameter for money demand. κ is the disutility of labour parameter, while $\frac{1}{\omega}$ gives the Frisch elasticity of the labour supply.[48]

The study makes use of an endogenous discount rate to deal with the well-known problems of representative agent models of small open economies.[49] Obstfeld (1990) points out that the use of an endogenous time preference avoids the 'sometimes troublesome non-convergence and hysteresis implied by constant time preference', while producing otherwise similar behaviour, at least in qualitative terms, to the standard model.[50] The discount factor employed in this study is a simplified version of Uzawa preferences, the most common form of an endogenous discount factor. The simplified version induces stationarity in the same manner as the standard one but is computationally much simpler.[51] The discount factor is assumed, in line with Schmitt-Grohé and Uribe (2003) to depend on per capita levels of consumption $\widehat{C}_t$, money demand $\widehat{m}_t$ and labour supply $\widehat{L}_t$, which the representative household takes as given.

The real consumption index C takes a Cobb-Douglas form defined as

$$C = \frac{C_H^{\gamma} C_F^{1-\gamma}}{\gamma^{\gamma} (1-\gamma)^{1-\gamma}}, \tag{4.2}$$

where C_H and C_F are the two consumption indexes that refer to the consumption of home and foreign produced goods, respectively. γ is the preference parameter, which gives the weight that the household puts on home goods,

[48] The Frisch elasticity is defined as the elasticity of labour supply with respect to wage, holding the marginal utility of consumption constant.

[49] If the real rate of return on foreign bonds exceeds the subjective rate of discount, the model displays perpetual positive growth. It is standard practice to eliminate this source of dynamics by assuming that the subjective discount rate equals the real rate of interest (Schmitt-Grohé and Uribe 2003, 164). The problems related to the standard model could also be avoided by assuming an overlapping-generations structure but as noted by Obstfeld (1990), this could unnecessarily complicate the analysis.

[50] Schmitt-Grohé and Uribe (2003) examine several techniques for inducing stationarity of the equilibrium dynamics in the small open economy model (two versions of endogenous discount factor, a debt-contingent interest rate premium, portfolio adjustment costs and complete asset markets) and examine the extent to which these stationarity-inducing techniques affect the equilibrium dynamics at business cycle frequencies. They find that once all models are made to share the same calibration, their quantitative predictions regarding the behaviour of key macroeconomic variables are virtually identical.

[51] The Uzawa type preferences use a subjective discount factor assumed to be decreasing in consumption, i.e. agents become more impatient the more they consume. Obstfeld (1990) also shows that impatience to consume increases as actual consumption rises. If fact, the assumption is necessary for convergence of the infinite-horizon optimal saving plan to a constant long-run consumption level. If this assumption is not met, i.e. impatience to consume would decrease as actual consumption increases, individual optimum may not exist.

and also the share of total expenditure allocated to the consumption of home goods. This Cobb-Douglas consumption index corresponds to a consumption-based price index:

$$P = P_H^{\gamma} P_F^{1-\gamma}. \tag{4.3}$$

The small open economy takes the prices as given and the law of one price is expected to hold, i.e. $P_F = \varepsilon P_F^*$, where ε is the nominal exchange rate (the home currency price of foreign currency). Maximizing equation (4.2) given total expenditure $Z \equiv P_H C_H + P_F C_F$, gives the household's demand for home and foreign goods,

$$C_H = \gamma \frac{P}{P_H} C \text{ and } C_F = (1-\gamma) \frac{P}{P_F} C, \tag{4.4}$$

respectively.

The period budget constraint of the home representative household i is

$$\begin{aligned} & C_t^i + \frac{B_{Ht+1}^i}{P_t} + \varepsilon_t \frac{B_{Ft+1}^i}{P_t} + \frac{M_t^i}{P_{st}} + V_t x_{t+1} \\ = \; & (1-\tau_t) w_t L_t^i + R_t \frac{B_{Ht}^i}{P_t} + f_{t-1} R_t^* \frac{B_{Ft}^i}{P_t} + \frac{M_{t-1}^i}{P_t} + (V_t + d_t) x_t, \end{aligned} \tag{4.5}$$

where B_{Ht}^i is the nominal holdings of the home government bond at the beginning of period t. These pay a nominal gross interest R_t, which is defined by $R_t = 1 + i_t$, where i_t is the nominal interest rate of home currency loans between t and $t+1$. Similarly, B_{Ft}^i is the nominal holdings of the foreign bond that pay a nominal gross interest R_t^*. f_{t-1} is the forward exchange rate determined in period $t-1$. V_t is a date t claim to the firm's entire future profits, while x_{t+1} is the share of the domestic firm owned by the representative household at the end of period t. d_t is the dividends issued in period t. τ_t is the tax-rate paid to the home government from wage income $w_t L_t^i$.

Households maximize equation (4.1) subject to equation (4.5), which produces the following first-order conditions for the household's problem with respect to consumption and labour supply:

$$\frac{1}{C_t} = R_{t+1} \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) \frac{P_t}{P_{t+1}} E_t \frac{1}{C_{t+1}} \tag{4.6}$$

$$\frac{1}{C_t} = R_{t+1}^* \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) \frac{P_t}{P_{t+1}} \frac{f_t}{\varepsilon_t} E_t \frac{1}{C_{t+1}} \tag{4.7}$$

$$\frac{V_t}{C_t} = (V_{t+1} + d_{t+1}) \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t \right) E_t \frac{1}{C_{t+1}} \tag{4.8}$$

$$\frac{M_t}{P_t} = \chi \frac{R_{t+1}}{R_{t+1}-1} C_t = \chi \frac{1+i_{t+1}}{i_{t+1}} C_t \tag{4.9}$$

$$\kappa L_t^{\omega} = \frac{(1-\tau_t)\, w_t}{C_t}. \tag{4.10}$$

Equation (4.6) is the standard first-order Euler condition for optimal intertemporal allocation of consumption. Together with equation (4.7) it implies the covered interest rate parity

$$(1+i_{t+1}) = \left(1+i^*_{t+1}\right) \frac{f_t}{\varepsilon_t}. \tag{4.11}$$

As the exchange rate is fixed, this implies that the home economy - the small open economy - takes the foreign interest rate as given. The Euler condition can also be written as follows:

$$\frac{1}{C_t} = (1+r_{t+1})\, \beta \left(\widehat{C}_t, \widehat{m}_t, \widehat{L}_t\right) E_t \frac{1}{C_{t+1}}. \tag{4.12}$$

where r_t is the real interest rate. This together with condition (4.8) implies that under perfect foresight, consumers will be indifferent on the margin between bond holdings and shares, provided the gross rate of return on shares equals the gross real interest rate:

$$1 + r_{t+1} = \frac{d_{t+1} + V_{t+1}}{V_t}. \tag{4.13}$$

Condition (4.9) states that households must be indifferent between consuming a unit of the consumption good on date t or using the same funds to raise cash balances, enjoying the derived transactions utility in period t and then converting the extra cash balances back to consumption in period $t+1$. As it is assumed that the small open economy takes the interest rate as exogenous and that money supply always equals money demand, from now on we can abstract from money without implications. Equation (4.10) is the leisure-consumption trade-off condition, which implies the following for labour supply:

$$L_t = \left[\frac{(1-\tau_t)\, w_t}{\kappa C_t}\right]^{\frac{1}{\omega}}. \tag{4.14}$$

In equilibrium, equation (4.5) can be written in intertemporal form as

follows

$$W_t = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} (1+r_j)^{-1} \right) \left[C_s^i - (1-\tau_s) w_s L_s \right], \tag{4.15}$$

where $W_t = \frac{B_{Ht}^i + \varepsilon_t B_{Ft}^i}{P_{t-1}} + V_{t-1} x_t$ is real household financial wealth at the beginning of period t. As the households fully use their lifetime wealth, the transversality condition implies that

$$\lim_{T \to \infty} \left(\prod_{j=t}^{T} (1+r_j)^{-1} \right) W_T = 0. \tag{4.16}$$

In equilibrium, we have that $\widehat{C}_t = C_t$ and $\widehat{L}_t = L_t$, keeping in mind that we have extracted money. The following functional form is assumed for the discount factor

$$\begin{aligned} \beta(C_t, L_t) &= \frac{\left[1 + \lambda\left(C_t - \overline{C}\right) + \varphi\left(L_t - \overline{L}\right)\right]^{-\psi}}{1+r} \\ ; \psi &\geq 0, \end{aligned} \tag{4.17}$$

where $\overline{C}$ and $\overline{L}$ are some positive constants and ψ the elasticity of the discount factor with respect to the aggregate $\left[1 + \lambda\left(C_t - \overline{C}\right) + \varphi\left(L_t - \overline{L}\right)\right]$.[52] The Euler equation (4.6) can now be written as

$$\frac{1}{C_t} = \left[1 + \lambda\left(C_t - \overline{C}\right) + \varphi\left(L_t - \overline{L}\right)\right]^{-\psi} E_t \frac{1}{C_{t+1}}. \tag{4.18}$$

In the steady state, the discount rate reduces to

$$\beta = \frac{1}{1+r}, \tag{4.19}$$

i.e. the use of the endogenous discount factor does not affect the calculation of the steady state.

To facilitate the numerical simulation in Section 3, equation (4.18) is written as follows

$$\frac{1}{C_t/Y_t} = \left\{1 + \lambda\left[(C_t/Y_t) - \overline{c}\right]\right\}^{-\psi} E_t \frac{1}{(C_{t+1}/Y_{t+1})} \left(\frac{Y_t}{Y_{t+1}} \right), \tag{4.20}$$

[52] If $\psi = 0$, the discount factor is constant and is equal to $\frac{1}{1+r}$, which would imply that the long-run levels of foreign debt and consumption depend on the initial level of foreign debt and the initial realization of the endowment shock. In other words, the model is non-stationary. (Schmitt-Grohé and Uribe 2003, 182).

where $\overline{c} = \frac{\overline{C}}{\overline{Y}}$ and it has been assumed that $\varphi = 0$. Giving other values to φ would not make a difference to the results, as labour supply is determined by equation (4.9). According to this formulation, the household smooths consumption in terms of consumption/output. This formulation enables the definition of the constant in the discount factor as a share of output rather than as the constant level, which appears sensible as the ratio of consumption to output typically remains relatively constant over time.

Production

Output is produced by a single representative domestic firm that behaves competitively and is owned entirely by domestic residents.[53] The firm hires labour at the real wage w and makes investment decisions, producing output according to the aggregate production function. The single good is produced with a Cobb-Douglas production technology $AF(K, L)$ that uses capital and labour as inputs. Thus, the output of the home economy, Y, is given by a constant-returns to scale production function:

$$Y = AF(K, L) = AK^{\alpha}L^{1-\alpha}, \tag{4.21}$$

where A is the productivity shifter that is assumed to follow the first-order autoregressive process:

$$A_t - \overline{A} = \rho\left(A_{t-1} - \overline{A}\right) + \epsilon_A;\ \rho \in (0, 1). \tag{4.22}$$

$\overline{A}$ is the steady state level of productivity that A_t converges to - this could be assumed to be the monetary union level - and ϵ_A is distributed $NIID(0, \sigma^2)$. Thus, the rate at which the economy converges to the steady state, i.e. the monetary union, level is $1 - \rho$, i.e. $1 - \rho$ of any difference between A_t and $\overline{A}$ tends to disappear each period, absent of any shocks. α and $1 - \alpha$ are the capital and labour elasticities in the production function. Labour is assumed to be internationally immobile but able to adjust to shocks immediately. Capital is internationally mobile but it can only be adjusted after one period.

The dividends, d_t, that the firm pays out each period are its current profits, equal to earnings, $Y_t - w_t L_t$, less investment expenditures, I_t, i.e.

$$d_t = Y_t - w_t L_t - I_t, \tag{4.23}$$

[53] In reality, the last assumption does not apply for the new Member States, as foreign ownership is common. This assumption is, however, not vital here, as stocks and bonds are perfect substitutes.

where $I_t = K_{t+1} - K_t$. The market value for the firm in period t is the present discounted value of the dividends it will pay shareholders over the future - starting from period $t+1$, i.e. after the dividend for period t has been issued. The date t claim to the firm's entire future profits V_t is defined as follows

$$\begin{aligned} V_t &= \sum_{s=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{s-t} d_s \\ &= \sum_{s=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{s-t} \left[A_s F\left(K_s, L_s\right) - w_s L_s - \left(K_{s+1} - K_s\right)\right]. \end{aligned} \tag{4.24}$$

The firm maximizes the present value of current and future dividends, i.e. $d_t + V_t$, subject to (4.21), taking K_t that is decided at time t as given, to determine current investment and hiring:

$$d_t + V_t = \sum_{s=t}^{\infty} \left(\frac{1}{1+r}\right)^{s-t} \left[A_s F\left(K_s, L_s\right) - w_s L_s - \left(K_{s+1} - K_s\right)\right]. \tag{4.25}$$

Maximization of (4.25) gives the following first-order conditions for capital and labour

$$A_t F_K\left(K_t, L_t\right) = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} = \alpha A_t k_t^{\alpha-1} = r \tag{4.26}$$

$$A_t F_L\left(K_t, L_t\right) = \left(1-\alpha\right) A_t K_t^{\alpha} L_t^{-\alpha} = \left(1-\alpha\right) A_t k_t^{\alpha} = w_t, \tag{4.27}$$

where k is the capital-labour ratio. The first-order conditions state that the marginal product of capital must equal the real interest rate and the marginal product of labour must equal the real wage.[54] As capital can only be adjusted in the next period, an unexpected shock at period t could cause equation (4.26) not to hold ex post. However, equation (4.27) would continue to hold, as labour can be adjusted immediately.

Demand for labour can now be written as:

$$L = \left[\frac{\left(1-\alpha\right) A}{w}\right]^{\frac{1}{\alpha}} K. \tag{4.28}$$

From the first-order conditions we can also solve the real wage as a function of r and A:

$$w = \left(1-\alpha\right)\left(\frac{r}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} A^{\frac{1}{1-\alpha}}. \tag{4.29}$$

[54] The first-order conditions also define α and $(1-\alpha)$ as the factor shares of income: $\frac{rK}{PY} = \alpha$ and $\frac{WL}{PY} = 1-\alpha$.

We can now define the zero-profit condition

$$AF(K,L) = AF_K K + AF_L L = rK + wL, \tag{4.30}$$

which holds as long as no unexpected shocks occur. This together with (4.25) implies for V_t:

$$V_t = \sum_{s=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{s-t} [rK_s - (K_{s+1} - K_s)] = K_{t+1}, \tag{4.31}$$

i.e. the maximizing firm's market value at date t equals the capital in place for production in the next period.[55]

Government

The government determines taxes and issues nominal government debt, which finance government consumption, defined, as in Railavo (2004b) by

$$G_t = \varkappa \frac{G_{t-1}}{Y_{t-1}} Y_t + (1-\varkappa)\, \upsilon Y_t + \epsilon_G;\ \varkappa \in (0,1) \tag{4.32}$$

where $\varkappa$ is the share of variable government consumption of total government consumption, υ is a constant public consumption to output ratio and ϵ_G is distributed $NIID\,(0,\sigma^2)$. The government real consumption index G takes the same general form as that of the household, given by equation (4.2):

$$G = \frac{G_H^{\delta} G_F^{1-\delta}}{\delta^{\delta}\,(1-\delta)^{1-\delta}}, \tag{4.33}$$

where the share of home goods in total government consumption is denoted by δ. This implies that the government demand functions for the home and foreign produced goods are also similar to those of the private sector:

$$G_H = \delta \frac{P}{P_H} G \text{ and } G_F = (1-\delta)\, \frac{P}{P_F} G. \tag{4.34}$$

The period budget constraint of the government is

$$\frac{D_{t+1}}{P_t} - \frac{D_t}{P_t} = -\tau_t w_t L_t + G_t + i_t \frac{D_t}{P_t}, \tag{4.35}$$

where D_t is the government's beginning-of-period debt paying a nominal interest rate i_t and $\tau_t w_t L_t - G_t - i_t \frac{D_t}{P_t}$ is the government budget balance. This

[55] This implies that household wealth W_t in equation (4.15) can in equilibrium be writtten as $W_t = \frac{B^i_{Ht} + \varepsilon_t B^i_{Ft}}{P_{t-1}} + K_t$, as in equilibrium $x_t = 1$.

definition of the government budget balance corresponds to that used by the EU in different contexts, e.g. in the Maastricht criterion. Equation (4.35) can also be written in intertemporal form as follows

$$\frac{D_t}{P_{t-1}} = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} (1+r_j)^{-1} \right) (\tau_s w_s L_s - G_s) . \tag{4.36}$$

with a transversality condition

$$\lim_{T\to\infty} \left(\prod_{j=t}^{T} (1+r_j)^{-1} \right) \frac{D_T}{P_T} = 0. \tag{4.37}$$

Equilibrium

In solving the model, we assume that international capital markets exist, where the home economy can borrow and lend unlimited amounts. Combining the budget constraints of the household and the government gives the asset position of the whole economy:

$$\frac{F_{t+1}}{P_t} = R_t \frac{F_t}{P_t} + Y_t - C_t - G_t - I_t, \tag{4.38}$$

where $F_t = B_{Ht} + \varepsilon_t B_{Ft} - D_t$ is the economy's net foreign assets in the beginning of period t.[56] In equilibrium, the intertemporal equation for the net foreign assets can be written as follows

$$\frac{F_t}{P_{t-1}} = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} (1+r_j)^{-1} \right) (C_s + G_s - Y_s - I_s) . \tag{4.39}$$

Labour market equilibrium gives the following wage equation:

$$w_t = \left[(1-\alpha) A_t \right]^{\frac{\omega}{\alpha+\omega}} \left[\frac{\kappa C_t}{(1-\tau_t)} \right]^{\frac{\alpha}{\alpha+\omega}} K_t^{\frac{\alpha\omega}{\alpha+\omega}} \tag{4.40}$$

The following equations, besides equations (4.38) and (4.40), form the equilibrium: Household and government budget constraints (4.5) and (4.35), equations for household and government consumption (4.20) and (4.32), the productivity process (4.22), and equations (4.13) and (4.26) determining the equilibrium capital level.

[56] Therefore, the current account equation is

$$\frac{CA_t}{P_t} = i_t \frac{F_t}{P_t} + Y_t - C_t - G_t - I_t.$$

4.2.2 Fiscal rules

A fiscal policy rule, in a macroeconomic context, can be defined as a permanent constraint on fiscal policy, typically defined in terms of an indicator of overall fiscal performance (Kopits and Symansky 1998, 2). Fiscal rules aim to increase the credibility of macroeconomic policies by removing discretionary intervention. Indeed, probably the most powerful argument for fiscal rules says that higher-order, possibly constitutional, constraints on fiscal policy are necessary due to the political economy aspect, i.e. the built-in bias that democratically elected governments have to deficits and the redistribution of income from future generations to the present voters (Kopits and Symansky 1998, 17).

Fiscal policy rules tend to be more heterogeneous and complex than monetary and exchange rate rules, as they vary with regard to the target variable, institutional coverage and the method of implementation. Kopits and Symansky (1998) classify fiscal policy rules into three categories: 1. balanced budget or deficit rules; 2. borrowing rules; and 3. debt or reserve rules.[57]

Most studies on fiscal rules have examined the interaction of different monetary and fiscal rules focusing on the effects on the price level. The studies examining a nominal interest rate peg - i.e. a monetary policy relevant for this analysis - all come to similar conclusions. Leeper (1991) shows that under pegged nominal interest rates and active fiscal behaviour, monetary policy's effect on prices depends on how the fiscal authority adjusts direct taxes in response to real debt movements. Sims (1994) proves that a monetary policy that fixes the nominal interest rate, even if it holds the interest rate constant regardless of the observed rate of inflation or money growth rate, may deliver a uniquely determined price level. Similarly, Woodford (1994) finds that the price level is uniquely determined under a nominal interest rate peg. Schmitt-Grohé and Uribe (2000) note that the key consideration for price level determination under an interest rate peg is whether fiscal policy is specified as an exogenous sequence of primary or secondary surpluses/deficits. Hence, these studies show that with a nominal interest rate peg, fiscal policy does

[57] The first category includes the balance between overall revenue and expenditure or limit on government deficit as a proportion of GDP, the balance between structural (or cyclically adjusted) revenue and expenditure or limit on structural (or cyclically adjusted) deficit as a proportion of GDP and the balance between current revenue and current expenditure, i.e. borrowing permitted only to finance capital expenditure, while examples of the second category are the prohibition of government borrowing from domestic sources or from the central bank or limit on such borrowing as a proportion of past government revenue or expenditure and in the third category, a limit on stock of gross (or net) government liabilities as a proportion of GDP or target stock of reserves of extra-budgetary contingency funds as a proportion of annual benefit payments.

matter for price level determination.

Marin (2002) examines fiscal sustainability by developing a rule resembling the SGP requirement of budgetary positions close to balance or in surplus, where the primary balance equals interest payments on the government debt. Using an overlapping generations model, he finds that in an environment of exogenous interest rates and price stability, this rule is sufficient to guarantee the sustainability of public finances while also allowing for the full operation of automatic stabilizers.

In this study, we will overlook the effects on the price level and focus on fiscal and external sustainability. We employ two types of fiscal rules, belonging to categories 1 and 3 in the Kopits and Symansky (1998) classification. The rules are derived from EU requirements and are similar to the rules employed e.g. in Leeper (1991), Woodford (2001) and Railavo (2004a, b). The first rule is a debt rule formulated as follows

$$\tau_t = \tau_{t-1} + \mu \left[\frac{D_t}{P_{t-1} Y_{t-1}} - \zeta \right], \tag{4.41}$$

where μ is the fiscal policy parameter that gives the weight the government places on meeting the target for the ratio of government debt to GDP ζ. The rule implies that if the debt-to-output ratio in the end of the previous period deviates from the target ratio, the government will alter the tax rate accordingly. In other words, if the debt-to-output ratio exceeds the target, the government will raise the tax rate. The rule can also be written using a long-term tax rate

$$\tau_t = \overline{\tau}_0 + \mu \left[\frac{D_t}{P_t Y_t} - \zeta \right], \tag{4.42}$$

where $\overline{\tau}_0$ is defined as $\frac{\upsilon + r\overline{\varsigma}}{1+\alpha}$. $\overline{\varsigma}$ is the long-term debt ratio, which can differ from the target debt ratio ζ.

The second rule is a deficit rule based on the Maastricht definition of the deficit and is written as follows

$$\begin{aligned} \tau_t &= \tau_{t-1} + \chi \left[\frac{def_{t-1}}{Y_{t-1}} - \xi \right] \\ &= \tau_{t-1} + \chi \left[\frac{G_{t-1} - \tau_{t-1} w_{t-1} L_{t-1}}{Y_{t-1}} + i_{t-1} \frac{D_{t-2}}{P_{t-1} Y_{t-1}} - \xi \right]. \end{aligned} \tag{4.43}$$

Here, χ is the fiscal policy parameter that gives the weight the fiscal authority places on balancing the government budget and ξ is the target for the deficit.

Also this rule can be written using the long-term tax rate

$$\tau_t = \overline{\tau}_0 + \chi \left[\frac{G_{t-1} - \tau_{t-1} w_{t-1} L_{t-1}}{Y_{t-1}} + i_{t-1} \frac{D_{t-2}}{P_{t-1} Y_{t-1}} - \xi \right]. \tag{4.44}$$

These two rules state that if the previous period deficit exceeds the target deficit, the government will raise taxes.

4.3 Calibration and Simulation

4.3.1 Parameters

To determine the steady state and its response to the different productivity shocks, numerical methods are employed. The parameter values were chosen in line with appropriate literature and, whenever possible, actual data were also consulted. The Baltic states were chosen as reference countries, as they have a long history with fixed exchange rate regimes and a reputation for fiscal discipline.

α and $1-\alpha$ represent capital's and labour's shares of the income generated. The value of $1-\alpha$ was set at 0.5, as the share of wages in output in the Baltic states is around 50% (IMF 2003a, b and c).[58] The value for the inverse of labour supply elasticity ω was set at 1.89 implying a Frisch labour supply elasticity of 0.53 in line with Siliverstovs and Koulikov (2003), who estimate this to be the labour elasticity with respect to wages in Estonia.[59] The value for the parameter κ was chosen so that the steady state labour supply is equal to approximately one-third (Cooley and Prescott 1995).

The private consumption to output ratio $\overline{c}$ in the Baltic states is 60% (IMF 2003a, b and c). However, as investment is zero in the model's steady state and most investment in the new Member States stems from the private sector, a higher ratio of 80% for private consumption to output was chosen. The level of real government consumption is set so that it amounts to 20% of GDP.[60]

[58] The share of wages in GDP in the CEECS is on average 40.5% compared with 59% in the 15 EU Member States (Galgóczi 2002).

[59] A survey by Domeij and Flodén (2001) points out that the estimates for labour supply for males in general range between 0 and 0.5 but these estimates can be too low, especially in the presence of borrowing constraints. Moreover, Killingsworth and Heckman (1986) note that most estimates suggest that female labour supply elasticity is large both in absolute terms and relative to male elasticities. Indeed, Saget (2000) finds that the elasticity of female labour supply in Hungary is 1.82.

[60] In IMF (2004a), a macroeconomic model for Estonia was constructed, in which the steady state levels of private consumption, public consumption and investment to GDP were calibrated. Based on 2003 data these were determined to be 56%, 19% and 26%,

ψ defines the minus elasticity of the discount factor, which determines the stationarity of the model and the speed of convergence to the steady state. In line with Scmitt-Grohé and Uribe (2003), this value is set at 0.01. Following equation (4.20), the remaining parameters in the discount factor are set so that the discount factor depends only on consumption, i.e. $\varphi = 0$ and $\lambda = 1$.[61]

The real interest rate for the monetary union, i.e. the euro area, is 0.04, the standard used in the literature. Cooley and Prescott (1995) set a quarterly value of ρ at 0.95, which implies an annual value of $\rho = 0.81$. Following Blanchard and Perotti (2002), σ is set at 0.95.[62] The chosen parameter values that remain fixed through the simulation exercise are summarized in Table 1.

TABLE 1 Parameter values*

α	ω	κ	ψ	λ	φ	ρ	σ	υ	r
0.5	1.89	9	0.01	1	0	0.81	0.95	0.2	0.04

* Values not altered in the course of the simulation

The fiscal policy parameters in the two rules take values 0.1, 0.5, 0.9 and 1.5 as in Railavo (2004b). The target deficit-output ratio was set at zero to mimic the close to balance requirement. Also other values would imply a debt ratio rising without limit. For the target debt-output ratio, values of 0%, 10%, 30%, 60% and 90% were examined.

4.3.2 Steady state model

The model converges to a steady state with both the debt and deficit rules. For the debt rule based on the difference of the tax rate (4.41), globally stable steady states can be found but the Blanchard-Kahn conditions are not met.[63] With the debt rule based on the long-term tax rate (4.42), it can be shown that a unique, stationary steady state exists, when the fiscal policy parameter μ is larger than $\mu \geq 0.103$. With $\mu \leq 0.102$, the model experiences the convergence problems. Numerically, the steady states for the two formulations of the debt rule are alike.

respectively. The share of private investment of total investment was according to IMF data for 2003 (IMF 2004b) over 90%, which would allow us to use the values of 80% for private consumption and 20% for public consumption.

[61] As noted before, giving other values to φ would not alter the results, as labour supply is determined by equation (4.10).

[62] It should be noted that the Blanchard and Perotti (2002) estimate is for the US, i.e. a large country.

[63] The Blanchard-Kahn (1980) conditions state that there exists a unique, stationary steady state, if and only if the number of eigenvalues outside the unit circle is equal to the number of forward-looking variables, which here is two.

A unique steady state can also be found for the deficit rule (4.43) based on the SGP close to balance requirement but the steady state is not globally stable.[64] Hence, the results must be analyzed with caution. Using the long-term tax rate based deficit rule (4.44) produces a steady state, which does not satisfy the Blanchard-Kahn conditions.[65]

Hence, it appears that the debt rule employing the long-term tax rate (4.42) produces the most reliable results. The steady states with the formulations of the debt and deficit rules that fulfil the Blanchard-Kahn conditions, namely rules (4.42) and (4.43), are compared in Table 2.[66]

TABLE 2 Steady state with debt and deficit rules

Debt/output*	**Tax rule**	**Output****	**Debt/output**	**Tax rate**
0%	Both	100%	0%	40%
10%	Debt	99.5%	10%	40.8%
	Deficit	99.5%	10.6%	40.8%
30%	Debt	98.6%	30%	42.4%
	Deficit	98.6%	29.9%	42.4%
60%	Debt	97.1%	60%	44.8%
	Deficit	97.1%	61%	45%
90%	Debt	95.7%	90%	47.2%
	Deficit	95.6%	91%	47.3%

* Target ratio with the debt rule and initial ratio with the deficit rule

** As a share of output with zero debt

The steady state with zero debt is the same for both rules and therefore functions as a benchmark. The deficit is zero in all the steady states and for all debt levels. The debt issued by the public sector is absorbed by the private sector, whose savings to output ratio corresponds to the debt to output ratio

[64] It appears that the steady state is particularly sensitive to the initial algorithm values of output, private consumption, tax rate, capital, labour supply and demand and the wage rate.

[65] Railavo (2004a) finds that a debt rule similar to (4.41) results in an unstable solution, with monetary policy consistent with the Taylor principle, whereas a deficit rule analogous to (4.43) has a range of stable solutions with a range of fiscal policy parameters.

[66] In the steady state, the debt rule (4.42) implies that

$$\frac{\overline{D}}{\overline{PY}} = \zeta,$$

while the deficit rule (4.43) entails

$$\overline{\tau} = (1-\alpha)^{-1}\left(\upsilon + r\frac{\overline{D}}{\overline{Y}}\right).$$

of the public sector in the steady state. With the debt rule, the debt to output ratio corresponds to the targeted debt ratio in all steady states, while with the deficit rule the debt to output ratios hover close to the debt ratios with the debt rule. Higher debt tends to result in lower output and a higher tax rate, e.g. with 10%, 30%, 60% and 90% debt output ratios the tax rate is respectively 2%, 6%, 12% and 18% higher than the tax rate in case of zero debt.

When employing the debt rule based on the long-term tax rate (4.42), we can also assume that the long-term debt ratio differs from the target debt ratio - e.g. a country with a high debt ratio could, and should, aim for debt reduction. Also this formulation of the debt rule produces a unique, stationary steady state. It can be shown that targeting debt reduction results in undershooting the debt target and a lower tax rate, which are higher, the larger the weight being given to achieving the fiscal target.

Finally, the sensitivity of the steady states to changes in key parameter values was examined for both rules. With the debt rule, it was found that the steady state is quite sensitive to changes in the value of α. For example, a 10% increase in α results in a 69% rise in output, consumption and debt, in case of a non-zero debt target ratio. The tax rate increases by 11%. The steady state also reacts to changes in κ, r, ω and υ, where output, consumption and debt fall slightly when κ, r or υ is increased by 10% and increase when ω is raised by the same amount. The deficit rule appears more sensitive to changes in parameter values. A 10% change in α or κ causes convergence problems, while a 5% increase in α brings about a debt-output-ratio of over 350% with no change in the level of output and a 1% increase in ω results in a debt-output-ratio of 16%, again with unchanged output.[67] The tax rates rise accordingly in both cases. In general, it can be said that with the deficit rule, changing the parameter value changes the debt level, not output. For example, raising the values of κ, r and υ by 10%, causes positive government assets of 71%, 215% and 31%, respectively, to appear. To conclude, the debt rule again appears more robust, at least with regard to the most central variables.

4.3.3 Permanent shock

The permanent shock examined here represents output level convergence via a shock to the productivity level. The permanent shock is implemented by

[67] It should be noted that in the case of a 5% increase in α, the Blanchard-Kahn conditions are not met.

setting the end value for the level of productivity 5%, 10%, 30% or 50% higher than the original level. This implies convergence from a level of productivity that is 95%, 91%, 77% or 67% of the end level, which in this case could be considered to be the EU level. As the steady state with the deficit rule (4.43) is not globally stable, the examination of a permanent shock can not be considered to provide reliable results. Hence, this part of the analysis was performed only for the debt rule.

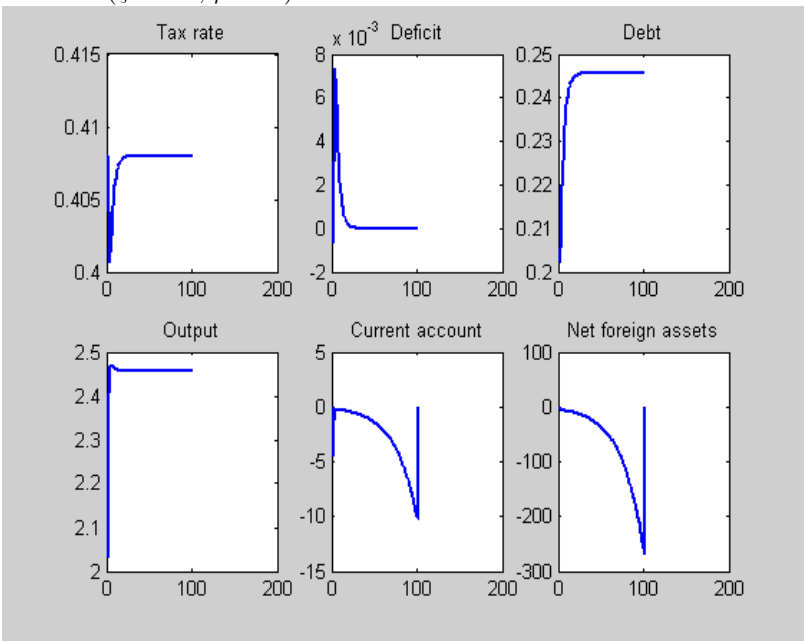
With the debt rule, a permanent productivity shock of 5% leads to a permanent output increase of 10%, while a 10% shock produces 21%, a 30% shock 69% and a 50% shock induces 125% more output. Private and public consumption, wages, capital and firm profits all rise with the same percentages, as do the levels of debt and savings when the debt to output target is other than zero. The tax rate and the labour supply remain unchanged.

The following graph shows the convergence to the new steady state for the tax rate, deficit, debt, output, current account and net foreign assets in the case of a 5% shock, when the debt target is 10% and the weight given to achieving the debt target $\mu = 0.5$.[68]

As there is perfect foresigh, the future rise in productivity has an immediate effect on the behaviour of consumers and firms. Output immediately jumps to the new steady state level due to the spike in investment needed to raise capital to the new steady state level and higher labour supply induced by the increased wage. Both private and public consumption rise. With higher output the debt to output ratio falls below the target ratio, which causes the tax rate to fall. This fall is larger with higher values of μ. Higher public expenditure together with the lower tax revenues cause a deficit - although not a very large one - to appear. This leads to an accumulation of debt. The increase in the debt to output ratio leads to a rise in the tax rate, which in turn diminishes the deficit. This continues until the new steady state levels are reached. Despite higher wage income, the households' increased consumption and the decreased firm dividends cause the households to accumulate debt. This in turn, together with increased government borrowing, leads to an accumulation of negative net foreign assets. These are corrected when productivity rises in the end of the period.

[68] Periods are set to 100 for practical purposes. The adjustment of most variables is rapid. The accumulation of private borrowing and negative net foreign assets would be considerably less with a shorter timeframe. The point of interest here is the direction of the change and the convergence to the steady state.

FIGURE 1 Permanent 5% shock to productivity:
Debt rule (ζ=10%; μ=0.5)



4.3.4 Transitory shock

Two types of transitory shocks are examined. First, a stochastic one period shock to productivity and second, a stochastic one period shock to government expenditure. The effects of a transitory productivity shock are examined to enable a comparison to be made between the two tax rules and to determine, if the transitory productivity shock has any long-term effects on debt and the external balance. A transitory shock to government expenditure is studied, as the occurrence of such shocks seems quite natural in connection with the entry of the new Member States into the EU. The two shocks are independent of each other.

The results for transitory shocks are reliable only when a unique, stationary steady state exists. As shown before, this is the case for the debt rule (4.42) and the deficit rule (4.43), where it should, however, be noted that the steady state is not globally stable. Figures 2 and 3 show the responses of the tax rate, deficit, debt level, output, the current account and net foreign assets to a 1% stochastic shock to productivity with the debt and deficit rules, respectively.[69]

[69] Changing the debt level or the value of μ has no an effect on the direction of the change.

FIGURE 2 Transitory shock to productivity:
Debt rule (ζ=60%; μ=0.5)

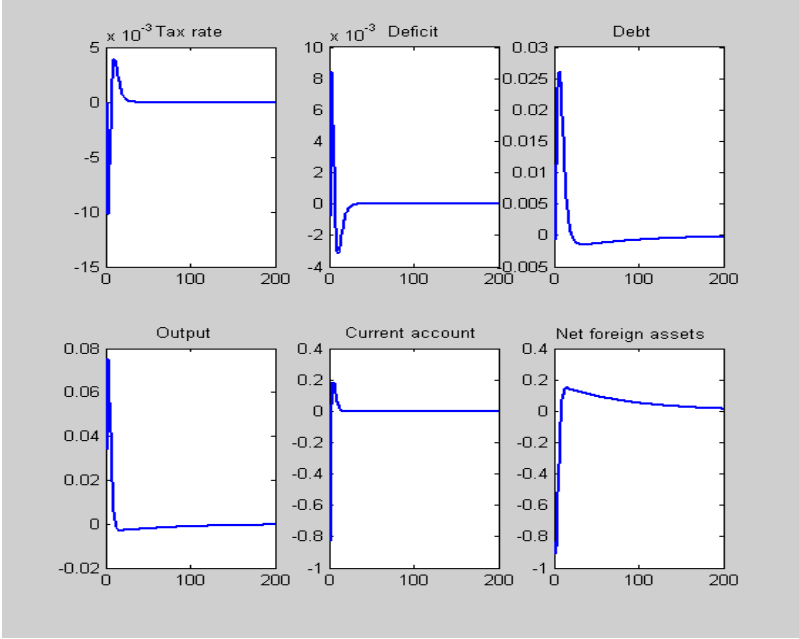
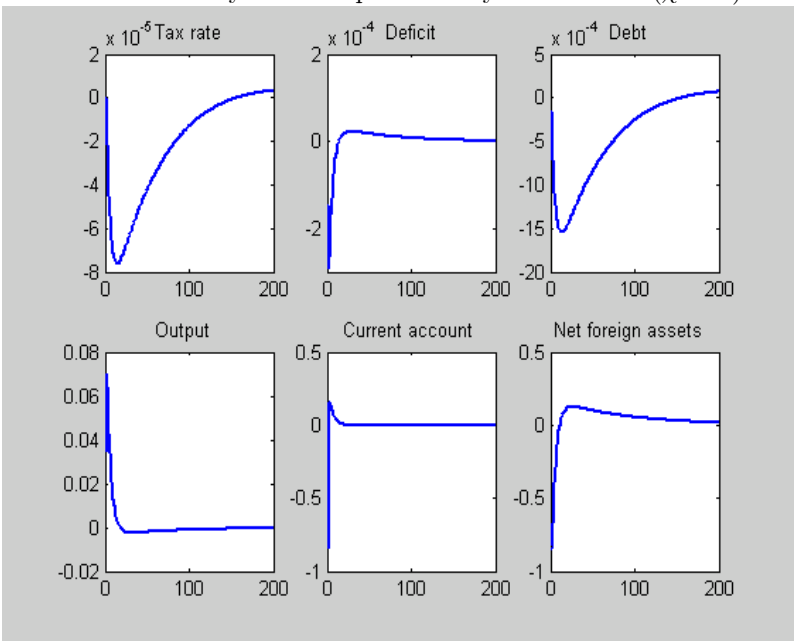


FIGURE 3 Transitory shock to productivity: Deficit rule (χ=0.1):



The Figures on the previous page show the deviations from the steady state and the adjustment back to the steady state. It should be noted that the changes are very small. The Figures confirm the linearization of the relevant equations presented in the Appendix. Essentially, it should be noted that the responses to a transitory shock are visible for quite a long time, e.g. on the debt level.

The productivity shock causes a spike in investment as well as an increase in consumption, which lead to negative savings, i.e. private sector borrowing, a current account deficit and in turn to negative net foreign assets.[70] Output jumps due to increased investment and labour supply. As the investment spike smooths out and consumption begins to return to the steady state level, private sector borrowing decreases.

The period t reactions of debt, deficit and the tax rate are identical for the two rules, except for the magnitude of the change of the debt and deficit levels, which is influenced by the steady state debt ratio, which here is higher for the debt rule. Higher output causes the debt level to fall slightly and a public finances surplus to be created, while there is no effect on the tax rate. In the next period, differences between the two rules emerge. With the debt rule, the tax rate is lowered due to the debt-to-output ratio falling below target as a result of lower debt and a higher output. As the decrease in the tax rate is rather large, deficit and debt begin to rise. As the debt ratio rises due to the positive deficit and the output spike smoothing out, the tax rate will be raised. Rising tax revenue will create a surplus in public finances, which brings about a fall in the debt ratio, which causes the tax rate to go down and enables a return to the steady state.

With the deficit rule, the tax rate is also lowered in the next period but not as much as with the debt rule. The debt level falls further. The tax rate will fall as long as there is a public finances surplus. Once that has been eliminated through lower taxes, the tax rate will be raised gradually and the economy will return to the steady state.

To conclude, with both rules a one period shock has rather long-term consequences, although it should be noted that the scale of changes is rather small. The adjustment appears somewhat faster with the debt rule. Productivity growth leads to a fall of the tax rate with both rules.

[70] The figure for net foreign assets corresponds exactly to that of private savings.

FIGURE 4 Transitory shock to government expenditure:
Debt rule (ζ=30%; μ=0.9)

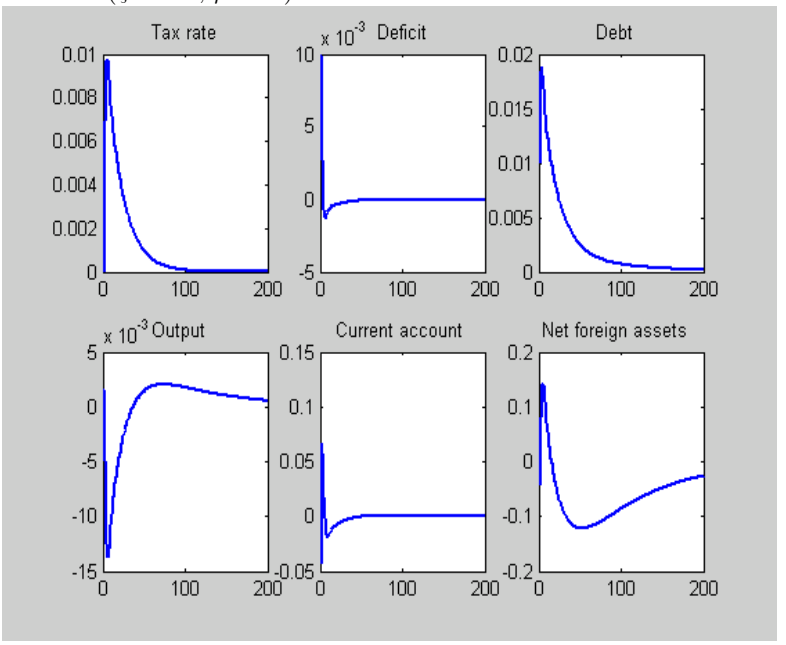
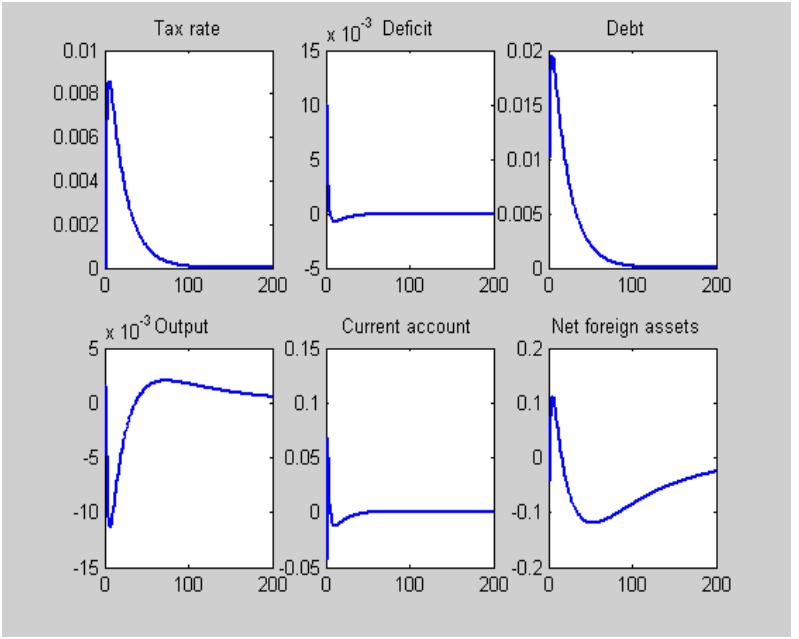


FIGURE 5 Transitory shock to government expenditure:
Deficit rule (χ=0.9)



However, the fall of the tax rate is much stronger with the debt rule, as is also shown by the linearizations in the Appendix and thus, it rapidly leads to a public finances deficit and increasing debt which, in turn, lead to an increase of the tax rate and a return to the steady state.

The other shock analyzed is a one period stochastic shock to government expenditure. Figures 4 and 5 present the responses of the tax rate, deficit, debt level, output, the current account and the net foreign assets when the debt and deficit rules are employed.

The effects of the rise in public expenditure on the deficit and debt are the same, regardless of the rule employed. Deficit and debt rise due to the rise in government consumption while output falls which leads to an increase in the next period tax rate for both rules. The fall in private consumption offsets the rise in public consumption and the fall in output, and enables the creation of a current account surplus. Due to lower private consumption, private saving increases bringing about a rise in net foreign assets.

After the spike in the deficit and debt and the subsequent rise the tax rate, deficit and debt begin to decrease. The higher tax rate reduces private savings and net foreign assets start the return towards the steady state.

4.4 Conclusions

The new EU Member States still have a way to go before they converge toward the current euro area in terms of output, productivity and price levels. Yet, the first wave of new Member States could adopt the euro as soon as 2007. On the one hand, many perceive the requirements for euro adoption as hindering the convergence process and preventing entry into the euro area, as e.g. higher inflation as well as current account and budget deficits can be considered an inevitable part of the convergence process. On the other hand, one could ask whether aiming to meet the criteria - e.g. by adopting fiscal rules, which should also support price and exchange rate stability - would help the new Member States to attain a better position with regard to external and fiscal sustainability and thus support convergence.

Kopits (2001) draws three lessons from the usefulness of fiscal policy rules. First, governments with a strong reputation for fiscal prudence do not need to be constrained by rules. Second, in countries where such reputation is lacking, fiscal rules can provide a useful policy framework and contribute over time to stability and growth. Third, to enhance their usefulness, fiscal rules need to be

well designed at the national and sub-national levels of government, combining simplicity, flexibility and growth-oriented criteria. (Kopits 2001, 19). Indeed, the Ecofin Council has recently reaffirmed that a rules-based system is the best guarantee for the enforcement of commitments and for all Member States to be treated equally (Council of the European Union 2005).

The European rules - at least until now - have placed much greater emphasis on the deficit, even though the Treaty stipulates that compliance with budgetary discipline has to be examined on the basis of both the deficit and the debt criterion. Nevertheless, several Member States were allowed to adopt the euro, when their debt levels exceeded the 60% reference value but were "sufficiently diminishing and approaching the reference value at a satisfactory pace". Moreover, there have been no sanctions for exceeding the reference value for debt or failing to lower the debt ratio, whereas excessive deficit procedures have been started for a number of old and new Member States based on a deficit in excess of the 3% reference value.[71] Nonetheless, the reform of the Stability and Growth Pact aims to put more emphasis on debt and sustainability, i.e. as noted in the report of the Ecofin Council (2005) on the reform of the Pact: "The long-term sustainability of public finances would be supported by the convergence of debt ratios towards prudent levels."

In this study, the aim is to examine the effects of EU fiscal policy rules on the fiscal variables and external balance in the new Member States that can be considered as small open economies with fixed exchange rate regimes and thus exogenously determined interest rates. The model is a fairly standard one-good small open economy model with capital, an endogenous labour supply and distortionary taxation.

Whereas the debt rule ensures a stable debt-to-output ratio and a zero deficit at all times, the deficit rule only guarantees the latter. Neither rule is able to control the development of net foreign assets. When the economy is hit by a transitory increase in output due to a productivity shock, reactions with the two rules differ. A government employing a debt rule will lower taxes much more than a government using a deficit rule where taxes are lowered more gradually. This implies that the government employing a debt rule is also forced to raise the tax rate much faster due to increases in the debt level. Adjustment with the deficit rule is much more gradual. The responses to a government expenditure shock are the same for both rules, i.e. both indicate an increase in debt, deficit and the tax rate.

[71] The Treaty sets out a procedure - the so called Excessive Deficit Procedure (EDP) - to be followed at Community level to identify and counter excessive deficits, including the possibility of financial sanctions.

With regard to external sustainability, the debt rule cannot constrain the accumulation of negative net foreign assets in case of a permanent shock to productivity, while the properties of the deficit rule did not allow us to conduct an examination of a permanent shock. It would appear that external imbalances and the accumulation of net foreign assets might be an unavoidable consequence of the convergence process. As fiscal rules prove not to be a panacea in this respect, it appears that attention needs to be paid also to growth of private sector indebtedness.[72] Finally, external imbalances might have to be accepted as a fairly permanent phenomenon in these countries, as long as they are catching up to the old Member States. Regardless, their development needs to be carefully monitored. To sum up, the choice of the appropriate fiscal policy rule depends on the policymakers' preferences as well as on the nature of the most prevalent shock.

The reform of the Pact is an improvement from the point of view of the deficit rule, as now the medium-term objective - earlier close to balance - for each Member State is tailored to the economic and debt situation of each country, so that high debt countries for instance should strive towards a more stringent objective.[73] An impediment to the usefulness of deficit rules is discovered by Von Hagen and Wolff (2004), who note that the SGP rules, which also they consider as focusing more on deficit than debt, have induced governments to use creative accounting to hide deficits. They calculate stock-flow adjustments - calculated as the first difference of debt levels minus the deficits - where positive stock-flow adjustment implies that the debt level has increased more than it should have given the deficit. Their calculations show a systematic re-

[72] Indeed, on the statement on Estonia's entry into ERM II (2004), it was noted that "to reduce the external imbalance and contain it at a sustainable level, the Estonian authorities will take the necessary measures to contain domestic credit growth and ensure effective financial supervision". In a similar manner, the statement on Latvia's entry into ERM II (2005) stated that "to help reduce the external imbalance and contain it at a sustainable level, the authorities will take measures to restrain domestic demand and they will remain vigilant concerning risks of excessive domestic credit growth. Continued effective financial supervision will assist the authorities in promoting prudent credit policies and in limiting credit risk in the banking system."

[73] The Ecofin Council (2005) report stipulates that "In light of the increased economic and budgetary heterogeneity in the EU of 25 Member States, the Council agrees that the medium-term objective should be differentiated for individual Member States to take into account the diversity of economic and budgetary positions and developments as well as of fiscal risk to the sustainability of public finances, also in the face of prospective demographic changes. Medium-term objectives should be differentiated and may diverge from "close to balance or in surplus" for individual Member States on the basis of their current debt ratio and potential growth, while preserving sufficient margin below the reference value of -3% of GDP. The range for the country-specific medium-term objectives for euro area and ERM II Member States would thus be, in cyclically adjusted terms, net of one-off and temporary measures, between -1% of GDP for low debt/high potential growth countries and balance or surplus for high debt/low potential growth countries."

lationship between stock-flow adjustments and deficits after the introduction of the EU fiscal framework.[74]

The reform of the SGP also implies an increased focus on debt which, if implemented in practice, if implemented in practice, can be considered a welcome change. The report of the Ecofin Council (2005) on the reform notes the following of the increased focus on debt:

> "The Council agrees that there should be increased focus on debt and sustainability, and reaffirms the need to reduce government debt to below 60% of GDP at a satisfactory pace, taking into account macroeconomic conditions. The higher the debt to GDP ratios of Member States, the greater must be their efforts to reduce them rapidly. The Council considers that the debt surveillance framework should be strengthened by applying the concept of "sufficiently diminishing and approaching the reference value at a satisfactory pace" for the debt ratio in qualitative terms, by taking into account macroeconomic conditions and debt dynamics, including the pursuit of appropriate levels of primary surpluses as well as other measures to reduce gross debt and debt management strategies. For countries above the reference value, the Council will formulate recommendations on the debt dynamics in its opinions on the Stability and Convergence Programmes."

A further improvement to the EU framework would be an increased attention to debt levels, especially the growth of debt levels. As can be seen from the results here, a debt-output target keeps the debt ratio stable even when output growth is very fast. Thus, also debt levels rise rapidly. Indeed, debt growth is a factor that should be taken into consideration in the analysis of Member States' public finances, especially those of countries experiencing significant output growth.

This study indicates several topics for future research. Moreover, different formulations of investment and taxes for example could provide important insights. The study would also benefit from a more detailed calibration to meet the country-specific characteristics of the new Member States. Further research is also needed on the causes of current account deficits.

[74] Dafflon and Rossi (1999) provide an overview of the one-off measures and other accounting tricks that EU Member States used to qualify for euro adoption.

References

Ballabriga, F., Martinez-Mongay, C., 2002. Has EMU shifted policy?. Economic Papers No. 166, European Commission, Directorate-general for Economic and Financial Affairs.

Blanchard, O.J., Kahn, C.M., 1980. The Solution of Linear Difference Models under Rational Expectations. Econometrica, 48:5, 1305-1312.

Blanchard, O., Perotti, R., 2002. An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. Quarterly Journal of Economics, 117:4, 1329-1368.

Brunila, A., Buti, M., Franco, D., 2001. Introduction in Brunila, A., Buti, M., Franco, D. (eds.), The Stability and Growth Pact The Architecture of Fiscal Policy in EMU, Palgrave, New York.

Canzoneri, M.B., Diba, B.T., 1996. Fiscal Constraints on Central Bank Independence and Price Stability. CEPR Discussion Paper No. 1463.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 1998a. Fiscal Discipline and Exchange Rate Regimes. CEPR Discussion Paper No. 1899.

Canzoneri, M.B., Cumby, R.E., Diba, B.T., 1998b. Is the Price Level Determined by the Needs of Fiscal Solvency?. NBER Working Paper No. 6471.

Central Intelligence Agency (CIA), 2005. The World Factbook. http://www.cia.gov/cia/publications/factbook.

Cooley, T.F., Prescott, E.C., 1995. Economic Growth and Business Cycles. In Cooley, T.F. (eds.). Frontiers of Business Cycle Research. Princeton University Press, Princeton, New Jersey. 1-38.

Council of the European Union, 2005. European Council Brussels 22 and 23 March 2005 Presidency Conclusions. http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/84335.pdf

Dafflon, B., Rossi, S., 1999. Public accounting fudges towards EMU: A first empirical survey and some public choice considerations. Public Choice, 101: 1-2, 59-84.

Domeij, D., Flodén, M., 2001. The labour-supply elasticity and borrowing constraints: Why estimates are biased. Stockholm School of Economics Economics and Finance Working Paper No. 480.

European Union, 2004. ERM II Exchange Rate Procedure, press release 27.6.2004. http://www.eu2004.ie/templates/news.asp?sNavlocator=66&list_id=894

European Union, 2005a. Latvian lats included in the Exchange Rate Mechanism II (ERM II), press release 29.4.2005. http://www.ecb.int/press/pr/date/2005/html/index.en.html

European Union, 2005b. Slovak koruna included in the Exchange Rate Mechanism II (ERM II), press release 25.11.2005. http://www.ecb.int/press/pr/date/2005/html/index.en.html

Galgóczi, B., 2002. Wage trends in Central and Eastern Europe. Labour Education, 2002/3:128. 39-44.

Governments of the Benelux countries, 2005. Statement by the Governments of the Benelux countries on the Stability and Growth Pact, 22.3.2005. http://www.eu2005.lu/en/actualites/documents_travail/2005/03/22benelux/

Hallerberg, M., Strauch, R., von Hagen, J., 2004. The Design of Fiscal Rules and Forms of Governance in European Union Countries. European Central Bank Working Paper No. 419.

IMF, 2003a. Republic of Estonia: Selected issues and Statistical Appendix. Country Report No. 03/331.

IMF, 2003b. Republic of Latvia: Statistical Appendix. Country Report No. 03/112.

IMF, 2003c. Republic of Lithuania: Statistical Appendix. Country Report No. 03/294.

IMF, 2004a. Republic of Estonia: Selected Issues. Country Report No. 04/357.

IMF, 2004b. Republic of Estonia: 2004 Article IV Consultation - Staff Report; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for the Republic of Estonia. Country Report No. 04/358.

Killingsworth, M.R., Heckman, J.J., 1986. Female labour Supply: A Survey. In Ashenfelter, O.C., Layard, R. (eds.) Handbook of labour Economics Vol. 1. 103-204.

Kopits, G., 2001. Fiscal Rules: Useful Policy Framework or Unnecessary Ornament?. IMF Working Paper, WP/01/145.

Kopits, G., Symansky, S., 1998. Fiscal Policy Rules. IMF Occasional Paper No. 162.

Leeper, E., 1991. Equilibria under 'active' and 'passive' monetary and fiscal policies. Journal of Monetary Economics, 27:1, 129-147.

Marin, J., 2002. Sustainability of Public Finances and Automatic Stabilisation under a Rule of Budgetary Discipline. European Central Bank Working Paper No. 193.

Ministry of Finance of the Republic of Latvia, 2004. Convergence Programme of the Republic of Latvia 2004-2007. http://europa.eu.int/comm/economy_finance/about/activities/sgp/country/countryfiles/lv/lv20042005_en.pdf

Obstfeld, M., 1990. Intertemporal dependence, impatience, and dynamics. Journal of Monetary Economics, 26:1, 45-75.

Obstfeld, M., Rogoff, K., 1998. Foundations of International Macroeconomics. The MIT Press, Cambridge, Massachusetts.

Obstfeld, M., Rogoff, K., 2000. New directions for stochastic open economy models. Journal of International Economics, 50:1, 117-153.

Railavo, J., 2004a. Stability consequences of fiscal policy rules. Bank of Finland Discussion Papers No. 1.

Railavo, J., 2004b. Monetary consequences of alternative fiscal policy rules. Bank of Finland Discussion Papers No. 20.

Saget, C. 2000. The determinants of female labour supply in Hungary. Economics of Transition, 7:3, 575-591.

Schmitt-Grohé, S., Uribe, M., 2000. Price level determinacy and monetary policy under a balanced-budget requirement. Journal of Monetary Economics, 45:1, 211-246.

Schmitt-Grohé, S., Uribe, M., 2003. Closing small open economy models. Journal of International Economics, 61:1, 163-185.

Siliverstovs, B., Koulikov, D., 2003. labour Supply of Married Females in Estonia. DIW Discussion Paper No. 321.

Sims, C.A., 1994. A simple model for the study of the determination of the price level and the interaction of monetary and fiscal policy. Economic Theory, 4:3, 381-399.

Von Hagen, J., Wolff, G., 2004. What Do Deficits Tell us About Debts? Empirical Evidence on Creative Accounting with Fiscal Rules in the EU. CEPR Discussion Paper No. 4759.

Woodford, M., 1994. Monetary policy and price level determinacy in a cash-in-advance economy. Economic Theory, 4:3, 345-380.

Woodford, M., 1995. Price-level determinacy without control of a monetary aggregate. Carnegie-Rochester Conference Series on Public Policy, 43, 1-46.

Woodford, M., 1996. Control of the Public Debt: A Requirement for Price Stability. NBER Working Paper No. 5684.

Woodford, M., 2001. Fiscal Requirements for Price Stability. NBER Working Paper No. 8072.

Woodford, M., 2003. Interest and Prices: Foundations of a Theory of Monetary Policy. Princeton University Press, Princeton, New Jersey.

Appendix

As linearization of the whole system appears too complicated, we restrict our attention to the linearization of a few key equation. The linearization of the government budget constraint around a steady state produces

$$\widetilde{D}_t = (1+r)\,\widetilde{D}_{t-1} + [\upsilon - (1-\alpha)\,\overline{\tau}]\,\widetilde{Y}_t - (1-\alpha)\,\overline{Y}\widetilde{\tau}_t \tag{4.45}$$

and the linearization of the deficit gives

$$\widetilde{def}_t = r\widetilde{D}_{t-1} + [\upsilon - (1-\alpha)\,\overline{\tau}]\,\widetilde{Y}_t - (1-\alpha)\,\overline{Y}\widetilde{\tau}_t. \tag{4.46}$$

The linearized debt rule (4.42) can be written as follows:

$$\widetilde{\tau}_t = \mu\left(\frac{\widetilde{D}_{t-1}}{\overline{Y}} - \frac{\overline{D}}{\overline{Y}}\frac{\widetilde{Y}_{t-1}}{\overline{Y}}\right), \tag{4.47}$$

while deficit rule (4.43) takes the following form, when linearized:

$$\widetilde{\tau}_t = \widetilde{\tau}_{t-1} + \chi\left(\frac{\widetilde{def}_{t-1}}{\overline{Y}} - \frac{\overline{def}}{\overline{Y}}\frac{\widetilde{Y}_{t-1}}{\overline{Y}}\right).$$

Following a productivity shock, output increases.[75] This implies the following for the tax rate and deficit and debt levels in period t, regardless of the tax rule used, assuming that the economy starts in a steady state in period $t-1$

$$\widetilde{\tau}_t = 0 \tag{4.48}$$

$$\widetilde{D}_t = \widetilde{def} = [\upsilon - (1-\alpha)\,\overline{\tau}]\,\widetilde{Y}_t = -r\frac{\overline{D}}{\overline{Y}}\widetilde{Y}_t, \tag{4.49}$$

which show that the effect of the positive output shock on the tax rate is zero in period t, while the debt level initially falls slightly. Then in the following period the tax rate will fall when the debt rule is employed, assuming a positive

[75] The linearized output equation can be written as follows

$$\frac{\widetilde{Y}_t}{\overline{Y}} = \frac{(1+\omega)}{(\alpha+\omega)}\frac{\widetilde{A}_t}{\overline{A}} - \frac{(1-\alpha)}{(\alpha+\omega)}\left(\frac{\widetilde{C}_t}{\overline{C}} + \frac{\widetilde{\tau}_t}{(1-\overline{\tau})}\right),$$

The reaction of output to a positive productivity shock appears positive in period t, which is supported by the numerical simulations.

steady state debt level:

$$\widetilde{\tau}_{t+1} = \mu \frac{\overline{D}}{\overline{\overline{Y}}} \left(\frac{\widetilde{D}_t}{\overline{\overline{D}}} - \frac{\widetilde{\overline{Y}}_t}{\overline{\overline{Y}}} \right) = -\mu \left(1 + r\right) \frac{\overline{D}}{\overline{\overline{Y}}} \frac{\widetilde{\overline{Y}}_t}{\overline{\overline{Y}}}, \tag{4.50}$$

while the debt level appears to rise

$$\widetilde{D}_{t+1} = \frac{\overline{D}}{\overline{\overline{Y}}} \left\{ \left(1 + r\right) \left[\left(1 - \alpha\right) \mu - r \right] \widetilde{\overline{Y}}_t - r \widetilde{\overline{Y}}_{t+1} \right\}. \tag{4.51}$$

Employing the deficit rule(4.43) has the following outcome for the tax rate and the deficit and debt levels in period $t + 1$

$$\widetilde{\tau}_{t+1} = -\chi r \frac{\overline{D}}{\overline{\overline{Y}}} \frac{\widetilde{\overline{Y}}_t}{\overline{\overline{Y}}}. \tag{4.52}$$

$$\widetilde{D}_{t+1} = r \frac{\overline{D}}{\overline{\overline{Y}}} \left\{ \left[\left(1 - \alpha\right) \chi - \left(1 + r\right) \right] \widetilde{\overline{Y}}_t - \widetilde{\overline{Y}}_{t+1} \right\}. \tag{4.53}$$

As the effect on period t deficit is negative, the tax rate falls in period $t + 1$, assuming a positive debt ratio.

The case with a government expenditure shock is more complicated, so we only present the responses in period t. Assuming that the economy starts in a steady state in period $t - 1$, the responses with the debt and deficit rules in period t are as follows

$$\widetilde{\tau}_t = 0 \tag{4.54}$$

$$\widetilde{D}_t = \widetilde{def} = \widetilde{G}_t - \left(1 - \alpha\right) \overline{\tau} \widetilde{\overline{Y}}_t \tag{4.55}$$

HELSINGIN KAUPPAKORKEAKOULUN JULKAISUJA
Publications of the Helsinki School of Economics

A-SARJA: VÄITÖSKIRJOJA - DOCTORAL DISSERTATIONS. ISSN 1237-556X.

A:229. PETER GABRIELSSON: Globalising Internationals: Product Strategies of ICT Companies. 2004. ISBN 951-791-825-9, ISBN 951-791-826-7 (Electronic dissertation).

A:230. SATU NURMI: Essays on Plant Size, Employment Dynamics and Survival. 2004. ISBN 951-791-829-1, ISBN 951-791-830-5 (Electronic dissertation).

A:231. MARJA-LIISA KURONEN: Vakuutusehtotekstin uudistamisprosessi, matkalla alamaisesta asiakkaaksi. 2004. ISBN 951-791-833-X, ISBN 951-791-834-8 (Electronic dissertation).

A:232. MIKA KUISMA: Erilaistuminen vai samanlaistuminen? Vertaileva tutkimus paperiteollisuusyhtiöiden ympäristöjohtamisesta. 2004. ISBN 951-791-835-6, ISBN 951-791-836-4 (Electronic dissertation).

A:233. ANTON HELANDER: Customer Care in System Business. 2004. ISBN 951-791-838-0.

A:234. MATTI KOIVU: A Stochastic Optimization Approach to Financial Decision Making. 2004. ISBN 951-791-841-0, ISBN 951-791-842-9 (Electronic dissertation).

A:235. RISTO VAITTINEN: Trade Policies and Integration – Evaluations with CGE -models. 2004. ISBN 951-791-843-7, ISBN 951-791-844-5 (Electronic dissertation).

A:236. ANU VALTONEN: Rethinking Free Time: A Study on Boundaries, Disorders, and Symbolic Goods. 2004. ISBN 951-791-848-8, ISBN 951-791-849-6 (Electronic dissertation).

A:237. PEKKA LAURI: Human Capital, Dynamic Inefficiency and Economic Growth. 2004. ISBN 951-791-854-2, ISBN 951-791-855-0 (Electronic dissertation).

A:238. SAMI JÄRVINEN: Essays on Pricing Commodity Derivatives. 2004. ISBN 951-791-861-5, ISBN 951-791-862-3 (Electronic dissertation).

A:239. PETRI I. SALONEN: Evaluation of a Product Platform Strategy for Analytical Application Software. 2004. ISBN 951-791-867-4, ISBN 951-791-868-2 (Electronic dissertation).

A:240 JUHA VIRRANKOSKI: Essays in Search Activity. 2004. ISBN 951-791-870-4, ISBN 951-791-871-2 (Electronic dissertation).

A:241. RAUNI SEPPOLA: Social Capital in International Business Networks. Confirming a Unique Type of Governance Structure. 2004. ISBN 951-791-876-3, ISBN 951-791-877-1 (Electronic dissertation).

A:242. TEEMU SANTONEN: Four Essays Studying the Effects of Customization and Market Environment on the Business Success of Online Newspapers in Finland. 2004. ISBN 951-791-878-X, ISBN 951-791-879-8 (Electronic dissertation)

A:243. SENJA SVAHN: Managing in Different Types of Business Nets: Capability Perspective. 2004. ISBN 951-791-887-9.

A:244. JUKKA MÄKINEN: John Rawlsin oikeudenmukaisuuskäsityksen merkitys normatiiviselle taloustieteelle. 2004. ISBN 951-791-889-5, ISBN 951-791-890-9 (Electronic dissertation).

A:245. ERJA KETTUNEN: Regionalism and the Geography of Trade Policies in EU-ASEAN Trade. 2004. ISBN 951-791-891-7, ISBN 951-791-892-5 (Electronic dissertation).

A:246. OLLI-PEKKA RUUSKANEN: An Econometric Analysis of Time Use in Finnish Households. 2004. ISBN 951-791-893-3, ISBN 951-791-894-1 (Electronic dissertation).

A:247. HILPPA SORJONEN: Taideorganisaation markkinaorientaatio. Markkinaorientaation edellytykset ja ilmeneminen esitystaideorganisaation ohjelmistosuunnittelussa. 2004. ISBN 951-791-898-4, ISBN 951-791-899-2 (Electronic dissertation).

A:248. PEKKA KILLSTRÖM: Strategic Groups and Performance of the Firm - Towards a New Competitive Environment in the Finnish Telecommunications Industry. 2005. ISBN 951-791-904-2, ISBN 951-791-905-0 (Electronic dissertation).

A:249. JUHANI YLIKERÄLÄ: Yrityshautomokokemuksen vaikutukset tradenomiopiskelijan yrittäjäuran syntyyn ja kehittymiseen. Yrityshautomotoiminta liiketalouden alan ammattikorkeakoulun yrittäjäkoulutuksessa. 2005. ISBN 951-791-910-7.

A:250 . TUURE TUUNANEN: Requirements Elicitation for Wide Audience End-Users. 2005. ISBN 951-791-911-5, ISBN 951-791-912-3 (Electronic dissertation).

A:251. SAMULI SKURNIK: Suomalaisen talousmallin murros. Suljetusta sääntelytaloudesta kaksinapaiseen globaalitalouteen. 2005. ISBN 951-791-915-8, ISBN 951-791-916-6 (Electronic dissertation).

A:252. ATSO ANDERSÉN: Essays on Stock Exchange Competition and Pricing. 2005. ISBN 951-791-917-4, ISBN 951-791-918-2 (Electronic dissertation).

A:253. PÄIVI J. TOSSAVAINEN: Transformation of Organizational Structures in a Multinational Enterprise. The case of an enterprise resource planning system utilization. 2005. ISBN 951-791-940-9, ISBN 951-791-941-7 (Electronic dissertation).

A:254. JOUNI LAINE: Redesign of Transfer Capabilities. Studies in Container Shipping Services. 2005. ISBN 951-791-947-6, ISBN 951-791-948-4 (Electronic dissertation).

A:255. GILAD SPERLING: Product, Operation and Market Strategies of Technology-Intensive Born Globals. The case of Israeli Telecommunication Born Globals. 2005. ISBN 951-791-954-9, ISBN 951-791-954-9 (Electronic dissertation).

A:256. ARLA JUNTUNEN: The Emergence of a New Business Through Collaborative Networks – A Longitudinal Study In The ICT Sector. 2005. ISBN 951-791-957-3.

A:257. MIRJAMI LEHIKOINEN: Kuluttajan suhdemotivaatio päivittäistavaroihin. Miksi äiti liittyy Piltti-piiriin? 2005. ISBN 951-791-925-5, ISBN 951-791-926-3 (Electronic dissertation).

A:258. JOUKO KINNUNEN: Migration, Imperfect Competition and Structural Adjustment. Essays on the Economy of the Åland Islands. 2005. ISBN 951-791-931-X, ISBN 951-791-932-8 (Electronic dissertation).

A:259. KIRSTI KUISMA: Essays in Foreign Aid, Conflicts, and Development. 2005. ISBN 951-791-933-6, ISBN 951-791-960-3 (Electronic dissertation).

A:260. SAMI KORTELAINEN: Innovating at the Interface. A Comparative Case Study of Innovation Process Dynamics and Outcomes in the Public-private Context. 2005 ISBN 951-791-938-7, ISBN 951-791-939-5 (e-version).

A:261. TAINA VUORELA: Approaches to a Business Negotiation Case Study: Teamwork, Humour and Teaching. 2005. ISBN 951-791-962-X, ISBN 951-791-963-8 (e-version).

A:262. HARRI TOIVONEN: Modeling, Valuation and Risk Management of Commodity Derivatives. 2005. ISBN 951-791-964-6, ISBN 951-791-965-4 (e-version).

A:263. PEKKA SÄÄSKILAHTI: Essays on the Economics of Networks and Social Relations. 2005. ISBN 951-791-966-2, ISBN 951-791-967-0 (e-version).

A:264. KATARIINA KEMPPAINEN: Priority Scheduling Revisited – Dominant Rules, Open Protocols, and Integrated Order Management. 2005. ISBN 951-791-968-9, ISBN 951-791-969-7 (e-version).

A:265. KRISTIINA KORHONEN: Foreign Direct Investment in a Changing Political Environment. Finnish Investment Decisions in South Korea. 2005. ISBN 951-791-973-5, ISBN 951-791-974-3 (e-version).

A:266. MARKETTA HENRIKSSON: Essays on Euro Area Enlargement. 2006. ISBN 951-791-988-3, ISBN 951-791-989-1 (e-version).

B-SARJA: TUTKIMUKSIA - RESEARCH REPORTS. ISSN 0356-889X.

B:54. JARMO ERONEN: Kielten välinen kilpailu: Taloustieteellis-sosiolingvistinen tarkastelu. 2004. ISBN 951-791-828-3.

B:47. PÄIVI KARHUNEN – RIITTA KOSONEN – MALLA PAAJANEN: Gateway-käsitteen elinkaari Venäjän-matkailussa. Etelä-Suomi Pietarin-matkailun väylänä. 2004. ISBN 951-791-846-1, korjattu painos.

B:55. TAISTO MIETTINEN: Veron minimointi yritysjärjestelyissä. 2004. ISBN 951-791-856-9.

B:56. SOILE TUORINSUO-BYMAN: Part-Time Work, Participation and Commitment. ISBN 951-791-866-6.

B:57. PIIA HELISTE – RIITTA KOSONEN – KAROLIINA LOIKKANEN: Kaksoiskaupunkeja vai kaupunkipareja? Tapaustutkimukset: Helsinki–Tallinna, Tornio–Haaparanta, Imatra–Svetogorsk. 2004. ISBN 951-791-886-0.

B:58. JARMO ERONEN: Central Asia – Development Paths and Geopolitical Imperatives. 2005 ISBN 951-791-906-9.

B:59. RIITTA KOSONEN – MALLA PAAJANEN – NOORA REITTU: Etelä-Suomi venäläisten turistien länsimatkailussa. 2005. ISBN 951-791-942-5.

B:60. KARI LILJA (ed.): The National Business System in Finland: Structure, Actors and Change. 2005. ISBN 951-791-952-2.

B:61. HANNU KAIPIO – SIMO LEPPÄNEN: Distribution Systems of the Food Sector in Russia: The Perspective of Finnish Food Industry. 2005.
ISBN 951-791-923-9, ISBN 951-791-924-7 (Electronic research reports).

B:62. OLLI KOTILA: Strateginen henkilöstöjohtaminen ja yrityksen tuloksellisuus. Cranet-projekti.
2005. ISBN 951-791-934-4, ISBN 951-791-935-2 (Electronic research reports).

B:63. KATARIINA JUVONEN – HELENA KANGASHARJU – PEKKA PÄLLI (toim.): Tulevaisuuspuhetta.
2005. ISBN 951-791-936-0, ISBN 951-791-937-9 (Electronic research reports).

B:64. JOHANNA LOGRÉN – JOAN LÖFGREN: Koukussa yrittäjyyteen. Suomalaisten ja venäläisten naisyrittäjien motiiveja ja haasteita.
2005. ISBN 951-791-975-1, ISBN 951-791-976-X (e-version).

B:65. HANS MÄNTYLÄ – PERTTI TIITTULA – MAARET WAGER (TOIM.): Pää hetkeksi pinnan alle. Akateeminen melontamatka. 2006. ISBN 951-791-982-4.

B:66. KRISTIINA KORHONEN WITH ERJA KETTUNEN & MERVI LIPPONEN: Development of Finno-Korean Politico-Economic Relations. 2005.
951-791-984-0, ISBN 951-791-985-9 (e-version).

B:67. RIITTA KOSONEN – MALLA PAAJANEN – NOORA REITTU: Gateway-matkailu tuottaa uusia matkailualueita. 2006. ISBN 951-791-986-7, ISBN 951-791-987-5 (e-version).

E-SARJA: SELVITYKSIÄ - REPORTS AND CATALOGUES. ISSN 1237-5330.

E:103. Research Catalogue 2002 – 2004. Projects snd Publications. 2005.
ISBN 951-791-837-2.

E:104. JUSSI KANERVA – KAIJA-STIINA PALOHEIMO (ed.): New Business Opportunities for Finnish Real Estate and ICT Clusters. 2005. ISBN 951-791-955-7.

N-SARJA: HELSINKI SCHOOL OF ECONOMICS. MIKKELI BUSINESS CAMPUS PUBLICATIONS. ISSN 1458-5383

N:36. MAARIT UKKONEN: Yrittäjyysmotivaatio ja yrittäjyysasenteet Helsingin kauppakorkeakoulun BScBa -tutkinto-opiskelijoiden ja Mikkelin ammattikorkeakouluopiskelijoiden keskuudessa. 2004. ISBN 951-791-874-7.

N:37. MIKKO SAARIKIVI: Helsingin kauppakorkeakoulun henkilöstön yrittäjyysmotivaatio ja yrittäjyysasenteet vuonna 2004. 2004. ISBN 951-791-882-8.

N:38. MIKKO SAARIKIVI: Helsinki-Tallinn: The Twin City of Science Interreg III A Project. 2004. ISBN 951-791-883-6.

N:39. MIKKO SAARIKIVI: Tieteen kaksoiskaupunki Helsinki-Tallinna Interreg III A -projekti. 2004. ISB 951-791-884-4.

N:40. TOM LAHTI: The Role of Venture Capital in Filling the Equity Gap. An Analysis of Policy Issues. 2004. ISBN 951-791-885-2.

N:41. VESA KOKKONEN: Etelä-Savon yritysten ulkomaankauppa 2003. 2004. ISBN 951-791-897-6.

N:42. MAARIT UKKONEN – MIKKO SAARIKIVI – ERKKI HÄMÄLÄINEN: Selvitys Uudenmaan yrityshautomoyritysten mentorointitarpeista. 2005. ISBN 951-791-900-X.

N:43 JOHANNA LOGRÉN: Suomalaiset ja venäläiset naisyrittäjät. Naisyrittäjien yhteistyöohjelmien (vv. 2000-2004) vaikuttavuus. 2005. ISBN 951-791-945-X.

N:44. VESA KOKKONEN: Yrittäjyyskoulutuksen vaikuttavuus. 2005. ISBN 951-791-971-9.

N:45. VESA KOKKONEN: mikkelin ammattikorkeakoulun opetushenkilökunnan yrittäjyysasenteet. 2005. ISBN 951-791-972-7.

W-SARJA: TYÖPAPEREITA - WORKING PAPERS . ISSN 1235-5674.
ELECTRONIC WORKING PAPERS, ISSN 1795-1828.

W:363. OSSI LINDSTRÖM – ALMAS HESHMATI: Interaction of Real and Financial Flexibility: An Empirical Analysis. 2004. ISBN 951-791-827-5 (Electronic working paper).

W:364. RAIMO VOUTILAINEN: Comparing alternative structures of financial alliances. 2004. ISBN 951-791-832-1 (Electronic working paper).

W:365. MATTI KELOHARJU – SAMULI KNÜPFER – SAMI TORSTILA: Retail Incentives in Privatizations: Anti-Flipping Devices or Money Left on the Table? 2004. ISBN 951-791-839-9 (Electronic working paper).

W:366. JARI VESANEN – MIKA RAULAS: Building Bridges for Personalization – A Process View. 2004. ISBN 951-791-840-2 (Electronic working paper).

W:367. MAIJU PERÄLÄ: Resource Flow Concentration and Social Fractionalization: A Recipe for A Curse? 2004. ISBN 951-791-845-3 (Electronic working paper).

W:368. PEKKA KORHONEN – RAIMO VOUTILAINEN: Finding the Most Preferred Alliance Structure between Banks and Insurance Companies. 2004. ISBN 951-791-847-X (Electronic working paper).

W:369. ANDRIY ANDREEV – ANTTI KANTO: A Note on Calculation of CVaR for Student´s Distribution. 2004. ISBN 951-791-850-X (Electronic working paper).

W:370. ILKKA HAAPALINNA – TOMI SEPPÄLÄ – SARI STENFORS – MIKKO SYRJÄNEN – LEENA TANNER : Use of Decision Support Methods in the Strategy Process – Executive View. 2004. ISBN 951-791-853-4 (Electronic working paper).

W:371. BERTTA SOKURA: Osaamispääoman ulottuvuudet. Arvoa luova näkökulma. 2004. ISBN 951-791-857-7 (Electronic working paper).

W:372. ANTTI RUOTOISTENMÄKI – TOMI SEPPÄLÄ – ANTTI KANTO: Accuracy of the Condition Data for a Road Network. 2004. ISBN 951-791-859-3 (Electronic working paper).

W:373. ESKO PENTTINEN: Bundling of Information Goods - Past, Present and Future. ISBN 951-791-864-X. (Electronic working paper).

W:374. KASIMIR KALIVA – LASSE KOSKINEN: Modelling Bubbles and Crashes on the Stock Market. ISBN 951-791-865-8 (Electronic working paper).

W:375. TEEMU SANTONEN: Evaluating the Effect of the Market Environmento on the Business Success of Online Newspapers. 2004. ISBN 951-791-873-9 (Electronic working paper)

W:376. MIKKO LEPPÄMÄKI – MIKKO MUSTONEN: Signaling with Externality. 2004. ISBN 951-791-880-1 (Elektronic working paper).

W:377. MIKKO LEPPÄMÄKI – MIKKO MUSTONEN: Signaling and Screening with Open Source Programming. 2004. ISBN 951-791-881-X (Electronic working paper).

W:378. TUURE TUUNANEN – KEN PEFFERS – CHARLES E. GENGLER: Wide Audience Requirements Engineering (Ware): A Practical Method And Case Study. 2004. ISBN 951-791-889-5. (Electronic working paper).

W:379. LARS MATHIASSEN – TIMO SAARINEN – TUURE TUUNANEN – MATTI ROSSI: Managing Requirements Engineering Risks: An Analysis and Synthesis of the Literature. 2004. ISBN 951-791-895-X (Electronic working paper).

W:380. PEKKA KORHONEN – LASSE KOSKINEN – RAIMO VOUTILAINEN: Finding the Most Preferred Alliance Structure between Banks and Insurance Companies from a Supervisory Point of View. 2004. ISBN-951-791-901-8 (Electronic working paper).

W:381. PEKKA J. KORHONEN – PYRY-ANTTI SIITARI: Using Lexicographic Parametric Programming for Identifying Efficient Units in Dea. 2004. ISBN 951-791-902-6. (Electronic working paper).

W:382. PEKKA MALO – ANTTI KANTO: Evaluating Multivariate GARCH models in the Nordic Electricity Markets. 2005. ISBN 951-791-903-4 (Electronic working paper).

W:383. OSSI LINDSTRÖM – ALMAS HESHMATI: Interacting Demand and Supply Conditions in European Bank Lending. 2005. ISBN 951-791-903-4 (Electronic working paper).

W:384. ANTTI PIRJETÄ – ANTTI RAUTIAINEN: ESO valuation under IFRS 2 – considerations of agency theory, risk aversion and the binomial model. 2005. ISBN 951-791-920-4 (Electronic working paper).

W:385. MIKA HYÖTYLÄINEN – HANNA ASIKAINEN: Knowledge Management in Designing and Developing ICT Consulting Services. 2005. ISBN 951-791-921-2 (Electronic working paper).

W:386. PEKKA KORHONEN – LASSE KOSKINEN – RAIMO VOUTILAINEN: A Customer View on the Most Preferred Alliance Structure between Banks and Insurance Companies. 2005. ISBN 951-791-922-0 (Electronic working paper).

W:387. MIIA ÄKKINEN: Conceptual Foundations of Online Communities. 2005. ISBN 951-791-959-X (Electronic working paper).

W:388. ANDRIY ANDREEV – ANTTI KANTO – PEKKA MALO: Simple Approach for Distribution Selection in the Pearson System. 2005.
ISBN 951-791-927-1 (Electronic working paper).

W:389. ANDRIY ANDREEV – ANTTI KANTO – PEKKA MALO: On Closed-form Calculation of CVaR. 2005. ISBN 951-791-928-X (Electronic working paper).

W:390. TUIJA VIRTANEN: Konsernijohtaminen parenting-teorian näkökulmasta. 2005
ISBN 951-791-929-8 (Electronic working paper).

W:391. JARI VESANEN: What is Personalization? A Literature Review and Framework. 2005.
ISBN 951-791-970-0 (Electronic working paper).

W:392. ELIAS RANTAPUSKA: Ex-Dividend Day Trading: Who, How, and Why?
2005. ISBN 951-791-978-6 (Electronic working paper).

W:393. ELIAS RANTAPUSKA: Do Investors Reinvest Dividends and Tender Offer Proceeds?
2005. ISBN 951-791-979-4 (Electronic working paper).

W:394. ELIAS RANTAPUSKA: Which Investors are Irrational? Evidence from Rights Issues.
2005. ISBN 951-791-980-8 (Electronic working paper).

W:395. PANU KALMI – ANTTI KAUHANEN: Workplace Innovations and Employee Outcomes: Evidence from a Representative Employee Survey. 2005.
ISBN 951-791-981-6 (Electronic working paper).

W:396. KATHRIN KLAMROTH – KAISA MIETTINEN: Interactive Approach Utilizing Approximations of the Nondominated Set. 2005. ISBN 951-791-983-2 (Electronic working paper).

Y-SARJA: HELSINKI SCHOOL OF ECONOMICS.
CENTRE FOR INTERNATIONAL BUSINESS RESEARCH. CIBR RESEARCH PAPERS.
ISBN 1237-394X.

Y:8. REIJO LUOSTARINEN – MIKA GABRIELSSON: Globalization and Marketing Strategies of Born Globals in SMOPECs. 2004. ISBN 951-701-851-8.

Z-SARJA: HELSINKI SCHOOL OF ECONOMICS.
CENTRE FOR INTERNATIONAL BUSINESS RESEARCH. CIBR WORKING PAPERS. ISSN 1235-3931.

Z:10. V.H. MANEK KIRPALANI – MIKA GABRIELSSON: Need for International Intellectual Entrepreneurs and How Business Schools Can Help. 2004. ISBN 951-791-852-6.

Kaikkia Helsingin kauppakorkeakoulun julkaisusarjassa ilmestyneitä julkaisuja voi tilata osoitteella:

KY-Palvelu Oy
Kirjakauppa
Runeberginkatu 14-16
00100 Helsinki
Puh. (09) 4313 8310, fax (09) 495 617
Sähköposti: kykirja@ky.hse.fi

Helsingin kauppakorkeakoulu
Julkaisutoimittaja
PL 1210
00101 Helsinki
Puh. (09) 4313 8579, fax (09) 4313 8305
Sähköposti: julkaisu@hse.fi

All the publications can be ordered from

Helsinki School of Economics
Publications officer
P.O.Box 1210
FIN-00101 Helsinki
Phone +358-9-4313 8579, fax +358-9-4313 8305
E-mail: julkaisu@hse.fi