Evaluating macroeconomic strategies with a calibrated model

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First draft

1 Introduction

CEE countries experience a catching up period in economic growth while preparing for accession to the European Union. In several countries we experience an expenditure boom arising from the exuberant expectations of consumers towards EU or EM or fiscal loosening explained by the arguments referring to intertemporal optimizing of expenditures. This paper intents to discuss the effects of these events on the growth path of these countries and tries finally to arrive at policy conclusions. Our undertaking is similar to the work of Fagan - Gaspar - Pereira (2003), but the scope of issues addressed are less and the framework of the analysis is simpler.

We first set up a model that tries to capture the catching-up process in a stylized way and then simulate scenarios with alternative assumptions on these events and policies.

The analysis is based on a model where market clearing is assumed. The reason of this is the effort to focus on one issue at a time and not that we diminute the effects of price stickiness on output.

The approach is in line with the literature on fundamental real exchange rates. The main idea of this approach can be traced back to Dornbusch (1980). A literature has grown up that is too large to be listed. Faruqee (1999), Stein (1995) are some the most marked representants of this approach. We will differ from these models in the long-run behavior, assuming a gradual adjustment of sectoral factor inputs that force the long-run equilibrium to approach a state where traded versus non-traded sectoral factor returns equalize.

The main assumptions of the model are the following.

In the very long run, i.e. in steady state the domestic rate of growth is equal to world growth. The stock of labor is assumed to be constant for the sake of simplicity (and a close approximation of forecasted developments). Catching-up to the steady state level of relative (to world) GDP is explained by an increase in capital intensity and a high total factor productivity produced by the external effect of the inflow of know-how.

Capital is disaggregated by origin into domestic and foreign capital. Both domestic and foreign capital intensities grow and contribute to a higher GDP/capita.

The role of domestic and foreign capital are not symmetric. Foreign capital has the special feature to produce positive output externalities. This means that foreign owners bring in elements of economic culture, like disci-

pline, marketing practices, education of labor, the benefits of which spill over to the rest of the economy. This approach is similar to that of Romer (1986) with the difference that in our model output will not have increasing returns to scale.

In the second section we describe the main assumptions and features of the model. In the third section we give a detailed description of the equation system. In the last section we give account of the simulation results and conclusions.

2 Main features of the model

Consumption-investment linkage in an open economy model

In the most stylized version of the open economy growth model the steady state level of output is independent of the consumption path. Investment is determined by the world interest rate and consumption depends on domestic intertemporal optimization. This makes it differ from the closed economy, where the "smoothing" behavior of consumption constrains investment through the endogenous interest rate.

In our open economy model even if investments could be financed from abroad without limit, the existence of risks prevents them from behaving independently from current savings. We assume that countries are segmented enough to have country-specific risks. The rate of this segmentation might decrease as integration deepens, we believe that country-specific macroeconomic risks will remain an important factor determining investments even in the next period of catching-up of EEC countries.

Capital returns therefore have and will have a country risk component. Without going into the discussion about the nature and determinants of the premium, we assume that country risk premium depends on the rate of indebtedness of the country.

There are two alternatives of measuring indebtedness. One is to consider the net foreign financial asset position as an indicator of the creditor's risk of default and thus as the explanatory variable of the interest rate premium. Another way is to consider the risks of the debtor in a more general context and say that labor income is the main source of risk and this can be insured by the accumulation of both financial and real assets. Although real assets are somewhat more risky than financial assets they are safe enough to hedge labor income risks. This assumption would justify a risk premium depending

on the total net assets owned by the residents of the country.

We used the former indebtedness ratio as a measure of the creditor's risk although we used total net assets as a target that consumers are targeting to hedge against their labor income risk.

By the inclusion of the risk premium into the model the steady-state capital-output ratio will depend on the time preference of the consumers (possibly overruled by fiscal policy). This means that the model has similar features as the closed economy: consumer patience results in a higher steady-state capital/labor and output/labor ratio.

Slow adjustment of assets and labor

Even if we assume market clearing on the goods market, there is much reason to believe that capital and labor markets do not clear instantly. On the contrary, adjustment processes may last years or even decades. The speed of adjustment depends on profit levels.

Labor is not mobile internationally. Capital is mobile, but both domestic and international investors adjust real capital gradually.

Neither capital nor labor is disaggregated into sectors explicitly. However, we assume that both capital and labor adjust across tradable and non-tradable sectors. As a result the relative price of non-tradables in terms of tradables approaches to an equilibrium rate determined only by relative costs irrespectively from demand.

Consumption behavior is represented in a reduced, shortcut way. Consumption is a function of income and assets, and the coefficients are calibrated to assure a targeted steady-state asset ratio. The partial equilibrium asset rate is approached at a rate of 5 years half-life. Interest rates are not included into the consumption function for the sake of simplicity.

Fiscal policy is implicitly represented by changes in consumption behavior. Permament changes in fiscal behavior mean a lower targeted steady-state asset ratio, while transitory fiscal expansion means a temporarily higher consumption with unchanged steady-state target.

Externalities of foreign investments as a source of catch-up

The driving force of the assumed catching up consists of three factors:

1. capital accumulation
2. autonomous rate of extra TFP growth rate
3. extra TFP growth owing to externalities provided by foreign capital

We calibrated the model in a way that the baseline simulation should rudimentary be in line with our knowledge about the relative economic position of Hungary (not significantly different from other CEE countries) to-

wards the European Union and a "balanced view" about the expected path of convergence.

This means that in the first observation GDP is at 50 percent. In the next 20-30 years

(1) about 10 percent will be added by increasing the capital/output ratio from the present 1.9 to the assumed EU-level of 2.2. Within this increase foreign capital will increase its rate from 0.6 to 0.71.

(2) about 20 percent will come come from the know-how and economic culture that will be created as an external effect of incoming foreign capital.

(3) the magnitude of the autonomous part of TFP growth is not determined by the model and does not effect anything in the model either. Thus anybody can add it relying on his own judgement. It is quite reasonable to think that a 20 percent gap in productivity will remain in steady state as it has been the case in past centuries but some might be more optimistic and add 20 percent without challenging our model assumptions.

Neglecting the autonomous component of TFP growth does not mean that we really think that it is 0. We know that education, institutional openness, law enforcement, smooth and flexible administration are important factors of growth. Foreign investors contribute to the enforcement of improving these institutions, but to a large extent this development is autonomous and causality is rather the opposite way: better institutions attract foreign capital. We used a specific calibration for the weight of imported know-how and left open the role autonomous institutional and human capital improvements.[1]

To represent the external effect of foreign owned capital we included the foreign capital capital/output ratio into the residual term of the production function. By entering this term in a ratio form we secured that the production function is still homogenous at degree 1.

3 The model

3.0.1 Output

The model is basically a one-sector model, where output is determined by a Cobb-Douglas production function.

[1] We did not find attrective enough to include human capital formally into the capital accumulation process along the lines of Barro - Sala-i-Martin (1991).

$$Y_t = A_0 \left(\frac{K_{f,t}}{Y_t} \right)^{\gamma_\mu} (1+\overline{\mu})^t K_{f,t}^{\alpha_f} K_{d,t}^{\alpha-\alpha_f} L^{1-\alpha}$$

Substituting output intensities:

$$Y_t = \left(A_0 \left(k_{f,t} \right)^{\gamma_\mu} (1+\overline{\mu})^t k_{f_t}^{\alpha_f} k_{d_t}^{\alpha-\alpha_f} L^{1-\alpha} \right)^{\frac{1}{1-\alpha}}$$

where

Y^s GDP

k_f stock of foreign owned capital in terms of output: $k_f = K_f/Y$,

k_d stock of domestically owned capital in terms of output: $k_d = K_d/Y$ „

$\overline{\mu}$ steady state TFP grow = international rate of TFP growth = $(1+\overline{g})^{\frac{1}{1-\alpha}}$

L labor supply (=1 by assumption),

GDP growth:

$$g_t = \frac{Y_{t+1} - Y_t}{Y_t} \tag{1}$$

Extra growth over the international rate g^* is generated by an accumulation of foreign and domestic capital. It is assumed that the share of foreign capital at the start is less than optimal. If stationary profits equalize, i.e. $\overline{\overline{\pi}}_f = \overline{\overline{\pi}}_d$, the optimal share of foreign capital will be α_f/α. The inflow of foreign capital is crucial because of its external effect. TFP is the sum of the steady state growth (equal to the international "standard") and a factor depending on the stock of foreign capital.

3.0.2 Some notations and definitions

The model is "real". Aggregates of volumes are understood as some weighted average of the individual items. Interest rates are defines as intertemporal relative prices of this basket of goods.

It is convenient to define some variables as the sum of their steady-state solution (bar variable) and an additional term (the particular solution). The s superscript denotes "short", annual rates.

Interest rate: $rr^s = \overline{r}^s + r^s$

Gross profit rate for domestic and foreign capital: $\pi\pi_d^s = \overline{\pi^s} + \pi_d^s$, $\pi\pi_f^s = \overline{\pi^s} + \pi_f^s$, where steady state gross profit is equal to the sum of interest rate, depreciation of capital and the equity premium: $\overline{\pi^s} = \overline{r^s} + 0.08 + 0.04$.

For the rest of the world growth rate, interest rate and profit rate as well as relative productivity of tradables versus non-tradables is assumed to be constant. The assumed baseline values for these constants are below.

Growth rate: $g^* = 0.02$

Interest rate risk premium: $prem^{s*} = 0$

Gross profit rate: $\pi^{s*} = r^{s*} + 0.08 + 0.04$, i.e: interest + depreciation + equity premium

Domestic interest rate contains a risk premium that depends on the net foreign asset position, nfa, of the country.

$$prem_t^s = \alpha_{prem} - \beta_{prem} nfa_t \tag{2}$$

This means, that in steady state returns on all capital items are higher than the international level by a risk premium. This required high return on capital means that consumer impatience will affect the steady-state level of capital stock and output, just like in the *closed* economy Ramsey-Solow model.

$$\overline{r}^s = r^{s*} + \overline{prem^s} \tag{3}$$

$$\overline{\pi_d^s} = \pi^{s*} + \overline{prem^s}$$

$$\overline{\pi_f^s} = \pi^{s*} + \overline{prem^s}$$

Let us define long-term rates the following (linearly approximated) way:

$$1 + r_t = 1 + \sum_{k=t}^{\infty} r_k^s$$

$$1 + \pi_t = 1 + \sum_{k=t}^{\infty} \pi_k^s$$

$$1 + prem_t = 1 + \sum_{k=t}^{\infty} prem_k^s$$

3.0.3 Long run interest rate parity

Uncovered interest rate parity is assumed to hold for long-run investments with the modification by the risk premium:

$$r_t = \theta q_t + prem_t,$$

where q is the price of non-tradables in terms of tradables in logarithmic scale, θ is a weight factor that converts q into the price of non-tradables into the price of the basket of the two sectors. θ is constant in the simulations for the sake of simplicity. q is normalized to be 0 in steady state.

3.0.4 Investment

Income parity would mean that the flow of factors of production equalized returns. It is well known that factor mobility is constrained both intertemporally and geographically. This constraint is explained usually by adjustment costs that we do not model explicitly.

This gradual behavior has to be taken into account both in aggregate capital investments and later in the assumed speed of factor flows across the tradable and non-tradable sectors.

Investments adjust capital stock to the optimal level, the speed of adjustment is finite.

$$k_{f,t} = \gamma_{k_f} k_{f,t-1} + \beta_{k_f} \left(\pi_{f,t-1} - r_{t-1}\right) + \left(1 - \gamma_{k_f}\right) \overline{k}_f \tag{4}$$

$$k_{d,t} = \gamma_{k_d} k_{d,t-1} + \beta_{k_d} \left(\pi_{d,t-1} - r_{t-1}\right) + \left(1 - \gamma_{k_d}\right) \overline{k}_d \tag{5}$$

where

k_f k_d intensity of foreign and domestically owned capital ,

π_f π_d return of foreign and domestic capital in excess of the steady state level

The speed of capital adjustment will depend not only on the parameter γ_k that might represent some constant "adjustment costs" factor, but – like in a closed economy – on the rate of saving, that determines profits via the real exchange rate and the risk premium.

$$i_{d,t} = (1 + g_t)\, k_{d,t+1} - (1 - \delta) k_{d,t} \tag{6}$$

$$i_{f,t} = (1 + g_t)\, k_{f,t+1} - (1 - \delta) k_{f,t} \tag{7}$$

$$i_t = i_{d,t} + i_{f,t}$$

3.0.5 Consumption

The consumption function is the reduced form of a model where consumers are striving to build up a steady state wealth rate in terms of labor income, y_{LAB_t}. In theory this wealth rate would depend on the interest rate, but this point is neglected in the model.

$$\begin{aligned} c_t &= \alpha_c w_t + \beta_c y_{LAB_t} \\ w_t &= nfa_t + k_{d,t} \\ nfa_{t+1} &= \frac{(1 + rr_t^s) nfa_t - c_t - i_{d,t} + y_{LAB,t} + \pi\pi_{d,t} k_{d,t}}{1 + g_t} \end{aligned}$$

The α_c and β_c parameters are calibrated to lead to a 0 level of $\overline{nfa}$ and a convergence speed with a 5 year half life.

Government does not exist in the model but the macroeconomic effects of government behavior can be simulated by changing the parameters of the consumption function or assuming shocks to consumption or both.

3.0.6 Incomes

We do not derive explicitly the relationship between capital stocks and profits. It is enough for our purpose to state that profits depend on the difference between the actual and the stationary rate of capital stocks:

$$\pi_{f,t} = \pi_{f,t+1} + \lambda_{\pi_f} \left(\overline{k_f} - k_{f,t} \right) \tag{8}$$

$$\pi_{d,t} = \pi_{d,t+1} + \lambda_{\pi_d} \left(\overline{k_d} - k_{d,t} \right) \tag{9}$$

Labor income

$$y_{LAB,t} = 1 - \pi\pi_{d,t} k_{d,t} - \pi\pi_{f,t} k_{f,t} \tag{10}$$

The trade balance

$$tr_t = 1 - c_t - i_t$$

3.0.7 The equilibrium exchange rate

Factors of production are mobile in the long run. This is true at least for capital internatinally and it is true intersectorally in the demestic market, both for capital and labor. This latter means that in the long run there are no specific factors in tradables or non-tradables production, the production function is Ricardian. The slope of this Ricardian production function is the real exchange rate. If this slope is the same internationally, we will observe purchasing power parity (PPP). We accept the "concensus" view of the literature that among highly developed countries the convergence towards PPP exists, although it is rather slow, with 3-5 years half-life.

For economies that are in another stage of development, the slope of the Ricardian production function may be different because of variances in productivities or factor intensities. We do not model the reasons of this difference, but take some observations as facts: costs of tradables in terms of non-tradables tend to decrease with an aggregate growth of productivity (Balassa-Samuelson effect). We consider this difference as an exogenous difference in the sectoral TFP-s. In our one-sector model it's consequence is taken into account implicitly: the cross-sectoral equalisation of factor returns

is assumed to take place along a real exchange rate path that depends on excess growth over international competitors. Actual real exchange rates will converge to this rate with the same 3-5 years half-life as in the PPP-case.

$$q_{BS,t} = q_{BS,t+1} - \tau \left(g_t - g^* \right)$$

The real exchange rate in the model is defined as the common tangential of the instantenous utility function and the production possibilities curve.

The consumers maximize a CES utility function constrained by a budget constraint given by output. To simplify arithmetics we assumed that substitutability between tradables and non-tradables behaves similarly in consumption and investment demand and aggregated them into total domestic use.

$$\begin{aligned} & max \left(A_1 \left(c+i \right)_1^{-\beta_d} + A_2 \left(c+i \right)_2^{-\beta_d} \right)^{-\frac{1}{\beta_d}} \\ s.t. \quad \left(c+i \right)_1 + q \left(c+i \right)_2 &= 1 - tr \end{aligned}$$

Producers maximize output constrained by the production possibilities constraint. The production possibilities constraint is formulated as a CET (constant elasticity of transformation)-function with negative β parameters.

$$\begin{aligned} & max \ \left(y_1 + q y_2 \right) \\ & s.t. \quad \left(B_1 y_1^{-\beta_s} + B_2 y_2^{-\beta_s} \right)^{-\frac{1}{\beta_s}} = y \end{aligned}$$

Were subscripts 1 and 2 refer to the tradable and the non-tradable sector respectively.

We used the equilibrium condition that domestic use is equal to domestic supply in the tradable sector:

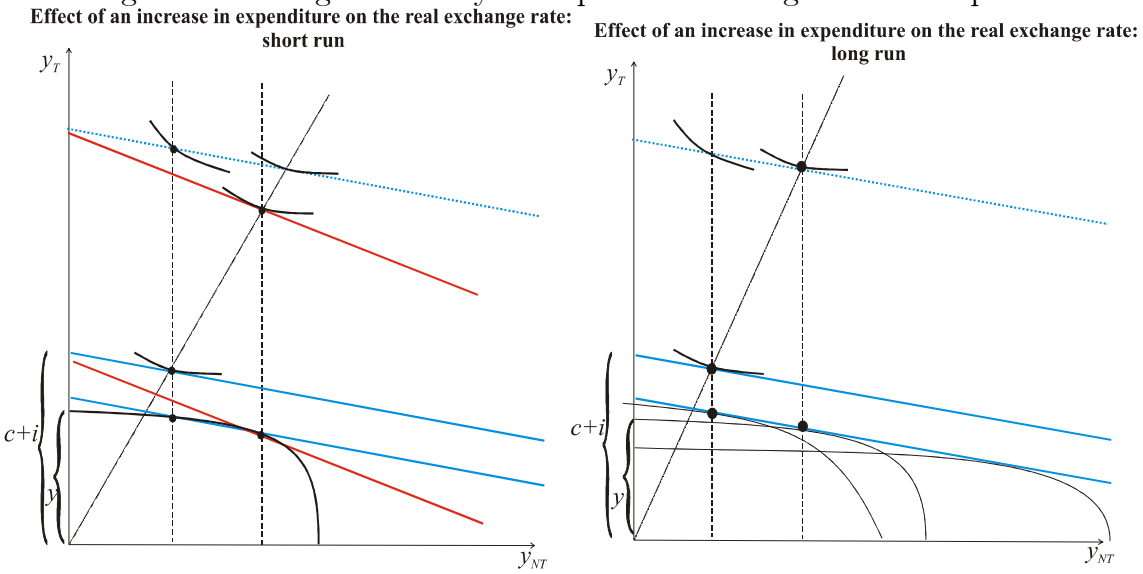
$$\left(c+i \right)_2 = y_2$$

After substitution the first order conditions are:

$$q = \frac{A_2}{A_1} \left(\frac{1 - tr - q y_2}{y_2} \right)^{\beta_d + 1} \tag{11}$$

$$y_2 = (1 - qy_2)\left(q\frac{B_1}{B_2}\right)^{-\frac{1}{\beta_s+1}} \tag{12}$$

The weighting parameters of supply are not constant. The weights depend on the allocation of production factors between the two sectors. Even if we assume that the exchange rate follows the equilibrium "Balassa-Samuelson (BS)" path, the weight parameters have to change as supply adjusts to the change in demand generated by the equilibrium change in relative prices.



Thus we may define an "equilibrium weight parameter", that represents a factor allocation consistent with the BS path. Along this path there are no profitable arbitrage possibilities for factor allocation.

$$B_{2BS,t} = q_{BS,t} \cdot B_1 \left(\frac{\frac{(1-tr_t)}{q_{BS,t}+\left(q_{BS,t}\frac{a1}{a2}\right)^{\frac{1}{1+\beta}}}}{1 - \frac{q_{BS,t}(1-tr_t)}{q_{BS,t}+\left(q_{BS,t}\frac{a1}{a2}\right)^{\frac{1}{1+\beta}}}} \right)^{1+\gamma}$$

Supply or demand shocks will create profit and wage wedges between sectors as the real exchange rate changes. Factor allocation will adjust to these shocks and shift relative weights of supply.

$$B_{2,t} = B_{2,t-1} - \lambda_s \left(B_{2BS,t-1} - B_{2,t-1}\right) \tag{13}$$

Comparison with other approaches Our model combines the features of the "sustainable real equilibrium exchange rate (REER)" models and the PPP approach. The difference in the two approaches can be interpreted as differences in assumptions about the length of adjustment processes. REER modellers consider PPP adjustment too slow to bother about. This means that they disregard the adjustment of production factor allocation between sectors, or in other words their production function in a long-run is based on the specific factor assumption.

Our approach uses the same assumption for the short run but considers factor adjustment in the long run. This means that no long-run correspondence exists between the real exchange rate and the balance of trade.

The difference between the two approaches becomes marked if a REER model is used to define a long run equilibrium exchange rate, like the NATREX-approach is doing it. The NATREX approach defines the long run as the time when capital movements subside (converge to a stock equilibrium) and the balance of trade has to cover only net asset incomes. Compared to the competing idea of PPP or its dynamic, BS-equilibrium, version, this idea is useful only if aggregate financial saving or capital accumulation adjusts stocks towards their steady state faster than intersectoral factor allocation adjustment takes place between tradables and non-tradables. History suggests that net savings of countries change very slowly and a rationale of this behavior can be given by theory as well (Simon-Várpalotai 2000). Investments bring about equilibrium stocks very slowly as well. These processes might take several decades, longer than the adjustment process that equalizes intersectoral returns and brings the exchange rate to the level of the BS-equilibrium.

Our prediction below that fiscal expansion appreciates the exchange rate in the short run, is in line with the results of the NATREX model (and others). In the long run NATREX-model infers that the interest burden of debt has to be serviced by net exports which is possible only by a depreciation of the real exchange rate. In our model the mechanism is different: in the long run, net exports and the real exchange rate are not directly interdependent. The exchange rate might depreciate but only as much as the risk premium created by the debt slows down accumulation, productivity and output and this feeds back to the BS exchange rate.

4 Simulations

The question that we try to answer numerically is how important is fiscal policy in the catching-up process. The model is constructed in a way that fiscal policy does effect the equilibrium growth path, but a numerical assessment of the magnitude of this affect can be made only by running simulations.

Fiscal policy is captured in the model as a change in consumer behavior. As fully non- Ricardian behavior is assumed, any net fiscal expenditure means a change in net aggregate expenditure. Fiscal investments are disregarded.

The channels where fiscal policy works out its effect are the following.

Fiscal expenditure increases interest rates and appreciates the currency. This worsens the net foreign asset position and increases the risk premium and in addition slows down capital imports. If the fiscal stance remains permanently loose, the result will be a decrease of steady-state wealth and consequently a permanently lower output flow. Is the result simply a change in the time preference within reasonable limits? The answer will depend on how much importace we assume to the externalities that investments, notably foreign investments produce, and how important is debt in determining the risk premium.

We created two baseline scenarios differing in the importance of these two channels. In the first set of scenarios we assumed acoefficient of 0.7 for the external effect of foreign capital. This means that a 1 percent increase in the foreign capital intensity (not the level) creates a 0.7 percent increase in TFP. This might seem to be a large number, but not far-fetching. It means that we explain about two third of the 60 percent increase in productivity in the past post-transition period by foreign owned capital expansion that increased capital intensity from 0 to 60 percent of GDP. (The rest of increase was mainly exogenous, total capital intensity did not change significantly.)

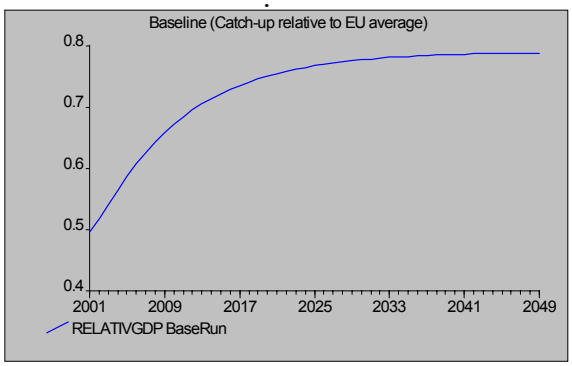
We assumed the coefficient of nfa on the risk premium to be 0.1. This means for example that if the external debt ratio increases by 10 percent, a 1 percent increase in the interest rate is required to keep the exchange rate unchanged. The relationship is presumably not linear. For low levels of indebtedness or for creditors the coefficient might be lower or even 0. We choose this figure as probably relevant for an indebted country like Hungary. Although the issue whether a robust relationship existed between the risk premium and foreign debt has probably not been settled, anecdotal evidence

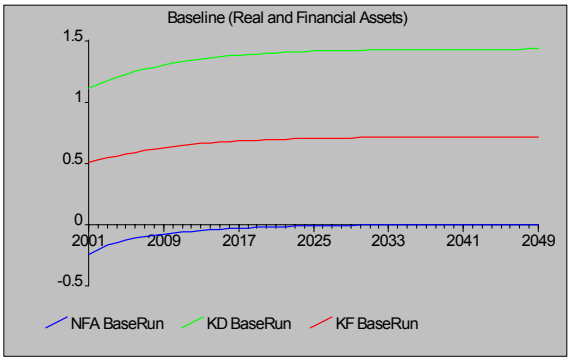
might support this assumption.[2]

As both of the above two assumptions have a weak empirical background we made a sensitivity analysis. We repeated the simulations with parameters that reflect a fully agnostic view towards both the endogenous growth effect and the risk premium effect. In this alternative model we assumed that FDI has no externalities and credit markets do not consider country risks.

4.1 Baseline

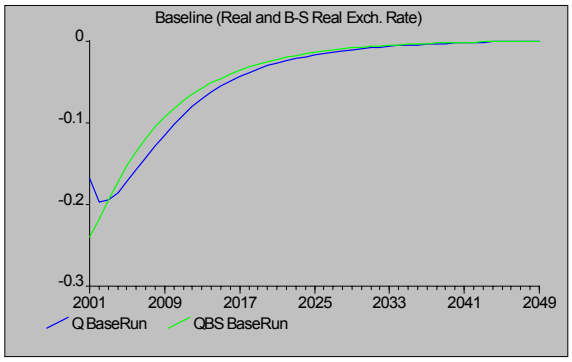
The baseline was calibrated to be close to actual Hungarian data and the expected growth process. Actual GDP is at the 50% level of the EU average. We expect to be close to 80 percent in about 25 years. The starting value of the exchange rate is taken to be somewhat above the BS rate.[3] Net financial assets are at -0.25 at the starting point and approach 0 steady-state value.

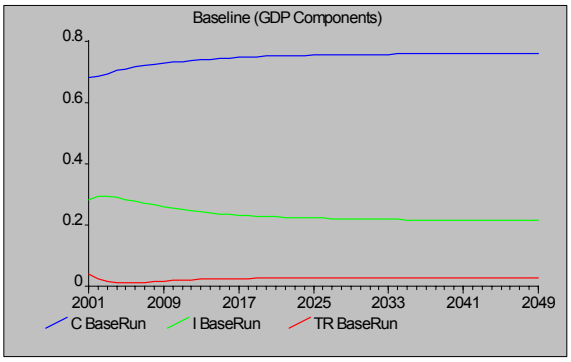


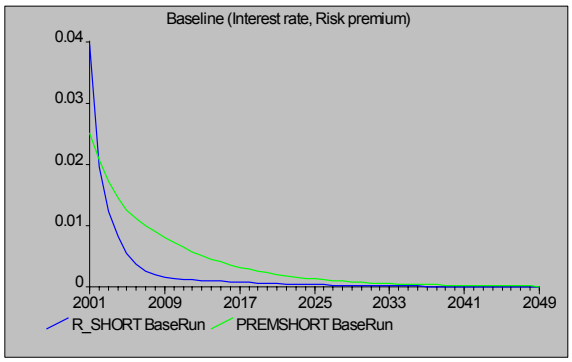


[2]Wadhwani (1999), Hansen-Roeger (2000) use debt indicators in explaining exchange rates.

[3]Presently we have technical difficulties in calibrating parallelly the short-run response of the trade balance on the exchange rate on the one hand and the adjustment speed of the exchange rate to the BS-rate on the other hand. We calibrated a 0.5 coefficient as the effect of the real exchange rate on the trade balance but the desired 3-5 years half life of exchange rate adjustment could not be established because of the interconnections of the parameters.







4.1.1 Comparison with NATREX

We tried to run an alternative simulation with the assumption that the B_1/B_2 parameter of the constant elasticity of transformation (CET) function of supply does not adjust to bring the exchange rate to the Balassa-Samuelson path. In the NATREX approach the level of the exchange rate is not determined. Therefore the path of the exchange rate is independent of the starting value. We put the starting value at a rate which brings 0 as a steady state. (Note that the exchange rate is in logs.) The difference between the initial value and the steady state value is just as much as justified by the alleviation in the interest burden as a result of the increase in nfa.

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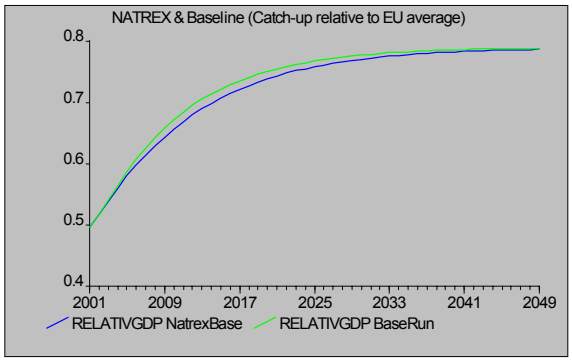
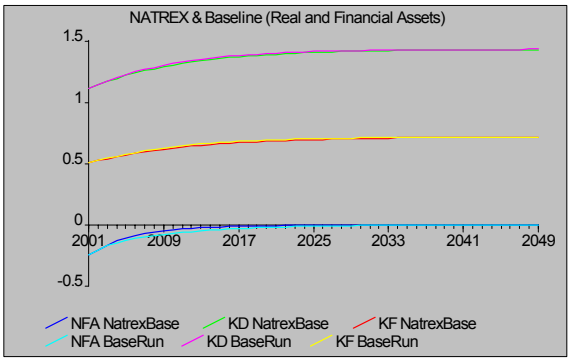
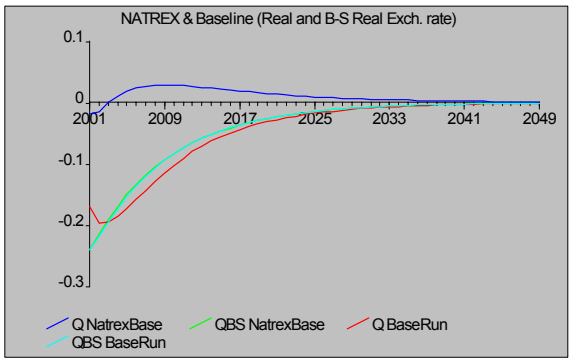
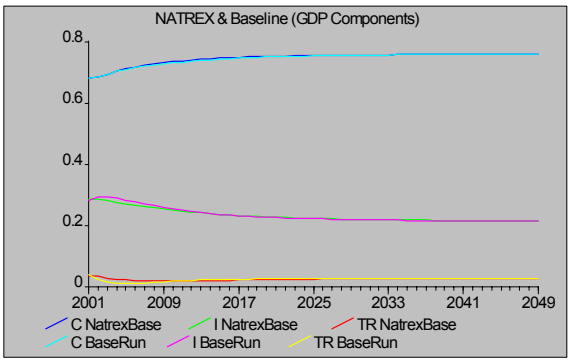
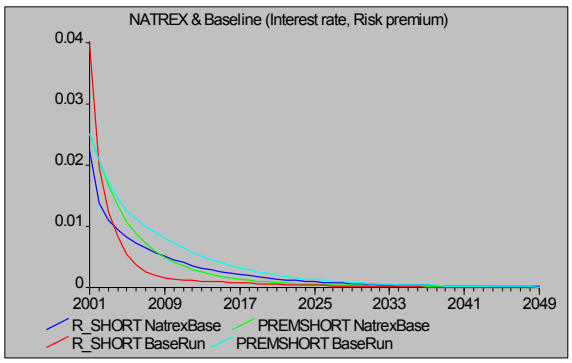










4.1.2 Fiscal policy shocks to the baseline

Fiscal policy is represented by changes in consumption behavior. As a *transitory* shock we increased the consumption rate in the first year by 1 percentage point but kept both the targeted steady state and the speed of convergence unchanged. As a *permanent* shock we mean a 1 percentage point increase in first year consumption together with a 1 percentage point decrease in the

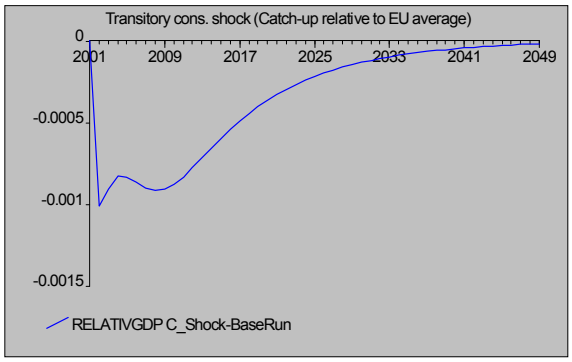
targeted wealth ratio. This is a specific interpretation of a permanent shock. Alternatively we could have assumed that only the targeted wealth ratio would change and consumption adjusts to this new target.

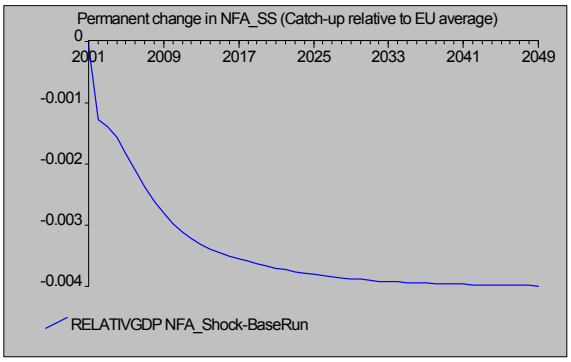
As a compact measure of the effect of fiscal policy on the path of GDP we calculated the internal interest rate that can be achieved by postponing consumption. Because of the externalities and the risk premium effects this internal interest rate turned out to be 21.2%

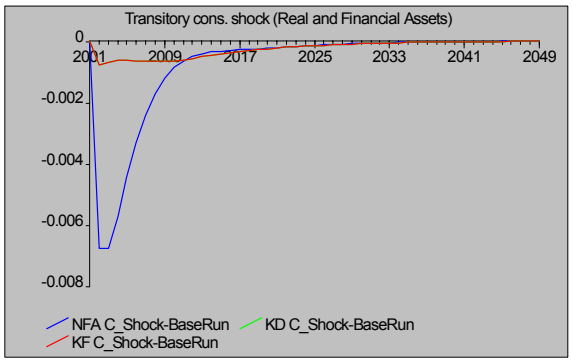
With the alternative view that externalities of investments do not exist and country risks do not exist, this interest rate becomes 3.2%.

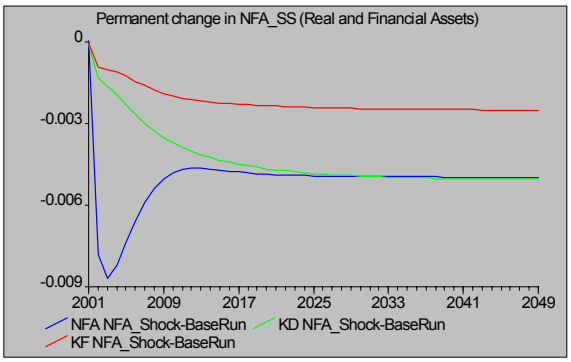
The latter might seem to be lower than the exogenously assumed world interest rate of 5%. In fact a direct comparison is misleading. Because of the BS effect the domestic real interest rate in terms of aggregate output (as it is defined in the model) has to be lower than the world rate and the calculated rate can be considered as equivalent to the assumed world rate. This means that in this case there is no extra windfall income, the fiscal decision is simply a choice of intertemporal optimization.

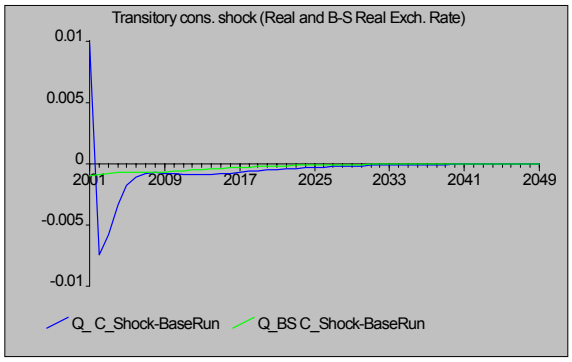
C_shock **NFA shock**

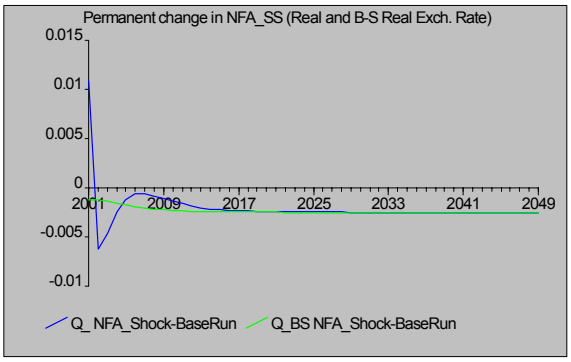


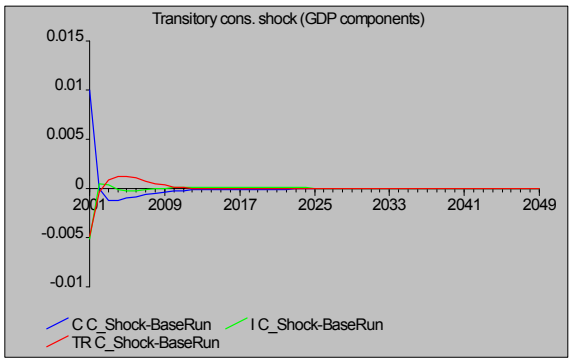


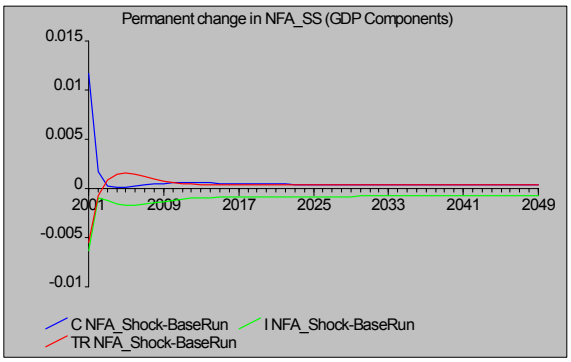


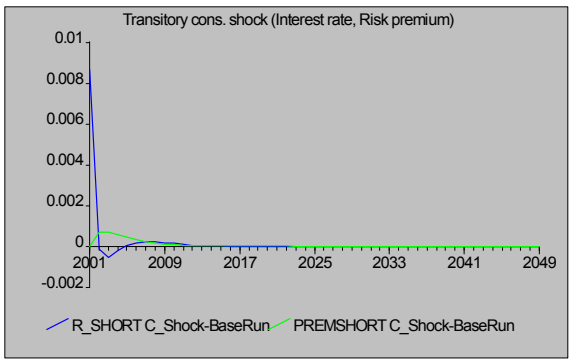


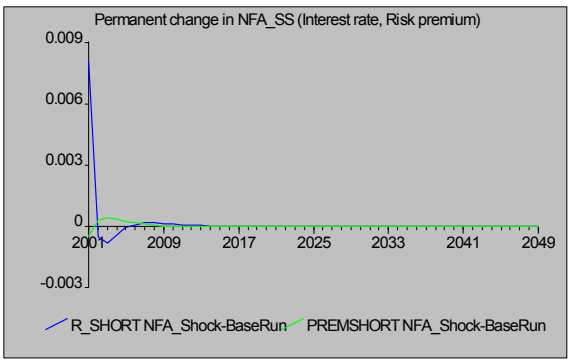

Transitory cons. shock (Real and B-S Real Exch. Rate)
0.01
0.005
0
-0.005
-0.01
2001
2009
2017
2025
2033
2041
2049
Q_ C_Shock-BaseRun
Q_BS C_Shock-BaseRun

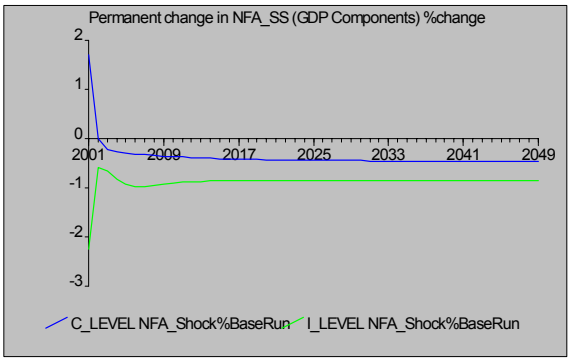

Permanent change in NFA_SS (Real and B-S Real Exch. Rate)
0.015
0.01
0.005
0
-0.005
-0.01
2001
2009
2017
2025
2033
2041
2049
Q_ NFA_Shock-BaseRun
Q_BS NFA_Shock-BaseRun

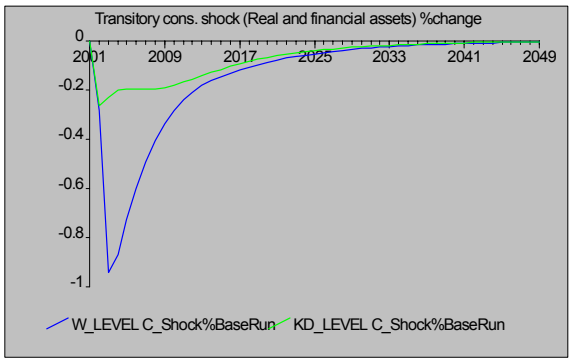

Transitory cons. shock (GDP components)
0.015
0.01
0.005
0
-0.005
-0.01
2001
2009
2017
2025
2033
2041
2049
C C_Shock-BaseRun
I C_Shock-BaseRun
TR C_Shock-BaseRun

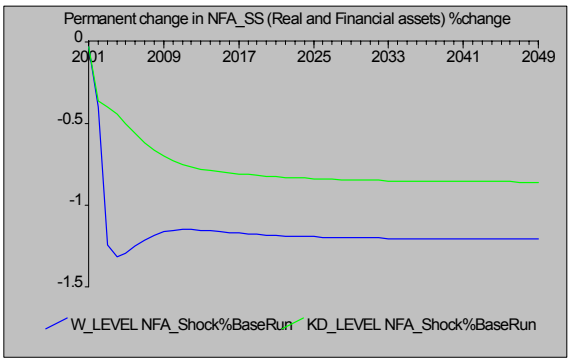

Permanent change in NFA_SS (GDP Components)
0.015
0.01
0.005
0
-0.005
-0.01
2001
2009
2017
2025
2033
2041
2049
C NFA_Shock-BaseRun
I NFA_Shock-BaseRun
TR NFA_Shock-BaseRun


Transitory cons. shock (Interest rate, Risk premium)
0.01
0.008
0.006
0.004
0.002
0
-0.002
2001
2009
2017
2025
2033
2041
2049
R_SHORT C_Shock-BaseRun
PREMSHORT C_Shock-BaseRun

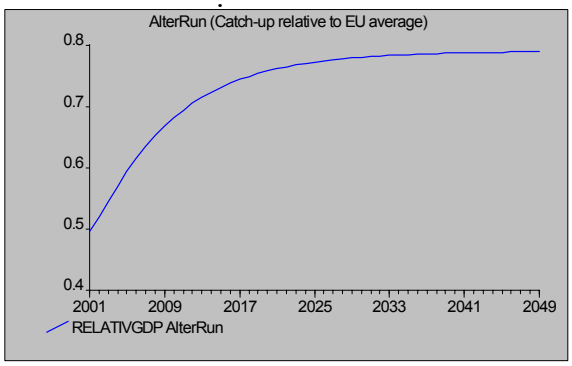

Permanent change in NFA_SS (Interest rate, Risk premium)
0.009
0.006
0.003
0
-0.003
2001
2009
2017
2025
2033
2041
2049
R_SHORT NFA_Shock-BaseRun
PREMSHORT NFA_Shock-BaseRun

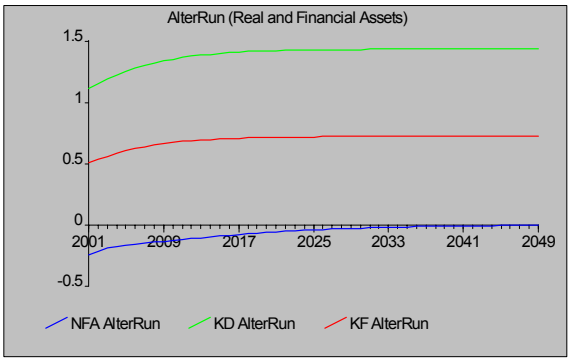


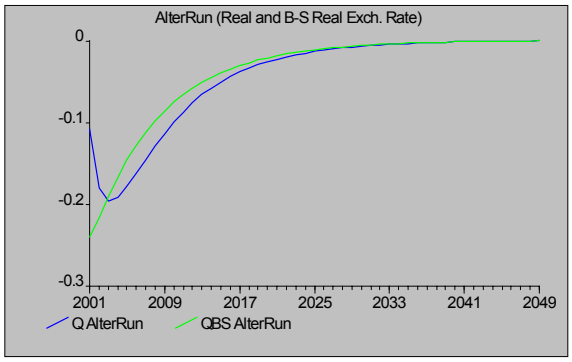


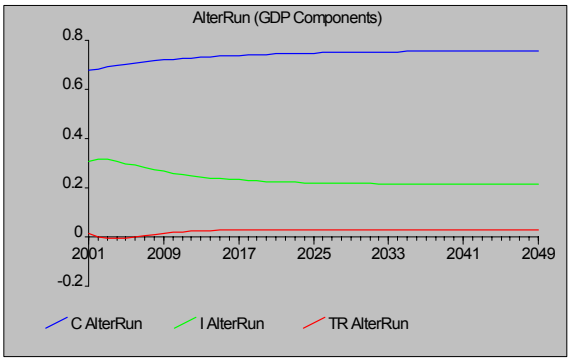


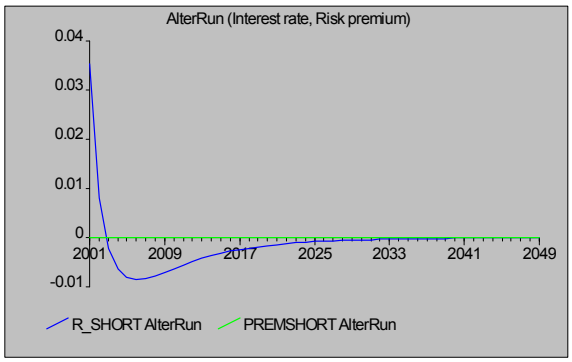
4.2 Alternative baseline





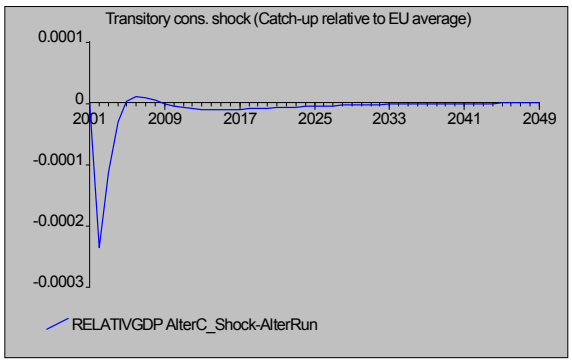

AlterRun (Real and B-S Real Exch. Rate)
0
-0.1
-0.2
-0.3
2001
2009
2017
2025
2033
2041
2049
Q AlterRun
QBS AlterRun

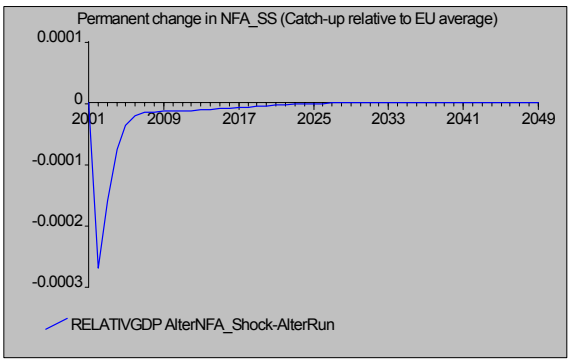

AlterRun (GDP Components)
0.8
0.6
0.4
0.2
0
-0.2
2001
2009
2017
2025
2033
2041
2049
C AlterRun
I AlterRun
TR AlterRun

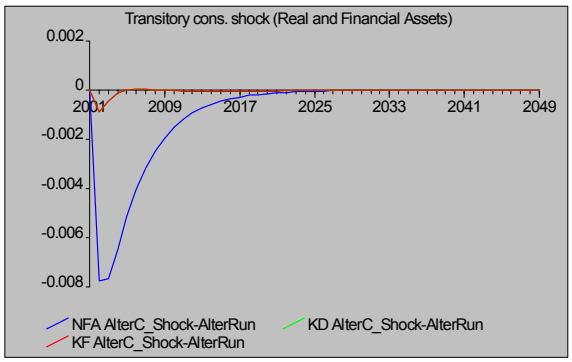

AlterRun (Interest rate, Risk premium)
0.04
0.03
0.02
0.01
0
-0.01
2001
2009
2017
2025
2033
2041
2049
R_SHORT AlterRun
PREMSHORT AlterRun

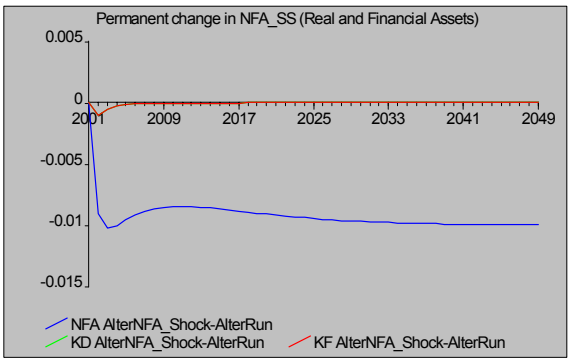
4.3 Alternative: C_shock and NFA shock

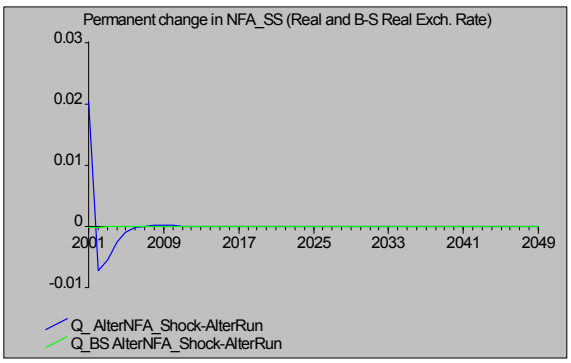
C_shock NFA shock

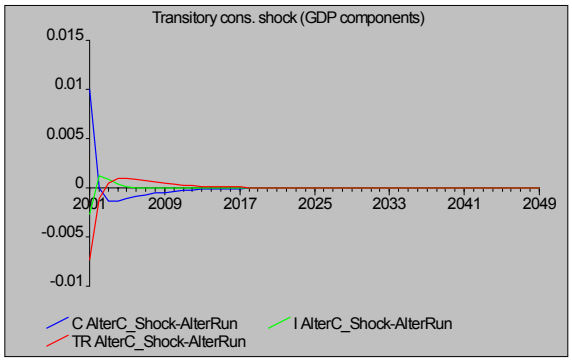


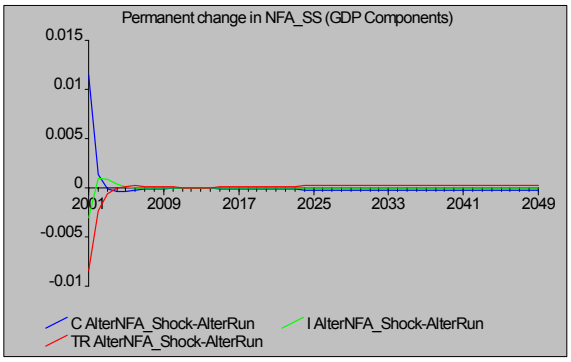


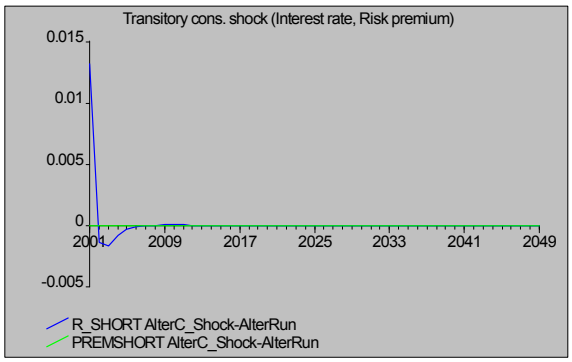


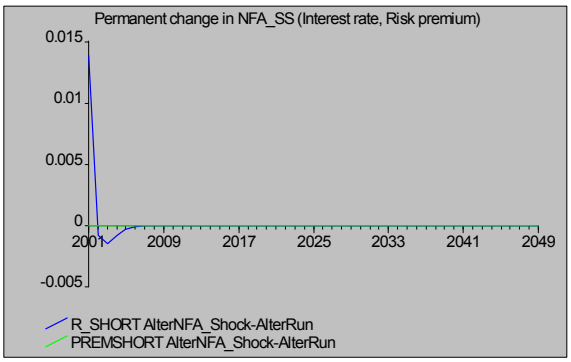


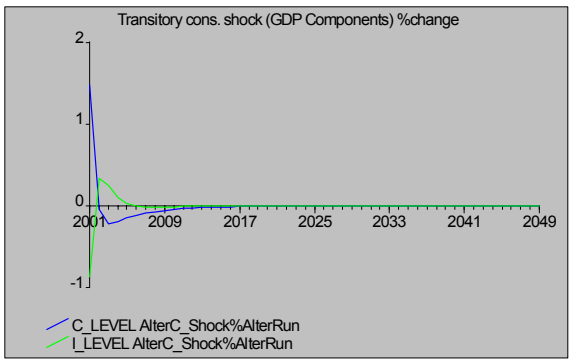


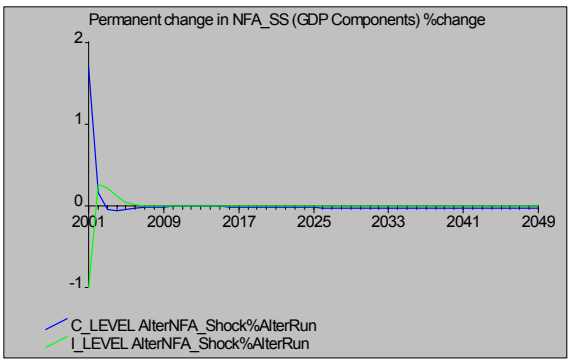

Transitory cons. shock (GDP components)
0.015
0.01
0.005
0
-0.005
-0.01
2001
2009
2017
2025
2033
2041
2049
C AlterC_Shock-AlterRun
I AlterC_Shock-AlterRun
TR AlterC_Shock-AlterRun

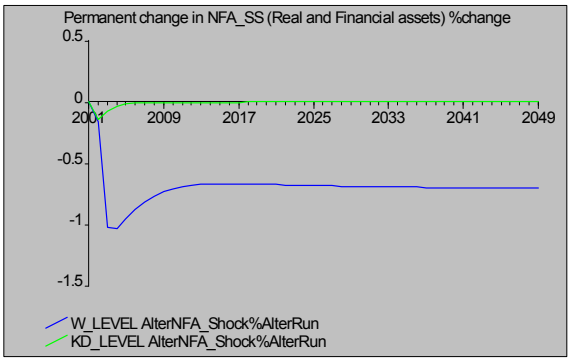

Permanent change in NFA_SS (GDP Components)
0.015
0.01
0.005
0
-0.005
-0.01
2001
2009
2017
2025
2033
2041
2049
C AlterNFA_Shock-AlterRun
I AlterNFA_Shock-AlterRun
TR AlterNFA_Shock-AlterRun


Transitory cons. shock (Interest rate, Risk premium)
0.015
0.01
0.005
0
-0.005
2001
2009
2017
2025
2033
2041
2049
R_SHORT AlterC_Shock-AlterRun
PREMSHORT AlterC_Shock-AlterRun


Permanent change in NFA_SS (Interest rate, Risk premium)
0.015
0.01
0.005
0
-0.005
2001
2009
2017
2025
2033
2041
2049
R_SHORT AlterNFA_Shock-AlterRun
PREMSHORT AlterNFA_Shock-AlterRun


Transitory cons. shock (GDP Components) %change
2
1
0
-1
2001
2009
2017
2025
2033
2041
2049
C_LEVEL AlterC_Shock%AlterRun
I_LEVEL AlterC_Shock%AlterRun


Permanent change in NFA_SS (GDP Components) %change
2
1
0
-1
2001
2009
2017
2025
2033
2041
2049
C_LEVEL AlterNFA_Shock%AlterRun
I_LEVEL AlterNFA_Shock%AlterRun



4.4 Conclusion

Fiscal restraint is a factor that might considerable effect the speed of convergence in the accession countries. The transmission mechanism of the growth effect works through the co-moving real exchange rate and real interest rate. Fiscal restraint keeps the exchange rate weaker, the interest rate lower, and boosts investments in a period when they bring high returns.

The effect crucially depends on whether country risks are important in determining investments and whether foreign investments bring externalities. If these factors would not exist the fiscal decision is simply am expression of intertemporal preferences.

5 References

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