ESTIMATING THE HARROD-BALASSA-SAMUELSON EFFECT FOR ROMANIA

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ABSTRACT

In the last ten (or more) years, there has been a tendency towards the appreciation of real exchange rates in Central and Eastern European countries, including Romania. One may identify different factors that could explain this tendency, but the present paper aims to investigate to what extent the real appreciation of the Romanian Leu (ROL) is explained by the Harrod-Balassa-Samuelson effect. Under certain assumptions, differences in productivity growth between tradable and non-tradable sectors in Romania that are larger than differences in productivity growth between tradable and non-tradable sectors in the euro zone lead to a real appreciation of the local currency (as a result of the catching-up process).

There are several theories explaining long-run deviations from PPP. The first and the most famous theory is known as the Harrod-Balassa-Samuelson effect - HBS (Harrod, 1933; Balassa, 1964; Samuelson, 1964). There is a growing body of literature regarding the existence and the extent of the HBS effect in transition countries, whose general conclusion is that its size is not as important as it had been considered in the early ’90s. The available estimates for Central and East European countries range from 0 to about 4 percentage points per year. Estimation methods differ from one paper to another (the most widespread being panel-data approaches) which render comparisons difficult. In this context, only a handful of papers such as Halpern and Wyplosz (1997), Dobrinsky (2001) deal with the HBS effect in Romania.

The HBS effect has major implications for interpreting inflation and exchange rate criteria for Romania ahead of joining the Economic and Monetary Union (EMU). The high productivity differential between Romania and EMU complicates the fulfilment of the Maastricht criterion on inflation; in addition, the impact of this differential on the real exchange rate should be taken into account when estimating the equilibrium exchange rate.

Summary

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THE HARROD-BALASSA-SAMUELSON EFFECT FOR ROMANIA

The Harrod-Balassa-Samuelson model (HBS) was created as an alternative for the long-run determination of the exchange rate (Purchasing Power Parity – PPP – which is the cornerstone for the majority of the theoretical models of international macroeconomics). According to Harrod (1933), Balassa (1964) and Samuelson (1964) the exchange rate of the developing countries is undervalued as compared to that suggested by the PPP. Moreover, the real exchange rate of the developing countries will appreciate as a result of the convergence process towards the level of economic development of the industrialized countries.

The model's hypotheses are the followings:

- Capital mobility across the two sectors and between the two countries which implies exogeneity of the interest rate;
- PPP is valid only for the tradables sector $\Longrightarrow$ the exchange rate is determined by the price level of tradables goods at home and abroad;
- Labour market competitivity and mobility – wage equalization across tradables and non-tradables sectors.

The Harrod-Balassa-Samuelson mechanism is as follows: productivity growth in the tradables sector is faster than that in the non-tradables sector and this rapid growth translates into rising wages in the former sector. Labour market competitivity ensures wage equalization across tradables and non-tradables sectors leading to a rise in production costs and, implicitly, in the prices of non-tradable goods, as wage increases are not accompanied by gains in productivity. It follows that productivity growth in the tradables sector causes prices in the non-tradables sector to rise, thus increasing relative prices[1] and consumer prices, thus generating inflation.

If domestic productivity growth is larger than the foreign one, inflation rate will be higher at home and, as a consequence, the CPI real exchange rate will appreciate. The theoretical model is presented in Annex 1.

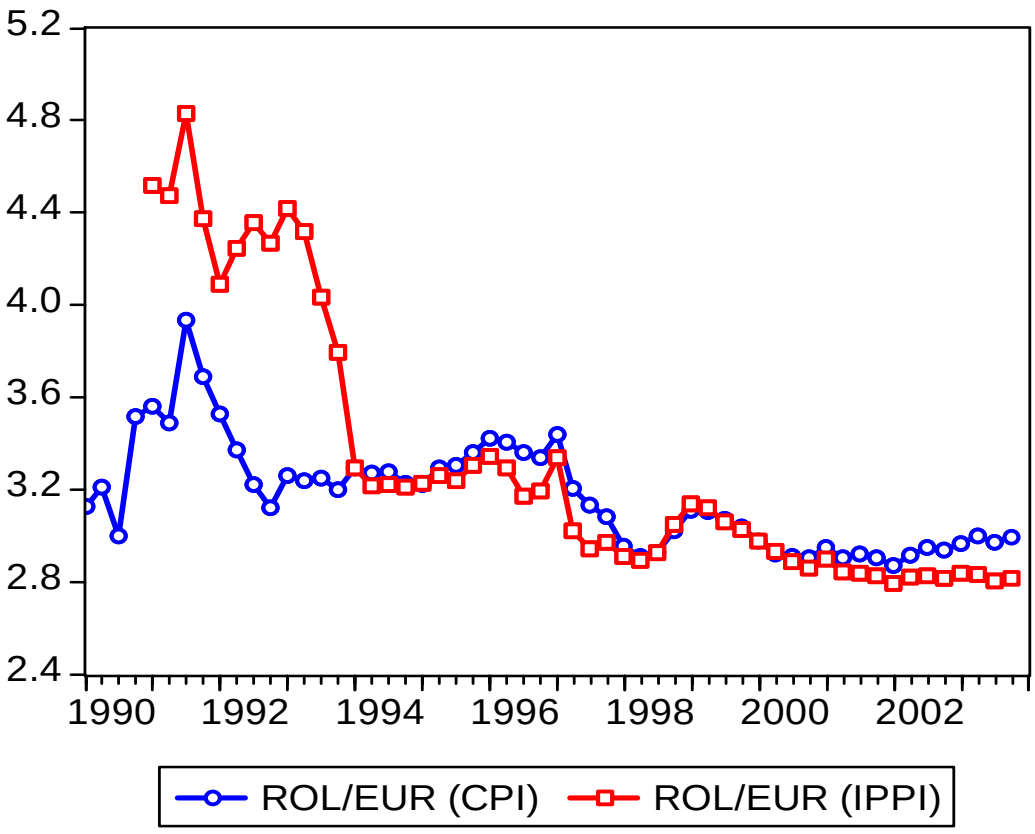
[1] The ratio between non-tradable and tradable goods prices

The estimation of the HBS effect was achieved in **two stages** as follows.

1. Testing the model's hypotheses (see Annex 2)
    a. PPP for the ROL/EUR real exchange rate
    b. Labour market mobility
    c. Capital mobility

a) In testing PPP for the ROL/EUR real exchange rate (computed based on industrial production price index – IPPI) we used ADF and PP tests. According to econometric results the ADF test confirms stationarity of the real exchange rate (significance level of 5%), but the PP test rejects the stationarity hypothesis. When testing for stationarity of the real exchange rate computed using consumer price index both tests have rejected the stationarity of the series and this implies rejection of PPP.

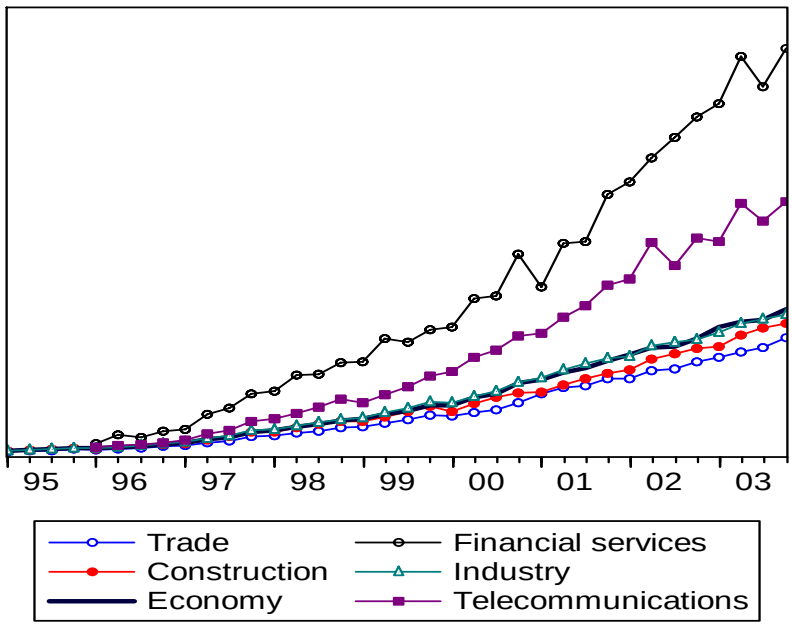
Graph 1 ROL/EUR real exchange rate computed using IPPI and CPI



b) Regarding the labour market there has been an equalization tendency between wages in trade and construction and those in industry starting with 2000. To highlight this tendency we computed relative wages (as a ratio between industry and non-tradables sector wages) and used the HP filter to identify the trend (see graph 3). Divergent evolutions of wages in different sectors are due to labour market segmentation restrictions (e.g. degree required for access to some qualifications: telecom sector, financial-banking sector).

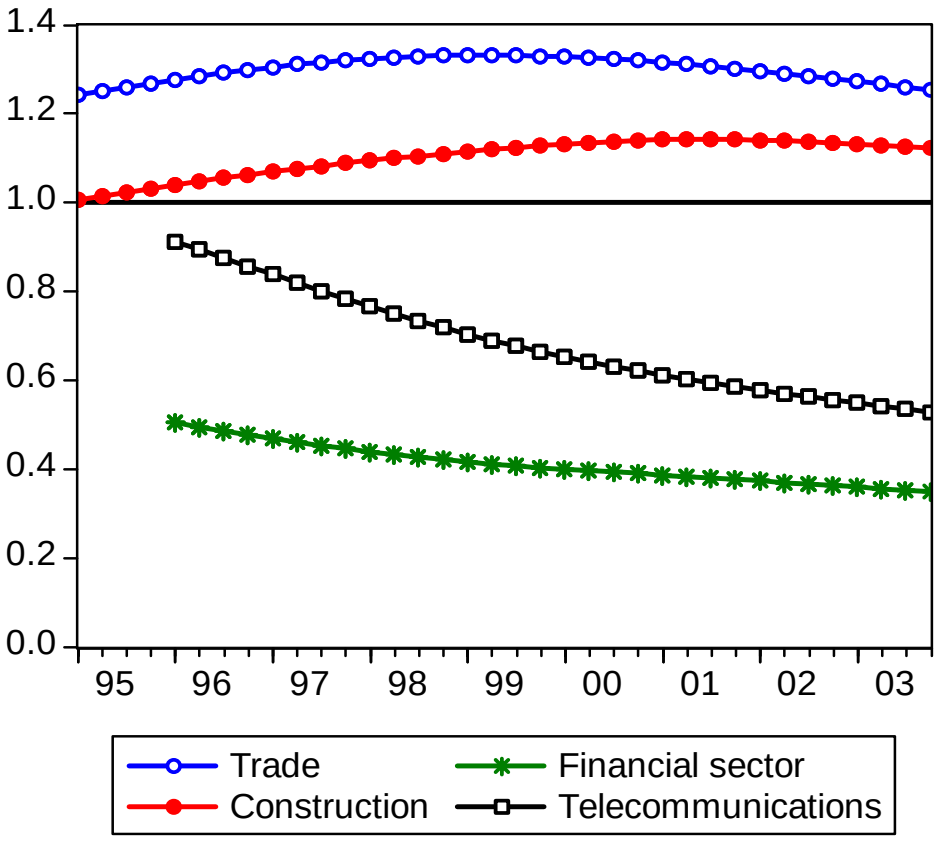
In order to test how an increase in wages in the tradables sector is transmitted into non-tradables sector we developed a VAR using nominal wages[2] in five sectors over the period April 1996 – April 2004. We looked at the impulse response functions of wages in the non-tradables sector to a shock of wages in industry. The results are conclusive and they show that nominal wages in different non-tradables sub-sectors respond strongly (rising) to a positive shock in wages in the tradables sector.

Graph 2 Nominal wages (Seasonally adjusted series)



[2] Seasonally adjusted series

Graph 3 Relative wages



We haven't found evidence of any cointegrating relation between productivity growth and real wage growth in the tradables sector.

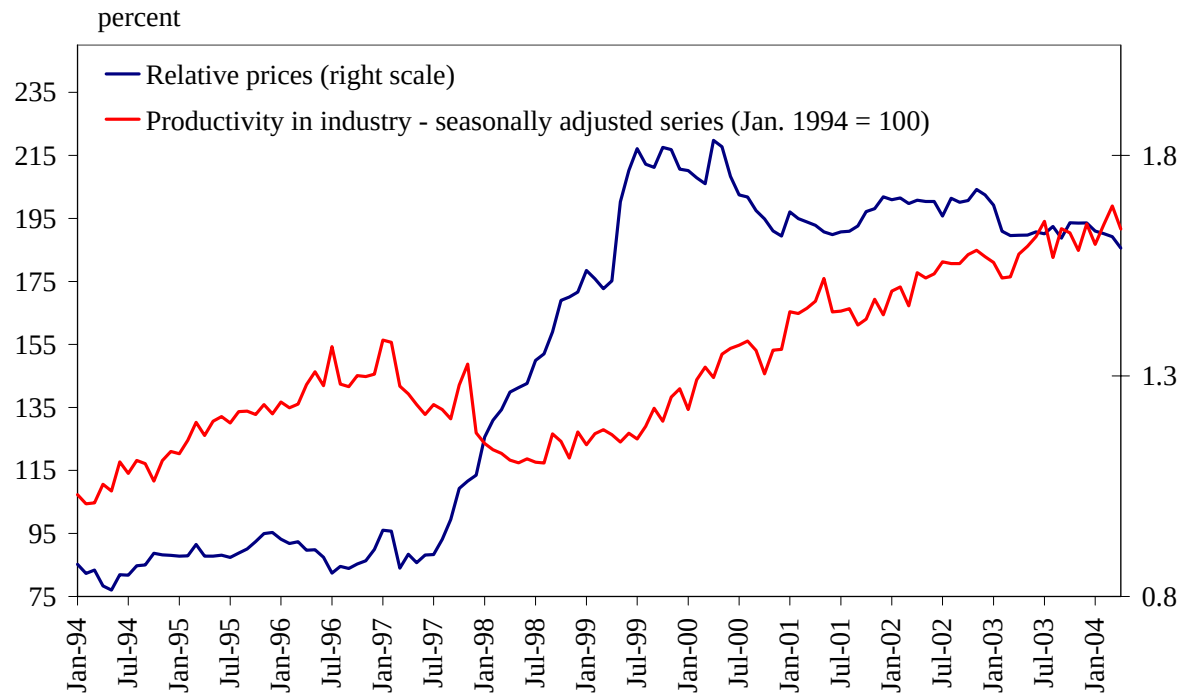
c) The third hypothesis – capital mobility – is partially fulfilled as the process of capital account liberalization started in 2001.

2. The presence of the HBS effect has been tested for using Johansen's cointegration test: productivity growth in the tradables sector is translated into relative prices, consumer prices and, finally, into real appreciation of the home currency.

According to econometric results shown in Annex 3 we may conclude that the HBS effect was present in Romania during the period 1995 – 2004. This conclusion is drawn from the cointegrating equation between labour productivity in industry and relative prices (internal transmission mechanism) and from the cointegrating equations between the productivity differential, relative prices

differential and the real exchange rate (external transmission mechanism). Also, using a vector error correction model (VECM) we highlighted that a faster increase in Romanian productivity as compared to productivity growth in the euro area leads to a real appreciation of ROL against the EUR. Furthermore, because of the likely rise of non-tradables weight in GDP and CPI basket, the real appreciation trend will sharpen.

Graph 4 Labour productivity in industry sector and relative prices



Using the methodology presented above, we determined the size of the HBS effect for Romania for the real exchange rate and the inflation differential.

During 1995 – 2003, the impact of the HBS effect on the inflation differential between Romania and the euro area lied between 1.7 and 2.4 percentage points per year (see Annex 4).

As shown in Table 1 below, the HBS effect in Romania was higher as compared to other countries that joined the EU in the first wave of accession. During 1995 – 2003 the magnitude of the HBS effect was between 1.4 and 1.6 percentage points per year on average (see Appendix IV). We must emphasize however that after 1999 a considerable increase of the HBS effect on the real exchange rate appreciation was

noticeable as the average values (obtained using different computing methodologies) have ranged between 2.7 and 3.8 pp per year.

Table 1 The estimated size of the HBS effect for different countries in Central and Eastern Europe

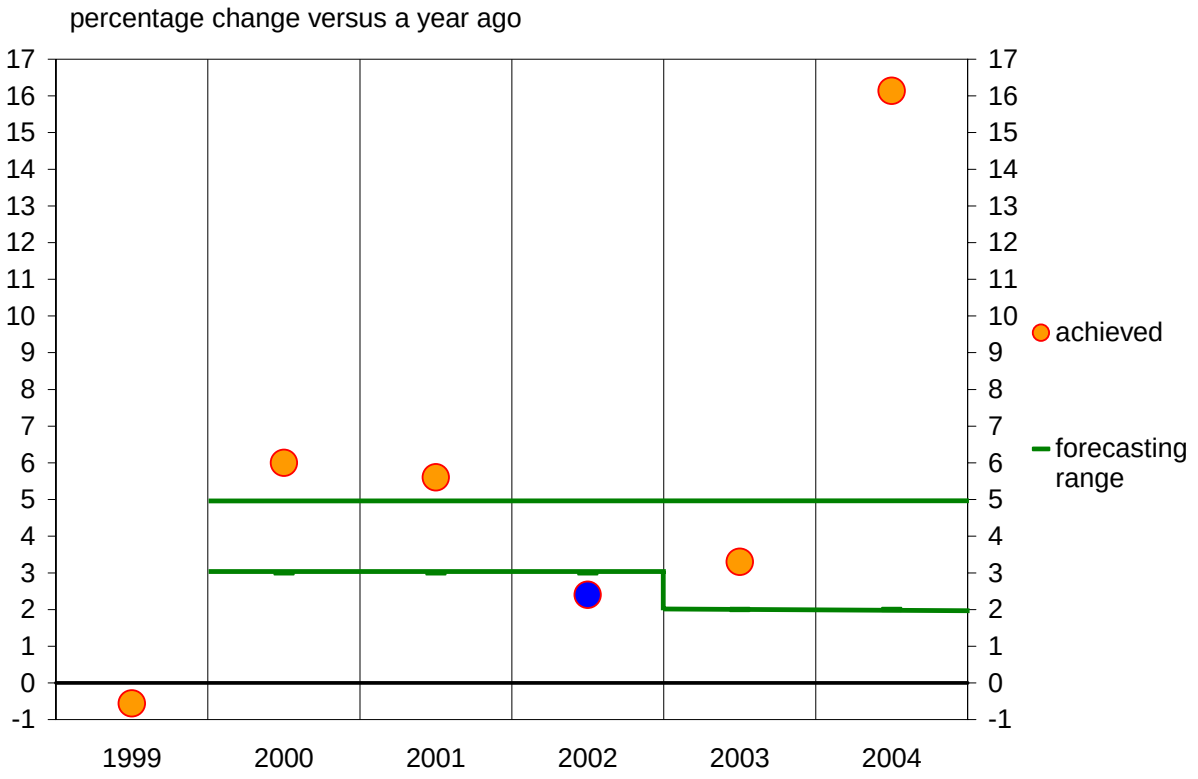
	Annual real appreciation	Estimated value of the HBS effect	
		Computed	Econometrically estimated
For the '90 compared with Germany			
Czech Republic	4.9	1.6	0.1
Hungary	2.4	1.9	1.0 – 2.0
Poland	5.8	-	1.2 – 1.5
Slovakia	4.3	1.0 - 2.0	-
Slovenia	2.2	0.7 – 1.4	1.0 - 2.0
For 1999 – 2003 compared with the euro area			
Romania	3.5	-	2.7 – 3.8

Source: Mihaly Andras Kovacs, NBH Working Paper 2002/5, p.3; author's estimates

This high value (as compared to the first wave countries) is due to the rapid pace of the convergence process of the Romanian economy, taking into account that initial conditions in Romania were not as favourable as they were in other countries. Hence, the rapid labour productivity growth in the tradables sector will lead to inflationary pressures (as an outcome of increases in relative prices) and to real appreciation of the national currency.

In this context the exchange rate policy of the central bank should not counteract the HBS effect but, on the contrary, it should allow a real appreciation of the national currency roughly equal to the size of the HBS effect. Owing to higher productivity growth in the tradables sector than real appreciation of the ROL against the EUR the tradables sector will not lose any of the external competitiveness. As is shown in graph 5, this was roughly the case for Romania during 2000 – 2003.

Graph 5 Average real exchange rate of the ROL against the currency basket



Source:National Institute of Statistics, own calculations

Moreover, beside the sustained growth in labour productivity, the improvement of macroeconomic conditions and low interest rates at the international level will lead to an increase of capital inflows (especially after full liberalization of the capital account that is envisaged to be achieved in April 2005), putting further pressure on the real appreciation of the home currency. Under these circumstances there is a need for an adequate fiscal policy to accompany the exchange rate policy of the central bank in order to maintain the macroeconomic equilibrium.

A restrictive fiscal policy against the background of capital inflows helps restrain aggregate demand and alleviate price increases; it may also limit real exchange rate appreciation – especially when a large portion of government spending goes on non-tradables goods – current account deficit and to stifle supplementary capital inflows (by contributing to the reduction of the interest rate) and, at the same time, it may increase savings.

According to Bercuson and Koenig (1993) for a vast majority of emerging economies (except Indonesia and Thailand) in practice there have not been implemented any

strong fiscal policies during the capital inflows because this type of measures did not found enough political support in their countries. Furthermore, the upward pressures on government spending might increase provided the authorities have easy access to foreign funding.

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Annex 1

THEORETICAL MODEL FOR THE HARROD-BALASSA-SAMUELSON EFFECT

I. General case

Consider a small open economy with two sectors – tradables and non-tradables – and corresponding production functions of capital and labour employed with constant returns:

$$Y^T = A^T \cdot F\left(K^T, L^T\right)$$
$$Y^{NT} = A^{NT} \cdot G\left(K^{NT}, L^{NT}\right)$$

where:

– superscript T denotes the tradables sector and superscript NT denotes the non-tradables sector;

A^T, A^{NT} – total factor productivity for tradables and non-tradables sectors;

L^T, L^{NT} – labour supply in the two sectors (total labour supply is flat);

K^T, K^{NT} – capital in the two sectors;

In what follows we will use tradables as the numeraire.

Assuming – for simplicity – a constant world interest rate in terms of tradables r firms' present value profits measured in terms of tradables are the following:

$$\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left[A_s^T F\left(K_s^T, L_s^T\right) - W_s \cdot L_s^T - \Delta K_{s+1}^T\right]$$

$$\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left[P_s \cdot A_s^{NT} G\left(K_s^{NT}, L_s^{NT}\right) - W_s \cdot L_s^{NT} - \Delta K_{s+1}^{NT}\right]$$

where:

P – relative prices;

W – nominal wage.

In order to maximize the firms' profits in the two sectors considered in this analysis we apply first-order conditions:

$$A^T f'\left(k^T\right) = R\,,\ A^T\left[f\left(k^T\right) - f'\left(k^T\right) \cdot k^T\right] = W$$

$$P \cdot A^{NT} g'\left(k^{NT}\right) = R\,,\ P \cdot A^{NT}\left[g\left(k^{NT}\right) - g'\left(k^{NT}\right) \cdot k^{NT}\right] = W$$

where:

R – nominal world interest rate, $k^T = \frac{K^T}{L^T}$, $k^{NT} = \frac{K^{NT}}{L^{NT}}$ – capital labour ratios in tradables and non-tradables goods production and $F(K,L) = f(k)$, $G(K,L) = g(k)$.

Taking logarithms and totally differentiating we get:

$$\hat{A}^T = \frac{W \cdot L^T}{Y^T}\hat{W} \text{ and } \hat{P} + \hat{A}^{NT} = \frac{W \cdot L^{NT}}{p \cdot Y^{NT}}\hat{W}$$

relations from which we can write the internal transmission mechanism of the HBS effect as:

$$\hat{P} = \frac{\frac{W \cdot L^{NT}}{p \cdot Y^{NT}}}{\frac{W \cdot L^T}{Y^T}} \cdot \hat{A}^T - \hat{A}^{NT} \text{ (where } \hat{X} = \frac{dX}{X}\text{)}$$

The internal transmission mechanism of the HBS effect is also known as the Baumol and Bowen effect[3].

The above relationship shows that there is a positive cross-sectional relation between long-run tradables and non-tradables productivity growth differentials and long-run rates of increase in p that implies the presence of inflationary pressures in the latter sector. The pressures are even stronger if the share of non-tradables labour force is higher than that in the tradables sector.

We assume that the price level is a geometrical average[4] of prices in tradables and non-tradables sectors with weights γ and *(1-*γ*).* Since we will use the tradables as the numeraire the price level in that sector will be normalized to unity in the two countries.

Considering this, $P_a = P^{1-\gamma}$ and $P_a^* = (P^*)^{1-\gamma}$ represent the home and foreign price levels. Using this relation and that known as the Baumol and Bowen effect and assuming that both countries' sectoral outputs are proportional to the same functions,

[3] Baumol and Bowen (1966)

[4] Formal derivation of such a form results from utility functions and they hold for any well-behaved price index.

but with possibly different factor productivities, we obtain the external transmission mechanism of the HBS effect:

$$\hat{P} - \hat{P}^* = (1-\gamma)\left[\frac{\frac{W \cdot L^{NT}}{P \cdot Y^{NT}}}{\frac{W \cdot L^{T}}{Y^{T}}}(\hat{A}^{T} - \hat{A}^{T^*}) - (\hat{A}^{NT} - \hat{A}^{NT^*})\right].$$

II. Particular case – output determined by a Cobb-Douglas production function

Let us consider production functions with constant return to scale for the tradables (Y^T) and non-tradables (Y^{NT}) sectors:

$$Y^T = A^T \left(L^T\right)^{\theta^T} \left(K^T\right)^{1-\theta^T}$$
$$Y^{NT} = A^{NT} \left(L^{NT}\right)^{\theta^{NT}} \left(K^{NT}\right)^{1-\theta^{NT}}$$

where:

θ^T, θ^{NT} – labour elasticities.

Corresponding to each of the sector we may write profit functions (G):

$$G^T = P^T \cdot Y^T - R \cdot K^T - W \cdot L^T$$
$$G^{NT} = P^{NT} \cdot Y^{NT} - R \cdot K^{NT} - W \cdot L^{NT}$$

Profit maximization in both sectors equates marginal products of labour and capital to the current wage and real interest rate, respectively (P is the relative price defined in the previous section):

$$W = P^T \frac{\partial Y^T}{\partial L^T},\ W = P^{NT} \frac{\partial Y^{NT}}{\partial L^{NT}}$$
$$R = P^T \frac{\partial Y^T}{\partial K^T},\ R = P^{NT} \frac{\partial Y^{NT}}{\partial K^{NT}}$$

or

$$\frac{\partial Y}{\partial L} = A \cdot \theta \cdot L^{\theta-1} \cdot K^{1-\theta} = \frac{W}{P}$$
$$\frac{\partial Y}{\partial K} = A \cdot (1-\theta) \cdot L^{\theta} \cdot K^{-\theta} = \frac{R}{P}$$

For a small open economy the capital's domestic rate of return equals the world interest rate under the assumption of perfect international capital mobility. Therefore, in the short term we may consider it as a constant. Taking logarithms of both above relations and noting that small letters denote logarithms, we subtract wages and interest rate equations at *t* from the same equations at *(t-1)* to get:

$$\dot{w} = \dot{a}^T + \left(1 - \theta^T\right) \cdot \left(\dot{k}^T - \dot{l}^T\right)$$

$$\dot{w} = \dot{p}^{NT} + \dot{a}^{NT} + \left(1 - \theta^{NT}\right) \cdot \left(\dot{k}^{NT} - \dot{l}^{NT}\right)$$

$$\dot{a}^T - \theta^T \left(\dot{k}^T - \dot{l}^T\right) = 0$$

$$\dot{p}^{NT} + \dot{a}^{NT} - \theta^{NT} \left(\dot{k}^{NT} - \dot{l}^{NT}\right) = 0$$

where $\dot{x} = \ln\left(X_t\right) - \ln\left(X_{t-1}\right)$

Using the four equations above we obtain:

$$\left(\dot{k}^{NT} - \dot{l}^{NT}\right) = \left(\dot{k}^T - \dot{l}^T\right) = \dot{w} = \frac{\dot{a}^T}{\theta^T}$$

$$\dot{p}^{NT} = \frac{\theta^{NT}}{\theta^T} \cdot \dot{a}^T - \dot{a}^{NT}$$

The latter relation is the already known internal transmission mechanism of the HBS effect according to which relative prices will rise in line with the rapid productivity growth in the tradables. Furthermore, the effect is greater the more labour intensive are non-tradables relative to tradables (as a general case, $\theta^{NT} > \theta^T$).

Extending the model for two countries and by applying the same rationale for the foreign country (denoted by a *) we get the relation between productivity differential and relative price differential:

$$\left(\dot{p}^{NT}-\dot{p}^{T}\right)-\left(\dot{p}^{NT*}-\dot{p}^{T*}\right)=\left(\dot{a}^{T}-\dot{a}^{NT}\right)-\left(\dot{a}^{T*}-\dot{a}^{NT*}\right).$$

The previous relation may be obtained by expressing inflation in tradables and non-tradables prices and calculating the price differential between domestic and foreign prices:

$$\dot{p}-\dot{p}*=\left(\dot{p}^{T}-\dot{p}^{T*}\right)+(1-\alpha)\left(\dot{a}^{T}-\dot{a}^{NT}\right)-(1-\alpha*)\left(\dot{a}^{T*}-\dot{a}^{NT*}\right)$$

where α ($\alpha*$) stands for the weights of tradable goods in the CPI basket in the home country and the foreign country respectively. In order to identify the relationship between the relative price differential and the real exchange rate we substitute for CPI (both domestic and foreign) in the real exchange rate identity with $\dot{p}=\alpha\cdot\dot{p}^{T}+(1-\alpha)\cdot\dot{p}^{NT}$, and $\dot{p}*=\alpha*\cdot\dot{p}^{T*}+(1-\alpha*)\cdot\dot{p}^{NT*}$ to obtain:

$$\dot{q}=\dot{e}+\dot{p}^{T*}-\dot{p}^{T}-(1-\alpha)\left(\dot{p}^{NT}-\dot{p}^{T}\right)+(1-\alpha*)\left(\dot{p}^{NT*}-\dot{p}^{T*}\right).$$

Assuming an identical CPI structure at home and abroad and that relative PPP holds for tradable goods, the previous equation boils down to:

$$\dot{q}=-(1-\alpha)\left[\left(\dot{p}^{NT}-\dot{p}^{T}\right)-\left(\dot{p}^{NT*}-\dot{p}^{T*}\right)\right].$$

Using this relationship and several others previous results we detect a direct link between the productivity differential and the real exchange rate:

$$\dot{q}=-(1-\alpha)\left[\left(\frac{\theta^{NT}}{\theta^{T}}\cdot\dot{a}^{T}-\dot{a}^{NT}\right)-(1-\alpha*)\left(\frac{\theta^{NT*}}{\theta^{T*}}\cdot\dot{a}^{T*}-\dot{a}^{NT*}\right)\right].$$

Annex 2

HYPOTHESIS TESTING FOR THE ROMANIAN ECONOMY

1. Testing the PPP hypothesis (PPP holds only for tradables sector and therefore the exchange rate is determined only by tradable goods prices).

$$S_t = P_t - P_t^* + \varepsilon_t ,$$

where:

S_t – nominal exchange rate;

P_t – domestic price level (CPI/PPI);

P_t^* – foreign price level (CPI/PPI);

ε_t – residual (real exchange rate).

Taking into account that nominal exchange rate and price levels are nonstationary series, in order that PPP holds (to be a cointegrating relationship between these variables), the real exchange rate should be stationary. Hence, testing the existence of PPP means testing the stationarity of the real exchange rate.

For testing this hypothesis, we use IPPI as a proxy for tradables prices.

According to the ADF and Phillips Perron stationarity tests, for Q1 1995 – Q1 2004, the PPP computed using the CPI index does not hold. In the case of the PPP computed using the IPPI, according to the ADF test, at 5 percent significance level, PPP holds. But it does not hold if the stationarity is tested using Phillips-Perron (Table 2.). The fact that the econometric results concerning the existence of PPP for tradables show that the HBS effect in not the only determinant of the real exchange rate.

Table 2 Stationarity tests concerning the real exchange rate

	ADF		Phillips-Perron	
	t-statistic	prob.	t-statistic	prob.
ROL/EUR (CPI) – level	-2.124	0.237	-1.356	0.592
ROL/EUR (CPI) – first difference	-3.064	0.040	-5.007	0.000
ROL/EUR (IPPI) – level	-4.091	0.015	-2.782	0.212
ROL/EUR (IPPI) – first difference	-3.891	0.005	-6.291	0.000

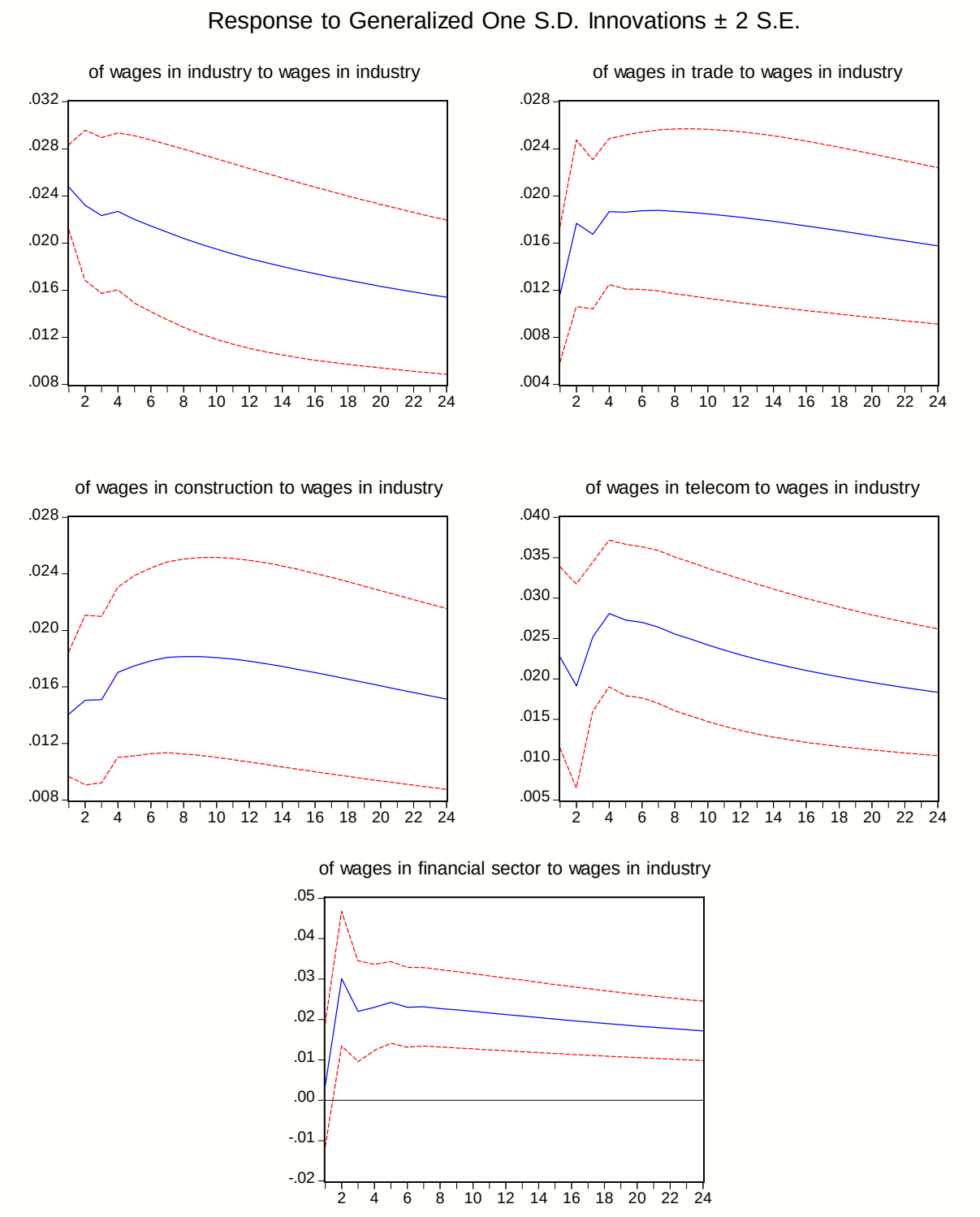
2. Hypothesis testing on the competitiveness of the labour market (wage equalisation between tradables and non-tradables sectors).

In order to test this hypothesis, wages in industry were used as a proxy for wages in tradables sector and as regards the wages in the non-tradables sector, the wages in construction, telecommunications, trade and financial sector were taken into account.

In order to highlight the transmission of a wage shock in the tradables sector to wages in the non-tradables sector, a VAR model was built using net nominal wages, seasonally adjusted, in those five sectors, using data from April 1996 to April 2004. Based on the VAR model, impulse-response functions were generated to show the impact of a wage shock in the tradables sector to wages in the non-tradables sector.

According to the results of the impulse-response functions, the nominal wages in all the non-tradables sectors taken into account respond to a shock of wages in the tradables sector (Graph 5.)

Graph 6 Response of other wages to a shock of wages in industry



Annex 3

TESTING THE HBS EFFECT FOR ROMANIA

The process consists in two steps:

- Testing the internal transmission mechanism of the HBS effect: the existence of cointegration between relative prices (the ratio between non-tradables and tradables prices) and labour productivity – an increase in the labour productivity should be accompanied by an increase in relative prices.
- Testing the external transmission mechanism: cointegrating relations between labour productivity differential, relative price differential and real exchange rate (computed using the CPI) – a larger increase in domestic labour productivity compared with foreign labour productivity leads to an increase in the relative price differential which will determine a real appreciation of the domestic currency.

As a proxy for relative prices, the ratio between CPI for services and PPI was used and as a proxy for total factor productivity, the productivity in industry was used.

According to Johansen cointegration test, for Romania, between Q1 1994 – Q1 2004 there is a cointegrating relation between relative prices and labour productivity in industry (the internal transmission mechanism) and the coefficient of the labour productivity is positive (Table 3)

Table 3 Cointegrating equation between relative prices and labour productivity in industry

Cointegrating Eq:	CointEq1
REL_PR_RO(-1)	1.000000
L_PROD_RO_SA(-1)	-3.146349 (0.45231) [-6.95613]
C	15.45004

For testing the external transmission mechanism for HBS effect between Romania and Eurozone, between Q1 1995 – Q4 2003, two methodologies were used:

- Building a VEC model with the following variables: productivity differential between Romania and Eurozone, relative price differential and real ROL/EUR exchange rate (computed using the CPI);
- Testing, using bivariate VEC models, for the existence of cointegrating relations between productivity differential and relative price differential and between relative price differential and real exchange rate.

According to the multivariate VEC model, there are two cointegrating equations which are consistent with the transmission mechanism of the HBS effect: a cointegrating equation between the productivity differential and the relative price differential, and a cointegrating equation between the relative price differential and the real exchange rate (Table 4).

Table 4 Cointegrating vectors of the VEC model

Cointegrating Eq:	CointEq1	CointEq2
RER_EUR(-1)	1.000000	0.000000
DIFF_PROD_RO_EU(-1)	0.000000	-5.362524 (1.58659) [-3.37991]
DIFF_RELPR_RO_EU(-1)	0.682498	1.000000
	(0.05330) [12.8042]	
C	-3.193838	0.341596

According to the second methodology, there are cointegrating equations between productivity differential and the relative prices differential and between the relative prices differential and real exchange rate (Table 5).

Table 5 Bivariate cointegrating equations

Cointegrating Eq:	CointEq1
DIFF_RELPR_RO_EU(-1)	1.000000
DIFF_PROD_RO_EU(-1)	-6.646758 (1.35573) [-4.90271]
C	0.479721

Cointegrating Eq:	CointEq1
RER_EUR(-1)	1.000000
DIFF_RELPR_RO_EU(-1)	0.603496 (0.09672) [6.23939]
C	-3.178460

Annex 4

ESTIMATION OF THE HARROD-BALASSA-SAMUELSON EFFECT IN ROMANIA

The HBS effect was computed using both methodologies used for its testing and using both the effective series and their trend (computed by Hodrick Prescott filter) for productivity differential (Table 6). In quantifying this effect, the weight of non-tradables prices in CPI basket was also taken into account (the average for the entire period was 13.5%).

Table 6 HBS effect on real exchange rate

Year	HBS effect		HBS effect (using Hodrick-Prescott filter)	
	multivariate VEC	bivariate VEC	multivariate VEC	bivariate VEC
1995	-2.843	-3.116	-0.312	-0.342
1996	-2.664	-2.919	0.039	0.043
1997	3.938	4.316	0.402	0.440
1998	5.679	6.224	0.030	0.032
1999	-2.468	-2.705	-0.988	-1.083
2000	-3.297	-3.614	-2.316	-2.538
2001	-7.175	-7.864	-3.261	-3.574
2002	-4.302	-4.715	-3.443	-3.773
2003	0.067	0.073	-3.447	-3.778
Total	-10.646	-11.668	-11.754	-12.882
Annual average	-1.452	-1.591	-2.691	-2.949

Using the same methodology, the impact of the HBS effect on inflation differential was computed. Taking into account the fact that the weight of non-tradables prices in CPI basket is small, the inflation differential between Romania and Eurozone due to HBS effect is between 1.7 and 2.4 pp per year over 1995 – 2003 (Table 7).

Table 7 HBS effect on inflation differential

Year	Inflation differential		Effective inflation differential, explained by:		Hodrick-Prescott trend inflation differential, explained by:	
	Effective	Hodrick-Prescott trend	VEC model	Bivariate model	*VEC* model	Bivariate model
1995	16.019	39.798	4.165	5.163	0.457	0.566
1996	38.574	53.147	3.903	4.837	-0.058	-0.071
1997	94.621	51.377	-5.770	-7.151	-0.589	-0.730
1998	35.457	46.219	-8.321	-10.314	-0.043	-0.054
1999	41.058	39.539	3.617	4.483	1.448	1.794
2000	32.371	32.713	4.831	5.988	3.393	4.206
2001	24.628	26.740	10.513	13.031	4.778	5.922
2002	14.640	22.571	6.304	7.813	5.044	6.252
2003	11.789	20.666	-0.098	-0.122	5.051	6.260
Total	309.158	332.770	15.599	19.334	17.221	21.346
Annual average	34.351	36.974	1.733	2.148	1.913	2.372