THE IMPACT OF THE EU ENLARGEMENT ON FOREIGN DIRECT INVESTMENT IN ACCEDING AND NON-ACCEDING COUNTRIES

by

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Abstract

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This thesis is devoted to the study of the impact of the European Union enlargement on Foreign Direct Investment (FDI) in acceding and non-acceding countries. The analysis is performed in the context of a dynamic general equilibrium model, which enables us to conduct both qualitative and quantitative investigation of the issue. The EU enlargement event is modeled through the changes in the closeness of environments between countries in the wake of accession and, thus, changes in the extra cost of investing abroad instead of the domestic economy. That effect was introduced in the model through the parameter of "border costs", empirical evidence on which was thoroughly studied. The simulations of the model, calibrated for the enlargement of 2004, have shown that the enlargement motivates foreigners to increase investment in acceding countries whereas does not appear to influence FDI pattern in non-acceding countries much. In addition, the analysis assesses the short-run and long-run welfare implications of the enlargement for the acceding and non-acceding countries as well as for the EU.

TABLE OF CONTENTS

LIST OF FIGURES

Number *Page*

LIST OF TABLES

Number *Page*

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GLOSSARY

CEE — Central and Eastern Europe

CEEC's — Central and Eastern European countries

CIS — Commonwealth of Independent States

CRRA — Constant Relative Risk Aversion

E&Y — Ernst & Young

EEG — East European Group

EIU —Economist Intelligent Unit

EU — European Union

FDI — foreign direct investment

GDP — gross domestic product

LR — long-run

MC — mean comparison test

NAC — non-acceding country

OECD — Organization for Economic Cooperation and Development

OLI — Ownership, Location, and Internalization

SR — short-run

VC — variance comparison test

Chapter 1

INTRODUCTION

Questions related to the European Union enlargement have recently become particularly topical ones in view of this year enlargement to the East. On the 1st May 2004 ten countries have joined the EU (8 CEE transition economies together with Cyprus and Malta). Issues concerning this enlargement to the East are of special interest for economists and policy-makers as well as for businessmen. Primarily, this is due to the fact that, though there have been four enlargements in the history of the EU, the current one promises to be an unprecedented attempt on political and economic integration by its scope, diversity and possible consequences. The European Commission considers the wide range of effects in the context of the coming enlargement, including the effects on trade, FDI, employment, and growth (see, e.g., Di Mauro, 2000). On the whole, enlargement is a complicated process with potentially widespread effects. In this regard the study of its possible impact on the FDI pattern in the region — one of the two main channels of economic integration along with trade channel— seems to be a subject of great interest.

Although in the modern economic literature there are some studies devoted to the effect of the EU enlargement on FDI flows, the main emphasis is put on the old and new member states, while non-acceding countries received very limited attention. The purpose of this paper is to move beyond the studies that make such focus and examine the effect on both acceding and non-acceding transition economies.

The investigation of possible changes in geographical distribution of FDI in transition economies deserve special attention based on the role that this outside source of funds plays in the transformation process and the spillover effect it may generate. It is widely believed that together with FDI new technology and new managerial culture flow in the country. Moreover, there are studies (Aitken, Hanson and Harrison, 1994) which point out such characteristic of FDI as facilitation of access to the international markets. FDI is also associated with upgrading of the workers skills, improving social standards, modernising equipment. Following Grabbe (2001) foreign investors are more effective than domestic owners in restructuring of firms after privatization. There is also plenty of empirical evidence in favour of the ability of FDI to accelerate growth and development (Maher et al., 2001). Thus the future dynamics of FDI in transition economies is a policy question which is worth studying.

The exploration of the issue, this paper tries to shed light on, appears to be both a crucially important and challenging task. First, it is important since EU enlargement may influence not only the accession countries but also the surrounding region, and although there is a firm perception that enlargement process positively influences the FDI attractiveness of accession states, whether the effect on investment dynamics will be positive or negative for non-acceding countries remains a contentious issue. Possible concentration of FDI in accession countries can result in a lack of foreign capital flows to non-acceding transition economies and lead to a widening gap in the regional development. Hence, it is important to better know the possible consequences in advance in order to be prepared for them. Second, it is challenging because the impact of EU enlargement is hard to predict and assess. Primarily, this is due to the vast variety of determinants of foreign investors' decisions and necessity to use ex ante analysis which complicates the formalization of the question a lot.

So far studies devoted to the investigation of the effect of the eastern enlargement on FDI flows were based predominantly on the descriptive methods of analysis, which use economic logic to make inferences, and quantitative analysis was mainly restricted to the use of gravity-type models for new and old members. This thesis contributes to the literature by investigating the impact of EU enlargement on FDI in acceding and non-acceding transition economies and tries to answer the question by applying the model which has an economic background in neoclassical growth theory. The basic model was built by Serguei and Lilia Maliar (2003) and developed further in close cooperation with them. Such methodology enables us to capture the overall impact of EU enlargement on FDI dynamics in acceding and non-acceding countries, examine the possible welfare implications, and trace the development of variables under consideration through time.

The rest of the paper proceeds as follows. *Chapter 2* provides a concise review of the studies related to the topic. The analysis of the literature on the impact of the EU enlargement on FDI flows suggests that despite the fact that the topic of the consequences of the coming enlargement noticeably draws the attention of researchers, there is a shortage of works employing the quantitative dynamic analysis based on the theoretical underpinnings. This can be partly explained by the challenge of dealing with the ex ante nature of the question. In *Chapter 3* follows the detailed discussion of the dynamic general equilibrium model in context of which the phenomena is studied. *Chapter 4* describes the data needed and employed in the analysis. *Chapter 5* presents the methodology and the results of the quantitative analysis. Finally, *Chapter 7* concludes the paper with the summary of results and suggests directions for further investigation.

Chapter 2

LITERATURE REVIEW

In this part of the paper follows a concise review of the theoretical and empirical findings related to the analysis of the EU enlargement and FDI. It is noteworthy that both phenomena attract a lot of attention of academic as well as business researchers. However, due to the complex multidimensional nature of the issue and ambiguity of possible effects there is still a lot of room for research. This review is mainly constrained to the papers pertinent to the relationship between eastern enlargement and FDI in acceding and non-acceding transition economies, yet some references to the literature that investigates other aspects of enlargement and FDI are also provided.

Before turning to the Enlargement and FDI literature, it is worth paying attention to the papers devoted to the general FDI characteristics. Despite the abundant variety of studies dealing with exploration of the determinants of FDI, there is no consensual view on which approach to consider the most justifiable. Since the main purpose of this paper lies beyond determining FDI location factors and there are a lot of studies fully devoted to this issue (e.g. Bismas, 2002; Van de Laar, 2000; Bevan and Estrin, 2000), we will discuss only the most prevalent approaches. Following Van de Laar (2000), the theory that incorporates almost all factors of FDI and is frequently updated and adjusted is the OLI paradigm, introduced by Dunning. According to this theory FDI is determined by Ownership, Location, and Internalization factors which are widely defined. Although the OLI framework explains the presence of FDI, it is criticized for its relative weakness in explaining the dynamics of FDI and its insufficiency in

providing empirical models due to the lack of uniqueness in the choice of factors. Van de Laar also argues that there is no dominating theory regarding FDI on the micro-level while gravity-type models are widely used for macro-level empirical analysis.

Starting from the nineties empirical papers have emerged concerning the issue of FDI in transition economies. A widely-cited research by Lankes and Venables (1996) analyses a survey of senior managers of 117 western manufacturing firms and concludes that the type of FDI projects (market-seeking and efficiency-seeking) undertaken by a firm depends significantly on the host country's progress in economic transition. Other stated important factors are local market size, factor costs, access to EU markets, political stability, and regulatory environment. The most recent study (Deichmann et al., 2003), employing a regression model based on twenty-six variables for Eurasian transition states, identifies the significant impact of labor skills and infrastructure as well as trade policy and market reforms on a country's investment appeal. The other interesting finding is that mainly human and social capital explains the distribution of FDI in favor of western states. A separate study for CEE countries conducted by Carstensen and Toubal (2003) brought comparable results. The authors used dynamic panel data methods and came to the conclusion that although both traditional and transition-specific factors (such as level and method of privatization, country risk) affect FDI, mainly the latter ones explain different attractiveness of Central vis-à-vis Eastern European countries. They also found a complimentary relationship between FDI and trade, which is consistent with other researches (e.g., Di Mauro, 2000). Though these studies have not considered the transition economies in the context of the EU enlargement, their findings may help in inferring about its impact on the geographical composition of FDI in transition economies. Moreover, the authors of the latter paper speculate about possible positive effect of integration on

market potential, transportation, trade, and negative one on unit labors costs for CEEC's, and propose to study the enlargement's effect on the location of multinationals.

During the last decade numerous attempts were made to gain a deeper insight into the enlargement process and the costs and benefits associated with it. Though there is at least one example of applying a general equilibrium model in this context (Baldwin, Francois, and Portes, 1997), most papers employ descriptive method of analysis or use gravity-type models to ground (or justify) their theoretical conclusions. Keeping in mind the purpose of the current paper to investigate the impact of eastern enlargement on FDI pattern in acceding and non-acceding countries, while proceeding with literature review, we will make the main focus on questions related to the research.

Recent works of Read and Bradley (2001), Smaghi (2002), and Grabbe (2003) would be an example of the academic descriptive literature devoted to the eastern enlargement. The authors of the first two papers emphasize the importance of the implications of enlargement for existing and new members and come to the conclusion that candidate countries appear to gain in general while there may be some adjustment costs. In particular, whereas capital is expected to benefit, labor could lose in terms of wages or employment. In comparison to these papers, Grabbe's work pays more attention to the investment effect of enlargement and points also at the influence on the surrounding region. The author argues in favor of significant implications of the process for 'left-out' countries[1] and states that a more negative effect could be expected for the CIS countries. Following Grabbe this can happen due to the adverse impact of visa

[1] The author distinguish between three group of 'left-out' countries: the candidate countries Bulgaria and Romania; the 'Western Balkans' of Albania, Bosnia and Herzegovina, Croatia, Macedonia, Yugoslavia; the European CIS countries of Belarus, Moldova, Ukraine.

and Shengen border regimes as well as a result of greater integration of CEE countries with Western Europe and widening gap with their eastern neighbors. Regarding investments, the author's opinion is that most of the trade diversion potentially affecting the 'left-outs' has already occurred because what is important is a trade liberalization, not the membership itself, and accession is expected to have much more impact on the geographic distribution of FDI partially due to the fact that EU entry will make the regulation in the accession countries more predictable.

A good discussion of the investment effect and other aspects of the enlargement can be found in another work of Grabbe (2001) — "Opening up the business opportunities of EU enlargement". As one of the key benefits of enlargement the author sees the opportunity it gives for foreign direct investors. Expanded market, open borders, common regulatory environment contribute to the predictability of political and economic futures of new members, reduce risk, lower transportation costs for cross-border business, and as a result increase the confidence for investing in the region. Moreover, the author suggests that accession prospects itself play an important role in FDI decisions[2] and based on the historical cases of Portugal and Spain concludes that significant capital flows in new member states may be expected. Considering the impact on the labor markets, Grabbe claims that, first, large-scale migration is unlikely to happen while some move of the highly skilled workers may occur, and, second, an increase in job creation for both old and new member states can be expected. On the whole, focusing on the old and new member states, this study presents the enlargement as a win-win process and spurs to treat such extremely optimistic view with some level of caution.

[2] This 'anticipatory effect' was also found in other studies (e.g. Bevan, Estrin and Grabbe, 2001; Egger, Pfaffermayr, 2002; Buch, Kokta and Piazolo, 2001)

Contrary to the above discussed paper, other examples of business research, while sharing the main conclusions, hold more moderate views. A study by EIU and E&Y (2002) reveals that there is unlikely to be a sharp increase of FDI flows to CEE as a result of accession since most interested investors have already taken into account this effect. However, the authors believe EU accession will create a new set of investment motives in favor of CEE over other global locations, similar to those presented in Grabbe (2001), — reduced risk and transaction costs, increased market and stability. Among other positive for CEE factors, infrastructure, proximity, and 'bridging function' of new members are mentioned. Another important conclusion of the study is that though new members will preserve relatively low production costs for the next 15 years[3], they will not be competitive on labor costs alone with Asia or Ukraine. The authors argue that increased wages have already led to the movement of some types of production further east. In relation to labor market, they expect an increase in employment over time with some short-run unemployment adjustment.

A number of attempts to get insights into the enlargement issue by using surveys can be found in both academic (e.g., White et al., 2002) and business (e.g., EIU, 2003) literature. The main goal of such studies is to identify the attitude and expectations toward the enlargement of different parties of the process. The authors of the first paper investigated the public disposition to the EU in Belarus, Moldova, Russia, and Ukraine, and found that a generally positive attitude in the outsider states is combined with ignorance and uncertainty. The second paper contains a survey of executives and shows results similar to the above discussed papers. On the whole, respondents see enlargement as a business opportunity, stemming from the improving economic and business environment. In addition, the survey reveals the expectations for an increase in operating costs, however,

[3] For a more detailed discussion of labor cost adjustment for CEE an interested reader is encouraged to refer to EEG and E&Y (2003)

regarding the possible changes in labor costs and FDI pattern, the results are consistent with EIU and E&Y (2002).

As it has already been discussed, empirical studies devoted to the enlargement and FDI issue use predominantly the gravitational approach[4]. Good examples would be the works of Egger and Pfaffermayr (2002) and Martín and Turrión (2003). Using OECD FDI statistics for 1986-1998, the former authors studied the effect of EU integration process[5] on FDI relations in Europe. In their gravity model specification they included population, real GDP per capita, bilateral effects (to control for time-invariant characteristics like distance, common language, common borders), time effects, and integration effects in the form of integration dummies. The main finding of Egger and Pfaffermayr is the existence of a positive but mainly anticipatory effect of each integration step on FDI relationship in Europe. Martín and Turrión, addressing the investigation of FDI pattern in present (EU-15) and future (ten CEE countries) members of the EU during 1992-1999, used a somewhat different specification of the gravitation model[6]. Based on the obtained results authors explain an increase in FDI flows in CEE countries during the nineties by the labor costs, human capital, and proximity advantages. In addition, they suppose that there may be a diversion of investment flows from Greece, Portugal, and Spain to CEE countries. However, Buch, Kokta and Piazolo (2001) and Galero, Vieira and Vieira (2002), who directly examined that question (besides by employing gravity-type models) have

[4] The basic gravity model originates from physics Newtonian model and gives the insight into bilateral FDI flows between countries depending on GDP, population size and geographical or economic distance. Although not without limitations (Van de Laar, 2000), it is widely used in the analysis of FDI flows.

[5] namely such events as the Single market Programme, the 1995 enlargement, and the European agreements between the EU and CEE

[6] As regressors they included technological advantage of home over host country, relative factor endowment (measured as a physical capital-labor ratio) of home country to host one, human capital stock and transport infrastructure of a host country, and geographical distance between capitals of home and host countries.

found no strong evidence of diversion of FDI flows from the South to the East of Europe.

As follows from the literature review above, regarding the impact of eastern enlargement on FDI flows, the main emphasis was made on the exploration of the effects on present and future EU members in the framework of descriptive analysis or quantitative approach based on the gravity-type models, which yet as some researchers state (Buch, Kokta and Piazolo, 2001; Van de Laar, 2000) should be treated with certain degree of caution, for example, because they do not take into account many specific variables. However, there is ground to suppose that there may be also some consequences for the non-acceding countries. Moreover, following Dyker's (2003) notes there are factors which can play both for (e.g. an increase in the gap between wages in CEE and non-CEE) and against (e.g. an improved perception of the political and business environment in accession states) the FDI appeal of non-acceding countries. Taking all those into account and the substantial role that FDI plays in transformation process, this thesis is aimed to investigate the impact of eastern EU enlargement on FDI dynamics in both acceding and non-acceding transition economies employing the multi-country growth model made by Serguei and Lilia Maliar (2003) and developed further in close cooperation with them.

Chapter 3

DESCRIPTION OF THE MODEL

Below follows a detailed description of the model specially built to explore the implications of the current EU enlargement in the framework of neoclassical growth theory.

The model considers a world economy consisting of three different countries. The variables of each country are denoted by superscripts "*s*", "*j*", and "*l*" correspondingly. The countries have identical fundamentals, that are preferences and technology, but they can differ in population and initial capital stock. The population sizes of the three countries are denoted by v^s, v^j, v^l, and are assumed to be constant over time. Each country solves the same optimization problem, which is described below on the example of country s. In addition, capital is assumed to be mobile across the countries whereas labor is not. Time is discrete and the horizon is infinite, $t \in T$, where $T = \{0, 1, 2, ...\}$

The general setup of the model: the country's problem

The *consumer's side* of country s consists of an infinitely-lived representative consumer who can invest both in its own country and the other countries. The consumer solves the following intertemporal utility maximization problem:

$$\max_{\{c_t^s, n_t^s, i_t^s, x_t^{s,j}, x_t^{s,l}, k_{t+1}^s, \phi_{t+1}^{s,j}, \phi_{t+1}^{s,l}\}_{t \in T}} \sum_{t=0}^{\infty} \delta^t u(c_t^s, 1 - n_t^s), \qquad (1)$$

subject to

$$c_t^s + i_t^s + x_t^{s,j} + x_t^{s,l} = w_t^s n_t^s + r_t^s k_t^s + \lambda^{s,j} r_t^j \phi_t^{s,j} + \lambda^{s,l} r_t^l \phi_t^{s,l}, \quad (2)$$

$$k_{t+1}^s = (1-d)k_t^s + i_t^s, \quad (3)$$

$$\phi_{t+1}^{s,j} = (1-d)\phi_t^{s,j} + x_t^{s,j}, \quad (4)$$

$$\phi_{t+1}^{s,l} = (1-d)\phi_t^{s,l} + x_t^{s,l} \quad (5)$$

where $c_t^s, n_t^s, i_t^s, x_t^{s,j}, x_t^{s,l}, k_{t+1}^s, \phi_{t+1}^{s,j}, \phi_{t+1}^{s,l} \geq 0$ and initial condition $(k_0^s, \phi_0^{s,j}, \phi_0^{s,l})$ is given. Here, $c_t^s, n_t^s, i_t^s, k_t^s, r_t^s$ and w_t^s denote consumption, units of labor supplied (hours worked), investment, capital, interest rate, and wage paid for one unit of labor in country s; $x_t^{s,j}$ and $\phi_t^{s,j}$ are, respectively, investment and capital going from s to j; $x_t^{s,l}$ and $\phi_t^{s,l}$ are, respectively, investment and capital going from s to l; r_t^j and r_t^l are interest rates in countries j and l; $\delta \in (0,1)$ is the discount factor; $d \in (0,1]$ is the depreciation rate of capital, and, finally, the *parameters* $0 \leq \lambda^{s,j}, \lambda^{s,l} \leq 1$ *are fractions of the foreign capital gains that country* s *receives from capital holdings in countries* j *and* l*, respectively*. The total time endowment of the agent is normalized to one, hence $(1-n_t^s)$ represents leisure. The period utility function, u, is continuously differentiable, strictly increasing in both arguments, and strictly concave.

The parameters $\lambda^{s,j}, \lambda^{s,l}$ play an important role in the analysis: through them, as described further in the thesis, the fact of enlargement is modelled. Therefore, let us treat the meaning of these parameters, which we call "border costs", in more details. First of all, the parameters imply that the existence of border between countries can lead to a loss of some profits due to, for example, such factors as currency exchange, higher cost of acquiring information about the foreign enterprises, transportation cost. Further, the quantitative expression of

the border costs depends on the distance between the countries s and corresponding country j or l. We adopt a broad definition of distance between countries, namely, it reflects the difference between countries environments and can depend on political, legislative, regulation etc. conditions.

After combining constraints (2)-(5) into a single budget constraint, we can re-write the consumer's problem as follows:

$$\max_{\{c_t^s, n_t^s, k_{t+1}^s, \phi_{t+1}^{s,j}, \phi_{t+1}^{s,l}\}_{t\in T}} \sum_{t=0}^{\infty} \delta^t u\left(c_t^s, 1-n_t^s\right), \tag{6}$$

subject to

$$\begin{aligned} c_t^s + k_{t+1}^s + \phi_{t+1}^{s,j} + \phi_{t+1}^{s,l} = \\ w_t^s n_t^s + (1-d)(k_t^s + \phi_t^{s,j} + \phi_t^{s,l}) + r_t^s k_t^s + \lambda^{s,j} r_t^j \phi_t^{s,j} + \lambda^{s,l} r_t^l \phi_t^{s,l}, \end{aligned} \tag{7}$$

where the initial condition $(k_0^s, \phi_0^{s,j}, \phi_0^{s,l})$ is given.

The *producer's side* of the economy consists of a representative firm producing a single output commodity from capital and labor inputs. The firm maximizes period-by-period profits by choosing demand for capital K_t^s and labor N_t^s, so that its problem is given by

$$\pi_t^s = \max_{K_t^s, N_t^s} \left\{ Af\left(K_t^s, N_t^s\right) - r_t^s K_t^s - w_t^s N_t^s \right\}, \tag{8}$$

where $K_t^s \equiv k_t^s v^s + \phi_t^{j,s} v^j + \phi_t^{l,s} v^l$ and $N_t^s \equiv n_t^s v^s$ are, respectively, total capital and labour demanded by the representative firm of country s; $\phi_t^{j,s}$ and $\phi_t^{l,s}$ are capital in the production of country s owned by countries j and l, respectively; $A > 0$ and the production function f has constant returns to scale, is strictly concave, continuously differentiable, strictly increasing with respect to both

arguments, and satisfies the appropriate Inada conditions[7]. Thus, according to our assumptions, the domestic and the foreign capital are perfect substitutes in the domestic production, and the capital stock employed in the production by a country s consists of the country's own capital and the capital stock held by all foreign investors while the labor employed in the economy is only domestic labor.

A *competitive equilibrium* in the world economy is defined as a sequence of consumer's allocations in all countries, $\left\{c_t^s, n_t^s, k_{t+1}^s, \phi_{t+1}^{s,j}, \phi_{t+1}^{s,l}\right\}_{t\in T}$, $\left\{c_t^j, n_t^j, k_{t+1}^j, \phi_{t+1}^{j,s}, \phi_{t+1}^{j,l}\right\}_{t\in T}$, $\left\{c_t^l, n_t^l, k_{t+1}^l, \phi_{t+1}^{l,s}, \phi_{t+1}^{l,j}\right\}_{t\in T}$, a sequence of producer's allocations in all countries, $\left\{K_t^s, n_t^s\right\}_{t\in T}$, $\left\{K_t^j, n_t^j\right\}_{t\in T}$, $\left\{K_t^l, n_t^l\right\}_{t\in T}$, and a sequence of prices in all countries, $\left\{r_t^s, w_t^s\right\}_{t\in T}$, $\left\{r_t^j, w_t^j\right\}_{t\in T}$, $\left\{r_t^l, w_t^l\right\}_{t\in T}$, such that given the prices

(i) the consumer's allocation solves the utility-maximization problem (6)-(7) for each country s, j, l;

(ii) the producer's allocation solves the profits-maximization problem (8) for each country s, j, l;

(iii) all markets clear.

The setup of the model of a two-country world

In order to simplify the analysis of equilibrium and to reduce the computational expense, Lilia and Serguei Maliar elaborated the way of numerical studying the model in a two- instead of three-country framework. For this purpose some additional assumptions are imposed on the model,

[7] Inada conditions state that $\lim_{i\to 0} f_i = \infty$, $\lim_{i\to\infty} f_i = 0$, where i denotes the argument of the function f and f_i denotes the first-order partial derivative of function f with respect to the argument i.

which are discussed in the next section (devoted to the issue of reducing the three-country model to two-country model for enabling the further numerical study of the model). Here, the supplementary two-country setup is presented.

In the world of two countries, preferences and technology of countries are assumed to be identical and coincide with those of the three-country world. One country is interpreted as the European Union (EU) and its variables are denoted by letters without superscript. Another country is interpreted as a Non-Acceding Country (NAC) and its variables are denoted by letters with superscript "n". The population of EU is v and the population of NAC is v^n. EU is assumed to have a larger initial capital stock per capita than NAC, $k_0 > k_0^n$. As a result, the interest rate in NAC will be higher than that in EU (since the interest rate is a decreasing function of capital), and hence we should observe capital flows from EU to NAC but not visa versa. The border cost that EU investors pay is measured by λ. We do not need to specify the border cost when capital flows from NAC to EU as such investment never takes place in the model. Thus, EU and NAC are not entirely symmetric since EU can invest in NAC but NAC cannot invest in EU in equilibrium.

Below follows the formalization of the problems solved by consumers and producers of the two-country world.

The *problem of the consumer of EU* is parallel to (6)-(7):

$$\max_{\{c_t, n_t, k_{t+1}, \phi_{t+1}\}_{t\in T}} \sum_{t=0}^{\infty} \delta^t u\left(c_t, 1-n_t\right), \tag{9}$$

subject to

$$c_t + k_{t+1} + \phi_{t+1} = w_t n_t + (1-d)(k_t + \phi_t) + r_t k_t + \lambda r_t^n \phi_t \tag{10}$$

where the initial condition (k_0, ϕ_0) is given.

The *problem of the producer of EU* is

$$\pi_t = \max_{k_t, n_t} \left\{ Af(k_t v, n_t v) - r_t k_t v - w_t n_t v \right\}, \tag{11}$$

as EU never receives foreign capital.

The *problem of the consumer of NAC* is the same as that of EU except for foreign investment is absent:

$$\max_{\{c_t^n, n_t^n, k_{t+1}^n\}_{t \in T}} \sum_{t=0}^{\infty} \delta^t u\left(c_t^n, 1 - n_t^n\right), \tag{12}$$

subject to

$$c_t^n + k_{t+1}^n = w_t^n n_t^n + (1-d) k_t^n + r_t^n k_t^n \tag{13}$$

where the initial condition k_0^n is given.

The *problem of the producer of NAC* is the same as that of EU except for producers of NAC can receive foreign capital:

$$\pi_t^n = \max_{K_t^n, n_t^n} \left\{ Af\left(K_t^n, n_t^n v^n\right) - r_t^n K_t^n - w_t^n n_t^n v^n \right\}, \tag{14}$$

where $K_t^n \equiv k_t^n v^n + \phi_t v$.

The *equilibrium conditions* that describe the consumer's choice for EU are as follows (the derivations of the equilibrium conditions for EU and NAC are given in the Appendix A):

$$u_2\left(c_t, 1 - n_t\right) = w_t u_1\left(c_t, 1 - n_t\right), \tag{15}$$

$$u_1\left(c_t, 1 - n_t\right) = \delta u_1\left(c_{t+1}, 1 - n_{t+1}\right)\left(1 - d + r_{t+1}\right), \tag{16}$$

$$u_1\left(c_t, 1 - n_t\right) + \eta_t = \delta u_1\left(c_{t+1}, 1 - n_{t+1}\right)\left(1 - d + \lambda r_{t+1}^n\right), \tag{17}$$

$$\eta_t \phi_{t+1} = 0 \quad \text{and} \quad \eta_t \geq 0, \tag{18}$$

where the last condition is the complementary slackness (Kuhn-Tucker) condition associated with the constraint $\phi_{t+1} \geq 0$ [8]. Here and further in the text we use notations of type z_i to denote the first-order partial derivative of function z with respect to the argument i.

The corresponding optimality conditions for NAC are as follows:

$$u_2\left(c_t^n, 1-n_t^n\right) = w_t^n u_1\left(c_t^n, 1-n_t^n\right), \tag{19}$$

$$u_1\left(c_t^n, 1-n_t^n\right) = \delta u_1\left(c_{t+1}^n, 1-n_{t+1}^n\right)\left(1-d+r_{t+1}^n\right). \tag{20}$$

Finally, the profit-maximizing conditions of the firm in EU and NAC, respectively, are as follows:

$$r_t = Af_1\left(k_t, n_t\right) \quad \text{and} \quad w_t = Af_2\left(k_t, n_t\right), \tag{21}$$

$$r_t^n = Af_1\left(K_t^n, n_t^n v^n\right) \quad \text{and} \quad w_t^n = Af_2\left(K_t^n, n_t^n v^n\right). \tag{22}$$

To see how the EU chooses the capital stock held in a foreign country, ϕ_{t+1}, let us consider the following. Suppose that the non-negativity constraint on the capital stock held in the foreign country is non-biding, or $\eta_t = 0$. Then, according to (16) and (17), we have that the effective interest rate (that is, the one obtained after taking into account the border cost) on the domestic and foreign capital stock held by the EU is the same

$$r_{t+1} = \lambda\, r_{t+1}^n, \tag{23}$$

which is the consequence of the effective factor-price-equalization.

[8] Note that, by the assumption, the production function satisfies the Inada condition, and, thus, the solution for the capital stock is non-negative $k_t \geq 0$; we do not explicitly write the Kuhn-Tucker conditions for the capital stock therefore.

By combining (21)-(23) we obtain

$$Af_1(k_{t+1}, n_{t+1}) = \lambda\, Af_1(k^n_{t+1}v^n + \phi_{t+1}v,\, n^n_{t+1}v^n)\,, \tag{24}$$

Thus, in case there is a positive value of ϕ_{t+1} which satisfies (24), it is an optimal choice of EU capital holdings abroad. If a positive solution ϕ_{t+1} to (24) does not exist, the non-negativity constraint on the foreign capital stock is binding, or $\eta_t > 0$. In this case, for the EU, investing in the foreign country is less profitable than investing in its own production, $r_{t+1} > \lambda\, r^n_{t+1}$, and thus the optimal choice of the EU investors is $\phi_{t+1} = 0$

$$Af_1(k_{t+1}, n_{t+1}) > \lambda\, Af_1(k^n_{t+1},\, n^n_{t+1})\,. \tag{25}$$

Let us introduce a new variable $\kappa_{t+1} \equiv k_{t+1} + \phi_{t+1}$, which is the stock held by the representative consumer of EU in both its own and foreign economies. Given the results (23)-(25), we can re-write the budget constraint (10) in terms of this new variable as follows

$$c_t + \kappa_{t+1} = w_t\, n_t + (1-d)\kappa_t + r_t\, \kappa_t\,. \tag{26}$$

This representation is convenient for the numerical analysis of this model. The solution algorithm suggested by Lilia and Serguei Maliar to the above two-country model is given in the Appendix C.

The three-country setup in the context of a two-country model

In this section of the work the connection between the two- and three-country models will be shown and three-country setups that can be studied in the context of a two-country model will be described.

For the purpose of the analysis, we assume that country s in the *general (three-country) setup of the model* has larger initial capital stock per capita than those of countries j and l, while the latter two countries have equal initial capital stocks per capita, that is, $k_0^s > k_0^j = k_0^l$. We interpret country s as the European Union (EU) in the initial period and countries j and l as candidates for acceding to the EU.

Regarding the border costs, we assume that they are the same between all three countries if no union is formed, $\lambda^{p,q} = \lambda^{q,p} = \lambda < 1$ for all $p \neq q$. If a country p joins a country q, then the border costs between these two countries disappear, $\lambda^{p,q} = \lambda^{q,p} = 1$, while the border costs between the union and the remaining country do not change.

Further, we assume that preferences of agents can be presented by the Cobb-Douglas utility function of the Constant Relative Risk Aversion (CRRA) type, that is,

$$u(c,1-n) = \frac{\left(c^{\mu}(1-n)^{1-\mu}\right)^{1-\gamma}}{1-\gamma}, \tag{27}$$

where $\gamma > 0$ is the coefficient of risk aversion which shows the consumer's willingness to sacrifice present consumption for future consumption; $0 < \mu < 1$ is the utility function parameter. The assumption of CRRA preferences will be needed further for construction of a representative consumer.

For studying the implications of the EU enlargement, we shall consider the following three scenarios. As described below, each of them, primarily a three-country setup, can be studied in the context of a two-country model.

The scenario *"Nobody joins the EU"* is a scenario when no union is formed between countries. In this case we can interpret country s as EU with initial capital stock $k_0 \equiv k_0^s$ and population $v \equiv v^s$. Given that initially countries j and l are identical in all respects and that none of them accedes the EU, we can view these two countries as one NAC country with an initial per capita stock of capital $k_0^n = k_0^j = k_0^l$ and population $v^n = v^j + v^l$.

The scenario *"Autarky"* is a scenario when no union is formed between countries and all capital flows between countries s, j, and l are prohibited, so that $\phi_t^{s,j} = \phi_t^{s,l} = \phi_t^{j,s} = \phi_t^{j,l} = \phi_t^{l,s} = \phi_t^{l,j} = 0$ for all t. In this case, each of the three countries develops independently. We can obtain the autarkic case as a particular case of the previously considered scenario by assuming that the border costs are infinitely large, so that $\lambda = 0$, and, thus, no country will ever invest in another country.

The scenario *"Country j joins EU"* is a scenario when a new country joins the EU. In this case, countries j and l are not identical any more after the accession, and hence their behavior cannot be modeled jointly. Nevertheless, given that border costs between countries s and j disappear after the accession, we can construct a fictitious composite country, reproduce the aggregate equilibrium allocation of the enlarged EU, and then restore the allocations for countries s and j from the aggregate allocation. This can be done by using aggregation results in Maliar and Maliar (2001) (the details are given in the Appendix D).

Chapter 4

DATA DESCRIPTION

For the calibration and simulation of the model the minimum data we need is population and GDP, and the maximum is the estimates of border costs for different countries. In the model we can generate any variable we need.

The raw data on population and GDP of the EU, acceding and non-acceding countries come from the World Development indicators 2003 published by the World Bank. The total population is considered to be the overall measure of the potential impact of the country on the world and within its region. The data on GDP are in constant 1995 U.S. dollars. Dollar figures are converted from domestic currencies using 1995 official exchange rates. GDP indicator is believed to provide the best available starting point for comparisons of economic strength and well-being between countries.

As far as the border costs are concerned, there are no empirical estimates available and hence the model, as it was discussed above, is explored by imposing some assumptions on this parameter. However, in order to get a deeper insight in that parameter and check the relevance of those assumptions for real world, I have used the index of economic freedom. It is published by the Heritage Foundation/Wall Street Journal for 161 countries and is available for the years 1995-2004 though there are a lot of missing observations for the first year of its existence. The purpose of the index is to reflect the economic environment in every country. This index ranges from 1 to 5 (the lower the better) and is computed on the basis of 50 independent variables which fall in 10 broad

categories by equally weighting the indexes for those 10 categories: 1) trade policy; 2) fiscal burden of government; 3) government intervention in the economy; 4) monetary policy; 5) capital flows and foreign investment; 6) banking and finance; 7) wages and prices; 8) property rights; 9) regulation; 10) informal market activity. The broad nature of the index with regard to the reflection of a country's environment and the way of its construction enable us to treat it as a proxy for measuring the closeness of countries' environments and, thus, the border costs between countries.

Chapter 5

QUANTITATIVE ANALYSIS

Calibration

To assess the implications of the model, we shall make specific assumptions about the utility and production functions and calibrate the parameter values. As regards the functional forms, we adopt the standard Cobb-Douglas specification for both the utility and production functions, $u(c,1-n)=\frac{\left(c^{\mu}(1-n)^{1-\mu}\right)^{1-\gamma}-1}{1-\gamma}$ with $0<\mu<1$ and $\gamma>0$, and $f(k,n)=k^{\alpha}n^{1-\alpha}$ with $0<\alpha<1$.

We choose the model's period to be one quarter and calibrate parameters so that the autarkic variant of the model is consistent with basic observations on actual economies, specifically, that in the steady state, our model generates the following statistics: consumption to output ratio $c/y=0.727$, a quarterly capital to output ratio $k/y=10.62$, hours worked $n=0.31$ of the total discretionary time, and the share of capital in production $\alpha=rk/y=0.339$ (the variables without time subscripts are used to denote steady state values)[9]. These statistics identify the parameters $\{d,\mu,\delta\}$ in the way seen below. We consider two alternative values for the coefficient of risk aversion $\gamma\in\{2,5\}$.

[9] These statistics are taken from Maliar and Maliar (2001) and are computed for the U.S. economy; however, similar numbers are observed for European economies and for transition economies like Ukraine. In any case, the predictions of the model are robust to variations in these parameters.

The capital stock evolves according to (3) and hence in the steady state we have

$$d = \frac{i}{k} = \frac{(i/y)}{(k/y)} = \frac{1-(c/y)}{(k/y)} = \frac{1-0.727}{10.62} = 0.0257 .$$

Evaluating the Euler equation (16) in the steady state, we have

$$1 = \delta(1-d+r) = \delta(1-d+\alpha k^{\alpha-1} n^{1-\alpha}) = \delta\left(1-d+\alpha\frac{1}{(k/y)}\right)$$

$$\delta = \frac{1}{1-d+\alpha\dfrac{1}{k/y}} = \frac{1}{1-0.0257+0.339*\dfrac{1}{10.62}} = 0.9938 .$$

With the assumption of the Cobb-Douglas production function $y_t = f(k_t, n_t) = k^{\alpha} n_t^{1-\alpha}$, we have that the wage is $w_t = (1-\alpha)k_t^{\alpha} n_t^{-\alpha}$ and hence, $w_t n_t / y_t = (1-\alpha) = 1-0.339 = 0.661$. Therefore, evaluating the intratemporal condition (15) in the steady state, we have

$(1-\mu)c = \mu(1-n)w \quad \Rightarrow$

$$\mu = \frac{c/y}{c/y + \dfrac{1-n}{n} * \dfrac{wn}{y}} = \frac{0.727}{0.727 + \dfrac{1-0.31}{0.31} * 0.661} = 0.3307$$

The Euler equation (16) implies that the capital stock in the steady state is

$1 = \delta\left(1-d+\alpha A k^{\alpha-1} n^{1-\alpha}\right) \quad \Rightarrow$

$$k = \left[\frac{1/\delta-(1-d)}{\alpha A}\right]^{1/(\alpha-1)} n = \left[\frac{1/0.9938-(1-0.0257)}{0.339*1}\right]^{1/(0.339-1)} 0.31 = 11.06 \quad (28)$$

We calibrate the model and compute the solution only to match the last 5th enlargement which has taken place on the first of May of 2004. Before providing the further results of calibration we describe the methodology for

selecting which countries should be included into the EU, acceding, and non-acceding groups.

The construction of the EU group is the least ambiguous. It comprises the EU members at the moment of enlargement. For the acceding group we consider two alternatives: 1) all countries which accede to the EU and 2) only transition countries which accede to the EU[10]. For the non-acceding group we consider six alternatives. The first one treats all the European countries plus Turkey as the non-acceding countries. We call this group "the broad group". The second one originates from the broad group by excluding so-called "no common border" countries — Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Tajikistan, Turkmenistan, Uzbekistan — which do not have a common border with the enlarged EU. The third group originates from the broad group by excluding "no common border" countries and Russia. The next three alternatives focus on the transition countries. Therefore, the forth non-acceding group comprises all the European transition economies and is called "the broad transition group". Sticking to the above logic, the fifth group originates from the broad transition group by excluding "no common border" countries whereas the sixth one also excludes Russia.

We calibrate the size of the EU, the acceding and non-acceding countries, v^{EU}, v^{a} and v^{na}, by the size of the population that lives in the EU, the acceding and non-acceding countries, respectively. We calibrate the initial ratios of per capita capital stocks of the acceding and non-acceding countries to the EU capital stock per capita by the levels of their initial GDP in the following way:

[10] In fact, Malta is excluded in both cases as there is no data on its GDP

$$\frac{k_0^p}{k_0^{EU}} \approx \frac{y_0^p}{y_0^{EU}} \tag{29}$$

where y_0^{EU} and y_0^p are GDP per capita of the EU and the country $p \in \{a, na\}$.

Thus, as the groups are defined, we compute the groups' parameters of interest (population and GDP), then find GDP per capita for groups, and finally infer the capital ratios from (29). We also compute weighted averages for the inferred capital stocks of acceding and non-acceding countries with the weights equal to the population shares of countries groups. The results corresponding to the above discussion are given in the *Table B.1* in the Appendix B.

As can be seen from the *Table B.1*, the EU population is about 400 mln., the one of the acceding countries is about 75 mln., and the one of non-acceding countries ranges from 100 to 400 mln. depending on how this group is constructed. We calibrate the model to roughly match these results, namely we assume that EU population is 5, the population of acceding countries is 1 and, as a benchmark parameterization, we use the population of non-acceding countries equal to 3.

In the benchmark case, we assume that the EU is initially in the steady state, and hence its initial capital stock is $k_0^{EU} \equiv k$. As described above, we proxy the capital stock of all countries by their GDP, so that we estimate the initial capital of acceding and non-acceding countries as 15% of the steady state. Finally, in the benchmark case, we assume the risk aversion coefficient of $\gamma = 2$ and the border costs of $\lambda = 0.9$. To sum up, we used the following values of parameters in the benchmark *Experiment 1*:

a	c/y	k/y	n	d	δ	μ	γ	λ	k	k_0	v^s	v^l	v^l
0.339	0.727	10.62	0.31	0.0257	0.9938	0.3307	2	0.9	11.06	$0.15k$	5	1	3

In *Experiments 2 and 3*, two alternative values for population of non-acceding countries such as 1 and 5, are considered, respectively. Further, proceeding from the benchmark parameterization, we study how the results are affected by the parameters of the model. Thus, in *Experiments 4 and 5* two other values of border costs λ such as 0.95 and 0.8, are considered, respectively. In *Experiment 6* we study how the results are affected by higher risk aversion by assuming $\gamma = 5$. Further, we explore how the results depend on the initial capital stock by assuming that the initial capital of acceding and non-acceding countries is 50% of the steady state. This gives rise to *Experiment 7*. Finally, in order to see how the predictions of the model would change if EU started below steady state, *Experiment 8* is run, in which it is assumed that EU has initial capital stock of 50% of steady state while acceding and non-acceding countries start with 7.5% of steady state, which implies the same ratio of capital of EU to those of acceding and non-acceding countries as in the benchmark case.

To solve the model, we employ an algorithm iteration that gives the solution to the Euler equations on the grid of prespecified points. A detailed description of the solution algorithm suggested by Lilia and Serguei Maliar is provided in Appendix C.

Notes on the border costs

As it was discussed above in the thesis, the model imposes some assumptions on the parameter of border costs to enable the numerical study of the EU enlargement. Specifically, it is assumed that, initially, looking from the

side of the EU, the border costs are the same for acceding and non-acceding groups while they become zero for acceding countries at the moment of accession whereas remain the same for non-acceding countries.

There are no empirical estimates available for the border costs. However, in order to analyze the evidence about those costs in data and check the relevance of the above assumptions, I constructed a proxy in the form of the index of economic freedom. The broad nature of the index with regard to the reflection of a country's environment enable us to treat it as a proxy for measuring the closeness of countries' environments and, thus, the border costs between countries.

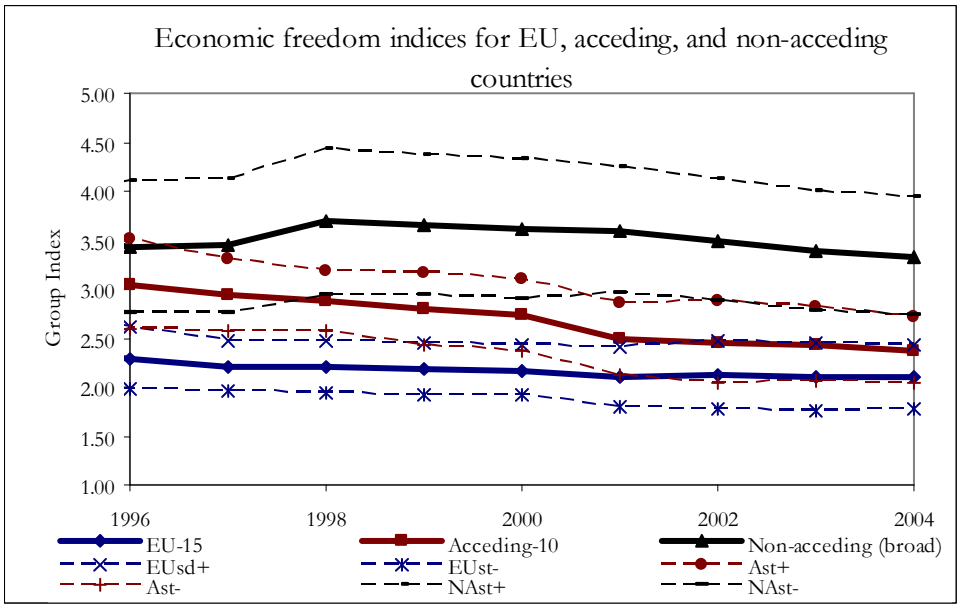
Figure 1 depicts the evolution of economic freedom indices for the EU, acceding, and non-acceding countries for the period of existence of that indicator[11]. To illustrate the dynamic more accurately, we plot the computed average scores for the groups under consideration together with their standard deviations.

The following important observations should be noted. First, the scores of acceding and non-acceding countries were, initially, close. This can be directly seen from the graph and, specifically, from the fact of overlapping of the standard deviation's regions for acceding and non-acceding countries. This evidence is in favor of the above assumption of initial similarity between border costs for acceding and non-acceding countries. Second, with the lapse of time the scores of EU and acceding countries become close. As can be seen from the graph, initially, their standard deviations did not overlap; however, with time the pattern reversed and in the wake of accession there is a quite large region of

[11] The year 1995 was omitted due to a large number of missing observations for the countries under consideration.

overlapping. Such tendency in the data makes the necessary for numerical study assumption of zero border costs between EU and acceding countries at the moment of accession quite reasonable. Finally, the relative scores for non-acceding countries did not change much supporting the assumption that border costs between EU and non-acceding countries remain the same.

Figure 1: Evolution of Economic Freedom Indices for EU, Acceding, and Non-Acceding Countries



To conduct a formal analysis of the tendencies observed on *Figure 1*, mean comparison (MC) and variance comparison (VC) tests were employed[12]. The former one performs a two-sample t test of the hypothesis that the mean of one variable equals the mean of other variable; the latter one performs an F test (variance ratio test) of the hypothesis that two variables have the same variance. In our case, we want to trace the closeness of the scores of acceding and non-acceding countries, EU and acceding/non-acceding countries through time. For

[12] All calculations for these tests were made with STATA 4.0 software: *ttest* and *sdtest* commands correspondingly.

this purpose we employ MC test and run VC test as auxiliary one in order to correctly apply options of MC test regarding equality of variances. The results of the analysis are summarized in *Table 5.1* below.

Table 5.1: Results of Test for Closeness of Economic Freedom Indices for EU, Acceding, and Non-Acceding Countries[1)]

Test	1996	1997	1998	1999	2000	2001	2002	2003	2004
Mean comparison test for acceding and non-acceding countries									
Ho: indices for acceding and non-acceding countries are the same									
p-value	0.1324	0.0456	0.0002	0.0002	0.0001	0	0	0.0001	0
Conclusion	the same	marginally the same	different	different	different	different	different	different	different
Mean comparison test for EU and acceding countries									
Ho: indiced for EU and acceding countries are the same									
p-value	0.0001	0	0	0.0001	0.0002	0.0092	0.041	0.0329	0.0561
Conclusion	different	different	different	different	different	different	different	different	the same
Mean comparison test for EU and non-acceding countries									
Ho: indices for EU and non-acceding countries are the same									
p-value	0	0	0	0	0	0	0	0	0
Conclusion	different	different	different	different	different	different	different	different	different

[1)] Conclusions for reported results are made for 5% level of significance.
Note: more complete results are given in Appendix B

As can be seen from the *Table 5.1*, the results of the above tests confirm the conclusions inferred from the visual analysis of economic freedom indices. Specifically, those that regard the following: first, the difference between countries' environments of acceding and non-acceding countries was statistically insignificant while with time the EU and acceding countries environments get close and in the year of accession they become statistically the same.

To sum up, though the assumptions about border costs are forced to be somewhat idealized in order to enable numerical study of the enlargement, they find the empirical support described above and, thus, make sense. In other words, the empirical findings about the dynamics of the constructed proxy for border costs allow concluding that the assumptions are quite reasonable and close to the real world.

Results

For producing results, which are fully given in the Appendix E, a Matlab's program designed by Lilia and Serguei Maliar was used. Given the initial conditions for model's parameters, the dynamic paths were restored for all three economies under consideration in *Experiments 1-8*. On the graphs, the equilibrium transition dynamics are illustrated for the first 100 periods, where one period lasts for a quarter. Dashed, solid, and dotted lines on the graphs correspond, respectively, to the scenarios *"Nobody joins the EU"*, *"Autarky"*, and *"Country j joins EU"*, the details of which were discussed above in the thesis.

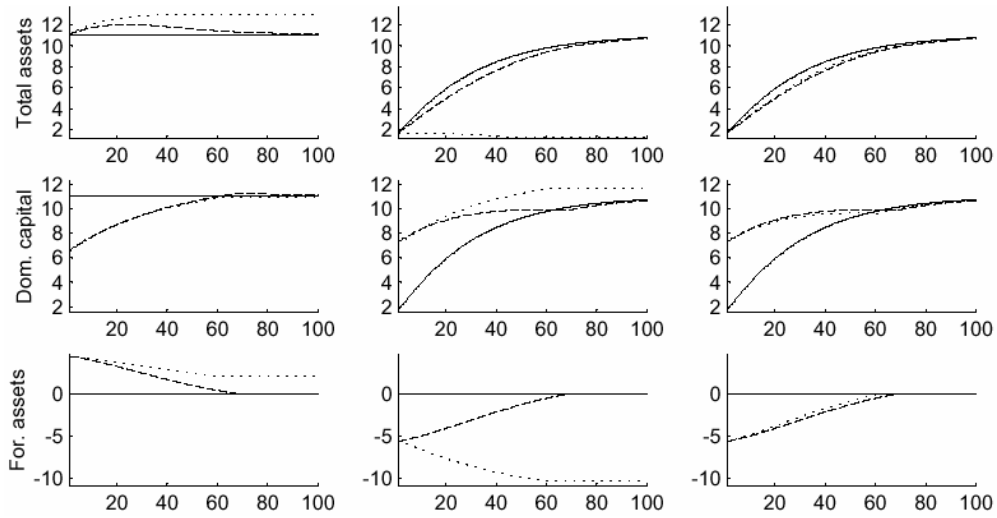
In general, the predictions turned to be very robust to the changes in model's parameters, so that the overall tendencies are common for all experiments. Below follows the detailed analysis of observed regularities, starting from the benchmark case. As the main research question of the thesis is the impact of the coming enlargement on foreign direct investment in acceding and non-acceding countries, the focus will be made on that. However, given the model's resources for conducting more versatile analysis, the implications on the welfare of the acceding and non-acceding countries will also be explored as well as some consequences for the EU itself.

Figure 2 depicts the dynamics of total assets owned by residents of a country, capital used in the domestic production, and inferred foreign capital stock for all three economies under consideration[13]. Let us recall that we compute the foreign capital stock as the difference between capital assets owned by residents and the capital stock employed in the country. In columns

[13] The variables investment and foreign investment are defined as gross ones in the model. Therefore, in interpretation of the results of the model it is better to look at stocks of capital and foreign capital.

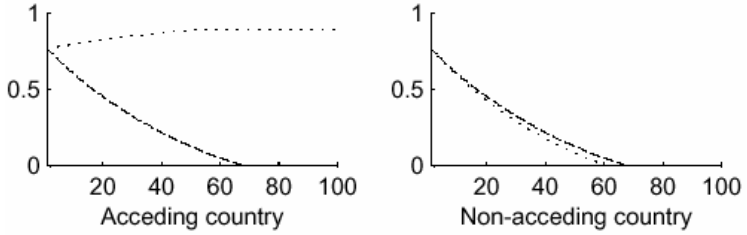
1, 2, 3 the results for EU, acceding, and non-acceding countries are presented respectively.

Figure 2: Simulated Transition Capital Path for EU, Acceding, and Non-Acceding Countries



As can be seen from the graph, after the enlargement the acceding country remains with roughly constant amount of assets or even somewhat decreases its assets. Such tendency is a reaction to the removing of the border costs between the EU and acceding country after the enlargement and the resulting increase in the foreign assets employed in the production. As *Figure 3* shows, with time the EU gets the ownership of most assets in acceding country.

Figure 3: Simulated Transition Path for Shares of Foreign Capital in the Production of Acceding and Non-Acceding Countries



The model's prediction about the increasing pattern of FDI into the acceding country is in accord with the conjecture of the previous literature regarding the improved investment attractiveness of the acceding country as a result of enlargement process. However, our model goes further and can give the insight into the capital dynamics for the non-acceding countries as well.

As can be seen from the *Figures 2 and 3*, in the presence of border costs, that is, for the non-acceding country, the share of foreign capital in the domestic production is diminishing and in the longer time span domestic investors gradually overcome the foreign ones as they do not have to pay border costs. Moreover, this tendency is almost the same for the non-accession and accession scenarios, which may point to the insignificant effect of crowding out of the FDI from non-acceding country in favor of acceding country as a result of the EU enlargement. In this sense, our model rebut the fear that FDI flows diverge from the non-acceding countries in favor of acceding ones driven by the lower border costs for the later due to entering the EU.

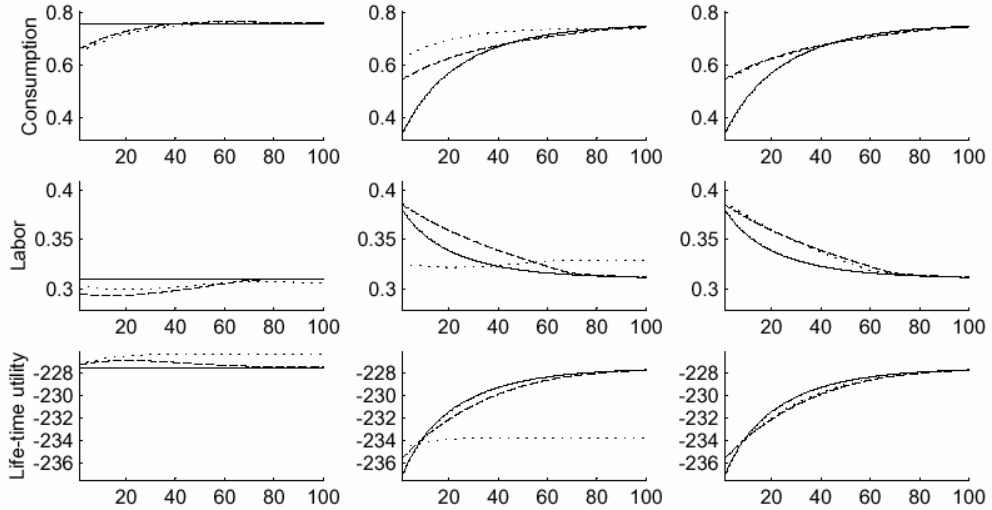
Thus, the revealed by the model tendencies regarding the impact of the EU enlargement on FDI in acceding and non-acceding countries are as follows. After the EU enlargement the FDI in the acceding country is expected to grow in the SR and then stabilize in the LR whereas the fact that some countries accede to the EU does not appear to significantly influence the FDI pattern in non-acceding countries.

The logic of the above inference is as follows. As the poor country accedes to the EU and the border costs are abolished, rich foreigners invest some of its capital into the new member country and maintain this capital forever. In contrast, as the border costs for non-acceding countries are the same before and after the enlargement, the dynamics of foreign capital flows seems

also to be similar. Specifically, foreigners invest in the very initial periods, when there is a large difference between the domestic and foreign countries, including the rate of return on capital. However, they will have to start withdrawing their capital because after some development, the domestic interest rate will go down and the interest rate difference will not be sufficient to cover the border costs. At the end, all foreigners will have to disinvest their stock, which will be bought off by domestic agents who do not face the border costs. Thus, unlike for acceding country, the presence of EU in non-acceding country is temporary and dies away with time because of the border costs.

Let us now turn to the model's welfare implications of the EU enlargement on the countries in hand. *Figure 4* depicts the dynamics of consumption, working hours, and life-time utility for the EU, acceding, and non-acceding countries, respectively, in the columns 1, 2, and 3.

Figure 4: Simulated Transition Paths for Consumption, Working Hours, and Life-Time Utility for the EU, Acceding, and Non-Acceding Countries

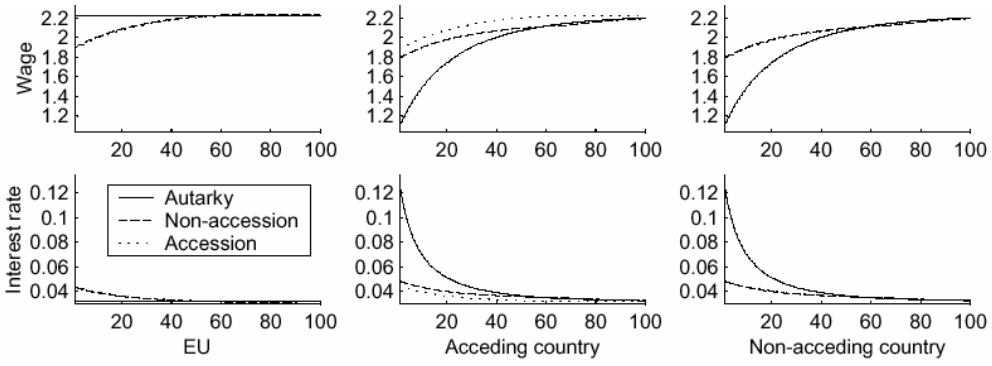


As can be clearly seen from the graph, the enlargement event positively influences the EU welfare. This implication of the model can be explained as

follows. As the EU gets the ownership of some assets in a new poor country member, it gets forever an additional capital income from those assets and, thus, it converges to a permanently lower working hours and higher consumption than in the financial autarky. Regarding the non-acceding country, its welfare is not affected much by the enlargement event. It follows from the fact that the accession of some countries to the EU does not change the border costs for non-acceding countries and thus the development of other employed in the model variables.

The interesting result with respect to the welfare changes is obtained for the acceding country. Specifically, the model's predictions show that after the entering the EU the acceding country appears to gain in the SR but to lose in the LR. Initially, the arrival of foreign capital in a country is beneficial for the home country since it results in an immediate increase in the capital stock used in domestic production and, in addition, raises the labor productivity and thus the wages. *Figure 5* depicts the evolution of the wages and interest rates. These, in turn, lead to the higher consumption and lower working hours than in the other scenarios.

Figure 5: Simulated Transition Paths for Wage and Interest Rate for the EU, Acceding, and Non-Acceding Countries



However, as can be seen from the *Figure 4*, the situation reverses in the LR. This occurs due to the fact that foreigners take away from domestic agents a part of the investment opportunities as well as a fraction of the output produced as a payment for their capital. In addition, as foreigners with time get the ownership of most assets in acceding country, its agents are forced to work more and consume less since they practically do not have capital income. The analysis, therefore, implies that, initially, when a country is poor, the accession to the EU and the resulting arrival of foreign capital is beneficial, however, as the country develops, the excessive presence of foreign capital in the country can be harmful.

In order to examine the sensitivity of the model's predictions to the changes in its parameters, several experiments were run. As can be seen from *Figure 2 and 3* of Appendix E (which depict the *Experiments 2 and 3* in respect of alternative values for population of non-acceding countries), the changes in population size of non-acceding countries do not vary the qualitative result of the model and the quantitative result differs only for the SR. Thus, as one would expect, for the non-acceding country which is smaller than the EU, a one unit of per capita capital invested by the EU transforms into more than one unit of per capita capital for non-acceding country. In other words, the larger populations size of non-acceding countries the smaller values for foreign capital and capital employed in the domestic production are in per capita terms. As a result, per capita output and consumption are also lower. In addition, since there is less capital in per capita terms utilized in the production, its marginal product and, thus, interest rate are higher whereas marginal product of labor and, thus, wages are lower. Though all those differences are initially visible, they vanish as economies approach their LR paths.

Regarding border costs, its influence can be clearly seen from *Experiments 4 and 5* depicted in *Figure 4 and 5* of Appendix E. Specifically, the higher border costs (the lower λ), the faster foreigners withdraw its capital and, thus, the more temporal their presence in the country. The intuition behind this is as follows. Investing abroad imposes some additional costs, called border costs. Initially, when the difference between returns on capital in domestic and foreign economies is sufficient to cover those costs, investors hold capital abroad. With further development, however, that difference shrinks and gives incentive for foreigners to withdraw its capital. Thus, the higher the border costs, the faster the difference between returns becomes insufficient to attract foreign investors. For acceding country the border costs are abolished after the enlargement, and, hence, in case of higher and persistent border costs for non-acceding countries, the foreign assets in acceding country grow faster than otherwise, however, they approach the same LR level. On the whole, the changes in border costs, like in the previous experiments, affect results quantitatively rather than qualitatively.

Let us now study how the results are affected by higher risk aversion. This case is considered in *Experiment 6* and presented in *Figure 6* of Appendix E. An increase in γ, the coefficient of risk aversion, leads to a decrease in the consumer's willingness to sacrifice present consumption for future consumption, and, therefore, to a more gradual accumulation of capital, domestic as well as foreign. This, in turn, induces the less rapid reduction in marginal product of capital and, thus, a more gradual decrease in return on capital. As a result, foreigners have an incentive to stay for a longer period in a country with border costs and do not fully withdraw capital for a longer time span, which seems to be more consistent with empirical observations.

In order to analyze the role of initial conditions for equilibrium transition paths predicted by the model, *Experiment 7* and *8* were run. The results for

Experiment 7 are given in *Figure 7* of Appendix E. In this experiment, it is assumed that the initial capital of acceding and non-acceding countries is 50% of the steady state. As can be seen from the graphs, a higher initial capital stock of acceding and non-acceding countries relative to the one of the EU results in a lower level of foreign capital in those countries. This can be easily explained by the diminishing return on capital. Specifically, the higher the capital stock, the lower is a return on capital, and the lower are the incentives to invest. Consequently, in the presence of border costs, that is, for non-acceding country, initial foreign share (and foreign capital) is lower and it decreases more quickly over time: foreigners withdraw its capital more rapidly since the lower initial difference in returns on capital implies that the moment when this difference is insufficient to cover border costs comes earlier. In the absence of border costs, that is, for acceding country after the enlargement, initial foreign capital is also lower as well as a share of foreign capital; this is the case since the higher initial capital of acceding country implies that the less foreign capital is needed to be added to reach the steady state.

Finally, in order to see how the predictions of the model would change if EU started below steady state, *Experiment 8* was run. The results for *Experiment 8* are given in *Figure 8* of Appendix E. In this experiment, it is assumed that EU has initial capital stock of 50% of steady state while acceding and non-acceding countries start with 7.5% of steady state, which implies the same ratio of capital of EU to those of acceding and non-acceding countries as in the benchmark case. The most important implications of this experiment are as follows. Though, as a result of lower capital stock of the EU, the foreign assets employed in the production of acceding and non-acceding countries are lower when measured in levels, a share of foreign capital is approximately the same as in the benchmark case. In addition, similar to the previous experiments, the

difference in the transition paths of variables of the model is only visible in SR while it vanishes in the LR.

Thus, the sensitivity analysis has shown that the models predictions are robust to the changes in parameters and emerged differences are visible only in the SR period whereas they vanish as the economies approach their LR levels.

Despite the fact that the above analysis revealed interesting implications that the EU enlargement may have on foreign capital dynamics and welfare in acceding and non-acceding countries, the obtained results should be carefully treated because of several necessary limitations of the model which are suggested below.

- The enlargement process is modeled through the discrete changes in the costs of investing abroad instead of the domestic economy. These border cost between acceding and EU countries are assumed to fully and instantly disappear after the EU enlargement. In practice, the pattern of adjustment of countries' environments to each other is more complicated and gradual; however, those gradual changes are hard to measure and thus it is difficult (if possible) to incorporate that mechanism in the model
- Inclusion of the trade channel in the model could change the effect of the enlargement on the welfare of countries. Nevertheless, the model's simplification and focus on capital channel is justified by the purpose of the analysis and impracticality of including all aspects of enlargement in one model
- Finally, the model assumes homogeneous technology among the countries and treats foreign and domestic capital as perfect substitutes (while considers labor as an immobile factor). Though those assumptions were done in order to simplify the numerical

analysis, if it were workable, the extension of the model to incorporate the spillover effect of the foreign direct investments could be of value.

The last chapter of this paper briefly summarizes the main findings of the analysis, emphasizing on policy implications, and suggest directions for further research.

Chapter 7

SUMMARY AND CONCLUSIONS

The analysis in this thesis was devoted to the issue of the EU enlargement of this year and, specifically, its impact on the FDI dynamics in acceding and non-acceding countries. The question was addressed in the context of the model, initially built by Lilia and Serguei Maliar and elaborated further in close cooperation with them. The model bases on the neoclassical growth theory which enables us not only to explore the question of interest but also to study the welfare implications in the framework of dynamic analysis.

As the review of the literature has shown, the effect of the Eastern enlargement on FDI flows has predominantly been studied using empirical methods of the analysis and quantitative analysis was mainly restricted to the use of gravity-type models for new and old members. This can be partly explained by the complexity of conducting ex ante analysis and multiplicity of potential FDI determinants as well as the difficulties in finding the data for non-acceding transition economies. This thesis tries to overcome those problems and explore the impact of the enlargement both on acceding and non-acceding countries in the context of dynamic general equilibrium model.

The model studies the EU enlargement through the changes in the closeness of environments between countries in the wake of accession and, thus, changes in the cost of investing abroad instead of the domestic economy. That effect was introduced in the model through the parameter of "border costs". As a proxy for empirical examining the adjustment of countries

environments in the wake of accession to the EU, the index of economic freedom was employed.

The main findings of the performed analysis can be summarized as follows. First, as the border costs between the EU and a poor acceding country die away with the enlargement, rich foreigners invest some additional capital into the new member country and maintain this capital forever. Thus, after the EU enlargement the FDI in the acceding country is expected to grow in the SR and then stabilize in the LR. Further, with time the EU gets the ownership of significant amount of assets in acceding country. This is somewhat agree with the conjecture of the previous literature that the acceding country has an improved investment attractiveness.

Second, as the border costs for non-acceding countries do not change before and after the enlargement, the dynamics of foreign capital flows seems also to be similar. In contrast to the acceding country, the presence of EU in non-acceding country is temporary and dies away with time because after some development the domestic interest rate will go down and the interest rate difference will not be sufficient to cover the border costs. Moreover, this pattern does not appear to be significantly influenced by the fact that some countries accede to the EU and, thus, the FDI dynamics seem to be driven by the changes in the inside, not outside, environment of a country.

Third, based on the analysis of FDI aspect of the enlargement, the accession event positively influences the EU welfare. This arises from the fact that the ownership of a large amount of assets in a new poor country member brings the EU an additional capital income. Regarding the non-acceding country, its welfare is not affected much by the enlargement event due to the reasons described in the previous paragraph.

Finally, the analysis provides an interesting result regarding the welfare changes for the acceding country. Focusing on the FDI aspect of the enlargement, the model's predictions show that after entering the EU the acceding country appears to gain in the SR but to lose in the LR. This outcome can be explained by the dual nature of foreign capital. On the one hand, it increases the capital stock used in domestic production and raises the factor productivity, which lead to the higher consumption and lower working hours. On the other hand, foreigners take away from domestic agents a part of the investment opportunities as well as a fraction of the output produced as a payment for their capital. Such development of the events forces the agents to work more and consume less since they have little capital income as most assets belong to the rich EU countries. In other words, in case of acceding country the agents are willing to sacrifice a part of its LR welfare in order to raise its nearest well-being.

Though the obtained results should not be interpreted literally and the reader should be aware of the caveats described at the end of the previous chapter, the analysis allows us to get a deeper insight into the intricate issues of the EU enlargement and to draw attention to the possible consequences of the event looking from the side of the FDI aspect. Taking all those into consideration, the obtained results beget two important policy implications. First, initially, when a country is poor, the accession to the EU and the resulting arrival of foreign capital is beneficial, however, as the country develops, the excessive presence of foreign capital in the country can be harmful. Thus, the officials, while making their policy decisions, would better be aware of the possibility of development of events in that course. In addition, the analysis points out on the need to sustain certain balance between the domestic and foreign savings in a country.

Second important policy implication is that FDI dynamics seem to be more driven by the changes in the inside environment of a country than by the outside fact of accession of some countries to the EU. Thus, if a country aims to change the intensity of coming of financial funds from abroad, the changes in the domestic environment (and thus the resulting changes in the investment risk) could be of value.

The versatility of the EU enlargement process and potentially interesting results obtained from the simulation of the event give rise to the broad field of action for further investigation and analysis. In particular, it would be interesting to check, once the event occurs and enough for empirical analysis time passes, whether the predicted developments resemble those observed in practice.

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APPENDIX A

For the consumer's problem of EU, the Lagrangian is

$$L = \max_{\{c_t, n_t, k_{t+1}, \phi_{t+1}\}_{t\in T}} \sum_{t=0}^{\infty} \delta^t u(c_t, 1-n_t) + \eta_t \phi_{t+1} +$$
$$+ \lambda_t \left[c_t + k_{t+1} + \phi_{t+1} - w_t n_t - (1-d)(k_t + \phi_t) - r_t k_t - \lambda r_t^n \phi_t \right] +$$
$$+ \lambda_{t+1} \left[c_{t+1} + k_{t+2} + \phi_{t+2} - w_{t+1} n_{t+1} - (1-d)(k_{t+1} + \phi_{t+1}) - r_{t+1} k_{t+1} - \lambda r_{t+1}^n \phi_{t+1} \right] + \ldots$$

where $\lambda_t, \lambda_{t+1}, \ldots$ are the Lagrange multipliers associated with the budget constraint and η_t is the Lagrange multiplier associated with non-negativity restriction on the capital stock held abroad.

The First-Order Conditions (FOCs) of the problem are

$$(c_t): \qquad \delta^t u_1(c_t, 1-n_t) = -\lambda_t, \tag{.1}$$

$$(c_{t+1}): \qquad \delta^{t+1} u_1(c_{t+1}, 1-n_{t+1}) = -\lambda_{t+1}, \tag{.2}$$

$$(n_t): \qquad \delta^t u_2(c_t, 1-n_t) = -\lambda_t w_t, \tag{.3}$$

$$(n_{t+1}): \qquad \delta^{t+1} u_2(c_{t+1}, 1-n_{t+1}) = -\lambda_{t+1} w_{t+1}, \tag{.4}$$

$$(k_{t+1}): \qquad \lambda_t = \lambda_{t+1}(1-d+r_{t+1}), \tag{.5}$$

$$(\phi_{t+1}): \qquad \lambda_t + \eta_t = \lambda_{t+1}(1-d+\lambda r_{t+1}^n), \tag{.6}$$

$$\eta_t \phi_{t+1} = 0 \quad \text{and} \quad \eta_t \geq 0, \tag{.7}$$

where the last is the complementary slackness (Kuhn-Tucker) condition.

By eliminating the Lagrange multipliers, we obtain the two intertemporal FOCs (the so-called Euler equations)

$$u_1(c_t, 1-n_t) = \delta u_1(c_{t+1}, 1-n_{t+1})(1-d+r_{t+1}), \tag{.8}$$

$$u_1(c_t, 1-n_t) + \eta_t = \delta u_1(c_{t+1}, 1-n_{t+1})(1-d+\lambda r_{t+1}^n), \tag{.9}$$

If we combine (.1) and (.3), we get the intratemporal condition:

$$u_2\left(c_t, 1-n_t\right) = w_t u_1\left(c_t, 1-n_t\right). \tag{.10}$$

Similarly, the equilibrium conditions for the consumer's choice of NAC are as follows:

$$u_2\left(c_t^n, 1-n_t^n\right) = w_t^n u_1\left(c_t^n, 1-n_t^n\right), \tag{.11}$$

$$u_1\left(c_t^n, 1-n_t^n\right) = \delta u_1\left(c_{t+1}^n, 1-n_{t+1}^n\right)\left(1-d+r_{t+1}^n\right). \tag{.12}$$

For the producer problem of EU the First-Order Conditions (FOCs) follow from (11)

$$(k_t): \qquad r_t = A f_1\left(k_t, n_t\right), \tag{.13}$$

$$(n_t): \qquad w_t = A f_2\left(k_t, n_t\right), \tag{.14}$$

which are the profit maximizing conditions of the firms.

Analogously, for the producer problem of NAC the First-Order Conditions (FOCs) follow from (14)

$$(K_t^n): \qquad r_t^n = A f_1\left(K_t^n, n_t^n v^n\right), \tag{.15}$$

$$(n_t^n): \qquad w_t^n = A f_2\left(K_t^n, n_t^n v^n\right). \tag{.16}$$

APPENDIX B

Table B.1. Selected statistics on countries groups (calibration results)

Countries Groups	Statistics				
	Population, mln	GDP		k ratio proxied by GDP ratio	weighted avg k ratio for acceding and non-acceding
		total, bln $	per ca, ths $		
EU-15 (Belgium, France, Germany, Italy, Luxembourg, Netherlands, Denmark, Ireland, UK, Greece, Portugal, Spain, Austria, Finland, Sweden)	378.9783	10040.2584	26.4930	1.0000	
Acceding (Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Rep., Slovenia, Cyprus, Malta)	74.3367	345.7112	4.6506	0.1755	
Non-acceding, broad (Norway, Switzerland, Albania, Bosnia and Herzegovina, Croatia, FYR Macedonia, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Rep., Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Turkey, Bulgaria, Romania)	405.8039	1340.8579	3.3042	0.1247	0.1326
Non-acceding (Norway, Switzerland, Albania, Croatia, FYR Macedonia, Belarus, Russia, Ukraine, Turkey, Bulgaria, Romania)	323.9437	1263.1876	3.8994	0.1472	0.1525
Non-acceding (Norway, Switzerland, Albania, Croatia, FYR Macedonia, Belarus, Ukraine, Turkey, Bulgaria, Romania)	179.8729	869.3368	4.8331	0.1824	0.1804
EU-15	378.9783	10040.2584	26.4930	1.0000	
Acceding (Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Rep., Slovenia)	73.5717	334.3899	4.5451	0.1716	
Non-acceding, broad transition (Albania, Bosnia and Herzegovina, Croatia, FYR Macedonia, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Rep., Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Bulgaria, Romania)	324.4117	620.0516	1.9113	0.0721	0.0905
Non-acceding (Albania, Croatia, FYR Macedonia, Belarus, Russia, Ukraine, Bulgaria, Romania)	242.5515	542.3813	2.2361	0.0844	0.1047
Non-acceding (Albania, Croatia, FYR Macedonia, Belarus, Ukraine, Bulgaria, Romania)	98.4807	148.5305	1.5082	0.0569	0.1059

Table B.2. Selected statistics on the EU enlargements

Enlargement	Countries Groups	Statistics					
		Population, mln		GDP, bln $			k ratio proxied by GDP ratio
		total	avg	total	avg	per ca	
I	EU-6 (*Belgium, France, Germany, Italy, Luxembourg, Netherlands*)	208.18	58.11	3434.80	976.29	16.8	1.0000
01.01.1973	Acceding (*Denmark, Ireland, UK*)	64.11	49.61	847.53	621.43	12.53	0.8012
II	EU-9 (*EU-6, Denmark, Ireland, UK*)	277.83	56.61	5299.90	1094.21	19.33	1.0000
01.01.1981	Acceding (*Greece*)	9.64	9.64	103.20	103.20	10.7	0.5610
III	EU-10 (*EU-9, Greece*)	289.45	55.07	5847.82	1145.38	20.8	1.0000
01.01.1986	Acceding (*Portugal, Spain*)	48.42	32.54	509.86	360.57	11.08	0.5212
IV	EU-12 (*EU-10, Portugal, Spain*)	348.60	53.74	7826.15	1275.51	23.74	1.0000
01.01.1995	Acceding (*Austria, Finland, Sweden*)	21.90	7.65	587.58	206.66	27.03	1.1953
V	EU-15 (*EU-12, Austria, Finland, Sweden*)	378.98	51.85	10040.3	1410.48	27.202	1.0000
01.05.2004	Acceding (*Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Rep., Slovenia, Cyprus, Malta*)	74.34	23.58	345.71	94.82	4.0215	0.1755

Table B.3. Mean Comparison and Variance Comparison Tests for EU, Acceding, and Non-Acceding Countries

	Test	1996	1997	1998	1999	2000	2001	2002	2003	2004
Acceding and Non-acceding countries	**Two-sample t test with equal variances**									
	Ho: mean(Acceding) - mean(Non-acceding) = diff = 0									
	p-value	0.1324	0.0456	0.0027	0.0016	0.001	0	0	0.0001	0.0001
	Two-sample t test with unequal variances									
	Ho: mean(Acceding) - mean(Non-acceding) = diff = 0									
	p-value	0.1099	0.0297	0.0002	0.0002	0.0001	0	0	0	0
	Variance ratio test									
	Ho: sd(Acceding) = sd(Non-acceding)									
	p-value	0.2252	0.0519	0.0046	0.0337	0.0351	0.0623	0.1742	0.1157	0.0449
EU and Acceding countries	**Two-sample t test with equal variances**									
	Ho: mean(EU) - mean(Acceding) = diff = 0									
	p-value	0.0001	0	0	0.0001	0.0002	0.0092	0.041	0.0329	0.0561
	Two-sample t test with unequal variances									
	Ho: mean(EU) - mean(Acceding) = diff = 0									
	p-value	0.0004	0.0001	0	0.0004	0.0009	0.0146	0.052	0.0385	0.06
	Variance ratio test									
	Ho: sd(EU) = sd(Acceding)									
	p-value	0.2693	0.242	0.6816	0.238	0.2339	0.5055	0.5765	0.7855	0.9278
EU and Non-Acceding countries	**Two-sample t test with equal variances**									
	Ho: mean(EU) - mean(Non-acceding) = diff = 0									
	p-value	0	0	0	0	0	0	0	0	0
	Two-sample t test with unequal variances									
	Ho: mean(EU) - mean(Non-acceding) = diff = 0									
	p-value	0	0	0	0	0	0	0	0	0
	Variance ratio test									
	Ho: sd(EU) = sd(Non-acceding)									
	p-value	0.0114	0.0008	0.0002	0.0002	0.0002	0.0038	0.0259	0.0321	0.0145

APPENDIX C

The solution algorithm of the two-country model, which can be used for solving the discussed three-country model, was suggested by Lilia and Serguie Maliar. We focus on a first-order recursive Markov equilibrium, in which the countries make all their decisions according to time invariant functions of the current state variables (κ_t, k_t^n). Let the labor functions that determine the optimal amount of working hours in EU and NAC, respectively, be introduced as follows

$$n_t = \Im\ (\kappa_t, k_t^n) \quad \text{and} \quad n_t^n = \Im^n(\kappa_t, k_t^n). \tag{.17}$$

The objective is to find these two unknown function. We solve for the two labor functions on the domain $K \times K$, where K is a grid of 100 equally spaced points in the range $[k_{\min}, k_{\max}]$, with $k_{\min} = 0.01k$ and $k_{\max} = 1.5k$, where k is the steady state capital stock satisfying (28). Therefore, we have $100^2 = 10000$ points in which the solution has to be evaluated. As we will see, with these functions, we can easily restore all the equilibrium. Let us take some labor function for the initial iteration, for example, let us assume that each country work 0.31 of their time endowment, as in the steady state, that is, $\Im\ (\kappa_t, k_t^n) = 0.31$ and $\Im^n(\kappa_t, k_t^n) = 0.31$

Now, consumption in the EU and NAC, c_t and c_t^n, respectively, can be computed from the intratemporal conditions (15) and (19), which can be written as

$$c_t = \frac{\mu(1-n_t)w_t}{(1-\mu)}, \qquad c_t^n = \frac{\mu(1-n_t^n)w_t^n}{(1-\mu)} \tag{.18}$$

As a next step, we compute the next period capital stock for the EU and NAC, κ_{t+1} and k^n_{t+1}, from (26) and (13), respectively.

Next, given the new capital stocks κ_{t+1}, k^n_{t+1} and the labor function (.17), we perform the same calculations for the period $t+1$ as we did for the period t, which yields $n_{t+1}, n^n_{t+1}, \kappa_{t+1}, k^n_{t+1}, c_{t+1},$ and c^n_{t+1}. To evaluate the consumption functions outside the grid, we use linear polynomial interpolation (see Matlab's routine "interp2" for a two dimensional interpolation).

We now can use the Euler equations (16) and (20) to iterate backward to solve for the implied consumption in period t. We shall eliminate consumption from the Euler equation replacing it with working hours from the intratemporal first-order condition (15) and (19). In this manner, we re-compute the labor in period t

$$\hat{n}_t = 1-(1-n_{t+1})\left[\delta(1-d+r_{t+1})\right]^{-\frac{1}{\gamma}}\left(\frac{w_{t+1}}{w_t}\right)^{\frac{1+\mu\gamma-\mu}{\gamma}}, \tag{.19}$$

$$\hat{n}^n_t = 1-(1-n^n_{t+1})\left[\delta(1-d+r^n_{t+1})\right]^{-\frac{1}{\gamma}}\left(\frac{w^n_{t+1}}{w^n_t}\right)^{\frac{1+\mu\gamma-\mu}{\gamma}}. \tag{.20}$$

Computing $\hat{n}_t$ and $\hat{n}^n_t$ in each point of the grid, we define new functions $\Im(\kappa_t, k^n_t) \equiv \hat{n}_t$ and $\Im^n(\kappa_t, k^n_t) \equiv \hat{n}^n_t$.

In the equilibrium, we must have that the labor functions received at the end of the iteration are the same (with a given precision) as those assumed at the beginning, that is,

$$\Im(\kappa_t, k^n_t) = \Im(\kappa_t, k^n_t), \quad \Im^n(\kappa_t, k^n_t) = \Im^n(\kappa_t, k^n_t) \tag{.21}$$

It does not have to be the case immediately, however, since we choose the initial consumption functions arbitrary. So, if the obtained consumption

functions are not the same (with a given precision), we will update the consumption functions (for all κ_t, k_t^n) as follows

$$\Im(\kappa_t, k_t^n) = \eta\Im(\kappa_t, k_t^n) + (1-\eta)\Im(\kappa_t, k_t^n),$$

$$\Im^n(\kappa_t, k_t^n) = \eta\Im^n(\kappa_t, k_t^n) + (1-\eta)\Im^n(\kappa_t, k_t^n)$$

where η is some number between zero and one , $\eta \in [0,1]$.

We will use the updated consumption function as an input for the next iteration (that is, in place of $\Im(\kappa_t, k_t^n)$, $\Im^n(\kappa_t, k_t^n)$. We shall continue iteration until the condition (.21) is satisfied with a given degree of precision. As a convergence criterion the requirement that the consumption function differ less than 10^{-6} in the two consecutive iterations according to a least square norm (see Matlab routine "norm") can be used.

Finally, in order to compute welfare weights accurately, an infinite sum in (.22) should be approximated with sufficient accuracy. For that purpose, the infinite sum is divided into two parts

$$\sum_{\tau=0}^{\infty} \delta^\tau \frac{u_1(c_\tau, 1-n_\tau)}{u_1(c_0, 1-n_0)} w_\tau = \sum_{\tau=0}^{N} \delta^\tau \frac{u_1(c_\tau, 1-n_\tau)}{u_1(c_0, 1-n_0)} w_\tau + \sum_{\tau=N+1}^{\infty} \delta^\tau \frac{u_1(c_\tau, 1-n_\tau)}{u_1(c_0, 1-n_0)} w_\tau .$$

The first term is computed by using simulated series and the second term is approximated by its steady state expression $\sum_{\tau=N+1}^{\infty} \delta^\tau \frac{u_1(c_\tau, 1-n_\tau)}{u_1(c_0, 1-n_0)} w_\tau \cong \sum_{\tau=N+1}^{\infty} \delta^\tau w = \frac{\delta^N}{1-\delta} w$. $N = 5000$ was used and it was checked that increasing N has no noticeable effect on the implied welfare weights.

APPENDIX D

It follows from Proposition 2 in Maliar and Maliar (2001) that if all agents in the economy have identical CRRA period utility functions (27), then the enlarged EU economy composed of two economies, s and j, can be replaced by a representative consumer economy (6)-(8) with the population $v = v^s + v^j$ and with the initial per capita stock of capital equal to the weighted average of those of countries s and j, $k_0 = \dfrac{k_0^s v^s + k_0^j v^j}{v^s + v^j}$.

As the two-country model is solved and the aggregate EU allocations $\{c_t, n_t, \kappa_{t+1}\}_{t\in T}$, $\{k_t, n_t\}_{t\in T}$ and prices $\{r_t, w_t\}_{t\in T}$ are computed, we need to restore the allocations for countries s and j. This can be done by using the equivalence between competitive equilibrium and Pareto optimal allocations according to Proposition 1 in Maliar and Maliar (2001). We specifically consider the associated planner's problem and solve it for welfare weights, which in turn correspond to a given distribution of the initial endowments of capital. According to Proposition 2, we have that, in equilibrium, consumption and hours worked of countries s and j, $c_t^s, c_t^j, n_t^s, n_t^j$, are related to the aggregate consumption and hours worked of the enlarged EU, c_t and n_t, by

$$c_t^p = c_t f^p, \qquad n_t^p = 1-(1-n_t) f^p$$

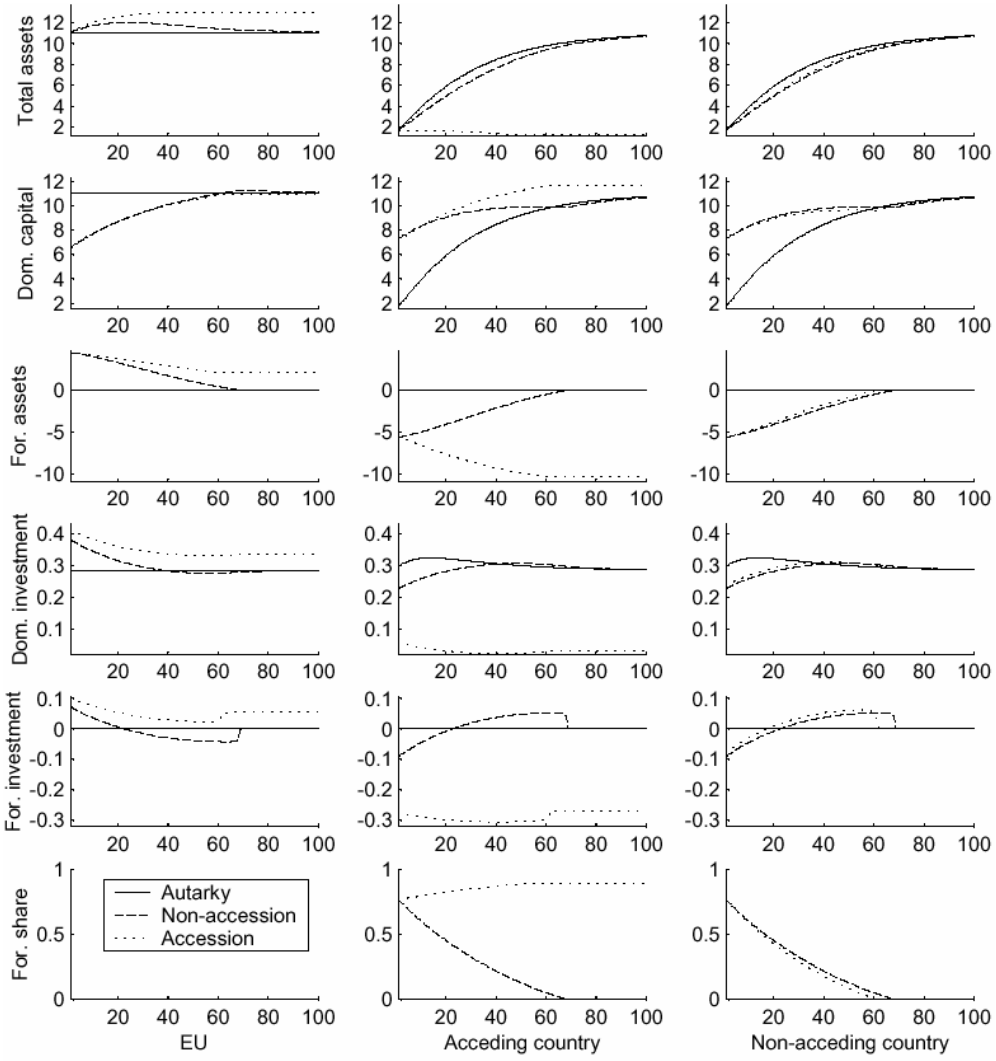
where f^p is given by

$$f^p = \frac{k_0^p (1-d+r_1) + \sum_{\tau=0}^{\infty} \delta^\tau \dfrac{u_1(c_\tau, 1-n_\tau)}{u_1(c_0, 1-n_0)} w_\tau}{\dfrac{k_0^s v^s + k_0^j v^j}{v^s + v^j}(1-d+r_1) + \sum_{\tau=0}^{\infty} \delta^\tau \dfrac{u_1(c_\tau, 1-n_\tau)}{u_1(c_0, 1-n_0)} w_\tau}, \quad p \in \{s, j\}, \qquad (.22)$$

and where $u_1(c_\tau, 1-n_\tau) = \mu(c_\tau)^{\mu(1-\gamma)-1}(1-n_\tau)^{(1-\mu)(1-\gamma)}$ is the marginal utility of consumption. Once we have consumption and working hours of countries s and j, we use budget constraints (7) to restore the total savings in each country. Next, we use equilibrium prices $\{r_t\}_{t\in T}$ to compute the capital stock employed in each of these countries. We then compute the foreign capital stock as the difference between capital assets owned by residents and the capital stock employed in the country. Finally, we use formulas (3) and (4) to restore the sequence of FDI.

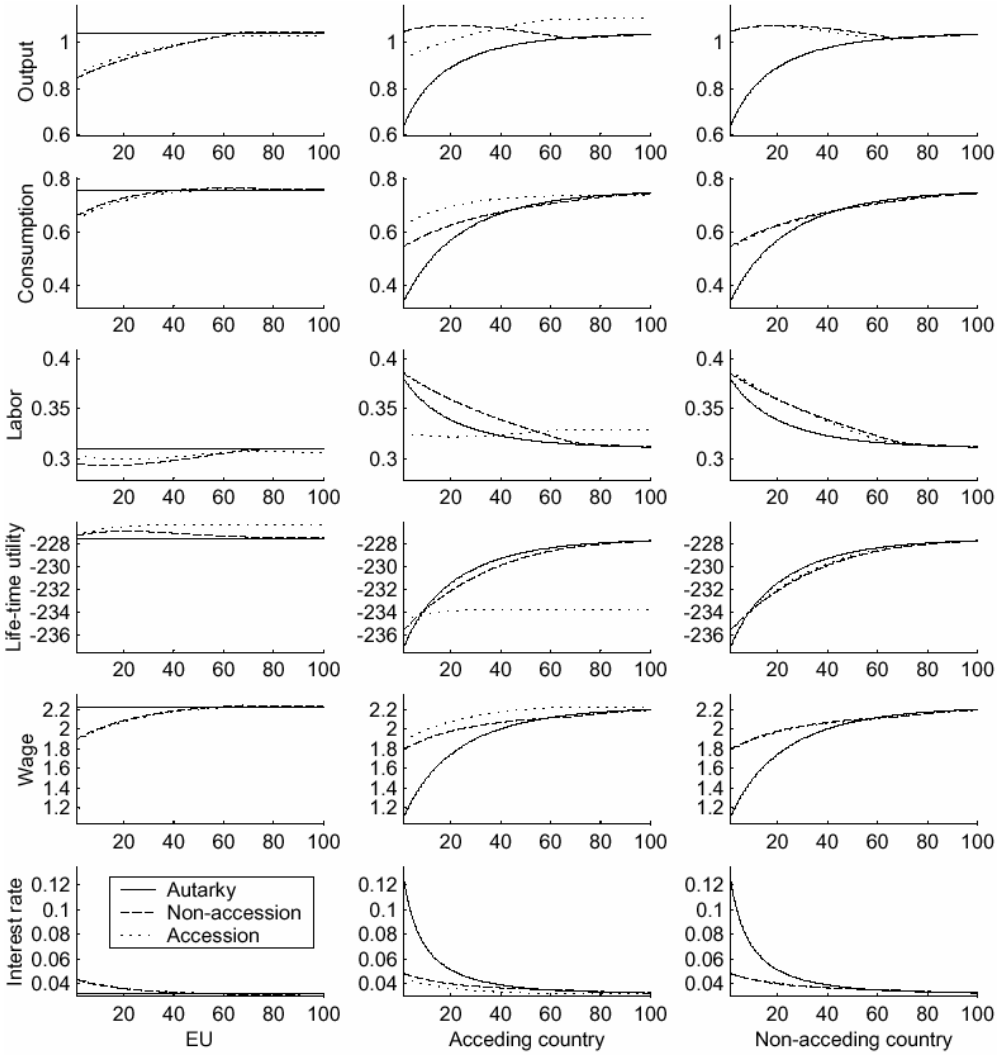
APPENDIX E

Figure E.1a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 1* (benchmark case)



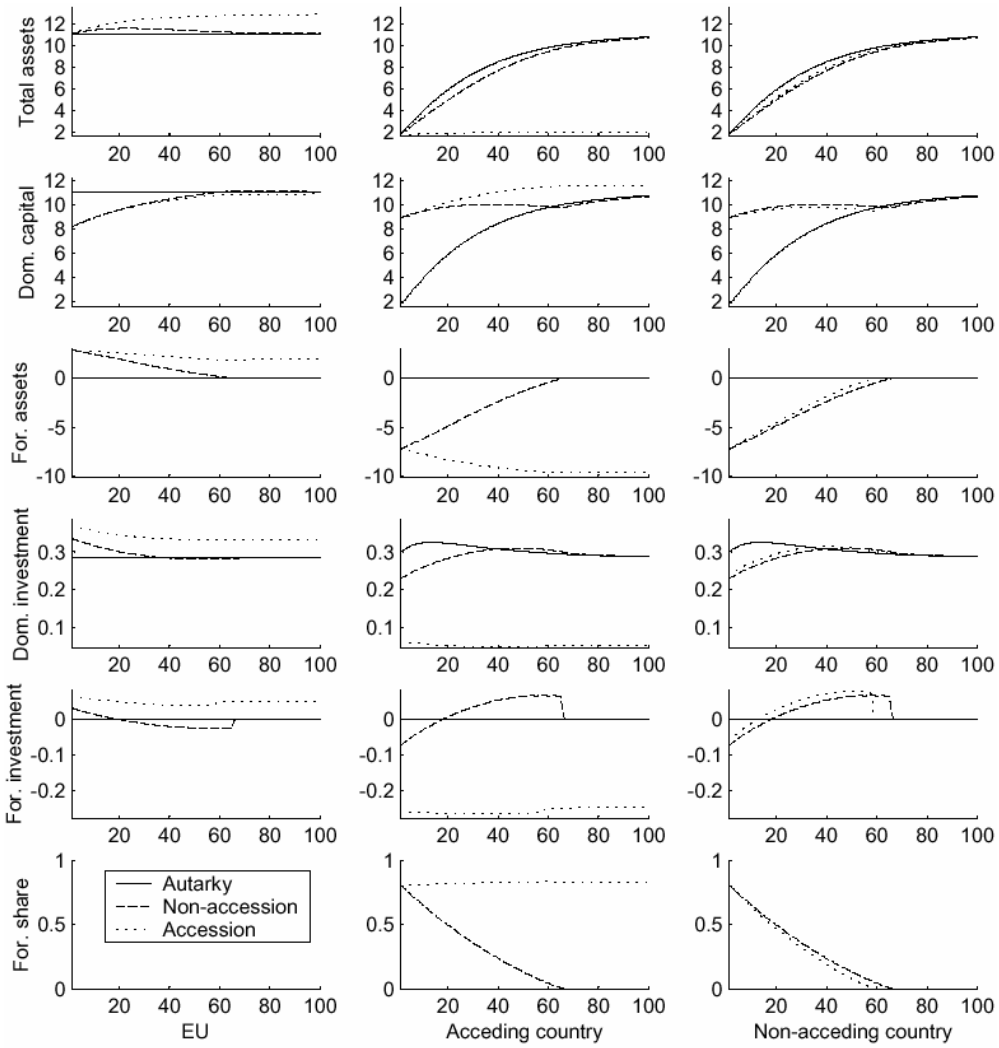
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.1b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 1* (benchmark case)



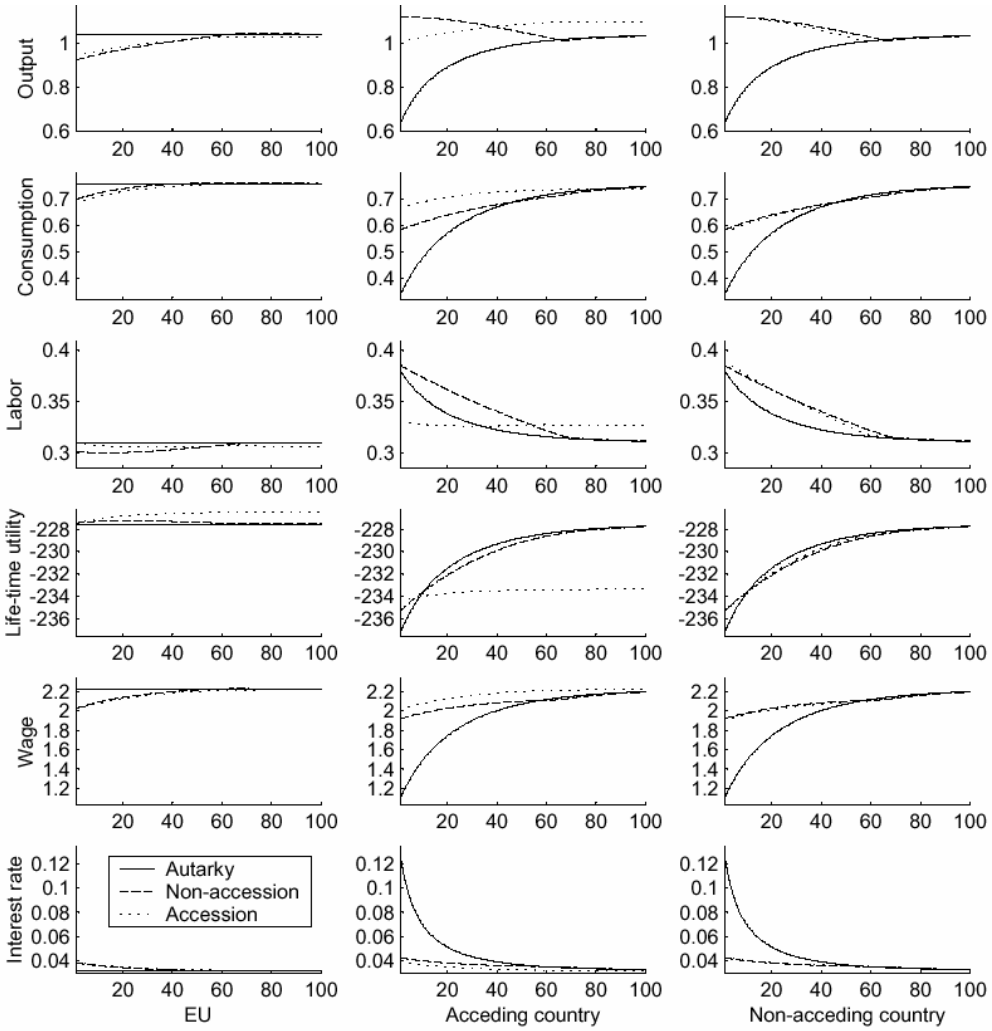
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.2a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 2* (population of non-acceding country is smaller)



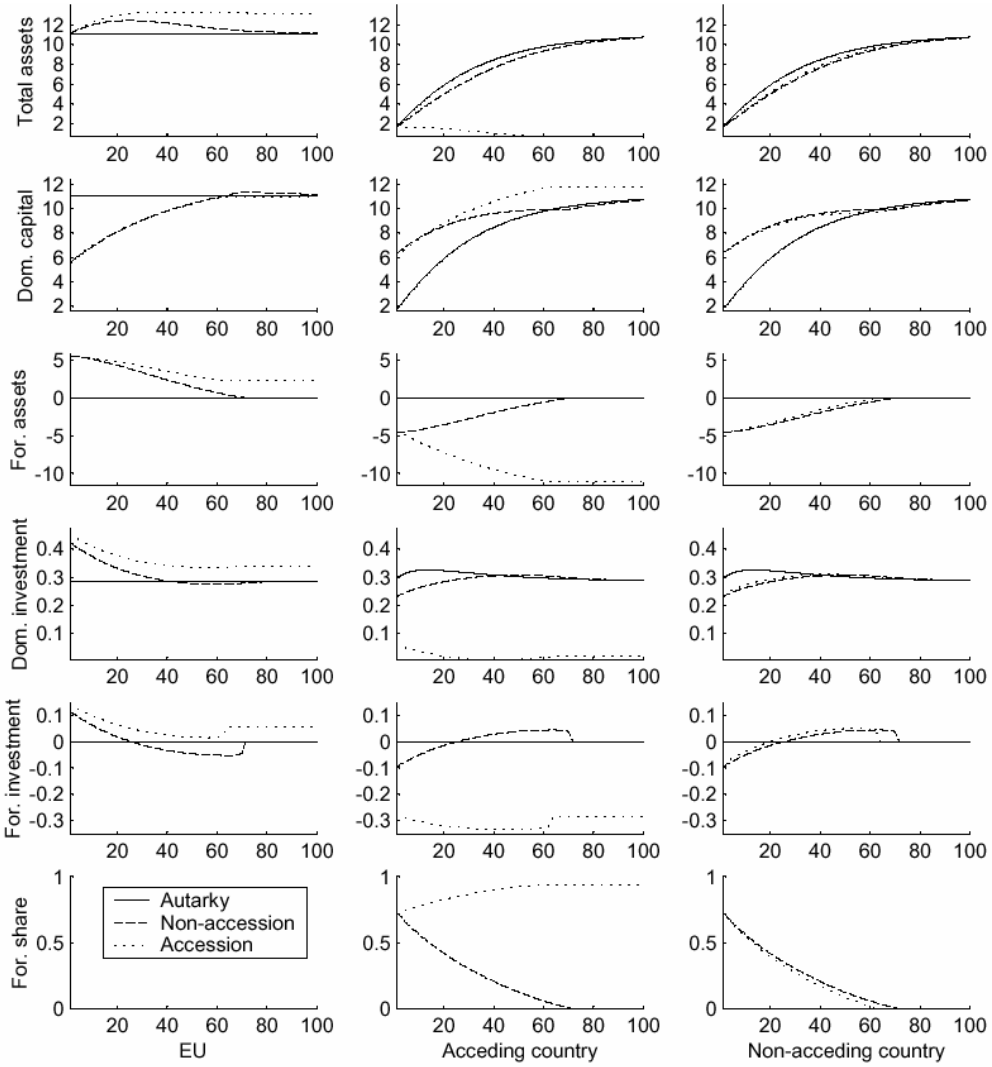
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 1$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.2b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 2* (population of non-acceding country is smaller)



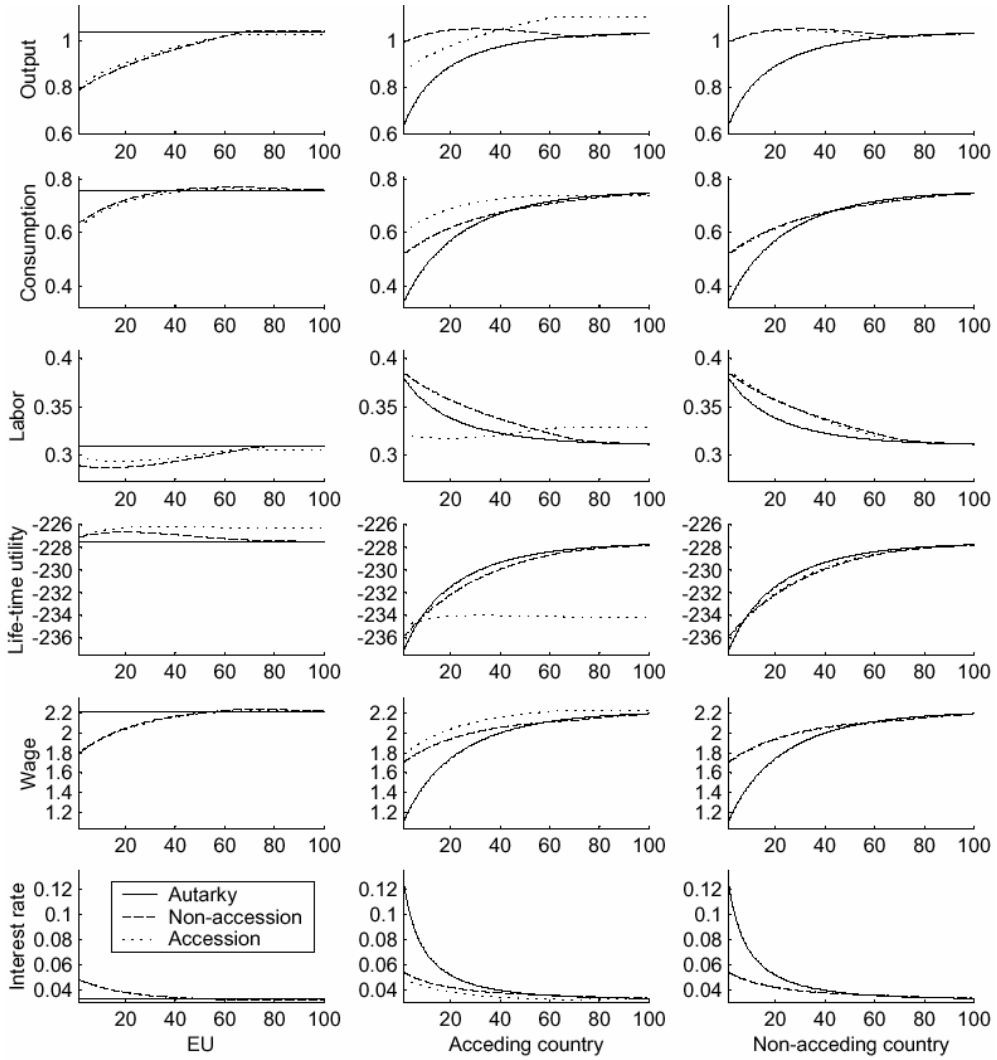
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 1$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.3a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 3* (population of non-acceding country is larger)



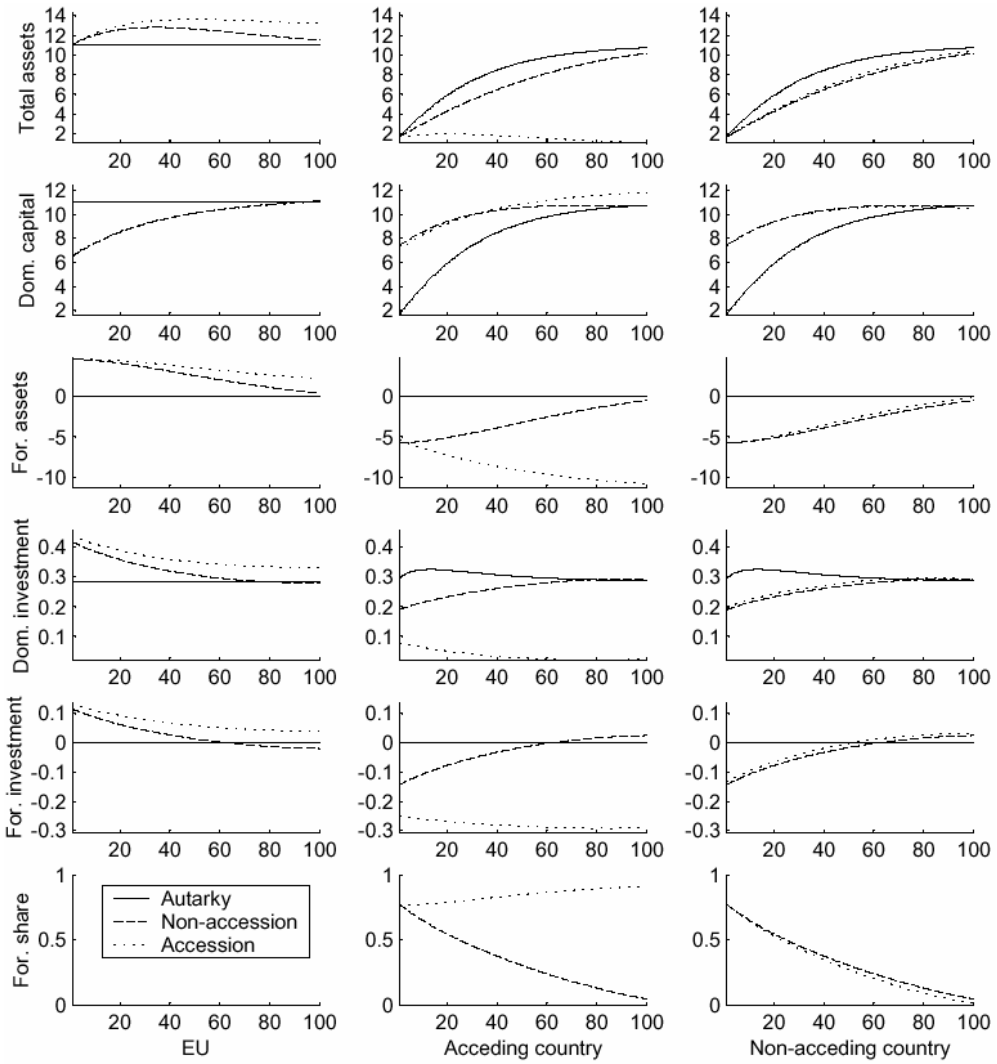
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 5$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.3b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 3* (population of non-acceding country is larger)



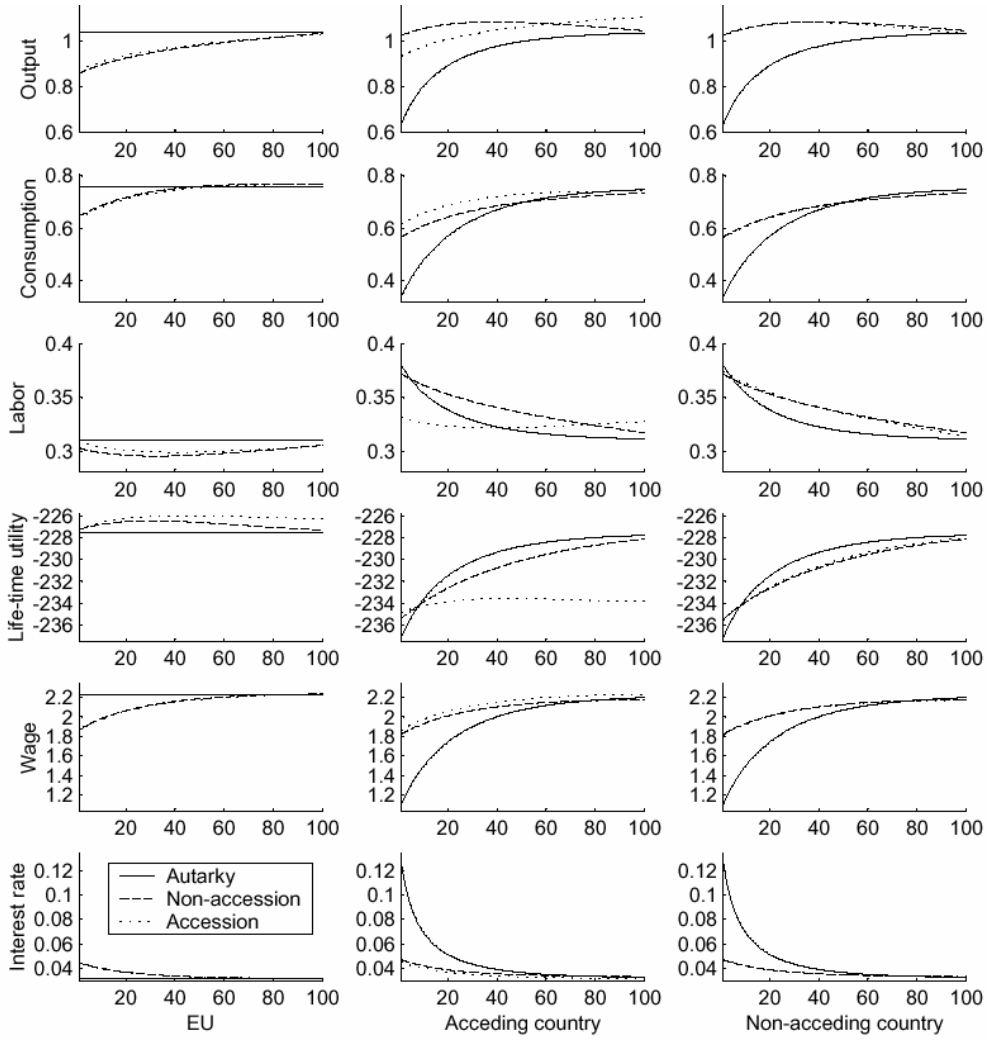
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 5$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.4a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 4* (lower border costs)



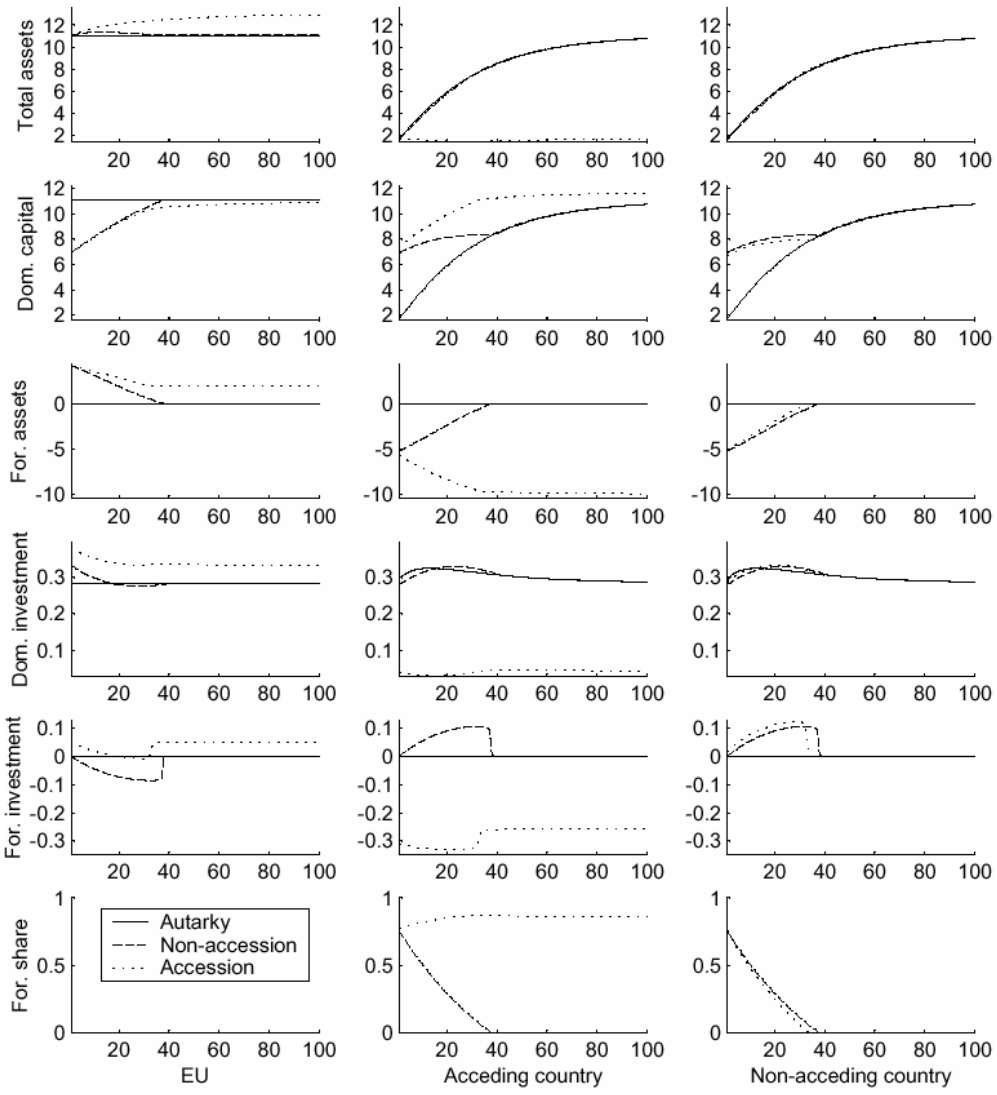
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.95$, $k_0 = 0.15k_{ss}$.

Figure E.4b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 4* (lower border costs)



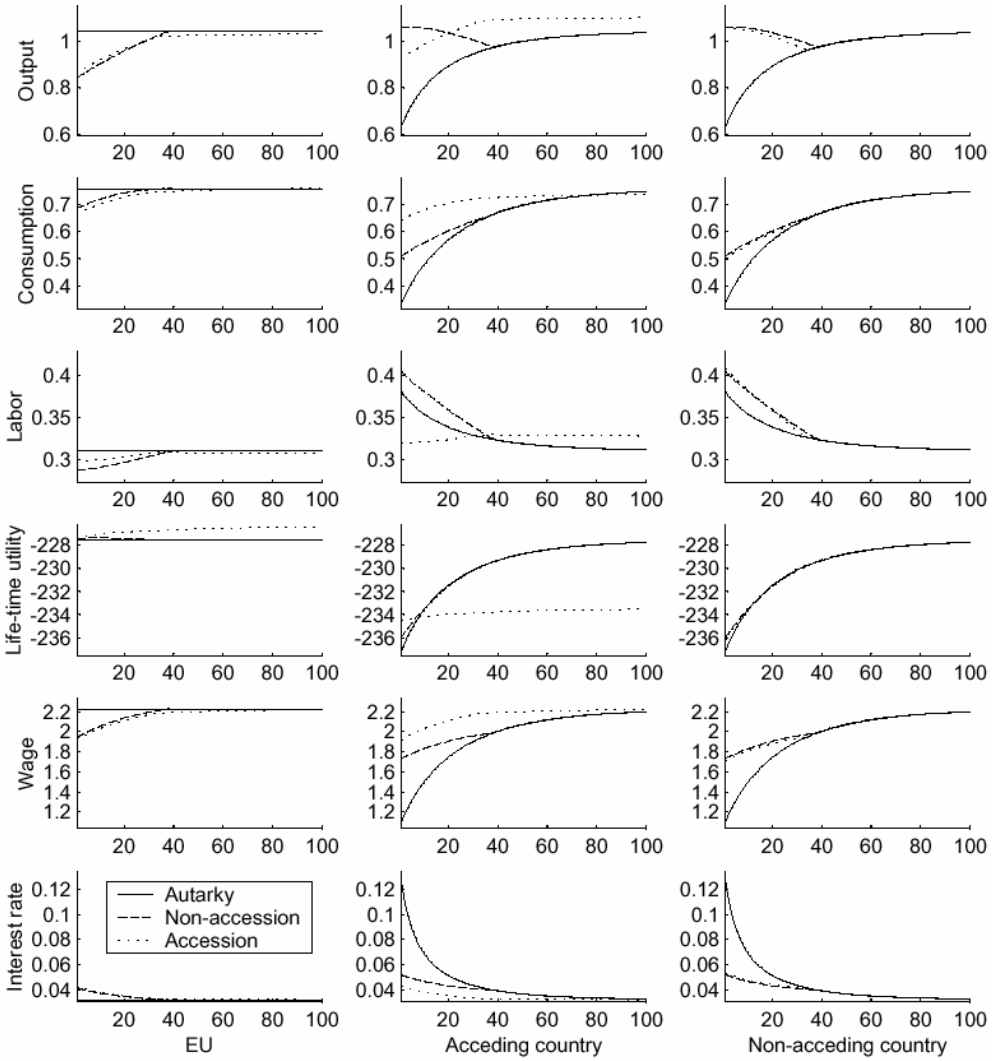
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.95$, $k_0 = 0.15k_{ss}$.

Figure E.5a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 5* (higher border costs)



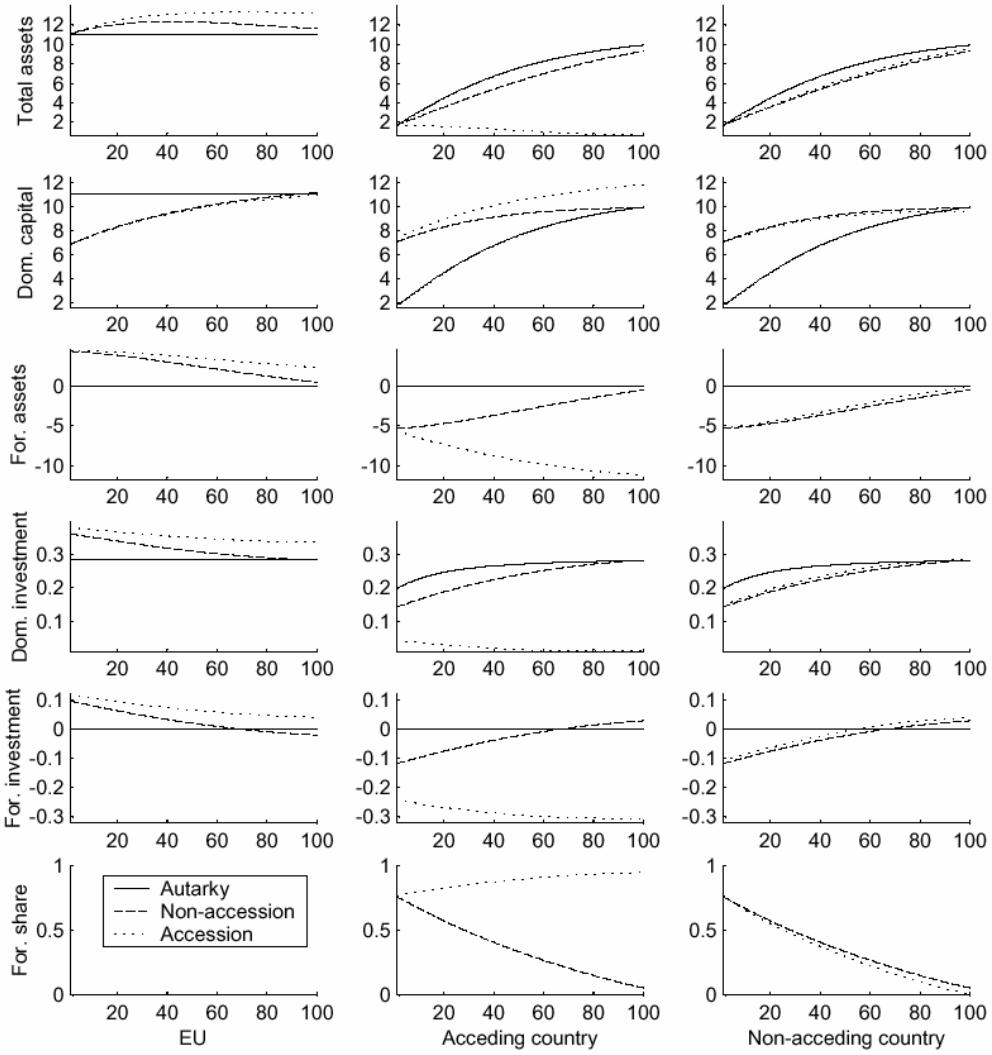
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.8$, $k_0 = 0.15k_{ss}$.

Figure E.5b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 5* (higher border costs)



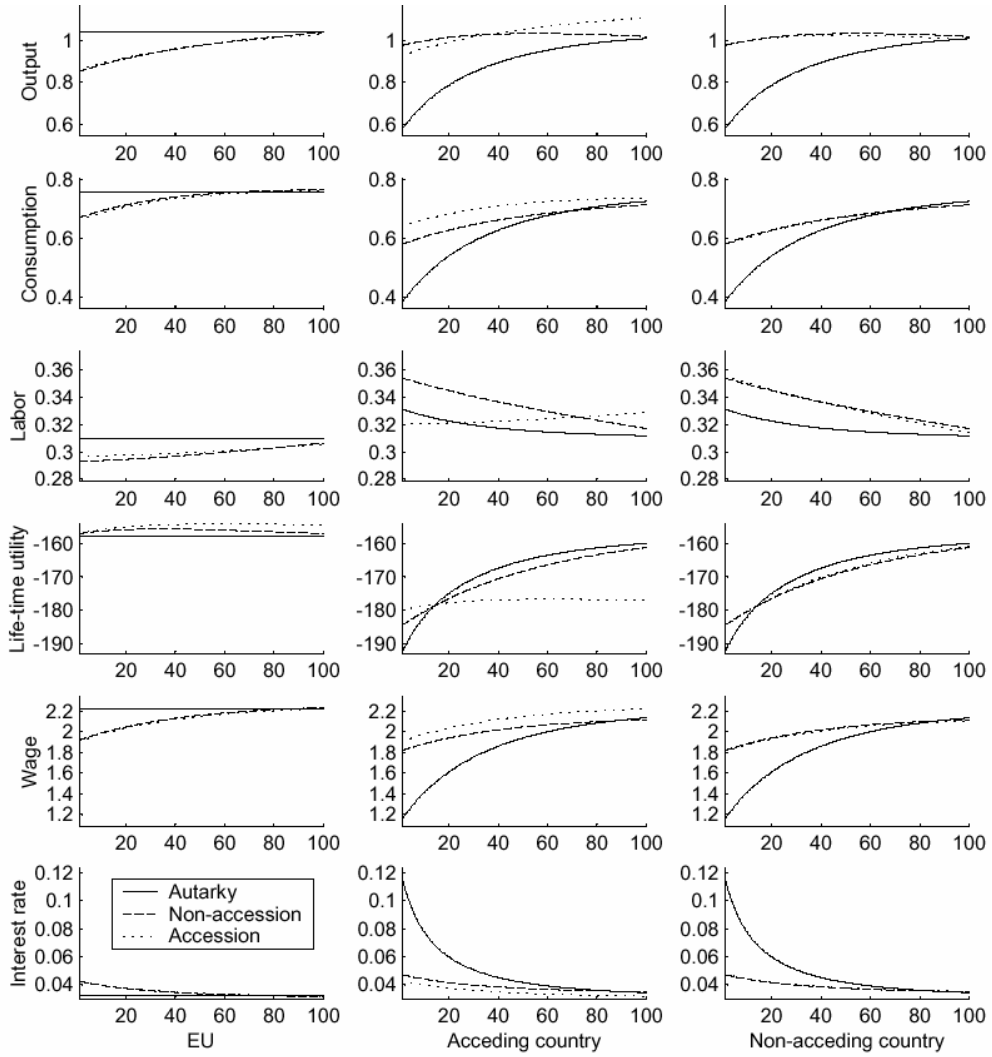
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.8$, $k_0 = 0.15k_{ss}$.

Figure E.6a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 6* (higher risk aversion)



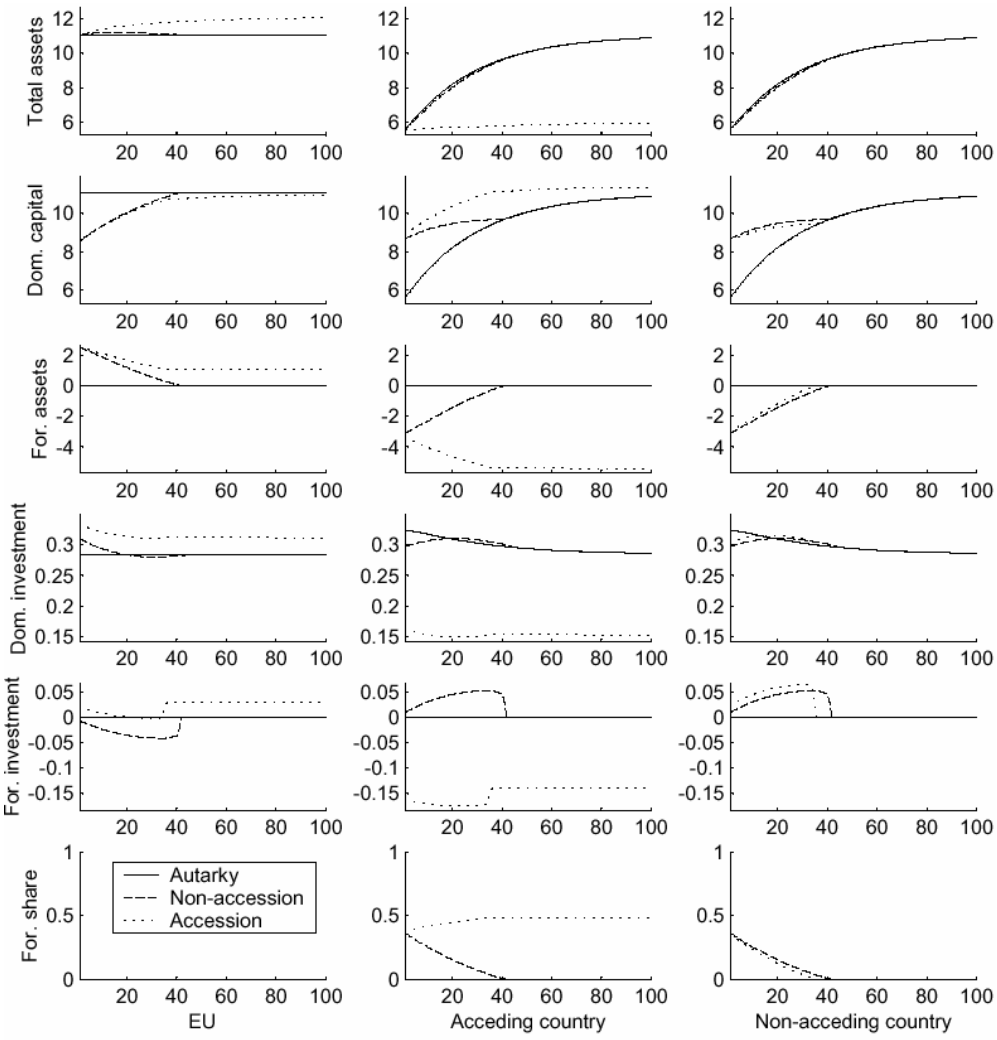
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 5$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.6b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 6* (higher risk aversion)



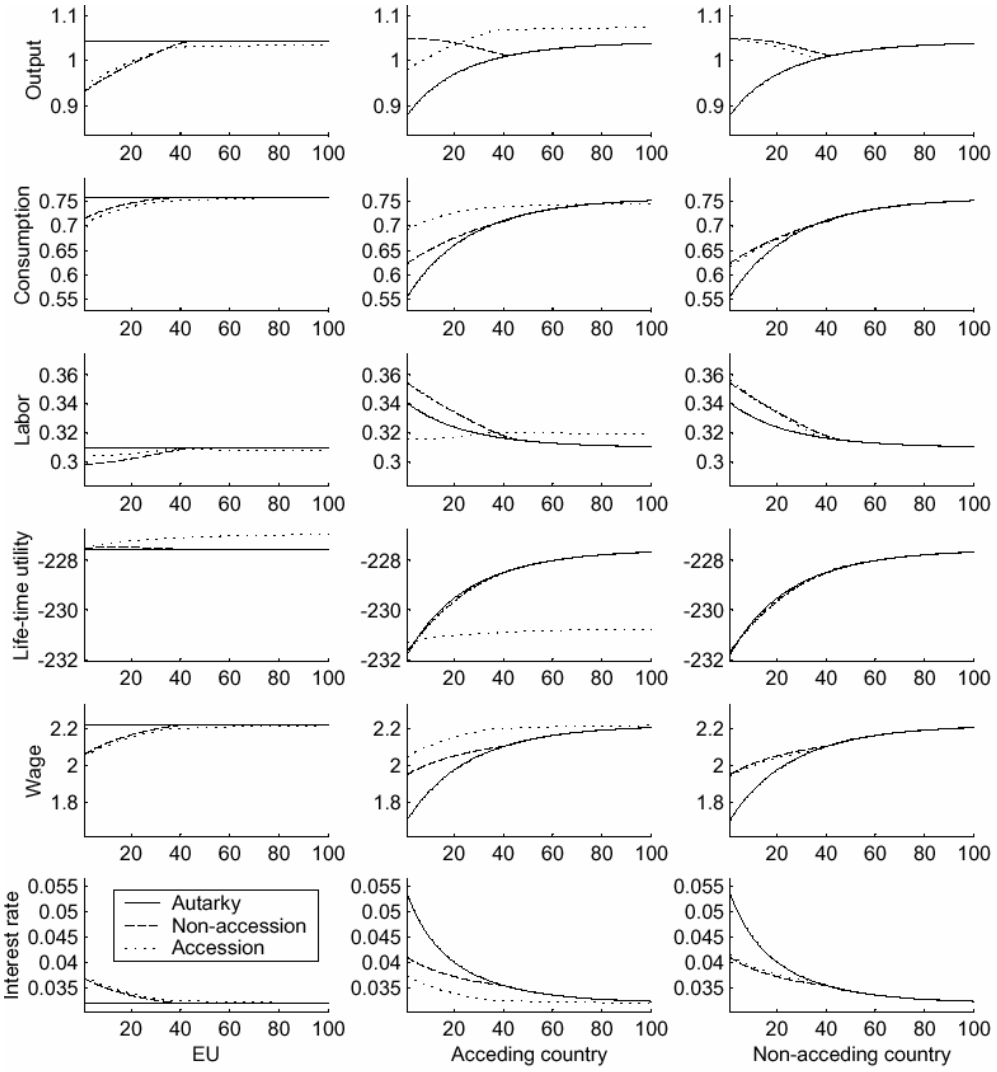
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 5$, $\lambda = 0.9$, $k_0 = 0.15k_{ss}$.

Figure E.7a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 7* (higher initial capital stocks of candidate countries)



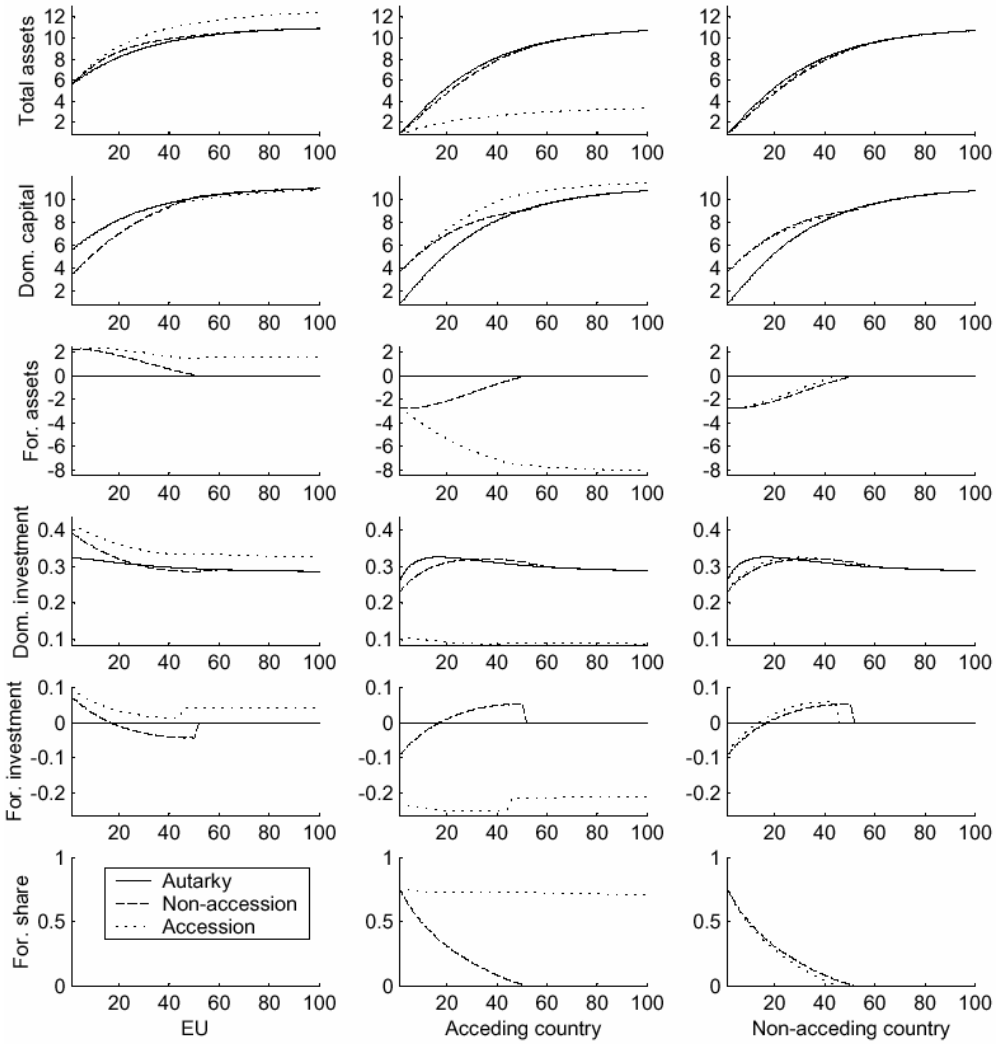
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.5k_{ss}$.

Figure E.7b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 7* (higher initial capital stocks of candidate countries)



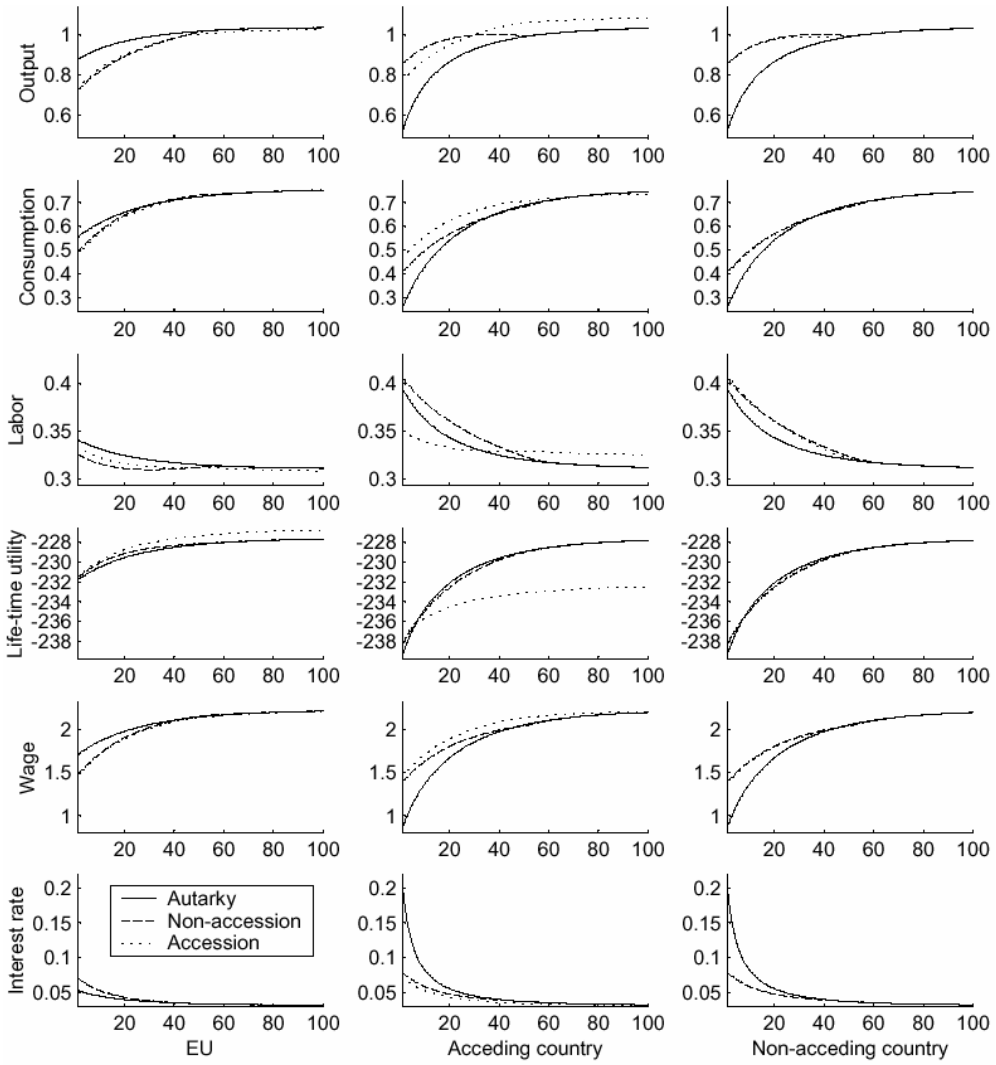
[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.5k_{ss}$.

Figure E.8a. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 8* (EU starts below the steady state)



[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.9$, $k_0 = 0.075k_{ss}$, $k_0^{EU} = 0.5k_{ss}$.

Figure E.8b. Simulated transition paths for EU, acceding, and non-acceding countries: *Experiment 8* (EU starts below the steady state)



[a] Parameter values: $v^{EU} = 5$, $v^{a} = 1$, $v^{na} = 3$, $\gamma = 2$, $\lambda = 0.9$, , $k_0 = 0.075k_{ss}$, $k_0^{EU} = 0.5k_{ss}$.