



THE WILLIAM DAVIDSON INSTITUTE  
AT THE UNIVERSITY OF MICHIGAN BUSINESS SCHOOL

***Dual Inflation Under the Currency Board:  
The Challenges of Bulgarian EU Accession***

*By: Nikolay Nenovsky and Kalina Dimitrova*

William Davidson Working Paper Number 487  
July 2002

# Dual Inflation under the Currency Board

## The challenges of Bulgarian EU accession

Nikolay Nenovsky\*  
Kalina Dimitrova\*

**Abstract:** The importance of analysing inflation sources and dynamics in Bulgaria is imposed by (i) the long run process of price and inflation convergence to the Euro area and (ii) by the Currency Board operating in the country. In this study we make an attempt to estimate Balassa - Samuelson (BS) effect in Bulgaria (after the introduction of the Currency Board). The BS explanation of inflation (or dual inflation) has acquired both academic recognition and popularity in practice in the recent years. The results of our empirical estimation do not provide a robust verification of the existence of BS effect in spite of the observed prerequisites and the accompanying economic indicators interrelations. Actually there are several factors that interfere with the BS effect lying in the wage convergence process in both sectors and others that influence productivity developments in the sectors. This prompts that the price movement in the country has other driving motions – above all wage setting and incomplete price liberalization, other factors productivity, imported inflation (pass through) and inflation generated by the temporary gaps between money demand and money supply.

**JEL classification:** C 22, E 24, E 42, F 15.

**Keywords:** inflation, currency board, EU accession, Bulgaria

---

\* Nikolay Nenovsky (Bulgarian National Bank, Sofia University of National and World Economy and University of Orleans, France), ([nenovsky.n@bnbank.org](mailto:nenovsky.n@bnbank.org) or [nenovsky@mail.netplus.bg](mailto:nenovsky@mail.netplus.bg)); Kalina Dimitrova (Bulgarian National Bank), ([dimitrova.ka@bnbank.org](mailto:dimitrova.ka@bnbank.org)). We would like to thank for the comments on the first version to Georgi Petrov, Neven Velev, to the participants at University of Orleans (LEO) seminar held on 12 March 2002, and especially to Philippe Saucier, Jean-Baptist Desquilbet, Raphaelle Bellando and Patrick Villieu. And for the comments of the revised version of the paper, we thank all participants of the workshop on convergence held at the University of Thessaly, Volos on 22 June 2002.

## I. Inflation on the long way to EU accession

The process of catching-up of the Bulgarian economy and of its nominal convergence to the euro area is connected mainly with price level convergence of accession countries. In general this implies higher inflation rates as well as relatively quick adjustments in the structure of relative prices. However such dynamics faces a conflict with a part of the *formal* membership criteria and with the choice of a hard monetary regime like the currency board (CB) as well. The problems and respectively the questions that emerge from the “*triangle of inconsistency*” (the CB, catching-up process and Maastricht criteria) can be stated in the following way:

(i) Do catching-up processes lead to appreciation of the real exchange rate (hence to low competitiveness of the Bulgarian export) especially when the nominal exchange rate is extremely rigid (fixed by law)? Answering this question, we have to study the impact of all aspects of the convergence process on the dynamics of the real exchange rate in Bulgaria and see whether it is depreciated or appreciated taking into account its possible initial depreciation before its pegging. And eventually, if the exchange rate is appreciated, is the CB as a monetary regime compatible with the “optimal” transition process? Furthermore, is the CB (providing price stability) compatible with the catching-up process requiring price level increase?

(ii) And while the CB and Maastricht criteria are on the side of low inflation, is it possible to comply with the nominal membership criteria (Maastricht criteria) and with the catching-up process<sup>1</sup> at the same time? This question tackles even the broader theoretical aspect of convergence. Whether different long run equilibrium paths of price levels and nominal interest rates exist for member and applicant countries or not? And if they exist, every group would follow its own equilibrium trend (steady state). In spite of the technology transfers and production factors flows, as stated by the neoclassical growth theory different groups of countries converge to different levels of their

---

<sup>1</sup> Art.121 of the Protocol and ECOFIN (2000). The problem was discussed recently by Buitter and Grafe (2001) and Szapary (2001).

fundamental variables (Jones, 1998)<sup>2</sup>. Moreover, many research papers on the topic suggest that the nominal and particularly the real catching-up process of Eastern European countries will take a lot of time (Fischer and al., 1998, Kolodko, 2000). In this framework, we think that it would be more appropriate to speak of some *reasonable* levels of convergence between the two groups and not in the context of *absolute and unconditional* convergence?<sup>3</sup>

(iii) What are the *sources of inflation* under the CB arrangements? Which factor dominates – monetary, real or the imported inflation? How the CB influences the relative prices' structure i.e. the *microfundamentals* of inflation? What is the role of labor productivity (particularly of the tradable and non-tradable sectors) in the real exchange rate movement?

(iv) What should be the *optimal price growth rate* in Bulgaria? Suppose we reached the agreement that the prices in the country should rise higher than those of the euro area by  $x$  % (given that the BS effect exists and its estimation is valid<sup>4</sup>). And the question of the optimal level of euro area prices arises (in some assessments it is higher than the observed and targeted level by the European Central Bank (ECB), Wyplosz, 2000). If the euro area rate is 4-5%, the optimal inflation rate in Bulgaria would be  $[4-5 + x]$  % i.e. it is significantly higher than the level we experienced in the recent years in the country. In the light of the above argument, how could the inflation dynamics under the CB in Bulgaria be interpreted when there were years of low inflation (1% in 1998), as well as months of deflation (see. figure 1)?

(v) Does the catching-up process favor the theory of *endogenous* currency area where real economy integration starts with a common currency? To some extent, the CB

---

<sup>2</sup> It is known that the price levels in the EU (Ireland is an indicative example – see. Artus, 2001), and in the different states of USA are significantly divergent (Kim, 1997).

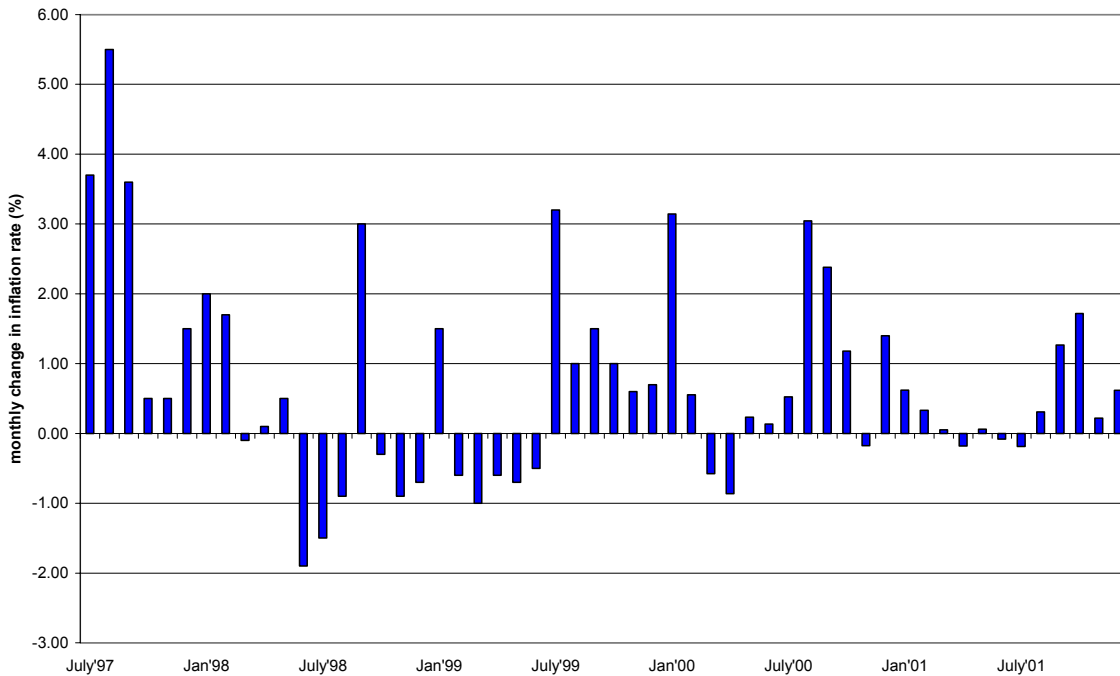
<sup>3</sup> The impossibility and even the dangerous side of inflation convergence prior to the monetary integration were stressed previously by De Grauwe (1992, 1995), Bayoumi and Masson (1995). See also Kocenda and Papell (1997) and Kocenda, (2001).

<sup>4</sup> It is very difficult to measure accurately and predict *ex ante* BS effects (Brada and Kutan, 2001)

itself can be interpreted as an application of this theory since the legally pegged exchange rate is *de facto* a common currency (composite good in Hicks's terminology).

(vi) Is it necessary to debate on the optimal price level when after all under the circumstances of the CB monetary authorities have *no influence on inflation* (since Balassa-Samuelson effect is an *equilibrium* phenomenon)<sup>5</sup>? In fact they can just observe it and cannot change it through monetary policy instruments and operations.

**Figure 1. Inflation Dynamics under the CB in Bulgaria**



Source: NSI.

To answer the above questions at least partially, we have chosen the following structure. In *Section 2* we will point out all sources of inflation under the CB in the process of accession. We will stress particularly on the BS explanation focusing on its specificities in the transition economy. This is the section where we present the empirical

---

<sup>5</sup> The focus of the impact on inflation is moved onto the fiscal policy.

methodology of BS measurement. *Section 3* presents the results of the empirical tests, and in the *final section* we will make some conclusions about the economic policy in Bulgaria and draw directions of future theoretical and empirical studies.

## **II. Sources of inflation under the CB**

### **1. Theoretical grounds**

Altogether the sources and dynamics of inflation in transition countries have been studied over and over in a long period of time focusing on different approaches: monetary-fiscal explanation of inflation (Dornbusch, 1991), structural explanation concerning the process of transition (Commander and Coricelli, 1991, Bauer, 1991, Blanchard and al., 1995), struggle between groups of different interests (Olson, 2000), purely fiscal explanation in the spirit of the fiscal theory of price level (Komulainen and Pirttila, 2000), dual or productivity-generated inflation (Arratibel and al., 2001, Dobrinsky, 2000, Pelkmans and al., 2000, Egert, 2002, Backe and al., 2002), structural synthesised model including the pass-through effect (Nenovsky and al., 2000, Darvas, 2001) among others<sup>6</sup>.

Nevertheless there are not many studies on inflation in transition countries under the CB arrangement and especially for Bulgaria<sup>7</sup>. Usually such analyses concentrate on the real sources of inflation expressed in the BS effect or pass-through effects. When inflation under the CB is studied, several questions should be concerned. The first question is whether and what kind of *monetary sources of inflation* exist. If there is monetary generated inflation, then what part of it is natural and what is caused by the deliberate or unconscious activities of the monetary authorities (in spite of the imposed constraints by the CB)? It is logically assumed that the natural levels of inflation can be bound to the temporary disequilibria of money supply and demand, which are connected

---

<sup>6</sup> In the last 2-3 years several research papers were written on the general convergence of Central and Eastern European countries to the EU (see Brada and Kutan, 2001, Kocenda, 2001, Weimann, 2001, Kutan and Pautola-Mol, 2002 and Halpern and Nemenyi, 2002 among others).

<sup>7</sup> For Estonia (Saarniit and al., 2000) and Lithuania – (BoL, 2000).

with the disequilibria of the non-tradable goods market (Hossain and Chowdhury, 1998 and Nenovsky and al., 2000).

The irrevocable pegging of the exchange rate upon the introduction of the CB eliminates in principle any purposeful independent monetary policy and results in the creation of an asymmetric monetary union<sup>8</sup> between the country practicing the CB and the country which currency is used for reserve currency. What is typical for the CBs established in the 90-ies is that they preserve some monetary policy instruments of the traditional central bank (Nenovsky and Hristov, 2002). These peculiarities in the design of the Bulgarian CB allow for some *short periods* the monetary conditions in the country to deviate from the ones in the euro area in spite of the common monetary policy. For instance, the Bulgarian National Bank took a decision to decrease the minimum required reserves in July 2000 from 11% to 8% in a period when the ECB (the institution setting externally our monetary policy) was pursuing a steady policy of increasing interest rates<sup>9</sup>. Another example for the impact on liquidity in the economy is the forthcoming introduction of the *RTGS* (in the second half of 2002) that could be interpreted as a technological innovation in money supply dynamics.

These periods of deviation of monetary conditions in the country from the ones in the euro area may not be long-lasting due to the existing mechanism of automatic convergence. The speed of neutralization of these differences is determined by the degree of integration of the Bulgarian banking system in the European one. In the case mentioned above, the Bulgarian commercial banks increased their foreign assets by restructuring their portfolios and to a great extent neutralized the differences between the

---

<sup>8</sup> The asymmetric nature of such a monetary union is expressed in the fact that the two countries have a common monetary policy in which decisions are made unilaterally by the country(s) whose currency is used as a reserve currency. Commercial banks in the country practicing the CB have no access to refinancing by the central bank pursuing the common monetary policy. This peculiarity influences the monetary policy transmission mechanism. The existence of this feature is to a great extent determined by the structure of the banking system of the country under the CB arrangement. The more integrated the national banking system of the CB country is in the financial system of the monetary union, the weaker the impact on the transmission mechanisms is. Usually the banking systems of countries practicing the CB are dominated by foreign banks, which have access to refinancing by the central bank conducting the common monetary policy.

<sup>9</sup> For the period from November 1999 to October 2000, the European Central Bank has increased interest rates by 225 basis points.

monetary conditions in Bulgaria and in the euro area. Under the CB, it is logical that there are no conditions for a *long-term* deviation of the monetary conditions in the Bulgarian economy from the ones in the euro area<sup>10</sup>. In other words, there are no *long-term* monetary sources of inflation in the Bulgarian economy as far as there are no such factors in the euro area.

However, the existence of a common monetary policy within the asymmetric monetary union does not preclude the possibility of occurrence of an inflation differential within this union. Although there is a common monetary policy (and we could also say a common currency, as the irreversible pegging of the exchange rate reduces exchange rate risk<sup>11</sup> dramatically) a number of microeconomic and structural differences remain. We could mention some like the difference in the degree of development of the economies, in the economic and industry structure, in the rates of growth, the structure of corporate governance, government tax policy, customs duties and expenditures<sup>12</sup>, the structure of goods and labor market etc.

The flexibility of the *labor market* is of particular interest in its relation to price dynamics and monetary regime stability: ways of setting salaries, flexibility of the general level and of relative real salaries, flexibility of employment contracts, working time flexibility, mobility of labor, etc.<sup>13</sup>. In a recent research comparison of the rigidity indices of real wages between Bulgaria and several developed countries the figures prove that the Bulgarian labor market is more rigid than the EU one, although certain

---

<sup>10</sup> Of course, short-term disproportions could exist between money supply and demand, due to a shock (innovation) in the money supply. In this case, economic agents are turning their real money stocks to the ones they would like to have after a certain lag. In annex 1 we discuss a model where temporary disproportions between money supply and demand are related to the non-tradable goods sector.

<sup>11</sup> It could be questioned here the argument that the pegging of the exchange rate at the time of introduction of the currency board eliminates exchange rate risk, as the level of pegging may be changed by the country's Parliament (Nenovsky and al., 2002). In establishing the monetary union, exchange rates are irrevocably fixed. For a discussion on this subject, see Berg and Borensztein (2000).

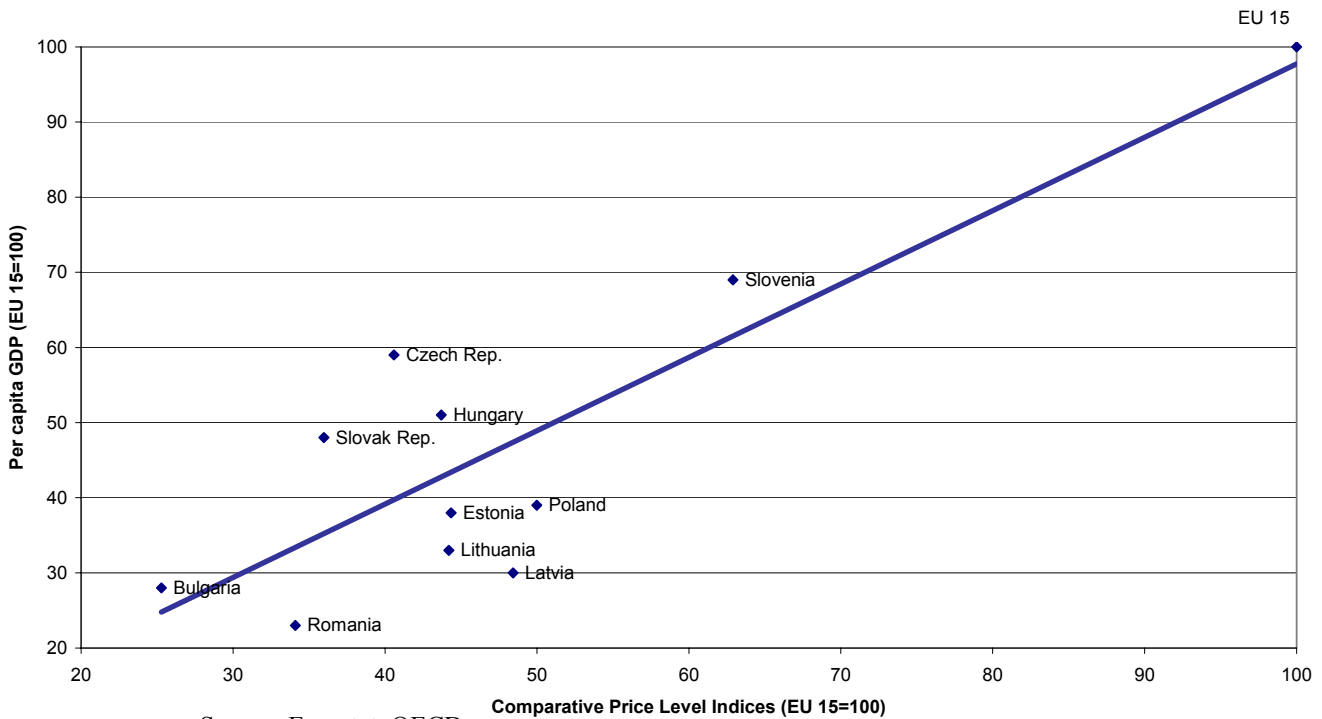
<sup>12</sup> Komulainen and Pirttila (2000) apply the fiscal theory approach to inflation in transition economies including Bulgaria.

<sup>13</sup> See Soltwedel and al., 1999. Real wages are considered to be more flexible where unemployment exerts a strong pressure on "equilibrium" salaries (Berthold and al., 1999).



improvement is evidenced after the introduction of the CB (see. Annex 3)<sup>14</sup>. The overall rigidity of real salaries leads to an increase of inflation by hindering the BS effect (which will be discussed later in the paper). The strong BS effect is limited by the fact that real wage rigidity is higher in the tradable sector (industry) than in the non-tradable sector (represented by services).

**Figure 2. Income and price convergence (at 2000)**



Source: Eurostat, OECD.

In general, the above-mentioned real factors have their effect on relative prices between the countries participating in a monetary union, and may generate long-lasting inflation differentials. As illustrated in figure 2, there is a considerable gap in the degree of economic development and price levels between the group of countries applying for EU (and later on for EMU membership) and the EU and further difference is obvious among the candidate countries themselves. The real convergence of the candidate

<sup>14</sup> The assessment is taken from the research of Nenovsky and Koleva (2001).

countries to the euro area members is expressed in a gradual elimination of these differences even after becoming a part of the EU (and EMU)<sup>15</sup>. With the increasing degree of integration into the EU, the applicant countries will catch up with the EU income levels. This is a long-term process, which will determine specific inflation differentials given the level of national income and its growth rates of each accession country (see. table 1 and table.2)<sup>16</sup>.

**Table 1. Inflation Differential (BG-EU15)**

	1995	1996	1997	1998	1999	2000	2001
annual average percentage change in inflation rate							
EU-15	2.8	2.4	1.7	1.3	1.2	2.1	2.4
BG	69.1	116.6	1268.0	46.3	0.4	10.1	7.5
Inflation Differential	66.3	114.2	1266.3	45.0	-0.8	8.0	5.1

Source: WIIW.

**Table 2. Real growth rate of GDP (%)**

	1996	1997	1998	1999	2000	2001
Eu-15	1.6	2.5	2.9	2.6	3.3	1.5
Bulgaria	-10.1	-7	3.5	2.4	5.8	4.0
Growth Differential	-11.7	-9.5	0.6	-0.2	2.5	2.5

Source: WIIW.

In the following section we will concentrate on the BS effect, which is conventional and one of the widely accepted explanations of inflation processes in the accession countries.

<sup>15</sup> The catching-up process is still on the agenda of EU (and particularly of EMU) member countries which experience different inflation rates due to price level convergence (see. ECB, 1999).

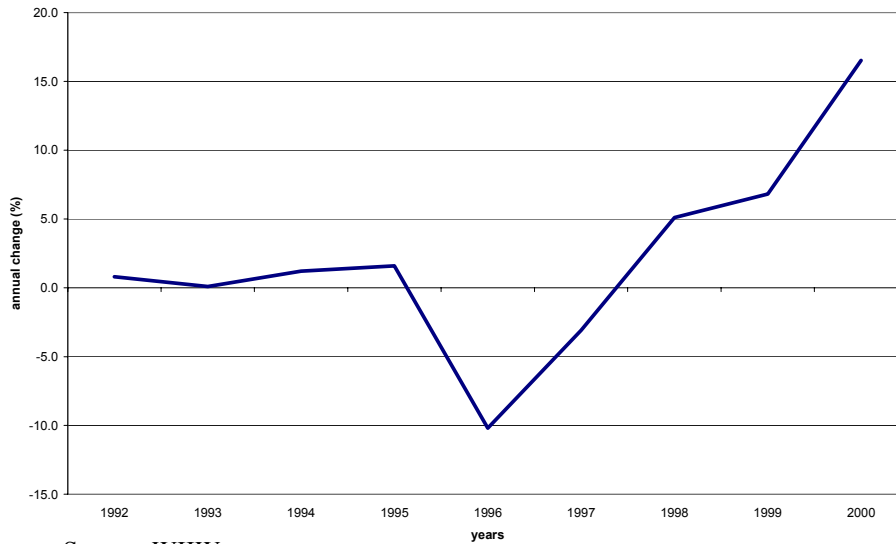
<sup>16</sup> For a detailed presentation of real convergence mechanisms see also Barro and Sala-i-Martin (1992), Kim (1997), Razin and Yuen (1995).

**2. Dual Inflation – summery and discussion**

In theory, the most popular explanation of the price convergence processes involves the productivity-based inflation known as dual inflation or BS effect, (Arratibel and al., 2001, Halpern and Wyplosz, 2001, Egert, 2002 and Backe and al., 2002 among others)<sup>17</sup>.

Low price levels in poorer countries are determined by the lower production capacity in the sectors producing tradable goods. Prices of tradable goods (primarily industrial ones) are determined on the international markets, while prices of non-tradables (mainly services) are determined at the local markets. The production capacity in the sectors producing non-tradable goods is relatively close in both countries of low and high per capita income. The low productivity of tradable goods in poorer countries reflects on the low salary levels in the sector and on the low prices of non-tradable goods, and hence low overall price levels. This is the static theoretical picture of the BS effect (i.e. *BS effect in levels - static BS*).

**Figure 3. Labor productivity in Bulgaria**



Source: WIIW

<sup>17</sup> While Balassa focuses more on salaries and production capacity in the tradable and non-tradable sector in the developed and developing countries, Samuelson discusses the same processes from the point of view of production factors' movements (labour and capital). For more details see Bartolini (1995), Benaroya and Janci (1996), ECB (1999), Busson and Villa (1996), Aglietta and al. (1998), Couder (1999).

**Table 3. Labor productivity growth rates (annual change, %)**

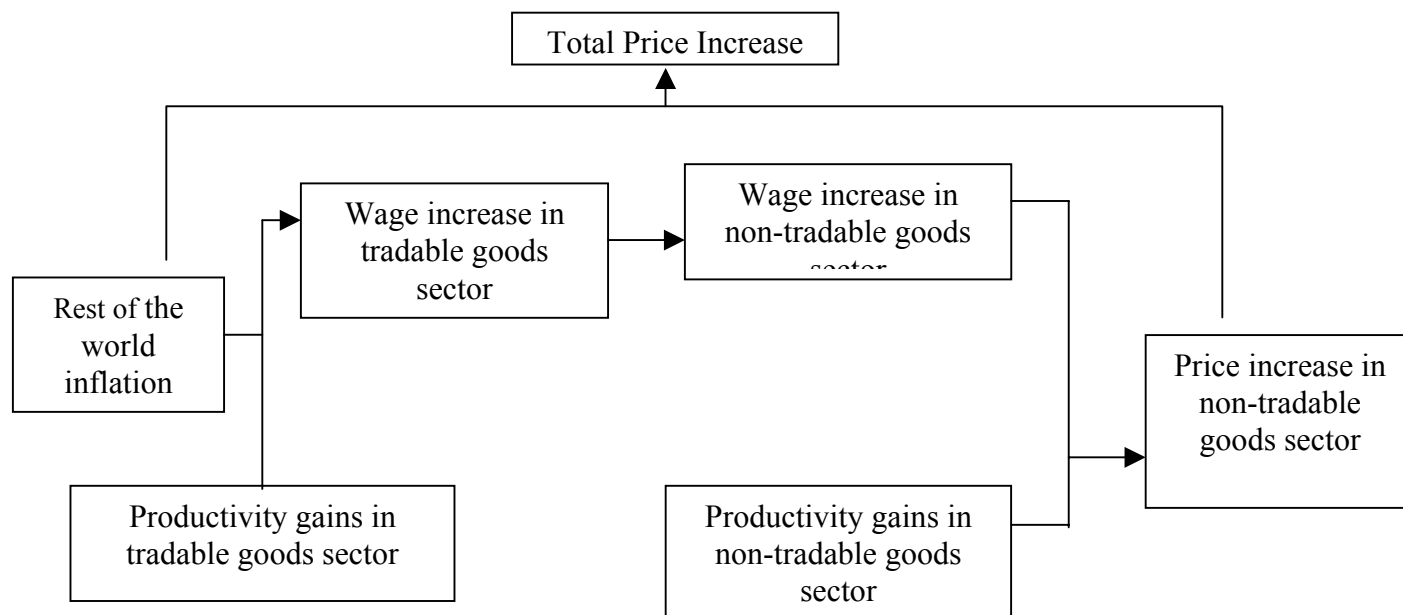
	1995	1996	1997	1998	1999	2000
EU-12	1.6	1.0	1.6	1.2	1.0	1.4
Bulgaria	1.6	-10.2	-3.1	5.1	6.8	16.5
Differential	0.0	-11.2	-4.7	3.9	5.8	15.1

Sources: WIIW, Eurostat.

If considered from the dynamic point of view, the BS effect means that countries featuring higher growth rates will have higher inflation rates (*dynamic BS*)<sup>18</sup>, see figure. 3 and table 3. This is accounted for by the fact that the production capacity in the tradable sector of the developing countries grows relatively faster than the one in the non-tradable sector, while salaries in both sectors tend to get equal. Thus, the growth rates of the general price level in the developing countries are higher than in the developed ones. Taking into consideration the fact that production capacity level in Bulgaria is much lower than the one in the EU countries and that rates of production capacity in Bulgaria are increasing, it is normal for the general price level to grow considerably faster than in the EU. The dynamic BS effect is illustrated in the following chart.

---

<sup>18</sup> Concerning the difference between the static and dynamic form of the BS effect, see Busson and Villa (1996).

**Chart 1. Model of Inflation - dynamic BS affect**

The stance of pre-accession economies is characterized by a number of features, which cause many problems not only in the BS effect estimation but in its clear detection as well. Various factors have different impact on the BS effect, making it either stronger or weaker. Let's point out some of them<sup>19</sup>.

*First of all*, the time of centrally planned economy is distinguished for the repression and low productivity in the services sector. The labor in the sector was not regarded as productive one<sup>20</sup> and it was not included in the produced national income (concept used in the socialist accounting instead of GDP). As a consequence of the recovering of the sector during the transition, high productivity rates are evident while the BS effect implies that productivity of the services sector does not exceed the productivity of industries (Busson and Villa, 1996). As a whole, this transition specificity reflects into a weaker BS effect.

<sup>19</sup> See for example Aglietta and al. (1998), Frensch (2001), Cheung and Lai, (2000), Brada and Kutan (2001).

<sup>20</sup> The definitions of productive and non-productive labor were typical for the centrally planned economy and used in Marxist terminology.

*Second*, the BS effect is mitigated by arbitrary liberalized price of main services during the transition period. In this respects market forces do not determine the principal part of the service price behavior. In this case, BS effect has a weaker influence on relative price adjustments.

*Third*, we should point out that we use labor productivity in stead of total factor productivity, which determines the prices of different goods and services, and thus we inevitably put some limits on the estimation of the BS effect. During the transition industrial structures were privatized. The tradable sector demands essential, productivity increasing investments. Further, industries gradually adjust to new technologies and new quality and standards of production and thus resulting in additional price increase of tradable goods. In this case dual inflation is weaker.

In the *fourth place*, labor markets in ex-planned economy is quite rigid (see annex 3), industrial workers are considerably high qualified and it is hardly likely for low qualified employees from the services sector to get the higher real salaries of all in the tradable sector. The real wages in the industry sector are much more rigid than the wages in the non-tradable sector and we could expect that wages might not converge across the sectors or get equal with the time. Moreover, if wages are not market determined, productivity formation of the wages in the tradable sector does not hold. This puts some constraints on the existence of the BS effect.

*Fifth*, according to "the cost recovery hypothesis" (Aglietta and al., 1998, Ross, 2000) in the post-stabilisation period the prices of liberalised services are striving to incorporate capital expenses, which have been inherited free of charge from the state.

*Sixth*, there are also some microeconomic factors and government policies that cause deviations from the 'law of one price' (LOOP), which should hold in the case of tradable goods. There are differences in the local (national) expenditures on non-tradable goods and services (transport expenses, on local level, availability of offices, storing facilities, etc.), differences in the customs tariffs and taxes, (which reflect in various prices of identical goods in different countries), and the mark-up differences among

countries determined by market segmentation and competitiveness<sup>21</sup>. The policies of price control and protection of industries producing tradable goods pursued by governments leads to violation of the LOOP and consequently to weaker (if any) BS effect.

There is a series of research papers studying the BS effect in Central and Eastern European countries. For instance, IMF (2000) estimates the effect for Slovenia of 2.5% percent per annum. According to the precise estimates of Pelkman and al. (2000), BS effect of around 3.5-4% is observed among the candidate countries. Simon and Kovacs (1998 and 2000) estimate the BS effect for Hungary at 1.9 percent per year during the period 1991-1998. According to Arratibel and al., 2001, the BS effect in five Central European countries is about 1-3% and it could be explained by a half of the inflation differential between the Euro area and these countries. More recently Egert (2002) estimated BS effect to be close to zero for the Czech republic, Slovakia and Slovenia, and around 1% and 3% for Hungary and Poland (the period of investigation is 1991:Q1 to 2001:Q2). In some of those papers, Bulgaria is included in the general conclusion of positive BS effect existence. However, up to the moment there is no direct econometric estimation for Bulgaria.

### **3. *Empirical foundations of the estimation of dual inflation under the CB***

In this paper we try to evaluate the BS effect in Bulgaria. Our estimation could be seen as an attempt to contribute to the discussion about the BS effect, which in some aspects is crucial for accession countries with fixed exchange rates. It is not a coincidence that recently Van Duisenberg said in his speech that "...what is known as the "Balassa-Samuelson effect", that is, the potential inflationary pressures arising from higher productivity growth in catching-up economies, has also been held responsible for higher

---

<sup>21</sup> See Dobrinsky (2000).

inflation in accession countries. However, research has shown that this effect should not be overestimated<sup>22</sup>.

Practically there are some preliminary steps that we will take for the estimation of the BS effect. The *methodology* we use is very similar to the one approved by Halpern and Wyplosz, 2001.

Step 1. The economic branches are grouped into two sectors: tradable and non-tradable. Productivity indices are formed for the tradable and non-tradable sectors in Bulgaria<sup>23</sup>. There is space for a third sector of semi-tradable goods. For instance De Broek and Slok (2001) outlined agriculture as an independent sector since it is known to be a “mixture of tradable and non-tradable activities” in the accession countries. Despite the great number of methodological studies (De Gregorio and al., 1994), there are no clear quality criteria for differentiating between tradable and non-tradable sectors so far.

Step 2. Productivity dynamics in both sectors is examined; we check which one is higher and whether they tend to get close to each other. According to the BS effect, productivity in the non-tradable sector is expected to be lower and/or to increase considerably slower.

Step 3. The process of wage convergence in both sectors is studied as a prerequisite for the presence of the BS effect.

Step 4. Price indices for the sectors are found and their movements are observed<sup>24</sup>.

Step 5. After analyzing the prerequisites of the BS effect existence, we proceed with the new direct estimation based on the following regression (1) (see for details De Gregorio and al., 1994).

---

<sup>22</sup> Speech by Dr. Willem F. Duisenberg, President of the European Central Bank, at the Frankfurt European Banking congress, at the Alte Oper in Frankfurt am Main, 23 November 2001.

<sup>23</sup> It is possible to estimate the BS effect in a two – country model (two zones). In the case of Bulgaria and in the context of convergence it is more appropriate to make a comparison with the EU (or Germany). See. ECB (1999).

<sup>24</sup> Productivity dynamics of prices and wages in both sectors can be estimated by different econometric techniques (simple regression, cointegration, VAR model) or can be described by common statistical features of the series (correlation between levels and rates).



$$(1) \quad \log\left(\frac{PNT}{PT}\right)_t = \alpha_0 + \alpha_1 \left( \frac{\lambda_{NT}}{\lambda_T} \log QT - \log QNT \right)_t + d_t,$$

where PNT and PT are the prices in the non-tradable and tradable sector respectively, QNT and QT are the corresponding productivity in the sectors,  $\lambda_{NT}$  and  $\lambda_T$  are the share of labor, in respectively, the non-tradable and tradable sector, and  $d$  is a vector of different demand factors like income, government expenditures and etc. If BS effect exists, the regression coefficient in front of QT should be positive, i.e. it should exert much influence on the values of  $\left(\frac{PNT}{PT}\right)$ , and the coefficient in front of QNT – negative and respectively should cause a decrease of  $\left(\frac{PNT}{PT}\right)$ . As the ratio  $\left(\frac{PNT}{PT}\right)$  is considered as an *internal real exchange rate*, an increase in the tradable sector productivity brings real appreciation of the exchange rate. On the contrary, an increase in the non-tradable sector productivity leads to real depreciation of the exchange rate. From equation (1) it is expected that the productivity of the tradable sector should have a “stronger” sign in the econometric estimation because non-tradable sector is more labor intensive which is in compliance with the contribution made by Paul Samuelson ( $\frac{\lambda_{NT}}{\lambda_T} > 1$ ). In the limits of equation (1),  $\alpha_1$  parameter can be tested as the econometric estimation of the coefficient in front of log QT is divided by the ratio  $\left(\frac{\lambda_{NT}}{\lambda_T}\right)$ .

### III. Econometric results of the BS effect estimation. Interpretation.

#### 1. Data description

The econometric estimation is conducted on the basis of *monthly data* in the period between July 1997 (the introduction of the CB) and December 2001, i.e. 54

observations in total. The period under survey is long enough to capture some cause-and-effect regularities in the inflation dynamics under the new monetary system.

In order to check the rate of price convergence and whether BS effect exists in Bulgaria or not, we need productivity indicators for the tradable and non-tradable groups. In the process of achieving high level of international statistical comparability, the data provided by the Bulgarian National Statistical Institute is primarily based on Eurostat methodology. However, some econometric estimations have not included Bulgaria on the ground of data unavailability or data unreliability (see. Backe, and al., 2002 ).

For defining the sectors as tradable and non-tradable we use a common approach applied by most studies on the subject where industry is regarded as tradable and services as non-tradable sector. However, there are some more specific criteria like the one used by De Gregorio and al., 1994 who treat a sector as tradable if more than 10% of its production is for export.

#### *Data on production, salaries and employees*

The production indicator is represented by the gross output from the quarterly national accounts by industry, services and agriculture sectors. According to the National Statistical Institute (NSI) methodology CPI structure corresponds with the definitions of the National Accounts system in relation to personal consumption and range. Since monthly data for the production of the non-tradable sector is not available (we could find a proxy for the tradable sector), we apply an econometric interpolation method for obtaining high frequency data keeping the fundamental variables' development.

Average monthly salaries and total number of employees are reported every month in a wide range of economic activity. In order to acquire data for industry and services we apply some aggregation techniques (see annex 2). *Tradable* sector (industry) includes employed people in mining and quarrying, manufacturing (15 branches), electricity, gas and water supply and construction while *non-tradable* (services) represent employees in trade, repairing activities, hotels and restaurants, transport, communication, financial intermediation, real estate and renting activities, research and development and other business activities, public administrations, compulsory social security, education,

health and social work, veterinary activities, non-government organizations activities, sewage and refuse disposal, sanitation and other services, cultural activities and recreational and sporting activities. Salaries are calculated with weights of the employees for the respective classification group in the whole number of the sector to which the branch belongs.

*Data on prices*

The structure of the CPI in Bulgaria is a national analogue of the international classification of consumers' expenditure known as COICOP (Classification Of Individual Consumption by Purpose) and it covers the structure of Harmonized Index of Consumer Prices (HICP). It is introduced in the end of 1996 and it constitutes a unique set of information since it is a homogeneous indicator for the comparison of inflation dynamics among accession countries as well as vis-à-vis the euro area.

As in other empirical studies, a first difficulty arises when trying to distinguish between tradable and non-tradable goods and services, as the different item categories included in the HICP cannot always be easily identified as tradables and non-tradables. In a recent research paper (Arratibel and al., 2001) the categories of HICP are classified in the following way without much loss of accuracy. Tradables are composed of food and non-alcoholic beverages, alcoholic beverages and tobacco, clothing and footwear and furnishings, household equipment and routine maintenance of the house. Non-tradables are composed of health, communication, recreation and culture, education, restaurants and hotels, and miscellaneous goods and services.

Since 1998 the Agency of Economic Analysis and Forecasts (AEAF) has developed a classification of the goods and services of the consumer bundle in three groups: tradable, potentially tradable and non-tradable. The criteria for distinguishing between tradable and potentially tradable goods are the administrative and transport barriers. "Pure import", later on called tradable goods, consists of goods with duty tax lower than 25% and no transport barriers while "broad import" comprises of goods that are subject only to administrative barriers and they represent the potentially tradable

ones<sup>25</sup>. In this study we are not making a separation between those groups but rather put them in a group, which we consider as tradable. The non-tradable group comprises primarily of services.

## ***2. Measuring the BS effect***

As we have already pointed out (in section 2) before the direct econometric estimation of BS effect existence, we make a preliminary verification of its basic analytical components.

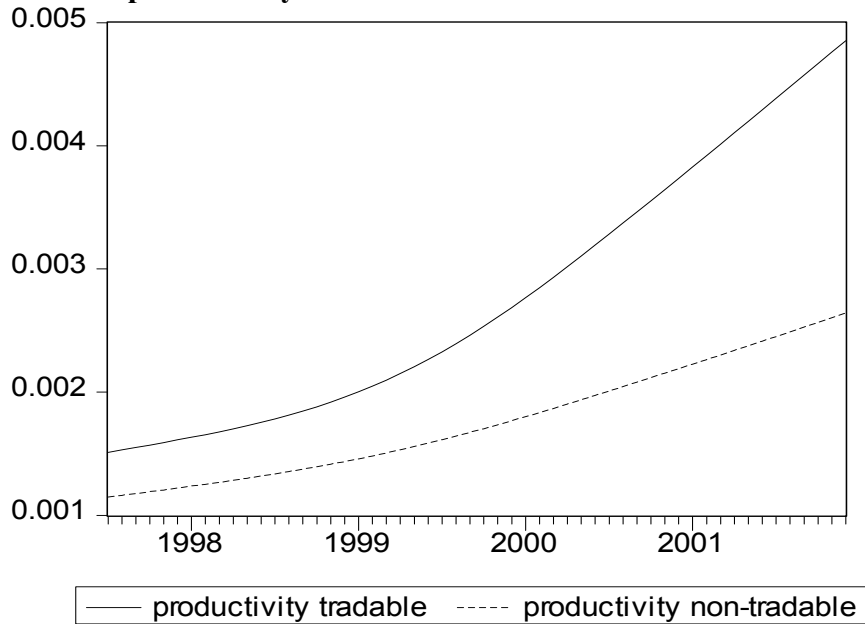
In principle when we speak of sectoral productivity, we need to look at total factor productivity, but this requires estimation of the production function, which is limited to some extent given the short period of time available. We follow the literature<sup>26</sup> in measuring instead labor productivity, the ratio of output to employment. We use a Hodrick-Prescott (HP) filter, econometric technique, to take out the cyclical and seasonal fluctuations from the productivity values in both sectors and thus obtaining their trends (figure 4). As expected, the productivity of the tradable sector (industry) is higher than the one in the non-tradable sector, which is a prerequisite of the presence of the BS effect.

---

<sup>25</sup> See AEA (1997).

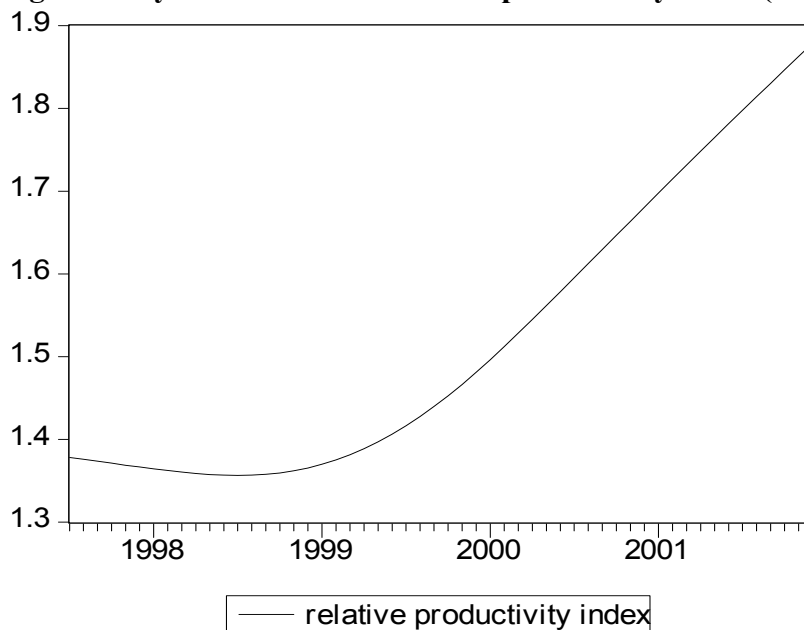
<sup>26</sup> Most of the studies dedicated on the BS effect involve labor productivity and it should be clearly stated that this “partial” productivity could produce different results. For more details, see also Backe and al., 2002.

**Figure 4. Labor productivity levels in the tradable and non-tradable sector (trend)**



For the purpose of an additional empirical check of the theory whether the productivity of the tradable sector is higher than the productivity of the non-tradable sector (like Halpern and Wyplosz, 2001) we build an index of the relative productivity. In the whole pattern the ratio of productivity in the tradable sector to that in the non-tradable sector  $\frac{QT}{QNT}$  increases (figure 5) and it is above 1.

**Figure 5. Dynamics of relative labor productivity index (trend)**

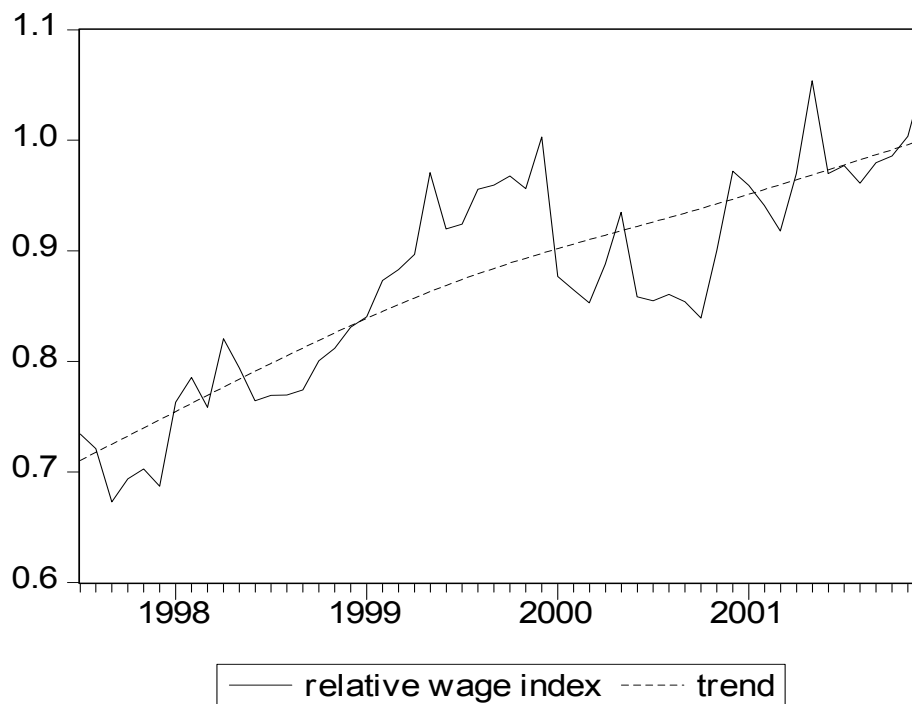


*Second*, an important precondition for BS effect availability is to have a convergence tendency of the non-tradable sector’s wages (which is lower) to the wage level in the tradable sector ( $WT > WNT$ ). The general dynamics exists and it is illustrated in the following figure.

**Figure 6. Wages dynamics in the tradable and non-tradable sector (trend, the orthogonal axis is in BGN)**



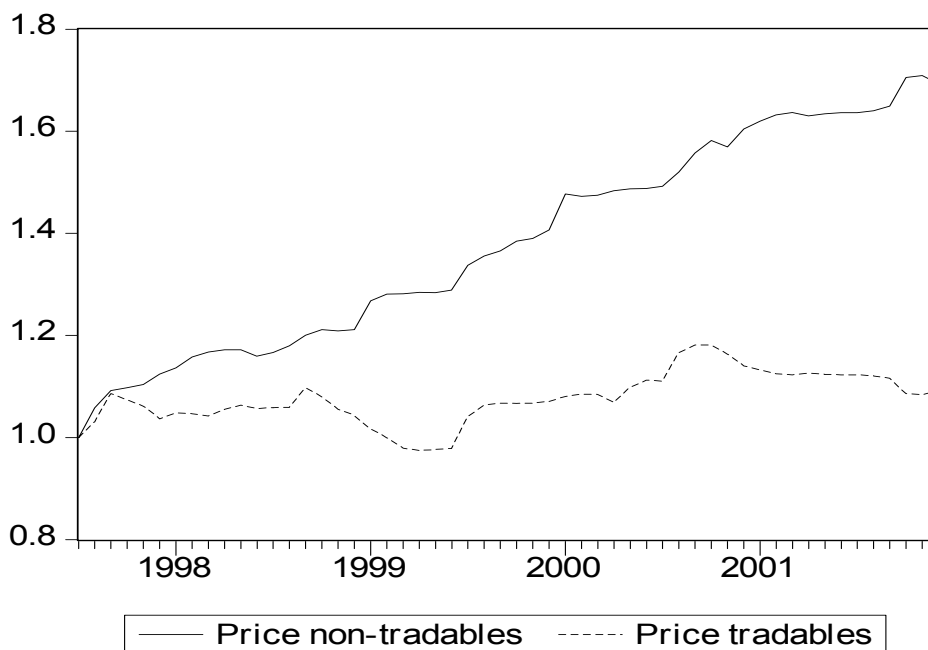
And this tendency is justified by the correlation between the wages of two sectors (0.86). In spite of the observed trend of smoothing, this process is very volatile in the recent years (figure.7). Regardless of the index of relative wage, defined in our case as the ratio “wages in the non-tradable/wages in the tradable sector  $\frac{WNT}{WT}$ ”, which points to 1 (see the trend), we shall check whether growth rate of the non-tradable wage is determined by the growth rate of the wages in the tradable sector.

**Figure 7. Dynamics of the relative wage index**

The reason for the observed relative wage dynamics lies to some extent in the still segmented labor market, which results in of high real wage rigidity in Bulgaria. Significant support to that consideration we find in the elasticity (econometrically estimated) of the non-tradable wage growth rate in response to changes in the tradable wage level. According to our estimations, the elasticity is under 1, i.e. 0.48, which implies that when salaries in the tradable sector increase by 10%, salaries in non-tradable sector rise only by 4.8%, and that there are other factors apart from labor productivity that determine nominal wage setting in the services sector.

In spite of the above-discussed *contradicting* initial assumptions, the following figure definitely shows the higher price dynamics in the non-tradable sector ( $PNT > PT$ ).

**Figure 8. Price dynamics in the tradable and non-tradable sector  
(1997:12 = 1)**



Before we attempt to make any conclusion of the existence of the BS effect, let's first see what its direct *econometric* estimation as stated in equation (1) is. We apply the econometric technique developed by Halpern and Wyplosz (2001). It might be surprising but the results of the tests of the BS equation for the period starting with the CB introduction in Bulgaria (1997:07 - 2001:12) are not very convincing even in terms of rates (*dynamic BS effect*):

$$(2) \quad \log(\text{PNT}/\text{PT}) = 2.38 - 0.04\log\text{QT} + 0.20\log\text{QNT} + \text{MA}(1) + \text{MA}(2)$$

$$(20.5) \quad (-2.7) \quad (12.4) \quad (8.1) \quad (1.4)$$

$$R^2 = 0.97, R^2_{\text{adj}} = 0.96, \text{DW} = 1.76$$

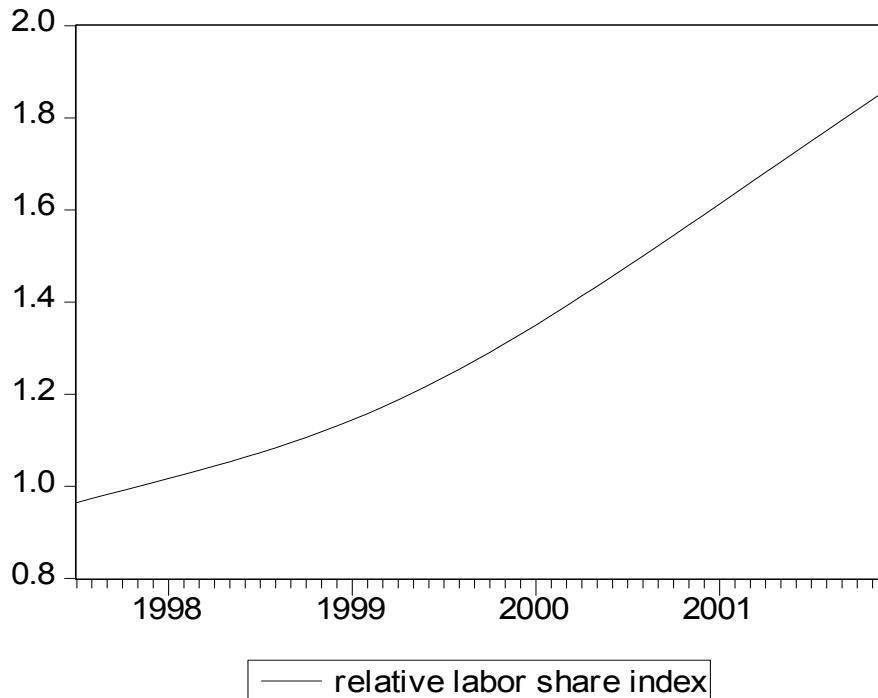


It is evident from the coefficients that the non-tradable goods and services have a very weak and positive influence on the real exchange rate (PNT/PT)<sup>27</sup>. We can also observe that the influence of the productivity level in the tradable sector on the real exchange rate is weaker than the influence of the productivity in the non-tradable sector. The coefficient in front of the productivity in the non-tradable sector (+0.20) is significant, although it does not have the theoretically justified negative sign (i.e. it is presumed that a rise in the productivity in this sector should lead to the depreciation of the Bulgarian lev).

Moreover, the coefficient in front of productivity in the tradable sector does not explain the fact that the non-tradable sector is more labor intensive. The latter is evident in the ratio of relative labor share in the production of respectively, the non-tradable and tradable sector ( $\frac{\lambda_{NT}}{\lambda_T}$ ) which is above 1 and implies that there are more labor expenses in the non-tradable sector (see. Figure 9). On one side, this is due to the relatively higher number of employees in the sector and to the services wage convergence to the wage level in industry. On the other side, the level and growth rate of the services gross output is lower than those of industry.

---

<sup>27</sup> The ratio PNT/PT is often interpreted as "internal real exchange rate" while the external real exchange rate is calculated by deflating the nominal exchange rate by different price indices in the country and of the major trade partners.

**Figure 9. Dynamics of relative labor share index (trend)**

#### IV. Policy implications and future directions of analysis

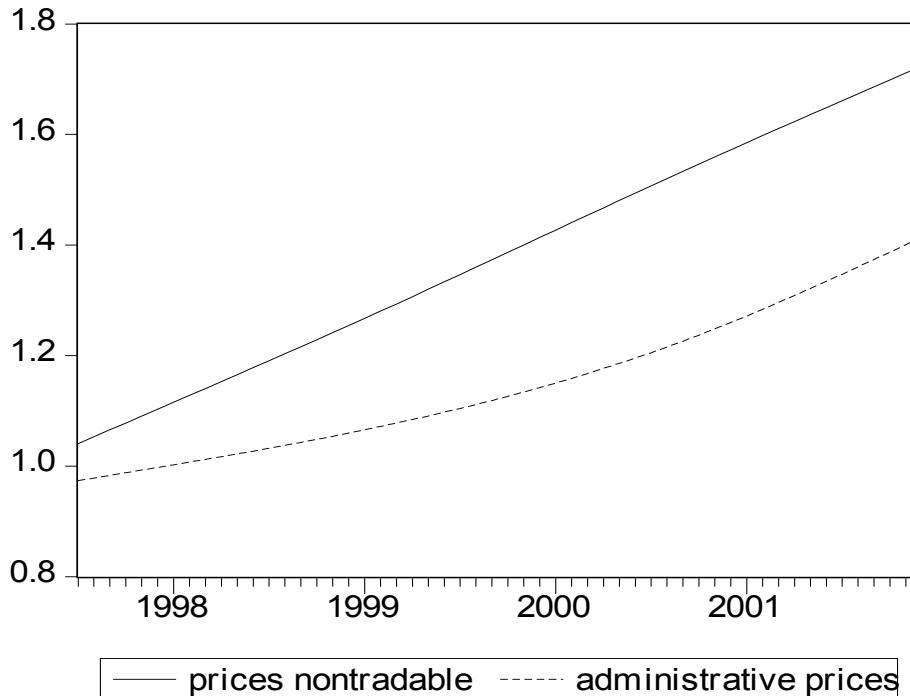
The traditional notion of the BS effect or dual inflation *does not ultimately hold* after the introduction of the CB in Bulgaria.

*First*, we can find an explanation for the lack of empirical justification in the heritage of centrally planned economic system characterized by *labor market segmentation* and real wage rigidity. The process of nominal wage convergence is driven by forces other than labor productivity.

*Second*, probably the most important factor that hinders our econometric verification of the BS effect is that great part of the non-tradable prices is presented by *administratively* managed prices, which were not completely liberalized. In the period of transition, some services (education, healthcare, etc.) were liberalized and automatically resulted in further increase in the general price level. The prices of energy, central heating, water supply and other utilities are still under their cost recovery levels. At the moment they present about 1/3 of the prices of non-tradables and are not market

determined. The inflation dynamics of these services is the main component of the inflation pattern of the prices of the non-tradable as illustrated in the following figure 10.

**Figure. 10. Inflation dynamics of the non-tradable and administratively managed prices, trend (07:1997=1)**

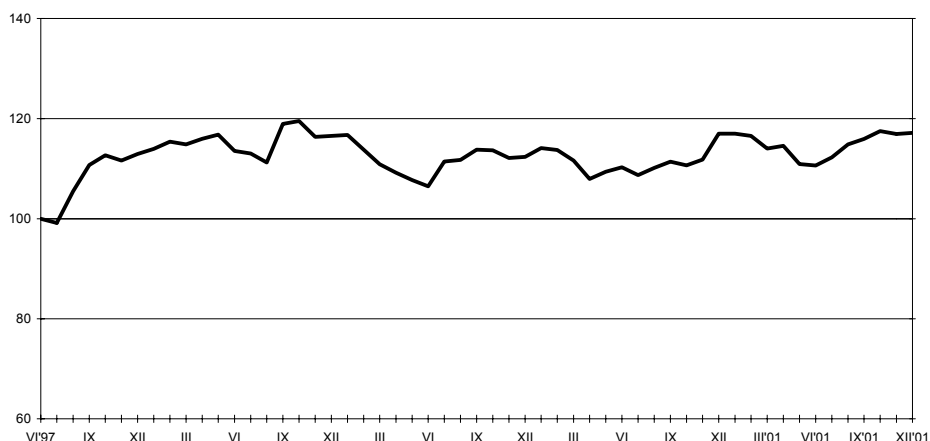


As long as the outcomes of our econometric tests are valid, our study rejects the widely spread view that all accession countries experience the BS effect which is blamed to cause real appreciation of their currencies.

However, dual inflation or the BS effect is likely to be present *in the long run* and this is provided by the initial assumptions of its existence (wage and productivity dynamics of both sectors). But its impact on the real exchange rate would be weaker due to other factors like real wage rigidity and ongoing liberalization among others. In fact,

the Bulgarian lev is experiencing some moderate real appreciation<sup>28</sup>, which seems to be somehow kept in limits (see Figure 11).

**Figure. 11. Real effective exchange rate appreciation index**



Source: BNB.

In fact Bulgarian monetary authorities do not have much room for maneuver in order to alleviate the effect of the real exchange rate appreciation. Taking into consideration the possible unfavorable consequences to expectations and economic behavior of an eventual exchange rate regime shift, the potential for exchange rate overshooting and the existence of price and wage rigidity, Bulgaria has no choice of strategies but keeping stable nominal exchange rate with somewhat higher inflation<sup>29</sup>.

On the side of the real economy, new efforts should be put in completing privatization and price liberalization. Further steps, typical for the catching-up process should be taken in respect to wage setting and making the labor market more flexible, establishing productivity-enhancing domestic and foreign investment, and efficient credit

<sup>28</sup> The Real Effective Exchange Rate Index is calculated as a basket of the three currencies with the largest share in the trade turnover: USD - 57.24%, DEM - 41.98%, CHF - 0.71%. Consumer prices are used as a measure to deflate the nominal exchange rates.

<sup>29</sup> For the range of issues under discussion before the monetary authorities of the accession countries undertake some strategy to cope with real appreciation see Backe and al., 2002.

channels, and last but not least, developing and implementing new technological innovation.

Regardless of the empirical estimations that do not prove the BS effect existence in Bulgaria and other research works that emphasize its insignificance (clearly observed in some countries than in others), a general strategy should be outlined in case this effect gets stronger in future. *Finally*, as most of the accession countries (especially these with CB) face the threat of high real exchange rate appreciation that will hinder the economic growth and convergence process, appropriate adjustment of the Maastricht criteria have been recently suggested. One of the Maastricht criteria is that one year prior to joining the EMU, the accession country's rate of inflation should not exceed by more than 1.5 percentage point the average rate of inflation in those three EU countries where inflation is the lowest. Some proposals are argued by Szapary (2001), who argues that the following changes of the criteria should be taken into consideration regardless of the fact that some of them are more easily carried out than the others:

- (i) From a strictly conceptual point of view, the first order solution would be to link the permissible inflation deviation to the size of the productivity growth differential, since it is the differential which determines the BS effect. However, to find a standard measurement of the BS effect, which can be uniformly applied for defining the permissible inflation deviation seems unfeasible due to economic, statistical and political reasons.
- (ii) Another solution is to group both the member countries and the accession countries on a per capita income basis and to define different price convergence criteria for each of them – the lowest per capita incomes countries should meet higher inflation requirements. This proposition is less likely than the first one because the principle of equal treatment involved in the initial criteria for joining the EMU would be broken and the negotiations paralyzed.
- (iii) A reasonable compromise would be to define the Maastricht criteria in reference to the average inflation rate of the euro zone (the Harmonized

Index of Consumer Prices, HICP), not the three EU members with the lowest inflation rate.

- (iv) The more radical proposition is to abolish completely the nominal criteria, which will complicate the transition countries real convergence to the euro zone.

Since the dual inflation cannot entirely determine the inflation behavior under the CB arrangements, it is reasonable to look for another sources of price increases – above all imported inflation (balance of payments driven inflation) and such caused by the temporary gap between money supply and demand (output gap driven inflation). For these purposes we have developed a synthetic model, which combines the three pointed causes of inflation in Bulgaria under the CB monetary regime, Nenovsky and al., 2000 (see. Annex 1). This model needs to be improved and empirically checked in the future.

Another axis of future research would be to develop and to estimate the BS effect in a model of inflation involving price, wage and productivity dynamics in Bulgaria and the EU. Such exercise however demands for high compatibility of the definition methods and of the structure of the available variables.

## References

- AEAF* (1997), Monthly Outlook Series No. 11
- Aglietta, M., C. Baulant and S. Moatti* (2002). Exchange rate regimes, monetary policies and competitiveness in Central Europe, paper for *International Conference: Towards regional currency areas*, Santiago, Chile, March 26&27.
- Aglietta, M., C. Baulant and V. Coudert* (1998) Compétitivité et régime de change en Europe Centrale, *CEPII, Document de travail, N 10, Octobre*.
- Arrabitel, O., D. Palenzuela and C. Thimann* (2001) Inflation Dynamics in a Panel of Accession Countries: a “New Phillips curve” Perspectives, *BOFIT Workshop on transition economies, Bank of Finland, Helsinki, April 19-20, 2001*.
- Artus, P.* (2001) Que doit faire l'Irlande?, CDC, Documents de recherche, 46/EI
- Asea, P. and M. Corden* (1994) The Balassa-Samuelson Model: An Overview, *Review of International Economics 2 (October)*, p.244-267.
- Backe, P., J. Fidermuc, T. Reininger and F. Schardax*, (2002) Price Dynamics in Central and Eastern European EU Accession Countries, *OeNB Working paper No. 61*.
- Bank for International Settlement* (2000) Seventieth Annual Report, 1 April 1999 - 31 March 2000, Basel.
- Bank of Lithuania* (2000) Price dynamics in Lithuania: Past Experience and Future Trends, *ECB Workshop on Price stability in Accession Countries, 30 October 2000, Frankfurt am Main*.
- Barro, R. and X. Sala-i-Martin* (1992) Convergence, *The Journal of Political Economy, Vol.100, Issue 2*, p.223-251.
- Bartolini, L.* (1995) Purchasing Power Parity Measures of Competitiveness, *Finance & Development, September Issue*.
- Bauer, T* (1991) The Macroeconomics of Inflation under Economic Reforms: Enterprises and Their Environment, *Managing Inflation in Socialist Economies in Transition, World Bank Publications, EDI Seminar Series*, p.107-120.
- Bayoumi, T. and P. Mason* (1995) Fiscal Flows in the United States and Canada: Lessons for Monetary Union in Europe, *European Economic Review, 39*, p. 253-274.
- Benaroya, F. and D. Janci* (1996) La sous-évaluation des monnaies asiatiques, *Economie Internationale, N 66*, p. 7-42.
- Benassy, A. and A. Lahrecher* (2000) The Euro as a Monetary Anchor in the CEECs, *Open Economies Review, n. 11*, p. 303-321.
- Berg, A. and E. Borensztein* (2000) The Pros and Cons of Full Dollarization, *IMF Working Paper WP/00/50*.
- Berthold, N., R. Fehn and E. Thode* (1999) Real Wage Rigidities, Accomodative Demand Policies, and the Functioning of EMU, *Wertwirtschaftliches Archiv, Vol. 135, n.4*, pp. 545-571.

- Blanchard, O. (1997)* The Economics of Post-Communist Transition, Oxford.
- Blanchard, O., S. Commander and F. Coricelli (1995)* Unemployment and Restructuring in Eastern Europe, *Unemployment, Restructuring, and the Labor Market in Eastern Europe and Russia, World Bank Publication*, p. 289-330.
- Brada, J. and A. Kutan (2001)* The Convergence of Monetary Policy Between Candidate Countries and the European Union, *Economic Systems, Vol. 25, n. 3*, p. 215-232.
- Buiter, M. and C. Grafe (2001)* Central Banking and the Choice of Currency Regime in Accession Countries, *Ten Years of Transition in Eastern European Countries, Special Issue of Revue d'Economie Financiere*, p. 287-319.
- Bulgarian National Bank (1997)* Annual report of the Bulgarian National Bank.
- Busson, F. and P. Villa (1996)* L'effet Balassa : un effet robuste et de longue période, *Economie Internationale, N 66*, p. 43-54.
- Calmfors, L. (1998)* Unemployment, Labour-Market Reform and Monetary Union, Center for Economic Studies, University of Munich, WP 173.
- Chadha, B., F. Coricelli and K. Krajnyák (1993)* Economic Restructuring, Unemployment, and Growth in a Transition Economy, *IMF Staff Papers, Vol. 40, December, n. 4*, pp.744-780.
- Cheung, Y. and K. Lai (2000)* On cross-country differences in the persistence of real exchange rates, *Journal of International Economics 50*, p. 375-397.
- Commander, S. and F. Coricelli (1991)* Levels, Rates, and Sources of Inflation in Socialist Economies: A Dynamic Framework, *World Bank Publication, EDI Seminar Series*, p. 29-68
- Couder, V. (1999)* Comment définir un taux de change d'équilibre pour les pays émergents ?, *Economie Internationale, N 77, 1-er trimestre*, p. 45-65.
- Darvas, Z (2001)* Exchange Rate Pass-Through and Real Exchange Rate in EU Candidate Countries, *Deutsche Bundesbank Discussion Paper 10*.
- De Broeck, M. and T. Slok (2001)* Interpreting Real Exchange Rate Movements in Transition Countries, *BOFIT Discussion Papers, No. 7*.
- De Grauwe, P. (1992)* Inflation Convergence During the Transition to EMU, *Economies at Societes, 26 (9-10)*, p. 13-32.
- De Grauwe, P. (1995)* The Economics of Convergence Towards Monetary Union in Europe, *CERP Discussion Paper No. 1213*.
- De Gregorio, J., A. Giovannini and H. Wolf (1994)* International Evidence on Tradables and Nontradables Inflation, *European Economic Review 38 (6)*, p. 1225-1244.
- Dobrinisky, R. (2000)*. Transition crisis in Bulgaria, *Cambridge Journal of Economics, vol. 24, n° 5*, pp. 581-602.



*Dornbusch, R. (1991) Experiences with Extreme Monetary Instability, Managing Inflation in Socialist Economies in Transition, World Bank Publication, EDI Seminar Series, p.175-196*

*Duisenberg, W. (2001) The ECB and the Accession Process, speech at the Frankfurt European Banking Congress, 23 November: <http://www.ecb.int/key/01/sp011123.htm>*

*European Central Bank (1999) Monthly Bulletin, October, pp. 35-44.*

*European Central Bank (2000) Monthly Bulletin, May, pp. 57-74.*

*Egert, B. (2002) Investigating the Balassa-Samuelson hypothesis in transition: do we understand what we see?, BOFIT Discussion Paper 06.*

*Fisher, S., R. Sahay, and C. Vegh (1998) How Far Is Eastern Europe from Brussels? IMF Working Paper 53*

*Freeman, R. (1998) War of the models: which labor market institutions for 21st century?, Labour Economics, n. 5, pp. 1-24.*

*Frensch, R. (2001) Some perspectives on currency relations between EMU and Central and East European EU accession countries, Economic Systems, Vol. 25, n. 3, p. 175 – 181.*

*Goldberg, P. and M. Knetter (1996) Good Prices and Exchange Rates: What Have We Learned?, NBER Working Paper 5862.*

*Halpern, L. and C. Wyplosz (2001) Economic Transformation and Real Exchange Rates in the 2000s: The Balassa-Samuelson Connection, UNECE Publications, March 2001.*

*Halpern, L. and J. Nemenyi (2002). Fiscal foundations of convergence to EU in pre-accession transition countries, Deutsche Bundesbank DP 03/02.*

*Hanke, S. (1999) Reflections on Exchange Rate Regimes, Cato Journal, vol. 18, n. 3, pp. 335-344.*

*Harris, J. R. and M. Todaro (1970) Migration, Unemployment and Development: A Two Sector Analysis, American Economic Review, LX, March, pp. 126-142.*

*Haskel, J. and H. Wolf (1999) Why Does the ‘Law of One Price’ Fail? A Case Study, CEPR Discussion Paper N 2187.*

*Hossain, A. and A. Chowdhury (1998). Open-Economy Macroeconomics for Developing Countries, Edward Elgar.*

*International Monetary Fund (2000), Exchange Rate Regimes in selected advanced Transition Economies – Coping with Transition, Capital Inflows, and EU Accession, SM/00/43. February 24.*

*Jones, C. (2000) Théorie de la croissance endogène, De Boeck Université, Paris.*

*Kim, S. (1997) Economic Integration and Convergence: US Regions 1840-1987, NBER Working Paper 6335.*

*Koceda, E. and D. Papell (1997) Inflation Convergence within the European Union: A Panel Data Analysis, International Journal of Finance and Economics Vol. 2, n 3, p. 189-198.*

*Kocenda, E. (2001) Macroeconomic Convergence in Transition Countries, Journal of Comparative Economics Vol. 29, n. 1, p. 1-23.*

*Kolodko, G. (2000) Globalization and Catching-Up: From Recession to Growth in Transition Economies, IMF Working Paper 100.*

*Komulainen, T. and J. Pirttila (2000) Fiscal Explanations for Inflation: Any Evidence for Transition Countries?, BOFIT Discussion Paper No. 11.*

*Kutan, A. and N. Pautola-Mol (2002), Integration of the Baltic States unto the EU and Institutions of Fiscal Convergence, BOFIT Discussion Papers, No. 1*

*Nenovsky, N. and V. Yotzov (1997) A Study on Demand for Money in Bulgaria, BNB Monthly Bulletin # 4 1997.*

*Nenovsky, N., K. Hristov and V. Yotzov (2000) Inflation under Currency Board (The Case of Bulgaria); Workshop Paper, ECB Workshop on Price Dynamics, November 2000.*

*Nenovsky, N. and D. Koleva (2001) Real Wage Rigidity and Monetary Regime Choice, BNB Discussion Paper 18.*

*Nenovsky, N. and K. Hristov (2002). The new currency boards and discretion: empirical evidence from Bulgaria; Economic Systems, 39, pp. 1-18.*

*Nenovsky, N., K. Hristov and M. Mihaylov (2002). Comparing institutional and organizational design of Currency Boards in transition countries, Eastern European Economics, January – February Issue, vol. 40, pp. 6-36.*

*Olson, M. (2000). Power and Prosperity. Outgrowing Communist and Capitalist Dictatorships, New York.*

*Pelkmans, J. D. Gros and J. Nunez Ferrer (2000) Long-run Economic Aspects of the European Union's Eastern Enlargement, Scientific Council for Government Policy, WRR, Working Paper 109.*

*Perrot, A. (1998) Les nouvelles théories du marché du travail, Edition La Découverte, Paris.*

*Razin, A. and C.W. Yuen (1995) Factor Mobility and Income Growth: Two Convergence Hypotheses, NBER Working Paper 5135.*

*Rivera-Batiz L. and A. Sy (2000) Currency Boards, Credibility and Macroeconomic Behavior, IMF Working Paper 97.*

*Rogoff, K. (1996) The Purchasing Power Parity Puzzle, Journal of Economic Literature, Vol. XXXIV, p. 647-668.*

*Ross, K. (2000) Post-stabilization inflation dynamics in Slovenia, Applied Economics, N 32, p. 135-149.*

*Saarniit, A., K. Tamla and M. Randveer (2000) Price dynamics in Estonia (Main features of disinflation and conversion), ECB Workshop on Price stability in Accession Countries, 30 October 2000, Frankfurt am Main.*

*Shapiro, C. and J. E. Stiglitz (1984) Equilibrium Unemployment as a Worker Discipline Device, The American Economic Review, Vol. 74, n. 3, p. 433-444.*

*Simon, A. and M. Kovacs (1998 and 2000), Components of the Real Exchange Rate in Hungary, NBH Working Paper 1998/3, and subsequent update (mimeo, 2000).*

*Sinn, H.-W. (1999) EU Enlargement, Migration, and lessons from German Unification, Center for Economic Studies, ifo Institute, Working Paper Series, WP 182.*

*Soltwedel, R., D. Dohse and C. Krieger-Boden (1999) EMU Challenges European Labour Markets, IMF, September, WP/99/131.*

*Szapary, G. (2001) Maastricht & the Choice of Exchange Rate Regime in Transition Countries during the Run-up to EMU, ENERPI Working Paper No. 6/ May 2001.*

*Viñals, J., J. Jimeno (1998) The impact of EMU on European unemployment, Oesterreichische Nationalbank, Working Paper 34.*

*Wyplosz, C. (2000) Do We Know How Low Should Inflation Be?, ECB Central Banking Conference "Why Price stability?", November 2000, Frankfurt, Germany.*

## Annexes

### Annex 1 Structural model of inflation under the Currency Board

After certain simplifications, the inflation under a CB can be approximated by means of the following structural model, which combines both the balancing between the prices of tradable and non-tradable goods and the balancing of the money market (demand and supply of money)<sup>30</sup>. This model presupposes that the balancing of the demand and supply of tradable goods is achieved through the volumes, while the balancing of the demand and supply of non-tradable goods is achieved through their prices, which are a function of money demand and supply.

The general level of prices is a sum of the prices of tradable (primarily industry and agriculture) and non-tradable goods (primarily services),  $PT$  and  $PNT$  respectively with weights  $\phi$  and  $(1-\phi)$ .

$$(1) \quad \ln P_t = \phi \ln PT_t + (1 - \phi) \ln PNT_t$$

If we suppose that the prices of tradable goods are a function of the prices of tradable goods abroad and of the exchange rate, then the following dependence would be valid

$$(2) \quad \ln PT_t = \alpha_0 + \alpha_1 \ln e_t + \alpha_2 \ln PT_t^f + \varepsilon_t,$$

where  $e$  is the exchange rate of the BGN as a direct quotation, and  $PT_t^f$  is the price level of tradable goods in foreign currency. The equation (2) shows that the prices

---

<sup>30</sup> This model could be considered as a model of the inflation under a fixed exchange rate which takes account of the different dynamics of prices of tradable and non-tradable goods. The automatic mechanism of the CB makes the balancing of the money market (between the desired and the actual amount of money) extremely fast. This is so, because the money supply, according to the CB rule, is almost entirely endogenous (set externally for the central bank). If we assume that the money market is always in equilibrium, then the above model would be limited to the traditional interpretations of inflation known as the BS effect.

of tradable goods in BGN depend on the changes in the exchange rate and the changes in the prices of tradable goods in foreign currency<sup>31</sup>.

The demand and supply of them on the domestic market determine the prices of non-tradable goods. If we assume that the prices of these goods are a function of the money market (the deviation of the desired real amount of money at the end of period  $m_t^d$  from the actual real amount of money at the beginning of period  $m_{t-1}$ ), then:

$$(3) \quad \ln PNT_t - \ln PNT_{t-1} = \gamma(\ln m_{t-1} - \ln m_t^d) + u_t$$

$m$  is equal to  $M/P$ , where  $M$  is a selected monetary aggregate,  $P$  is the general price level, and  $\gamma$  is the balancing velocity ( $0 < \gamma < 1$ ). After moving to first differences of the equation (1) and (2) we get:

$$(4) \quad \ln(P_t / P_{t-1}) = \phi \ln(PT_t / PT_{t-1}) + (1 - \phi) \ln(PNT_t / PNT_{t-1})$$

$$(5) \quad \ln(PT_t / PT_{t-1}) = \alpha_0 + \alpha_1 \ln(e_t / e_{t-1}) + \alpha_2 \ln(PT_t^f / PT_{t-1}^f) + \varepsilon_t$$

After substituting (3) and (5) in (4) we come to the following equation, which describes the dynamics of inflation.

$$(6) \quad \ln(P_t / P_{t-1}) = \phi [\alpha_0 + \alpha_1 \ln(e_t / e_{t-1}) + \alpha_2 \ln(PT_t^f / PT_{t-1}^f) + \varepsilon_t] + (1 - \phi) \gamma (\ln m_{t-1} - \ln m_t^d) + (1 - \phi) u_t$$

From previous surveys of the demand for money in Bulgaria (Nenovsky and Yotzov, 1997) we know that the most appropriate approximation for real money stocks demand is as follows:

$$(7) \quad \ln m_t^d = \beta_0 + \beta_1 \ln y_t - \beta_2 \ln r_t - \beta_3 \ln(e_t / e_{t-1}) + \xi_t$$

where  $m$  is currency in circulation (in real terms),  $y$  is total real expenses of households (real monetary expenses or real wages of households may be used<sup>32</sup>),  $r$  is the

---

<sup>31</sup> If we assume that the purchasing power parity of tradable goods is valid (i.e. prices of tradable goods are exogenously set), then the equation (2) would look like this:

$$(2') \quad \ln PT_t = \ln e_t + \ln PT_t^f,$$

nominal interest rate, and  $\ln(e_t/e_{t-1})$  is the depreciation of the BGN (the Euro) against the US Dollar<sup>33</sup>.

The econometric form of the function of measuring inflation (in equation (6)) is:

$$(8) \quad \ln(P_t/P_{t-1}) = c_0 + c_1 \ln(e_t/e_{t-1}) + c_2 \ln(PT_t^f/PT_{t-1}^f) + c_3 (\ln m_{t-1} - \ln m_t^d) + \mathcal{G}_t$$

where  $(\ln m_{t-1} - \ln m_t^d)$  is the difference between the money supply at the time  $t-1$  and the assessed values of the money demand at the time  $t$  in equation (7). According to the theoretical treatment the expected signs of the coefficients in equation (8) are the following:

$$c_1 + c_2 \begin{matrix} > \\ < \end{matrix} 1$$

$$c_3 > 0$$

The interpretation of the sum of the two coefficients ( $c_1 + c_2$ ) is based on the assumption that the LOOP for tradable goods is in force. In the case where  $c_1 + c_2 = 1$ , we have a complete exchange rate pass-through effect, and the change in the prices of tradable goods expressed in foreign currency and the effect of the exchange rate change are fully transposed in the prices of tradable goods expressed in the local currency.

In the case where  $c_1 + c_2 < 1$  we have an incomplete exchange rate pass-through effect, and where  $c_1 + c_2 > 1$  we have excess response of tradable goods prices. The

<sup>32</sup> In this case wages participate in the equation on the side of the demand for money as an approximation of the transaction demand. Actually, wages form prices through costs as well. Prices in this case are positively linked with wages and negatively linked with productivity. The different dynamics of productivity and wages in the tradable and non-tradable sectors are the foundation of the Balassa model.

<sup>33</sup> In the money demand function, instead of the depreciation of the BGN against the USD we may use inflation. The final form of the function of the inflation is:

$$(8') \quad \begin{aligned} \ln(P_t/P_{t-1}) = & \phi\alpha_0 - (1-\phi)\gamma\beta_0 + [\phi\alpha_1 + (1-\phi)\gamma\beta_3] \ln(e_t/e_{t-1}) + \phi\alpha_2 \ln(PT_t^f/PT_{t-1}^f) + \\ & + (1-\phi)\gamma \ln m_{t-1} - (1-\phi)\gamma\beta_1 \ln y_t + (1-\phi)\gamma\beta_2 \ln r_t + \phi\varepsilon_t - (1-\phi)\gamma\xi_t + (1-\phi)u_t \end{aligned}$$

interpretation of the overshooting in the case where  $c_1 + c_2 > 1$  is based on the fact that in small and heavily open economies prices are strongly dependent on the change in the exchange rate.

**Annex 2**

In order to calculate the average monthly wage and the number of employed people in the tradable and non-tradable sector, we group all economic activities (according to NSI) into two major groups.

Tradable	Non-tradable
Mining of coals, extraction of petroleum and natural gas	Trade, repairing activities
Mining of ores	Hotels and restaurants
Other mining and quarrying	Transport
Manufacturing foods, beverages and tobacco	Communications
Textiles	Financial intermediation
Wearing apparel	Real estate and renting activities
Leather, leather and fur clothes, footwear and products	Research and development
Wood and products of wood and cork, plaiting materials	Other business activities
Pulp, paper and paper products; publishing and printing	Public administrations; compulsory social security
Coke, refined petroleum products and nuclear fuel	Education
Chemicals, chemical products and man-made fibers	Health and social work
Rubber and plastic products	Veterinary activities
Other non-metallic mineral products	Activities of membership organizations n.e.c.
Basic metals except casting of metals	Sewage and refuse disposal, sanitation and other services
Metal products; machinery and equipment; casting	Cultural activities
Electrical and optical equipment	Recreational and sporting activities
Transport equipment	
Manufacturing n.e.c.	
Electricity, gas and water supply	
Construction	



**Annex 3** Real Wage Rigidity Index Calculations (Nenovsky and Koleva, 2001)

The dilemma “unemployment – devaluation” underlies the issue of monetary authority credibility. This basic theoretical assumption serves as a basis for modelling a speculative attack against the currency board (Rivera-Batiz and Sy, 2000). Since real wage rigidity is a major condition for absorbing possible shocks in the economy under a static central bank, construction of the so-called *real wage rigidity index* is a key element in the labour market analysis.

The basic structural model for estimating rigidity is proposed by Layard and al. (1991) and is based on a system of equations describing wages and prices:

$$w - p = -c(u - hu_{-1}) + z^w \quad (1)$$

$$z^w = e^s + e^w, \quad (2)$$

where  $w$ ,  $p$ ,  $u$  are the logarithms of nominal wages, the price index and unemployment respectively,  $u_{-1}$  is logarithm of unemployment with one lag,  $c$  and  $h$  are the parameters for estimation, and  $z^w$  reflects shocks on nominal wages (the sum of  $e^s$  – technological shock, and  $e^w$  – labour-supply shock).  $h$  measures unemployment inertia, its hysteresis effect, and  $c$  shows the elasticity of real wages to changes in unemployment. The rigidity index is calculated by replacing the estimated  $c$  and  $h$  in the formula below:

$$\text{RWR} = (c(1-h))^{-1} = \frac{1}{c(1-h)} \quad (3)$$

Some of the weaknesses of the Layard model (a structural model) are overcome by Vinals and Jimeno (1998) who generate the values of the parameters in question by estimating two versions of BVAR model, relating real wage dynamics both with unemployment level and unemployment dynamics rate. Their models show both mutual responses to shocks and the decomposition of real wage response and unemployment response, the average lag of the response to unemployment being  $\frac{h}{1-h}$ .

The following tables exhibit the results for the real wage rigidity index in some of the developed countries in comparison to Bulgaria (prior and after the CB), and only in Bulgaria by sectors produced by the pool model connecting the dynamics of the real wages and employment after the introduction of the CB. The conclusions from the study on Bulgaria support the hypothesis that unemployment is first and foremost a structural phenomenon of transition and labour market liberalisation is the only alternative for an economy with a rule-based monetary regime.

**Table 1. Real wage rigidity in the developed countries and Bulgaria**

Country	Estimations from the structural model (equations on wages and prices)	Estimations from the VAR model (D(W-P),U)	Estimations from the VAR model (D(W-P),DU)
Bulgaria	Prior the CB ( $\infty$ ) After the CB (6.76)	Prior the CB ( $\infty$ ) After the CB (17.77)	Prior the CB ( $\infty$ ) After the CB (14.30)
Belgium	0.25	2.86	1.42
Denmark	0.58	3.44	1.10
France	0.23	5.13	1.58
Germany	0.63	3.76	1.48
Ireland	0.27	2.92	1.68
Italy	0.06	4.29	1.00
Netherlands	0.25	2.11	1.52
Spain	0.52	4.20	1.94
England	0.77	3.43	1.16
Austria	0.11	4.49	0.85
Finland	0.29	9.55	1.71
Sweden	0.08	4.92	1.41
EU	0.42	4.09	1.39
USA	0.25	2.39	0.73
Japan	0.06	2.21	0.89

**Table 2. Rigidity of real wages in Bulgaria by sectors.**

Sectors with flexible wages	Sectors with rigid wages
Trade	Heavy industry
Hotels and Restaurants	Gas and Petrol industry
Construction	Health services
Paper and Printing industry	Education
Food industry	R&D
Real estate activities	Public administration
Financial intermediation	
Chemical industry	
Agriculture (relatively flexible)	

Sources: For Bulgaria (Nenovsky and Koleva, 2001), for the others countries Vinals and Jimeno, 1998, p. 23).

## DAVIDSON INSTITUTE WORKING PAPER SERIES - Most Recent Papers

The entire Working Paper Series may be downloaded free of charge at: [www.wdi.bus.umich.edu](http://www.wdi.bus.umich.edu)

CURRENT AS OF 7/31/02

<b>Publication</b>	<b>Authors</b>	<b>Date</b>
No. 487: Dual Inflation under the Currency Board: The challenges of Bulgarian EU accession	Nikolay Nenovsky and Kalina Dimitrova	July 2002
No. 486: Worker Flows, Job Flows and Firm Wage Policies: An Analysis of Slovenia	John Haltiwanger and Milan Vodopivec	July 2002
No. 485: Do Schumpeterian Waves of Creative Destruction Lead to Higher Productivity? Panel Data Evidence from Poland	Frederic Warzynski	July 2002
No. 484: Labor Market Institutions and Restructuring: Evidence from Regulated and Unregulated Labor Markets in Brazil	Jasper Hoek	July 2002
No. 483: The Balassa-Samuelson effect in Central and Eastern Europe: Myth or reality?	Balázs Égert, Imed Drine, Kirsten Lommatzsch and Christophe Rault	July 2002
No. 482: Real Exchange Rates in Transition Economies	Boštjan Jazbec	July 2002
No. 481: Labor Force Participation Dynamics in the Romanian Labor Market	Alexandru Voicu	July 2002
No. 480: Equilibrium Real Exchange Rates in Central Europe's Transition Economies : Knocking on Heaven's Door	Balázs Égert	July 2002
No. 479: The Impact of Minimum Wages on Wage Inequality and Employment in the Formal and Informal Sector in Costa Rica	Fatma El-Hamidi and Katherine Terrell	Apr. 2001
No. 478: Beyond Oaxaca -Blinder: Accounting for Differences in Household Income Distributions	François Bourguignon, Francisco H. G. Ferreira and Phillippe G. Leite	Feb. 2002
No. 477: Participation Behavior of East German Women after German Unification	Holger Bonin and Rob Euwals	July 2002
No. 476: Duration and Risk of Unemployment in Argentina	Sebastian Galiani and Hugo A. Hopenhayn	Oct. 2001
No. 475: After, Before and During: Returns to Education in the Hungarian Transition	Nauro F. Campos and Dean Jolliffe	Apr. 2002
No. 474: The Locking-in Effect of Subsidized Jobs	Jan C. van Ours	June 2002
No. 473: How Reform Worked in China	Yingyi Qian	June 2002
No. 472: An Economic Perspective on Russia's Accession to the WTO	Robert M. Stern	June 2002
No. 471: The Effects of Ownership Forms and Concentration on Firm Performance after Large-Scale Privatization	Evzen Kocenda and Jan Svejnar	May 2002
No. 470: Growth in Transition: What We Know, What We Don't, and What We Should	Nauro F. Campos and Fabrizio Coricelli	Feb. 2002
No. 469: Barriers to Investment by Russian Firms: Property Protection or Credit Constraints?	Susan J. Linz	May 2002
No. 468: Job Satisfaction Among Russian Workers	Susan J. Linz	May 2002
No. 467: Assessing the Problem of Human Capital Mismatch in Transition Economies	Viliam Druska, Byeong ju Jeong, Michal Kejak, and Viatcheslav Vinogradov	Mar. 2002
No. 466: Motivating Russian Workers: Analysis of Age and Gender Differences	Susan J. Linz	Feb. 2002
No. 465: Virtual Reality: Barter and Restructuring in Russian Industry	Gary Krueger and Susan J. Linz	Apr. 2001
No. 464: Lending of Last Resort, Moral Hazard and Twin Crises: Lessons from the Bulgarian Financial Crisis 1996/1997	Michael Berlemann, Kalin Hristov and Nikolay Nenovsky	May 2002
No. 463: Deindustrialisation. Lessons from the Structural Outcomes of Post-Communist Transition	Tomasz Mickiewicz and Anna Zalewska	Jan. 2002
No. 462: Joint Liability Lending and the Rise and Fall of China's Township and Village Enterprises	Albert Park and Minggao Shen	July 2001
No. 461: A Refinancing Model of Decentralization with Empirical Evidence from China	Albert Park and Minggao Shen	Apr. 2002