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Estimating the FEER for the Czech Economy

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1. The Sustainability of the Czech Exchange-Rate Regime in 1996

In 1996, the Czech Republic was a country with history of four successful transitional years. The Czech transitional strategy was based on a rapid trade and financial liberalisation, voucher privatisation scheme and stabilisation program for which a pegged exchange rate provided nominal anchor with the support of a balanced budget. During transitional years of 1993-1996¹ these transitional steps led to a relatively low inflation, increasing role of a private sector, economic growth and a fast development of financial markets.

As a consequence of these successful trends, the Czech Republic faced benefits and costs of capital inflows, and similarly to group of other developing economies, its emerging market became attractive for foreign investors. Countries from this group often suffer from various types of external crisis² such as

¹ The paper analyses the Czech experience although a transitional process started in 1990 when the Czech Republic was a member country of the former Czechoslovakia.

² Eichengreen, Rose, Wyplosz (1995) examine currency attacks in a set of developing and industrial countries. Frankel, Rose (1996) investigate reasons of large currency crashes in 100 developing countries. Milesi-Ferretti, Razin (1996) analyse the East-Asian and Latin American experience with external imbalances. Sachs, Tornel, Velasco (1996b) study reasons of financial crises in 20 emerging markets (excluding Eastern Europe). Calvo, Mendoza (1996), Dornbusch, Werner (1994) and Sachs, Tornel, Velasco (1996a) concentrate on

unsustainable foreign indebtedness (Latin America), liquidity crisis (Mexico) or they need to prevent crises at the costs of restrictions on capital flows (East Asia). Since some features of the Czech economic development were similar to those of the above-mentioned group, their experience with the exchange-rate mismanagement became relevant for the Czech Republic. It was very important to recognise whether the exchange-rate regime maintained by authorities was sustainable - whether it allowed for the exchange rate to move in accordance with the economic fundamentals.

Table 1

Basic Macro-Economic Indicators (in %)

	s1	s2	i1	i2	y	p
1992	27.45	25.38	28.53	27.23	-6.40	11.00
1993	20.23	22.53	26.56	24.85	-0.67	20.80
1994	20.11	22.17	30.04	28.41	2.62	10.00
1995	22.76	23.18	32.18	31.48	4.84	9.10
1996	22.74	22.74	33.81	33.90	4.36	8.80

Notes: Indicators are defined as follows: s1=(GDP-C-G)/GDP in nominal terms, s2=(GDP-C-G)/GDP in real terms, i1=Investment/GDP in nominal terms, i2=Investment/GDP in real terms, y is growth rate of GDP in real terms, and p is inflation (CPI).

Data sources: Czech National Bank (CNB), Czech Statistical Office (CSU).

Let us summarise briefly the economic development in the Czech Republic in 1993-1996 using a set of indicators that are usually watched by analysts as warning signals of forthcoming external crisis³. Table 1 shows that during the analysed transitional years both the saving ratio as well as investment ratio were relatively high. However, there was a persistent gap between domestic savings and investment needs of the economy. The country's inflation and growth record was satisfactory. Specifically, in 1994-1996 after shocks from both the price liberalisation as well as the Czechoslovakia's separation had been absorbed, the growth rate was high and inflation reduced to a one-digit scale. However, inflation as well as nominal interest

Mexican experience with external crises. Helpman, Leiderman, Bufman (1994) describe the problems with external balance of the three sample countries: Chile, Israel and Mexico.

³ Mainly, these are indicators applied in other case studies by Calvo, Mendoza (1996), Cohen (1985), Dornbusch, Werner (1994), Eichengreen, Rose, Wyplosz (1995), Frankel, Rose (1996), Haque, Kumar, Mark, Mathieson (1996), Milesi-Ferretti, Razin (1996), Sachs, Tornel, Velasco (1996a) and Sachs, Tornel, Velasco (1996b).

rates remained higher than in the countries whose currencies served as the basket ones.

Table 2 demonstrates increasing seriousness of the problem of external imbalance implied by the saving-investment gap. It is worth noting that the sensitivity of the Czech economy to the external imbalance was high due to a large degree of its openness.

Table 2

Indicators of External Balance (in %)

	x1	x2	m1	m2	tb1	tb2	ca
1992	56.62	54.18	56.25	48.72	0.38	5.46	-1.09
1993	56.73	60.31	54.50	55.53	2.23	4.79	0.37
1994	52.45	58.88	52.88	58.27	-0.42	0.61	-0.14
1995	51.14	60.55	56.34	66.09	-5.21	-5.55	-2.98
1996	58.02	61.11	65.64	71.73	-7.61	-10.6%	-8.57

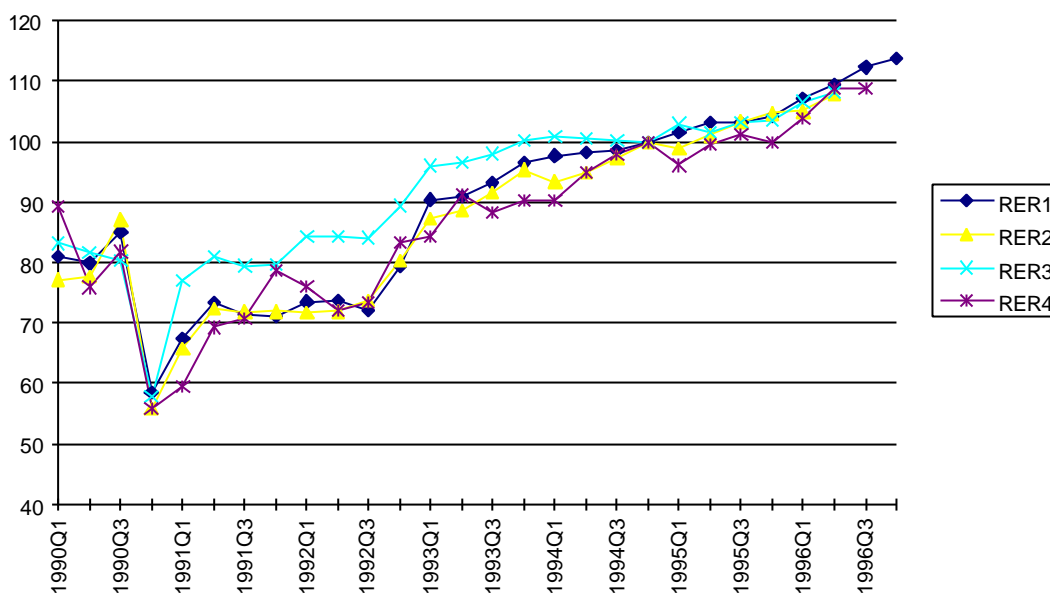
Notes: Indicators are defined as follows: x1=Export/GDP in nominal terms, x2=Export/GDP in real terms, m1=Import/GDP in nominal terms, m2=Import /GDP in real terms, tb1 is a ratio of trade balance to GDP in nominal terms, tb2 is a ratio of trade balance to GDP in real terms, ca is a ratio of current balance to GDP in nominal terms.

Data sources: Czech National Bank (CNB), Czech Statistical Office (CSU).

Figure 1 shows the various measures of competitiveness of the Czech exports. The indicators based on producer price indexes, consumer price index, unit labour cost and effective price indexes of exporters suggest that the value of the Czech crown in real terms returned to its pre-transitional level in 1995. The real appreciation of the Czech crown was a consequence of the cumulative inflation differential as well as nominal appreciation of the Czech crown that followed in 1996 after a change in the exchange-rate regime as shown on Figure 2. The broadening of bands was a policy response of the central bank to large capital inflows that reached the peak in 1995 of 18% of GDP.

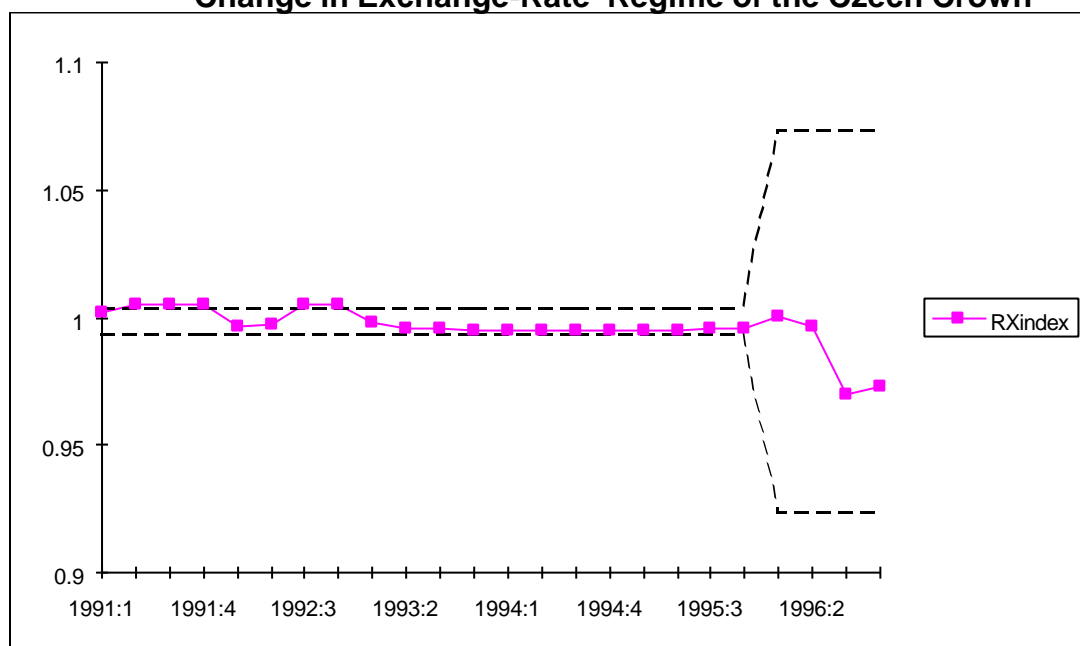
Figure 1

Indicators of Competitiveness



Notes: Indicators are defined as follows: RER1 is index of competitiveness derived as a real exchange rate using producer price indexes, RER2 is index of competitiveness derived as a real exchange rate using consumer price indexes, RER3 is index of competitiveness derived as a real exchange rate using unit labour costs, and RER4 is index of competitiveness derived according to the NIESR methodology of real effective exchange rate with weights derived from the matrix trading of major trading partners.

Data sources: Czech National Bank (CNB), Czech Statistical Office (CSU), International Financial Statistics (IMF), National Institute of Economic and Social Research (NIESR).

Figure 2**Change in Exchange-Rate Regime of the Czech Crown**

Notes: RXindex is nominal exchange rate index of the Czech crown vis-a-vis its basket currencies (with approximate weights of 65% for DM and 35% for \$). The dotted lines show exchange-rate bands.

Data sources: Czech National Bank (CNB).

In addition to domestic factors, the problem of external imbalance was worsened by “foreign fundamentals” that are summarised in Table 3. A development of both foreign demand for the Czech exports as well as world inflation was unfavourable in 1996.

Table 3**Foreign Sector - Indicators (in %)**

	p1	p2	p3	s1	s2
1992	3.28	4.69	2.93	4.24	7.59
1993	2.65	4.01	3.19	1.30	2.52
1994	2.39	2.94	3.22	10.65	10.63
1995	2.23	1.91	1.44	10.17	5.85
1996	2.08	1.93	-2.16	5.50	-1.58

Notes: Indicators are defined as follows: p1 is the US inflation measured by CPI, p2 is the German inflation measured by CPI, p3 is the weighted inflation of foreign importers, s1 is index of demand for Czech exports (weighted average of trading partners’ demands), and s2 is index of demand for Czech exports (average weighted according to a basket definition).

Data sources: International Financial Statistics (IMF).

Although the current account deficit reached 8.6% of GDP in 1996, it was sustainable at least in the medium-run from the point of view of debt indicators as confirmed by Table 4. The Czech economy started the period of external imbalance with a very low debt to GDP ratio and relatively high level of foreign reserves built up during period of capital inflows. Hence the debt burden did not exceed the usually considered safety limit of 40%.

Table 4

Indicators of Debt Sustainability (in %)				
	D1	D2	FX1	FX2
1992	7.57	25.33	3.01	12.79
1993	6.36	27.21	12.40	20.00
1994	6.11	29.67	17.32	24.67
1995	4.29	36.25	30.72	38.09
1996	3.27	39.72	23.81	33.51

Notes: Indicators are defined as follows: D1=(Government Foreign Debt)/GDP in nominal terms, D2=(Foreign Debt)/GDP in nominal terms, FX1=(Reserves of the Central Bank)/GDP in nominal terms, and FX2= (Country's Reserves)/GDP in nominal terms.

Data sources: Czech National Bank (CNB), Czech Statistical Office (CSU).

Similarly to indicators of debt sustainability, the indicators of solvency did not signal serious problems until 1996. Table 5 illustrates that the ratios of interest payments to export did not exceed the solvency limits. Moreover, the ratios of reserves to imports remained relatively high.

Table 5

Indicators of Solvency (in %)					
	R1	R2	R3	FX/IMP1	FX/IMP2
1992	6.63	4.82	3.54	5.36	7.00
1993	5.11	3.75	3.75	22.75	22.75
1994	5.77	4.28	4.28	32.75	32.75
1995	6.06	4.61	5.57	54.52	46.74
1996	8.65	6.33	6.20	36.27	36.74

Notes: Indicators are defined as follows: R1=(Debt Interest Payments)/(Exports of Goods and Services from BOP accounts), R2=(Debt Interest Payments)/(Exports of Goods from BOP accounts), R3=(Debt Interest Payments)/(Exports from GDP accounts in nominal terms), FX/IMP1=(Reserves of the Central Bank)/(Imports from GDP accounts in nominal terms), and FX/IMP2=(Reserves of the Central Bank)/(Imports of Goods and Services from BOP accounts).

Data sources: Czech National Bank (CNB), Czech Statistical Office (CSU).

On the other hand, the financial indicators presented in Table 6 show that vulnerability of financial sector towards capital outflow was enlarged as financial markets deepened gradually. Specifically, the volumes of financial assets traded on the Prague Stock Exchange increased with respect to the official foreign reserves. This vulnerability was not reflected in residents' expectations. Small weight of deposits in foreign currency did not indicate that they would expect external imbalance to jeopardise the exchange rate stability.

Table 6

Financial Indicators (in %)					
	M1/FX	M2/FX	Df/FX	S/FX	B/FX
1993	317.98	637.72	50.49	2.01	1.12
1994	234.30	484.18	33.95	15.50	8.63
1995	121.67	279.34	23.64	21.14	15.57
1996	131.87	316.39	24.63	49.13	21.06

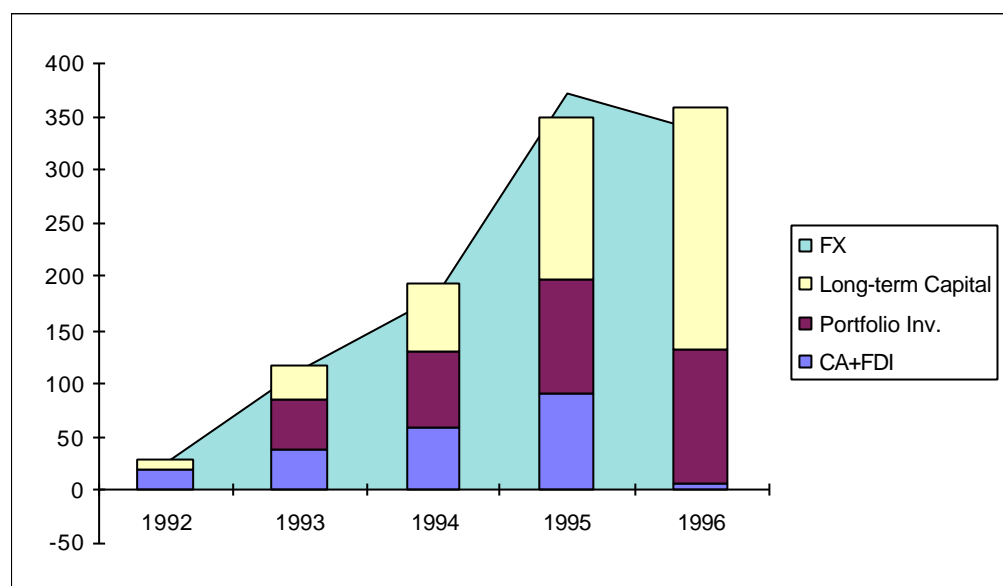
Notes: Indicators are defined as follows: $M1/FX = (\text{Narrow Money}) / (\text{Reserves of the Central Bank})$, $M2/FX = (\text{Broad Money}) / (\text{Reserves of the Central Bank})$, $Df/FX = (\text{Deposits in Foreign Currency}) / (\text{Reserves of the Central Bank})$, $S/FX = (\text{Equities-Annual Trade Volumes}) / (\text{Reserves of the Central Bank})$, $B/FX = (\text{Bonds-Annual Trade Volumes}) / (\text{Reserves of the Central Bank})$.

Data sources: Czech National Bank (CNB), Czech Statistical Office (CSU).

The analysis of sources of foreign reserves reveals that in 1996 there was rather dramatic change in trends of development (See Figure 3). Not only the foreign official reserves started falling, the share of stable sources (such as foreign reserves earned by the current account surplus or receivables from foreign direct investment projects) felt significantly. As a consequence, the vulnerability of the Czech economy to external instabilities increased.

Figure 3

Structure of Foreign Reserves



Notes: The series are defined as follows (billion crowns): FX=Reserves of the central bank, Long-term Capital= Cumulative inflow of long-term capital as defined by the BOP accounts, Portfolio Inv.= Cumulative inflow of portfolio investment as defined by the BOP accounts, and CA+FDI= Cumulative balance of the current account plus cumulative inflow of foreign direct investment as defined by the BOP accounts.

Data sources: Czech National Bank (CNB).

Although the indicators of external stability suggested that there was neither a problem of unsustainable foreign indebtedness nor the problem of solvency, the large current imbalance placed the Czech economy among the economies with the highest deficit in the world⁴ that together with some indicators of financial vulnerability caused worries of possible reverse of capital flows and worsening of conditions on foreign borrowing. Moreover, some simple indicators of competitiveness that were watched by markets and formed the expectations signalled that the crown was overvalued since 1995. The question of how likely a shift in the exchange-rate policy would be in the near future became topical.

There were several studies that tried to answer this question using different criteria when judging whether there was the real exchange rate misalignment.

⁴ See for example “Emerging Markets Biweekly”, Issue No. 97/10 by GoldmanSachs that compared various indicators for 26 emerging markets in Africa, Eastern Europe, Latin America, Middle East and Asia. In this report, in 1996 the Czech Republic had the highest current account deficit (in % of GDP) and the recommendation for foreign investors was to stay short in their crown positions.

However, they did not give unambiguous answer. Lazarova, Kreidl (1997) estimated the equilibrium exchange rate for the Czech economy. The results suggest quite strong nominal overvaluation of the Czech crown in the end of 1996. However, their conclusion relied on partial analysis with only two trade equations included in the model under implicit assumption that the exchange rate was in equilibrium in 1990.

Halpern, Wyplosz (1996) estimated the equilibrium exchange rates for several transitional economies using the international comparison of dollar wages. For the Czech Republic, they argue that the initial undervaluation of the crown was not completely reversed by the end of 1996 due to a change in national characteristics such as a size of government sector, GDP per worker, school enrolment and a ratio of agriculture-to-industry.

In this paper, the problem of sustainability of the exchange-rate regime of the Czech crown is analysed using the framework of the fundamental equilibrium exchange rate (FEER) that has been developed in order to indicate a need for a change in the economic policy package. The rest of the paper is organised as follows. The next section summarises the FEER methodology that uses the structural approach relying on model simulations in order to detect unsustainable external developments and presents the underlying model. In the third section, the results of estimations of the FEER for the Czech economy are summarised. The last section concludes.

2. The FEER as a Warning Signal of External Crisis

In this study, the FEER is estimated as a potential early-warning signal of external crisis. As suggested in Clark, Bartolini, Bayoumi, Symansky (1994) and Williamson (1994) this approach has two important advantages when compared to other methods. First, if simple indicators are used, the conclusions may be misleading for neglecting some important factors. For example, indicators based on the PPP would call for a policy shift although the significant productivity growth and changes in a country's portfolio ensure its external stability. Second, some methods tend to be backward-looking since they are derived from trends of their determinants under assumption of a starting point being an equilibrium. On the contrary, when using the FEER, the structural macro-model allows to capture important links in the economy and to work in a mode that is more forward-looking since it defines the equilibrium with respect to the future desired level of foreign indebtedness.

Williamson (1994) summarises reasons why equilibrium exchange rate changes over time. It can be due to productivity bias, a change in an asset equilibrium, unstable relative income elasticity of export and import, or a change in a country's relations to the international capital market. These factors are very important when analysing transitional economy for which a selection of a point of

initial equilibrium is extremely difficult, and assumption of relevance of backward-looking trends is debatable. Since the Czech economy has gone through many transitional changes, and has been catching up with the developed world, the FEER methodology seems to be appropriate one to find an indicator of external stability.

There are several approaches to defining and estimating the equilibrium exchange rate in real terms that are reviewed mainly in Clark, Bartolini, Bayoumi, Symansky (1994), Edwards (1989), Stein, Allen (1995) and Williamson (1994)⁵. This paper follows the FEER approach outlined in Barrell, Wren-Lewis (1989), Williamson (1994), Artis, Taylor (1995), and extended in Barrell, Sefton (1997) that uses a Mundell-Fleming framework in which the internal balance is defined as a medium-term concept consistent with the NAIRU and the external balance requires trade balance plus structural flows consistent with the asset market equilibrium.

Since this framework defines the FEER as the real exchange rate achieving both balances by some date in the medium-run future, it allows us to use the interpretation of the equilibrium suitable for a transitional country⁶ that can go through a period of short-run imbalances in order to catch up with the developed world without losing the prospect of a medium-run external balance. Specifically, the FEER approach seems to be superior to results of partial analysis that consider only trade balance equilibrium as a benchmark.

The structure of the underlying model can be summarised as follows. The model works with four trade equations (export of goods, export of services, import of goods, import of services) that enter together with factor payments on net foreign assets the current account equation. In each period, a change in net foreign assets equals to current account balance enlarged by structural inflows. The external balance in the model is a normative concept since authorities are assumed to target a ratio of a change in net foreign assets to nominal GDP (that is equivalent to having condition on the ratio of foreign indebtedness to GDP):

⁵ It is worth noting that definitions of internal and external stability as well as model framework vary from author to author. Hence the policy implications for preventing an external crisis depend on the FEER methodology chosen.

⁶ The approach has been used for other Asian developing countries in Barrell, Anderton, Lansbury, Sefton (1996).

$$(1) MG = s_1 \cdot D^{s_2} \cdot \left(\frac{\chi E \cdot Pm^*}{\chi P \rho} \right)^{-s_3},$$

where MG is import of goods in volumes, D is final expenditures, E is crown-dollar exchange rate, P is domestic price (CPI), and Pm* is price of imports defined as effective index of prices of exports of trading partners,

$$(2) MS = d_1 \cdot D^{d_2} \cdot \left(\frac{\chi E \cdot Pm^*}{\chi P \rho} \right)^{-d_3},$$

where MS is import of services in volumes,

$$(3) XG = c_1 \cdot (Sg^*)^{c_2} \cdot \left(\frac{\chi E \cdot Px^*}{\chi P \rho} \right)^{c_3},$$

where XG is export of goods in volumes, Sg* is foreign demand for goods (effective index), and Px* is price of exports defined as effective index from CPI's of trading partners,

$$(4) XS = v_1 \cdot (S^*) \cdot \left(\frac{\chi E \cdot Px^*}{\chi P \rho} \right)^{v_3+1},$$

where XS is export of services in volumes, S* is foreign demand for services,

$$(5) \frac{CA}{E \cdot Px^*} = v_1 \cdot S^* \cdot \left(\frac{\chi E \cdot Px^*}{\chi P \rho} \right)^{v_3+1} + c_1 \cdot Sg^{*c_2} \cdot \left(\frac{\chi E \cdot Px^*}{\chi P \rho} \right)^{c_3} - s_1 \cdot D^{s_2} \cdot \left(\frac{\chi E \cdot Pm^*}{\chi P \rho} \right)^{-s_3} \cdot \frac{Pm^*}{Px^*} - d_1 \cdot D^{d_2} \cdot \left(\frac{\chi E \cdot Pm^*}{\chi P \rho} \right)^{-d_3} \cdot \frac{Pm^*}{Px^*} + \frac{r^* \cdot F_{-1}}{E \cdot Px^*}$$

where CA is current account balance, r* is foreign real interest rate, and F₋₁ is net foreign assets in the end of previous period,

$$(6) F = CA + F_{-1} + FDI,$$

where F is net foreign assets in the end of current period, and FDI is exogenous structural inflow defined as foreign direct investment,

$$(7) t = \frac{CA + FDI}{Y \cdot P},$$

where t is a ratio targeted by authorities, and Y is real GDP.

The next two equations ensure internal balance for domestic economy by projecting the inflation non-accelerating growth rate of GDP, and subsequently, deriving final expenditures from policy scenario for government expenditures and real financial wealth of the private sector (those variables together provide a measure of restrictiveness of a mix of fiscal and monetary policy):

$$(8) \quad D = \mathbf{b}_0 \cdot Y^{b_1} \cdot RW^{b_2} + G + XG + XS,$$

where D is final expenditures (private demand plus government consumption plus foreign demand), Y is projected path for GDP, RW is real financial wealth of private sector (includes both government debt as well as narrow money) and G government consumption,

$$(9) \quad P = \mathbf{p}_0 \cdot ULC^{p_1} \cdot (P_X^* \cdot E)^{p_2},$$

where P is domestic price and ULC is unit labour cost implied by the projected path of the GDP.

In the model, there are three categories of exogenous variables: (i) foreign variables (r^* , FDI, P_m^* , P_x^* , S^* , S_g^*), (ii) domestic variables that are projected according to their medium-run trends (ULC, Y) and (iii) domestic variables that represent the policy scenario (G, RW, t). The FEER is obtained when solving the system for the real exchange rate ($P_x^* \cdot E/P$) that is compatible with the target t in the equation (7). Consequently, the path of the FEER is a normative result that depends on what authorities in the model consider to be a sustainable current account deficit. It is worth noting that the path of the FEER is formed by the paths of exogenous variables and by important elasticities in export, import, consumption functions and price equation. Also, the initial stock of net foreign assets determines the path of solution.

3. Search for the Crown's FEER

In order to apply the FEER methodology to the Czech case it was necessary to find the parameters for the above presented model framework. For this purpose, the long-run structure of the Czech satellite model has been used. The satellite model has been estimated as a part of the NIGEM (National Institute Global Econometric Model) in a dynamic form as described in Šmídková (1997). Although estimates of some equations were not completely satisfactory and quarterly data series were relatively short (1992-1996), the set of obtained long-run coefficients that are important when solving for the FEER was verified by model simulations. They proved to yield satisfactory results in the case of a simulation of a nominal depreciation shock. Table 7 gives the values of important elasticities:

Table 7**Important Elasticities**

Coefficient	Elasticity	Value
s2	Import of goods to final expenditures	1.47
s3	Import of goods to real exchange rate	0.45
d2	Import of services to final expenditures	1.08
d3	Import of services to real exchange rate	0.68
c2	Export of goods to foreign demand	1.00*
c3	Export of goods to real exchange rate	0.81
z2	Export of services to foreign demand	1.54
z3+1	Export of services to real exchange rate	0.9
b1	Private demand to output	0.79
b2	Private demand to real financial wealth	0.21*
p1	Domestic prices to ULC	0.65
p2	Domestic prices to $P_x \cdot E$	0.35*

Notes: Values of coefficients labelled with (*) have been imposed during estimations. Exports, imports and foreign demand are defined in volumes.

As far as exogenous variables are concerned, twelve scenarios have been defined that differ in assumptions about the value of the target t , inflow of FDI, and increase in real financial wealth. There have been three alternative targets considered as definitions of sustainable current deficit: (i) “zero” target ($t=0\%$) in which authorities strictly define target as a balance - this scenario implies constant foreign indebtedness, (ii) “ambitious” target ($t = -4\%$) in which authorities assume that a country will be able to repay higher stock of debt - this scenario implies relatively fast increase in foreign indebtedness, (iii) “realistic” target ($t=-2.04\%$) in which authorities allow for low deficit - this scenario implies slower increase in foreign indebtedness.

There have been two alternative assumptions used on what the structural flows would be: (i) “low-inflow” assumption takes the average value of FDI inflows from the whole period of 1991-1996, (ii) “average-inflow” assumption works with average value of FDI inflows in 1993-1996. The latter assumption is more optimistic since it considers only the period of relatively high structural inflows attracted to a significant extent by various privatisation schemes⁷.

⁷ See Lansbury, Pain, Šmídková (1996) for analysis of determinants of the FDI inflows in Central and Eastern Europe.

Similarly, two alternative paths for real financial wealth have been used for the purposes of simulations: (i) “restrictive” path has been derived from the actual values of real financial wealth in 1993-1996 - it reflects the impact of privatisation transfers as well as of a change in monetary policy stance from neutral to restrictive in the second half of 1996 (in 1997 the real financial wealth is projected to grow in accordance with real GDP), (ii) “expansive” path has been defined for the whole period of 1993-1997 with the average growth rate of real financial wealth in 1993-1995 under assumption that the real financial wealth continued growing faster than real GDP as if the impact of privatisation and neutral monetary policy continued.

The model works with the empirical approximation of the real financial wealth of the private sector. It is defined as a sum of government bonds in the hands of private sector, net foreign assets, narrow money and voucher shares that have been transferred into the hands of private sector during privatisation⁸. It implies that the model assumes a weak form of the Ricardian equivalence to hold. Consequently, although in the model the real financial wealth is a policy variable that functions as an important factor in determining the degree of real exchange rate misalignment, it is not possible to distinguish whether it was fiscal or monetary policy that drove the real exchange rate out of the FEER corridor. It is always a mix of policies that is either restrictive or expansive. Table 8 compares the twelve above-described scenarios.

Table 8

Twelve Scenarios

Scenario	value of t (in %)	Real Financial Wealth	FDI
1	0.00	restrictive	average
2	-4.00	restrictive	average
3	-4.00	restrictive	low
4	-2.04	restrictive	average
5	0.00	restrictive	low
6	-2.04	restrictive	low
7	0.00	expansive	average
8	-4.00	expansive	average
9	-4.00	expansive	low

⁸ See Allen, Šmídková (1997) for description of voucher privatisation scheme and analysis of the impact of voucher privatisation on private sector's demand for goods and financial assets.

10	-2.04	expansive	average
11	0.00	expansive	low
12	-2.04	expansive	low

Notes: Value of t is target for current account, real financial wealth is a policy variable determined by a mix of monetary and fiscal policies as well as privatisation strategy, FDI is structural inflow (foreign direct investment).

As far as other exogenous variables are concerned, the paths of foreign variables have been set equal to observed values (the NiGEM forecast has been used for 1997) for all twelve scenarios. For 1997, government consumption has been set equal to trend values since it was stable for a sample period. The path for real GDP has been derived from average annual growth rate over the period of 1991-1996. This assumption implies the growth rate slightly below 1%⁹.

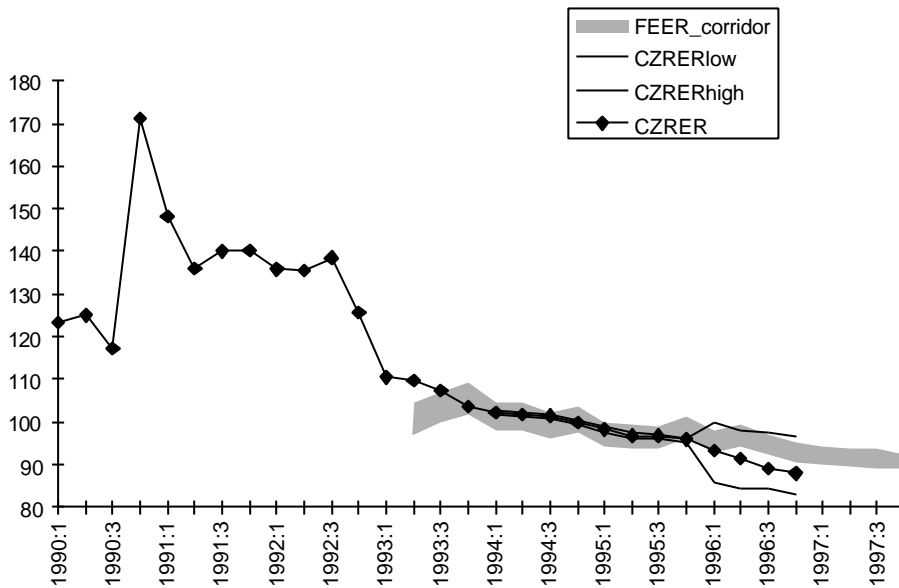
The model simulations have been run for the period of 1993-1997 (four quarters out of sample) in order to detect whether (and when) the FEER started diverging significantly from the corridor implied by the exchange-rate regime of the Czech crown. Twelve paths of the FEER obtained from simulations under alternative scenarios (described in Table 8) have been used in order to construct a corridor of FEER's. The FEER corridor captures some of the uncertainty linked with assumptions that were necessary for model solutions. In order to relate the FEER corridor to the limits of the exchange-rate regime, the real exchange-rate corridor has been constructed that shows the maximum possible exchange-rate movements implied by the bands.

The two following Figures compare the results of the FEER simulations for two categories of solutions. Figure 4 shows the FEER corridor for scenarios 1-6 from Table 8 that assume restrictive economic policies took place. On the contrary, Figure 5 presents the FEER corridor based on scenarios 7-12 from Table 8 that assume expansive economic policies took place. This implies that centre values of the two FEER corridors differ due to simulation path for the real financial wealth while the bands of the FEER corridors are determined by a sensitivity of solutions to the assumptions about the scope of FDI flows and the level of a target t .

⁹ The attempt has been made to test sensitivity of assumption about the underlying growth rate. However, when the growth rate has been set higher than the average, the results produced have not been satisfactory due to inability of the model to account for medium-run impact of technological change on exportable sector. This remains area for further research.

Figure 4

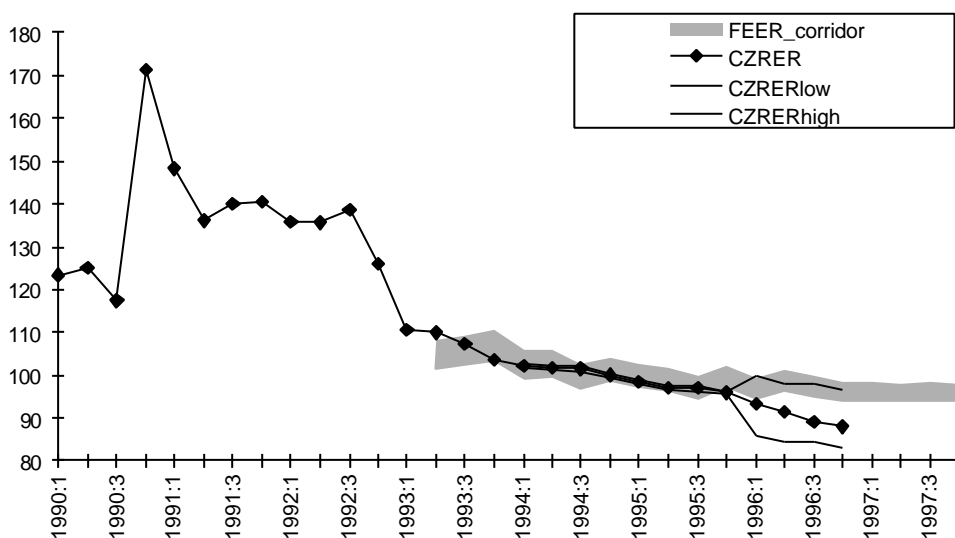
“Restrictive” Scenarios



Notes: CZRER is the real effective exchange rate of the Czech crown. The FEER corridor has been constructed around the average value of the FEER solutions of scenarios 1-6 (Table 8) under assumption of restrictive economic policies. The bands (CZRERlow, CZRERhigh) show the limits of the exchange-rate regime.

Figure 5

“Expansive” Scenarios



Notes: CZRER is the real effective exchange rate of the Czech crown. The FEER corridor has been constructed around the average value of the FEER solutions of scenarios 7-12 (Table 8)

under assumption of expansive economic policies. The bands (CZREERlow, CZREERhigh) show the limits of the exchange-rate regime.

Both expansive as well as restrictive scenarios start indicating the overvaluation of the Czech crown since 1996. In both cases, the real exchange rate left the FEER corridor. However, the two categories differ in the scale of overvaluation implied. In the first quarter of 1996, the real overvaluation was from 0.4 to 6.8% according to expansive scenarios while it was -1.4 to 5.4% according to restrictive ones. In the end of 1996, expansive scenarios signal the real overvaluation from 5.8 to 11.2% and the restrictive scenarios from 2.1 to 8.5%. Also, restrictive scenarios signal the overvaluation problem one quarter later than expansive ones.

Summing up results of model simulations, the FEER methodology indicate that there was a real exchange-rate misalignment of the Czech crown in 1996. Since the construction of the FEER corridor takes into account both the behaviour of the real economy as well as the financial side of the economy (specifically the impact of foreign indebtedness on the current account), this conclusion could be used as an early-warning signal for policy-makers.

4. Conclusions

In May 1997, the speculative attack on the Czech crown emphasised the importance of watching early-warning signals¹⁰ that would indicate to policy-makers that applied mix of economic policies is not consistent with the development of the economy and with the exchange-rate regime. The previous sections demonstrated that in 1996 some indicators, specifically those working with long-run horizon such as criteria of debt sustainability, offered a relatively optimistic view. Other indicators gave warning that there might be a danger of capital outflow if foreign investors, and subsequently domestic agents, emphasised short-run analysis or indicators based on the PPP.

¹⁰ Since external crises impose ex post large fiscal costs on the government because of bailouts of banks, firms as well as costs of external borrowing necessary for supporting the currency under attack, many economic studies both theoretical and empirical suggest that research should aim at finding good early-warning signals. The experience of surveyed countries suggest that in the case of unsustainable external development an early policy shift reduces costs of external imbalances to a large extent. Artis, Taylor (1995) provide a rule of thumb that when five years adjustment to initial 15% overvaluation depreciate FEER by additional 2.5% in comparison to immediate adjustment.

The view formed by the methodology of the FEER simulations fits somewhere in between. The FEER corridors identified a relatively small-scale real overvaluation of the Czech crown for the end of 1996. If one takes into account the sensitivity of results with respect to assumptions, and compares the bands of the FEER corridor with the bands of the corridor implied by the limits of the exchange-rate regime, it is possible to argue that under assumption of the early applied restrictive economic policy mix, there was a space for the exchange rate to accommodate without a necessity to change the exchange-rate regime itself. It is important to note that the FEER methodology detects the problem of potential external crisis by declaring a real exchange rate misalignment. However, although the real exchange rate is in the centre of analysis, the signalled misalignment should be viewed as a consequence of the mix of events rather than of an inappropriate exchange-rate policy alone¹¹.

¹¹ The ambiguity of the concept of real equilibrium exchange rate is recognised by Breuer in Williamson (1994) who exposes a problem of whether desired exchange rate system should ensure internal and external stability or whether policies should be designed to create the internal and external conditions under which the desired equilibrium naturally emerges? The conflict between tools and targets is also, explained in Williamson (1994). If a target zone is the selected exchange-rate regime, fiscal policy becomes a tool for defending the zone, and cannot be designed according to other fiscal rule. Adding to the difficulties, there is not an agreement on which policy tool (whether fiscal or monetary policy) should be assigned to the exchange-rate target.

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