DUAL INFLATION UNDER THE CURRENCY BOARD
THE CHALLENGES OF BULGARIAN EU ACCESSION

Nikolay Nenovsky,
Kalina Dimitrova[*]

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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 BS effect in Bulgaria (after Currency Board introduction). BS explanation of inflation (or dual inflation) has acquired not only academic recognition and popularity in practice as well. Altogether, the results of our empirical estimation do not completely corroborate the existence of this effect but rather they justify its existence as a tendency (as a rate/speed of changes). Actually there are several factors that hinder wage convergence in both sectors and such that alter productivity developments in the sectors. In our opinion, we could speak of BS effect only in terms of rate (dynamic BS) and not in levels (static BS). This prompts us that the price movement in the country has other driving motions – above all imported inflation and inflation generated by the temporary gaps between money demand and supply.

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I. Inflation and problems of 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 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 fixed by law? What is in fact the dynamics of the real exchange rate in Bulgaria, 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 accession process?

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[*] Nikolay Nenovsky is the head of Monetary and Financial Research Division at the Bulgarian National Bank (BNB) and Kalina Dimitrova is an economist of Macroeconomic Analyses Division at the BNB. K. Hristov (expert of Monetary and Financial Research Division at the BNB) contributed to the study with some charts and data.

(ii) Is it possible to comply with the nominal membership criteria (Maastricht criteria) and with the catching up process[1] at the *same* time? 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 then every group would follow its own equilibrium trend (steady state). In spite of the technology transfers and production factors flows, it is known from the neoclassical growth theory that different groups of countries converge to different levels of their fundamental variables (Jones, 1998)[2]. 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, Sahay, and Vegh, 1998, Kolodko, 2000). In this framework, we think that it more appropriate to speak of some *reasonable* levels of convergence between the two groups and not in the context of *absolute and unconditional* convergence?[3]

(iii) Which are the *sources of inflation* under currency board arrangements (CBA) and in the process of catching up (how do both combine with each other)? Which sources dominate – monetary, real or the imported inflation? What is the role of the labor productivity (particularly by sectors) in the movement of the real exchange rate?

(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* % (Balassa-Samuelson effect (BS) exists and we have estimated it[4]). Then the question of the optimal level of Euro area prices arise (in some assessments it is higher than the observed and targeted level by the European Central Bank (ECB), Halpern and Wyplosz, 2001). 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. We can recall several years of low inflation (1998 – 1%) as well as months of deflation.

(v) How do the processes of accession under CBA influence the relative prices' structure i.e. the *micro fundamentals* of inflation?

(vi) Do catching up process favor the theory of endogenous currency area when real economy integration starts with common money? To some extent, CB itself can be interpreted as an application of the same theory since the legally pegged exchange rate is *de facto* a common currency (composite good in a Hicks's terminology).

(vii) Is not it unnecessary to debate on the price level when after all under the conditions of CBA monetary authorities have *no influence on inflation* (since Balassa

[1] Art.121 of the Protocol and ECOFIN (2000)

[2] It is evident that even today the price levels in the EU (Ireland is an indicative example – see. Artus, 2001), and in the different states of USA as well are significantly divergent (Kim, 1997).

[3] The impossibility and the 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).

[4] Despite the fact that is very difficult to accurately measure and predict *ex ante* BS effects (Brada and Kutan, 2001)

Samuelson effect is an *equilibrium* phenomenon)[5]? They can just observe it and cannot change it.

To answer the above questions to some extent, we have chosen the following structure. In *Section 2* we will point out all sources of inflation under CBA in the process of accession. We will stress particularly the BS explanation (dual inflation) and we will explain the empirical methodology of BS. *Section 3* presents the results of the empirical tests, and in the final section we will make some conclusions about the economic policy in the country and draw directions of future theoretical and empirical studies.

II. Sources of inflation under CBA

1. Theoretical fundations

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, 1995), struggle between groups of different interests (Olson, 2000), purely fiscal explanation (Komulainen and Pirttila, 2000,), dual or productivity generated inflation (Arratibel and alli., 2001, Dobrinsky, 2000), structural synthesised model including the pass-through effect (Nenovsky, Yotzov and Hristov, 2000, Darvas, 2001) among others.

Nevertheless there are not many studies on inflation in the CBA transition countries. Usually such analyses concentrate on the real sources of inflation expressed in BS effect. When the inflation under CBA is studied, several questions should be concerned. The first question is whether and what kind of *monetary sources of inflation* exist. If monetary generated inflation is experienced then what part of it is natural and what caused by the deliberate or unconscious activities of monetary authorities? It is logically assumed that the natural levels of inflation can be bound to the temporary disequilibria of money supply and demand that on their part are connected with the disequilibria of the non-tradable goods market (Hossain, and Chowdhury, 1998 and Nenovsky, Yotzov and Hristov, 2000).

The irrevocable pegging of the exchange rate upon the introduction of the currency board eliminates any purposeful independent monetary policy and results in the creation of an asymmetric monetary union[6] between the country practicing the currency board and the country whose currency is used as the reserve currency[7]. What

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[5] The importance is carried on the fiscal policy.

[6] 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.

[7] The asymmetric nature of this type of monetary union is expressed in the fact that commercial banks in the country practicing a currency board have no access to refinancing by the central bank pursuing the general monetary policy. This peculiarity impacts on the transmission mechanism of the general monetary policy. The existence of this peculiarity is to a great extent determined by the structure of the banking system of the country with a currency board. The more

is typical for the currency boards established in the 90-ies is that they preserve some monetary policy instruments characteristic of traditional central banks (Nenovsky and Hristov, 2002). These peculiarities in the design of the Bulgarian currency board allow in *short periods* to have the monetary conditions in the country deviate from the ones in the euro area in spite of the common monetary policy.[11] It could be taken as an example the decision made of the Bulgarian National Bank to decrease the minimum required reserves in July 2000 from 11% to 8% in a period when the European Central Bank – the institution setting externally our monetary policy - was pursuing a steady policy of increasing interest rates[8]. Another example for the impact on liquidity in the economy is the forthcoming introduction of *RTGS* (in the middle of 2002) which could be interpreted as a technological innovation in money supply.

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, by restructuring their portfolios Bulgarian banks increased their foreign assets and to a great extent neutralized the differences between monetary condition in Bulgaria and in the Euro area. It is clear from what was said so far, that with the existing monetary regime in Bulgaria there are no conditions for a *long-term* deviation of monetary conditions in Bulgarian economy from the ones in the Euro area[9]. In other words, there are no *long-term* monetary sources of inflation in the Bulgarian economy as far as there are no such 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 it could be also said a common currency, as the irreversible pegging of the exchange rate eliminates exchange rate risk[10]) 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 management and ownership of companies, government policy as regards taxes[11], customs duties and expenditures, the structure of goods and labor

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integrated the national banking system of the currency board country is in the financial system of the monetary union, the less the effect is. Usually banking systems of countries practicing a currency board are dominated by foreign banks, which have access to refinancing by the central bank conducting the common monetary policy (Estonia and Bulgaria are an indicative example of this.)

[8] For the period from November 1999 to October 2000, the European Central Bank has increased interest rates by 225 basis points.

[9] Of course, some short term disproportion could exist between money supply and demand, due to a shock in the money supply. In this case, economic agents are tuning their real money stocks to the ones they would like to have after a certain lag. In the model we are discussing later on, temporary disproportion between money supply and demand are related to the non-tradable goods sector.

[10] 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. In establishing the monetary union, exchange rates are irrevocably fixed. For a discussion o this subject, see Berg and Borensztein (2000).

[11] Komulainen and Pirttila (2000) apply the approach of fiscal explanation of inflation.

market. The flexibility of the labor market is of particular interest as regards the dynamics of prices and stability of a given monetary regime: ways of setting salaries, flexibility of the general level and of relative real salaries, flexibility of employment contracts, flexibility of working hours, mobility of labor, etc.[12]). In Appendices 3 and 4 the rigidity indices of real wages in the developed countries and in Bulgaria and also in 38 branches of the Bulgarian economy[13] are presented. It is seen there that the labor market in Bulgaria is considerably more rigid than the EU one, although certain improvement is evidenced after the introduction of the currency board. The rigidity of real salaries leads to an increase of inflation by increasing the BS effect (which will be discussed below).

Table 1 Convergence

	Per capita GDP* (USA=100)			Comparative Price Level Indices (USA=100)		
	1996	1997	1998	1996	1997	1998
EU 11	71.5	70.4	69.9	119.6	-	-
EU 15	70.8	69.9	69.3	118.8	105.6	105.5
Bulgaria	**17.9**	**16.2**	**16.3**	**23.6**	**25.7**	**30.4**
Czech Rep.	45.7	44.6	43.1	43.1	38.5	40.6
Estonia	23.9	25.7	26.1	44.7	42.2	44.3
Hungary	33.2	33.7	34.5	47.5	45.2	44.8
Latvia	18.1	19.2	19.4	40.8	40.5	43.6
Lithuania	20.7	21.2	21.5	37.0	41.5	43.9
Poland	26.3	27.2	27.6	50.6	46.1	47.8
Romania	23.9	21.5	19.4	23.6	24.5	28.5
Slovak Rep.	31.6	32.5	32.8	39.8	37.9	37.4
Slovenia	47.5	48.1	48.5	71.7	64.9	66.4

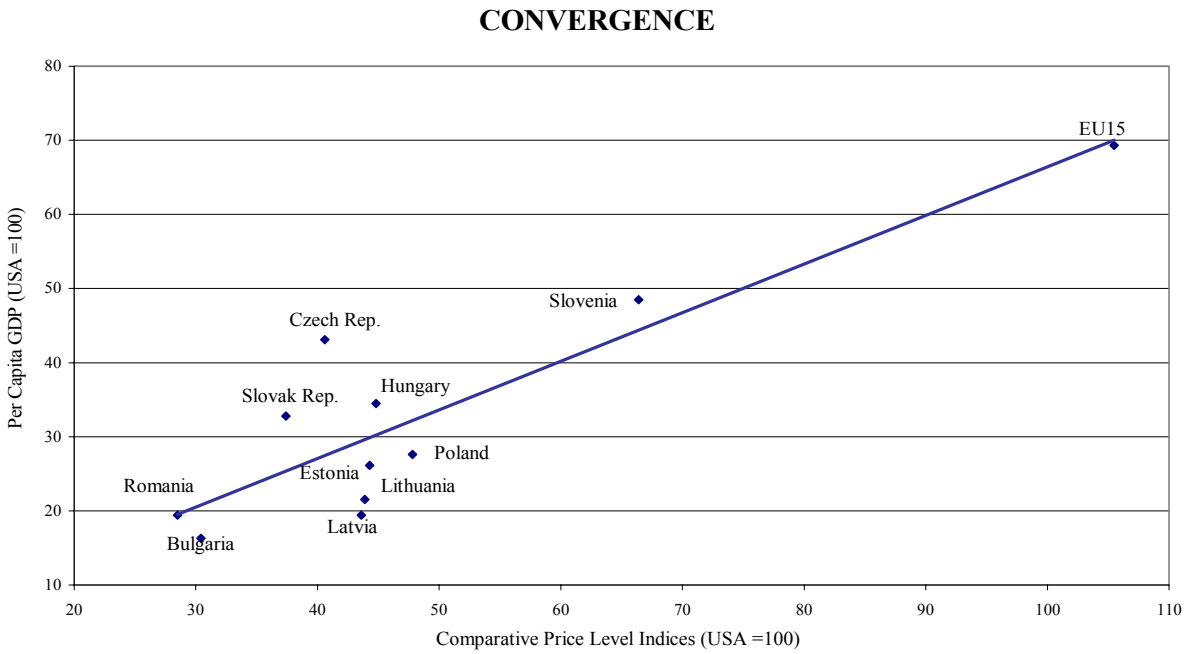
* - Purchasing power standards

Source: Eurostat, OECD

[12] See Soltwedel, Dohse and Kriegel-Boden, 1999. Real wages are considered to be more flexible where unemployment exerts a strong pressure on “equilibrium” salaries (Berthold, Fehn and Thode, 1999).

[13] The results are taken from the research of Nenovsky and Koleva (2001).

Figure 1 Convergence



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 it is seen from table 1 and figure 1, considerable differences exist in the degree of economic development and price levels among EMU member countries and the countries applying for EU membership, and later EMU membership. The real convergence between the countries applying for EU and EMU membership and the Euro area member countries is expressed in a gradual elimination of these differences. With the increasing degree of integration of the applicant countries into the EU, these will catch up with the EU income levels. This is a long-term process, which will determine inflation differentials[14].

In the following section we will concentrate on BS effect, because it is conventional, widely accepted explanation of inflation processes in the applicant countries.

2. Dual inflation – summery and discussion

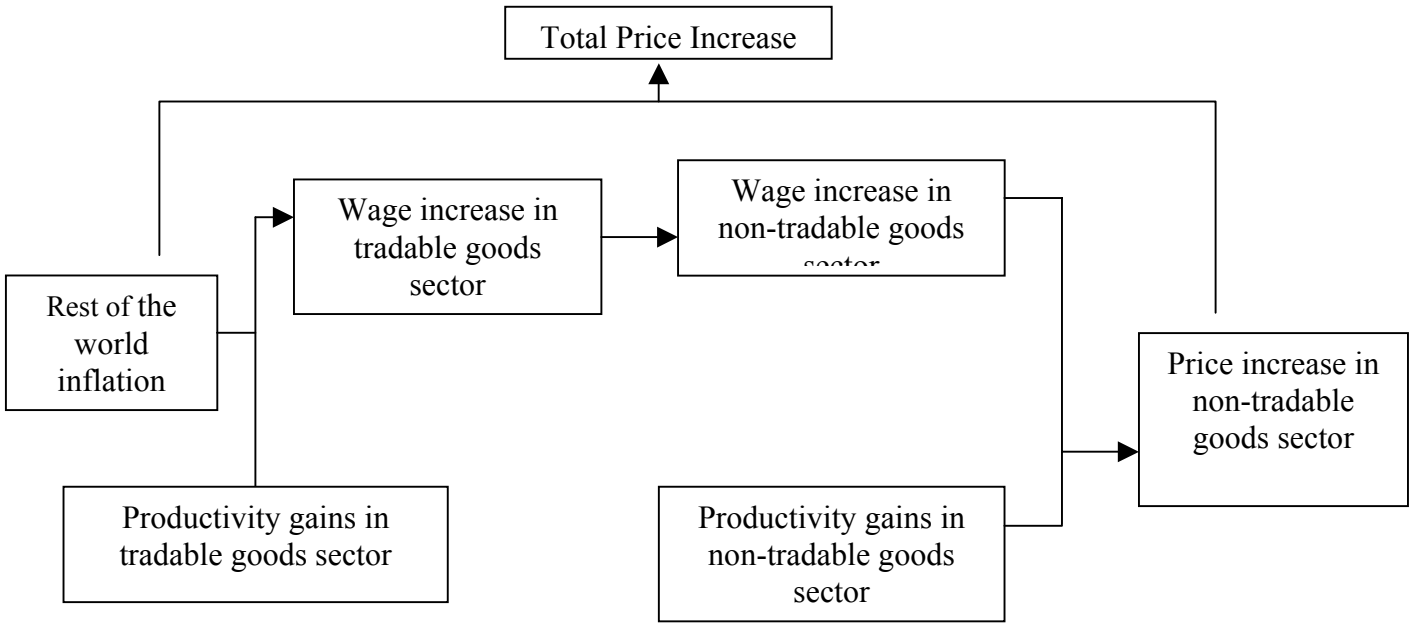
In theory, the most popular explanation of the convergence processes is by the productivity based inflation known as the dual inflation or BS effect, (Arratibel and alli., 2001, Halpern and Wyplosz, 2001).[15] Low price levels in poorer countries are

[14] For a detailed presentation of real convergence mechanisms see also Barro and Sala-i-Martin, 1992;Kim, 1997; Razin and Yuen, 1995.

[15] 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 movement of production factors (labour and capital). For more details see

determined by the lower production capacity in the sectors producing tradable goods. Prices of tradable goods (primarily industrial ones) are determined at the international markets, while the ones of non-tradable (mainly services) are determined at the local markets. The production capacity in the sectors producing non-tradable goods is relatively close in countries with a low and a high per capita income. The lower production capacity in the sectors producing tradable goods in poorer countries is reflected in lower salary levels, lower prices of non-tradable goods, and hence lower overall price levels. This is the static situation (i.e. *BS effect on levels*). If seen from the point of view of dynamics, the BS effect means that countries featuring higher growth rates will have higher inflation rates. This is accounted for by the fact that the production capacity in the tradable sector of developing countries grows relatively faster than the one in the non-tradables 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, then given the higher rates of increase of the production capacity in Bulgaria, it is normal for the general price level to grow considerably faster than in the EU. We can add to it the liberalization of great part of services (education, health care, etc.) which were administratively managed, and this will automatically result in an increase in the general price level. The dynamic BS effect on the general price level is shown on Figure 2.

Figure 2 Tradable-Non-tradable Sectors Model of Inflation (BS dynamic approach)



also Bartolini, 1995, Benaroya and Janci, 1996, ECB, 1999, Busson, and Villa, 1996, Aglietta and alli, 1998, Couder, 1999.

The stance of pre-accession economies is characterized by a number of features, which cause many problems not only in BS effect estimation but in its clear detection as well. Let's point out some of them[16].

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 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 BS effect implies that productivity do not increase in the services sector (Busson and Villa, 1996).

Second, the BS effect is mitigated by arbitrary liberalized price of main services during the transitional period. In this respects market forces do not determine the principal part of the service price behavior.

Third, in the tradable sector it is observed that industrial structures gradually adjust to new technologies and new quality of goods and thus resulting in 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, workers are considerably high qualified and it is hardly likely for low qualified workers from the services sector to get the higher real salaries of all in the tradable sector.

Fifth, according to "the cost recovery hypothesis" (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 the policy of the government, which determine the deviations from 'low of one price' (LOOP) which should be valid in the case of tradable goods. The differences in local (national) expenditures, which are 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 determine price differences of identical goods in different countries. The mark-up differences in different countries determined by market segmentation and competitiveness[17]. The policies of price control and protection of industries producing tradable goods pursued by governments, which lead to violation of the LOOP.

Altogether (taking into account all mentioned factors) according to Arratibel and alli., 2001, BS effect in CEEC5 (five central Europeans countries) is about 1-3% and it could be explained by a half of the inflation differential between the Euro area and these countries.

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 effects, which in some aspects is crucial for the country with fixed exchange rate. 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

[16] See for example Frensch (2001), Cheung and Lai, (2000), Brada and Kutan (2001).
[17] See Dobrinsky (2000).

from higher productivity growth in catching-up economies, has also been held responsible for higher inflation in accession countries. However, research has shown that this effect should not be overestimated"[18].

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

Step 1. The branches are grouped into two sectors: tradable and non-tradable. Productivity indexes are formed for the tradable and non-tradable sectors in Bulgaria and the Euro area (or Germany). There is space for a third sector of semi-tradable goods. For instance De Broek and Slok, 2001, agriculture is outlined 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 alli, 1994), there are no clear quality criteria for differentiating between tradable and non-tradable sectors yet.

Step 2. Productivity dynamics in both sectors is examined, 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 to increase considerably slower.

Step 3. Processes of wage convergence in both sectors are studied (which is a prerequisite for BS effect presence).

Step 4. Price indexes for the sectors are formed and their movements are observed. 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).

Step 5. Justifying the preliminary requirements for BS effect existence, we proceed with the new direct estimation based on the following regression (0) (see: De Gregorio and alli, 1994).

$$(0) \qquad \log\left(\frac{PNT}{PT}\right)_t = \alpha_0 + \alpha_1\left(\frac{\lambda_{NT}}{\lambda_T}\log QT - \log QNT\right)_t + d_t,$$

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, λ_{NT} and λ_T are the employees' shares in 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 cause high 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, and an increase in the

[18] Speech by Dr. Willem F.Duisenberg, President of the European Central Bank, at the Frankfurt European Banking congress, at the Alte Oper in Frankurt am Main, 23 November 2001.

non-tradable sector productivity leads to real depreciation of the exchange rate. From equation (0) it is seen, that the productivity of the non-tradable sector should have a "stronger" sign in the econometric estimation because this sector is more labor intensive according to the contribution made by Paul Samuelson ($\frac{\lambda_{NT}}{\lambda_T} > 1$).

III. Econometric results of BS and their interpretation

1. Data description

The econometric estimation is conducted on the basis of monthly data on the period between July 1997 (the introduction of the CBA) and June 2001, i.e. 48 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 categories. 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. For defining the sectors as tradable and non-tradable we use a common approach applied by many studies on the subject where industry is regarded as tradable and services as non-tradable sector.

Data on production, salaries and employees

The production indicator is represented by the gross value added data from the quarterly national accounts[19] by sectors: industry, services and agriculture. Since monthly data for the non-tradable sector is not available (for the tradable sector we could find a proxy), we apply an econometric interpolation method for obtaining high frequency data keeping the fundamental variables' development.

Average monthly salaries and total number of employees each month are statistically estimated in a wide range of economic activity (38 groups). In order to acquire data for industry and services we apply the following aggregation. *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.

[19] 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.

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). It is introduced on the basis of COICOP/HICP according to Regulation N 2214/96 of 20 November 1996[20], added and altered by Regulation N 1749/99 of 23 July 1999 of EC[21]. The CPI hierarchy is developed in five levels. The first three levels cover the structure of COICOP/HICP as they face the requirements of Article 3 of the EC Regulation N 1739/96 of 9 September 1996[22], added and altered by Regulation N 1687/98 of 20 July 1998 of the EC.

Since 1998 there is a classification made by the Agency of Economic Analyses and Forecasts (AEAF) of the Bulgarian CPI goods and services in three groups: tradable, potentially tradable and non-tradable. The criterion for distinguishing between the tradable and potentially tradable goods is the duty tax. "Pure import" later on called tradable goods are goods with duty tax lower than 25% and "broad import" (goods traded on the external markets) consists of goods of between 25 and 40 % duty tax that represent the potentially tradable ones[23]. 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 mostly of services (and some kinds of food that do not face import competition).

HICP has special aggregates' definitions where services are opposed to goods (industrial and food). We use the common approximation of non-tradable to services and tradable to industrial goods. Comparability of the Bulgarian and EU data on price indicators for the sectors is a result of the high level of legal and standards' harmonization between the Bulgarian and EU statistics.

2. The BS effect

As we have already pointed out (in section 3) before the direct econometric estimation of BS effect existence, we make a preliminary verification of its basic analytical components.

First, productivity in the tradable and non-tradable sector is formulated (according to the accepted classification) as we divide the real net value added by the total number of employed in both sectors. We use a Hodrick-Prescott (HP) filter to take out the cyclical and seasonal fluctuations form the productivity values in both sectors and thus obtaining their trends (figure 3). It is obvious that in contrast to the assumptions of BS effect, productivity in the non-tradable sector is higher in most of

[20] Commission Regulation (EC) N 2214/96, Article 2 "For the purpose of this Regulation, a 'sub-index of the HICP', is defined as a price index for any of the categories of expenditure listed in Annex I and illustrated in Annex II to the this Regulation. This are based on the Coicop/HICP classification".

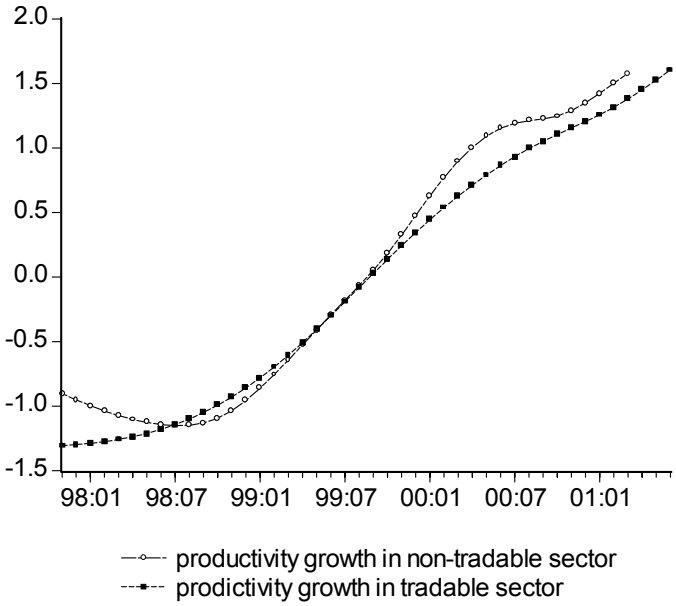
[21] Commission Regulation (EC) N 1749/99 of 23 July 1999, "Commission Regulation (EC) N 2214/96 establishes the sub-indices of the HICP based on Coicop/HICP (classification of individual consumption by purpose adapted to the needs of HICPs) classification."

[22] "HICPs which include price indices and weights for each category given Annex I accounting for more than one part in a thousand of the total expenditure covered by all these categories, shall be deemed comparable."

[23] Monthly Outlook Series, AEAF, No.12/1997

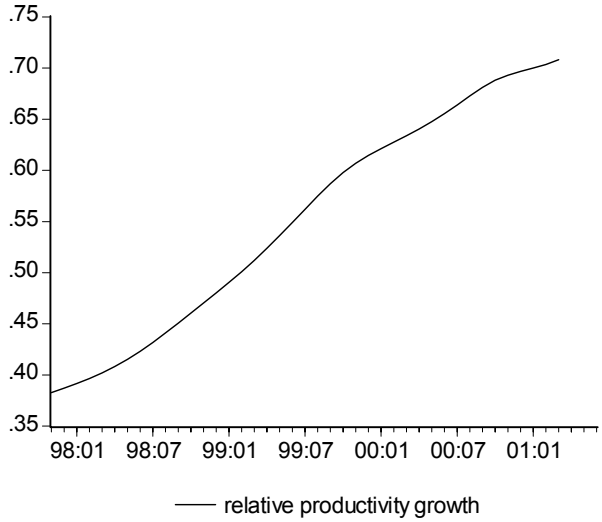
the time of the studies period then that of the tradable sector, particularly after the first half of 1999.

Figure 3. Productivity dynamics in the tradable and non-tradable sector (trends seasonally adjusted) – normalized scale



For the purpose of 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 relative productivity *growth*. In the whole pattern the ratio of productivity in the tradable sector to that in the non-tradable sector increases (figure 4) and tends to 1 (while it is still beneath 1).

Figure 4. Dynamics of relative productivity growth (ratio of the productivity in the tradable sector to the productivity of the non-tradable sector)

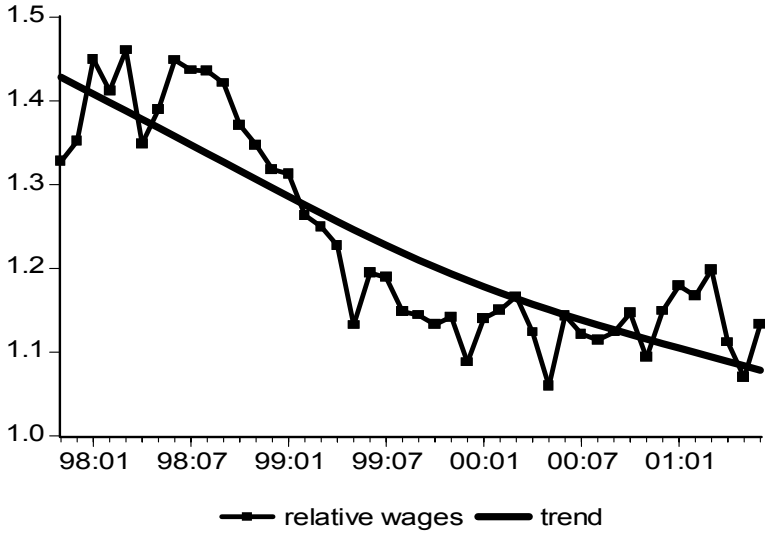


Second, an important condition for BS effect availability is to have a convergence tendency of the non-tradable sector's wages to the wage level in the tradable sector. It is evident in figure 5 that the general dynamics exist in broad outlines.

Figure 5. Wages dynamics in the tradable and non-tradable sector (the orthogonal axis is in BGN)

And this tendency is justified by the strong correlation between the wages growth rates (0.91). In spite of the observed trend of smoothing, this process is very volatile in the recent years as it can be seen in figure 6. Regardless of the ratio "wages in the tradable/wages in the non-tradable sector" that points to 1 (see the trend), in the last 2-3 years its development is not clearly stated but rather it follows a cyclical pattern.

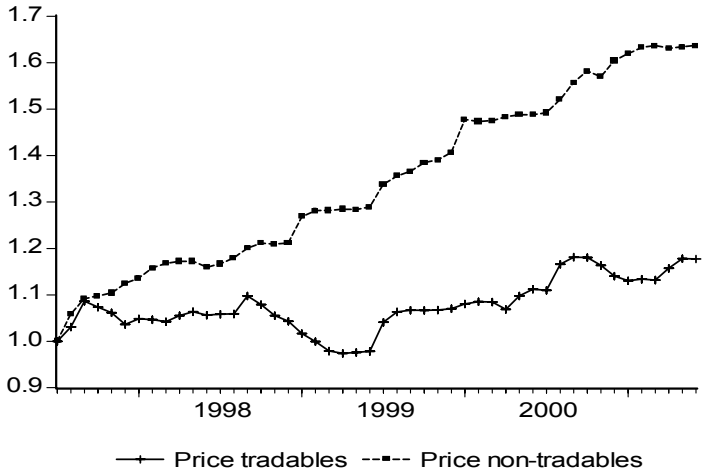
Figure 6. Dynamics of Relative Salaries (ratio of the salaries in the tradable sector to the salaries in the non-tradable sector)



The reason for that could be that there are still segments in the labor market. Significant support to that consideration we find in the elasticity (econometrically estimated) of the salaries in the non-tradable sector in response to changes in the salaries in the tradable sector (see. equation 2). The elasticity is under 1, i.e. 0.61, which implies that when salaries in the tradable sector increase by 10%, salaries in non-tradable sector rise only by 6.1%.

In spite of the above-discussed *contradicting* initial assumptions, the following figure 7 definitely shows the higher price dynamics in the non-tradable sector.

Figure 7. Price dynamics in the tradable and non-tradable sector (1997:07 = 1)



Before we attempt to give explanation to the detected inconsistency in the price development, let's first see what the direct *econometric* estimations of BS effect in equation (0) are (the same econometric technique is applied by Halpern and Wyplosz, 2001). The results from the tests for the period starting with the introduction of the CB in Bulgaria (1997:07 - 2001:06) are as follows (BS in terms of levels):

(1) $\log(PNT/PT) = 2.92 + 0.16\log QT - 0.006\log QNT + AR(1) - AR(2)$

(1.82) (1.93) (-0.14) (7.33) (1.85)

$R^2 = 0.959$, $R^2adj = 0.954$, DW = 2.084

It is evident form the coefficients that the non-tradable goods and services have a very weak influence on the real exchange rate (PNT/PT)[24]. We can also observe that an increase in the productivity level in the tradable sector causes appreciation of the real exchange rate. The coefficient in front of the productivity in the non-tradable sector (-0.006) is insignificant, although it has the theoretically justified negative sign (i.e. it is presumed that rise in the productivity in this sector should lead to BGN depreciation).

[24] 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 indexes in the country and of the major trade partners.

However, when we estimate the equation (0) in terms of rates *(dynamic BS effect*), we obtain considerably better results:

(2) dlog(PNT/PT) = -1.95 + 0.61dlogQT - 0.87dlogQNT + MA(1) + MA(2)
(-1.45) (6.42) (-3.31) (7.87) (1.38)

$R^2 = 0.968$, $R^2adj = 0.965$, DW = 1.72

They can be interpreted in the following way. As a whole, BS effect exists in dynamics, in rates. In this case the coefficient in front of the growth productivity rates in the non-tradable sector (-0.87) is significant and is higher as an absolute value than the productivity of the tradable sector (+0.61). The results explain the fact that the non-tradable sector is more labor intensive.

IV. Policy implications and future directions of analysis

The traditional notion of BS effect or dual inflation in terms of levels does not ultimately hold after the introduction of CB in Bulgaria. We can find an explanation for the lack of empirical justification to this theoretical statement in the heritage of centrally planned economic system characterized by labor market segmentation as well as in the incomplete liberalization of the transition economy. However, dual inflation or BS effect does exist in terms of rates, i.e. speed or pace of change. And this is provided by the initial assumptions of its existence (wage and productivity dynamics of both sectors) as well as by the direct econometric estimation.

As long as the outcomes of the econometric test are valid, our study rejects the widely spread view that countries with fixed exchange rate monetary regime (and particularly with CB arrangements) are threatened by real appreciation of their currencies. Such a threat exists but only as a tendency in the long run.

Further, since the dual inflation cannot entirely determine the inflation behavior under CB arrangements, it is reasonable to look for another sources of price increases – above all like the imported inflation and such caused by the temporary gap between money supply and demand. Annex 1 represents a synthetic model, which combines the three pointed causes of inflation under CB monetary regime[25].

[25] See Nenovsky, Yotzov and Hristov, 2000 for empirical verification for the period (1997:07 - 2000:06).

Annexes

Annex 1 Structural model of inflation under the Currency Board

After certain simplifications, the inflation under a CBA 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)[26]. 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 ϕ and (1-ϕ).

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

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

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

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 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[27].

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:

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

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

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

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

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[26] 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 CBA 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 CBA 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.

[27] 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:

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

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

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

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:

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

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[28]), *r* is the nominal interest rate, and $\ln(e_t/e_{t-1})$ is the depreciation of the BGN (the Euro) against the US Dollar[29].

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

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

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 interpretation of the overshooting in the case where $c_1 + c_2 > 1$ is based

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[28] 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.

[29] 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:

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

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 corc, 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 wages rigidity index in Bulgaria (prior and after the CBA) and in some of developed countries

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 CBA → ∞ After the CBA - 6.76	Prior the CBA → ∞ After the CBA - 17.77	Prior the CBA → ∞ After the CBA - 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

Sources: For Bulgaria (own calculations), for the others countries Vinals and Jimeno, 1998, p. 23).

Annex 4

Rigidity of real wages in Bulgaria by sectors. Produced by the pool model connecting the dynamics of the real wages and employment after the introduction of the CBA

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)	

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