DEPARTMENT OF ECONOMICS

Accession to the Euro-Area: A Stylized Analysis Using a NK Model

Bas van Aarle, Harry Garretsen & Cindy Moons

UNIVERSITY OF ANTWERP
Faculty of Applied Economics

Stadscampus
Prinsstraat 13, B.213
BE-2000 Antwerpen
Tel. +32 (0)3 220 40 32
Fax +32 (0)3 220 47 99
http://www.ua.ac.be/tew

FACULTY OF APPLIED ECONOMICS

DEPARTMENT OF ECONOMICS

Accession to the Euro-Area: A Stylized Analysis Using a NK Model

Bas van Aarle, Harry Garretsen & Cindy Moons

RESEARCH PAPER 2007-015
JUNE 2007

University of Antwerp, City Campus, Prinsstraat 13, B-2000 Antwerp, Belgium
Research Administration – room B.213
phone: (32) 3 220 40 32
fax: (32) 3 220 47 99
e-mail: joeri.nys@ua.ac.be

The papers can be also found at our website:
www.ua.ac.be/tew
(research > working papers)

D/2007/1169/015

Accession to the Euro-Area: A Stylized Analysis Using a NK Model.*

Bas van Aarle[1], Harry Garretsen[2] and Cindy Moons[3]

Abstract

This paper analyses the accession to the Euro-Area by new members using a stylized new-Keynesian model. We analyze macro-economic adjustment in the pre- and post accession case and calculate welfare in both situations to obtain net benefit/loss from accession. It is shown how the effects of accession is related to the conduct of monetary policy and fiscal policy in the pre- and post accession case. The simulation examples point at the potential costs that accession might entail due its consequences on monetary and fiscal policy design. These consequences from accession in terms of macro-economic stabilization ability of monetary and fiscal policies have not always been fully acknowledged and need attention in our opinion.

Keywords: Euro-area, Fiscal Policy, Monetary Policy
JEL Code: F31, F41, G15

March 2007

[1] Department of Economics, University of Maastricht, the Netherlands and research affiliate at CESifo, Munich, Germany.

[2] Utrecht School of Economics, Utrecht University, The Netherlands; Centre for German Studies (CDS), University of Nijmegen, the Netherlands and research fellow at CESifo, Munich, Germany.

[3] University of Antwerp, Department of Economics, Prinsstraat 13, 2000 Antwerpen, Belgium.

* We are grateful for comments received from participants of the CESifo conference "Macro, Money and International Finance 2006" held in Munich, November 24, 2006.

1. Introduction.

On January 1th 2007, Slovenia -as the first of the 10 countries that entered the European Union (EU) on May 1th 2004- also entered the Euro Area (EA). Among many other obligations, the new members of the EU also committed themselves to join the European Economic and Monetary Union (EMU) as soon as they have fulfilled the entry conditions laid down in the Treaty of Maastricht. The Maastricht Criteria (article 109 j (1)) provides convergence criteria in terms of inflation, interest rates, debt and deficits for the countries to qualify for entrance into the EMU plus the requirement that a candidate country should first follow for 2 years the ERM II mechanism. Depending on the amount of effort that countries invest in complying with these entrance criteria there is a certain degree of freedom in choosing the exact point in time to enter. In practice, this means that the period between 2007 and 2012 seems the most likely time for their EA accessions.[1]

The right timing for joining a monetary union is crucial and it is very unlikely that a single strategy could be recommended to all acceding countries regarding macroeconomic stabilization on the road to the euro. Arguments in favor of adopting the euro as early as possible include a smaller financial risk due to the elimination of conversion costs and exchange rate uncertainty, interest rate convergence and overall gains in monetary credibility, while arguments for a slower pace to the euro include the need to remove first distortions that impede wage and price flexibility and the need to first make fiscal and financial policy sustainable and compatible with participation in the EMU. Autonomy in monetary and fiscal policy could still be very useful in the short and medium term for the new Member States that are in a process of gradual convergence to the EA and may still be subject to larger asymmetric shocks and adjustments. During the recent years, monetary policy in the accession countries has indeed displayed a large variation ranging from very strict euro pegging in the form of a currency board in small accession countries such as Estonia to informal euro target zones in larger accession countries like Poland. Also the adjustment of fiscal indicators like government spending, tax revenues and budget deficit display a marked variation among the candidate EA countries.

Apart from the timing and convergence scenarios, the accession to the EA raises several other fundamental questions. E.g. what are the consequences for the accession countries and is the accession beneficial for the acceding countries (and the current EA members)? How does the accession of new members affect the monetary policy of the ECB? How does the accession affect the coordination of fiscal policies? Is there any effect of accession on the interaction between the EA and the rest of the world?

Such questions are in many ways related to more fundamental questions on the degree to which the acceding countries constitute an optimal currency area (OCA) with the current EA. In fact, many of these questions concerning the accession of new countries to the EA are related and/or similar to questions that were raised during the construction of the current EA. As concerning the OCA questions, several studies

[1] Also for Bulgaria and Romania that will enter the EU on January 1, 2007 entering the EA will become a relevant aspect in the medium to long term. von Hagen and Traistaru (2005) and Backe (2004) review in large detail the current exchange rate regimes, the performance of the new Member States wrt the Maastricht criteria and the OCA aspects

have analyzed the degree to which the accession countries may form an OCA with the current EA. In terms of trade interdependence and business cycle convergence with the E(M)U, the accession countries reach comparable scores like current member countries (see e.g. Boone and Maurel (1999)). On the other hand, the degree of symmetry of shocks is generally found to be lower (see e.g. Fidrmuc and Korhonen (2003)). The latter finding may be problematic in the sense that the accession countries by acceding to the EA give up national monetary policy independence and in particular the possibility of exchange rate adjustment vis-à-vis the EA in case they experience asymmetric shocks. Upon accession, their monetary policy will be set by the ECB. In addition, the accession countries will adopt the fiscal policy cooperation and surveillance procedures of the Stability and Growth Pact.

Given the considerations listed above it is, therefore, by no means clear under which conditions the accession is likely to occur. The loss of exchange rate and interest rate flexibility is likely to entail negative costs for the acceding country, as does the possible increase in fiscal conservatism stemming from SGP alike requirements. Or put alternatively, acceding to the EA –as it implies a removal of monetary policy flexibility- may actually require an increase in fiscal flexibility rather than a reduction. On the other hand, the change in the institutional settings and micro-economic efficiency gains from a reduction of transaction costs will benefit the accession countries. It is clear that these micro-economic efficiency gains from a common currency are hard to quantify. The National Bank of Poland (2004) e.g. assumes EA accession would contribute to a permanent 1.5% drop in real interest rates and an associated permanent increase of the real GDP growth rate of 0.2%.

This paper studies the effects of accession of new members to the EA using a stylized New Keynesian macroeconomic model of an accession country that considers the accession to the EA. In our model, acceding the monetary union implies that for the accession country: (i) there are no longer exchange rate adjustments possible vis-à-vis countries that participate in the monetary union; (ii) its monetary policy is now set by the common central bank whose policy may not be optimal for the acceding country because (a) it targets EA aggregate output and inflation and (b) may have different preferences; (iii) participating in the monetary union could require that fiscal flexibility is stronger restrained because of the necessary adoption of fiscal stringency measures like the Stability and Growth Pact when a country enters the monetary union.[2] Numerical simulations of the model are used to analyze the effects of accession to the monetary union and under which conditions such an accession is beneficial for the acceding country. The correct way to measure and evaluate accession effects (on macroeconomic adjustment, policy formation and cooperation, and the

relating to their accession. The convergence to EMU and the intended dates of accession are also considered.

[2] In addition there are a number of additional effects that are ignored in this paper. These relate in particular to changes in the area of policy coordination in the EA and decision making inside the ECB. Accession changes the strategic settings and the possibilities for cooperation of policies for both acceding and existing member states. For the common central bank, the accession of additional countries, implies that: (i) there is a redefinition of the aggregate target variables; this by itself may already induce changes in optimal policymaking; (ii) its preferences may change if the acceding countries have different preferences; this will affect policymaking; (iii) the strategic configurations (coalition formation process) in which the common central bank operates have changed: the number of fiscal players in the monetary union increases and the number of outside monetary and fiscal players decreases. The adjustment dynamics from exchange rate adjustment are changed.

resulting welfare losses) is by comparing identical situations (in terms of shocks, structures, and preferences) under two scenarios: (i) without accession (or pre-accession) and (ii) with accession (or post-accession). The net effects can then be solely attributed to the accession. We analyze macro-economic adjustment in the pre- and post accession case and calculate welfare in both cases to obtain net benefit/loss from accession.

The simulation examples point at the potential costs that accession might entail due its consequences on monetary and fiscal policy design. Somewhat ironically, these costs increase the more efficient monetary and fiscal policy are in the pre-accession phase: countries that are facing difficulties with monetary policy commitment and fiscal deficit bias, are likely to find that accession helps tackling both issues to a certain extent. Countries that have obtained a high degree of monetary policy commitment and fiscal prudence, however, are likely to find their stabilization ability largely decreased upon accession.

A number of papers have studied aspects of EA accession that are relevant for our study as well: Natalluci and Ravenna (2002) study the different monetary and exchange rate strategies in these countries and the possible conflict between the inflation and exchange rate criterion due to presence of the Balassa-Samuelson effect. Bayoumi et al. (2005) calibrate a NOEM model of the EA accession countries to assess the static and dynamic benefits of the fall in trading costs and higher level of trade integration from entering EMU, and the role of nominal and real rigidities in the dynamics of this process. The analysis is optimistic on the potential benefits from accession: in their base case calibration a 1 percentage point reduction in trading costs (as a result of accession) increases the trade of accession countries by 6 percent over the long term, and raises the long-term welfare of accession countries by the equivalent of about one percent of consumption. The main benefit comes from higher output and consumption, although there is also some decrease in hours worked and hence an increase in leisure. Additional benefits from accession come from financial integration and lower real interest rates. Accession leads to boom including steady and large increases in trade, consumption and welfare, and a boost to investment. This is financed by foreign borrowing which is repaid in the long-term through a trade surplus. Ca' Zorzi et al. (2005) develop a static model of an accession country. The benefits of a common currency are modeled as an increase in potential output and confronted with the losses from the disappearance of exchange rate flexibility. Devereux (2003) analyzes the effects of EU enlargement (inducing a capital inflow shock, an increase in trade flows and a fall in the external risk premium) under a fixed and a floating exchange rate.

The paper has been structured as follows: Section 2 proposes a stylized NK model. Section 3 discusses the design of monetary policy in this model. Section 4 discusses the simulation results for various shocks. In Section 5 some sensitivity analysis of the outcomes w.r.t. a few crucial model parameters is undertaken. The conclusion summarizes our main results.

2. Effects of Accession: A Stylized NK Model.

Starting point of the analysis is a country that is considering to accede to the euro-area. A crucial assumption is that the accession country is small relative to the EA. This 'small-country' assumption implies that it has

no influence on EA developments and takes them as being exogenous. Looking at the size, e.g. in terms of GDP, of the accession countries to the current EA12 this assumption appears realistic. In case the country decides to enter the EA at some moment, the EA variables in the model strictly speaking need to be interpreted as referring to the EA-excluding the accession country. Given the small country assumption these variables can be approximated by the aggregate EA.

The setup of the model is rather standard and e.g. similar to Giordani (2001), Muscatelli et al. (2004), Svensson (2000), Leitemo et al. (2002) and others. The model is a stylized NK model in two respects: (a) while its structure is broadly consistent with the NK literature we do not attempt to work out a fully specified underlying micro-economic structure, (b) as a counterpart of (a), we do not attempt to estimate all model parameters for the EA accession countries ourselves but instead use a set of plausible values.

2.1 The macroeconomic structure

The basic blocs of the model are the aggregate demand and aggregate supply curves, the Uncovered Interest Parity (UIP) condition and the design of monetary and fiscal policies. Concerning the latter: we try to include in the model a number of aspects that are relevant for actual monetary and fiscal policies in the context of accession, in particular the distinction between monetary policy commitment versus discretion in the pre-accession case and restrictions on fiscal flexibility in the form of the Stability and Growth Pact (SGP) in the post-accession phase.

The aggregate demand -IS curve-, of the candidate EA economy takes the following form:

$$y_t = \psi y_{t-1} + (1-\psi)E_t y_{t+1} - \alpha\left(i_t - E_t \Delta p_{t+1} - \bar{r}\right) + \eta g_t + \sigma y_t^{EA} + \delta(e_t + p_t^{EA} - p_t) + u_t^d \qquad (1)$$

y denotes output produced in the accession country[3], i the short-term nominal interest rate, (the monetary policy instrument), p the general price level, g the fiscal balance (a positive value of g denotes a fiscal deficit), e is the nominal exchange rate against the Euro (a positive value implying a depreciation); $\bar{r}$ is the equilibrium real interest rate. u^d is an aggregate demand shock. All variables are given in logarithms and refer to deviations from an initial steady-state. y^{EA} and p^{EA} denote EA output and output prices, respectively.

In this reduced form, output depends on past output, expected future output, the real interest rate (expressed as a deviation from the equilibrium real interest rate), net government spending, net exports[4] and a demand shock. This IS curves nests several alternative formulations that can be found in the literature: the current output gap can be positively related to past output gaps only (Fuhrer and Moore (1995), Huh and Lansing (2000)), both past and expected future output gaps, Clarida et al., (1999)), or expected future output gaps only (McCallum (2001), Woodford (2001)). The backward-looking component in the IS curve results from "habit formation" in consumption decisions[5]. The forward-looking part is produced by rational,

[3] Output and output gap in fact can be used interchangeably as long as equilibrium output remains constant.

[4] Net exports are a function of foreign output and price competitiveness: net exports = $\sigma y_t^{EA} + \delta(e_t + p_t^{EA} - p_t)$.

[5] Leith and Malley (2002), Batini et al. (2003) and McCallum and Nelson (1999) provide micro-foundations for the presence of habit formation in consumption. Empirical evidence is provided that the backward looking component in

intertemporally maximizing agents that apply the principles of optimal "consumption smoothing". In case consumers are entirely forward looking ($\psi_i = 0$), (1) is also sometimes referred to as the "intertemporal IS".

Exchange rates adjusts in such a manner that uncovered interest rate parity holds throughout:

$$E_t e_{t+1} = e_t + i_t - i_t^{EA} \qquad (2)$$

where i_t^{EA} denotes the EA interest rate.

Inflation dynamics are given by hybrid Phillips-curves which contain elements of both forward and backward-looking price setting. In addition, demand-pull and cost-push factors affect inflation,

$$\Delta p_t = \omega \Delta p_{t-1} + (1-\omega) E_t \Delta p_{t+1} + \gamma (y_t - \overline{y}_t) + \tau \Delta (p_t^{EA} + e_t) + u_t^s \qquad (3)$$

Inflation equals the first difference of the general price level and is assumed to be a function of past inflation, expected future inflation, the output gap, $y_t - \overline{y}_t$, -reflecting demand pull inflation- and inflation of import prices, $\Delta(p_t^{EA} + e_t)$ (the s.c. "pass-through"), which induces cost-push inflation.[6] u_t^s, are domestic cost push shocks (or "mark-up" shocks) which will be interpreted as supply-shocks in the remainder of the analysis since (3) can also be considered as describing the short-run aggregate supply (AS) curve. In addition, the supply side of the economy can be hit by shocks to potential output viz. productivity shocks $\overline{y}_t = \overline{y}_{t-1} + u_t^{\overline{y}}$.

If $\omega = 1$, we obtain the backward-looking Phillips curve, if $\omega = 0$, on the other hand, we obtain the forward-looking New-Keynesian Phillips curve[7]. In the first case, current inflation is strongly driven by past inflation (and economic conditions), creating inertia in the adjustment of inflation. In the presence of forward-looking expectations, current price setting depends on expectations about future inflation viz. economic conditions. The hybrid Phillips curve assumes that both backward and forward-looking price setting are present, it results if ω lies in between 0 and 1. The hybrid Phillips curve allows for both a forward-looking component and a backward-looking component, reflecting e.g. learning effects, staggered contracts or other institutional arrangements that affect pricing behavior.

Demand shocks (u^d), cost-push shocks (u^s), potential output shocks ($u_t^{\overline{y}}$), fiscal shocks (u^g), EA output shocks (u^{yEA}), EA price shocks (u^{pEA}) and EA interest rate shocks (u^{iEA}) are all assumed to follow

---

consumption is substantial.

[6] See e.g. Gagnon and Ihrig (2002), Leitemo et al. (2002), Coenen and Wieland (2002) that use similar open economy Phillips curves.

[7] See e.g. Clarida et al. (1999) for a similar analytical framework and a detailed discussion on the generalised IS (1) and Phillips curves (2). They illustrate how ψ and ω jointly determine the endogenous inflation and output persistence. Leith and Malley (2002) derive (2) from the overlapping contracts model a la Calvo. In empirical applications, more lags of output (in case of the IS curve) and output and inflation (Phillips curve) are often included to improve the empirical fit. Adding these lags will also induce a more persistent and therefore more realistic adjustment to shocks. In empirical studies and monetary policy analysis sometimes concepts of equilibrium and/or core inflation are added to (2), to distinguish short-run fluctuations of inflation from longer term, equilibrium inflation. In our analysis this issue is not dealt with and inflation (as all other variables) is defined in terms of deviations from (possibly non-zero inflation) steady-state.

stationary AR(1) processes $u_t = \rho\, u_{t-1} + v_t$, with $0 \le \rho < 1$ and v_t is white noise, $v \propto N(0, \sigma_v^2)$, all shocks are assumed to be contemporaneously uncorrelated, $E\left[v_i\ v_j\right] = 0,\ \forall i, j$.

2.2 Monetary and Fiscal Policy Design and the Effects of Accession

Macroeconomic shocks lead to fluctuations in output and prices. The transmission of shocks in the model, however, can be markedly different in the pre- and post-accession regimes due to the differences in the monetary and fiscal policy design. In the pre-accession regime, monetary policy autonomy implies that interest rates (and consequent changes in exchange rates) can be used the central bank to stabilize macroeconomic fluctuations, in particular of inflation and output. Fiscal policy is also assumed to be flexible in the pre-accession regime (or at least not affected from external constraints on fiscal flexibility such as the SGP). Upon accession, domestic monetary policy is replaced by a common monetary policy and possibly stronger restraints of fiscal flexibility.

Following the terminology of Svensson (2000), the framework of monetary policy in the pre-accession phase can be referred to as a setting of targeting rules. Targeting rules seek to determine optimal policy responses to economic conditions, given a set of objectives. In the context of the above model, we look at the policy strategies that minimize the following inter-temporal quadratic loss function:

$$L_t^E = E_t \sum_{\tau=0}^{\infty} \Gamma^{\tau} [\beta \left(\Delta p_{t+\tau}\right)^2 + \xi \left(y_{t+\tau} - \overline{y}_{t+\tau}\right)^2 + \nu \left(\Delta i_{t+\tau}\right)^2 + \kappa \left(\Delta e_{t+\tau}\right)^2] \qquad (4)$$

subject to the adjustment dynamics of the economy, (1)-(3), (5) and under assumptions whether or not the monetary policymaker acts under commitment or discretion. Strict inflation targeting implies $\beta > 0,\ \xi = \nu = \kappa = 0$, flexible inflation targeting implies that inflation targeting is an important objective of the CB but that it is also concerned about output and interest rate / exchange rate stability, $\beta > 0,\ \xi > 0,\ \nu > 0,\ \kappa > 0$ which seems to be the most realistic case.

Concerning monetary policy in the pre-accession phase we distinguish two regimes, depending on whether monetary authorities implement monetary policy (i) assuming commitment or (ii) assuming discretion. In our dynamic NK model, the difference between the commitment and discretionary case results from the forward-looking part of the model (the expectations of the private sector about output, inflation and exchange rates). Under (i) commitment the policymaker is able to optimally smooth the stabilization costs over time: if a macroeconomic shock hits the economy, the policymaker can announce a path of current and future policy actions and credibly implement this strategy. The private sector sets its expectations accordingly. Under (ii) discretion, such announcements of future policy contingent on past commitments are not credible. As a result, under commitment adjustments of interest rates and inflation will typically display more gradual adjustment and less volatility than under discretion, given this ability to smooth out the adjustment costs over time. Under discretion, policies and inflation are excessively volatile in the short run compared to the commitment case and also welfare losses will be higher with discretionary policymaking

due to the existence of such a stabilization bias in the short-run[8]. The differences between commitment and discretion will vanish when output and inflation expectations become increasingly backward-looking[9], since in that case the private sector expectations are less and less affected by policy commitments, or stated differently, optimal policies will suffer less and less from time-inconsistency problems when expectations become less and less forward-looking. In a purely backward-looking model, the time-inconsistency problems of optimal monetary policy disappear by definition.

Concerning fiscal policy we assume that net government spending is determined by a fiscal policy rule. Taylor (2000), developed a framework for simple fiscal policies that relate net government spending to the structural fiscal balance, $\overline{g}$, and the cyclical fiscal stance, as measured by the automatic stabilizers $-\chi y_t$, the elasticity of the deficit to cyclical output fluctuations times output. In addition, we allow for the possibility of deficit smoothing and the occurrence of stochastic deficit shocks, u^g:

$$g_t = \lambda_g g_{t-1} + (1-\lambda_g)\left(\overline{g} - \chi_g y_t\right) + u_t^g \qquad (5)$$

If $\chi > 0$, fiscal policy contains a countercyclical component that provides automatic stabilization of the business cycle fluctuations. The parameter λ_g (where $0 \le \lambda_g \le 1$) captures the degree of fiscal policy inertia/activism: a high value of λ_g would mean a very inert –but highly persistent- fiscal policy that could be explained by difficulties to implement changes in tax policies (e.g. pension reforms) and government spending (e.g. healthcare reforms).

The fiscal policy rule (5) enables to represent in the model -albeit in a highly stylized way- the various budgetary rules and strategies one may observe in practice. Here, we would like also to relate the fiscal policy rules with the provisions in the Stability and Growth Pact that the accession country faces in the post-accession face. The budgetary target $\overline{g}$ can be thought e.g. as being the "close-to balance or in surplus medium term objective", reflecting a preference for long-run sustainability and neutrality. The build-in flexibility in the Stability Pact relies on allowing as much as possible the workings of the automatic stabilizers in the short-run. In a related manner, the amount of inertia in fiscal policy, summarized by λ_g, reflects the ability of fiscal policymakers to adjust fiscal policy in the short-run. If $\lambda_g = 0$ fiscal flexibility is the highest and the fiscal balance only driven by the automatic stabilizers. If λ_g increases, fiscal flexibility declines, implying more persistence in fiscal adjustments. In the limiting case where $\lambda_g = 1$, fiscal deficits do not adjust at all over time. Ignoring fiscal shocks, this would imply the absence of fiscal stabilization.

In our analysis we focus on a pre-accession phase that is characterized by a combination of national monetary policy autonomy and a significant amount of fiscal flexibility. The accession the

[8] Discretionary policies will also induce an inflationary bias in case the policymaker chooses an output objective that exceeds the potential output, reflecting e.g the case of a dependent Central Bank that is steered by political objectives. In the remainder of this study we will, however, not deal with such cases.

[9] Note that in our analysis, we will assume that exchange rate expectations are always set in an entirely forward-looking manner.

EA takes away the monetary policy autonomy, and possibly also fiscal flexibility. Taking away monetary policy autonomy implies the loss of nominal interest rates and nominal exchange rates as adjustment instruments in the hands of the policymakers of the acceding country. This is costly in particular if the authorities had achieved already a high degree of commitment and credibility. If they lacked credibility before, the "monetary tying of the hands of domestic policymakers" (by entering a monetary union and giving up monetary policy autonomy) may actually be beneficial in itself, in that it addresses the stabilization bias problem associated with discretion. If acceding the monetary union also requires that fiscal flexibility is taken from the hands of domestic policymakers, there is additional loss of stabilization tools. If fiscal management was generally adequate before the accession, this restricting of fiscal flexibility at the national level may be counterproductive in the sense of contributing to unnecessary volatility and prolonged adjustment after macroeconomic shocks. If fiscal management was not adequate in the first place, the accession may be conducive to disciplining also fiscal policymakers by imposing a restrictive framework upon them. In that case a fiscal " tying of the hands of the domestic policymakers" may be beneficial to address a fiscal deficit bias problem. It acts as an external fiscal commitment mechanism to undertake unpopular deficit-reducing measures.

In general, the accession countries have made substantial progress concerning credibility of monetary policy as witness convergence to low levels of inflation and inflation variability -which do not differ dramatically from the ones observed in the EU-, increased Central Bank independence and transparency of monetary policy.[10] As concerning fiscal policy there are considerably larger differences and fiscal stances range between very prudent to excessively expansionary as some countries were faced with substantial fiscal shocks and difficulties in fiscal management. For accession countries with fiscal imbalances, clearly the fiscal convergence requirements from the Maastricht Treaty are a major hurdle to take and will take away any room for active fiscal management.

4. The Effects of Accession: A Simulation Analysis.

This section uses simulations with the model introduced in Section 3 to illustrate a number of insights concerning EA accession. We simulate the effects of demand shocks, cost-push shocks, potential output shocks, fiscal shocks, and shocks to the EA variables in the model. All shocks are 1 percent in size, occur in period 0, are unanticipated and have zero persistence. The assumption of zero persistence of shocks enables to strictly distinguish the impact of shocks and their subsequent propagation. The simulations of the shocks

[10] See e.g. Dvorsky (2000) on CB independence in the countries in Central and Eastern Europe.

provide (a) impulse response functions that give the dynamics adjustments resulting from the shocks, including the transmission of macroeconomic policies (b) variances and welfare losses resulting from stochastic simulations of these shocks (based on 100 replications), allowing us to investigate into more detail aspects of efficiency.

We compare the adjustments under four scenarios. Two "pre-accession" scenarios feature domestic monetary policy autonomy: (i) optimal monetary policy in case of policy discretion, (ii) optimal monetary policy in case of commitment. Two "post-accession" scenarios which imply that (iii) monetary policy is set exogenously by the ECB but fiscal policy remains equally flexible as in the pre-accession case, (iv) monetary policy is set exogenously by the ECB and also fiscal disappears in the post-accession case. In the simulations we in particular want to obtain insights into: (a) the effects of accession relating to monetary policy, (b) the effects of accession relating to fiscal policy. The first effect is studied by comparing outcomes under domestic monetary policy and under a monetary union, i.e. comparing case (i) and (ii) with case (iii)). The second effect is analyzed by considering that accession not only leads to the loss of monetary policy autonomy but may in addition also lead to a larger amount of fiscal stringency, reflecting the workings of the SGP that an acceding country needs to comply with upon accession to the EA, i.e. comparing case (iii) and (iv).

Underlying all the simulations in this section is a set of baseline parameters provided in Table 1 that characterizes in a stylized manner the structure of the accession country. The set of baseline parameters in the model concern: (i) the hybrid IS and Phillips curves: ψ, ω, (ii) other reduced-form parameters of the NK model: $\alpha, \eta, \sigma, \delta, \gamma, \tau$.: (iii) parameters that characterize monetary and fiscal policy rules $\lambda_i, \phi_i, \chi_i, \mu_i, \lambda_g, \chi_g$, and monetary policy preference parameters $\Gamma, \beta, \xi, \nu, \kappa$, (iii) assumptions on variances and autocorrelations of shocks, $\rho^{v^i}, \sigma^2_{v^i}$.

[Insert Table 1 here]

These parameters of the IS and Phillips curve and policy rules are set to values that are broadly consistent with empirical estimates for the EA accession countries.[11] A number of empirical studies suggest that most EA accession countries are characterized by a (i) substantial degree of backward looking in output and inflation, (ii) a substantial degree of deficit and interest rate smoothing in the policy rules. In the absence of estimates and also for the reason noted above we assume that all shocks are uncorrelated with each other and across time ($\rho^{v^i} = 0$) and equal variances ($\sigma^2_{v^i} = 1$). In the terminology of the traditional OCA theory this implies that we concentrate on asymmetric shocks, i.e. when e.g. a domestic demand or supply shock

[11] While the absence of any own empirical estimations may seem a bit unsatisfying this type of analysis based on calibrated parameters and/or parameters that appears plausible from empirical studies, is quite common in NK papers. See e.g. Jensen (2002) that follows this line of thought and analysis and refers to "compromise values" when choosing parameter values that would seem plausible for the U.S. case in his analysis.

occurs it is an asymmetric shock in the sense that (the rest of) the EA does not experience a similar shock. The OCA highlights the importance of national policy autonomy and exchange rate adjustment in such a setting of asymmetric shocks. Given that the OCA theory focuses on asymmetric shocks, the assumption about the nature of shocks in our model seems adequate. Moreover, we do not only consider the traditional focus of the OCA on asymmetric demand and supply shocks that hit a small open economy but also consider a broader set of shocks, in particular shocks in the EA. Given the high degree of integration between the EA and the accession countries, this seems a useful extension. Monetary theory, namely, also prescribes the usefulness of exchange rate flexibility and domestic policy autonomy to ward off the effects of foreign disturbances and contain spillover effects on the domestic economy.

Naturally, outcomes may be more or less specific to this set of baseline assumptions. In case of small changes in the parameters, the differences compared to the baseline are typically of a quantitative nature rather than a qualitative nature. If changes get larger, the results can also change qualitatively. In Section 5 we will undertake some sensitivity analysis to try to shed some light on that aspect of the analysis.

Simulations of various shocks and their transmissions in the different regimes allows to analyze and compare the macroeconomic adjustment produced in the different regimes. Stochastic simulation analysis is used to study the effects on the variability of inflation, output, interest rates and exchange rates and to study welfare implications using the definition of the loss function (4). In addition, three welfare indices are calculated: (i) the stabilization bias I^{SB} is a measure of welfare loss coming from discretionary policy making in the pre-accession phase, (ii) the optimal currency indices I^{OCA} and II^{OCA} are measures of the welfare gains/losses coming from the shift from a pre-accession regime with domestic monetary policy to a post-accession regime with a common currency, (iii) the fiscal flexibility index I^{FF} calculates the difference in losses in the post-accession regimes with (L^{MU}) and without fiscal flexibility (L^{SGP}). In other words:

$$I^{SB} = \frac{L^{DIS}}{L^{COM}}, I^{OCA} = \frac{L^{MU}}{L^{COM}}, \quad II^{OCA} = \frac{L^{MU}}{L^{DIS}}, I^{FF} = \frac{L^{SGP}}{L^{MU}} \quad (6)$$

A value of the OCA index smaller than one implies a net gain from accession.[12] For the OCA index we make two calculations: one index (I^{OCA}) that calculates the welfare gains/losses from accession using the pre-accession regime using national optimal monetary policy under commitment as the benchmark and a second index (II^{OCA}) that uses national optimal monetary policy under discretion as the benchmark. Since monetary policy under commitment has always equal or less welfare losses than discretion, the net welfare gain from accession is always lower in case of commitment in the pre-accession case. A value of the fiscal flexibility index larger than one implies an additional loss after acceding the EA caused by a strict interpretation of the SGP.

1) A positive demand shock

[12] Note that we ignore the benefits from accession in the form of lower transaction costs and other micro-economic efficiency gains, if these would amount to some amount Δ% we could subtract that amount from the OCA index to get the overall amount of net losses. Since we have no concrete estimate of Δ it is ignored in the analysis. Empirical studies

Figure 2 displays the adjustments that are produced by a positive one percent demand shock in the accession country at $t = 0$, ($v^d(0) = 1\%$). Outcomes under discretion (dashed lines), commitment (dotted lines), monetary union (dashed-dotted lines) and monetary union with a strict Stability and Growth Pact (dotted-dashed lines) are denoted with suffix _DIS, _COM, _MU and _SGP, respectively.

[Insert Figure 1 here]

The demand shock increases output in the short-run which tends to increase inflation. In the pre-accession case, the Central Bank reacts by raising the interest rate. This causes an initial appreciation after which the exchange rate depreciates according to the UIP condition, in other words exchange rate overshooting occurs. Net exports are negative due to the increase in output and the appreciation. The increase of the real interest rate, the real appreciation and the fiscal surplus produced by the automatic stabilizers contribute to the stabilization of output and inflation. It is interesting to note that the cyclical adjustment dynamics are the result of the combination/interaction of both forward-looking and backward-looking mechanisms in output and inflation: both a purely forward-looking and a purely backward-looking parametrization of the model would lead to a monotonic adjustment from the same demand shock.

In the pre-accession regime, the flexibility of nominal interest rates and nominal exchange rates is a useful stabilization tool. This is clear from the smaller size of the fluctuations and more rapid adjustments in the pre-accession cases. It is seen that the monetary policy regime has an impact on the outcomes produced by the demand shock. Compared to discretion, commitment results in a more smooth adjustment of the interest rate and inflation, reflecting the stabilization bias present under discretion. Accession has a considerable impact upon the transmission of the same demand shock: fluctuations of output, inflation, fiscal deficits and net exports are larger than in the pre-accession cases. An additional aspect, is the greater use of fiscal policy in the post-accession regime than in the pre-accession case. Therefore, if in the post-accession case also fiscal flexibility is taken away there are even larger output fluctuations and a more prolonged adjustment path (implying additional welfare losses from accession).

The differences in terms of losses between outcomes in the different regimes can be quantified more precisely using the outcomes from the stochastic simulation found in Table 2. It provides for the various shocks and policy regimes, the variances of inflation, output gap, interest rates, exchange rates and fiscal deficit plus the welfare losses and the welfare metrics defined above. In case of demand shocks, the pre-accession regime shows that a substantial gain results from commitment compared to discretion, as indicated by the stabilization bias index of 2.29.[13] Commitment reduces in particular inflation variability compared to discretion, contributing to the lower losses under commitment. The pre-accession regimes score considerably better than the post-accession ones: the OCA indexes show that there is a clear gain from keeping monetary

suggest that these efficiency gains are typically in the range of 1-5% of GDP.

[13] Note that these indices are dimensionless, they do not provide information concerning e.g. the costs/benefits of accession in terms of foregone/increased GDP as is sometimes tried in empirical studies.

policy autonomy not only under commitment (OCA index of 2.83), even under discretion (OCA index of 1.24). Giving up fiscal flexibility in the post-accession regime would lead to an additional welfare loss since the fiscal flexibility index equals 1.72.

[Insert Table 2 here]

2) A positive cost-push shock

Next, we analyse the effects of a non-persistent one percent cost-push shock in Figure 2 ($v^s(0) = 1\%$):

[Insert Figure 2 here]

A cost-push shock typically produces stagflationary adjustments: there is a substantial decline in output and a burst in inflation. As a result of the initial output fall, fiscal deficits and current account surpluses result. In the pre-accession case with discretion, the interest rate increases and the nominal exchange rate depreciates. Commitment produces a considerably smoother stabilization of inflation and output and less strong monetary policy intervention than discretion. Lacking short term flexibility of the interest rate and exchange rate (and fiscal flexibility in the SGP regime), the post-accession regimes display stronger fluctuations of output and prices especially in a medium run. The resulting losses in Table 2 show again a considerable stabilization bias problem (the stabilization bias index has a value of 1.95). The OCA indices indicate that in case of commitment a loss is obtained from accession ($I^{OCA} = 1.07$) in case of discretion, however, a significant gain results from accession ($II^{OCA} = 0.55$). This is a clear illustration of the general notion that the effects of accession depend very much on the monetary policy framework in the pre-accession regime and that the more efficient monetary policy is set in the pre-accession, the smaller are the expected benefits from accession. Fiscal flexibility in the post-accession regime clearly matters given a value of 1.66 of the fiscal flexibility index.

3) A positive fiscal shock

The workings of a one time expansionary fiscal shock ($v^g(0) = 1\%$) are quite similar to a demand shock as shown in Figure 3.

[Insert Figure 3 here]

One important difference comes from the fiscal rule itself: the initial shock leads to a dynamic adjustment process in the fiscal deficit itself due to the deficit smoothing mechanism. This is clearly seen in the adjustment of the deficit in Figure 4. The increase of output and appreciation of the exchange rate lead to a current account deficit. Concerning variability of output, inflation and interest rate and welfare losses we mostly reach the same conclusions as in case of the demand shocks. However, one aspect differs: given that

the source of the macro-economic adjustments is from the fiscal side, now in the post-accession case, the regime without fiscal flexibility is conducive to macro-economic stability as it limits the fiscal dynamics to a one-off shock. As a result it scores better than the accession with fiscal flexibility regime (the fiscal flexibility index as a result equals 0.49). This case relates to the argument noted in Section 2.2 that EA accession with a reduction of fiscal flexibility could be beneficial for those countries that struggle with a fiscal deficit bias in a pre-accession setting. Accession that imposes an external constraint or commitment mechanism on domestic fiscal profligacy and deficit bias.

4) A negative shock to the EA interest rate

Shocks (1)-(3) were shocks of domestic origin. In line with the traditional OCA theories which concentrate on adjustment under asymmetric demand and supply shocks, our analysis quite strongly supported the notion that monetary policy autonomy (and also fiscal flexibility once in a monetary union) is desirable in the presence of domestic (or asymmetric) shocks. Pursuing this line of reasoning, one can also ask what are the effects of shocks originating from foreign sources, such as foreign output, foreign price and foreign interest rate shocks. Also these shocks will continue to hit the accession country once it has moved from a pre-accession to a post-accession status. It is therefore interesting to consider in the model also the effects of monetary and fiscal policy flexibility in the presence of foreign shocks. Figure 5 displays the effects from a shock to EA output ($v^{yEA}(0) = 1\%$).

[Insert Figure 4 here]

The effects of the shock to EA interest rates differ quite markedly between the pre- and post-accession regimes. In the pre-accession phase the exchange rate appreciates instantaneously which stabilizes most of the impact of the shock: the effects on output, inflation and domestic interest rates is limited compared to the post-accession regime. Monetary policy commitment delivers again significant gains in stabilizing inflation and output compared to discretionary monetary policy ($I^{SB} = 2.19$). In the post-accession case, the EA interest rate decline implies also a same decline in the domestic interest rate. This induces stronger and more cyclical fluctuations in output and inflation than in the pre-accession case. This is also clear from the values of the OCA indices. The values of 15.87 and 7.25 of I^{OCA} and II^{OCA} point at a quite dramatic stabilization loss from accession. To make things worse, upon accession fiscal flexibility is not providing much value added as suggests a fiscal flexibility index of 1.06. This example, in other words, highlights the notion that not only domestic shocks are highly relevant when analyzing the effects of accession but also foreign shocks and spillovers need to be taken into consideration. In fact, in this case there are very strong differences in the pre- and post accession, relating to the different adjustment of exchange rates (or better non-adjustment in the post-accession case) and interest rates in both regimes.

5) A positive shock to EA output

Another shock that deserves attention is a shock to EA output. With a high degree of integration between the accession country and the EA, accession countries will be subject to stronger spillover effects through trade. Figure 6 shows the adjustments produced by a 1% increase of EA output ($v^{yEA}(0) = 1\%$).

[Insert Figure 6 here]

The direction of the effects are similar to those produced by a demand shock but the size of the effects is considerably smaller given that net exports are only a fraction of total demand. In addition, the foreign output shock leads to a current account surplus rather than a deficit. Accession implies that the spillovers increase as there are no longer adjustments in exchange rate and interest rate that would partly offset the shock as in the pre-accession regime. This is clear from the increase in interest rate and the (nominal and real) exchange rate appreciation in the pre-accession case that contribute to stabilizing the EA output shock. Taking out fiscal flexibility in the post-accession regime is further aggravating the macro-economic adjustment problems for the acceding countries. The welfare indices highlight this aspect: I^{OCA}, II^{OCA} and I^{FF} equal 2.83, 1.23 and 1.72, respectively (i.e. the same outcomes as under a demand shock).

The results obtained above were based on the specific set of baseline parameters that was used and it may well be that some values may be inaccurate. It is therefore interesting and useful to check if the outcomes change if we change the baseline parameters. We experimented with the following variations relative to the baseline set of parameters: (i) the degree of forward-looking in the IS and Phillips curves: $\psi_1, \psi_2, \omega_1, \omega_2$. Clearly, the amount of forward-looking in the IS and Phillips curves plays a crucial role in the transmission of shocks in the different regimes and the effects of accession. (ii) other structural parameters: $\alpha, \eta, \sigma, \zeta, \delta, \gamma, \tau$. (iii) parameters that characterize fiscal policy rules λ_g, χ_g and monetary policy preference parameters $\Gamma, \beta, \xi, \nu, \kappa$. We experimented with alternative fiscal policy rules to assess their effects. Both in case of demand and cost-push shocks, a more inert and persistent fiscal policy increases the variance of inflation and output. In case of demand shocks, less fiscal flexibility raises the variance of interest rate, whereas the variance of interest rate is lowered in case of cost-push shocks. This suggests that from the perspective of the monetary policymaker, fiscal flexibility is preferred in case of demand shocks, but in case of cost-push shocks constraints on fiscal flexibility are needed. This outcome is robust across the three monetary policy regimes.

Next, we varied the preferences of the ECB under commitment and discretion. (a) the variance of inflation increases if the preferences for interest rate smoothing increase and it decreases with a higher preference for output stability. (b) The variance of the output gap increases if interest rate smoothing increases and it decreases with preferences for higher output stability. (c) Interest rate variability decreases with higher preferences for interest rate stability and it increases with higher preferences for output stability. Moreover, these effects conclusions hold both in case of commitment and discretion. (iv) assumptions on variances and autocorrelations of shocks, $\sigma^2_{v^i}, \rho^i$. The effects of increasing or decreasing the variance of

shocks are straightforward: this will lead to proportional changes in the variances of inflation, output etc. In addition, in the baseline equal variances of all shocks were assumed and it was seen that e.g. in terms of variability of output, cost-push shocks imply the highest variability of output and foreign output shocks the lowest. Increasing e.g. the variability of foreign output shocks will, ceteris paribus, increases the relative importance of foreign output shocks -and decreases the relative importance of the other type of shocks- in explaining the variability of output. Finally, the baseline set of parameters assumes that all shocks are uncorrelated with each other and are uncorrelated over time. The last assumption was not only done because of absence of empirical estimations but also for expositional reasons: increasing the degree of persistence of shocks has strong effects on all adjustments. The increased persistence of shocks will add to the internal persistence of the model produced in particular by the amount of backward-looking in inflation and output and the policy regime. In case of persistent shocks it will however no longer be impossible to distinguish how much of the persistence of variables is due to the persistence of shocks and how much of the persistence is intrinsic to the model

Conclusions

The enlargement of the EA with a new members, is receiving increasing attention and interest. Most economic questions relate directly and indirectly to the traditional OCA theory. In this paper, we focused on the role of monetary and fiscal policy design in acceding to the EA, using a stylized NK model of EA accession. We compared outcomes in a pre-accession and a post-accession regime to obtain the effects from accession to the EA by an accession country. In the pre-accession regime we focused on the importance of monetary policy being set in a context of policy commitment or discretion, in the post-accession regime we focused on the importance of fiscal flexibility. While the original OCA theory focuses on demand and supply shocks, we add more type of shocks to the analysis. In particular, we also analyzed the consequences of shocks in the (rest of) the EA on the accession countries. It was illustrated that also these shocks matter when considering the effects of accession.

The simulation examples point at the potential costs that accession might entail due its consequences on monetary and fiscal policy design. These consequences from accession in terms of macro-economic stabilization ability of monetary and fiscal policies have not always been fully acknowledged and need attention in our opinion. Somewhat ironically, these costs increase the more efficient monetary and fiscal policy are in the pre-accession phase: countries that are facing difficulties with monetary policy commitment and fiscal deficit bias, are likely to find that accession helps tackling both issues to a certain extent. Countries that have obtained a high degree of monetary policy commitment and fiscal prudence, however, may risk to find their stabilization ability largely decreased upon accession.

Extensions of the analysis could go into several directions: in particular one could envisage to estimate the model for one of the accession countries. This would enable to obtained more solid conclusions concerning the effects of EA enlargement in practice. Another aspect that could be considered concerns the

coordination of monetary and fiscal policy in the pre-accession phase and compare it with the outcomes in the post-accession phase. Introducing coordination of monetary and fiscal policy in the pre-accession is likely to underline the potential benefits from the unrestricted policy design in the pre-accession phase and would therefore further support rather than weaken our analysis.

Appendix

The model (1)-(4) can be written in state-space form:

$$\begin{bmatrix} X_{t+1} \\ x_{t+1} \end{bmatrix} = A \begin{bmatrix} X_t \\ x_t \end{bmatrix} + Bi_t + Cv_{t+1} \qquad \text{(A.1)}$$

where $X_t = \left[y_{t-1}\ \Delta p_{t-1}\ e_{t-1}\ p_{t-1}\ p_{t-1}^{EA}\ u_t^d\ \bar{y}_t\ u_t^s\ y_t^{EA}\ p_t^{EA}\ i_t^{EA}\ i_{t-1} g_t\ p_t \right]$ is a 14*1 vector of predetermined variables in the model, $x_t = \left[y_t\ \Delta p_t\ e_t \right]$ a 3*1 vector of forward-looking variables, $i_t = \left[i_t \right]$ a 1*1 vector of instruments and $v_t = \left[v_t^d\ v_t^{\bar{y}}\ v_t^s\ v_t^{yEA}\ v_t^{pEA}\ v_t^{iEA}\ v_t^g \right]$ a 7*1 vector of macroeconomic shocks.

The objective function of the policymaker (6) can be rewritten as;

$$\min_{i_t} L_t^E = E_t \sum_{\tau=0}^{\infty} \Gamma^{\tau}\ Y_{t+\tau}' W Y_{t+\tau} \text{ s.t. (A.1)} \qquad \text{(A.2)}$$

where $Y_t = \begin{bmatrix} y_t - \bar{y}_t \\ \pi_t \\ i_t - i_{t-1} \\ e_t - e_{t-1} \end{bmatrix} = D \begin{bmatrix} X_t \\ x_t \end{bmatrix} + C_i i_t$ is a 4*1 vector of target variables and $W = \begin{bmatrix} \beta & 0 & 0 & 0 \\ 0 & \xi & 0 & 0 \\ 0 & 0 & \nu & 0 \\ 0 & 0 & 0 & \kappa \end{bmatrix}$, the matrix with weighs of the different objectives.

The model (A.1)-(A.2) is a standard linear stochastic regulator problem with rational expectations and forward-looking variables Optimal policies can be determined (a) under a regime of policy commitment, (b) under policy discretion (see e.g. Oudiz and Sachs (1985), Backus and Driffill (1986), and Söderlind (1999), Jensen (2002) for the detailed working out of the optima; policies under commitment and discretion cases).

References

Backé P., C. Thimann, O. Arratibel, O. Calvo-Gonzalez, A. Mehl and C. Nerlich (2004), The Acceding Countries' Strategies Towards ERM II and the Adoption of the Euro: An Analytical Review, Occasional Paper Series No. 10.

Bayoumi, T, M. Kumhof, D. Laxton and K. Naknoi (2005), Exchange rate regimes, international linkages, and the macroeconomic performance of the New Member States, in Detken, C., Gaspar, V. and G. Noblet (eds.), The New EU Member States. Convergence and Stability, p. 121-171. Frankfurt, European Central Bank.

Boone, L. and M. Maurel (1999), An Optimal Currency Area Perspective of the EU Enlargement to the CEECs, CEPR Discussion Paper no. 2119.

Ca' Zorzi, M., R. De Santis, and F. Zampolli (2005), Welfare Implications of Joining A Common Currency, ECB Working Paper Series No. 445.

Devereux, M. (2003), A Macroeconomics Analysis of EU Accession under Alternative Monetary Policy, Journal of Common Market Studies, vol. 41 (5), pp.941-964.

Dvorsky, S. (2000), Measuring Central Bank Independence in Selected Transition Countries, OENB Focus on Transition 2/2000.

von Hagen, J. and I. Traistaru (2005), Macroeconomic Adjustment in the New EU Member States, in Detken, C., Gaspar, V. and G. Noblet (eds.), The New EU Member States. Convergence and Stability, p. 121-171. Frankfurt, European Central Bank.

Fidrmuc, J. and I. Korhonen (2003), Similarity of Supply and Demand Shocks Between the Euro Areas and the CEECs, Economic Systems, vol.27, p.313-334.

Natalucci, F. and F. Ravenna (2002), The Road to Adopting the Euro: Monetary Policy and Exchange Rate Regimes in EU Candidate Countries, Board of Governors of the Federal Reserve System, International Finance Discussion Papers No. 741.

Backus, D. and J. Driffill (1986), The Consistency of Optimal Policy in Stochastic Rational Expectations Models, CEPR Discussion Paper 124.

Batini, N., R. Harrison, and S. Millard (2003), Monetary Policy Rules for an Open Economy, *Journal of Economic Dynamics and Control*, vol.27, p.2059-2094.

Blanchard, O. and C. Kahn (1980), The Solution of Linear Difference Models under Rational Expectations, Econometrica, vol. 48(5), p.1305-1311.

Clarida, R., J. Gali, and M. Gertler (1999), The Science of Monetary Policy: A New Keynesian Perspective, *Journal of Economic Literature*, vol.37, p.1661-1707.

Ehrmann, M. and Smets (2003), Uncertain Potential Output: Implications for Monetary Policy, *Journal of Economics and Dynamics*, vol.27, p.1611-1638.

Fuhrer, J. and G. Moore (1995), Monetary Policy Trade-Offs and the Correlation between Nominal Interest Rates and Real Output, *American Economic Review*, vol.85(1), p.219-239.

Gagnon, J. and J. Ihrig (2002), Monetary Policy and Exchange Rate Pass-Through, mimeo.

Giordani, P. (2004), Evaluating New-Keynesian Models of a Small Open Economy, *Oxford Bulletin of Economics and Statistics*, vol.66, p.713-733.

Huh, C. and K. Lansing (2000), Expectations, Credibility, and Disinflation in a Small Macroeconomic Model, *Journal of Economics and Business*, vol.51(1-2), 51-86.

Jensen, H. (2002), Targeting Nominal Income Growth or Inflation?, American Economic Review, vol.92(4), p.928-956.

Leitemo, K. O. Roisland and R. Torvik (2002), Time Inconsistency and the Exchange Rate Channel of Monetary Policy, *Scandinavian Journal of Economics*, vol.104(3), p.391-397.

Leith, C. and J. Malley (2002), Estimated General Equilibrium Models for the Evaluation of Monetary Policy in the US and Europe, CESifo Working Paper no.699.

Muscatelli, V., P. Tirelli and C. Trecroci (2004), Fiscal and Monetary Policy Interactions: Empirical Evidence and Optimal Policy Using a Structural New-Keynesian model, *Journal of Macroeconomics*, vol.26, p.257-280.

Oudiz, G. and J. Sachs (1985), International Policy Coordination in Dynamic Macroeconomic Models. In Buiter,W. and R. Marston (eds.), International Economic Policy Coordination. Cambrigde University Press, Cambridge.

Smets, F. (2003), Maintaining Price Stability: How Long is the medium Term?, Journal of Monetary Economics, vol.50, p.1293-1309.

Smets, F. and R. Wouters (2002), Openness, Imperfect Exchange Rate Pass-Through and Monetary Policy, *Journal of Monetary Economics*, vol.49(5), p.947-981.

Söderlind, P. (1999), Solution and Estimation of RE Macromodels with Optimal Policy, European Economic Review, vol.43, p.813-823.

Svensson, L. (2000), Open-economy Inflation Targeting, *Journal of International Economics*, vol.50, p.155-183.

Taylor, J. (2000), Reassessing Discretionary Fiscal Policy, *Journal of Economic Perspectives*, vol.14(3), p.21-36.

Woodford, M. (2003), Interest and Prices: Foundations of a Theory of Monetary Policy. Princeton University Press, Princeton.

ψ	0.5	Γ	0.995	ρ^{v^i}	0.0
α	0.3	β	1.0	$\sigma^2_{v^i}$	1.0
η	0.5	ξ	0.5	$cor(v^i, v^j)$	0.0
σ	0.5	ν	0.5		
δ	0.2	κ	0.0		
ω	0.5	λ_g	0.5		
γ	0.1	χ_g	0.4		
τ	0.2				

Table 1
Baseline parameters of the IS and Phillips curves, Taylor rules and macroeconomic shocks.

		Pre-accession		Post-accesion	
		(i) Commitment	(ii) Discretion	(iii) Monetary Union	(iv) No Fiscal Flexibility
v^d	var(π)	0.057	0.188	0.087	0.234
	var($y - \overline{y}$)	0.527	1.040	1.865	3.048
	var(i)	0.146	0.414	0.000	0.000
	var(e)	9.675	1.079	0.000	0.000
	var(g)	0.027	0.068	0.112	0.000
	L	71.473	163.339	202.130	346.699
	I^{SB}	2.29		I^{FF}	1.72
	I^{OCA}	2.83		II^{OCA}	1.24
v^s	var(π)	1.383	5.377	1.899	1.973
	var($y - \overline{y}$)	6.816	7.553	6.523	13.297
	var(i)	0.782	1.599	0.000	0.000
	var(e)	0.548	7.747	0.000	0.000
	var(g)	0.055	0.853	0.749	0.000
	L	950.168	1853.487	1017.362	1691.884
	I^{SB}	1.95		I^{FF}	1.66
	I^{OCA}	1.07		II^{OCA}	0.55
v^g	var(π)	0.076	0.311	0.148	0.0603
	var($y - \overline{y}$)	0.163	0.842	1.526	0.7757
	var(i)	0.058	0.351	0.000	0.000
	var(e)	15.230	1.474	0.000	0.000
	var(g)	1.262	1.267	1.137	1.000
	L	32.446	152.197	179.977	88.404
	I^{SB}	4.69		I^{FF}	0.49
	I^{OCA}	5.55		II^{OCA}	1.18
V^{yEA}	var(π)	0.009	0.030	0.014	0.037
	var($y - \overline{y}$)	0.084	0.166	0.298	0.488
	var(i)	0.023	0.066	0.000	0.000
	var(e)	1.548	0.173	0.000	0.000
	var(g)	0.004	0.011	0.018	0.000
	L	11.436	26.134	32.341	55.472
	I^{SB}	2.29		I^{FF}	1.72
	I^{OCA}	2.83		II^{OCA}	1.24
V^{iEA}	var(π)	0.037	0.090	0.008	0.021
	var($y - \overline{y}$)	0.040	0.091	0.168	0.274
	var(i)	0.042	0.030	0.000	0.999
	var(e)	1.150	0.773	0.000	0.000
	var(g)	0.004	0.010	0.010	0.000
	L	13.668	29.927	216.855	229.664
	I^{SB}	2.19		I^{FF}	1.06
	I^{OCA}	15.87		II^{OCA}	7.25

Table 2
Variance analysis and losses from various shocks.

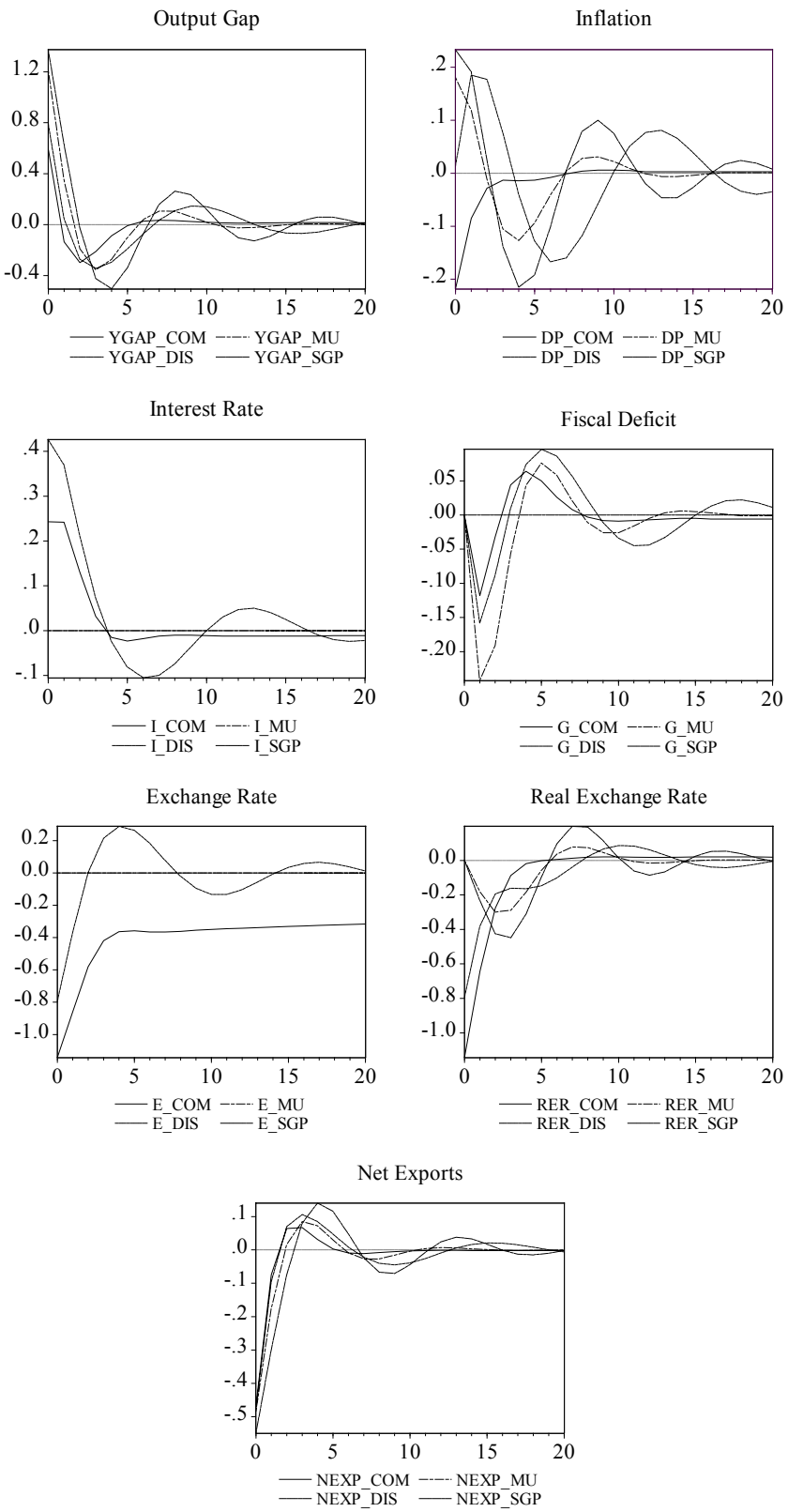

Figure 1
Effects of a Demand Shock

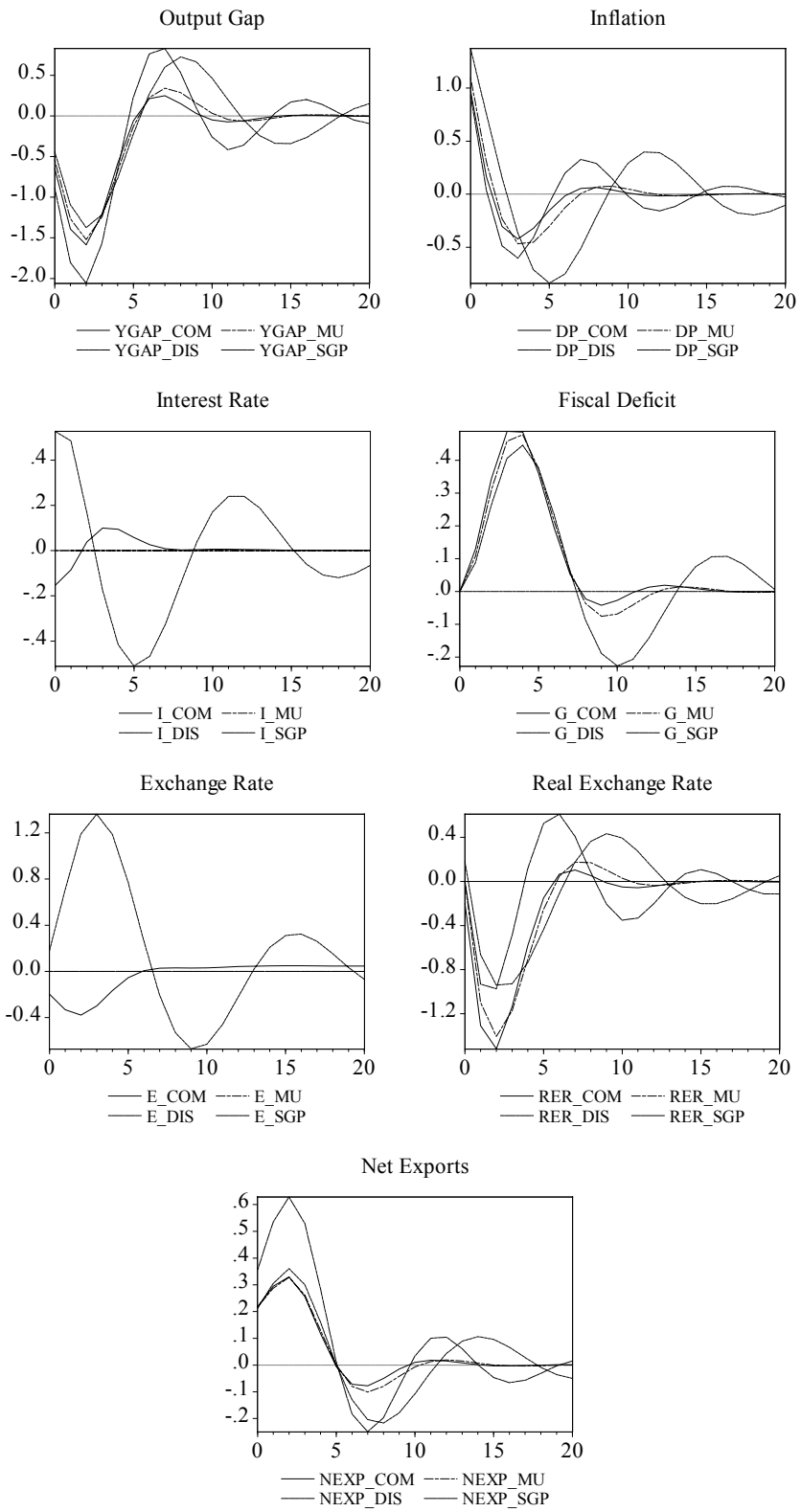

Figure 2
Effects of a Cost-Push Shock

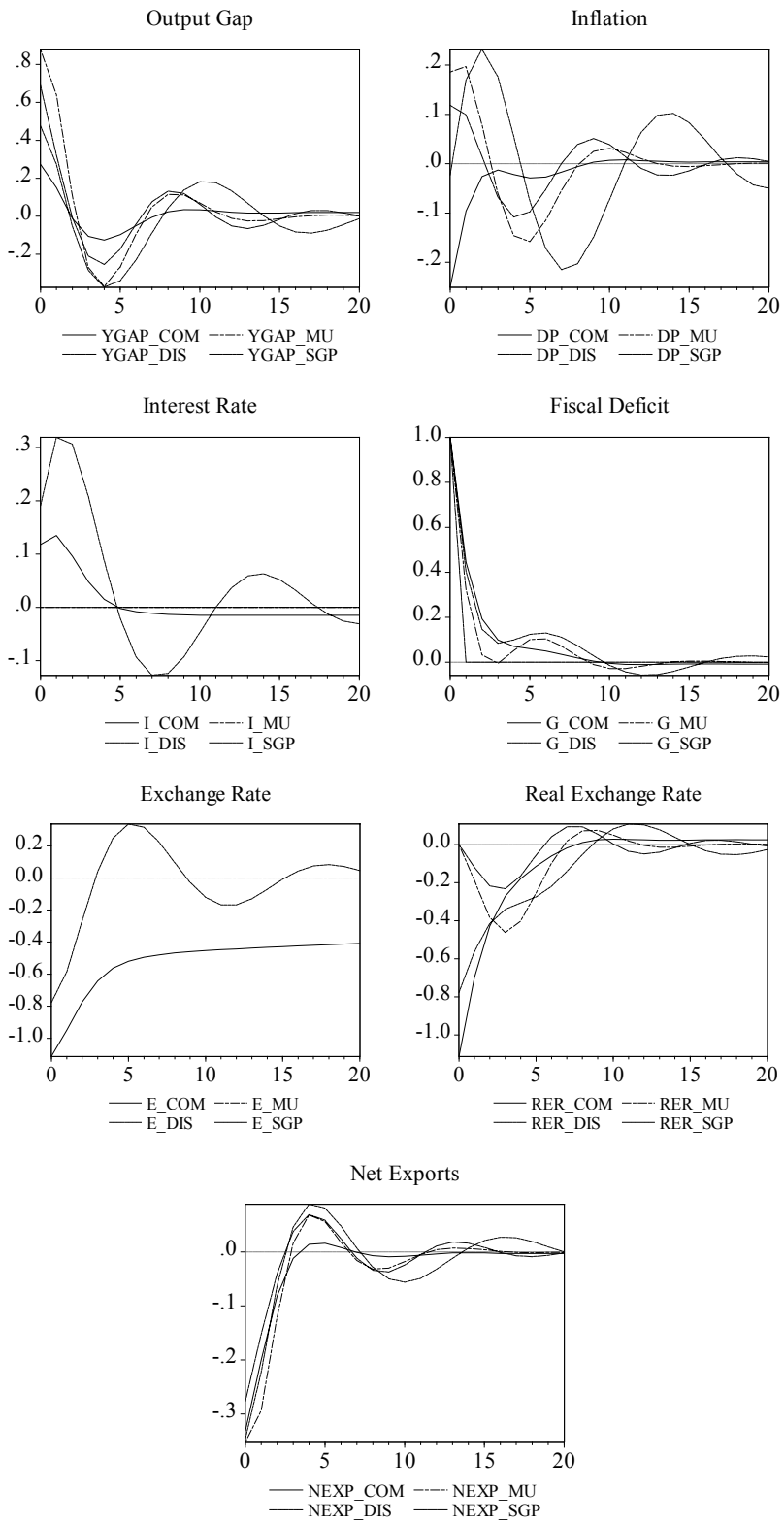

Figure 4
Effects of a Fiscal Shock

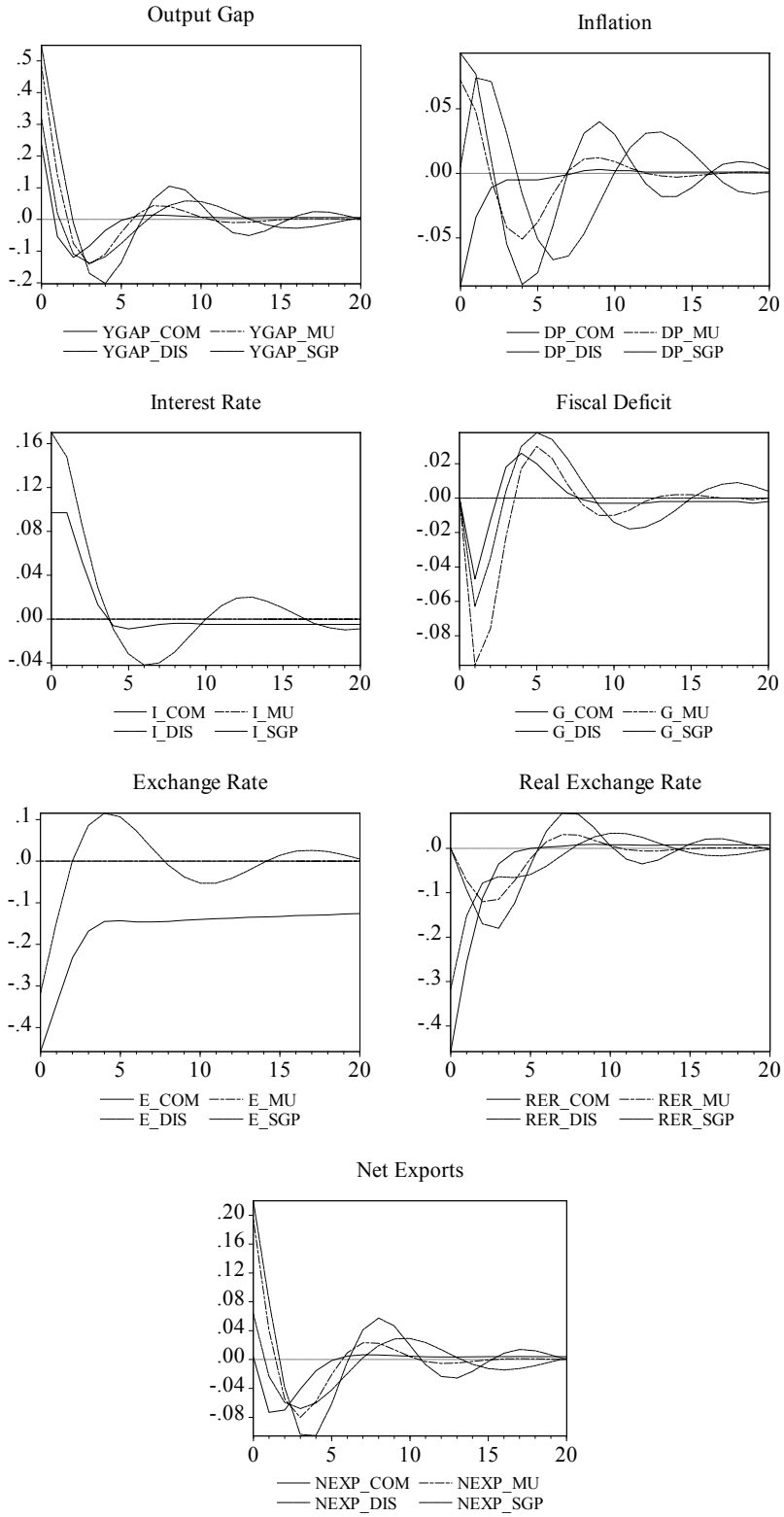

Figure 5
Effects of a EA Output Shock

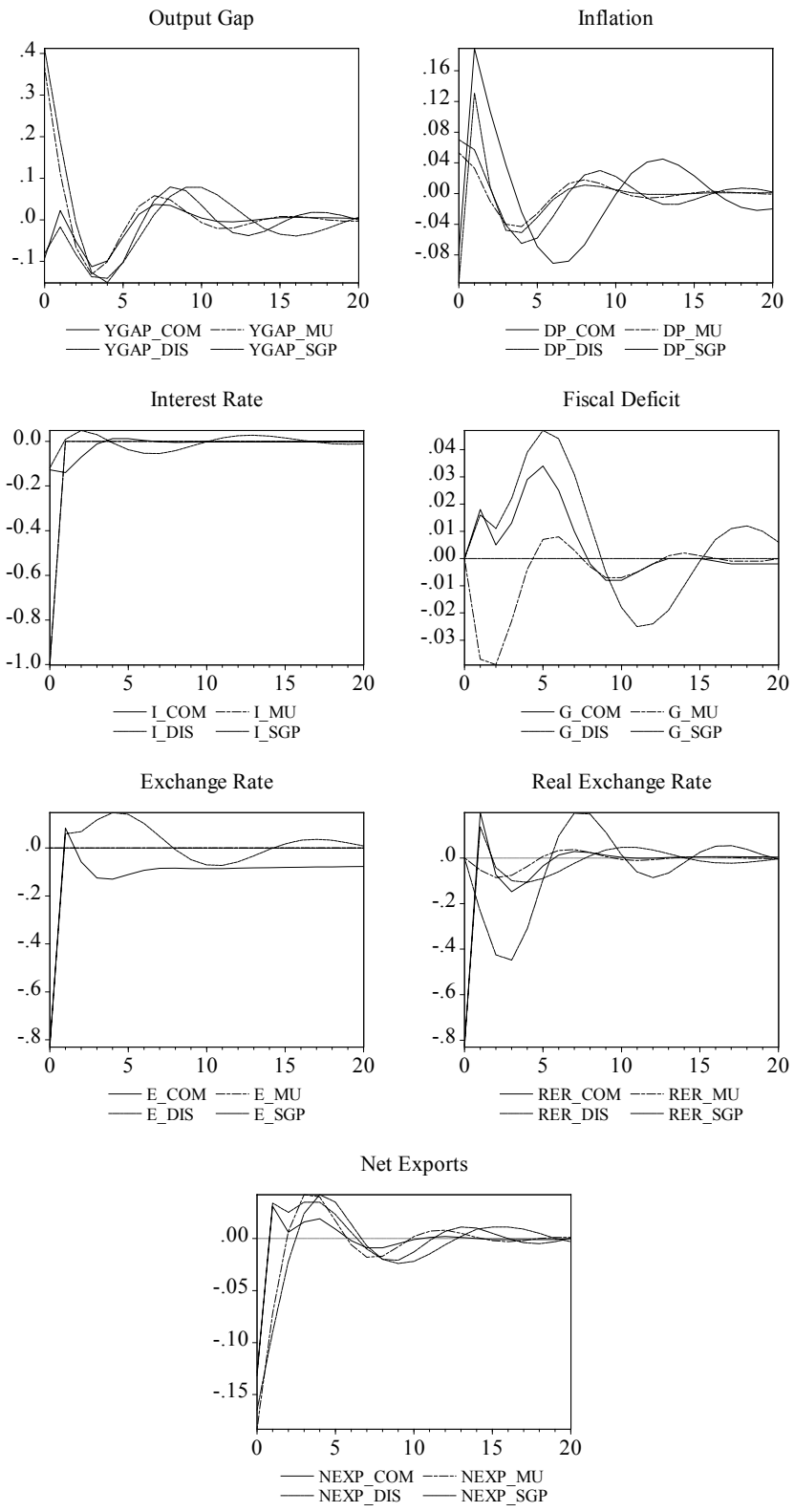

Figure 6
Effects of a EA Interest Rate Shock