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Modeling the equilibrium SKK/Euro exchange rate in the convergence process of Slovakia by means of a multi-equation gap model.

(Contribution in the 2nd Research Workshop on Macroeconomic Policy, October 2-3 2003, Budapest)

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Introduction and motivation.

There are many tools for modeling exchange rate and a choice between them should be made with regard to the expected usage of the selected tool and its results. The aim of this paper was to investigate the determinants of the exchange rate, the way they are determining it and the feedbacks. This shall enable us to construct a conditional forecast of the exchange rate from predictions of its determinants. If we set certain target values to selected macroeconomic variables, we could obtain a path of exchange rate leading to these target values. This path of exchange rate could be interpreted as the equilibrium exchange rate.

As we want to study the exchange rate with its interdependencies with other variables, we can exclude singe variable techniques. As we want to study also the feedbacks, we need a multi-equation model. As the data series are to short and erratic to simply "let them speak", we exclude the VARs. We need a possibility to express our a priori information in the estimating process in a simple way. For our purposes, estimating the structural equations by single equation methods and assembly the equations into a complex model will do best. We are aware of possibility of bias in inconsistency of such estimates, but as we have only about 40 observations and want to introduce some lags and leads, there is no sufficient space for more elaborate techniques.

We could build a simplified open-economy Keynesian macromodel, possibly enhance it with equations modeling balance of payments, determine level of potential output and variables for controlling absorption. Then wee could look for exchange rate and absorption level equating output to its potential and making balance of payments non-negative. We could thus compute the fundamental exchange rate. But we could hardly capture and explain the process of nominal convergence.

We build a hybrid of first generation model, similar to that of New Zealand, used originally for inflation targeting, see Laxton and Scott (2000)[1], simplified balance of payments model amd an equation for real effective exchange similar to that used in BEER approach.

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[1] Laxton, D., - Scott, A. (2000). On Developing a Structured Forecasting and Policy Analysis System Designed To Support Inflation forecast Targeting (IFT). In: Inflation Targeting Experiences, England, Finland, Poland, Mexico, Brazil, Chile. The Central Bank of Republic of Turkey.

We estimated the model using the official data from Slovak statistical office, National Bank of Slovakia, OLISNET database (for foreign statistics) and internal estimates of National Bank of Slovakia (for core inflation). We used the quarterly series from beginning 1993 to 4th quarter of 2002

Description of the model.

The presented model used is improved version of that presented at the research meeting on "Monetary Policy Transmission in the Euro Area and in Accession Countries in November last year[2]. The Main structure is similar, so that the model contains these behavioral relations:

- Forward-looking Philips curve
- Modified UIP condition (dependent variable is real effective exchange rate)
- Equation for share of net export on GDP
- Equation for output and output gap
- Equation for unit labor costs (backward looking), containing also interest rate
- Equation for labor productivity

The Philips curve

determines quarterly core inflation rate (DLCPIC) as a function of its lagged and leading value, log difference of unit import costs (DLUMC), dummies (D95q3 ,D98q3, d94q3), output gap (LYGAP3) and the error correcting term containing log of core price level (LCPIC) unit labor costs(LULC) and unit import costs (LUMC)[3]. We added the variable RESDLCPICNT to be able to “flip the model”(to add a residual in every behavioral equation and solve for it so that the dependent variable is equal to its actual value) but did not use it yet:

DLCPIC=0.269341+(0.453115+CALP)*DLCPIC(-1)+(0.532245-CALP)*DLCPIC(1)+(1-0.453115-0.532245)*DLUMC(-1)+(-0.0181596)*D98Q3+0.0236057*D95Q3+0.0348791*D94Q3+0.0161322*D0Q1+0.156975*LYGAP3(-1)+(-0.0497776)*(LCPIC(-1)-0.631056*LULC(-1)-(1-0.631056)*LUMC(-1)) +RESDLCPIC

The Philips curve contains simply leading value of the dependent variable instead of an average. It was estimated by non-linear least squares (Pesarans method for estimating ECMs), not like the other equations, by OLS. Both short and long run homogeneity is imposed. It is more forward-looking than in the older version, the weight of leading inflation being at about 0.5.

We experimented with varying weights of lagged and leading inflation and for this we introduced the parameter CALP. If the parameter becomes negative (e. g. increasing the weights of leading inflation), the fit of the model improves somewhat. But as certain values of the parameter make the model fail to converge and we find high weights of leading inflation (above 0.7) hardly interpretable from economic point of view, in simulations presented here the parameter is equal to zero.

[2] Marian Nemec and Michal Bencik: Monetary Policy Transmission in Slovakia, Institute of Monetary and Financial Studies, National Bank of Slovakia, 2002

[3] Parameter summary and their test statistics are in appendix.

The real exchange rate.

The UIP condition and net export equation in the older version of the model contained exchange rate in *difference*, not in *level*. This resulted in steady depreciation (both nominal and real) in ex ante simulations. This version contains augmented functional forms of these equations that ensure economically more viable results. If reasonable values of exogenous variables are used, these results can be interpreted as equilibrium exchange rate.

The equation for real effective exchange rate can be also classified as an extension of the BEER approach, since it is basically cointegrating equation.It explains real effective exchange rate (AREERNBS9) as a function of its lagged difference, ratio of cumulated net FDI (QPZIC), a dummy (D99Q2), difference between three month BRIBOR interest rate and three month USD LIBOR (INTDIF), ratio of net foreign assets to GDP (QNFA) and index of Slovak real GDP to that of euro-zone (IGDP). Residual variable (RESAREERNBS9) is added analog to previous equation:

AREERNBS9 = 0.456973 + (AREERNBS9(-1)-AREERNBS9(-2))
*** 0.791556 - D99Q2 * 0.104103 - QPZIC *0.463537E-01 +**
INTDIF(-2) * 0.146429E-02 + IGDP * 4907.67 + QNFA(-1) * 0.132866
+RESAREERNBS9

The series of real effective exchange rate consists of currencies of nine trade partners, but it can be very well (and in model is) approximated by combination of just two real exchange rates, SKK vs. Euro and SKK vs. CZK with roughly equal weights. These weights corresponded to foreign trade structure in 1993, but they do not now. We were not able, however, to find a economically interpretable equations for other series (most notably Euro and USD real exchange rate). The relevance of Czech crown to Slovak foreign trade can be explained by the competition between Czech Republic and Slovakia after the split of Czecho-slovakia having similar impact as if the countries traded together.

The interest rate difference has very small parameter in this specification, partially because the inclusion of net foreign assets. If the positive interest rate difference induces capital inflows, these are also accounted in net foreign assets. We accepted the current specification for its simplicity despite this double counting. In future versions we might decompose net foreign assets, but this will certainly complicate the model a lot.

This version of our model assumes that the real exchange rate is determined first and the nominal exchange rate is determined from the real one and price levels in the next step. As the nominal exchange rate affects prices positively, there is a positive feedback between the prices and nominal exchange rate.

The net exports to GDP ratio

This variable allows to take foreign trade into account, both for exchange rate development and for output gap. This is important, as Slovakia is a very opened economy and small relative achanges in exports and imports load to large changes in net exports as a fraction of GDP.

The equation for net exports ratio (QNX) explains it with its lagged value, ratio of gross fixed capital formation to GDP (QI) dummy (D96Q1, D97Q4), and real exchange rate (AREERNBS9; RESQNX is a residual with zero value unless indicated otherwise).

QNX=0.311416845+0.51885703*QNX(-1)+(-0.539644834)*QI+(-0.108926594)*D96Q1+

**(-0.191015167)*AREERNBS9+0.069597241*D97Q4+0.193765825*
(DEUMG/DEUMG(-4)-1)+(- 0.058026448)*DUDM+RESQNX**

It is striking that the equation does not contain the output gap. In the Slovak case, dropping real income after devaluation of depreciation almost always caused the contraction of aggregate demand and a negative output gap. Thus, output gap in this equation was collinear with exchange rate and gross fixed capital formation ratio and was insignificant, but the information is there.

Net exports affect the exchange rate through net foreign assets, that in the model cumulate from their changes. The net foreign assets changes are decomposed in net exports, net FDI and rest. In the equation for exchange rate the sum appears with positive parameter and cumulative FDI with negative. This reflects the hypothesis that FDIs (mainly revenues from privatization) do not affect equilibrium exchange rate as strong as cumulative net exports.

The growth rate of GDP

The output gap and output level are modeled in similar fashion to the older version, but the domestic part of demand is measured by the share of wages on GDP, instead of the fiscal variable of the old version. The log difference of GDP (DLNAGDPR) depends upon its lagged value, the log labor share (LQL), the output gap (LYGAP3), the net exports ratio (QNX), dummies (T1, T2. D97Q4) and a residual RESDLNAGDPR (zero in the simulations)

**DLNAGDPR=0.250564321+0.262912247*DLNAGDPR(-1)+0.126924755*LQL+(-
0.606126891)*LYGAP3(-1)+(-0.125615054)*T1+(-0.102949942)*T2+(-0.144394652)
*T4+0.032583557*QNX(-5)+0.029016997*D97Q4 +RESDLNAGDPR**

To this equation belong the identities aggregating the level of real GDP and computing output gap. The output gap is computed from series of log GDP and a broken linear trend function, This trend function was set more – less ad hoc to produce series of output gap, that we found likely from a subjective perspective. In the simulations the trend function grows with the slope from the period around the year 2000. We tried also to remove the seasonality from output gap, but did not fully succeed.

Unit labor costs

Because of substitution in the GDP curve, the unit labor costs, linked to the income share by an identity, become dual meaning. First, traditional as a cost factor entering the Philips curve and second, as a measure of income expansion and contraction, entering the equation for GDP This created a second channel between unit labor costs and inflation strengthening their impact. As the unit labor costs are an income measure, we examined whether they are sensitive to interest rate. We were able to establish a weak but significant negative link between unit labor costs and the interest rate. This can be roughly interpreted as a reduced form of interest rate channel or credit channel of the transmission mechanism. Together with the equation for GDP, it lets the GDP and output gap drop with rising interest rates, the foreign demand being equal (although this change is only marginal). The log difference of unit labor costs (DLULC) depends on log difference of labor productivity /DLPRODL), seasonal dummies (T1, T2, T3), truncated series of BRIBOR rate DMMR3MT, the log level of CPI (LCPIALL) and the lagged level of unit labor costs (LULC), last two variable being the error correcting term. After estimation,. the residual RESDLULC was added:

**DLULC=(-0.42000609)+0.643695886*DLPRODL(-2)+(-0.127165676)*T1+0.01989107*
T3+0.10809529*T4+(-0.069578801)*LULC(-1)+0.069578801*LCPIALL(-1)+(-
0.001435728)*DMMR3MT(-3) +RESDLULC**

Unfortunately, it is doubtful, whether the restriction ensuring linear homogeneity of unit labor costs on prices is accepted or not. We decided to use a restricted equation because of its better economic interpretation.

Labor productivity.

As the equation for unit labor costs contains labor productivity instead of output gap, a behavioral equation for labor productivity is needed. Labor productivity (LPRODL) is determinef by potential product and by output gap.(LYGAP3). The elasticity on potential product is according to expectation one, the elasticity on output gap is about one half. After the estimation, we replaced the potential product variable with the trend function (expression of TIME, TIMEK and seasonals in brackets multiplied by 1.0078808) and added the residual RESLPRODL:

LPRODL=(-7.582145)+0.492646376*LYGAP3+(-0.14533547)*T1+(-0.019098869)*T2+(-0.072600189)*T4+0.026201756*D0Q1+0.030637617*D0Q2+0.025591816*D94Q4+ 1.0078808*((4.78+0.0125*TIME)-(0.0053*0.65)*TIMEK)-((-0.047540802)*T1+0.022841183*T2+0.035579046*T3) +RESLPRODL

Other equations are listed in the appendix.

<u>Computation of within sample simulation and standard run ex ante.</u>

We prolonged the exogenous variables, either with time series methods, last values or adapted forecasts from project LINK, run at University Toronto. We added the terminal condition for the forward-looking Philips curve setting the core inflation equal to 0.3% quarterly, what meant that we believe it to be near the inflation in the Euro-zone.

With these assumptions we calculated forecasts, that indicated the appreciation of real effective exchange rate 10 % above the level of beginning 1993 and its further stagnation. Offsetting the positive trend of GDP ratio in the equation for exchange rate by declining net foreign assets caused this. That in turn declined due to large negative net exports.

We believe however, that the export competitiveness will improve towards end of forecast period due to integration of Slovak firms into multinational concerns and increased quality and sophistication of goods. We added thus 0.02 to the intercept of equation for net export ratio from 2^{nd} quarter 2006 till the end of 2010.This is a subjective augmentation of the model, we *assume* that, but *do not prove* it, as the link between cumulated investments and improved net exports is missing so far. With this add-factor we arrived to steadily appreciating real effective exchange rate (up to 17 percent above the level of beginning 1993), rising net foreign assets, decreasing inflation and output gap approaching zero and growing further. At this stage, we accept this as our preliminary standard forecast, but this will be subject of discussions in the NBS.[4]

The forecast is an equilibrium exchange rate in the sense that under assumptions about exogenous variables and changes in export competitiveness formulated in mathematic terms as described above, the net foreign assets are non-decreasing and the output gap is moving from negative values to positive. Whether this is the most probable path of exchange rate will be subject of further discussions.

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[4] In the first four graphs, the values without the add-factor are labeled as simulated and with add-factor as QNX incr.

Computation of alternative scenarios.

We examined reactions of the model to two sets of changes: a permanent interest rate rise and a combined permanent potential output and net exports improvement.

In the first case, we increased the policy rate by 1 percent, e. g. 100 points beginning in 1997. This caused appreciation and slight temporary reduction of inflation, comparing with the standard run. The net exports dropped only temporarily and by small amount, so that the difference between net foreign assets from this simulation and from standard run remains constant. The GDP does not change significantly. The rise in real effective exchange rate is only small and dies out (not shown in the graph). This small change however triggers drop in inflation rate, that cumulates to relatively sharp fall in level of consumer prices and in nominal exchange rate. There is a strong positive feedback between the nominal exchange rate and CPI.

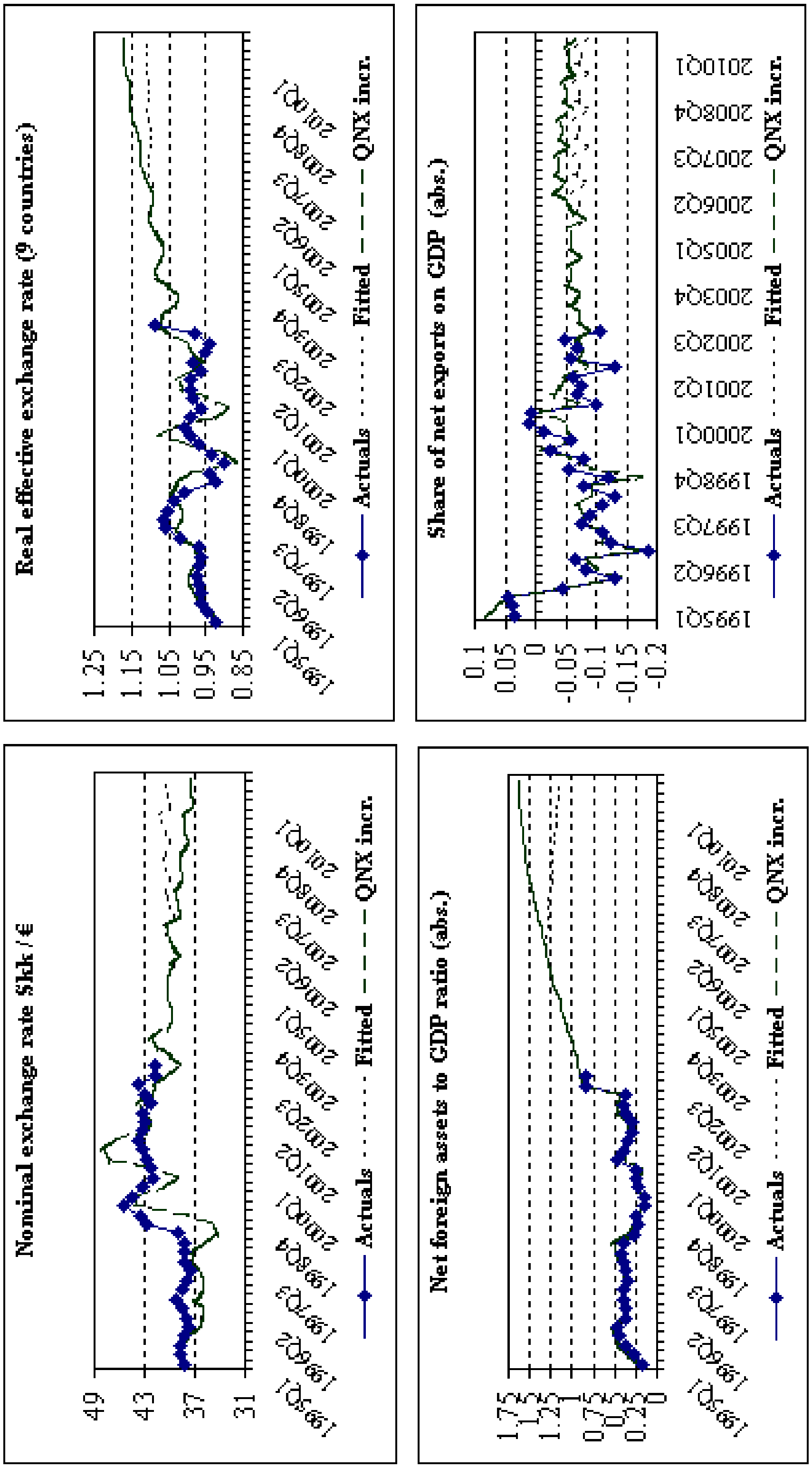
The second simulation inspects relationships between real and nominal convergence. We increased the rate of growth of potential product (roughly visible from graph[5]) and increased the add-factor in the equation of net exports by 0,005 – both permanently beginning in 1999. The changes cause increase in both real effective exchange rate, net exports and net foreign assets. There is also some temporary drop in inflation rate, that does not cumulate in so large drop in CPI as before because of some inflationary pressure from real economy. The evolution of real effective exchange rate and price level leads to nominal appreciation, although this is not as strong as when the interest rate is increased. This two scenarios lead to similar paths of nominal exchange rate, but in the first case the appreciation is caused solely by monetary factors whereas in the second case it is caused by improved fundamentals.

Conclusion

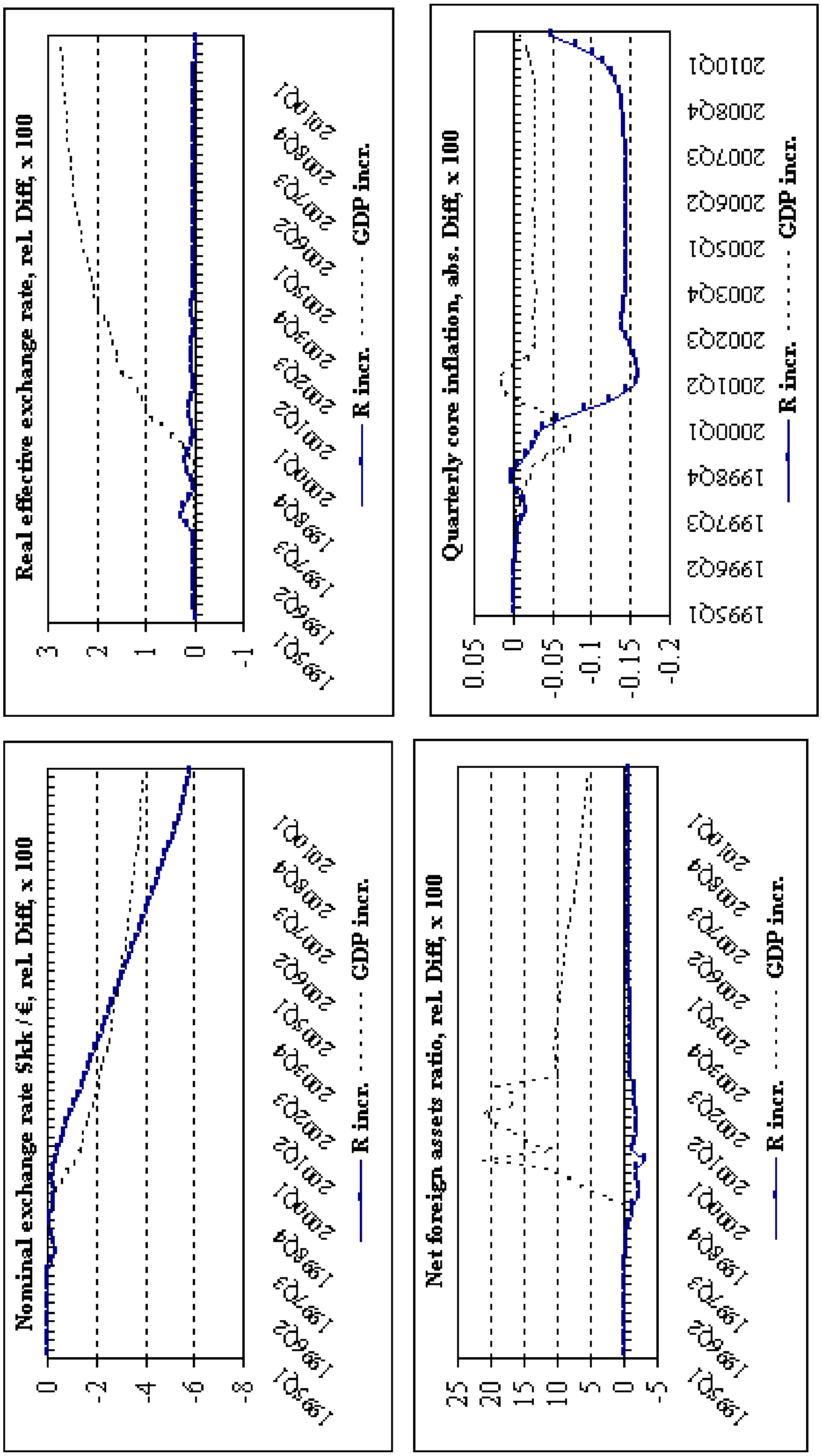
In this contribution we construct a structural gap model for the transmission mechanism in Slovakia. We use this model to derive a forecast for group of endogenous variables with certain properties (non decreasing net foreign assets, non decreasing output gap). Because these properties state the external and internal equilibrium in the broad sense, we interpret the forecasted series of exchange rate as equilibrium exchange rate. As we made some compromises constructing the model and the extrapolations of exogenous variables, the forecast is meant rather as a starting point for a discussion than as a definitive optimal path of exchange rate in the future. According to our opinion, the main gain form the model is that the paths of endogenous variables are analyzed in compound manner, reflecting their interdependence. The outcomes of computations lead to three qualitative statements:

- Although the (equilibrium) real exchange rate is a function of the relative economic performance of the two countries, measured by GDP, *both faster GDP growth and better net export performance* are required for real appreciation
- The changes of interest rate have only marginal effects on real economy in Slovakia.
- The real convergence is rather a complementary goal to the nominal convergence then a substitute goal. The presented model allows computing paths for different assumptions about the supply side of the economy, as the second alternative scenario showed. In fact, these factors may be the main determinants of the optimal path of exchange rate in the convergence process.

[5] The graphs 5 to 8 show differences of the two alternative scenarios from that with increased net export ratio. For inflation, absolute differences are depicted, for other relative percentage differences are shown. The series labeled „R incr." is the result of increased interest rate, „GDP incr." is the result of increased potential output.



Charts 1, 2, 3, 4 Actuals, simulated values without and with add-factor for net exports



Charts 5, 6, 7, 8 Impact of increased interest rate and increased output, difference from standard run

Appendix Nr. 1: List of equations

PHILIPS CURVE

DLCPIC=0.269341+(0.453115+CALP)*DLCPIC(-1)+(0.532245-CALP)*DLCPIC(1)+(1-0.453115-0.532245)*DLUMC(-1)+(-0.0181596)*D98Q3+0.0236057*D95Q3+0.0348791*D94Q3+0.0161322*D0Q1+0.156975*LYGAP3(-1)+(-0.0497776)*(LCPIC(-1)-0.631056*LULC(-1)-(1-0.631056)*LUMC(-1)) +RESDLCPIC

AUXILIARY TRANSFORMATIONS

LCPIC = LCPIC(-1) + DLCPIC
DLUMC=LUMC-LUMC(-1)
LCPIALL=LCPIC + QCPI
CPIALL=EXP(LCPIALL)
PPIALL=CPIALL*QPPI
DLPRODL=LPRODL-LPRODL(-1)

REAL EFFECTIVE EXCHANGE RATE

AREERNBS9 = 0.456973 + (AREERNBS9(-1)-AREERNBS9(-2)) * 0.791556 - D99Q2 * 0.104103 - QPZIC *0.463537E-01 + INTDIF(-2) * 0.146429E-02 + IGDP * 4907.67 + QNFA(-1) * 0.132866 +RESAREERNBS9

SHARE OF SLOVAK GDP TO THAT OF EU12

IGDP=(NAGDPR+NAGDPR(-1)+NAGDPR(-2)+NAGDPR(-3)) /(GDPE12SC +GDPE12SC(-1)+ GDPE12SC(-2) +GDPE12SC(-3))

NOMINAL EXCHANGE RATE SKK/EURO

SKKEURA=PPIALL/((0.591125374*EURCZKA*FPCZRPPI+0.016448837*EUZPPI)*AREERNBS9)

GDP CURVE - SUBSTITUTE FOR IS CURVE

DLNAGDPR=0.250564321+0.262912247*DLNAGDPR(-1)+0.126924755*LQL+(-0.606126891)*LYGAP3(-1)+(-0.125615054)*T1+(-0.102949942)*T2+(-0.144394652)*T4+0.032583557*QNX(-5)+0.029016997*D97Q4 +RESDLNAGDPR

SHARE OF WAGES ON GDP

LQL=LULC-LOG(CPIALL*QPY)

TRANSFORMATION TO LEVEL

LNAGDPR = LNAGDPR(-1) + DLNAGDPR

TAKING ANTILOG

NAGDPR=EXP(LNAGDPR)

DEFINITION OF OUTPUT GAP

LYGAP3=LNAGDPR-((4.78+0.0125*TIME)-(0.0053*0.65)*TIMEK)-

((-0.047540802)*T1+0.022841183*T2+0.035579046*T3)

UNIT IMPORT COSTS

LUMC =LOG(SKKEURA) +QUMC

SHARE OF NET EXPORTS ON GDP

QNX=0.311416845+0.51885703*QNX(-1)+(-0.539644834)*QI+(-0.108926594)*D96Q1+
(-0.191015167)*AREERNBS9+0.069597241*D97Q4+0.193765825*
(DEUMG/DEUMG(-4)-1)+(-
0.058026448)*DUDM+RESQNX

SHARE OF NET FOREIGN ASSETS ON NOMINAL GDP

QNFA=QNFA(-1)+QPZI+QNX +QDNFAEX

LOG LABOUR PRODUCTIVITY

LPRODL=(-7.582145)+0.492646376*LYGAP3+(-0.14533547)*T1+(-0.019098869)*T2+(
-0.072600189)*T4+0.026201756*D0Q1+0.030637617*D0Q2+0.025591816*D94Q4+
1.0078808*((4.78+0.0125*TIME)-(0.0053*0.65)*TIMEK)-
((-0.047540802)*T1+0.022841183*T2+0.035579046*T3) +RESLPRODL

SHORTENED INTEREST RATE SERIES

DMMR3MT = DMMR3M*(TIME>26)

BRIBOR RATE 3 MONTHS

DMMR3M=REPO2W+RESDMMR3M

INTEREST RATE DIFFERENCE

INTDIF=DMMR3M-LONDONUSD

UNIT LABOR COSTS

DLULC=(-0.42000609)+0.643695886*DLPRODL(-2)+(-0.127165676)*T1+0.01989107*
T3+0.10809529*T4+(-0.069578801)*LULC(-1)+0.069578801*LCPIALL(-1)+(-
0.001435728)*DMMR3MT(-3) +RESDLULC

TRANSFORMATION TO LEVEL

LULC=LULC(-1)+DLULC

Appendix Nr. 2: Variable list

.

AREERNBS9	Real effective exchange rate, 9 countries
CPIALL	CPI total 1995=100
D0Q1	Dummy 1-st quarter 2000=1
D0Q2	Dummy variable, 2^{nd} quarter of 2000=1
D1Q1	Dummy 1-st quarter 2001=1
D93Q3	Dummy, 3-rd quarter 1993 =1
D94Q3	Dummy, 3-rd quarter 1994 =1
D95Q3	Dummy, 3-rd quarter 1995 =1
D97Q4	Dummy, 4-th quarter 1997 = 1
D98Q3	Dummy, 3-rd quarter 1998 = 1
D99Q1	Dummy, 1-st quarter of 19=1
D99Q2	Dummy, 2-nd quarter of 1999=1
DEUMG	German imports of goods and services
DLCPIC	Core inflation, log difference (quarterly rate of change)
DLNAGDPR	Moving average of real GDP (1995 prices), log difference
DLPRODL	Labor productivity, log difference
DLULC	Unit labor costs, log difference
DLUMC	Unit import cost, log difference
DMMR3M	BRIBOR rate 3 month, percentage points
DMMR3MT	Truncated series of Bribor (up to 3^{rd} quarter 1998=0)
DUDM	Dummy variable for removing fluctuations in German imports
EURCZKA	Euro/ Czech koruna exchange rate
EUZPPI	Euro zone producer price index
FPCZRPPI	Producer price index, Czech republic
GDPE12SC	Real GDP, Euro zone
IGDP	Ratio of Slovak real GDP to that of Euro area
INTDIF	Interest rate differential (between 3 month BRIBOR and LIBOR
LCPIALL	CPI total, log
LCPIC	Core inflation, log
LNAGDPR	real GDP, log
LONDONUSD	LIBOR 3 month USD rate, percentage points
LPRODL	Labor productivity, log
LQL	Share of wage income on GDP, log
LULC	Unit labor costs, log
LUMC	Unit import cost, log
LYGAP3	Output gap , log
NAGDPR	Real GDP, 1995 prices
PPIALL	Industrial producer prices , leve
QCPI	Log of (total inflation / core inflation) ratio
QDNFAEX	Ratio of exogenous increment of NFA to GDP
QI	Share of gross fixed capital formation to GDP on real GDP
QNFA	Ratio of net foreign assets to nominal GDP
QNX	Share of nominal net exports to nominal GDP

QPPI	Ratio of industrial producer prices and consumer prrices
QPY	Ratio of GDP deflator to CPI
QPZI	Ratio of net FDI to nominal GDP
QPZIC	Ratio of cumulative net FDI to nominal GDP
QUMC	ratio or unit import costs to nominal exchange rate, log
REPO2W	Two weeks repo interest rate (taken as policy rate)
RESAREERNBS9	Residual in behavioral equation (exchange rate)
RESDLCPIC	Residual in behavioral equation (Philips curve)
RESDLNAGDPR	Residual of behavioral equation (GDP)
RESDLULC	Residual in behavioral equation (unit labor costs)
RESDMMR3M	Exogenous difference between REPO and 3 month BRIBOR
RESLPRODL	Residual in behavioral equation (labor productivity)
RESQNX	Residual in behavioral equation (net exports share)
SKKEURA	Nominal exchange rate skk /Euro
T1, T2, T3. T4	Seasonal dummies
TIME, TIMEK	Time trends

Appendix Nr. 3 – Statistical parameters for behavioral equations

The raw equation for Philips curve estimation was:

dlcpic=a0+a1*dlcpic{-1}+a2*dlcpic(1)+(1-a1-a2)*dlumc{-1}+a3*d98q3+a4*d95q3 +a5*d94q3+a6*d0q1+a7*lygap3{-1}+a8*(lcpic{-1}-a9*lulc{-1}-(1-a9)*lumc{-1})

with staring values a0 0 a1 0.3 a2 0.3 a3 0 a4 0 a5 0 a6 0 a7 -0.1 a8 -0.1 a9 0.5

```
         Nonlinear Least Squares

 Convergence achieved after 3 iterations.

         Equation PHILC3

         Dependent variable is DLCPIC
```

Variable	Coefficient	Std Err	T-stat	Signf
A0	0.269341	0.139806	1.92652	0.065
A1	0.453115	0.796611E-01	5.68803	0.000
A2	0.532245	0.772684E-01	6.88826	0.000
A3	-0.181596E-01	0.633030E-02	-2.86868	0.008
A4	0.236057E-01	0.685218E-02	3.44499	0.002
A5	0.348791E-01	0.799668E-02	4.36170	0.000
A6	0.161322E-01	0.703163E-02	2.29424	0.030
A7	0.156975	0.798769E-01	1.96522	0.060
A8	-0.497776E-01	0.251064E-01	-1.98267	0.058
A9	0.631056	0.173790	3.63115	0.001

```
      R-Squared= 0.73382     No. obs=    37
      R-Bar-Squared (adj)        =  0.64509
      Durbin-Watson (   0 gaps) =  2.322220
      Sum of squared residuals =   0.103815E-02
      Std. error of regression =   0.620081E-02
      Sum of residuals =           0.610623E-15
      Mean of dependent variable = 0.146886E-01
      Log of likelihood function =  141.402

REGRESS : dependent variable is AREERNBS9

 Using   1994Q4-2002Q3
```

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	0.456973	0.172158	2.65438	0.014
INTDIF{-2}	0.146429E-02	0.116731E-02	1.25441	0.221
IGDP	4907.67	1952.44	2.51361	0.019
QNFA{-1}	0.132866	0.418229E-01	3.17688	0.004
DAREERNBS9{-1}	0.791556	0.161885	4.88961	0.000
D99Q2	-0.104103	0.241299E-01	-4.31425	0.000
QPZIC	-0.463537E-01	0.271550E-01	-1.70700	0.100

```
                            Equation Summary

   No. of Observations =       32       R2=  0.7543   (adj)=  0.6953
   Sum of Sq. Resid. =  0.126345E-01   Std. Error of Reg.= 0.224807E-01
   Log(likelihood)   =   79.9869       Durbin-Watson     =  1.91990
```

```
   Schwarz Criterion =   67.8568       F (   6,     25) =   12.7916
   Akaike Criterion  =   72.9869       Significance     =  0.000001
```

REGRESS : dependent variable is DLNAGDPR

Using 1994Q3-2002Q3

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	0.250564	0.695517E-01	3.60256	0.001
DLNAGDPR{-1}	0.262912	0.170508	1.54193	0.136
LQL	0.126925	0.564206E-01	2.24962	0.034
LYGAP3{-1}	-0.606127	0.158004	-3.83615	0.001
T1	-0.125615	0.533956E-02	-23.5254	0.000
T2	-0.102950	0.216860E-01	-4.74729	0.000
T4	-0.144395	0.141280E-01	-10.2205	0.000
QNX{-5}	0.325836E-01	0.296426E-01	1.09921	0.283
D97Q4	0.290170E-01	0.111093E-01	2.61196	0.015

Equation Summary

```
   No. of Obs. =   33  R2=  0.971 (adj)=  0.961 Durbins H= -0.38191
   Sum of Sq. Resid. =  0.237903E-02   Std. Error of Reg.= 0.995622E-02
   Log(likelihood)   =   110.545       Durbin-Watson     =  2.02608
   Schwarz Criterion =   94.8106       F (   8,     24) =   100.077
   Akaike Criterion  =   101.545       Significance     =  0.000000
```

REGRESS : dependent variable is QNX

Using 1994Q4-2002Q3

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	0.311417	0.140313	2.21944	0.036
QNX{-1}	0.518857	0.867396E-01	5.98178	0.000
QI	-0.539645	0.774838E-01	-6.96462	0.000
D96Q1	-0.108927	0.264646E-01	-4.11594	0.000
AREERNBS9	-0.191015	0.145004	-1.31731	0.200
D97Q4	0.695972E-01	0.307940E-01	2.26009	0.033
GDEUMG	0.193766	0.105109	1.84347	0.078
DUDM	-0.580264E-01	0.266564E-01	-2.17683	0.040

Equation Summary

```
   No. of Obs. =   32  R2=  0.852 (adj)=  0.809 Durbins H= -0.75723
   Sum of Sq. Resid. =  0.157139E-01   Std. Error of Reg.= 0.255880E-01
   Log(likelihood)   =   76.4971       Durbin-Watson     =  2.06144
   Schwarz Criterion =   62.6341       F (   7,     24) =   19.7538
   Akaike Criterion  =   68.4971       Significance     =  0.000000
```

REGRESS : dependent variable is LPRODL

Using 1994Q1-2002Q4

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-7.58215	0.499847E-01	-151.689	0.000
LYGAP3	0.492646	0.733767E-01	6.71394	0.000
T1	-0.145335	0.342003E-02	-42.4954	0.000
T2	-0.190989E-01	0.366746E-02	-5.20765	0.000
T4	-0.726002E-01	0.346611E-02	-20.9457	0.000
D0Q1	0.262018E-01	0.693227E-02	3.77968	0.001

D0Q2	0.306376E-01	0.696454E-02	4.39909	0.000
D4Q4	0.255918E-01	0.716418E-02	3.57219	0.001
LYPOT3	1.00788	0.100081E-01	100.706	0.000

Equation Summary

```
No. of Observations =      36       R2=  0.9979   (adj)=  0.9972
Sum of Sq. Resid. =  0.112222E-02   Std. Error of Reg.= 0.644698E-02
Log(likelihood)   =   135.686       Durbin-Watson     =  1.68963
Schwarz Criterion =   119.560       F (   8,     27) =   1568.31
Akaike Criterion  =   126.686       Significance     =  0.000000
```

RLS : dependent variable is DLULC

Using 1994Q3-2002Q4

Restricted Least-Squares

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-0.420006	0.300029	-1.39989	0.173
DLPRODL{-2}	0.643696	0.196282	3.27945	0.003
T1	-0.127166	0.118169E-01	-10.7614	0.000
T3	0.198911E-01	0.860157E-02	2.31249	0.029
T4	0.108095	0.183755E-01	5.88258	0.000
LULC{-1}	-0.695788E-01	0.486019E-01	-1.43161	0.164
LCPIALL{-1}	0.695788E-01	0.486019E-01	1.43161	0.164
DMMR3MT{-3}	-0.143573E-02	0.746887E-03	-1.92228	0.066

```
R-Squared =   0.977226 No. obs=    34
R-Bar-Squared (Adj for df)=  0.972166
Log of likelihood function =  93.8300
Durbin-Watson    (   0 gaps) =  2.419774
Durbin-Watson(4) (   0 gaps) =  1.036258
Sum of squared residuals   = 0.797912E-02
Std. error of regression   = 0.171908E-01
Sum of residuals           =-0.446865E-14
Mean of dependent variable = 0.161796E-01
F(     6,      27)         =  193.097
Significance level        =  0.000000

Hypothesis SSR=       0.633153E-03
df=    1 Mean Sq=     0.633153E-03
F(   1,  26)=          2.24095
Significance=         0.146440
```